

# electronics

A MCGRAW-HILL PUBLICATION

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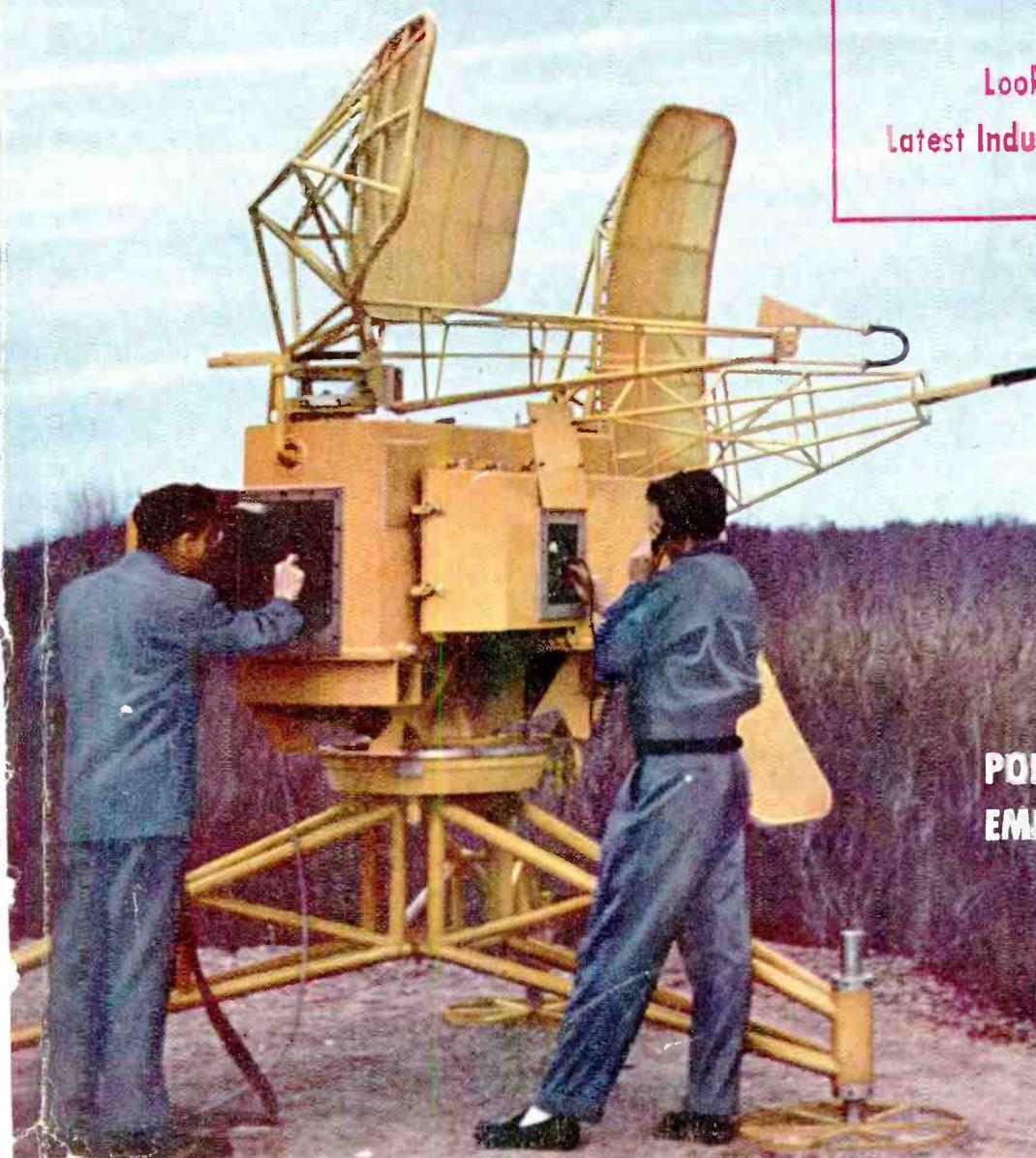


## MULTIPLEXING F-M TRANSMITTERS

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Latest Industry Moves . . . . . 348



**PORTABLE GCA FOR  
EMERGENCY AIRSTRIPS**

OUR MILLIONTH FILTER SHIPPED THIS YEAR...

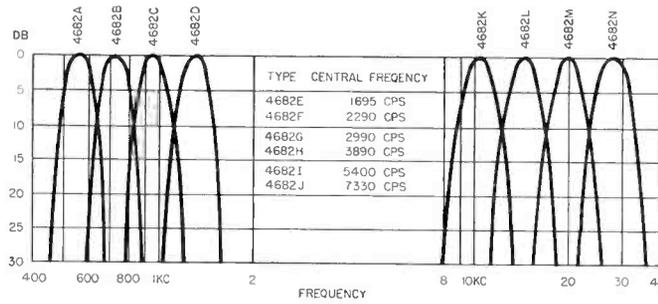
# FILTERS

## FOR EVERY APPLICATION



### TELEMETERING FILTERS

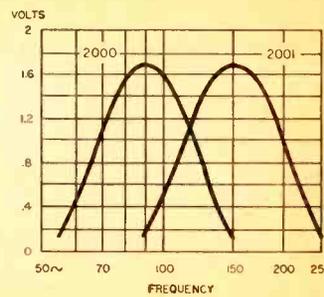
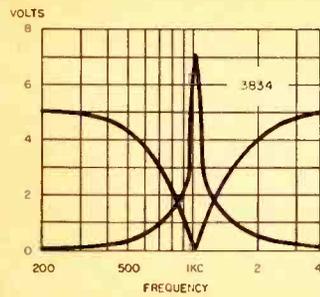
UTC manufactures a wide variety of band pass filters for multi-channel telemetering. Illustrated are a group of filters supplied for 400 cycle to 40 KC service. Miniaturized units have been made for many applications. For example a group of 4 cubic inch units which provide 50 channels between 4 KC and 100 KC.



Dimensions:  
(4682A) 1½ x 2 x 4"



Dimensions:  
(3834) 1¼ x 1¾ x 2-3/16"  
(2000, 1) 1¼ x 1¾ x 1½"



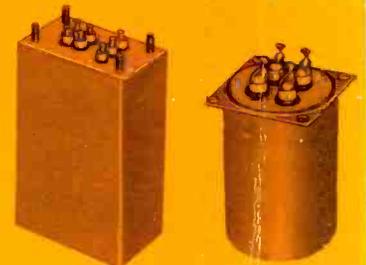
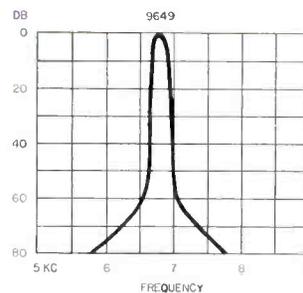
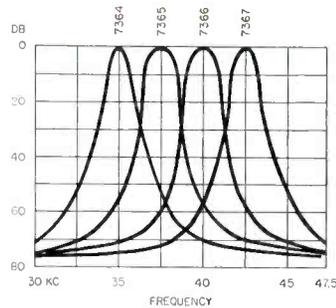
### AIRCRAFT FILTERS

UTC has produced the bulk of filters used in aircraft equipment for over a decade. The curve at the left is that of a miniaturized (1020 cycles) range filter providing high attenuation between voice and range frequencies.

Curves at the right are that of our miniaturized 90 and 150 cycle filters for glide path systems.

### CARRIER FILTERS

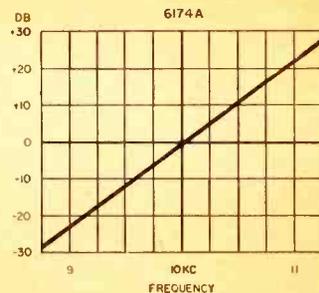
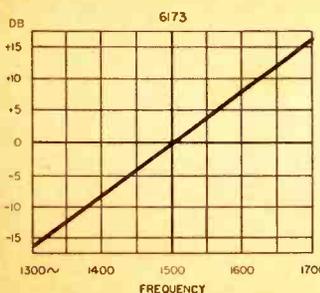
A wide variety of carrier filters are available for specific applications. This type of tone channel filter can be supplied in a varied range of band widths and attenuations. The curves shown are typical units.



Dimensions:  
(7364 series) 1½ x 1½ x 2¼"  
(9649) 1½ x 2 x 4"

### DISCRIMINATORS

These high Q discriminators provide exceptional amplification and linearity. Typical characteristics available are illustrated by the low and higher frequency curves shown.



Dimensions:  
(6173) 1-1/16 x 1¾ x 3"  
(6174A) 1 x 1¼ x 2¼"

For full data on stock UTC transformers, reactors, filters, and high Q coils, write for Catalog A.

**UNITED TRANSFORMER CO.**

150 Varick Street, New York 13, N. Y. EXPORT DIVISION: 13 E. 40th St., New York 16, N. Y. CABLES: "UTCO"

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PORTABLE GCA FOR EMERGENCY AIRSTRIPS—Precision approach radar system made by Laboratory for Electronics, Boston, weighs only 2,100 lb including monitor equipment. Intended for small military and commercial airports, it can be set up in six hours by two-man crew (see p 154). COVER

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# SHOP

**MONEY-MAKING F-M**—When FCC recently authorized multiplexed paid programs for f-m broadcast stations, the editors began thinking of potential writers for articles on the subject. It took no cudgeling of brains to come up with the name of an expert and competent author for an initial basic article.

Johnny Bose was Major Armstrong's right-hand man at the Marcellus Hartley laboratories from the time he graduated with honors from Columbia University in 1935. Armstrong gave him great credit for work on the double-channel phase-shift modulator. Bose carried out development of a highly successful multiplex system under Armstrong's direction — the last big project before the Major's death.

An old friend of John's, associate editor MacKenzie went to see him.

We think the resultant article spells out for the engineer in simple and concrete terms what has been done and what excellent results can be obtained with multiplexed f-m. It's on page 146 of this issue.

**MUSICAL EDITORS** — The high fidelity bug has hit nearly every staff member at some time or another. Most of us have operating equipment, some homemade from circuits published in *ELECTRONICS*. Output power ranges up to 30 watts.

The bass-reflex type of baffle arrangement is popular with the staff. Partly for a gag, one editor built one of these with quarter-inch-thick wood, now needs strain gages to

# electronics

OCTOBER, 1955 Vol. 28, No. 10



Member ABC and ABP

# TAK

in and out displacement accurately. Another has reflex enclosures. One is the volume of the other. the small one.

staff have two or more receivers or sets. To receive a certain recent program, broadcast on a-m only, one editor belatedly discovered that he had only f-m in bedroom, living room, dining room and kitchen. His wife had relegated all a-m receivers to basement storage. He heard the broadcast, but out in the driveway, in his car, in the rain.

Record-playing equipment averages more than one per editor because of the three speeds available. Half the staff can handle all three.

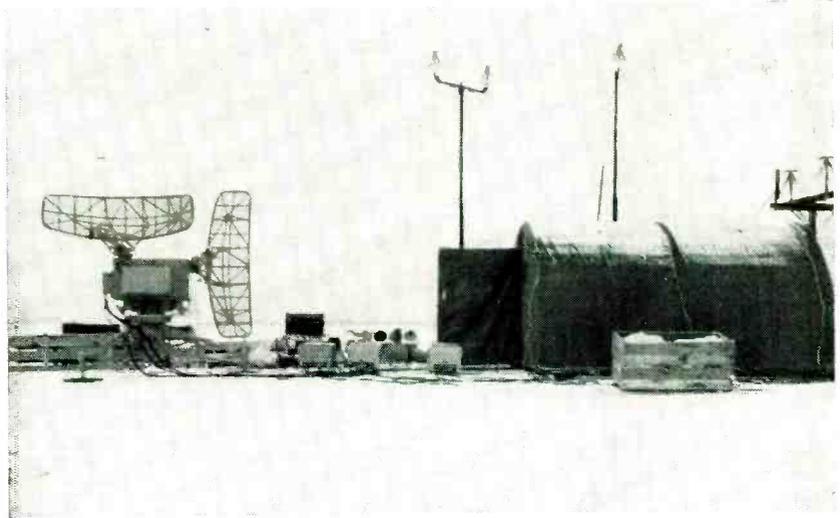
One editor proudly informs us that he can play two and four-minute cylinders, on one of his museum pieces.

Another museum piece is a camera-size German player, a 78, circa 1900, with folding turntable. Volume control is achieved by adjusting slots in the front of a small horn.

#### STORY BEHIND HEADLINE—

Much of the material used in the article in our July Industry Report on the growth of electronics in France was furnished by McGraw-Hill World News Service.

While editing the item, assistant editor Arnold decided to add statistics on the number of radio and television sets in use in recent years in that country. He soon found that this took some doing.



**OUR COVER** shows one view of a portable gca and the photo above shows the same equipment undergoing tests in Alaska at 42 below zero. The record-breaking heat wave in New York this summer made us wish we could witness such tests

He contacted the New York office of the French Embassy, United Nations, Voice of America, the French Broadcasting System, DuMont International and RCA Frequency Labs.

He got the data. We call him Bill Arnvoy now.

**COMING NEXT MONTH** — First published details of the machines and mechanisms in the Signal Corps-GE system for assembling components on wiring boards automatically under control of punched cards will appear in **ELECTRONICS** next month. Four operators load components, etched wiring boards and a stack of punched cards, and take out finished, dip-soldered and

fully tested boards.

Intended for job-lot production of small quantities of complex military electronic equipment, the system assembles 20 boards at a time. There is only one insertion head; the boards circulate under this in ring-around-the-rosie fashion, pausing a moment for the head to jab in a component.

When each board has received the first component, the punched cards call for a new component magazine and servo the head to a new position for the second trip around. With this system, there are no training problems when designs are changed frequently, because the production know-how is stored in the stacks of punched cards.

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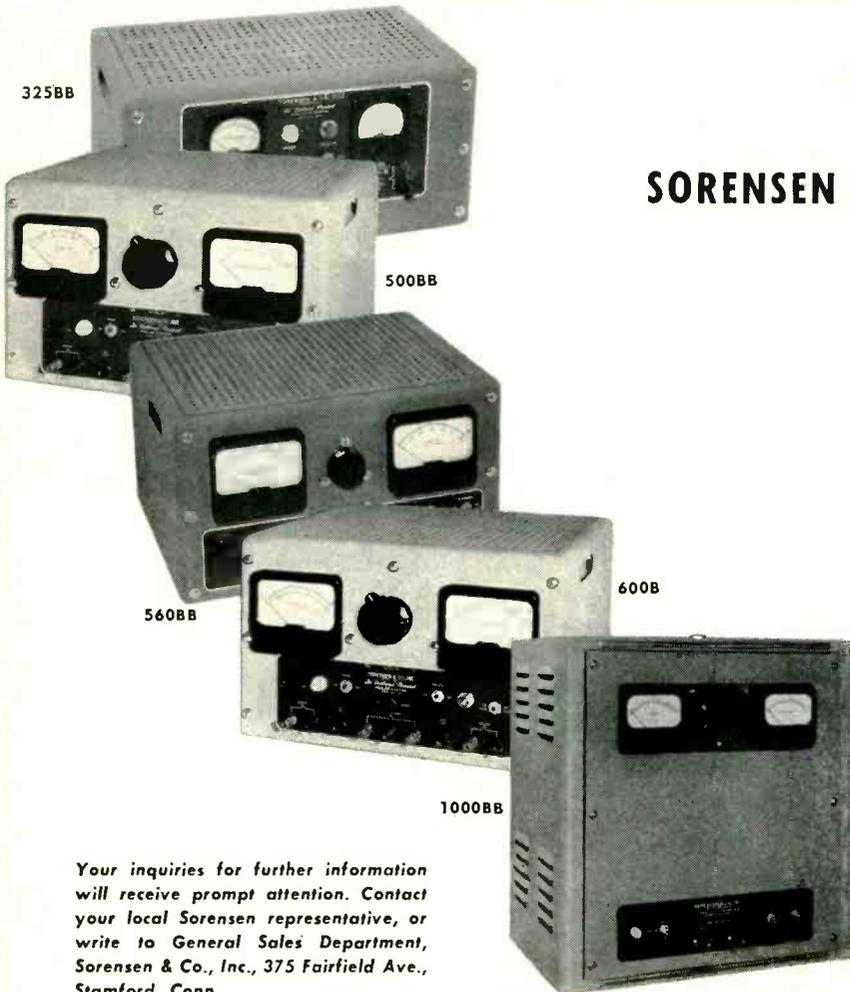
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**SORENSEN B-NOBATRONS** (B Power Supplies) were designed specifically to provide an economical answer for a very wide range of technical requirements.

Look them over. Five catalog models, available from stock, give you choice of outputs from 0-325, 0-500, 0-600, and 0-1000 VDC, accurately regulated. High grade engineering, high grade materials, and Sorensen's unequalled know-how in designing and manufacturing regulated power equipment combine to assure you top performance, dependability, and fair price.

\*Reg. U.S. Pat. Off.

#### DC POWER SUPPLY SPECIFICATIONS

Model	325BB	560BB	500BB	600B	1000BB
AC input range (50-60 cps, 10)	105-125	105-125	105-125	105-125	105-125
Output range (VDC)	0-325	0-500	0-500	0-600	200-1000
Output current (Ma)	0-125	0-200	0-300	0-500	0-500
Regulation accuracy	±0.5%	±0.5%	±0.5%	±0.25%	±0.5%
Ripple (MV-RMS)	5 max.	5 max.	5 max.	3 max.	20 max.
Bias supply (VDC at 0.5Ma)	0-150	0-150	0-150	0-150	—
Internal impedance (max)	2 ohms	2 ohms	2 ohms	2 ohms	2 ohms
AC voltage (C.T., unreg.)	6.3 at 10 amp.	6.3 at 10 amp.	6.3 at 10 amp.	6.3 at 15 amp.	—
Max. bias circuit impedance	25000 ohms	25000 ohms	25000 ohms	50000 ohms	—

CONTROLLED POWER FOR



RESEARCH AND INDUSTRY

# A HIGH FREQUENCY HYSTERESIS MOTOR

## —WITH BUILT-IN GEAR BOX



The practical uses of a hysteresis motor designed for high frequency operation have hitherto been restricted by the high rotor speed of this type of motor. The Muirhead D-565-G Hysteresis Motor employs an integral gearbox so that although the rotor speed is 10,000 rev/min when operating from a 1000 c/s supply, the output spindle speed is only 720 rev/min — a convenient speed for many applications.

The motor may be supplied from a single-phase push-pull amplifier using a phase splitting capacitor in the output. The tuning may be adjusted to vary the relationship between the pull-in and the pull-out torque.



Power supply	- - - - - 50V, 0.4A at 1000 c/s	Output spindle speed	- 720 rev/min
Maximum pull-out torque	- Not less than 9 oz in (650 gm cm)	Full load efficiency	- - 30%
Maximum pull-in torque	- Not less than 2.5 oz in (180 gm cm)	Weight	- - 1¼ lb (0.6 kg)



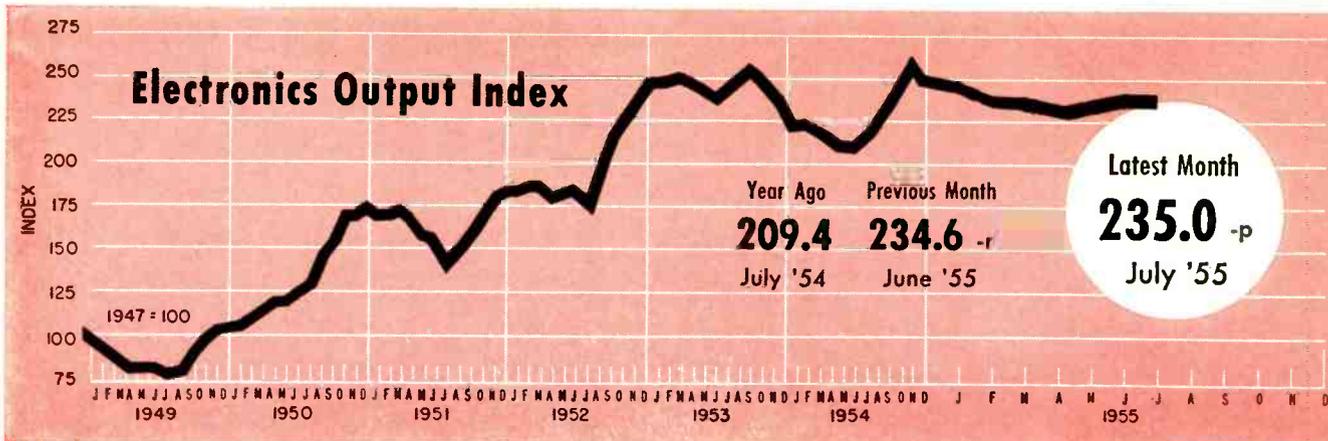
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## FIGURES OF THE MONTH

	Latest Month	Previous Month	Year Ago		Latest Month	Previous Month	Year Ago
<b>RECEIVER PRODUCTION</b>				<b>TV SETS INSTALLED</b>			
(Source: RETMA)	July '55	June '55	July '54	(Source: NBC Research Dept.)	July '55	June '55	July '54
Television sets, total	344,295	589,973	306,985	Total sets	36,477,000	36,100,000	30,717,000
With UHF	63,466	59,892	57,838	<b>BROADCAST STATIONS</b>			
Color sets	nr	nr	nr	(Source: FCC)	July '55	June '55	July '54
Radio sets, total	718,489	1,204,935	438,061	TV stations on air	461	458	409
With F-M	2,385	9,106	8,622	TV stations CPs—not on air	123	124	169
Home sets	141,119	181,930	150,002	TV stations—new requests	17	16	16
Clock radios	93,517	182,605	57,100	A-M stations on air	2,748	2,732	2,592
Portable sets	79,410	255,833	39,447	A-M stations CPs—not on air	125	108	121
Auto sets	404,443	584,567	191,512	A-M stations—new requests	201	222	167
<b>RECEIVER SALES</b>				F-M stations on air	538	540	559
(Source: RETMA)	July '55	June '55	July '54	F-M stations CPs—not on air	17	12	12
Television sets, units	381,567	429,357	368,634	F-M stations—new requests	4	6	5
Radio sets (except auto)	303,965	421,387	411,197	<b>COMMUNICATION AUTHORIZATIONS</b>			
<b>RECEIVING TUBE SALES</b>				(Source: FCC)	July '55	June '55	July '54
(Source: RETMA)	July '55	June '55	July '54	Aeronautical	44,435	43,855	40,708
Receiv. tubes, total units	28,340,000	40,819,961	24,146,012	Marine	51,528	50,714	46,621
Receiv. tubes, value	\$21,167,000	\$31,254,324	\$18,082,753	Police, fire, etc.	18,593	18,415	15,926
Picture tubes, total units	515,793	706,890	514,346	Industrial	25,189	24,845	21,867
Picture tubes, value	\$9,498,169	\$13,244,499	\$10,102,903	Land transportation	7,792	7,668	6,925
<b>SEMICONDUCTOR SALES</b>				Amateur	137,682	139,993	120,409
	May '55	Apr. '55	May '54	Citizens radio	12,801	12,334	8,093
Germanium diodes, units	1,493,211	1,419,245	1,001,905	Disaster	317	317	305
Silicon diodes, units				<b>EMPLOYMENT AND PAYROLLS</b>			
				(Source: Bur. Labor Statistics)	June '55	May '55	June '54
				Prod. workers, comm. equip.	355,300-p	350,000-r	329,300
				Av. wkly. earnings, comm.	\$71.38-p	\$70.98-r	\$68.51
				Av. wkly. earnings, radio	\$68.68-p	\$68.85-r	\$67.32
				Av. wkly. hours, comm.	40.1 -p	40.1	39.6
				Av. wkly. hours, radio	39.7 -p	39.8 -r	39.6
				<b>STOCK PRICE AVERAGES</b>			
				(Source: Standard and Poor's)	Aug. '55	July '55	Aug. '54
				Radio-tv & electronics	462.1	484.8	354.8
				Radio broadcasters	533.9	560.4	381.3
				p—provisional; r—revised nr—not reported			

## FIGURES OF THE YEAR

	1955	1954	Percent Change	1954 Total
Television set production	4,173,088	3,152,132	+32.4	7,346,715
Radio set production	7,777,378	5,324,620	+46.1	10,400,530
Television set sales	3,584,562	3,174,394	+12.9	7,317,034
Radio set sales (except auto)	2,732,983	2,822,090	-3.2	6,430,743
Receiving tube sales	254,842,000	189,856,000	+34.2	385,089,458
Cathode-ray tube sales	5,429,817	4,471,584	+21.4	9,913,504

	1955	1954	Percent Change	1954 Total
Television set production	4,173,088	3,152,132	+32.4	7,346,715
Radio set production	7,777,378	5,324,620	+46.1	10,400,530
Television set sales	3,584,562	3,174,394	+12.9	7,317,034
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# INDUSTRY REPORT

electronics—October • 1955

## More Setmakers Move Into Color TV

**Color may bloom in spring. Industry byword now is "wait and see"**

REMAINING months of 1955 will see limited production of color television sets as manufacturers feel the water. First production will be slanted toward supplying dealers with demonstration models and getting sets into bars and hotel lobbies.

Should customer interest warrant, spring will see setmakers tooling up in earnest and a strong pitch at the upper middle income group readied for fall 1956.

► **Immediate Plans**—RCA avowedly is out to take first place in color. For the most part other manufacturers are content to let RCA run with the ball at least initially.

There are three kinds of setmakers when it comes to color: those with no set at all, 15 or 20 who are buying RCA chassis and installing them in cabinets and those who are cautiously making short production runs on sets of their own.

► **Industry Activity**—Here's what a few set manufacturers are saying and doing about color tv for the balance of 1955:

Admiral plans limited production. Du Mont will make limited quantities of a set to retail at \$949. Emerson plans progressively increasing production of a 28-tube 21-in. console selling for \$894.

Motorola will produce to meet distributor needs. Its 19-in. model will sell for \$695. Olympic plans a

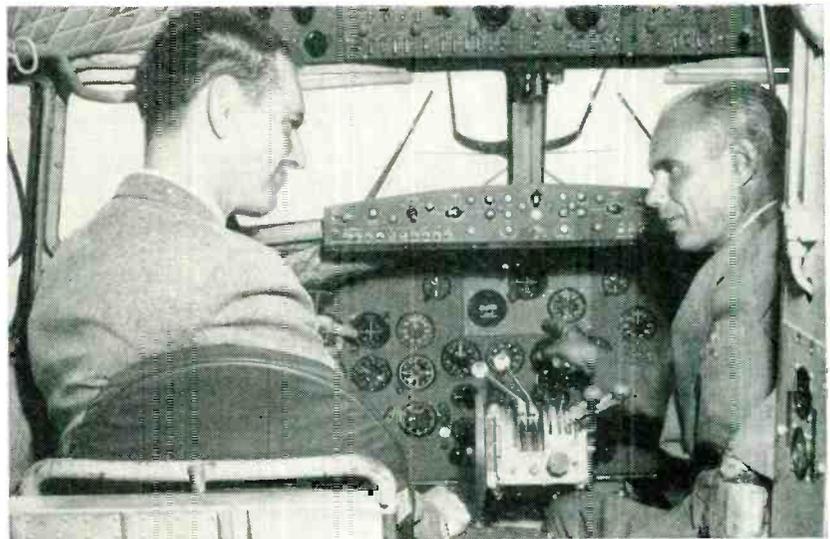
pilot run in November to supply dealers. Magnavox and Sentinel will also offer color sets.

Philco will make color sets in limited quantities for delivery to distributors Oct. 1. Models will sell for \$795 and \$89. Raytheon will have a 21-in. set; table model \$795, console \$895. Zenith is planning color set production. Development at Zenith has been directed toward

decoding circuits using the 6AR8.

CBS-Columbia has no production line at present; will sell the 205C2 console for \$795 from stock. Westinghouse will sell 15 and 19-in. sets from stock. Plans are to put out 28-tube sets—perhaps in spring.

GE, Bendix, Crosley and Sylvania have no immediate set production plans but Sylvania is coming out with an RCA-type chassis.



New navigation aid called . . .

## Tacan Comes Out From Wraps

SUBJECT of controversy as replacement for VOR-DME system sponsored by CAA, Tacan (for tactical air navigation) has importance in its own right as development sponsored by U. S. Navy and Air Force.

Declassification of system ele-

ments was implemented by Federal Telecommunication Laboratories, division of IT&T, who have started demonstrations for government, financial and press groups.

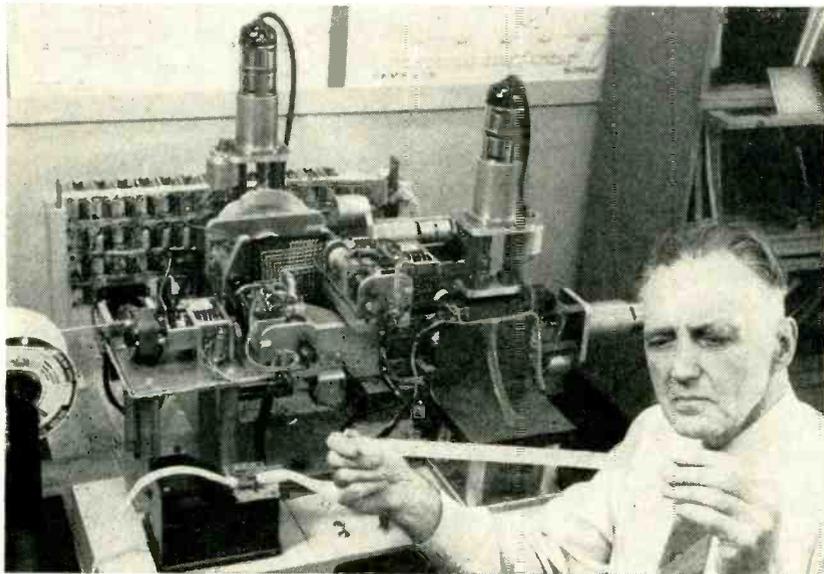
► **Direct Reading**—Visual indica-

tions of direction and distance to the ground station are displayed in the pilot's cockpit. Bearing accuracy is within a degree either way and distance is accurate to within about 600 feet. Technical details are given on page 174.

Big advantage of Tacan is relative freedom from siting errors

caused by nearby obstructions that reflect a portion of the radio wave upon which determination depends. This feature is particularly helpful on aircraft carriers.

Plans are nearing completion for manufacture of a nonmilitary receiver indicator to sell for about \$2,000.



PUNCHED paper tape gives the instructions and . . .

## Research Radio Stations Increase

Rise in experimental station authorizations mirrors development growth

DURING the past three years the number of stations authorized by the FCC in the experimental radio services has increased nearly 70 percent. In 1952 there were 369 experimental authorizations. In June, the total stood at 625.

► **Types**—There are two classes of experimental stations (see chart). Approximately 60 percent of the authorizations are of the research type. However, the number in the development class, has increased by more than 260 percent since 1952.

According to FCC, research stations are for fundamental or general research, or the development, testing or calibration of equipment not relating to an existing service.

Developmental stations are for the development of equipment, engineering data or techniques for an existing or proposed service.

► **Research**—Greatest use of research stations is for contract and export development work. This includes developing equipment or techniques under contract with federal agencies and the development of equipment for use abroad.

## Automatic Machine Wires Chassis

Another approach to mechanized wiring uses no solder, wraps wire connections

AN EXPERIMENTAL machine that automatically wires electrical apparatus by following instructions from a punched tape has been developed by Bell Telephone Laboratories. A series of relays translates the taped information into electrical signals which control the machine.

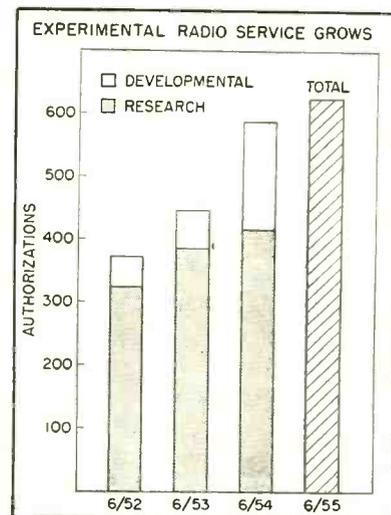
► **Winder**—The M-4, as the machine is called, wires a chassis using solderless wrapped connections. This method, applied by hand-controlled tools, is now used for production work by Western Electric. Connections are made by automatically winding six tight turns of solid-conductor wire around a rectangular terminal. An airtight, corrosion-resistant contact results between the wire and

terminal at numerous points.

Bell Laboratories tests indicate that such connections could be expected to provide a satisfactory connection for at least the usual life expectancy of the apparatus.

► **How It Works**—The experimental machine uses two rotating spindles. One spindle pulls the wire from a large spool to a connecting terminal. At the same time the wire is cut to the correct length at the second spindle.

The spindles strip some insulation from each end of the wire and whip the bare wire ends around the terminals. This produces a pressure of about 15,000 pounds per square inch at each contacting area. The spindles then pick up the supply wire from the spool and move to the next electrical connection and repeat the operation according to punched tape instructions.



(Continued on page 10)

# NEW

# V.L.I.

(VERY LOW IMPEDANCE)

# DIODE

up to 300 ma at 1 volt with excellent stability and fast recovery time

V.L.I. DIODE CHARACTERISTICS @ 25° C							
	Reverse Current Microamps Max.					Max. Reverse Working Voltage	Max. Average Anode Current ma
Forward Current @ + IV ma min.	-10V	-30V	-50V	-100V	-150V		
1N447	25	20	60			30	60
1N448	25		30	100		100	60
1N449	50	10	30			30	60
1N450	50		30	100		100	60
1N451	50				150	150	60
1N452	100		30			30	80
1N453	100		30	100		100	80
1N454	200			50		50	100
1N455	300		30			30	100

The new Sylvania V.L.I. Diode is a significant development for electronic equipment designers with applications for high current carrying diodes. For the first time, you can expect high forward conductance combined with stable, drift-free performance, and fast recovery time.

The new Very Low Impedance diode is the result of recent technological advances in the diode field by Sylvania research engineers. It's the ideal diode for demanding computer applications in clipper, clamper, and logical circuits. In fact, it's the only diode wherever you want high forward conductance with high back resistance—high current carrying capacity with fast recovery time—and high rectification efficiency. The V.L.I. diode is designed into the Sylvania sealed-in-glass package and is 100% inspected for a positive, protective seal.

There's a full line of V.L.I. Diodes in a range of current-carrying capacity. Write for complete information or samples. Address Dept. K20R.

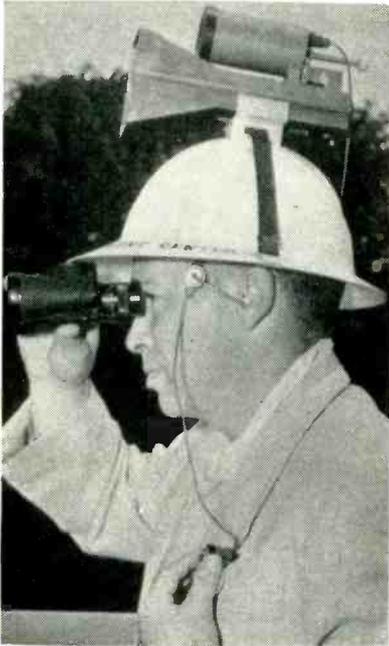
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**GROUND** observers get all-weather eye when . . .

## Radar Helmet Helps Aircraft Spotters

**Microwave receiver uses transistors to reduce weight and power drain**

TWENTY-ounce radar receiver mounted on helmets designed for the Air Force's civilian Ground Observer Corps by the ARDC center at Rome, N. Y., will tighten U.S. air defenses. With the receiver, part-time aircraft spotters can pick up a plane's search, navigation or fire-control radar.

► **How It Works**—The microwave horn antenna picks up the signal which is passed through a crystal detector. Transistors on a printed circuit board provide a pulse amplifier. A coaxial choke with filtering action delivers a sharp pulse to the amplifier.

Signals from the amplifier are fed directly to the light-weight headphones.

► **Weight and Power**—A four-ounce battery pack supplies the required power. The set's low power drain makes possible operation for a week under normal conditions.

## Dwindling Selenium Conserved

**As supplies drop sharply BDSA requests rectifier makers to reclaim scrap**

PRODUCTION of selenium in the U. S. has again suffered a severe cutback due mainly to work stoppages in the copper industry. The electronics industry, which consumes 45 percent of the metal, is feeling the effects. A survey made by the Business and Defense Services Administration indicates that there is less than a month's supply of high-purity selenium.

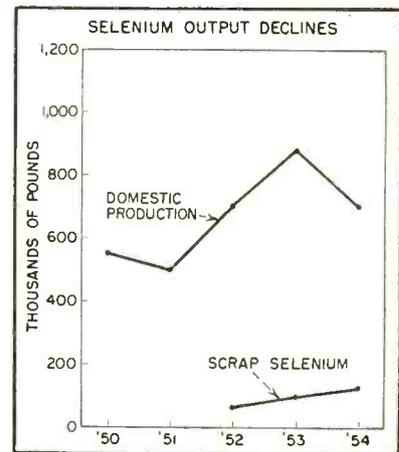
A few selenium rectifier makers have shut down because of lack of the metal. Supplies are considerably lower now than they were last year when selenium shortages appeared. Then the amount of elemental selenium held by primary producers amounted to a two-month supply because work stoppages in the copper industry had not been as prolonged.

► **Action**—BDSA has asked rectifier makers to make every effort to recover all discarded selenium rectifiers. It suggests that distribution outlets return discarded rectifiers. According to BDSA, such a program should result in an annual reclamation of approximately 20 percent of the total amount of high-purity selenium used.

Rectifier manufacturers are getting behind the program. Sarkes Tarzian and IT&T's. Federal Telephone & Radio Co. have announced reclamation drives and other companies are planning to do so.

Last year some 125,000 pounds of the metal were recovered compared to 98,000 pounds a year earlier. Sarkes Tarzian is allowing 10 cents merchandise credit on each replaced rectifier returned regardless of size or make. Last year the company offered 2.5 cents credit for rectifiers rated at 65 to 150 ma and 5 cents for those rated at 200 ma or more.

► **Imports**—Reduced production of



selenium in the U. S. has led to increased imports. In 1954, 195,000 pounds were imported compared to 100,000 pounds in 1953 and 123,000 pounds in 1952.

Canada is the main foreign source, accounting for about 90 percent of total imports. Japan, Sweden, West Germany and Belgium are other sources.

## Electronics Builds Up In Chemical Plants

**More chemical plants are using electronic instruments to foster increased production**

EXTENT to which electronics is entering the chemical industry was indicated at a symposium on electronics and automatic production held in San Francisco. It was estimated by V. F. Hanson of du Pont that whereas ten years ago the investment in instruments was about one or two percent of a complete chemical plant, it has risen to 7 to 10 percent on plants built during the past four or five years.

This growth was seen continuing as long as total plant investment and operating costs can be reduced by use of smaller process equipment. This in turn is made possible by faster and more accurate control.

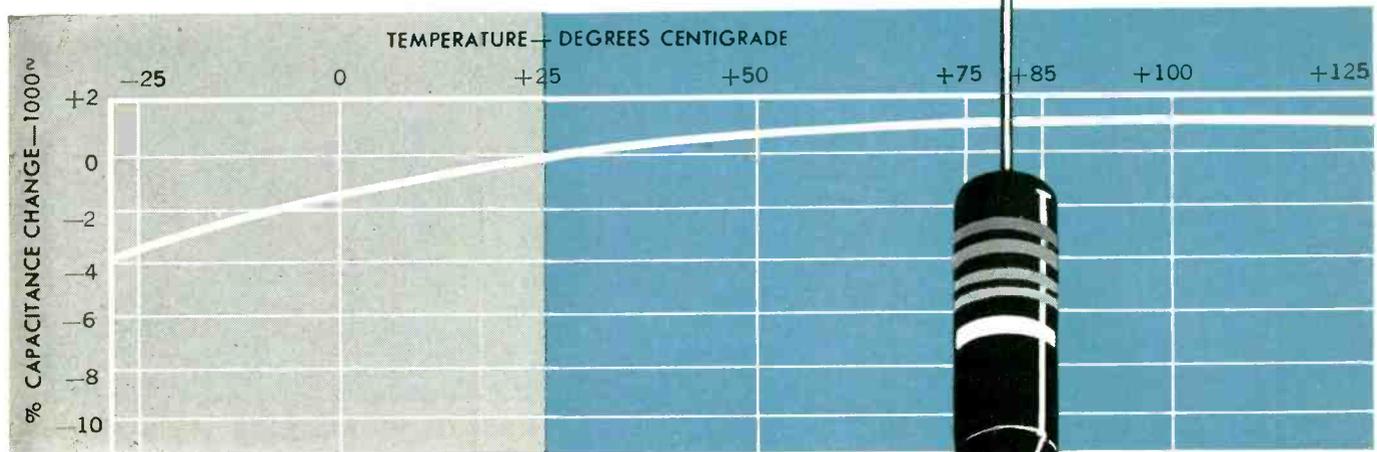
► **Gear**—The chemical industry is pioneering many of the special elec-

(Continued on page 12)

# new!

a solid-dielectric molded paper tubular capacitor

with flat capacitance-temperature characteristics



**HCX\*—impregnated Black Beauty<sup>®</sup> capacitors**

**offer improved circuit performance**

*Sprague, on request, will provide you with complete application engineering service for optimum results in the use of molded paper tubular capacitors.*

SPRAGUE'S NEW TYPE 109P CAPACITORS use a unique new impregnant identified by the trademark HCX. Developed in the Sprague research laboratories in the search for a better material than the polyesters customarily used for impregnating solid dielectric paper tubulars, HCX is a hydrocarbon which polymerizes after the rolled section has been vacuum impregnated. Its salient electrical characteristic of insulation resistance, power factor, and capacitance change with temperature are superior to those of the ordinary polyester units on the market today.

Type 109P Black Beauty Telecaps are molded in non-flammable phenolic and are mechanically rugged. They make an ideal capacitor for all TV and auto radio operations and are well suited for automation assembly by machine since the lead concentricity is closely fixed and there is no outer wax dip to jam inserting heads or magazines.

Complete performance data covering the wide range of sizes and ratings are in Engineering Bulletin 223, available on letterhead request to the Technical Literature Section, Sprague Electric Company, 35 Marshall Street, North Adams, Massachusetts.

\*Trademark

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*world's largest capacitor manufacturer*

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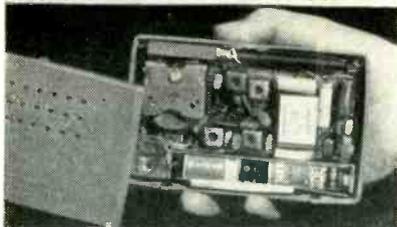
tronic instruments needed to give instantaneous answers about the operating conditions of processes. It is developing its own staffs of qualified instrument mechanics, instrument engineers and research and development physicists.

As a result, in many cases, chemical companies have licensed instrument firms to make developments available to industry as a whole. This has come about because instrument manufacturers have not been expected to develop equipment to do special jobs because of high development costs, limitation of the market and a lack of knowledge of the problems that require quick solutions in a plant.

► **Needs**—Substantial gains in process equipment design along with improvements in product quality were seen possible providing instruments could be developed to measure continuously more process variables. These would include chemical composition, color, molecular weight and viscosity of flowing streams.

Instruments are needed also to measure weight per unit length of yarns and filaments, thickness measurements of moving webs of films and fabric and molecular orientation in fibers and films.

## Japanese Portable Uses Five Transistors



**SONY** set delivers 10-mw to 2.5-in. speaker. Sensitivity is 1-2 mv/m. Uses agc and second-detector diodes. Sold in Japan since August



**BATTERY**-powered base station using Du Mont radiophone goes to work in Delaware River valley as . . .

## Radio Aids Flood-Stricken East

### Amateurs, commercial users and regular disaster groups employ radio equipment

**MOBILE** radio again proved its emergency value when devastating floods swept through the river valleys of the North-East in August. Police, National Guard, Red Cross and Civil Defense units used the equipment extensively. Amateurs put their equipment into service and one station in the Hartford, Connecticut area handled an estimated 800 messages during the disaster.

► **On the Spot**—The first amateurs to participate in flood relief work were mostly those enrolled in the civil defense organizations. Short range radio equipment, most of it mobile or portable, was put into service in hard-hit communities in Connecticut, Pennsylvania, and other disaster areas.

To replace telephone service disrupted by overflowing rivers, amateurs were stationed with equipment at fire houses, police stations, hospitals, dispatch points for rescue boats and helicopters and other strategic spots.

Others carried officials on damage-inspection tours, did patrol

duty and served in other ways. Some manned longer-range radio gear at city or CD headquarters for contact with other communities.

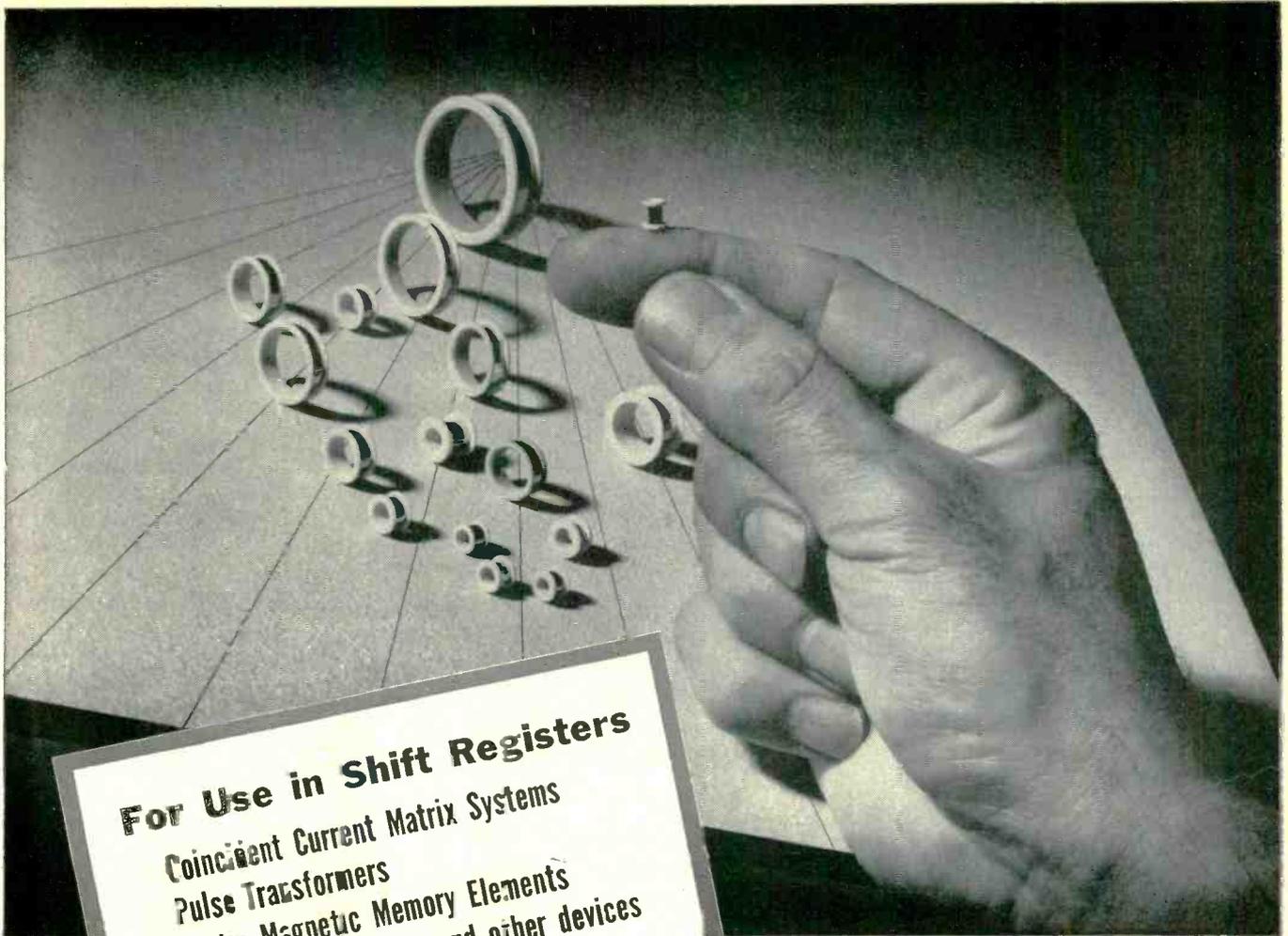
► **Relay Service**—Amateurs outside the heaviest-hit areas relayed messages for the Red Cross, state health and highway departments, the press services, Civil Defense and other authorities.

Amateurs were credited with an important part in the rescue of 300 youngsters on Pennington Island, in the Delaware River. Surveying the situation from the river bank, an amateur radioed from his car to state CD officials that helicopters would be needed. The last several children evacuated were in waist-deep water.

► **Town**—Commercial users of two-way radio pressed their equipment into service and communications firms in or near the flooded areas offered their equipment for use during the disaster. One company, Arnolt Communications Service of Metuchen, N. J., sent its emergency base station and four mobile units into the Delaware River valley area to aid flood victims.

The base station was set up at

(Continued on page 14)



**For Use in Shift Registers**  
 Coincident Current Matrix Systems  
 Pulse Transformers  
 Static Magnetic Memory Elements  
 Harmonic Generators, and other devices

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**"TAPE-WOUND BOBBIN CORES FOR COMPUTER APPLICATIONS"**

Includes essential data on applications and properties, fabrication and testing of Arnold Bobbin Cores; lists standard sizes, etc.

ADDRESS DEPT. E-510

These cores, fabricated by winding ultra-thin tape of high-permeability magnetic materials on ceramic bobbin cores, possess ideal qualities for use in electronic computer assemblies as memory cells.

Specifically, their desirable properties include quite rectangular hysteresis loops, relatively low coercive values and high saturation densities; plus temperature stability and the ability to shift in a few microseconds from negative remanence to positive saturation, and vice versa, under conditions of pulse excitation.

Arnold Bobbin Cores are available in a wide range of sizes, tape thicknesses, widths and number of wraps to suit the ultimate use of the core. Magnetic materials usually employed are Deltamax, Square Permalloy and Supermalloy, in standard thicknesses of .001", .0005", .00025" and .000125". Special advantages derive from Arnold's position as a fully-integrated producer of wound cores, able to maintain precise control over every production operation . . . melting, rolling, winding, testing, etc.

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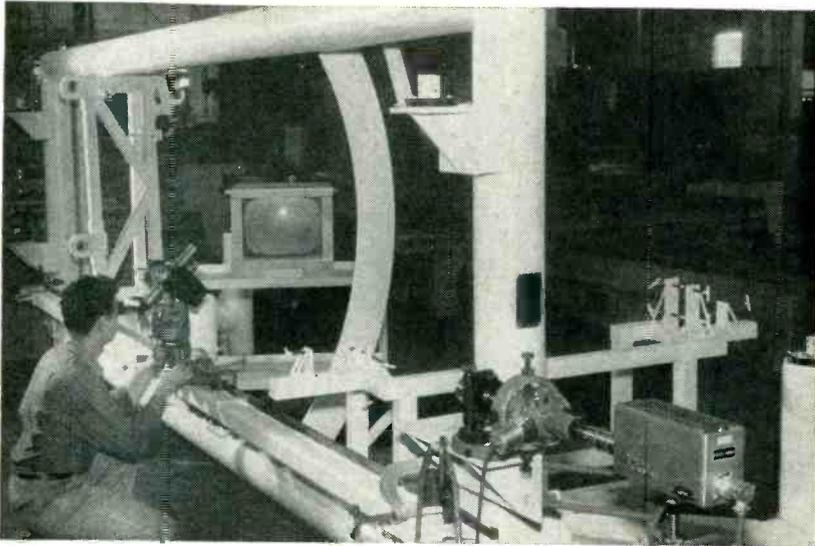
Los Angeles: 3450 Wilshire Blvd.

Boston: 200 Berkeley St.



Carpentersville, a town of 400 persons, where rescue work had been proceeding slowly.

The four mobile units roamed a 15-mile area along the river, providing communications.



ITV, aimed at eyepiece of a jig transit of Douglas Aircraft, facilitates adjustment of aircraft assembly jigs as . . .

## More Industries Put ITV To Work

Applications are increasing rapidly as tv manufacturers and customers push its use

STEPPEd-UP use of closed-circuit industrial television equipment has been evident this year in many widely varied fields of business and industry. This has been largely due to the growing number of companies that are now making, promoting and selling the equipment. There are now 27 firms in the field.

New applications of equipment have not necessarily meant increased sales for all of the manufacturers because some of the uses have been on an experimental basis. However, sales in the field are up and total sales volume for 1955 has been variously estimated at from \$3 million to \$6 million.

► **Use**—Range of applications that have been made of closed-circuit tv show in the following list:

- Dental and medical school instruction
- Chemistry class instruction
- Controlling linoleum mix
- Guiding cranes and steam shovels
- Railroad car classification
- Auto and train tunnel viewing
- Cueing sound effects in stage plays
- Disseminating plane and train departure information

- Interoffice and interplant two-way communication
- Guarding plant entrances
- Verifying signatures at banks and stores
- Taking hotel reservations
- Scheduling passenger and freight elevators
- Baby sitting at supermarkets
- Lining up aircraft assembly jigs
- Reading water gages
- Checking burner flames and smoke stacks
- Remote medical diagnosis
- Monitoring cigarette paper manufacturing
- Aiding on-the-job training
- Watching toll booth collections
- Watching gambling tables
- Watching for forest fires
- Remote viewing of meetings and conventions
- Interhospital consultation
- Displaying merchandise in stores
- Finding space in parking lots
- Viewing fishery equipment underwater
- Checking freight car numbers
- Catching thieves in action
- Viewing police lineups
- Displaying meats in freezer to customers
- Riding guided missiles
- Watching atomic reactions
- Defusing unloading bombs
- Underwater salvage
- Guarding prisoners in jail
- Displaying odds at race track
- Viewing hot steel rolling mill operations
- Providing entertainment on moving train
- Remote viewing aboard ship
- Viewing molten steel pouring
- Allowing mass viewing of one microscope
- Making motion pictures
- Underwater viewing of river beds for dam sites
- Monitoring furnace operations
- Underwater inspection of docks and wharves
- Studying oyster beds
- Checking sugar cane conveyors
- Observing plane landings in bad weather
- Viewing military exercises

► **Future**—As can be seen from the list of actual installations, the possible uses for industrial tv are virtually limitless, bridled only by its initial cost and upkeep versus savings to be made by its use.

## Copper Prices Soar As Supplies Drop

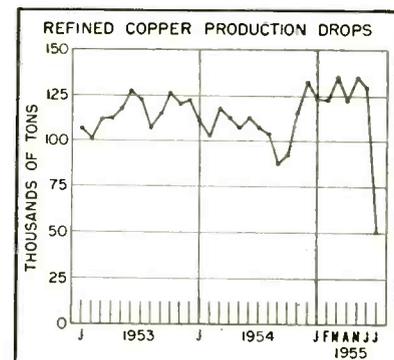
Strikes and floods combine to bring worst crisis in the industry's history

PRODUCTION of refined copper dropped from 131,431 tons in June to 51,182 tons in July and indications are that the decline is continuing. Demand has increased and copper prices have climbed steadily from 30 cents a pound in May to a current price of 43 cents a pound.

Some electronics manufacturers have already felt increasing prices or tightness of supply. Electrolytic sheet copper for printed circuits has gone up about 7 cents a pound in the past month and one type is now selling for about 80 cents a pound in 1,000-pound lots.

American Brass, supplier of electrolytic sheet copper, had no flood damage to its electrolytic sheet plant located in New Jersey. Reverse Copper & Brass, which now supplies rolled printed circuit copper, also had no flood damage. But work stoppages and shutdowns in the copper industry earlier this summer combined with the effects of the flood on other segments of the industry have kept the entire copper supply picture critical.

► **Plea**—At the end of August, in a meeting of the Business and Defense Services Administration and the Primary Copper Producers Industry Advisory Committee, it was estimated domestic copper production would return to normal by the end of September. However,



(Continued on page 16)

# KÄHLE

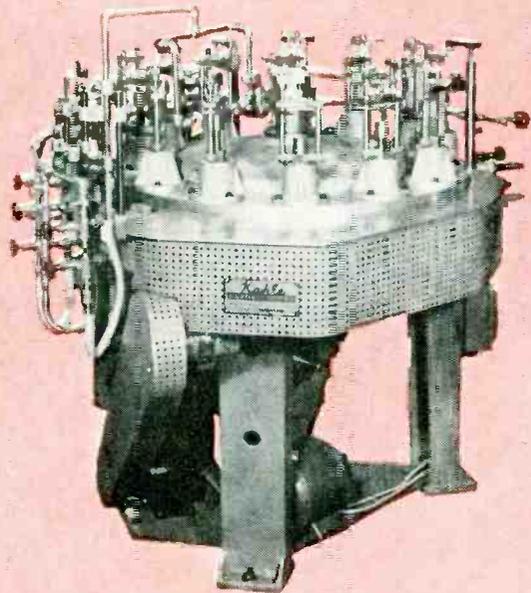
## automatic machines

ARE PRODUCING

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DIODES, TUBES AND  
TUBE COMPONENTS...

faster,  
more economically.



TRANSISTOR BUTTON STEM MACHINE NO. 2707

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**Kähle** ENGINEERING COMPANY

1310 Seventh Street North Bergen, New Jersey

on September 6, President Eisenhower was asked to call a special session of Congress if necessary to bring relief to the copper and brass industry now confronted with "the worst crisis in the industry's history".

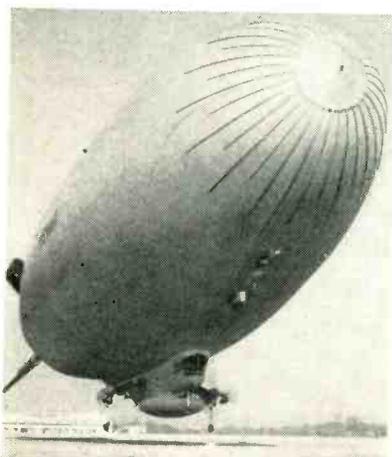
The request was made by the Copper and Brass Warehouse Association speaking also for the Copper and Brass Research Association and the wire and cable section of NEMA. The group asked for release of 100,000 tons of copper from the nation's stockpile.

According to the association, a nationwide survey indicated that brass and copper inventories have been reduced almost to the vanishing point. Distributors and warehouses across the country reported an average of one to three weeks supply on hand.

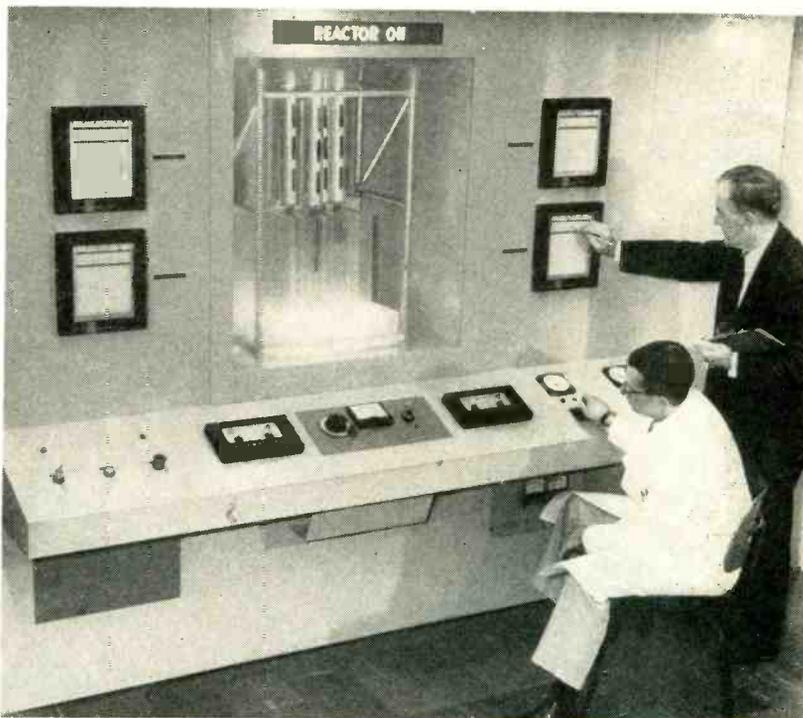
Normally reserve stocks in warehouses are sufficient to meet demands for two to three months. The survey also showed that 30,000 small manufacturing plants would have to shut down by the end of September unless deliveries returned nearer to normal.

The government has diverted a total of over 45,000 tons of copper from its stockpile for use by civilian industry this year.

## Radar Network Link Takes To The Air



Mushroom-shaped radome beneath the cabin of this Navy picket blimp houses the antenna of high-power search radar, type AN/APS-20E, new airborne link in the radar network guarding North America



CONTROL rods move upwards and a ghostly blue light sweeps up the core when . . .

## Mock Reactor Trains Engineers

**Panel board, plastic core and analog computers provide operating experience**

A TOTAL of 250 reactor engineers will complete training this year but by 1965 the atomic-energy industry may require 15,000. One answer may be the nuclear reactor simulator recently demonstrated by Leeds and Northrup.

Patterned after the Geneva swimming-pool reactor, the reactor model is made of plastic. The full-sized control panel is complete with

instruments and controls. Rods in the reactor model move up and down in response to the controls.

► **Analog Computers**—Operating conditions are simulated by the equipment's analog computer. Incorporated in the control panel, it solves continuously the differential equations describing the kinetic operation of the reactor.

The mock-up reactor costs from \$11,000 to \$17,000 as against \$350,000 for a real swimming-pool reactor. Simulators can be built for other types of reactors.

## Flooded Industries Bounce Back

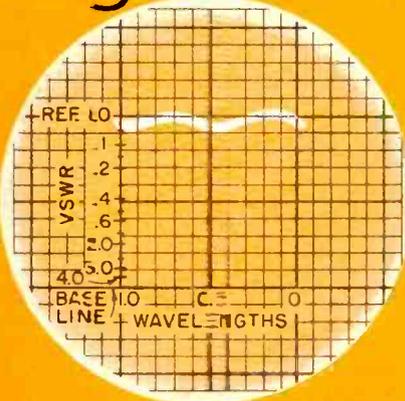
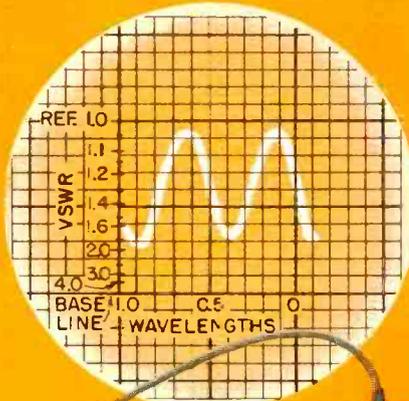
**Defense contracts will aid recovery of electronic-component manufacturers**

DAMAGE to electronics-manufacturing industry by recent floods will be partly alleviated by action of the Signal Corps. It is placing 100 to 150 contracts, at an estimated dollar value of \$750,000, in the disaster areas.

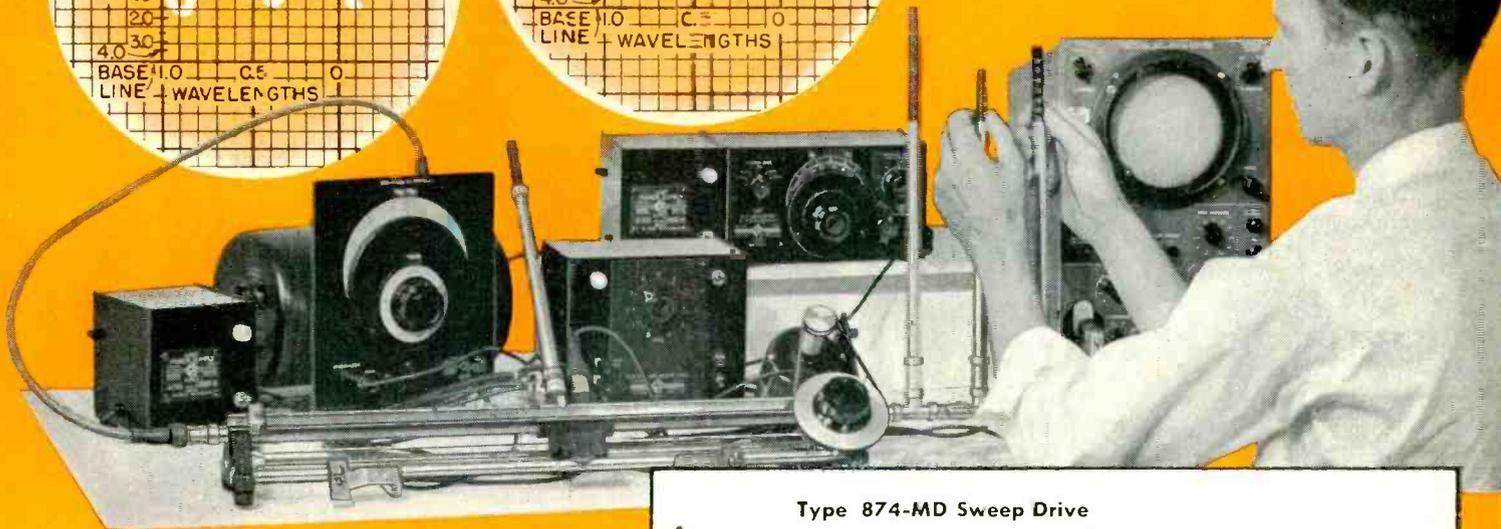
Every procurement with the exception of mobilization base items, purchases under \$1,000 and urgently required delivery items will be negotiated solely in the officially declared areas whenever a qualified source is known to exist in those areas. In procuring the urgently needed items, qualified firms in the disaster areas will be given an opportunity to compete

(Continued on page 20)

# for *Busy Engineers* ...not *Lazy ones*



**VSWR of 1.8 to 1.02**  
**in a Fraction**  
**of a Minute**

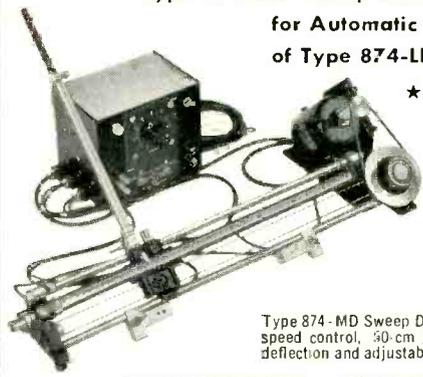


Anyone who has adjusted a three-stub matching network for minimum VSWR at microwave frequencies knows this is a time-consuming trial and error operation.

With the new G-R Type 874-MD Sweep Drive providing automatic sweep for the Type 874-LBA Slotted Line, this adjustment can be accomplished in 45 seconds. Without automatic sweep, the job could take as long as 15 minutes; two dozen or more stub adjustments and slotted-line hand-driven operations might be required before the matched condition is accomplished. This relatively simple application is an excellent example of the benefits which can be derived through an Automatic Sweep for the precision Type 874-LBA Slotted Line.

Wherever load adjustments or settings of any kind must be made in production or laboratory . . . to minimize VSWR, create a matched condition or to arrive at some desired impedance . . . the Sweep Drive can save hours of valuable engineering time. While the Slotted-Line probe carriage is automatically driven back and forth along the Line, the load adjustment or change is made slowly but *continuously*, as one notes the consequent change in VSWR pattern on the CRO face (or meter dial). The instantaneous indication of VSWR for each immediate setting provides the feedback link, via the operator's eye, which permits him to quickly "ease" the adjustable element in the load into the optimum position. There are no trial and error operations. The correct condition is arrived at the first time.

**Type 874-MD Sweep Drive**  
**for Automatic Cyclic-Sweeping**  
**of Type 874-LBA Slotted Line**



- ★ SWEEP SPEED — continuously adjustable from one full sweep (46 cm) in more than 10 seconds, to one full sweep in less than one second.
- ★ SWEEP RANGE — continuously adjustable from 1 cm to 46 cm.
- ★ CRO HORIZONTAL DEFLECTION SIGNAL — voltage divider with sliding contact on probe carriage provides d-c output.

Type 874-MD Sweep Drive . . . includes motor and drive mechanism, speed control, 40-cm long precision-wound potentiometer for CRO deflection and adjustable travel stops. . . . \$220.00

Type 874-LBA Slotted Line . . . with Adjustable Stub for tuning crystal rectifier. . . \$231.00

The uses for this new tool in research and development laboratories are many. With an oscilloscope, this equipment not only gives an accurate visual presentation of the standing-wave over a very wide range of frequencies, but also presents the phase of the reflection coefficient. Impedance is *directly measured* from information on the scope face. For production "Go, No-Go" testing, the scope face can be crayon-marked for maximum acceptable VSWR — the answer appears as rapidly as the terminations, coaxial switches, connectors or other elements are connected to the Slotted Line.

The combination of the G-R Slotted Line with Automatic Sweep provided by the Type 874-MD Sweep Drive can save valuable engineering man-hours each day, at a time when engineers are in short supply. *Keep in mind, this equipment is designed for busy engineers — not lazy ones.*

**GENERAL RADIO Company**

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# NEWER SMALLER TRANSISTORS



Transistor shown actual size

## HERE'S PROOF!

Size of Raytheon 2N130 Series compared with other makes

Type	Volume <sup>*</sup> cu. in.
Transistor made by "A"	0.0546
Transistor made by "B"	0.0318
Transistor made by "C"	0.0242
Raytheon's New Transistors	0.0087

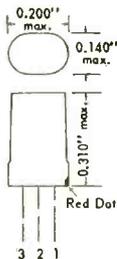
\*The volume is that of the smallest rectangular parallelepiped which will contain the transistor.

Here they are! The new Raytheon Transistors that are only *one quarter to one third the former size*. They permit *real* miniaturization of equipment. Hermetically sealed; completely stabilized and interchangeable.

Hundreds of thousands of these new, small Raytheon Transistors have set new standards of performance in hearing aid service for more than a year. They are equally available for all other applications.

Look at the characteristics charted below including 2N133 with maximum noise factor of 10db. They are based on over two and a half years of mass production of transistors for commercial applications.

No other producer of transistors even approaches Raytheon's experience in manufacture and quality control or Raytheon's knowledge gained through large scale usage in everyday operation.



Type	Collector			Emitter mA	Base ohms	Base Current Ampl. Factor	Max. Noise Factor db	Alpha Freq. Cutoff mc.	Max. Junction Temp. °C	Temp. Rise °C/mW
	Volts	Meg. ohms	Cutoff μA							
<b>2N130</b>	-6	2.0	6	-1.0	350	22	25	0.6	85	0.77
<b>2N131</b>	-6	2.0	6	-1.0	700	45	22	0.8	85	0.77
<b>2N132</b>	-6	2.0	6	-1.0	1500	90	20	1.2	85	0.77
<b>2N133</b>	-1.5	1.0	6	-0.5	700	45	10	0.8	85	0.77

**RAYTHEON TRANSISTORS**  
*more in use than all other makes combined*



for predictable

# UNIFORMITY and STABILITY

specify

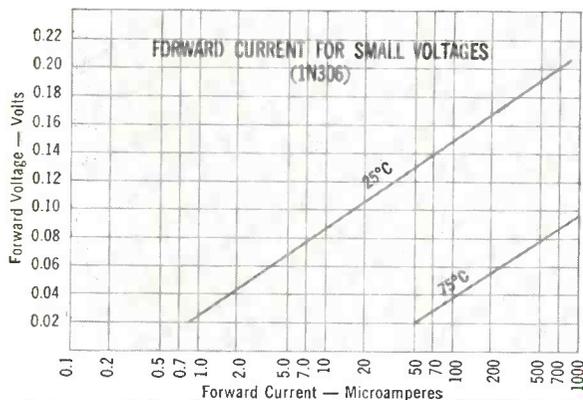


Gold Bonded Germanium  
**DIODES**

You'll find these small, rugged, hermetically sealed Raytheon Germanium Diodes ideal for Computers, Magnetic Amplifiers, Power Supplies, Detectors, Meter Protection or countless other applications where extremely low forward resistance and high reverse resistance characteristics are important. Here are some of the advantages you get when you specify Raytheon

1N305, 1N306 and 1N307 DIODES:

- High forward current at low voltage
- Low saturation current
- Operable to 90°C with high uniformity and stability
- Mechanical ruggedness
- Small size



	Forward Volts for 100 mA	DC mA. (max.)	Peak Inverse Volts	Reverse $\mu$ A at -10V
1N305	0.8	125	60	2
1N306	0.8	150	15	2
1N307	1.0	50	125	5

Temperature rating -55°C to +90°C (Above ratings at 25°C)

### MULTIPLE DIODE ASSEMBLIES

Raytheon can supply both germanium and silicon diodes, electrically matched, if required, in assemblies to meet your needs. For quotation, send your specifications to the nearest Raytheon office.

## RAYTHEON MANUFACTURING COMPANY

Semiconductor Division

Home Office: 55 Chapel St., Newton 58, Mass., Bldg 4-7500

For application information write or call the Home Office or:  
9501 Grand Ave., Franklin Park (Chicago), Ill., TUXedo 9-5400  
589 Fifth Avenue, New York 17, New York, PLaza 9-3900  
622 South La Brea Ave., Los Angeles 36, Calif., WEbster 8-2851

### RAYTHEON MAKES ALL THESE:

RELIABLE SUBMINIATURE AND MINIATURE TUBES • SEMICONDUCTOR DIODES, POWER RECTIFIERS AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES

Visit RAYTHEON Booths 73-4-5 at the National Electronics Conference, Chicago

with past and present suppliers.

Hardest-hit of several regions was that of Naugatuck River valley of Connecticut. Here, however, several electronic-component manufacturers of those affected are back to almost full production.

► **Typical Cases**—Haydon Manufacturing Co. of Torrington had losses totaling approximately \$13,000. Their production of timers was interrupted primarily by lack of power.

Technicraft Lab. of Thomaston, Conn. had 6½ feet of water rushing through its plant at 45 mph. The water took with it most of the company's inventory and damaged equipment resulting in \$150,000 loss. Except for some delays in deliveries, the company sees no loss of business. Production and

facilities are expected to return to normal by October 1.

Inventory loss was experienced by Dano Electric Co. of Winsted, Conn. Most of the firm's equipment was at a level higher than the maximum reached by the flood waters. Inventory lost consisted of semifinished materials for production of coil windings and transformers. Full-scale production is expected before October 1.

Most damage was incurred by the American Brass Co. with six divisions in plants in Waterbury, Torrington and Ansonia. A producer of brass, copper and other metal rods and sheets, the company sustained a \$15,000,000 loss, principally in fabricating machinery and buildings. Loss of inventory was relatively small.

## Factory Inventories Set New Highs

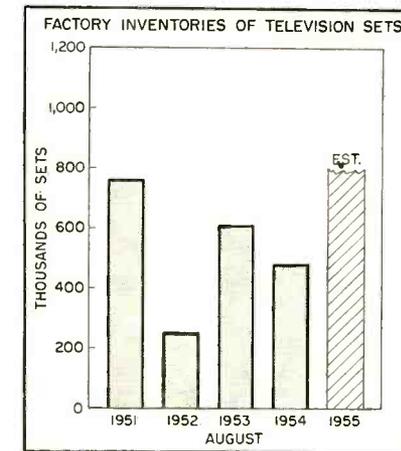
**Manufacturers' warehouses bulged. Production and sales continue at a high rate**

FACTORY inventories of tv receivers during the second and third quarters of this year have been the highest in history.

Between 700,000 and 800,000 sets were stacked in factory warehouses in August, equaling the record high stocks of 1951. In June and July, factory inventories approached one million units, by far the largest stocks ever held.

Inventories at distributor and dealer levels were also high, bringing total stocks in the industry to over 2.4 million sets, approximately one-third higher than in 1954. But dealer inventory was not as high as in 1954. At the end of June, retail outlets held 742,000 sets compared to 878,000 in June of 1954.

► **Makeup**—According to Standard & Poor's, at the end of June, 1954, high-priced console sets constituted 46 percent of total tv unit inventories and table models accounted for 52 percent. At mid-1955, these percentages had changed to 40 percent and 58 percent respectively.



► **Effect**—Television set manufacturers do not seem overly concerned about the current inventory situation. The summer months are traditionally the periods of high factory inventories.

After new line introductions have been made, shipments to distributors start and stocks dwindle rapidly. This year, factory inventories dropped approximately 200,000 units by September as distribution pipelines were filled.

Retail sales continued at a record pace. During the first seven months of this year, retail outlets sold 3.6 million tv sets and established a record for the period.

## Computer Firms Report Gains

**Smaller companies reveal several new installations and product developments**

SALES of small, medium and special-purpose computers contribute significantly to the electronic digital computer business.

ElectroData discloses that 13 of their Datatron medium-sized computers are in use. Another machine will be installed this month for Babcock and Wilcox in New York.

► **Other Machines**—Two special-purpose machines are being installed at Convair-San Diego to solve differential equations in aircraft and missile dynamics. They will check solutions from analog computers. The machines are CRC-105's built by Computer Research division of National Cash Register.

Monrobot V is being checked out at the Corp of Engineers' Research and Development Labs, Fort Belvoir, Va. The 1,500-lb, 5-kw machine is designed for loading into a mobile laboratory. It will be used in preparing military maps. The machine is a product of the Monrobot Laboratory, Morris Plains, N. J.

► **Reservations**—Braniff Airways will install Teleregister Corp. equipment to keep track of reservations on all flights 31 days in advance. The equipment will be tied in with a 12,000-teleprinter network linking 58 U. S. cities and Latin American points.

Another Teleregister system will be installed by the New York Central to store information regarding up to 600,000 accommodations. Magnetic storage drums at New York, Chicago and Cleveland will serve 48 locations in 36 cities.

► **New Developments**—The Burroughs' character recognizer which reads serial numbers on 120 checks a minute is completing field tests at First National City Bank of New

(Continued on page 22)

# **NO SHOCK MOUNT EVER HAD IT SO TOUGH**

**That's why  
ALL-ANGL  
Barry mounts  
are used in  
MARTIN'S  
MATADOR**



Under the cumulative shock of rocket-boosted zero-length take-off, jet-fighter flight maneuvering, and on-target dive that cracks the sound barrier, the nation's first operational pilotless bomber relies on ALL-ANGL Barrymount® isolators to protect critical electronic control gear.

Equally effective in every flight attitude, ALL-ANGL mounts permit bulkhead mounting that saves vital space in this deadly weapon. And their proved performance makes Barry mounts Martin's choice for the Matador.



Let us show you how Barry's new ALL-ANGL isolators can lick your tough mounting problems. Data sheet M-9 gives mechanical and dynamic specifications. For specific recommendations, call your nearest Barry Sales Representative.

PHOTOGRAPH COURTESY THE MARTIN COMPANY

**BARRY CONTROLS**  
INCORPORATED

707 PLEASANT ST., WATERTOWN, MASS.

York. The machine did work 10 times as fast as by manual means while reducing errors 90 percent.

Under development is an automatic bank bookkeeping system, a joint venture by Burroughs, Todd and Addressograph-Multigraph. Coded information in the form of invisible fluorescent dots is placed on a check as a by-product of other operations. Thus coded, the check can be used as input to data processing systems. Varying sized checks can be handled.

► **Fast Printing**—Installation of the Burroughs 900-line-a-minute printer will be this month in the New York area. The machine will combine multiple printing and card-punching operations from one pass of cards through the machine.

Burroughs has also under development an electrographic recording process in which characters are printed at the rate of 5,000 a second when coated paper carrying a pinpoint pattern of electrostatic charges is passed through a dry ink bath.

Several orders are reported for the E101, a \$32,500-computer with input-output mechanism based on a standard type bookkeeping machine.

## U.S. Contract Awards Emphasize Radar

**Radar buying accounts for seven of ten big contracts let in August**

GOVERNMENT contract awards amounting to one million dollars or more were let to seven firms during August. Total value of the ten contracts involved was \$34,585,429.

Seven contracts amounting to \$26,725,218 were for radar sets and related equipment. Three contracts for radio equipment totaled \$7,860,211.

► **Contractors** — Two contracts were awarded to General Electric. Value amounted to \$16,497,930. The contracts were for electronic countermeasures transmitters and

for ground-based search radar.

RCA received contracts worth \$4,512,051 for two models of radar equipment one of which was an airborne navigational radar.

► **More Radar**—Two contracts for airborne search radar and for radar parts went to Motorola. Value was \$3,672,500.

Western Electric received a \$2,042,737 contract for shipborne gun-

directing radar equipment.

► **Radio Equipment**—Magnavox received a \$3,096,619 contract for airborne navigational equipment. A \$3,587,418 contract went to Crosley for ground-based radio communications equipment.

Kearfoot was awarded a contract for \$1,176,174 worth of loop assemblies, indicators and other electronic parts.

## Gas-Tube Shift Noted

**Rectifier and control types have lost volume but hydrogen thyratrons have gained rapidly**

SIGNIFICANT changes have been taking place in the gas-tube business in the past few years. Total sales for all types of gas-filled tubes have grown as have other electronics products.

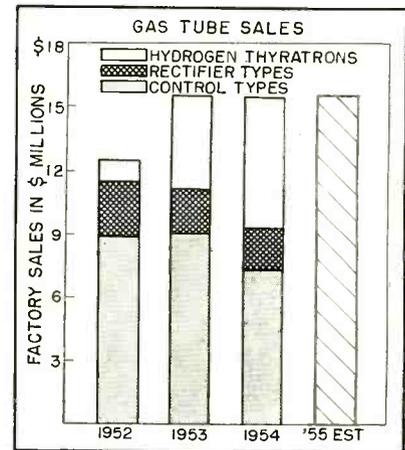
Total sales rose from \$10.6 million in 1951 to \$15.5 million last year. Some producers see 1955 sales continuing on the upgrade.

The makeup of these rising sales has changed considerably in the past three years. Hydrogen thyratron sales have risen from about \$900,000 in 1952 to \$6.2 million last year. Hydrogen thyratrons, primarily used as radar pulsers, are classified separately from control tubes by the industry.

► **Units**—Annual sales of rectifier and control types of gas or vapor tubes have both dropped more than \$1 million since 1952. Rectifier types dropped from 455,000 units in 1952 to 293,000 in 1954 while control types declined from 1.5 million to 1.1 million during the period. Unit volume of hydrogen thyratrons climbed from 21,000 units to 64,000.

► **Gas**—Of the five rare gases of the atmosphere: argon, neon, xenon, helium and krypton, the first three find greatest use in electronics.

Argon is used in a number of electronic devices and as a fill gas for incandescent lamps. It is a major factor in the automatic elec-

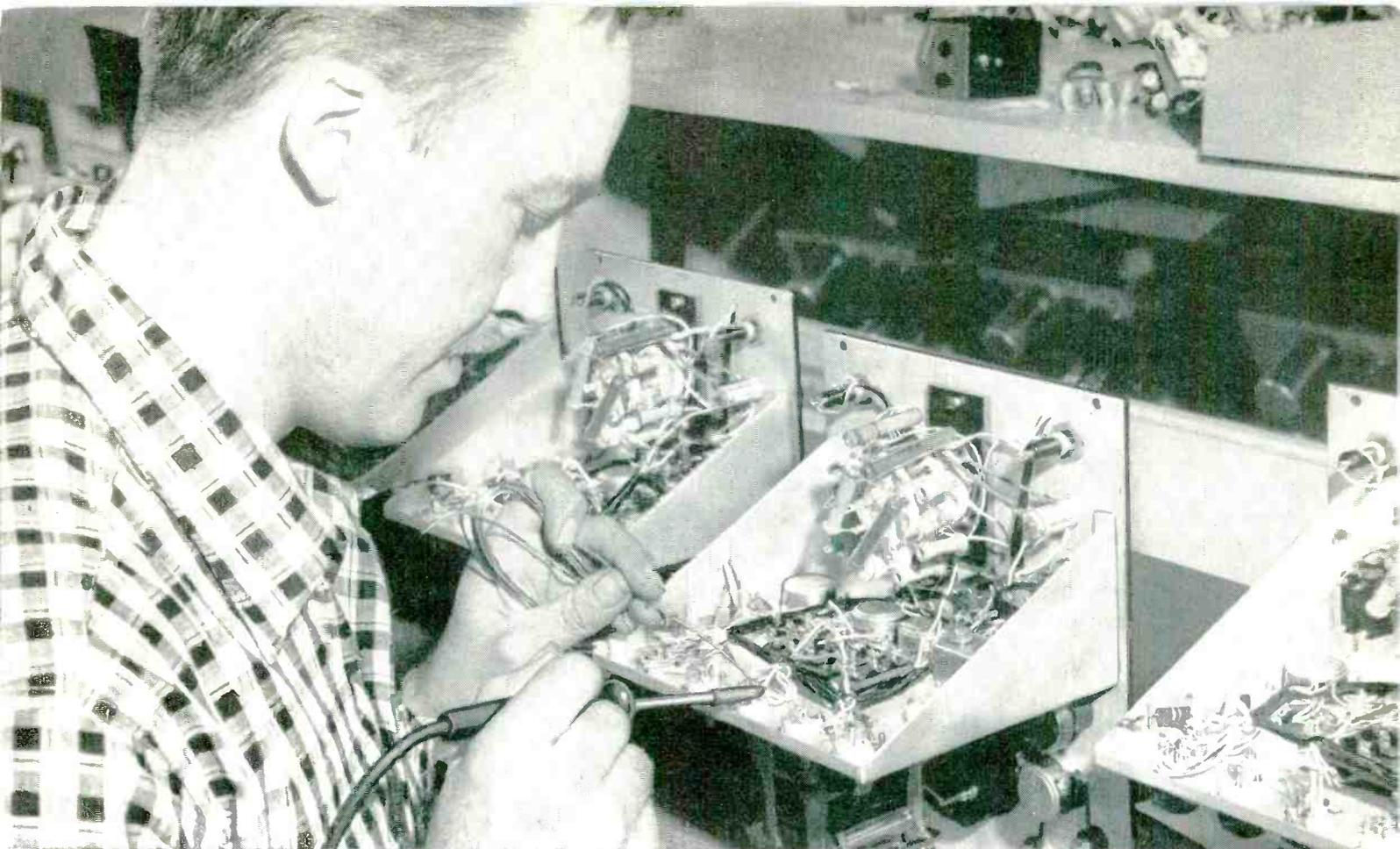


tric welding industry. Neon, with other rare gases, is used in voltage regulator tubes, Geiger-Muller tubes, glow lamps and other electronic devices. Xenon is used in thyratrons and in high-speed photographic lamps.

► **Up**—According to the Department of Commerce use of argon by the electronics and electric-lamp industries rose from 8.8 million cubic feet in 1951 to 12.2 million cubic feet in 1953. Last year annual consumption reached a high of 13 million cubic feet. With prices of the purified grade of argon varying from 9 to 12 cents per cubic foot, this represented a dollar volume of some \$1.3 million.

Nine companies produce argon in 14 plants across the U. S. Their combined capacity amounts to about 450 million cubic feet of refined argon per year. By the end of 1956 12 companies will be operating 21 plants with a capacity of 550 million cubic feet.

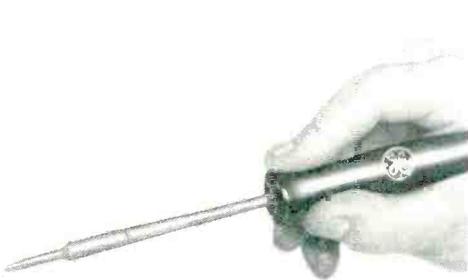
(Continued on page 24)



"BEST IRON WE'VE HAD in the plant," says William Fish, a production supervisor of General Radio, Cambridge, Mass. This company has switched to G-E Midget irons for soldering *both*

delicate and heavy joints in their Type 1862-B Megohmmeters — jobs which formerly required *both* a heavy and a light iron. G-E Midget iron's light weight also helps reduce fatigue.

## 50 G-E Midget irons do work of 100 former irons at General Radio Co., boost production 25%



**HANDLES LIKE A PENCIL**—Weighing less than a package of cigarettes, the General Electric Midget soldering iron speeds production by reducing operator fatigue.



**RAPID HEAT TRANSFER** is achieved through a famous Calrod\* heater located in the ironclad-copper tip. Result—the G-E Midget iron's heat efficiency is 90%.

\*Reg. trademark of the General Electric Company



**THREE-IN-ONE IRON** with  $\frac{1}{8}$ ",  $\frac{1}{4}$ ",  $\frac{3}{16}$ " tip sizes gives you greater versatility to meet your soldering requirements. Tips can be changed in only 5 seconds.

For more information write for GED-2263, G-E Midget Soldering Iron, Section 724-3, General Electric Co., Schenectady 5, N. Y.

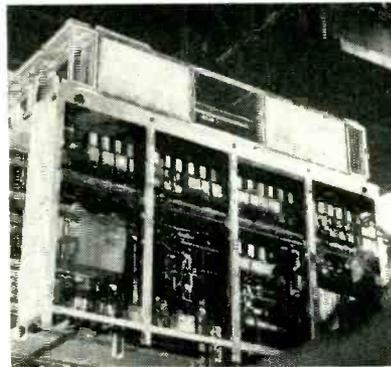
GENERAL  ELECTRIC

## More Locomotives Use Rectifiers

**Ignitrons permit operating mass-produced d-c motors from railroad's a-c lines**

TWELVE 3,300-hp rectifier locomotives now on order with GE will haul Virginian Railway trains over the 134-mile mountainous road from Roanoke to Mullins, W. Va. A pantograph trolley will collect 11,000-v, 25-cps, single-phase a-c from overhead lines. In each locomotive, 12 type GL6504 ignitrons will convert the a-c to low-voltage d-c.

The locomotives may thus be equipped with the mass-produced d-c traction motors developed originally for diesel-electric service. The ignitrons used weigh approximately 100 lbs each and measure 8 in. in diameter.



Preassembled control units speed locomotive erection

► **New Haven**—In March, GE delivered the first of 10 rectifier locomotives to the New York, New Haven and Hartford Railroad. The New Haven locomotives can operate from both 11,000-v a-c and 600-v d-c power.

## Medical Television Makes Progress

**Contract awarded to RCA for three color tv systems to be used in hospital activities**

COMPATIBLE color tv installation is underway at the Walter Reed Army Medical Center for use in medical research, teaching and consultation.

The installation will provide three color television systems for use by the Armed Forces Institute of Pathology, the Walter Reed Army Hospital, and the Army Medical Service Graduate School.

► **Amount**—Contract for the color television system was awarded RCA on the basis of a low bid of \$425,800. Installation is scheduled for completion early next year. The system will be operated by the Army Signal Corps.

Ultimately, it will be expanded to connect other governmental hospitals and military medical installations into a network for exchange of information and services.

► **Setup**—The three separate and complete color television studios



New tv camera developed by RCA for medical use

can be operated independently, or joined as a network. Each will be equipped for closed-circuit operation and for direct transmission to commercial networks.

Thirty RCA Victor 21-inch color television receivers will be used.

The pictures transmitted by each studio can be confined to certain receivers or can be fed to a

central control for distribution over an antenna system to all 30 receivers. Provisions are made for relay of signals from any studio to a projector in a central auditorium for large-screen pictures.

The antenna system provides three channels, one for each studio.

## Computer Controls Cut Machining Costs

**Machine tool manufacturers offer programming systems on wide range of tools**

ELECTRONICS portion of the estimated \$2-billion that manufacturers will spend in the next 18 months for new machine tools will be the largest ever and is expected to grow with the trend to more automatic production.

A survey by *American Machinist* comparing 1947 and 1955 machine tools indicates that the use of electrical and electronic equipment has increased by about two-thirds in the eight-year period.

► **Automobiles**—In the auto industry, where all major manufacturers are building or operating highly automatic engine building lines, the amount spent for electronic equipment has doubled. In the recently completed \$22-million Packard engine plant, the entire operation is under the control of 14 separate electronic systems.

► **Computers**—Complete machining operations under control of analog or digital computers are now being supplied for lathes, boring machines, grinders, millers, punch presses and gear shapers. These units receive their instructions from punch cards, tape (both magnetic and punched paper) or from dial settings made by an operator.

► **Costs**—Although addition of computer control adds a sizable amount to the price tag on a machine tool, the saving in machining time can make up for it. In one

(Continued on page 26)

# Performance is TOPS!

When you buy communications receivers, you buy performance above all else. And, performance is what you get when you buy the *NEW* PRO-310. It's the receiver designed with performance in mind. And, the PRO-310 outperforms all other receivers in its class. Here's why —

- ✓ Took 3 years engineering and design time to develop, including 1½ years to iron out the 'bugs'.
- ✓ Hammarlund has the receiver know-how gained by making thousands of sets for gov't. service.
- ✓ These features:
  - Frequency readings to 1 part in 5000
  - Continuously calibrated bandspread *over the entire range*
  - Exceptional stability
  - High Image Rejection—*on all 6 bands*
  - Sectionalized construction
  - Etched and plated circuits in the RF section
  - Many others

Check on the *NEW* PRO-310—it's made to order for your "tough-spot" service. Write for specs and other details to The Hammarlund Manufacturing Co., Inc., 460 West 34th Street, New York 1, N. Y. Ask for Bulletin E-10.

## The "Heart" of the Pro-310

Newly developed front-end with three tuned circuits but only one RF tube amplifier provides remarkable selectivity and ultra-high signal-to-noise-ratio.

 **HAMMARLUND**

*Since 1910*

*New*  
**PRO-310**



instance, machining time on jet engine parts was reduced from 56 hours to less than four minutes.

## Financial Roundup

### More first half profit reports show the industry's healthy business volume

ALTHOUGH net profits in the first six months of this year for individual companies in the electronics field have shown wide variation, they have left no doubt as to the overall well-being of the industry. This can be seen in the following profit reports of 11 firms in the field for the fiscal periods indicated:

Company	1955	Net Profit	1954
Barry Controls 6m	\$180,515		\$168,926
Clary Corp. 6m	179,632	(loss)	40,638
Coleman Eng. 12m	52,290		30,687
CBS 6m	6,327,672		5,177,449
Eastman Kodak 6m	36,365,989		28,134,192
T. A. Edison 6m	571,378		459,603
Lear 6m	876,366		1,397,558
National Cash Reg. 6m	6,263,683		5,627,065
Texas Inst. 6m	696,010		591,596
Topp Industries 12m	130,274		71,885
United-Carr 6m	1,963,686		1,068,754

► **Securities**—Philco sold \$15 million of 25-year 3.5-percent sinking fund notes to John Hancock Mutual Life Insurance. Proceeds will be added to working capital and will be used to finance expanded business volume planned in the advanced electronic and appliance fields.

El-Tronics offered 100,000 shares of common stock, par 5 cents, at \$2.75 per share. Net proceeds are to be used to increase working capital and reduce accounts payable.

Tel-Instrument Electronics offered 199,999 shares of common stock, par 10 cents, at 1.50 per share. Net proceeds are to be used to purchase stock or assets of Roebink, Labscope and Therica Equipment; for a research program and for acquisition of inventory and working capital.

Precision Radiation Instruments offered 225,000 shares of common stock, par 50 cents, at \$5 per share. Proceeds will be used for acquisition of property, equipment and for working capital.

## FUTURE MEETINGS

- Oct. 3-5: National Electronics Conference, Hotel Sherman, Chicago, Ill.
- Oct. 3-7: AIEE Fall General Meeting, Morrison Hotel, Chicago, Ill.
- Oct. 3-7: 78th Convention of SMPTE, Lake Placid Club, Essex County, New York.
- Oct. 10-12: AMA Conference on Automatic Production, Hotel Roosevelt, New York, N. Y.
- Oct. 12-15: 1955 Convention of the Audio Engineering Society concurrent with the Audio Fair, Hotel New Yorker, New York, N. Y.
- Oct. 17-19: RETMA Radio Fall Meeting, Hotel Syracuse, Syracuse, N. Y.
- Oct. 20-22: Eighth Annual Gaseous Electronics Conference, GE Research Lab., The Knolls, Schenectady, N. Y.
- Oct. 24-25: First Annual Technical Meeting, IRE Professional Group On Electron Devices, Shoreham Hotel, Washington, D. C.
- Oct. 25-27: International Conference on Electronic Digital Computers and Information Processing, Darmstadt, Germany.
- Oct. 26-28: Fourth Annual Conference, Atomic Energy In Industry, NICB, Waldorf-Astoria Hotel, New York, N. Y.
- Oct. 28-29: 1955 Symposium of Philadelphia ISA, Penn Sherwood Hotel, Philadelphia, Pa.
- Oct. 31-Nov. 1: 1955 East Coast Conference on Aeronautical and Navigational Electronics, IRE, Lord Baltimore Hotel, Baltimore, Md.
- Oct. 31-Nov. 1: International conference on scientific basis of applied solar energy, University of Arizona, Tucson.
- Nov. 1-5: World Symposium On Applied Solar Energy sponsored by AASE, Stanford Research Institute and University of Arizona, Phoenix, Ariz.
- Nov. 3-4: Eighth Annual Electronics Conference, Kansas City IRE, Town House, Kansas City, Kan.
- Nov. 7-9: IRE, AIEE, ACM Eastern Joint Computer Conference, Hotel Statler, Boston, Mass.
- Nov. 14-15: IRE symposium on Communication by Scatter Techniques, Lisner Hall of George Washington University, Washington, D. C.
- Nov. 14-16: IRE, AIEE, ISA Electrical Technology in Biology & Medicine, Shoreham Hotel, Washington, D. C.
- Nov. 15-17: Second International Automation Exposition, Navy Pier, Chicago, Ill.
- Nov. 21-22: IRE Aeronautical Communications symposium, Hotel Utica, Utica, N. Y.
- Nov. 28-30: IRE Instrument Conference & Exhibit, Hotel Biltmore, Atlanta, Georgia.
- Dec. 12-16: Nuclear Engineering and Science Congress, coordinated by Engineers Joint Council, Cleveland, Ohio.

## Industry Shorts

- **Mini-Resistron** tube that is 90 mm long and 15 mm in diameter is used in a hand-size miniature tv camera introduced by Grundig at the German Radio Exhibition.
- **Conduction-type** radiation counter small enough for use in the body of a living animal or person has been designed and developed by Battelle Institute for the Army Chemical Corps.

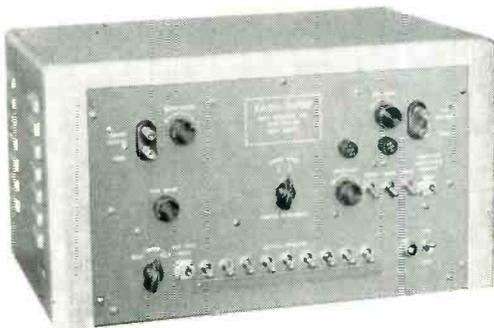
- **Total power** supplied in the U. S. from the annual production of batteries is approximately 2 million watts, according to E. G. Linder of RCA.
- **More** than one tv antenna is used in about 75 percent of tv set installations in Caracas, Venezuela, according to Channel Master.
- **Special Industrial Radio Service** liberalized by FCC now includes building construction, mining, oil, gas and ice deliveries.

# KAY

## Wide Band Sweeps for Aligning Radar IF Amplifiers



The Radaligner is a two-band sweeping oscillator designed to be used with a standard oscilloscope to determine frequency response of circuits from 10 to 170 mc. For frequency identification, the Radaligner includes eight narrow, customer-specified, crystal-controlled markers and a single variable marker covering both sweeping oscillator ranges. Center frequencies of sweep ranges also set to customer's requirements.



A combined sweeping oscillator and crystal marker generator, the Rada-Sweep is designed especially for rapid alignment of radar IF amplifiers. Used with an oscilloscope, it will display response curves of IF amplifiers and mark up to nine frequencies to allow precise adjustment of response.

For complete information write:

## KAY Radaligner

### SPECIFICATIONS

**Sweep:** Regular sawtooth, adjustable around or synchronized with 60 cps power line.

**Frequency Range:** Center frequencies may be selected at any two points in the 15 to 80 mc band.

<b>Sweep Width:</b> Center Frequency below 30 mcs:	Wide Band	Narrow Band
	$\pm 5$ mcs	$\pm 0.5$ mcs
Center Frequency above 30 mcs:	$\pm 10$ mcs	$\pm 1.5$ mcs

**Amplitude Modulation While Sweeping:** Less than 0.05 db/mc.

**RF Output Voltage:** 250 millivolts into 70 ohms.

**RF Output Control:** Switched attenuators: 20 db, 10 db and 3 db.  
Continuous attenuator: approximately 6 db.

**Markers: Fixed:** Eight, narrow pulse-type, crystal-controlled markers, positioned at customer's option. Available singly or in any combination through individual switches.

**Variable:** Frequency continuously variable throughout selected sweep ranges. Frequency calibration accurate to within 0.5%.

**Marker Output Voltage:** Positive pulse, approximately 10 volts peak.

**Marker Output Control:** Continuously variable, zero to maximum.

**Power Requirements:** 105 to 125 volts, 50-60 cps, approx. 110 watts.

**Price:** \$795.00 (rack-mounted), f.o.b. plant. Cabinet \$35.00 extra.

## KAY Rada-Sweep

### SPECIFICATIONS

**Center Frequencies:** 30 and 60 megacycles.  
Others may be added to special order.

**Sweep Width:** Wide—20 mcs or Narrow—3 mcs selected by a panel switch.

**Sweep:** All electronic, linear sawtooth. Sweep signal is brought out to terminals for connection to oscilloscope horizontal amplifier. Sweep repetition rate is adjustable around and may be synchronized to the cps line.

**Markers:** Up to 9 crystal positioned pulse type marks fed directly to scope vertical amplifier. Four supplied standard at 25, 35, 55 and 65 mcs. Others located as specified by purchaser. The standard marks may be replaced with others as specified. Individual on-off control of each mark.

**Amplitude Modulation While Sweeping:** Less than .05 db/mc.

**RF Output Voltage:** 250 millivolts across 70 ohms.

**RF Output Control:** Switched Attenuator: 20 db, 20 db, 10 db. Continuous Attenuator: covers approximately 5:1 ratio.

**Marker Output Voltage:** Positive pulse, approx. 10 V peak.

**Marker Output Control:** Continuously variable, 0 to maximum.

**Power Supply:** 105 to 125 volts, 50 to 60 cps. Power input approximately 100 watts. Circuit electronically regulated.

**Price:** \$395.00 f.o.b. plant with standard marks. Any standard mark may be replaced with a special frequency—\$10.00 each. Additional marks at \$20.00 each.

# KAY ELECTRIC COMPANY

DEPT. E-10 14 MAPLE AVENUE PINE BROOK, N. J.

# TWO channels for ONE

with NORTHERN RADIO ...



## NEW! TWINPLEX COMMUNICATION UNITS



- provide 2 channels of FS communication with existing single channel transmitter and receiving facilities— with performance comparable to the existing single channel system

This Twinplex communication system makes possible a 2-channel radio circuit whereby 2 non-synchronous or synchronous telegraph transmissions modulate a single radio carrier wave by causing the carrier to assume one of four specific frequencies with 400 cps separations.

The transmitting equipment consists of the Twinplex Combiner Type 177 Model 1 and an RF Frequency Shift Keyer such as the Northern Radio Type 105 Model 4. The Combiner converts the four possible conditions of two telegraph signals (M1-M2, M1-S2, S1-M2, S1-S2) respectively into one of four voltages related in a 0-1-2-3 manner. The Combiner output voltage modulates the FS Keyer.

The receiving equipment consists of the Twinplex Converter Type 178 Model 1 and a single or diversity receiver

such as the Northern Radio Type 110 Dual Diversity Receiving System. The Converter demodulates and separates the four audio tones from the radio receiver(s) into two channels each carrying the originally transmitted intelligence. The Twinplex Converter replaces the standard FS Converter for this purpose.

The two telegraph channels provide the same operational flexibility as that of two separate single channel FS systems. One can, for example, simultaneously use channel #1 on 60 wpm teletype and channel #2 on high-speed Morse or Time Division Multiplex. It further permits the reception of channel #1 signals on all standard FS converters (tunable to 400 cps shift) without need for a Twinplex Converter: this is valuable for "Forked Circuit Operation" where the intelligence of channel #1 is intended for pick-up by other receiving stations which are not equipped for Twinplex Reception in addition to the main receiving stations which are so equipped. Reception of channel #2 (or of both channels) requires the receiving end to be equipped with a Twinplex Converter.



Write for complete information.

- Frequency Shift Keyers
- Master Oscillators
- Diversity Receivers
- Frequency Shift Converters
- Multi-Channel Tone Systems
- Tone Keyers
- Demodulators
- Monitors
- Radio Multiplex Systems
- Tone Filters
- Line Amplifiers
- Twinplex Equipment

**NORTHERN RADIO COMPANY, inc.**  
147 WEST 22nd ST., NEW YORK 11, NEW YORK  
Pace-Setter in Quality Communication Equipment

IN CANADA: Northern Radio Mfg. Co., Ltd., 1950 Bank St., Billings Bridge, Ottawa, Ontario.



**IMMEDIATE DELIVERY  
on a NEW TUBELESS!**

MAGNETIC AMPLIFIER

# AC LINE VOLTAGE REGULATOR

MODEL MLR - 1000

## 1 KVA

- ☆ NO TUBES TO REPLACE
- ☆ NO MOVING PARTS
- ☆ NO VIBRATING CONTACTS
- ☆ REGULATES RMS VALUE
- ☆ IDEAL FOR UNATTENDED INSTALLATIONS



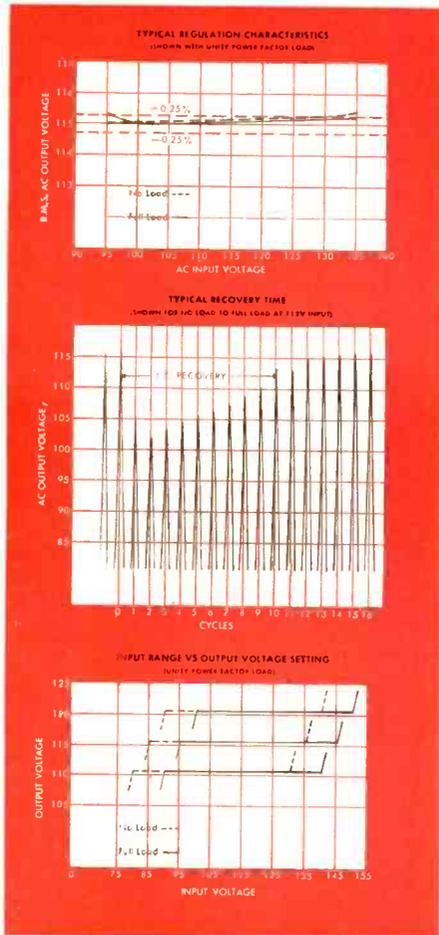
### Specifications...

- Input Voltage Range: 95 to 135 volts
- Output Voltage: Nominal 115 volts. can be adjusted from 110 to 120 volts.
- Output Current: 8.5 amperes
- Regulation Accuracy:  $\pm 0.25\%$  for any combination of line or load
- Frequency Range: 60 cycles  $\pm 10\%$
- Wave Form Distortion: 3% maximum
- Power Factor Range: 0.5 lagging to 0.9 leading
- Response Time: 0.2 sec.
- Maximum Load: 1.0 KVA
- Ambient Temperature Range: Up to 45° C.
- Dimensions: 19½" wide x 11" high x 11½" deep (cabinet)  
19" wide x 10½" high x 11½" deep (rack panel)
- Mounting: Cabinet or 19" Rack Panel
- Finish: Gray Hammetone
- Weight: 85 lbs.



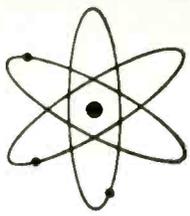
Write for Bulletin MLR 1000

**PERKIN ENGINEERING CORP.**  
345 KANSAS ST., EL SEGUNDO, CALIF. PHONE: OREGON 8-7215



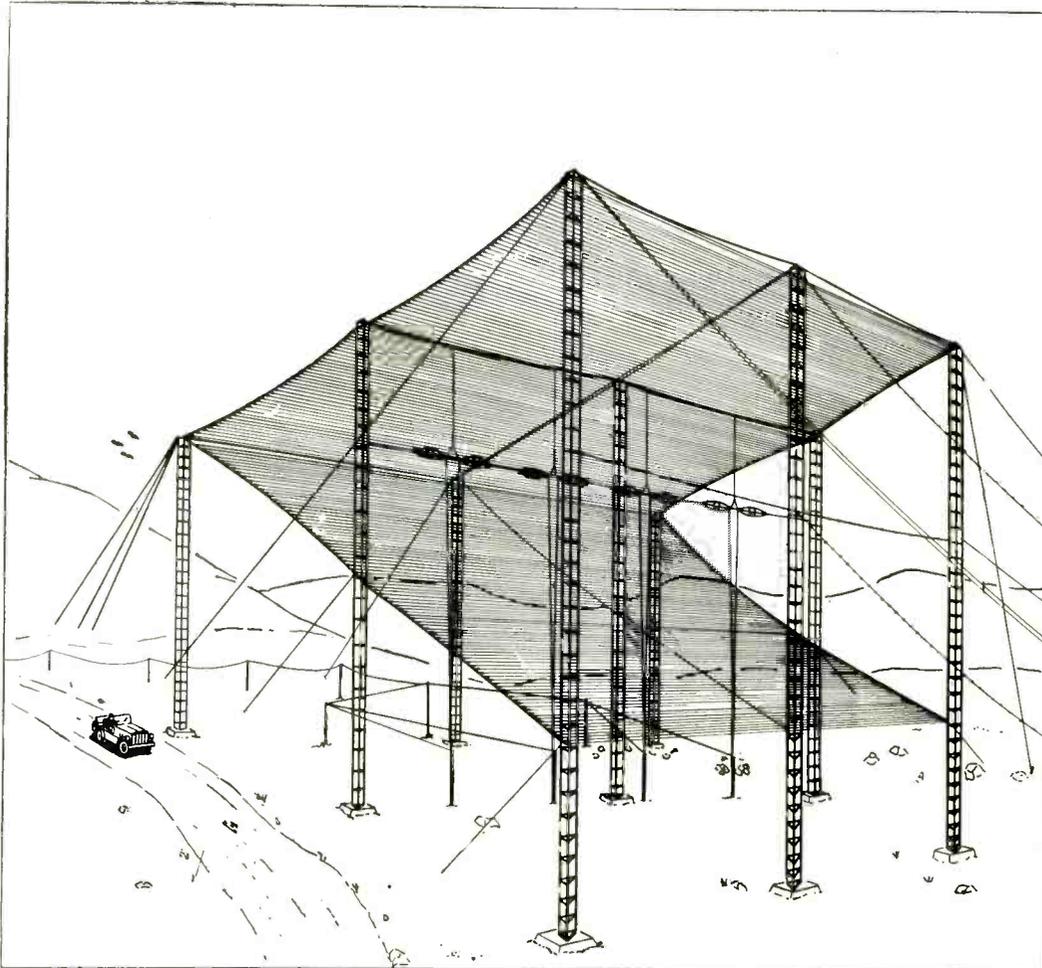
For PROMPT REPLY, wire the factory collect or phone our nearest sales office.

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 Philadelphia: NORristown 5-2600  
 Chicago: DIVERsey 8-6885  
 St. Louis: DELmar 7701  
 Kansas City, Mo.: JEFFerson 7221  
 Dallas: FORrest 8-8306  
 Denver: MAIN 3-0343  
 San Francisco: ULmar 1-7129  
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Openings for Qualified Engineers

# SOLVING TOMORROW'S PROBLEMS



## Easiest way yet to tell where you are

Flying military aircraft over unfamiliar skyways is complicated enough without wondering where you are. Easiest answer yet is new radar beacon that automatically tells its range, bearing and *identity* to Air Force planes.

This beacon is built around Klystron tubes especially designed for this application by Webster-Chicago's Government Division . . . another example of how Webster-Chicago serves the Services — by helping solve tomorrow's problems today.

Our engineers and facilities are at your call.

. . . from an idea to a prototype  
. . . from a prototype to production

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Government Division • 836 N. Kedzie, Chicago 51, Illinois  
Maker of Webcor products since 1914



## B-H VINYL-SIL 8000 FIBERGLAS SLEEVING

*unequaled*

*moisture resistance*

BH Vinyl-Sil 8000 has no capillary attraction to water. The heat-treated Fiberglas braid supporting the stabilized vinyl coating is pre-treated with a silicone sizing for water repellency — keeps it as dry as the Sahara at high noon.

In product assembly, proper varnish impregnation is difficult with a sleeving containing moisture. During operation, entrapped moisture will impair the insulation resistance of the sleeving. The presence of moisture will produce corrosive effects when coating breakdown is brought about by excessive overheating. But not when your products are protected by BH Vinyl-Sil 8000 — it has unequalled moisture resistance.

And, there are these additional features . . . *minimum* guaranteed dielectric breakdown of 8000 volts; high resistance to heat-aging, flow, oils, chemicals, abrasion and cut-thru; excellent low temperature flexibility.

All this positive protection is available at a cost no greater than that for less modern sleeveings. Then, add this saving: BH Vinyl-Sil 8000 can be used for many varied insulation applications — helps keep sleeving inventories low.

There's only one way to know what BH Vinyl-Sil 8000 can do for you — try it. Send for a sample — split it and dip the end in an inkwell. You'll see that there is no capillary attraction to moisture — then make the same test with your present sleeving. Samples and data are yours for the asking — write today.

BENTLEY, HARRIS MANUFACTURING CO. 1310 Barclay St.  
CONSHOHOCKEN, PA. Telephone: Conshohocken 6-0634

\*BH Non-Fraying Fiberglas Sleeveings are made by an exclusive Bentley, Harris process (U.S. Pat. Nos. 2393530; 2647296 and 2647288). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.

**BENTLEY, HARRIS**

*Fiberglas\**  
**SLEEVINGS**

**Ward Leonard's**

# Vitrohm...



**the rheostat  
that wears  
many hats**

Why do motor and generator builders prefer – and specify – Ward Leonard Vitrohm rheostats?

It's because the tremendous variety of standard accessories we build enables our rheostats to fit exact job requirements.

Standard Ward Leonard Vitrohm rheostats ranging from 120 to 3200 sigma watts (per plate) are available for mounting front or back of panel – in single or multi deck and in combinations of small and large plates – with single or concentric drive – and for manual or motor operation.

You get this exceptional versatility along with Ward Leonard's famous Vitrohm construction – steel plate foundation and large rectangular brass contacts embedded in vitreous enamel. Adds up to more rheostat for your money – when you shop at Ward Leonard.

For information on Vitrohm rheostats, send for fully illustrated, data-packed catalog #60. Write Ward Leonard Electric Company, 350 South Street, Mount Vernon, N.Y.

5.3

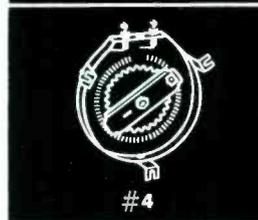
- #3 Rear view 8" rheostat with standard contacts
- #4 Rear view 8" rheostat with multistep contacts
- #10 2 deck rheostat for back of board; single handwheel
- #12 2 deck rheostat for front of board; concentric handwheel
- #19A Rheostat with enclosing cover
- #19B Rheostat with cover and conduit fitting
- #21 Rheostat with adjustable stop
- #24 3 terminal rheostat for potentiometer connection
- #27 Special panel for extruder and capstan take-up
- #29 Special motor operator for variable speed drive



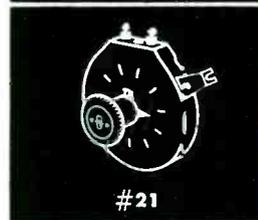
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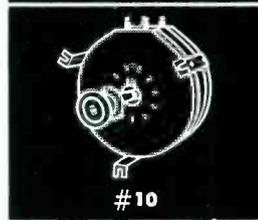
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#4



#21



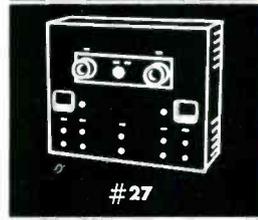
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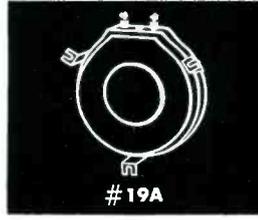
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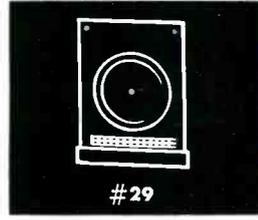
#12



#27



#19A



#29



**WARD LEONARD  
ELECTRIC COMPANY**  
MOUNT VERNON, NEW YORK



RHEOSTATS



RESISTORS



RELAYS



MOTOR CONTROLS



DIMMERS

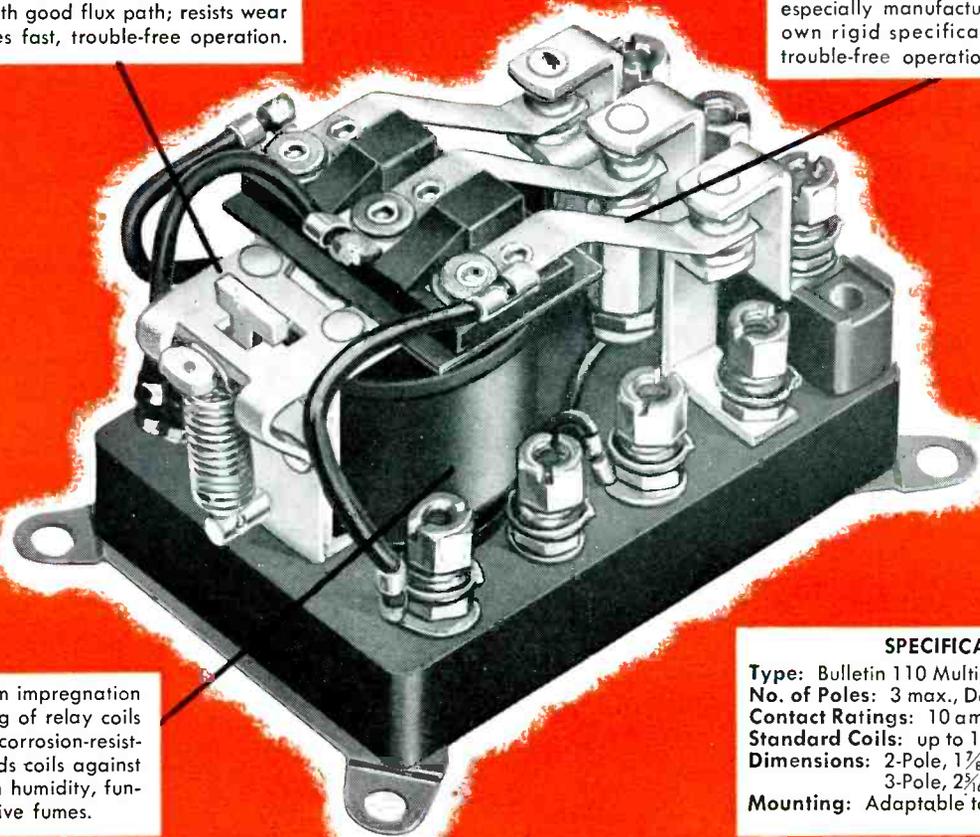


CHROMASTER

**Result-Engineered Controls Since 1892**

**ARMATURE-FRAME** — has semi "knife-edge" construction with good flux path; resists wear and guarantees fast, trouble-free operation.

**CONTACT FINGERS** — alloy leaf-spring type especially manufactured to Ward Leonard's own rigid specifications gives millions of trouble-free operations.



**COIL** — vacuum impregnation and end sealing of relay coils plus a special corrosion-resistant finish guards coils against salt spray, high humidity, fungus and corrosive fumes.

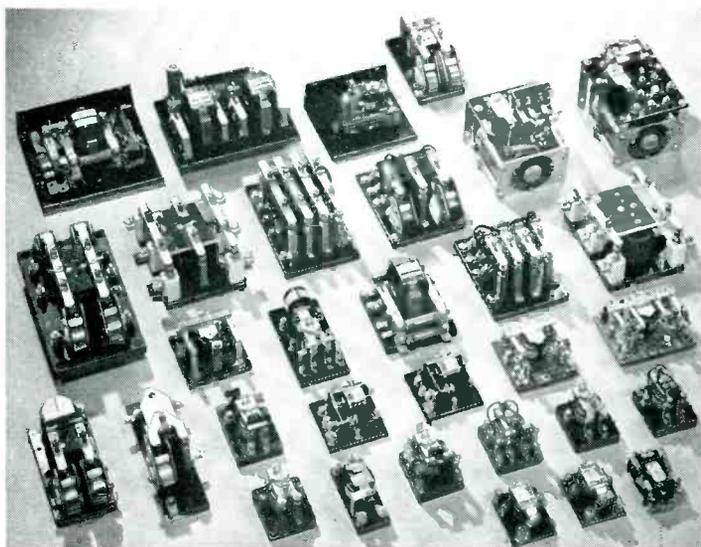
**SPECIFICATIONS**  
**Type:** Bulletin 110 Multipole Midget  
**No. of Poles:** 3 max., Double Throw  
**Contact Ratings:** 10 amps., 115 volts, A.C. max.  
**Standard Coils:** up to 115 volts, A.C. or D.C.  
**Dimensions:** 2-Pole, 1 $\frac{1}{8}$ " x 3" x 1 $\frac{1}{8}$ " high  
 3-Pole, 2 $\frac{3}{8}$ " x 3 $\frac{3}{8}$ " x 1 $\frac{1}{8}$ " high  
**Mounting:** Adaptable to plug-in mounting

## Here's why you get long life from Ward Leonard relays

- When applied properly and given normal care, Bulletin 110 relays, shown above, have a life expectancy of several million operations. Such exceptionally long life, typical of Ward Leonard's relay line, is made possible by: 1. Good mechanical design. 2. Quality-controlled manufacturing methods and materials. 3. Ample "safety-factor" electrically and mechanically.

Whether your product is a complex electronic instrument or a simple household gadget, our engineers will be glad to help you select the dependable electrical controls you need. Write Ward Leonard Electric Co., 350 South St., Mount Vernon, New York.

**SHOWN AT RIGHT** are typical Ward Leonard relays designed to meet your specific requirements in dimensions, methods of mounting, circuit connections, contact materials, coils and other features.



**WARD LEONARD  
 ELECTRIC COMPANY**  
 MOUNT VERNON, NEW YORK



RHEOSTATS



RESISTORS



RELAYS



MOTOR CONTROLS



DIMMERS



CHROMASTER

**R**esult-**E**ngineered Controls Since 1892

another outstanding  
feature .. REEVES

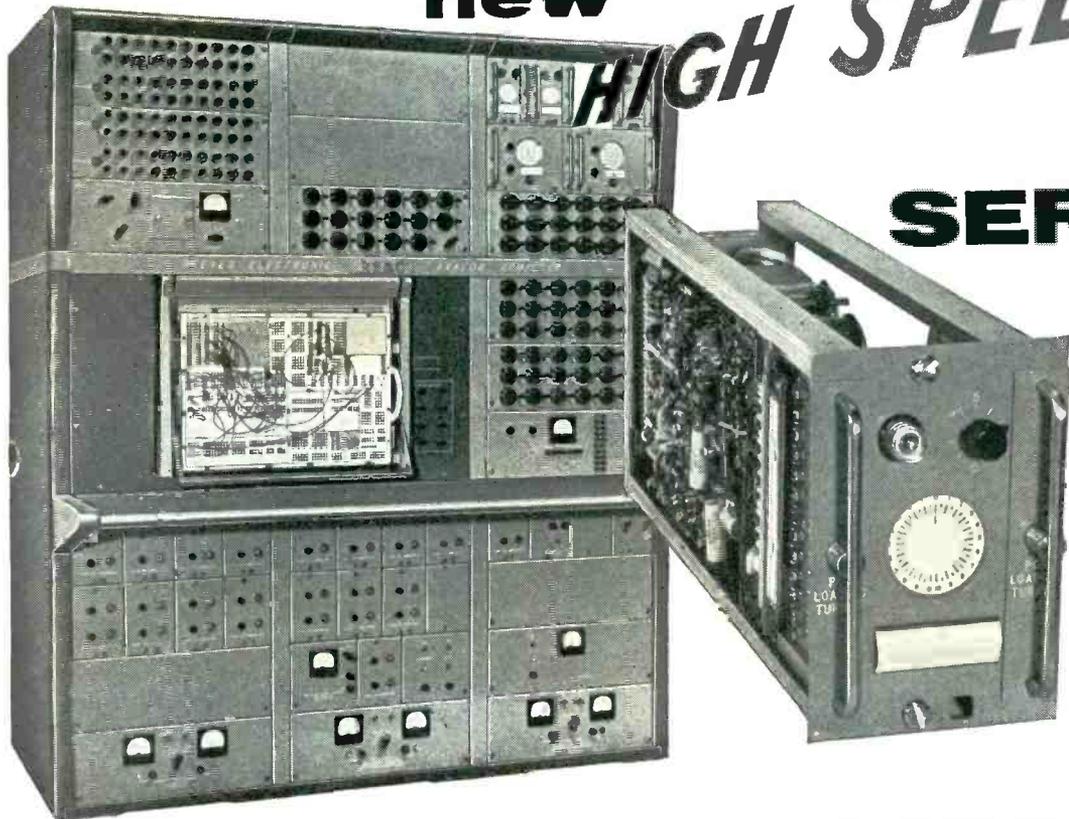
# REAC 400

ANALOG COMPUTER

new

**HIGH SPEED**

**SERVOS**



- Bandwidth over 50 cps.
- Velocity 1500 v/sec.
- Plug-in turrets for function generation

**New BUILDING-BLOCK CONSTRUCTION**  
Permits assembly of computer elements in any desired combination to do particular job or expand existing installation

**New CONVENIENT PATCHBAY**  
Available in units of 1632, 3264 or 4896 holes for maximum flexibility. Patchboard changes possible during operation.

**New POWERFUL AMPLIFIERS**  
Noise less than 3 mv rms in cabinet. Phase shift 0.075° @ 100 cps. in cabinet. Bandwidth over 10 KC in cabinet.

**New HIGH SPEED RESOLVERS**  
Vastly improved dynamic performance . . . 35-cycle bandwidth.

- ★ **Six gang multiplying potentiometers.** Accuracy equivalent to 0.1% linearity potentiometers (over-all multiplying accuracy 0.2% including mechanical non-linearities). Two gangs tapped for function generation.
- ★ **Two front panel plug-in turrets** for padding or feeding voltages into the tapped pots for function generation. Turrets may be stored for future use.
- ★ **High Speed** — Velocity 1500 v/sec.
- ★ **Long Life** — Carbon film potentiometer gives exceptionally long life even at high velocities.
- ★ **Superior Frequency Response:**  
Maximum amplitude rise 1.4 @ 40 cps.  
Bandwidth over 50 cps.  
Dynamic error less than 0.5% of input @ 2 cps.!  
Phase shift less than 0.3° @ 3 cps.!
- ★ **Exceptional low speed performance too** — Typical tracking error less than 0.05 volts maximum for ramp input as low as 0.01 v/sec.



**REEVES INSTRUMENT CORPORATION**

A Subsidiary of Dynamics Corporation of America  
201 East 91st St., New York 28, N. Y.

REAC Analog Computers



Precision Floated GYROS



Precision RESOLVERS and PHASE SHIFTERS



SERVO MECHANICAL PARTS



5RV55

**AIRCRAFT LOAD METER**

Range: 50 MV, Arbitrary scale in LOAD.  
Used in conjunction with external shunt to  
measure load on EC aircraft systems.



**The SKY'S the Limit!**

**AIRCRAFT VOLTMETER**

Range: 150 VAC  
Supplied in 400 cycle, 350-1000  
cycle, 800-1400 cycle frequencies.



**DUAL VOLT-AMMETER**

Ranges: 15-33 volts—0-150, 0-300, 0-450 am-  
peres. This meter is produced exclusively by  
Roller-Smith.

**IN AVIATION  
THERE'S NO INSTRUMENT PROBLEM  
TOO GREAT FOR  
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Aviation today relies on Roller-Smith to supply high  
quality precision aircraft instruments. Drawing on a  
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If you have a specific problem in instrument research  
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years of experience and know-how . . . consult our  
engineering staff for the answer.

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CORPORATION

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Precision Products Since 1908

**Now! Use your  
524B Electronic Counter**

**to**

**12**

**KMC!**

Your *-hp-* 524B is the world's premier electronic counter—standard of the industry. Today, the usefulness of this outstanding instrument is extended—vastly—by one simple new instrument from the Hewlett-Packard laboratory.

**NOW YOU CAN HAVE...**

# FREQUENCY MEASUREMENT 0 TO 12 KMC!

MENT



You need just these two basic instruments\*  
**-hp- 524B ELECTRONIC COUNTER**  
**NEW -hp- 540A TRANSFER OSCILLATOR**

With the perfection of the versatile -hp- 540A Transfer Oscillator, Hewlett-Packard has made possible—for the first time—convenient high accuracy frequency measurements far into the microwave region.

Measurements can now be made with electronic counter accuracy to 12 KMC—with a new system composed of the 524B counter, the new 540A, and the 524B's appropriate plug-in Frequency Converter, -hp- 525B.

The heart of the system is the precision -hp- 524B Elec-

tronic Counter—in terms of capability, accuracy, convenience and quality, the world's premier counter and standard of the electronic industry. Together with its unique plug-in frequency converters, video amplifiers and time interval units, this versatile instrument will measure frequency from 10 cps to 220 MC, interval from 1  $\mu$ sec to 100 days and period from 0 cps to 10 KC.

The development of the new -hp- 540A Transfer Oscillator permits the 524B, together with its converter, to measure

\*Oscilloscope required for pulsed measurements. External detector (-hp- 440A) required for measurements above 5 KMC.



## SPECIFICATIONS

### -hp- 540A Transfer Oscillator



#### GENERAL

**Frequency Range:** 10 MC to 5,000 MC. (10 MC to 12,000 MC or higher with external detector such as -hp- 440A.)

**Input Signal:** CW, FM, AM or pulse.

**Input Signal Level:** 50 MV to 5 v peak across 50 ohms.

**Accuracy:** CW: Approx. 1/1,000,000 or better.

#### OSCILLATOR

**Fundamental Frequency Range:** 100 MC to 220 MC.

**Harmonic Frequency Range:** Above 12,000 MC.

**Stability:** Less than 0.002% change per minute after 30 minute warmup.

**Dial:** Six inch dia., calibrated in 1 MC increments. Accuracy:  $\pm 1/2\%$ .

**Output:** Approx. 2 v into 50 ohms.

#### ATTENUATOR

**Range:** Approximately 20 db to 80 db.

**Input Impedance:** 50 ohms, SWR: 1.5 max. at 1 KMC; 3 max. at 5 KMC.

#### AMPLIFIER

**Gain:** Variable, 40 db max.

**Bandwidth:** Variable. High Frequency: 3 db point adjustable 1 KC to 2 MC. Low Frequency: 3 db point switched from 100 cycles to below 10 KC. Adjustable to above 400 KC.

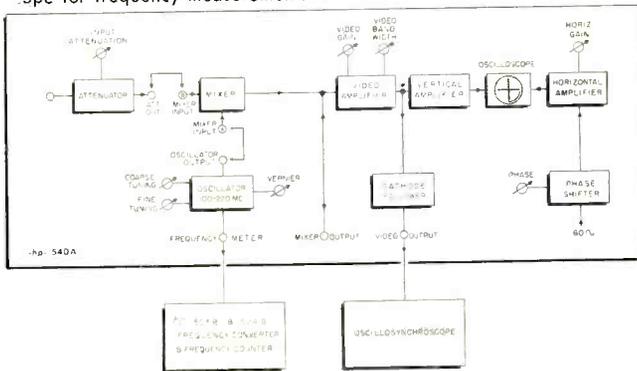
Today, more than ever,  stands for

# Measure pulsed, FM, CW, AM or noisy signals with electronic counter accuracy!

With precision hitherto associated with these instruments now make possible determination of frequency in CW, pulsed, FM, or noisy signals. They determine center frequency and deviation with appreciable FM or noise. With them you can make highly accurate measurements in pulsed signals.

The 540A has a stable, 100 to 220 MC oscillator and a 12 KMC for comparison with the unknown. The device is a diode mixer, amplifier, and oscilloscope. (See Figure 1)

Block diagram, -hp- 540A with 524B, 525B and oscilloscope for frequency measurement.



In operation (assuming approximate frequency of signal to be measured is known), the -hp- 540A oscillator is tuned until one of its harmonics zero beats with the unknown. The multiplying factor is noted. The transfer oscillator frequency is measured directly on the 524B counter. This 524B reading, times the multiplying factor, gives the frequency of the unknown.

When the frequency to be measured is totally unknown, a convenient method employing two or more harmonics can be used to calculate the multiplying factor.

In measuring carrier frequency of pulsed power, an external oscillosynchroscope is used to display the detected pulse. Zero beat appears as horizontal lines across the pulse when the oscillator is tuned to an exact sub-multiple. ‡

In working with noisy or AM signals, the -hp- 540A delivers a CW signal to the counter while the comparison circuits are narrowed so that accurate indication of zero beat may be obtained. ‡

In signals with appreciable FM, the 540A's built-in oscilloscope presents a characteristic pattern delineating upper and lower frequency deviation limits. If FM deviation is uniform, center frequency will also be determined. When used with the new -hp- 500B Frequency Meter, the 540A will permit indication of exact FM deviation. ‡

## ACCURACY

Accuracy of the system is approximately 1/1,000,000 or better on clean CW signals. On pulsed signals, the accuracy of measurement depends on the frequency of the carrier and the length of the pulse. Typical accuracy is approximately 2/1,000,000. On signals where high amounts of noise or intense AM is present, the transfer oscillator system often provides the only means of making accurate measurement. The accuracy of the system in general is better than 10 times that of the best microwave wavemeters.

## UNIQUE QUALITY FEATURES

Each of the circuit elements of the 540A Transfer Oscillator (see Figure 1) may be used separately by shifting patch cords on the instrument panel. Tuning controls are triple; including a coarse and fine mechanical control and an electric vernier. Vernier range is approximately  $\pm 125$  parts per million. The instrument's video amplifier has both gain and bandwidth control. Horizontal input to the oscilloscope is 60 cps, with phase control. Input attenuation is variable from 20 to 80 db to adjust signal for optimum mixing level.

‡For complete discussion of microwave measuring with transfer oscillator and electronic counter, write to -hp- for -hp- Journal, Vol. 6, No. 12.



**Output:** 1 volt peak max. into 1,000 ohms.

### OSCILLOSCOPE (SELF-CONTAINED)

**Frequency Range:** 100 cps to 200 KC.

**Vertical Deflection Sensitivity:** 1 volt per inch.

**Horizontal Sweep:** Internal, power supply frequency with phase control, or external (connection at rear).

### MISCELLANEOUS

**Connectors:** Input, type N; all others type BNC.

**Size:** Cabinet Mount: 20 $\frac{3}{4}$ " wide, 12 $\frac{1}{2}$ " high, 14 $\frac{3}{4}$ " deep.

Rack Mount: 19" wide, 10 $\frac{1}{2}$ " high, 12 $\frac{3}{4}$ " deep.

**Power Supply:** 115/230 v  $\pm 10\%$ , 50/60 cps, app. 75 watts.

**Auxiliary Equipment:** -hp- 524B Electronic Counter, \$2150.00  
-hp- 525B Frequency Converter, \$250.00  
-hp- 440A Detector Mount, \$85.00

**Price:** -hp- 540A Transfer Oscillator, \$615.00.

Data subject to change without notice. Prices f.o.b. factory.

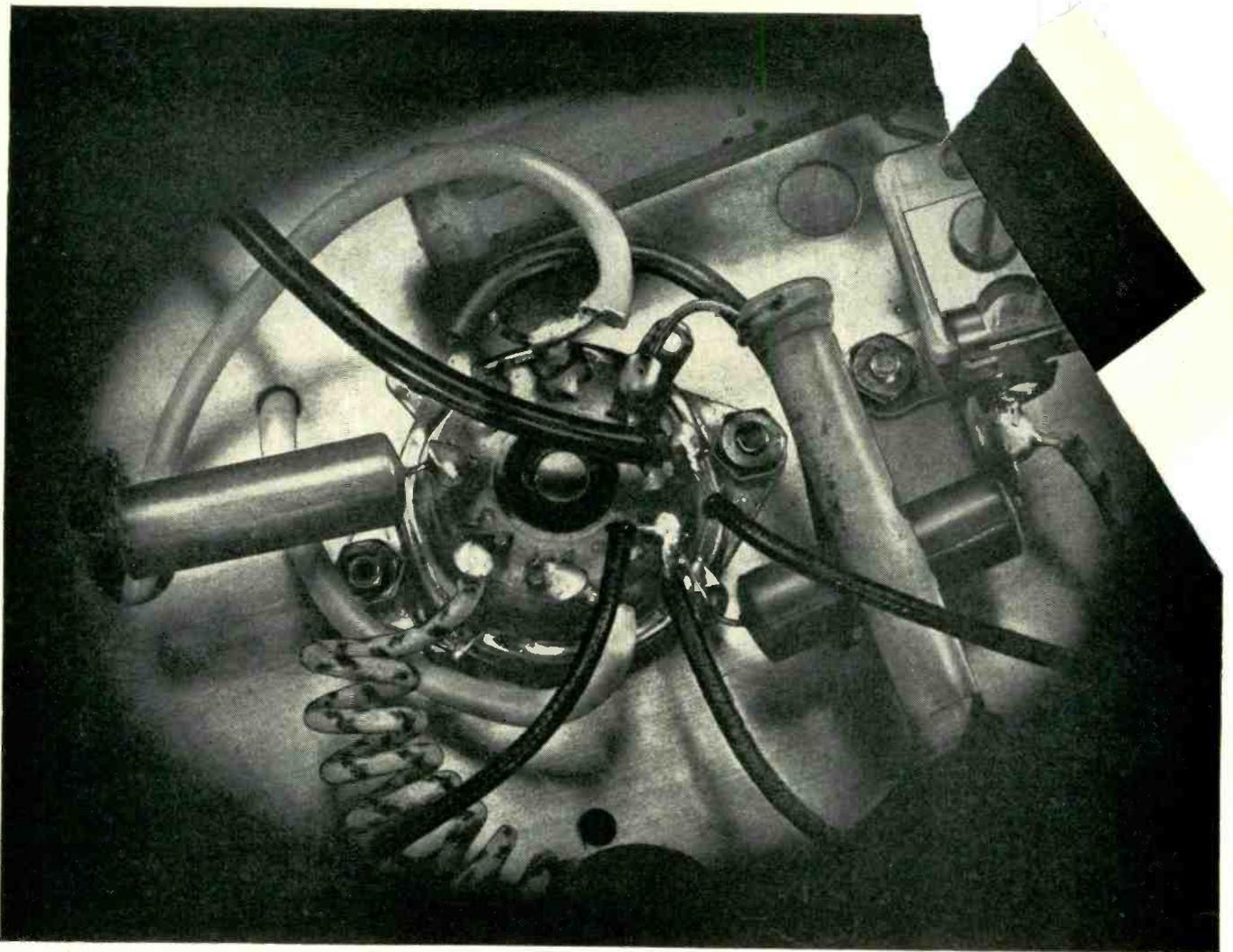
## HEWLETT-PACKARD COMPANY

3334A PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U. S. A.

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Field representatives in all principal areas

# highest quality, complete coverage



## Vacuum-melted alloys give superior electrical properties...

HERE ARE SOME EXAMPLES...

Vacuum-melted cathode nickel alloys, iron and metal-glass-seal alloys are held to extremely close standards of purity, composition and uniformity. Secondary emissions and outgassing are minimized — shelf life increased — for vacuum tubes of many kinds.

Vacuum-melted copper shows marked increase in purity, soundness and conductivity.

Soft magnetic alloys achieve improved permeability, both initial and saturation — with stronger directional properties.

The reason lies in the process itself. Undesirable interstitial elements such as oxygen, nitrogen and carbon are literally sucked from the molten metal by the high vacuum that's used. The result is high-purity, gas-free alloys of closely controllable composition... alloys that may far outperform conventional air-melted metals.

Vacuum Metals Corporation, with its newly expanded facilities, can now deliver a wide range of vacuum-melted alloys for electrical and electronic uses. But can these superior materials improve *your* products? Let our engineers help you decide. Write us, giving full details of the application in which you are interested, *Vacuum Metals Corporation, P.O. Box 977, Syracuse 1, N. Y.*



# VACUUM METALS CORPORATION

Jointly owned by Crucible Steel Company of America and National Research Corporation

# NEW— MICRO POWER METER DC to 11,000 mc



MODEL P-2

- simplified operation
- only one probe
- linear and dbm scale
- self-calibrating

Over the entire frequency range DC to 11,000 mc, Polarad's Micro Power Meter utilizes only one power probe, supplied as an integral part of the instrument. This unique power probe will sustain severe overloads without burnout since it does not contain hot wire barretters or other delicate components.

This new rugged and stable instrument reduces microwave power readings to the simplicity of everyday low frequency measurements. It is a true rms milliwatt indicating meter accurately measuring CW and pulse power, in milliwatts and dbm. Insensitive to line voltage changes.

Because of its wide band coverage, the Polarad Model P-2 is outstanding as a general lab and field instrument, available for power measurements at all commonly used frequencies. The P-2 can be completely calibrated from its own self-contained regulated DC source.

## SPECIFICATIONS

- Single power probe for all frequencies.
- 150% overload without burnout.
- Direct reading.
- Broadband Coverage....DC to 11,000 mc continuous in single mount.
- Multi-Power Range.....0-1 mw, 0-10 mw, 0-100 mw, 0 dbm, +10 dbm, +20 dbm.
- Impedance .....50 ohms coaxial.
- VSWR .....Less than 1.4:1 from 0 to 5000 mc. Less than 2:1 from 5000 to 11,000 mc.
- Accuracy .....± 1.0 db.
- Connector .....Type N plug.
- Input Power Required...115v ± 10%, 60 cps.
- Dimensions .....10" x 8" x 8".
- Weight .....14 lbs.

Price: \$360



**ELECTRONICS CORPORATION** 43-20 34th STREET, LONG ISLAND CITY 1, N. Y.

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Philadelphia • San Francisco • Syracuse • Washington, D. C. • Westbury • Winston-Salem • Canada, Arnprior, Toronto—Export: Rocke International Corporation

### Direct Reading Scale



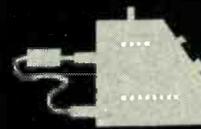
Reads from DC to 11,000 mc with three power ranges: Full scale readings: 1 mw (0 dbm), 10 mw (+10 dbm), and 100 mw (+20 dbm)

### Single Broadband Probe



Used for entire frequency range DC to 11,000 mc. Can withstand 150 percent overload without damage or burnout.

### Self Calibrating



DC calibrating circuit provided to recalibrate or check meter operation without additional external equipment.

**AVAILABLE ON EQUIPMENT LEASE PLAN**

**FIELD MAINTENANCE SERVICE AVAILABLE THROUGHOUT THE COUNTRY**

NOW PHELPS DODGE **SODEREZE**\*

SUITABLE FOR ALL



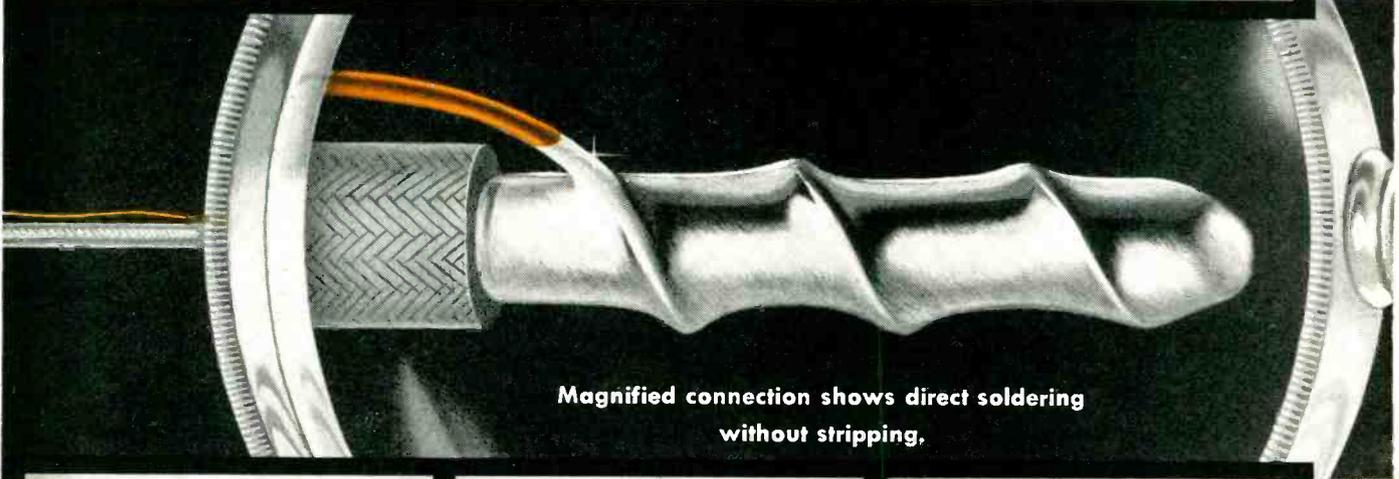
Instrument motor stator



Fly-back coil



I. F. coil



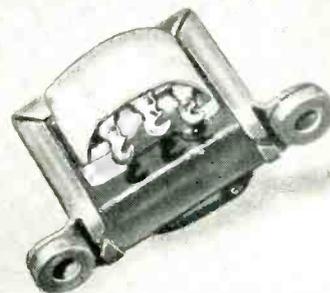
Magnified connection shows direct soldering  
without stripping.



Universal wound  
TV choke coil



Solenoid coil



Transformer coil

*First for Lasting Quality—from Mine to Market!*

\*Reg. U. S. Pat. Off.

**GIVES HIGH  
CLASS "A"**

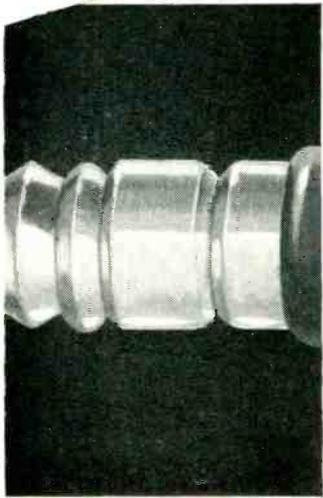
**GH "Q"...**

**"A" APPLICATIONS!**

**materials assure high "Q".**

**essential properties equal or superior  
existing film wires.**

**sitive uniform soldering. No stripping  
cleaning necessary.**



Phelps Dodge Sodereze represents a new advance in ready-to-solder magnet wire. It's a typical Phelps Dodge development designed to keep pace with industry's growing need for wires that handle easily, reduce over-all cost and satisfy a variety of operating conditions.

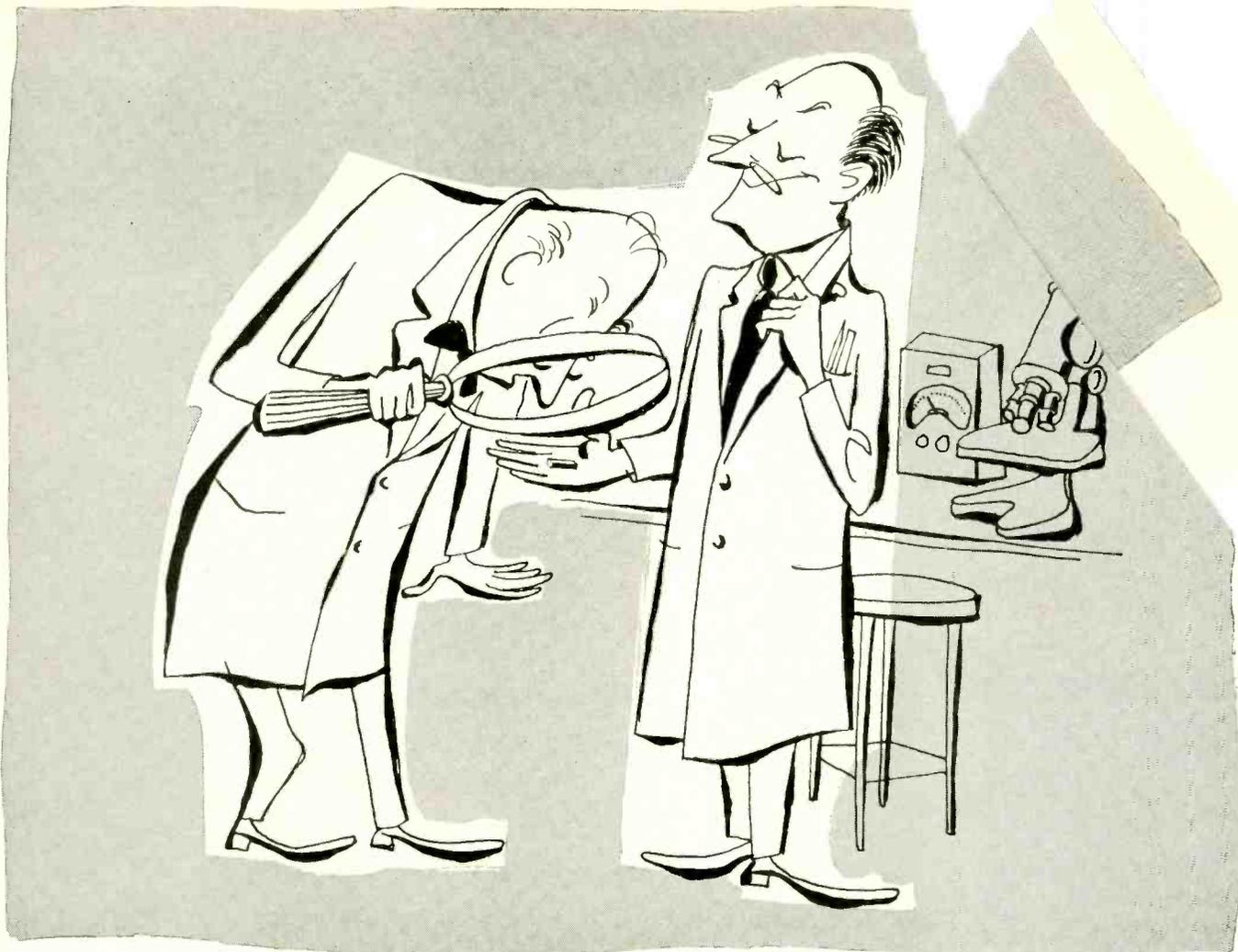
Phelps Dodge Sodereze offers a unique combination of improved chemical and mechanical properties with the advantage of high "Q". The versatility of Phelps Dodge Sodereze not only permits its use wherever solderable wires have been proven practical but suggests new applications, particularly in the finer sizes, to replace conventional wires.

*Any time magnet wire is your problem, consult Phelps Dodge for the quickest, easiest answer!*



***PHELPS DODGE COPPER PRODUCTS***  
**CORPORATION**

**INCA MANUFACTURING DIVISION**  
FORT WAYNE, INDIANA



## How to make a Magnetic Core that's really small? Use PERMENDUR!



Write for  
your copy

### "MAGNETIC MATERIALS"

This 32-page book contains valuable data on all Allegheny Ludlum magnetic materials, silicon steels and special electrical alloys. Illustrated in full color, includes essential information on properties, characteristics, applications, etc. Your copy gladly sent free on request.

ADDRESS DEPT. E-70

When the conditions of service make it imperative for you to hold the size and weight of magnetic cores at an absolute minimum, that's the place to use Permendur. With it you can push the flux density up to 20 kilogausses, and practically eliminate weight as a consideration.

Along with its suitability for cores wherever the premium is laid on compactness, Permendur is just the thing for sonar magnetostriction applications, too. We maintain proper annealing facilities for this

alloy. Write for technical data on it, and let our engineers help you to cash in on its possibilities.

In addition to Permendur, we offer a range of high-permeability alloys, oriented silicon steels and other electrical alloys that is unmatched in its completeness. Our services also include the most modern facilities for lamination fabrication and heat treatment.

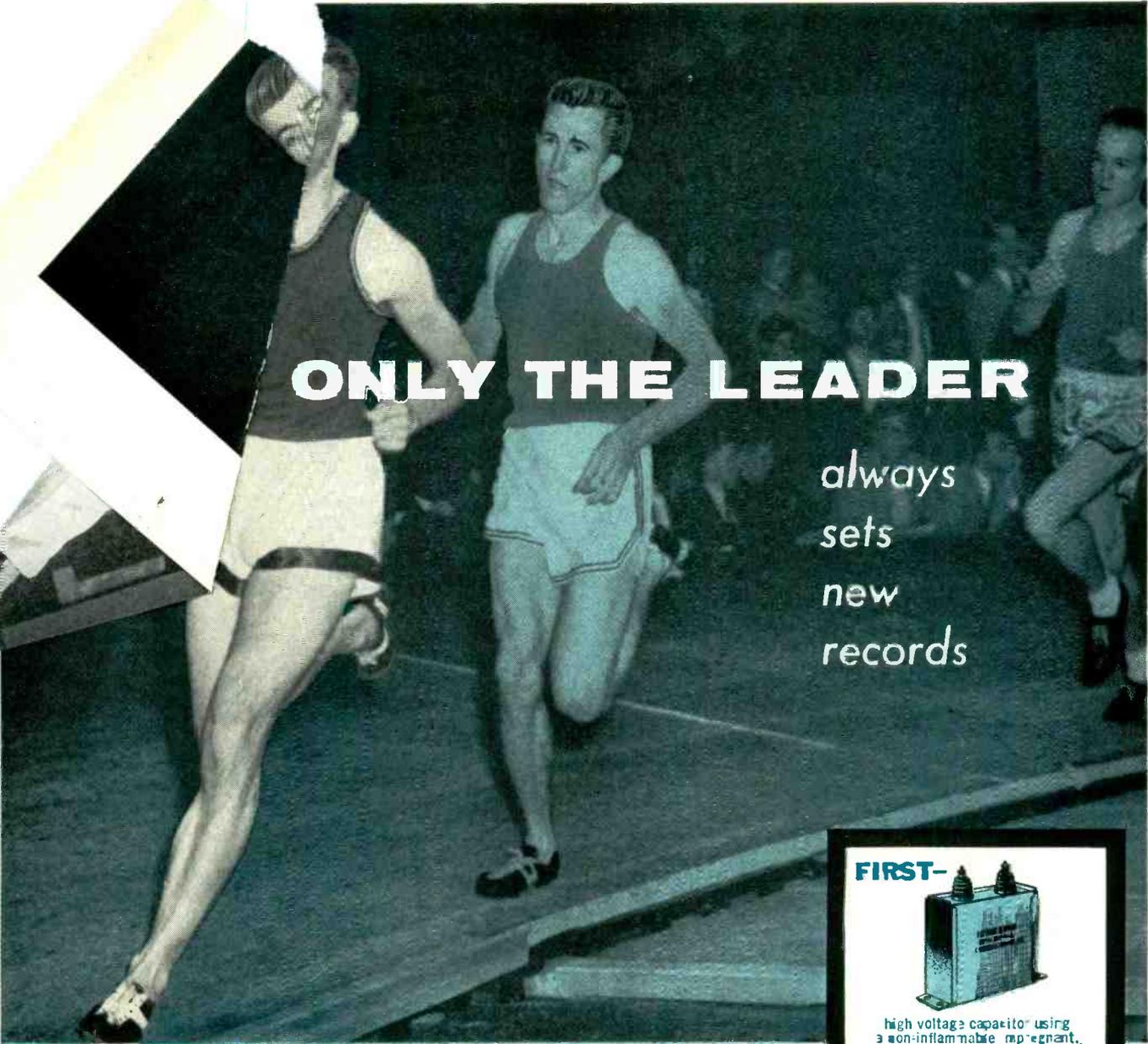
Let us supply your requirements. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

**STEELMAKERS** to the Electrical Industry

# Allegheny Ludlum

W&D 5443





**ONLY THE LEADER**

*always  
sets  
new  
records*

Setting the first 4-minute mile record or making the first miniaturized capacitors are feats that only leaders can accomplish. Cornell-Dubilier's miniaturized capacitor is only one of hundreds of new capacitor developments that we have contributed in our record-making history.

**FIRST-**



high voltage capacitor using a non-inflammable impregnant.

**FIRST-**



high voltage paper capacitor oil impregnated and filled.

## **C·D...45 YEARS OF FAMOUS FIRSTS**

Typical of these "famous firsts" are the three examples shown here ... *proof* that whatever your capacitor requirements may be, your needs can be filled by C-D. Write to Cornell-Dubilier Electric Corp., Dept.K-105, South Plainfield, N. J.

**FIRST-**



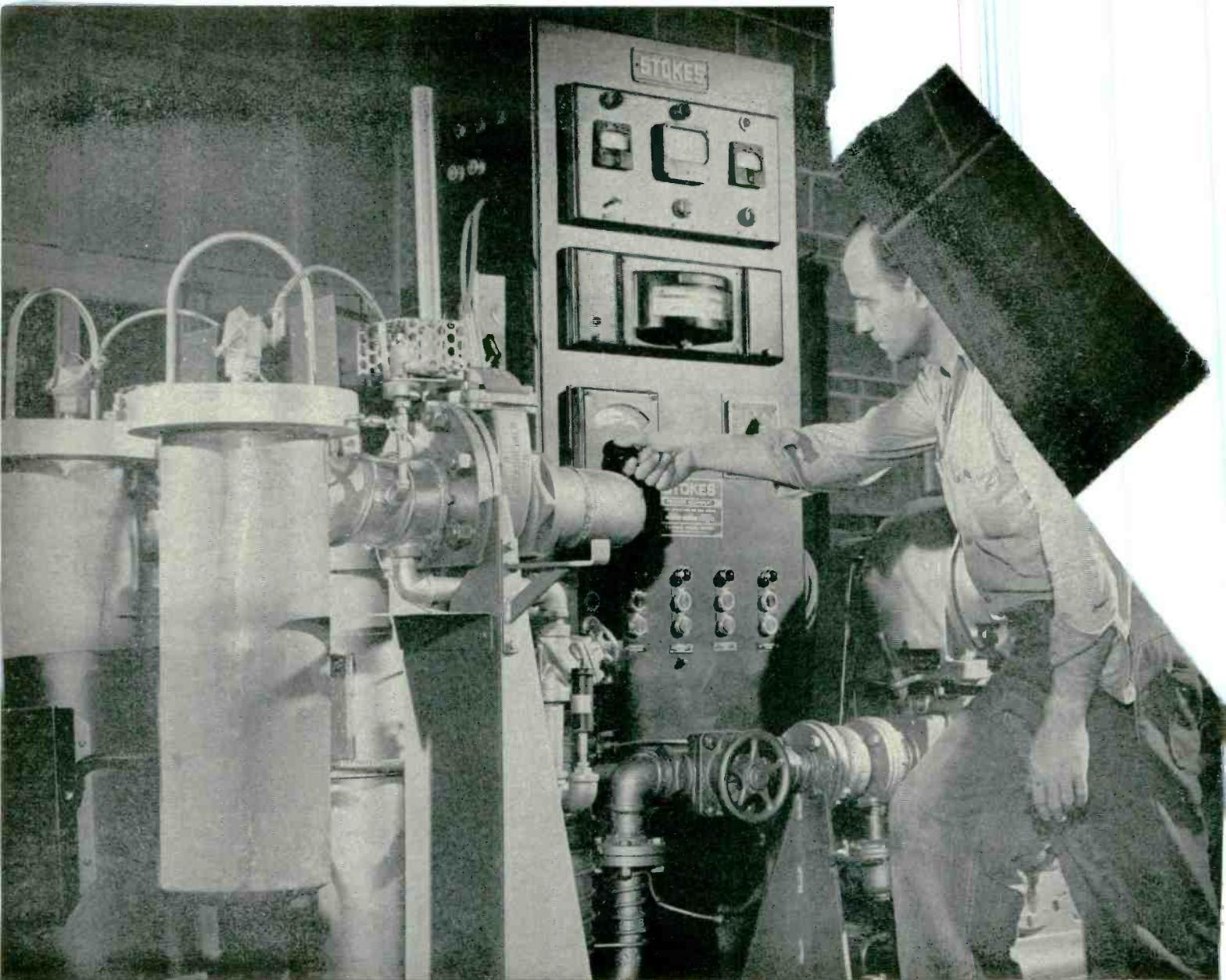
box-type, ceiling-mounting, power capacitors.



CONSISTENTLY DEPENDABLE  
**CORNELL-DUBILIER CAPACITORS**

PLANTS IN SO. PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER AND CAMBRIDGE, MASS.; PROVIDENCE AND HOPE VALLEY, R. I.; INDIANAPOLIS, IND.; SANFORD AND FUQUAY SPRINGS, N. C.; SUBSIDIARY, RADIART CORP., CLEVELAND, OHIO.

THERE ARE MORE C-D CAPACITORS IN USE TODAY THAN ANY OTHER MAKE

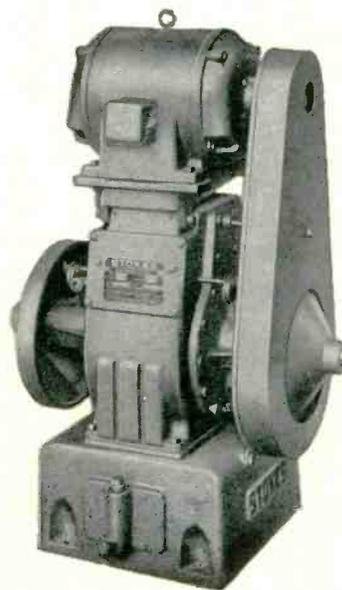


Operator checks pyrometer control of a standard Stokes dual-retort high-vacuum furnace.

## THE COMPLETE LINE OF STOKES

Stokes manufactures a complete line of vacuum pumping equipment. This includes mechanical vacuum pumps, diffusion and booster pumps, vacuum valves and gages, and complete vacuum instrumentation. In engineered high vacuum equipment, Stokes builds vacuum metallizers, vacuum furnaces and other vacuum processing equipment.

Stokes has for many years been active in vacuum research. Vacuum experience among our engineers covers the range from laboratory equipment to some of the largest vacuum equipment in service. This experience is available to help solve your vacuum problems.



### STOKES MECHANICAL VACUUM PUMPS

For vacuum processing systems and for maintaining low forepressures in high-vacuum systems, the Stokes Microvac pump provides efficient, economical operation. Designed with fully automatic lubrication and a long-lasting exhaust valve assembly, every Microvac pump is assured of smooth, trouble-free operation. Six sizes give capacities from 15 to 500 cfm. Send for catalog listed at right.

# Production vacuum furnaces now available for the Electronics Industry

You can now buy specially designed Stokes vacuum furnaces for all phases of heat treating and outgassing. They are compact . . . give maximum capacity for minimum floor area. Sequence-operated grouped controls permit even unskilled personnel to handle furnace operations.

The basic problems of vacuum design and engineering have been a Stokes specialty for many years. Stokes vacuum furnaces for commercial production have proved their efficiency and earned the respect of manufacturers in numerous fields of technology. Stokes is the leading supplier of vacuum furnaces for industry.

The new Stokes Ring-Jet pumps described below are incorporated in Stokes vacuum systems to assure pumping cycles of maximum speed.

Stokes vacuum furnaces of numerous basic types are made in sizes and with modifications to fit users' requirements.

If you are interested in heat treating, degassing or melting of metals, you'll want to know more about Stokes high-vacuum furnaces. Write for your free copy of Stokes Catalog No. 790, "High-Vacuum Furnaces".

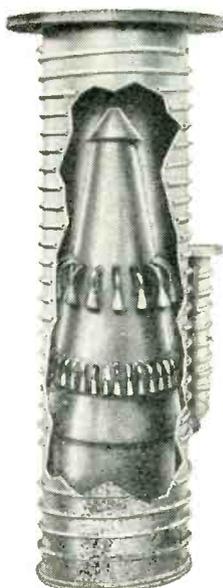
F. J. STOKES MACHINE COMPANY  
5503 TABOR ROAD  
PHILADELPHIA 20, PA.

**SEND FOR TECHNICAL LITERATURE:**

- Microvac Pumps—Catalog 750
- Diffusion and Booster Pump Specification sheets and performance curves
- The Story of the Ring-Jet Pump
- Complete Vacuum Processing Systems—Catalog 730
- How to Care for Your Vacuum Pump—Booklet 755
- Vacuum Impregnation—Catalog 760
- Vacuum Drying—Catalog 720
- Vacuum Furnaces—Catalog 790
- Vacuum Metallizing—Catalog 780
- Vacuum Calculator Slide Rule



## VACUUM EQUIPMENT



### STOKES RING-JET DIFFUSION AND BOOSTER PUMPS

The new Stokes Ring-Jet Pumps embody a new concept of the diffusion principle. Size for size, they have pumping speeds of 10% to more than 100% above any other diffusion pump for a given heat input. Ring-Jet Diffusion Pumps are available in sizes of 4, 6, 10, 14 and 16 inches; Booster Pumps in sizes of 4, 6, 10 and 16 inches. Send for information listed.



### STOKES VACUUM VALVES

To control vacuum safely and surely, Stokes vacuum valves are available in 4, 6, 10 and 16-inch standard flange sizes.

### STOKES-MCLEOD VACUUM GAGES

For measuring vacuums from fractions of a micron up to 50 mm, Stokes-McLeod gages are the standard of reference. Four sizes available.



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Pin-point accuracy for medium high-power applications

## Centralab Series PA-230 Rotary Power Switch

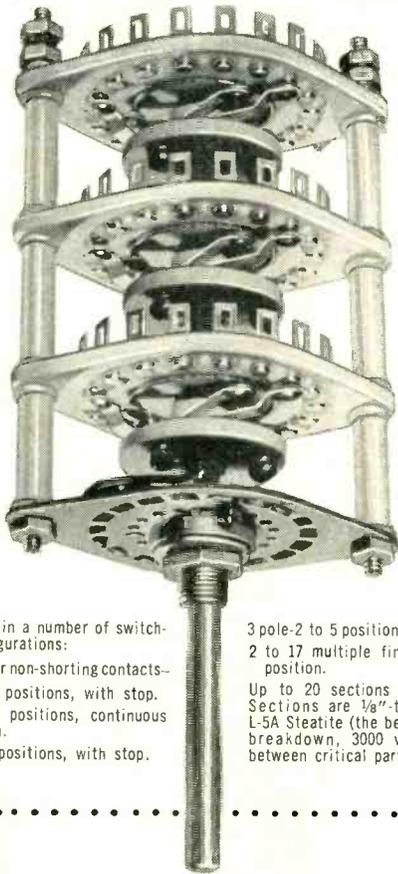
*7½ amps. -110 v.a.c. — meets the requirements of transmitter, industrial control and balancing, laboratory testing, power-supply converter, and many other special applications*

**Low frequency loss** — Wiping contact assures long life. You get low-loss operation at high frequencies and high voltages.

**Excellent accuracy** — Each contact and clip is aligned by hand. Contact pressure is individually adjusted. Exclusive, floating, square-shaft construction prevents any "play" in rotation.

**Positive, non-stall rotation** — Special index insures minimum of 25,000 cycles of operation. Distinctive Centralab design permits operating with ball-bearing ease.

Write today for Technical Bulletin EP-74 that gives complete engineering data.



Available in a number of switching configurations:

Shorting or non-shorting contacts—

1 pole-17 positions, with stop.

1 pole-18 positions, continuous rotation.

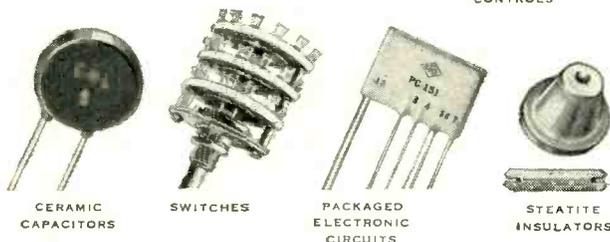
2 pole-8 positions, with stop.

3 pole-2 to 5 positions, with stop.  
2 to 17 multiple fingers at any position.

Up to 20 sections per switch. Sections are ¼" thick, Grade L-5A Steatite (the best). Voltage breakdown, 3000 volts R.M.S. between critical parts.

**More proof that  
if it's a job  
for electronic components,  
it's a job for Centralab**

Centralab's advanced engineering continues to create the prototypes of the components industry



CERAMIC CAPACITORS

SWITCHES

PACKAGED ELECTRONIC CIRCUITS

STEATITE INSULATORS



CONTROLS

### NEW THIS MONTH! Electroni-Kwiz† No.8

1st Prize

A two-in-one "football special" Binoculars and Stadium Robe

Sound good to you? Why not try for it? Simply answer this question in 50 words, more or less:

**How can distributors be more helpful to you on your small-run requirements?**

A leading editor will pick the winner of this month's major prize.

Mail your entry to us before October 30.

†Nothing to buy. Employees of Centralab and their advertising agency not eligible. Duplicate prizes awarded in case of tie. Entries become the property of Centralab — none can be returned.

P-5510

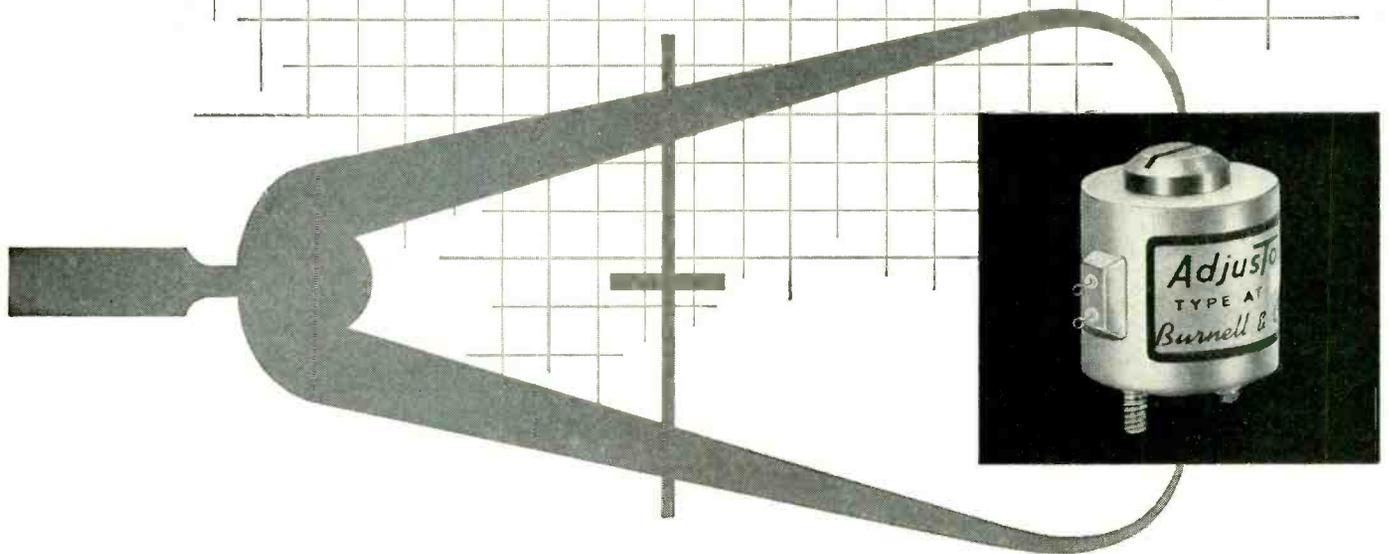
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Technical Brochure C

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*Many types of Adjustoroids and Rotoroids  
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**BURNELL & CO., INC.**

45 Warburton Avenue  
Yonkers 2, New York

Pacific Division: 720 Mission St., S. Pasadena, Calif.

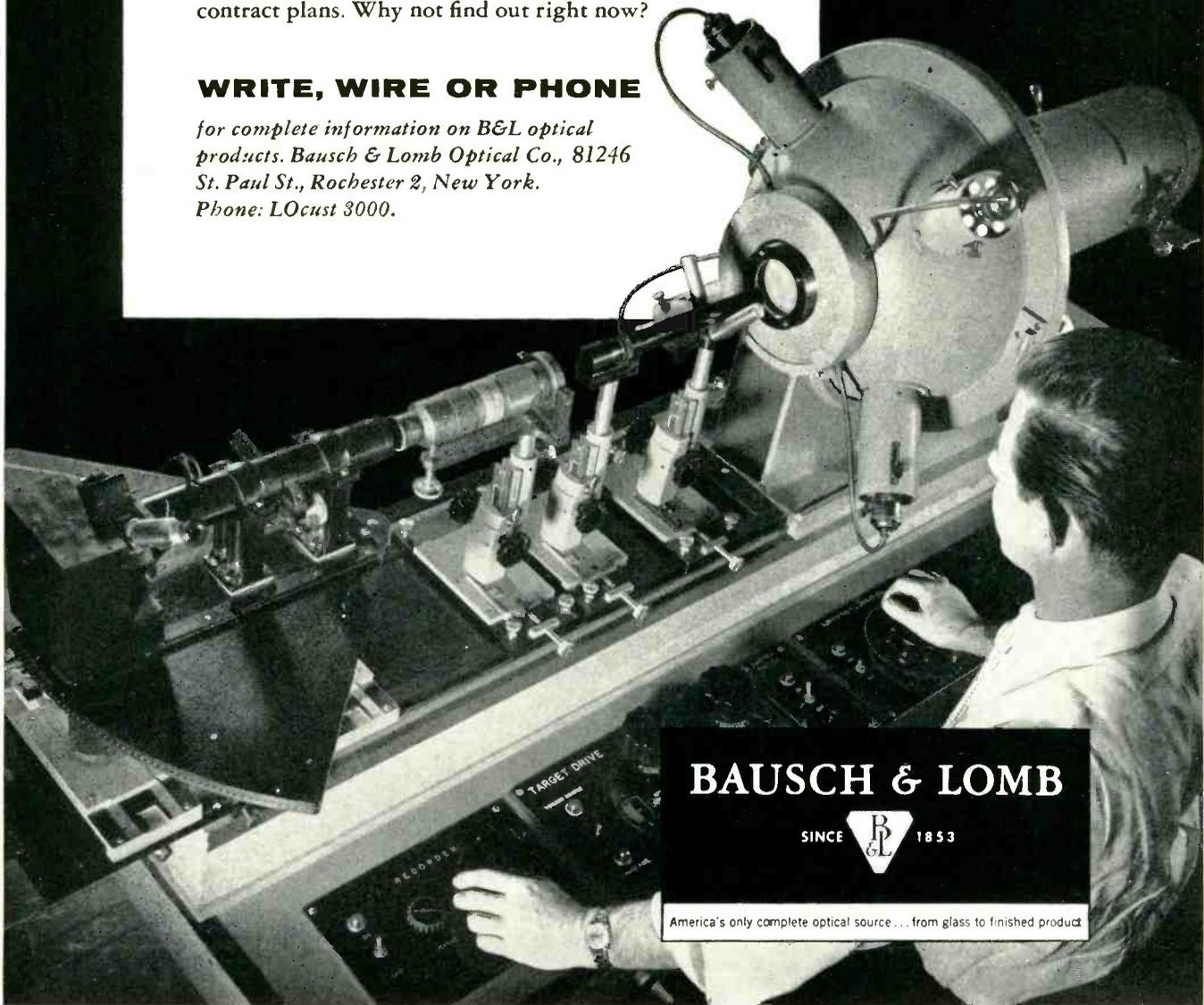
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Controlling light to your performance requirements is routine with Bausch & Lomb. Standard production includes hundreds of different optical elements to keep your product designs simple and your costs down. And B&L optical competence assures prompt, dependable execution of special orders for volume manufacture . . . from components to complete instruments and equipments. B&L may well prove the expediting factor in your present defense contract plans. Why not find out right now?

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# BAUSCH & LOMB

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America's only complete optical source . . . from glass to finished product

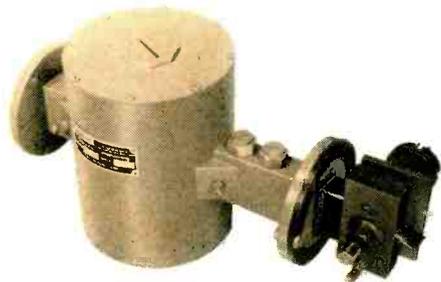
SOMETHING NEW FROM VARIAN...

# HIGH STABILITY

WITHOUT ELECTRONIC COMPONENTS



VA-1281  
Stalo Cavity  
with VA-201 klystron



VA-1282  
Stalo Cavity  
with X-26 klystron



VA-1280  
Stalo Cavity  
with VA-201 klystron

Now—with Varian's new line of high Q Cavities, frequency stabilized local oscillators (Stalos) utilizing direct cavity stabilization are commercially practical. Varian Stalo Cavities provide a very high degree of short time frequency stability. Stabilization is completely independent of the frequency of oscillator fluctuations and external disturbances... an inherent advantage over electronic stabilization systems utilizing the feedback principle. Elimination of all electronic components except the klystron oscillator also affords greater reliability and longer life.

The ratio of the oscillator modulation sensitivity to the modulation sensitivity of the stabilized oscillator defines the stabilization factor of the cavity. Varian Stalo Cavities are available in three models—VA-1280, 1281 and 1282—offer stabilization factors from 15 to 160... cover a wide range of important applications, including stabilization of signal sources in high power klystron transmitters... airborne uses in conjunction with receiver local oscillators... laboratory testing. When used with Varian's new highly stable reflex klystron oscillators, stability comparable to that of many crystal controlled oscillators can be obtained.

**COMPLETE TECHNICAL  
DATA and specifications  
are now available.**

*Your inquiry is cordially invited.*

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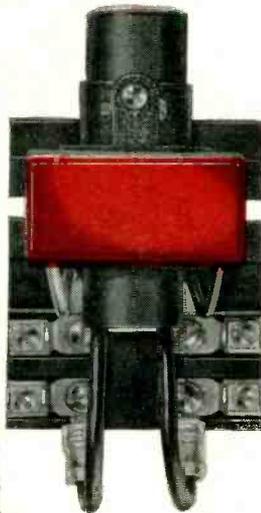
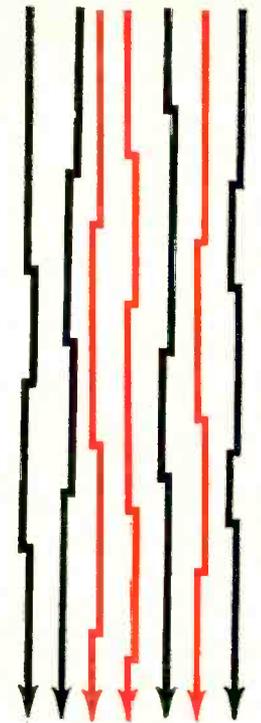


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to protect  
equipment  
against  
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use Adlake  
mercury relays

The new Adlake Mighty Midget relay, like *all* Adlake relays, requires no maintenance whatever . . . is quiet and chatterless . . . free from explosion hazard. Dust, dirt, moisture and temperature changes can't affect its operation. Mercury-to-mercury contact gives ideal snap action, with no burning, pitting or sticking.

*Write for catalog and information.*

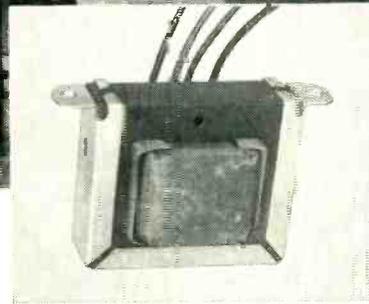
**The Adams & Westlake Company**  
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*the original and largest manufacturers  
of mercury plunger-type relays*



New Leeson No. 108 Coil Winders (foreground) in the plant of Ram Electronics, Inc., Irvington, N. Y., where Leeson Winders have become "standard equipment." These were added as best winders for producing short runs of stick-wound coils of varying specifications. (Inset) Ram has built an excellent reputation for winding quality coils and transformers used in radio and TV equipment.



## RAM standardizes on Leeson coil winders...adds No. 108 machines

*These winders help maintain highest quality standards . . . with good production performance*

Ram Electronics, Inc. (Irvington, N. Y.) earned its fine reputation by adhering to unusually high quality standards.

This reputation, of course, is one they intend to keep. So in adding to coil winding facilities they picked

Leeson No. 108 Coil Winders, standardizing on Leeson equipment which has served them so well in the past. To quote Mr. Del Vecchio, plant manager:

"We have come to count on Leeson Coil Winders to assure the high quality coils we insist upon for our products. That's why any additions to our present installation will be Leeson winders."

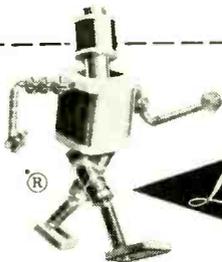
The Leeson No. 108 Hand Feed

Coil Winder was designed specifically for complete accuracy, great flexibility and top production at low operating cost.

### *Investigate*

how Leeson No. 108 Coil Winders can perform with great efficiency in your plant. The coupon will bring you complete details, together with other helpful coil winding information. Why not check and mail it today?

23B-5-6



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IN QUANTITY...  
ACCURATELY... USE  
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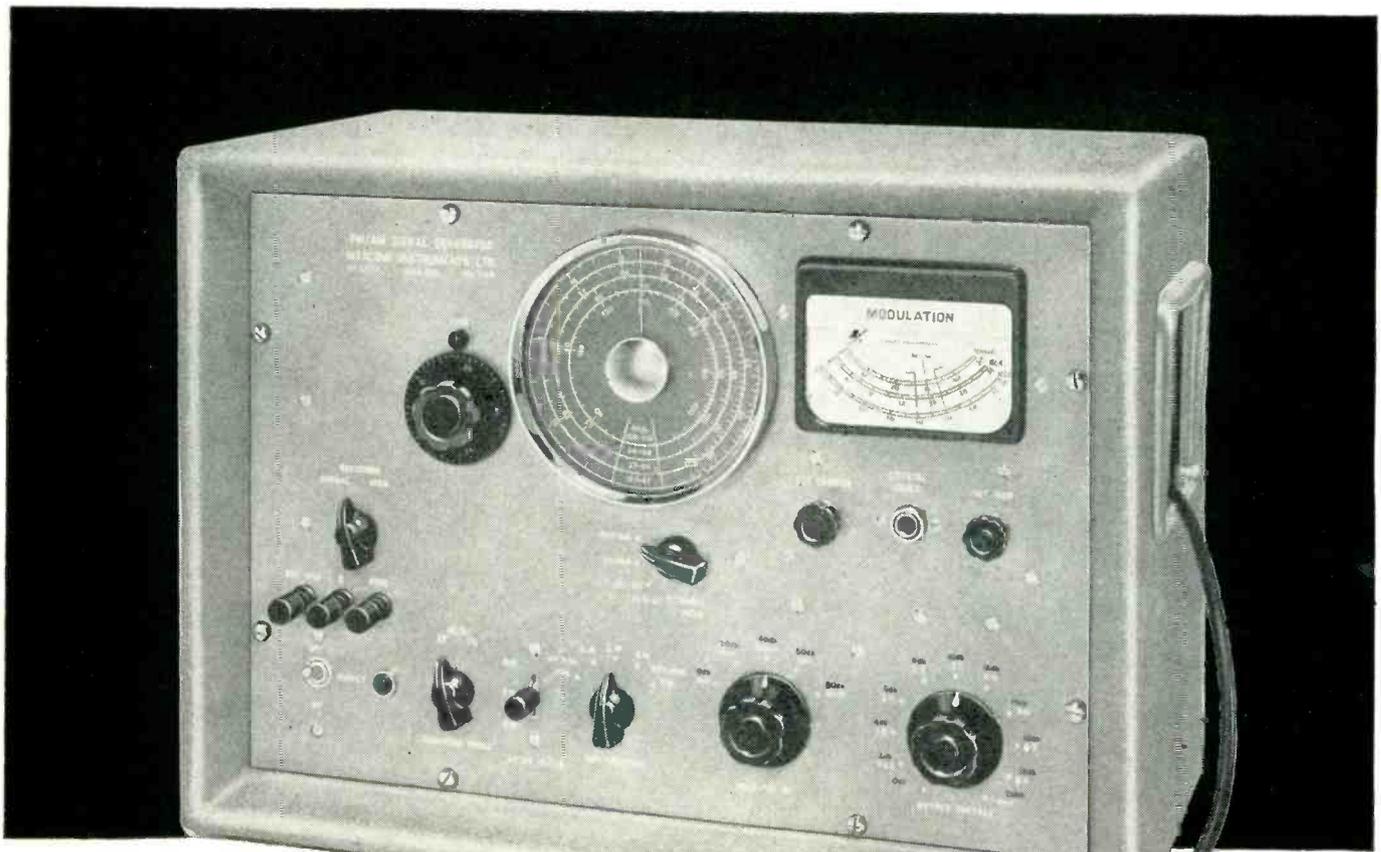
Please send me

- Bulletin on the Leeson No. 108 Hand-Feed Coil Winder.
- Condensed catalog of Leeson Winders.
- Bulletin on the new Leeson Pay-As-You-Profit Plans for purchasing or leasing modern coil winding machinery.

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Company.....

City.....Zone.....State.....



# MARCONI SIGNAL GENERATOR

**TYPE  
TF 995A/1**

*For both r.f. and i.f. testing  
with c.w., f.m., a.m.,  
or simultaneous f.m. and a.m.*

The MARCONI Signal Generator Type TF 995A/1 is a compact, transportable, a.c. operated instrument. It covers from 1.5 to 220 megacycles in five bands and there are facilities for crystal standardization from 13.5 megacycles upwards; its open-circuit output level is variable, in 1-db steps, from a minimum of 0.1 microvolt to a maximum of 100 millivolts at 52 ohms and 200 millivolts at 75 ohms. The output may be continuous wave, frequency modulated, amplitude modulated, or simultaneously both frequency and amplitude modulated. The modulation, obtained either from an internal 1000-cps oscillator or from an external source, is variable to maximum frequency deviations ranging from 25 to 600 kc for f.m., and to depths up to 50% for a.m.



F.M. and A.M. SIGNAL GENERATORS

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## New Self-Balancing Strain Gauge System With Direct Reading Remote Indicator

Now, for the first time in aviation history, the pilot can know, while in flight, the exact load being placed on his aircraft at strategic points due to severe weather, air shocks, etc. Strain gauges can be placed on all essential parts of the aircraft, and a direct reading obtained from the indicator in the cockpit.

The maximum deviation of the system from a straight line does not exceed 0.1% full scale. Overall accuracy is less than 1% under all conditions and repeatability is within 0.1% of full scale. Inputs of 10 to 50 m.v. display full scale deflection.

This system has been thoroughly tested and proven in service—it is designed to meet military specifications. The total volume of the entire system is less than 125 cubic inches and weight is under 10 lbs.

Use of this system will improve safety, reduce maintenance hours and provide stress or strain information prior to structural failure. Write, wire or 'phone today.

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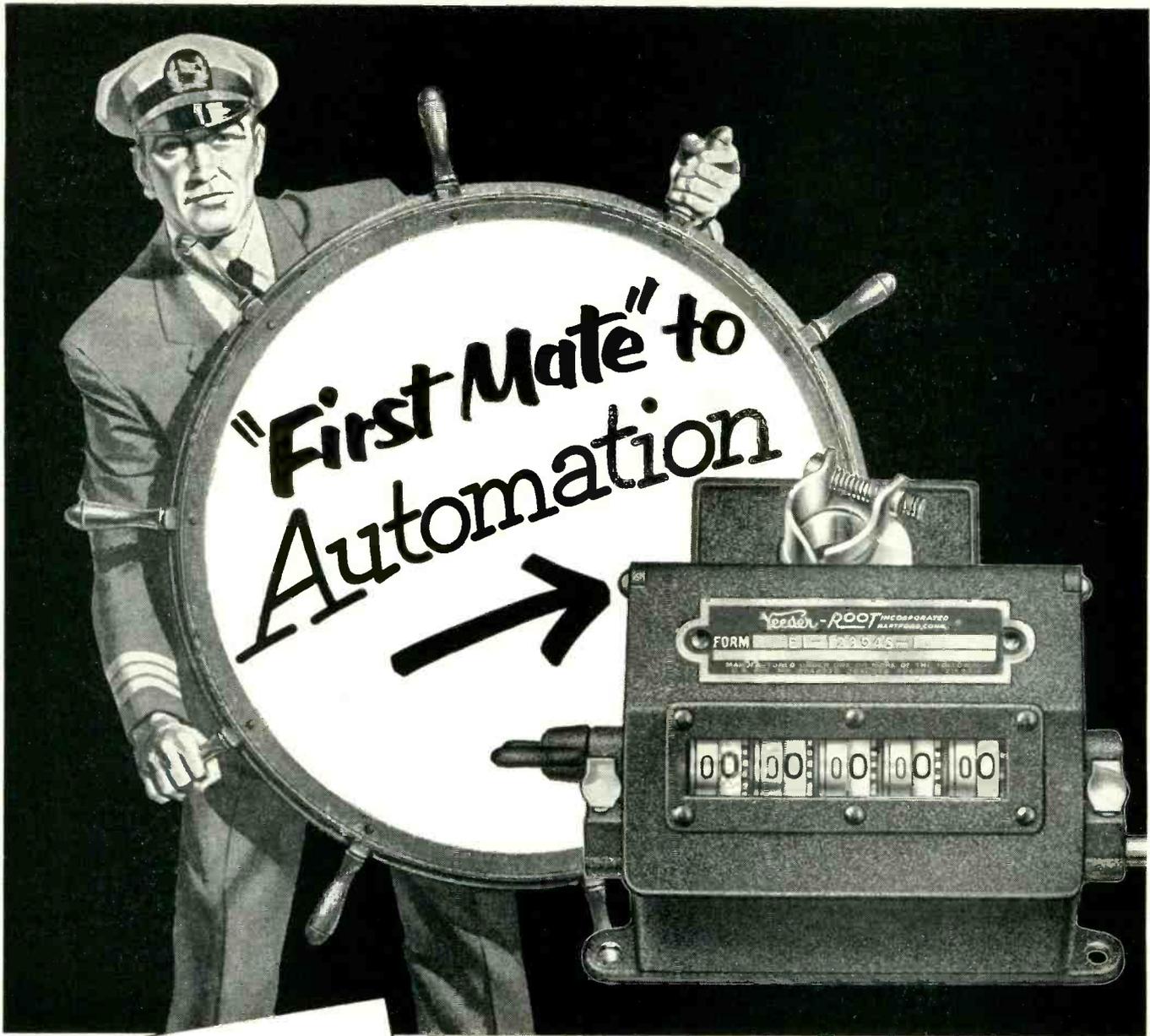
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Producers of the HIG-3 and HIG-4 Gyros, Rate and Free Gyros, Differential Pressure Mach Meters, Air Speed Indicators, Computers, Switches and many other precision-built components.



Added Evidence  
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Everyone Can Count on  
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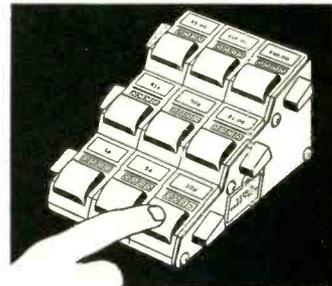
In figuring out new systems of automatic electrical control, Veeder-Root Control can supply vital connecting links. For instance, this Predetermining Counter can be hooked into such a system to light a light, ring a bell, or actuate a mechanism to stop a machine or process *at any pre-set point*. And there are many other Veeder-Root Counters that can serve as "count-ponents" in almost any way desired. Or special counters can be designed for specific applications. Engineers in any industry, now engaged in working out automatic control systems, can count on Veeder-Root engineers to work with them on any problem where reliable facts-in-figures are needed.

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**"The Name That Counts"**



New Vary-Tally Multiple-Unit Reset Counter comes in any combination up to 6 banks high, and 12 units wide. Write for news sheet and prices.



# ELECTRONIC DESIGN

PROPERTY AND APPLICATION DATA ON THESE  
VERSATILE ENGINEERING MATERIALS: "ZYTEL,"  
"ALATHON," "TEFLON," "LUCITE."

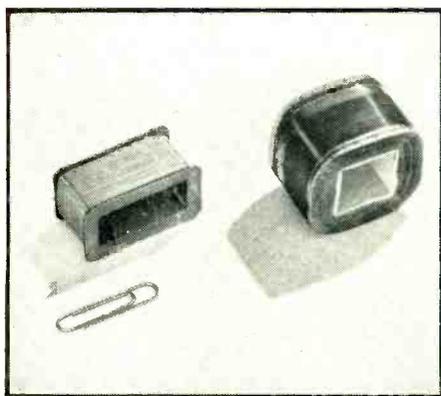
# NEWS

Better Things for Better Living  
... through Chemistry

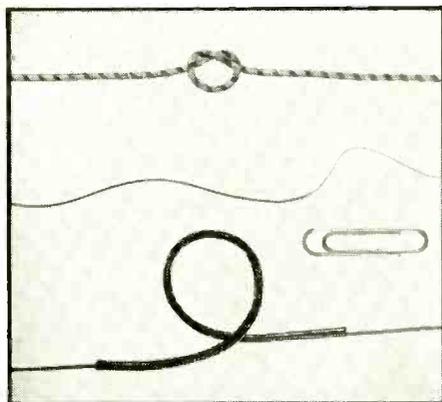
NO. 4

1955

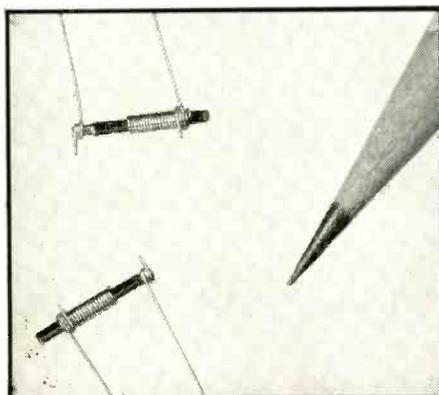
## Miniaturized Components Utilize Unique Insulating Properties of TEFLON®



The paper clip indicates the small size of these coils. The insulation of "Teflon" is one important reason why they can be miniaturized.



Here are shown (top) a striped, wrapped lead wire and (bottom) two samples of miniaturized flexible sleeves—all insulated with "Teflon."



These small capacitors use "Teflon" as the dielectric. Their degree of miniaturization is shown by comparison with end of lead pencil.

Working temperature range of Du Pont "Teflon": -450°F. to +500°F.

Miniaturization of electronic components is possible with a unique engineering material: Du Pont "Teflon" tetrafluoroethylene resin.

"Teflon" has a low loss factor, low dielectric constant, and high volume resistivity. It is nonflammable, and unaffected by moisture. "Teflon" is the only insulating material available today that is inert to every commercially used solvent and chemical, excepting only molten alkali metals and fluorine at high temperatures and pressures.

Use of "Teflon" helps cut production costs, too. In soldering operations, the iron will not burn or melt insulation of "Teflon." This important fact can save time, labor, and materials.

The three photographs on this page show some current uses for insulation of "Teflon." The wire is manufactured by Hitemp Wires, Inc., Mincola, New York. Other typical applications by Hitemp which utilize Du Pont "Teflon" are listed below.

The six products listed, insulated with "Teflon" and used in a wide variety of applications, illustrate the application of this material in current electronic designs:

**MAGNET WIRE.** Such wire, coated with "Teflon," is widely used on high-temperature components for aircraft and guided missiles: transformers, relays and various types of motors.

**HOOKUP WIRE AND LEAD WIRE.** Insulation of "Teflon" on hookup and lead wire proves advantageous on transformers, motors, and harness assemblies for high-temperature applications. The chemical resistance of "Teflon" is particularly valuable in gyros and other hermetically sealed components.

**COAXIAL CABLE.** Used as the dielectric medium of coaxial cable, "Teflon" permits the design of miniature constructions which are the equivalent of coaxial cables using much thicker insulation of other materials.

**TUBING.** Insulation of "Teflon" provides excellent protection for tubing used as bus wire and jumpers.

**RESISTANCE WIRE.** Insulation of "Teflon" on small resistance wire facilitates miniaturization of heating equipment.

**FIBER-GLASS PRODUCTS.** Insulation of "Teflon" is being applied currently to such fiber-glass products as lacing, tape and sewing thread. "Teflon" provides excellent temperature resistance, and withstands cutting action of glass fibers.

### NEED MORE INFORMATION?

#### CLIP THE COUPON . . .

If you would like further information about the properties and uses of "Teflon" as an electronic design material, fill out and mail the coupon.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department  
Room 2210, Du Pont Building, Wilmington 98, Delaware  
In Canada: Du Pont Company of Canada Limited,  
P. O. Box 660, Montreal, Quebec

Please send me more information on the Du Pont engineering materials checked:  "Teflon"\* tetrafluoroethylene resin;  "Alathon"\* polyethylene resin;  "Zytel"\* nylon resin;  "Lucite"\* acrylic resin. I am interested in evaluating these

materials for \_\_\_\_\_

NAME \_\_\_\_\_

POSITION \_\_\_\_\_

COMPANY \_\_\_\_\_

STREET \_\_\_\_\_

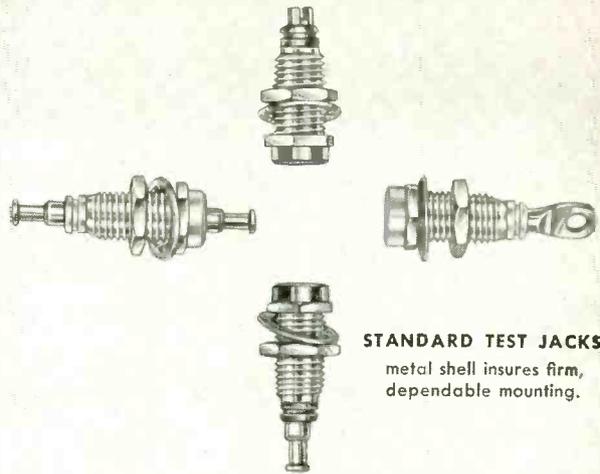
CITY \_\_\_\_\_ STATE \_\_\_\_\_

TYPE OF BUSINESS \_\_\_\_\_

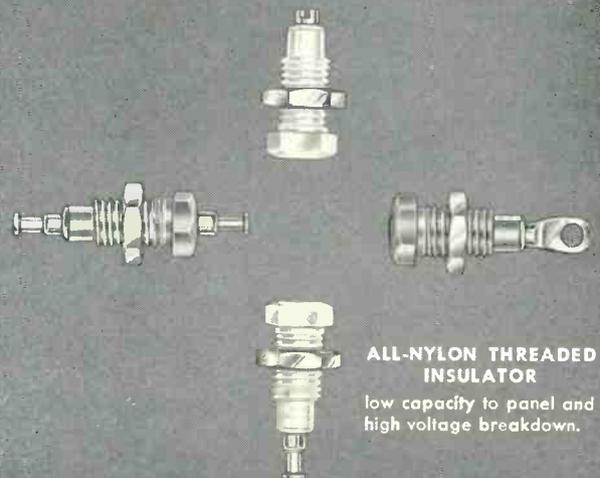
\* "Teflon," "Alathon," "Zytel" and "Lucite" are registered trademarks of E. I. du Pont de Nemours & Co. (Inc.)

# new

**BACK-MOUNTING TEST JACKS**  
permit bench soldering to wiring  
harness before mounting.



**STANDARD TEST JACKS**  
metal shell insures firm,  
dependable mounting.



**ALL-NYLON THREADED  
INSULATOR**  
low capacity to panel and  
high voltage breakdown.

## Test Jacks by Ucinite

The introduction of Ucinite's back-mounting jacks makes available for the first time a *complete* line of *high quality* test jacks suitable for use in equipment where long life and dependability are essential.

Ucinite Test Jacks, designed for standard .080 phone tips, are available in a variety of colors ideally suited to coded application. Silver-plated, heat treated beryllium copper contact is made in one piece with large terminal ends for easy solder-

ing. The feed through type is provided with a one-piece brass terminal stud, tin-plated.

The specialized abilities and experience of Ucinite's own staff of design engineers are available for work on new and unusual problems. Volume production facilities ensure fulfillment of the largest requirements.

For full information, call your nearest Ucinite or United-Carr representative or write directly to us.



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Newtonville 60, Mass.  
Division of United-Carr Fastener Corp.

**Specialists in**  
**ELECTRICAL ASSEMBLIES,**  
**RADIO AND AUTOMOTIVE**

NEW STAR...

# A WASHER NUT

that locks and seals itself



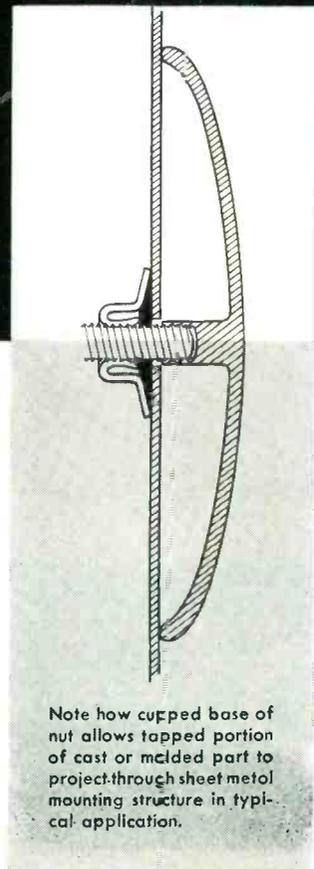
**3/8" HEX. #10**

**THREE IN ONE** — eliminates nut, cupped washer and separate sealing ring. Cupped flange and integral sealing ring provide tight, moisture and dust-proof seal.

**FREE SPINNING** — nut spins easily onto bolt . . . sealing ring does not drag until it comes into contact with surfaces to be fastened.

**STRONG** — multiple threads ensure high torque and tensile strength.

**TWO FLANGE SIZES** — 3/8" flange available with notches for extra locking power and positive grounding (shoulders bite into finish of parts to be fastened and prevent nut from vibrating loose). Both 3/8" and 1/2" flange available with or without sealing ring. (Locking type heat treated for extra tension.)



Note how cupped base of nut allows tapped portion of cast or milled part to project through sheet metal mounting structure in typical application.

For further information on WASHER NUTS or any other problems involving special fasteners or self-fastening devices, contact your nearest United-Carr representative or write us direct.

## UNITED-CARR

FASTENER CORPORATION • 31 Ames Street, Cambridge 42, Mass.

MAKERS OF **DOT** FASTENERS

# Designed for one...



## ... SOUGHT BY MANY

Seeking to overcome the deficiencies in many of today's standard electronic devices, engineers at Airborne Instruments Laboratory created the devices shown here. Though developed for use at AIL, their adaptability for many applications has resulted in a wide demand by manufacturers and users of electronic equipment. Thus, production and sales have become important areas of operations at Airborne.

### TYPE 124A WIDE RANGE POWER OSCILLATOR

Frequency Range: 200-2500 mc (in three ranges, 200-300, 300-900 and 900-2500 mc).

Power Output: 300 mc: 8 watts, 600 mc: 20 watts, 1500 mc: 10 watts, 2500 mc: 2.5 watts.

Output Impedance: 50 ohms

**\$ 2285.**



### TYPE 40 INTEGRATING AMPLIFIER

The type 40 INTEGRATING AMPLIFIER is a four-tube electronic integrator for use as a component of specialized electronic analogue computers.

The characteristics of the unit especially adapt it for such difficult applications as:  
Integration of video or other pulse signals of low duty factor;  
long term memory of information derived by intermittent sampling of data.

**\$ 500.**



### TYPE 30 PRECISION 30 MC ATTENUATOR

Accuracy:  $\pm 0.2$  db at any frequency from 25 to 35 Mc. Counter-type indicator reads attenuation above minimum insertion loss in tenths of a decibel.

Range of Attenuation: 80 db  
Input Impedance: 50 ohms (BNC connector)  
Output Impedance: 50 ohms (BNC connector)  
Minimum insertion loss: 25.0 db (at 30 Mc)

**\$ 395.**



### TYPE 373 RECTANGULAR COORDINATE RECORDING SYSTEM

#### PEN POSITION SYSTEM

Range: 80 db of recorded voltage

Pen Speed: full scale deflection (10 inches) in  $\frac{1}{4}$  second.

Accuracy: static error less than  $\pm 0.25$  db dynamic error less than  $\pm 0.4$  db at maximum pen speed of 40 inches per second.

Input: audio frequency voltage of fixed frequency in the range 500 to 2000 cps. 2 microvolts minimum input from 200 ohm source. Selective amplifier bandwidth 35 cps.

#### CHART POSITION SYSTEM

20- $\frac{1}{4}$ , 121- $\frac{1}{2}$ , and 729 inches per revolution of device under test. Maximum chart speed 10 inches per second. Reversible chart drive.

**\$ 8,500.**



### TYPE 390A MICROWAVE CRYSTAL TEST SET

Accepts ceramic cartridge and coaxial types of both normal and reversed polarities.

Remote test jack permits testing crystals without removing them from receiver.

Portable  
Self-contained

**\$ 97.**



All prices F.O.B., Mineola, N. Y.  
Subject to change without notice.

### TYPE 116R POLAR PATTERN RECORDING SYSTEM

#### Pen Positioning System

Input:  
Audio-frequency voltage of fixed frequency between 500 and 2000 cps. Amplifier bandwidth 35 cps. Maximum sensitivity 100 microvolts for full scale deflection.

Pen Speed:  
15 inches per second.

Accuracy:  
Overall system static accuracy  $\pm 1\%$  of full scale.

#### Turntable Positioning System

Input:  
1:1 and/or 36:1 synchro signals, 115 volts 60 cps, size 5.

Accuracy:  
 $\pm$  Maximum error degree.  $0.2^\circ$  at 6 R.P.M.

**\$ 7500.**

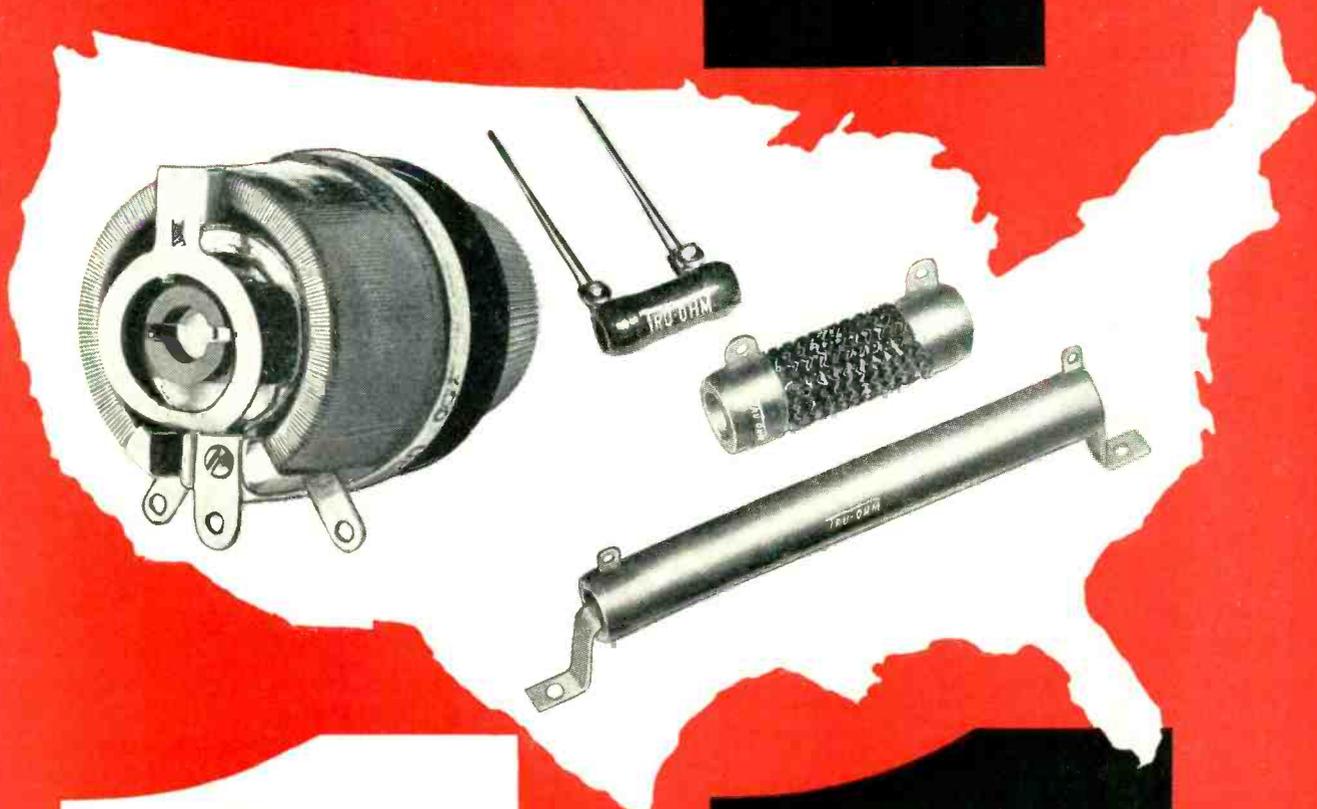


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AMERICA'S NO.

1

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We maintain a large stock for  
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need. Our rheostats are in-  
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Division of Model Engineering & Mfg., Inc.

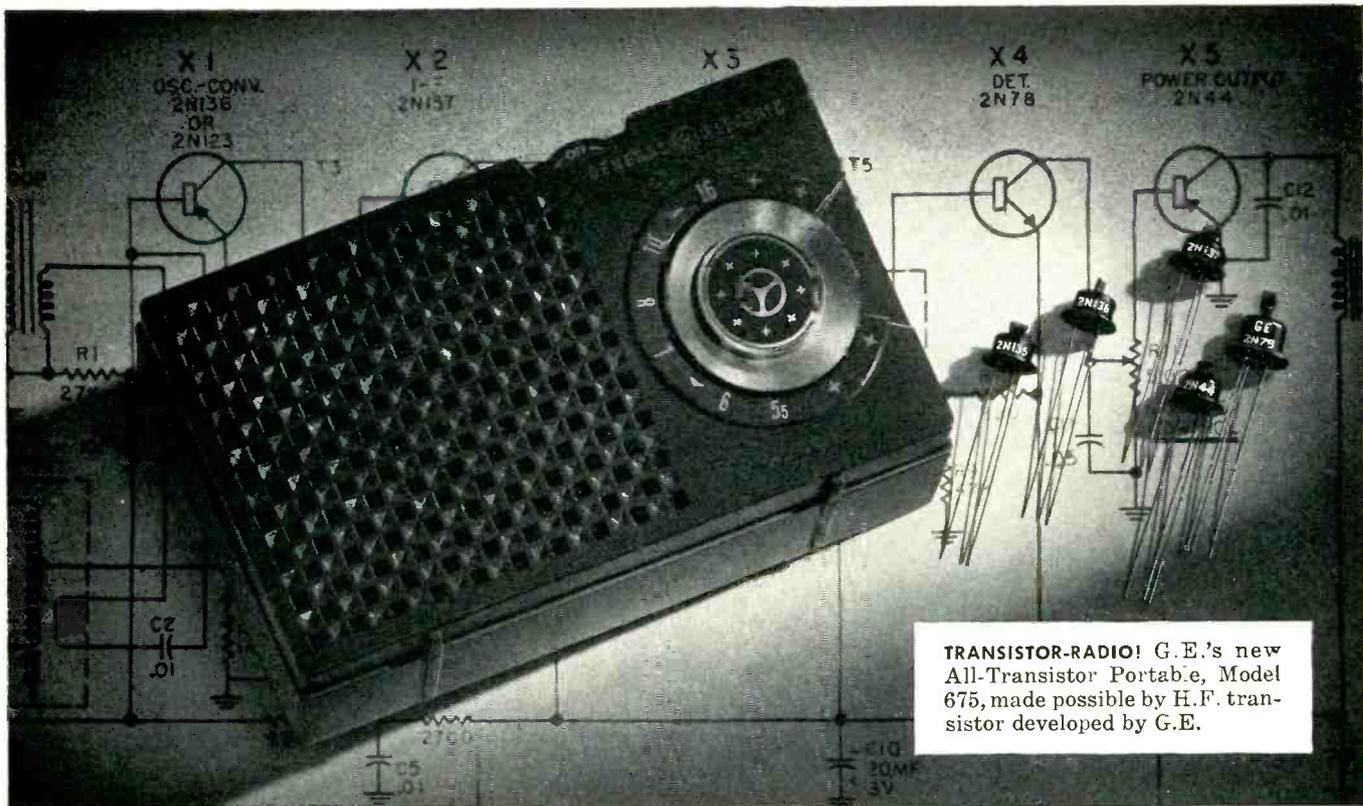
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Factory: Huntington, Indiana

"Largest producers of wire-wound resistors in the U. S. A."



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New G-E H.F. PNP Transistors, 2N135, 2N136, 2N137, Complement the G-E 2N78 NPN

**T**HIS new line of G-E High Frequency PNP Transistors offers immediate benefits to electronics manufacturers for use in RF and IF amplifier circuits. The new High Frequency designs, now in full production, were created specifically for use in radio circuits. The line provides minimum alpha cut-offs of 3 MC, 5 MC and 7 MC—coupled with a 5 ua maximum collector cut-off current. The result: all the high-gain and high-power advantages of other General Electric transistors, *plus* operating ranges extending from 3 to 15 MC depend-

ing on the transistor selected.

**NOW IN COMMERCIAL RADIO CIRCUITS**  
In the circuit above, the 2N136 is used as a converter—its 5 MC minimum alpha cut-off assures stable oscillator performance and high conversion gain. The 2N137—with 7 MC minimum alpha cut-off—provides 33 db gain at 455 KC. The high frequency 2N135 offers a higher collector voltage rating for the second IF where it is needed. The 2N78 NPN transistor—originally designed for computer and RF circuitry—proved ideal as a power detector and audio amplifier to drive a

2N44 power output transistor with direct coupling.

**PRODUCTION QUANTITIES AVAILABLE**  
General Electric's new high frequency line is in mass production now. Detailed characteristics and specifications of the G-E 2N135, 2N136, and 2N137 transistors may be obtained upon request. Your G-E Semiconductor specialist and our factory application engineers have the answers to your transistor radio circuit questions. Call them in, or write: *General Electric Co., Semiconductor Products, Section X4105, Electronics Park, Syracuse, N. Y.*

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**GENERAL  ELECTRIC**

For Generation of Pulse Voltages -

# CHATHAM MODEL 5C22 HYDROGEN THYRATRON



A three electrode zero bias thyatron with peak power handling capacity to 2.6 megawatts

## ELECTRICAL DATA

	MIN.	BOGEY	MAX.	
HEATER VOLTAGE	5.8	6.3	6.8	Volts
HEATER CURRENT @6.3V	9.6	10.6	11.6	Amps
CATHODE HEATING TIME	300			Sec.
ANODE VOLTAGE DROP, PEAK	100	150	200	Volts

For detailed characteristic data request sheet DSW-104-1

## MAXIMUM RATINGS—Absolute Values

Maximum Peak Anode Voltage	
Inverse	16 Kilovolts
Forward	16 Kilovolts
Minimum Peak Anode Voltage	
Inverse	800 Volts
Forward	4500 Volts
Maximum Cathode Current	
Peak	325 Amperes
Average	200 Milliampères
Averaging Time	1 Cycle
Minimum D.C. Anode Voltage	4500 Volts
Maximum Operating Frequency (Note 1)	1000 cps
Minimum Peak Trigger Voltage	200 Volts
Maximum Peak Trigger Voltage	600 Volts
Maximum Heating Factor (Note 2)	$3.2 \times 10^9$
Maximum Current Rate of Rise	1500 Amps/ $\mu$ s.
Maximum Anode Delay Time	1 $\mu$ s.
Maximum Time Jitter	0.02 $\mu$ s.
Ambient Temperature	+90 to -50°C

NOTE 1: This is not necessarily the upper operating frequency limit but represents the highest repetition rate for present life test requirements.

NOTE 2: Heating factor is the product (epy x prr x ib).

### CHATHAM TYPE VC-1257

Hydrogen filled, zero bias thyatron with hydrogen reservoir for generation of pulse power up to 33 megawatts.



### CHATHAM TYPE 5948/1754

Hydrogen filled, zero bias thyatron with hydrogen reservoir for generation of peak pulse power up to 12.5 megawatts.



### CHATHAM TYPE 5949/1907

Hydrogen filled, zero bias thyatron with hydrogen reservoir for generation of peak pulse power up to 6.25 megawatts.



### CHATHAM TYPE VC-1258

Zero bias miniature hydrogen thyatron for the generation of peak pulse power up to 10 KW. Also available with a 28 v heater and in a super ruggedized type for extreme vibration.



Chatham Hydrogen Thyatrons are the product of many years of concentrated experience in this specialized field. Embodying the most advanced developments in the art, the tubes illustrated offer uniformly high performance

when employed in the generation of pulse voltages in the order of microseconds. For complete data and specifications on Chatham Hydrogen Thyatrons, call, write or wire today - no obligation.

## Chatham Electronics

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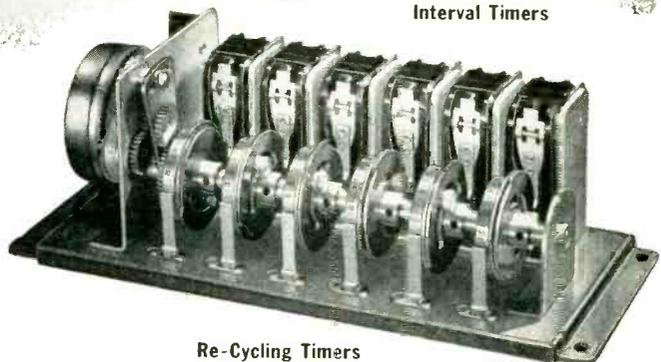
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To meet the widely different requirements of our customers, we work with 17 basic types, from which we have so far developed 721 combinations. 19 years of successfully "timing" these customers has equipped us with a breadth of practical experience that you can draw on. The timers we manufacture comprise a complete line in 4 broad classifications.

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Our deliveries are extra good because we maintain large stocks of our 17 basic types, and even if your order is very "special" you'll be more than satisfied with our service. Send us your specifications; you'll get a prompt reply.



Running Time Meters

*Timers that Control  
the Pulse Beat of Industry*



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This latest ANDREW cable, introduced just 18 months ago, has received phenomenal industry acceptance. This is easy to understand, when you consider that HELIAX offers electrical performance equal to that of the finest copper cables, yet is far lower in price and much easier to install.

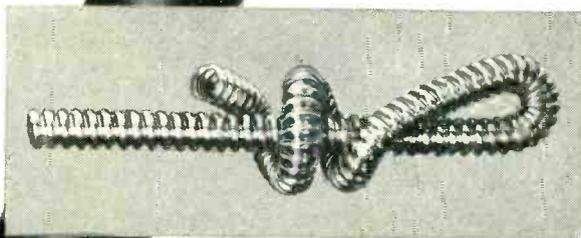
HELIAX has its own complete series of connectors, matching the superior electrical performance of the cable.

These fittings are pressurized and weatherproofed, and attach easily without special tools.

For a maximum of convenience in the field, HELIAX is normally supplied in complete assemblies, with end fittings factory attached. Available in 7/8" and 1 1/8" sizes.

Continuous lengths to 3,000 feet.

*Write now for complete engineering data and a sample of this remarkable cable.*



The secret of HELIAX lies in its corrugated outer conductor. As demonstrated at the left, this by itself can be bent on its own diameter without breaking, kinking or going out of round. These qualities give HELIAX its unusual flexibility, strength and ease of handling.

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## DIRECT READING FREQUENCY METER

### FOR AIRBORNE AND GROUND POWER EQUIPMENT



When an electrical system requires a reliable Direct Reading Frequency Meter — check VARO. This ruggedly built Frequency Dial Meter and Control Box is accurate to  $\pm 0.2\%$ .

It meets all military environmental specifications and no temperature correction is required. A precision tuning fork is used as the reference standard and the signal to the indicator can be used simultaneously for chart recordings where permanent record is desired. The 400 cycle calibration on the meter face is offset from null position to cause actual indicator movement for more positive calibration.

Compact and light in weight, the VARO Frequency Meter is ideally suited for either airborne or ground power equipment.

Other VARO Products made for Military Aircraft Fire Control and Navigational Systems.

Frequency Standards	Electronic Inverters
Frequency Changers	Regulated Supplies
Voltage Regulators	Speed Controls
Voltage and Frequency Sensitive Relays	



The MD-3 Ground Power Equipment designed and manufactured by Beech Aircraft Corp. is used by the Air Force to check out aircraft in pre-flight test. The VARO Frequency Meter is utilized as part of the system to provide accurate and reliable measurement of 400 cycle electrical systems.

#### SPECIFICATIONS

**INPUT:** 110 to 120 Volts AC  
350 to 450 cycles (Meter not damaged at 200 cps.)  
28 Volts DC at 1 ampere

**OUTPUT:** Meter scale calibrated at 1 cps, intervals between 395 and 405. Pointer indicates high or low over the range of 350 to 450.

#### PHYSICAL DESCRIPTION

CONTROL SECTION	INDICATOR SECTION
Height: 4 inches	Standard meter case per MIL-M-10304 for sealed ruggedized instrument.
Width: 2½ inches	Body dimensions 2.800" max. diameter and 1.405" depth. Weight: 14 oz.
Depth: 7 inches	
Weight: 2 lbs., 14 oz.	

## VARO

For further information please write:  
**MANUFACTURING CO., INC.**  
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Representatives: Box 553, Far Hills Branch, Dayton, Ohio, Pacific Scientific Co., 1430 Grande Vista Ave., Los Angeles 23, California

PRODUCTION DELAYS  
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*Caused by*

**V.V.T.** \*

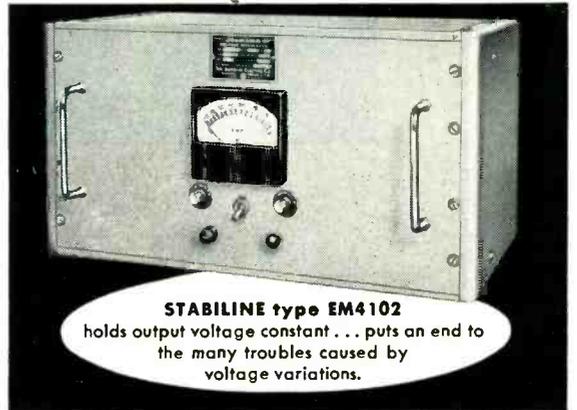
\***Varying Voltage Troubles** can occur in your plant every time the voltage varies to electrically-operated equipment — and that can be happening many times a day!

V.V.T. can be the cause of unexplained production delays, rejects, defective units, burned out lamps or motors, tube failures in electronic equipment. A single department can be "dogged" by V.V.T. — or your entire production line.

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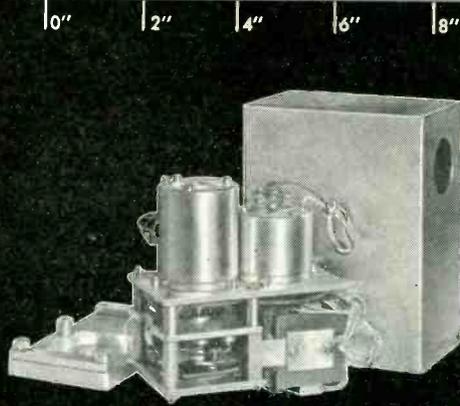
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built to do just one servo control job . . .

**p e r f e c t l y**



*An incremental synchro positioner before wiring to header and hermetic sealing. The synchro rotor is stepped in one or fifteen degree increments clockwise or counterclockwise depending upon which of four coils is momentarily energized by a d-c pulse. The synchro can be rotated any number of degrees or revolutions. The cylindrical member resets the synchro to electrical zero if a pulse is applied to the "reset" circuit.*

Like all Transicoil servo assemblies, this incremental positioner "does the job right" because it was designed for a single application . . . by a company whose major function is to provide complete servo assemblies precisely engineered and manufactured to solve individual servo control problems.

Of course, if you merely want servo components, you'll find Transicoil's control motors, motor-gear train combinations, motor-gear train-generator combinations, and servo amplifiers built to the highest order of precision and accuracy. But it is in the "package" engineering of unique assemblies that Transicoil's experience and creative imagination offer the greatest value. And in most cases, these assemblies cost no more than the individual components would purchased separately.

That's why it pays to check your servo problems out with Transicoil first. Write outlining your problem, and ask for Transicoil's new gear-motor bulletin. You'll find it a mighty handy availability guide in designing for tight production schedules.

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This complete line of PermaSeal Resistors is designed for applications which require highly accurate resistance values in small physical size at 85°C. and 125°C. operating temperatures.

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The winding forms, resistance wire, and embedding material are matched and integrated to assure long term stability at rated wattage over the operating temperature range.

These high-accuracy units are available in close resistance tolerances down to 0.1%. They are carefully and properly aged for high stability by a special Sprague process.

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SPRAGUE ELECTRIC COMPANY • 35 MARSHALL ST. • NORTH ADAMS, MASS.



Use **GENERAL PLATE Composite Contacts** to cut costs,  
*Brighten Your Product's Future*  
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General Plate's "know how" in the production of Composite Contact Materials can indeed brighten your products' future. By having General Plate fabricate your complete contact assemblies, you will save money, time, and trouble . . . eliminate needless equipment cost and problems of scrap disposal . . . and have at your disposal contacts and contact assemblies made to exact specifications shipped to you ready for installation when you want them.

Or, you may prefer to fabricate your own assemblies. General Plate Composite Contact Materials — available in overlay, edgelay, top-lay and inlay strips — make it possible for you to produce complete contact assemblies to close tolerances by simple blanking and forming operations.

In either case, comparison of the final costs of properly designed Composite Contact Assemblies fabricated from General Plate Composite Contact Materials against costs of similar assemblies produced by older methods of brazing, welding, staking, or spinning will reveal the resultant economies and fabricating ease available to you.

Write for complete information and catalog PR700 which describes General Plate Composite Contacts and other General Plate Composite Metals.

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**GENERAL PLATE DIVISION**  
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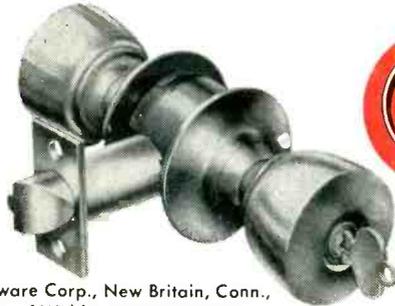


**GENERAL PLATE ELECTRICAL CONTACT KITS FOR LABORATORY AND DEVELOPMENT USE**

Kit K11 contains a wide assortment of silver rivet contacts; Kit K12 has representative standard button contacts. Also included are composite metal strips for fabrication of contact posts. These kits are available at nominal cost.

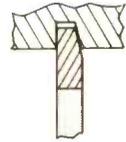
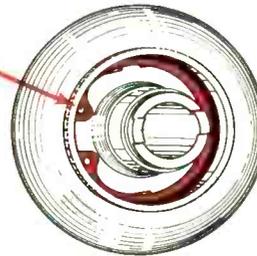
You can profit by using  
 General Plate Composite Metals!

# Waldes Truarc Retaining Rings Eliminate Machining— Provide Stronger Assembly, Greater Accuracy



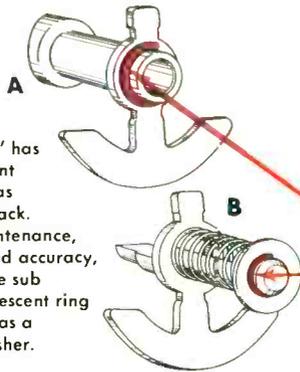
The American Hardware Corp., New Britain, Conn., uses 4 different types of Waldes Truarc Retaining Rings in the original design of these famous Corbin and Russwin Heavy Duty Cylindrical Locks. Truarc rings improve product performance, eliminate rejects, and cut labor costs.

## Knob Sub Assembly



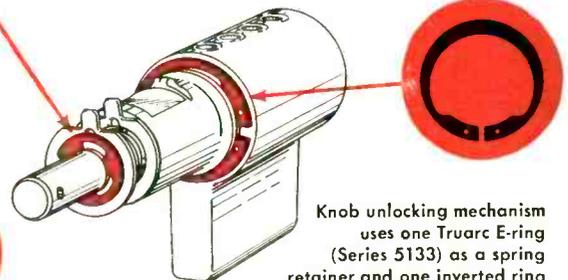
Truarc Beveled Ring (Series 5002) couples the knob to the knob shank. It eliminates two tapped holes and two screws, provides stronger assembly and greater accuracy. Beveled ring takes up end play rigidly.

## Spindle Sub Assembly



Spindle sub assembly "A" has two Waldes Truarc crescent rings (Series 5103) used as locating flanges for rollback. This saves labor and maintenance, improves performance and accuracy, eliminates rejects. Spindle sub assembly "B" uses one crescent ring as a spring retainer and as a locating shoulder for washer.

## Cylinder Sub Assembly



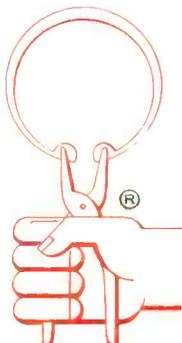
Knob unlocking mechanism uses one Truarc E-ring (Series 5133) as a spring retainer and one inverted ring (Series 5108) for retaining the cylinder plug. Rings are re-usable in the event of disassembly for maintenance. Rejects are eliminated.

Whatever you make, there's a Waldes Truarc Retaining Ring designed to improve your product...to save you material, machining and labor costs. They're quick and easy to assemble and disassemble, and they do a better job of holding parts together. Truarc rings are precision engineered and precision made, quality controlled from raw material to finished ring.

**36 functionally different types...as many as 97**

different sizes within a type...5 metal specifications and 14 different finishes. Truarc rings are available from 90 stocking points throughout the U.S.A. and Canada. **More than 30** engineering-minded factory representatives and 700 field men are available to you on call. Send us your blueprints today...let our Truarc engineers help you solve design, assembly and production problems...without obligation.

For precision internal grooving and undercutting...Waldes Truarc Grooving Tool!



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**TRUARC**<sup>®</sup>  
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Please send the new supplement No. 1 which brings Truarc Catalog RR 9-52 up to date.  
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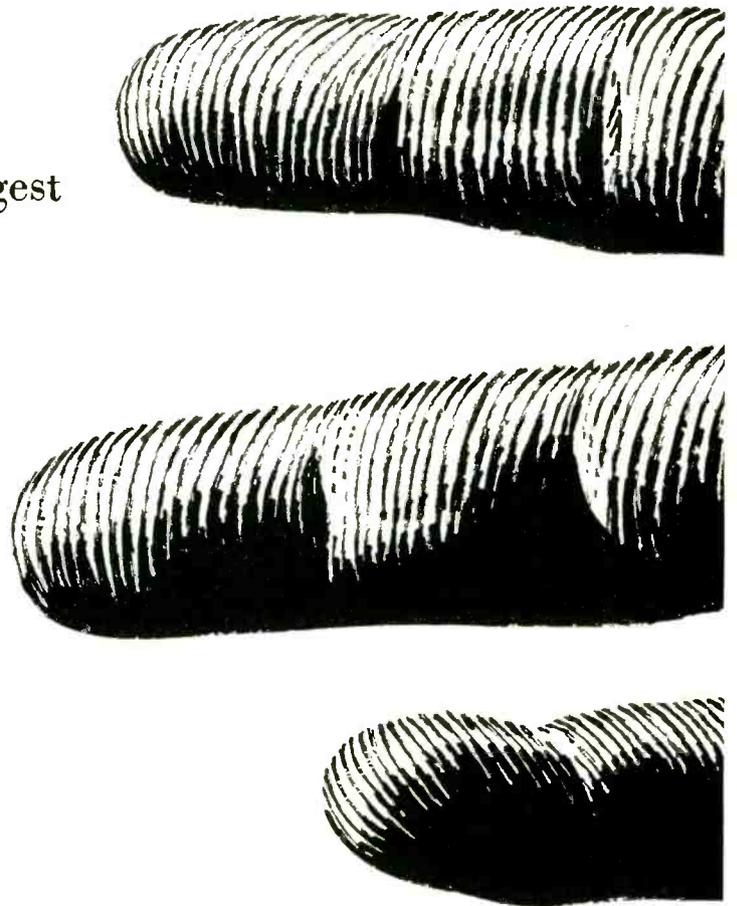
WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.

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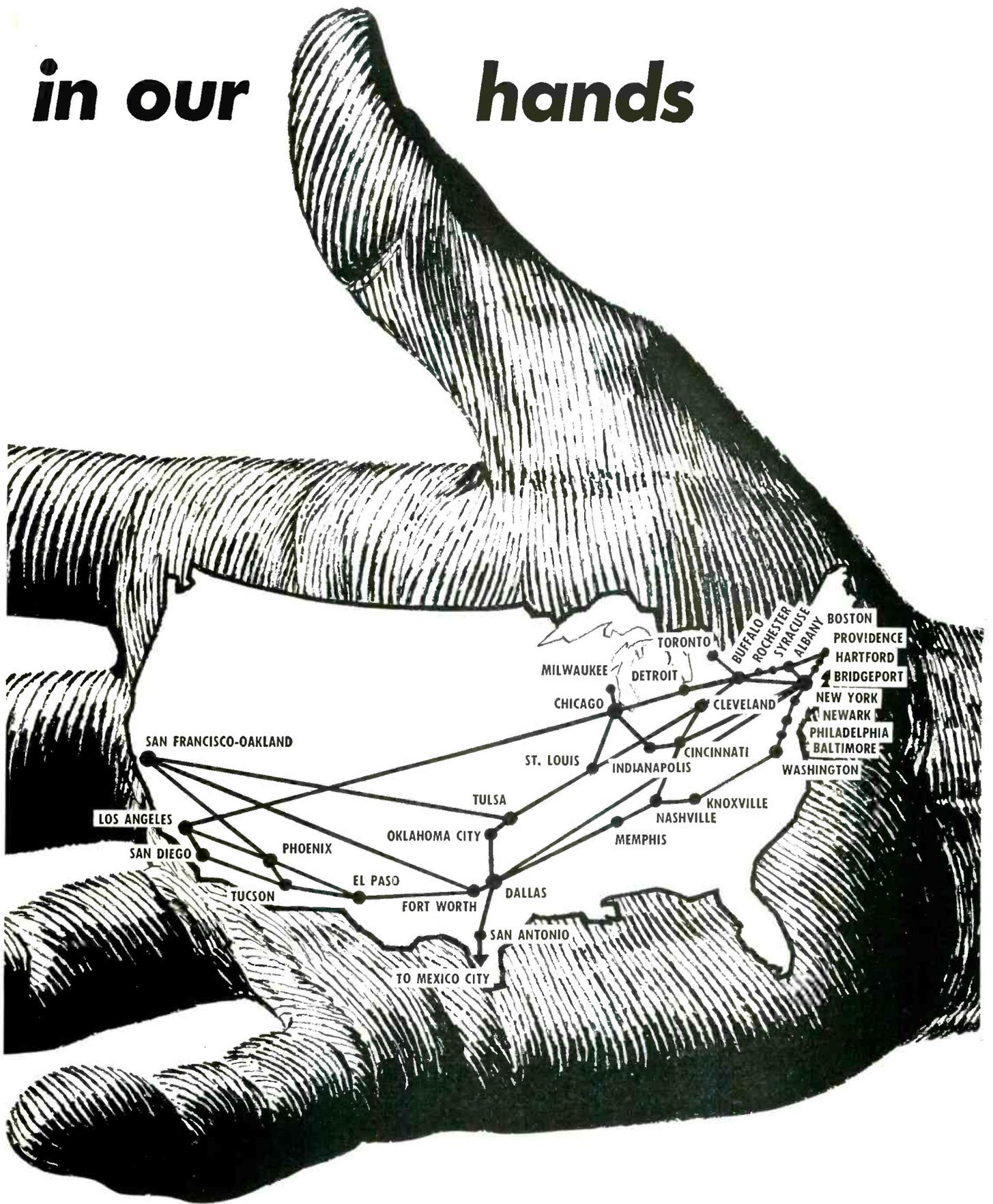


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HIGH QUALITY

LOW WEIGHT  
SMALL SIZE  
ECONOMICAL

# FREQUENCIES

## FREQUENCY STANDARD

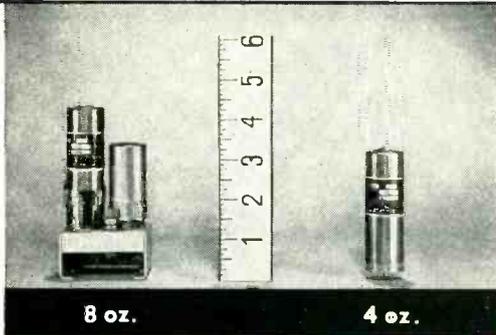
240 to 800 Cycles

Type 50 C

$\pm .02\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$

Type R 50 C

$\pm .002\%$  at  $15^{\circ}$  to  $35^{\circ}\text{C}$



8 oz.

4 oz.

## PRECISION FORK UNIT

240 to 800 Cycles

Type 50

$\pm .02\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$

Type R 50

$\pm .002\%$  at  $15^{\circ}$  to  $35^{\circ}\text{C}$

## FREQUENCY STANDARD

200 to 4000 Cycles

Type 2003 C

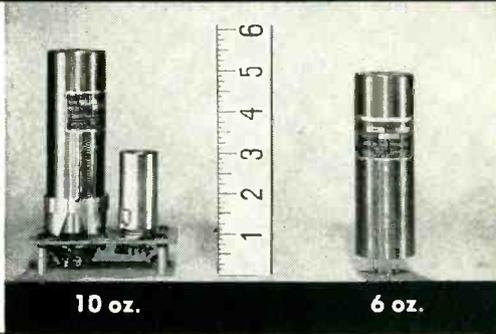
$\pm .02\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$

Type R 2003 C

$\pm .002\%$  at  $15^{\circ}$  to  $35^{\circ}\text{C}$

Type W 2003 C

$\pm .005\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$



10 oz.

6 oz.

## PRECISION FORK UNIT

200 to 4000 Cycles

Type 2003

$\pm .02\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$

Type R 2003

$\pm .002\%$  at  $15^{\circ}$  to  $35^{\circ}\text{C}$

Type W 2003

$\pm .005\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$

## FREQUENCY STANDARD

200 to 2000 Cycles

Sub-miniature Tube

Type 2007

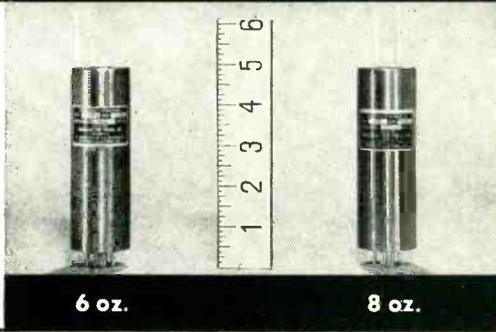
$\pm .02\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$

Type R 2007

$\pm .002\%$  at  $15^{\circ}$  to  $35^{\circ}\text{C}$

Type W 2007

$\pm .005\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$



6 oz.

8 oz.

## FREQUENCY STANDARD

240 to 1000 Cycles

Transistorized

Type 2007 T

$\pm .02\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$

Type R 2007 T

$\pm .002\%$  at  $15^{\circ}$  to  $35^{\circ}\text{C}$

Type W 2007 T

$\pm .005\%$  at  $-65^{\circ}$  to  $85^{\circ}\text{C}$

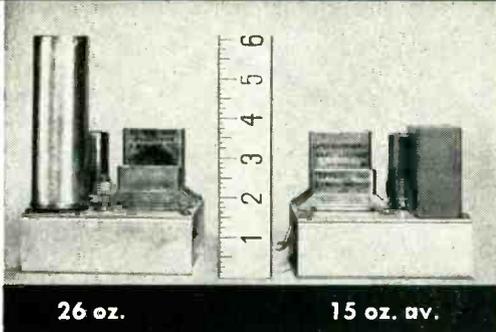
## FREQUENCY STANDARD

200 to 3000 Cycles

Type 2001-2

$\pm .001\%$  at  $20^{\circ}$  to  $30^{\circ}\text{C}$

WHEN REQUESTING  
INFORMATION  
PLEASE SPECIFY  
TYPE NUMBER



26 oz.

15 oz. av.

## ACCESSORY UNITS

for Type 2001-2

L—for low frequencies,  
multi-vibrator type, 40-200 cy.

D—for low frequencies,  
counter type, 40-200 cy.

H—for high freqs., up to 20 KC

M—Power Amplifier, 2W output

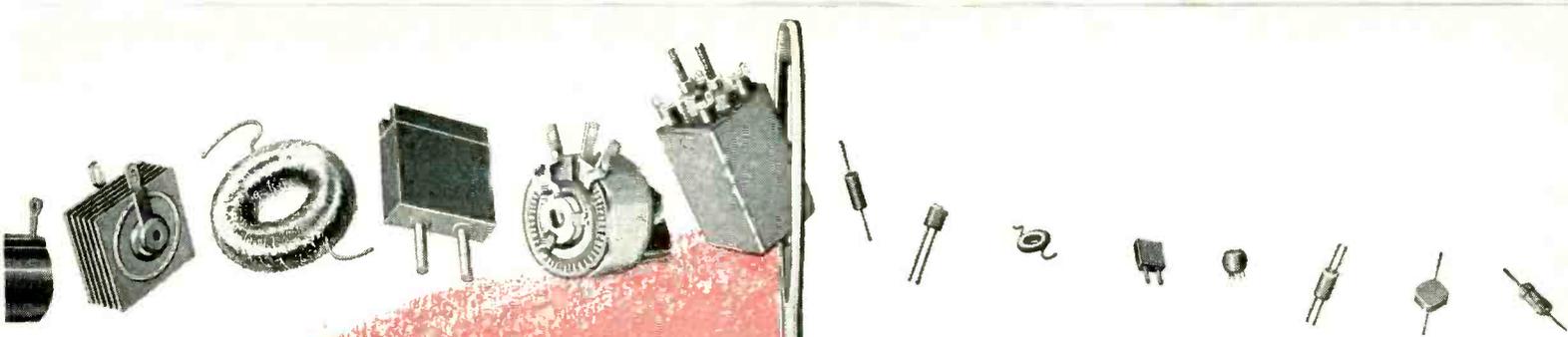
P—Power Supply.

# American Time Products, Inc.

580 Fifth Avenue

New York 36, N. Y.

OPERATING UNDER PATENTS OF WESTERN ELECTRIC COMPANY



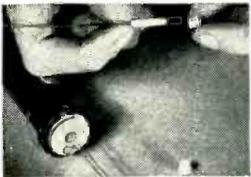
# MINIATURIZATION

*When there's only room for  
...there's a treasury of ideas in* **improvement**

## **KEL-F<sup>®</sup> PLASTIC**



Space saving insulation... machined from KEL-F Plastic rod.



Miniature Test Jacks for 500 volt RMS "HF" circuit... injection molded of KEL-F Plastic.



Contact Bar insulated with KEL-F Plastic... injection molded directly to beryllium-copper.

When you have to squeeze more and more into less and less space... when materials lack the specific properties you need for miniaturization, we suggest you look into the possibilities of KEL-F Plastic.

The development of KEL-F Plastic, a fluorocarbon polymer, was inspired by a vital problem of miniaturization in the field of electronics. What it accomplished then, it can repeat for your products.

KEL-F Polymer is a dense, tough thermoplastic with outstanding resistance to the effects of high and low temperatures. In wire insulation, tube sockets, connector blocks, printed circuit bases, transistor seals, and other applications its zero moisture absorption, non-wettability and dimensional stability can provide high level performance under severe conditions of temperature and humidity.

The compressive strength is high. Bearing loads

of 8,000 psi result in only 4% to 5% permanent set. KEL-F Plastic can actually be used for structural members. Electrical properties are outstanding. They include superior resistance to arcing, surface flash-over and thermal cycling.

KEL-F Plastic is readily moldable by extrusion, compression, injection and transfer methods. Molding techniques are fully perfected, and molded components can be depended on to exhibit all the inherent characteristics of the original molding material.

KEL-F Plastic is available as a molding compound, or it can be obtained in rods, tubing, sheets and film from a number of suppliers. It is also available in dispersions, suitable for bake-coating of metals and certain non-metals. The full story of KEL-F Polymer should be in your active file. Write us.

®Registered trademark for The M. W. Kellogg Company's Fluorocarbon polymers.

Miniature Rectifier and mount for parts... injection molded of KEL-F Plastic.

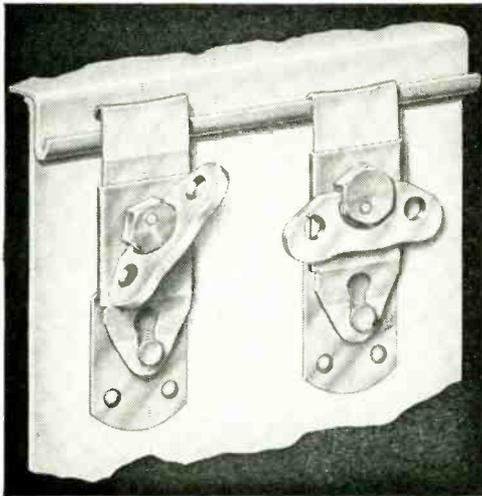


**THE M. W. KELLOGG COMPANY**  
Chemical Manufacturing Division, P. O. Box 469, Jersey City, N. J.  
SUBSIDIARY OF PULLMAN INCORPORATED

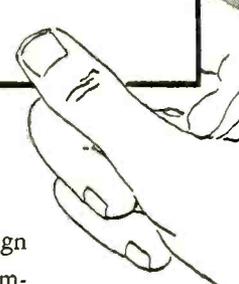
Want more information? Use post card on last page.

# Have you a similar fastening problem?

File: **Simmons LINK-LOCK**



When the armed forces needed a positive, high-strength fastening device for instrument housings, transit cases, and storage boxes, Simmons developed LINK-LOCK. This *brand-new* device doesn't use springs, yet works with fingertip pressure through a unique mechanical arrangement: the vertical sliding latch is moved in and out of locking position by a disc rotated with a wing nut. The fastener is immune to low temperatures, is easy to operate even with arctic mittens, furnishes up to 450-lb. pull-down pressure. Open or closed, it lies flat against the side of the case it fastens.



**LINK-LOCK may be the answer** to your fastening problem. If your design involves heavy fastening pressures, watertight sealing, high strength, resistance to impact, ask about LINK-LOCK. Simmons can furnish it with special engagement-latch details, or for operation by bolt or screwhead instead of wing nut. Write for LINK-LOCK DATA SHEET today. It gives complete details and dimensions. A Simmons engineer will be glad to work with you on your fastening problems.

SIMMONS FASTENER CORPORATION, 1750 No. Broadway, Albany 1, New York

## Simmons

QUICK-LOCK SPRING-LOCK ROTO-LOCK LINK-LOCK DUAL-LOCK

**JUST OUT: NEW 36-PAGE CATALOG WITH APPLICATIONS. SEND FOR IT!**

INTER-OFFICE MEMO

SUBJECT:

A "new look" in Trade Shows

Electronic Engineering Representatives ROAD SHOW

Now — the nation's newest electronic instrumentation and equipment will be brought to the doorstep of engineers in Greater New York City, New Jersey and Eastern Pennsylvania. The First Annual EER Road Show, sponsored by the leading representatives of instrumentation and equipment manufacturers, will observe the following schedule:

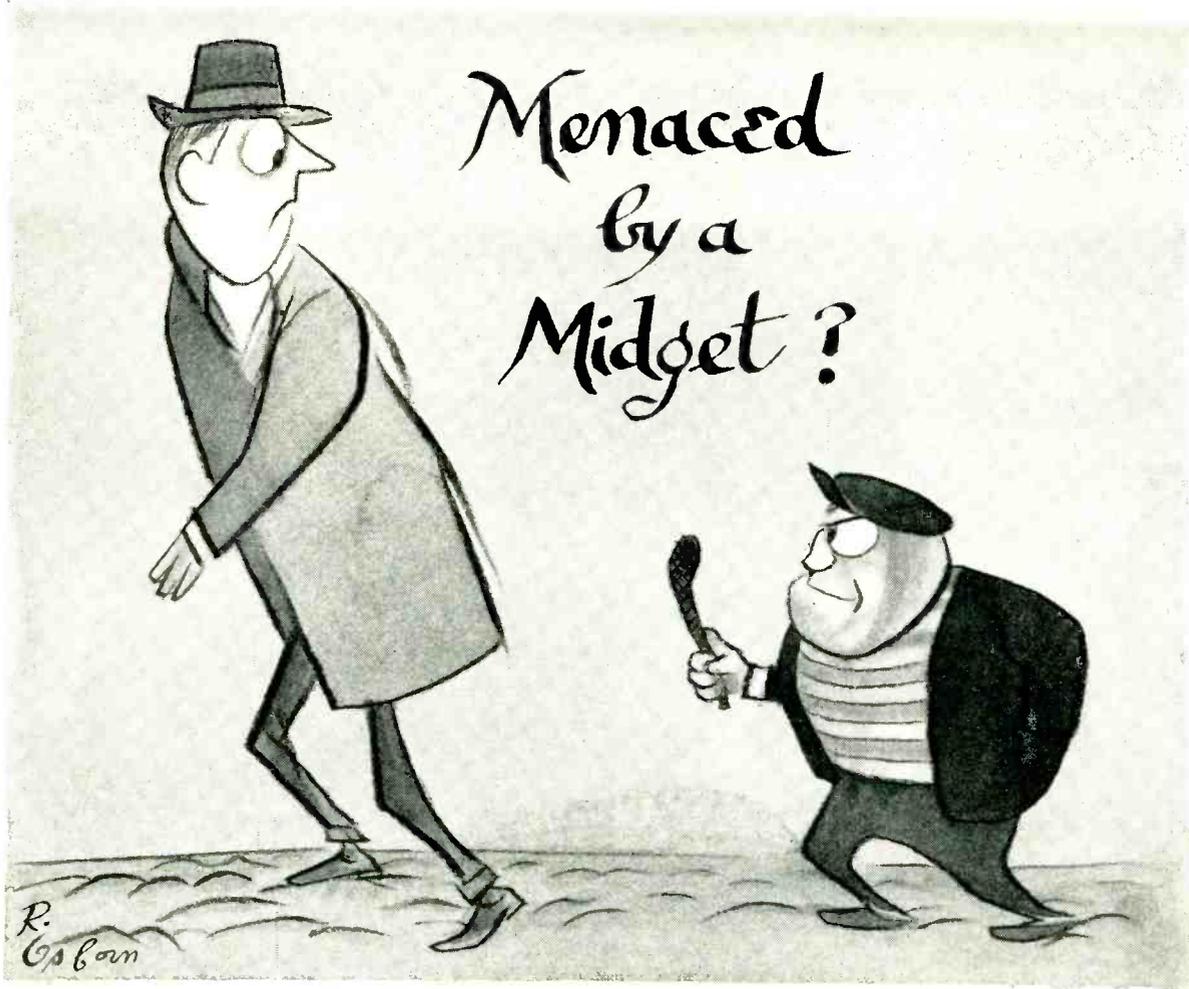
- Oct. 17—Westchester County Center White Plains, N. Y.
  - Oct. 19—Garden City Hotel Garden City, L. I., N. Y.
  - Oct. 21—West Orange Armory West Orange, N. J.
  - Oct. 25—Hotel Sylvania Philadelphia, Pa.
- Free parking space. Admission free. Hours: 12 noon to 10 p.m.

You are cordially invited to attend whichever of these sessions is most convenient for you. The Road Show is another example of EER members serving your electronic equipment needs the truly modern way!

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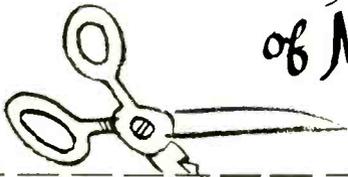




# Menaced by a Midget?

R.  
Caporn

Being hounded by a problem in miniaturization? Are you harassed by a toughie in the increasingly critical field of design diminution, weight and size reduction, power and component capsulation? If you are, simply stop in at the nearest scissors store. Get a pair of pinking shears and cut out this coupon. It will get you the complete catalog of MPB's \* such as these



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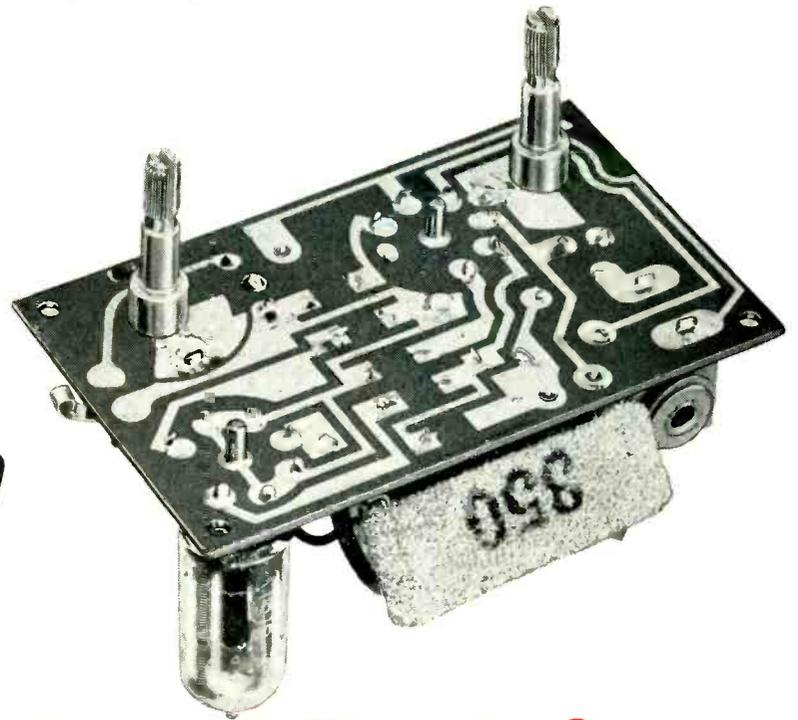
zone

state

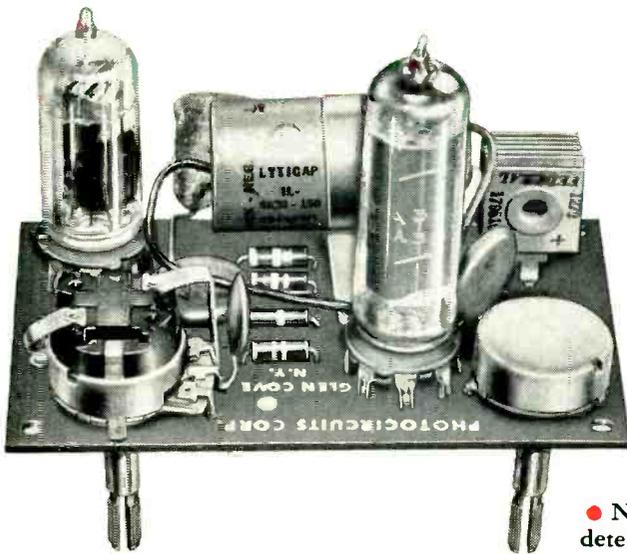


MINIATURE PRECISION BEARINGS, INC., KEENE, N. H.

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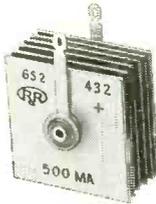
Founded by Paul Revere in 1801  
230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y.  
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Years of service in every kind of application have proved the long life and dependability of these rugged units. Available in various voltage and current combinations up to several hundred kilowatts, they are useful in a multitude of industrial and power circuits such as power supplies, magnetic amplifiers, electro-plating, battery charging, etc.



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Millions of these stacks are in service in radio and TV circuits as well as many small power applications. Thoroughly dependable under all types of grueling conditions, they are specified by an increasing number of engineers in the U. S. and throughout the world. Available for black and white as well as color TV in ratings up to 750 MA.



**EMBEDDED RECTIFIERS**

For top protection in military and other applications calling for the strictest requirements. Recommended for use where size and weight are important considerations such as in aircraft.



**HIGH TEMPERATURE TYPES**

High temperature rectifiers are now available in the larger cell sizes up to 5" x 6" to operate without derating at 125°C. Radio Receptor research has brought the cost down so that the field is now wide open for use in many applications once considered prohibitive because of size and price.



**HERMETICALLY SEALED UNITS**

Built to special requirements to meet unusually severe conditions. Designed to meet individual needs.

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Special designs will be submitted to meet individual requirements. However in many cases standard Radio Receptor stacks will give highly satisfactory performance in mag-amp applications, saving both time and money. Let us study your specs and make recommendations.

If you have a problem involving rectification, submit your requirements and our engineering department will be glad to aid you in the solution . . . without obligation, of course. See our catalog in Sweet's Product Design File and write for our latest bulletin No. E-11

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Reliable

# FOR YOUR AUTOMATION PROGRAM

## VARIABLE RESISTORS FOR PRINTED CIRCUITS

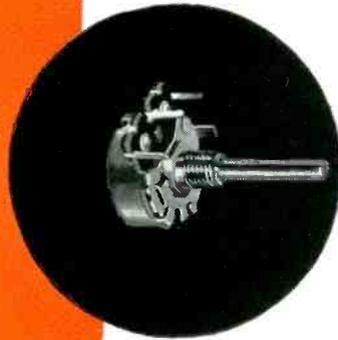
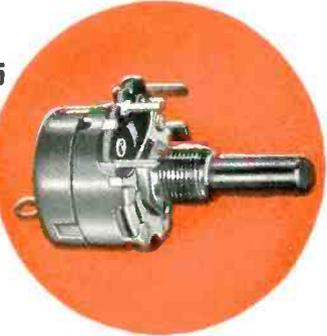


### Type UPM-45

For TV preset control applications. Control mounts directly on printed circuit panel with no shaft extension through panel. Recessed screwdriver slot in front of control and 3/8" knurled shaft extension out back of control for finger adjustment. Terminals extend perpendicularly 7/32" from control's mounting surface.

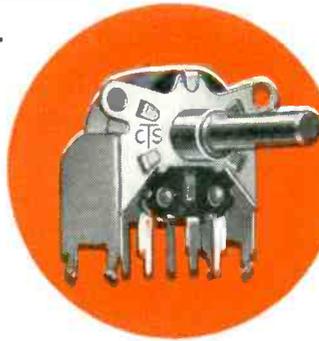
### Type GC-U45

Threaded bushing mounting. Terminals extend perpendicularly 7/32" from control's mounting surface. Available with or without associated switches.



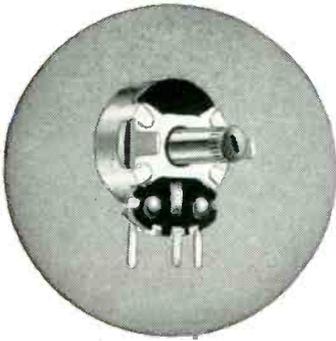
### Type U70 (Miniaturized)

Threaded bushing mounting. Terminals extend perpendicularly 5/32" from control's mounting surface.



### Type YGC-B45

Self-supporting snap-in bracket mounted control. Shaft center spaced 29/32" above printed circuit panel. Terminals extend 1-1/32" from control center.



### Type XP-45

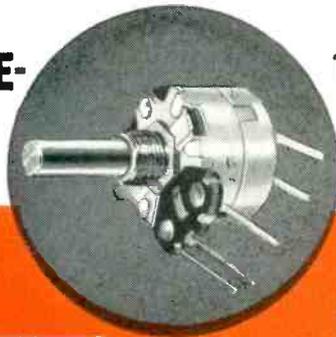
For TV preset control applications. Control mounts on chassis or supporting bracket by twisting two ears. Available in numerous shaft lengths and types.

### Type XGC-45

For applications using a mounting chassis to support printed circuit panel. Threaded bushing mounting.



## VARIABLE RESISTORS FOR SOLDERLESS "WIRE-WRAP" CONNECTIONS



### Type WGC-45

Designed for solderless wire-wrapped connections with the use of present wire-wrapping tools. Available with or without switch and in single or dual construction.

The controls illustrated are typical constructions. CTS' years of engineering and technical experience makes available many other types for your automation needs.



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# RELAYS...

## Engineered RELAYS for Engineered Products

"Your best source for relays" is Potter & Brumfield, because of an enviable reputation earned through a *quarter century* of relay specialization.

Millions of relays of *all styles* and *sizes* designed and manufactured to meet customer specification.

From small sub-miniature, precision, sensi-

tive relays to heavy duty power types, each fulfilling an exacting requirement.

Enclosed, hermetically sealed or open relay structures to meet demands of various environmental conditions.

*Priced competitively at all quality levels. Samples available for immediate shipment. Send your specification for recommendations and quotations.*

**ALL TYPES—ALL SIZES—FOR ALL APPLICATIONS**

*discriminating*  
~~most~~

# engineers choose Potter & Brumfield

## 100% HI-POT TEST

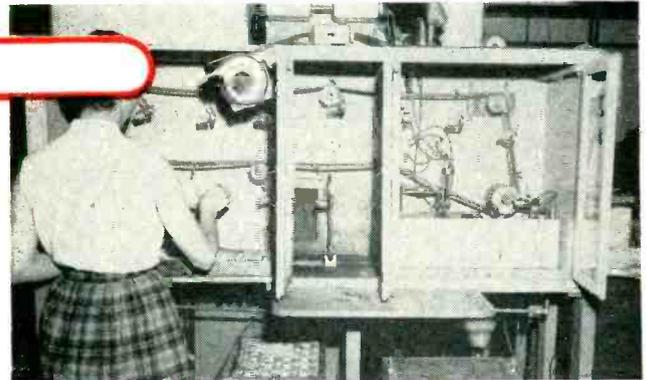
Some sealed relays have as many as ninety possible voltage breakdown points. This tester, developed by Potter & Brumfield, checks every breakdown point automatically with extra high voltage and for the necessary time interval.



## ULTRASONIC CLEANING

Another Potter & Brumfield development, the use of Ultrasonic cleaning in relay manufacture.

Potter & Brumfield sealed relays are tops because they are thoroughly cleaned of all dirt, solder flux and other contaminants by silent sound.



## MICROSCOPIC INSPECTION AND ASSEMBLY

The small watch size parts of many Potter & Brumfield relays are inspected and assembled under ten power magnification.

Thus assuring the close tolerances necessary for long life and dependable operation of miniature and sub-miniature relays.



*For quick delivery, over 350 different standard relays stocked by 500 Franchised Electronic Parts Distributors throughout the United States and Canada.*



**POTTER & BRUMFIELD MFG. CO., INC.**  
Princeton, Indiana

**ALL TYPES—ALL SIZES—FOR ALL APPLICATIONS**



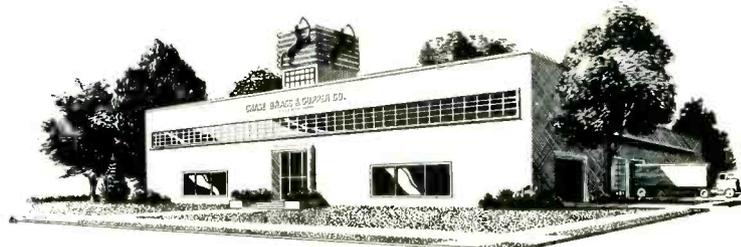
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*Illustrated above: Just three of the 25 efficient Chase warehouses dotting the nation.*

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# Here's the Relay for today's high speed devices

**Highly Sensitive  
No Contact Bounce  
Billions of Operations**

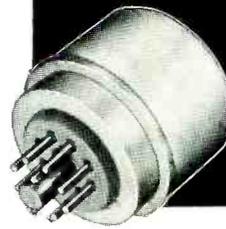
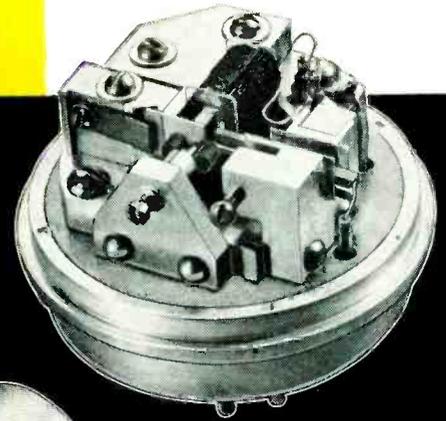
● Announcement of the CLARE Type T High Frequency Relay two years ago set off such a deluge of inquiries for samples and information that it is only just now that production facilities permit us to mention it again.

Originally designed for use in an analog computer, this relay is ideal for designs which call for a highly sensitive relay completely free from contact bounce and capable of billions of operations at extremely high speeds.

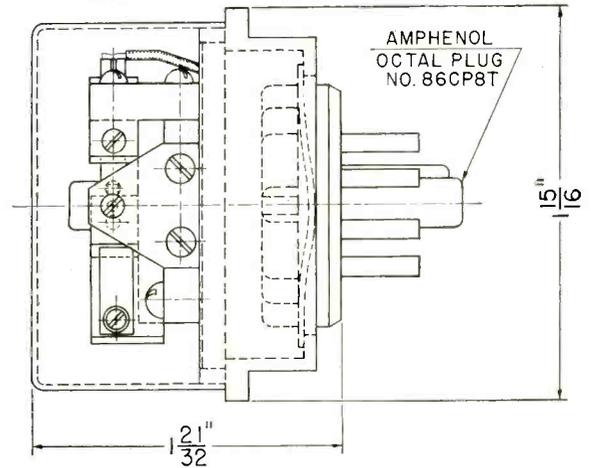
Pull-in time of this relay, for instance, is 120 microseconds. With dropout time of 100 microseconds, the relay follows up to 2500 cycles per second; aperiodic to 1000 cycles per second.

Manufacture of the CLARE Type T Relay, with its high speed, no bounce and other unusual characteristics, necessitated the development of entirely new techniques. It is built to extremely close tolerances, with a high degree of precision and fabricated under conditions of utmost cleanliness.

**THE CLARE TYPE T**  
High Frequency  
Impulse relay



● Shown above with dust-tight cover removed (left) ready for mounting.



## SPECIFICATIONS

### MECHANICAL

**Size:** 1-15/16 in. dia. x 2-3/16 in. overall.  
Weight: 5 oz.

**Mounting:** Equipped with plug, to fit standard 8-pin octal socket.

**Cover:** Removable dust-tight cover.

#### Contacts:

**Type:** Form A (s.p.s.t., normally open)

**Material:** Platinum-iridium

**Gap:** 0.0005 inch

**Pressure:** 30 grams, min. (Coil energized with 50 ampere-turns)

#### Coil:

**Type:** Single winding, bobbin-wound.

**Wire:** Heavy formex.

### ELECTRICAL

**Operate Ampere-Turns:** 8 to 20.

**Release Ampere-Turns:** 1 to 4 less than operate ampere-turns.

**Nominal Ampere-Turns for High-Speed Operation:** 16 to 40.

**Speed of Operation:** will follow 2500 cycles per second; aperiodic to 1000 cycles per second.

**Operate Time:** 100 to 180 microseconds.

**Release Time:** 60 to 120 microseconds.

**Contact Bounce:** None.

**Contact Current Rating:** 0.05 amp., max.

**Contact Voltage Rating:** 150 V., max.

**Dielectric Strength:** 500 V., rms.

**Coil Resistance:** up to 600 ohms.

**Life Expectancy:** 5 x 10<sup>9</sup> operations (determined by contact load).

### TYPICAL CHARACTERISTICS

**Coil Resistance:** 135 ohms.

**Coil Inductance:** .35 Hy.

**Operate Current:** 10 to 12 ma.

**Release Current:** 8 to 10 ma.

**Nominal Current:** 40 ma., steady state; 20 ma., average.

**Operate Time:** 130 microseconds.

**Release Time:** 100 microseconds.

**Energizing Circuit:** Coil in plate circuit of vacuum tube with 300 volt plate supply.

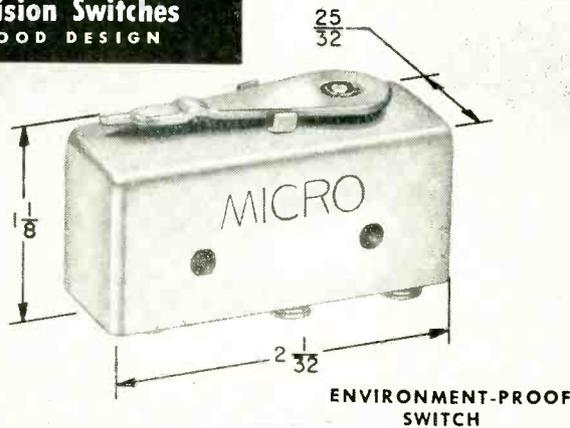
For full information on the CLARE Type T Relay —or for consultation on any relay problem—see your nearest CLARE Sales Engineer or write C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada, Canadian Line Materials Ltd., Toronto 13. Cable Address: CLARELAY.

Send for Clare Bulletin Number 117

FIRST IN THE INDUSTRIAL FIELD

# CLARE RELAYS

**MICRO SWITCH Precision Switches**  
A PRINCIPLE OF GOOD DESIGN



**New MICRO SWITCH products meet exacting electronic requirements**

Keeping pace with the ever-changing needs of the electronics industry has always been an important consideration of MICRO SWITCH engineering development.

New switches and new switch assemblies are always on the drawing boards and on test at MICRO SWITCH. Often designers find these switches fit, without change, the particular service at hand. At other times consultation with MICRO SWITCH engineering results in modification of an old design or development of one entirely new.

Whatever the task, MICRO SWITCH components either are or can be made available to give the utmost in reliable

service performance. Does your current problem involve any switches like these?

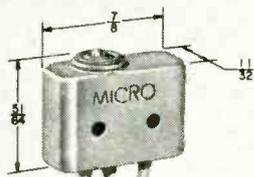
**A Multiple Circuit Rotary Switch**—Will handle up to 8 circuits at 20 amperes at 115 volts a-c.

**New Environment-Proof Switch**—Provided with split contact circuit arrangement.

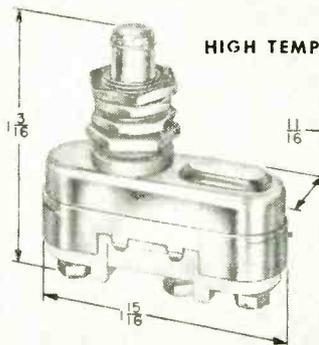
**Sealed Subminiature Switch**—Completely environment-proof, has high electrical capacity and long life.

**High Temperature Switch**—Designed to operate perfectly in temperatures up to 1000° F.

MICRO SWITCH field engineers are conveniently located at 20 branch offices. Consultation with them involves no cost. It can save you much time and money.



**SEALED SUBMINIATURE SWITCH**



**HIGH TEMPERATURE SWITCH**



A complete line of snap-action and mercury switches

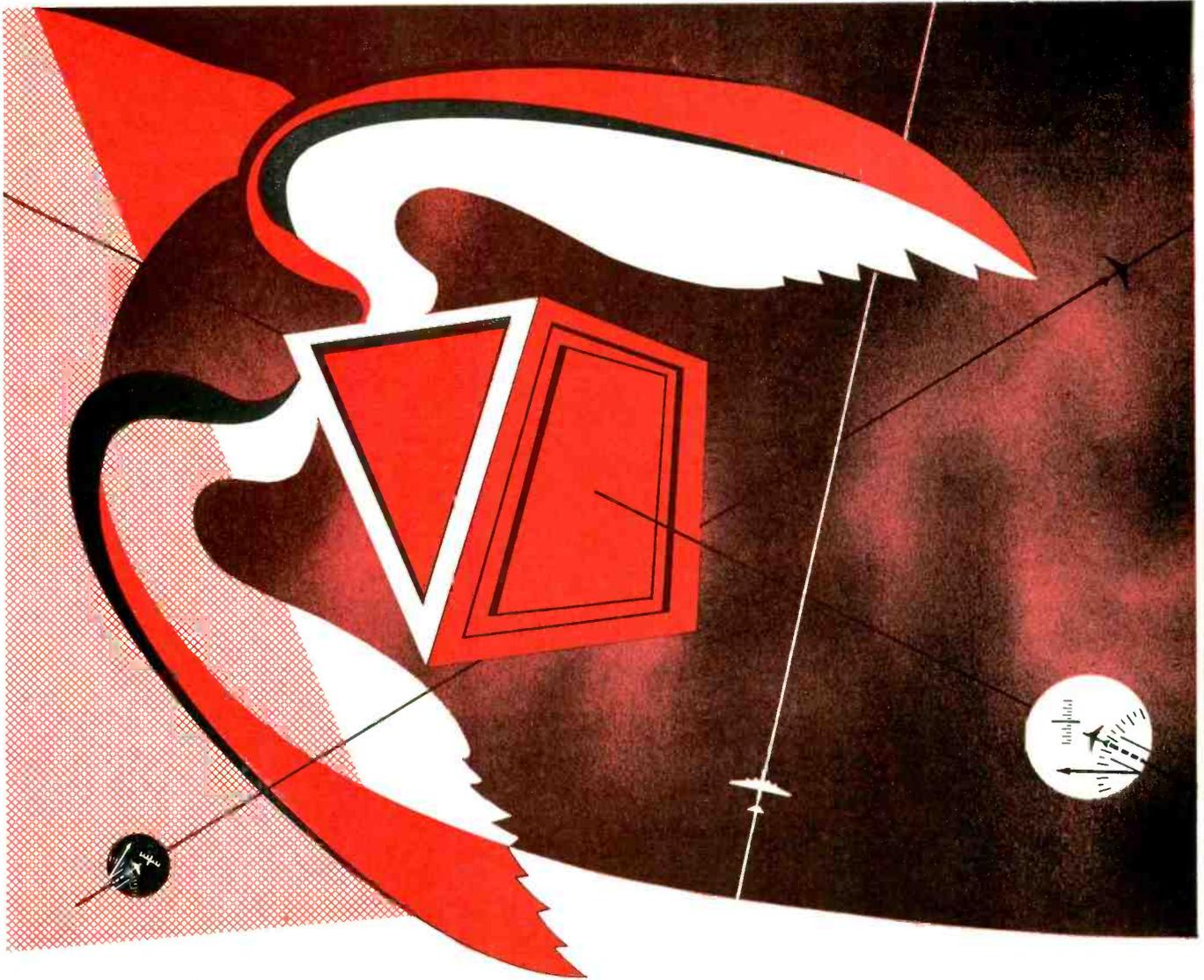
MICRO SWITCH provides a complete line of extremely reliable, small-size, high-capacity, snap-action precision switches and mercury switches. Available in a wide variety of sizes, shapes, weights, actuators and electrical characteristics. For all types of electrical controls.

**MICRO SWITCH**

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The ancient priests of Egypt were engineers whose great pyramid of Cheops was sextant, compass and slide rule—all in one. From sighting the Pole Star, to squaring the compass, to the mathematics of pi—it's all there in the pyramid of Gizeh.

## flying pyramids

Wonder of the world for ages, Gizeh's pyramid was a fount of mathematical data—a tool to check measures, an aid to celestial navigation. Today's aircraft are "flying pyramids"—collecting and integrating instantaneous measurements for orientation and control. Kollsman activities cover these seven fields:

- AIRCRAFT INSTRUMENTS**
- PRECISION CONTROLS**
- PRECISION COMPUTERS AND COMPONENTS**
- OPTICAL COMPONENTS AND SYSTEMS**
- RADIO COMMUNICATIONS AND NAVIGATION EQUIPMENT**
- MOTORS AND SYNCHROS**
- INSTRUMENTS FOR SIMULATED FLIGHT TRAINERS**

Our manufacturing and research facilities . . . our skills and talents, are available to those seeking solutions to instrumentation and control problems.



**kollsman** INSTRUMENT CORPORATION

80-10A 45th AVE., ELMHURST, N. Y. • GLENDALE, CALIF. • SUBSIDIARY OF *Standard* COIL PRODUCTS CO. INC.



# Turn to BUSS for all your fuse needs

## COMPLETE LINE

It is easy to select a BUSS fuse to do the job right. The BUSS fuse line includes: dual-element (slow blowing), renewable and one-time types — in sizes from 1/500 ampere up . . . plus a companion line of fuse clips, blocks and holders.

## BUSS FUSES ARE MADE TO PROTECT — NOT TO BLOW NEEDLESSLY

To assure unfailing dependability — every BUSS fuse normally used by the Electronic Industries is tested in a sensitive electronic device. Any fuse not correctly calibrated, properly constructed and right in all physical dimensions is automatically rejected.

With the cost of a fuse being so insignificant compared to the value of the equipment it protects and the value of your good name — it is just good business to refuse to take a chance on anything less than BUSS quality in fuses.

## IF YOUR PROTECTION PROBLEM IS "DIFFERENT"!

You can save engineering time by letting the BUSS fuse engineers help you select the fuse best suited to your particular conditions. If possible, the fuse selected will be available in local wholesalers' stocks, so that your device can be easily serviced.

Be sure to get the latest information on BUSS and FUSETRON small dimension fuses and fuseholders . . . Write for bulletin SFB.

Makers of a complete line of fuses for home, farm, commercial, electronic, automotive and industrial use.

BUSSMANN MFG. CO. (Division of McGraw Electric Co.)  
UNIVERSITY AT JEFFERSON ST. LOUIS 7, MO.



ELRC 1085

**A TIME-RATE INDICATOR YOU CAN REALLY COUNT ON!**

# *the* **LFE** *501*



## facts

You Ought to Know  
about The LFE 501

**THE 501:** Features built-in temperature compensated crystal controlled timing pulse generator with scaler determined time base.

Measures frequency in megacycles up to 10 mc with accuracy up to 1 part in 10 million — and totalizes measurement.

Measures periodic functions from 10  $\mu$ sec to 28,000 hours (pulse).

Measures time interval in the range from 0.1  $\mu$ sec to 28,000 hours.

Measures frequency ratio between two input frequencies.

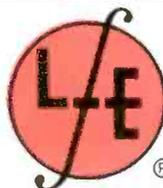
Counts up to 10 million pulses per second with a relative accuracy up to  $\pm$  count.

Includes built-in wide band, high gain amplifier covering a bandwidth of 10 cps to 10 mc and with a sensitivity of 20 mv.

*accurate*  
*reliable*  
*lightning fast*

What's *your* problem? Frequency measurements? Data recording? Process control?

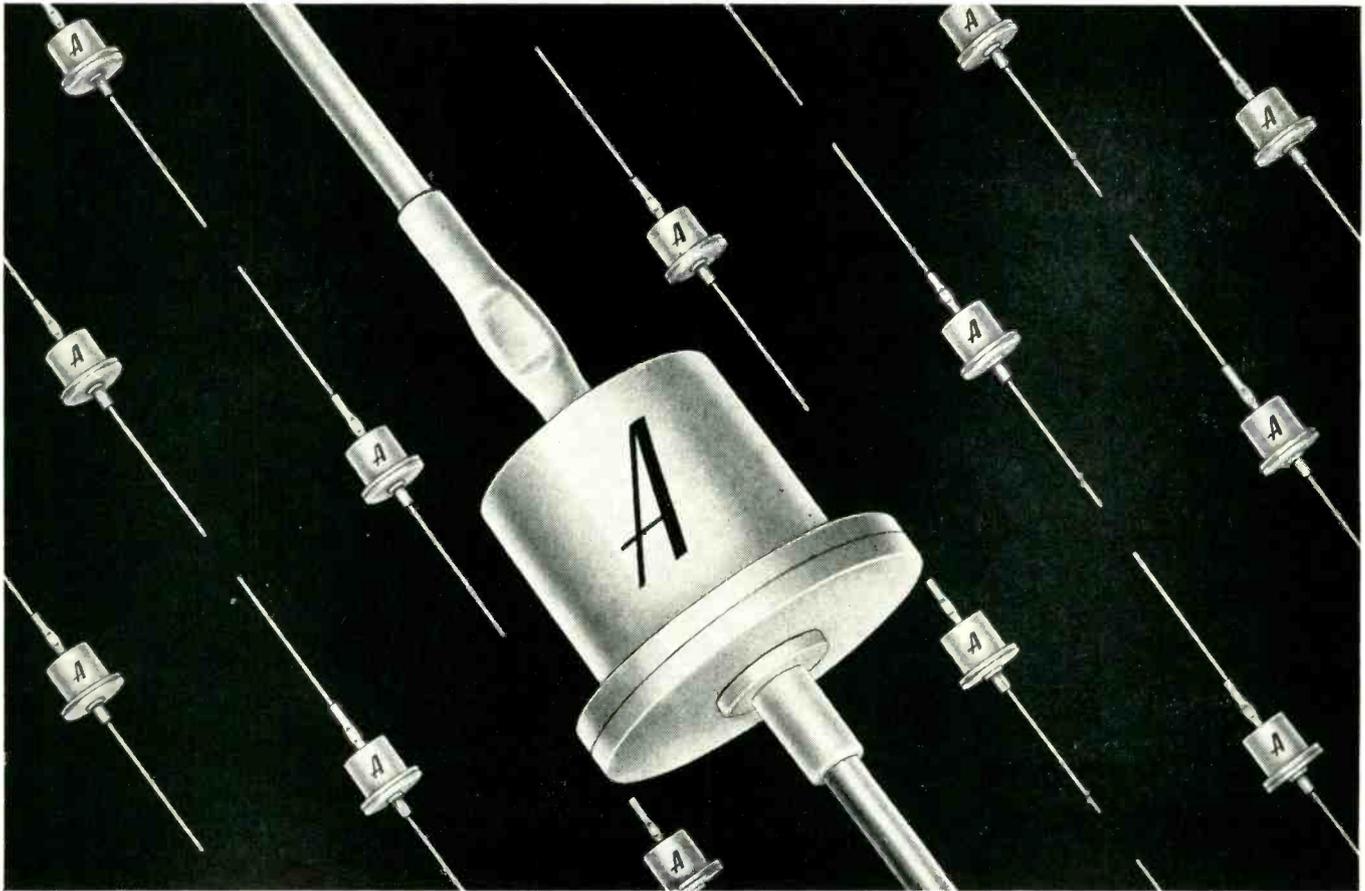
Whether you're counting marbles or megohms — instrumentation or automation — LFE's 501 Time-Rate Indicator can do more for less money than any similar device on the market. This high speed electronic counter is much more reliable, because it uses a scaler-determined time base — a device of extraordinary accuracy found in no other indicator.



**LABORATORY FOR  
ELECTRONICS, INC.**

75 PITTS ST., BOSTON 14, MASS.

Representatives in principal cities in U. S. and Canada.  
Inquiries on export sales should be addressed to:  
Andrew S. Szucs, Inc., 50 Broad Street, New York 4, N. Y.



# ***AUTOMATIC...a dependable source for SILICON POWER RECTIFIERS***

**Medium Power Series of 6 Types.  
Ratings up to 600 P.I.V. and 300 Ma.**

**Featuring:**

- Infinitesimally small reverse leakage current (Reverse resistance of 1000 megohms)
- Ambient temperature range: — 55°C to 150°C
- No de-rating up to 100°C
- Extremely low forward resistance (1 ohm)
- Highest rectification ratios (10<sup>9</sup>)
- Convenient coaxial pigtail leads
- All-welded hermetic seal for long life

Automatic Silicon Power Rectifiers are ideally suited for use in all types of miniaturized equipment. Complete technical data covering the six types (1N440 to 1N445) already available is contained in a 4 page illustrated catalog available on request. Your inquiry will receive prompt attention.

ABSOLUTE MAXIMUM RATINGS (For 55°C Ambient)	1N440	1N441	1N442	1N443	1N444	1N445
Peak Inverse Voltage (volts) <sup>1</sup>	100	200	300	400	500	600
D.C. Output Current (ma.) <sup>2</sup>	300	300	300	300	300	300
Peak Forward Current (amps.)	1.5	1.5	1.5	1.5	1.5	1.5
Full Load Voltage Drop (volts)	1.5	1.5	1.5	1.5	1.5	1.5
Reverse Current at Rated P.I.V. (microamps.)	0.30	0.75	1.00	1.50	1.75	2.00

1. Continuous reverse voltage equal to the P.I.V. may be applied.

2. For ambient temperatures greater than 100°C, de-rate the D.C. output current by 60 ma. for each 10°C above 100°C.

**NOTE:** Silicon power rectifier types with higher peak inverse voltages than those shown above are available to meet specific requirements.



*Every part Automatic uses  
... Automatic makes.*

**MASS PRODUCERS OF  
ELECTRONIC COMPONENTS**

65 GOUVERNEUR ST.,  
NEWARK 4, N. J.

\*T.M. Reg. U.S. Pat. Off.

# BENDIX - PACIFIC DISCRIMINATORS

FOR FM / FM TELEMETERING RECEIVING STATIONS



## CHARACTERISTICS

**Center Frequency**  
250 cycles to 110 kc

**Deviation**  
 $\pm 5\%$  to  $\pm 40\%$  of center frequency

**Frequency Response**  
DC to 40% of bandwidth

**Input Signal**  
0.01 volt rms minimum per subcarrier and 15 volts rms maximum for composite of all subcarriers

**Amplitude Modulation**  
Less than 1% of bandwidth change for 10 db input steps

**Output**  
3 single ended outputs providing 20 ma of output current

**Stability**  
 $\pm 0.4\%$  after one hour warming

**Sensitivity Stability**  
 $\pm 0.25\%$

**Linearity**  
 $\pm 0.1\%$  from best straight line

**Power Source**  
105 to 125 volts, 60 cycles, 200 watts nominal

The new Bendix-Pacific TDA-9 Subcarrier Discriminator provides the accuracy and stability necessary to permit expansion of Frequency Modulation telemetering systems into high precision and automatic data handling facilities.

Normal, extended or reduced intelligence frequency response is selected by a switch. Signals from proper impedances are of sufficient level to directly accommodate many of the commonly employed data recording and handling equipment without additional amplifiers. Freedom from drift and gain instability is maintained by a chopper-stabilized DC amplifier.

The design of the band pass filters used in the TDA-9 discriminator includes a flat response over the pass band, a linear phase shift characteristic to provide constant time delay of the intelligence signal, and selectivity to provide adequate channel rejection, preventing systems intermodulation.

Provisions for fine balance adjustment of center frequency from a remote location as well as wow and flutter compensation during tape recorder playback have been provided.

Standard discriminators are available for operation on all RDB bands. The unit is also operable over an extended frequency range with center frequencies of 250 cps to 110 kc without deteriorating the performance characteristics. Operation using wide deviations up to  $\pm 40\%$  of the channel center frequency can be provided.



EAST COAST OFFICE: 475 5th AVE., N.Y. 17 • DAYTON, OHIO—1207 AMERICAN BLDG., DAYTON 2, OHIO • WASHINGTON, D.C.—SUITE 803, 1701 "K" ST., N.W.  
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AEROCOM'S 1046 H. F. TRANSMITTER



# POWER + STABILITY

1000 WATTS

WITH

.003% STABILITY

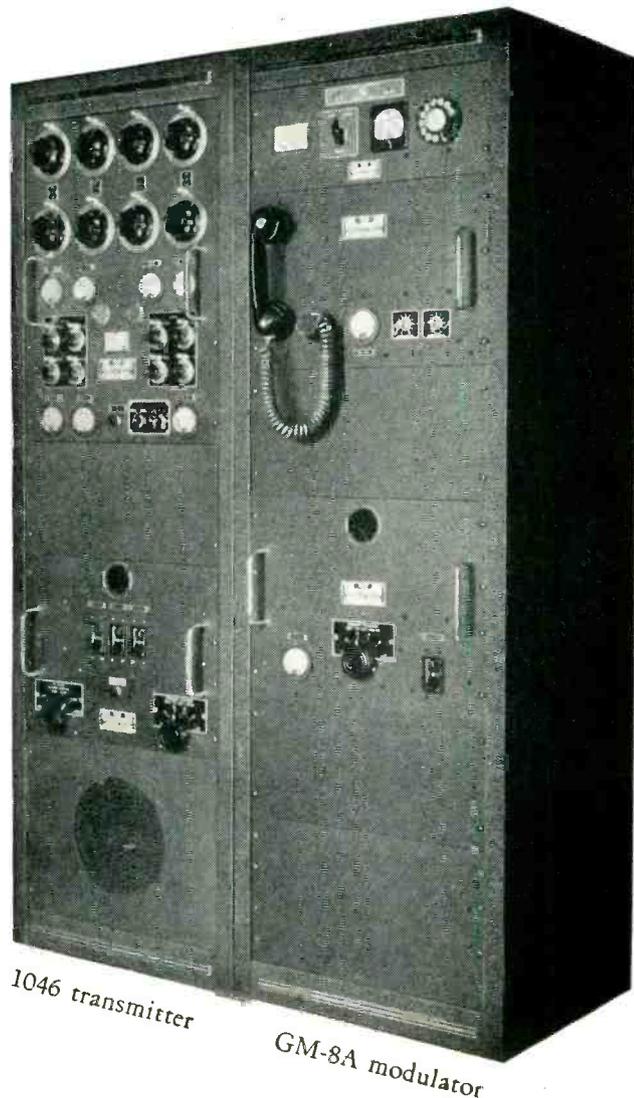
Rugged, versatile general purpose H. F. transmitter—Aerocom's 1046 packs 1000 watts of power and high .003% stability under normal operating conditions ( $0^{\circ}$  to  $+50^{\circ}$  C.). Excellent for point-to-point or ground-to-air communications.

Multi-channel operation on telegraph A1, or telephone A3 with GM-8A modulator... new Aerocom 1046 can be *remotely controlled* with TMC-R at control position and uses only one pair of telephone lines. In A3 operation, the local dial control panel is located in modulator cabinet.

Transmitter cabinet has  $8\frac{3}{4}$  inch panel space available for either local dial control panel or frequency shift keyer.

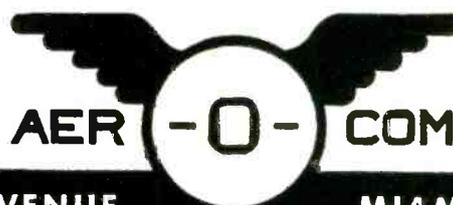
Model 1046 operates on 4 crystal-controlled frequencies (plus 2 closely spaced frequencies) in the band 2.0—24 Mcs. Operates on one frequency at a time; channeling time 2 seconds. Operates into either balanced or unbalanced loads. Operates in ambient  $-35^{\circ}$  to  $+50^{\circ}$  C. Power supply: nominal 220 volts, 50-60 cycles, single phase.

*Complete technical data on request*



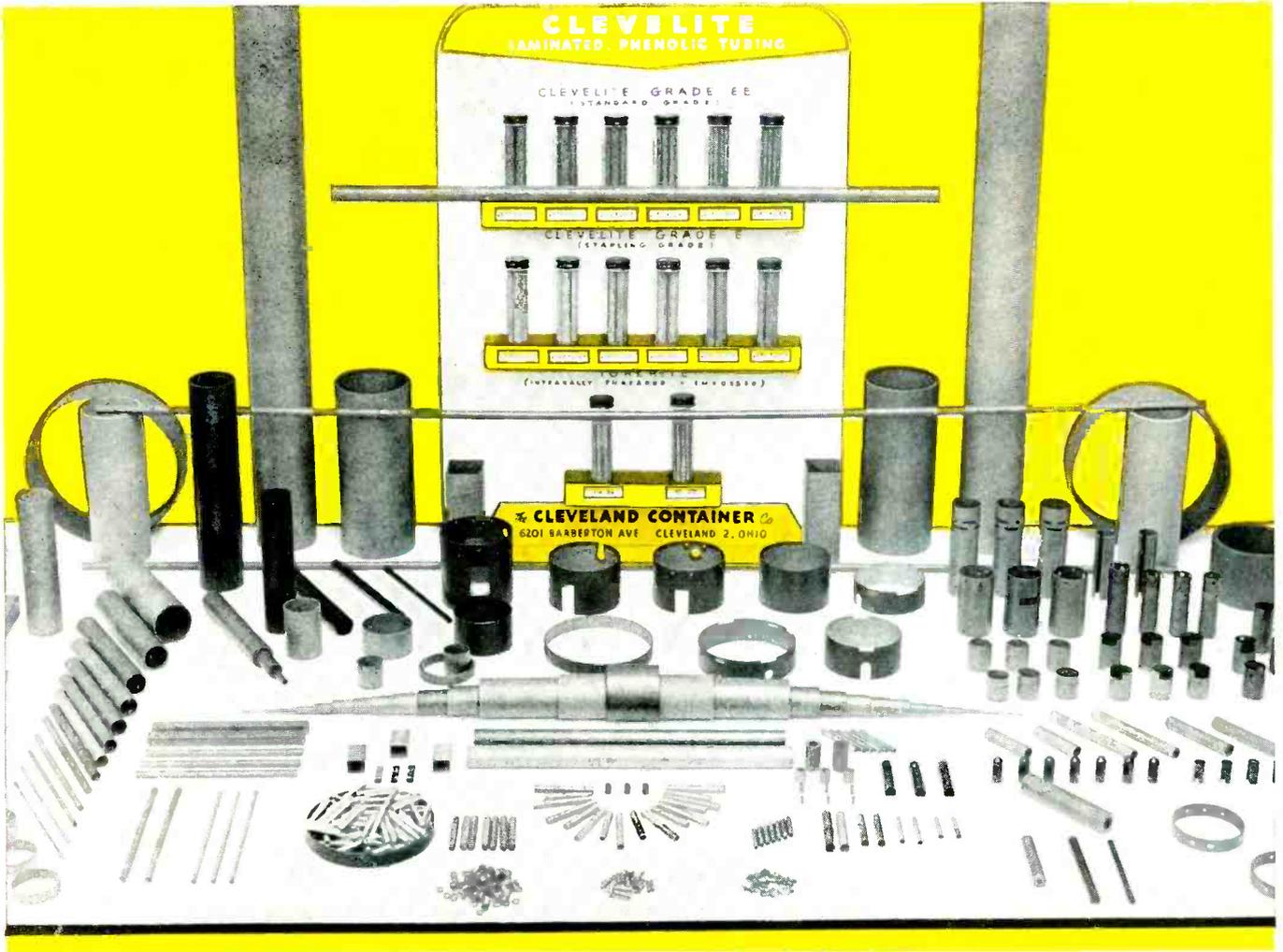
1046 transmitter

GM-8A modulator



3090 S.W. 37th AVENUE

MIAMI 33, FLORIDA



## TORKRITE

... newly improved  
... and at lower prices.

This fine internally threaded and embossed tubing is now made to fit 8/32, 10/32, 1/4-28, 5/16-24, and 5/16-28 cores.



INVESTIGATE  
this outstanding  
coil form!



\*Reg. U. S. Pat. Off.

## CLEVELITE\* FOR EVERY USE

It possesses excellent electrical insulation properties, has good machinability, and is highly resistant to moisture.

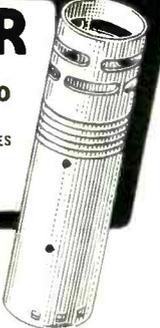
Clevelite is structurally strong, very light and may be easily punched, machined or sawed . . . certain tough grades may be cold punched satisfactorily.

Clevelite chemical properties are also exceptional . . . unaffected by solvents and oils . . . resistant to normal strength basic acidic, and salt solutions.

Write for folder detailing the seven grades in which CLEVELITE is produced.

Why pay more? For Good Quality . . . call CLEVELAND!

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# Exciting New Development

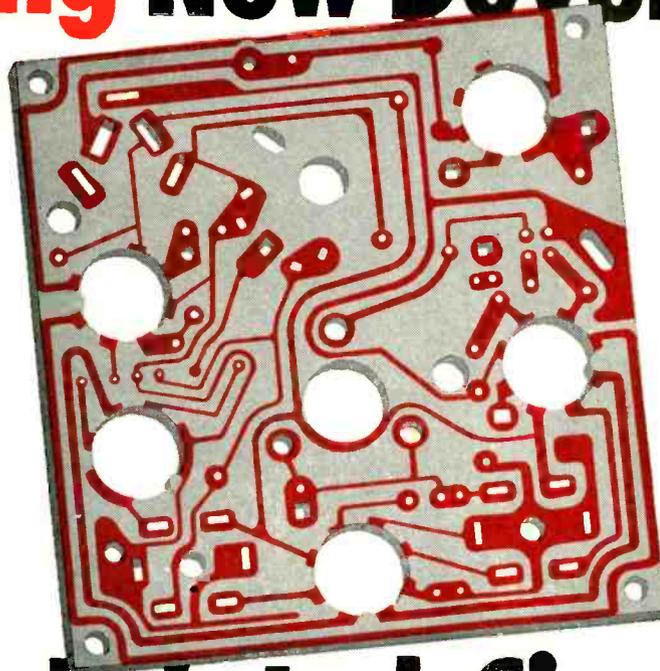


Photo courtesy  
Methode Manufacturing Corp.  
Chicago, Ill.

## in Printed Circuits!

New CuCLAD\* copper-clad laminate offers unequalled bond strength, heat resistance, solderability, punchability, electrical performance!

Here's the foil-clad laminate you've been waiting for! It's CuCLAD LAMICOID®—made possible by an entirely new concept in bonding material, specially designed equipment developed exclusively by Mica Insulator Company. This new bond and unique bonding method give you unequalled performance that's consistent and dependable from sheet to sheet, lot to lot.

\*Trade-mark

You get all these advantages:

- A STRONGER BOND WHICH IMPROVES WITH AGE AND HEAT
- BETTER HEAT RESISTANCE
- BETTER REACTION TO HOT SOLDER
- BOND ELECTRICALLY EQUAL TO LAMINATE
- IMPROVED ARC RESISTANCE
- SUPERIOR PUNCHABILITY
- UNIFORMITY

and CuCLAD LAMICOID is competitively priced!

CuCLAD LAMICOID is available NOW, in several grades. Tell us your requirements or problems—or ask to have a Mico Sales Engineer call.

#### LOOK AT THESE TYPICAL PRODUCTION RUN VALUES ON 6028 XXXP CuCLAD LAMICOID:

BOND STRENGTH—Guaranteed min: 6 lb.; avg. 9 lbs. (90° peel at 2 lbs./min.)	
SOLDER TEST—Guaranteed no blisters @ 230-240° C. for 10 seconds, 1" square floated on molten solder	
HEAT RESISTANCE—Guaranteed no change at 150° C. for 1/2 hour in air-circulated oven, air flow parallel to specimen	
PUNCHABILITY—Excellent	
SURFACE RESISTIVITY, megohms	
C-96/35/90	7.3 x 10 <sup>4</sup>
VOLUME RESISTIVITY, megohm cm.	
C-96/35/90	3.7 x 10 <sup>10</sup>
WATER ABSORPTION	
1/16" th., E-1/105 + D-24/23	
copper on	0.1%
1/16" th., E-1/105 + D-24/23	
copper removed	0.7%



**MICA** *Insulator* **COMPANY**

Schenectady 1, New York

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# PYRAMID SOLID DIELECTRIC GLASSEAL<sup>®</sup> CAPACITORS FOR 6 POINT PREFERENCE

Burton Browne / New York



1. Hermetically sealed in metallic cases.
2. Power factor less than 1%.
3. Subminiature in size.
4. Available in both inserted tab and extended foil constructions.

For complete engineering information contact your local Pyramid representative or write to —



CAPACITOR DIVISION

**PYRAMID** ELECTRIC COMPANY

1445 Hudson Blvd. • North Bergen, N. J.

1

Especially sturdy capacitors capable of withstanding vibrational stresses of high acceleration and frequency, and severe shock conditions encountered in guided missiles and airborne equipment.

2

Utilize new, rugged compression-seal type, glass-to-metal solder-seal terminals. Terminals will not work loose or rotate under any operating conditions.

3

Functional operating range from  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

4

Operates normally under severe humidity conditions.

5

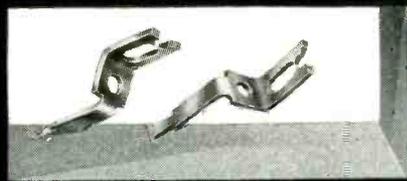
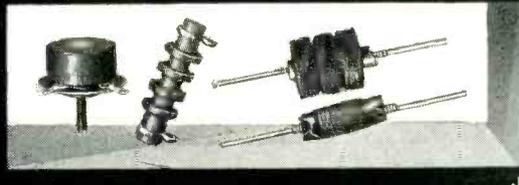
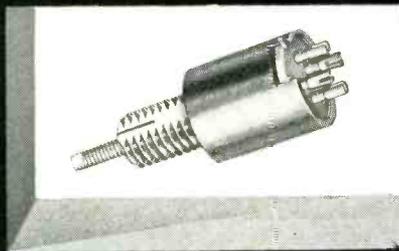
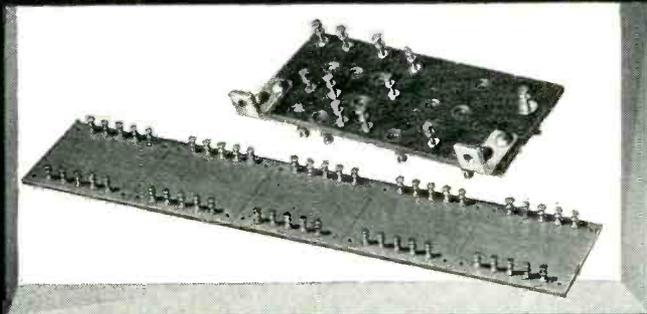
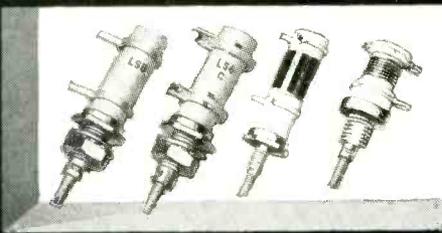
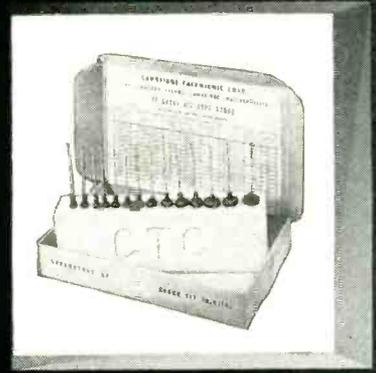
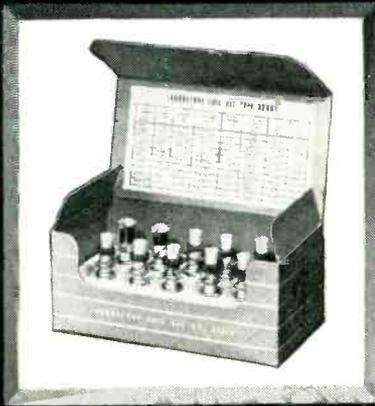
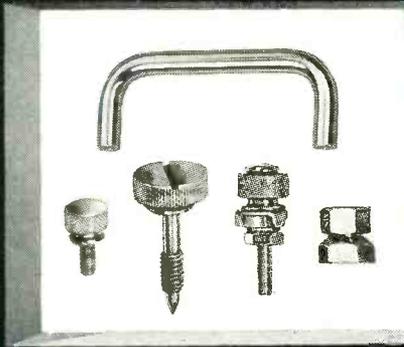
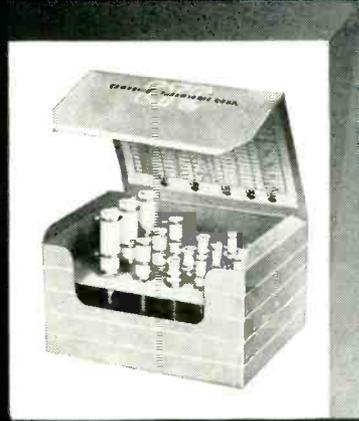
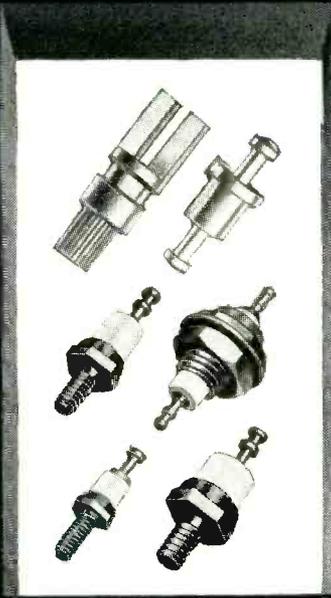
Production tests for voltage breakdown, capacitance, power factor, insulation resistance and seal are performed on a 100% basis.

6

Capacitance range: .001 mfd. to 1.0 mfd.; voltage range: 100 to 600 V.D.C. operating; can be provided to standard tolerance of  $\pm 20\%$  or to closer tolerance, if desired.

+ FACTORS





# One big family with a single thought

Whether you need terminals, clips, coils, chokes, capacitors — or any of a number of electronic components — you can be sure they're right if they're made by CTC.

One continuing basic idea governs the manufacture of every CTC product. And that idea is: *quality control*. We could not guarantee our products as we do without a constant check of numerous details that determine reliable performance. Our quality control engineers see to it that these manufacturing standards are consistently maintained — from close scrutiny of raw materials right through to inspection of finished product.

Pictured here are a number of components available at CTC including our

three kits. These components come in standard form and are also custom engineered to meet your particular requirements. We would be glad to give you complete details, including specifications and prices, on any or all CTC units — as well as information on how CTC components can be specially designed to solve your electronic components problems.

You will find it well worthwhile to use components that are *guaranteed*. Write to Cambridge Thermionic Corporation, 437 Concord Avenue, Cambridge 38, Mass. West Coast Manufacturers contact: E. V. Roberts, 5068 West Washington Blvd., Los Angeles 16 and 988 Market Street, San Francisco, California.

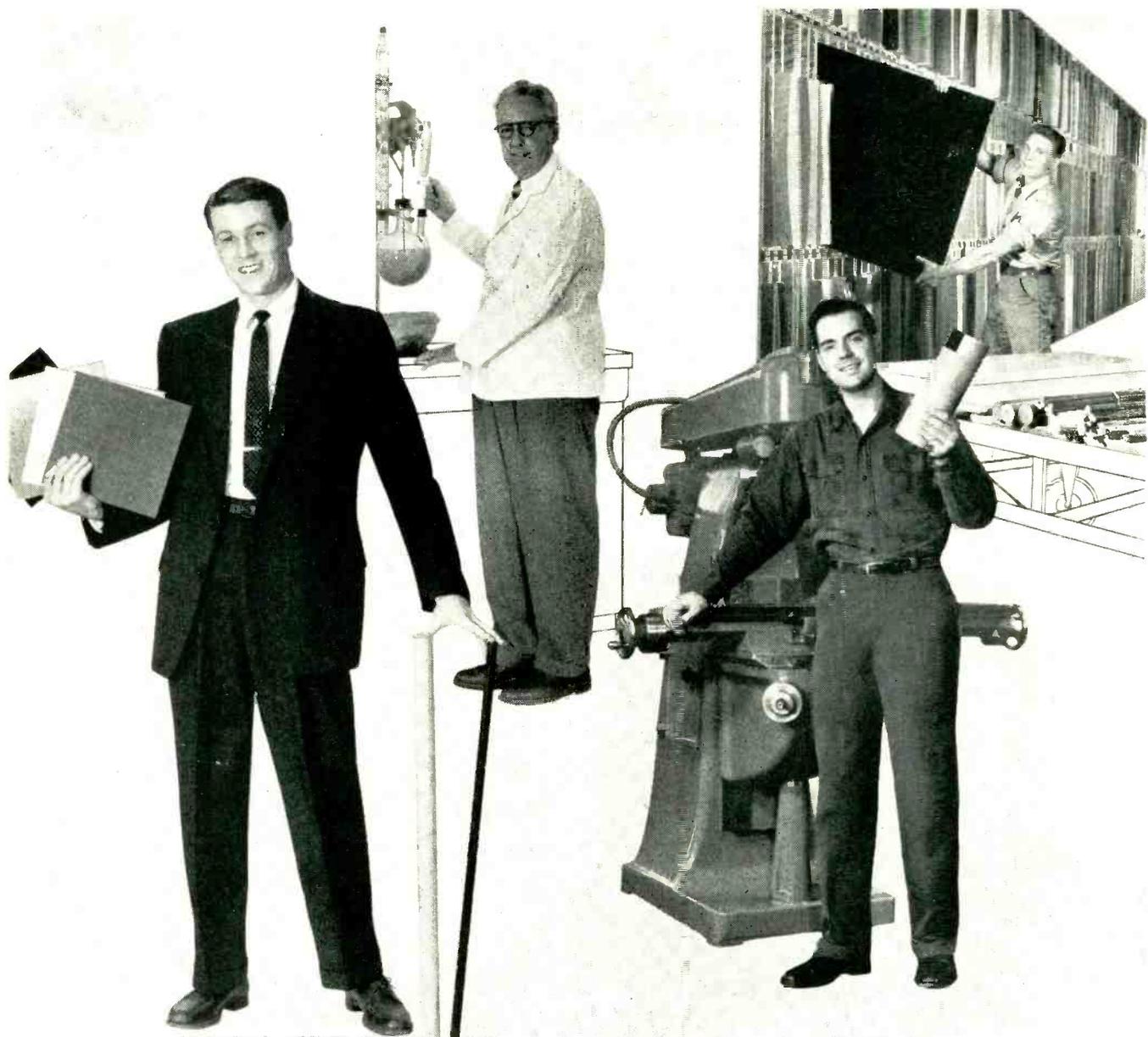
# CTC

**CAMBRIDGE THERMIONIC CORPORATION**

*makers of guaranteed electronic components,  
custom or standard*



◀ *CTC Components shown include: A. capacitor; B. standard and insulated terminals; C. coil form kit; D. panel hardware; E. coil kit; F. RF choke kit; G. coil forms and coils; H. standard and custom terminal boards; I. shielded coil form; J. RF chokes; K. diode clips.*



## New Formica 4-point laminated plastics service --- valuable aid for the electronics engineer

**Formica has just announced a new laminated plastics service of real value to you in your search for new materials to improve the performance and reduce the cost of electronic components.**

This new service makes it easy for you to evaluate and apply Formica laminated plastics. Here's how it works:

**1. Application engineering** analyzes your application and recommends one of Formica's 53 standard grades . . . if it meets your requirements. This saves your time.

**2. Research** can produce a new

grade with properties engineered to your exact specifications, thus saving time and lowering development cost.

**3. Fabricating, molding and post-forming** bring Formica material to you in any shape or size—quickly, accurately and in volume.

**4. Customer Stock Service:** For the first time large stocks of standard sheets and rods are now ready

for rapid delivery . . . to serve your fast moving production schedule.

For further information on how this unique new service can implement your product research and development, call your Formica district office, or . . .



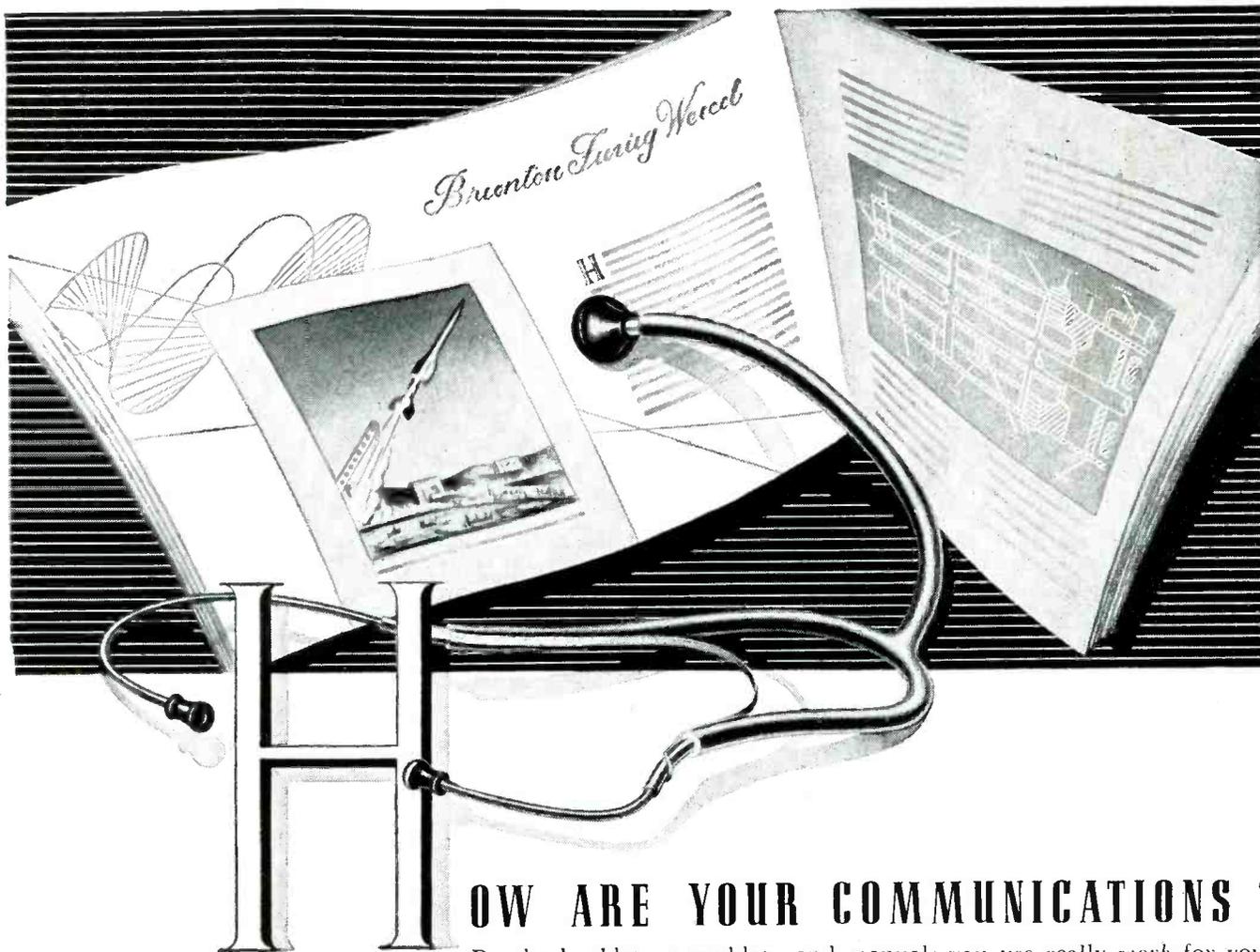
Send for your free copy of the new "Formica 4" folder (form 58-1)



**THE FORMICA CO., 4640 SPRING GROVE AVE., CINCINNATI 32, OHIO**

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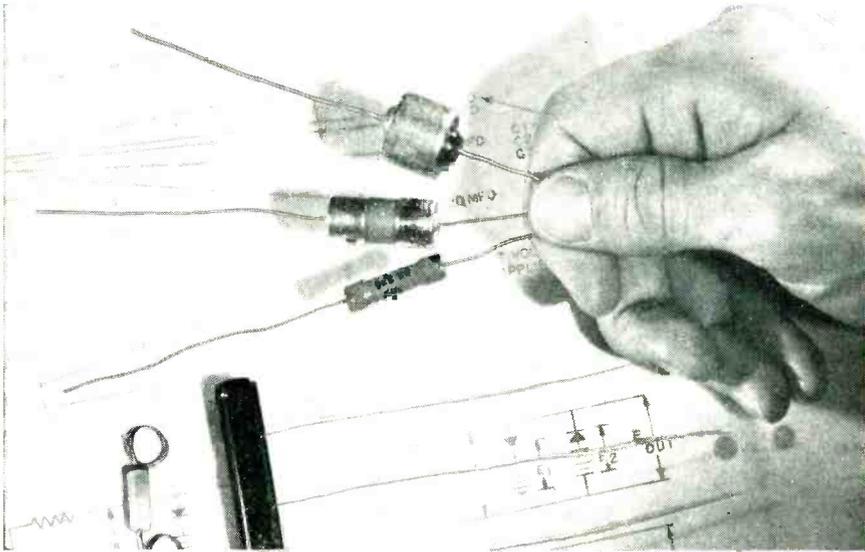
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# DESIGNER'S

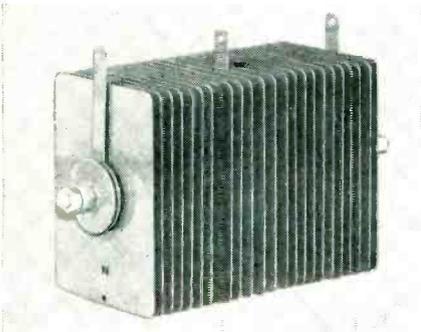
## New G-E *Vacu-Sel*\* component rectifiers top 80,000-hour-life expectancy



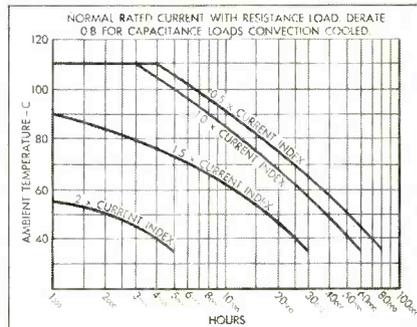
Life expectancy has now been raised from 60,000 to over 80,000 hours for General Electric's new miniature Vac-u-Sel rectifier stacks. Achieved by constantly improving processing techniques, this 20,000 hour increase in life is backed up by laboratory tests. Developed for electronic, industrial-control, and power applications, these units offer compactness and stability of electrical characteristics. Ambient temperature range is broad— $-65^{\circ}\text{C}$  to  $130^{\circ}\text{C}$ —and a wide variety of sizes, housings and finishes are available.

The "Selecto-Chart" shown below is part of a new application approach developed by G.E. It gives you greater freedom of design in selecting from the many rectifier sizes and types. Send for GEA-5935A, GEA-6273.

\*Registered trade-mark of General Electric Co.



**COMPACT RECTIFIER STACKS** offer designers stable electrical characteristics.



**INCREASE IN LIFE EXPECTANCY** is shown in typical curves for 45-volt cells.



**SELECTION IS EASY** with new G-E Vac-u-Sel rectifier "Selecto-Chart."

## G-E molded-case circuit breakers provide safe fuseless circuit protection



Thermal-magnetic trip elements in G-E molded-case circuit breakers help guard conductors against short circuits and sustained overloads. Operation is cool, life is lengthened through de-ionizing arc quenchers that quickly dissipate arcs.

Extra safety results from trip-free operating mechanism that opens contacts against overcurrents even if handle is held closed. Solderless lugs, straight-in wiring make installation simple.

Ratings from 10 through 600 amperes for circuits of 120, 240, 480, 600 volts a-c, and for 125, 250 volts d-c. GEC-1032.

# — GENERAL ELECTRIC —

# DIGEST

## TIMELY HIGHLIGHTS ON G-E COMPONENTS

### G.E. cuts radar transformer weights up to 35%



Small or large, narrow or wide, light weight, long life—whatever your requirements, General Electric will build high-voltage, oil-filled transformers and inductors to your specifications. The picture at left, for example, shows how G.E. cut 61 pounds from a typical radar power supply by redesigning with smaller embedded-layer coil. These corona-free components are suitable for many electronic applications other than radar.

Among the advantages of these smaller and more reliable G-E components are: (1) more efficient cores permit weight savings to 11%, (2) alumina terminals add reliability, and (3) the use of Formex\* wire and new embedded-layer winding techniques re-

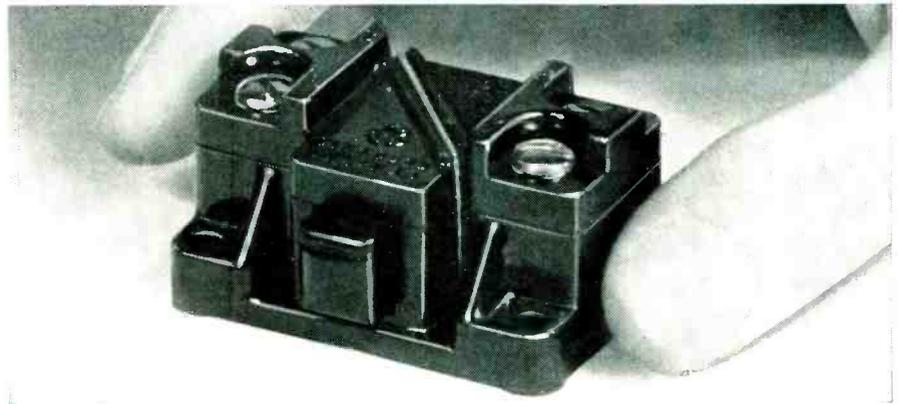
duce coil sizes as much as 53%.

All G-E radar components are designed for compact installation. All can be manufactured to MIL-T-27 specifications. All have characteristics and features to meet a wide range of requirements. G.E.'s fully equipped model shop pools engineering and manufacturing skill to fulfill your needs. The shop can deliver prototype units for your experimental or system development projects—in a hurry—because work on your jobs begins immediately. Testing is strict. Vibration, thermal-cycling and moisture resistance tests are extra steps that can be taken by G.E. to assure components of the highest quality. Ask for Bulletin GEA-5963.

\*Registered trade-mark of G.E. Co.

### Two oz. switchette operates up to 50,000 ft. alt., from -70° F to 200° F

Versatile, corrosion-resistant and compact, General Electric Size 2 switchettes perform perfectly under extremes of altitude and temperature, combine low-inertia moving parts with high contact-tip force. Totally enclosed contact structure protects it from tampering and dirt. Screw-type terminals simplify wiring. For aircraft use where vibration is severe and space limited, its snap action and double-break-contact construction are especially valuable. Spring-return button on the housing can be actuated by lever, bellows, or other means. Bulletin GEC-207A.



#### EQUIPMENT FOR ELECTRONIC MANUFACTURERS

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Meters, instruments  
Dynamotors  
Capacitor  
Transformers  
Pulse-forming networks  
Delay lines  
Reactors  
Motor-generator sets  
Inductrols  
Resistors  
Voltage stabilizers

Fractional-hp motors  
Rectifiers  
Timers  
Indicating lights  
Control switches  
Generators  
Selsyns  
Relays  
Amplidynes  
Amplistats  
Terminal boards  
Push buttons  
Photovoltaic cells  
Glass bushings

##### Development and Production

##### Equipment

Soldering irons  
Resistance-welding control  
Current-limited high-potential tester  
Insulation testers  
Vacuum-tube voltmeter  
Photoelectric recorders  
Demagnetizers

General Electric Company, Apparatus Sales Division  
Section A667-32  
Schenectady 5, N. Y.

Please send me the following bulletins:

for reference only     for planning an immediate project

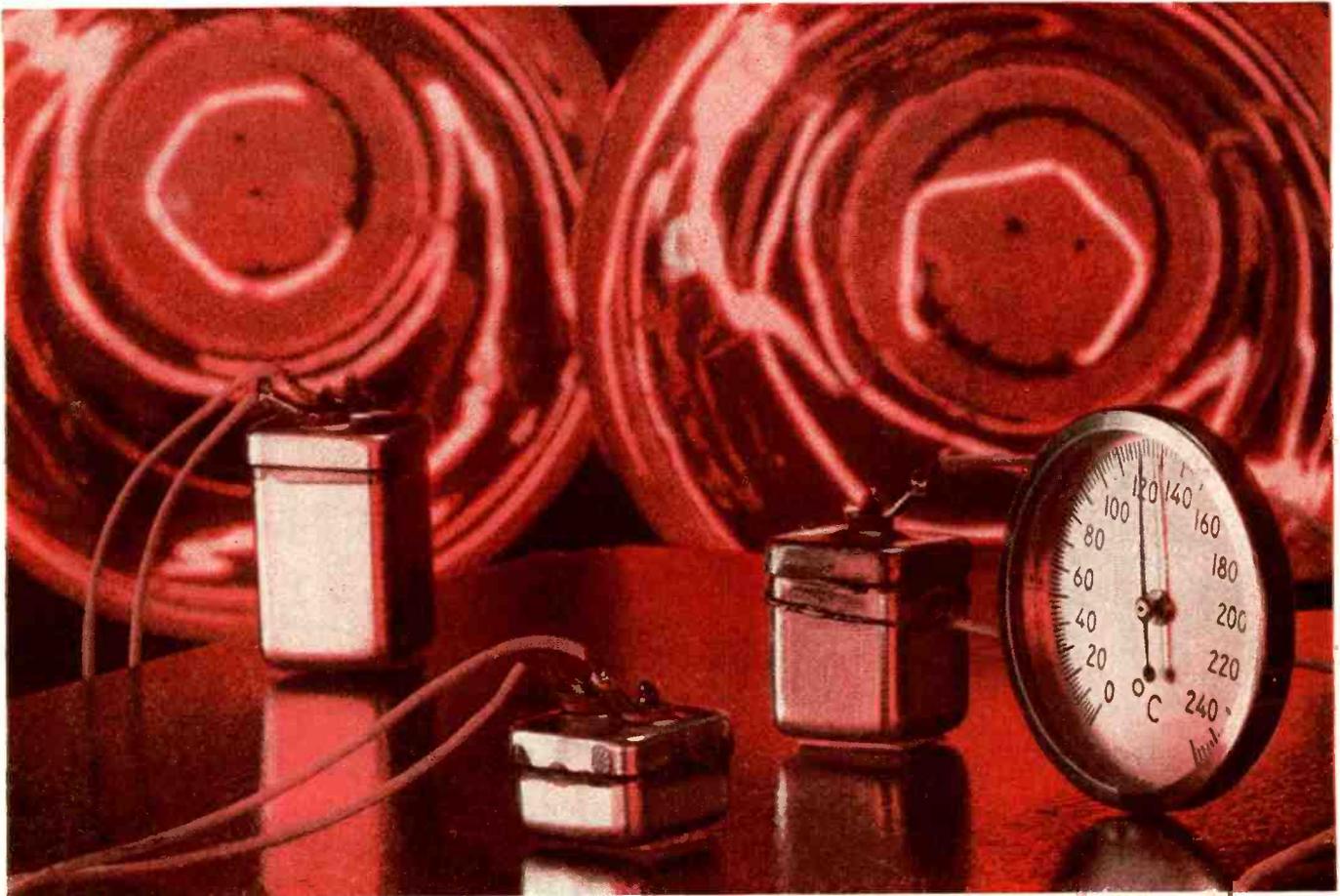
- GEA-5963 Radar Transformers
- GEC-207A Switchettes
- GEC-1032 Molded-case Circuit Breakers
- GEA-5935A Miniature Vac-u-Sel Rectifiers
- GEA-6273 New Vac-u-Sel Component Rectifiers

Name .....

Company .....

City..... State.....

**TURN PAGE FOR MORE G-E COMPONENT HIGHLIGHTS**



INFRA-RED LAMPS subject new G-E capacitor to 125° C ambient temperature.

## New G-E high-temperature Tantalytic\* capacitors operate in +125° C ambient at full voltage

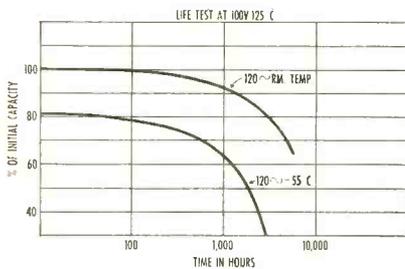
Where quality, long life and small size are required in high-temperature, miniaturized, high-reliability equipment, specify General Electric's new 125° C Tantalytic capacitors. Designed to operate at full voltage in high temperature, they

meet the tough requirements of miniaturized military equipment: energy storage, filtering, or by-pass applications in electronic ordnance, guided missile, navigation, communication, and control equipment.

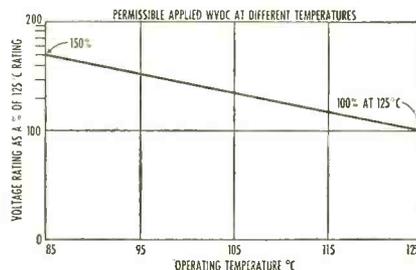
Three rectangular case sizes permit ratings from 36 uf at 100 volts d-c to 180 uf at 30 volts d-c. All three sizes have same square base, varying only in height to maintain high volumetric efficiency at lower ratings.

Features: low leakage currents, long shelf and operating life, availability in polar and nonpolar construction for use in both a-c and d-c circuits. When operated at ambient of 125° C at rated voltage, units meet qualification requirements of 1000 hours with not more than 20 per cent loss in initial 25° C capacitance.

Unlike other types of Tantalytic capacitors, the foil construction offers chemically neutral electrolyte to minimize corrosion danger, plus excellent mechanical stability and freedom from electrical noise under shock or vibration. Ask for Bulletins GEA-6258 and GED-2620.



LONG LIFE of G-E 125° C Tantalytic capacitors is shown by graph of life vs. loss of capacitance for typical 100-v d-c unit.



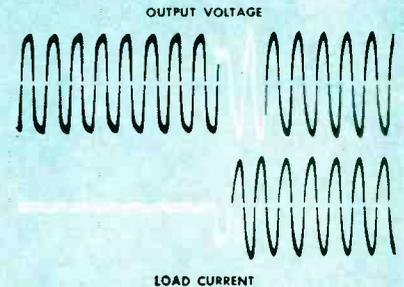
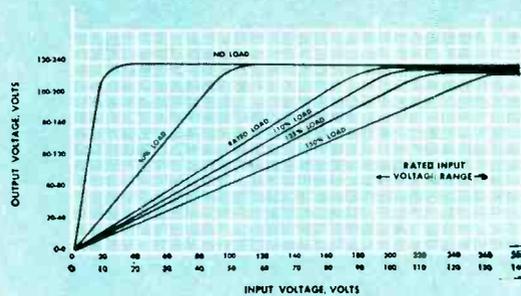
HIGHER VOLTAGES than 100 VDC can be applied with no life loss at ambients below rated +125° C as shown above.

GENERAL  ELECTRIC

### G.E. protects equipment with instantaneous voltage stabilization within $\pm 1\%$



VOLTAGE STABILIZATION CHARACTERISTICS OF A TYPICAL STANDARD 115- OR 230-VOLT UNIT OPERATED AT VARIOUS LOADS

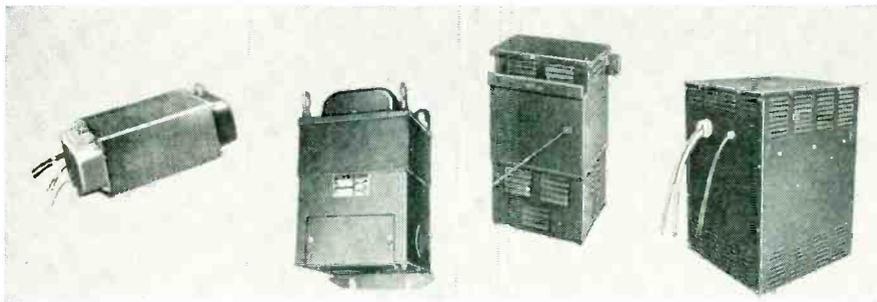


Output voltage is stabilized within two cycles as load current jumps from 0 to full load.

General Electric voltage-stabilizing transformers are completely automatic. The compact units offer low losses, high input factor, fast response. They are easily installed, have no moving parts, and need virtually no maintenance. Often designers find standard units most satisfactory, either incorporated in new equipment or adapted to existing circuits. If special units are required, G-E engineers will co-operate in finding solu-

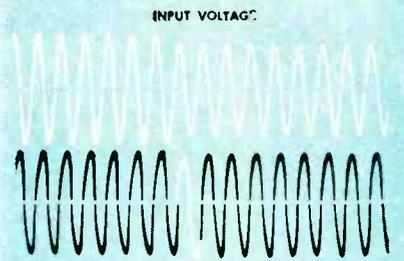
tions for you. You can use them in literally hundreds of types of equipment. New applications and new methods of applying these voltage-stabilizing transformers are continually being discovered. The rapid responses of control with these units are shown graphically in the three curves at right, and typical characteristics above. Bulletin GEA-5754A.

### G-E saturable reactors control individual power loads at low cost

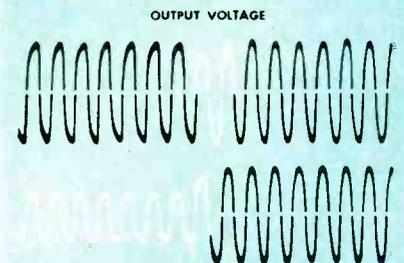


Faced with fixed power sources, application and design engineers can draw on General Electric's "design pool" of more than 1000 different saturable reactor designs. This will simplify solving the problems they often face of controlling individual power loads manually or automatically at low cost. Very efficient even at light loads, a G-E saturable reactor provides control in an a-c circuit by direct current. Adjustment is smooth all the way. They can be satisfactorily utilized in a wide range of applications, including electrically heated furnaces and boilers, or milk pasteurizers and X-ray equipment. Apply them, too, in reduced-voltage starting, or continuously adjustable re-

active load banks. G.E. can design them in a wide variety of a-c and d-c ratings to meet your special application needs. Bulletin GEA-6354.



Output voltage is stabilized in less than 1 1/2 cycles as input drops from 130 to 100 volts.



Output voltage is stabilized within two cycles as load current jumps from half load to full load.

General Electric Company, Apparatus Sales Division  
Section A667-32  
Schenectady 5, N. Y.

Please send me the following bulletins:

- |                                   |                            |                                    |                     |
|-----------------------------------|----------------------------|------------------------------------|---------------------|
| <input type="checkbox"/> GEA-6258 | 125C Tantalytic Capacitors | <input type="checkbox"/> GEA-6354  | Saturable Reactors  |
| <input type="checkbox"/> GED-2620 | Capacitors for Electronics | <input type="checkbox"/> GEA-5754A | Voltage Stabilizers |
- For information on other products, contact your nearest G-E Apparatus Sales Office.

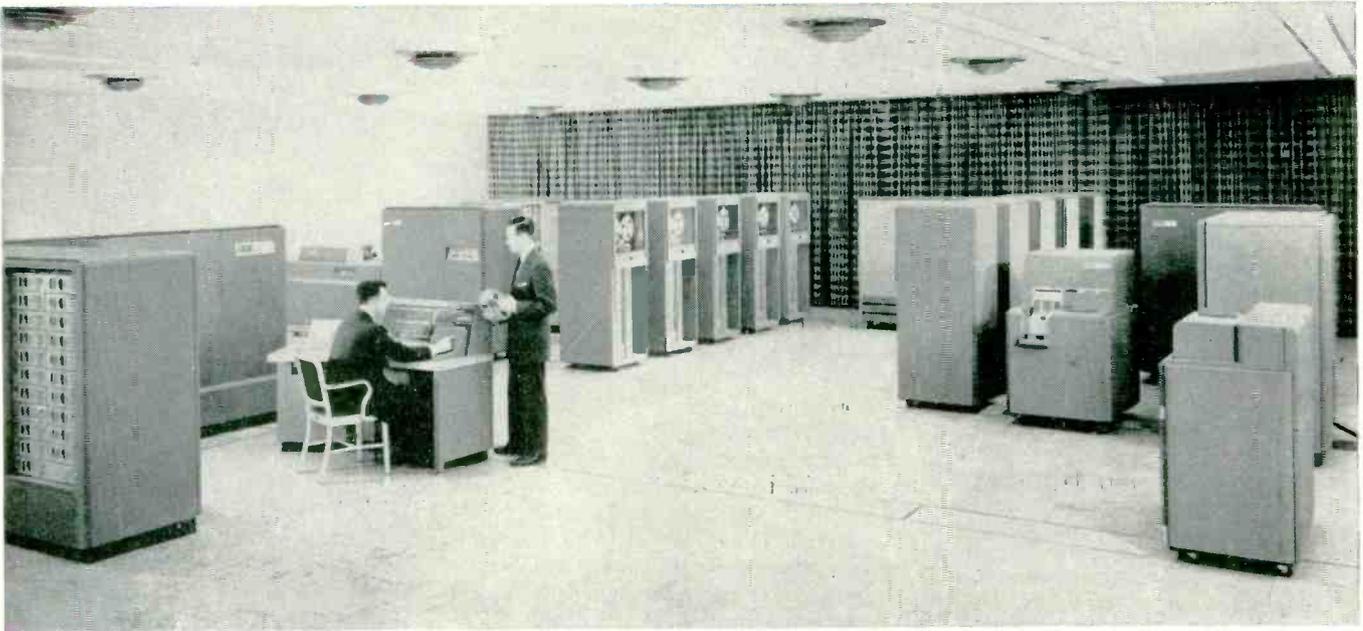
Name \_\_\_\_\_  
Company \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

# CABLES CONSTRUCTED with

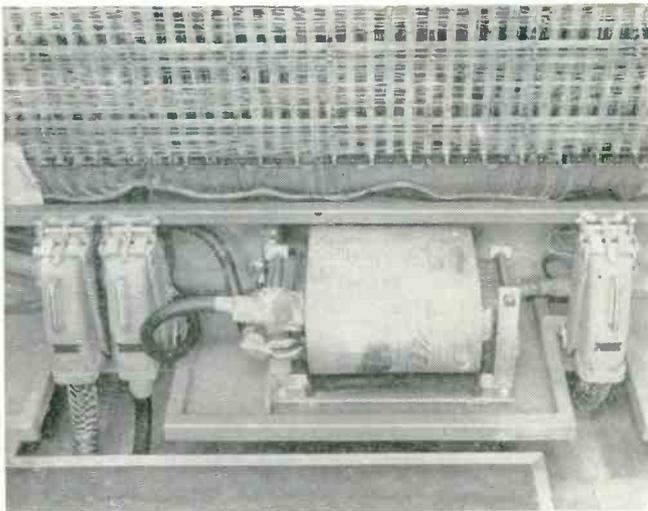
# BAKELITE POLYETHYLENE and VINYL PLASTICS

TRADE-MARK

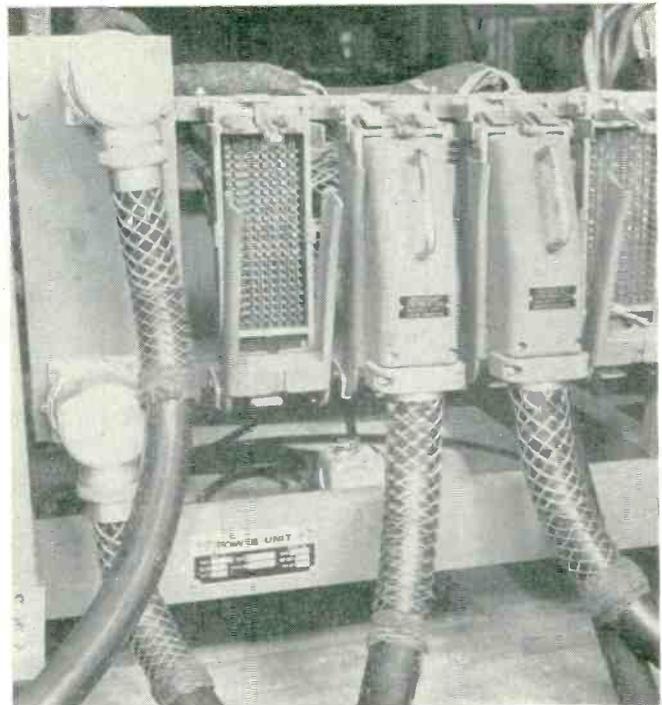
*— feed the components of this IBM*



Designed for business use, the IBM 702 Electronic Data Processing Machine has its component units housed in separate cabinets. This permits assembly of the most efficient system to fit user's needs. Essentials are the arithmetical and logical unit, the operator's control console, magnetic tape units, an input card reader, and an output printer and card punch. One or more magnetic drums are also often included.



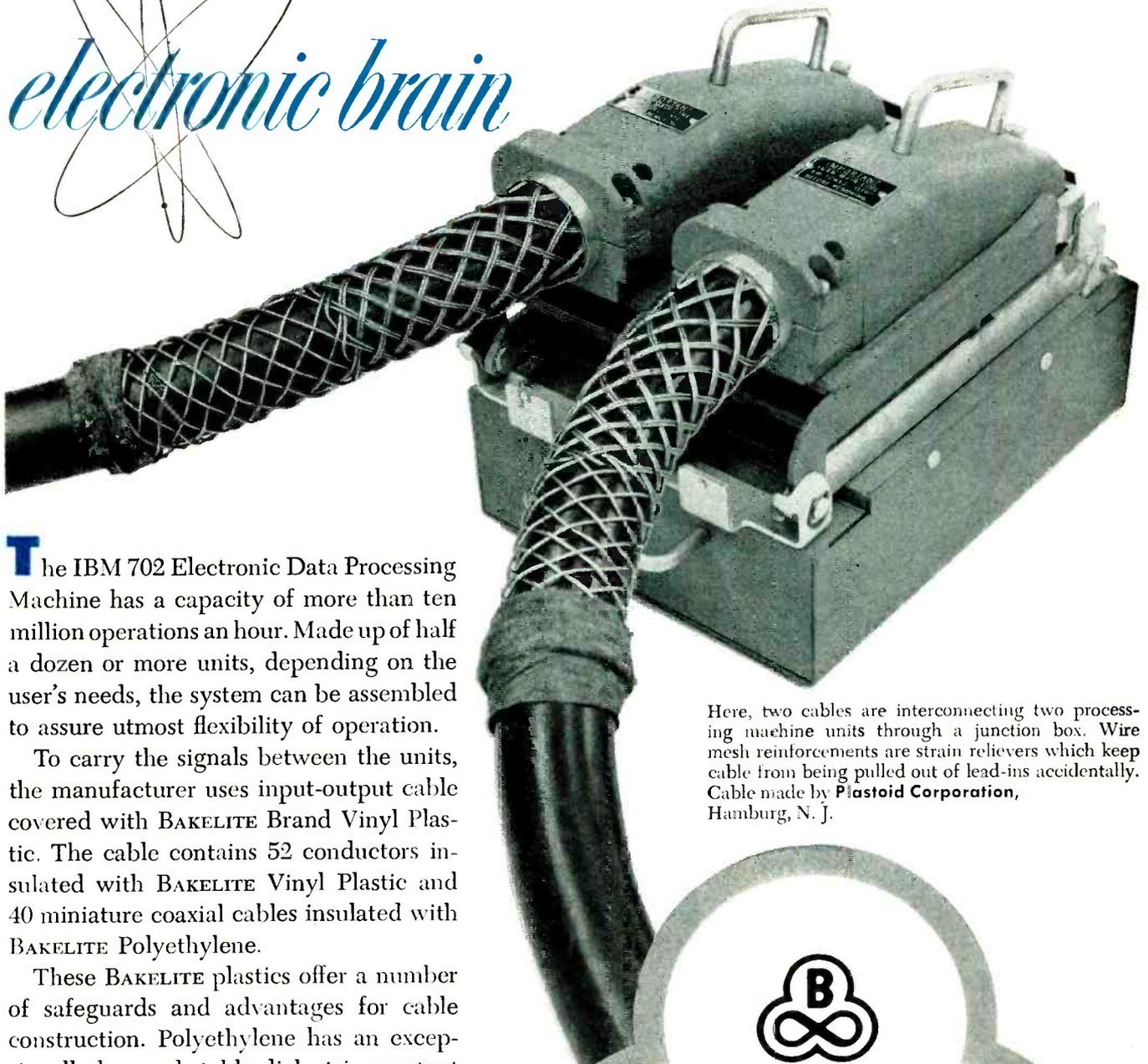
Three input-output cables are shown leading into the central processing unit of the machine. They are separated here by a filament transformer.



This picture shows the tape control unit employing two harness cables through which its signals are transmitted. Two power cables are at left.



# electronic brain



**T**he IBM 702 Electronic Data Processing Machine has a capacity of more than ten million operations an hour. Made up of half a dozen or more units, depending on the user's needs, the system can be assembled to assure utmost flexibility of operation.

To carry the signals between the units, the manufacturer uses input-output cable covered with BAKELITE Brand Vinyl Plastic. The cable contains 52 conductors insulated with BAKELITE Vinyl Plastic and 40 miniature coaxial cables insulated with BAKELITE Polyethylene.

These BAKELITE plastics offer a number of safeguards and advantages for cable construction. Polyethylene has an exceptionally low and stable dielectric constant and low power factor. Vinyl plastic is flexible, tough and abrasion resistant—an excellent protective material for complex cable assemblies.

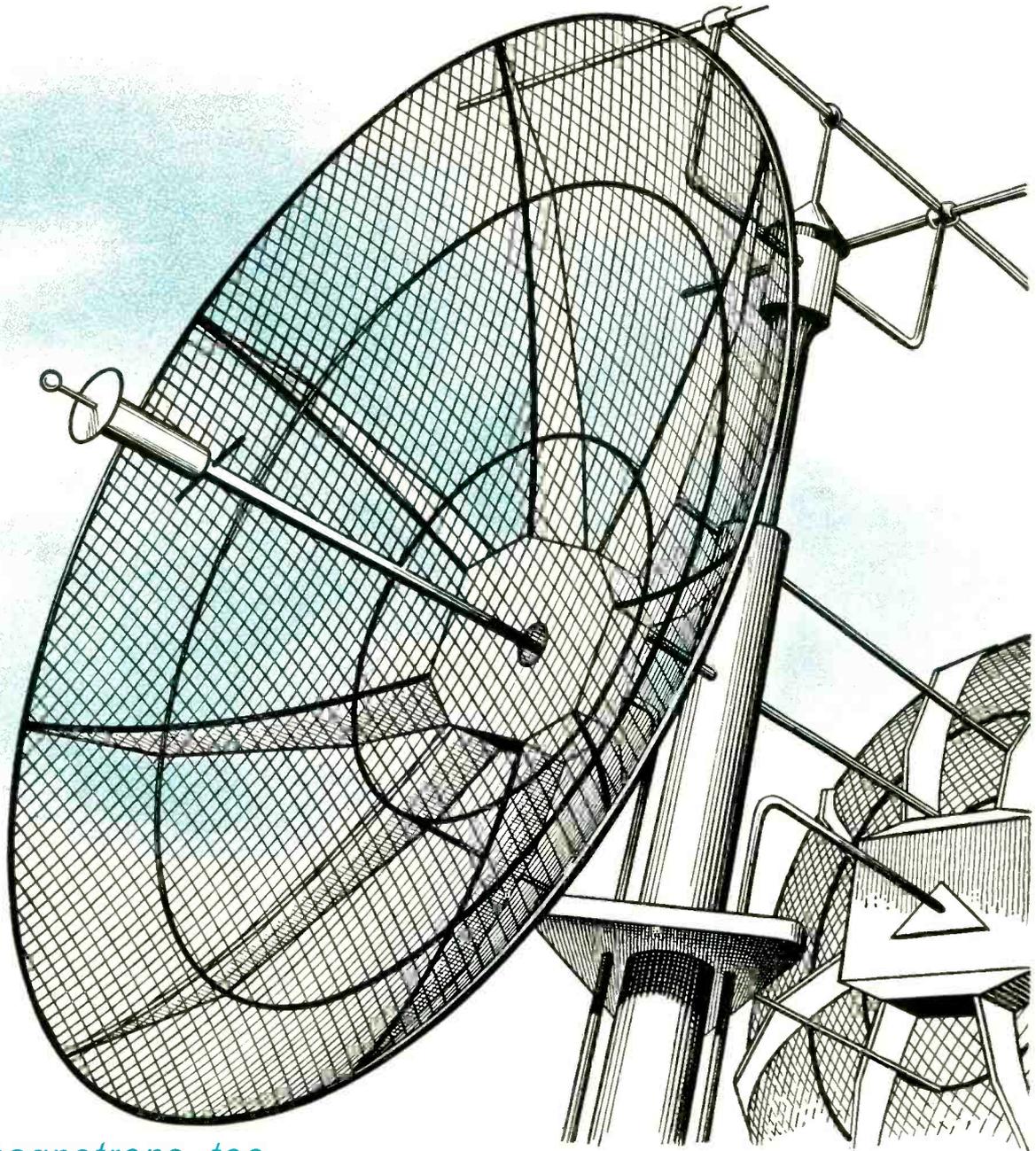
Your own particular application for wire and cable may well benefit from the use of BAKELITE Polyethylene and Vinyl plastics, as insulation or jacketing. Write Dept. KM-50 for data and engineering assistance.

Here, two cables are interconnecting two processing machine units through a junction box. Wire mesh reinforcements are strain relievers which keep cable from being pulled out of lead-ins accidentally. Cable made by **Plastoid Corporation**, Hamburg, N. J.



**BAKELITE**  
BRAND  
**Polyethylene and Vinyl  
Plastics**

**BAKELITE COMPANY**, A Division of Union Carbide and Carbon Corporation  30 East 42nd Street, New York 17, N. Y.  
In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario  
The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC



*In magnetrons, too*

## **CRUCIBLE PERMANENT MAGNETS**

*provide maximum energy... minimum size*

In designing magnetrons for radar systems — or any very high-frequency oscillator application — you can be sure of a *consistently higher* energy product with Crucible alnico magnets. *This means more power from a minimum size magnet!*

Crucible alnico permanent magnets are made to meet practically any size requirement from a fraction of an ounce to several hundred pounds. And they're sand cast, shell molded

or investment cast to the exact size, shape, tolerance and finish you need.

Crucible has been one of the largest producers of permanent magnets since the development of alnico alloys. Its unsurpassed magnet experience is backed by over 50 years of fine steelmaking. That's why the best solution to magnet problems starts with a call to Crucible. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 22, Pa.*

**CRUCIBLE**

first name in special purpose steels

**Crucible Steel Company of America**

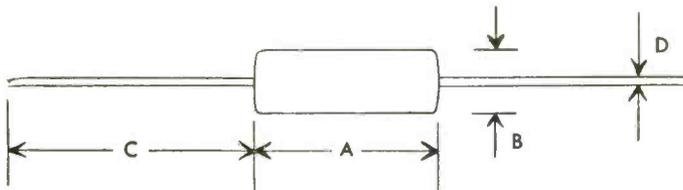
# NOW

## $\frac{1}{8}$ , $\frac{1}{4}$ and $\frac{1}{2}$ watt *Molded* Precistors

IRC *molded* Deposited and Boron Carbon Precistors are now available in  $\frac{1}{8}$ ,  $\frac{1}{4}$  and  $\frac{1}{2}$  watt sizes. These 1% precision film type resistors combine the advantages of high stability, small size and low cost in either deposited carbon or boron carbon units. Ratings are based on full load at 70°C. ambient.

The *molded* plastic housing provides complete mechanical protection, minimizes the effect of moisture and improves load life characteristics.

Equivalent In Size To IRC's Popular Types BTS • BW $\frac{1}{2}$  • BTA



Precistor Types	IRC Size Equivalent	Dimension			
		A	B	C	D
MDA — MBA	BTS	$1\frac{1}{32}$ "	$\frac{1}{8}$ "	$1\frac{1}{2}$ "	.025"
MDB — MBB	BW $\frac{1}{2}$	$\frac{3}{8}$ "	$\frac{3}{16}$ "	$1\frac{1}{2}$ "	.025"
MDC — MBC	BTA	$2\frac{1}{32}$ "	$\frac{1}{4}$ "	$1\frac{1}{2}$ "	.032"

### MOLDED DEPOSITED CARBON PRECISTORS

  
Type MDA —  $\frac{1}{8}$  Watt

  
Type MDB —  $\frac{1}{4}$  Watt

  
Type MDC —  $\frac{1}{2}$  Watt

### MOLDED BORON CARBON PRECISTORS

  
Type MBA —  $\frac{1}{8}$  Watt

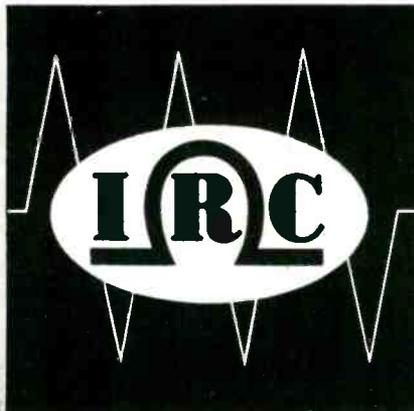
  
Type MBB —  $\frac{1}{4}$  Watt

  
Type MBC —  $\frac{1}{2}$  Watt

Precision Wire Wounds • Ultra HF and Hi-Voltage Resistors • Low Value Capacitors • Selenium Rectifiers • Insulated Chokes • and Hermetic Sealing Terminals

*Wherever the Circuit Says*

Voltmeter Multipliers • Boron & Deposited Carbon Precistors • Controls and Potentiometers • Power Resistors • Low Wattage Wire Wounds • Germanium Diodes • Insulated Composition Resistors



### INTERNATIONAL RESISTANCE CO.

Dept. 232, 401 N. Broad St., Philadelphia 8, Pa.

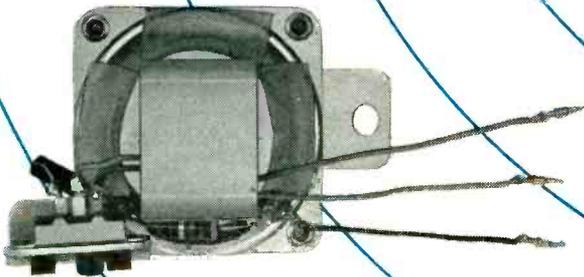
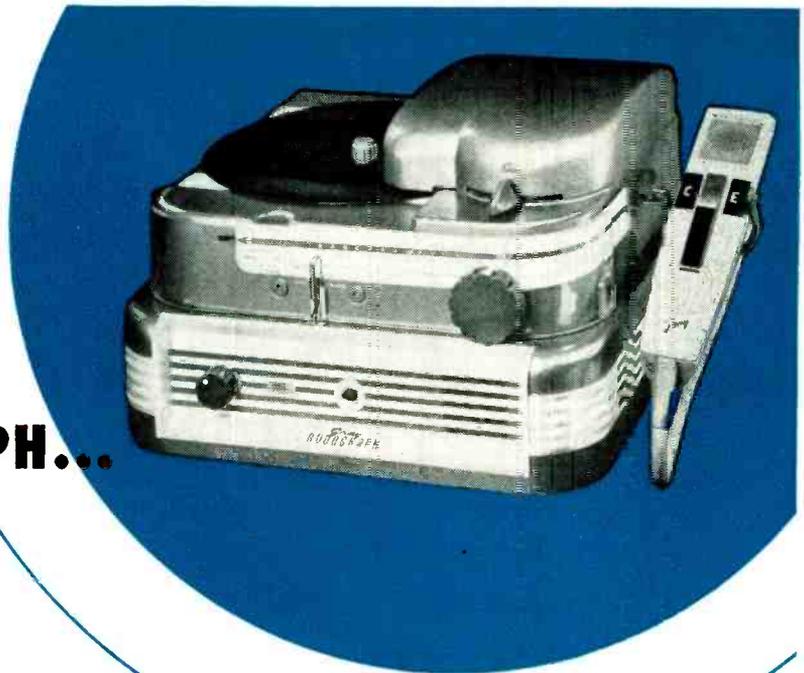
In Canada: International Resistance Co., Ltd., Toronto, Licensee

Send me data on:

- Molded Deposited Carbon Precistors  
 Molded Boron Carbon Precistors

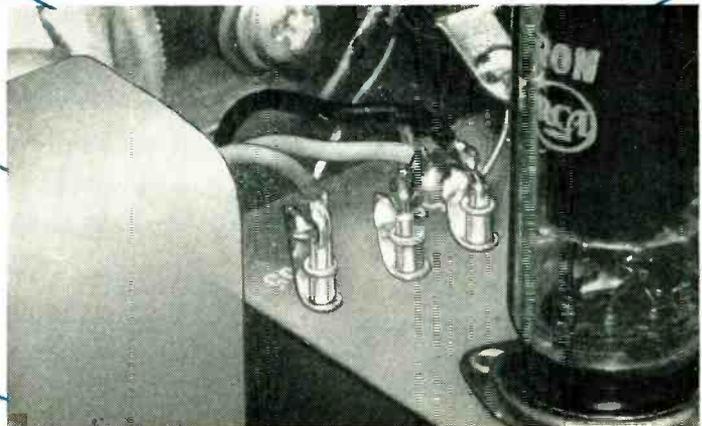
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The **NEW**  
**GRAY** **AUDOGRAPH...**



**...GETS A VOICE**

**IN A HURRY...**



**HUBBELL**  
*Interlock* **Sub-Miniature Plugs**

**Eliminate Soldering For Fast Installation Of Speaker Kit!**

Now, one model takes the place of three in the new Gray Audograph line. These famous dictation machines are designed with built-in eyelets to receive Type "C" Interlock Plugs. When speaker-equipped models are ordered, specially designed speaker kits, wired with the Sub-miniature Plugs, are quickly and easily plugged in. Hubbell Interlock's exclusive automatic lock-

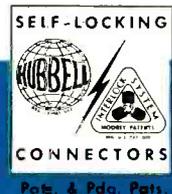
ing-quick disconnect feature makes possible a solderless, low contact resistance connection from the speaker kit to the panel eyelets. The tiny Type "C" Plugs are also easily and quickly disconnected for maintenance or replacement of speaker if necessary. Our Development Laboratory will cooperate with your Engineers to adapt Interlock for your specific applications.

Sub-miniature Plugs: Cat. No. 601C31 • For Further Information, Write Dept. A



**HARVEY HUBBELL, INC.**

Interlock Electronic Connector Dept., Bridgeport 2, Conn.



# NOW

## a new wire wound potentiometer

The mechanical and electrical features of Type 2W Rheostat-Potentiometer are designed for current and future electronic circuits. This modern, 2 watt unit offers maximum application adaptability plus typical IRC superior performance. Electrical operation is improved by one-piece center terminal and collector ring, and direct contact between collector ring and contactor. Advanced mechanical design anchors winding securely to strip, locks element into position, and assures accurate location of terminals.

### IMPROVED DESIGN FEATURES

**Better Heat Dissipation**

**Greater Dust Protection**

**Increased Mechanical Rotation**

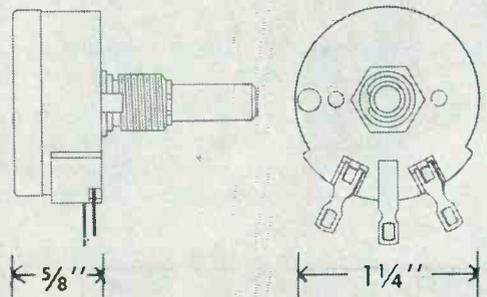
**Increased Electrical Rotation**

**More Resistance Values**

**Double and Single Taps Available**



Equivalent To JAN-R-19  
Style RA20 Specification



New IRC Design  
Smaller and More Compact



2 Watt Power Rating Based On 60°C. Rise  
Above 40°C. Ambient

SEND COUPON FOR DATA BULLETIN

Voltmeter Multipliers • Boron & Deposited Carbon Precistors • Insulated Composition Resistors • Power Resistors • Controls and Potentiometers • Low Wattage Wire Wounds • Germanium Diodes

*Whenever the Circuit Says*

Precision Wire Wounds • Ultra HF and Hi-Voltage Resistors • Low Value Capacitors • Selenium Rectifiers • Insulated Chokes • Hermetic Sealing Terminals

### INTERNATIONAL RESISTANCE CO.

Dept. 234, 403 N. Broad Street, Philadelphia 8, Pa.  
In Canada: International Resistance Co., Ltd., Toronto, Licensee

Send Bulletin describing Type 2W Potentiometers:

Name \_\_\_\_\_  
Title \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_



# DATA FOR

**RCA-5691**  
High-Mu Twin Triode



**RCA-5693**  
Sharp-Cutoff Pentode



**RCA-5690**  
Full-Wave Vacuum Rectifier

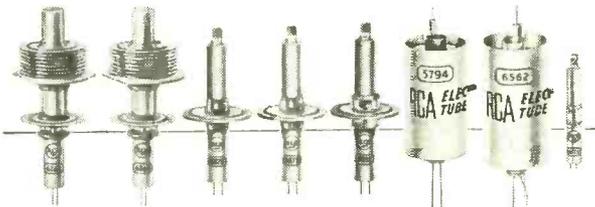


**RCA-5692**  
Medium-Mu Twin Triode



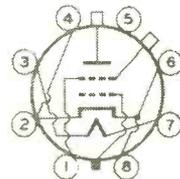
## RCA "SPECIAL REDS" COVERED BY WARRANTY TO GIVE AT LEAST TWO YEARS OR 10,000 HOURS OF SERVICE

RCA "Special Reds"—built for long life—are specially designed to withstand extremes of temperature, humidity, atmospheric pressures, vibration, impact, and mechanical shock. Recommended especially for industrial electronics and airborne communications equipment.



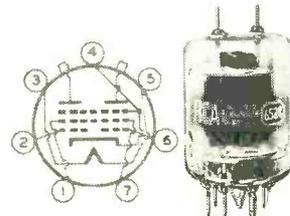
## RCA "PENCIL" TUBES FOR METEOROLOGICAL SURVEY, AIRCRAFT CONTROL EQUIPMENT, COMMUNICATIONS, AND UHF TEST EQUIPMENT

RCA-6263, -6264, -5876, -5675, -5893, -5794, -6562, and -6173 . . . eight types featuring small size, light weight, low heater wattage, good thermal stability, minimum transit time, low lead-inductance and low interelectrode-capacitances. These types include tubes for power amplifier, frequency multiplier, pulse detection and oscillator applications. Investigate these highly efficient tubes for your designs. For catalog information on RCA "Pencil" Tubes write for booklet RIT-104.



## FOR DEPENDABILITY . . . RCA-4X150A BEAM POWER TUBE

RCA-4X150A . . . manufactured at RCA's modern Lancaster plant . . . is a compact, forced-air-cooled, beam power tube of coaxial-electrode construction—with a max. plate-dissipation rating of 150 watts. For UHF power amplifier, or oscillator service up to 500 Mc. Also may be used as wideband amplifier in video applications. The dependability of the RCA-4X150A has been proved in military and commercial applications.



## TWIN BEAM POWER TUBE FOR UHF COMMUNICATIONS SERVICES BETWEEN 450 AND 470 Mc

RCA-6524 . . . 25 watts max. plate dissipation (ICAS). As push-pull rf power amplifier in class C service (ICAS) at 462 Mc, the 6524 has a max. power input of 45 watts and can deliver a power output of approximately 20 watts. Features high power sensitivity, compact size, and sturdy construction. For use as push-pull rf power amplifier, frequency tripler, or audio modulator in fixed or mobile communications. (Medium-button septar 7, pin base.)

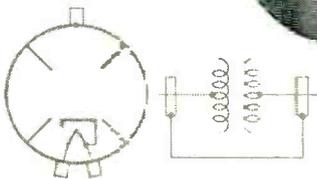
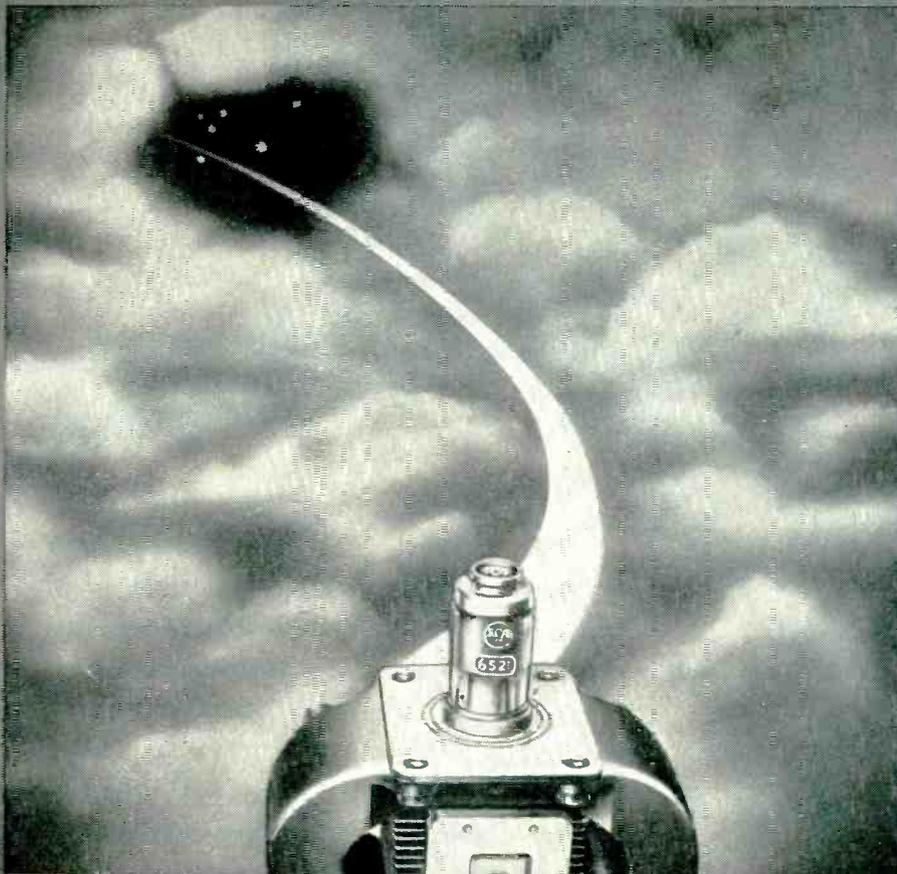


**RADIO CORPORATION of AMERICA**  
TUBE DIVISION

HARRISON, N. J.

# DESIGNERS

**ELECTRON TUBES  
SEMICONDUCTOR DEVICES  
BATTERIES  
TEST EQUIPMENT  
ELECTRONIC COMPONENTS**



## NEW "HEART THROB" OF THE AIRLINES

Air navigation, today, conquers stormy weather zones by means of "weather radar" which guides aircraft to the paths of least turbulence. The RCA-6521 Magnetron—the very heart of "weather-radar" equipment—was designed specifically for this service. Of the internal-resonant-circuit type with an integral magnet, the RCA-6521 is designed and conservatively rated for long, reliable performance as a pulsed oscillator at a fixed frequency of 5400 Mc. It is capable of giving a peak power output of 100 Kw.

## TWO NEW RCA PUBLICATIONS



**#PG101B** . . . "RCA POWER & GAS TUBES"  
. . . 24 pages of technical data on 178 RCA vacuum power tubes including forced-air-cooled and water-cooled types, rectifier types, thyatrons, ignitrons, magnetrons, and vacuum-gauge types.

**#RIT-104** . . . "RCA RECEIVING-TYPE TUBES FOR INDUSTRY AND COMMUNICATIONS"  
. . . 20 pages of technical data on 130 RCA small industrial tubes including "Special Reds", "Premium" types, "Pencil" and other types for special UHF applications, glow-discharge types, thyatrons, computer types, low-microphonic types, and many other types.

### Call Your RCA Representative:

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744 Broad Street  
Newark 1, N. J.

**Midwest:** Whitehall 4-2900  
Suite 1181,  
Merchandise Mart Plaza,  
Chicago 54, Ill.

**West:** MADison 9-3671  
420 S. San Pedro Street  
Los Angeles 13, Calif.

### FOR TECHNICAL INFORMATION

Write: RCA, Commercial Engineering, Section J-19-R, Harrison, N.J. Use this coupon. Circle items in which you are interested.

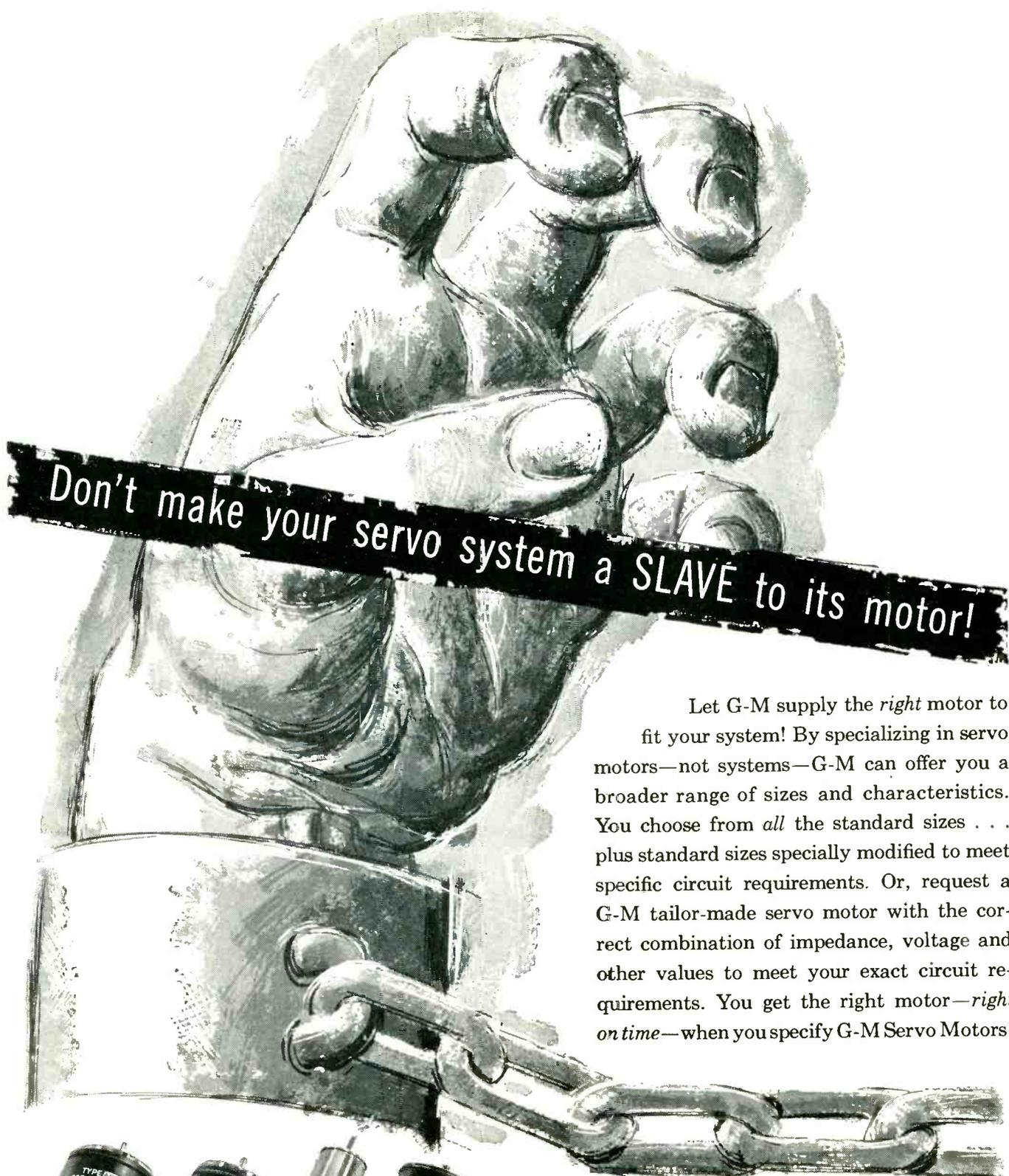
"Special Reds" 6521 4X150A 6524  
Booklet #RIT-104 Booklet #PG101B

Name \_\_\_\_\_

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Company \_\_\_\_\_

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Don't make your servo system a **SLAVE** to its motor!

Let G-M supply the *right* motor to fit your system! By specializing in servo motors—not systems—G-M can offer you a broader range of sizes and characteristics. You choose from *all* the standard sizes . . . plus standard sizes specially modified to meet specific circuit requirements. Or, request a G-M tailor-made servo motor with the correct combination of impedance, voltage and other values to meet your exact circuit requirements. You get the right motor—*right on time*—when you specify G-M Servo Motors!



• SERVO MOTORS • MOTOR GENERATORS • SYNCHRONOUS-HYSTERESIS MOTORS

Write for literature and information! Use G-M charts and specifications to select the best values for the control phase of your servo motor. Whether you are designing a new system, or seeking better performance in an existing system, let G-M help.

**GM**  
**G-M Servo Motors**  
manufactured by the Components Division of  
**G-M LABORATORIES INC.**  
4336 N. Knox Avenue • Chicago 41



## WHY LEADING MANUFACTURERS USE RAYTHEON MAGNETRONS AND KLYSTRONS

*Excellence in Electronics*



**RAYTHEON MAKES:**

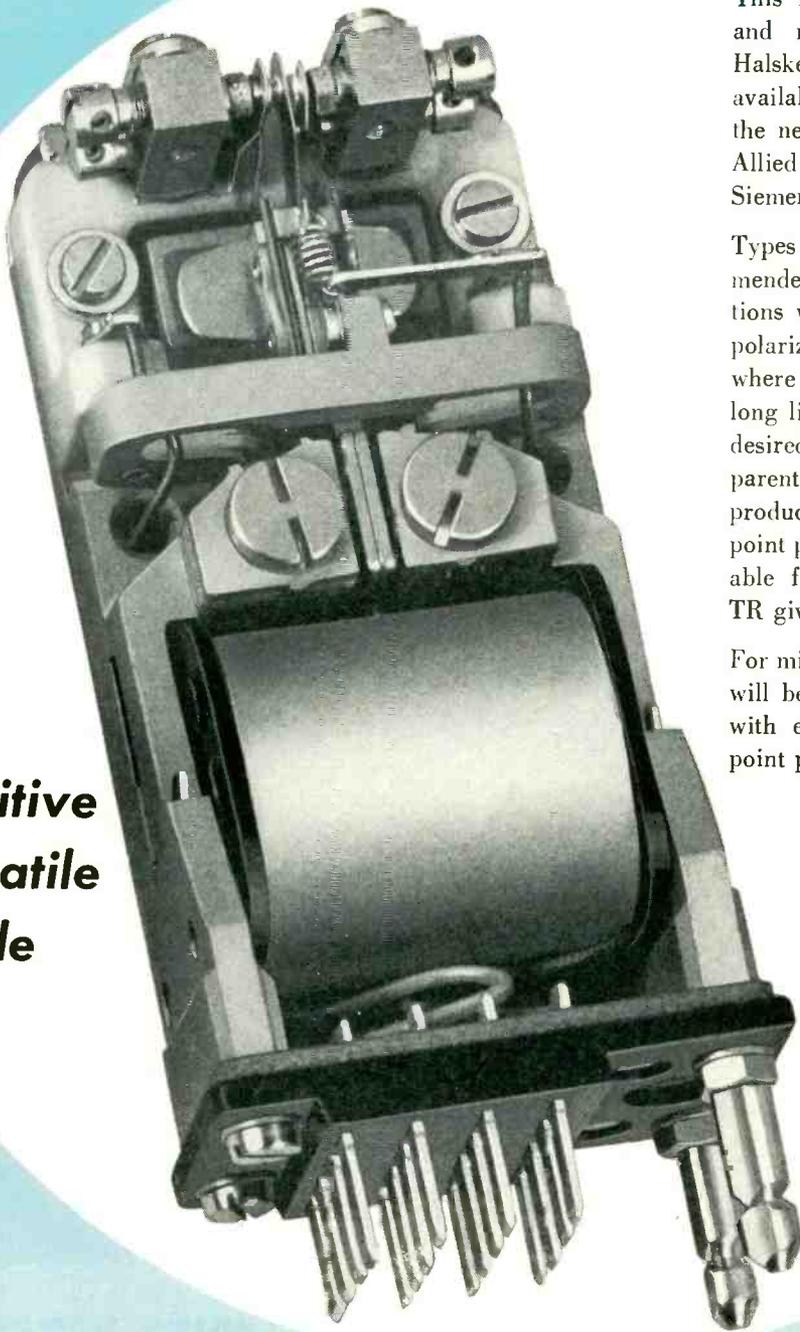
Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Receiving Tubes, Transistors

A good test of any product is the company it keeps. The famous trademarks above belong to only four of the many distinguished companies which use Raytheon magnetrons and klystrons in their microwave equipments.

Manufactured under precision controls by skilled men and women, Raytheon microwave tubes give you the utmost in first-rate performance, long life, and continuous duty under demanding conditions.

**RAYTHEON MANUFACTURING COMPANY**  
Microwave and Power Tube Operations, Sec. PT-26  
Waltham 54, Mass.

# ALLIED'S **NEW**



**Sensitive  
Versatile  
Stable**

This new polarized relay, designed and manufactured by Siemens & Halske Company of Germany, is now available from Allied Control, and in the near future will be produced by Allied with the technical assistance of Siemens & Halske.

Types Trls 63 to 69 are recommended for use in industrial applications where the special features of a polarized relay are required, or where its inherent high sensitivity, long life and precision operation are desired. They are available with transparent or metal dust covers and are produced with solder terminals or 16 point plug-in bases (sockets are available from Allied Control). Bulletin TR gives complete details.

For military applications, these relays will be available hermetically sealed with either solder terminals or 16 point plug-in base.

# POLARIZED RELAY

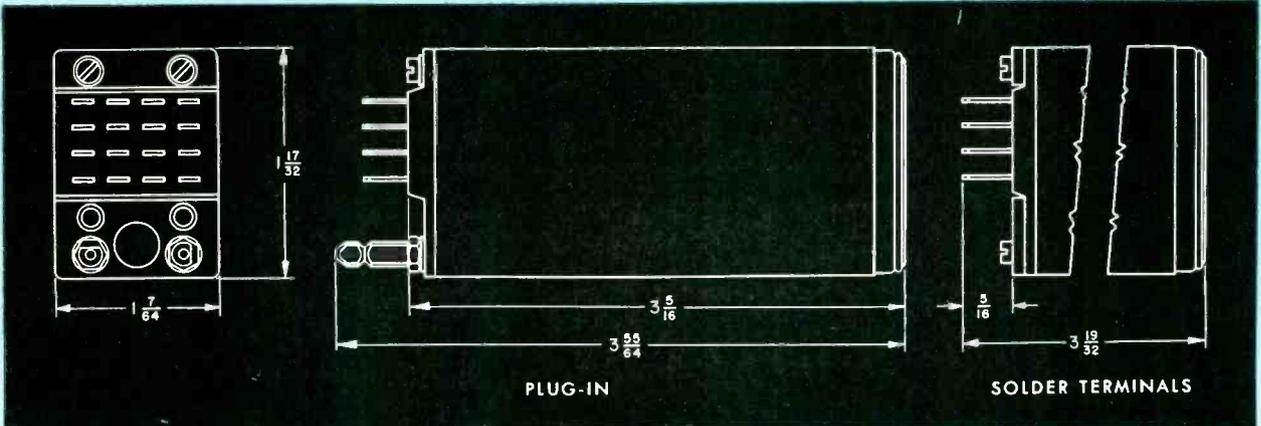
## Specifications For Allied's Types Trls 63-69

Type Number		Trls 63	Trls 64	Trls 65	Trls 66	Trls 67	Trls 68	Trls 69
Description	Positions	2		3	2	2	3	2
	Operation	Magnetic Latch High Contact Pressure		High Sensitivity	Null-Center	Magnetic Latch	Spring Biased	Null-Center
Contact Arrangement		SPDT		SPDT	DPDT	SPDT	DPDT	DPDT
Circuit Symbols	for telegraphy							
	other purposes							
"Operate" Excitation	Amp. Turns	7	2	2.2	5.5	5	4	15
"Operate" Power	μ Watts	500	40	50	300	250	160	2250
Working Excitation	Amp. Turns	15	4	6	10	10	10	25
Working Power	μ Watts	2250	160	360	1000	1000	1000	6250
"Release" Excitation	Amp. Turns			2.2		2.4	4	5
Max. Rate of Operation	Oper./Sec.	200	200	200	200	100	200	100

Contacts:	Silver, General Purpose
	2 amp., 28v d-c resistive load
	Platinum Alloy A. Low-Level
	Applications up to 1 amp.
	Platinum Alloy B. Heavy Duty
	Applications above 1 amp.
	Max. Continuous Current 5 amps.

Dielectric Test Voltage	Coil to Frame	500v rms.
	Contact to Contact	350v rms.
	Contact to Frame	500v rms.
	Coil to Coil	150-500v rms.
Standard Coils	Resistances from 1.1 to 18,000 ohms	
	Max. number of windings	8
	Max. Continuous Loading	1 watt
Temperature	Max. Ambient	85°C

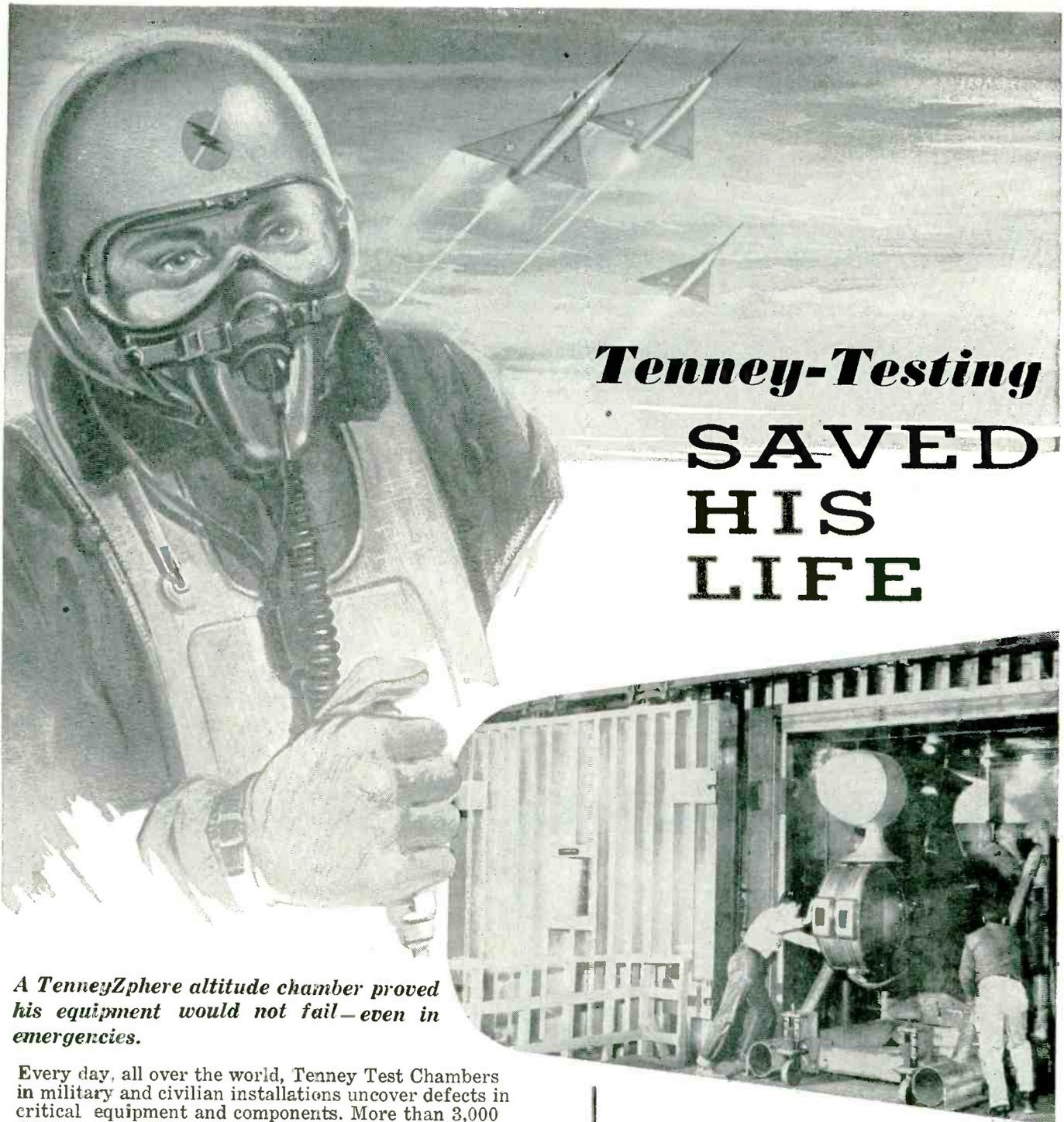
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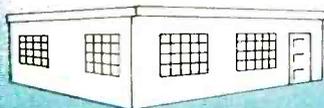
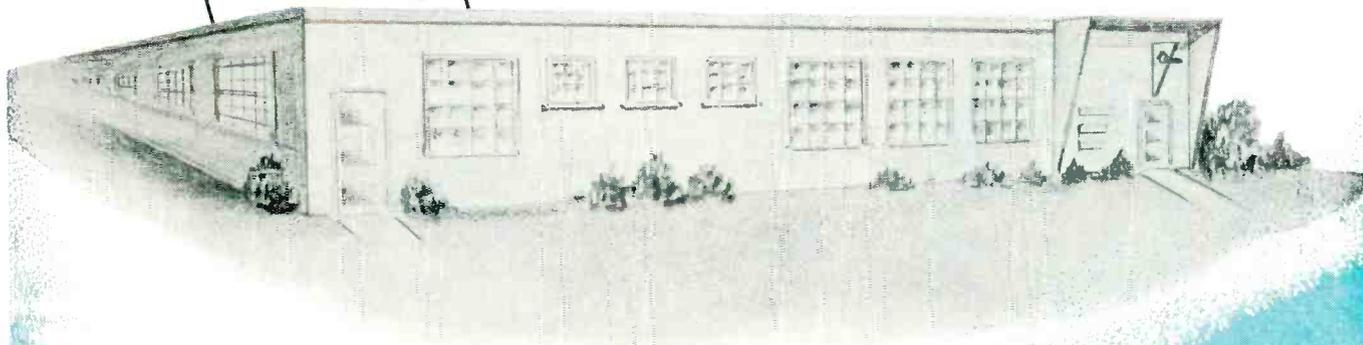
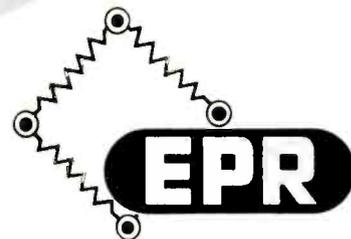
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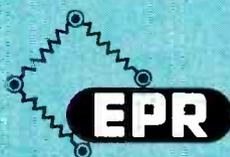


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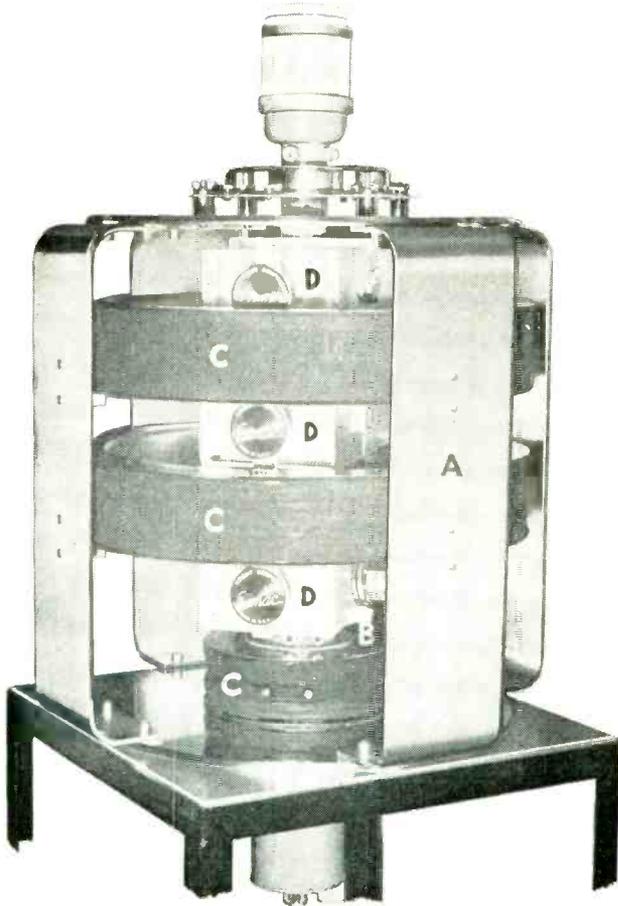


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# Eimac Amplifier Klystrons and Circuit Components

— the easy, economical approach to high power, UHF/microwave transmitters

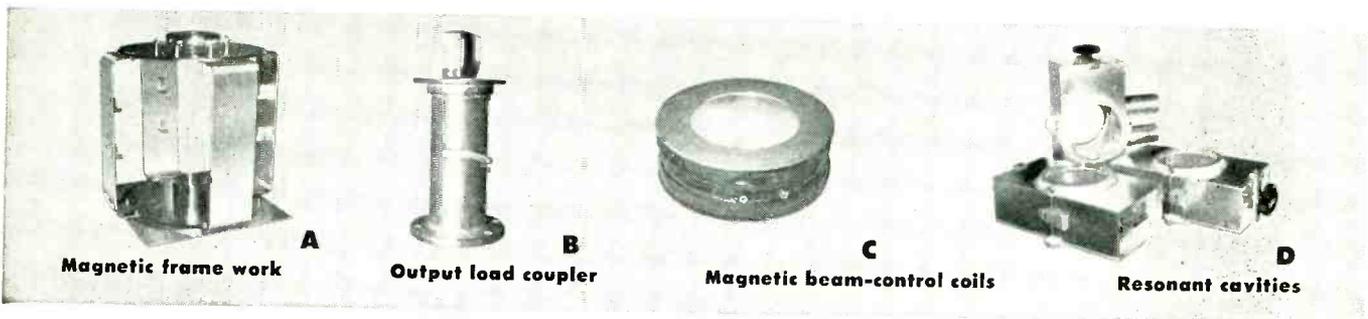


Design and construction of a high power UHF/microwave transmitter for beyond-the-horizon communication and other microwave applications is simple and straight-forward with an Eimac amplifier klystron and circuit components. In fact, it's easier to build than a low frequency Class C amplifier. Eimac high power amplifier klystrons, plus Eimac circuit components consisting of A) Magnetic framework B) RF output load coupler C) Magnetic beam-control coils and D) Convenient tuning wide range RF resonant cavities comprise the essential elements of a final amplifier package. By adding conventional power supplies, control circuits, driver and cabinets to the Eimac klystron-circuit component package, high power at UHF is easily obtained. Eimac developed klystron and circuit components provide equipment manufacturers with the easy economical approach to high power microwave transmitters. In many cases, existing low power equipment can be used as a driver for the higher powered amplifier.

Radio Frequency circuitry is completed outside the vacuum system of Eimac klystrons through circuit components. This allows unmatched economy by eliminating repurchase of costly RF circuitry with each tube replacement.

The reliability and performance of Eimac klystrons is proven, as they were employed extensively in established microwave scatter-type communication systems.

For an easy and economical approach to reliable high power microwave transmitting equipment, investigate the incomparable capabilities of performance-proved Eimac developed klystrons and klystron circuit components.



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FREQUENCY RANGE—MC			FREQUENCY RANGE—MC			FREQUENCY RANGE—MC		
		CW POWER			CW POWER			CW POWER
3K3000LA	400-600	2000w	3K20,000LF	580-720	5000w	3K50,000LF	580-720	10,000w
3K3000LQ	760-980	2000w	3K20,000LK	720-890	5000w	3K50,000LK	720-890	10,000w
3K20,000LA	470-580	5000w	3K50,000LA	470-580	10,000w	3K50,000LQ	850-1000	10,000w
						4K50,000LQ	750-1000	10,000w



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## watts of real power to drive antennas



MODEL  
(BJ-30A)  
Hi-Power  
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Signal  
Generator

### AND MICROVOLTS TO MEASURE NOISE

5 watts RF output into 50 ohms impedance.

160 db range of attenuation —15.0 volts to 0.10 uV.

CW—AM—PM operation.

Master oscillator—tuned power amplifier circuit.

Continuous tuning 40 MC to 400 MC—spiral dial scale 4 feet long.

Dial calibrated at intervals of 1% frequency.

Leakage fields less than 0.1 uV/meter.



USM-16  
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Multi-Purpose  
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*a clear, sharp crystal note*

AT 440 MC!

**FLEXIBILITY PLUS!... with AM, FM, PM  
or Sweep Modulation available at the flip of a switch**

Continuous coverage 10 to 440 MC. Single band; no switching.

Tunes to within less than 1000 cps of desired frequency with respect to two-step temperature-controlled crystal calibrator.

Automatic frequency stabilization at any desired frequency.

Internal or external AM, FM, PM (alone or in conjunction with video pulse and Sync Out pulse). Sweep Frequency modulation with marker pip.

Output 0.1 uV to 0.224 volt (—127 to 0 dbm) into 50 ohm load. Selected output remains constant over full frequency range.

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Write to the undermentioned distributors for full details of Mullard tubes:—

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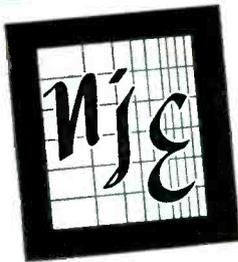
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MEV 25



# MEMO

**FROM:** The custom engineering staff at NJE  
**TO:** Designers of computers, telemetering equipment, TV transmitters, etc.

## SUBJECT: Why SEMI-Regulated Power Supplies?

We receive over twenty-five requests each week for custom power supply quotations. Most of these requests are obviously built around vacuum-tube or mag-amp regulated power supplies.

Of course, we're in an excellent position to evaluate these specifications objectively—since we manufacture all seven types of electronic power supplies—over \$50,000/month of them on a custom basis.

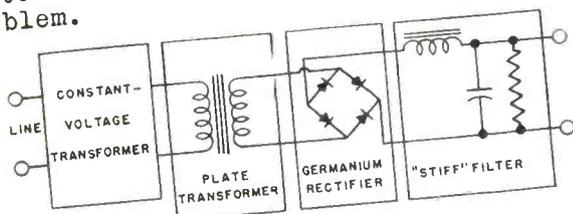
.....over thirty percent of these applications do not require regulated supplies. We usually recommend our ELG type, which is simpler, cheaper, and much more stable. Typical life expectancy is in excess of 30,000 hours without maintenance. No heat. No mag-amps. No saturable reactor. No "trick tubes". No tubes at all in fact.

No secret about it...brute force. We use the new semi-conductor power rectifiers, and really "stiff" transformers and filters, in conjunction with a line-regulating transformer. The high energy-storage of the filter provides excellent transient response. Zero response time, if you need it. Regulation compares favorably with vacuum tube types.

Cheaper, too.

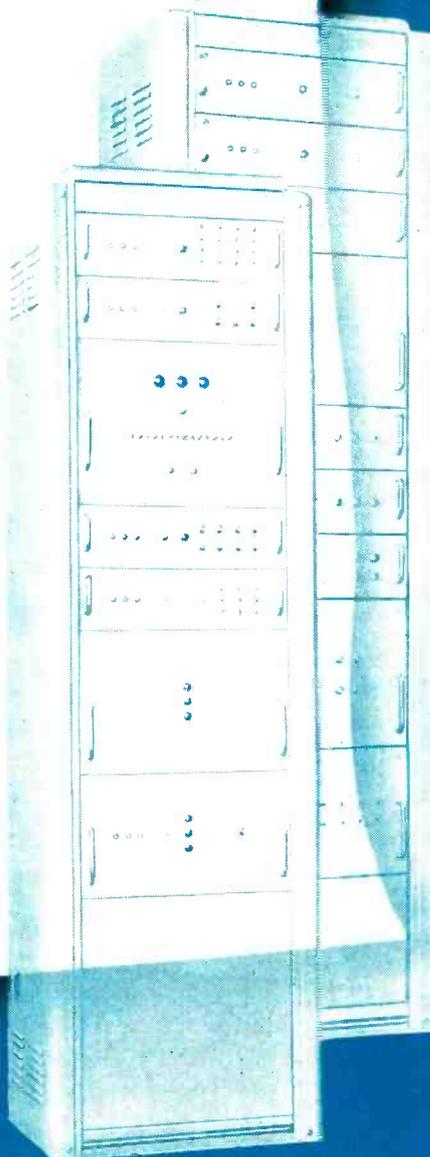
Make sense?

Write—we're interested in your power supply problem.



**A good example:** Thirteen outputs totalling 5.5 KW of well-regulated, well-filtered, transient-free DC power for a computer. Priced about \$8,000. (Would have been about \$15,000 with regulators.) Occupies two cabinet racks. (Would have been 5 racks with regulators.)

For our complete line of electronic power supplies See electronics Pp. 113-120 **BUYERS' GUIDE**



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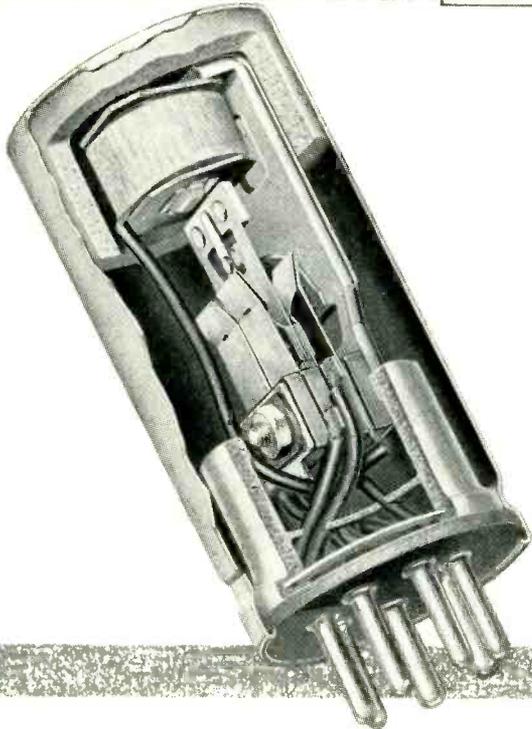
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THE MALLORY LOGO  
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*New 1700 series Mallory split-reed vibrator\* uses special alloy leaves which serve both as contacts and as springs . . . eliminating usual button contacts. Life is greatly increased, constancy of output improved, and driving power reduced.*  
\*Patent Applied For

## New Heavy Duty Mallory Vibrator

*gives far longer life, constant output*

For the peak in dependability and performance, plan to use this newest Mallory vibrator in your communications equipment. A completely new idea in vibrator design eliminates conventional contact buttons. The spring leaves themselves . . . made of special contact alloy . . . act as contacting members. This design provides greatly increased contact area, with these important advantages:

**Consistently Longer Life.** Tests made on heavy duty cycles prove up to 100% greater service can be expected . . . with a high degree of consistency.

**Steadier Output.** The decreased rate of erosion means less change in contact spacing, less variation in voltage.

**Flare-Proof Starting.** The new low-mass design permits wider contact spacing to prevent start-up flare . . . without need for greater driving power.

**Exceptional Uniformity** of characteristics is made possible by the simplified design.

**Minimum Size** for heavy duty ratings.

The new design is available in the split-reed type shown here, for 6/12 volt service, and in the Duplex heavy duty model without the split reed construction. For full technical data, and for a consultation on your specific power supply requirements, write or call Mallory.

### COMPLETE POWER SUPPLIES

It may be that you can save time and reduce over-all costs by employing a complete Mallory Vibrapack® power supply. Vibrapacks can be engineered around the new heavy-duty 1700 series vibrator to give long, reliable service. Design includes precise balancing of critical components. Normal ratings are conservative. Compact-sized Vibrapacks fit readily into crowded layouts. For further information, advise Mallory of your specific requirements.

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CROSS  
TALK

► **TOMORROW'S AIRPLANE . . .** Electronics expert with one of the major airlines thinks the following equipment will be found in ships of the future:

Two vhf or uhf navigational systems, each with radio magnetic indicator and fpdi presentation.

Two uhf distance-measuring systems, perhaps part of the above navigational systems.

Off-set-course computer, possibly a theta-theta unit.

Two uhf glide slope receivers.

Two automatic l/mf direction finders.

75-mc marker beacon receiver with three-light audio system.

Two vhf communications transmitters and receivers, one of each with selcal.

H-F communications transmitter and receiver, each with selcal.

Radar safety beacon with cockpit flag warning of non-operation.

Airborne radar, pilot operated, with two scopes each with separate range marking.

Radar-above-terrain altimeter, 0-5,000 feet.

Proximity indicator system.

Autopilot-automatic approach equipment.

Cabin p-a system.

Two cockpit loudspeakers.

Isolation amplifier system.

If this prediction comes true, the efforts now being made to make electronic equipment smaller, lighter and more reliable will seem like child's play.

► **LEND-LEASE . . .** In the past two months our curiosity has been excited by a number of phone calls from men who wanted to know if complex test equipment could be leased.

Computer time can be rented in a number of places around the country, and we recall that electron microscopes have at times been

made available on this basis. But we do not know to what extent other types of lab equipment can be obtained.

Apparently there is some need for lend-lease plans among concerns having short-term r & d contracts.

► **FLYING SINGLE-SIDEBAND . . .**

As speeds approach 600 mph there is sufficient doppler effect upon a 30-mc signal received by an airplane to shift frequency 30 cycles.

Experiments with single-side-

band transmission of voice signals at such speeds have provided satisfactory communications. But when a plane moves much faster absolute frequency control does not reinsert the carrier at a suitable point.

Some military aircraft obviously fly too fast for conventional s-s. But we understand it may be possible to get around this curious situation by inserting a pilot tone and automatic frequency control.

S-S enthusiasts, as is well known, do not give up easily.

**LOOKING AHEAD . . .**

Satellite experiments will throw more light on radio propagation methods already utilizing upper-air particles in a different way. Use of new knowledge to provide completely reliable communications should be commonplace within 10 years

*Electronic ignition systems are once more on the drawing boards. Advances in component design may make automotive engineers more receptive than they were some years ago*

Geneva conference on nuclear energy has stimulated construction of reactors throughout the world. This should be quickly reflected in increased demand for electronic instruments associated with such programs

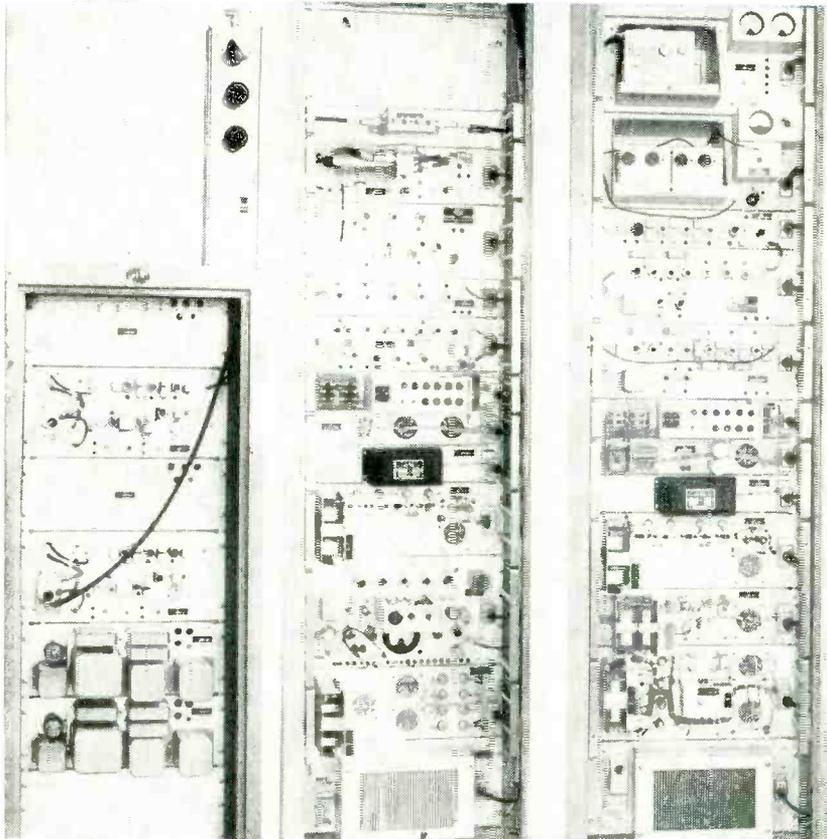
*Long-distance reception of h-f signals will be on the increase for the next four or five years. Sunspot activity could be mixed blessing, delighting fringe audiences or bringing them troublesome interference*

# Beyond-Horizon Signals

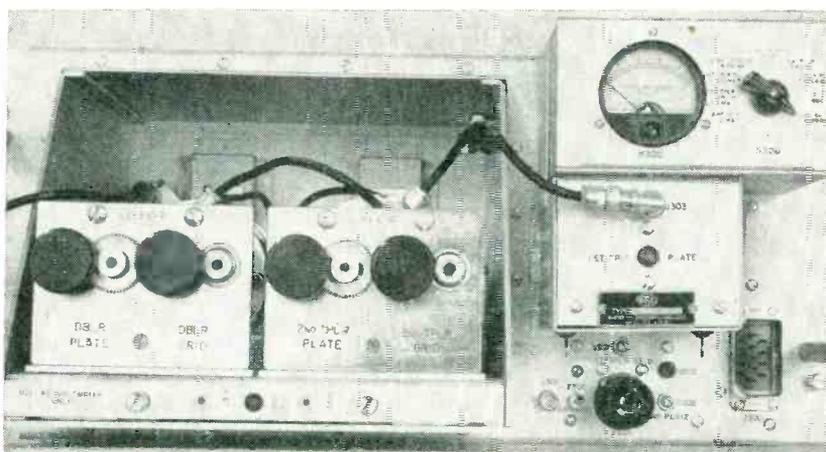
**SUMMARY** — Bending of uhf waves, sometimes known as tropospheric forward-scatter, results in weak but continuous signals far beyond the optical horizon. Modern equipment techniques, using 10-kw klystrons, high-gain

By **JAMES R. DAY**

*Vice-president  
Radio Engineering Laboratories, Inc  
Long Island City, N. Y.*



Low-power equipment racks with covers removed. At left are receiver preselector (top), operating and standby r-f heads for diversity antennas. Center is the receiver bay. Exciter and 60-watt amplifier are shown at right



Power-output panel of the 10-watt exciter stage shown in rack above at right

**B**EST present justification, for economic reasons or otherwise, for beyond-horizon circuits at uhf is for the transmission of many telephone channels on a single radio carrier. Line-of-sight circuits for this purpose usually employ frequency-modulated radio carriers; multiplexing is by frequency division and the modulation is generally single sideband suppressed carrier. The equipments to be described are also of this kind. Generally they comprise two-way radio terminals for the transmission of signals in a band from voice frequencies to 600 kc or more. This provides for up to the equivalent of 150 telephone channels.

## **Different Techniques**

The outstanding differences between equipments for use in line-of-sight circuits of a few tens of miles and in beyond-horizon circuits of over 50 miles lie in the means taken to increase the radio gain for offsetting greatly increased span loss. Typical span losses for line-of-sight circuits approximate free-space values and may run 120 to 130 db. For beyond-horizon circuits<sup>1,2</sup> of 150 miles or more, they are in the neighborhood of 200 db. This 60 to 90-db difference must be made up by increased transmitter power, larger and higher-gain antennas and maximum exploitation of the method used.

For example, consider a transmitter of 5 watts output (7 db above 1 watt), two antenna and transmission line systems with a

# Extend Communications

transmitting and receiving antennas and special receiving diversity combiners provide economical, fade-free multiplex communications circuits with repeaters spaced every 175 miles

total gain (over a half-wave dipole) of 45 db and a receiver of such a noise factor and deviation ratio that a signal 80 db below 1 watt is required for the planned signal-to-noise ratio. All these together will provide a span capability of 132 db. If more margin is required, it may be had by a modest increase in antenna size, an increase in deviation ratio and perhaps by a small increase in transmitter power.

Power outputs of 10 kw or more are available in practical and economic form over most of the uhf region suitable for beyond-horizon transmission. This represents a possible 35-db improvement over the example given. Antennas with gains over dipole up to 40 db are practical in some parts of the uhf band. This upper limit will be discussed further in connection with diversity reception. Allowing a conservative 5 db for line losses, two such antenna systems will give a 75-db contribution, or 30 db more than for the line-of-sight example.

## Receiver Preamplifier

For economic reasons, the receiver in the first example is assumed not to have a preamplifier. By using the preamplifier described below and increasing the deviation ratio in the system, it is practical to set up with receivers requiring a signal of 90 db below one watt for a satisfactory signal-to-noise ratio.

Dual diversity employing combining will give 3 db for that fraction of the total time that the two signals are nearly equal in amplitude. Triple diversity will yield 5 db. Thus, in round numbers it is practical to improve on the line-of-sight example by something in the order of 80 db. This does not come

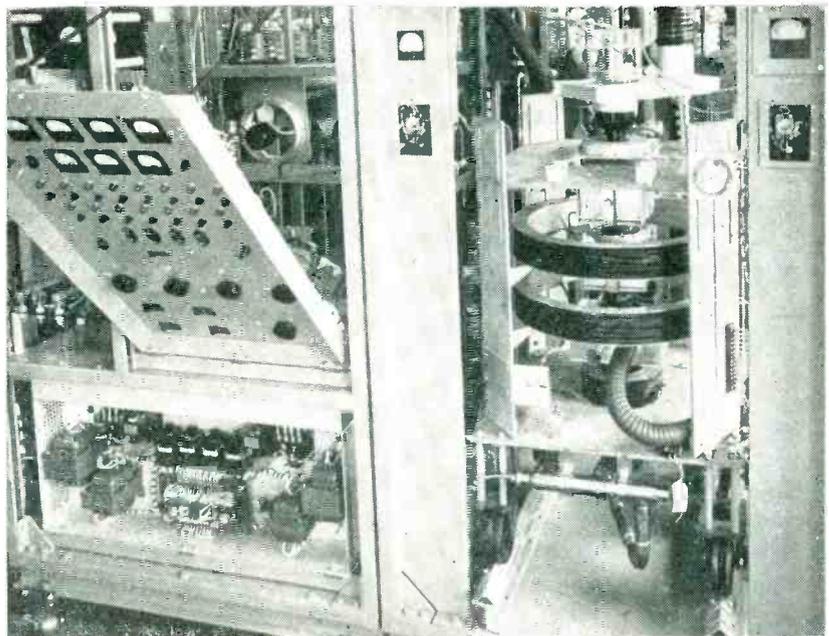
## HOW SCATTER WORKS

The mechanisms of various forms of beyond-horizon propagation are presently in a stage of intensive study and some controversy. It is sufficient for busy communications engineers to recognize only a few facts.

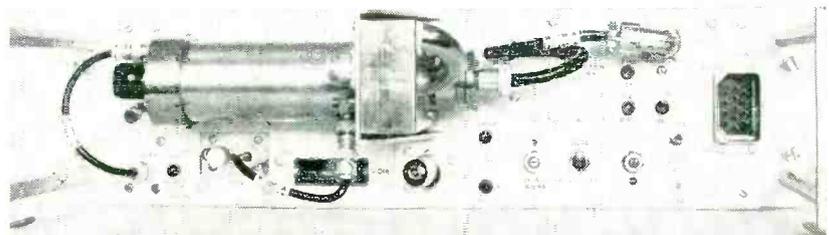
Long-distance (500 to 1,500-mile) communication at about 50 mc can result from ionospheric scatter. The general technique was summarized in *ELECTRONICS* on page 102 of the June, 1952 issue.

Beyond-horizon propagation at uhf has resulted in practical multichannel circuits up to about 200 miles. This mode of communications is often referred to as tropospheric forward-scatter. Multi-hop circuits can be extended thousands of miles.

For some engineering purposes, subject to variations resulting from changes in season, climate and terrain, the approximate rate of increase of tropospheric transmission loss is 18db per octave in the 100 to 200-mile region in addition to the free-space loss that occurs.—The Editors



Klystron amplifier (right) has 10-kw output at uhf and can be removed on dolly. Control circuits at left are visible with covers off and hinged panel let down



Receiver preamplifier for which circuit is shown in Fig. 5 provides much needed sensitivity for long-distance tropospheric service

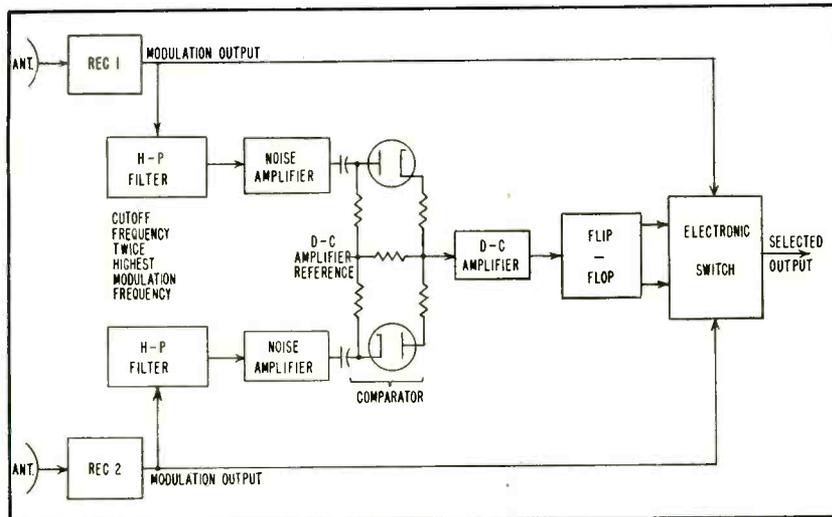


FIG. 1—Dual-diversity switch that serves as basis of the combiner circuit

easily or cheaply and the final margins are strongly dependent on thoroughness of design to yield every last db of system gain.

It has been long suspected and finally confirmed that the gain of a mirror or horn type antenna cannot be increased indefinitely by an increase in dimensions. For such increase to be possible would require that the phase and amplitude relations among all elements of the received wave remain stable with time and within ever-narrowing limits as the gain is increased. Figuratively speaking, it can be said that distance lends disorder and that antenna aperture increase beyond that necessary to give 40 to 45-db gain over a dipole are unprofitable.

### Amplitude Fluctuation

Received signals well beyond the horizon are characterized by random short-time amplitude fluctuations. The distribution<sup>3</sup> is such that for 10 percent of the time the signal will be more than about 10 db below the short time median, 1 percent more than 20 db, 0.1 percent more than 30 db and so on. Since in most applications minimum circuit performance must be had for at least 99.9 percent of the time the situation above is unsatisfactory.

It has been found that as two antennas, initially coincident, are separated (particularly in a direction at right angles to the direction of transmission) the amplitude fluctuations of the two

received signals, initially identical, become progressively unrelated. At separations of more than 150 wavelengths or so the correlation is negligible for practical purposes. With a switch that continuously selects the better of two such signals the losses versus percentage of time are halved and an otherwise useless circuit is made satisfactory by space diversity.

The devising of such switches served as the first practical approach to this problem. Since the rate of change of amplitude during this fading is rapid, the sensing means used to operate the switch must be fast, that is, derived from a source of good bandwidth. The noise amplitude well above the highest modulating frequency in an f-m receiver is inversely proportional to signal strength. If filtered off, amplified and rectified it provides a suitable switch control.

Figure 1 shows a block diagram of a complete dual-diversity switch. The condition of the flip-flop and hence the circuit selected depends on the polarity of the output of the comparator, the latter depending on the relative output of the noise amplifiers. Not shown but included is a common age system for the noise amplifiers, which acts to enhance the difference in the noise-amplifier outputs, and hence the positiveness of action.

Similar switches operate an electronic switch at intermediate frequency. All these switches have a sensing speed in the order of one millisecond. The i-f switch fol-

lowed by an independent limiter and final f-m detector has a minimum switching transient. The flip-flops operate in a few microseconds.

### Diversity Combiner

Switches, however, have two grave disadvantages. No matter how well designed, they offer the strong likelihood of producing errors in any telegraphic information in the baseband. Since they merely select the better signal, during that portion of the total time when the radio signals are about equal, many profitless switchovers may occur, increasing the likelihood of errors.

Combining two or more signals in such fashion as always to present an optimum signal-to-noise ratio is a more attractive solution. This can be done simply.

In Fig. 2 are shown two or more generators in parallel. The pairs of generators represent the outputs of two receivers. Signals  $S_1$  and  $S_2$  are the modulation and are equal and in phase. Generators  $N_1$  and  $N_2$  are the totally unrelated noises present in the two receiver outputs. Resistors  $R_1$  and  $R_2$  represent internal impedances of the two branches. Since  $S_1$  and  $S_2$  are equal and in phase, no loop current flows and the output voltage  $E_o$  is equal to  $S = S_1 = S_2$ . The quantities  $N_1$  and  $N_2$  being unrelated divide across the output giving two contributions

$$N_1 \frac{(R_2)}{(R_1 + R_2)} \text{ and } N_2 \frac{(R_1)}{(R_1 + R_2)}$$

When the radio signals are equal and the amplitudes squared of the  $N$ 's are equal and assuming  $R_1 = R_2 = R$  the combined noise output in  $E_o$  is  $N/\sqrt{2}$ , which with  $S$  gives a 3-db improvement in signal-to-noise ratio. It can be shown that if the  $R$ 's are caused to vary as the square of the individual  $N$ 's, the output combination signal-to-noise ratio is always optimum and never poorer than the better of the individual ratios. Such a method is smooth and always better than switching. For that fraction of the time when the signal-noise ratios are the same or nearly so the gain for dual diversity is 3 db, 5 db for triple and so on.

Figure 3 shows an arrangement similar to that for switching except that the electronic switch has been replaced by a pair of cathode followers with their cathodes tied together for d-c. To each grid is applied the  $S$  and the  $N$  from the receiver as well as an appropriate control voltage  $C$ , which is derived from a noise amplifier-rectifier. Here the internal impedances of the cathode followers are the  $R$ 's of Fig. 2 and they are caused to vary by the  $C$ 's.

It is the relative value of the  $C$ 's that affects this variation, in that if the  $C$ 's change equally the relative situation between the cath-

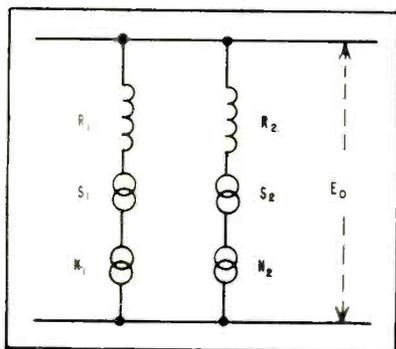


FIG. 2—Signal, noise and impedance relationship for a diversity combiner

ode follower is unaltered. The proper law of variation of the  $C$ 's versus noise to meet the optimum condition is easy to secure and keep by means of the agc on the noise amplifiers, using any medium or high- $\mu$  tube as cathode follower.

For beyond-horizon circuits, owing to the type of fading encountered, some form of diversity is an absolute necessity. Combining in the form described provides an optimum solution.

Cost alone will not insure any path an excess of received signal. Sound margins are normally provided in systems design but with transmitter power, antenna gains and receiver noise figure pushed to the maximum economic extent, it is imperative to exploit the maximum possibilities of the system in all details of circuit design. Some of the more important of these are described below.

The common application of these equipments is in fairly long systems comprising many spans and yet requiring demodulation to base

band at all stations. This requires that the design be predicated on full modulate-demodulate, rather than the so-called heterodyne method. In turn, this places unusually severe requirements on the modulator and demodulator. The equipments are capable of 20 to 40 repeats with signal to distortion noise ratios consistent with toll telephone circuit quality standards.

### Linearity of Transmission

The Serrasoid modulator<sup>4</sup> used at each transmitter for f-m is the phase-shift type shown in Fig. 4. It produces a frequency-modulated wave by modulating the phase of a subcarrier whose stability is independently controlled by a crystal. In it a sawtooth wave of high linearity is generated as the subcarrier frequency. A short pulse is generated at half amplitude of the sawtooth in the unmodulated condition by applying the wave to a biased gate that is small in aperture relative to the sawtooth.

Modulation consists of varying the bias, causing the pulse to be advanced and retarded from the reference phase. The pulse train is converted to c-w by selective circuits at a harmonic of the sub-

carrier, and the final f-m signal derived by suitable frequency multiplication and heterodyning. This method is inherently ideal and can be made as linear as desired by refinements of circuit detail.

It is entirely aperiodic, requiring no adjustments and uses tubes only as switches, not depending on the shape of their characteristics. Whereas frequencies of 100 kc for the subcarrier are suitable when the top modulating frequency is 15 to 20 kc as in the broadcast version of the circuit, it is necessary to raise the subcarrier rate to 2 or 2.5 mc for 600-kc modulation. It is of interest that in the high-frequency modulator, for the operating distortion levels of 0.1 percent or less, departures from linearity constitute timing errors of less than 1 micromicrosecond.

Demodulator requirements are met by use of a discriminator of peak-to-peak width in excess of three times the deviation. Experience has shown that the f-m detector as such is properly considered as part of a demodulator system that includes the limiter. This is particularly true where low distortion is required. Frequency-modulation detectors are vulner-

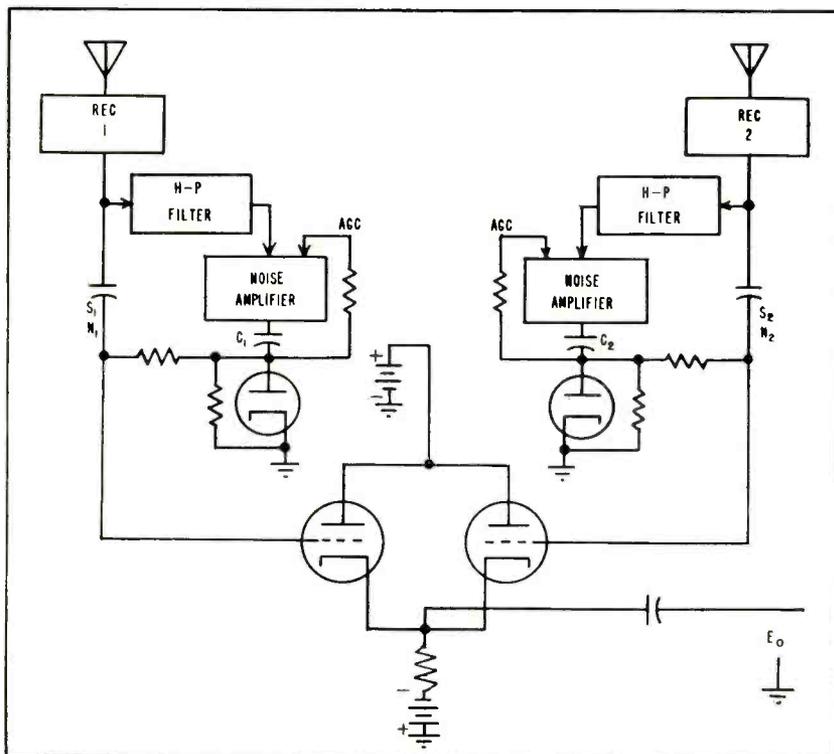


FIG. 3—Block and schematic representation of the dual diversity combiner circuit with a 3-db advantage

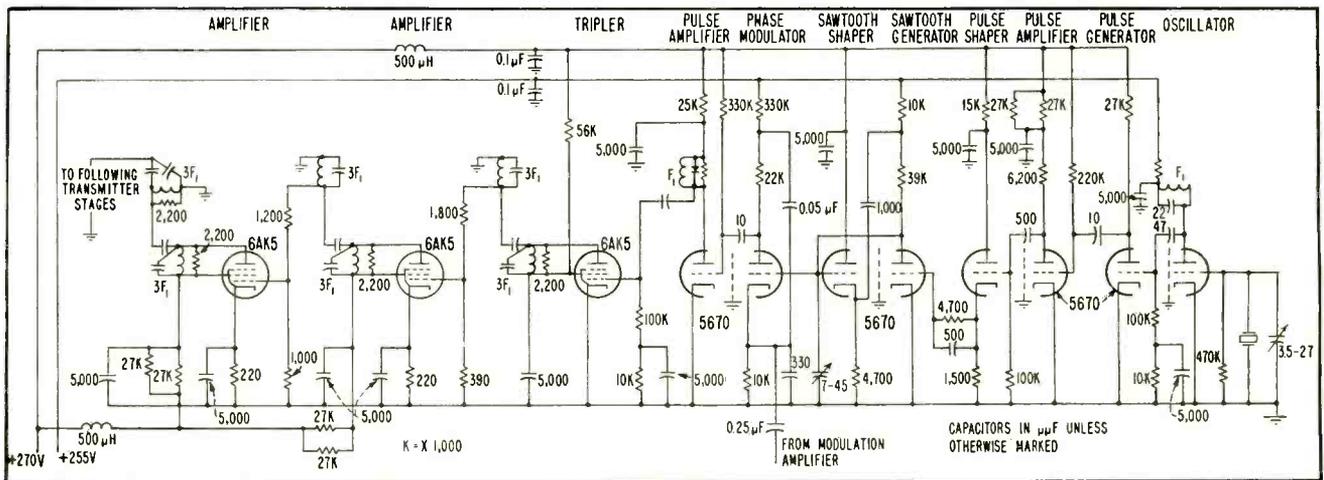


FIG. 4—Phase-shift modulation equipment is a modification of f-m broadcast type. Negative cathode returns are omitted for simplicity

able to changes in the wave shape of the i-f signal supplied to them. It becomes a problem in limiter design to secure constant wave-shape as signal amplitude changes and yet provide the amount and speed of limiting required to exhaust the f-m capabilities of the receiver.

After the modulator and demodulator elements, the elements affecting linearity are all the coupling circuits used in the transmitter and receiver. It is in the latter that the closest design is required. This is because bandwidth, which controls distortion also determines the operating threshold of the receiver and hence the ultimate fading margin of the receiver. By careful attention to the nature and location of the important coupling circuits, the delay distortion may be controlled to a linearity of better than 0.1 percent with a receiver noise bandwidth of about 2.5 times the peak-to-peak deviation.

### Gain Stability

In any long system, where some of the individual channels may run through many repeaters, it is important that both the short and long-time gain stability at modulating frequencies be fairly high. The elements involved in this are the base-band amplifiers, the modulator and the demodulator. Provided the limiting section of the demodulator is well designed, the r-f parts do not affect gain as modulating frequencies.

Base-band amplifiers are stabilized by feedback. The modulator alone exhibits gain changes of less than 0.1 db up to the point of tube failure. The gain of the f-m detector is stabilized by the use of biased charging diodes, as in a ratio detector, but using a regulated fixed bias rather than the automatic self-bias of the usual form.

In effect this replaces the dynamic limiter of a ratio detector by a fixed bias limiter, yielding a detector slope independent of the i-f drive and hence, of the condition of previous tubes. The detector stability is also in the order of 0.1 db.

### Equipment

Equipment is grouped as exciters, power amplifiers and receivers. An exciter rack comprises the modulator, transmitting converter and 10-watt output amplifier. The modulator panel includes the phase-shift modulator and a three or four fold frequency multiplier. Output is in the order of 20 milliwatts at around 10 mc. It is fed to a transmitting converter where the input signal is heterodyned to a frequency of  $\frac{1}{8}$  or  $\frac{1}{2}$  the final radio frequency and amplified to about 0.5 watt. Output stages use 2C39A or 2C39B tubes to feed the power amplifier in a separate cabinet.

Anode and bias power equipment is stabilized by circuit design so that power-supply regulation is not required for  $\pm 10$  percent line

changes. Heater supply generally incorporates stabilization to 1 or 2 percent for prolongation of tube life. Filtered air is supplied through a duct distribution system where required.

### Diversity Receivers

Receiver assembly is based on a rack-panel design as shown in the photograph with one single receiver to a bay. The panels start with an r-f preamplifier comprising one stage of 6280/416B amplification (18 db) with double-tuned band-pass output. This unit feeds into a receiving converter where the r-f signal is converted by crystal-controlled heterodyne to an intermediate frequency near 30 or 60 mc, depending on application and amplified about 20 db. The selective amplifier follows, which comprises the bulk of the linear i-f gain, the controlling selectivity and the i-f agc system, feeding into the demodulator. This panel contains a multistage limiter, f-m detector and initial base-band amplifier.

The diversity combiner contains the noise amplifier-rectifier system and the cathode follower for this branch of the diversity arrangement. All diversity cathodes are tied together for d-c by interbay cables and each combiner contains an independent output base-band amplifier. This makes possible the immediate use of receivers in any diversity combination, or singly without diversity. Control, power supply and blower panels are gen-

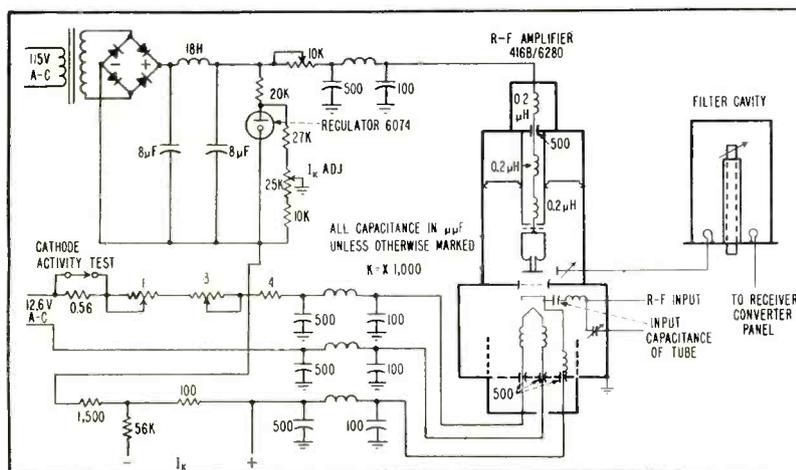


FIG. 3—Detail of the receiver r-f amplifier circuit showing use of 416B tube

erally similar to those for the exciter.

The power amplifiers used with these equipments employ Eimac external cavity klystrons. The 10-kw amplifier uses the four-cavity 4K50000L and the 1-kw amplifier the three-cavity 3K3000L. The larger tube is liquid cooled and the smaller is air cooled.

In the 10-kw unit the equipment is arranged in four frames. The power rectifier contains an Askarel-filled unit to supply unfiltered 17-kv at 2 amperes for the klystron beam. Rectifiers are twelve Eimac 2-240's in a three-phase full-wave bridge. The bombarder supply contains an Askarel-filled filament and bombarder anode source for 2,200 v at 0.75 amp. The 1-kw air-cooled unit is mounted in a single cabinet. The smaller tube uses a package heater.

A feature of these amplifiers, particularly in applications where there is a premium on bandwidth control for distortion purposes, is the absence of feedback. There is consequent complete independence of the individual tuning controls. The entire r-f system is at ground potential and is enclosed without break by blocking capacitors or otherwise. Leakage field is entirely negligible.

At the bandwidths required, the power gain of the four-cavity tube is over 30 db and of the three-cavity tube over 20 db, permitting the use of the same basic exciter for either output. In use, the input and output cavities are tuned to resonance and the intermediate

cavity or cavities detuned. Intermediate cavity detuning is determined by minimum a-m output using a test deviation and a-m probe detector with an oscilloscope on the output. Tuning procedure for f-m linearity limits using the above indication takes about two minutes.

#### Random Noise Loading

In the development of these equipments an important adjunct tool has been random noise loading for evaluation of modulation-product generation or intermodulation. The modulation signal with frequency-division multiplex telephony during actual service is a relatively random affair, strongly resembling thermal noise.

The similarity is close enough to enable the rather close simulation of traffic by its use. The ideal way is to provide a filtered block of uniformly distributed noise as signal, extending over the entire base band except for a slot of width approximating a single-sideband telephone channel 4 kc wide with adjustable location in the base-band.

Power level is adjusted to represent the desired loading. Using an analyzer type meter at the output of the device under test, the ratio of power per unit of small bandwidth in the illuminated region and the dark slot is measured. This is a direct evidence of the average nonlinearity of the device under test.

As a practical matter, it has

been found that, if the center 50 percent or more of the base band of these radio equipments is illuminated and the dark low and high ends used to secure ratios, the data yielded reliably indicates the traffic performance. This method is used in circuit design, production testing and field maintenance. It gives answers directly interpretable in terms of performance under traffic conditions. It is intrinsically simpler than measurements using tones. An f-m transmitter-receiver combination of the kind described here, with the illumination peaks extending to the rated complex deviation and exhibiting ratios in the order of 50 db, is comparable in linearity to this equipment.

The radio-frequency amplifier shown schematically in Fig. 5 exhibits an important feature for this class of equipment. The grid is grounded for d-c and the cathode is returned to a negative supply through a high resistance. This supply is in the order of 50 volts negative to ground and is stabilized. By this means, which is d-c feedback, the static tube current is heavily stabilized, resulting in considerably more uniform performance, including gain, throughout tube life. It likewise enhances prolonged effective tube life. All miniature tubes in addition to the 416B are so handled in both exciter and receiver. Negative cathode returns are not shown in Fig. 4 for diagram simplicity.

While the 416B tube originated as a low-power transmitting tube at 4 mc, it has exhibited superior performance as a small-signal amplifier up to frequencies well in excess of 1,000 mc. Typically it provides maximum noise figures of 5 db at 500 mc and 8 db at 1,000 mc. Its transconductance is high enough and the transit time low enough in this range that no noise figure improvement by mismatch is secured.

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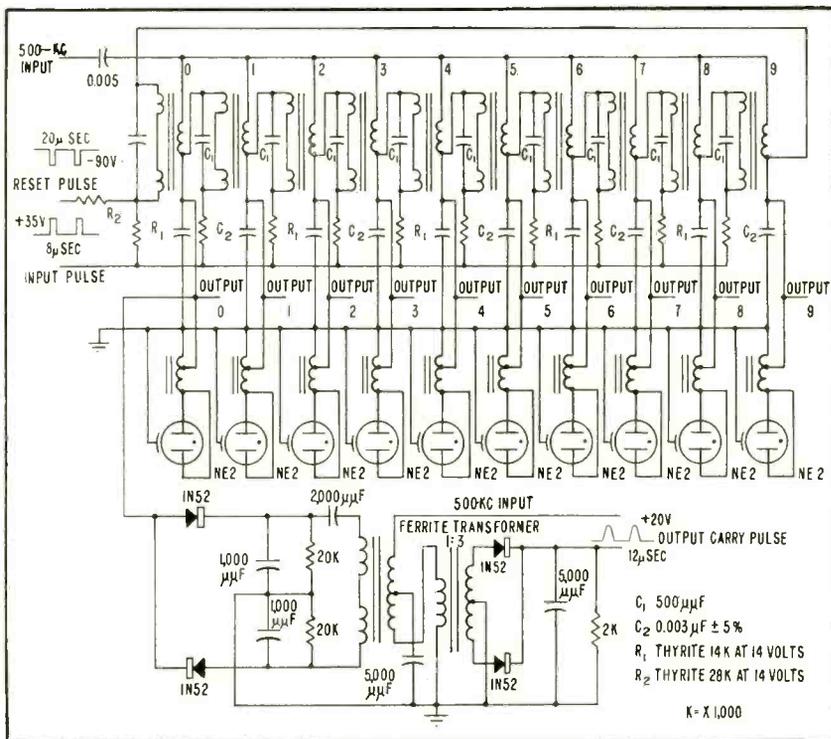
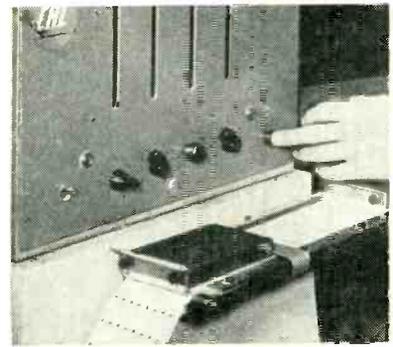
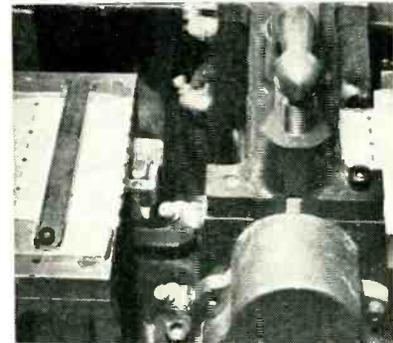


FIG. 1—Ferroresonant ring decade scaler eliminates vacuum tubes



Automatic reset repeats cycle



Selenium photocell mounting

# Counting Labels With

**SUMMARY** — Industrial application of photocell device and predetermined counter gives precise count and automatic control of paper-tape winding machine. Decade counters provide direct readout of label units

By **ERIC SWARTHE** and **CARL ISBORN**

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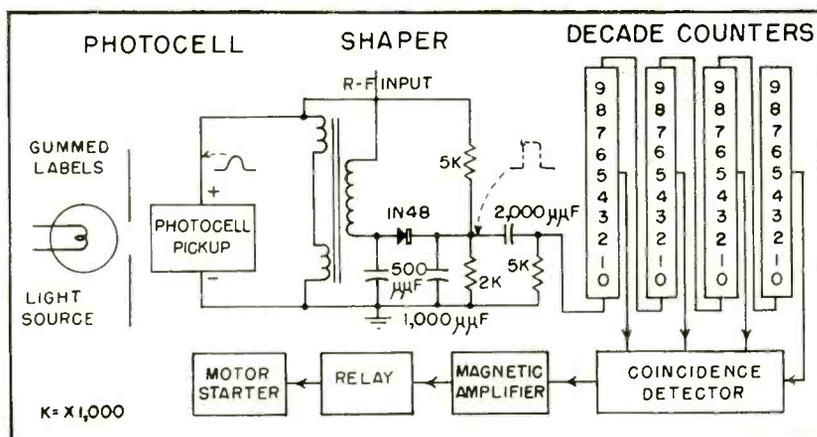
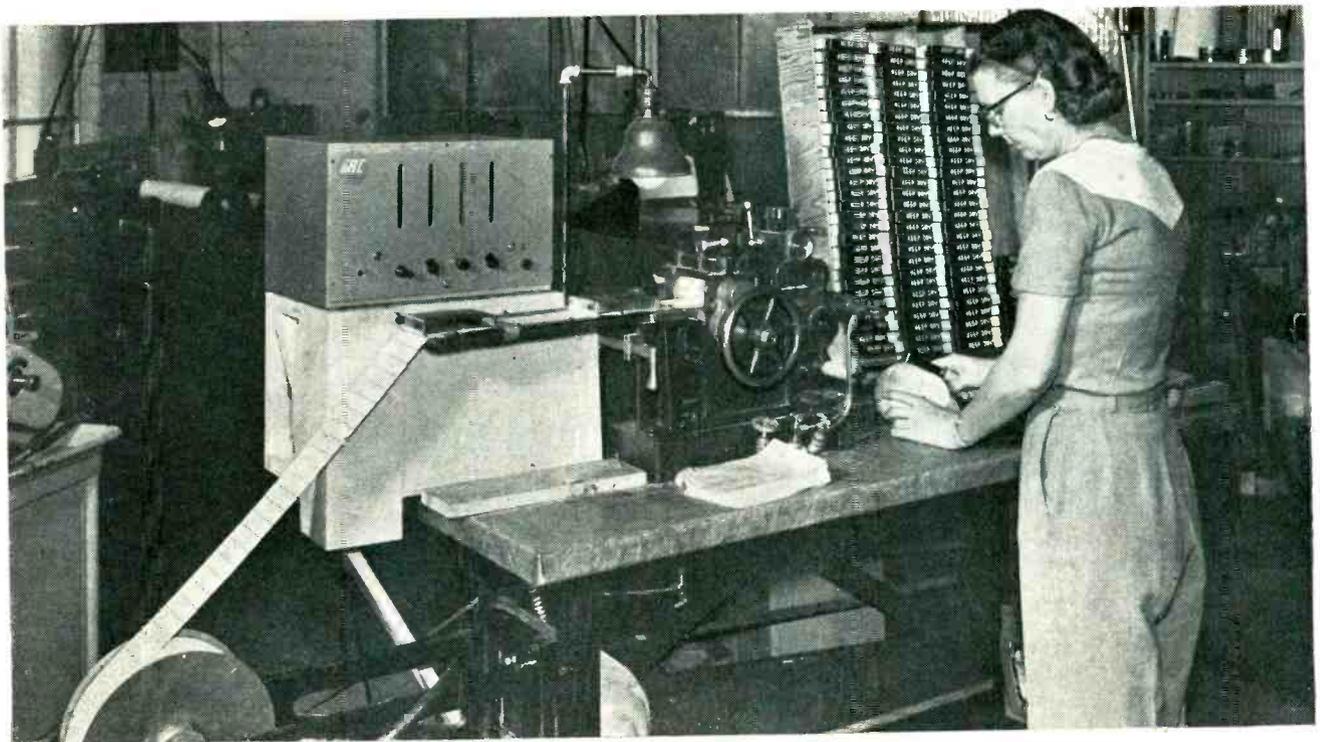


FIG. 2—Interconnection of units shows motor control actuated by light on photocell

**T**HE LABEL MANUFACTURER'S PROBLEM of counting labels accurately is important because an error of 1 percent can amount to a loss of several thousand dollars a year. As labels vary in width, counting them by recording the revolutions of a pair of rubber-coated drive rolls requires computation. Slippage through the drive rolls makes accurate counting impossible and impairs the efficiency of the slitting operation.

A method of directly counting individual labels has been developed. A photocell pickup is used to detect the diamond-shaped hole between labels. The photocell output is fed into the input of a predetermined counter. This arrangement simplifies the mechanical



Label-counter is actuated by light (above machine) falling through diamond-shaped holes between labels onto photocell

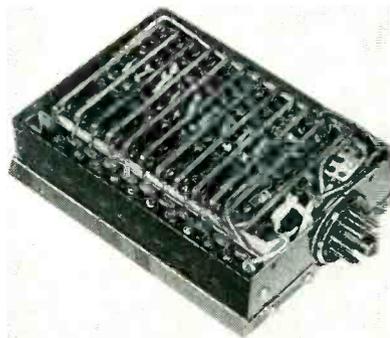
# Ferroresonant Rings

problem of high-speed feed as the paper is pulled through the slitter knives by driving only the take-up reel.

The problem then is resolved into selecting a four-digit predetermined counter that can count at rates above 30 a second, is not over 10 inches high, 12 inches long and 11 inches deep and does not require maintenance by a technician. Use of ferroresonant ring elements permits building a counter to meet these needs.

The ring elements are built into decades as shown in Fig. 1. The system is connected as indicated in Fig. 2. A hermetically sealed selenium photocell is used.

The coincidence circuit employs only four 10-position rotary switches and four diodes. More control points can be added for other operations as required, such as for slowing down or speeding up the motor. The output of the coincidence gate is fed into a miniature magnetic amplifier that operates a re-



Plug-in decade counter assembly

lay. The relay controls the motor's magnetic starter coil in a conventional manner.

While magnetic amplifiers could be used throughout, the motor starter is used instead for reasons of economy. The r-f power supply uses a selenium rectifier.

A characteristic of ferroresonant circuit operation is the all-or-none feature. The counter being made of true rings cannot, in the event of a malfunctioning component, divide by two or some other

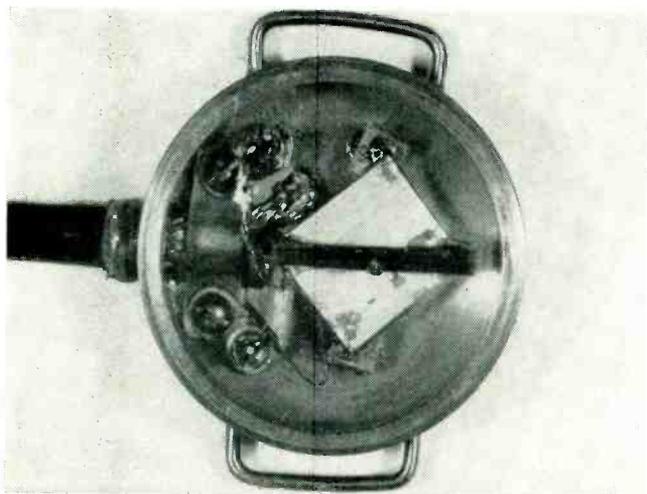
integer. It will either count correctly or not at all.

Should the counter malfunction, the service procedure is simple. If the indicators do not light, the r-f power supply has failed. The oscillator tube or the plug-in unit can be replaced. Plate supply failures are extremely rare because of the low power requirements—about 20 watts input.

Simplicity and reliability of ferroresonant circuit design make its use suitable for other applications such as frequency dividers, time-control circuits, frequency meters and memory systems. Other applications are production counters, shaft positioning, electrical replacement of gear trains and complex control systems.

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Brachial-artery pickup microphone with diaphragm removed is housed in Fleisher-type stethoscope

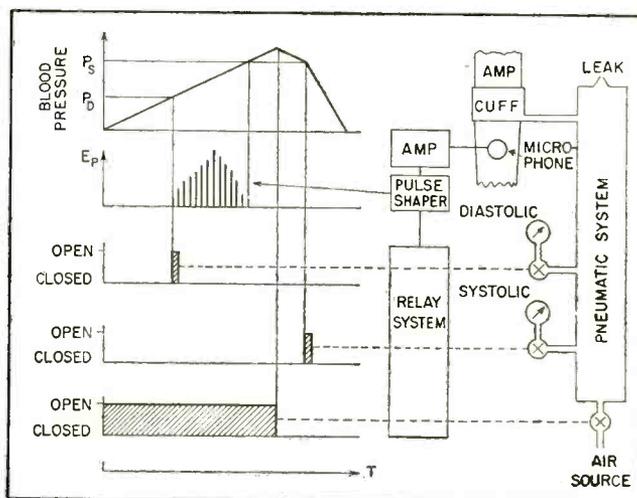


FIG. 1—Functional diagram shows interrelation of components for measuring blood pressure

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# Physiological Monitor

**SUMMARY** — Selected physiological variables on patient undergoing anesthesia and surgery are monitored automatically. Changes are indicated on operating-room console and also continuously recorded. Design features provide safeguards against operating-room environmental hazards

**C**HANGES in the blood pressure, pulse rate and respiratory rate and minute volume of a patient under anesthesia are automatically detected by a physiological monitor that has been developed.

The monitoring equipment is housed in two sheet metal cabinets as shown in the photograph. The low cabinet on the right is the operating room console, which is made safe for use in the presence of explosive vapors by maintaining the enclosure at a positive internal pressure with respect to its surroundings. The large cabinet is placed in a location free of explosive vapors and houses the recorder and purging air supply as well as other circuit components whose proximity

to the patient is not required. The units are interconnected by cable and air line permitting a maximum separation of about 20 feet.

## Blood-Pressure Measurement

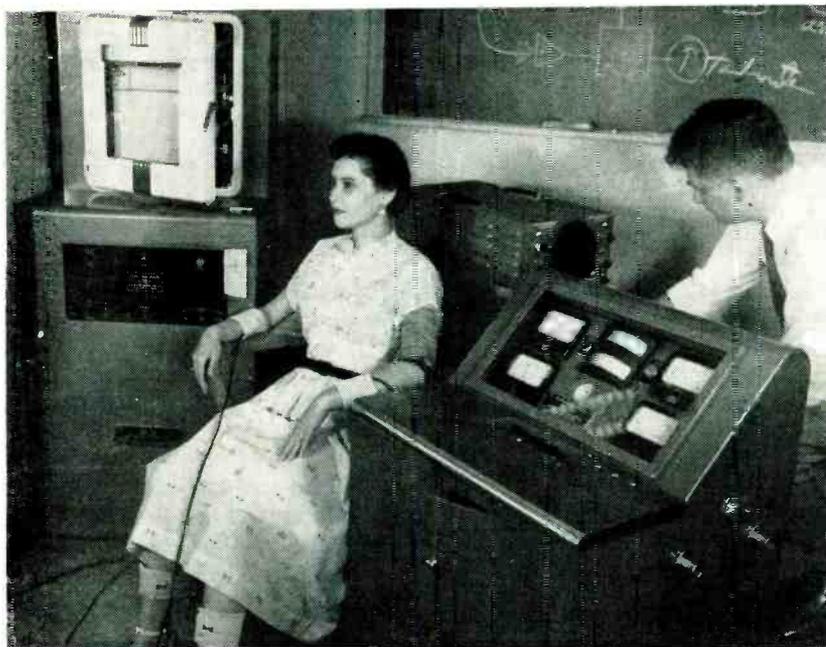
An indirect method of arterial blood-pressure measurement is used by adapting a clinical sphygmomanometer. Measurement is made by detecting the maximum and minimum arterial pressures from the points at which sound disappears when the arm artery is occluded.

Figure 1 is a functional diagram of the system showing the interrelation of the components. Pressure in the cuff (arm band used to measure blood pressure) increases as in the upper curve when the valve

from the air source is opened. A microphone located over the brachial artery begins to indicate sounds as the pressure exceeds the diastolic value,  $P_d$ , approximately as illustrated in the second characteristic. This sound reaches a maximum and decreases, disappearing after the cuff pressure exceeds the systolic point,  $P_s$ .

The amplifier and relay circuit are arranged so that upon the inception of the first sound a solenoid valve opens permitting an attached gage to attain the diastolic pressure and then closes retaining this pressure. Pressure in the system continues to rise until systolic pressure is reached. Since it is not

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Physiological monitor in operation. Electrodes are connected to patient's arms and legs. Microphone is strapped over the brachial artery in arm

# for Anesthesia

possible to determine the point at which sound disappears until that point has been passed, the pressure is carried beyond this point and the inflating source is removed from the system. A small orifice in the system permits pressure to decrease slowly and as the first sounds corresponding to the systolic pressure are received a second solenoid valve and gage are opened to retain this pressure. Following this, the cuff is rapidly deflated to minimize the period of pressure application.

The entire process proceeds automatically under the control of a program switch that initiates the measurement at 3-minute intervals. The systolic and diastolic pressure information is displayed on two electrical panel meters, which retain the measured value until a new determination is made.

Excessively high pressures are prevented by including a mechanical popoff valve, which opens and relieves cuff pressure when the system pressure exceeds a preset value. In addition, an adjustable electrical

limit switch, set at a value reasonably well above the patient's systolic pressure, resets the system to its initial deflated state if the system pressure exceeds this value.

### Safety Features

Application of pressure for long intervals of time is prevented in two ways. A solenoid-operated valve, normally functioning to discharge the air from the system at the end of each determination, is of the open type that would discharge the air in the event of power failure. A continuous slow leak makes it impossible to sustain pressure in the system without an active source.

Sound originating in the artery during the measurement of blood pressure is considerably attenuated by the time it emerges from the tissues and impinges on the microphone. Considerable sensitivity is required of the microphone-amplifier combination to detect the onset of sound and raise it to the level required to operate the threshold de-

tor. This sensitivity had to be achieved while minimizing unwanted signals originating from microphone frictional noises and ambient acoustical disturbances in the immediate vicinity.

A suitable microphone, shown in a photograph, was developed by modifying a displacement type pickup. This unit has good response at the lower audio frequencies up to 100 cps, an important requirement for this application.

### Circuit Details

Figure 2 is a schematic of the amplifier. The 5879 input tube ( $V_1$ ) is required to keep hum level from the heater source at a minimum because of the small signals.

A total gain of approximately 10,000 is realized from  $V_1$  and  $V_2$ . Triode  $V_{3A}$  brings the signal level up by a factor of five before going through the 3-section R-C filter.

The filter output is introduced into a pulse stretching and equalizing circuit in the form of cathode-coupled one-shot multivibrator  $V_4$ . Triode  $V_{3B}$  serves as a buffer stage which makes the triggering of the multivibrator less dependent on amplitude and waveform of incoming pulses. An NE-51 neon lamp connected to the plate of  $V_{4A}$ , the normally nonconducting triode of the multivibrator, flashes each time a pulse triggers the multivibrator. This indicator permits the operator to adjust gain control  $R_1$  to the point where the proper sound level at the microphone operates the multivibrator.

This portion of the system converts sound pulses that are above a certain threshold level and have the proper frequency content into electrical pulses of uniform amplitude and duration. These pulses provide the information by which the relay and control circuits perform the measurement functions of the system.

The method of applying cutoff bias to the pulse amplifier requires a brief explanation. The two triode sections of  $V_5$  are connected in a series arrangement. Signals from the multivibrator are applied to the grid of  $V_{5A}$  and the gating voltage is applied to the grid of  $V_{5B}$ . The negative gating bias can be applied to the grid of  $V_{5A}$  either when con-

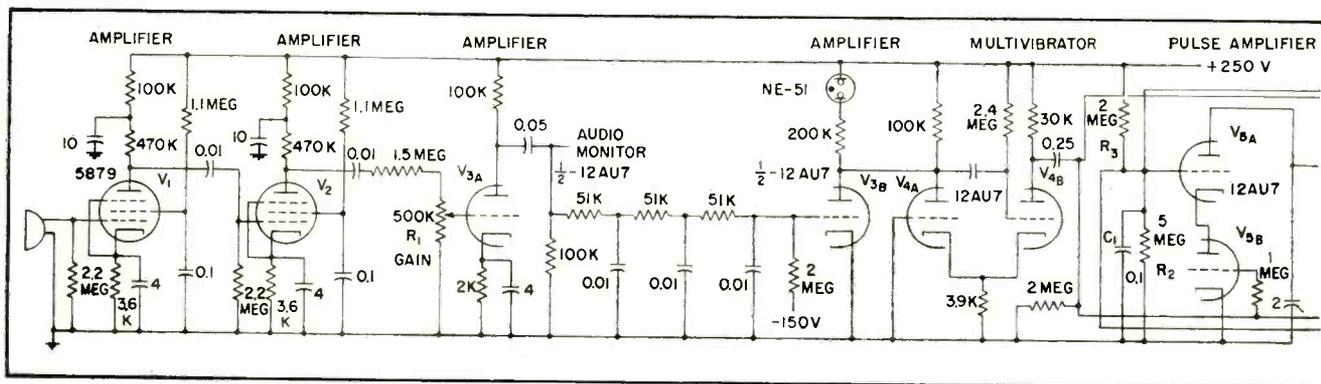


FIG. 2—Three-stage microphone amplifier feeds pulse-stretching and equalizing multivibrator. Output pulses trigger relay system

tacts of one of the relays or a pressure switch are closed. When these contacts are opened, positive bias is restored to the gating grid after a time delay determined by capacitor  $C_1$  and resistors  $R_2$  and  $R_3$  permitting pulses on the input grid to operate another switching relay.

This time delay prevents electrical disturbances created by the opening and closing of the many relay contacts from introducing spurious signals into the system.

### Heart Rate Measurement

The body responds to stress by changing the rate at which blood is pumped through the circulation by increasing or decreasing the pulse rate, depending upon the circumstances. It is particularly important in surgery and anesthesia to monitor pulse rate, since the action of some of the anesthetic drugs and surgical procedures tend to increase cardiac irritability.

The common clinical method of determining pulse consists of counting the number of cardiac actions, manifested in the momentary dilation of the radial artery, that occur in the given base period.

The system developed for determining heart rate is similar in principle to that determined by Sturm and Wood.<sup>1</sup> The point of departure results from a need to memorize and display the peak voltage reached by the timing capacitor.

The input from the patient electrodes, similar to conventional electrocardiogram leads, is applied to a differential-amplifier input stage, which is adjusted to give good discrimination against electrostatically induced interference from the power line. The resulting single-ended output is amplified by

several additional stages and is applied to a pulse shaper in the form of a single-shot multivibrator. The signal level is adjusted to the point where the R wave (medical term for sharp-peaked waveform in cardiac potential) can trigger the multivibrator once for each cardiac cycle, causing a momentary actuation of a relay.

In the timing operation, the function of the relay is to transfer the voltage from a timing capacitor to a storage capacitor and to follow this by resetting the timing capacitor to zero voltage. The timing capacitor charges linearly between relay actuations and the maximum potential attained during this period is proportional to its duration. This voltage is transferred to the storage capacitor.

The electrocardiograph (ekg) amplifier and threshold detector portions of the cardiometer system are shown in Fig. 3. This unit amplifies the signal picked up at the patient electrodes to a level sufficient to trigger a one-shot multivibrator. The amplifier design is such that small signals from sources having large distributed capacitances in the presence of power-frequency fields can be amplified.

Input tubes  $V_1$  and  $V_2$  are connected as differential amplifiers. One input signal is applied to the grid of  $V_1$  while the other input is applied to the cathode through cathode follower  $V_2$ , which operates near unity gain. To compensate for the departure of  $V_2$  from unity gain, which affects the attainable differential action, the signal is fed back from the plate of  $V_1$  through  $R_1$  to the cathode of  $V_1$  and adjusted for maximum differential action.

Plate and cathode lines are heavily decoupled to eliminate transients in the low-level amplifier stages. Electrolytic bypass capacitors paralleled with paper capacitors eliminate high speed transients.

The signal is passed from the differential stage to  $V_{4A}$  through a 6AU6 pentode stage of conventional design except for biasing. Bias is derived through the grid leak to eliminate the large cathode capacitor that would be required for cathode bias. In addition,  $R_2$  provides a high-impedance path to prevent blocking on overloads. The output of  $V_{4A}$  is applied to a low-pass R-C filter, which discriminates against spurious high frequency noise signals. The signal feeding the filter is also brought out to a jack on the panel from which the electrocardiogram may be recorded. The signal from the filter is introduced into a pulse stretching and equalizing network in the form of cathode-coupled one-shot multivibrator  $V_5$  and associated network.

Each R wave of the cardiac potential is of sufficient magnitude after amplification to trigger the multivibrator whose output then consists of a series of pulses of equal magnitude and duration that are in synchronism with the pulse. Duration of output pulses are adjusted to permit proper functioning of the tachometer (Fig. 4).

Triode  $V_{5B}$  to which these pulses are fed is a current amplifier which operates the relay on the cardiometer chassis (Fig. 4) for the duration of the pulse.

### Pulse-Rate Indicator

The timing circuit in Fig. 4 consists of a linear sweep circuit plus



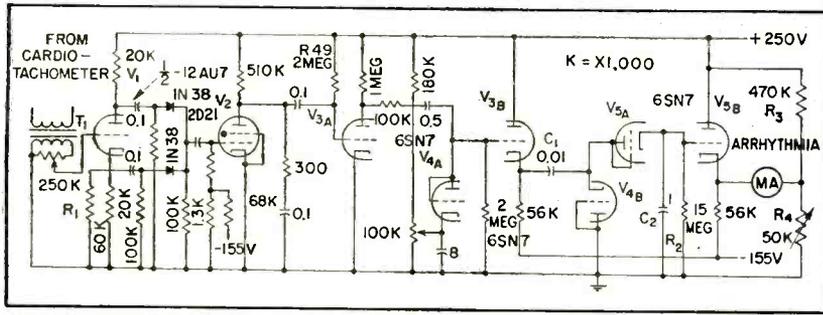


FIG. 5—Arrhythmia-detector gives indication of cardiac irregularities

time average of these incidents is the output of the system and indicates the irregularity duration.

The circuitry resembles that of an instantaneous tachometer. The arrhythmia detector derives its input at the point where the tachometer transfers its data to the storage or memory function. If the time intervals between pulses are equal, the storage capacitor in the memory system remains at the same potential except for a small loss through leakage. However, for any deviation between two successive pulses, current must flow from or to the storage capacitor, equalizing the voltage with that of the sweep circuit.

As the transfer switch closes, a pulse of current passes through a high-turns-ratio transformer and gives rise to a voltage on the output side that is introduced into a pulse-height discriminator. If this pulse is of sufficiently high amplitude the discriminator responds and produces an output pulse via the second pulse shaper that is fed into the integrator circuit. The time average of these pulses appears on the output indicator.

### Circuit Details

Figure 5 shows the arrhythmia-detecting circuit, which derives its input from transformer  $T_1$ . The primary winding of  $T_1$  receives the charging current of the storage capacitor during the interval that the information is transferred from the timing circuit. The polarity of the resulting voltage across the secondary impedance depends on whether the pulse time interval is greater or less than the previous interval. Since the threshold interval deviation detector must respond to either condition, it is necessary to put the input signal through a stage that

converts signals of either polarity into the positive-going voltage required to trigger the threshold detector.

The converter stage developed around  $V_1$  is a split-load phase inverter whose plate and cathode outputs are put through crystal diodes and then mixed. The diodes are connected so that only positive-going voltages appear across the output. A negative-going input to the converter stage appears as a positive signal via the plate output circuit. A positive-going signal appears positive at the output via the cathode route.

Depending on the level of this converted signal, which can be adjusted to the required interval deviation by  $R_1$ , the threshold detector in the form of biased thyatron  $V_2$  can be made to fire. The result is a negative-going pulse at the plate, which is capacitance-coupled to normally fully conducting  $V_{3A}$ . The plate of this tube gives a positive-going pulse limited in amplitude by  $V_{1A}$ .

At this point, a pulse of fixed amplitude and duration appears each time the amplitude of the input pulse exceeds a predetermined threshold. The equalized pulses are accumulated and their time average obtained. The equalized pulse is put through  $V_{3B}$  and the output is applied to the series arrangement of  $C_1$ ,  $V_{5A}$  and  $C_2$ . Capacitors  $C_1$  and  $C_2$  are so proportioned that only 1 percent of the applied voltage accumulates on  $C_2$  for each pulse.

Diode  $V_{5A}$  prevents the discharge of  $C_2$  and  $V_{5B}$  discharges capacitor  $C_1$ , making it ready for the application of the next pulse. Each succeeding pulse adds an approximately equal increment of charge to  $C_2$ . If  $C_2$  were isolated, the voltage across it would continue to in-

crease; however, the presence of  $R_2$  shunting  $C_2$  bleeds off charge from  $C_2$  to make the voltage appearing across this R-C combination a function of the number of pulses received per unit time.

This voltage is the input for  $V_{5B}$ , which supplies the current for an indicating meter. The output current of  $V_{5B}$  corresponding to zero input is balanced out by returning the indicator to divider  $R_3R_4$ .

The accurate measurement of minute volume, the volume of air in liters brought into the lungs in a minute, is important in the estimation of respiratory adequacy.

A patient undergoing inhalative anesthesia is tightly coupled to an anesthesia apparatus through a face mask or endotracheal tube. The equipment for the measurement of volume and rate is placed in the out-flow tube.

A bellows-type positive-displacement flow meter was modified to provide an output shaft in place of the conventional dial indicator. Minute volume is by definition the volume of expired air passing through the meter in a minute. Consequently the angular rotation of the output shaft is measured for the timing interval and then displayed in the proper units. The system retains and displays this information during the period required to obtain subsequent minute volume data.

Respiratory rate is obtained also from the output shaft of the displacement meter by counting the number of times the shaft stops and starts during the 1-minute base timing interval.

It is not possible to identify personally all contributors to the development of this instrumentation. However, the advice, participation and interest of S. B. White, E. B. Touhy, John C. Rose, Edward D. Fries, Edward H. Partenope, Charles S. Coakley and Solomon Albert are gratefully acknowledged.

This research was supported jointly by the Veterans Administration and the Office of Basic Instrumentation, National Bureau of Standards.

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# Automatic Programming Cuts Broadcasting Costs

**SUMMARY** — Nonattended system permits continuous automatic a-m station operation for as long as 18 hours. Announcements and musical selections can be alternated in manner undetectable from live program. Automatic correction of timing errors assures split-second accuracy of station breaks

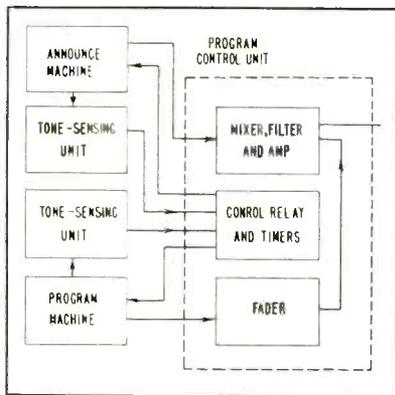


FIG. 1—Programming system

By PHILIP SMALLER

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**B**ROADCASTERS can solve the problem of making profits and maintaining or lowering rate levels in the face of increasing costs by increasing operating efficiency through use of automatic controls.

The programming system to be described permits automatic, non-attended broadcasting of program schedules as long as 18 hours. Program material played on the system is, in every way, identical to a live broadcast. Announcements and musical selections can be alternately played. Every 30 minutes a station break can be interposed. Following the station break, with smooth con-

tinuity, the succeeding half-hour program will start in perfect synchronism with real time.

## Equipment

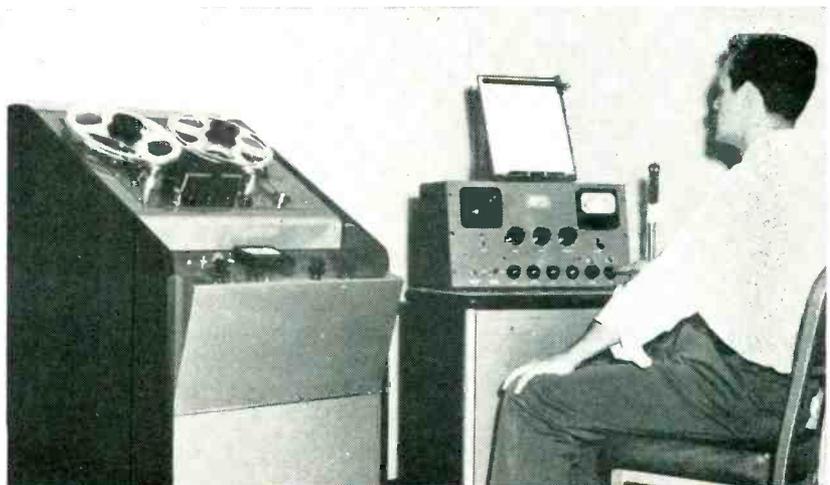
Two Ampex Model 450B long-playing tape reproducers are used for playback. One playback unit, called the program machine, is used to reproduce the music tape and the other, called the announce machine, is for reproducing the local-announcement tape. To record the local-announcement tape the system requires a Model 350 or comparable machine. In addition to these standard components, two special units are required. The first, the program-control unit, oversees the operation of the system during playback. The second unit, the record console,

houses the necessary components for recording the voice announcements.

The system components are shown in Fig. 1. The music tape, with a 25-cycle control tone recorded after each selection, is placed on the program machine. The announce tape, with a 25-cycle control tone after each announcement, is placed on the announce machine.

## Operating Sequence

The program machine plays the first selection. At the end of the selection the control tone from the music tape energizes relays that shut down the program machine and start the announce machine. At the end of the announcement, the control tone on the announce tape



Announcer seated in front of record console prepares announcement tape

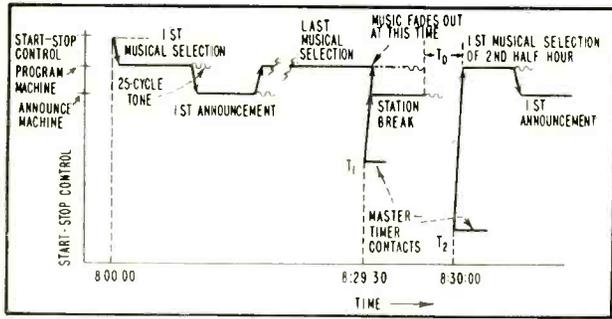


FIG. 2—Switching-sequence diagram for half-hour program

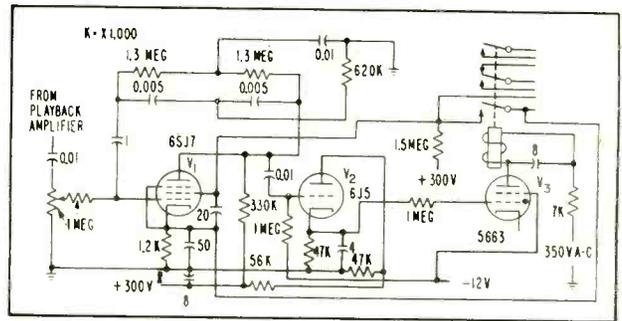


FIG. 3—Tone-sensing unit used in playback machines

shuts down the announce machine and starts the program machine. This flip-flop operation continues for the greater part of the program.

Audio output from the program machine is fed to both the program-control unit and the control-tone-sensing unit. If there is any 25-cycle signal in the output the sensing unit will energize the appropriate relays in the program-control unit to deenergize the capstan solenoid of the program machine and energize the capstan solenoid of the announce machine. Energizing and deenergizing the capstan solenoid instantly starts and stops the motion of the tape.

The program control unit also mixes the signals from both machines to a common output and filters out all the 25-cycle components. The fader circuit is necessary to re-

duce the level of the music during station break. A master timer controls the station breaks and a reversing timer reverses the direction of the program machine.

### Timing Errors

If the system is to be used for a long time interval, say for a period of two or more hours, it will be necessary to correct the system every half hour for timing errors. Figure 2 is a sequence diagram of a typical half-hour program. The half hour under observation is from 8:00 to 8:30. At time 8:00, the start switch is thrown and the first musical selection is reproduced.

At the end of the selection, the 25-cycle tone switches the operation to the announce machine. Similarly, at the end of the announcement, the tone switches the operation back to the program machine.

Since the restriction is imposed that the total running time of music and announcements be nominally 29:45 minutes in the half-hour program, it is certain that at time 8:29:30 the system is reproducing the last musical selection of the half-hour program. At this time, the master timer assumes control over the system operation and initiates the following sequence.

At 8:29:30 master-timer contact  $T_1$  closes starting the announce machine for reproduction of the station break. At the instant the announce machine starts, the music from the program machine begins to fade out, but the machine continues to operate. Hence both machines are on at the same time. The listener hears the station break with the music barely audible in the background. When the music, which is timed to end some time between 8:29:30 and 8:30:00 reaches the

end of the selection, the tone shuts off the program machine. The announce machine continues to the end of the station break, at which time it also shuts off, but is prevented from starting the program machine. At exactly 8:30:00, master-timer contact  $T_2$  closes and the program machine starts for the beginning of a new half-hour program segment.

The time between the end of the station break and start of the program machine for the new half hour is dead air and is shown as  $T_d$ . This period can be made as small as desired. It may be reduced to zero by making the station break greater than 30 seconds, in which case it extends into the new half-hour. Regardless of how long the station break is, the program machine starts at 8:30:00 in order that the system stay in synchronism with real time. If the station break is still playing at 8:30:00, the program starts with the music faded under and then, when the station break ends, the music is allowed to fade in. This feature of overlapping music with announcements, with the music faded under, can be used at any time during the program.

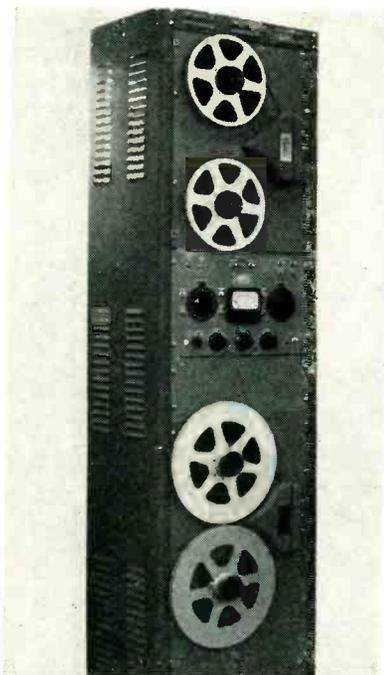
The action of the switching circuits assure less than 2 seconds between the end of an announcement and start of the music.

### Tone Sensing Unit

The tone sensing unit, which detects the 25-cycle control tone is shown in Fig. 3.

The first stage is a highly selective voltage amplifier achieved by using a parallel-T network tuned to 25 cycles in the feedback loop.

Second-stage triode  $V_2$  is biased



Program-control unit with two playback machines mounted in rack

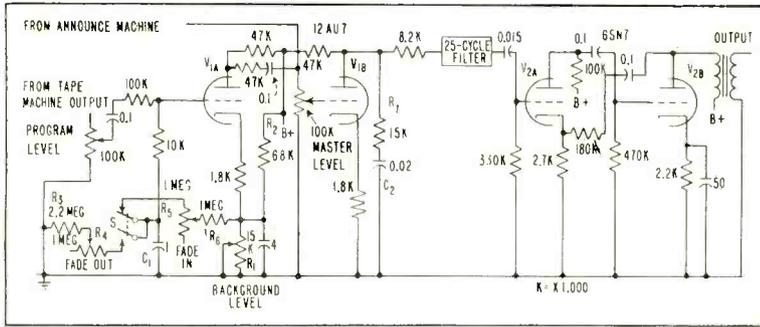


FIG. 4—Partial circuitry of electronic portion of program-control unit

to cutoff until the 25-cycle tone is reproduced from the tape and amplified by  $V_{1A}$ . Upon reproduction of the tone,  $V_{1B}$  starts conducting and a positive pulse is applied to the grid of thyatron  $V_{2B}$ . The pulse has sufficient amplitude to start the thyatron conducting and thereby energize the relay. Since the plate of the thyatron is supplied with 350 v a-c, the tube extinguishes itself when the signal ceases and the grid returns to ground potential. Contacts on the relay in turn energize the appropriate relays in the program control unit and tape transports. Both the program and announce machines have their own tone-sensing units.

### Circuits

Figure 4 is a simplified diagram of a portion of the circuitry in the program-control unit. The contacts on the program-control-unit relay responsible for the fading are shown as  $S$ .

Fading is accomplished as follows. The cathode of  $V_{1A}$  is biased approximately 35 volts positive by voltage divider  $R_3R_4$ . For normal operation of the tube, the contacts on  $S$  are closed as shown and the grid of  $V_{1A}$  is at the same positive potential as the cathode. When the relay is energized and the normally open contacts close,  $C_1$ , which was charged to +35 volts, begins to discharge to ground through the series combination of  $R_3$  and  $R_4$ . The time constant of the discharge is adjustable by varying  $R_4$ . When  $C_1$  is fully discharged, the grid is then at ground potential while the cathode is still 35 volts positive. This is sufficient bias to cut the tube off. The cutoff is gradual because of the shape of the transfer characteristics of  $V_{1A}$ .

To keep the distortion low during the fade-out, the input signal was reduced to less than 0.1 volt and the cathode resistor was left unby-passed. To achieve the fade-in,  $C_1$  is allowed to charge to +35 volts through resistors  $R_3$  and  $R_4$ . The rate of fade-in is adjustable by varying  $R_4$ .

Bias level control  $R_1$  varies the degree to which the signal is faded. By increasing  $R_1$ , the tube is driven further into cutoff and the background level of the music decreases.

The parallel-T filter network following  $V_{1B}$  attenuates the 25-cycle signal before it reaches the transmitter. The bass-boost network, composed of  $R_2$  and  $C_2$  raises the 50-cycle response of the system to give an overall frequency response of  $\pm 3$  db from 50 to 7,500 cps at a tape speed of 3 $\frac{3}{4}$  ips. Ten db of feedback around the last two stages maintains the overall distortion through the system at less than 0.7 percent total harmonic. The signal-to-noise ratio is better than 55 db. The balanced output stage will feed a 600-ohm studio line at a 0-vu level.

### Record Console

Figure 5 is the block diagram of the record console used to record the local announcement tape.

The line inputs are balanced and will accommodate input levels of 0 vu to  $\pm 10$  vu. The 25-cycle parallel-T filter prevents any 25-cycle component introduced in either the microphone or line channels from being recorded on the announcement tape.

The tone generator is a phase-shift oscillator using a 6U8. Oscillations are initiated by removing the ground connection to the grid of the

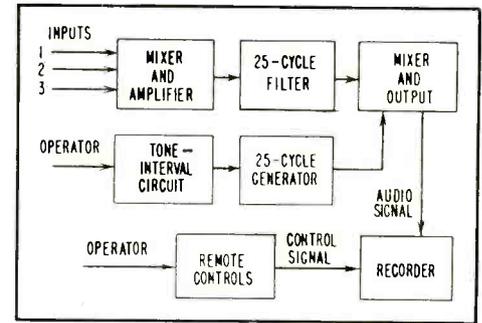


FIG. 5—Record-console block diagram

first stage of the 6U8. Since it requires several cycles for the oscillations to build up, the switching transient is negligible. A timer, which is energized whenever the announce tape is in motion, is used to indicate the exact amount of time the announcements have consumed.

In preparing the announce tapes, the following technique is used. Number of musical selections fixes the number of breaks in which announcements may be placed. Total running time of the music fixes the minimum time which must be consumed by the announcements. The combined running time of music plus announcements should be nominally 29:45

If more announce time is desired in the half-hour program, the announcer can overlap music and announcements with music faded under.

The announcer, in preparing the announce tape, starts the recorder and begins reading the announcements. At the end of each announcement he presses the tone button and the 25-cycle control tone is automatically recorded for a fixed interval. All announcements may be recorded without stopping the recorder. Following the last announcement the station break is recorded.

If no announcement is to be made following a selection, the announcer places the tone on the tape. Then, during playback the system will automatically continue on to the succeeding musical selection.

Figure 2 shows a typical sequence with the station break illustrated as being a few seconds less than 30 seconds in length.

The system can be modified to operate a multiple record changer so the latest record releases can be used.

# Juke Box Uses

**SUMMARY** — Solenoid-actuated selection storage levers are replaced by ferrite toroids in coin-operated automatic phonograph. Coincident write-in currents, each of half the required amplitude, eliminate group-switching relays. Automatic core-inspection equipment speeds mass production

By **CLARENCE W. SCHULTZ**

and **GEORGE F. BOESEN**

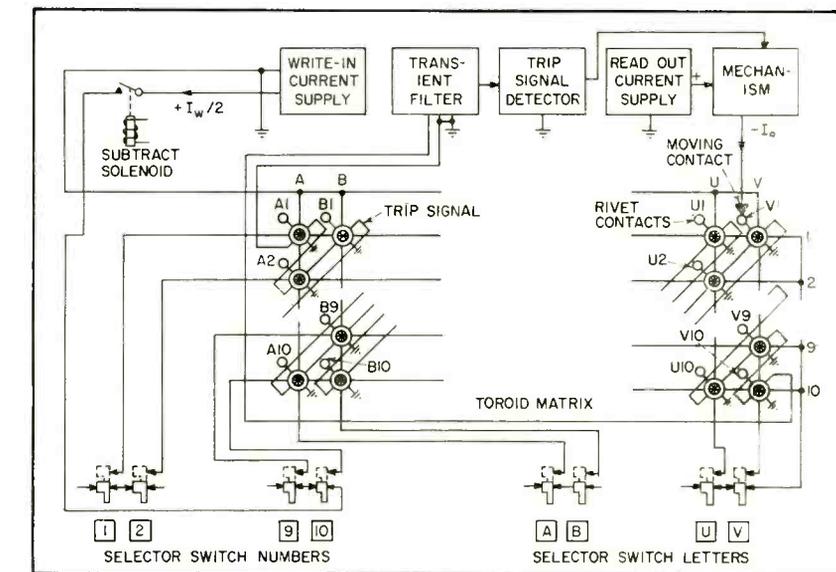
*The J. P. Seeburg Corp.  
Chicago, Illinois*

**C**OINCIDENT-CURRENT magnetic matrices have been successfully used in laboratory<sup>1,2,3</sup> and commercial<sup>4</sup> digital computers. Although other applications of this random-access information-storage system have been suggested,<sup>1</sup> its use in an automatic phonograph is believed to be a new application.

The low speed of operation has made it possible to eliminate the complex vacuum-tube driving circuits used in computers and permits magnetic cores to compete economically with any other memory system. Basic design work on the phonograph selection system was completed in 1953<sup>5</sup> but much work was necessary to perfect the system and change over all phonograph production.

## Coincident-Current Memory

In a digital computer using magnetic-core memory one binary digit is stored in each toroidal core. In the automatic phonograph using magnetic-core memory one selection is stored in each core. Each core has two normal states of magnetization. Remanent flux  $\phi_R$  exists in either the clockwise or counterclockwise direction. One of these states is arbitrarily called zero or no selection. When a selec-



**FIG. 1**—Storage system uses coincident write-in currents and individual read out. Signal output is picked up on single wire threaded through all the cores

tion is written into the memory system the appropriate core has its magnetization reversed by a pulse of current through wires threading that core. This state is called one or a selection.

The matrix is an array of storage elements constructed such that any element in the array may be energized by the coincident operation of two input lines. The magnetic state of the ferrite core is set by the field of the currents in the two independent write-in wires threaded through the center of the core. Any core of the 200-core array in the phonograph can be reached by energizing 2 out of 30 wires.

In the phonograph, Fig. 1, each of the two wires selected simultaneously carries a current pulse of amplitude  $+\frac{1}{2} I_w$ . The current in a single wire is not large enough to

change the magnetization of any core from zero to one, only the core at the intersection of the selected wires where the total magnetizing current is  $+I_w$  will have its magnetization reversed. Of the remaining two wires of the four threaded through the core center, one wire supplies read-out current  $-I_R$  and one is used for signal pickup.

## Phonograph Operation

The Seeburg Select-O-Matic 200 is an automatic 45-rpm 200-selection phonograph mechanism.<sup>6</sup> The records are stored vertically in a row and played in a vertical position. See Fig. 2. The turntable is mounted on a carriage which moves on rails past the records. The carriage stops at the selected record positions and plays the record. The carriage travels in one direction

# Ferrite-Core Memory

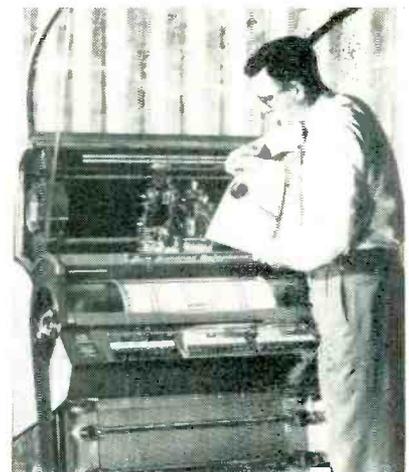
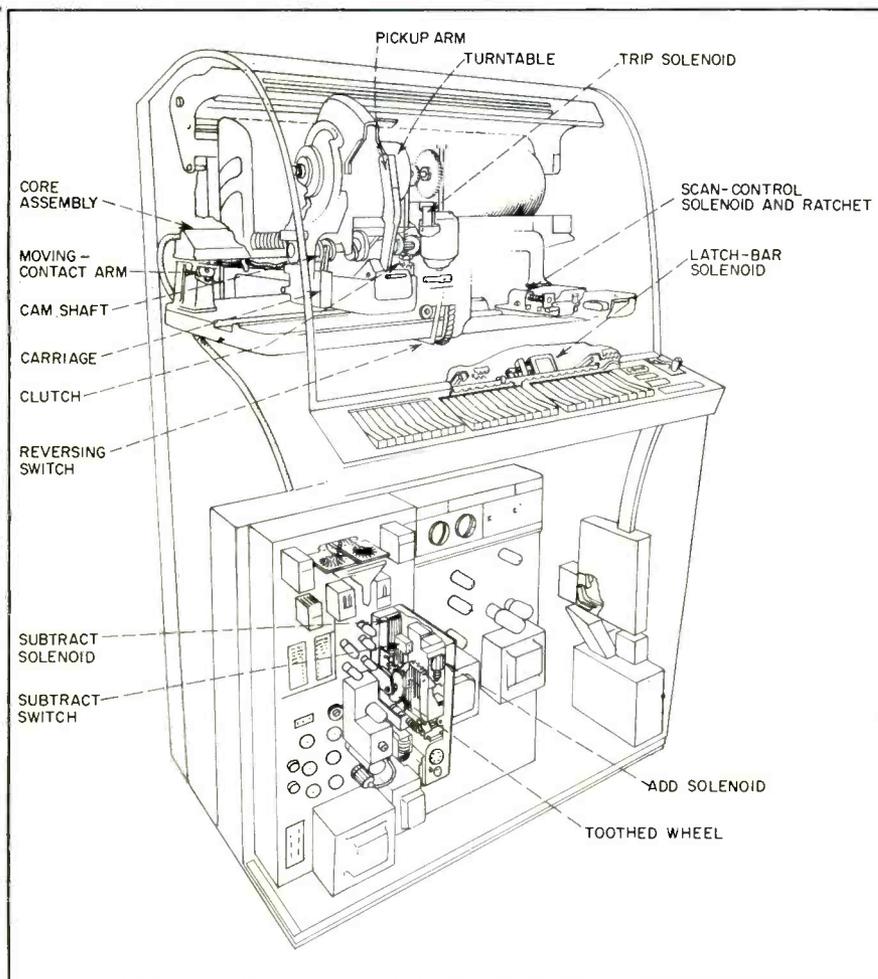


FIG. 2—Mechanical details of phonograph with parts in their relative position, left. Also shown are rear and front views of instrument

playing one side of selected records before reversing direction to play the opposite side of selected records.

## Selection

When the customer drops coins through the slot, credit is made by energizing an add solenoid through coin operated switches. This solenoid drives a pawl which advances a toothed wheel a number of notches proportional to the total value of the coins inserted. A contact plate is rotated into position so that current is momentarily supplied to a solenoid which controls a latching bar behind the selector pushbuttons.

When the customer closes both a letter and a number switch with the pushbuttons, the switches are locked in position. A subtract solenoid rotates the toothed wheel a number of notches in the reverse

direction proportional to the value of the selection played and closes a momentary subtract switch.

One set of contacts on this switch connects the write-in current supply capacitor  $C_w$  (Fig. 3) to the number selector switch, through one of 10 matrix row wires, back to the letter selector switch, through one of 20 matrix column wires to magnetizing the core at the intersection of the two chosen matrix wires in the direction of a selection.

The same current flows through both write-in wires in the core. To keep the write-in current waveform stable this set of contacts is a silver-alloy connection. Low switching voltage and stable low resistance contact material prevent contact vaporization and erratic current flow during the first few microsec-

onds of contact closure. The same subtract switch closes the circuit to the scan-control solenoid. This solenoid pulls a ratchet to the last of three pawl positions, closing the power switch to the motor in the carriage. Another contact of the subtract switch supplies current to a timing relay which opens the circuit of the subtract solenoid after a pre-determined interval.

## Scanning

The carriage is driven past the record magazine starting from the right end of the magazine. Direction of travel is changed at each end by a reversing switch. Each time the carriage returns to the right end of the magazine the scan-control ratchet is stepped down one notch by a mechanical cancel lever. When the pawl returns to the first

position on the ratchet, the motor circuit is opened. Normally after two round trips the carriage returns to the right end of the magazine.

It is necessary to correlate the magnetization of each ferrite core in the matrix with one side of a record stored in the phonograph library. The cores are physically arranged in two rows parallel to the mechanism carriage rail, one row for right-to-left carriage travel for playing the right side of each record and the other row for the left side. Scanning of all 200 cores takes 40 seconds.

Read-out current  $-I_R$  is applied to each core in turn of the appropriate row of cores from a moving contact arm on the carriage through an electrical contact at each core.

Current is supplied by the discharge of capacitor  $C_R$  through the 2D21 read-out thyatron shown in Fig. 3. Firing of the thyatron occurs during the time the contact arm is on an individual core contact and is synchronized by a star-wheel switch geared to the stationary rack. Due to the high read-out current and voltage a thyatron is

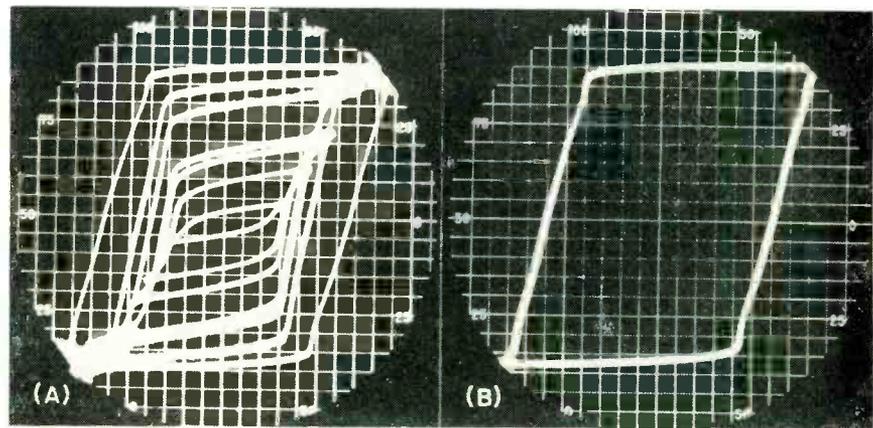


FIG. 4—Family of hysteresis loops of square-loop ferrite using 400-cps power (A). Also shown is curve for optimum value for coincident write in and read out (B)

required to ensure a positive acting switch free of bounce for a clean read-out current pulse.

Cores in which no selections have been written are in the zero state and are not affected by read-out current as the carriage travels by. If, however, a selected core is reached, that core's magnetization is reversed. A signal output wire threading all cores in the matrix is used to the sense the reversal of magnetization in any one of the cores, Fig. 1.

This signal is fed through a sig-

nal detector to operate a trip solenoid on the carriage. A low-pass filter is required to prevent transmission of relay switching transients. A ferrite pulse transformer with a step-up ratio of 1:15 in the signal detector eliminates a voltage amplifier but a pulse-stretching multivibrator is necessary to assure firing the trip thyatron during the positive half cycle of the alternating voltage on the thyatron plate.

### Record Play

When a selected core is found, the carriage is stopped and a record is played. To do this the trip solenoid disengages the drive clutch from the gear rack and connects the clutch to a cam shaft. The cam rotates 180 deg, operating levers which cause a transfer arm to raise the record into position, clamps the pickup arm on the record. At the end of the record a trip switch energizes the trip solenoid causing the rotation of the cam through the remaining 180 deg and return of the record to the magazine. The carriage resumes scanning until it is stopped by another selected record.

### Memory-Core Response

Successful operation of a coincident-current system depends upon the squareness of the B-H hysteresis loop. The steep sides, nearly horizontal top and bottom and square corners are properties of a good memory core. Figure 4 shows a family of hysteresis loops of a square-loop ferrite using 400 cps power. As the driving currents are increased the hysteresis loop be-

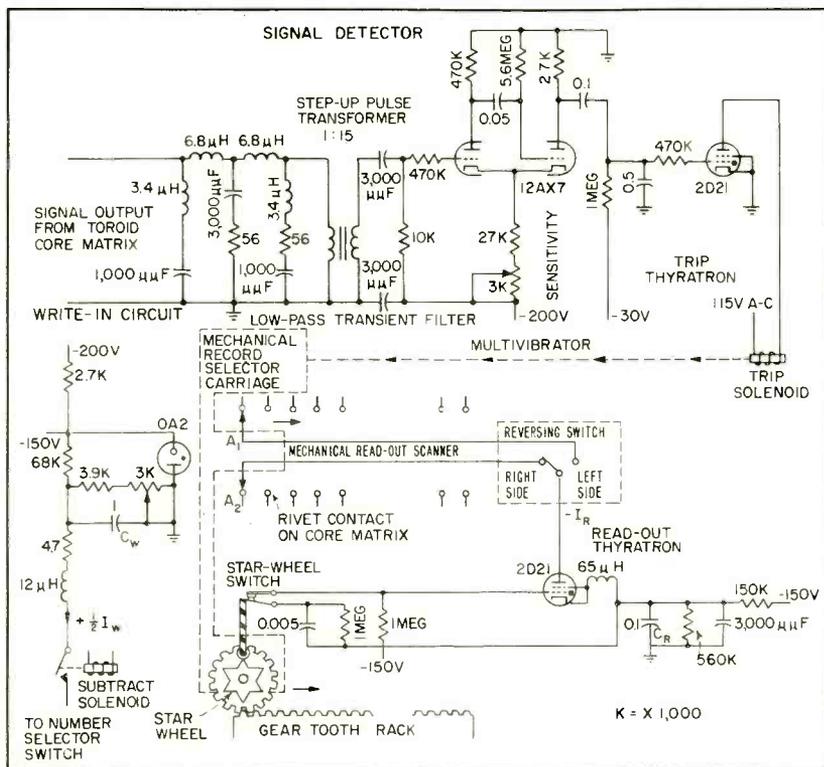


FIG. 3—Storage is effected by closing one number and one letter pushbutton. Subtract solenoid closes, discharging  $C_R$  through circuit. As mechanism scans past record, connection is made through read-out thyatron. Star-wheel switch closes discharging  $C_R$  through core

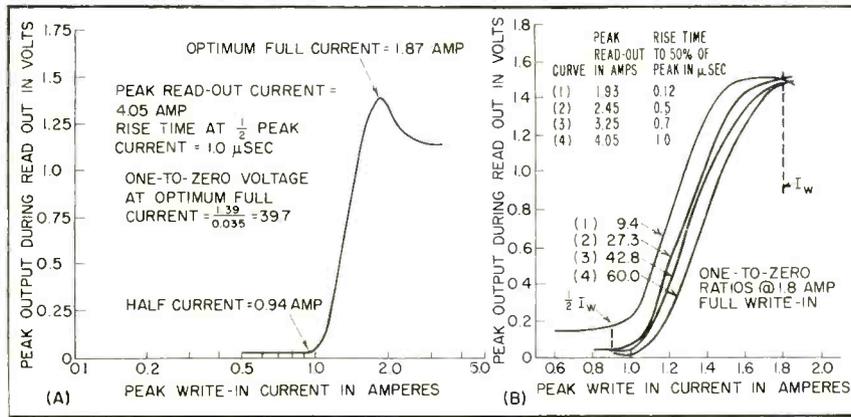


FIG. 5—Squareness curve (A) and family of squareness curves (B) for a test core of Ferroxcube 402 with 0.18 in. o-d  $\times$  0.09 in. i-d  $\times$  0.09 in. thickness

comes larger and improves in squareness. This indicates that there is a minimum amplitude of current pulses to obtain good coincident current operation.

A maximum amplitude of current is set by the effect of a half current  $+\frac{1}{2}I_w$ . A point is reached where the core saturates at the same current level regardless of the driving-current amplitude. A half current at these levels would tend to go over the knee of the curve changing the state of flux in the core. Due to losses at high frequencies it is difficult to obtain useful quantitative data at low frequencies for use on pulsed operation. Response of the core must be determined under actual pulsed conditions.

The driving currents must be such that it is easy to discriminate between the output of a selected core and an unselected core. In this system the output is used to trip a multivibrator. Thus the ratio of the amplitude of a one output voltage pulse to a zero should be a maximum. In this system a set of curves is helpful in determining the current amplitudes and waveforms

for a maximum one-to-zero ratio. These are called squareness curves.

Using a read-out current which is sufficient to saturate the core, the write-in current amplitude is adjusted over a range to plot the output voltage during the read-out pulse as in Fig. 5A. Since the state of the core after write-in depends primarily on the peak current reached, effects of write-in current rise time are unimportant. This curve is used to determine the optimum write-in current amplitude  $I_w$  for a maximum ratio of one-to-zero signal by comparing the output voltage on the curve at the chosen value of  $I_w$  and  $\frac{1}{2}I_w$ . The same type of curve is plotted in Fig. 5B.

At the optimum value of write-in current found from Fig. 5A, the read-out current amplitude and rise time are independently adjusted to obtain a given signal voltage pulse width and amplitude. In this application the signal pulse must have a minimum pulse width to pass through the transient filter and trigger the multivibrator. With each set of read-out amplitude and rise time, write-in current is adjusted

over a range to obtain a squareness curve. A family of curves is obtained from which it can be seen that the one-to-zero ratio improves as the read-out current amplitude increases and rise time decreases.

Therefore it is advisable to obtain as large a current for read-out as possible in this application. One-to-zero signal voltage ratios as high as 60 to 1 have been obtained by the unsymmetrical hysteresis loop used.

A capacitor is an excellent current source for this low-duty-cycle system. The matrix is a low impedance to the capacitor so that the rise time, amplitude and pulse width of the capacitor discharge current can be controlled by other elements in a series RLC circuit. By using a high power-supply source impedance, only a low capacitor charging current is required.

By solving

$$L di/dt + iR + \frac{1}{C} \int_0^t i dt = E_c$$

for  $i(t)$  there are three cases: Critically damped

$$i(t) = (E_c/L)t \exp(-Rt/2L)$$

Underdamped

$$i(t) = (E_c/L) [(1/LC) - R^2/4L^2]^{-1/2} \sin [(1/LC) - R^2/4L^2]^{1/2} \exp(-Rt/2L)$$

Overdamped

$$i(t) = (E_c/L) [(R^2/4L^2) - 1/LC]^{-1/2} \sinh [(R^2/4L^2) - 1/LC]^{1/2} \exp(-Rt/2L)$$

A normalized plot of current versus time is shown in Fig. 6A. The effect of adjustment of any circuit element can be quickly determined. Photographs of actual driving current and voltage output waveforms are shown in Fig. 6B and 6C.

Since high peak currents are easily obtained from the capacitor discharge current source and there is no need for extreme size reduction, a toroidal core is used which

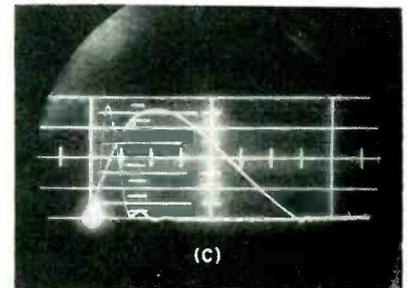
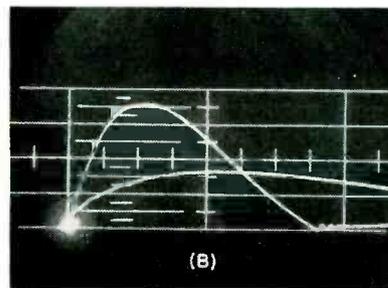
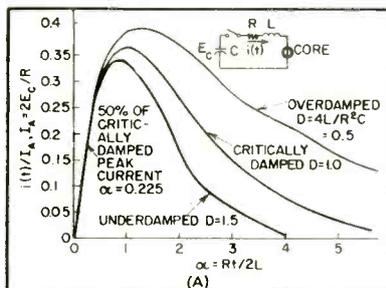


FIG. 6—Normalized plots of current in RLC circuit for various degrees of damping (A), write-in and read-out current waveforms (B) and read-in current and voltage waveforms (C)

is of larger dimensions (0.09 in. i-d  $\times$  0.18 in. o-d  $\times$  0.09 in. thick) than that in digital computer systems (0.05 in. i-d  $\times$  0.08 in. o-d  $\times$  0.025 in. thick). The larger core increased the signal voltage magnitude from 0.2 volt to over 1.0 volt per turn of pickup loop. Usable ferrite materials include Ferroxcube 402 and General Ceramics S-1.

### Advantages

It is possible to obtain a definite reduction in equipment size through the use of a magnetic memory matrix, although there is no necessity for it in this application. The group-switching relays formerly used are eliminated in the coincident-current matrix. Since the read-out current pulse reverses the magnetization of the cores to the zero state, no cancel solenoid is required to reset the core. The cost of ferrite memory cores is expected to continue to decrease as larger-quantity production is reached, since material cost is a small part of the price and yield of a specified standard is likely to increase.

Cost per bit is reduced with greater matrix size because address equipment costs are independent of

matrix size in low-speed memories. Elimination of selection levers has reduced the number of moving parts in the selection storage system to the two rows of read-out contacts. A brush wipes read-out contacts as the carriage travels along its rails. The life of the magnetic memory matrix is limited only by brush wear on the read-out contacts. Critical mechanical adjustments are eliminated. Since the magnetic state of the core is self-latching, there is no loss of storage with interruption of main power.

### Inspection of Cores

Although the phonograph-selection storage matrix has been designed for mass production, the replacement of substandard cores requires rewiring. To prevent this, cores receive 100 percent inspection upon arrival. An automatic core-testing machine, shown in Fig. 7 feeds cores from a bin, spindles and tests them at the rate of 100 per minute. Each core is tested using current pulses identical with those employed in the memory matrix and through the cycle:  $I_R$ ,  $20 (\frac{1}{2}I_w)$ ,  $I_R$ ,  $I_w$  and  $I_R$ .

A closed hysteresis loop is estab-



FIG. 7—Automatic inspection device tests 100 cores a minute

lished by the fifth cycle. Glow-discharge-type decade counter tubes gate the read-out pulse amplifiers, turning them on at the beginning of the fifth cycle. To be accepted each core must pass both a half-write and full-write test.

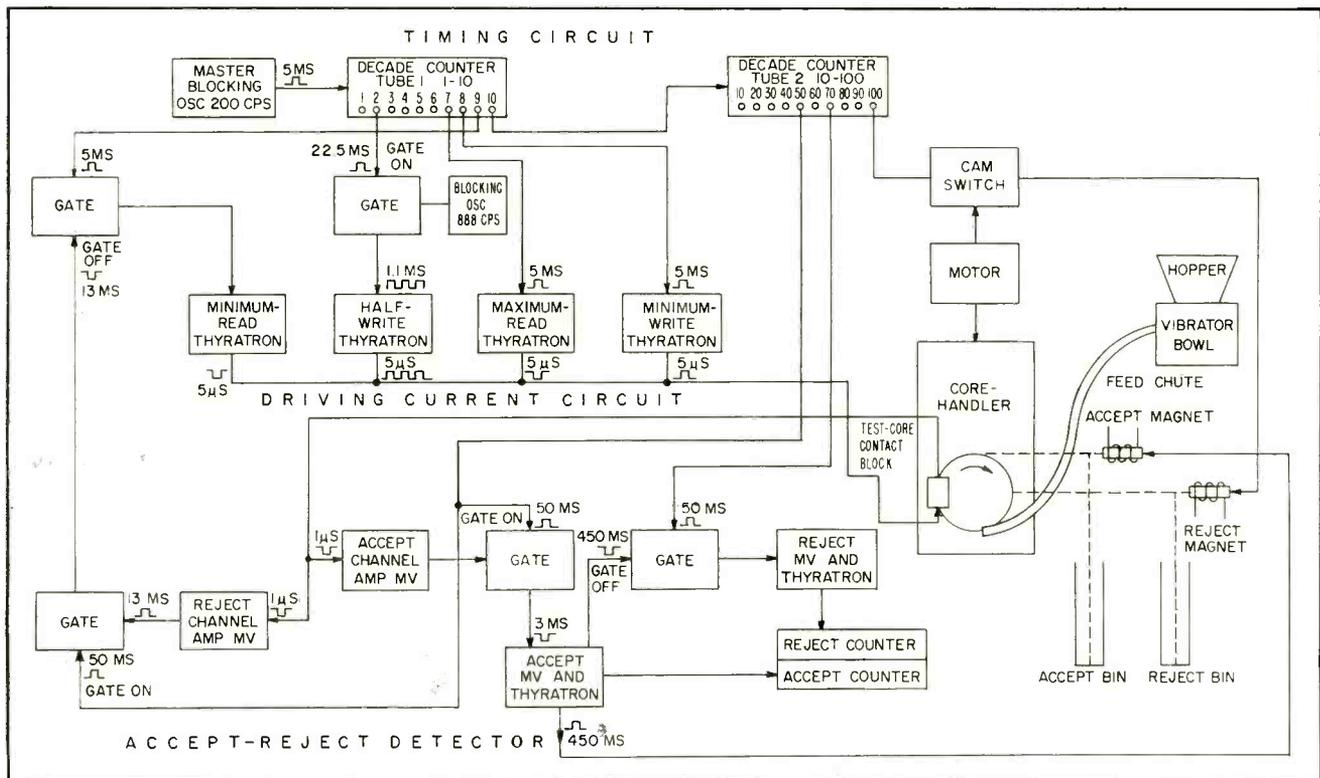


FIG. 8—Operation of core tester. Timing signals are supplied to ten-stage gas counting tubes. Driving currents are supplied by thyratrons

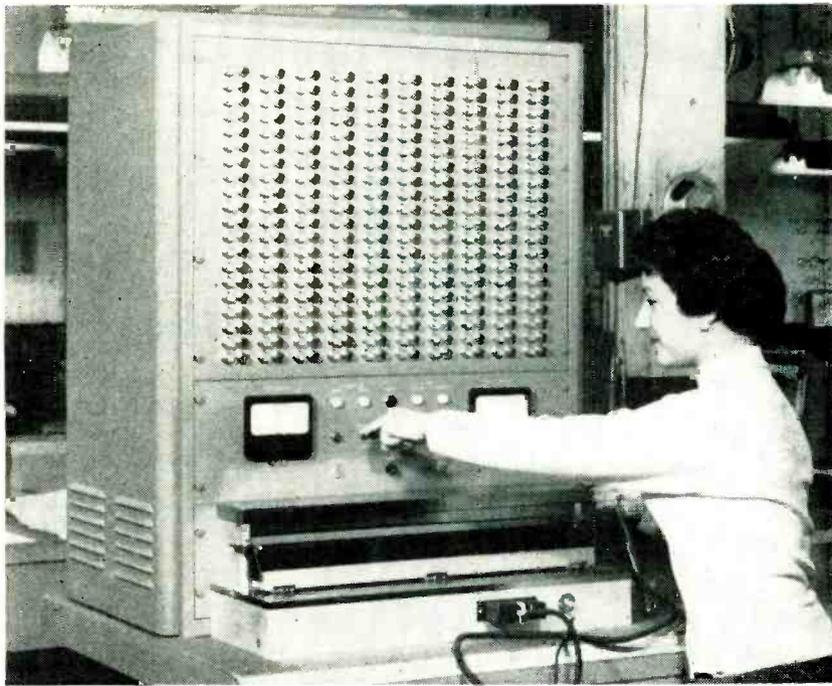


FIG. 9—Complete ferrite core matrix is plugged into unit for test. Entire assembly is checked in one minute

Rejection can occur either from too large a read-out voltage pulse following the twenty half-current write-in pulses or too small a read-out voltage pulse following the one full-current write-in pulse. The test equipment is periodically checked with standard cores chosen to be at the limits of tolerance. An accept or reject count is made on every core tested and an alarm is sounded after a preset number of either occurs without at least one of the other.

Figure 8 is a block diagram of the automatic core tester. Batches of cores are poured into a hopper. Then they are vibrated up a spiral ramp and fed down a chute in a single line to a loading point. Cam action causes a pin on one of four arms of a wheel to spindle the core. The arm moves along the arc of a circle bringing the core up to the test-position contacts where it remains for 415 milliseconds during the test.

At this time a cam switch resets decade-counter tube No. 2 to zero, starting the test cycle. A master blocking oscillator continuously triggers decade-counter tube No. 1 which operates the driving current thyratrons in sequence. After four complete cycles of driving current, the output from stage four of decade-counter tube No.

2 gates the accept and reject amplifier channels.

If the reject channel is triggered by a signal during the read current after the twenty half-write pulses, the gate to the full-read-current thyatron is closed and it will not be possible to trigger the accept channel. If the accept channel is triggered by an output during the read-current pulse following the full-write pulse, the accept pickoff magnet is energized for 450 milliseconds, the accept counter is stepped up one count and the reject count gate is closed.

If the accept channel is not triggered, the reject gate permits a pulse from decade counter No. 2 to operate the reject counter. After sufficient time for electronic testing to take place, the spindled core is moved to a second position along the arc of the circle. If the accept magnet has been energized, the core is pulled off the spindle and dropped into the accept bin when the magnet is deenergized.

During the time the spindle is moved to a third position, the reject magnet is energized by the cam switch, pulling the core off the spindle if the core had not been accepted. The core is dropped into the reject bin when the magnet is deenergized.

When each block of 20 cores is as-

sembled with the letter write-in, read-out and signal output wires, the block is tested as an assembly. Write-in current is applied to all cores at once. Each core is then read out in sequence and checked against a standard. A breakdown voltage of 250 volts is applied between each of the wire to test for poor insulation.

After complete assembly each matrix is tested in a jig designed to write-in and read-out every selection in turn. This is done automatically without the use of moving contacts in 2½ minutes. All outputs are compared with that of a standard core. An array of 400 panel lights (Fig. 9) indicates false signals or weak signals from each storage element. A dozen different types of wiring errors can be quickly pinpointed and corrected.

### Other Applications

This use of ferrite memory cores in a slow speed system suggests their application in a large variety of equipment. Any memory system which would involve preselection of a certain number of items out of a group can be constructed of ferrite cores. In applications where a number of operations are to be programmed, such devices could be used. Libraries, filing controls, elevator operation and automatic sequence operation of machinery are typical examples.

It would also be possible to allot a number of cores to each item and identify each item by a binary code using the magnetic state of its cores. Such a system could be used in electronic inventory control.

The products and test equipment herein described are the results of the efforts of many engineers of the J. P. Seeburg Corporation. Their contributions are gratefully acknowledged.

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# Subaudio Oscillator

**SUMMARY** — Stable unit with beating oscillators near 2,000 cps has less than 0.2-cycle per hour drift and less than 1-percent distortion. Output up to 3 volts is constant within 2 percent over the frequency range. Novel high-level mixer circuit employs a pair of selenium rectifiers, avoiding complexity of either d-c or capacitance-coupled amplifier

**N**O ONE TYPE of oscillator for low frequencies has attained a general acceptance comparable to the wide use of Wien bridge type oscillators<sup>1</sup> in the audio-frequency field.

Nearly every possible means has been used for generating low frequencies: motor-driven potentiometers, photoelectric function generators, L-C oscillators using inductance tubes and L-C oscillators using the inductive properties of a thermistor. The regular Wien bridge oscillator circuit has been made to operate down to 0.3 cycle,<sup>2</sup> the phase-shift oscillator down to 1 cycle<sup>3</sup> and a three-phase, phase-shift circuit<sup>4</sup> down to 0.01 cycle. Another approach starts with a low-frequency multivibrator, from which the wave is shaped into a sinusoid.<sup>5,6,7</sup>

## Beat-Frequency Advantages

The beat-frequency type of oscillator has important advantages over the common variety of R-C oscillator. It is the only type that can be used with an automatic response-curve recorder, because the whole frequency range is covered without switching. There are no output transients when the frequency dial setting is quickly changed. Output level is inherently constant over the whole frequency range.

The equipment to be described is simple. Beat-frequency oscillators have been built before for low-frequency work, using carriers in the 1,000-cycle region, but apparently

have never been described in print. If a capacitor-coupled amplifier is used following the mixer, the low frequency limit suffers and if a d-c amplifier is used, circuit and operation tend to be complicated.

In the present oscillator there is no such amplification. The mixer is a pair of selenium rectifiers operating at high signal level. A balanced detector circuit eliminates any d-c component in the output; the a-c output signal is symmetrical within 5 percent with respect to ground. Thus the tube complement consists entirely of carrier oscillator and buffer amplifiers, with no tubes operating at low output frequency.

## Circuit Design

The beat-frequency oscillator was invented in 1920 by Scriven of Bell Telephone Laboratories. His patent<sup>8</sup> explains the basic requirements: two similar, low-drift oscillators; buffers or other isolating means to prevent locking or pulling of the two oscillators and a detector or mixer.

The carrier oscillators in the present instrument use a stable circuit devised by Harris,<sup>9</sup> which has the virtue of unusual simplicity. The complete circuit, except for the conventional power supply, is shown in Fig. 1. The oscillators are a variation of the Colpitts type in which the cathode of the tube is tapped across a very low-impedance portion of the tuned circuit using capacitors. The inductors are high-Q toroids with dust cores of

low temperature coefficient. Capacitors are silver mica or air dielectric except for the large 0.5- $\mu$ f units. Variations in the capacitance of the 0.5- $\mu$ f capacitors have very little effect on the oscillator frequency.

Temperature coefficient of frequency of the oscillators is essentially that of the tuned circuits themselves. The frequency stability problem is mainly one of keeping the temperature rise of the tuned circuits small and similar. Since the external field of toroids is so small, it is feasible to locate them physically close to each other without magnetic shielding.

The oscillator frequencies are about 2 kc. It is usual in beat-frequency oscillators to use a carrier frequency about six times that of the highest beat frequency desired, for example, 100 kc for 0-to-16 kc output. For a low-frequency instrument, however, practical considerations favor a relatively higher carrier frequency; for one reason, a higher Q is attainable in the inductors.

Each oscillator ( $V_1$  and  $V_2$ ) is followed by a cathode-follower buffer stage, using the other half of the dual triode. Direct potentiometer coupling between the tuned circuits and the cathode-follower grids provides necessary positive bias return for the latter with a minimum number of components. Both oscillators and buffers are fed plate voltage from a v-r tube to keep the amplitude constant with varying line

# Tunes 0 To 50 Cycles

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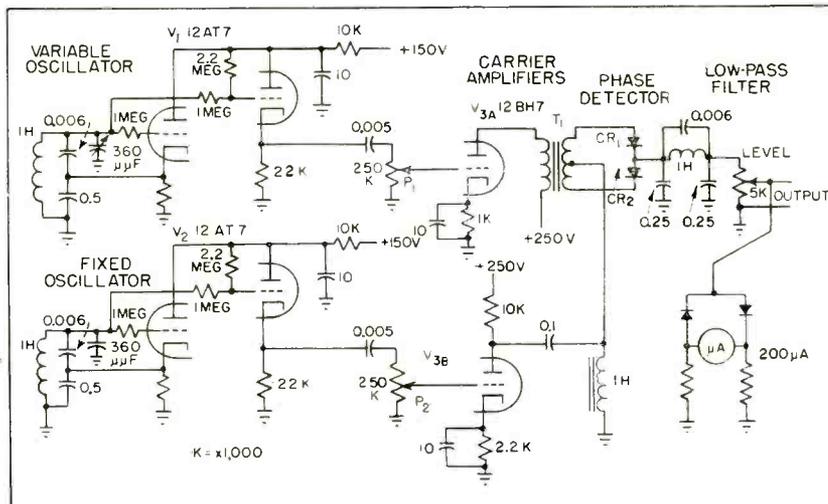


FIG. 1—Carriers in the order of 2,000 cycles are mixed at high level in a balanced selenium diode circuit. Output has internal impedance of 3,000 ohms maximum

voltage. The cathode-follower buffers feed carrier signals in turn to the respective halves of double triode  $V_{3A}$ , the carrier output amplifiers.

When mixing two sine waves in a linear rectifier circuit one signal should be considerably larger than the other to obtain a beat signal of low distortion. The beat voltage depends mostly on the size of the smaller of the two signals; is essentially independent of that of the larger one.

Hence it is customary in such instruments to make the variable oscillator signal the large one and the fixed oscillator signal the small one, so variation of beat output with frequency is minimized. Triodes  $V_{3A}$  and  $V_{3B}$  are operated as amplifiers, delivering relatively large signals to mixer  $CR_1$ ,  $CR_2$ . Screwdriver adjustments  $P_1$ ,  $P_2$  are provided to adjust the carrier levels for minimum distortion. Maximum beat voltage at the output terminals is 3 volts rms.

## Mixer

Use of high-level diode mixers was suggested as long ago as 1935, but apparently never employed. It has little advantage in an audio-frequency oscillator, but in a low-frequency instrument it is the only way to remove all restrictions on the lowest attainable output frequency without using a d-c amplifier, with its attendant complications of multiple power supplies and balancing adjustments.

A further problem in mixing, once the high-level diode idea is adopted, is how to get rid of the steady d-c component that normally attends the rectification process. This is accomplished here by effect-provided to adjust the carrier levels <sup>10,11</sup>

Mixer diodes  $CR_1$  and  $CR_2$  may be standard 115-volt selenium rectifiers. They are fed in series from the secondary of transformer  $T_1$ . The smaller carrier is then fed in between the transformer center tap and the junction of the two rectifiers, in series with the low-pass filter and output circuit.

Without any balancing adjustment on the rectifiers, the d-c component of the output is less than 5 percent of the peak a-c voltage, which is believed adequate for most applications. For precise symmetry of the output with respect to ground, there are several ways in which a balancing trimmer potentiometer can be connected.

The low-pass filter uses constants that are modified considerably from the theoretical, to satisfy requirements of low input impedance at the carrier frequency and tolerance to output load changes. Carrier rejection is enhanced by parallel-resonating the inductor with a capacitor at the carrier frequency.

Carrier and noise are 60 db below the output level.

## Output Metering

The zero-beat point can be checked against the dial reading and may be indicated by a zero-center d-c meter. However, if a rectifier is added to the meter, the meter system will also read a-c output at frequencies above 5 cycles or so, where pointer motion is small. Below 5 cycles the meter is no longer usable as an a-c indicating instrument, although the a-c output is actually the same; there is nothing in the circuit to cause any change in output.

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# Multiplexing F-M

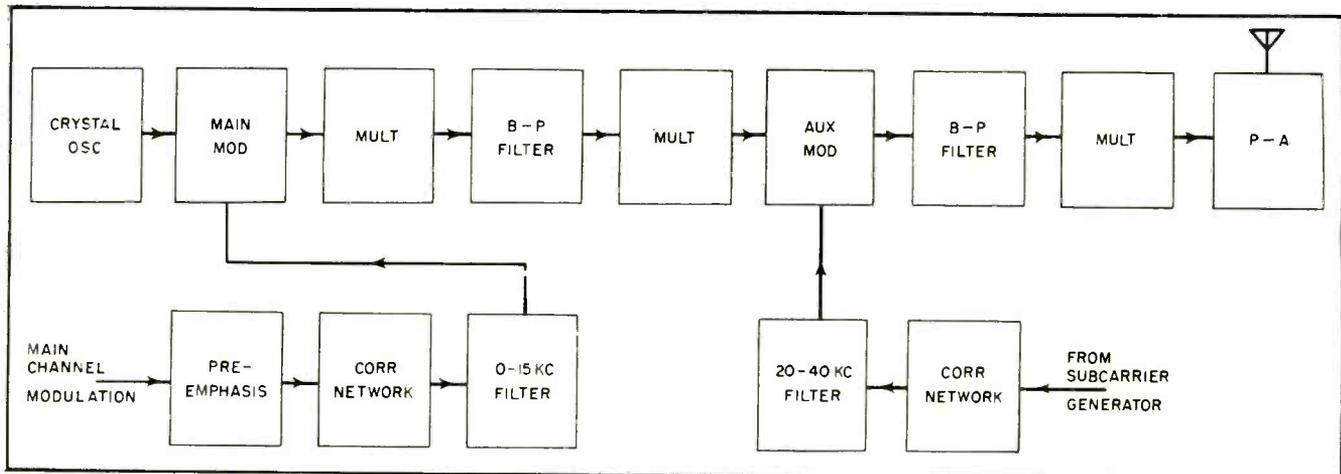


FIG. 1—Multiplex system modulator uses second phase-shift modulator at higher point in multiplication chain since less frequency deviation is needed for the subcarrier

RECENT ACTION by the Federal Communications Commission makes possible, for the first time, extensive use of frequency-modulation broadcasting facilities in special commercial applications. Any f-m broadcast licensee may now obtain a subsidiary communications authorization (SCA) that permits him to transmit for pay a simultaneous multiplex program. A special receiver is employed to detect the subcarrier modulation. Audio muting or amplification can, in addition, be actuated by transmission of ultrasonic or so-called beep tones.

While these techniques are entirely feasible, good engineering practices must be employed to avoid crosstalk between the main and subcarrier channels. In general, only skillfully designed transmitters and receivers will meet high-quality commercial performance requirements. While present legal authorization extends only to multiplexing of entertainment and news, there are no technical barriers to employment of two or more subcarriers for narrow-band communications purposes.

Experiments carried on since 1934<sup>1</sup> clearly indicate the general nature of inherent problems and their successful solutions. At that time, four different sets of signals were successfully transmitted at

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41 mc from station W2XDG located in the Empire State Building in New York City to Haddonfield, N. J., a distance of 85 miles. These signals comprised a musical program on the main channel, a facsimile program on a superaudible subcarrier on a second channel, a synchronizing signal for facsimile on a third and a telegraph order circuit on a fourth subcarrier frequency. Amplitude-modulated subcarriers were used at this time.

In April 1935, a frequency-modulated subcarrier was employed for simultaneous transmission of two broadcast music programs. There was substantial improvement as compared with the a-m subcarrier technique and this has since become accepted experimental practice. Operations under an SCA can only be carried out using f-m subcarriers.

## Transmitter Problem

Exhaustive tests continuing over the years and particularly since 1948 show that considerable care must be paid to both the transmitter and receiver. These tests were carried on by the late E. H. Armstrong assisted by the author and

others using laboratory facilities at Columbia University and those of the experimental f-m broadcast station KE2XCC at Alpine, N. J. In broadcasting where transmission is basically for entertainment, the effect of cross modulation in transmitters is much more severe than in communications. This is particularly so during the transmission of a separate program on a second channel when a diminuendo or a period of silence of that channel corresponds with a crescendo on the main channel. Experience indicates that cross talk above the level of the background noise of the second channel is objectionable. The energy content of the cross modulation with respect to signal level must be held to -50 decibels or less, or an energy content in the order of one one-hundred-thousandth part of the program level of the second channel. A ratio of 60 db or one part in a million is an attainable goal.

Since the auxiliary channel lies in the 20 to 40 kilocycle band and since the second and third harmonics of the upper half of the main channel modulation fall within that band, it will be clear that the transmitter problem will not yield readily to a solution by any direct method of modulation, for the free oscillator type of cir-

# Broadcast Transmitters

**SUMMARY** — Long-term practical experiments prove that the main carrier of an f-m broadcast station can be modulated  $\pm 20$  kc with an f-m subcarrier of 30 kc without affecting quality or disturbing receivers now in use. Signal-noise ratio in the auxiliary channel is better than 60 db

cuit does not lend itself to the required low-distortion level.

Present-day practice in f-m broadcast transmission uses the phase-shift method of producing frequency modulation. The invention by J. R. Day of the Serrasoid<sup>2</sup> type of modulator (which made use of an idea originally advanced by R. D. Kell) has solved, for simplex signaling, the problem of residual modulator noise in the phase-shift method of producing frequency modulation.

## Background Noise

All phase-shift modulators have had to contend with transmitter background noise, which comes about basically because the limited initial frequency change that can be obtained in a phase-shift modulator entails a high degree of frequency multiplication to produce the ultimately required deviation of the transmitted wave. The high order of multiplication has the effect of enhancing those noise frequency modulations that result from the interaction of thermal and tube noise currents with the basic carrier in the oscillator and modulator circuits. An appreciable background hiss level was thus characteristic of the early phase-shift modulators (-65 db) which was reduced to values that were relatively unimportant for simplex signaling by the inventions of the double-channel, (-70 db) and the Serrasoid modulators (-80 db).

For multiplex signaling in the broadcast service, when an attempt is made to increase the frequency range of modulation, then, even with the Serrasoid modulator, the difficulty again manifests itself. This results because the fluctuation

current components lying 20 to 40 kc distant from the oscillator frequency produce correspondingly enhanced frequency deviations within the range of subcarrier channels.

These deviations, after being enhanced by the same amount of frequency multiplication that is required for a 30-cycle modulating frequency, produce a level of background noise in auxiliary channels that is not acceptable. A second difficulty incident to introducing subcarrier modulation on phase-shift modulators lies in the cross-modulation introduced in the multiplier chain because of the selectivity characteristics required of the multiplier coupling impedances.

It is essential that the lower frequency stages be sufficiently selective to eliminate the frequency-modulation superimposed on the transmitted frequency at the basic oscillator frequency, a phenomenon that has its origin in the initial multiplier stages. Hence, the selectivity that is needed in the inter-multiplier coupling stages to remove this frequency modulation results in a lack of linearity in the phase characteristic for frequencies required to carry the subcarrier and so gives rise to cross modulation in those stages.

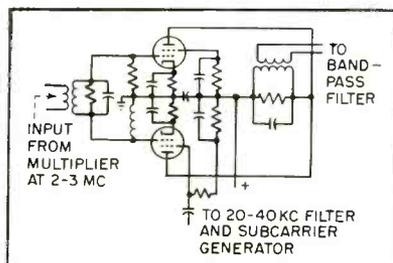


FIG. 2—Phase-shift modulator of the type used for subcarrier multiplexing

A solution for this difficulty has been found through segregation of the modulation functions shown in Fig. 1. Here the modulation and the initial multiplications of the main channel are carried out (with certain modifications) as in simplex operation. The modulation of the auxiliary channel is superimposed at a point in the multiplication chain where relatively few additional stages are required to obtain the necessary subcarrier swing at the radiated frequency. An appropriate point for introducing the auxiliary modulation is around the 2 to 3 megacycle frequency range where the amount of phase shift necessary at the subcarrier frequency to produce the required ultimate change in frequency of the radiated wave is in the order of 1 degree.

By contrast, the shift necessary at the modulator for the main channel is approximately 150 degrees (plus and minus) to obtain the full deviation range at 30 cycles.

## Linearity Solution

As a consequence, no linearity problem results from the operation of two phase-shift modulators in cascade. A phase shift modulator like that in Fig. 2 may be employed. The cross-modulation problem in the multiplier coupling stages is avoided because it is possible to make the coupling circuits of the last few multiplication stages quite broad. This can be done because the frequency modulations imposed on the transmitted carrier by the basic oscillator frequency and by the fluctuation disturbances lying in the subcarrier frequency range are no longer a problem at this



phase linearity to prevent the effect.

To contain the frequency range of the auxiliary channel modulation to the channel capability, an 8.5-kc low-pass filter was used ahead of the audio input to the auxiliary channel modulator.

The advantages of this method of generating the subcarrier are crystal control of the subcarrier with the attendant advantages of reliability and stability of operation and low noise and distortion characteristics of the modulator.

The usual 75 microsecond pre-emphasis circuits were available for use in both the main channel and the auxiliary channel.

### Multiplex Receiver

The general arrangement of the receiving equipment used in the field tests and for making the measurements has been described under discussion of the receiver.

Field experience indicated the desirability of preceding this receiver with a fixed tuned 93.1-mc 6BK7 cascode amplifier. Such an amplifier was used ahead of the above described receiver in making the reported measurements. The input impedance of this pre-amplifier was approximately 75 ohms.

The auxiliary channel portion of the multiplex receiver which receives its signal from the main channel discriminator detector has been described.

Overall frequency characteristics of the auxiliary channel are shown in Fig. 6A. For these measurements no pre-emphasis was used in the auxiliary channel transmitter. The audio input was held constant so that for all modulating frequencies the deviation of the 27.5-kc subcarrier was  $\pm 5$  kc.

The resultant frequency characteristic was obtained by subtracting the 75 microsecond de-emphasis characteristic from the measured characteristic to take into account the effect of the 75 microsecond de-emphasis network following the detector in the auxiliary channel receiver.

The roll-off above 6,000 cycles results from the cumulative effect of the low-pass filter at the input and the band-pass filter at the out-

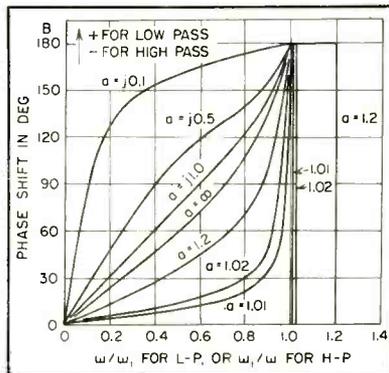


FIG. 4—Phase-shift per section for constant  $k$  filter

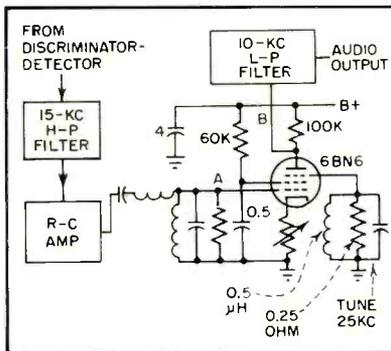


FIG. 5—Simplified receiver not used in accumulating data gives satisfactory reception

put of the auxiliary channel transmitter, the band-pass filter and the frequency-sensitive network in the auxiliary channel receiver and the 10-kc low-pass filter used to remove the subcarrier. These are factors within the control of the designer and are governed by the requirements of the system to be established.

Overall distortion characteristics of the auxiliary channel is illustrated in Fig. 6B. Distortion measurements shown were made for 100 percent and 50 percent modulation of the auxiliary channel. A Hewlett-Packard model 330B distortion analyzer connected to the audio output terminals of the auxiliary channel receiver was employed in recording these data.

A public demonstration at Columbia University was made with this receiver. Subsequent work with a similar receiver has shown that the distortion can be held to less than 2 percent for  $\pm 5$  kc deviation of the subcarrier for all the modulating frequencies involved. To do this requires closer attention to the design of the band-pass circuits and a different frequency-sensitive network. Here again, the

system requirements would control.

Crosstalk in the auxiliary channel due to main-channel modulation is shown in Fig. 6C. For these measurements the deviation of the 93.1-mc carrier by the 27.5-kc subcarrier was  $\pm 20$  kc.

To minimize the masking effects of hum and any residual subcarrier leakage in the output of the auxiliary channel receiver, a 500-cycle high-pass and a 15-kc low-pass filter were connected in cascade in the receiver output. The signal level was then established by modulating the subcarrier  $\pm 5$  kc with a 600-cycle modulating tone. With this modulation removed and no modulation on the main channel, the noise in the auxiliary channel was down 69 db.

It should be noted that for these measurements the 93.1-mc signal level across the 75-ohm input to the external cascode was approximately 1 millivolt, at which level the noise in the main and auxiliary channels is independent of receiver noise and is determined by the respective transmitters. This will be evident on examining Fig. 6D.

### Main Modulation

The curves shown are for three different modulation levels of the main channel. In each case the main-channel deviation was held constant and the frequency of the main-channel modulating voltage was varied. The curves show the resultant crosstalk measured in the auxiliary channel output in db below the level established by modulating the auxiliary channel  $\pm 5$ -kc with a 600-cycle modulating tone.

These measurements were made in the laboratory at Columbia University but were spot checked at a receiving location approximately 2.5 miles from KE2XCC at Alpine, New Jersey. The site was chosen to make the measurements independent of receiver noise and possible multipath effects. No significant differences were observed between the field measurements and the curves shown in Fig. 6C.

For normal program modulation of the main channel (peak deviation  $\pm 75$  kc) the cross talk as measured with a Hewlett-Packard model 330B distortion analyzer

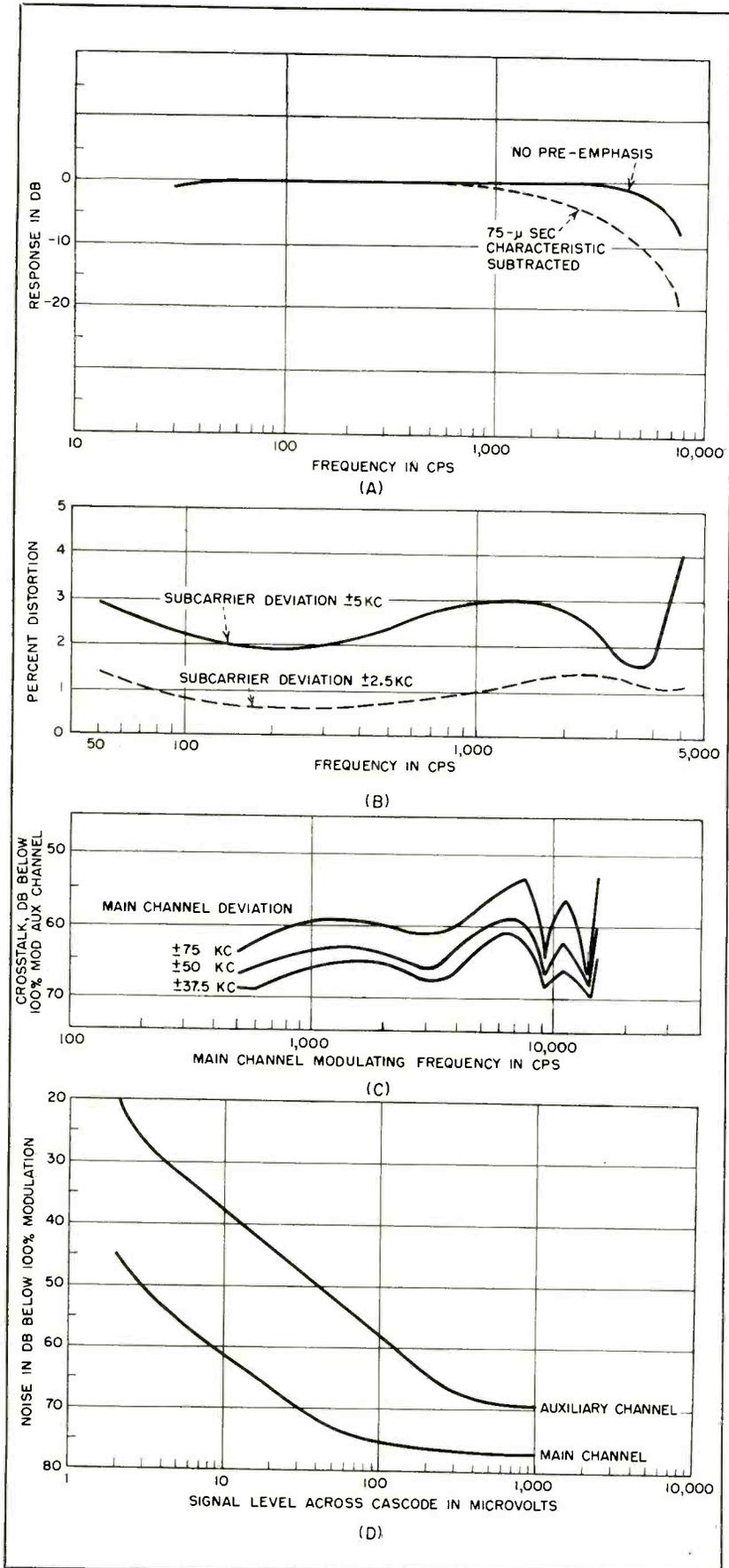


FIG. 6—Overall frequency characteristic of the auxiliary channel (A) overall distortion of the auxiliary channel for two subcarrier deviations (B) crosstalk in auxiliary channel owing to main-channel modulation (C) and signal-noise ratios of main and auxiliary channels using external cascode amplifier (D)

averages between  $-60$  db and  $-65$  db below full signal level for the auxiliary channel. For field tests where the peak deviation of the main channel was limited to  $\pm 50$  kc, the crosstalk was usually difficult to measure.

Signal to noise ratios of the main and auxiliary channels are shown in Fig. 6D. For these curves, the 93.1-mc carrier was deviated  $\pm 20$  kc by the 27.5-kc subcarrier.

The signal level for the auxiliary channel was established by deviating the subcarrier  $\pm 5$  kc with a 600-cycle modulating tone. The upper curve shows the noise in db below this level as a function of the signal level across the 75-ohm input to the cascode preamplifier.

The signal level for the main channel was established by deviating the main carrier  $\pm 75$  kc with a 600-cycle modulating tone. The lower curve shows the noise in db below this level as a function of the signal level as above.

For both curves the noise is measured in a 500-to-15,000 cycle band to eliminate the masking effects of hum and subcarrier leakage. This was found to be necessary in view of the high signal-to-noise ratios being measured.

It is of interest to note that for signals in excess of 500 microvolts across the input terminals, the signal-to-noise ratio of 69 db for the auxiliary channel and 77 db for the main channel are determined by the noise in the respective modulators.

Postwar laboratory development of the application of multiplexing to carriers in the 88 to 108-mc f-m broadcast band was begun in 1946, with field testing starting in the spring of 1949. This development was continued, with minor interruptions, until the present time and has included field experience with facsimile and program modulated subcarriers.

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# Current Regulator for van de Graaff Magnet

**SUMMARY** — Voltage and current feedback loops control the output of an amplidyne generator to provide the regulated current required by a 3.6 million electron-volt van de Graaff electrostatic accelerator. Filtering system removes hash, ripple and slip-frequency components from output

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**I**N THE 3-billion electron-volt Cosmotron, the protons enter the doughnut with an energy of 3.6-million electron-volts. This energy is imparted by the van de Graaff electrostatic generator. The energy level of the injected protons must be held constant to within 0.02 percent.

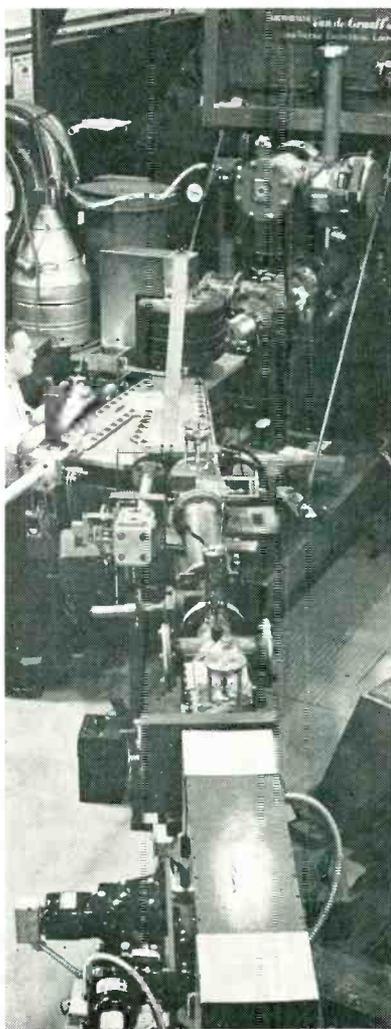
This initial energy level is determined by the strength of the field in the analyzing magnet. The analyzing magnet is used to separate the protons from the diatomic ions in the beam.

Since a high-gain feedback circuit regulates the voltage of the van de Graaff to maintain a constant angular deflection of the ions in the field of the magnet, the current in the magnet is the primary reference for the energy of the injected protons.<sup>1</sup>

## Regulator Requirements

Examination of the behavior of a charged particle in a magnetic field indicates the requirements which must be imposed on the magnet current regulator. The radius of curvature of the particle path is  $r = mv/He$  where  $m$  is the mass of the particle,  $e$  is the charge of the particle,  $v$  is its velocity and quantity  $H$  denotes the magnetic field strength.

The voltage of the Van de Graaff



Van de Graaff generator that feeds Brookhaven's Cosmotron

is related to the velocity by  $V = mv^2/2e$ . Eliminating  $v$  gives  $V = H^2 r^2 e / 2m$ . Differentiating  $\Delta V/V = 2\Delta H/H$ . For 0.02-percent energy regulation the magnet current must be held to 0.01 percent. For design purposes 0.005 percent was specified.

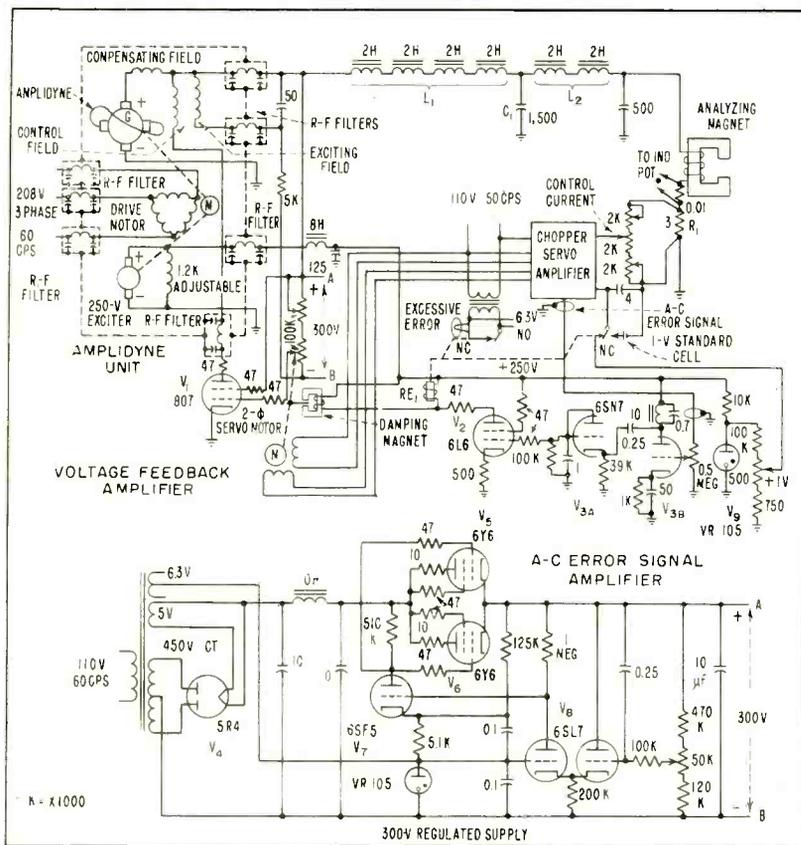
To provide for variable beam energy the current in the 90-ohm magnet coil is continuously variable from 1.0 to 2.5 amperes. The amplidyne generator is ideally suited to supply currents and voltages of this order. It provides an excellent means for controlling the load current over the full range without employing power dissipating devices.

## Circuit Design

Examination of the amplidyne output voltage disclosed an assortment of noise. Commutator hash was spread out over a large portion of the r-f spectrum with broad peaks at 20 and 200 kc. Peak amplitude was 12 volts.

Commutator ripple was present with components at 30 and 2,000 cps. Peak amplitude was 15 volts.

A slip-frequency component caused by magnetic coupling between the driving motor and generator fields was evident. The frequency varied from 1 to 5 cps depending on output load. Peak



Voltage and current feedback loops, top, and 300-v amplidyne-field supply below

amplitude was 2.18 volts.

The slip-frequency component, along with fast line surges is handled by degenerative voltage regulation directly at the amplidyne output. At the lowest output current setting the amplidyne output voltage is 100 volts with a peak slip component of 2.18 volts at 1 cps. The filtering effect of the magnet will reduce the current fluctuations by the ratio of the impedance of the magnet at 1 cps to the d-c resistance. The magnet has an inductance of 40 henrys and a resistance of 90 ohms. A 2.18-percent voltage fluctuation will produce a current fluctuation of 0.0218  $|R/(R + j\omega L)| = 0.73$  percent at 1 cps.

To reduce this variation to the required 0.005 percent required a loop gain of  $0.73/0.005 = 146$ . The amplidyne has a voltage gain of 12.5 from control field to output. An 807,  $V_1$  in the circuit diagram, with the 1,600-ohm amplidyne control field in its plate circuit provides a gain of 14, raising the loop gain to 200. This feedback loop effectively eliminates line-voltage variations and the slip-frequency varia-

tion from the output.

The bandwidth of the amplidyne response is only a few cps hence this loop cannot remove the commutator ripple from the output. Line-voltage fluctuations which are too fast for the voltage feedback loop are filtered out by the mechanical inertia of the armature.

### Filtering

Commutator ripple is removed by a two-section L-C filter. The filter components are mounted on the chassis shown in one of the photographs. The total inductance and capacitance are divided unevenly to allow the first filter section to have the lowest possible cut-off frequency and leave the second section large enough to provide adequate attenuation of the 30-cycle component of the commutator ripple.

The first section has a cut-off frequency of 3 cps, enabling it to give some attenuation to the higher-frequency components of line transients which might get through the amplidyne. The second section with a cut-off frequency of 7 cycles is still effective against the 30-cycle

component of the commutator ripple thus providing a two-section filter at this frequency.

Feedthrough-type radio noise filters are used to eliminate the r-f commutator hash. It was necessary to install a filter in each of the motor and generator leads where it enters the frame of the amplidyne. Even a short external lead between the machine and the filter would radiate enough noise to overload the sensitive input circuit of the servo amplifier in the current feedback loop.

### Current Feedback

A second feedback loop is used to regulate the current to the magnet. A fraction of the voltage across the 3-ohm precision resistor,  $R_1$ , is compared with the terminal voltage of a 1-volt standard cell by a chopper-type servo amplifier and motor combination. The two-phase servo motor drives the 15-turn 100,000-ohm precision potentiometer in the 807 grid circuit with as little as  $10^{-5}$  volts at the amplifier input terminals.

The voltage between the slider and the upper end of the potentiometer is placed in series opposition to the amplidyne output voltage. Thus the difference between the two voltages appears at the grid of the 807 and controls the amplidyne field excitation. Motor drive is always in the proper direction to adjust the magnet current to balance out the voltage at the input to the servo amplifier. By adjusting the current control potentiometer the voltage across  $R_1$  may be selected to balance against the 1 volt from the standard cell for the desired output current.

### Dynamic Stability

In the voltage feedback loop appreciable phase shift can take place in the L-C circuit formed by the inductance of the control field and the  $r_p$  of  $V_1$  and in the amplidyne generator itself. Due to the high plate resistance of  $V_1$  the response in its plate circuit is much faster than the amplidyne response. Thus it does not contribute enough phase shift to cause positive feedback to take place within the pass-band of the machine.

The current feedback loop in-

cludes the amplidyne, the large L-C filter in the amplidyne output circuit, the analyzer magnet, the Brown amplifier and the motor-potentiometer combination. At approximately 1 cps the total phase lag reaches 180 deg. At this frequency the loop gain is still far greater than one. Thus the condition for oscillation is fulfilled.

The extremely low frequencies involved make mechanical damping of the system more feasible than stabilization by electrical phase correction networks.

A copper disk, rotating in a magnetic field is gear driven from the output shaft of the Brown motor. Eddy currents in the copper disk produce a damping force which is directly proportional to its angular velocity. The low-speed, high-torque motor characteristic makes it necessary to use a pair of gears providing a stepup ratio of 12.5 to 1 between motor shaft and disk.

The disk, 6 in. in diameter and  $\frac{1}{4}$  in. thick, rotates between a pair of magnet poles 2 in. square with a 0.2-in. gap length. The magnet is wound with 50,000 turns of No. 30 magnet wire. Critical damping occurs when the field in the magnet is approximately 3,250 gauss. This type of damping is extremely smooth, introducing virtually no static friction.

The large damping factor required for stability, if continually applied, would seriously limit the speed with which large current changes could be accomplished. Since damping need be applied only in the vicinity of zero error signal, this limitation is avoided by de-energization of the damping mag-

net for all but small error signals.

The output of the second stage in the servo amplifier is applied to one triode of a 6SN7,  $V_{a1}$ , operating as a tuned amplifier. The other half of the 6SN7  $V_{a2}$ , is diode-connected to rectify the amplified signal, producing a negative d-c signal proportional to the absolute value of the error signal.

The damping magnet is in the plate circuit  $V_2$ , the grid of which is biased by the negative rectifier output. When the error exceeds about 0.5 percent  $V_2$  is cut off and the damping magnet is de-energized allowing the motor to run freely.

### Protective Measures

By tuning the input transformer, the servo amplifier impedance is raised from its original 400 ohms to 5,000 ohms. An additional 10,000 ohms in series can be tolerated,

leaving a sensitivity of  $3 \times 10^{-5}$  volt and raising the total input impedance to 15,000 ohms. For the maximum possible error input signal of 1.5 volts the current through the standard cell would be 100  $\mu$ amp. Currents of only a few microamperes however, will destroy the stability of the standard cell.

This problem is solved by the use of an auxiliary reference voltage source using a VR105,  $V_0$ , and a voltage dividing network. When the magnet current error becomes smaller than 0.5 percent, the damping magnet circuit is energized. In this circuit is included relay  $RE_1$ , which simultaneously replaces the auxiliary reference source with the standard cell. At 0.5-percent error the input is 0.005 volt giving an input circuit current of 0.33  $\mu$ amp which rapidly approaches zero as the error is corrected.

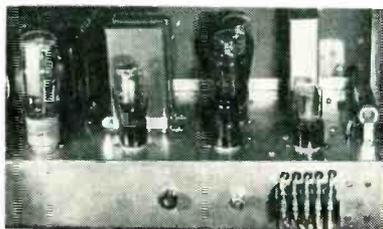
### Performance

The voltage across the 3-ohm zero-temperature-coefficient resistor in series with the magnet has been observed to deviate less than 0.002 percent of the mean value for any magnet current setting between 1 and 2.5 amperes. The hysteresis effect in the magnet core reduces the actual magnetic field fluctuations to even smaller values. A fast line voltage step of 5 volts fails to change the magnet current measurably.

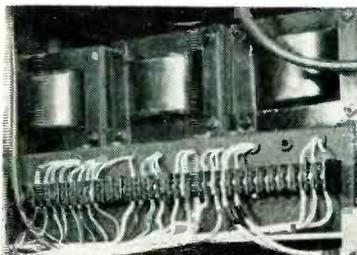
This work was performed under the auspices of the U. S. Atomic Energy Commission.

### REFERENCE

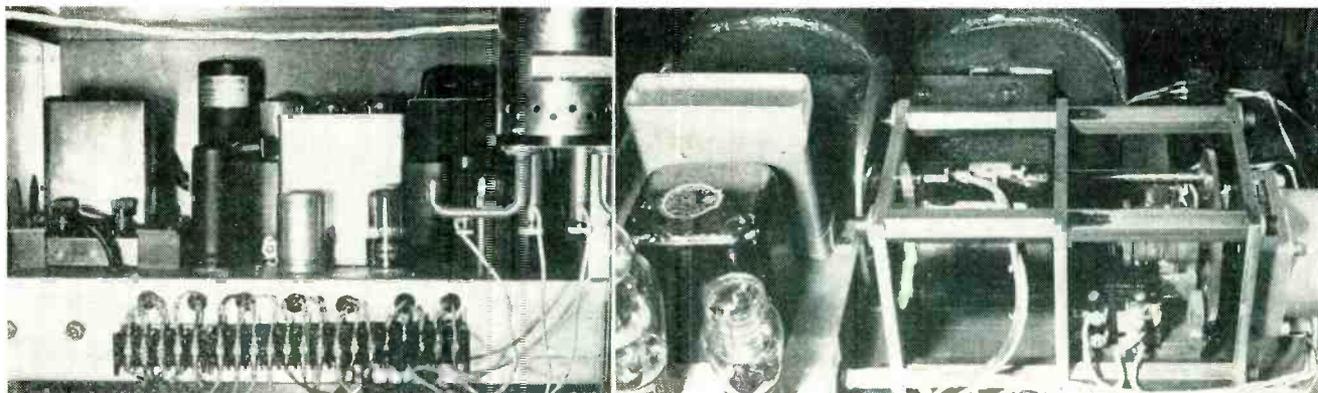
- (1) E. J. Rogers and C. M. Turner, Injection System—Part I—Van de Graaff Accelerator, *Rev Sci Inst.*, Sept. 1953.



Chassis of 300-v regulated amplidyne-field supply



Filter for commutator ripple uses 2-h. 2-amp chokes



Current feedback circuit includes: servo amplifier, standard cell and error signal amplifier, left; servo motor, motor-driven potentiometer and magnetic damper, right

# Portable Precision

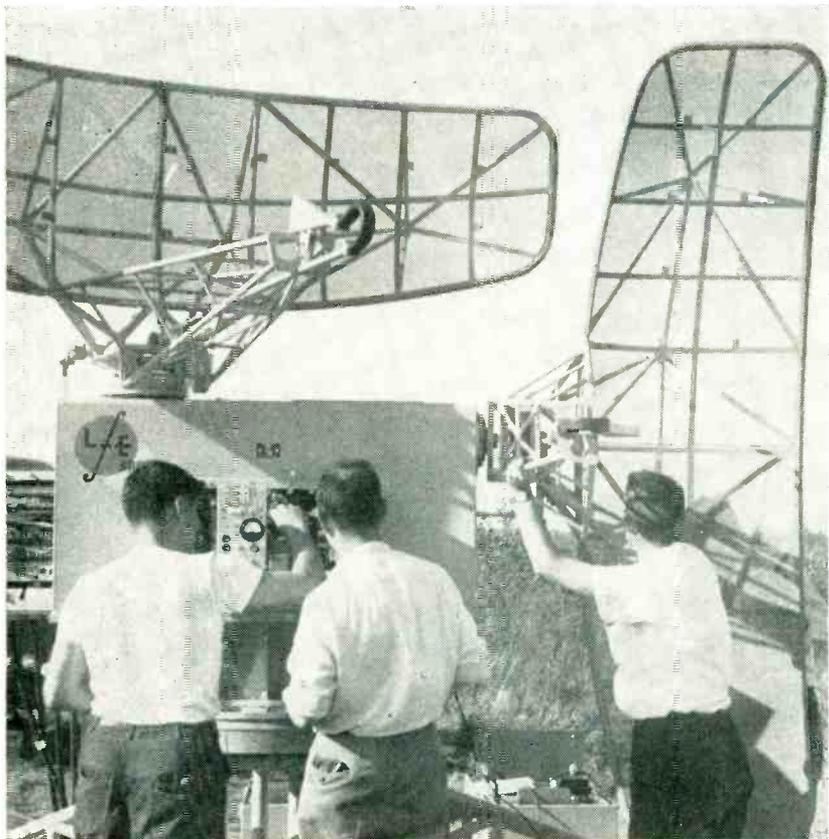
By J. B. LEVIN

Senior Engineer  
Laboratory for Electronics, Inc.  
Boston, Mass.

## The Front Cover



Portable SPAR approach radar unit is capable of guiding landing plane to within twenty feet of selected touchdown point. When radar is in operation plane would approach from right. The r-f head consisting of transmitter mixers, preamplifier and cfc unit are mounted in a pressurized compartment on the antenna pedestal



Set-up time for par unit is six hours. Rotatable pedestal provides coverage of more than one runway

**A**NY precision-approach radar must provide information regarding the accuracy with which landing aircraft are following a prescribed flight path and should include lateral deviation from the runway, vertical deviation from the glide path and distance to go to touchdown.

Small deviations of the aircraft from the glidepath or runway center line in the vicinity of touchdown must be clearly and accurately displayed. The absolute value of the range to touchdown is not required, but the position of the touchdown point must be precisely located with respect to the flight path.

In the SPAR approach control system described here, two corner reflectors are used to determine the touchdown point, the runway centerline and the elevation reference. All system errors are effectively calibrated out at touchdown. The accuracy is then limited only by the ability of the operator and errors, such as scintillation, inherent in the received signal. Because of these limitations, the specified deviation accuracy is taken to be 0.5 percent of the range from touchdown,  $\pm 20$  feet.

Deviation and range information are displayed on a 17-inch rectangular tube with a P-19, long persistence phosphor. Two displays are time shared on one indicator, the elevation sector on top, azimuth on the bottom. A flight-path computer in each indicator generates functions representing the glide path and runway extensions as viewed from the antennas. These are displayed on the indicator along

# Approach Radar

**SUMMARY** — Military operations and smaller airports require light-weight, flexible gca radar for all-weather landings. This unit with six-hour set-up time, provisions for runway changing and clutter elimination provides touchdown accuracy of better than  $\pm 20$  feet

with range marks and normal video, as shown in the photograph.

A beta-scan display (angle versus range) is used to give expansion of small errors at short ranges.

To achieve a high information rate, separate antennas are used for azimuth and elevation coverage. These scan their respective planes at a rate of 2 cps, with a phase difference of 90 deg between the motions of the reflectors.

To achieve high angular accuracy and resolution, the antenna beamwidths are each 0.8 degree in the plane of scan.

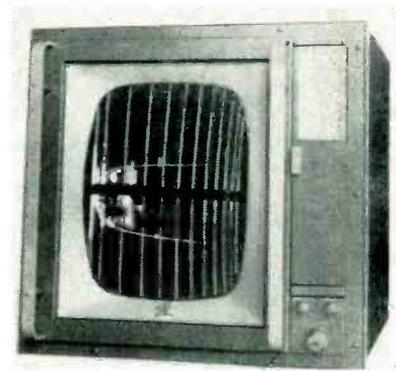
This imposes the requirement of operating at a transmitter frequency high enough to limit the reflectors to a reasonable size. Although K-band might seem attractive, all-weather performance is

poor at these frequencies and X-band is therefore used as the best compromise.

## Clutter Elimination

Rain clutter may often completely obscure targets at X-band frequencies. This clutter may be minimized by circular polarization in the antenna feed but with an effective loss in system performance. Linear polarization should therefore be used in the absence of precipitation. Both types of polarization are provided, selectable by a solenoid-actuated polarization switch.

To permit maximum flexibility of siting, antenna coverage should be as wide as possible in the plane at right angles to the direction of scan. The radiation patterns fol-



Beta-type display shows elevation of landing aircraft on upper section of screen and azimuth position on lower section

low a  $\text{csc}^2$  law to 30 deg in the wide plane of the antenna.

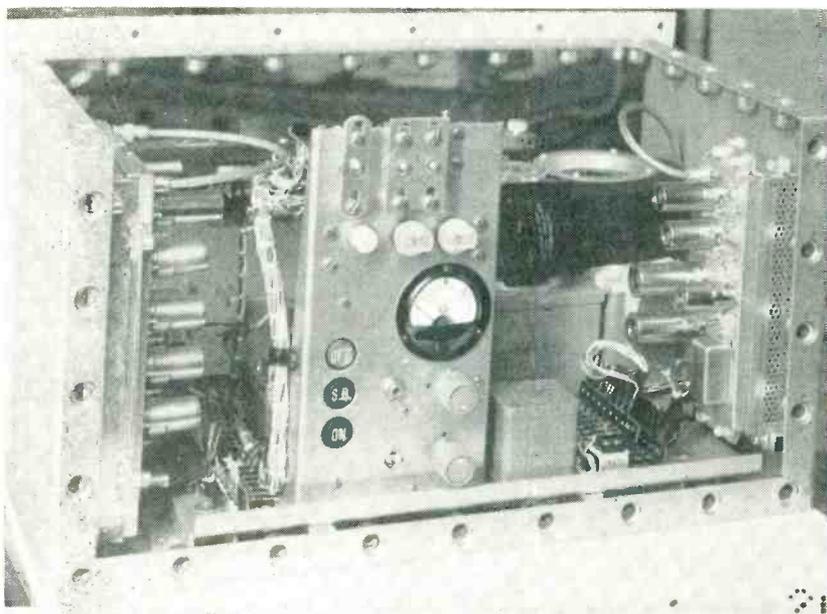
For the same reason, and to achieve sufficient coverage for aircraft deviating widely from the glide path, the antenna scan sectors extend from  $-1$  deg to  $+9$  deg in elevation, and  $-10$  deg to  $+20$  deg in azimuth, as shown in Fig. 1. The 30-deg azimuth sector also provides increased flexibility in siting.

The normal position of the radar is to the left of the runway, as viewed from an approaching aircraft. To get the same coverage for the right side of runway operation, the horizontal pattern can be reversed by inverting the dish.

## System Description

A block diagram of the system is shown in Fig. 2. The transmitter uses a 2J51 tunable magnetron operating in the 9,080-mc band at a prf of 2,000 cps, a pulse width of  $0.5 \mu\text{sec}$  and a peak output power of 50 kw.

Transmitter power output is



Chassis of r-f section. Preamplifier is at right and afc at left. Magnetron is at right behind preamp and control panel

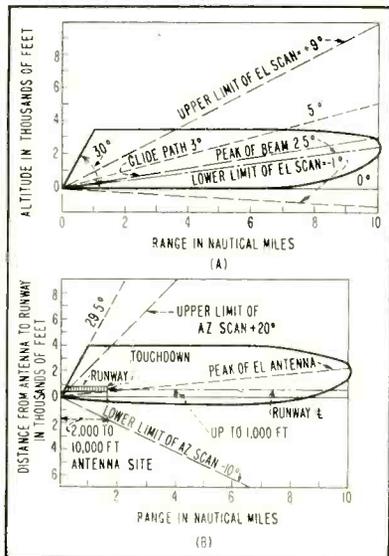


FIG. 1—Elevation (A) and azimuth (B) coverage of par antennas. For operation from right side of runway, azimuth pattern would be inverted

switched between antennas by a rotating-blade r-f switch coupled to the antenna drive motor. A 2K25-klystron local oscillator is locked 30 mc above the transmitter frequency by a 15-mc bandwidth a-f circuit with high loop gain which insures stable receiver operation with short warm-up time. A balanced mixer and low-noise pre-amplifier with input circuits detuned to compensate for induced grid noise result in an overall system sensitivity of more than 100 dbm. A logarithmic i-f amplifier then amplifies the signals to a level of 1.5 v where they are rectified.

The signals are then further amplified to a level of 5.0 v and fed to the indicator through a coaxial cable. The logarithmic amplitude response of the i-f amplifier compresses the output signals to within the dynamic range of the crt without limiting. This prevents weak signals from limiting in the presence of clutter and also provides contrast between strong signals of different amplitudes. A compression ratio of 12 db at the output is achieved for a 60-db range of input signals.

Angle information is derived from miniature precision resolvers coupled directly to the reflector drive shafts. Resolver errors are adjusted to zero at touchdown and are less than  $\frac{1}{4}$  deg over the operating range. The resolver outputs

are demodulated and combined in the signal-data converter and then fed to the indicator through a single coaxial cable at a level of  $\pm 25$  v.

In the indicator these voltages are fed to the vertical sweep circuits and the flight-path computer. The video is amplified to a 70-v level and then displayed on the crt together with 1-mile range marks and the output of the flight-path computer. The logarithmic 10-mile horizontal sweep provides expansion at ranges near touchdown where the greatest accuracy is required. The horizontal sweep circuits and high voltage power supply are similar to the flyback circuits commonly used in television receivers.

### Signal Data Converter

The signal-data converter supplies regulated carrier voltage to the resolvers, demodulates and combines output voltages of the resolvers (varying from 0 to 25-v a-c peak) and feeds the resultant envelope voltage at low impedance through a coaxial cable to the indicator. The detector and amplifier portion has an overall linearity of  $\pm 0.25$  percent.

A block diagram of the signal-data converter is shown in Fig. 3. A 2-ke oscillator supplies carrier voltage to the resolver stators and also serves as the basic timing oscil-

lator for the radar. The input voltage to the resolvers is held constant to within 1 percent by a feedback amplifier in the oscillator circuit.

Output voltages of the resolver rotors, modulated according to the angular position of the reflectors, are returned to the signal-data converter where they are combined and sampled by the input gate. These voltages are then fed to the a-c feedback amplifier, which provides a low-impedance source for driving the keyed detector. The keyed detector provides an accurate means of demodulating the angle voltages without phase shift. The resultant slowly varying signal is then fed to the d-c feedback amplifier which provides a low-impedance source for driving the coaxial cable to the indicator.

The complete schematic diagram of the signal-data converter is shown in Fig. 4. Tubes  $V_1$  and  $V_{2A}$  constitute a phase-shift oscillator whose frequency may be adjusted by  $R_1$ .

The power amplification to drive the resolvers is supplied by  $V_3$  whose output is also rectified by  $V_6$ , amplified by  $V_8$  and fed back to the suppressor grid of  $V_1$  to provide amplitude stabilization of the oscillator. The output of  $V_3$  is also fed to Miller amplifier  $V_{2B}$  where it is phase-shifted 90 deg and then shaped and clipped in  $V_{11}$ . Blocking oscillator  $V_{12}$  supplies 1- $\mu$ sec

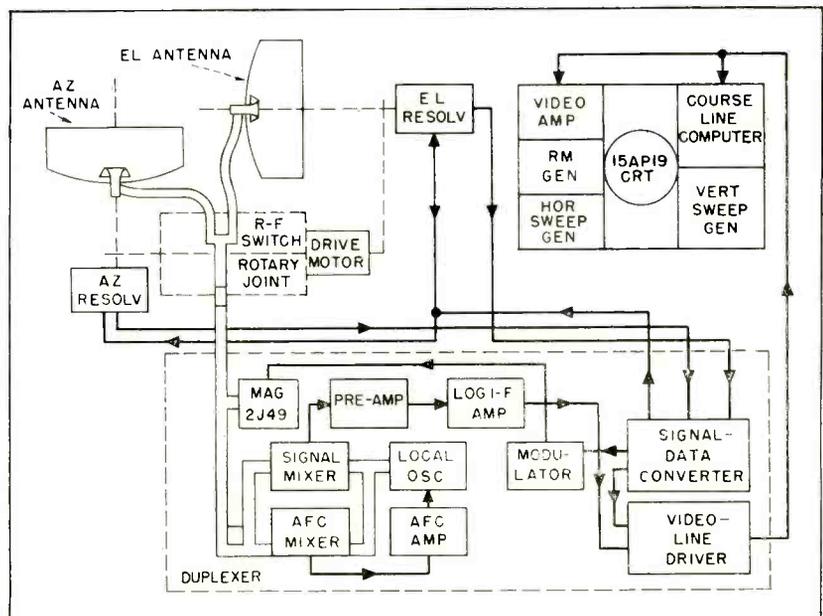


FIG. 2—Circuits within dashed box are mounted on antenna pedestal

sampling pulses to the grids of keyed detector  $V_7$  and a trigger pulse to blocking oscillator  $V_{13}$ . This, in turn, supplies a 0.5- $\mu$ sec system trigger to the indicator and modulator.

The output of the azimuth and elevation resolvers are fed to the grids of  $V_4$  which are switched at the same rate as the antennas by the azimuth-elevation gate. This gate is derived from a snap-action switch on the pedestal and shaped by Schmidt trigger  $V_{10}$  and amplified by  $V_{11}$ .

The combined resolver outputs are then amplified in  $V_5$  and  $V_{6A}$ , comprising a unity-gain a-c feedback amplifier, and demodulated by keyed detector  $V_7$ . The rectified output of  $V_7$  is again amplified by  $V_{10}$  and  $V_{17}$  comprising the unity gain d-c feedback amplifier. Tube  $V_{10}$  is a constant current mode gain and

improves the d-c balance of  $V_{10}$ .

Constant current tube  $V_{18B}$  acts as an infinite impedance coupling resistor between  $V_{15A}$  and  $V_{17}$  resulting in increased open-loop gain and larger swing on the grid of  $V_{17B}$ .

The output of  $V_{17B}$  is fed to the indicator through a coaxial cable. Video from the logarithmic i-f amplifier is amplified by  $V_{17A}$ ,  $V_{16}$  and  $V_{15}$  and then goes to the indicator via coaxial cable.

### Flight-Path Computer

The flight-path computer generates range marks as a function of angle voltage to precisely represent the projection of the glide path on the horizontal and vertical planes intersecting the runway, as viewed from the radar. The geometry is illustrated in Fig. 5. Angles  $\theta$  and  $\phi$  are between the sector edge and a point on horizontal or vertical projections of the glide path and are determined by the angular positions of the azimuth and elevation antennas.

The angles between the sector edge and a line parallel to the runway and the glide path are  $\theta$ , and

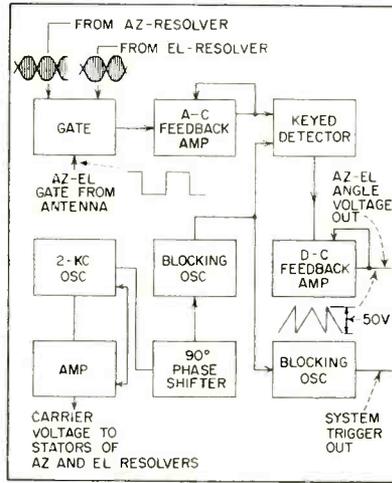


FIG. 3—Signal-data converter system with waveforms at various points

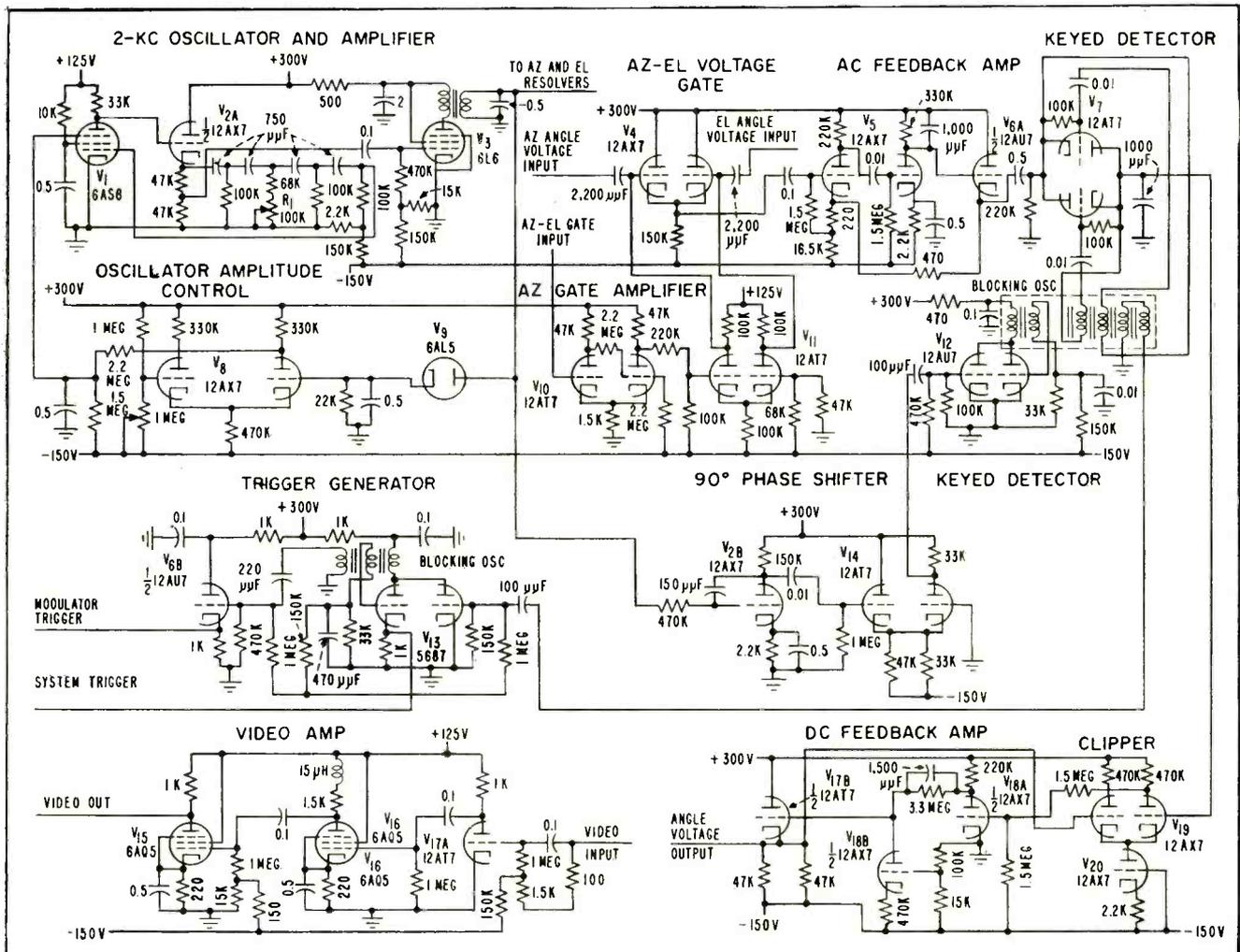


FIG. 4—Two-kilocycle phase-shift oscillator in signal-data converter provides basic timing signal for entire radar unit. Blocking oscillator  $V_{13}$  supplies 0.5- $\mu$  sec system trigger to indicator and modulator.

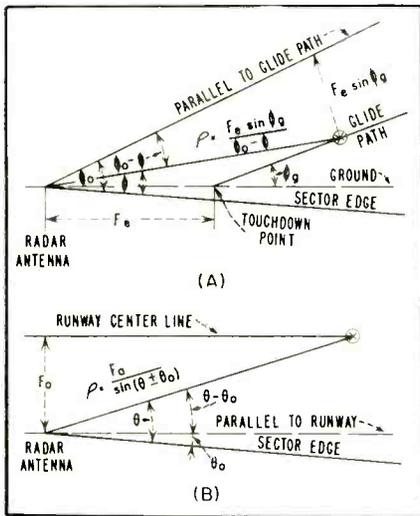


FIG. 5—Geometry of elevation (A) and azimuth (B) corrections

$\phi_0$ , and are determined from a site survey and the orientation of the antennas. Angle  $\phi_0$  is the glide angle and  $\rho$  is the slant range between the radar and a point on the glide path.

The flight-path computer must then generate range marks according to the relationships  $\rho = F_0 \phi_0 / (\phi_0 - \phi)$  during the elevation scan interval and  $\rho = F_0 / (\theta \pm \theta_0)$  during the azimuth scan interval.

### Flight-Path Computer

A block diagram of the flight-path computer is shown in Fig. 6. The combined angle voltage from

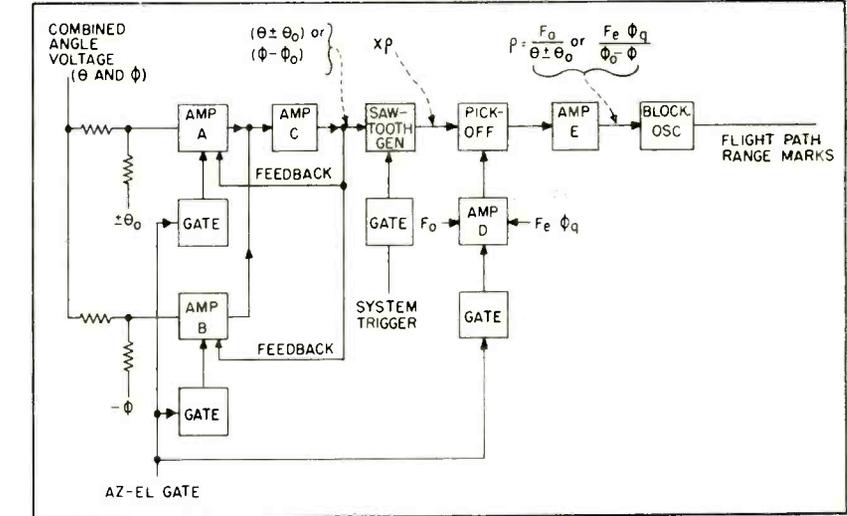


FIG. 6—Flight-path computer generates glide path and range lines for  $\beta$ -type display

the signal-data converter is added separately through resistance networks to fixed but adjustable voltages proportional to  $\phi$  in one case, and  $\pm \theta$  in the other. The new voltages are then fed, respectively, to amplifier A and amplifier B, which are turned on or off by the az-el gate and together constitute a unity-gain feedback amplifier which provides a low impedance driving source for the saw-tooth generator. The saw tooth thus generated has a slope proportional to the output of amplifier C, is gated on at the time of the system trigger and runs for the full sweep duration.

The amplitude of the saw tooth voltage at any time is equal to the product of its slope and the elapsed time since the system trigger. The angle voltage is thus effectively multiplied by range. The saw tooth is then fed into one side of a pick-off circuit whose reference is a voltage proportional to the off-set distance  $F_0$  or  $F_0 \phi_0$ . When the saw-tooth amplitude, proportional to  $\rho$  ( $\theta \pm \theta_0$ ) or  $\rho (\phi_0 - \phi)$ , reaches the voltage  $F_0$  or  $F_0 \phi_0$  a pulse is emitted from the plate of the pick-off tube, shaped in amplifier E and then fed to the grid of the blocking oscillator. Thus, the time, and hence the range, of this pulse satisfies the

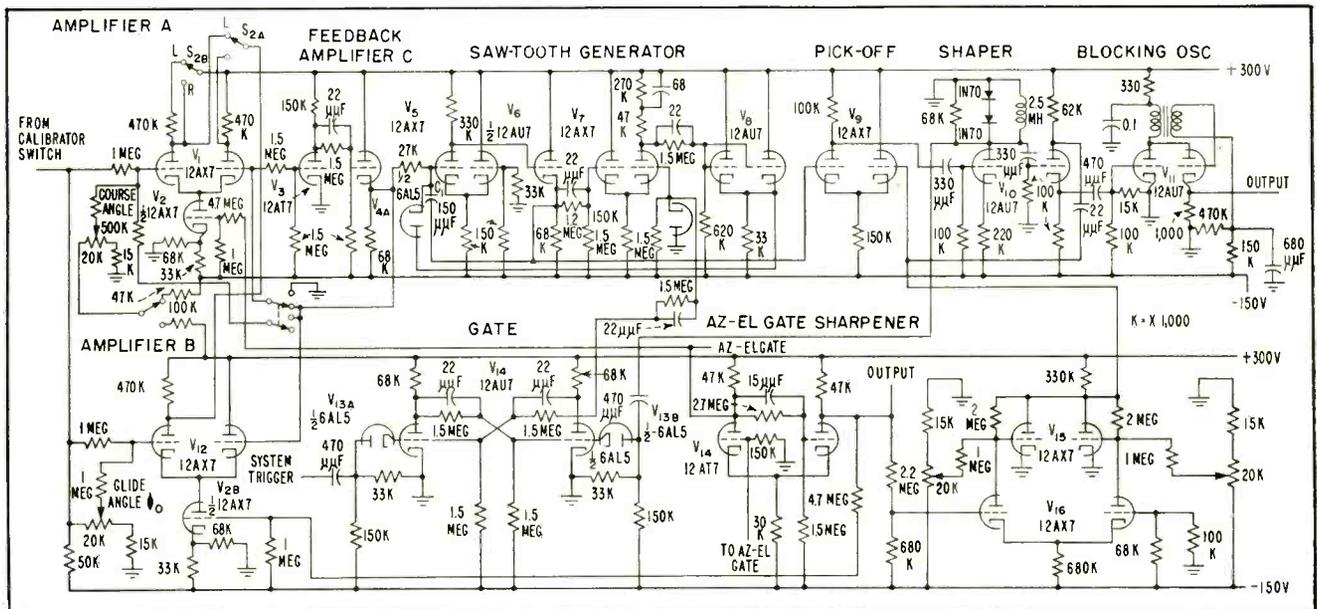


FIG. 7—Circuit of flight-path computer. Switch  $S_2$  selects operation for right or left side of runway

conditions for  $\rho$  in both equations.

The complete schematic diagram is given in Fig. 7. Tubes  $V_1$  and  $V_{12}$  correspond to amplifiers A and B in the block diagram,  $V_3$  corresponds to amplifier C and  $V_4, V_5, V_6$  and  $V_7$  comprise the saw-tooth generator.

During the interval between sweeps, the saw-tooth gate generator clamps the right-hand grid of  $V_7$  to ground through diode  $V_{14}$  and  $V_7$  is therefore in a conducting state. Amplifiers  $V_6$  and  $V_7$  in conjunction with cathode followers  $V_5$  and  $V_8$  amplify signals on the left-hand grid of  $V_5$  and feed them back through diode  $V_{14}$  which forces the left-hand grid to assume the same

potential as the fixed bias on the right-hand grid of  $V_5$ .

When the saw tooth on the left-hand grid of  $V_5$  reaches a value equal to that of  $F_a$  or  $\phi_p F_a$  on the right-hand grid, a negative pulse is fed to amplifier-shaper  $V_{10}$  whose output triggers blocking oscillator  $V_{11}$ . Meanwhile, the offset voltages, set up on the two potentiometers, are fed to the grids of  $V_{15}$ , which are gated by the azimuth-elevation gate through balanced modulator  $V_{16}$ . The voltage at the plate of  $V_{16}$  and the right-hand grid of  $V_5$  is therefore proportional to either  $F_a$  or  $\phi_p F_a$ , depending on the condition of the az-el gate.

### Polarization Switch

The polarization switch provides selection of either linear or circular polarization. The basis of the switching device is the turnstile junction, illustrated in Fig. 8. This is a hybrid junction having four arms of standard rectangular waveguide symmetrical about the H-plane and one arm of round or square waveguide connected to the junction in the plane of symmetry. The output of the duplexer is fed into A. Waveguides B and D are terminated in moveable short circuits, C is terminated in the characteristic impedance of the guide and E is connected to the antenna feed horn.

Any type of polarization may be propagated in the output arm with no energy propagated in C, depending on the position of the short circuits. Energy reflected back into the junction will be propagated in either A or C depending on the phase and amplitude characteristics of the signal. If the arms are adjusted to transmit linear polarization, components of the reflected energy polarized in the same direction will be propagated in A and the receiver. Components polarized orthogonally will be propagated in C, and dissipated in the termination.

In the case of circular polarization, a certain sense of rotation may be assigned to the vector representing the transmitted field. Upon reflection from a perfect specular reflector, the sense of rotation, as seen from direction of propagation, will be reversed. The effect

of the various phase shifts in the arms of the turnstile will then be to cancel all energy entering A and to reinforce energy entering C. Consequently, to the extent that precipitation behaves like a specular reflector, the energy reflected from it will be dissipated in the termination and will not reach the receiver. Nonspecular reflectors, such as aircraft, will depolarize the signal to a certain extent, and the depolarized energy will enter the receiver. For a random scatterer this amounts to a theoretical loss of about 3 to 6 db. In practice the loss is generally somewhat less.

Measurements made with corner reflectors have indicated 50-db

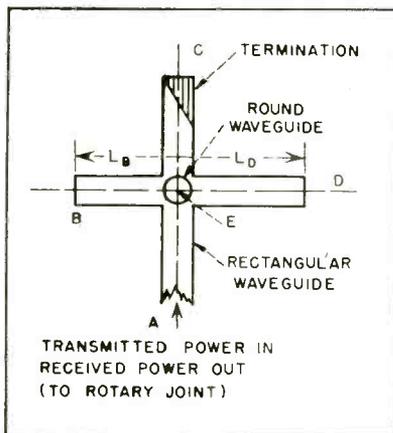
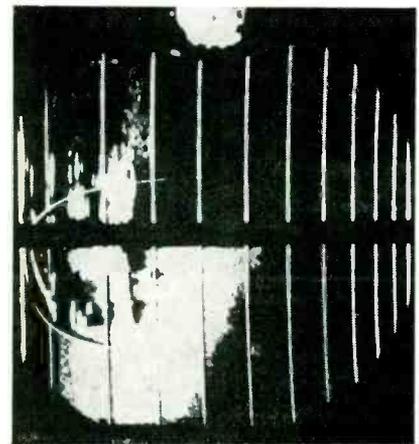


FIG. 8—Turnstile junction for selecting circular or linear polarization



Circular polarization (top half) reduces clutter visible with linear polarization

potential as the fixed bias on the right-hand grid. This accurately fixes the starting voltage of the saw tooth. Any tendency for feedback to take place through capacitor  $C_1$  is prevented by the much lower impedance presented to the grid of  $V_5$  by the cathode of  $V_6$ .

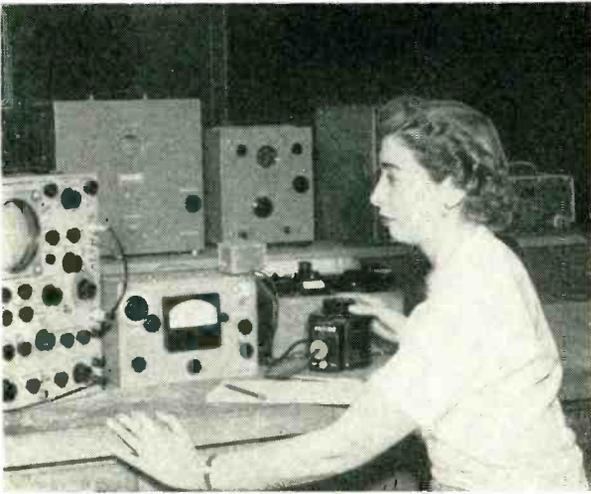
At the time of the system trigger, the saw-tooth gate generator drives the right-hand grid of  $V_7$  positive. This causes the grids and cathodes of  $V_8$  to go negative, opens diode  $V_{14}$  and opens the d-c coupled portion of the feedback loop. Amplifier  $V_6$  and cathode follower  $V_5$  then cause a constant current to flow in capacitor  $C_1$  equal to the current flowing in  $R_1$  due to the angle voltage and generates a highly linear rise of voltage at the cathode of  $V_6$ . The resultant saw-tooth is fed to differential ampli-

specular target rejection in field tests on the polarizer. The effect of the polarizer on actual rain return is shown in Fig. 9.

In approximately 3,000 hours of field testing, over 1,500 approaches were flown with many different types of aircraft. Deviation errors at touchdown of 10 feet or less were achieved regularly.

The author wishes to acknowledge and thank N. Repella, P. A. Crandell, M. Rosen, J. L. Freedman and W. J. Charrow for their assistance in the development of the par system.

Extensive field tests and evaluation of the prototype unit were performed under the direction of N. Repella. Final production engineering of the equipment was accomplished under the direction of J. H. Cook.



Inspection of quartz crystal transmission characteristics

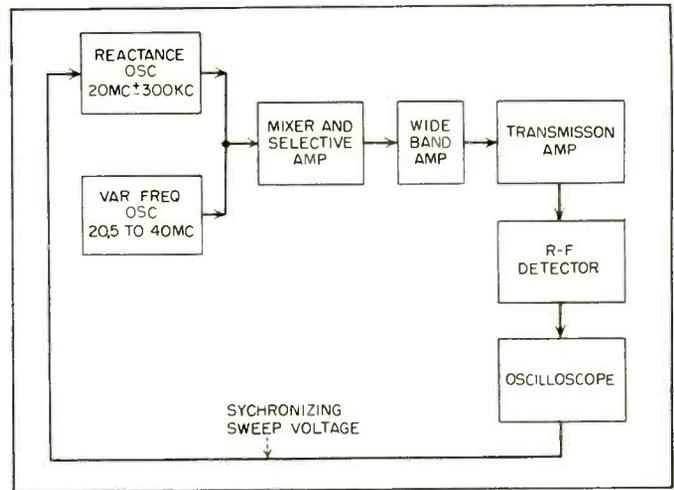


FIG. 2—Block diagram of crystal spectrum analyzer

# Spectrum Analyzer

**S**PECTRAL analysis of the response characteristics of a quartz crystal provides an efficient means for determining its Q factor under dynamic conditions. This technique also provides a reliable method for determining the existence and nature of any spurious resonances that may exist in proximity to the desired resonant frequency.

A spectrum analyzer is described which will, when used with an oscilloscope, display a visible frequency spectrum up to  $\pm 300$  kc of the selected center frequency for any selected crystal in the frequency

range from 0.5 to 20 megacycles.

The major requirement for spectral analysis of high-Q circuit elements is that the network be scanned with a signal of slowly varying frequency and constant magnitude of voltage.

Mathematical treatments on the response of resonant circuits to varying frequency have been given by Hok<sup>1</sup> and Barber.<sup>2</sup> Interpretation of both analyses revealed that to reproduce accurately the response characteristic of a resonant circuit, the rate of change of the scanning frequency must be compatible with the bandwidth ( $\pm 3$ -db points) of the scanned circuit.

Incompatibility will cause: ringing (a condition which results from a beat between the forced oscillation of the resonant circuit and the driving frequency of the system); error in the peak transmission current; apparent shift in the resonant frequency; and apparent increase in the bandwidth of the scanned crystal.

## Quartz Crystal Characteristic

The equivalent electrical circuit of a quartz crystal is shown in Fig. 1 and is related to its motional impedance.<sup>3</sup> Since a quartz crystal possesses many inherent modes of

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motion, an equal number of electrical resonances may occur due to the elastic coupling between these vibrational modes. Existence of undesired resonances may create: an abnormally high effective resistance for series operation; a lack of positive selection of the desired frequency oscillation; and undesired shifts of oscillating modes at elevated temperature. In fabricating a precision quartz crystal, an attempt is made to suppress all but the desired mode of vibration by proper orientation of the wafer.

## Analyzer Data

The crystal analyzer will provide an effective means of reproducing visually the true admittance characteristic of the finished plate, while revealing the existence and magnitude of any spurious resonance that may exist within the displayed frequency spectrum.

The crystal spectrum analyzer in Fig. 2 employs a sweep-frequency oscillator having a sweep width

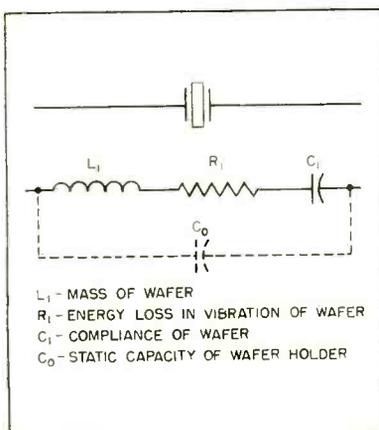


FIG. 1—Electrical equivalent circuit of a mounted quartz crystal

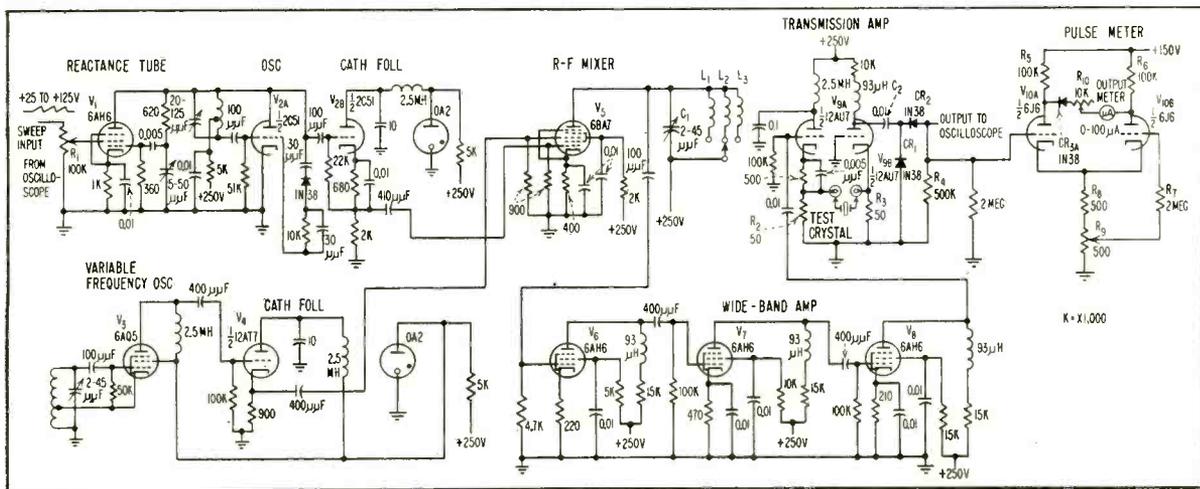


FIG. 3—Circuit diagram of crystal spectrum analyzer which has frequency range of 0.5 to 20.0 mc

# for Quartz Crystals

**SUMMARY** — Sweep-frequency oscillator has constant output voltage over entire swept band for use in checking electrical characteristics of quartz crystals. Slow rate-of-change frequency gives accurate spectrum analysis

variable up to  $\pm 300$  kc of a 20-mc mean frequency. This sweep-frequency is fed to a converter where it is mixed with a selected signal from a 20.5-mc to 40-mc oscillator.

The output of the converter which is designed to select the difference frequency of these two signals is coupled to a broadband amplifier. After amplification, the resultant sweep frequency is fed to a cathode-coupled transmission-type amplifier. Here the quartz crystal under investigation is inserted for an electrical analysis of its transmission characteristics throughout the applied sweep-frequency spectrum.

A diode detector is used to produce d-c voltages proportional to the magnitude of the r-f signal admitted to the final stage of the transmission amplifier by the quartz crystal. The detector output is applied to the vertical d-c amplifier of an oscilloscope whose time-base generator controls the repetition rate of the sweep-frequency oscilla-

tor. This arrangement provides a visual spectrum of the response characteristics of the quartz crystal unit throughout a maximum bandwidth of  $\pm 300$  kc of its fundamental frequency. A circuit diagram of the system is shown in Fig. 3.

### Reactance-Tube Oscillator

Modulating voltage for the reactance oscillator is applied directly to the screen grid of the reactance tube instead of the conventional arrangement of capacitance coupling to the control grid. By utilizing this method the previous limit for rates of modulation imposed by the capacitor in the control grid has been eliminated.

When applying this high-level sweep voltage (25-to-125 v d-c) to the screen grid, a varying r-f current, in quadrature with the capacitive current of the system, is generated. Variation of the current in reactance tube  $V_1$  causes linear variation in the frequency of oscil-

lation for this system. The magnitude of frequency deviation is controlled by the setting of potentiometer  $R_1$ . Tube  $V_{2B}$  is a cathode follower which isolates the system from external loads.

The variable frequency oscillator  $V_3$  is a conventional Hartley type oscillator designed to oscillate over a frequency range from 20.5 mc to 40 mc. Tube  $V_4$  is a cathode-follower which isolates the vfo from external loads.

### Mixer-Selective Amplifier

Mixer tube  $V_5$  is a 6BA7 pentagrid converter whose output feeds to a broadly tuned selective amplifier. The variable frequency oscillator signal is fed to the signal grid of the pentagrid converter, while the frequency-modulated signal is fed to the control grid. As these two signals are heterodyned, sweep voltages result that are sums and differences of the applied signals.

The tank circuit ( $C_1, L_1, L_2$  or  $L_3$ ) serves as a low impedance to the

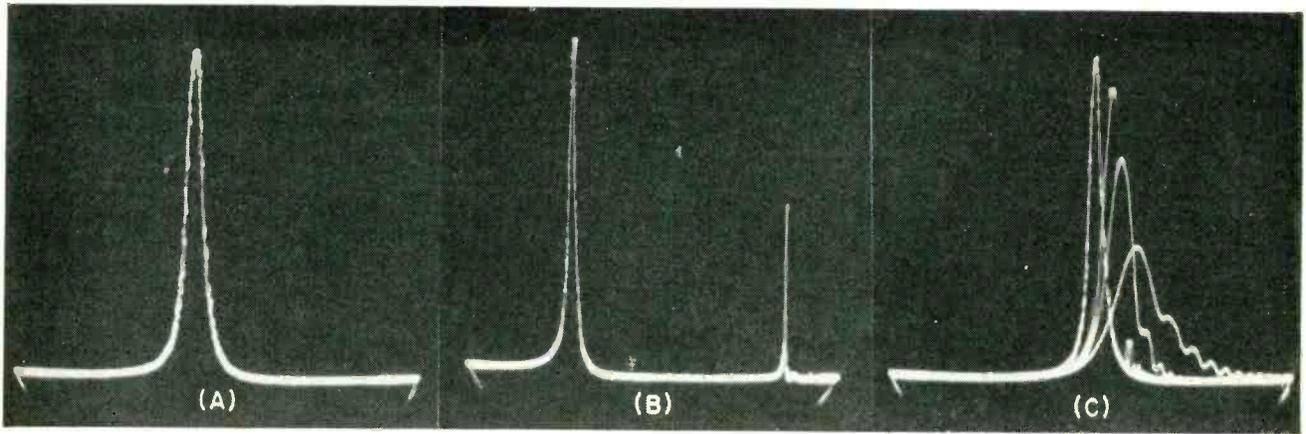


FIG. 4—Symmetrical response curve of a 6-mc crystal unit (A); undesired response to the right of the desired nominal frequency with a sweep width of 40 kc (B); and four sweep cycles of different rates of change of frequency (C)

sum of the signals (which are effectively grounded), and becomes a relatively high impedance to the difference frequencies which are the desired heterodyned signals. The low Q of the tank circuit is necessary to provide constant load impedance over the sweep width of the difference frequency of the two signals.

The wide-band amplifier consists of three stages  $V_6$ ,  $V_7$ , and  $V_8$  with shunt peaking in the plate load of each tube. The overall gain of the amplifier is approximately 20 db  $\pm 6$  db from 100 kc to 20 mc. The output from the mixer tube is fed to this section so that sufficient voltage may thus be obtained to drive the crystal unit.

### Transmission Amplifier

This amplifier was designed to measure the transmission characteristics of quartz crystals over a preselected frequency range. The necessity for this type of circuit may be realized from a review of the influence of external reactances on the dynamic evaluation of quartz resonators.<sup>4</sup>

Vacuum tube  $V_{6A}$  is a cathode follower which provides relatively constant input impedance over a wide range of frequencies. The output of  $V_{6A}$  is coupled from  $R_2$  through the crystal unit under analysis to the cathode of  $V_{6B}$ . This section forms a grounded-grid amplifier whose output is determined by the magnitude of r-f voltage admitted to  $R_3$  due to the admittance of the quartz crystal. The values of  $R_2$  and  $R_3$  were selected so that a minimum phase shift would

occur due to the effects of stray capacitance associated with the measuring circuit.

### R-F Detector

The network comprising  $C_3$ ,  $CR_1$ ,  $CR_2$  and  $R_4$  forms an r-f detector which provides a d-c voltage whose magnitude varies linearly with the amplitude of the r-f input voltage. Diode  $CR_1$  serves to discharge capacitor  $C_2$  which accumulates a negative charge during the conduction of diode  $CR_2$ . As the f-m signal is fed to the input of the transmission amplifier,  $V_{6A}$ , the output of  $V_{6B}$  varies in magnitude with the admittance characteristic of the test crystal.

This voltage is then rectified in the r-f detector stage and applied to the vertical plates of the oscilloscope. The frequency-modulating voltage applied to  $V_1$  screen grid is obtained from the output of the oscilloscope's time-base generator. Therefore, the characteristic display on the oscilloscope represents an essentially linear frequency spectrum providing relative magnitudes of frequency response throughout the visible spectrum.

### Vacuum-Tube Pulsemeter

This circuit is incorporated to provide a spurious frequency examination of a quartz crystal without the use of an oscilloscope. It consists of a direct-coupled bridge-type amplifier,  $V_{10}$  whose unbalance is effected by variations in the detected output from the r-f detector stage. This unbalance is indicated by a microammeter which is connected between the plates of  $V_{10A}$

and  $V_{10B}$ . Resistor  $R_5$  and tube  $V_{10A}$  form one section of the bridge system, while  $R_6$  and  $V_{10B}$  form the other section.

Balance of the system is accomplished by the setting of potentiometer  $R_9$  which compensates in  $V_{10B}$  for the d-c level at the grid of  $V_{10A}$  due to direct coupling. Diode  $CR_3$  is used as an unidirectional controller. Degeneration in the amplifier through  $R_8$  and  $R_9$  provides increased stability of the system against effects of line-voltage or tube-characteristic variations. Potentiometer  $R_{10}$  is used to limit the current through the meter. It is adjusted to provide ample deflection sensitivity for each crystal analysed.

The analyzer can be adapted to the investigation of mechanical i-f filters as well as other tuned circuits whose bandwidths do not exceed the sweep spectrum of the frequency generator.

The author wishes to thank John F. Alves who assisted in this development; Albin M. Snadyc for his technical supervision and George C. Neuschaefer for his helpful suggestions and encouragement.

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switches controlling one or two channels.

### Switch Design

The electronic switch described here was designed for auditory research but can be used in musical instruments, radio broadcasting, electroacoustics and industrial applications as well.

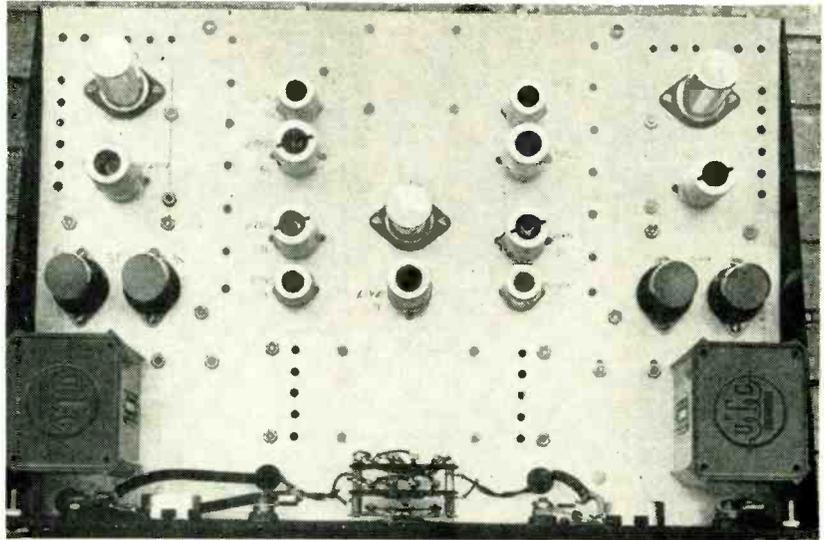
In conventional systems, switching of the signal is accomplished by biasing a tube to cutoff. This causes a large change in plate voltage which is superimposed on the signal. This fast voltage change is undesired but difficult to eliminate.

Steady-state plate current variations can be compensated relatively easily, but differences in transfer characteristics during the transition from off to on cause transients which are much more difficult to control. In psychoacoustic applications, this transition period may be an area of experimental interest. Unless precautions are taken to compensate for differences in the cutoff characteristics of the tubes used in balanced switches, the transition transient is usually only 20 to 30 decibels below the desired output signal.

In this circuit provision is made not only to balance switch-tube plate currents at the full-on condition but also at some intermediate point which can be shifted to make the best overall match along the entire transition characteristic. This balance is effected by means of separate adjustments which differentially control both the d-c level and amplitude of the switching voltages. The result is a reduction in the switching transient by 10 to 20 decibels more than in previous designs.

### Construction

The present instrument consists of two identical but separate audio channels on the same chassis with a power supply. The channels can be turned on or off manually or automatically. This switching may occur alternately, simultaneously or independently. Automatic switching rates of one every two seconds or three per second may be selected internally. Externally controlled switching is also obtainable through



Chassis arrangement has channel circuits at left and right, multivibrator in center

jacks on the rear of the chassis.

The rise and fall times of the signal are controlled by a six-position switch. Small adjustments of signal output may be made by means of the input attenuators which have a continuous range of three decibels.

### Circuit Details

In the circuit diagram of Fig. 1, tube  $V_1$  is an astable multivibrator used as the internal repetition-rate control. The timing of this multivibrator is determined by the grid resistors  $R_1$  and  $R_2$  and the plate-to-grid coupling capacitors switched in or out by  $S_1$ .

The output waveform from the plate of  $V_{3B}$  is shown on the circuit diagram. Only the negative-going edge of this waveform coupled through  $C_1$  or  $C_2$  is used as the trigger source for either turning on or off the corresponding channel. Switch  $S_2$  is used to transmit these triggering pulses or comparable external pulses either simultaneously, alternately or independently to the on-off multivibrator  $V_3$  in each channel.

The on-off multivibrator is bistable. The section conducting is determined by the negative triggering pulses through coupling diodes  $V_2$ . These control pulses may be derived from the repetition-rate multivibrator or from an external source. They may be obtained manually also by depressing either the on or off button on the front panel.

When a negative voltage pulse

of sufficient amplitude appears on the cathode of  $V_{2A}$ , for example, the diode draws current, dropping the voltage on the plate of  $V_{2A}$ . This pulse is coupled to the grid of  $V_{3B}$ , cutting off plate current.

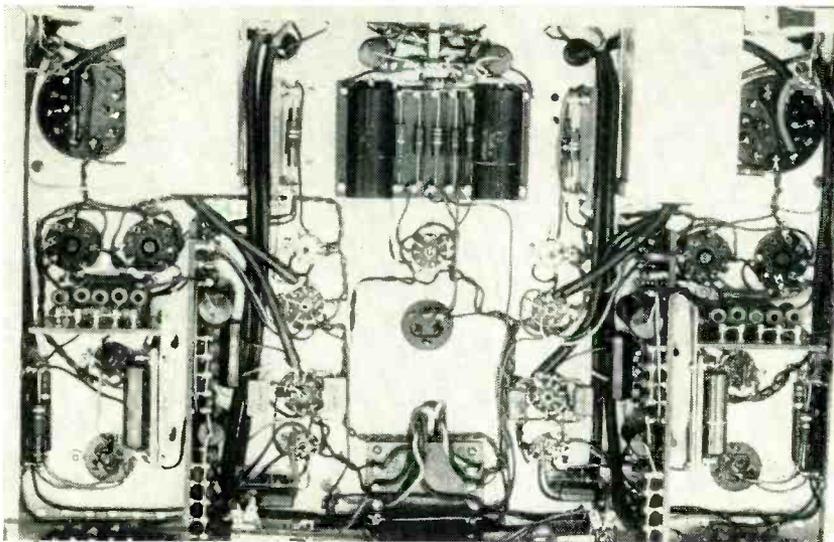
The plate voltage of  $V_{3B}$  then rises to +170 volts. This positive voltage step is coupled to the control grid of  $V_{3A}$ , turning that section of the tube on. This is one of the stable states of the multivibrator.

When a negative pulse is coupled through diode  $V_{2B}$  the reverse process occurs;  $V_{3A}$  is turned off and  $V_{3B}$  is turned on, resulting in a drop in plate voltage to -100 volts. This is so because the circuit returns to a -250-volt supply. This other stable state of the multivibrator turns the channel off.

As soon as one section of  $V_3$  is conducting the coupling diode connected to it is made nonconducting because its cathode is then at a much higher potential than its plate. The diode thus effectively decouples the multivibrator from the trigger circuit. Only a negative pulse at the opposite diode can now get through.

### Integrator

The switching voltage generated at the plate of  $V_{3B}$  is fed to an integrating and clamping circuit, producing the waveforms shown for this section of the circuit. The integrating circuit, which determines the rise-fall time of the signal, consists of  $R_3$  and one of the six capacitors selected by switch  $S_5$ . Values of



Terminal board construction is used on electronic switch chassis

these capacitors range from  $300 \mu\text{f}$  to  $0.1 \mu\text{f}$ . This circuit converts the vertical sides of the switching waveform to sloping sides with the rate of change of voltage depending on the time constant of the integrator.

The upper and lower limits of this waveform are clamped at predetermined levels by duodiode  $V_4$ . Linear rise and fall of the trapezoidal waveform requires that the rectangular switching voltage be as large as possible. For equal rise and fall times the rectangle must be symmetrical about the mean value of the trapezoid. This is another reason for a negative supply.

The trapezoid is fed to the grid of cathode follower  $V_{5A}$ . The maximum cathode voltage is about 31 volts, the optimum value for turning on the switch tubes with the least distortion. The minimum voltage at the cathode is  $-8$  volts, low enough to cut off the plate current in the switch tubes.

The grid voltage of  $V_{5A}$  is purposely made to swing beyond the value needed to cut off the plate current. The extra time involved in this process thereby insures that the channel is not turned on before the other is completely off.

### Balancing

Balance potentiometers  $R_6$  and  $R_7$  compensate for unbalance in switch tubes  $V_6$  and  $V_7$ . Potentiometer  $R_6$  connected directly to the output of  $V_{5A}$  changes the amplitude of the switching voltage, and the center

tap of  $R_6$  connects to the positive supply to change the average value of the trapezoid on one grid relative to the other.

The balance potentiometers are designed to change these variables by about one percent. This is sufficient to minimize the transient in the output of the switch tubes.

The audio signal from the input terminals is fed through the 3-db attenuator to the input transformer. The secondary of this transformer is split so that the signal is presented to the control grids of the switch tubes out of phase and in series with the switching voltage from the balance potentiometers.

Switching tubes  $V_6$  and  $V_7$  are arranged as a differential push-pull amplifier. When they are switched on the signal is picked off the plate of  $V_6$  through  $R_6$ . This signal is not degenerated by the common cathode resistor, since it has out-of-phase signal currents flowing through it without any net signal voltage across it. This is indicated in the waveform at this point showing only the switching trapezoid at the cathode.

Because the plate resistors are twice as large as the cathode resistance and  $R_6$  and  $R_7$  are equal the voltage at their junction is one-half the supply voltage for these tubes, or 50 volts. This is true whether the switch is on or off. The differential arrangement of the switch tubes acts to keep the output independent of in-phase voltage changes

at the grids produced by the switching waveform. The output is thus free of switching transients insofar as the tubes and associated components are balanced. One-percent resistors are used in this portion of the circuit. The bridge circuit which balances out the d-c shifts at plate and cathode was developed by the Grason Stadler Co. of Cambridge, Mass.

The discrimination of a differential amplifier against in-phase signals depends on equality of tube characteristics. They can not be made equal all the way from cutoff to full on but they are partially compensated for by the balance circuit.

The output of the switch tubes is fed to the double triode  $V_8$  connected as a cathode follower. The high mutual conductance of the 12AT7 makes it very effective for this purpose. Its large amplification factor also helps to discriminate against power supply noise. This circuit provides a one-volt output into 600 ohms with the distortion down 45 to 50 db.

The peak-to-peak switching transient has been found to be less than one percent of the signal for eight out of ten 6J5 tubes when they were grouped in best matched pairs. To increase stability of the balance the tubes were aged 100 hours. The short-term stability of the circuit is exceptionally good because of the regulated power supply. But because the switch tubes are direct-coupled the balance is subject to the usual cathode emission drift and thus has to be checked occasionally.

Two instruments have been built aided by a grant from the National Institutes of Neurological Diseases and Blindness and are now in operation. One is being used for psychoacoustic research at Central Institute for the Deaf in Saint Louis. The other is to be used in connection with medical research on the brain at the University of Wisconsin in Madison.

The authors acknowledge the assistance of Gerard M. Shickman of Central Institute for the Deaf in construction of the first instrument.

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# Simple Color Computer

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**R**EDUCTION OF DATA describing the spectral characteristic of a reflecting or transmitting light source to CIE tristimulus values and trichromatic coefficients<sup>1</sup> involves a tedious series of operations.

An analog-type tristimulus-value computer has been constructed for performing colorimetric data reduction with a minimum of effort.

The instrument depends for its accuracy upon a precision microammeter. The meter is used not only for calibration, but also to set in data and to read out results. Ultimate accuracy which can be achieved is therefore controlled largely by the accuracy to which the meter scale can be read by the operator.

The complete instrument is designed in such a way that the calibration can be easily checked and has sufficient sensitivity to compute trichromatic coefficients for any radiance occupying a band of more than 10 millimicrons ( $m\mu$ ) throughout a substantial portion of the visible spectrum. For wavelength ranges near the extreme red and blue ends of the spectrum, the sensitivity is somewhat reduced. Experience with the computer has shown that trichromatic coefficients may be determined within  $\pm 0.005$ .

The tristimulus values for any

radiance distribution  $R(\lambda)$  are given by the expressions

$$\begin{aligned} X &= \int_{400}^{700} R(\lambda) \bar{x} d\lambda \\ Y &= \int_{400}^{700} R(\lambda) \bar{y} d\lambda \\ Z &= \int_{400}^{700} R(\lambda) \bar{z} d\lambda \end{aligned} \quad (1)$$

where  $X$ ,  $Y$  and  $Z$  are the tristimulus values;  $x$ ,  $y$  and  $z$  are the CIE colorimetric weighting functions;  $R(\lambda)$  is the radiance in question and the integrals are understood to be taken over the visible interval from 400 to 700  $m\mu$ .

Functions  $x$ ,  $y$  and  $z$  are shown in Fig. 1 normalized against  $z = 1.0$  at 450 millimicrons. They represent in effect the color mixture curves for a standard observer and the CIE hypothetical primaries  $X$ ,  $Y$  and  $Z$ . The ordinates of the three curves are adjusted so that there is an equal area under each curve.

## Integral Evaluation

Evaluation of the integrals in Eq. 1 is complicated by the fact that  $x$ ,  $y$  and  $z$  are not analytic. However, their values have been calculated to a high degree of precision for every wavelength in the visible spectrum; a partial tabulation is given in Table I. In addition, it is only rarely true that the radiance  $R(\lambda)$  can be written in a closed mathematical form. The indicated integrations are therefore invariably performed mechanically by one of the methods which are essentially equivalent to Simpson's rule. This calculation represents the bulk of the labor in colorimetric data reduction.

Having computed the quantities  $X$ ,  $Y$  and  $Z$  the trichromatic coefficients  $x$ ,  $y$  and  $z$  are obtained as

$$\begin{aligned} x &= X/(X + Y + Z) = X/T \\ y &= Y/(X + Y + Z) = Y/T \\ z &= Z/(X + Y + Z) = Z/T \end{aligned} \quad (2)$$

where  $T$  represent total tristimulus value or  $X + Y + Z$ . Since only two of the trichromatic coefficients are independent of each other, it is cus-

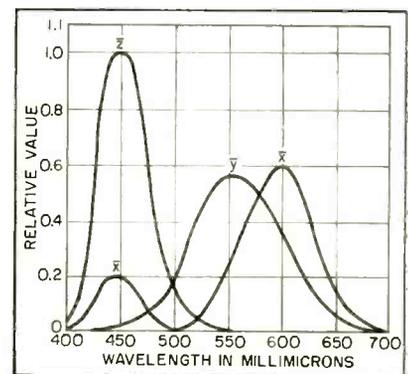


FIG. 1—Functions  $x$ ,  $y$  and  $z$  normalized against  $z = 1.0$  at 450  $m\mu$ .

tomary to express a color by the three quantities  $x$ ,  $y$  and  $Y$ . The CIE system of color specification is arranged so that the quantity  $Y$  carries information regarding the luminance of the color.

The tristimulus computer to be described performs the operations in Eq. 1 and Eq. 2 automatically.

To use the calculator, data on the radiance  $R(\lambda)$  must be available at regularly spaced intervals throughout the visible spectrum. Specifically, it is desirable that the ordinates of  $R(\lambda)$  be known at 10-millimicron intervals in the region from 400 to 690 millimicrons. The input elements to the computer comprise a group of 30 potentiometers, one for each such ordinate in the spectrum.

## Computer

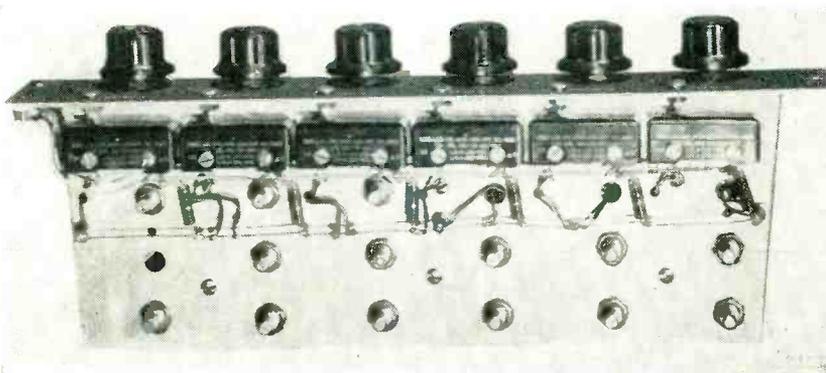
A schematic representation of the five calculating panels of the computer is shown in Fig. 2. The input potentiometers at the top of



Control panel of tristimulus computer

# Gives Tristimulus Values

**SUMMARY** — Trichromatic coefficients for CIE color-specification system are automatically computed by setting potentiometers to points on spectral transmission curve of filter or reflection curve of colored surface. Luminous efficiency of reflecting or transmitting surface may also be determined when absolute value of data is known



One of five computer subchassis. Each vertical row of controls and switches represents different wavelength channel

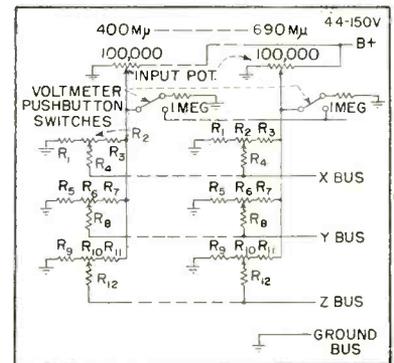


FIG. 2—Computer has identical set of controls for each wavelength

the diagram are all connected in parallel between a source of variable voltage and ground. Immediately adjacent to each of the potentiometer knobs, as shown in a photograph, a screw-headed push-button is provided, which may be depressed to connect the precision microammeter as a voltmeter to the arm of the potentiometer. Circuit resistance values are listed in Table II.

When operating the computer, each of the input potentiometers in turn is set to produce a voltage at its arm proportional to or equal to the value of the radiance ordinate at that particular wavelength by pressing the associated voltmeter button and reading the microammeter indication. When each potentiometer of the group has been adjusted, the data exists in the computer as a voltage distribution along the potentiometer string.

The arm of each input potentiometer in Fig. 2 is connected to a

group of three networks. These networks may be thought of as voltage dividers. Their purpose is to weight the voltage existing on the potentiometer arm in accordance with the functions  $\bar{x}$ ,  $\bar{y}$  and  $\bar{z}$ . The voltage output from each of the dividers therefore represents one of the steps required in the mechanical integration of Eq. 1.

The output signal from each weighting network is delivered to a common busbar through a high value of series resistance. These busbars are labeled X, Y and Z in Fig. 2 and are terminated in a low resistance on the order of 50 ohms. As a result, by virtue of the high series resistance, the current delivered to each of the busbars by each of the networks is essentially proportional only to the setting of the corresponding input potentiometer and the value of the weighting function (attenuation) for that ordinate. The total current flowing in each of the three busbars

is therefore proportional to the corresponding integral in Eq. 1.

The tristimulus value current on each of the three busbars is converted to trichromatic coefficient data by the circuit of Fig. 3, which performs the functions of Eq. 2. Switch  $S_1$  determines the operating condition of the instrument. In position 1, the microammeter is connected as a voltmeter for use in setting the original data into the machine. In position 2 (marked SET  $T = 100$ ) all three of the tristimulus value busbars are connected through the meter to ground. For this position of the switch the meter reading is therefore proportional to  $X + Y + Z$ .

To obtain the trichromatic coefficients the meter-set control, Fig. 4, which varies the power supply potential of the instrument, is adjusted until the meter reads full scale or 100 units. This operation is in effect a normalizing process since it results in setting  $T = X + Y +$

**Table I—Tristimulus Values**

Normalized against  $z = 1.0000$  at  $450\text{ m}\mu$

Wavelength (m $\mu$ )	$\bar{x}$	$\bar{y}$	$\bar{z}$
400	0.0081	0.0002	0.0383
410	0.0245	0.0007	0.1170
420	0.0758	0.0022	0.3643
430	0.1602	0.0065	0.7819
440	0.1965	0.0130	0.9859
450	0.1897	0.0214	1.0000
460	0.1641	0.0339	0.9419
470	0.1103	0.0514	0.7266
480	0.0539	0.0784	0.4588
490	0.0181	0.1174	0.2625
500	0.0028	0.1823	0.1535
510	0.0052	0.2838	0.0893
520	0.0357	0.4007	0.0441
530	0.0934	0.4864	0.0238
540	0.1639	0.5383	0.0115
550	0.2446	0.5615	0.0049
560	0.3355	0.5615	0.0022
570	0.4301	0.5372	0.0012
580	0.5171	0.4909	0.0010
590	0.5791	0.4272	0.0006
600	0.5994	0.3561	0.0005
610	0.5658	0.2838	0.0002
620	0.4821	0.2150	0.0001
630	0.3625	0.1495	.....
640	0.2527	0.0988	.....
650	0.1600	0.0604	.....
660	0.0931	0.0344	.....
670	0.0493	0.0181	.....
680	0.0264	0.0096	.....
690	0.0128	0.0046	.....

**Table II—Circuit values for calculating panels of Fig. 2**

Wave-length (m $\mu$ )	$R_1$	$R_2$	$R_3$	$R_4$	$R_5$	$R_6$	$R_7$	$R_8$	$R_9$	$R_{10}$	$R_{11}$	$R_{12}$
400	8.2 k	0	1 meg	1 meg	220	0	1 meg	1 meg	39 k	0	1 meg	1 meg
410	27 k	0	1 meg	1 meg	680	0	1 meg	1 meg	0	250 k	820 k	1 meg
420	0	100 k	1 meg	1 meg	2.2k	0	1 meg	1 meg	0	500 k	470 k	820 k
430	0	250 k	820 k	820 k	6.8 k	0	1 meg	1 meg	470 k	500 k	0	820 k
440	0	500 k	470 k	820 k	12 k	0	1 meg	1 meg	1 meg	100 k	0	1 meg
450	0	500 k	470 k	820 k	22 k	0	1 meg	1 meg	$\infty$	0	0	1 meg
460	0	500 k	470 k	1 meg	33 k	0	1 meg	1 meg	1 meg	100 k	0	1 meg
470	0	250 k	820 k	1 meg	0	100 k	1 meg	1 meg	470 k	500 k	0	820 k
480	0	100 k	1 meg	1 meg	0	100 k	1 meg	1 meg	220 k	500 k	270 k	680 k
490	18 k	0	1 meg	1 meg	0	250 k	820 k	820 k	0	500 k	470 k	820 k
500	2.7 k	0	1 meg	1 meg	0	500 k	470 k	820 k	0	250 k	820 k	820 k
510	5.6 k	0	1 meg	1 meg	0	500 k	470 k	820 k	47 k	100 k	1 meg	1 meg
520	33 k	0	1 meg	1 meg	220 k	500 k	270 k	680 k	47 k	0	1 meg	1 meg
530	0	250 k	820 k	820 k	220 k	500 k	270 k	680 k	22 k	0	1 meg	1 meg
540	0	250 k	820 k	820 k	270 k	500 k	220 k	680 k	12 k	0	1 meg	1 meg
550	0	500 k	470 k	820 k	270 k	500 k	220 k	680 k	4.7 k	0	1 meg	1 meg
560	0	500 k	470 k	820 k	270 k	500 k	220 k	680 k	2.2 k	0	1 meg	1 meg
570	220 k	500 k	270 k	680 k	270 k	500 k	220 k	680 k	1.2 k	0	1 meg	1 meg
580	270 k	500 k	220 k	680 k	220 k	500 k	270 k	680 k	1.0 k	0	1 meg	1 meg
590	270 k	500 k	220 k	680 k	220 k	500 k	270 k	680 k	560	0	1 meg	1 meg
600	270 k	500 k	220 k	680 k	0	500 k	470 k	820 k	470	0	1 meg	1 meg
610	270 k	500 k	220 k	680 k	0	500 k	470 k	820 k	220	0	1 meg	1 meg
620	220 k	500 k	270 k	680 k	0	500 k	470 k	820 k	100	0	1 meg	1 meg
630	0	500 k	470 k	820 k	0	250 k	820 k	820 k	0	0	$\infty$	1 meg
640	0	500 k	470 k	820 k	0	250 k	820 k	820 k	0	0	$\infty$	1 meg
650	0	250 k	820 k	820 k	0	100 k	1 meg	1 meg	0	0	$\infty$	1 meg
660	0	250 k	820 k	820 k	33 k	0	1 meg	1 meg	0	0	$\infty$	1 meg
670	0	100 k	1 meg	1 meg	18 k	0	1 meg	1 meg	0	0	$\infty$	1 meg
680	27 k	0	1 meg	1 meg	10 k	0	1 meg	1 meg	0	0	$\infty$	1 meg
690	12 k	0	1 meg	1 meg	4.7 k	0	1 meg	1 meg	0	0	$\infty$	1 meg

$K = \times 1,000$

$Z = 100$  in Eq. 2.

Switch  $S_1$  is next thrown to position 3 (marked x). For this connection, the Y and Z busbars pass directly to ground through a resistance equivalent to the meter resistance so that only the X busbar current flows through the meter itself. Because of the normalizing process the meter deflection is proportional to the contribution of X to the total tristimulus value T. If the full-scale meter reading is taken as unity, the meter reading therefore corresponds to the trichromatic coefficient  $x$ . The remaining positions of  $S_1$  allow a measurement of the relative contributions of Y and Z to the total and therefore yield the trichromatic coefficients  $y$  and  $z$ .

The tristimulus computer may be used to calculate the luminous efficiency of a transmitting filter or a reflecting surface by a technique involving a comparison of the luminosity of the given radiance with that of equal-energy white.

**Luminous Efficiency**

The spectral characteristic of a Wratten No. 58 (tricolor green) filter is shown in Fig. 5. The ordi-

nates of this curve represent the transmission of the filter at any wavelength relative to a perfectly transmitting medium. The maximum transmission occurs at approximately 530 millimicrons and has a magnitude of approximately 53.6 percent. The luminous efficiency of such filter or of any reflecting or transmitting medium is a measure of the luminance of the light from the sample relative to the luminance of a perfectly transmitting or reflecting medium when both are illuminated by the same intensity of equal-energy white light.

The luminous efficiency  $B$  of any spectral distribution is given by

$$B = Y/Y_e \tag{3}$$

where  $Y_e$  represents luminance of the reference equal-energy white source. Calculation of the quantity  $B$  on the tristimulus computer may be made by taking advantage of the fact that, from Eq. 2

$$Y = yT \tag{4}$$

so that

$$B = yT/Y_e \tag{5}$$

The computation therefore depends only upon finding  $y$  and  $T$  for the spectral data and upon normal-

izing  $T$  to the same scale as  $Y_e$ . It is necessary that the absolute value of the data be known. The curve of Fig. 5 provides a typical example.

**Calculation**

Calculation is begun by setting all of the computer data input potentiometers to their maximum positions. This sets reference equal-energy white into the machine. Switch  $S_1$  is then turned to the position for reading  $y$  and the meter-set control is adjusted for a scale reading of 100 on the meter. Note the meter-set dial reading for future use as this dial setting calibrates the computer for  $Y_e = 100$  in Eq. 5. For any particular model of the computer, this dial reading should always be the same.

Switch  $S_1$  is then turned to the SET-ORDINATES position. With any one data input potentiometer set to its maximum position, the meter-set control is adjusted to give a reading of 100 on the meter when the corresponding push button is depressed. The ordinates of the curve may now be set into the computer directly in terms of percentage transmission or reflectance.

For example, the data of Fig. 5

indicates the transmission of the filter to be 53.6 per cent at a wavelength of 530 millimicrons. The 530-millimicron input potentiometer would therefore be set to give a reading of 53.6 on the meter.

When all of the data has been set into the computer in this manner, the meter-set dial is set to the reading noted at the start of the computation which calibrated the computer for  $Y_e = 100$ . Switch  $S_1$  is now set to the SET  $T = 100$  position. The meter reading is noted; this gives the value of  $T/Y =$  absolute value of  $T/100$  in Eq. 5.

The final factor  $y$ , in Eq. 5, must now be found. With the data input potentiometers and  $S_1$  positions unchanged, the meter-set dial is turned until the meter reads full scale. Switch  $S_1$  is then turned to the Y position and the meter reading noted. The luminous efficiency of the spectral characteristic is now the product of the last two factors noted according to Eq. 5.

It is well to remember during this last step of the calculation that the value of  $y$  always lies in the range of 0 to 1.0. The values of  $T$  and  $Y_e$  will usually be of the same order of magnitude. Attention should be paid to the scale factor when reading the value of  $T$  from the instrument.

### Calibration and Adjustment

The microammeter is also used to insert the colorimetric functions  $\bar{x}$ ,  $\bar{y}$  and  $\bar{z}$  into the instrument. The procedure depends upon successive measurements of the current contributed by each of the 90 dividing networks to their respective tristimulus value busbars. The reference used for this operation is the maximum value of the function  $\bar{z}$  at the wavelength 450 millimicrons (Table I). This maximum value exceeds those of the other two functions and is arbitrarily taken as a unity-value weighting coefficient.

To proceed with the adjustment, all of the data input potentiometers, save the one corresponding to 450 millimicrons should be turned to zero. The 450-millimicron potentiometer should be set to maximum value. With the microammeter selector switch  $S_1$  set to the  $z$  trichro-

matic-coefficient position the power-supply voltage (meter-set dial) and the meter shunt should be adjusted until a full-scale reading is obtained. The meter-set dial should not be changed during the remainder of the adjustment procedure, although the microammeter shunt may be manipulated to expand low readings if this appears desirable.

Having normalized the microammeter reading in this manner, the 450-millimicron input potentiometer is turned to zero. Next, with switch  $S_1$  remaining on the  $z$ -trichromatic-coefficient position, each one of the data input potentiometers is, in turn, advanced to maximum. The division ratio of the corresponding  $z$  busbar dividing network is then adjusted so that the microammeter reading agrees with the tabulation of the  $z$  function in Table I. When each network is ad-

justed, the potentiometer is returned to zero and the operator proceeds to the next network. The location of the adjusting potentiometers is shown in the side-view photograph of one of the calculating panels.

When the entire group of 30 dividing networks for the Z busbar has been adjusted or checked, meter-selector switch  $S_1$  should be thrown either to the X busbar or the Y busbar and the entire procedure repeated. It will be noted from Table II that a number of the division ratios are fixed. This is because their contribution to the overall current is so small that a precision adjustment is not required. It should be emphasized that throughout the entire procedure the value of  $\bar{z}$  at 450 millimicrons provides the reference value for the adjustments. As the adjustment procedure is time con-

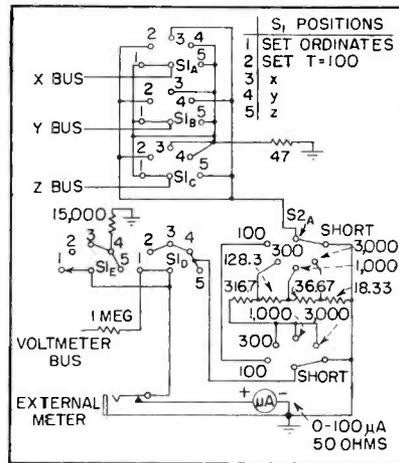


FIG. 3—Computer switching circuits

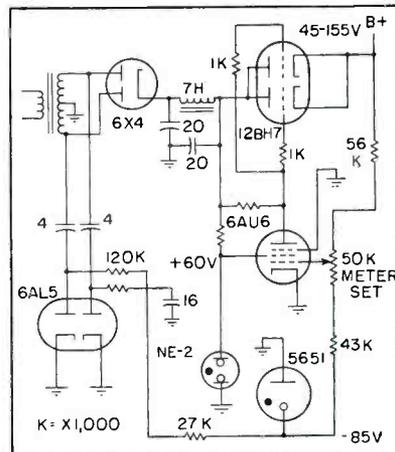


FIG. 4—Variable-voltage power supply. Meter-set control is 10-turn helical potentiometer

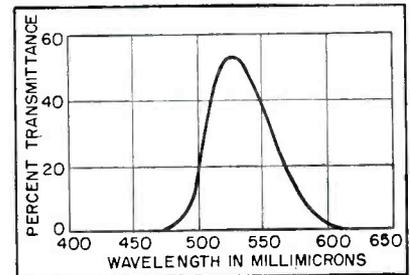


FIG. 5—Characteristics of Wratten No. 58 (tricolor green) filter

suming, it is desirable to check the power-supply voltage against this reference point from time to time.

Upon completion of the adjustment, a check of the accuracy which has been achieved may be made by advancing all the data-input potentiometers to their maximum value. The meter-set control should then be adjusted until the meter reads full scale. Transfer of the meter to the three trichromatic-coefficient positions should yield readings of 0.333 in each case. These are, of course, the trichromatic coefficients of an equal-energy white source.

### REFERENCE

(1) Commission Internationale de l'Eclairage, Recueil des Travaux et compte des Seances—Huitieme Session, Cambridge, England, Sept. 1931.

# Power Rating Parasitic Suppressors

**SUMMARY** — Incomplete bypassing of parasitic suppressors to harmonic currents imposes power requirements on the resistors. Chart enables designer to estimate power ratings of resistors used as parasitic suppressors

By **JOSEPH A. HUIE**

Penfield, New York

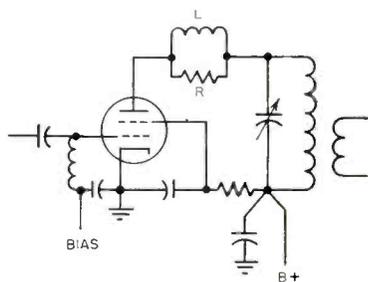


FIG. 1—R-L parasitic suppressor

ONE most common and effective method for preventing vhf parasitic oscillation in high-frequency amplifiers is use of a parallel R-L network in the plate lead of the amplifier as shown in Fig. 1. The coil is usually about 4 to 6 turns wound on a small form, often the resistor. The resistor value is normally between 50 and 100 ohms.

It is sometimes assumed that the coil at the operating frequency acts as a perfect bypass so the resistor carries no current and the wattage rating is not important. This is not strictly the case. The coil always has some reactance and at high operating frequencies this becomes an important consideration.

The curves relate the factor  $K$

to the inductive reactance-over-resistance ratio  $X_L/R$  at the fundamental frequency, where  $K$  is proportional to the square of the effective heating current through the resistor. Curves are given for three values of conduction angle in class-C amplifier operation. The curves were computed assuming  $a = 3/2$  and considering all harmonics up to the fourth.

### Example

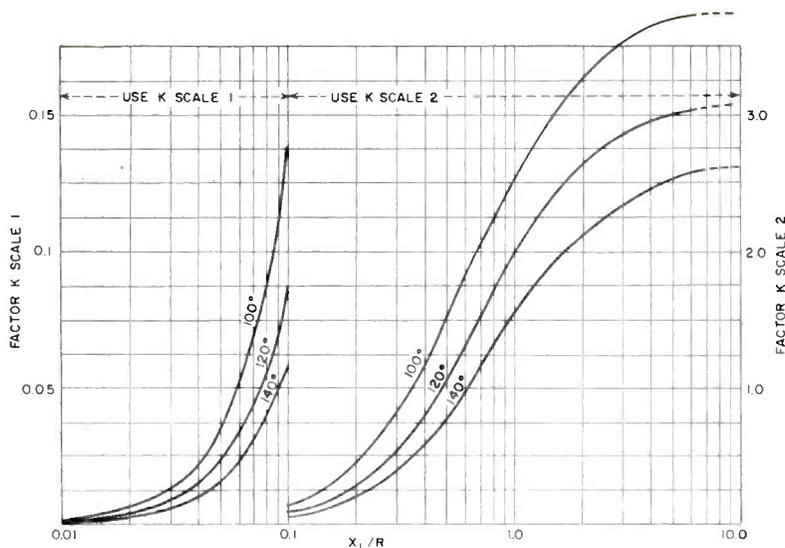
The power dissipated in the parasitic suppressor resistor is  $I_{a-c}^2 RK$ , where  $I_{a-c}$  is the d-c plate current in amperes,  $R$  is the resistance in ohms and  $K$  is the factor taken from the curves.

The following information is known: coil =  $\frac{3}{8}$  in. dia  $\times$   $\frac{5}{8}$  in. long, 5 turns; resistor = 47 ohms;  $I_{a-c} = 200$  ma.; conduction angle = 120 deg and frequency = 20 mc.

The coil inductance can be computed or measured to be about  $0.115 \mu\text{h}$ . Then  $X_L = 2\pi fL = 14.4$  ohms and  $X_L/R = 0.308$ .

From the curves  $K$  is found to be 0.6, so the power dissipated in the resistor is  $I_{a-c}^2 RK = 1.12$  watts.

If the amplifier is modulated 100 percent with a sine wave, the resistor power will be about 1.5 times the unmodulated power or 1.68 watts. A 2-watt resistor should then be used.



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# Microphone Nomograph

**SUMMARY** — Chart relates sound pressure level, microphone sensitivity and output in decibels and volts as aid in design of microphone systems and related equipment. Typical sound levels for common sounds are indicated

By **WILLIAM B. CONOVER**  
*Transformer Laboratories Department  
 General Electric Company  
 Pittsfield, Mass.*

**M**ICROPHONE response is usually expressed in decibels referred to 1 volt per dyne/cm<sup>2</sup>. Thus a microphone which produces 1 volt when exposed to a sound pressure of 1 dyne/cm<sup>2</sup>

has a response of 0 db. Most microphones are far less sensitive than this.

Unless otherwise specified, the open-circuit voltage is used in arriving at the response figure. The nomograph is based on the definition of pressure response in the American Standard Specification for Laboratory

Standard Microphones.

Expressed symbolically, this definition becomes

$$\rho = 20 \log (e_o/p) \quad (1)$$

where  $\rho$  = pressure response,  $e_o$  = open-circuit output voltage and  $p$  = pressure in dynes/cm<sup>2</sup>.

Equation 1 may be rewritten

$$\rho = 20 \log e_o - 20 \log p \quad (2)$$

Sound pressure is commonly expressed in decibels relative to a reference pressure  $p_o = 2 \times 10^{-4}$  dynes/cm<sup>2</sup>. When so expressed it is called sound pressure level *SPL* and is defined by

$$SPL = 20 \log (p/p_o) \text{ decibels} \quad (3)$$

Equation 2 and 3 yield

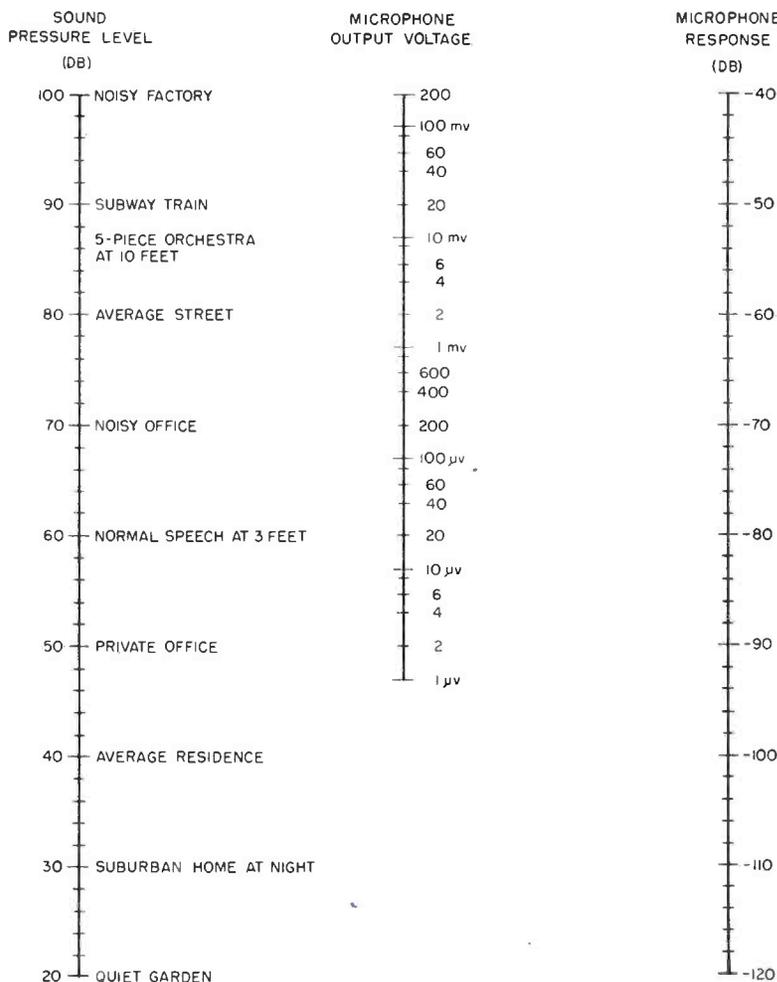
$$\rho = 20 \log e_o - SPL + 74 \text{ decibels} \quad (4)$$

Should absolute sound pressures be required, they may be filled in on the lefthand scale by noting that 100 db = 20 dynes/cm<sup>2</sup>, 80 db = 2 dynes/cm<sup>2</sup>, 60 db = 0.2 dyne/cm<sup>2</sup> and so forth.

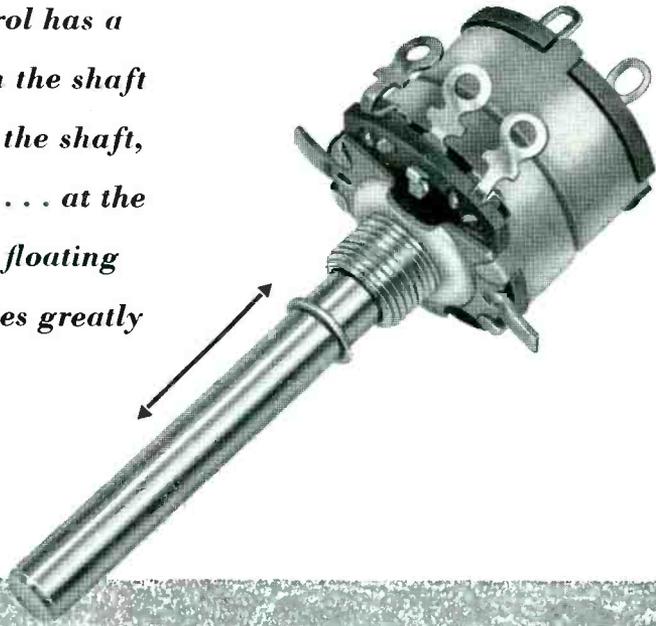
A microphone with a response of -50 db is to be used to measure sound levels of 35 db or more. For what minimum input voltage should the amplifier be designed?

A straight line drawn between 35 db on the *SPL* scale and -50 db on the  $\rho$  scale intersects the  $e_o$  scale at about 35 $\mu$ v. This is the open-circuit microphone voltage.

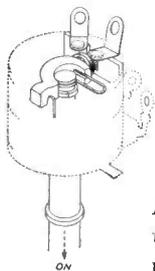
Sound level in a jet-engine test control room is 112 db; a pneumatic chipper at a distance of 5 feet has a sound level of 122 db. At takeoff and 80 ft from the tail, an F-84 has a sound level of 130 db, all typical values.



*New Mallory volume control has a unique on-off switch. Push the shaft and the set turns off. Pull the shaft, and the set is switched on . . . at the same volume setting. New floating ring contact action provides greatly increased switch life.*



## New Push-pull On-off Action— in Mallory Volume Control Switches



**Floating ring contact\*  
gives  
extra long switch life**

A new kind of contact is used in the Mallory push-pull switch to provide exceptionally long service.

The circuit is made and broken by the movement of a ring of special Mallory contact alloy. The ring "floats" on a pin. Every time the switch is used, the contact ring rotates slightly, exposing a new portion of its surface to the stationary contacts. Contact wear and erosion are thus spread around the whole circumference of the ring . . . and contact life is thus substantially increased.

*\*Patent applied for*

**T**HIS new sales feature can be designed into radio and television sets, by using the new Mallory volume control switch. To turn on and off, this switch operates by push-pull action instead of the conventional rotary motion. Two principal advantages of this new idea are evident:

Greater convenience to the set owner. He turns the set on at the same volume at which he turned it off . . . doesn't have to re-adjust.

Longer life of the volume control. Instead of being rotated through most of its travel every time the set is turned on or off, the control is moved only for minor volume adjustments. Consequently, there is far less mechanical wear on the carbon element.

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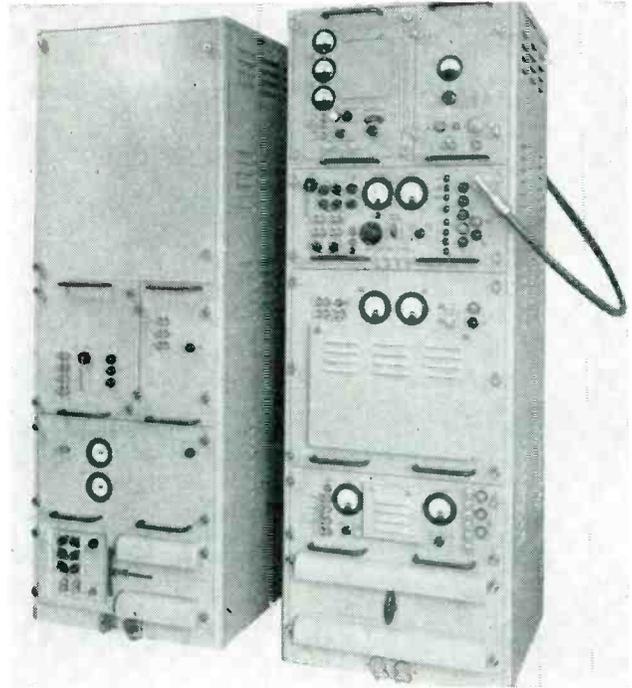
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Shipborne TACAN receiver and transmitter units

## TACAN Navigation System Shows Bearing and Distance

TACAN (*TACTical Air Navigation*) is a polar co-ordinate type of air navigation system combining a bearing facility and distance facility. The pilot receives from the ground station information that automatically displays degrees of bearing and distance in miles to locate the position of his aircraft. Bearing accuracy is better than plus or minus 1 deg and distance is accurate within plus or minus 600 feet plus 0.15 percent of the distance measured.

The entire system operates in the region of 1,000 mc. A single multichannel receiver-transmitter, operating with pulses, provides distance and omnirange information. Pulse coding is not used for channeling purposes, which makes it possible to add other functions such as localizer, glide path and marker beacon.

The distance indication facility (DME) is an outgrowth of radar ranging techniques whereby distance is determined by measuring round-trip time of travel of radio pulses. This is illustrated in Fig. 1. Each plane's interrogation

pulses are wobbled or jittered to prevent ambiguities that might arise if regular pulses from two or more planes coincided. Actually, twin pulses are used with prearranged spacing of 12 microseconds. Both ground and air receivers contain twin-pulse decoders that reject single pulses or groups with other than prearranged spacing.

Bearing indication depends upon a complex transmitting antenna comprising a fixed center section and two coaxial rotating sections. The unit under its protective cover is a cylinder about four feet high and three and a half in diameter. No counterpoise is required, thus simplifying the siting of the ground station.

As shown in Fig. 2, (though not drawn to scale), r-f energy is fed to the central element, which is sta-

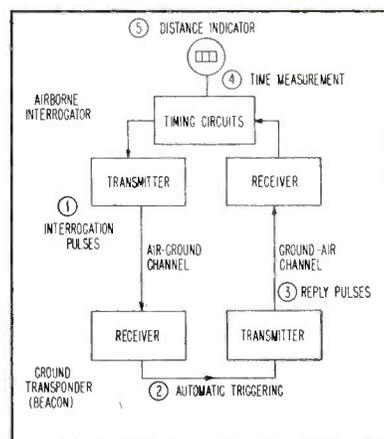


FIG. 1—Principles of DME operation

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#### ★ POWER SUPPLY VARIABLE LOAD — MODEL 910

The power supply variable load consists of an electronic load and a resistor load. The electronic load covers the range 60-600 volts from 0-600 ma. The resistor load covers the range 0-100 volts, 0-600 ma. Provision is made for automatically modulating either the resistor load or the electronic load 10 seconds on and 10 seconds off. In addition, the electronic load can be internally modulated with a 60 cycle square wave or externally modulated with a voltage wave of any shape or frequency.

#### ★ LINE VOLTAGE ADJUSTER — MODEL 920

The line voltage adjuster provides for adjusting the line voltage from 95 to 135 volts AC for any fixed input voltage in the range 95 to 135 volts AC. The capacity of this unit is 3KVA. At any fixed output voltage setting, the output voltage can be decreased as a step function from 0 to 40 volts.

★ Units are available separately

#### VOLTAGE REGULATED POWER SUPPLY UNDER TEST

KEPCO Voltage Regulated Power Supplies are conservatively rated. The regulation specified for each unit is available under all line and load conditions within the range of the instrument.

**REGULATION:** As shown in table for both line fluctuations from 105-125 volts and load variations from minimum to maximum current.

\***REGULATION FOR BIAS SUPPLY:** 10 millivolts for line 105-125 volts. ½% for load at 150 volts.  
† AC Voltage is unregulated.



MODEL 605



OUTPUT	VOLTS	CURRENT	REGULATION	RIPPLE
1	0-600	0-500 Ma.	0.2 Volts	3 Mv.
2	0-150 Bias	0-5 Ma.	*	1 Mv.
3	6.3 AC	20 Amp.	†	

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tionary. It is actually a stack of disccone radiators. Diameter is a few inches.

An inner cylinder of fiber glass with diameter of about 5 inches carries a vertical metal wire. As it rotates, it generates a cardioid pattern by interaction with the vertical antenna. Rotation rate is 15 rps. The aircraft receives, in effect, a 15-cps audio sine wave. A coded reference signal sent out by the reference pulse disk serves as timing reference.

When received on the aircraft, it is used to measure the phase of the pulse envelope wave resulting from the combination of vertical-wire rotation and double pulses. By this means, the bearing of the aircraft relative to the ground station can be determined and appropriately displayed.

However, there are limitations to the accuracy of the simple cardioid system. The antenna structure is therefore equipped with an outer cylinder about 33 inches in diameter. Nine wires, or parasitic antenna elements, are spaced uniformly 40 degrees apart. As these wires rotate integrally at 15 rps with the inner cylinder a resulting composite pattern is generated as shown in Fig. 3. The overall cardioid is still present, but superimposed upon it are nine secondary

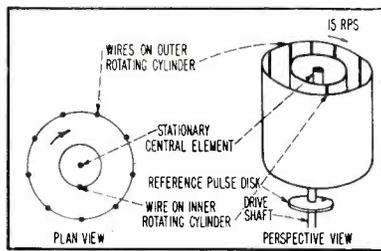


FIG. 2—Tacan antenna design explained in text

ripples with maxima spaced 40 degrees apart.

The composite envelope wave received on the aircraft and shown in rectangular coordinates in the lower half of Fig. 3 has a 9th harmonic frequency of 135 cycles per second.

By filtering and using both signals, small changes in bearing within any 40-deg sector can be detected, producing a vernier or fine indication. The ambiguity of the 135-cps phase measurement is resolved by the 15-cps phase measurement.

Avoidance of site errors, which are propagational rather than instrumental, generally require that the ground beacon of an omnirange station be situated over very flat terrain with no large buildings or structures within a considerable distance.

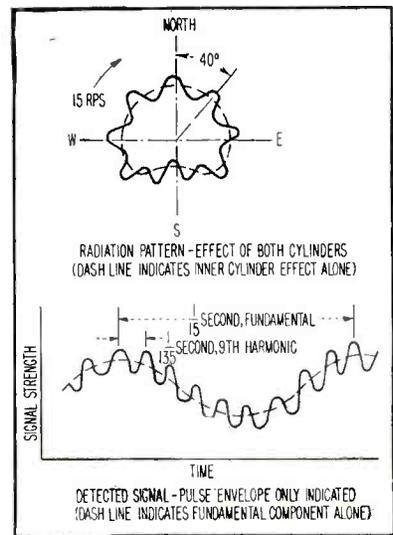


FIG. 3—Tacan fine omnirange principles resulting from triple antenna

This type of error is minimized by use of the nine-lobed fine omnirange operation of Tacan, and is probably the system's most important feature.

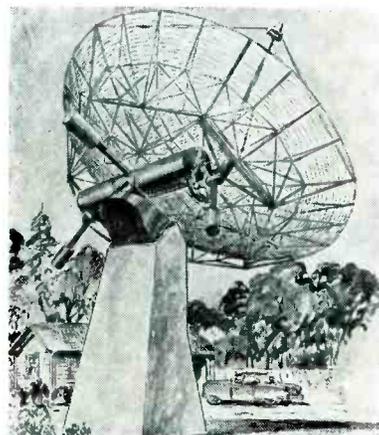
This brief abstract of the basic Tacan system has been taken from a more complete report prepared by R. I. Colin, Assistant to the Technical Director, Federal Telecommunication Laboratories. The system was originated and developed by this division of International Telephone and Telegraph Corp. under contract with the U. S. Navy and Air Force.

## Dynamic Spectrum Analyzer To Study Sun

DEVELOPMENT and construction of a new radio telescope for solar research has been announced by Donald H. Menzel, director of Harvard College Observatory. Technically known as the dynamic spectrum analyzer, it will be used to further basic knowledge of the sun by studies of the radio emission from active sunspots and other solar disturbances. The behavior of active regions in the sun's corona and chromosphere is closely related to many terrestrial phenomena such as magnetic and ionospheric disturbances, the aurora borealis and cosmic rays.

The radio telescope will consist of an antenna 28 feet in diameter, used in conjunction with highly sensitive receivers, which scan the

frequency range from 100 to 600 megacycles ten times a second. This solar radio telescope, will be the

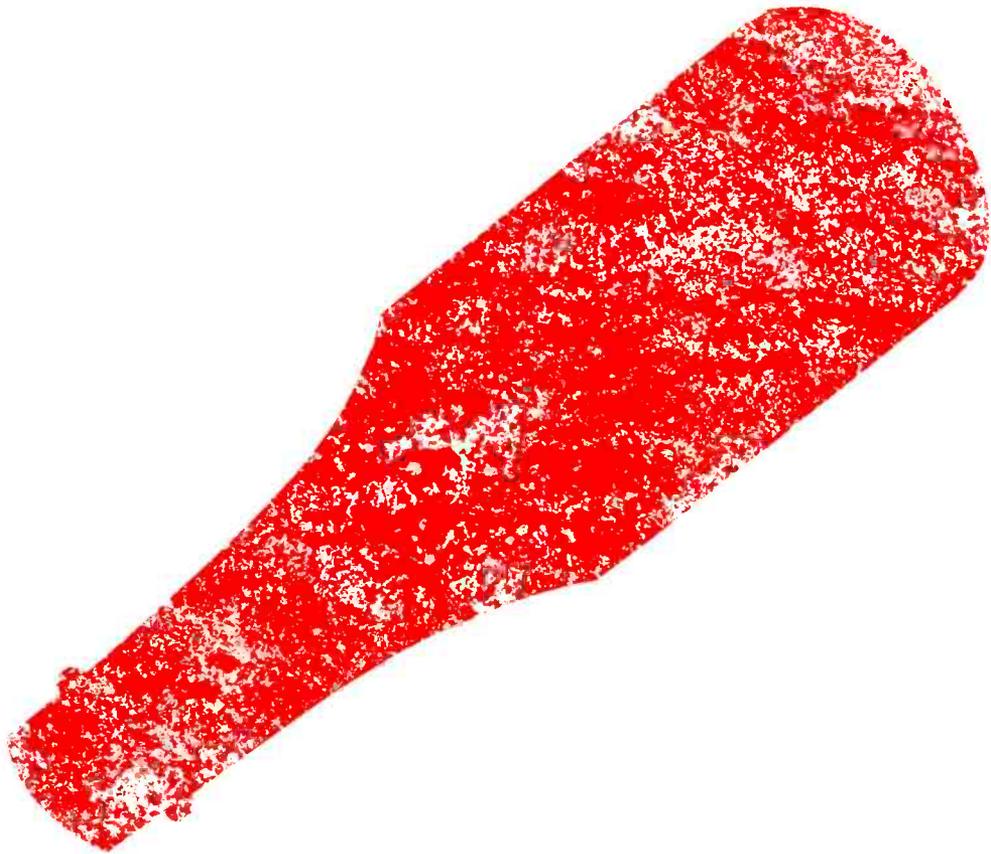


Artist's conception of the new Sacramento Peak radio telescope now under construction for installation next year

first of its type in this country.

Henry Jasik, consulting engineer of Mineola, Long Island, serves as electronics consultant to the project and is responsible for carrying out antenna development. The large parabolic reflector and its equatorial mounting will be constructed by D. S. Kennedy Co. of Cohasset, Mass. Frequency-scanning receivers will be built at Airborne Instruments Laboratory, Mineola, Long Island.

The equipment will be placed in operation at the Upper Air Research Observatory at Sacramento Peak, New Mexico in the early part of 1956. This observatory, which is a joint scientific operation by Harvard and the Air Force, is now devoted largely to optical observa-



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Season with the same inventiveness used by Dr. A. O. Beckman to develop  
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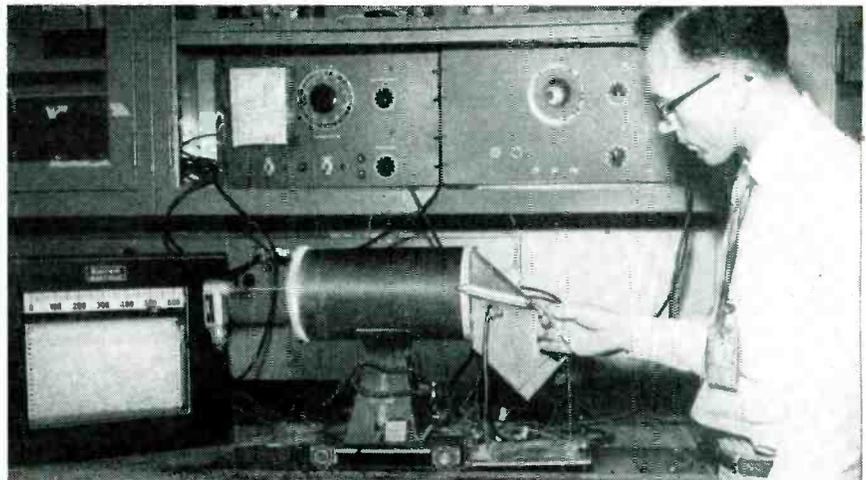
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tions of the sun with coronagraphs and other specialized optical instruments. Construction of the new radio telescope has been made possible through financial support extended by the Geophysical Directorate of the Air Force Cambridge Research Center.

Electronically controlled apparatus developed by U. S. Naval Ordnance Laboratory in Silver Spring, Md. changes composition of PbS. Crystals and a quantity of sulphur are placed at opposite ends of a sealed evacuated quartz tube and put in a double oven to control crystal-vapor equilibrium and sulfur vapor pressure. Robert F. Brebrick of the Solid State Division, Physics Research Dept. is shown in the photograph

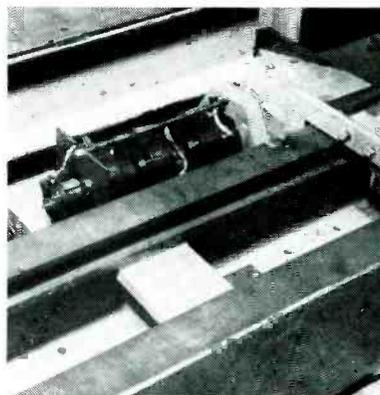
## Properties of Lead Sulfide Crystals Changed



## Card-Controlled Machines Are Thrice As Productive



Operating a standard business machine to punch holes in cards, the young lady simply follows the instruction program previously worked out for a specific job. A hand-punched hole made at the controlled machine can be used to change the instructions



Selsyn pickup unit installed on an 80-ton turret type punch press. This unit gives an automatic measurement of the table position to the numerical positioning control installation that carries out work orders contained in the previously punched cards



Business machine cards are loaded into GE positioning control director. A separate card is used for each punched hole. Direct-current feed drives the punch press as directed by selsyns in accordance with directions. Lights show sequence of work

## Remote TV Camera Spots Forest Fires

RECENT TESTS of closed circuit television for fire control were made by Hancock Electronics Corp. of Oakland, Calif. for the California State Division of Forestry at Mount Danaher Station near Placerville.

The camera was mounted on the side of a 100-foot lookout tower and transmitted a picture to a fire

dispatcher's office a few hundred yards distant. Mounted on a pan and tilt unit, full 360-deg pan with the camera was possible, either automatic or manual. Remote control of the lens turret was likewise obtained.

Tests showed that an eight-inch lens was best for general scanning

and a 20-inch most desirable for detail. Best results were obtained with a Wratten K2 filter.

Television system used was a Vicon III that is flat to 8.5 mc. Output of the system is a composite video signal with equalizing pulses. A usable picture at  $\frac{1}{2}$  foot-candle is produced with better than 550

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<p><b>Fluid Fitting Seals</b></p> <p>Lock-O-Seal (Series 250)</p> <p>Gask-O-Seal (Series 350-360)</p> <p>Stat-O-Seal (Series 620)</p> <p>Gask-O-Seal (Special)</p>	<p><b>Orifice Seals</b></p> <p>Gask-O-Seal (Series 46Q)</p> <p>Gask-O-Seal (Series 1460)</p> <p>Strip-O-Seal (Series 430)</p> <p>Gask-O-Seal (Special)</p>	<p><b>Closure Seals</b></p> <p>Gask-O-Seal (Special)</p> <p>Gask-O-Seal (Special)</p> <p>Riv-O-Seal (Series 860)</p> <p>Gask-O-Seal (Series 660)</p>	<p><b>Fastener Seals</b></p> <p>Lock-O-Seal (Series 800-220)</p> <p>Stat-O-Seal (Series 600)</p> <p>Bolt-O-Seal (Series 630-640)</p> <p>Special O' Rings</p> <p>and various cross sections to meet AN or other fine tolerance requirements available.</p>	<p><b>"O" Rings</b></p> <p>MS 29512 &amp; MS 29513 (formerly AF 93A)</p> <p>NOTE: Special Design available for Electronic and Electro-Chemical applications.</p>
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NOTE: GASK-O-SEAL can be designed & manufactured to meet almost any configuration with either one side or two side seals.

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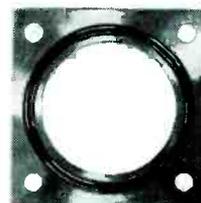


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Cabin on Mt. Danaher lookout tower is 100 feet above ground

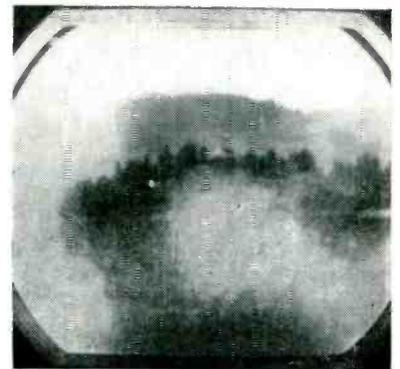
lines of horizontal resolution.

During tests, television was able to spot smokes ahead of human lookouts. Elapsed time between setting off a smoke and discovering it with television ranged from 3 to

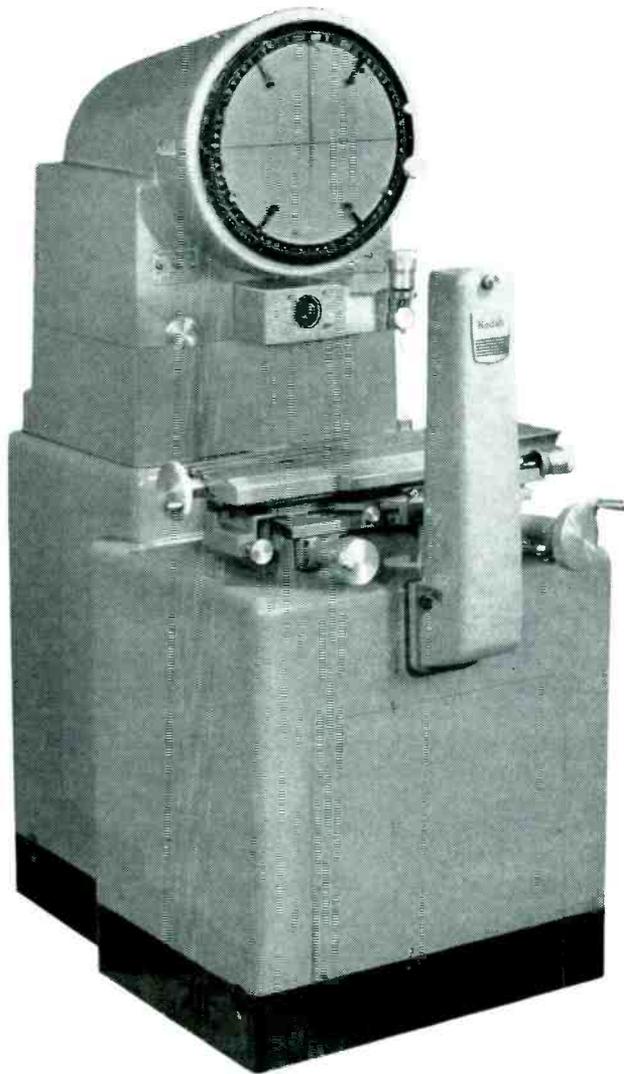


Experimental pan and tilt equipment used with Vicon III and 16-in lens

9 seconds. Time elapsed between spotting the smoke by television and receiving a report from any lookout ranged from 20 seconds to 5 minutes. Average time was 2½ minutes. In two cases, the television camera



Slate Mountain View lookout, 8 miles distant, through 20-in. lens



Here's how  
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with 14-inch  
screen economy**

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If you make heavy, bulky parts to close tolerances, the new Kodak Contour Projector, Model 14-5, has a place in your inspection program.

For the 14-5 combines the heavy-duty work table and 8" travel of the Model 30 with the economy of a 14-inch screen.

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Mechanically, the Model 14-5 provides a large (26" x 8") work table built to handle heavy loads without measurable deviation. A full 17.5" throat clearance helps you position cumbersome parts quickly and easily. Table travel of 8" in both horizontal and vertical planes speeds measurement. A built-in helix table ro-

tates 15° in either direction for gaging threads or similar parts.

Optically, the Model 14-5 incorporates all the unique developments that have made the Kodak Contour Projector, Model 2A, leader in its field: bright screen image for easy reading, six-station lens turret for instant change of magnification, and self-contained Surface Illuminator.

For complete information on the Model 14-5, write for the new 12-page booklet "Projection Gaging with Kodak Contour Projectors." It tells how this new precision projector can help you check parts and components to accuracies of the order of .0001"—quickly and economically.

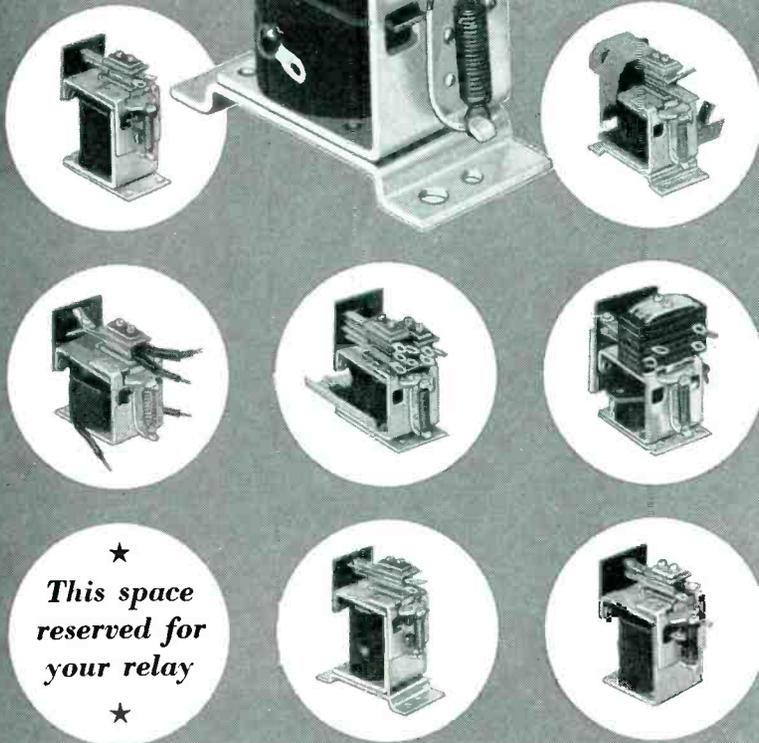
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Special Products Sales Division, Rochester 4, N. Y.

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Automotive Industries



California State Foresters with monitors and camera pan and tilt control (on desk)

was able to pick up smokes at 20 miles. These could not be seen with binoculars.

## Single-Tube Capacitance Transducer Circuit

By LAWRENCE FLEMING

Chief Engineer  
Electronic Engineering & Service Co., Inc.  
Falls Church, Va.

ELECTRONIC MEASUREMENTS of mechanical displacements are made with a variety of pickup or sensing devices: self-generating piezoelectric transducers; variable-resistance devices, variable-inductance and variable-capacitance transducers. The capacitance transducer is inherently the lightest and simplest of all. Its wider application has been handicapped, however, by the complexity of circuits required for sensitive and stable results.

The circuit described here uses only one tube operating in an r-oscillator circuit. Indications are that sensitivity is primarily a function of the passive circuit parameters and depends only slightly on tube characteristics. Sensitivity is adequate for many applications. In a typical case, 50-mv a-c signal output is obtained from a surface vibrating at 0.001-in. peak amplitude,

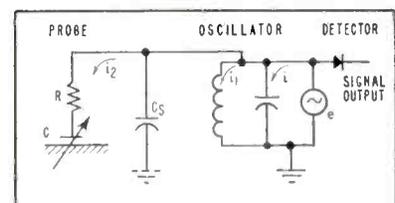
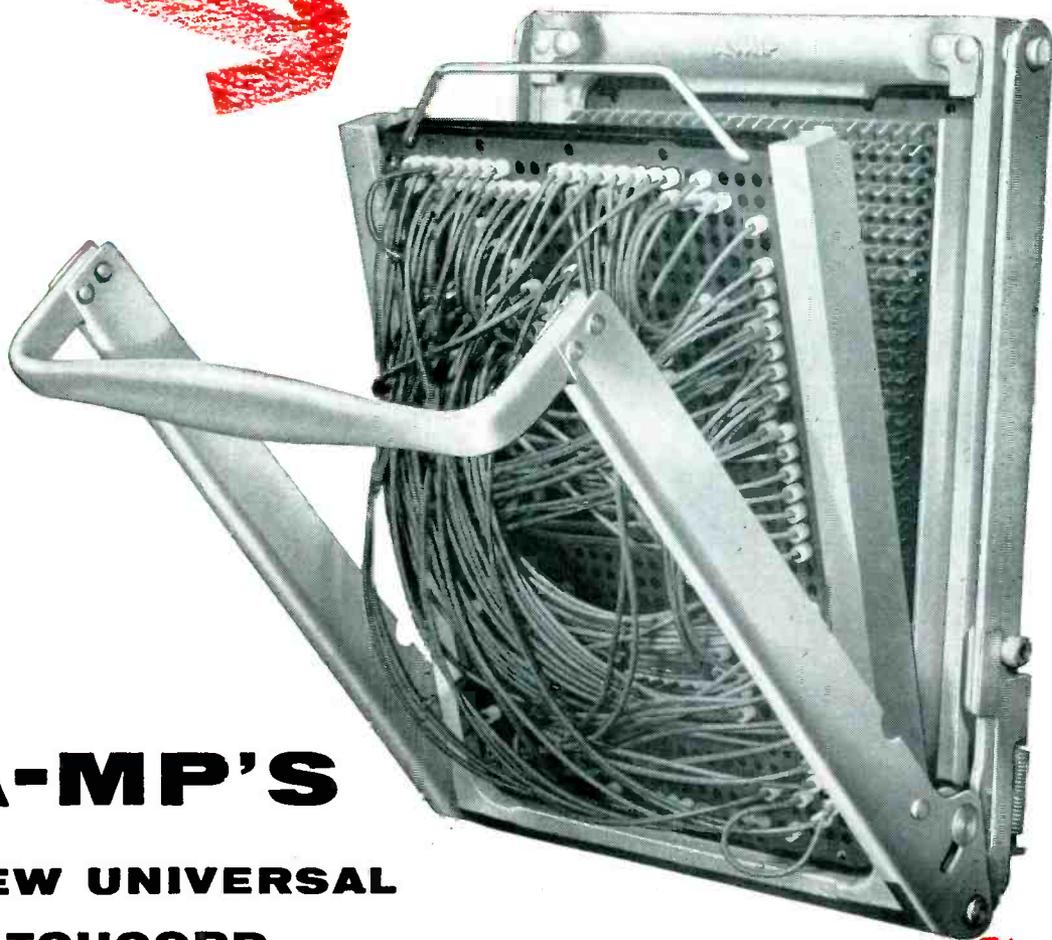


FIG. 1—Elementary circuit of capacitance transducer



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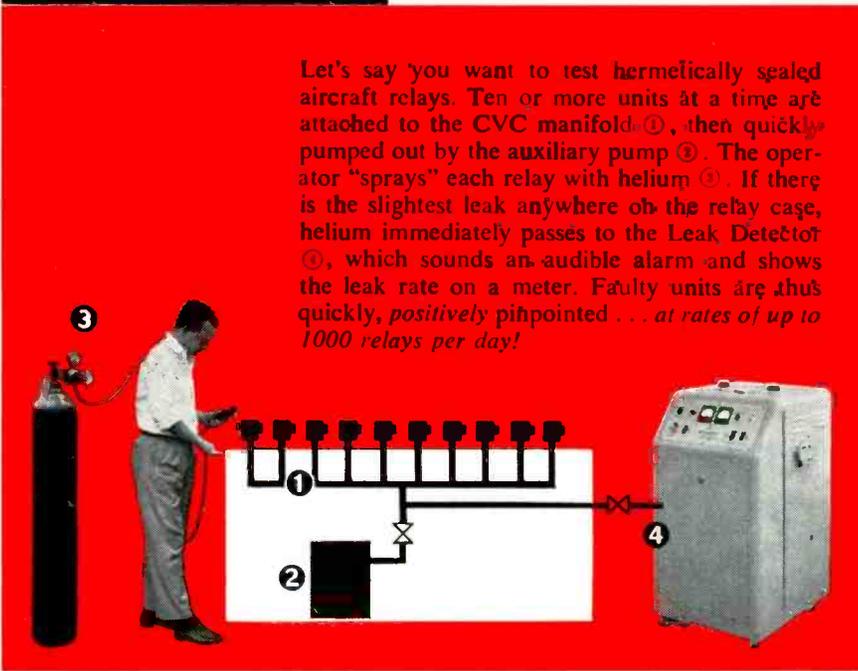
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using a probe plate 1-cm square spaced 2-mm away from the vibrating surface. This represents roughly 1-percent modulation of a  $0.5\text{-}\mu\text{f}$  capacitance.

The probe or measuring head need contain only a resistor in addition to the capacitance plate itself. The probe can often be located a foot or two away from the tube and other circuits. Operation does not involve alignment of tuned circuits.

Figure 1 illustrates the principle of operation. An ordinary r-f oscillator has a capacitance  $C$  and re-

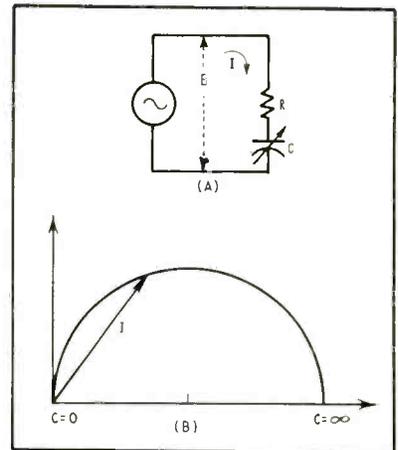


FIG. 2—Equivalent circuit of RC load (A) has locus of current values (B) as  $C$  is varied

sistance  $R$  in series connected across the tuned circuit. Capacitance  $C$  is the capacitance between the probe plate and the moving or vibrating object under investigation. The series resistance  $R$  is in the order of magnitude of the reactance of  $C$  at the oscillator frequency.

Under these conditions, variations in  $C$  will be translated into variations in the resistive loading on the oscillator. The resulting amplitude variations in the r-f voltage are detected and the detector output constitutes the signal. Such f-m as may occur does not affect the result.

In actual practice, the impedance of the R-C combination will be low compared to the resonant impedance of the oscillator tuned circuit. The load current  $i_c$  will be much larger than the circulating current  $i_s$ . Provided the generator  $e$  is a constant-current source delivering an r-f current  $i$ , the detected voltage will depend only on  $i$ ,  $R$  and  $C$ . In actual oscillators, a fair approximation to a constant-current source can be achieved, so that with a given cir-

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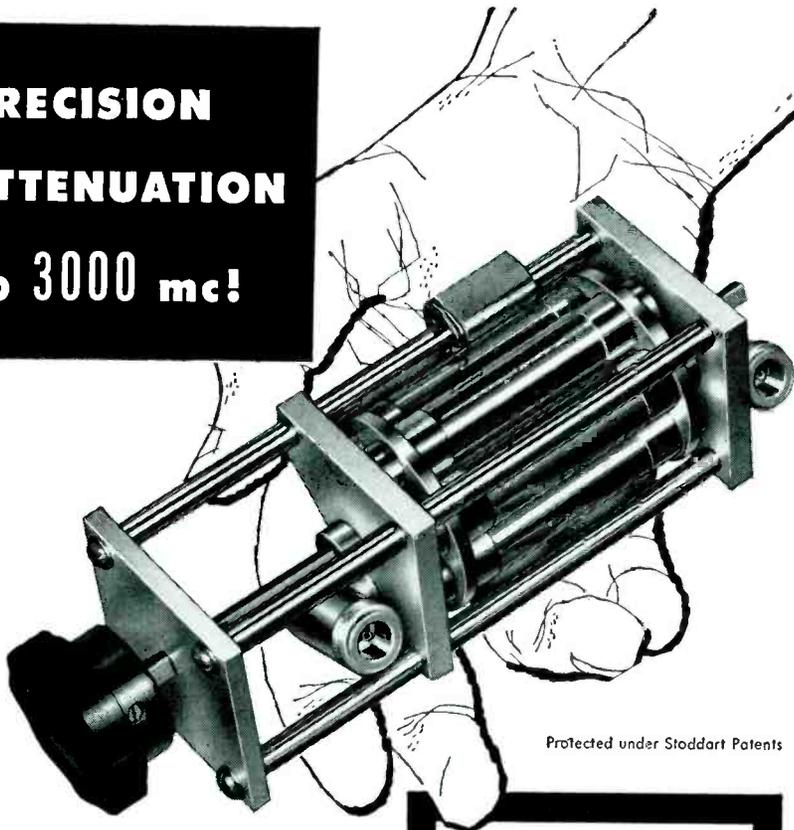


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**FREQUENCY RANGE:** dc to 3000 mc.  
**CHARACTERISTIC IMPEDANCE:** 50 ohms.  
**CONNECTORS:** Type "N" Coaxial female fittings each end.  
**AVAILABLE ATTENUATION:** Any value from 1 db to 60 db.  
**VSWR:** 1.2 max., dc to 3000 mc/s, values from 10 to 60 db. As value decreases below 10 db, VSWR increases to not over 1.5.  
**ACCURACY:**  $\pm 0.5$  db.  
**POWER RATING:** One watt sine wave power dissipation.

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**STODDART AIRCRAFT RADIO Co., Inc.**  
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cuit the effective driving current  $i$  will depend essentially on the plate-supply voltage.

Figure 2 shows the locus of load current  $I$  in a series R-C circuit as  $C$  is varied. In the region near where  $X_c=R$ , a variation in  $C$  produces a change only in the real component of the current (conductance). This is the reverse of the situation where a varying resistance and fixed reactance are used to produce frequency modulation, by varying the reactive component

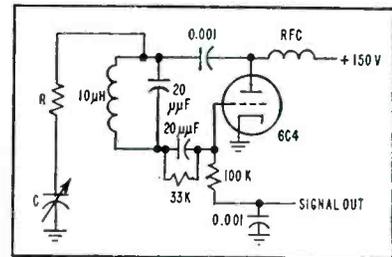


FIG. 3—Hartley oscillator circuit as used in capacitance transducer

of the admittance<sup>1</sup>.

It can be shown that the rate of change of load current  $I$  with respect to capacitance  $C$  goes through a maximum when  $R = \sqrt{2} X_c$ .

Measurements show that the maximum sensitivity is obtained when  $R$  is much lower than the reactance of the capacitance  $C$ .

Referring to Fig. 1,  $C_s$  represents the stray capacitance to ground of the lead connecting the oscillator to the probe. Variations in this stray capacitance will change the frequency of the oscillator but will have comparatively little effect on conductance component of the loading, hence will produce little output signal.

Measurements have shown a ratio of 50 and 300-to-1 between the signal produced by an increment in capacitance  $C$  after the resistor and those produced by similar increments in  $C_s$  or other capacitance directly across the tuned circuit. With the proper choice of oscillator coil, the tuned-circuit impedance can be made constant over a narrow range of capacitance change and thus the effects of reasonable changes in  $C_s$  canceled out.

In practice, an open wire a foot long generally introduces negligible disturbance. Shielding the lead is unnecessary since the impedance to

# CODE MODULATED MULTIPLE-PULSE MICROWAVE SIGNAL GENERATOR

**Model B 950-10,750 mc**

*Generates multi-pulse modulated carrier for beacons, missiles, radar... provides 5 independently adjustable pulse channels, 4 interchangeable r-f oscillator heads, precision oscilloscope, self-contained power supplies... all in one integrated mobile instrument.*

The Polarad Model B is an essential instrument for testing beacons, missiles, radar, navigational systems such as DME, Tacan, H. F. Loran, etc., where multi-pulse modulated, microwave frequency energy with accurately controlled pulse width, delay, and repetition rate is required for coding.

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**Five Independently Adjustable Pulse Channels**—each channel features variable pulse width and delay; has provisions for external pulse-time modulation.

**Precision Oscilloscope with Built-In Wide Band RF Detector** for viewing the modulation en-

velope and accurately calibrating the r-f pulse width, delay, and group repetition rate. Equipped with built-in calibration markers.

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Contact your Polarad representative or write to the factory for detailed information.

Variable width—width of each of 5 pulses can be adjusted independently.

Variable delay—delay between each of 5 pulses can be adjusted independently.



**CODE MODULATED MULTIPLE-PULSE  
MICROWAVE SIGNAL GENERATOR  
Model B**



Pulse-time modulation—input provided in each of 5 pulse channels for external pulse-time modulation.

Variable repetition rate—repetition rate of each group of pulses can be varied.

## SPECIFICATIONS:

### Frequency Range:

- Band 1... 950 to 2400 mc
- Band 2... 2150 to 4600 mc
- Band 3... 4450 to 8000 mc
- Band 4... 7850 to 10,750 mc

Frequency Accuracy...  $\pm 1\%$

RF Power Output... 1 milliwatt maximum (0 DBM)

### Attenuator:

- Output Range... 0 to  $-127$  DBM
- Output Accuracy...  $\pm 2$  db
- Output Impedance... 50 ohms nominal

### RF Pulse Characteristics:

- a. Rise Time... Better than 0.1 microsecond as measured between 10 and 90% of maximum amplitude of the initial rise.
- b. Decay Time... Less than 0.1 microsecond as measured between 10 and 90% of maximum amplitude of the final decay.
- c. Overshoot... Less than 10% of maximum amplitude of the initial rise.

### Internal Pulse Modulation:

- No. of Channels... 1 to 5 Independently on or off
- Repetition Rate... 40 to 4000 pps
- Pulse Width... 0.2 to 2.0 microseconds
- Pulse Delay... 0 to 30 microseconds
- Accuracy of Pulse Setting... 0.1 microsecond
- Minimum Pulse Separation... 0.3 microsecond
- Initial Channel Delay... 2 microseconds from sync. pulse
- Internal Square Wave... 40-4000 pps (separate output)

### Pulse Time Modulation:

- Frequency... 40-400 cps any or all channels
- Required Ext. Mod... 1 volt rms min.
- Maximum deviation...  $\pm 0.5$  microsecond
- Power Input (built-in power supply) 105/125 v. 60 cps 1200 watts.

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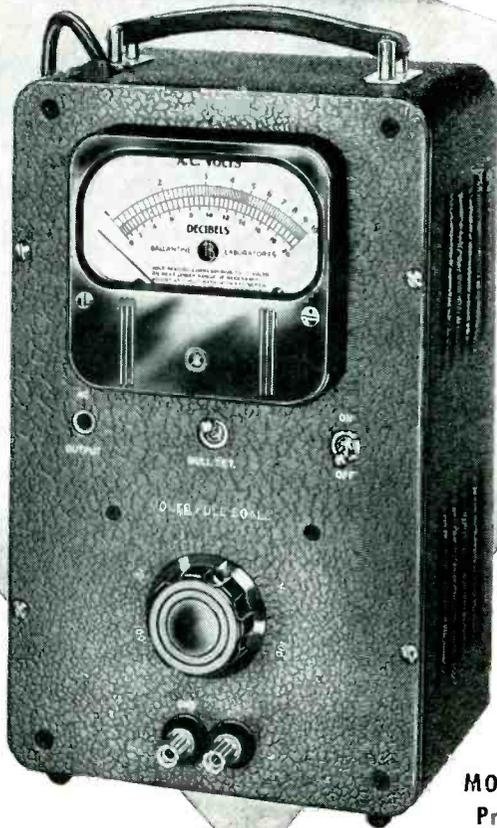
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with accuracy ( $> 100 \mu\text{v}$ ) . . . 3% to 1 mc; 5% above  
Input impedance . . . . . 2 megohms shunted by 15 mmfd  
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Usable as null detector sensitive to  $10 \mu\text{v}$  from 5 cps to 4 mc

Improvements include lower noise level; enhanced frequency response; reduced susceptibility to line voltage variations; incorporation of premium tubes throughout amplifier system, etc.

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100 FANNY ROAD, BOONTON, NEW JERSEY

ground at 60 cps is extremely low. Figure 3 shows a practical circuit operating at 10 mc. The oscillator is an ordinary class-C Hartley, with the grid providing the amplitude detection. The probe may be connected to either side of the coil.

A measured curve of signal output versus resistance  $R$  is shown in Fig. 4. Capacitance  $C$  was  $10 \mu\text{mf}$ , modulated approximately 1-percent peak. Maximum signal output occurs at 160 ohms, where the oscillator amplitude, as measured by the

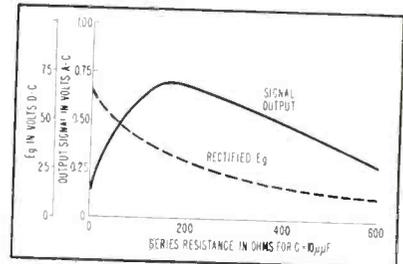


FIG. 4—Signal output and  $E_g$  as plotted against series resistance  $R$ . Capacitance  $C$  is  $10 \mu\text{mf}$  modulated about 1 percent

rectified d-c grid voltage, is down to about half its unloaded value.

Figure 5 shows another circuit that gives about twice the sensitivity to capacitance changes as the circuit of Fig. 3 but the value of  $R$  is more critical. Operating frequency is about 550 kc and the r-f voltage is low, to minimize radiation. For  $C = 10 \mu\text{mf}$ , maximum sensitivity occurs when  $R = 15,000$  ohms. The tube here serves as a class-B oscillator and detector and as a signal amplifier. It is advantageous in some cases to insert an r-f choke in series with the cathode resistor.

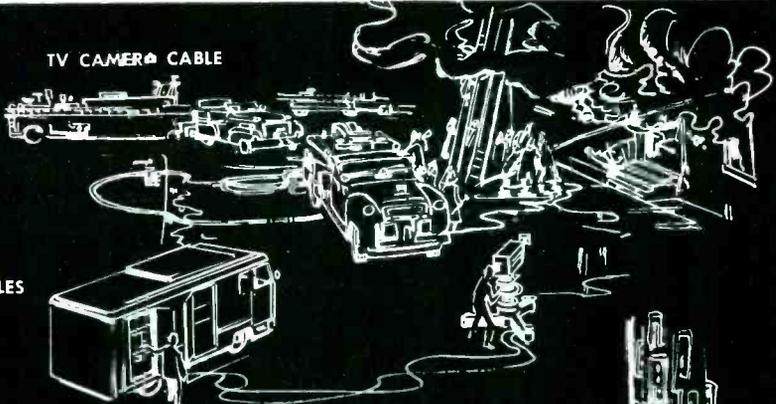
Separate diode detectors, r-f oscillator-amplifier combinations and tuned circuits located in the probe and fed through a low-impedance line are among the elaborations possible for special applications.

The circuits shown appear to be quite applicable as condenser microphone preamplifiers. Calculations indicate a probable increase of about 10 db in output from a condenser microphone, over the circuit usually used, together with removal of difficulties owing to insulation leakage and elimination of limitations on low-frequency response.

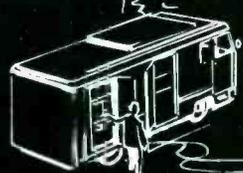
This type of circuit is readily transistorized. Features of the cir-



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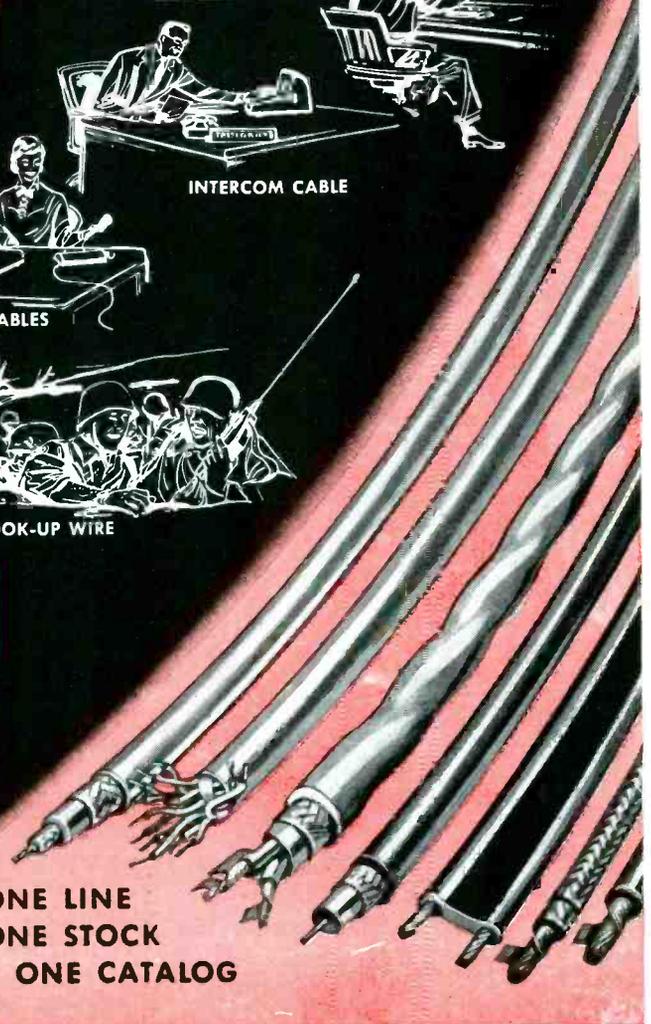
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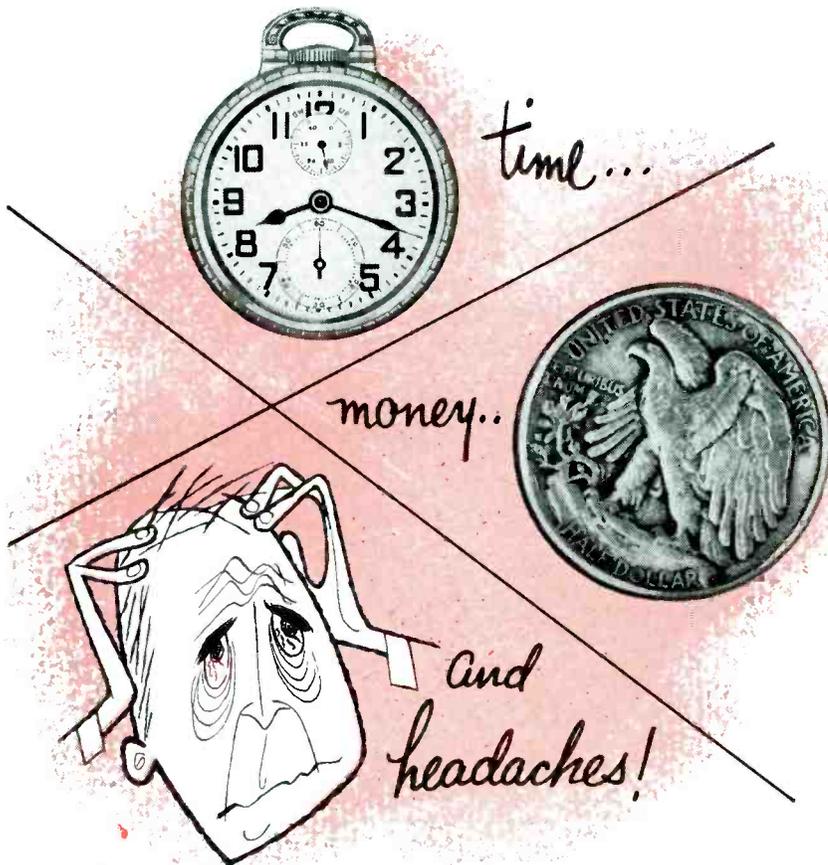


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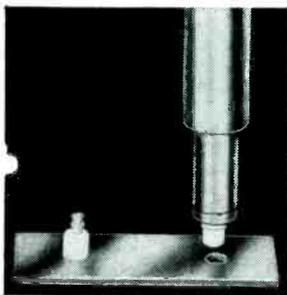


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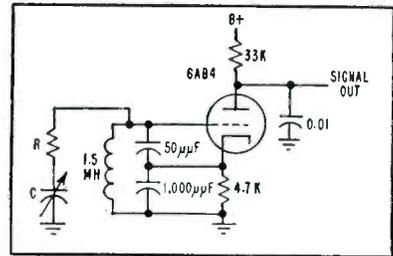


FIG. 5—Class-B Harris 550-kc oscillator circuit using single triode as oscillator-detector and signal amplifier

cuit described are covered in an application for U. S. patent.

### REFERENCE

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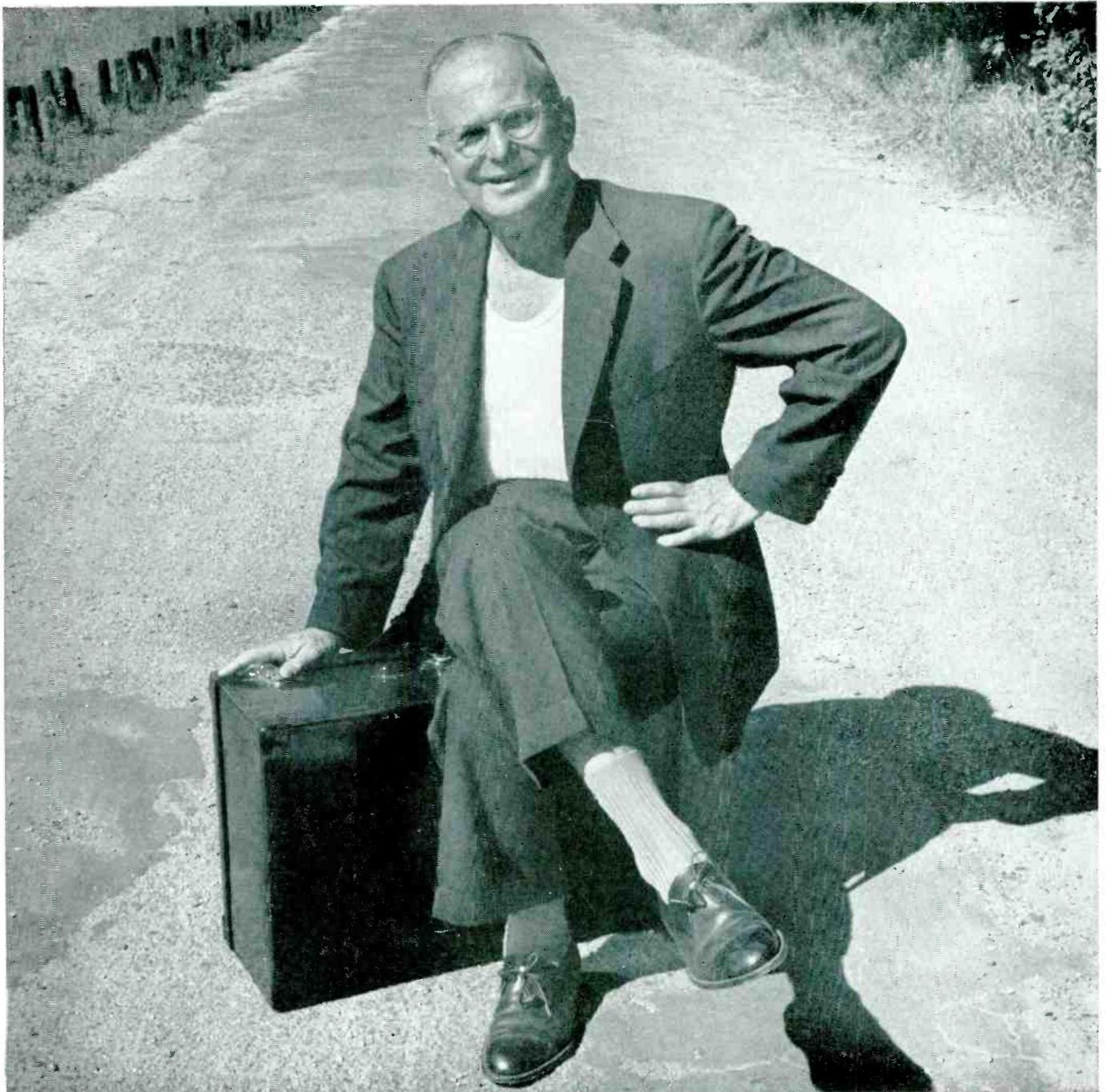
## Improving Audio Quality of Mobile Radio

By RICHARD BUESING  
General Electric Co.  
Syracuse, N. Y.

OF THE SEVERAL TYPES of microphones available, the single-button carbon and the controlled-reluctance microphones are the most popular in two way mobile radio systems.

The carbon microphone has been chiefly used because of its high output level at low impedance, its freedom from inductive interference, and its ruggedness.

Its chief disadvantage is the high distortion produced. Harmonic distortion in the order of 10 percent and intermodulation distortion of approximately 30 percent are typical measured values. A further disadvantage is the requirement for excitation current. Since the element is composed of relatively loosely-packed carbon



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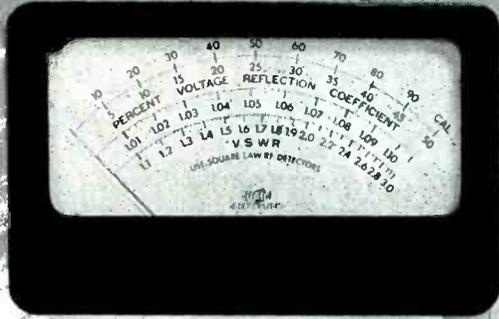
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granules, there is an inherent hiss produced and can be noticed in the intervals between words. There is a variation between microphones of a given type, a factor which must be carefully considered in the design of the associated circuits. Finally, the carbon granules are subject to packing and wear and may eventually lose output and require replacement.

The methods of application of carbon microphones vary considerably. Their internal impedance is

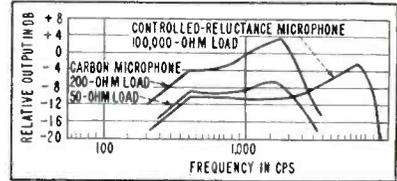


FIG. 1—Frequency response curves for carbon and controlled-reluctance microphones

approximately 100 ohms. Frequency response is as shown in Fig. 1. The 200-ohm load curve cannot be used as a pre-emphasis curve since the curve is not a true 6 db per octave pre-emphasis curve. It is not reproducible and provision must be made for wire-line input. Loading the microphone more heavily produces a curve similar to the curve taken with a 50-ohm load. Not only is the output flattened; it is reduced. The reduction is not intolerable since the output is approximately the same level that must be accommodated from wire lines. Excitation current may be taken from a battery, a bleeder across B+, or from a cathode or bias supply capable of furnishing the required power.

The controlled-reluctance cartridge was developed for Navy use when a microphone more rugged than those available was needed. A design was evolved in which the coil is stationary while the armature moves. The structure is rugged, capable of surviving shock, blast, humidity, vibration and temperature tests.

Harmonic distortion is in the order of 0.5 percent while the intermodulation distortion is only 1 to 2 percent. No excitation current is required and the stationary coil may be wound for various impedances. The most serious disadvantage lies in susceptibility to

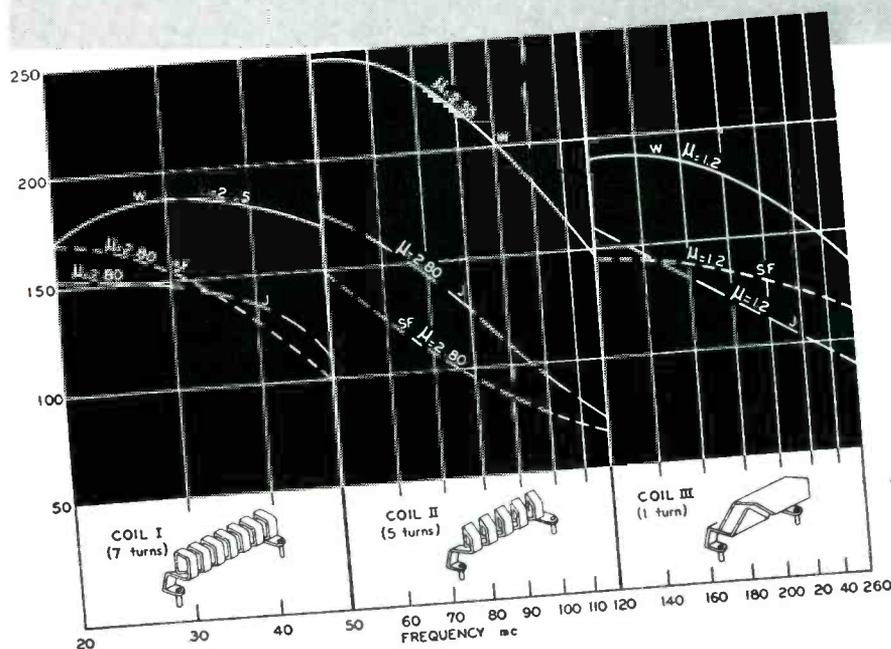
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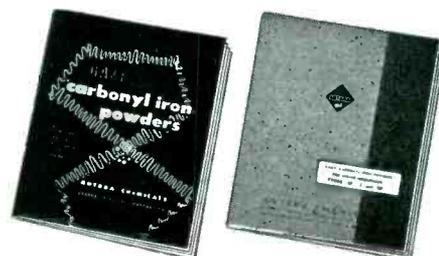
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Density of particles, g/cm <sup>3</sup> .....	7.35	7.35	7.81
Apparent density, g/cm <sup>3</sup> .....	2.6	2.8	3.0



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induction interference but proper shielding, reduces this problem to a minimum.

A typical frequency response curve for a controlled-reluctance microphone is shown in Fig. 1. The output level compares with that of the heavily-loaded carbon microphone. No circuit changes beyond the first grid were needed to con-

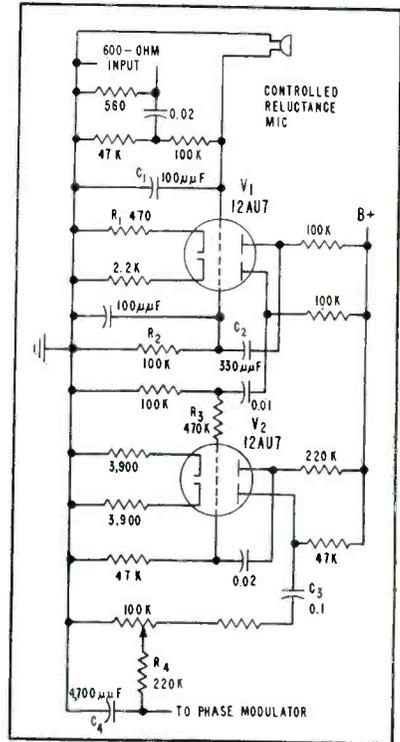


FIG. 2—Modulator input circuit used with controlled-reluctance microphone

vert from carbon to controlled-reluctance microphones, yet maximum flexibility is maintained. The input circuit shown in Fig. 2 is designed for proper modulation of the transmitter when the microphone is held within two inches of the lips and a normal conversational voice level is used. Bypassing  $R_1$  adds another 2 db to the gain figure. Limiting action is sharp and symmetrical, but the circuit has a high articulation index when tested in conjunction with a broadcast-quality microphone, amplifier and speaker system.

Since the FCC requires that the deviation of the transmitter be controlled quite rigidly,  $V_2$  is used as the modulation limiter.

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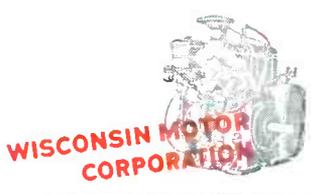
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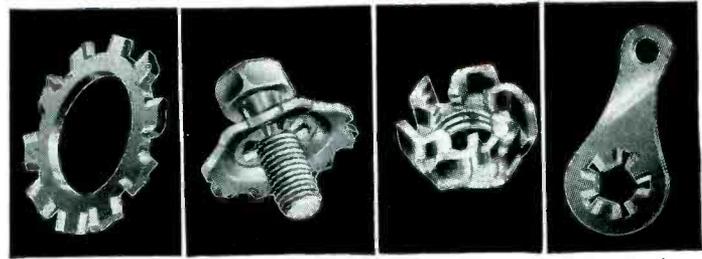
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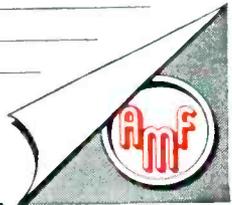
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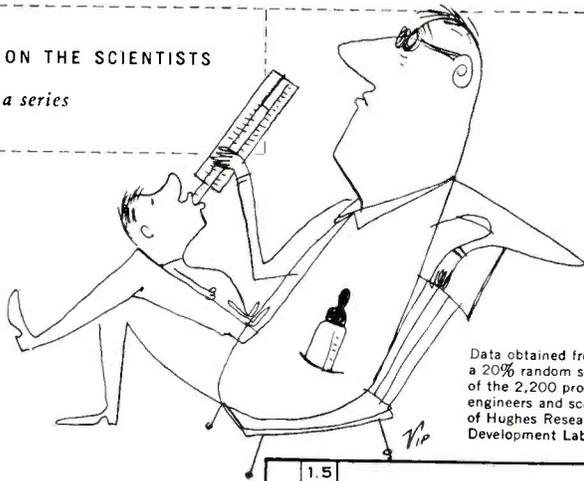
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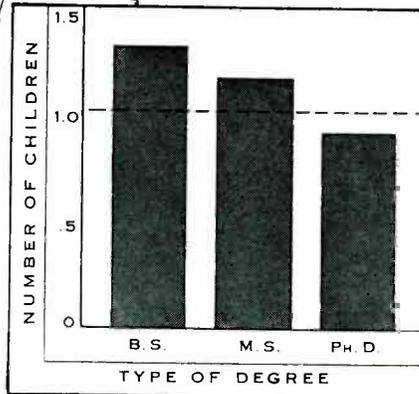
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and grid limited at signals above a specified level. Since the half-cycle limited by cutoff is more square than the half limited by plate saturation, the action is repeated in the second half of  $V_2$ . By virtue of the 180 deg reversal occurring in the first half of  $V_2$ , the output wave at  $C_3$  is made symmetrical and square after being limited in the second half of  $V_2$ . Resistor  $R_3$  is inserted in series with the grid of

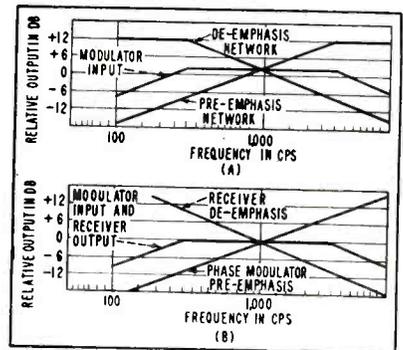
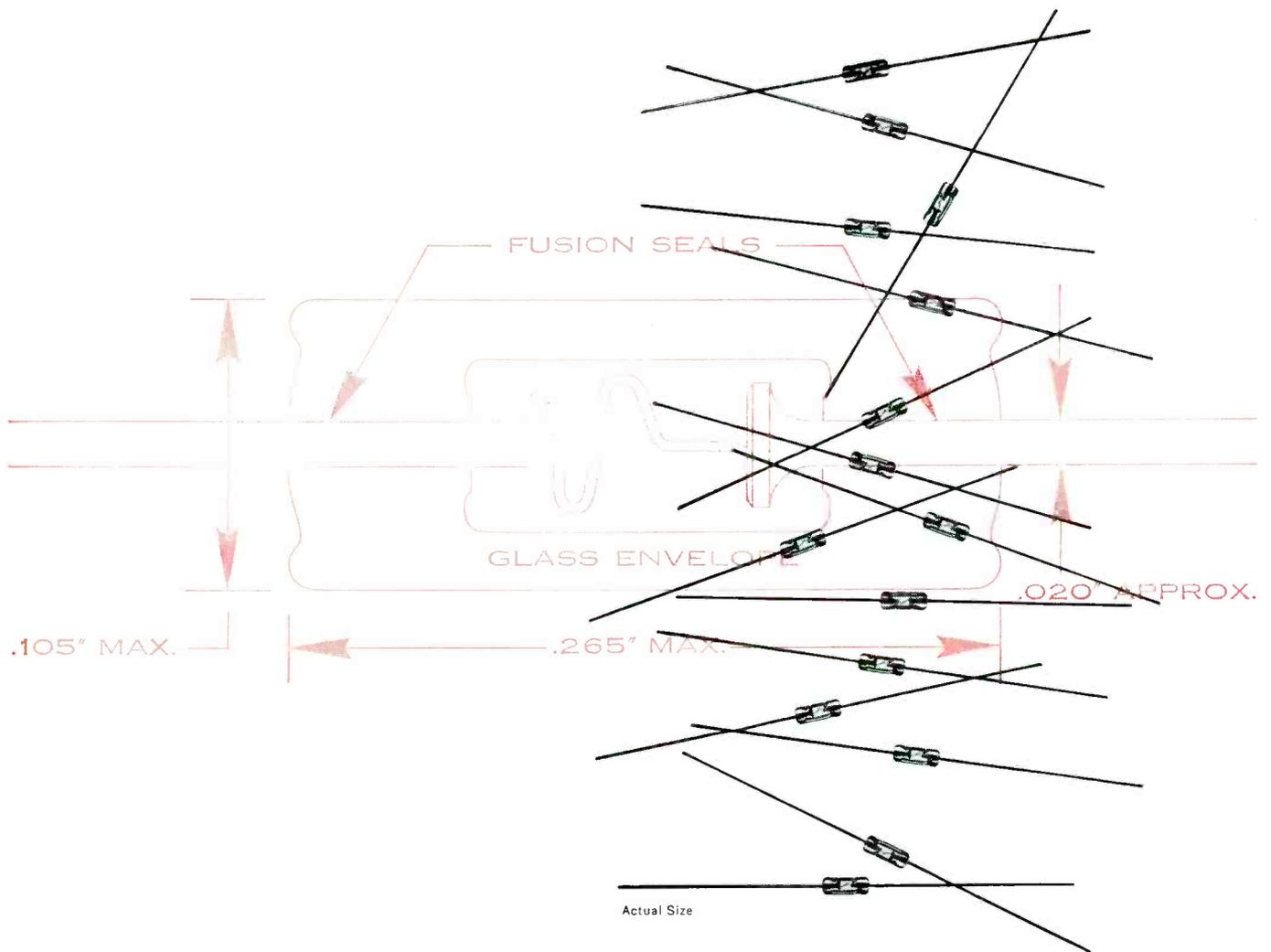


FIG. 3—Pre-emphasis and de-emphasis network characteristics for transmitter (A) and receiver (B)

the first half of  $V_2$  to cause the tube to rebias itself to the correct operating point when it begins to draw grid current during limiting.

The transition from an output that increases linearly with input to an output constant with input level takes place with a 2-db difference in input level. With this sharp discontinuity, intermodulation distortion is reduced by a considerable amount. Since the output at  $C_2$  is a square-wave at levels above the limiting threshold, it is necessary to attenuate the high-order harmonics found in the square wave before they are applied to the modulator. The network made up of  $R_1$  and  $C_1$  is the de-emphasis network that is used for the attenuating purpose. The lower the frequency at which this network can be made to cutoff, the more the high-order harmonics will be attenuated.

Figure 3A shows the frequency response of the networks. Since the voice-frequency band is approximately 300 to 3,000 cycles, this is the band over which the transmission characteristic must be maintained flat. The de-emphasis curve may then be tailored to cutoff at approximately 300 cps to



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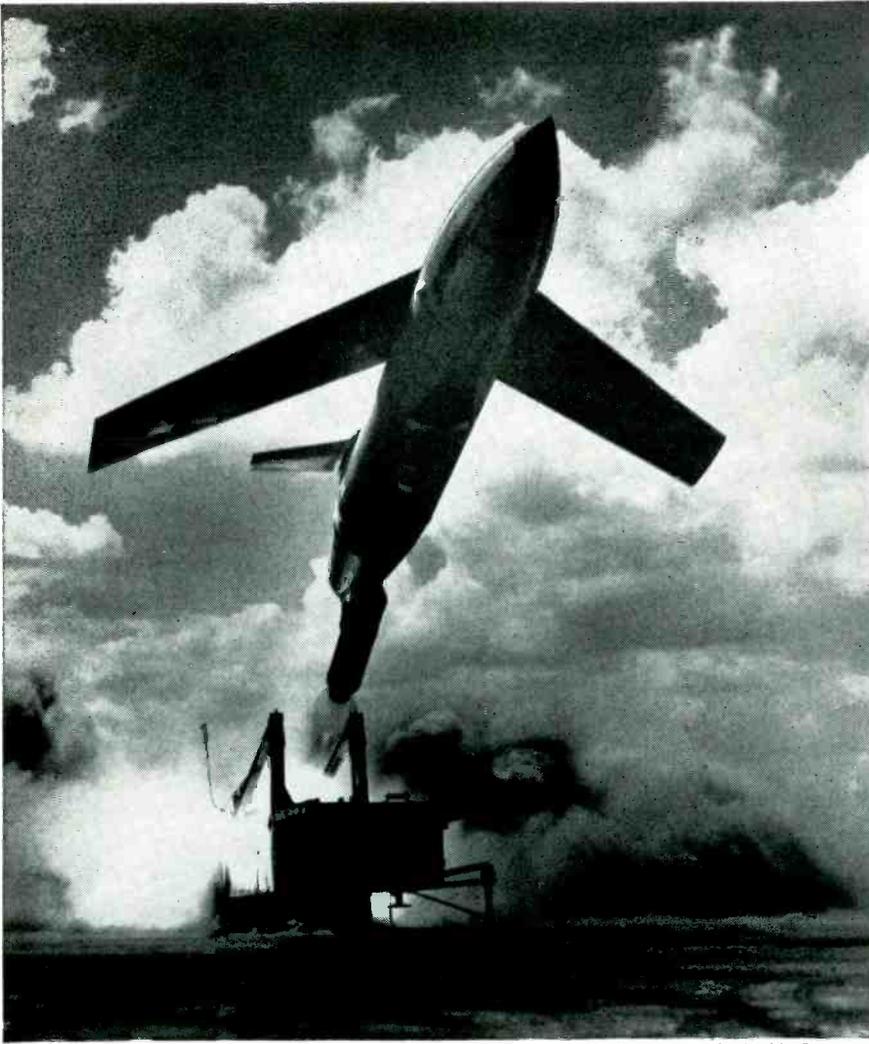
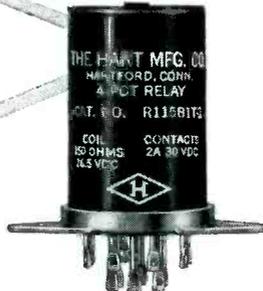


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provide maximum attenuation at high frequencies. The frequency band now slopes at a rate of 6-db per octave.

To attain a flat characteristic, a network to pre-emphasize the input to the limiter must be incorporated and is composed of capacitor  $C_2$  and resistor  $R_2$  which have a cut-off frequency of 3,000 cps. Adding the two curves results in a flat characteristic over the transmission band as shown in Fig. 3A.

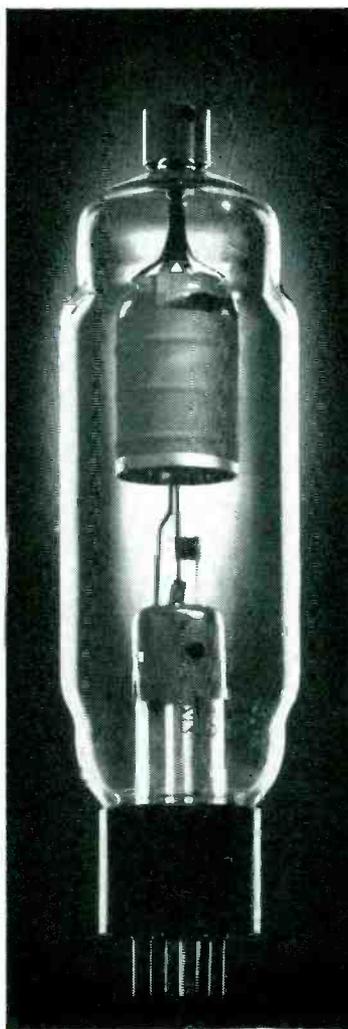
Applying this curve to the phase modulator, which is inherently a pre-emphasis device, requires receiver de-emphasis, as shown in Fig. 3B, in order that a flat response may be reproduced at the receiver output. The audio amplifier, made up of both halves of  $V_1$  in Fig. 2 makes up for the insertion loss of the pre-emphasis and de-emphasis circuits and raises the input level.

From the curves of Fig. 1, the carbon-button microphone would seem to emphasize highs. During listening tests, however, the carbon microphone sounded more bassy than the controlled-reluctance type. The reason for this is that the high order of intermodulation distortion in the carbon element produces

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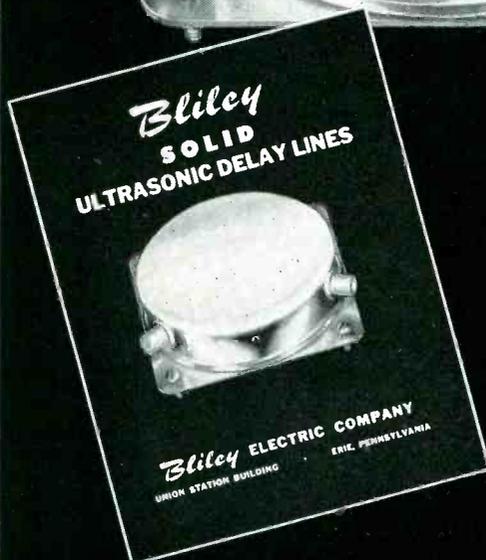
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both the sum and difference of two frequencies appearing at the input. For example, if two frequencies, 300 and 500 cps, are passed through a nonlinear device, these two frequencies plus their sum, 800 cps, and their difference, 200 cps, will be produced at the output. The sum products tend to work themselves out of the upper pass band limit while the difference frequencies tend to bunch up at the lower end.

### Fingertip Touch Actuates Circuit

PORTABLE LAMP control with the possibility of wide application in the medical field has been named Touchtron by General Electric. It is now being tested in situations that permit paralyzed or similarly handicapped people to operate devices merely by touching especially designed plates with either side of the face or hand.

Permanently connected to the power line, the device employs a half-wave rectifier to provide a direct voltage. Although dependent upon the magnitude of the a-c input, the d-c never reaches a potential sufficient to break down the control tube.

In series with the control tube is a latching relay that closes whenever the electrolytic capacitor is discharged by firing of the tube. Leads from the touch plates are connected to the firing electrode and also the anode side of the a-c line.

The impedance or conduction of the hand in bridging the plates



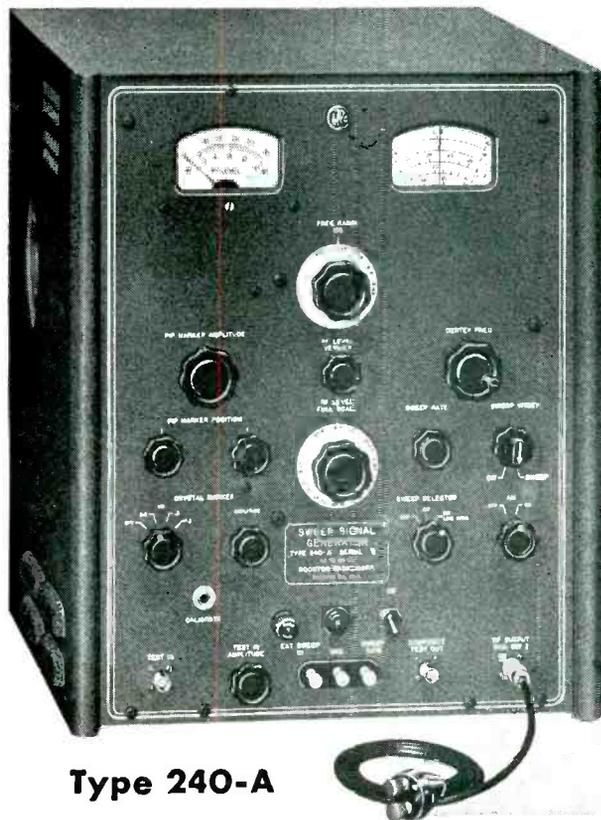
Entire electronic and electrical circuit can be packaged as shown to fit in base of lamp. Other conformations are possible for specific uses

# New!

# MULTI-PURPOSE

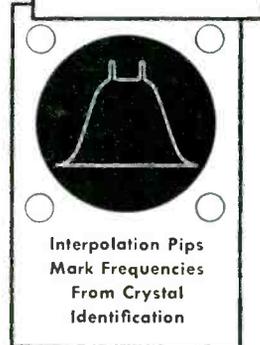
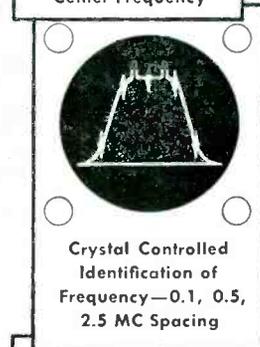
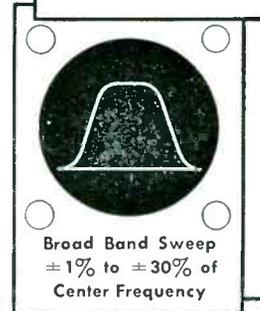
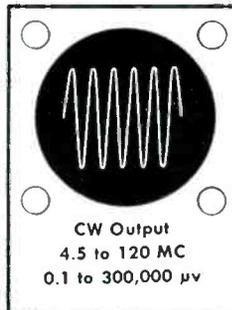
# Sweep Signal Generator

## 4.5 to 120 mc.



**Type 240-A**

- A wide range of continuously variable linear-frequency sweep widths.
- Crystal controlled frequency identification.
- Adjustable frequency-interpolation pip marks.
- Internal mixer for forming composite display signal.
- Accurate continuously-tuned CW with choice of internal AM.
- Internal crystal calibrator for CW.
- Wide range of calibrated output voltage.



The Sweep Signal Generator Type 240-A is a continuously-tuned, accurate CW Signal Generator with internal AM. The output voltage is continuously monitored, indicated and calibrated over a wide range. The CW Signal can be calibrated against an internal crystal. Electronic sweep circuits are included which produce an output signal having an AGC-controlled constant-amplitude and a wide range of continuously-variable linear-frequency sweep widths. Two systems are included for frequency identification while sweeping. One of these is crystal controlled and the other is an interpolation system. An internal mixer adds the frequency identification information to the test receiver output signal prior to its connection to the display oscilloscope.

### SPECIFICATIONS:

**RF FREQUENCY RANGE:** 4.5 to 120 MC continuously variable in five ranges.

**RF FREQUENCY ACCURACY:** ±1%.

**RF OUTPUT VOLTAGE:** 1 to 300,000 microvolts. 0.1 to 30,000 microvolts with external attenuator.

**AMPLITUDE MODULATION:** Factory adjusted to 30% from internal 1000 cps oscillator.

**RANGE OF SWEEP WIDTHS:** Continuously variable from ±1% of center frequency to ±15 MC or ±30% of center frequency whichever is smaller.

**LINEARITY OF SWEEPED RF FREQUENCY:** Within 10% over middle 80% of sweep excursion, within 20% over remainder.

**FLATNESS OF SWEEPED RF OUTPUT:** Within 7% under all conditions.

**FREQUENCY IDENTIFICATION MARKS:** Crystal frequency identification spaced 0.1, 0.5, 2.5 MC. Tuning dial identifies center mark. Two adjustable-position interpolation pip marks.

**PRICE:** \$1375.00 FOB BOONTON, N. J.



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Our engineering department will be glad to help you with special scales, ranges or specifications. For the complete technical data sheets write to Electronic Sales Division, DeJUR-Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, N. Y.

**MODEL R-230** 1/2 Actual Size



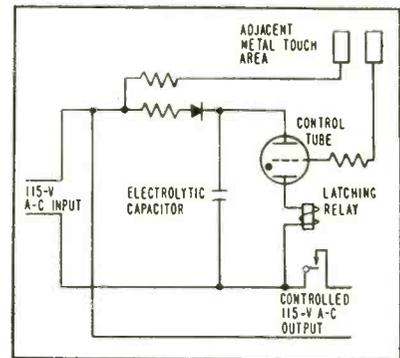
**2 1/2" Ruggedized or Sealed**—Withstands shock, vibration and temperature extremes. Sealed windows and terminals. Also available in 3 1/2" size.

**SERIES HD-654** 1/4 Actual Size



**3 1/2" Elapsed Time Indicator**—Easy to read 5 digit counters can be provided to register tenths of minutes or hours.

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Basic circuit of the touch control designed for lamps

raises the potential of the firing electrode towards that of the anode and causes the tube to fire.

## Sensitive Limit Detector

By JOHN H. PORTER

Rochester, New York

To PROVIDE an indication when a voltage exceeds a preset limit, some type of a differential device that generates sufficient power to operate an indicating or correcting mechanism is generally used. In regulated power supplies, for example, the output voltage is compared with a reference voltage in a tube. Subsequent plate-current variations are amplified and act to restore the level of the output voltage to some preset value.

Differential amplifiers have been devised that generate an output current proportional to the difference in potentials applied to the two inputs and such amplifiers can be made substantially independent of the common level of the input signals. However, differential amplifiers in a simple form lack sensitivity and in general are dependent on the operating current of the relay.

Circuits that employ an a-c driven chopper as a switch to apply alternately the unknown and reference signals to the input of an amplifier and a phase detector to recover the polarity sense and amplitude scale and operate appropriate relays, are satisfactory when the input to the chopper is on the order of a few volts. These circuits can be made to have very high sensitivity. However, when an at-

# precision Continental Connectors

## MINIATURE



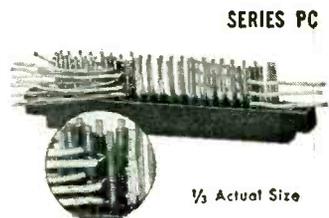
**SERIES 20**  
 Contacts: 7, 8, 9, 11, 14, 18, 20, 21, 26, 34, 50, 75, 104. For #20 AWG wire. Current rating: 5 amps. Voltage: 2100V. RMS.

## SUB-MINIATURE



**SERIES SM-20**  
 Contacts: 7, 11, 14, 20, 26, 34. For #20 AWG wire. Current rating: 5 amps. Voltage: 1900V. RMS.

## PRINTED CIRCUIT



**SERIES PC**  
 Solderless wire wrap (double rows of 22 contacts) or standard type printed circuit receptacle (6, 10, 15, 18, 22 contacts). Current rating: 10 Amps. Voltage: 2500V. RMS.

## HIGH VOLTAGE AN-TYPE

For AN-36 shell. 15 contacts. 3 high voltage contacts in center are removable. Current ratings: 10 and 20 Amps.



## MINIATURE AN

One-piece molded inserts. Current rating: 7.5 Amps. Voltage: 3000V. RMS.

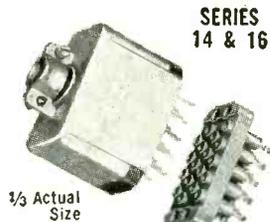


## EASY RELEASE



Solder cup contacts, taper pin cups for solderless wiring or turret terminals. Current rating: 10 Amps. Voltage: 4500V. RMS.

## POWER



**SERIES 14 & 16**  
 Contacts: 12, 18, 24, 34. Spring loaded contacts for easy release. Coaxial contacts and bayonet locks also available. Current rating: 10 and 25 Amps. Voltage: 4700V. RMS.

## SPECIAL DESIGNS



Our engineering department will be glad to design types to your exact specifications. Send us your requirements for analysis.

## HERMETIC SEAL

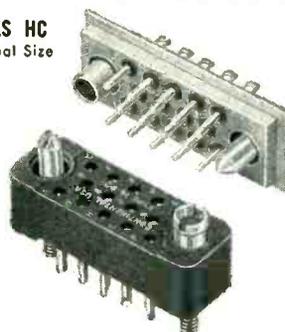
For high altitude applications. Plug contacts individually compression sealed in glass. Guide pin and guide socket, or polarizing screwlock available. Fits series 20 receptacles.



**SERIES HC-20**  
 3/4 Actual Size

## SERIES HC

3/4 Actual Size



Hexagonal hermetic plug has solid glass insert. For pressurized electronic equipment. 4, 5, 7, 9 and 10 contacts.

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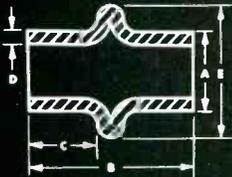
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#### BULGED SEAMLESS TUBES



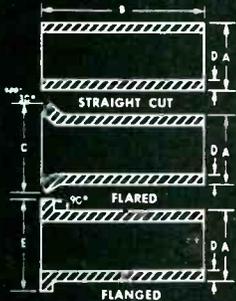
BULGED SEAMLESS TUBES

A	B	C	D	E
.040	1/8 to 3/8	1/8 to 1/2	.005	.060
.050	1/8 to 3/8	1/8 to 1/2	.007	.075
.060	1/8 to 3/8	1/8 to 1/2	.010	.090
.075	1/8 to 3/8	1/8 to 1/2	.010	.110
.090	1/8 to 3/8	1/8 to 1/2	.010	.120
.125	1/8 to 3/8	1/8 to 1/2	.010	.160
.156	1/8 to 3/8	1/8 to 1/2	.010	.200



★ Other Dimensions Available

#### STRAIGHT CUT FLARED FLANGED

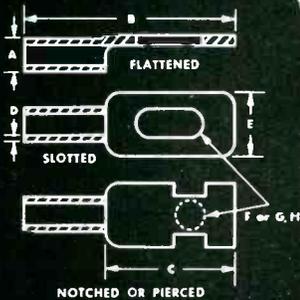


A	B	C	D	E
.040	1/8 to 1 1/4	.050	.005	.055
.050	1/8 to 1 1/4	.060	.007	.070
.060	1/8 to 1 1/4	.075	.010	.080
.075	1/8 to 1 1/4	.090	.010	.100
.090	1/8 to 1 1/4	.110	.010	.115
.125	1/8 to 1 1/4	.160	.010	.170
.156	1/8 to 1 1/4	.185	.010	.200



★ Other Dimensions Available

#### FLATTENED SLOTTED NOTCHED OR PIERCED



A	B	C	D	E	F	G	H
.040	1/8 to 3/8	.230	.005	.070	.040	.015	.040
					.100	.075	
.050	1/8 to 3/8	.230	.007	.090	.045	.020	.060
					.120	.075	
.060	1/8 to 3/8	.230	.010	.105	.055	.025	.062
					.120	.090	
.075	1/8 to 3/8	.230	.010	.120	.060	.025	.075
					.125	.090	



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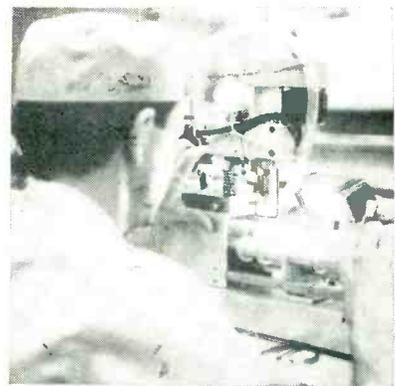
tenuator is used to reduce an unknown voltage to a comparable level, the small variations in the unknown will be likewise attenuated.

A circuit is shown that acts as the detector in a system wherein two voltages are mixed in a common input circuit, one voltage being the unknown and the other a reference voltage set to the level to be studied.

Ultimate, instantaneous sensitivity is in the order of 1 millivolt. Stability of the level at which the device changes states abruptly from conducting to nonconducting can be held to ±3 millivolts over an extended period by using components designed for long-term stability and a power supply of good regulation.

The reference voltage,  $e_2$ , is introduced in the summing network whose output to the grid of the tube is approximately  $\frac{1}{2}(e_1 + e_2)$  with the constants given. If the reference voltage is so introduced, the stability and sensitivity of the limit detector itself remain at less than ±3 millivolts regardless of input level. Overall stability of the device is limited by the stability of the reference voltage supply. For small inputs, of the order of 1 or 2 volts, the reference voltage may simply be

### Aseptic Machine Shop

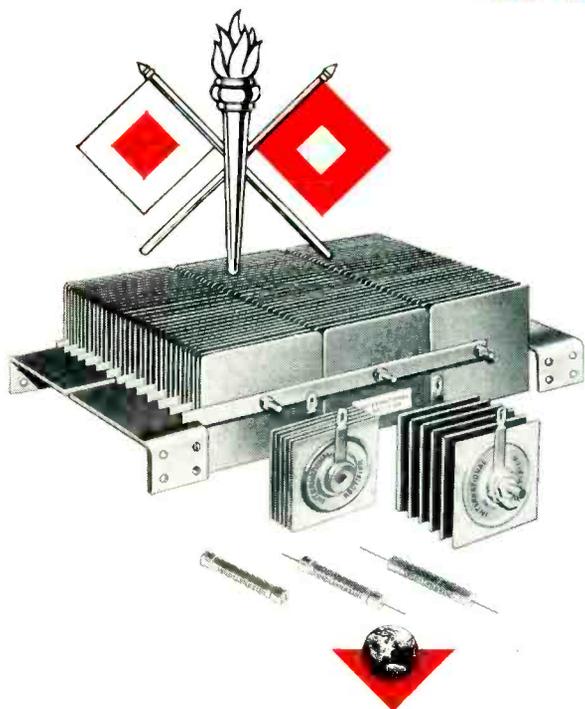


Precise laboratory conditions, including control of humidity and temperature, will help increase reliability and life of deep sea amplifiers used on first telephone cable between North America and the British Isles. Technician is using precision drill to bore holes in components that are attached to repeater with Lucite pins. British and Canadian agencies have joined with American Telephone and Telegraph Co. to provide fade-free telephone service

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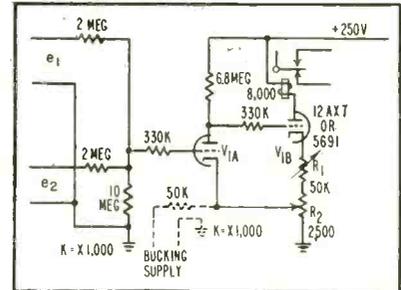
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ELECTRONS AT WORK

(continued)

introduced as a bucking supply in the cathode circuit, as shown in dashed lines.

The detector has two stable states and depends on positive feedback in the cathode circuit for regeneration. Tube  $V_{1A}$  saturates readily with the large plate load and never draws over 25 microamperes. Tube  $V_{1B}$  is either cutoff or conducting



Reference voltage is introduced either at  $e_2$  or as bucking supply to cathode of limit detector

depending on the grid input to  $V_{1A}$  and its plate-current differential is adjusted by  $R_1$  to fit the characteristics of the relay used. With an 8,000-ohm relay and  $R_1 = 35,000$  ohms, the current is either 0.8 or 2.5 milliamperes.

The input firing level is dependent linearly on both plate and filament potentials. A 0.1 percent variation in B+ will cause approximately 0.4-millivolt change in input firing level. This indicates that voltage reference tubes such as the 5651 are adequate to stabilize the plate supply. A 1 percent variation of filament voltage can cause a 7-millivolt variation in firing level, hence use of a constant voltage filament transformer is recommended. This effect is apparently caused by the contact potential variation since the grids are driven positive during conduction.

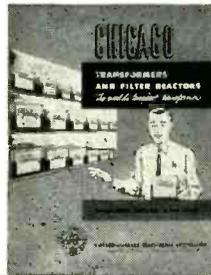
Adjustment of the feedback adjustment  $R_2$  is rather critical, and should not be used as a gain or sensitivity control. The gain of the circuit is 8,000 or more during the transition from conducting to nonconducting states and constant at approximately 10 during either of the stable states. It is apparent that excessive feedback results in hysteresis and is evident in the form of backlash.

Insufficient feedback again allows the decision to be based on the relay

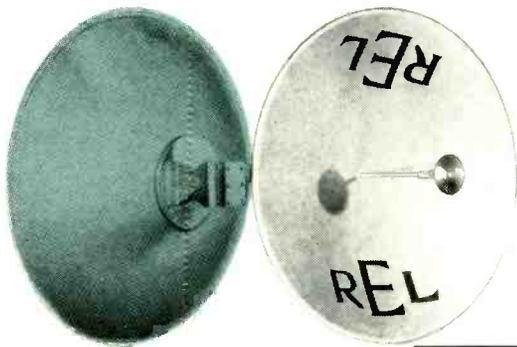
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**Chicago Catalog CT-554**

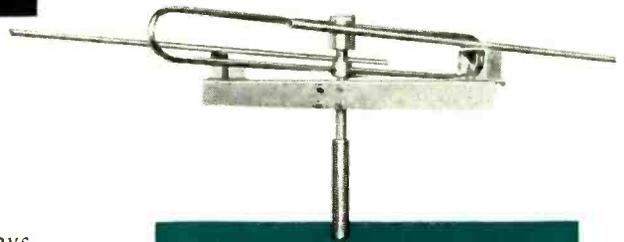
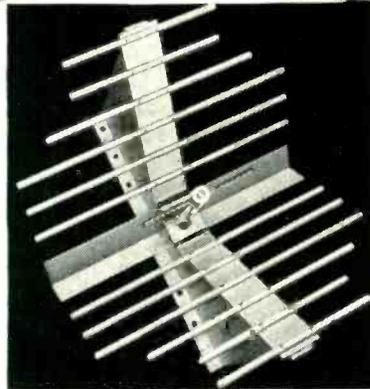
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characteristics. An optimum adjustment can be attained where a nearly vertical input-output curve exists, and such that a 1 or 2-millivolt increment on the input grid causes a plate-current variation adequate to embrace the difference between pull-in and drop-out currents of the relay used.

## Bias Supply Design for Bolometers

By EDWARD H. BRAUN

*Microwave Antennas and Components  
Branch  
Electronics Division  
Naval Research Laboratory  
Washington, D. C.*

ELECTRONIC BOLOMETER biasing circuits are usually fairly elaborate, requiring separate power supplies and methods of limiting the voltage across the bolometer. In some cases the open circuit voltage across the bolometer holder is so large that if the bolometer is disconnected and then reconnected the bolometer will burn out. In addition there is some danger of shock to the operator if he removes the bolometer with the bias on.

The following circuit with the indicated parameters obviates these disadvantages. It is simple, requiring in most cases only two resistors, two capacitors and a wirewound potentiometer. The open-circuit voltage across the bolometer is only a few volts. The current drain is the same with or without the bolometer connected, and the bolometer current may be varied continuously from zero to any specified value with the same supply.

The circuit for use with a 200-ohm bolometer taking up to 10 ma is shown in Fig. 1. This supply draws 21 ma with or without the bolometer connected. The open cir-

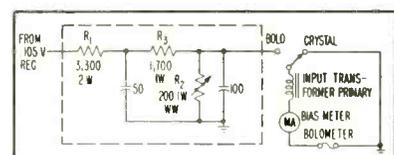


FIG. 1—Constant current drain bias supply protects against applying overvoltage to bolometer

Government model TS-148/UP Frequency-meter Range - 8470 to 9630 MC/S  $\pm 5$  MC/S max. error.  
Sensitivity to CW - Spectrum Amplified Pos. - 80 db. below 1 watt for 1 inch deflection.

# SPECTRUM ANALYZER

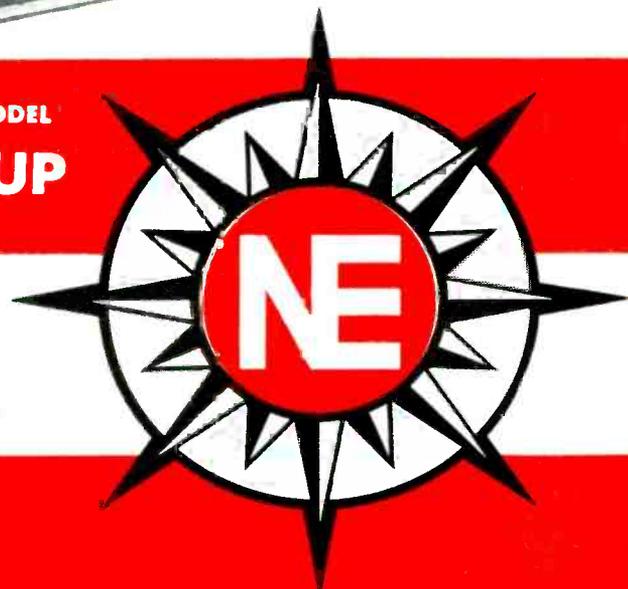
Spectrum Position - 55db. below 1 watt for 1 inch deflection. Maximum dispersion of spectra.  
Attenuation - uncalibrated. Variable 3 to 70 db. 1.5 MC/S per inch.



GOVT. MODEL  
TS-148/UP

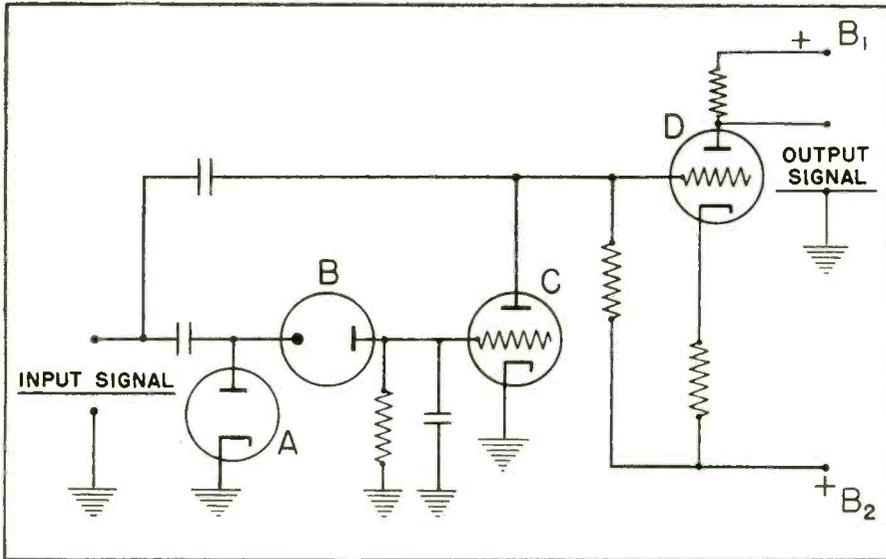
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## ELECTRONIC AMPLIFYING SWITCHING CIRCUIT

Both electronic switches and electronic amplifiers are used successfully in computer design. A very unusual circuit, patented by the Ford Instrument Company, combines positive switching action with amplification, and is particularly useful in such applications as multi-speed servomechanisms, in which several signals are to be applied selectively to operate the mechanism. When such a circuit is used, the inactive signals can be left connected without producing any noise whatever in the response to the active signal.

The key to the operation of this circuit is the voltage-doubler circuit consisting of diode A and gas tube B. When the signal voltage is below a specified level, gas tube B cannot fire and triode C draws a very large current, making the grid of tube D at almost ground potential. The cathode voltage of triode D is at a voltage  $B_2$  above ground, thereby effectively cutting tube D off. If the signal voltage is above the specified level, gas tube B breaks down, cutting tube C off, thereby permitting tube D to conduct and actuate the servomechanism. The amplification produced by tube D, in addition to providing the required signal level at the servomechanism, contributes also to the effectiveness of the electronic switching, and the resultant circuit is more compact and has a higher parts economy than produced by the use of a separate switch and amplifier.

Electronic circuitry is but one of the many facets of Ford Instrument design and development. Ford Instrument engineers work every day with control systems, using mechanics, electronics, hydraulics, electro-mechanics, magnetics, and atomics. If you have a problem in automatic control, Ford Instrument stands ready to help you.

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circuit voltage across an  $8\frac{1}{2}$  ma bolometer, for example, is about 3.5 volts. About 8 volts is required for burnout. The current requirement may be reduced at the expense of increasing the open-circuit voltage somewhat. Most bolometer amplifiers draw only about 10 to 15 ma and an additional 21-ma drain for the bias supply should not require

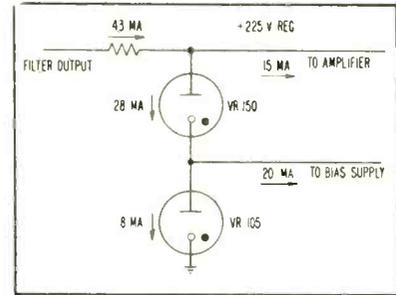


FIG. 2—Regulator circuit for bolometer bias supply

any significant changes in the power supply.

The bias supply should be fed from a power supply which is regulated, either electronically or by means of v-r tubes. The most suitable method is to use two v-r tubes in series in the main power supply with the bias supply tapped off one v-r tube as shown in Fig. 2. Current values are shown in the various branches.

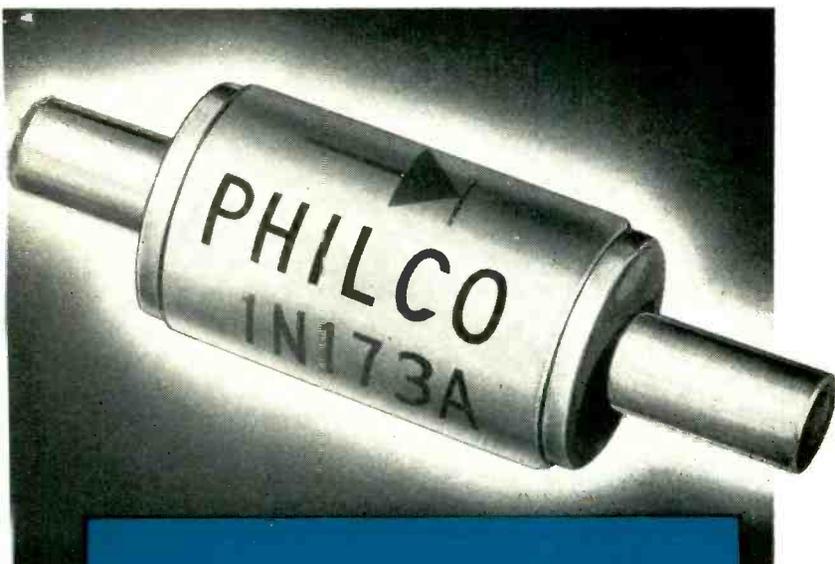
Other methods for providing the bias supply with regulated voltage are also suitable, but operating a separate v-r tube for the supply in parallel with v-r tubes in the main supply should be avoided, as difficulties may be encountered in igniting both tubes simultaneously.

It is advisable to build the entire bias supply in a shielded box. If this is impractical, it must be kept as far from stray fields as possible.

Several of these supplies have been built and have performed very satisfactorily with amplifiers having gains up to 25,000. There is no measurable increase in noise level when using the supplies, hence they should be suitable for use in amplifiers having considerably higher gain.

If  $i_u$  is the specified current drain of the supply, then

# A New UHF Mixer Diode *Specifically Designed* for UHF Tuners



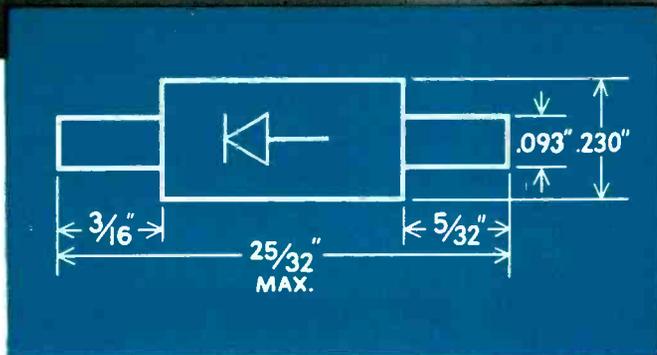
## *New* PHILCO 1N173A

Production of the Philco 1N173A Diode is a *special process!*

In dozen lots, or thousands, these mixer diodes have characteristics unexcelled in uniformity. Special Philco production and control techniques assure a new standard of dependable performance never before available in UHF mixer diodes.

Precise electric pulse "forming" welds the platinum alloy whisker wire and germanium crystal into a complete, integrated unit. Impregnated and sealed in a ceramic moisture-proof case, the Philco 1N173A maintains unusual stability regardless of shock, vibration or wide variations of temperature.

Design engineers find the exceptional uniformity of the Philco Mixer Diode the answer to high performance tuner operation over the entire UHF band. Exact impedance . . . low noise level . . . minimum Local Oscillator drive requirements . . . all the features that insure optimum performance are designed into the Philco 1N173A . . . and these diodes are available now! For complete information on the Philco 1N173A Mixer Diode write to Philco, Department E, today.



### FEATURES

- Low Noise Factor
- Low local oscillator drive requirements
- Stability over long life
- Uniformity of characteristics
- Rugged and compact mechanical construction

## PHILCO CORPORATION

GOVERNMENT AND INDUSTRIAL DIVISION • PHILADELPHIA 44, PENNSYLVANIA

In Canada: Philco Corporation of Canada Limited, Don Mills, Ontario



Consolidated announces the

# Evapor-ion

the first **dry** high-vacuum pump

## Consolidated Vacuum Corporation

announces a revolutionary new pump for producing high vacuum without organic or mercury fluids—the EVAPOR-ION—the only commercially available pump to create a “dry” vacuum in the pressure range from  $10^{-4}$  to  $10^{-9}$ mm Hg.

The EVAPOR-ION is the invention of Professor Ray Herb, Physics Department, University of Wisconsin. It is an electronically-operated device which entraps gas molecules through the combined application of metal evaporation and ion pumping, producing high pumping speeds, low ultimate pressures, and organic vapor-free operating conditions.

Consolidated has entered into a world-wide licensing agreement with the Wisconsin Alumni Research Foundation to manufacture and market the EVAPOR-ION pump—a pump that operates *without* organic or mercury fluids, *without* a jet assembly, and *without* continuous mechanical pump forepressure.

It needs no refrigerated traps or baffles (which inhibit maximum pumping speed) to produce low ultimate pressures of  $10^{-9}$ mm Hg.

The EVAPOR-ION pump is ideal for noncyclic vacuum systems like those of Van de Graaffs, synchrotrons, and other high-voltage particle accelerators. Its potential applications include the evacuation of electron power tubes, color TV tubes, large X-ray tubes, and mass spectrometers.

Now available for sale is Consolidated's type 3161-01 EVAPOR-ION pump (twelve-inch nominal diameter casing) having a speed for nitrogen of 2,000 liters per second and 3,000 liters per second for hydrogen.

For further information, write for your copy of Data Sheet No. 6-140.

Consolidated Vacuum Corporation, Rochester 3, New York (a subsidiary of Consolidated Engineering Corporation of Pasadena, California). Sales offices throughout the United States.

$$R_2 = \frac{V}{2} \left[ \frac{1}{i_u} - \frac{1}{i_B} + \sqrt{\left( \frac{1}{i_u} - \frac{1}{i_B} \right)^2 + \frac{4R_B}{i_u V}} \right]$$

$$R_3 = \frac{1}{3} \left[ \frac{V}{i_u} - R_2 \right]$$

$$R_1 = 2R_3$$

where

$V$  = regulated d-c voltage to the supply

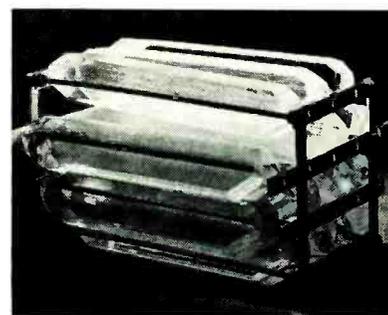
$i_B$  = maximum bolometer current required in amperes

$R_B$  = bolometer resistance in ohms

The open circuit voltage across a bolometer drawing the maximum current  $i_B$  is given by  $V_{oc} = R_B i_B$ . The actual open circuit voltage across any bolometer having a resistance  $R_B$  and drawing less than the maximum current will be lower than this and may be obtained by recalculating  $R_2$  (call this  $R_2'$ ) using for  $i_B$  the actual bolometer current ( $i_B'$ ) rather than the maximum current required from the supply. The actual open-circuit voltage across this bolometer will then be  $V_{oc}' = R_2' i_u$ . However this value ( $V_{oc}'$ ) is only used as a check; the circuit should be built using  $R_2$  not  $R_2'$ , so that currents up to the maximum current  $i_B$  may be obtained.

If for a given  $i_u$  the open circuit bolometer voltage  $V_{oc}'$  comes out too high, increase  $i_u$  and repeat the calculation. If  $V_{oc}'$  comes out very small then  $i_u$  may be reduced some-

## Synthetic Quartz Commercially Available



Synthetic quartz crystals of electronic grade like those above in autoclave rack can be grown free of twins and other defects. By controlling size, shape and orientation to some extent, reduction of material waste and processing man-hours can result in economies. Output from Brush Laboratories, previously reserved to the Signal Corps, is now available commercially



# "H-H long-life resistors"—the title earned by **FIELD EXPERIENCE**

The greatly increased protection made possible by the development of our high-temperature gray enamel is the most important improvement of these resistors, but it is not all. True, this enamel is thermo-shock-proof and crazeless; but in addition

#### THESE RESISTORS OFFER...

- **Stronger core** with higher resistance to vibration and shock.
- **Special alloy terminals** more securely fastened to the ceramic body by spot-welding — highly resistant to corrosion.

- **All wire connections** are protected by a positive non-corrosive bonding.

The fixed, the ferrule and the flat types are especially designed for and manufactured in accordance with MIL-R-26 specifications.



**HARDWICK, HINDLE, INC.** Rheostats and Resistors Newark 5, N. J. U. S. A.

# INSTRUMENTS INDUSTRY NEEDS

Hycon engineering skill and design keep pace with ever-changing industry, producing instruments that anticipate need—designed to simplify and speed production. Depend on Hycon for electronic testing equipment.

## MODEL 625 DIGITAL RATIO METER

Measures ratio of two DC voltages where one is derived from the other. Ratio is displayed on a three digit servo-positioned counter.

Provides a discreet indication of one part in a thousand. Slewing time is less than 4½ seconds full scale. The response is critically damped. **\$550.00**



## MODEL 615 DIGITAL VTVM

Ideal for production-line testing and the laboratory, this new VTVM gives direct readings, without interpolation. Features illuminated digital scale with decimal point and polarity sign... 12 ranges (AC, DC, ohms)... response with auxiliary probe to 250 mc... accuracy: 1% on DC and ohms; 2% on AC **FIELD RUGGEDNESS... LAB PRECISION \$374.50**

## MODEL 617 3" OSCILLOSCOPE

Designed both for color TV servicing and laboratory requirements. Features high deflection sensitivity (.01 v/in rms); 4.5 mc vertical bandpass, flat within ±1 db; internal 5% calibrating voltage. Small, lightweight... but accurate enough for the most exacting work.

**SPECIAL FLAT FACE 3" CRT PROVIDES UNDISTORTED TRACE EDGE TO EDGE \$269.50**



Write for catalog sheets and detailed specifications of any of the instruments shown above — or for complete list of Hycon field testing equipment.

# Hycon Mfg. Company

2961 East Colorado Street  
Pasadena 8, California

"Where accuracy counts"

ORDNANCE · ELECTRONIC TEST INSTRUMENTS  
ELECTRONIC SYSTEMS · AERIAL SURVEYS  
BASIC ELECTRONIC RESEARCH · AERIAL CAMERAS  
GO NO-30 MISSILE TEST SYSTEMS

what if necessary and the calculation repeated.

If it is desired to specify the open-circuit voltage initially rather than the current drain, then

$$R_2 = \frac{V \left[ \frac{V_{oc}}{i_B} - R_B \right]}{V - V_{oc}}$$

where  $V_{oc}'$  is the open circuit voltage across a bolometer drawing the maximum current.

The current drain required by this supply is then

$$i_u = \frac{V_{oc}}{R_2}$$

If  $i_u$  is too large,  $V_{oc}$  must be increased.

The open-circuit voltage  $V_{oc}'$  which will exist across any other bolometer used with this supply, drawing a current  $i_B'$ , is obtained as before from the product of  $R_2'$  and  $i_u$ .

The remaining parameters are calculated from  $R_2$  as before, or directly in terms of  $V_{oc}$  from

$$R_3 = \frac{R_2}{3} \left[ \frac{V}{V_{oc}} - 1 \right]$$

$$R_1 = 2R_3$$

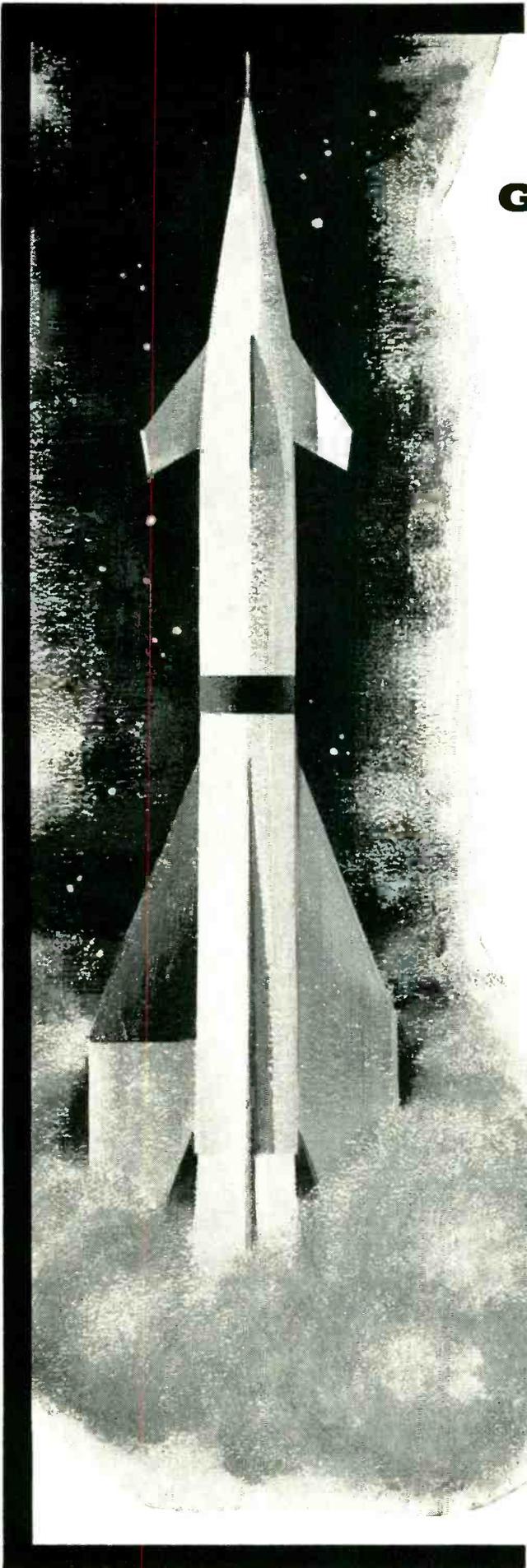
The actual values of  $R_1$ ,  $R_2$  and  $R_3$  calculated from the formulas will not be available in general as standard resistors. They may be changed to standard values if  $R_1 + R_2 + R_3$  is kept approximately the same. In addition  $R_2$  should not be made smaller than calculated, but the next larger standard size should be used.

## Defense-Emergency Radio Van

CIVIL DEFENSE authorities in the city of Newark, N. J. have recently acquired a route-van type truck to provide emergency mobile communications. The unit, designed and



Mobile van obtains power from generator on trailer or other source



## GOING UP!

...with Sylvania transformers sealed in "Scotchcast"

In a matter of seconds, rockets leave searing hot desert heat for freezing upper-atmosphere temperatures! That's one of the many reasons why Sylvania Electric Products, Inc., chose "SCOTCHCAST" for their new sealed-in-resin transformers used in many types of new military missiles and aircraft.

Wherever rigid military specifications call for insulated electrical components, one of the "SCOTCHCAST" Resins will do the job.

These epoxy-type resins, products of 3M Research, cure into a solid, shock-resistant, moisture-resistant insulation. And "SCOTCHCAST" sticks tight to most metals, plastics and conductors—is unaffected by acids, alkalis, solvents, oils and extremes of temperature.

A quick look at the features of these new Sylvania transformers shows many advantages gained by the use of "SCOTCHCAST":

- MIL-T-27 GRADE 1 CLASS A
- 100K-200K Megohms IR values after complete Mil-T-27 testing
- Dielectric Strength: 1500 V/Mil
- Extreme temperature range: -65°C to 110°C
- Reduced weight
- Good thermal properties
- High impact strength
- Versatile shapes and mountings
- Fungus proof
- Permanent hand-etched marking
- Non-inflammable
- Minimum space

For more information on what "SCOTCHCAST" Resins can do for *you*, write Minnesota Mining and Manufacturing Co., Dept. CA-105, St. Paul 6, Minn.

TRADEMARK  
**SCOTCHCAST**  
BRAND  
**RESIN**

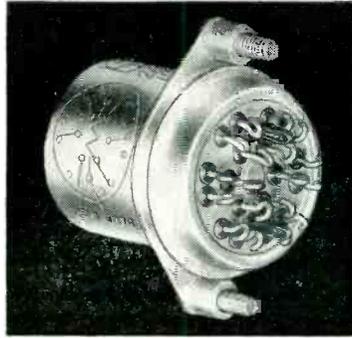


The term "SCOTCHCAST" is a registered trademark of Minnesota Mining and Manufacturing Co., St. Paul 6, Minn. Export Sales Office: 99 Park Ave., New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

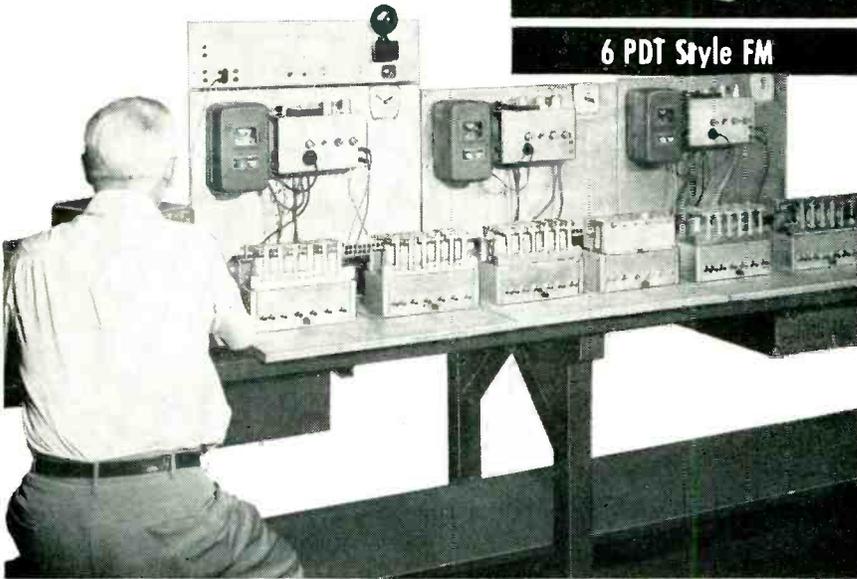


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to guarantee perfect performance



6 PDT Style FM



Here is a production run-in test at Union Switch & Signal of our miniature relay, with gold alloy contacts, for a specific dry circuit application. To guarantee utmost reliability for this application where contact resistance must remain below a specified value throughout a required life, these relays are subjected to thousands of operations under exact circuit conditions as prescribed by the customer. Only those relays which provide *perfect performance* are selected for shipment.

*For complete information, call our nearest sales representative listed below, or write for literature.*

GENERAL APPARATUS SALES

## UNION SWITCH & SIGNAL

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

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Interior of insulated van showing radio equipment. Rack of portable radiotelephone transmitter-receivers stowed at the upper left

built by Instruments for Industry, Inc. of Mineola, N. Y., is packed with radio equipment capable of operating on frequencies assigned to police, fire, taxi, amateur and other services.

In the event of any serious emergency, the unit can be used as a main communications station or can be dispatched to cover an outlying district from which telephone service has been cut off.

Antennas are mounted on the roof of the truck and power is supplied from the 10-kw gas-engine driven generator that is towed on a trailer. For fixed station use, a collapsible mast 50 feet high extends coverage.

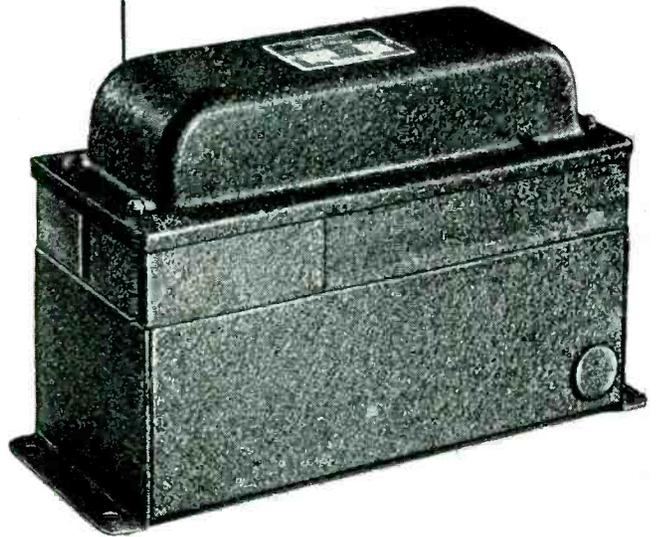
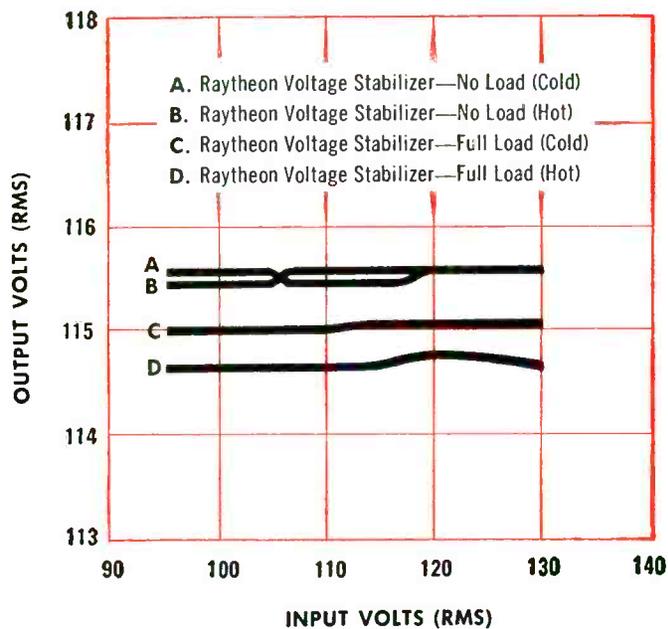
### Tank Capacitor Energy Storage

LARGE QUANTITIES of energy for short time periods are conveniently obtained from energy storage capacitors that are charged to a relatively high voltage and discharged through the required load.

Such capacitors must have minimum internal inductance and resistance. Low-loss, low-inductance capacitors are likewise used in high-power radio-frequency generators.

The capacitor illustrated has been developed by Tobe Deutschmann Corp. for experimental applications in the field of nuclear research. It has an inductance of less than 0.08 microhenry and internal resistance corresponding to a Q in excess of 1,000. Electrical rating is 0.12 mi-

## Output vs. Input Voltage



## Why Raytheon Voltage Stabilizers mean satisfied customers for you

When you incorporate a Raytheon Voltage Stabilizer in your equipment, you help assure complete customer satisfaction—for these important reasons:

1. Your equipment will operate as it was designed to, regardless of voltage variations of your customers' electrical source.
2. Since most components have maximum life when operating at their designed voltage, a Raytheon Voltage Stabilizer prolongs the life of components—and your equipment. A plus feature is provided by the short-circuit protection inherent in Raytheon Voltage Stabilizers.
3. Because Raytheon Voltage Stabilizers are superior to any other static type stabilizer under virtually all operating conditions, your equipment will work better and longer—characteristics your customers really appreciate.

### Check these important points of Raytheon

#### Voltage Stabilizer superiority

Raytheon Model VR-6113 (120 watts) chosen at random and compared with a similarly rated competitive model.

- Guaranteed to deliver accurate AC voltage within  $\pm\frac{1}{2}\%$  (competitive model 1%)
- 14% lighter, 22% smaller
- Three times more accurate no-load to full-load regulation
- 17% less change in voltage output as frequency varies
- 28% closer regulation as temperature changes

For full information see your electronic supply house  
or write Dept. 6120

**RAYTHEON MANUFACTURING COMPANY**

Equipment Marketing Division, Waltham 54, Mass.



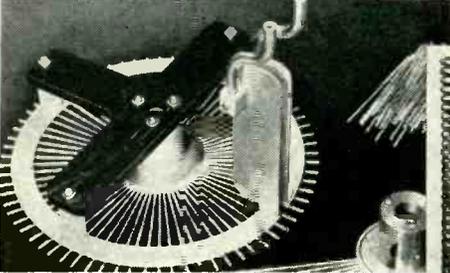
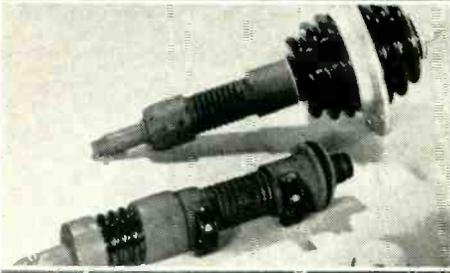
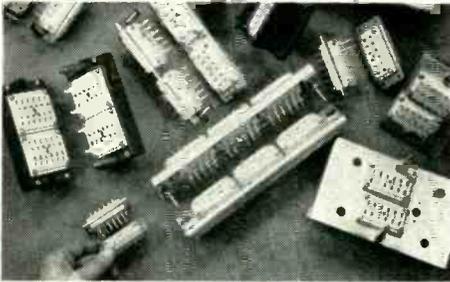
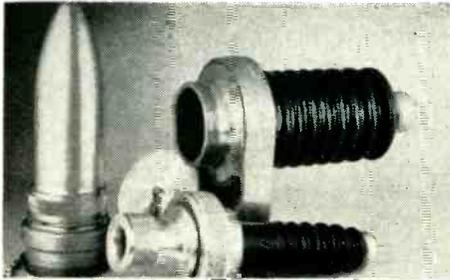
*Excellence in Electronics*

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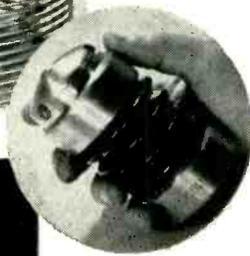
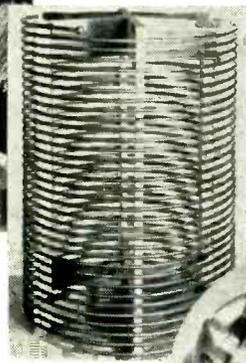
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From the earliest day of radio and radio-frequency circuits, Lapp has pioneered the application of electrical porcelain and steatite to the special requirements of this industry. Today, "Radio Specialties" identifies a large and efficient department at Lapp where hundreds of parts for hundreds of specialized requirements have been designed and built. We welcome the opportunity to help you—in design and production—with your requirements for insulating parts and associated sub-assemblies. Write Lapp Insulator Co., Inc., Radio Specialties Division, 242 Sumner Street, Le Roy, N. Y.



**Lapp**



Low-inductance energy storage capacitor rated at 0.117 uf at 50 kv peak is 2 feet high with a diameter of 3 feet

crofarad at 50 kv peak with an allowable r-f current up to 40,000 amperes.

### Balloons Gather Lightning Information

NINE balloon flights to altitudes between 60,000 and 100,000 feet will be launched in central Florida by Air Research and Development Command to study electrical charges set up by thunderstorms.

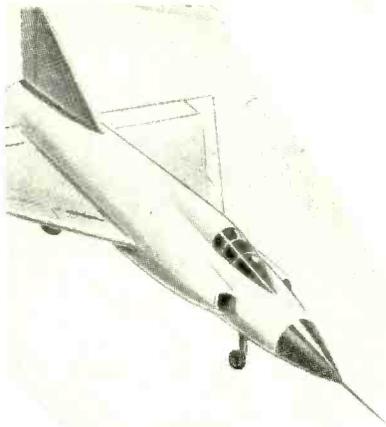
The balloons are designed to float horizontally at a specified altitude where instruments will measure the electrical field and currents caused by lightning discharges. The information is telemetered to the ground where it is to be evaluated as to its effect on weather and communications.

Radar stations at Patrick AFB and Pinecastle AFB will check height and position of thunderclouds and will likewise track the balloons in flight.

### Interior Dept. Uses Underwater TV



Inquisitive fish snooping around shrimp trap are picked up by underwater television camera and their likenesses are displayed on a monitor screen. U. S. Fish and Wildlife Service has an RCA closed-circuit system for observations at 60 feet below the surface



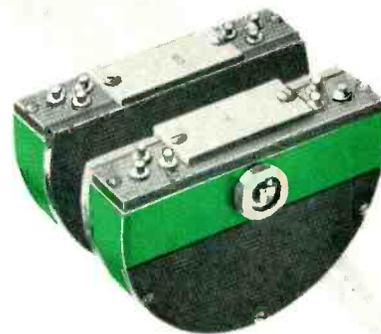
Need a special potentiometer design? Our engineers are specialists in designing sub-miniature potentiometers, sector and open card winding potentiometers, and other combinations of special factors and functions. As the leader in standard precision potentiometer production, Fairchild has all the advanced techniques and facilities to give you fast service on both test models and production runs of potentiometers built to your exacting requirements.

## **SPECIAL POTENTIOMETERS** for your special needs

This is a special sector potentiometer. It came into being when the Eclipse-Pioneer Division of the Bendix Aviation Corporation needed a potentiometer with gear drive to mount within limited space in the altitude compensator of their Beam Guidance System. Excessive torque would cause inaccurate readings and result in unsatisfactory operation of the system, so a potentiometer with minimum torque was necessary. Since space limitations dictated an unusual configuration, our engineers worked with Eclipse-Pioneer engineers to develop this special design. The critical torque requirements of 0.075 oz.-in. on a 4 gang unit were met by specially designed wipers, windings, and slip rings. This same constructive cooperation can help you when you need a special or a standard potentiometer. So, call Fairchild first. Potentiometer Division, Fairchild Controls Corp., a subsidiary of Fairchild Camera & Instrument Corp., 225 Park Ave., Hicksville, N. Y., Dept. 140-67A.

**EAST COAST**  
225 Park Avenue  
Hicksville, L. I., N. Y.

**WEST COAST**  
6111 E. Washington Blvd.  
Los Angeles, Cal.



**FAIRCHILD**  
PRECISION POTENTIOMETERS

## Silvering Ends of Resistors with ConveyORIZED Painting Setup

BANDS of silver are automatically applied to the ends of deposited carbon resistor bodies by a mechanized production setup engineered and constructed in the Kansas City plant of Electra Mfg. Co. Capacity is several thousand units per hour, which is about six times more than was obtained previously with a manual silvering operation.

Resistor bodies are dumped into the hopper of a Syntron feeder, for feeding end-to-end down a length of copper tubing to the painting machine. Here the resistor bodies are rotated while in contact with rubber ink-transferring wheels run-

ning in silver solution, for applying a silver band in accurately predetermined width to the body of the resistor at each end.

After coating, the resistor bodies drop between sprockets of a conveyor chain so designed that the resistors are supported only in their uncoated central areas. The chain conveyor takes the resistors through a baking oven that provides the required firing temperature.

Automatic silvering machine setup. Baking oven is at lower right. Caps with attached axial leads are pressed over resistor ends after firing



## Constant-Tension Automatic Wire-Twisting Machine

A SIMPLE, completely automatic wire-twisting machine that reduces work time by approximately two-thirds over previous manual methods has been developed by Ford Instrument Co. for prototype and

production wiring on complex electronic instruments. It can be run safely by an unskilled operator without sacrificing uniform quality.

With a few minor adjustments the machine can twist doubles,

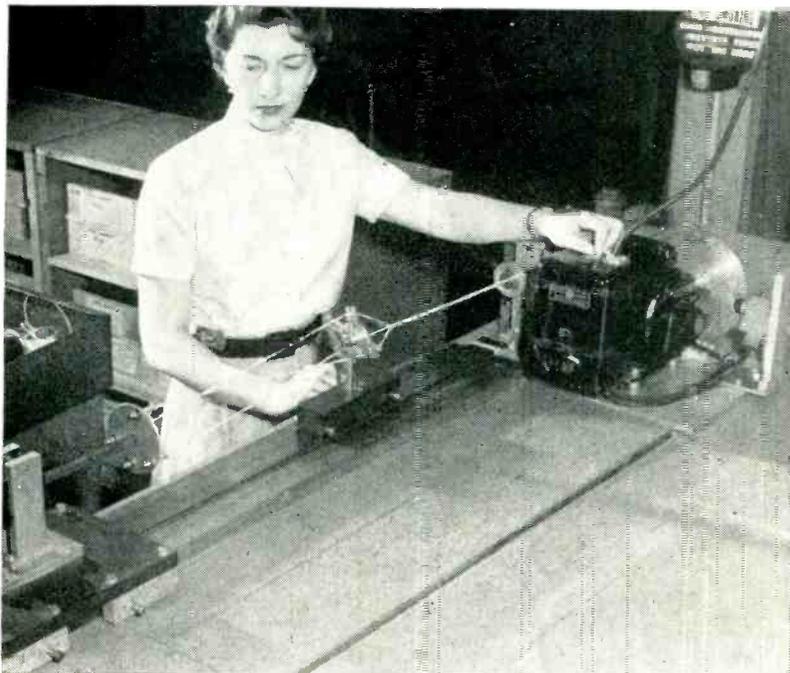
triples, or more if necessary, by employing friction drags that automatically compensate for the constantly decreasing length of wire and the increased load.

The operator secures one end of the wires to a rotation head. Geared to this head is a large dial calibrated in feet. The dial is set for the exact length of wires to be twisted.

A tension device locked to the track at the desired length holds the wires at the opposite end in swivels which remove the individual spin in each wire as the twisting is being performed. The plate upon which the swivels are mounted is supported by a long rod.

The rod possesses a variable friction which automatically compensates for the shortening as the wires twist and prevents any stretching of the wires.

The operator's only remaining function is to press a switch atop an electric motor, starting the machine. A four-wheeled trolley with a wire guide affixed to it then travels along a 30-foot-long steel track from power supplied by the



Machine setup for twisting three wires together with uniform pitch

# *tunes* UP TIRED ASSEMBLY LINES



"44" RESIN, "RESIN-FIVE" and PLASTIC ROSIN—  
Kester Flux Core Solders belong at the very top  
of the solder hit parade when it comes to quality,  
speed, uniformity and economy. An unbroken rec-  
ord of dependability is what makes Kester a sure-  
fire "cure" for lagging production. Better switch  
now to Kester . . . a real production record maker!

WRITE TODAY for Kester's New 78-  
Page Informative Textbook, "SOLDER...  
Its Fundamentals and Usage."



# KESTER SOLDER

COMPANY 4204 Wrightwood Avenue, Chicago 39, Illinois; Newark 5, N. J.; Brantford, Canada

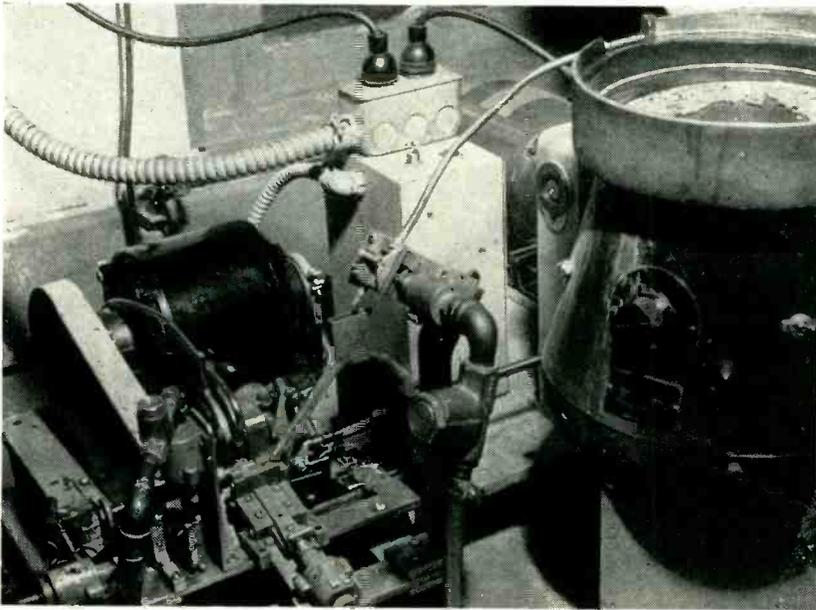
twisting action. When leads are completely twisted, a pin mounted on the dial trips a snap-action

switch, instantly and automatically stopping the operation.

One advantage of such complete

starting and stopping control is a fixed number of turns per foot throughout the length of wire.

## Resistor-Spiraling Machine is Completely Automatic



Mechanized setup for bringing deposited carbon resistor bodies to specified value within 1-percent tolerance by spiraling. Associated control equipment is in separate cabinet under bench. Operator merely dumps resistor bodies into hopper of feeder at right and removes tray of finished resistors under machine

DEPOSITED carbon resistor bodies dumped into the hopper of a Syntron feeder are automatically spiraled to desired value within 1-percent tolerance on a mechanized setup developed by the engineering

department of Electra Mfg. Co., Kansas City, Missouri. The production rate is several-hundred resistors per hour. The operator merely dumps a batch of resistors into the hopper and empties the

tote tray as it becomes filled with spiraled resistors. The blanks used on this machine are previously sorted to a 2½-percent tolerance range to insure that they can be spiraled up to the desired precision value.

The vibratory feeder pushes resistor bodies end to end down a length of copper tubing to a gate controlled by an air cylinder. When a resistor has been spiraled to value and dropped into the tote box, this gate opens to release one resistor body into a funnel soldered to another short length of tubing. This brings the resistor into the insulated jaws of a miniature lathe. The jaws grip the resistor by its silver bands for measuring its value continuously during rotation by an electric motor drive. Sequenced air cylinders then bring a rotating cutter wheel against a resistor body and move the wheel longitudinally while the resistor rotates, to produce a spiral that serves to increase the electrical value of the resistor. When the desired value is reached, the measuring circuit withdraws the cutting wheel and opens the contact jaws.

## Assembly Fixture for Ganged Precision Potentiometers



Placing third section on multigang potentiometer being assembled on phasing fixture having large calibrated dial

TO ACHIEVE the required precision of phasing when assembling two or more precision potentiometers on a common shaft, a combination assembly and checking fixture is used in Fairchild's Hicksville, N. Y. plant. The front plate is inserted first and clamped in position by tightening a knurled knob. The angle-checking plate of the fixture is then tightened with the next lower knob. A collet is tightened over the potentiometer shaft with the lowest knob of the fixture.

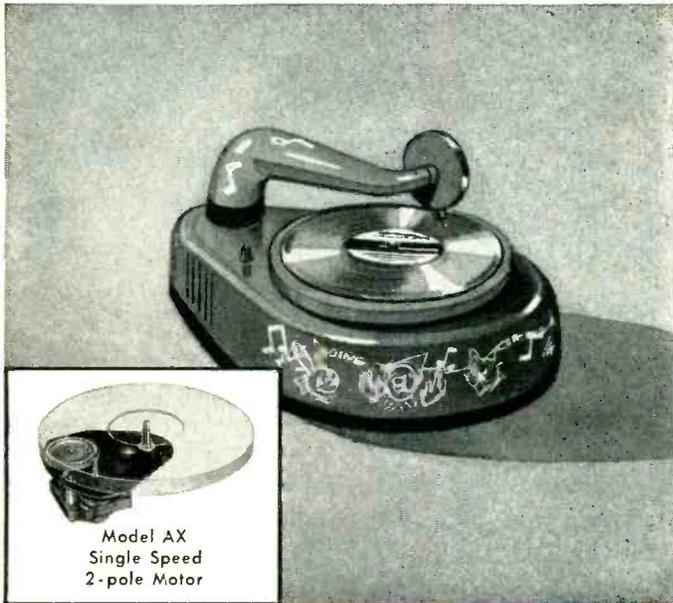
The first potentiometer element is now indexed by connecting to its

terminals an indicator circuit that includes a 6-inch precision 100,000-ohm master potentiometer and a cathode-ray indicator. For a linear winding, the master is usually preset at its midpoint. The locking knob for the angle plate on the fixture is then loosened and the plate is rotated to null out the scope.

The master and the pot under test form two legs of a d-c resistance bridge, with a Waterman S-11A pocketoscope connected between the wipers of the two pots. The d-c voltage applied to the bridge is 45 volts.

The combination of the three

From nursery phonographs . . . to hi-fidelity units



Model AX  
Single Speed  
2-pole Motor



Models DDS  
3-speed, 4-pole motor

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World's only complete line . . . one convenient source for *every* phonomotor need — that's GI! No matter what the application: portables . . . Hi-Fi (2 and 4 pole motors) . . . combinations . . . record changers . . . tape and disc recorders . . . GI has the right motor for the job. First choice of leading original equipment manufac-

turers, first choice for replacement, GI motors through the years have won a reputation for quality and dependability that is unsurpassed anywhere. Write today for a complete catalog giving descriptions and specifications of phonomotors in the famous GI "Smooth Power" Line.



Model DR  
2-speed,  
4-pole motor



Model SS  
3-speed,  
2-pole motor



Model RM4  
Single speed,  
4-pole motor

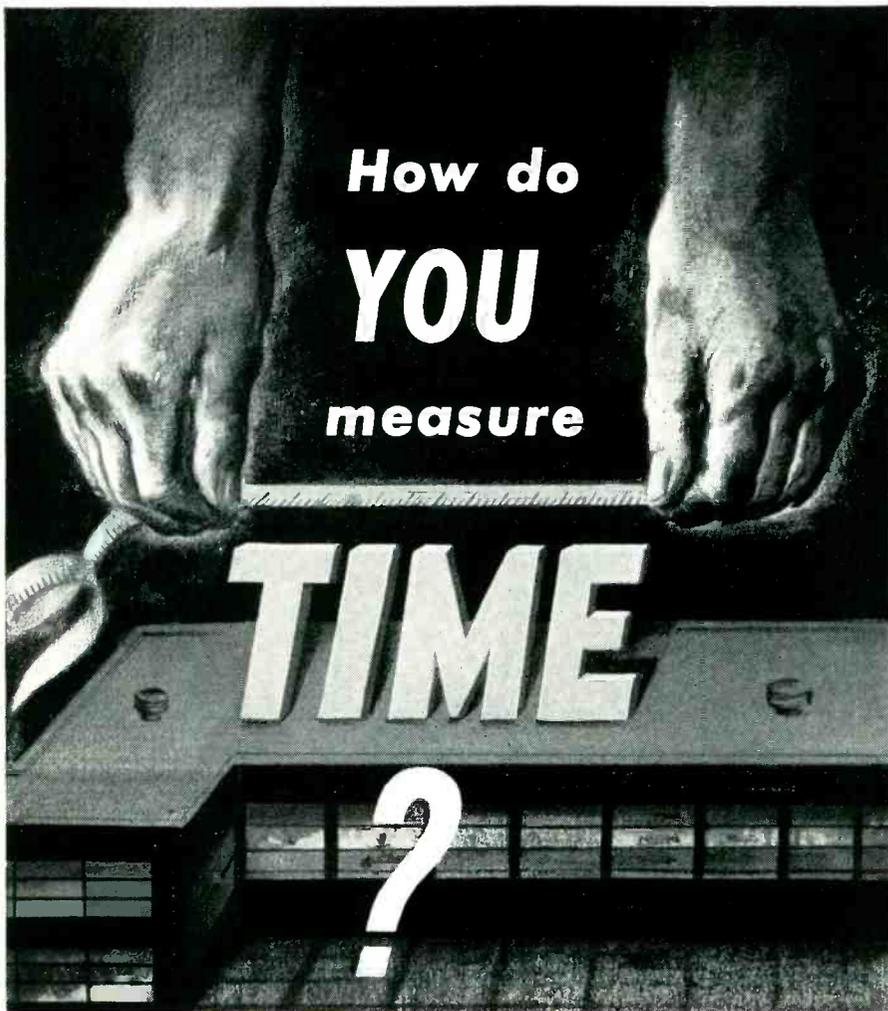


Model D-10 — 4-pole,  
shaded pole AC Induction  
type for tape,  
wire or disc recorders.



THE GENERAL INDUSTRIES CO.

DEPARTMENT GA • ELYRIA, OHIO



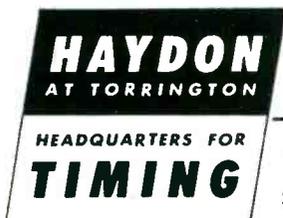
If your business involves measuring time in hours, minutes or seconds, you know that there are other, equally important standards of measure for Time and Timing. Check your present Timing sources; how do they measure up in terms of —

**QUALITY?** — Remember that HAYDON\* has the complete, up-to-the-minute research and manufacturing facilities, the long experience and the skilled personnel essential to producing Timing Motors and Devices of the highest uniform quality and the most advanced design.

**COMPLETE SERVICE?** — Ready to serve you for all your timing needs, HAYDON has the complete, fully integrated engineering and manufacturing facilities to take your timing projects from design and development through to finished product . . . economically manufactured in small or large lots to meet your requirements.

**TRAINED REPRESENTATIVES?** — Making all of these facilities and services conveniently available to you are HAYDON's Field Engineers. Each of these men is a Timing Specialist . . . fully qualified by training and experience to help fill your timing needs. There is one of these Specialists in your area. Why not phone him today and make an appointment to discuss your requirements!

\*Trademark Reg. U.S. Patent Office



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**HAYDON Manufacturing Company, Inc.**  
2434 ELM STREET, TORRINGTON, CONNECTICUT



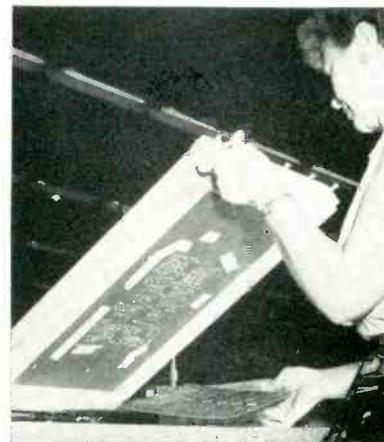
Removing assembled three-gang potentiometer from fixture

locking knobs and the angle plate permits setting each section in turn so that the 50-percent points are in phase. Connections are made to each section in turn during the assembly process.

After phasing a section, a switch is thrown to give a horizontal-line indication on the scope and the potentiometer is rotated while watching for grass on the pattern or loss of contact.

### Stencilled Symbols Aid Assembly on Etched Wiring Boards

THE TIME required to bring a new moving-conveyor assembly line up to speed was greatly reduced in Westinghouse's Metuchen, N. J. plant by screen-printing an identifying number on each lead hole in the seven-tube etched wiring board and using similarly printed sche-



Hinged silk-screen frame used for applying numbers and component symbols to back of etched wiring board

# PERFORMANCE IS BUILT INTO THIS CHOPPER



Painted case resists corrosion and is hermetically sealed to the base so that this chopper operates reliably in any atmosphere from sea level to 50,000 feet.



Permanent magnet polarizes switching to provide phase sensitive mechanical modulation of low-level signals.



Drive coil is conservatively rated for 6.3 volts RMS  $\pm$  10% at 400 CPS  $\pm$  5%.



Vibrating reed is resonant well above operating frequency to assure that switching phase of 65 degrees remains within  $\pm$  15 degrees for all operating conditions.



Buffer plate counteracts any tendency to chatter at make and break.



Ceramic insulators provide at least 100 megohms between contacts and case for use in high-impedance circuits.



Wiping action on fixed contacts, as in all Airpax choppers, help assure rated life of 2,000 hours.



Miniature 7-pin tube-type base rigidly supports internal assembly of this Airpax Type 300 chopper so that it withstands shock and vibration.

For complete specifications write to



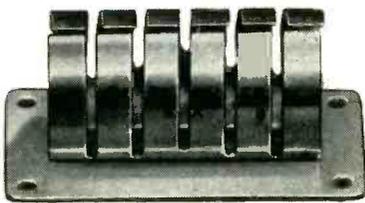
MIDDLE RIVER

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**BIRTCHER  
 KOOL KLAMPS**



Now available in sizes to fit all miniature and sub-miniature tubes and components. Manufactured in a variety of designs to meet any chassis mounting requirement. Made of 99½% pure tempered silver Kool Klamps can reduce bulb temperatures by as much as 40°C under certain conditions. Write for Kool Klamp catalog.

**BIRTCHER  
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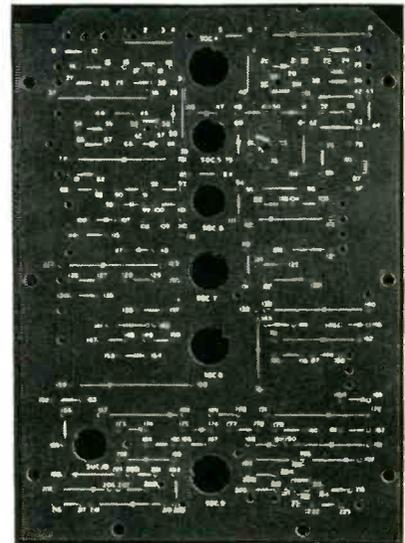
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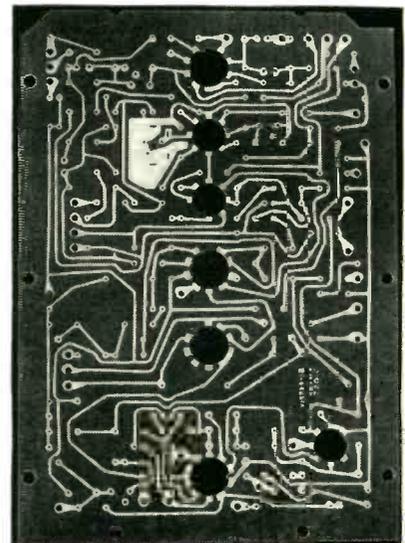
matic symbols and lines to connect pairs of holes for each component.

A sample board was prepared for each station on the line, containing only the components to be inserted there. The corresponding typed instructions were fastened over the board with rubber bands in such a way that the area there being loaded was not hidden. A typical assignment for one station involved inserting three bare jumper wires, one paper capacitor, three disk capacitors, two resistors and a ceramic filter plate.

The components are kept in dispenser bins supported in front of each operator by a metal frame. Cardboard cylinders with reinforced



Screen-printed pattern used as training aid on top side of etched wiring board

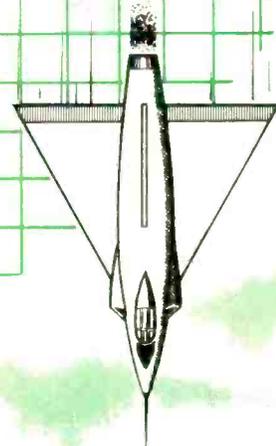
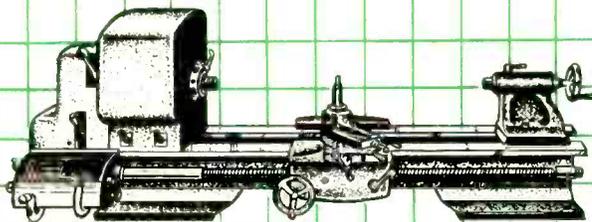


Bottom of same board, showing etched wiring pattern used for audio and sync stages of new Westinghouse tv receiver

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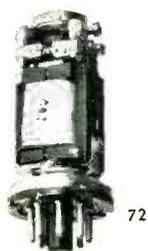


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41st and Sheridan Road

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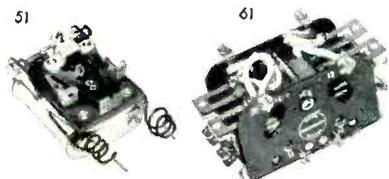
# SIGMA SENSITIVE RELAYS



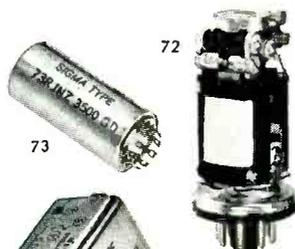
HIGH SPEED RELAYS



LOW COST POLAR RELAY



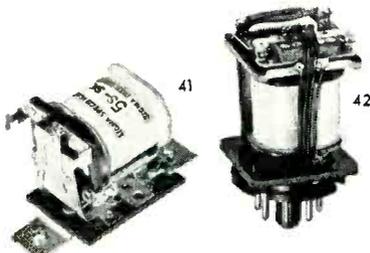
25 AMPERE SENSITIVE CONTACTORS



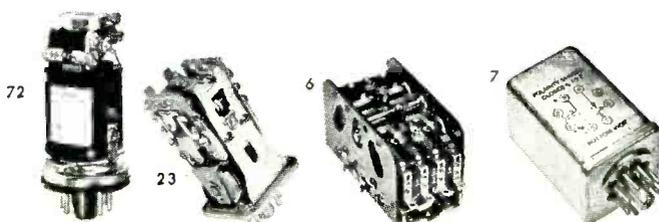
MISSILE RELAYS



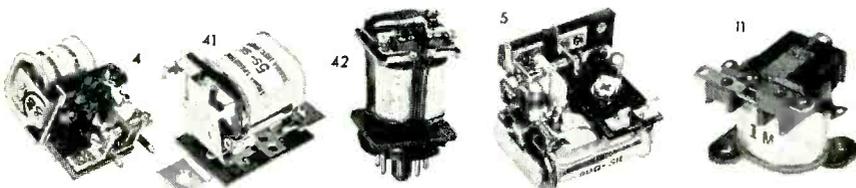
MINIATURE SENSITIVE, GENERAL PURPOSE DC RELAYS



SENSITIVE, LOW COST AC RELAYS



NULL-SEEKING RELAYS

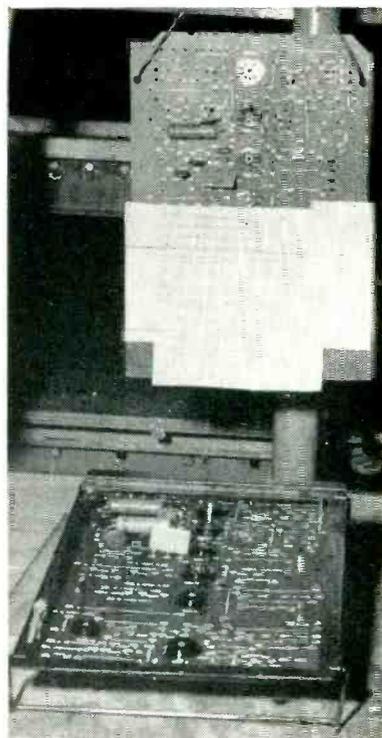


GENERAL PURPOSE SENSITIVE DC RELAYS

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Numbers indicate Sigma Relay Series

**SIGMA INSTRUMENTS, Inc.**  
62 Pearl Street, So. Braintree, Boston 85, Mass.



Sample board and instructions for inserting ten items at typical work position on belt conveyor line. Jaw of alligator clip is inserted through hole in metal pallet and board to lock board in position

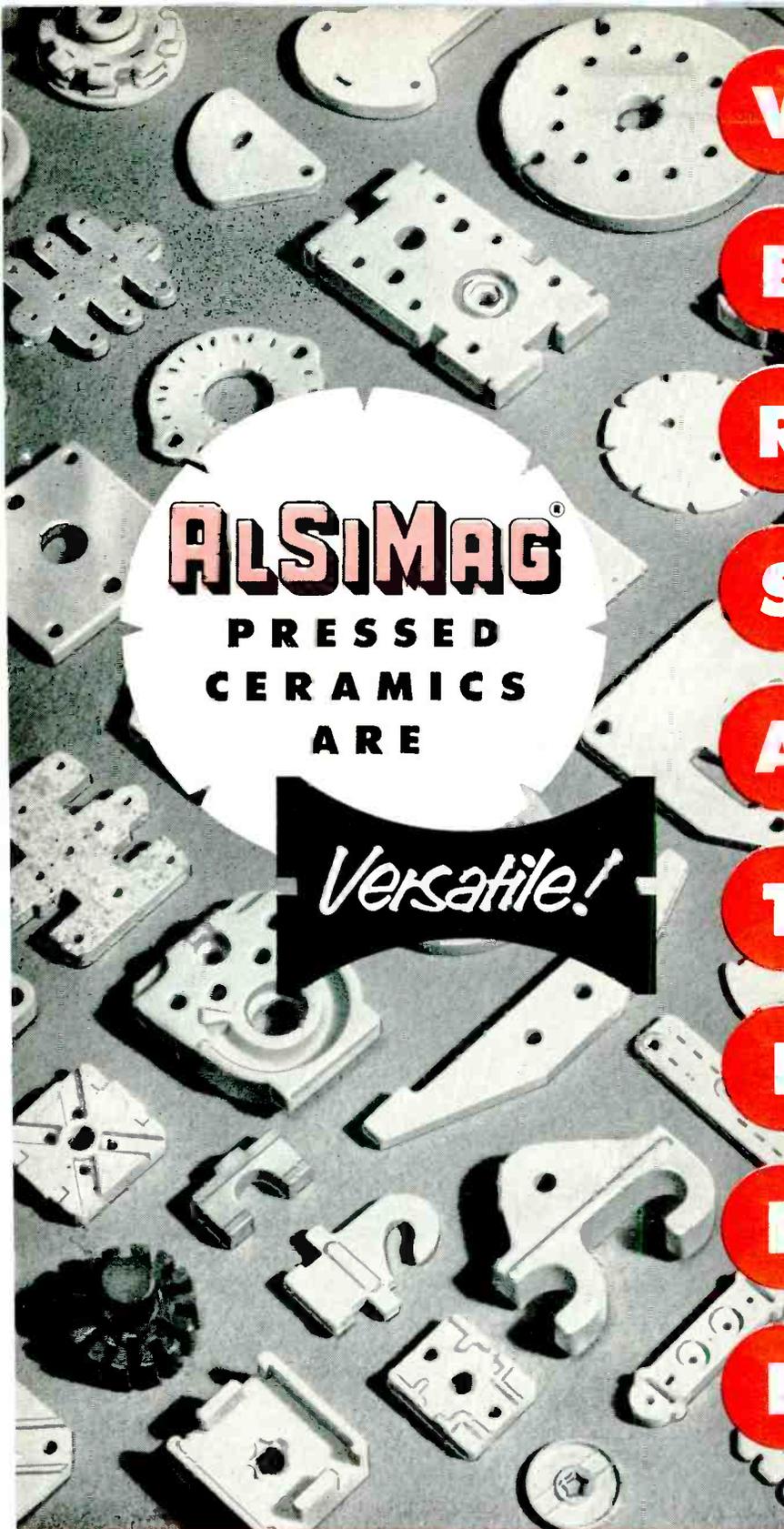
metal tops and bottoms serve as the storage bins for the dispensers. The cylinders are held by spring clips, for easy replacement when empty.

When the variety of components required at a station calls for more than six bins, they are arranged in two tiers on a hinged frame. This frame is swung out for replacement of cylinders in the rear row, which are there supported by backward-facing spring clips.

Components are cut and formed in a preparation area before being



Typical work position on line, showing method of holding cardboard storage cylinders in dispenser bins. Boards are dip soldered without clinching leads



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# Shallcross

for precision resistors

SINCE 1929

## AKRA-OHM Precision Wirewounds



Bulletin L-35

High-quality, yet moderately-priced precision resistors suitable for the majority of applications. Reverse-pi wound on accurately-machined ceramic bobbins. Coated, if desired, with moisture-resistant varnish. Std. tolerance—1%, 0.5%, 0.25%, 0.1%, and 0.05%. Meets MIL-R-93A. Five mounting styles available.

## "P" TYPE Encapsulated Wirewounds



Bulletin L-30

Small, hermetically-sealed resistors at a truly low price. Unmatched stability for critical applications. Std. tolerance—same as Akra-Ohm types above. Meet and exceed MIL-R-93A requirements including salt water immersion tests. Radial leads, axial leads, or lug type terminals.

## DEPOSITED CARBON Precision Resistors



Bulletin L-33

These small carbon-film resistors achieve exceptional stability through deposition of a uniform, uncontaminated film of carbon on a ceramic core. Temperature coefficient: 500 ppm per °C above 1 meg., 300 ppm per °C below 1 meg. Std. tolerance—1%, 2%, and 5%. Meet characteristic R of MIL-R-10509A. 1/2, 1, and 2 watt sizes.

## CASTOHM® Ceramic Power Resistors



Bulletin L-29

Unusually light-weight wirewound power resistors with a unique integral core and coating having exceptional resistance to thermal shock and excellent heat conductivity. Ten humidity-resistant, tab-terminal styles available with ratings from 8 to 225 watts at 350°C. hot-spot. Meet MIL-R-10566, Amendment 1.

## CMP and MP Miniature Power Wirewounds



Bulletin L-36

Lead-mounting, miniature power wirewounds for crowded chassis or printed circuits. MP types enclosed in a Fiberglas sleeve and coated with silicone-impregnated ceramic. CMP types encased in ceramic tube with ends hermetically sealed with silicone cement. Designed to MIL-R-26B. 3 to 10 watt sizes available.

## SPECIALS . . . . .



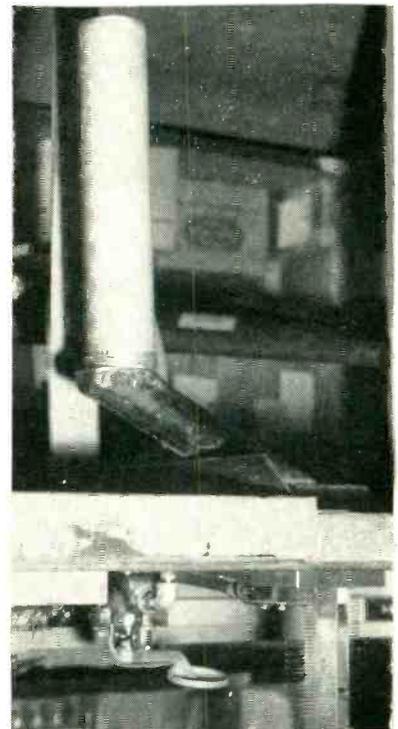
Bulletin L-37

Hermetically-sealed Steatite resistors, Ayrton-Perry resistors, high-voltage surge resistors, card-type resistors, multi-section bobbin resistors, and many other special types are regularly produced to individual specifications.

SHALLCROSS MANUFACTURING CO., 522 Pusey Ave., Collingdale, Pa.



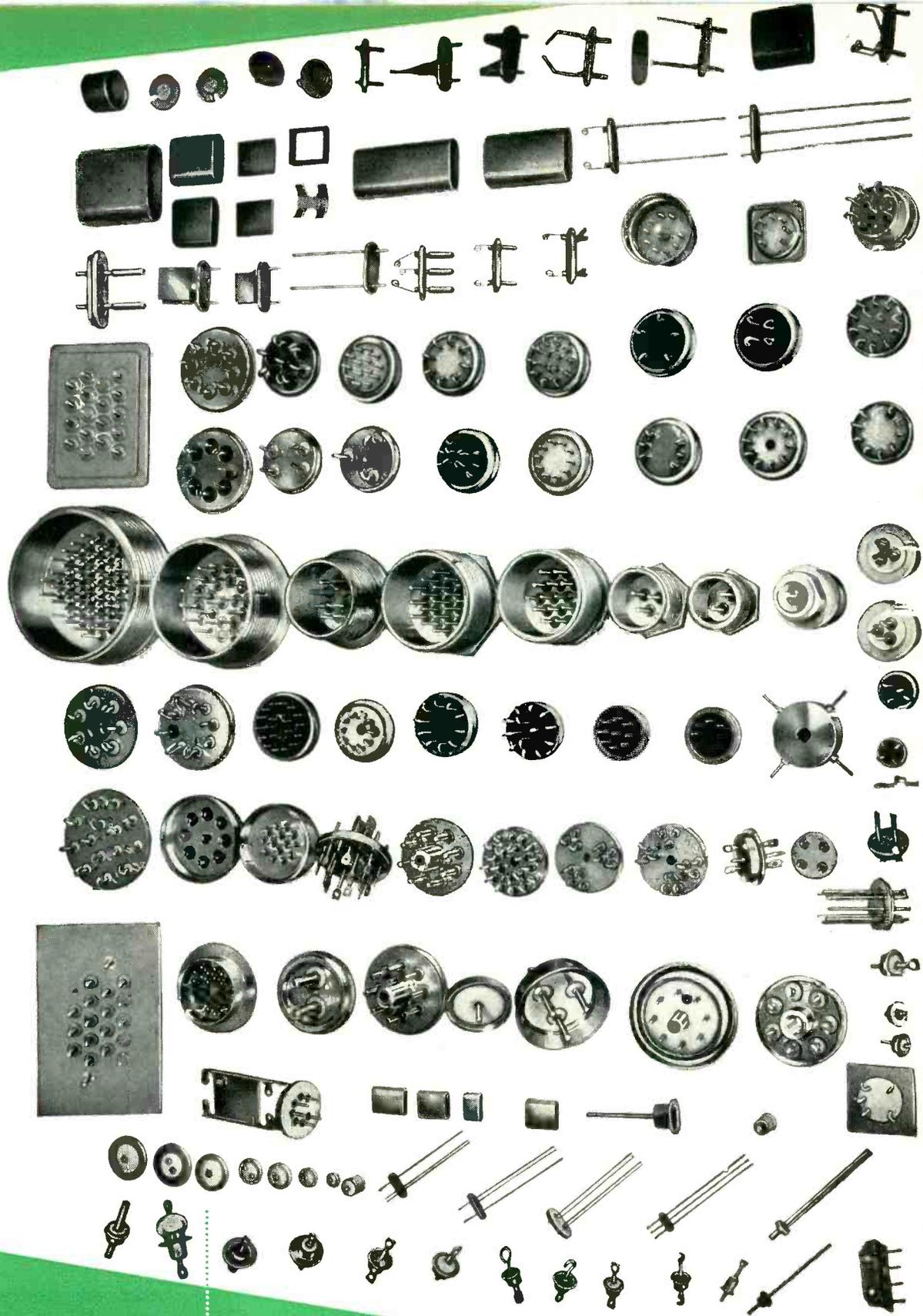
Method of swinging out dispenser frame for replacing cardboard cylinders in rear row. Hand is held over full cylinder as shown when placing in rack



Air-operated setup for cutting and forming resistor leads. Formed components drop down chute into cardboard cylinder. When filled, cylinder is unscrewed and taken directly to assembly line for use in dispenser bins

brought to the assembly line. Some of the semiautomatic machines used for this purpose feed the prepared components down a chute directly into the component storage cylinders. The threaded metal cap for the cylinder is soldered to the end of the chute after its top is cut out, to serve as a support for a cylinder during loading.

The etched wiring boards are supported in metal pallets having heavy wire legs that fit into drilled holes in a plain plywood pallet that rides on the belt conveyor. Each



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SIMPLIFY CIRCUIT TRIMMING *with*

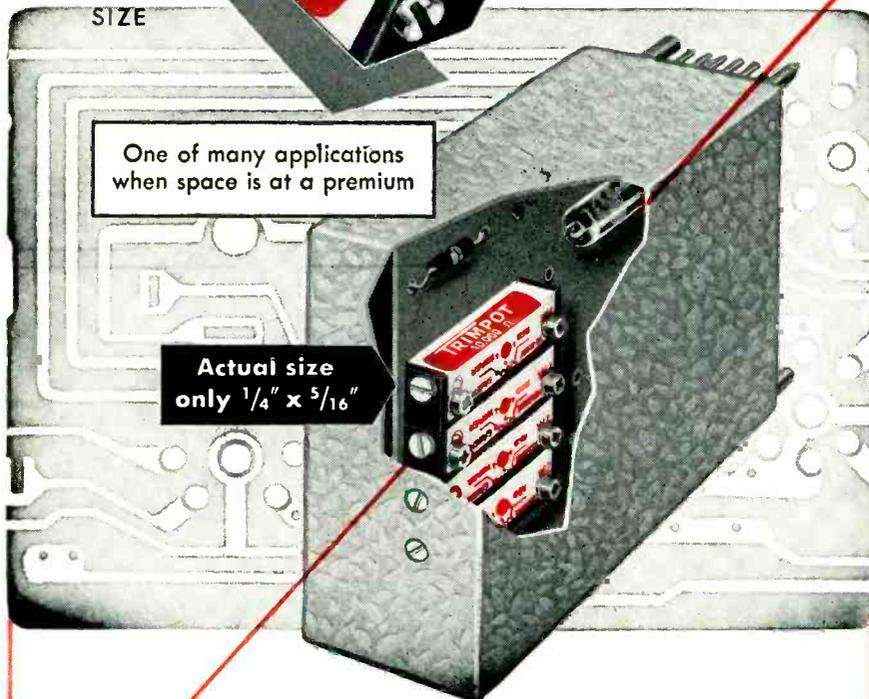
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*sub-miniature*

**TRIMPOTS**

TRADE MARK

3 TIMES  
ACTUAL  
SIZE



One of many applications when space is at a premium

Actual size only 1/4" x 5/16"

- **RESOLUTION: AS LOW AS 0.25%**
- **POWER RATING: 0.25 WATT AT 100° F.**
- **WEIGHT: ONLY 0.1 OZ.**

BOURNS TRIMPOT is a 25 turn, fully adjustable wire-wound potentiometer, designed and manufactured exclusively by BOURNS LABORATORIES. This rugged, precision instrument, developed expressly for trimming or balancing electrical circuits in miniaturized equipment, is accepted as a standard component by aircraft and missile manufacturers and major industrial organizations.

Accurate electrical adjustments are easily made by turning the exposed slotted shaft with a screw driver. Self-locking feature of the shaft eliminates awkward lock-nuts. Electrical settings are securely maintained during vibration of 20 G's up to 2,000 cps or sustained acceleration of 100 G's. BOURNS TRIMPOTS may be mounted individually or in stacked assemblies with two standard screws through the body eyelets. Immediate delivery is available in standard resistance values from 10 ohms to 20,000 ohms. BOURNS TRIMPOTS can also be furnished with various modifications including dual outputs, special resistances and extended shafts.

*BOURNS also manufactures precision potentiometers to measure Linear Motion; Gage, Absolute, and Differential Pressure and Acceleration*



**BOURNS LABORATORIES**

6135 MAGNOLIA AVENUE, RIVERSIDE, CALIFORNIA

Technical Bulletin On Request, Dept. 12

● B. L. PATENTS PENDING

plywood pallet holds two wiring boards. The plywood pallets stabilize the wiring boards during assembly on the moving-conveyor line.

**Sorting Silvered Resistors**

AFTER silver terminal bands have been applied to deposited carbon resistor bodies and fired, the resistors are automatically sorted according to value by special mechanized setups engineered and developed by Electra Mfg. Co. for use in its own Kansas City, Mo. plant. The resistors are sorted into plus or minus 2½ percent ranges in preparation for spiraling to still

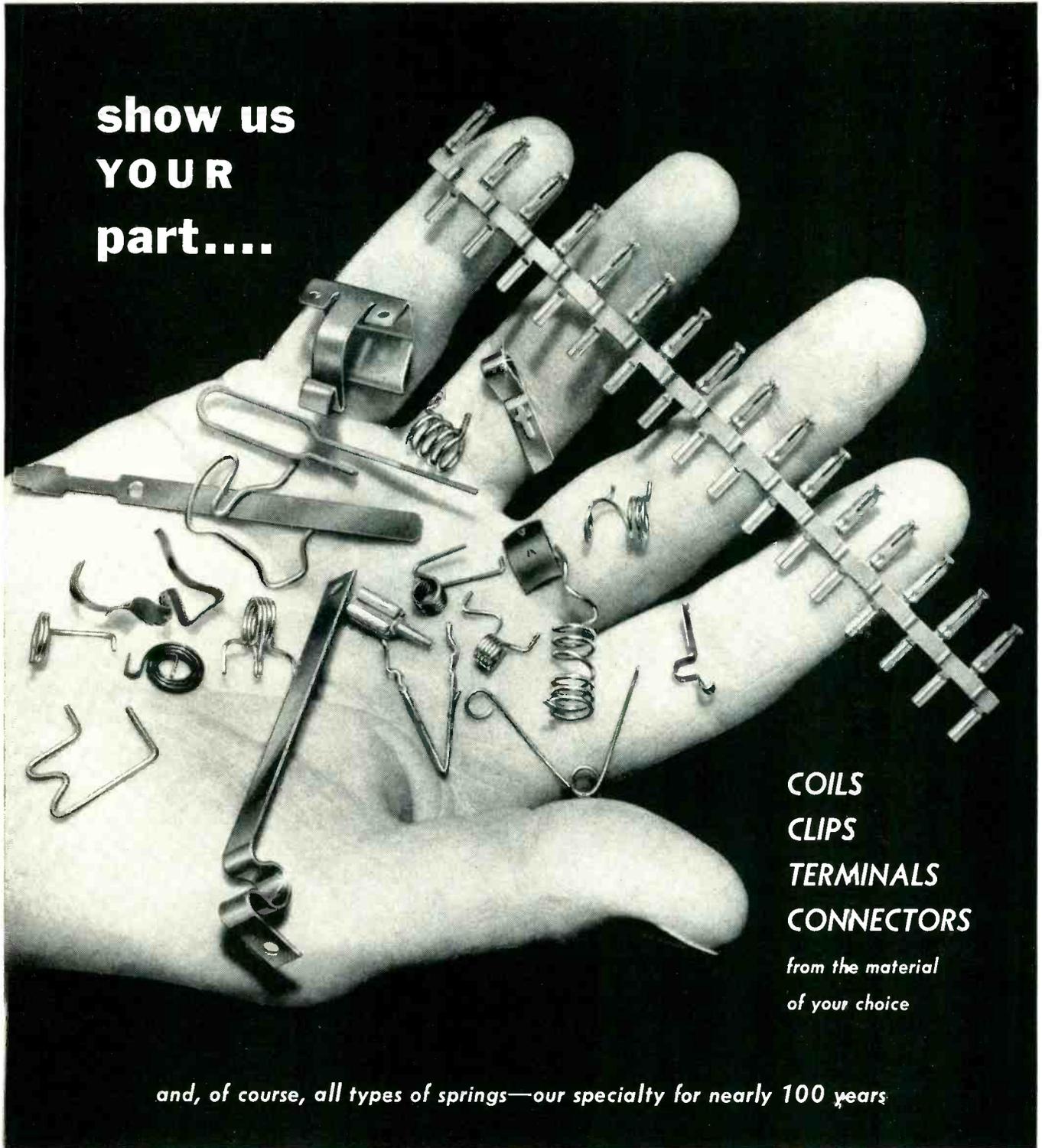


Mechanized setups for sorting silvered resistors into twelve value ranges

more precise values on other machines. Quick-change contact jigs are available for each of the four sorting machines, so that several different sizes can be sorted on one machine during the course of the day with minimum lost time due to setup changes.

With the four machines and several sets of contact jigs for each, resistors ranging from 5 ohms to 15,000 ohms can be sorted automatically once the operator dumps a batch into the hopper of the Syntron feeder. The feeder lines up the resistors end to end and sends them down the length of copper tubing to the measuring position. Here a small air cylinder holds each resistor in turn against spring contacts. Under this measuring position is a rotating wheel containing 12 tote boxes, mounted on the same vertical shaft as the master contact jig assembly atop the machine. The

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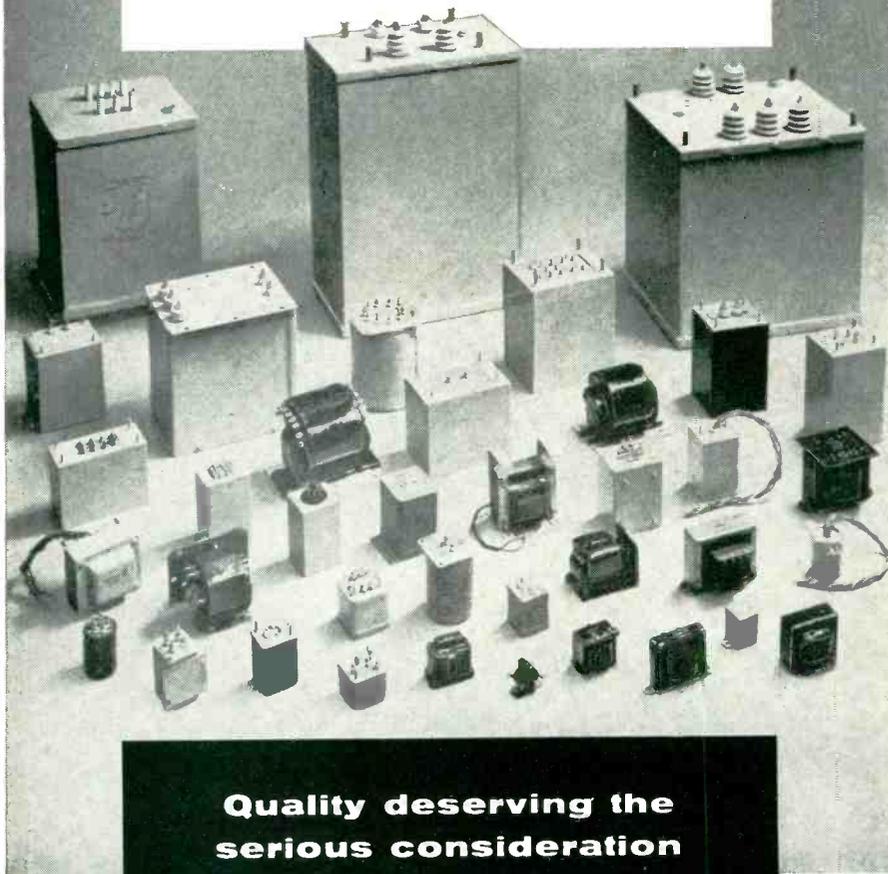
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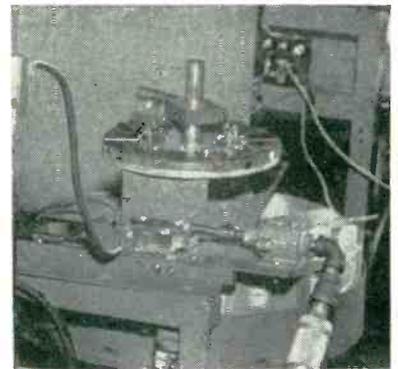


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**A Subsidiary of the W. L. Maxson Corporation**



Closeup of sorting mechanism. Quick-change contact jig clamps onto vertical shaft on top. Circular pan holding 12 tote boxes is mounted on lower end of same shaft. Air cylinder in foreground holds resistor against contacts during measurement

contact jig and the tote-box pan are driven in unison by an electric motor through a speed-reducing belt and rim drive much like that used in phonographs. When the correct tote box is under the resistor being measured, the contact-making air cylinder is released by the control circuit, allowing the resistor to drop. One operator can easily tend all four machines, emptying the filled tote boxes as required, since the time cycle of operation is relatively slow.

## Shadowless Lighting for TV Assembly Line

SPECIAL shadowless lighting fixtures minimize the brightness of reflections from a cadmium-plated television chassis on the tv assembly line in Sylvania's new Batavia, N. Y. plant, while still providing a high level of illumination. Large-area light sources simulate the per-



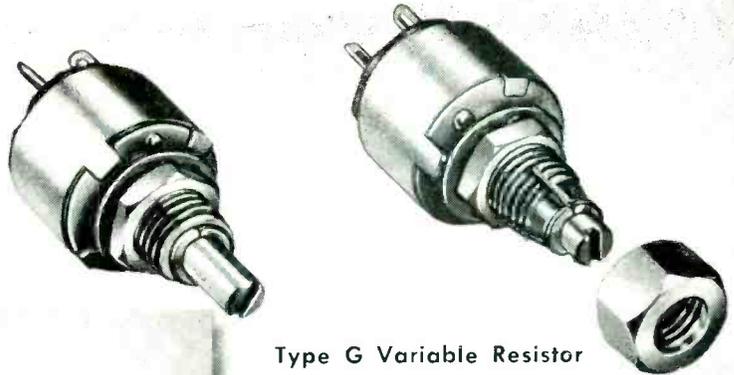
Chassis assembly line with new shadowless overhead lighting

ACTUAL SIZE

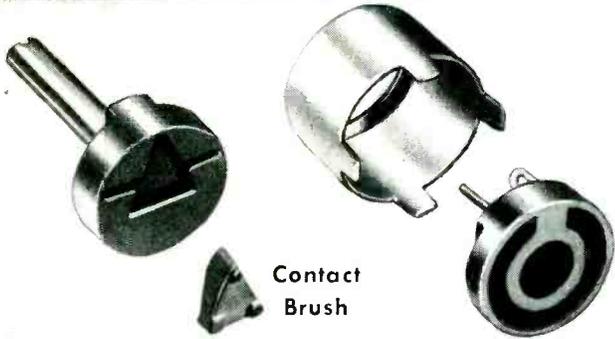


Type G Variable Resistor

ENLARGED VIEW



Type G Variable Resistor



Contact Brush

Molded Resistor Ring

## HIGH QUALITY TYPE G Continuously Variable 1/2 Watt Resistors

### Solid Molded Resistor Assures Long Life, Low Noise, and Permanent Characteristics



Type T Resistor

A 1/2 watt variable resistor has 2 styles of operating covers—for hand or screwdriver adjustment.



Type J Resistor

A 2 watt solid molded variable resistor available with various types of adjusting shafts.



Dual Type J Resistor with Concentric Shafts  
Two units with separate, concentric adjusting shafts for individual circuit control.

The tiny Allen-Bradley Type G, 1/2 watt variable resistor is a miniature version of the well-known Type J 2 watt variable resistor. It has a solid-molded resistor element progressively tapered in resistance to produce any resistance-rotation curve.

The graduated resistor element is NOT a painted or sprayed unit. The Type G element—being solid molded—does not deteriorate with age or use. It is not affected by heat or moisture. It is conservatively rated at 1/2 watt at 70 C ambient . . . not at the usual 40 C. The carbon contact brush improves with use. The Type G unit is a QUALITY product, through and through . . . made for electronic applications where performance is the dominant requirement.

Let us send you full technical data on Allen-Bradley variable resistors. Write today.

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Milwaukee 4, Wis.



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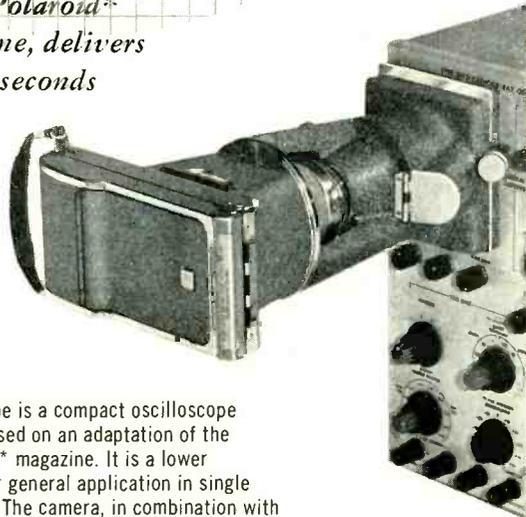
# ALLEN-BRADLEY

RADIO, ELECTRONIC AND TELEVISION COMPONENTS

*a new lower cost precision camera  
for economical single-frame  
oscilloscope recording*

# THE AREMAC RECORDOSCOPE 1414

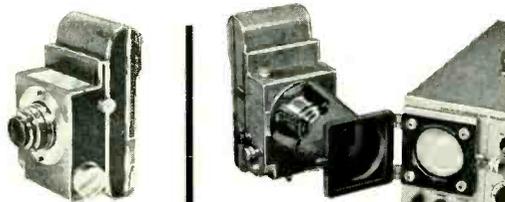
*utilizes the new small Polaroid\*  
self-developing magazine, delivers  
black-field prints in 60 seconds*



The new Aremac 1414 Recordoscope is a compact oscilloscope camera of special configuration based on an adaptation of the 60-second self-developing Polaroid\* magazine. It is a lower cost model designed principally for general application in single frame oscilloscope data recording. The camera, in combination with a packaged accessory group, mounts easily and sturdily on any standard 3" or 5" scope.

A single camera is capable of servicing several scopes of different manufacture when used in conjunction with scope-mounted Aremac swing-away hoods. Overall versatility, plus fine technical performance at a new lower cost, makes the 1414 Recordoscope a standard engineering instrument requirement for electrical, electronic, industrial and basic r & d laboratories.

\*POLAROID IS THE REGISTERED TRADE NAME OF THE POLAROID CORPORATION.



1185-C MANUAL RECORDOSCOPE

1185-B AUTOMATIC RECORDOSCOPE

The 1185-B RECORDOSCOPE features automatic magazine-shifting operation. Camera pre-sets to record from 3-to-16 traces on each 3" x 4" print. Automatic movement is triggered by remote control, cable or manual shutter release. The 1185-C... a manually operated version for use where applications do not justify the automatic-magazine shifting feature.

*Write for complete technical literature on  
Aremac's Oscilloscope Data Recording Cameras.*

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*Manufacturers of Precision Mechanical and Optical Instruments*  
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formance of operating-room lights by eliminating shadows even with hands of assembly workers close to the chassis when soldering wires and making connections.

The new luminaire consists of two continuous rows of dual 90-watt open-end industrial units, mounted side by side and shielded by a continuous row of 32-inch square sections of framed white diffusing corrugated vinyl plastic. Corrugations are normal to the lamps for greatest brightness uniformity. Initial brightness of the plastic panels is 800 foot-lamberts.

The shielding is mounted approximately 2 inches below the reflectors and centered 54 inches above the center of the average chassis centers. A plastic panel can be lifted and slid over an adjacent section for lamp maintenance or the panels can be removed readily for cleaning.

### Automatic Screw Feeder for Power Screwdrivers

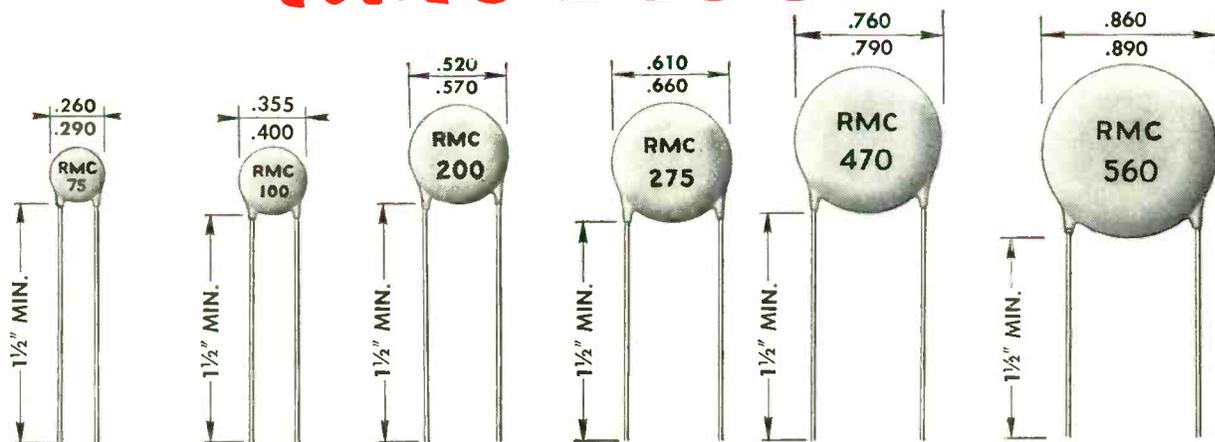
SPEED of screw fastening operations on electronic equipment has been stepped-up as much as 400 percent by a development of Pneuma-Serve, Inc., Cleveland, that feeds screws automatically and almost instantaneously from a hopper to a unique head fitting virtually any standard



Mechanized setup for inserting screws in housing at rate of one per second. Screws in hopper of work feeder at right are blown through plastic tubing one at a time by compressed air, to position under bit of screwdriver

the **PROVED** replacement  
for tubular ceramic and mica capacitors

# RMC DISCAPS



TC	1/4 Dia.	5/16 Dia.	1/2 Dia.	5/8 Dia.	3/4 Dia.	7/8 Dia.
P-100	1- 3 MMF	4- 9 MMF	10- 20 MMF	—	—	—
NPO	2- 12	13- 27	28- 56	57- 62 MMF	63-100 MMF	101-150 MMF
N- 33	2- 12	13- 27	28- 56	57- 62	63-100	101-150
N- 75	2- 12	13- 27	28- 56	57- 68	69-110	111-150
N- 150	2- 15	16- 30	31- 68	69- 75	76-140	141-150
N- 220	3- 15	16- 30	31- 75	76- 90	91-130	131-190
N- 330	3- 15	16- 30	31- 75	76-100	101-150	151-190
N- 470	3- 20	21- 40	41- 80	81-120	121-200	201-240
N- 750	5- 25	26- 56	57-150	151-180	181-300	301-350
N-1500	15- 50	51-100	101-200	201-250	251-330	331-560
N-2200	47- 75	76-150	151-200	201-275	276-470	471-560

## SPECIFICATIONS

**POWER FACTOR:** Over 10 MMF less than .1% at 1 megacycle. Under 10 MMF less than .2% at 1 megacycle.

**WORKING VOLTAGE:** 1000 V.D.C.

**TEST VOLTAGE (FLASH):** 1750 V.D.C.

**CODING:** Capacity, tolerance and TC stamped on disc

**INSULATION:** Durez phenolic-vacuum waxed

**INITIAL LEAKAGE RESISTANCE:** Guaranteed higher than 7500 megohms

**AFTER HUMIDITY LEAKAGE RESISTANCE:** Guaranteed higher than 1000 megohms

**LEADS:** No. 22 tinned copper (.026 dia.)

**TOLERANCES:** ±5% ±10% ±20%

These capacitors conform to the RTMA specification for Class I ceramic condensers

The capacity of these condensers will not change under voltage

Temperature coefficients up to N-5200 available on special order.

Leading manufacturers of electrical and electronic products have proved by their continued use that Type C DISCAPS replace tubular ceramic and mica capacitors at lower cost.

Type C DISCAPS are available for varied applications in a wide range of capacities and temperature coefficients. These capacitors feature smaller size, lower self inductance, and greater dielectric strength. Rated at 1000 working volts, Type C DISCAPS assure trouble-free performance and cost no more than ordinary 600 volt capacitors. Specify Type C DISCAPS for your product, their many mechanical and electrical advantages combine with a lower initial price permitting substantial production cost reductions. These capacitors are available for use with printed wire circuits.

DISCAP  
CERAMIC  
CAPACITORS



**RADIO MATERIALS CORPORATION**  
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

**FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.**  
Two RMC Plants Devoted Exclusively to Ceramic Capacitors

Soldering Time  
cut **60%**



with  
**TIN-ZINC**  
plated parts

A midwestern electronics manufacturer has cut soldering time a full 60% by changing from cadmium plated to tin-zinc plated parts. As a result they increased assembly production by 250%.

Corrosion-resisting tin-zinc offers many assembly and plating advantages to manufacturers of electronic parts —

**PRODUCTION** — The soldering operation is made easier and considerable assembly time can be saved—parts can be soldered at lower temperatures . . . Embrittlement of fine wire is greatly reduced — solderability is retained longer (*even after 2 years on the shelf tin-zinc plated parts have been soldered without difficulty*) . . . Need for flux is entirely eliminated.

**PLATING** — Tin-zinc plating is economical, easy, and assures a corrosion-resisting finish with good coverage even on difficult metals such as malleable iron.

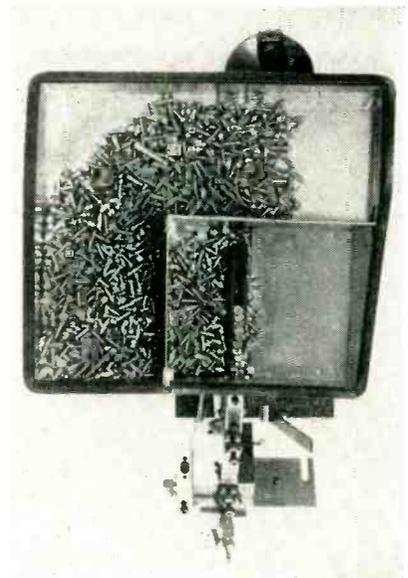
Tin-zinc plating may solve your production problems, too. For detailed information on the process or technical assistance, write us without obligation.



**METAL & THERMIT CORPORATION**

*Chemical & Metals Department*

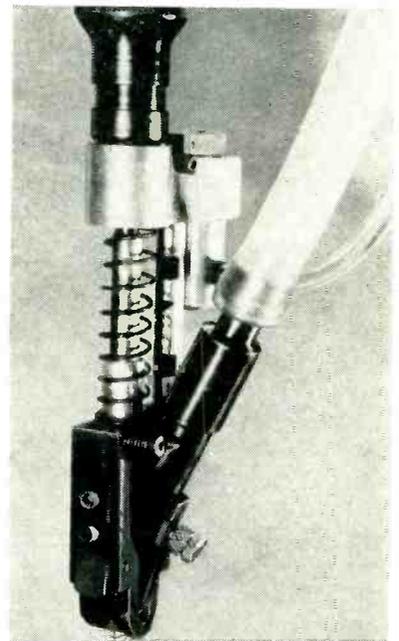
100 EAST 42nd STREET • NEW YORK 17, N. Y.



Top view of screw feeder. Screws selected by elevator at bottom of smaller pickup hopper are fed to magazine track which delivers them to plastic feed tube. Larger area of hopper holds 4-hour reserve of screws

power screwdriver.

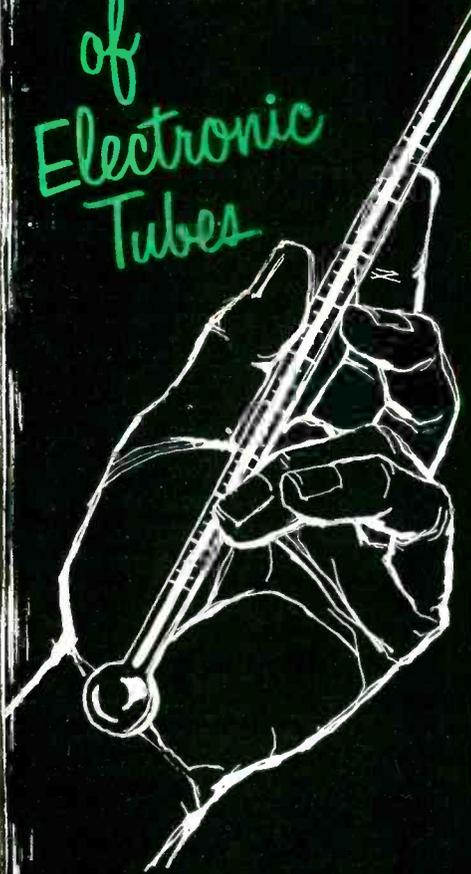
Even in highly mechanized plants using power screwdrivers, screws until now have been placed and started by hand. In some instances, special devices have been developed to deliver screws to the fastening point. However, equipment of this type must be rigidly fixed, requiring that parts to be fastened be brought directly underneath the



When bit of screw-feeding device retracts after driving screw home, next screw is automatically and almost instantly blown into position through transparent plastic feed tube

# LIQUID COOLING

of  
Electronic  
Tubes



WITH **Eastern**  
COOLING UNITS

By a sustained program of research, Eastern continuously extends the uses of the latest units in electronic tube cooling, pressurizing electronic equipment, and pumping fuels and hydraulic fluids. Research and testing laboratories, a model shop, and three manufacturing plants provide the specialized equipment and manpower to turn out fully qualified units to meet appropriate government specifications.

From our extensive line of existing units, adaptations of these units, or completely new designs, Eastern can provide equipment to handle your project well. Your inquiry is welcomed.



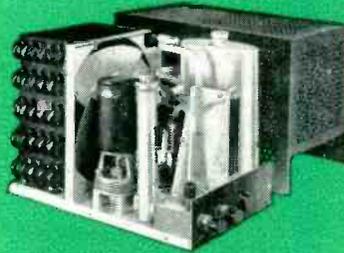
**EASTERN INDUSTRIES, INC.**  
100 SKIFF STREET  
HAMDEN 14, CONNECTICUT

Eastern Cooling Units provide coolant liquid for maintaining within safe operating temperature limits liquid cooled electronic tubes or similar devices. The units are completely self-contained and usually comprise such components as heat exchangers, fans or blowers, liquid pumps, reservoirs, flow switch, thermostat, etc. Cooling units can be modified as required for varying conditions encountered in land or sea as well as aircraft service. Almost all units are designed to meet such specifications as MIL-E-3400 and MIL-E-5272.

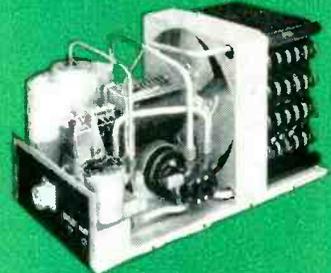
The units shown below are intended only to illustrate the varying requirements which can be satisfied. By utilizing fairly standard components and designs based on broad experience in this field, Eastern is able to provide at minimum cost equipment exactly suiting a specific requirement.

Eastern welcomes your consultation on liquid cooling problems ranging from 200 to 20,000 watts dissipation.

Write for Aviation Products Bulletin 330.



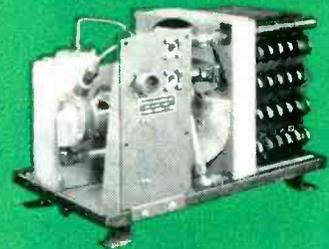
**MODEL MB-175, TYPE 200** DISSIPATION: 2,000 watts. ALTITUDE RANGE: sea level to 50,000 feet. POWER REQUIRED: 28 volts D.C. WEIGHT: 25 pounds. SIZE: 10" x 15-15/16" x 10-1/4" high.



**MODEL E/HT-205, TYPE 200A** DISSIPATION: 1600 watts. ALTITUDE RANGE: sea level to 5,000 feet. POWER REQUIRED: 28 volts D.C. WEIGHT: 25 pounds. SIZE: 10" x 21" x 10" high.



**MODEL MB-177, TYPE 202** DISSIPATION: 1700 watts. ALTITUDE RANGE: sea level to 50,000 feet. POWER REQUIRED: 110 volt, 400 cycle, 3 phase. WEIGHT: 27 pounds. SIZE: 10" x 19 5/32" x 7 1/4" high, per JAN-C-1720A, size B1-D1.



**MODEL E/HT-210, TYPE 200** DISSIPATION: 1500 watts. ALTITUDE RANGE: sea level to 10,000 feet. POWER REQUIRED: 208 volts, 400 cycle, 3 phase. WEIGHT: 35 pounds. SIZE: 11 1/4" x 19 1/2" x 12 1/2" high.



**MODEL E/HT-200, TYPE 201** DISSIPATION: 1,000 watts. ALTITUDE RANGE: sea level to 50,000 feet. POWER REQUIRED: 28 volts D.C. WEIGHT: 14 1/2 pounds. SIZE: 10" x 10" x 6" high.



**MODEL NO. 5-A** DISSIPATION: 1,000 watts. ALTITUDE RANGE: sea level to 5,000 feet. POWER REQUIRED: 100 to 110 volts D.C. WEIGHT: 10 pounds. SIZE: 7 1/4" x 13 1/4" x 9-1/16" high.



## MODERN WAVE ANALYZER

MODEL 21

A step forward in Wave Analyzer design. Identifies and evaluates harmonic or other components of input signal voltages. New design offers wide frequency range from 30 to 50,000 cps and full scale voltage readings of 160 microvolts to 500 volts. Amplitudes of subsidiary components are indicated directly as percentages of the component with highest level — \$445.

# ADVANCED INSTRUMENTATION



## WOW AND FLUTTER METER

MODEL 28

An all new instrument for measuring phenomena that can be expressed as frequency or phase modulation of an audio frequency. Completely portable. Meets all applicable requirements of the IRE, SMPTE and ASA — \$295.

# DONNER SCIENTIFIC COMPANY

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all prices f.o.b. Berkeley, California

Write for specification sheets on the above instruments and  
the complete Donner line of advanced instrumentation 2-A



Screw passing through feed tube

driver manually or by conveyors.

The Pneuma-Serve removes this limitation on production methods. Screws pass in a split second from a hopper, holding enough screws for 5 to 8 hours' work, through a plastic hose to a special head mounted on a power screwdriver. The head grips screws in such a way that they may be driven at any angle, in any plane. After one screw has been driven, the next is automatically fed and instantly positioned. The operator may take the driver and head assembly to work stations as far as 20 feet from the hopper.

A large variety of types and sizes of screws up to  $\frac{1}{4}$  inch in diameter and up to  $1\frac{1}{2}$  inches in length may be handled. The machine will accommodate virtually any head style, including bolts or screws with washer attached, self-tapping screws, sheet metal screws, machine screws and wood screws.

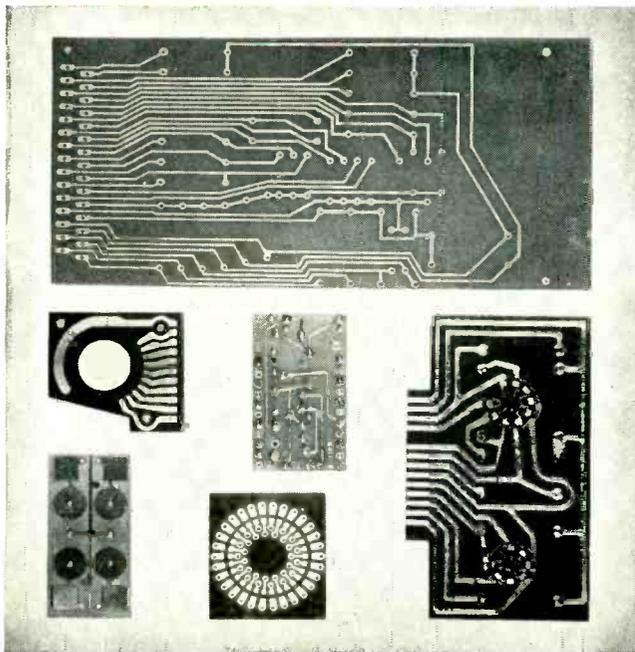
## Capping Resistors

A VISE with contoured jaws is closed by an air cylinder to press lead caps over the silvered ends of deposited carbon resistors in the Kansas City plant of Electra Mfg. Co. The operator first places the caps, with attached axial leads, in slotted recesses in the jaws of the vise. Next, the body of the resistor is set into position on a support between the jaws. An air valve is then pressed



Removing capped resistor from air-operated vise used for assembly

# For the most dependable printed circuits, you need the high bond strength, workability, heat-resistance of **C-D-F DILECTO<sup>®</sup> METAL-CLAD LAMINATES**



Printed circuits based on C-D-F materials are being used with great success in military electronic equipment, commercial television and radio sets, telephone switchboards—even sub-miniature radiosonde equipment and hearing aids.

Photos courtesy of Photocircuits, Inc., Glen Cove, N. Y.

**HIGH BOND STRENGTH**—C-D-F's special adhesive for metal-clad Dilecto bonds the copper foil to the plastic without affecting the laminate's superior electrical properties. Heat-resistance, dissipation factor, dielectric constant, dielectric strength, and insulation resistance of the Dilecto base remain unaffected. The closely-bonded foil can be etched cleanly and dipped in hot solder to 220°C. (428°F.) for ten seconds with a guarantee of no blistering or separating. Metal-Clad Dilecto can be punched or machined either before or after etching.

**EXCELLENT WORKABILITY**—On all five Dilecto metal-clad grades, you can solder, punch, saw, and assemble components either by hand or automatically. Thanks to the inherently superior workability of the plastics laminate over that of ceramic-type materials, Dilecto can be dropped, jammed into tight chassis, and otherwise treated roughly on the assembly line and in service.

**HIGH HEAT-RESISTANCE**—Metal-Clad Dilecto Laminates are made of phenolic, epoxy, or Teflon\* resin for various conditions of service and assembly, and have either cellulosic paper or woven glass-fabric base. All are ideally suited to printed-circuit applications in which heat-dissipation is a major problem. Continuous exposure to high ambient operating temperatures in enclosed electronic equipment has no significant effects on Dilecto's electrical and physical properties.

**UNLOAD YOUR HEADACHE HERE!** C-D-F, a big, reliable source of supply, can help you get the most for your printed-circuit money by reducing rejects, lowering fabrication costs, assuring dependable quality every time. Send us your print or problem, and we'll gladly supply appropriate test samples free. See our catalog in the Product Design File (Sweet's) or send for the new 20-page Dilecto catalog. Let your nearby C-D-F sales engineer (listed in Sweet's) help you right from the design stage!

## TYPICAL PROPERTY VALUES

	Copper-Clad PHENOLIC (Grade XXXP-26)	Copper-Clad PHENOLIC (Grade XXXP-24)	Copper-Clad EPOXY (Grade GB-116E)	Copper-Clad EPOXY (Grade GB-181E)	Copper-Clad TEFLON* (Grade GB-116T)
BOND STRENGTH—0.0014" foil (Lbs. reqd. to separate 1" width of foil from laminate)	5 to 8	5 to 8	8 to 12	8 to 12	5 to 8
MAXIMUM CONTINUOUS OPERATING TEMP. (Deg. C.)	120	120	150	150	200
DIELECTRIC STRENGTH (Maximum voltage per mil.)	800	800	700	650	700
INSULATION RESISTANCE (Megohms) 96 hrs. at 35°C. & 90% RH	50,000	50,000	30,000	20,000	Over 10 <sup>6</sup> megohms
DIELECTRIC CONSTANT 10 <sup>6</sup> Cycles	4.20	4.20	4.90	4.95	2.85
DISSIPATION FACTOR 10 <sup>6</sup> Cycles	0.026	0.026	0.019	0.018	0.0006
ARC-RESISTANCE (Seconds)	10	10	60	80	180
TENSILE STRENGTH (psi.)	16,000 x 13,000	14,000 x 11,000	46,000 x 42,000	48,000 x 44,000	23,000 x 21,000
FLEXURAL STRENGTH (psi.)	21,000 x 18,000	19,000 x 16,000	60,000 x 55,000	75,000 x 65,000	13,000 x 11,000
IZOD IMPACT STRENGTH edgewise (ft. lbs. per inch of notch)	0.40 x 0.35	0.40 x 0.35	6.5 x 6.0	13.5 x 11.5	6.0 x 5.0
COMPRESSIVE STRENGTH flatwise (psi.)	28,000	27,000	60,000	62,000	20,000
BASE MATERIAL OF LAMINATE	Cotton rag paper	Cotton rag paper	Fine-weave, medium-weight glass cloth	Medium-weave, medium-weight glass cloth	Fine-weave, medium-weight glass cloth
COLOR OF UNCLAD LAMINATE	Natural greenish	Natural Brown	Natural	Natural	Natural

All these standard grades are available with 0.0014", 0.0028", 0.0042", or thicker electrolytic or rolled copper foil on one or both surfaces. Other metal foils and other resin-and-base combinations can be supplied on special order.

\*duPont Trademark



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With your  
**VERY BEST MULTI-PURPOSE TEST INSTRUMENT**  
**CAN YOU MEASURE**

0.1 volt to 300 volts AC up to 700MC?  
 0.02 ohm up to 5,000,000,000 ohms?  
 0.1 volt to 30,000 volts DC?  
 0.001 microampere to 100 milliamperes?  
**WITH LABORATORY ACCURACY?**



**THIS MEASUREMENT  
 LABORATORY IN ONE  
 COMPACT INSTRUMENT  
 DOES!**

**EXTENDED RANGE**

Yes, the 800-B combines the utility of a voltmeter . . . millivoltmeter . . . milliammeter . . . microammeter . . . millimicroammeter . . . ohmmeter . . . megohmmeter into one instrument. In addition, this "Portable Measurement Laboratory" features:

- high feedback amplifier
- unique circuitry
- precision components
- voltage-regulated plate and filament supply
- elimination of the effects of tube aging and meter-resistance fluctuations

For high accuracy and high stability. Write for Bulletin I-105 for full information.

**TECHNOLOGY INSTRUMENT CORP.**

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with the right hand to close the vise, thereby pressing the caps firmly in position. A Redington air-actuated counter is paralleled with the vise air cylinder to give a production count automatically.

**Magnet Controls Torque in New Air Screwdriver**

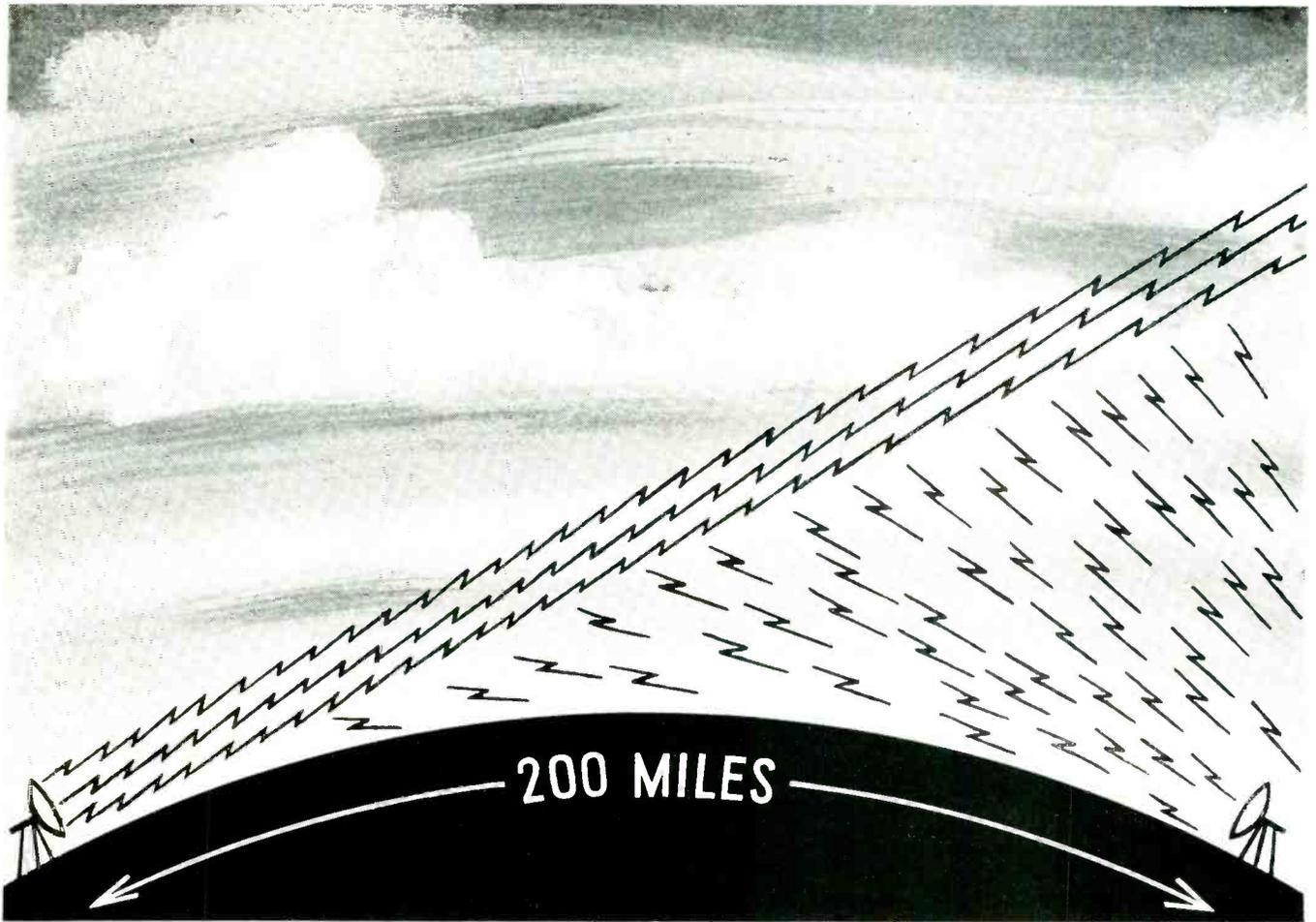
A NEW TORQUE-CONTROLLED air gun known as the Magnamatic, announced by Chicago Pneumatic Tool Co., disengages fully the instant that proper torque is attained. The tool stays disengaged until the screwdriver or nut runner is removed from the work. The human element in determining proper fastener tightness is removed entirely from the driving operation. Because the clutch jaws remain separated, the objectionable ratcheting or impacting action and other undesirable features found in conventional clutches are eliminated.

The life of clutch components is greatly increased, due to the absence of any hammering action; screw bits last as much as twenty times longer due to the total absence of impacting; damage to screw heads and surface finishes of products is greatly diminished and the objectionable noise of an impacting clutch is eliminated.

To get maximum efficiency from a threaded fastener, it usually

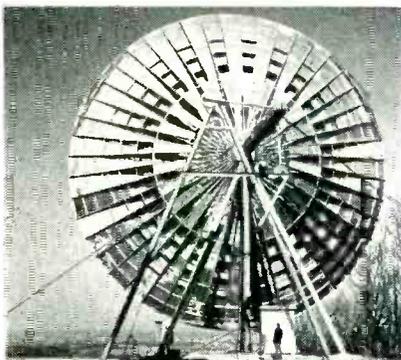


Driving assembly screws in filter units with new magnetic-clutch air tool



Highly schematic drawing illustrates the possible distribution of energy in ultra-high-frequency "over-the-horizon" transmission. The effect is similar to that of a powerful searchlight whose beam points into the sky. Light can be seen miles away from behind a hill even when the searchlight lens is invisible.

## Something new on the telephone horizon



This experimental 60-foot antenna (rear view) photographed at Bell Laboratories in Holmdel, New Jersey, is designed for study of "over-the-horizon" phenomena.

Telephone conversations and television pictures can now travel by ultra-high-frequency radio waves far beyond the horizon. This was recently demonstrated by Bell Telephone Laboratories and Massachusetts Institute of Technology scientists using "over-the-horizon" wave propagation, an important recent development in the radio transmission field.

This technique makes possible 200-mile spans between stations, instead of the 30-mile spans used for present line-of-sight transmission. It opens the way to ultra-high frequencies across water or over rugged terrain, where relay

stations would be difficult to build.

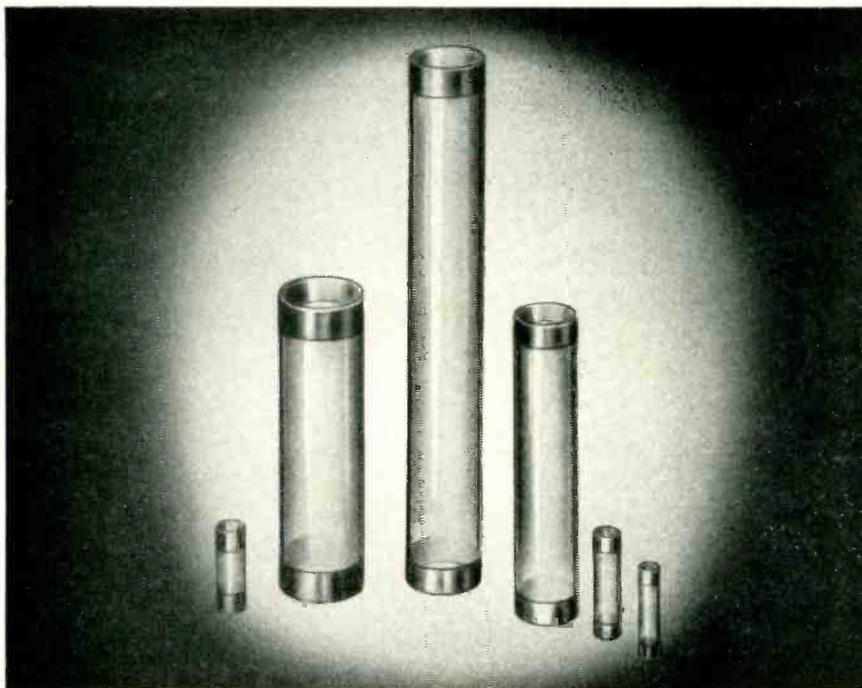
In standard microwave line-of-sight transmission, stations are so spaced that the main beam can be used. But now, with huge 60-foot antennas, and much higher power, some signals drop off this main beam as it shoots off into space. These signals reach distant points beyond the horizon after reflection or scattering by the atmosphere. The greater power and larger antennas of the "over-the-horizon" system permit recapture of some of these signals and make them useful carriers. The system will be a valuable supplement to existing radio relay links.

**BELL TELEPHONE LABORATORIES**

*Improving telephone service for America provides careers for creative men in scientific and technical fields.*

Want more information? Use post card on last page.





Corning Metallized Glass Enclosures like these are used for hermetically sealing rectifiers, resistors and capacitors.



New tool drives screws to optimum tightness in plastic housing of tape recorder, avoiding distortion of housing

## How to protect delicate components from moisture, mold, dirt, thermal shock

You've got to safeguard delicate components so they can stand up under rough and tumble operating conditions.

Encapsulate sensitive components in rugged Corning Metallized Glass Tubes and you give them stamina they otherwise lack.

You protect them in a hermetic seal from moisture. You keep out dust and dirt. You prevent moulds and fungi from settling on them.

When assembled with metal end caps, Corning Metallized Glass Enclosures can take sudden temperature changes—from as much as 275° C. to ice water. And they are not affected by atmospheric changes.

The protection of metallized glass enclosures is permanent. Bond strength for metallizing used on enclosure tubes has been measured at 1500 to 2000 pounds per square inch. Because the glass is transparent, you can see inside the tubes to check the condition of components. The electrical characteristics of the glass are excellent.

You can get metallized glass enclosures in a variety of sizes. We'll be happy to send you a descriptive catalog sheet telling you more about them. Or, if you have some specific problems metallized glass enclosures might help you solve, we'll be pleased to work with you. Write, wire or phone us.

should be driven to from 80 to 85 percent of its breaking or stripping load. A screw that is driven too tightly may strip its threads, break or distort the part or cause ultimate failure of the assembly. Failure also can occur if the fastener is too loose because of low fatigue resistance.

The new tool permits desired torque to be applied consistently over high production runs without reliance on operator skill, with increased tool life, and at higher production rates.

Torque setting is achieved by screwing a permanent magnet assembly in or out of the upper clutch jaw. This adjustment changes the depth of engagement and the angle of contact of the teeth on the clutch jaws.

The top drawing in Fig. 1 shows the clutch set to deliver maximum torque. The magnet assembly has been screwed as far into the upper jaw as it will go, allowing the lower jaw to move to the left until the armature plate contacts the magnet assembly. The teeth of the jaws are now at their maximum depth of engagement and the torque required to cam the lower jaw out of and away from the upper jaw will be high because of the steep angle of contact of the teeth.

The lower drawing shows the



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New Products Division

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Address .....

Company .....

City ..... Zone ..... State .....



**THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE**



Modern methods assure product uniformity.

It takes a unique combination of modern production facilities, rigid quality control techniques and skilled workers to make *consistently* top quality magnet wire...and General Cable has it! That's why General Cable magnet wire is noted throughout industry for its extraordinary uniformity...providing the ultimate in high level performance.

Important, too, General Cable can always supply you with *exactly* the magnet wire you want...when you want it! They make every type, shape and size:

Formvar, Plain Enamel, Nylon Enamel, Silicone, and other synthetic enamels, with light, intermediate or heavy coatings.

Cotton, Paper, Silk, Nylon, Glass and Special High Temperature Covering with single and double wrappings, similar and dissimilar materials.

Plus bonded paper and glass, or other specialized types. You name it and General Cable makes it... and makes it *right!* So look to General Cable for *all* your electrical wire and cable needs!

## **GENERAL CABLE** CORPORATION



**BARE, WEATHERPROOF, INSULATED WIRES and CABLES FOR EVERY ELECTRICAL PURPOSE**

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to suit you best

**MANSOL makes**

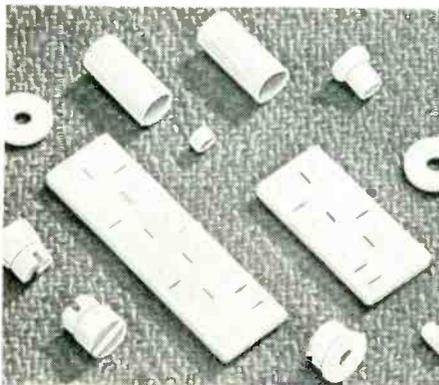
**GLASS MULTIFORMS**

*Custom Tailored*

to your exact specifications

### GLASS MULTIFORMS

Did you know that multiforms in glass have greater inherent elasticity to make them more shock resistant than glass tubing or pressed glass? Here are the ideal multiforms for Iron Sealing and Kovar Sealing, matching the expansion of these metals over their entire working range. They resist mercury attack, have ample mechanical strength and seal readily. Our laboratory is prepared to assist you in selecting the proper glass for any metal.



#### NOW USED IN MAKING OF:

Hermetic Seals, Gun Mounts, Thyatron Tubes, Diodes, transistors, Connectors, sealed-TERMINALS, Insulators and Dial Lights.

MANSOL can produce MULTIFORMS to seal to the following: Dumet, Kovar, Fernico, Rodar, Molybdenum, Mica, Platinum, #4 Alloy, Tungsten and Stainless Steel.

#### MANSOL also makes MULTIFORMS of STEATITE

We specialize in small die-pressed ceramic parts held to the closest tolerances. All tools and dies are made in our shop to assure quick delivery.

- If you are still making your own multiforms, let Mansol help you with your multiform problems.
- Write to Dept. E for the complete story about Multiforms, Steatite and our production facilities. No obligation, of course.

**MANSOL CERAMICS COMPANY**  
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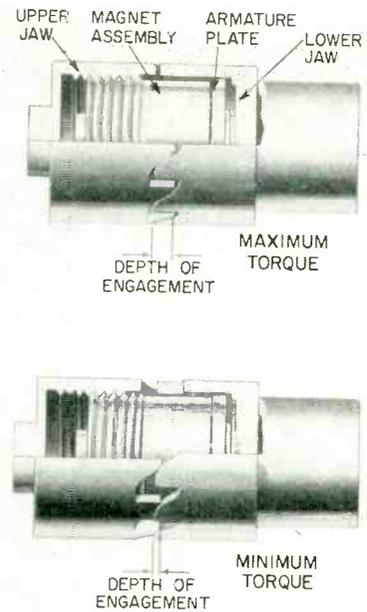


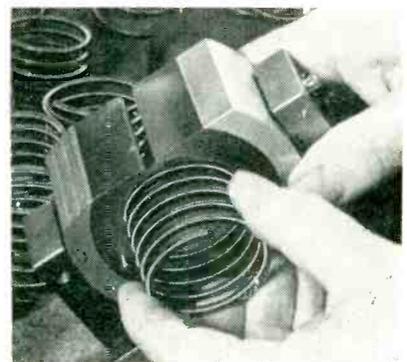
FIG. 1—Screw adjustment in magnetic clutch

clutch set to deliver minimum torque. The magnet assembly has been screwed out of the upper jaw. With this setting, the armature plate contacts the magnet assembly before the jaw teeth are fully meshed. With the teeth so engaged, the angle of contact is relatively small and a considerably small torque will cause the lower jaw to cam out of the upper jaw.

### Cutting and Flattening Helices for Potentiometers

RESISTANCE elements for single-turn precision potentiometers are wound on straight wire cores, coiled into a five-turn helix, sawed apart and then flattened to give single-turn elements that fit into the cups of linear precision potentiometers, in the Hicksville, N. Y. plant of Fairchild Controls Corp.

The first step in the cutting-apart



Inserting helix in holding fixture

# Keeping in step with fast-stepping PRINTED WIRING...

## CLAROSTAT PRINTED WIRING CONTROLS and RESISTORS



### SERIES 43 CONTROL

- 1 ohm to 50,000 ohms. Wire-wound. Plus/minus 10%. Closer tolerances available. 2-watt rating.
- 1 1/8" diameter X 9/16" deep.
- Terminals reversed to meet printed-wiring requirements.
- Rotation: Mechanical, 300°; effective, 280°.



### SERIES 39 CONTROL

- Screwdriver-adjusted for semi-permanent settings.
- Available as rheostat or potentiometer. Wire-wound. 2-watt rating.
- Terminals designed for printed-wiring connections.
- 4 ohm to 5,000 ohms; plus/minus 20%.
- 3/4" diameter X 3/8" deep.

### STANDEE<sup>®</sup> RESISTOR

- Terminals designed for printed-wiring circuitry. Spring-clip action locks STANDEE securely during soldering phase of assembly.
- Available in 10 watts to 30 watts.
- 6000 to 21,000 ohms. (Wattage and Ohmage based on length).
- Five lengths — 1 1/2" to 4"
- Plus/minus 10%. Closer tolerances available.
- Resistance element wound on glass fiber core, sealed in steatite tube.
- Standee permits maximum heat dissipation above printed-circuit mounting panel.

Three typical printed-wiring components by Clarostat. Others available. Ease of installation in sub-assemblies of printed-wiring

circuitry, accounts for low cost factor. Always, there's a Clarostat control or resistor to meet every application need.



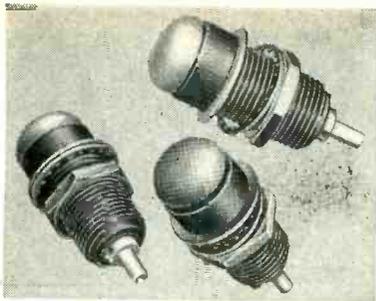
Let us collaborate in your printed-wiring and other automation requirements and problems. Latest Engineering Data on request.

*Controls and Resistors*

**CLAROSTAT MFG. CO. INC., DOVER, NEW HAMPSHIRE**

*In Canada: Canadian Marconi Co., Ltd., Toronto 17, Ont.*

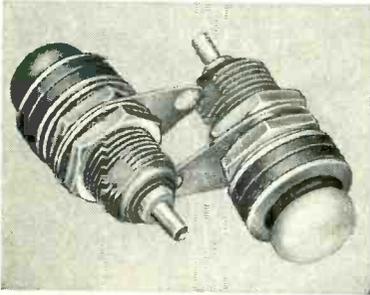
*Manufactured under license in Great Britain by A. B. Metal Products Ltd., 17 Stratton St., London W. 1, Concessionaires for British Commonwealth except Canada.*



**EDGE-LIT PANEL MOUNTING**

**Series L2000**

Designed for MIL-P-7788 panels. Sturdily constructed with integral molded-in terminal and snug-fitting plastic lens that will not vibrate loose. Easy to mount. Write for Hetherington Bulletin L1.



**REGULAR PANEL MOUNTING**

**Series L1000**

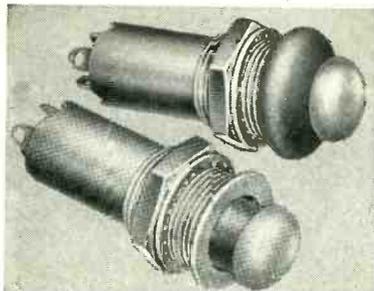
Combines exceptionally small size and light weight with durable construction. Unaffected by heavy shock or vibration. Effectively sealed against moisture. Terminal is molded into the assembly. Write today for Hetherington Bulletin L1.

**for maximum dependability**

*specify*

**HETHERINGTON  
INDICATOR LIGHTS**

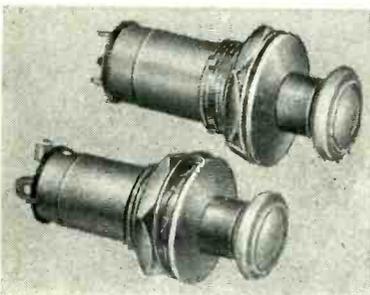
In addition to the standard indicator lights illustrated, Hetherington produces many adaptations and "specials" for military as well as commercial needs. Write for details on any type.



**"PUSH-TO-TEST" INDICATORS**

**Series L3000**

Widely used in military aircraft and ideally adapted to many industrial uses. Bulb is lit by pressing spring-mounted plastic lens button. Supplied with or without silicone rubber boot for moisture protection. Write for Hetherington Bulletin L1.



**SWITCHES**

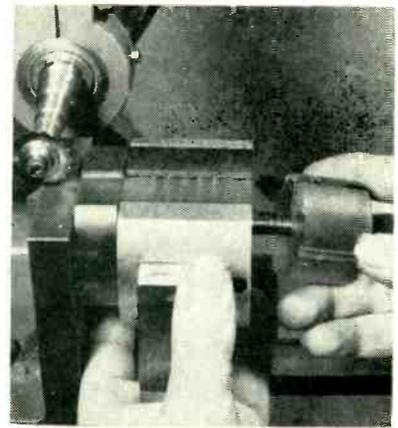
**WITH BUILT-IN LIGHTS . . .**

in a variety of types and switching arrangements save weight and panel space. Write for Hetherington catalog.

**HETHERINGTON, INC.**

SHARON HILL, PA.

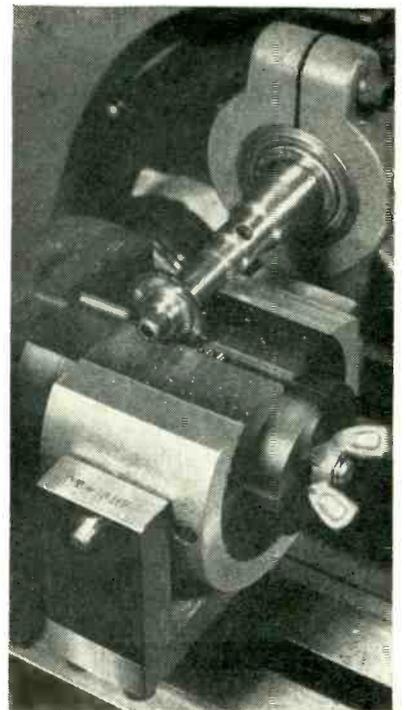
West Coast Division: El Segundo, California



Inserting compressing plug over bolt anchored in anvil of machine to hold fixture in position and tighten helix



Moving lever of armature undercutter to move helix through cutting wheel



Cutting helix into single-turn windings. Thumb nut is placed over bolt to hold fixture in position and tighten helix

# now selenium rectifiers



designed  
for printed circuits!

Four output ratings from 65 to 150 milliamps, and a choice of three terminal styles, are now available from Federal to meet your printed circuit requirements.

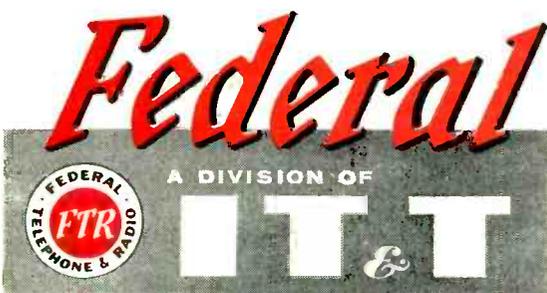
The new terminal designs cut your assembly and soldering costs . . . permit rapid *automatic* or *manual* insertion into printed circuit boards.

Terminal shoulder stops keep the rectifier plates off the board. Result: rectifier cooling is improved and extra board area is freed for additional printing!

And, as with all Federal selenium rectifiers, you can count on their long life, high output voltage, low temperature rise, excellent humidity resistance, and UL acceptance.

TERMINAL TYPES		
TYPE	DESCRIPTION	DETAIL DRAWING
a	<b>Square Tipped</b> —for light-gauge printed circuit boards up to 1/16" thick.	
b	<b>Snap-In</b> —for 1/16" printed circuit boards subject to vibration or inversion. Terminals lock rectifier in place.	
c	<b>Tapered</b> —for maximum ease of insertion in heavy-gauge printed circuit boards up to 1/8" thick.	

FEDERAL PRINTED CIRCUIT RECTIFIERS												
FTR No.	1266	1279	1265	1308	1444	1357	1297	1445	1400	1383	1494	1495
DC Output ma (maximum)	65	65	65	65	65	75	75	75	100	100	100	150
AC Input V (rms maximum)	130	130	130	130	130	130	130	130	130	130	130	130
Terminal Type	A	B	A	B	C	A	B	C	A	B	B	B



For more information on Federal Printed Circuit Rectifiers phone NUTley 2-3600, or write Dept. F-913.

Federal printed circuit rectifiers can be designed for your application in ratings up to 195 volts AC and 600 milliamps DC

**Federal Telephone and Radio Company**  
A Division of INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION  
COMPONENTS DIVISION • 100 KINGSLAND ROAD • CLIFTON, N. J.

In Canada: Standard Telephones and Cables Mfg. Co. (Canada) Ltd., Montreal, P. Q.  
Export Distributors: International Standard Electric Corp., 67 Broad St., New York

# HERE'S HELP IN TESTING

**INSTRUMENTS  
EQUIPMENT  
PARTS  
COMPONENTS  
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A single test to check your own findings  
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satisfy your customer or the Government.\*

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To do your testing, E.T.L. maintains thirteen separate well equipped, fully staffed laboratories in these fields:

Electronic*	Mechanical	Radioactive
Environmental	Physical	Spectrophotometric
Electrical	Photometric	Ultrasonic
Chemical	Radiometric	X-ray
	Photomicrographic	

\*In the Electronic field, for instance, measurements and determinations can be made over extreme high and low range of parameters for the usual characteristics such as Capacitance, Resistance, Frequency (including the microwave region), Power, Power Factor, Interference, etc. Qualification Tests can be made to Military Specifications such as:

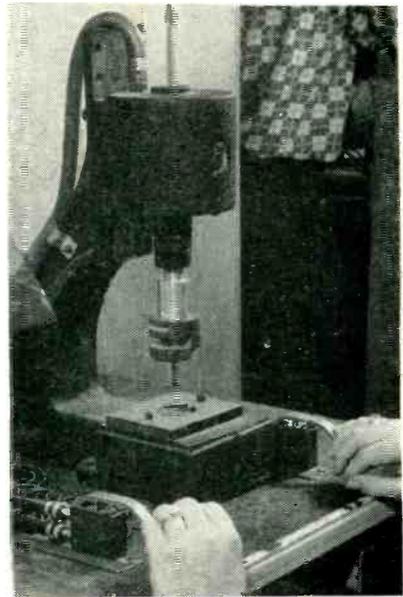
ASESA List No. 100	Electronic Parts and Materials
MIL-E-5272	Electronic Equipment, Aeronautical
MIL-E-5400	Electronic Equipment, Airborne
MIL-E-8189	Electronic Equipment, Pilotless
MIL-I-6181	Electronic Equipment, Interference
MIL-STD-108	
MIL-STD-202	
MIL-L-770	Radioactive Material
MIL-L-25412	Luminescent Material—Fluorescent

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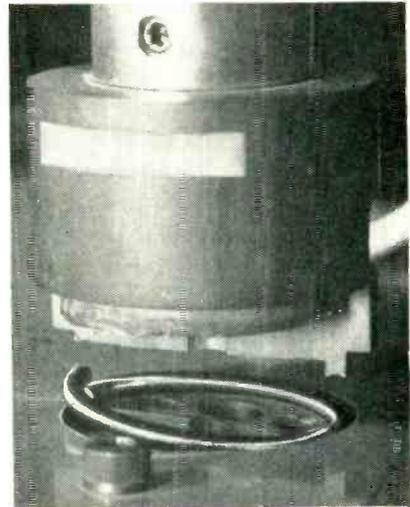
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2 EAST END AVENUE • BUTTERFIELD 8-2600 • NEW YORK 21, N. Y.



Pneumatic hammer setup used to flatten single-turn windings



Contoured flattening head and anvil with winding in position

operation involves inserting the five-turn helix into a circular plastic-lined holding fixture having a slot through which the blade of the cutting saw can run. With the helix in position, the fixture is slipped over a bolt on the anvil of an armature undercutter made by Hullhorst Tools Inc., Toledo, Ohio. A special plug is inserted in the other end of the fixture, and a thumb-screw is placed over the bolt and tightened to compress the helix and at the same time fasten the fixture to the anvil. A lever attached to the bed of the machine is then used to move the helix through the high-speed cutting wheel.

Individual turns are flattened with a pneumatic hammer having

**NEW**

# high-power rectifier

MINIATURIZED BY  
**amperex**<sup>®</sup>



Only 2" (without leads) and 3/4" in diameter, the AMPEREX 6339, a miniaturized, ruggedized version of the 3B29, operates under more stringent conditions than its prototype. This miniature, high-vacuum, external-anode, clipper diode and rectifier tube is designed to be enclosed in a complete liquid-cooled package, including power supply and pulse modulator components. It may also be operated in air at reduced ratings, in applications where liquid cooling is not required.

**PARTIAL DATA — AMPEREX 6339**

Filament Voltage	6.3
Filament Current	1.55

**IN OIL** Maximum Ratings

Peak Inverse Voltage	10,000	16,000	volts
Peak Current	400	250	ma
Average Current	100	65	ma dc
Silicone Oil Coolant Temp.	-65°C to +165°C		

Typical Operation (Three-phase, Bridge, Choke Input Filter)

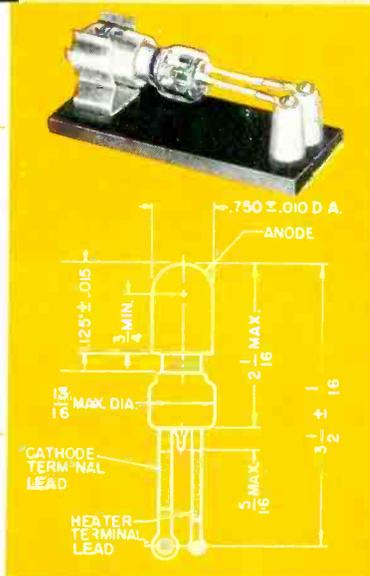
No. of Tubes	6		
Peak Inverse Voltage	16,000 volts		
Peak Anode Current	195 ma		
Average Anode Current (per tube)	65 ma dc		
Output Voltage	14,000 volts dc		
Output Current	195 ma dc		

**IN AIR** Maximum Ratings (sea level)

	Without Auxiliary Cooler	With Auxiliary Cooler	
Peak Inverse Voltage	12,000	12,000	volts
Peak Current	200	400	ma
Average Current	50	100	ma dc
Ambient Temperature	-55 to +85		-55 to +85°C

Typical Operation (Three-phase, Bridge, Choke Input Filter)

No. of Tubes	6	6	
Peak Inverse Voltage	12,000	12,000	volts
Peak Anode Current	100	200	ma
Average Anode Current (per tube)	33	67	ma dc
Output Voltage	10,500	10,500	volts dc
Output Current	100	200	ma dc



The AMPEREX 6339 may be mounted in a standard 60 amp. fuse clip, as illustrated. For high-power operation in air, an auxiliary cooler which will also serve as a mount may be used. Flexible leads terminating in #6 and #8 lugs are used for heater and cathode connection. These allow the tube to be mounted in an extremely small space, and the leads may be brought out to any convenient terminal strip or stand-off insulator.

AMPEREX 6339 ..... \$35.00 net  
See it at your local electronic parts distributor, or write direct to factory for detailed data sheets.

RETUBE WITH **amperex**  
**amperex** ELECTRONIC CORP.

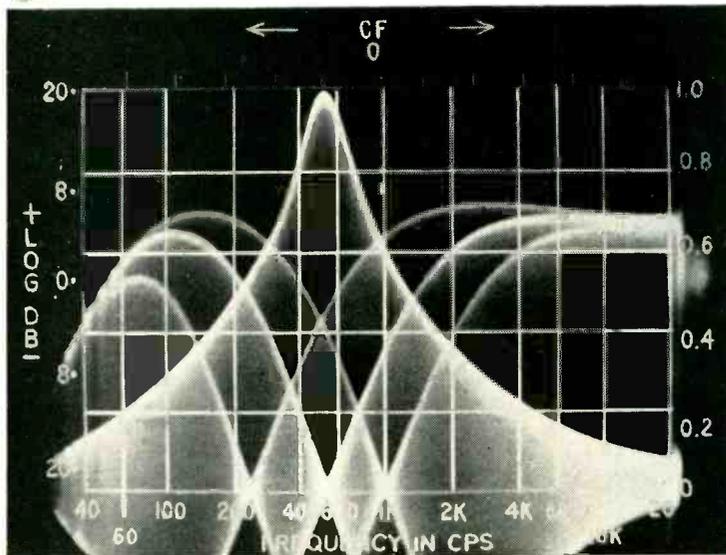
230 Duffy Ave., Hicksville, L. I., N. Y.

In Canada: Rogers Majestic Electronics, Ltd.  
11-19 Brentcliffe Road, Leaside (Toronto 17)





*in  
sixty  
seconds...*



Performance evaluation of a Fischer electronic (low frequency—high frequency) filter; wave forms signify the following: Variable null marker to check points on response curve at 1 Kc, 2.2 Kc and 5.5 Kc. This is a log amplitude presentation where the frequency is multiplied by a factor of 10. Instrument used is SGI Sweep Generator; courtesy Panoramic Radio Products Corporation.

## a full-size photo of any scope pattern for evaluation of transient phenomena!

This special Fairchild adaptation of the Polaroid-Land principle delivers a permanent, photographically accurate, full-size record of single transients or identical repetitive phenomena in 60 seconds after they appear on the C-R Tube. It is the only practical method to obtain a quick, permanent record of scope patterns like the one above. Because this photographic method is so fast, laboratory work can proceed continuously without interruptions or delays so usual where conventional film is used. The life size 3¼ x 4¼ in. image makes evaluation easy and accurate. Camera is automatically in focus when attached to the oscilloscope. Also provides for critical focusing adjustment where thick grids or filters are interposed between the tube face and camera hood.

For accurate records of continuously varying phenomena or single transients and stationary patterns on 35 mm. film, the Fairchild Oscillo-Record Camera is available. For more information, write Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Expressway, Jamaica, New York, Department 120-23A2.

# FAIRCHILD

**OSCILLOSCOPE RECORDING CAMERAS**

contoured faces made from reinforced fiber. This hammer setup bends the ends of the single turn just far enough in the opposite direction so that they meet precisely when they spring back after the hammer is released.

Use of fiber and plastic on all tools prevents damage to the fine resistance wire during this processing action.

## Resistor-Varnishing Setup

A MOISTURE-RESISTANT varnish coating is applied to finished deposited carbon resistors by a semiautomatic mechanized setup in the Kansas City plant of Electra Mfg. Co. Machine capacity is over 10,000 resistors per day.

The operator transfers resistors one by one from a metal tote rack to the projections of a motor-driven feed wheel at the input end of the machine. This wheel takes the resistor bodies through a varnish bath, then transfers the resistors automatically to a short conveyor chain running at a slant so surplus varnish drains off one end of the resistor without forming tears. At the other end, this draining chain runs between two motor-driven



Loading resistors on feed wheel at input of varnishing machine. The comb-like metal tote racks used for these resistors have slots through which the leads project, with the bodies of the resistors fully protected. Resistor bodies are not touched by hand until after they have received the varnish coating

# for your exacting requirements

## Good-ALL capacitors

### marbelite



Premium capacitors at economical cost. This small, compact style is impregnated with a tough, plastic material used exclusively by Good-All. The paper tubes are heavily impregnated. Ends are sealed with thermo-setting plastic. Marbelite will not crack or dry out—assures long service life and superior field performance. MYLAR or paper dielectric.

### seramelite



High heat and humidity resistance at low comparative cost. Good-All's thermo-setting plastic end seal bonds securely to the leads and to the tubular ceramic case. The seramelite capacitor series includes pin-type design in which both leads emerge from the same tube end. MYLAR or paper dielectric may be specified.

### film-x



A family of hermetically-sealed capacitors with MYLAR dielectric. All types provide high insulation resistance and low power factor. In the temperature range up to 85°C an appreciative space saving is gained through the use of Film-X. For higher ambient temperatures, Good-All has designed its "HT" series of high-temperature MYLAR capacitors.

### military



To extend our service to customers, we have designed a wide line of capacitors to Mil-C-25A specifications. Current QPL listings will supply approval information. Design and production facilities are kept available for specialized work in conjunction with new or unusual requirements. MYLAR equivalents are available for all CP-type capacitors.

### printed circuit



Many capacitor designs for printed circuits are in quantity production for Good-All customers. A special printed circuit bulletin which illustrates various lead and case arrangements is available. Other designs can be created to meet the electrical and mechanical needs of new applications. Special packaging for magazine feeding can be provided as required.

### service plus...

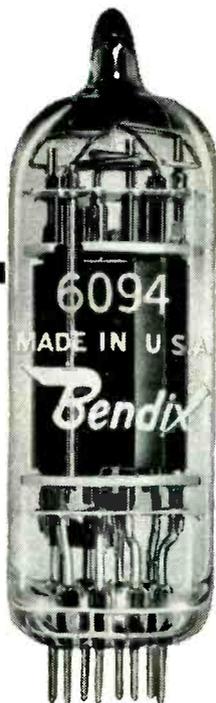
We pride ourselves on out-doing other large capacitor manufacturers in providing customer service. Flexible production scheduling, plus efficient paperwork handling, plus excellent shipping facilities make Good-All service the best in the industry. Our engineers are ready to work with you on special applications. Write, wire or phone for specifications and quotations.

**GOOD-ALL ELECTRIC MFG. CO.**  
GOODALL BLDG. • OGALLALA, NEBRASKA

**Where dependability,  
long life and uniform  
performance are  
all-important ... select**



## **HARD GLASS Miniature Beam Power Amplifier**



Here's another advance in the Bendix Red Bank "Reliable" Vacuum Tube program. Featuring a hard glass bulb and stem with gold-plated pins . . . plus a conservative design center of cathode temperature . . . the Bendix Red Bank RETMA 6094 can operate at temperatures up to 300° C. compared to an average of only 175° C. for soft glass bulbs. Thus, this new tube ideally meets aircraft, military and industrial applications where freedom from early failure, long service life, and uniform performance are essential.

The Bendix 6094 uses pressed ceramic spacers, instead of mica, for element separation. In other tubes, deterioration of mica in contact with the hot cathode causes loss of emission which is greatly accelerated under shock and vibration. Ceramic eliminates this problem and greatly reduces damage caused by fatigue failure of parts.

For complete details on our special-purpose tubes, write today.

### **ELECTRICAL RATINGS\***

Heater voltage (AC or DC)**	6.3 volts
Heater current	0.6 amps.
Plate voltage (maximum DC)	275 volts
Screen voltage (maximum DC)	275 volts
Peak plate voltage (max. instantaneous)	550 volts
Plate dissipation (absolute max.)	12.5 watts
Screen dissipation (absolute max.)	2.0 watts
Cathode current (max. instantaneous peak value)	100.0 ma
Heater-cathode voltage (max.)	±450 volts
Grid resistance (max.)	0.1 megohm
Grid voltage (max.)	+5.0 volts
(min.)	-200.0 volts
Cathode warm-up time	45 seconds

(Plate and heater voltage may be applied simultaneously.)

\*To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously.

\*\*Voltage should not fluctuate more than ±5%.

### **MECHANICAL DATA**

Base	9 pin miniature hard glass—gold plated tungsten pins
Bulb	Hard glass—T6½
Max. over-all length	2½"
Max. seated height	2½"
Max. diameter	¾"
Mounting position	any
Max. altitude	80,000 feet
Max. bulb temperature	300°C.
Max. impact shock	500g
Max. vibrational acceleration	50g

(100-hour shock excited fatigue test, sample basis.)

wheels that pick up the resistors by their leads and transfer them to a clean conveyor chain for transport through a long baking oven. A single electric motor working through a reduction gear drives all conveyors and wheels, insuring precise synchronism of feed.

## **Packaging Resistors for Automatic Unloading**

THE PROBLEM of loading ½-watt carbon resistors into a bulk shipping carton holding 2,500 resistors, with the units neatly oriented to give an automation pack that can be fed directly into automatic handling equipment, has been solved in the Philadelphia plant of International Resistance Co. with a unique vibrator-activated loading machine.

The resistors are dumped into the



Setup used for achieving perfect alignment of resistors as they are fed into shipping carton. Operator at top distributes incoming batch of 2,500 resistors approximately equally to the five chutes of the loading machine. Operator at bottom removes loaded cartons and puts empties in position

input of this machine in bulk lots of 2,500 at a time and counted out by weighing. An operator on an elevated platform spreads out these resistors and breaks up tangled batches as they slide down a wide metal chute under the action of a motor-driven oscillating feeder. About half-way down, this chute has longitudinal partitions that align the resistors parallel with their direction of motion in five



EATONTOWN, N. J.

West Coast Sales and Service: 117 E. Providencia Ave., Burbank, Calif.  
Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.  
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P.Q.

Manufacturers of Special-Purpose Electron Tubes, Inverters, Dynamotors, Voltage Regulators, Fractional D.C. Motors and A.C. and D.C. Generators.



DIVISION OF



# MARK OF THE CRAFTSMAN...

Antonius Stradiuarius Cremonensis  
Fabricabat Anno 1716

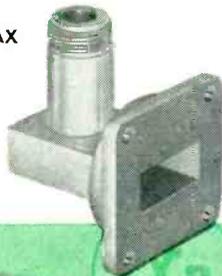
Just as the mark of the master craftsman is applied only to those articles worthy of his reputation, the FXR seal on Precision Microwave Test Equipment marks each production line unit as a masterpiece of custom craftsmanship.

## DEPENDABLE SUPPORT ITEMS FOR MICROWAVE SYSTEMS

Stradivarius aimed for the perfect violin. At FXR, the goal is perfection in microwave components. The Waveguide-to-Coax Adapter, the Directional Coupler, and the Broadband Thermistor Mount shown below were designed with excellent characteristics over the entire waveguide frequency range. They are only part of our complete line, each item of which is in its own way a masterpiece of mechanical design and electronic performance. These are products worthy of the name they carry and the industry they serve.

WAVEGUIDE-TO-COAX ADAPTER  
VSWR  $\leq$  1.25

X601B



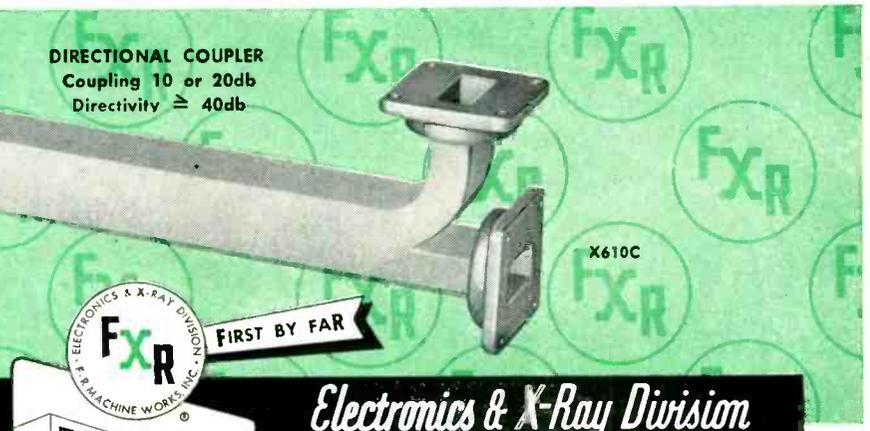
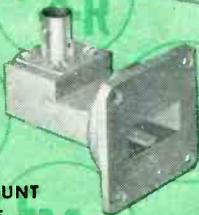
Send for the FXR catalog, showing a complete line of custom-crafted Precision Microwave Test Equipment.

DIRECTIONAL COUPLER  
Coupling 10 or 20db  
Directivity  $\geq$  40db

X610C

BROADBAND THERMISTOR MOUNT  
VSWR  $\leq$  1.5

X216A



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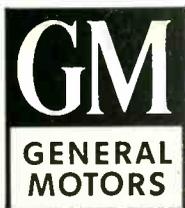
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The unusual employe benefits of General Motors are provided by this 20-year-old GM electronics division. Relocation expenses are paid. Pleasant Indiana community with excellent living conditions, schools and many other advantages. Letters held in complete confidence. Give information on education, experience, military duty and personal data.

Address: Personnel Director, Department MM



*Delco Radio*

DIVISION OF

**GENERAL MOTORS**

KOKOMO, INDIANA

rows. The resistors drop lead-first off the main chute into five narrow secondary chutes running almost vertically downward and then gradually curving to an almost horizontal angle at the output.

The secondary chutes are attached to the main chute and receive the same  $\frac{1}{4}$ -inch vibratory stroke at 490 rpm.

An operator at the output of the loading machine first places an empty cardboard carton in the holding fixture, which is mounted on a shaper mechanism. Next, she inserts in the carton a temporary alignment frame having four metal separators. These divide the shipping carton into five sections, each directly under one of the five output chutes. Finally, a sheet metal back-plate is placed over the separators and locked in place by pushing down holding clamps.

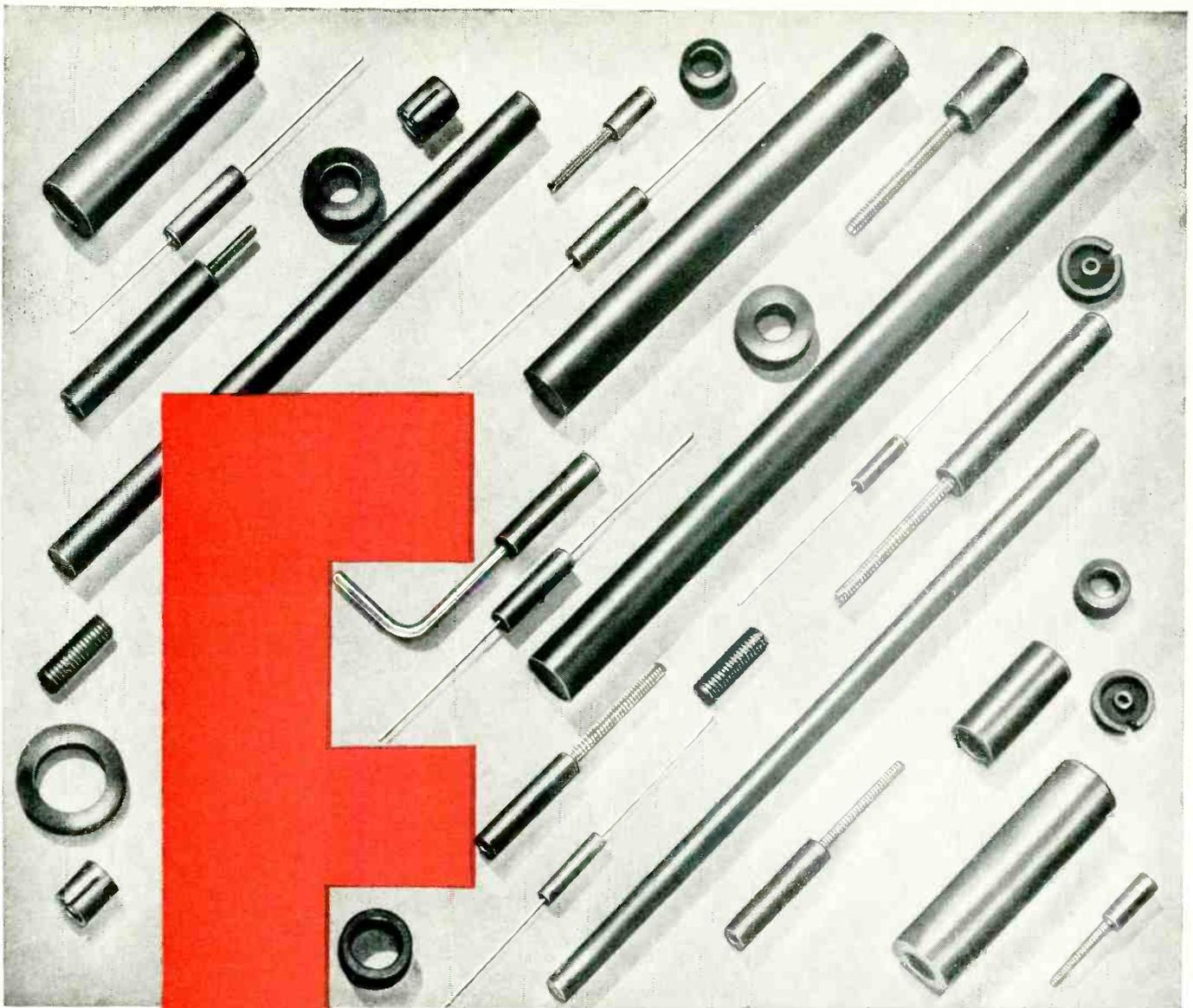
As resistors emerge from the secondary chute, they hit the back-



Placing separator frame in empty carton that rests on top of shaker mechanism



Placing baffle over separator frame



# FERRITES

*by Moldite ...*

**Whatever you need in Ferrites**

- Antenna Rods      Sleeves
- Toroids              Threaded Cores
- Cups                Coil Forms
- Cores

There is a MOLDITE quality engineered product perfect for your application.

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... and backed by MOLDITE'S reputation for highest quality and guaranteed uniformity from first to last.

*The use of a MOLDITE ferricore properly designed into a specific coil has the following advantages.*

- Lower losses (eddy current)
- Smaller sizes for more compact construction
- Higher efficiency
- Higher permeability
- Lower operating temperatures
- Less corona effect
- Lighter weight
- Lower cost



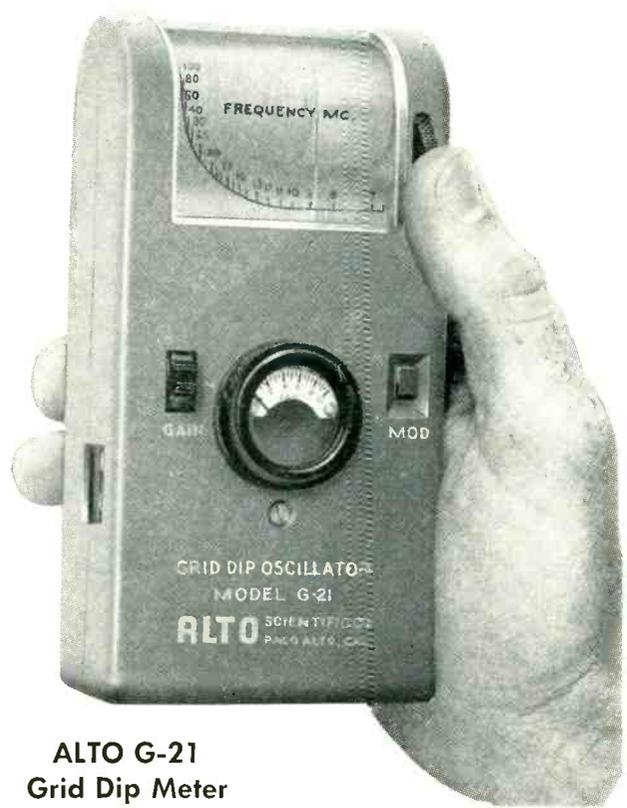
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**LOOK!**

# A 120 MC Grid Dip Oscillator You Hold in Your Hand!



**ALTO G-21**  
Grid Dip Meter  
**\$150<sup>00</sup>**

**New! 7 to 120 MC! ±5% accuracy! Transistorized!**  
**Printed Circuits! Direct reading! No plug-in coils!**  
**Rugged, battery driven, weighs 18 oz.!**

Cradle this unbelievable, feather-weight new Grid Dip Oscillator in your hand—and make transmitter, receiver or system frequency measurements with convenience never known before! Operate all controls with one hand—with your fingertips. Obtain 1 KC modulation with a flick of modulator switch (audible signal in headphones). Increase gain for good “dip” indication on front panel meter. Open the rugged, shock proof alkyd resin case; study the radical yet proven new circuitry that makes this possible.

The price? \$150—much less than a large, ac powered laboratory instrument would cost you.

Why not check the brief specifications, then write today for complete details!

**SPECIFICATIONS**

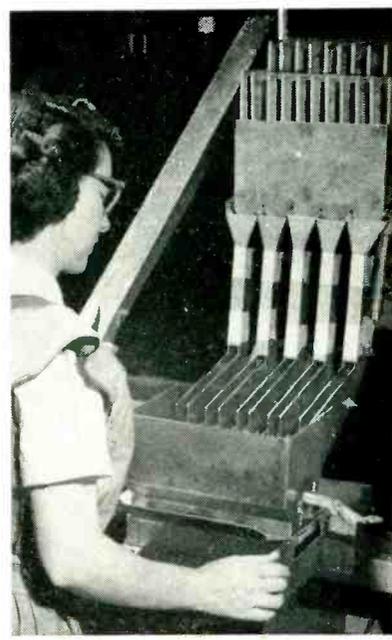
Frequency Range . . . . .	7 to 120 MC
Modulator Frequency . . . . .	1 KC nominal
Accuracy . . . . .	± 5% below 100 MC
Battery Life . . . . .	30 hrs. (continuous)
Size . . . . .	1½" x 3" x 5¾"
Weight . . . . .	18 oz., complete
Price . . . . .	\$150.00 f.o.b. factory

*Data subject to change without notice*

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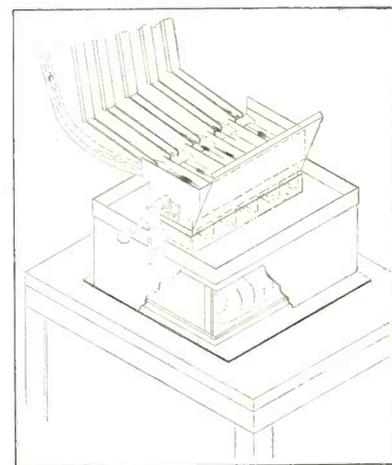
855 COMMERCIAL ST. • PALO ALTO, CALIFORNIA, U. S. A.  
DAVENPORT 44733



Resistors sliding down five output chutes hit baffle plate end-on with just sufficient momentum to drop flat into carton below, giving desired alignment of resistors in carton

plate end-on and drop into their respective compartments. While being filled, the carton and inserts are shaken by the shaker mechanism, which serves to slide the resistors back and forth so that their bodies interweave while still remaining parallel. This gives maximum utilization of carton space. A combination of 490-rpm speed and ¼-inch stroke proved optimum for keeping the resistors in perfect alignment as they drop into the shipping carton at the output of the chutes.

When all the resistors of a batch have dropped into the carton, the



Isometric sketch of shaker-box assembly and output chutes. Electric motor driving eccentric weight arrangement in box causes resistors to slide back and forth past each other in carton for maximum utilization of space



# Why we choose **WINCO** DYNAMOTORS

"Precision airborne communication equipment must have a dynamotor of consistently reliable quality . . . that's why we specify Winco."

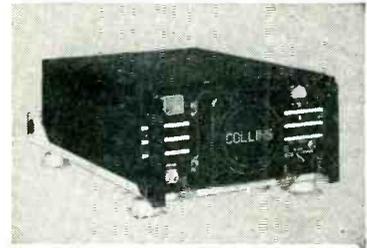
says Mr. Paul Wulfsberg,  
Ass't. Director Engineering and Research

## COLLINS RADIO CO.

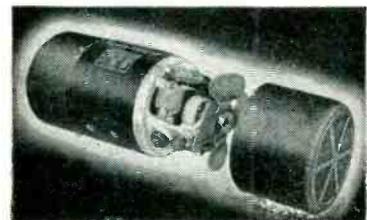
Cedar Rapids, Iowa.

WINCO DYNAMOTORS are manufactured on a wide range of rugged frames that allow for broad design applications. Winco engineers have a decade of experience in successfully designing dynamotors to rigid military and commercial specifications. They tackle each power conversion and/or supply problem individually, either modifying a standard Winco machine, or designing a special unit to meet your exact requirements. Winco specialists then plan its manufacture on a production basis to keep costs down and final performance quality at its best.

Winco dynamotors are lightweight, compact and totally enclosed and ventilated. Precise static and dynamic balance is assured by the most modern machines — each dynamotor is thoroughly tested with periodically calibrated precision meters.



Collins 185 Transmitter/Receiver, used for reliable HF communications in major air-lines and executive aircraft uses a Winco-Engineered Frame 51 Dynamotor.



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# WINCHARGER CORPORATION

Sioux City 2, Iowa

Subsidiary of ZENITH Radio Corporation

To Wincharger Corp., Sioux City 2, Iowa.

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City..... State.....

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# Questions Design Engineers ask about

**REGOHM**



**Q.** What is a REGOHM?

**A.** A compact, universal electric circuit controller of the direct-acting finger type, for voltage, speed or current regulation. (For details, see General Bulletin #505.00)

**Q.** Who uses the REGOHM?

**A.** It is specified as a component in equipment made by every major power equipment manufacturer in the United States. (Applications Manual #3.00 "Separately Excited Machines")

**Q.** Why is REGOHM so widely used?

**A.** For its almost unlimited life; its sensitivity and reaction-speed; its continuous control and rugged compactness. (Applications Manual #1.00 "Regulated Rectifiers")

**Q.** Where is REGOHM used?

**A.** In every corner of the earth where there is U. S. made equipment; at sea; under the sea; in the air, and beyond the range of human flight in guided missile applications. (Applications Manual #3.00 "Separately Excited Machines")

**Q.** When is REGOHM specified?

**A.** When performance under severely adverse conditions must be predictable mathematically. (Applications Manual #2.00 "Power Amplifiers")

**Q.** How does REGOHM compare with other kinds of regulation?

**A.**

- Many times better performance than carbon-piles, and far less bulky. (Applications Manual #506.21 "Inverter Control")
- Requires far less space than vacuum tubes and thyratrons. (Applications Manual #1.00 "Regulated Rectifiers")
- Magnetic amplifiers depend for long life on other limited-life equipment. REGOHM does not. (Applications Manual #1.00 "Regulated Rectifiers")

*Questions often asked about REGOHM are only partially answered above. Get full details by checking the free literature you want. Attach a basic circuit of your design problem. Let Electric Regulator Corporation's engineers help you design long life into tough applications.*

#### Check List

- |   |  |
|---|--|
| <input type="checkbox"/> General Bulletin #505.00                                   | <input type="checkbox"/> Applications Manual #2.00<br>"Power Amplifiers"   |
| <input type="checkbox"/> Applications Manual #3.00<br>"Separately Excited Machines" | <input type="checkbox"/> Applications Manual #506.21<br>"Inverter Control" |
| <input type="checkbox"/> Applications Manual #1.00<br>"Regulated Rectifiers"        |  |

Mail to Dept. 100

**Electric Regulator Corp., Norwalk, Conn. Temple 8-4311**



Placing corrugated cardboard over resistors in carton, after having first inserted vertically ribbed strips against ends of resistor leads to achieve pack that will not shift during shipping

operator removes the baffle and the separator assembly, takes out the loaded carton and then reloads in readiness for the next batch.

At the final carton-closing position, another operator places strips of corrugated cardboard against the ends of the leads on each side, with the corrugations vertical and exposed on the sides facing the resistors. The resultant ribbing preserves the perfect alignment of the resistors despite vibration and rough handling during shipment.

To prevent bending of leads during insertion of the ribbed cardboard strips, the operator first inserts a metal plate between the lead ends and the side of the carton. She then pushes the leads just enough with this plate so the cardboard strip can be inserted between the plate and the carton. The metal strip is then removed and the procedure repeated for the other side. An ordinary cardboard corrugated piece is then placed over the resistors horizontally and the cover is tucked in to complete the package.

### Tube-Aging Conveyor

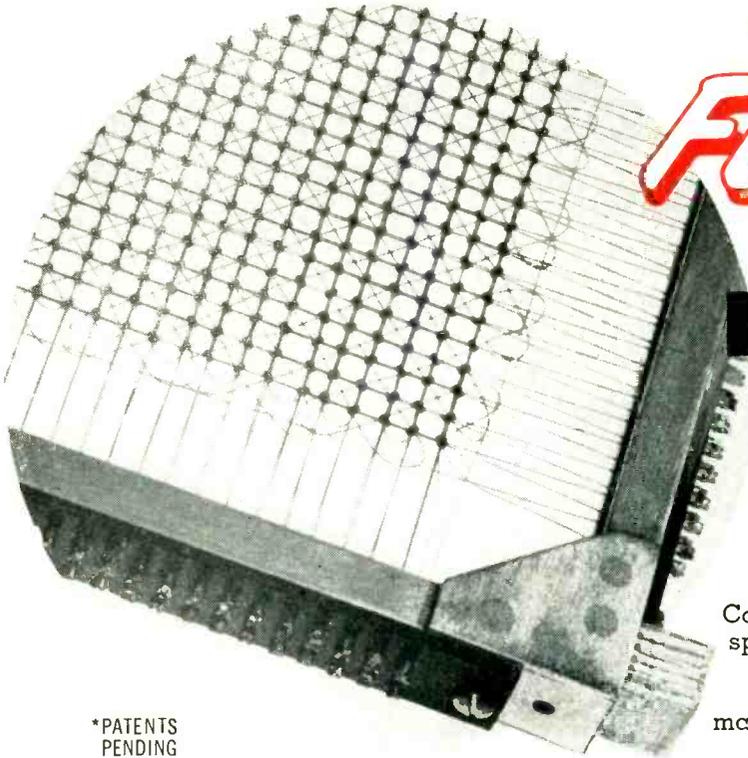
A CONVEYORIZED aging rack having sufficient design flexibility to permit use with over 20 different types of tubes is widely used in a CBS-Hytron tube plant. The mechanized

IN COMPUTERS...IT'S ACCURACY THAT COUNTS!

GENERAL CERAMICS

**FERRAMIC®**

MAGNETIC  
**MEMORY  
CORES\***



\*PATENTS  
PENDING

**One or a million, every core can be depended on for uniform electrical and mechanical characteristics**

General Ceramics has supplied all Square Hysteresis Loop Ferrite Cores for all of the presently operating large scale magnetic memories. Our experience in manufacturing these millions of Ferrite Memory Rings is available to you to help solve your problems. We can supply you with unassembled and tested cores, or with fully assembled matrices to fit your needs.

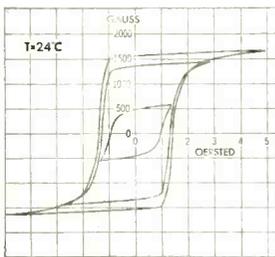


Diagram illustrates flux-current characteristics of ferrite toroid with nearly rectangular hysteresis loop. In addition to high volume resistivity and low loss factor, high efficiency is maintained at both high and low frequencies. Response time is approximately 1.0 microsecond.

**Specify FERRAMIC S-1\* and S-3\* Memory Cores — Developed and Produced by General Ceramics**

General Ceramics initiated the development of Rectangular Hysteresis Loop Ferrites, for which it has applied for patents and which it markets under the name Ferramic S-1\* and S-3\*. The application of these materials to Computer Memories has so vastly improved the speed, accuracy and reliability that this system of memory is replacing all others. The reduction in initial installation costs and maintenance have further enhanced the value of this development and has so increased the reliability and speed of digital computers that the use of this type is becoming more and more wide spread.

STANDARD CORE SIZES

SMALL F-394	MEDIUM F-426	LARGE F-262
.080" O.D.	.100" O.D.	.375" O.D.
.050" I.D.	.070" I.D.	.187" I.D.
.025" THICK	.030" THICK	.125" THICK

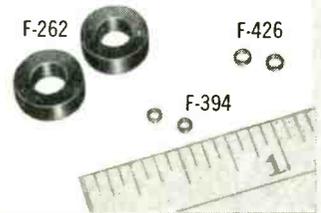


TABLE OF MAGNETIC PROPERTIES

		FERRAMIC "S-1"	FERRAMIC "S-3"
Initial permeability (1 Mc)	$\mu_0$	40	45
Maximum permeability (DC)	$\mu_{max}$	515	1800
Saturation Flux Density (DC) gauss	$B_s$	1780	2000
Retentivity (DC) gauss	$B_r$	1590	1920
Coercive Force oersteds	$H_c$	1.5 max.	.65 max.
Switching Time microseconds	$\tau$	1	>4
$B_r/B_s$ Ratio		0.90	.96
Maximum Squareness Ratio $\phi (=Im)/\phi (Im)$ 2	$R_s$	0.8	.95
Optimum Magnetomotive Force (oersteds)	$H_m$	2.0	.80



**General CERAMICS CORPORATION**  
TELEPHONE: VALLEY 6-5100  
GENERAL OFFICES and PLANT: KEASBEY, NEW JERSEY

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# Match Lines Fast!



## Sierra 136B Reflection Coefficient Meter

This compact, moderately-priced instrument gives you materially greater speed and convenience for measuring coaxial transmission line reflection coefficient, VSWR, or for matching loads to line. The instrument has high accuracy; sensitivity permits operation with any standard CW signal generator. (See Figure 1) It provides continuous monitoring of the reflected signal, is simple to operate, and sturdily built for laboratory, production line or field use. Frequency coverage is continuous from 32 to 1125 mc.

The new 136B employs the unique Sierra Wideband Directional Couplers (Model 138 for 51.5 ohms and Model 138A for 50.0 ohms) to sample incident and reflected voltage in a transmission line. A built-in superheterodyne VTVM may be switched to indicate either reflected or incident voltage directly. In the incident position, a precision attenuator calibrated directly in reflection coefficient and VSWR is inserted in the IF amplifier circuit.

**WRITE DIRECT FOR BULLETIN**

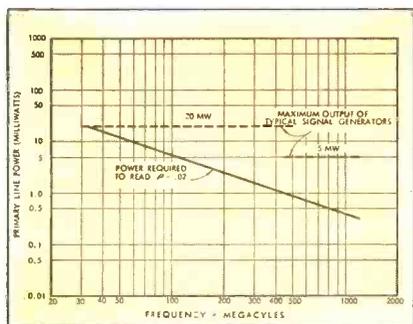


Figure 1. Sensitivity, Sierra 136B. Primary line CW power required to read reflection coefficient 0.02 as a function of frequency. Values are for Sierra 138 and 138A Directional Couplers.

Data subject to change without notice



# sierra

### Sierra Electronic Corporation

San Carlos 2, California, U. S. A.

Sales representatives in major cities

Manufacturers of Carrier Frequency Voltmeters, Wave Analyzers, Line Fault Analyzers, Directional Couplers, Wideband RF Transformers, Custom Radio Transmitters, VHF-UHF Detectors, Variable Impedance Wattmeters, Reflection Coefficient Meters.

3232



Tube-aging conveyors, moving counterclockwise, are loaded by operator at left end, who receives tubes from a chute running behind each conveyor to its corresponding seal-off machine at the right

aging system greatly reduces floor space requirements as compared to the conventional fixed racks that would be required for 100-percent aging of tube production. In addition, the machine cuts down in-plant transportation and delay cycles while allowing long aging schedules to be used.



Loading position on conveyor. Tubes come down a chute at rear from seal-off machine and roll off chute down table to within easy reach of operator

After tubes have been finished and exhausted, they travel down a chute from the seal-off machine to one end of the aging conveyor. Here an operator picks up the tubes and loads them into sockets on the conveyor. Under each socket panel is a lamp bank, connected so that lamps are in series with the elements of the tubes.

As the aging conveyor moves slowly counterclockwise, various voltages are picked up through sliding contacts on segmented busbars. These voltages are set up beforehand with controls on the center



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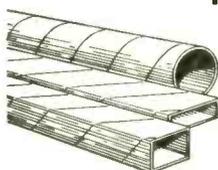
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PRODUCTION  
COSTS  
with  
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### PRECISION LOW COST PAPER TUBES



Order in any length, size, shape, I.D. or O.D. and in any quantity. Precision Paper Tubes are crush resistant and light weight, with excellent dimensional stability. They are fabricated to the same high standards governing Precision Bobbins.

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- Upstate New York: Syracuse, New York, Syracuse 4-2141
- Northern Ohio, Western Penn.: Cleveland, Ohio, Atlantic 1-1060
- Indiana, Southern Ohio: Logansport, Indiana, Logansport 2555
- California: Pasadena, California, Sycamore 8-3919
- Canada: Montreal, Quebec, Canada, Walnut 0337



**PRECISION PAPER TUBE CO.**

2041 W. CHARLESTON ST. CHICAGO 47, ILL.  
Plant No. 2: 79 Chapel St., Hartford, Conn.

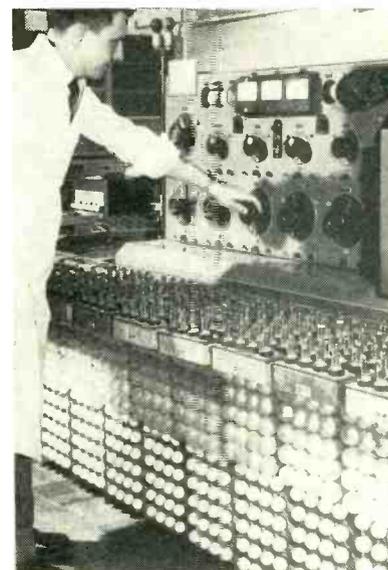
panel inside the oval of the conveyor.

The tubes being aged travel about three-quarters of the distance around the conveyor, to two test stations. At each there is one operator who removes the tubes, makes a quick shorts test, then



Preheat and test stations alongside output end of conveyor. Hexagonal preheating fixture has six panels, each holding nine tubes, and is rotated manually

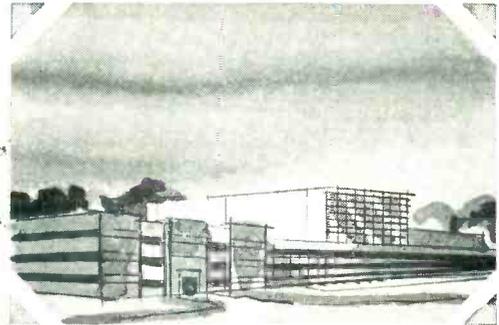
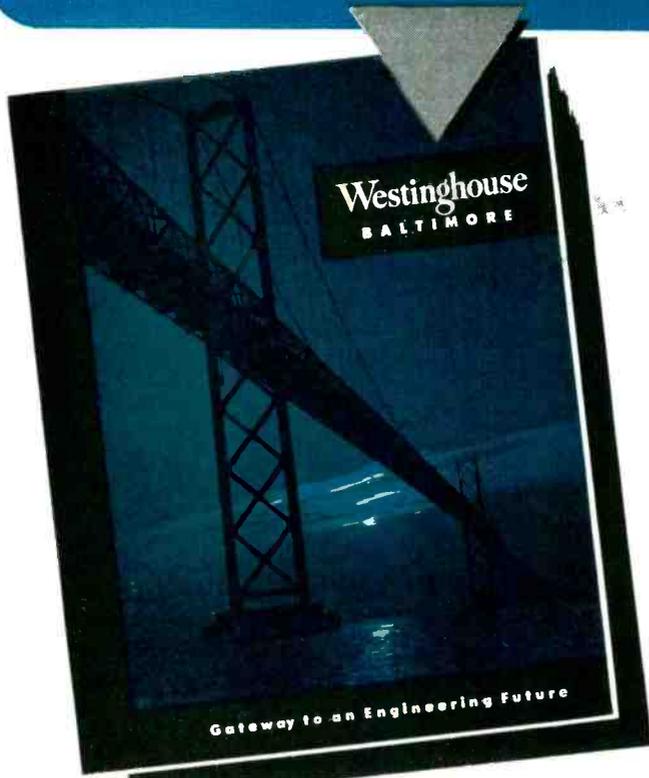
plugs them into a hexagonal preheater. The second operator at a test station takes tubes from the preheater and performs the final tests. The preheater is rotated manually counterclockwise by the first operator when she has filled one of its panels, thereby bringing another panel of preheated tubes in front of the second operator for testing.



Setting controls that determine aging voltages applied to tubes along each section of conveyor. Tube socket panels and associated lamp banks are easily unhooked from conveyor for changing over to others for a different tube type

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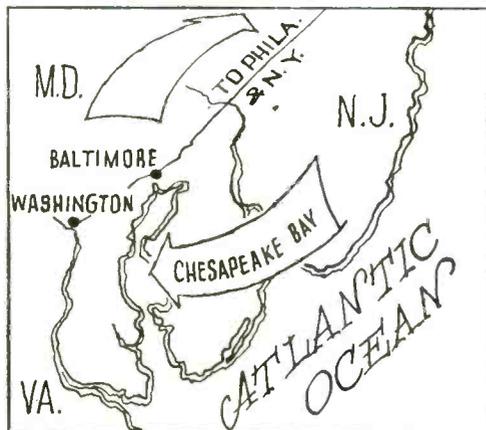
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# New Products

Edited by WILLIAM P. O'BRIEN

80 New Products and 43 Manufacturers' Bulletins Are Reviewed  
. . . Control, Testing and Measuring Equipment Described and  
Illustrated . . . Recent Tubes and Components Are Covered

## MICROWAVE OSCILLATORS

RAYTHEON MFG. Co., Waltham 54, Mass. Known as backward-wave oscillators, these tubes sustain oscillation by energy interchange between an electron beam and a guided electromagnetic wave. Conventional applications include local oscillators, sweep-frequency signal generators, high-speed afc circuits and laboratory microwave signal

offer wide-range tuning



sources. The new tubes outperform other microwave oscillators not only in bandwidth capability (with a single type covering a 2,000-mc range), but also in low pulling figure, freedom from hysteresis and long-line effects, and freedom from spurious modulation when modulated at high frequencies. These tubes will find applications in mobile tv relays, and as modulators for terminal stations of microwave radio links.

## POWER TETRODE

is the radial-beam type



EITEL-MCCULLOUGH, INC., San Bruno, Calif., has available the Eimac 4X250B, a radial-beam power tetrode unilaterally interchangeable with the 4X150A in nearly all cases. This new bantam, cooled by convection and forced air, is intended for modulator, oscillator, amplifier and frequency multiplier application at all frequencies into uhf. Its integral-finned anode, plus other design improvements, make it con-

siderably easier to cool than the 4X150A. A newly designed, highly efficient oxide cathode and the lower seal temperatures enables the 4X250B to meet the most critical standards. Electrical advancements permit an increased plate dissipation rating of 250 w, plate voltages to 2,000 v and doubled plate power of 500 w. A single 4X250B in a coaxial-cavity amplifier circuit will deliver up to 300 w of useful power output at 400 mc. Its high transconductance makes the tube useful at relatively low plate voltages.

## RASTER TIMER

for physical problem study

AMERICAN ELECTRONIC LABORATORIES, INC., Philadelphia, Pa. The oscilloscope display timer makes possible detailed study of phenomena separated in time. Applicable to a variety of special physical problems, these units may be used for sonar, geophysical research, system control reactions, electrophysiological research and many other studies. The device provides the ordinary oscilloscope with a time-base in the form of a 10-line raster containing accurate timing calibra-

tion markers. Two models are available. The raster timer 101 has a raster range of 10 ms to 0.1 sec and a sweep range of 1 ms to 10 ms;



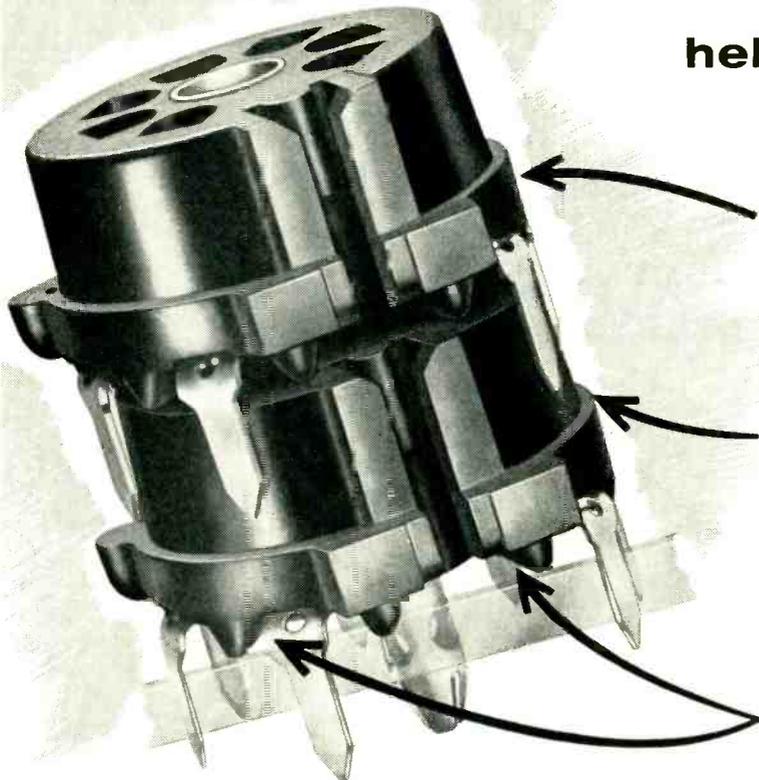
the 101A has a raster range of 1 to 50 sec and a sweep range of 0.1 to 5.0 sec. Timing calibration markers in both units are controlled to 0.1 percent or better. Both models are packaged suitable for rack or bench use.

## NEW TUBE TYPES for tv circuits

SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa., announces two new tubes for vertical and horizontal tv

# 3 ways better...

One look tells you 3 ways this new Sylvania socket can help you produce a better printed circuit chassis



## 1. "It supports"

new collar design supports the metal tube shield isolating it from the printed circuit board and contact tails. Short circuits are eliminated.

## 2. "It stacks"

designed for foolproof nesting to accommodate automatic assembly techniques. Ground-strap slot keys sockets for proper orientation.

## 3. "It sits up"

contact-tail barriers keep the socket perched higher off the printed circuit board for greater heat dissipation and freedom from flux contamination.

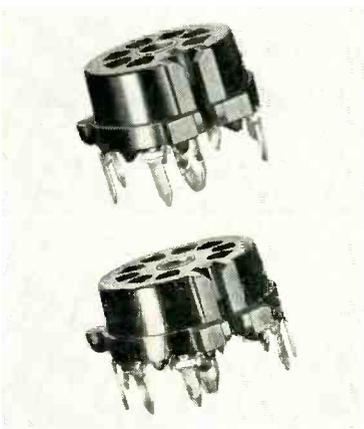
← Available in 7- and 9-pin types

Sylvania printed circuit sockets offer you all the important advantages you need for design efficiency. You get freedom of layout. Contacts fit through smaller holes in the circuit board. You can arrange your circuits for shortest conductor paths.

Sylvania sockets are all-molded. Moisture traps are eliminated; insula-

tion qualities are higher. Contact characteristics are superior. Printed circuit production is more economical because Sylvania sockets are designed for automatic production methods.

Before you package your printed circuit design be sure you take a close look at these sockets. Write for data or samples. Address Dept. K20S.



# SYLVANIA<sup>®</sup>

SYLVANIA ELECTRIC PRODUCTS INC.  
1740 Broadway, New York 19, N. Y.  
In Canada: Sylvania Electric (Canada) Ltd.  
University Tower Bldg., Montreal

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circuit applications. Type 6CS7 is a miniature 9-pin, medium  $\mu$ , dual triode with dissimilar sections and is suitable for vertical deflection and oscillator applications using conventional transformer supply voltage. The output section has a plate dissipation rating of 6.5 w,

high perveance, and an absolute peak positive pulse plate voltage of 2,200 v. The other triode section of this dual purpose tube is intended for service as an oscillator, detector or amplifier. The tube is also designed for series string or conventional parallel operation. The

25DN6 is a beam power pentode rated for tv service as a horizontal deflection amplifier and was designed particularly for use in off-the-line series string sets utilizing low B+ voltages. The tube has a desirable low plate knee characteristic at zero bias.

## PHASE COMPARATOR

for lab or production line

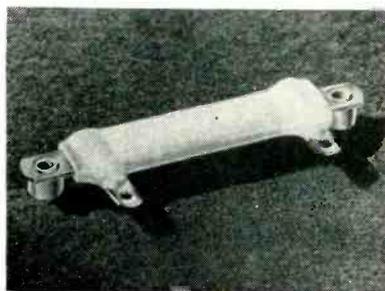
LINK AVIATION, INC., Binghamton, N. Y. Model 201 phase comparator, for accurate phase measurement in the laboratory or on the production line, is designed especially for use in the computer field where phase shift is an important factor. The instrument permits precision measurement of phase relationship of in-phase and out-of-phase voltages, measuring input voltages from



1.0 to 120 v through a frequency range of 60 cycles to 400 cycles with an accuracy of 0.33 milliradian at 400 cycles and 0.1 milliradian at 60 cycles. Effective angle of phase comparison is  $+1$  radian around 0 and 180. A null voltage measurement on a vtvm provides the phase angle measurement. Model 201 is ideal for phase measurements of transformers, amplifiers, tach generators, resolvers, synchro control transformers and analog computer circuitry.

## POWER RESISTOR

has built-in mountings



WARD LEONARD ELECTRIC Co., 115 MacQuesten Parkway South, Mt. Vernon, N. Y. The Ministrip 20-w miniature power resistor has been added to the Stripohm resistor line. Each resistor has a strong oval shaped ceramic core on which a special alloy resistance wire is wound and silver brazed to tightly banded tab terminals. Winding is sealed

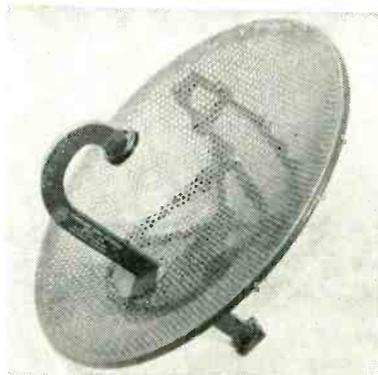
and protected by Vitrohm vitreous enamel. Nonremovable solid brass brackets extend through the core supplying a convenient, simplified method of mounting. Features include: space-saving design; low, built-in mounting brackets; and oval-shaped core for maximum strength. The resistors are conservatively rated at 20 w based on 300 C rise. They feature stock resistance values to 50,000 ohms maximum, tolerance  $\pm 5$  percent.

## ANTENNAS

can be used as laboratory tools

COLOR TELEVISION, INC., 935 E. San Carlos Ave., San Carlos, Calif. Parabolas (as illustrated), horns, dipoles and dipole arrays with precision gain calibration to 0.2 db are now offered as accurate laboratory tools to be used in the determination of propagation gain. The various types cited cover the frequency spectrum from 100 mc to 50,000 mc. From 2,600 to 50,000 mc, and for gains of 20 db and more, parabolas are generally used. For lower gains in the same frequency region, horns are most widely useful, and can be supplied

on short delivery in a series of nine sizes covering the commonly used microwave frequencies. For the



frequency spectrum down to 100 mc, dipoles and dipole arrays are provided. Special requirements as to frequency, gain and mechanical design can be met on all these antennas.

## GAS THYRATRON TUBE for motor-control service

RADIO CORP. OF AMERICA, Harrison, N. J. The 3D22-A is a gas thyatron tube of the negative control type. The sensitive four-electrode thyatron with indirectly heated cathode was designed for use in relay and grid-controlled rectifier

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the revolutionary  
**ELECTRO TEC**  
 process\* for your  
**LARGE**  
**SLIP RING ASSEMBLIES**

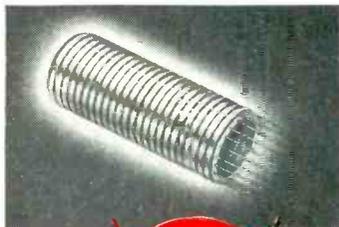


↑ An assembly with 14 concentric, hard silver rings electro deposited into machined plastic blank. Dovetail locks rings in place. Machined blank insures accuracy. Diameter approx. 11", thickness approx. 5/16".

→ Cylindrical assembly with 25 rings. Three wide rings accommodate large contact brushes for high current capacity. Length 14", O.D. approx. 5 3/8".

→ An assembly with 30 rings of various widths to accommodate various current requirements. Unit is approx. 4-5/16" long, designed for flange mounting.

→ Cylinder type assembly approx. 3 3/4" long with 24 hard silver rings. 1 3/8" O.D. with wall thickness less than 1/4".



\*PAT. NO.  
2,696,570

Our Engineering Department is available for consultation on any of your slip ring problems without obligation.



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*featuring*

- LOWER COST • CLOSED TOLERANCES
- ONE-PIECE CONSTRUCTION • JEWEL-LIKE FINISH • UNIFORM RING HARDNESS
- REDUCED WEIGHT



**Now a Complete Service  
 in all sizes of Slip Ring Assemblies**

ELECTRO TEC is now tooled up, with new expanded facilities for production of large Slip Ring Assemblies to exact customer specification. Sizes range up to 36" in diameter, either cylindrical or disc type.

The exclusive ELECTRO TEC PROCESS\*—the electro-deposition of hard silver rings into an accurately machined plastic blank—consistently yields a high degree of dimensional accuracy, excellent concentricity, and a jewel-like ring finish. This process also eliminates expensive tooling and mold charges, frequently lowers costs to 30% of other methods of manufacture. The silver rings are uniformly hard for long life—70-95 Brinell.

ELECTRO TEC one-piece construction precludes dimensional variation due to accumulated errors. The plastic base is fully cured before rings are plated into it, thus preventing separation of base material from the rings.

ELECTRO TEC LARGE SLIP RING Assemblies are widely used in Radar Equipment, Fire Control Systems, Test Tables and many other critical applications. Light weight combined with rugged durability recommends their use in airborne applications.

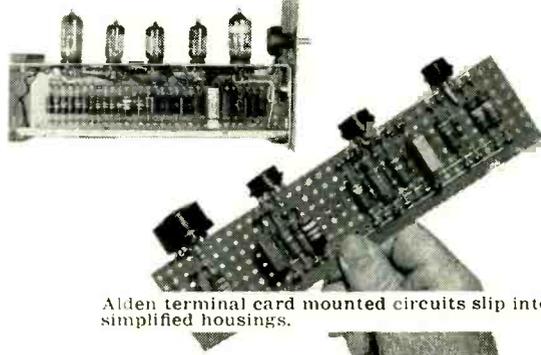
Every user knows the ELECTRO TEC reputation for quality and superiority in miniature and sub-miniature slip ring assemblies.

# Ideas, Techniques, Designs

from the Alden Handbook of mechanical components to mount, house, fasten, connect and monitor electronic circuitry.

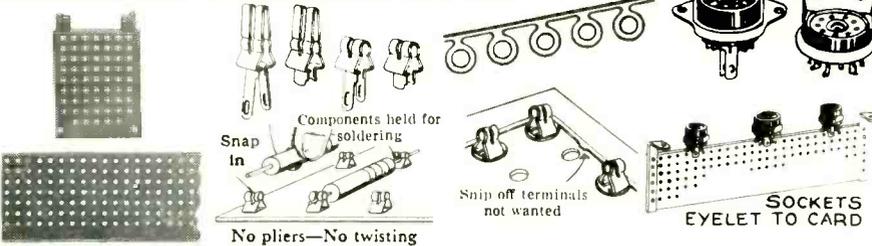
## Making terminal cards your electronic chassis

Now for the first time, using standard Alden Terminal Mounting Card Components, you can mount all circuitry elements including vacuum tubes and other plug-in sockets directly on terminal cards with all their associated components . . . to have a construction that for all intents and purposes makes your terminal card the complete electronic chassis by itself.



Alden terminal card mounted circuits slip into simplified housings.

It's as simple as this — you start with these standard Alden Terminal Mounting Card Components in your lab:



- 1 You take the Alden Pre-punched Terminal Mounting Cards and plan your component locations on planning sheets.
- 2 Choose the Alden Miniature Ratchet Terminals that fit your components, and stake them per pattern using lab staking tool.
- 3 Use Jumper Strip staked under terminals to eliminate wiring to common circuit.
- 4 Bracket and turret mounting Tube Sockets eyelet directly to the card.

Simply and easily you end up with beautiful sub-assemblies of completed circuitry. If you wish, Alden will handle the volume staking production, delivering to you the cards with all terminals, jumpers and sockets staked into position.

By making the Terminal Card your chassis, you —



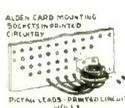
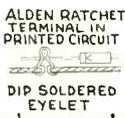
- 1) Eliminate point-to-point chassis wiring.
- 2) Make your circuitry simple unit sub-assemblies . . .
- 3) . . . that mount compactly in chassis as accessible rows of wiring.

## It's a simple step to printed circuitry

Once your circuitry is organized on Alden Terminal Cards it's a simple step to go to printed wiring for your volume requirements. All components are in a single plane, components are oriented for easy insertion into printed circuit holes—this orientation is even most favorable for automated component assembly.

Even in printed circuitry, Alden Ratchet Terminals may be used as stand-off terminals for leads— isolation of heat sensitive components—or for components that must be removed without disturbing the printed circuitry solder.

For printed circuits, Alden Card Mounting Sockets are available with pigtails on each contact. These pigtails simply insert in printed circuit holes for dip solder connection.



## Simple circuitry packaging

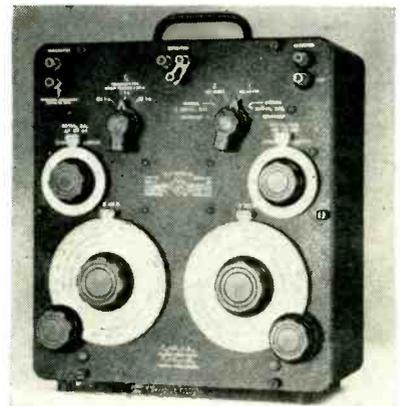
By organizing all circuitry in single planes, packaging problems are tremendously simplified by permitting their mounting in close spaced rows in metal chassis. The metal chassis now returns to its proper function of being a protective housing, like a watch case — and your circuitry, though taking little space, is accessible for easy checking, removal or replacement — with spare circuit cards being small enough to airmail.

For those who would like standard housing for their card mounted circuitry, Alden Basic Chassis are available to group your circuitry function by function as plug-in replaceable units.

To get the whole story, write to us for the latest Alden Handbook specification sheet on the Alden Terminal Card mounting and let us know what your particular problems are so we can send specific information.

**ALDEN PRODUCTS CO.**  
3127 N. MAIN ST., BROCKTON 64, MASS.

applications, particularly those involving motor-control service. In power control service it is operated so that its output voltage to the load is varied by varying the time of firing during the a-c input cycle. When used for d-c voltage control, two 3D22-A's in a full-wave circuit with resistive load are capable of handling up to 660 w at a d-c output voltage up to about 410 v. When used for a-c voltage control, two of the tubes in a full-wave circuit are capable of handling up to 800 w. The 3D22-A uses a T16 bulb and can be mounted in any position. It is 4 5/8 in. long, with a maximum diameter of 2 3/8 in.



## Z-Y BRIDGE measures a-f impedance

GENERAL RADIO Co., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1603-A Z-Y bridge can be balanced for any impedance connected to its terminals. From short circuit to open circuit, real or imaginary, positive or negative, a bridge balance can be obtained with ease. Nominal accuracy of the bridge is 1 percent over the 20-cycle to 20-ke range. The bridge reads directly the resistive and reactive components, or the conductive and susceptive components, depending on the value of the unknown. An outstanding feature of the bridge is its ability to measure impedances which are grounded, ungrounded or balanced to ground. Price is \$335.

## PRINTED CIRCUIT KIT available in several sizes

TECHNIQUES, INC., 135 Belmont St., Englewood, N. J. Designed pri-

**MISSILE TEST EQUIPMENT** For over ten years Farnsworth has participated in the design, development, and production of guidance and control systems and special test equipment for such missile programs as Terrier, Talos, Sparrow, and others. Numerous "firsts" in this field have been accomplished as a result of contributions in the form of missile receivers, control systems, power supplies and complete system analyses.

**INDUSTRIAL TELEVISION** Standard model 600A is the result of Farnsworth's more than 30 years experience in the design and production of complex military and industrial equipment—engineered especially for industrial, educational and business use.

**IMAGE CONVERTER TUBES** Used in any application where it is necessary or desirable to "see in the dark." Convert an infrared image into a visible image. Applications: medical and biological research, hot-body observation, temperature distribution, crime detection, security, and photography.

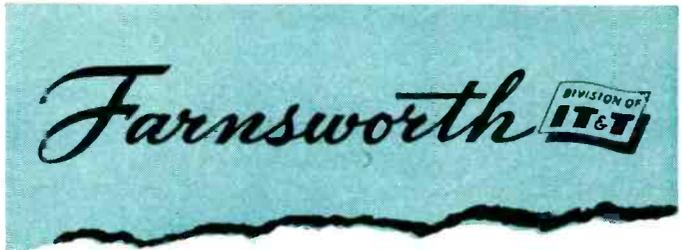
**INFRARED VIEWER** This unique, compact, easy to handle viewer is a valuable tool for crime detection, research and industrial application. Observation of objects or scenes in the dark is easily accomplished when they are illuminated by infrared radiation.

**PHOTOMULTIPLIER TUBES** Responsive in the near infrared spectrum featuring sensitivities as high as 50 amperes per lumen of incident radiation. Applications include photometric measurements for industrial and scientific uses.

**IMAGE DISSECTOR** A highly versatile TV camera tube particularly well adapted for use as a slide or facsimile scanner. This tube can be constructed in a variety of types to meet special requirements.

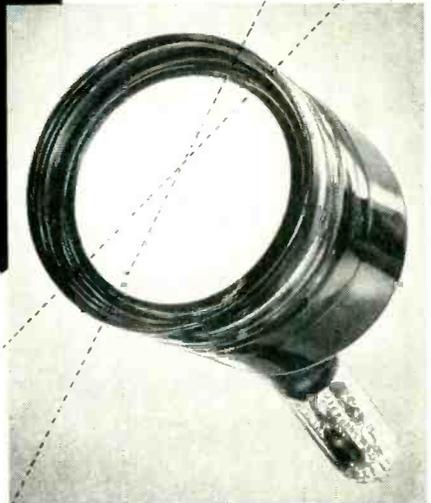
**RADAR RANGE CALIBRATOR, AN/UPM-11A** A precision instrument incorporating both "Radar" and "Beacon" functions. The equipment operates as a radar transponder in that pulsed r-f energy fed into the equipment results in a series of return echo pulses being fed back from the equipment to the radar under calibration. This simulates radar targets at accurately determined ranges.

**PORTABLE CABLE TESTER** Designed for testing all radio frequency cables that will accommodate, or can be adapted to, type "HN", "N", or "BNC" connectors. It will supply a d-c voltage up to 12,000 volts provided the current drain is negligible, and current surges of at least 3,000 amperes peak into a load of 0.05 ohm at room temperature.



*vision . . . beyond the range of sight . . .*

This is the Farnsworth  
**iatron**  
*the tube with*  
**SUN-LIKE BRILLIANCE  
AND MEMORY, TOO!**



- BRILLIANCE!** Display brilliance up to 10,000 foot-lamberts. Ideal for projection purposes.
- MEMORY!** Image storage and presentation of several minutes duration. Operator-controllable.
- RESOLUTION!** Excellent detail. 300 TV lines.

*Write Dept. F-21 for complete details.*



**RESEARCH**

Applied Physics, Circuit Research, Solid State Physics, Low Temperature Physics.



**RADAR**

Transmitters and Receivers, Computers, Microwave Components, Pulse-Coding and Circuitry.



**ELECTRON TUBES**

Photomultipliers, Storage Tubes, Image Tubes, Infrared Tubes.



**MISSILE**

Guidance and Control Systems, Test Equipment.

**Another Farnsworth achievement . . .**

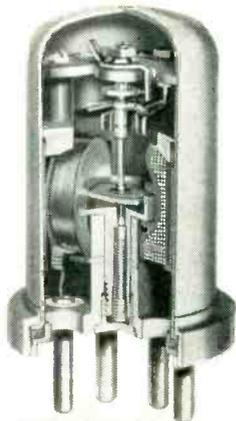
one of many complex electronic products developed, designed and produced for defense and industry . . . backed by over a quarter of a century of continuous success and leadership in the field of electronics . . . the key to amazing tomorrows.

**FARNSWORTH ELECTRONICS COMPANY • FORT WAYNE, INDIANA**  
*a division of International Telephone and Telegraph Corporation*

Thomas A. Edison

A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

When you need  
**more** than a relay  
consider the **Edison 219**



So sensitive — so sure in action is the new EDISON 219 Sensitive Control Relay that it actually eliminates the need for a vacuum tube amplifier. Because of low operating power level, the Model 219 can operate *directly* from a thermocouple or photo-cell output. And this extreme sensitivity is matched with compact design and relative lightness in weight.

Designed and developed in the world-famous EDISON Laboratory, the new Sensitive Control Relay has proven reliability in military and commercial applications.

Important features of the EDISON Model 219 include:

**extreme versatility** — interchangeable coils can be supplied with resistances from 0.5 to 23,000 ohms. Normal closing power may be increased 10,000 times without adverse effects.

**absolute stability** — repeatability averages about  $\pm 1.5\%$ .

**platinum-iridium contacts** — either SPST or SPDT, with capacity of  $\frac{1}{2}$  ampere at 28 volts DC, non-inductive.

**maximum vibration resistance** — relay will withstand shock of 50 g's in all planes without damage.

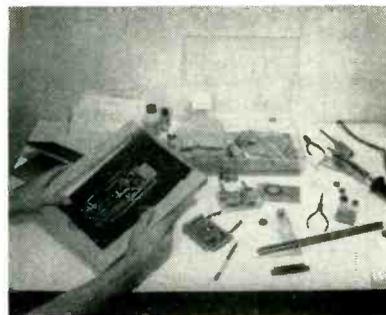
Simplify your design problems by writing for complete data on the new EDISON Model 219 — today!

**Thomas A. Edison**  
INCORPORATED

INSTRUMENT DIVISION • 54 LAKESIDE AVENUE • WEST ORANGE, NEW JERSEY

NEW PRODUCTS

(continued)



marily as an aid in prototype development, this comprehensive kit of materials will enable industrial and research laboratories to process their own etched-wire printed circuit models. An assortment of sizes of XXXP copper-clad phenolic laminate is provided, including double surfaced as well as single surfaced boards. Special printed circuit tube sockets of 10 different types will allow design engineers to experiment with numerous variations of model design.



### SIGNAL GENERATOR with a 10-500 mc range

MARCONI INSTRUMENTS, 44 New St., New York, N. Y. Model TF-801B signal generator, with a frequency range from 10 to 500 mc, features longer oscillator tube life, high output (2 v), down to  $0.1 \mu\text{v}$ , low f-m insured by tuned amplifier, 50-ohm output from piston attenuator calibrated in volts, db and dbm, internal modulation 0 to 90 percent metered, external modulation from d-c to 3 mc maximum. The unit has capacitance-coupled, contactless coil turrets.

### IMPEDANCE METER tests 5-mc quartz crystals

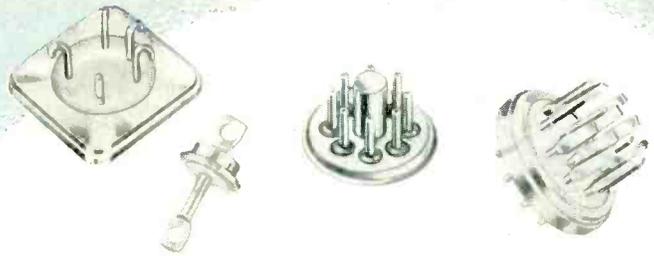
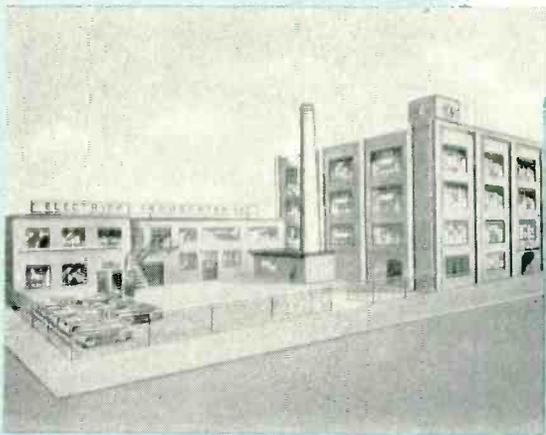
RADIO FREQUENCY LABORATORIES, INC., Boonton 3, N. J. Model 991 crystal impedance meter is designed

# E-I

OFFERS...

## 8 DESIGN ADVANTAGES

**Cushioned Glass Construction**  
**High Dielectric Strength**  
**Design Standardization**  
**Vacuum Tight Sealing**  
**Vibration Resistance**  
**Super Durability**  
**Maximum Rigidity**  
**Miniaturization**



## - and COMPLETE FACILITIES

**MAIN PRODUCTION FACILITIES IN NEWARK, NEW JERSEY**  
The Newark plant houses the main engineering and production facilities at E-I. Designing, tooling and assembly departments include the most modern methods and equipment known to industry, today.

**CONTINUING RESEARCH KEEPS PACE WITH INDUSTRY'S NEEDS.** The complete research laboratory located in Irvington-on-Hudson in New York assures products that anticipate the ever more critical requirements of the electronic industry.

**THE HICKSVILLE PLANT ON LONG ISLAND IS EQUIPPED** for all types of electronic production. The Hicksville facility is one of the oldest producers of transmitting tubes, x-ray tubes, magnetrons and all forms of glass-to-metal seals.

**E-I HEADQUARTERS**—for Compression Seals, Multiple Headers, Sealed Terminals, Condenser End Seals, Threaded Seals, Transistor Closures, Miniature Closures, Color Coded Terminals, etc.

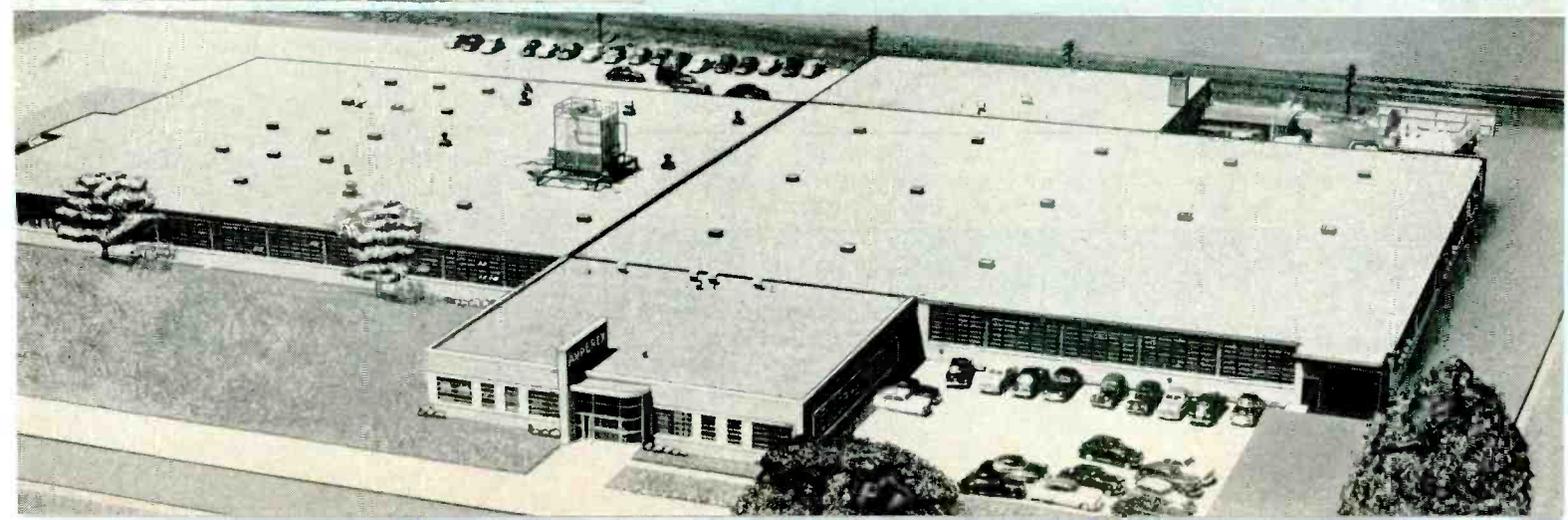
*One dependable source  
for all hermetically sealed  
terminal requirements*

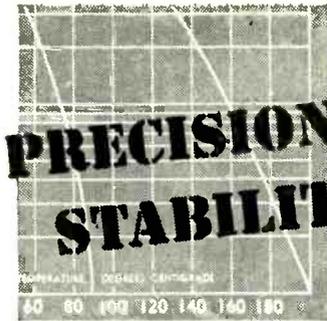
**ELECTRICAL  
INDUSTRIES**



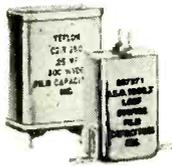
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Division of Amperex Electronic Corp. — 44 SUMMER AVE., NEWARK 4, N. J.





**Signposts of Quality that make F.C.I. Capacitors ideal for exacting applications.**



**POLYSTYRENE and TEFLON CAPACITORS**

For applications where the ultimate in low power factor, low soakage, high IR, and high capacitance stability are of vital importance. Voltage ranges from 100 V up; operating temperatures to 85° C for Polystyrene; to 200° C for Teflon.



**ADJUSTABLE CAPACITORS**

Designed for circuits requiring large capacitances at close tolerance. They provide instantaneous capacitance changes without subsequent drift. Adjustments can be made within ±1.5% of nominal value. Non-inductive windings minimize power factor and soakage. Electrical characteristics same as fixed polystyrene capacitors.



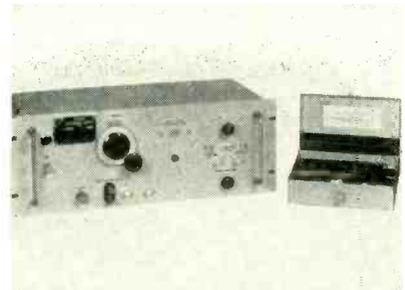
**HIGH VOLTAGE CAPACITORS**

Employ a "high-breakdown" plastic film producing capacitors remarkably smaller and lighter than previously available. Operation at temperatures to 125° C, with voltages from 2 to 60 KV. Hermetic glass tube housings with wire leads or threaded stud mountings.

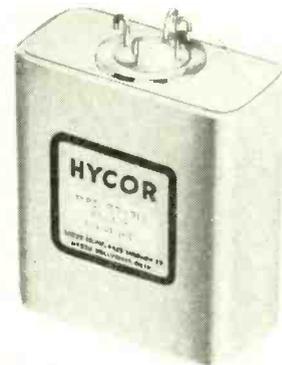


**MINIATURE CERAMIC CAPACITORS**

Mylar\* dielectric capacitors housed in ceramic jackets with thermosetting plastic end fill. Specially impregnated to minimize temperature coefficient. Insulation resistance is maintained under the most severe conditions of temperature and humidity. \*Du Pont trademark



to test the recently developed 5-mc overtone quartz crystals used in primary frequency standards. The oscillator circuit suppresses oscillation at undesired frequencies and provides the required gain and phase shift. An avc type circuit controls the drive level on the crystal. With a close tolerance oven and a 5-mc overtone crystal, the model 991 becomes a primary frequency standard. The equipment consists of a crystal oscillator circuit, a crystal drive level control circuit, a standard front panel test network, and an electronic regulated power supply. Fifteen precision calibrating resistors ranging in value between 100 and 200 ohms are supplied in a small metal box. Overall dimensions of the meter are 19 in. long by 10½ in. wide by 7 in. high.



**TRANSFORMERS with up to 10 ratio taps**

HYCOR Co., Inc., 11423 Vanowen St., North Hollywood, Calif., announces a cataloged line of miniature precision voltage ratio transformers. The precision units are specially useful where voltage division or multiplication is required to accuracies up to 0.01 percent. They are available in plastic encapsulated form or in hermetically sealed cases. Units having up to 10 ratio taps are available. Accuracies are

**ELECTRICAL CHARACTERISTICS**

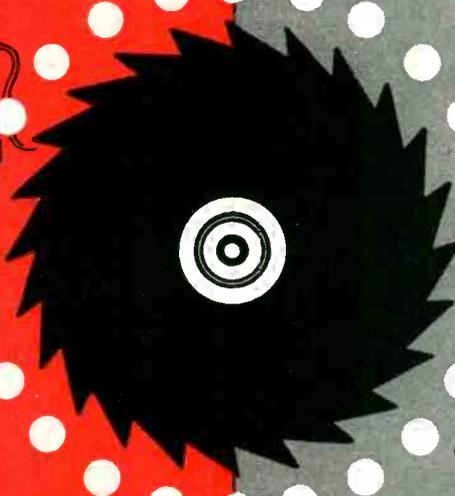
	POLYSTYRENE	TEFLON	H.V.	MINIATURE MYLAR
Operating Temp. Range	-55°C to +85°C	-55° to +200°C	-55°C to +125°C	-55° to +125°C
Voltage Range, D.C.	100 to 30,000	100 to 30,000	600V to 60KV	100-600V
Capacitance Range	.001 to 20 MF	.001 to 20 MF	.0001 to 0.1 MF	.0001 to 1.0 MF
Power Factor	.02% @ 1KC	.02% @ 1 KC	0.3% @ 1 KC	0.3% @ 1 KC
Dielectric Absorption	.01%	.01%	0.1%	0.1%
Voltage Derating at 85°C	none	none	30%	none
Voltage Derating at 125°C	not operable	none	66%	30%
Voltage Derating at 150°C	not operable	none	not operable	not operable
Voltage Derating at 200°C	not operable	33%	not operable	not operable
Temperature Coefficient	-100 PPM/°C	-100 PPM/°C	+500 PPM/°C	+60 PPM/°C up to 70 C
I.R. at Room Temperature	10 <sup>7</sup> megohms/MF	10 <sup>7</sup> megohms/MF	10 <sup>7</sup> megohms/MF	10 <sup>7</sup> megohms, MF
Capacitance Stability	0.1%	0.1%	0.5%	0.2%

When your industrial capacitors specs. call for precision and stability, specify FCI. Excellent delivery on standard or special types—Capacitors made to your specifications. For more complete technical data, write for catalog.



the switch is ON to

**GUARDIAN**



GUARDIAN

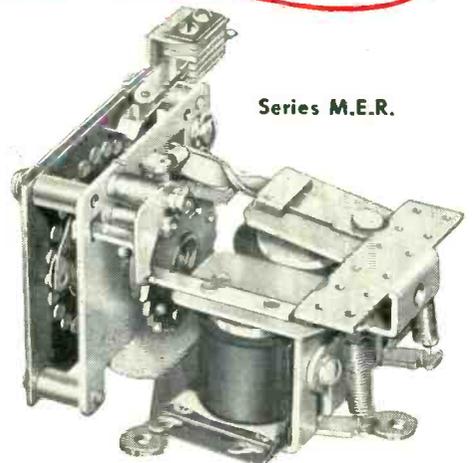
*High Precision*

**STEPPERS**

These *high precision* standard Guardian Steppers afford positive selection and control of multiple circuits in Business Machines, Counting Devices, Totalizers, Computers and a vast array of similar products *at low cost*. Applications include: automatic circuit selection; automatic sequence selection of circuits; automatic sequence cross-connection of circuits.

**SERIES M. E. R. GUARDIAN MIDGET ELECTRICAL RESET STEPPER**

Keeps the reset magnet open, allows the ratchet to reset freely on a pulse of 10 milli-seconds. Stepping magnet releases lock mechanism on first step to ready unit for recycle. Standard unit has one disk with one finger rotating counter-clockwise. Two fingers available. Up to 21 of total 24 points on disk are active. Rated at 10 steps per second. Voltage ranges: 6 v. to 115 v. A.C., 60 cycles, or 6 v. to 110 v. D.C. Auxiliary small combination contact switches can be mounted on ratchet or on either magnet. New 3-point mounting for easy installation.



Series M.E.R.



Series M.A.S.

**SERIES M. A. S. STEPPER**

A compact dependable Add and Subtract unit. Up to 27 active points on total of 30. Rated at 10 steps per second. S.P.D.T. contact switch can be mounted on any ratchet position or on either magnet. Available to operate on 6 v. up to 115 v. A.C., 60 cycles, or from 6 v. 110 v. D.C.

**SERIES M-120 STEPPER**

Up to 3 position contact combinations are available on the Guardian Series M-120 Stepper. 24 point ratchet employs case hardened steel construction to assure long life precision operation. Contact combinations in 3 standard ratings: 1.5, 10 and 12 amps. at 115v., 60 cycles, non-inductive. Voltage range: 6 v. to 115 v. A.C., 60 cycles; or 6 v. to 110 v. D.C. intermittent duty.



Series M-120

*Write* for catalogs featuring Guardian Steppers, Relays, Solenoids, Switches, Solenoid Contactors and Hermetically Sealed Controls.

**GUARDIAN**  **ELECTRIC**

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CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

# How SECON Fine Wire is used in critical Government end-use items

Secon's highly engineered fine wire is being used to meet critical specifications by manufacturers of important defense and military end-use items.

## Precision Wire-Wound Potentiometers

In supplying precious metal alloy wire for these, Secon not only conforms to the physical and electrical characteristics on the manufacturer's specifications, but also winds a prototype potentiometer from each melt, which is tested for life, noise, and other characteristics which cannot be specified on the wire. Roundness of so small a magnitude that it cannot be measured is a carefully controlled characteristic which receives Secon's continuous attention.

## Direct-Heated Cathodes in Electronic Vacuum Tubes

Wire and ribbon for use here are individually prepared for each manufacturer to insure satisfactory operation. Secon sets aside the melts until the manufacturer has ascertained the emission and life characteristics of the melt. Approved Secon melts are then used exclusively to supply the manufacturer who made the tests.

## Electro-Plated Grid Wire for Electronic Vacuum Tubes

Precious metals used for these are carefully selected for purity. Only high purity gold, rhodium, silver and others are employed.

## Strain Gauge Wires

These are most carefully selected, in both precious and base metals. Samples of Secon melts are tested by the manufacturer of the strain gauge for temperature coefficient of resistance, gauge factor, and other important characteristics. To insure uniformity, Secon sets aside approved melts for the exclusive use of the manufacturer who made the tests.

## New Wire Products for Semiconductors, Transistors, Diodes, Crystals

Developed through special research for application in these fields, the new products include:

**Gold:** fine gold in purities up to 99.99%; and doped gold alloys.

**Aluminum:** fine aluminum wire in four grades: (1) 2S aluminum, 99% pure; (2) EC grade aluminum, 99.4% pure; (3) 99.97% pure aluminum; (4) special high purity aluminum, 99.99% pure.

**Whisker Wires:** in base metals as well as hard platinum alloys, with close tolerances on straightness and hardness in all types.

**Lead-in Wires** of a great variety such as tinned copper wire or ribbon.

Secon specializes in the development, research and production of special alloys and pure metals, processed to very small diameter wire—in all shapes—round, oval, flat, ribbon, grooved—for highly engineered applications in electronics, instrumentation, ordnance, aviation, nuclear physics, atomic energy, guided missiles, automotive industry, and other fields.

Close tolerances and controlled specifications can be held on many important characteristics such as: resistance, tensile strength, elongation, surface appearance, special spooling, purity, torque, linearity, composition, cross section, weight per unit length, uniform plating, dependable insulation, temperature coefficient of expansion and resistance, and strain sensitivity.

## Secon end-products include:

- Fine Wire drawn to 0.0003" diameter
- Ribbon rolled to 0.0001" in thickness
- Electro-Plated Wire and Ribbon
- Special Solder
- Enameled and Insulated Wire
- Pirani Gauge Wire
- Electric Primer Ignition Wire
- Galvanometer Suspension Strip
- Etched Wire
- Precision Potentiometer Wire
- Transistor Wire Components
- Electronic Vacuum Tube Wire Components
- Experimental Melts

Secon invites you to discuss your metallurgical problems with its Research and Development Department.

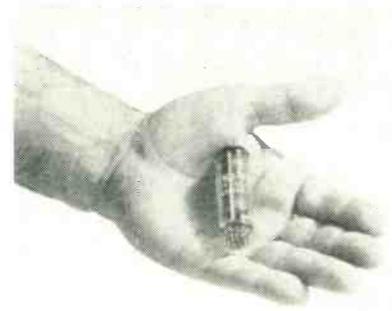
Write for Pamphlet E-10

## SECON METALS CORPORATION

7 Intervale Street, White Plains, N. Y.  
White Plains 9-4757

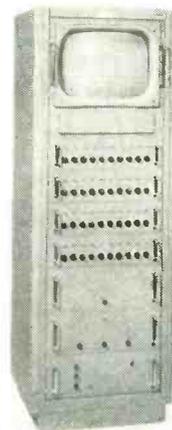


maintained with moderate output loading.



## AMPLIFIER TUBE for car radios

TUNG-SOL ELECTRIC INC., Newark 4, N. J., has developed an audio power amplifier tube designed specifically for car radios. The 12AB5 is intended to be used either singly or in push-pull for power output stage use. Using the 9-pin all glass miniature envelope, the 12AB5 provides a wider margin of safety than previously found in the smaller 7-pin types 6AQ5 and 12AQ5. Because there is no compromise with household radio or tv needs, the 12AB5 will therefore provide greater reliability and service life.



## DISPLAY OSCILLOSCOPE features 40 input channels

ELECTROMECH, INC., 5121 San Fernando Road, Los Angeles 39, Calif. A new large screen display oscilloscope features 40 input channels. It provides a vertical line graph 9 in. high by 12 in. wide on a 17-in. cylindrical face crt. Each vertical line

# SANBORN

## 150 SERIES

**1 to 8 channel systems  
with interchangeable  
preamplifiers**

... versatile answers to the wide  
variety of problems in

## OSCILLOGRAPHIC RECORDING

**S**ANBORN equipment allows you to record accurately and graphically almost any phenomena in the 0 to 100 cps frequency range — such as stress, strain, vibration; pressure, displacement, thickness; flow, force, load, position, RPM, tension, velocity, acceleration, temperature. Systems may be assembled to record simultaneously as many as *eight* channels of information — all alike, all different, or a combination of both, depending upon your selection of plug-in preamplifiers or “front ends” displayed at the left.

Should requirements change, the preamplifiers may be interchanged by simple plug-in to the Driver Amplifier-Power Supply unit of each channel, thus equipping the basic system for the new requirements. In addition to this versatility of *application* you also gain advantages in greater over-all *economy* and increased *operating* efficiency.

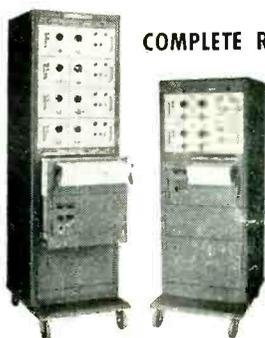
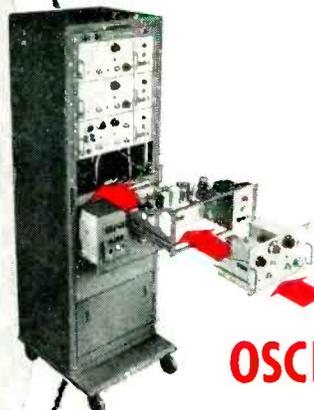
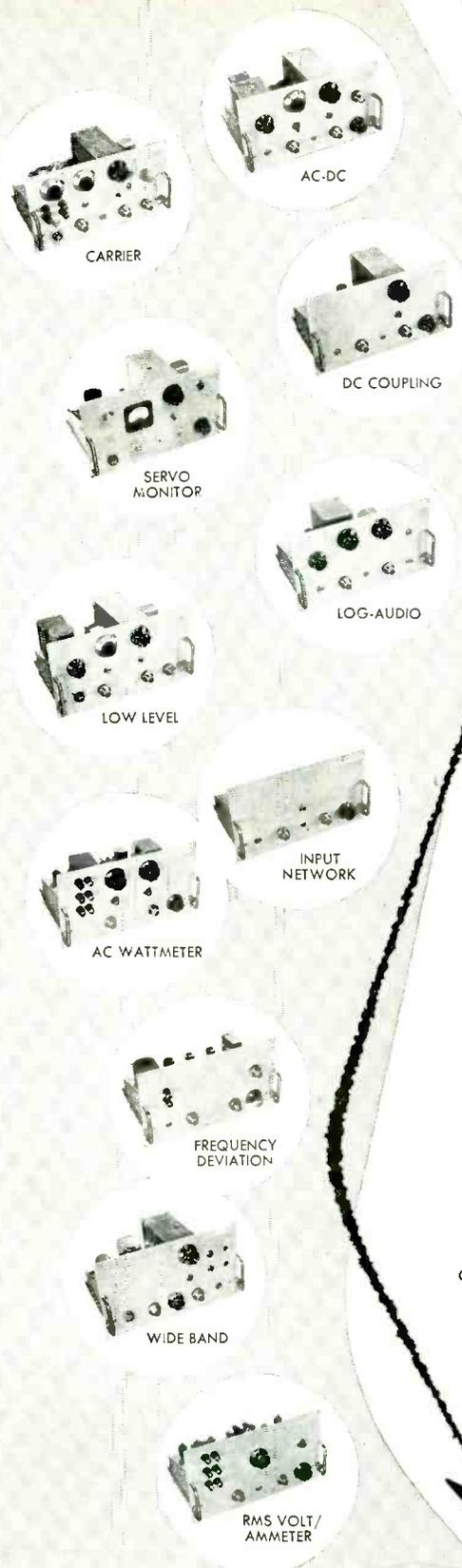
### SANBORN SYSTEM FEATURES INCLUDE:

- Inkless recording in true rectangular coordinates
- Driver Amplifier (current feedback), improved regulated Power Supply, individual ON-OFF and stylus temperature controls IN EACH CHANNEL.
- Recorder slides out for easy paper loading, better view of recording, making notations on record.
- High-torque (200,000 dyne cm) galvanometer
- Many chart speeds — from 0.25 to 100 mm/sec.
- Controls for timing, manual and remote coding

The equipment illustrated indicates the scope of the Sanborn “150” line. Other components, not shown, include a Wide Band Driver Amplifier and Power Supply, and a Master Oscillator Power Amplifier. All Sanborn equipment is available for assembling into complete systems, or as separate components for integration as “original equipment” in existing apparatus.

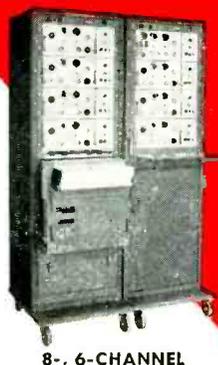
Sanborn engineers will be glad to help solve your recording problems, with either standard or specially modified equipment. Write for complete specifications and performance data on any system.

**SANBORN COMPANY**  
CAMBRIDGE 39, MASSACHUSETTS



### COMPLETE RECORDING SYSTEMS

Designed primarily for recording outputs of analog computers, or other applications where 1 volt/cm sensitivity is usable. In 8-, 6-, 4-, 2-, and 1-channel models. One dual-channel DC Amplifier for every TWO channels.



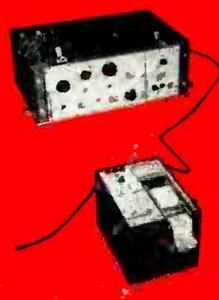
8-, 6-CHANNEL



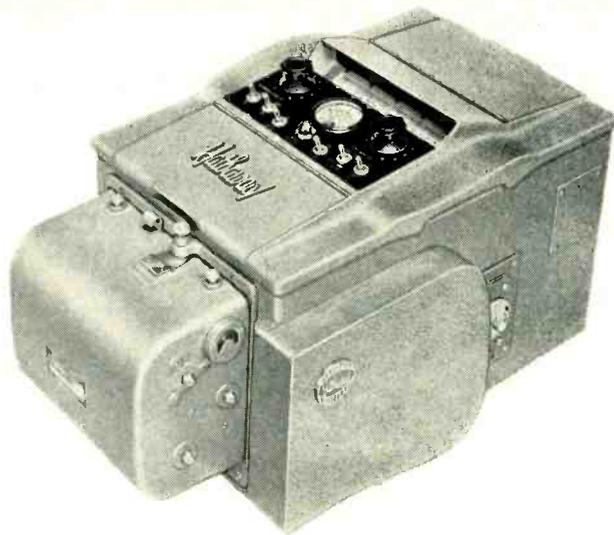
4-CHANNEL



2-CHANNEL



1-CHANNEL



## The S14-E Oscillograph, New High in Versatility

Versatility is important in an oscillograph because it reduces instrument investment.

The Hathaway New S14-E is designed to be versatile. It can readily be used for many different types of recording and is a high quality, general-purpose oscillograph available with an unusually wide assortment of standard accessories.

The versatility and the low price of the Hathaway S14-E have established it as a "standard" instrument in many laboratories both large and small.

### SPECIFICATIONS

Channels: To 24

Chart Size: 6 inches x 100 or 200 feet; 6 inches x 15 inches

Chart Speed: 1/10 to 600 inches per second

Chart Speed Change: Quick change transmission allowing 9 easily selected speeds

Galvanometers: Sensitivities to 30,000 mm per ma. per meter; frequencies to 10,000 cps; single

and multi-phase watt galvanometers

Power: 115 volts, 50-60 cycles; 12 or 24 volt d-c models available on special order

Case: Walnut or lightweight aluminum

Optical System: Individually controlled galvanometer traces

Size: 24 x 13 x 14 inches

Weight: 60 pounds

### AVAILABLE ACCESSORIES

Synchronous time line markers, giving 10, 1, 1/10 and 1/100 second times lines (tenth lines heavier)

Scanning-type viewing device

Automatic recording attachments

High-speed shutter and drum for fast recording

Record numbering device

Write for Bulletin 2-D1-A

# Hathaway

INSTRUMENT COMPANY

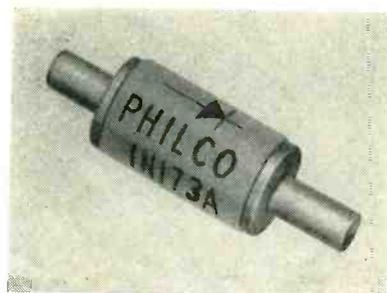
SUBSIDIARY OF

# Hamilton

WATCH COMPANY

1315 SOUTH CLARKSON • DENVER, COLORADO

terminates in a dot to permit rapid and accurate readability. The output of each of the 40 amplifiers is scanned each  $\frac{1}{4}$  sec. Frequency response of each channel is within 2 percent from 10 cps to 10 kc and down no more than 3 db at 50 kc. Sweep linearity is approximately 2 percent with a system linearity of 1 percent. Jitter and crosstalk are negligible.



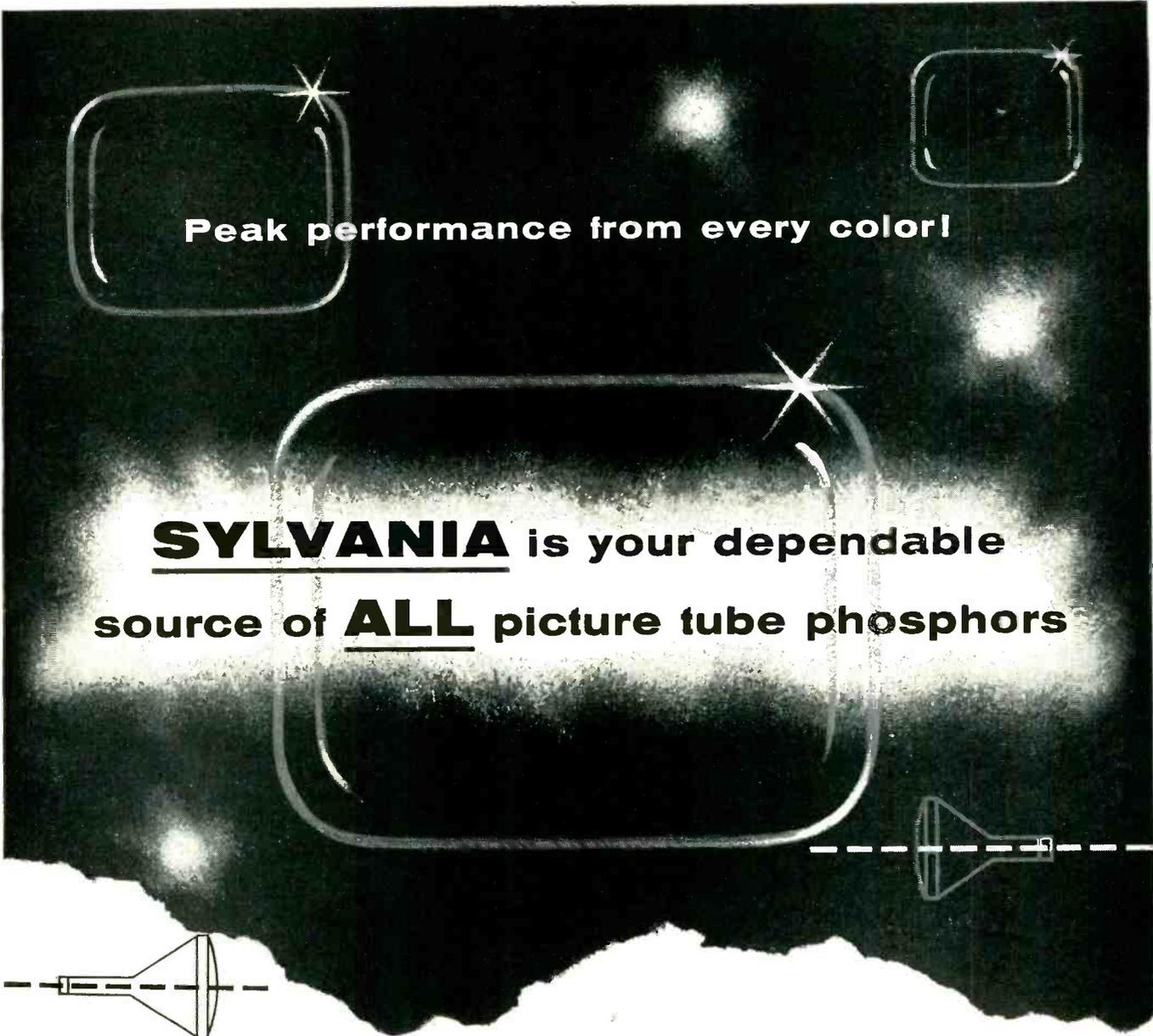
### UHF MIXER DIODE for use in tuners

PHILCO CORP., Philadelphia, Pa., has announced a new uhf mixer diode specifically designed for uhf tuners. The 1N173A tuner diode is manufactured by a special process which results in excellent uniformity characteristics for high performance tuner operation over the entire uhf band. The diodes are moisture-proof and maintain stability regardless of shock, vibration and temperature variations. The company can make the uhf mixer diode available to all other tuner manufacturers.



### I-F AMPLIFIERS are subminiature type

THE W. L. MAXSON CORP., 460 W. 34th St., New York 1, N. Y., has developed a new series of subminiature i-f amplifiers used in airborne radar systems and broadband re-



Peak performance from every color!

**SYLVANIA** is your dependable  
source of **ALL** picture tube phosphors

Whether you need phosphors for black-and-white or color picture tubes, Sylvania's long experience, highly developed production facilities and exacting quality control add up to *dependability*.

All Sylvania tube phosphors are rigidly inspected for purity, particle size, brightness and uniformity of color. There is a full range of phosphor formulations available to meet your requirements, including special blends for maximum cross-burn resistance. All Sylvania phosphors can be supplied in 1000-lb. lots to eliminate color-matching problems.

To help you secure long-lasting screen brightness and good color, Sylvania also manufactures high-purity *potassium silicate*. Exact control of potassium-to-silica ratio assures maximum wet-screen strength.

For complete information about high-performance Sylvania phosphors and TV Picture Tube components, write to:

SYLVANIA ELECTRIC PRODUCTS INC.,  
1740 Broadway, New York 19, N. Y.

*In Canada:*

*Sylvania Electric (Canada) Ltd.,  
University Tower Bldg., St. Catherine St.,  
Montreal, P. Q.*

**SYLVANIA** 

Lighting • Radio • Electronics • Television • Atomic Energy



# High Frequency Crystals . . .

**have you investigated how they can save  
you money and increase performance?**

New high frequency crystal applications developed by Scientific can help you solve problems of size, cost, and performance in frequency control devices. The services of Scientific's Research and Development Department are available to you in working out these problems for your equipment and new designs.



*This department is headed by E. M. Sbideler, a nationally-known pioneer in crystal research whose latest paper — VHF Crystal Resonators — was presented last May at the Frequency Control Symposium sponsored by the U. S. Signal Corps.*

To use this development and counseling service to its fullest advantage, send your sketches while they are still in the design stage to Scientific's Research Department. There is no cost or obligation.



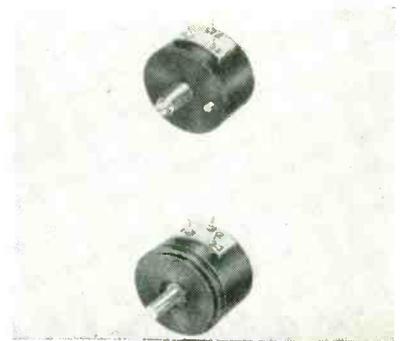
*One of the Oldest Manufacturers  
of Crystals in the United States.*

# Scientific

## RADIO PRODUCTS, INC.

215 SOUTH 11TH STREET.. ATLantic 9787. OMAHA, NEBRASKA

ceivers. Gains of over 100 db are obtained simultaneously with bandwidths over 12 mc at center frequencies of 30, 60 or 90 mc. Design and construction provide complete shielding and absence of regeneration even with covers removed. The amplifiers are built to meet rigid military specifications and contain tubes having a rated life of over 5,000 hr. Measurements are 12 in. × 2 in. × 1 in. Each model consists of a low-noise cascade amplifier followed by three flat staggered triples. The last triple feeds an infinite impedance detector and a cathode follower output stage. A bias adjustment is incorporated in each unit to control the gain over a range of at least 40 db.



### POTENTIOMETERS in intermediate size

DE JUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City 1, N. Y. The C-158 precision ganging potentiometers (1½ in. in diameter) are ideal for applications requiring high accuracy in limited space. Multiple ganged units can be electrically phased independently without disassembly. Precious metal contacts are used exclusively, including the company's three wiper contact brush. All single and ganged assemblies are completely enclosed by permanent dust-covers. Both threaded bushing and servo-mounting types are available. Complete specifications and other features are described fully in the illustrated technical bulletin C158-455.

### POWER SUPPLY for electrostatic spraying

SCIENTIFIC ELECTRIC, 105-119 Monroe St., Garfield, N. J., has developed

# TAYLOR

Laminated Plastics  
Vulcanized Fibre

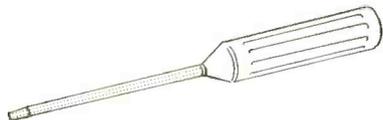
# Shop Talk

TAYLOR FIBRE CO.

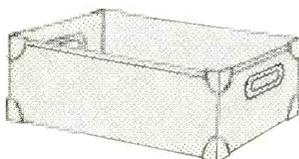
Plants in Norristown, Pa. and La Verne, Calif.

PHENOL—MELAMINE—SILICONE—EPOXY LAMINATES • COMBINATION LAMINATES • VULCANIZED FIBRE • POLYESTER GLASS ROD

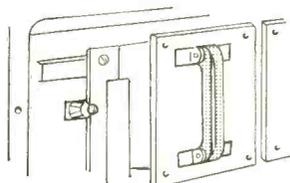
## Tips for designers



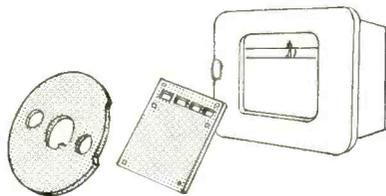
**Insulated fibre screw drivers**, made of high dielectric strength Taylor Fibre, are electrically safe, physically tough.



**Tote boxes** must withstand severe usage . . . an ideal application for tough, durable Taylor Vulcanized Fibre.



**Fuse box handle** formed from Taylor G-5 Melamine Laminate has high electrical and mechanical strength . . . provides high resistance against corrosive fumes.



**Cam and terminal board** for recording instrument is made of Taylor Grade XP Laminate . . . noted for its electrical insulating properties and ease of machining.

### TAYLOR FABRICATING FACILITIES

Your production can be simplified . . . schedules safeguarded . . . inventory headaches cured . . . and over-all costs reduced by having Taylor fabricate finished parts to your specifications. Efficient, modern facilities are ready to serve you. Get in touch with Taylor about your specific requirements.



Tip of 2" diameter Taylor Built-Up Vulcanized Fibre Rod used as drift pin for driving out stuck roll-up shafts in paper mill. Heavy sledge hammer blows on end of rod could not split apart the laminations at bond joints.

## Taylor Built-Up Fibre withstands severest impact

The unretouched photograph above shows the strength and toughness of Taylor Built-Up Vulcanized Fibre. This is the tip of a 2" diameter x 36" long built-up fibre rod after more than a year's use as a crowbar and drift pin in a paper mill.

It was used as a bar to lift and pry 800 lb. objects. It was pounded with a 16 lb. sledge hammer in its use as a drift pin to drive out stuck roll-up shafts. Despite this severe and repeated abuse the rod was unbent. *And note that hundreds of sledge hammer blows have not severed the adhesive bonds between laminations.* Rather it is the fibre itself which has first failed. This is proof that built-up fibre is just as strong and as tough as homogeneous fibre.

Wherever exceptionally thick sections are required—for rods, plates, blocks—Built-Up Fibre can be pro-

duced in thicknesses up to 3 inches. Laminations are bonded together with specially developed adhesives to make a tough, solid mass.

For many applications, Taylor Built-Up Fibre can be used as a direct replacement for more expensive homogeneous commercial fibres. Moreover, it is available in a fraction of the delivery time. Outstanding physical and electrical properties make it the ideal material for heavy switchgear, arc barriers, insulating plates, rods, cutting blocks, bumper blocks . . . and a variety of similar uses.

Ask your Taylor representative about the numerous profitable applications for versatile Taylor Vulcanized Fibre and Taylor Laminates in your product. There are literally thousands of uses for economical, easy-to-form Taylor products.

at last!

# A CALORIMETRIC TYPE RF WATTMETER

0-3000 MCS.

0-300 WATTS

MODEL 641N—an instrument designed to measure RF power with the precision of a Primary Standard.



▶▶▶ **DESIGNED FOR USE** wherever extremely accurate RF Power measurements are needed, the 641N Wattmeter serves as a Primary Standard for such measurements. As such, it can be used to check the accuracy of other types of RF wattmeters, and to determine the actual power output of an RF power source, the approximate magnitude of which is known. Over the entire frequency range of 0 to 3000 megacycles this instrument has an accuracy of better than plus or minus 2 percent of full scale, using the calibration curve supplied. For more accurate measurements, the 641N Wattmeter may be calibrated by the user at DC or 60 cycles. AC-DC wattmeters with an accuracy of 1/4 of 1 percent may be used in this calibration, and the resulting RF power level may be established to an accuracy of better than 1 percent.

## SPECIFICATIONS

Impedance: 52 ohms  
 Frequency Range: 0 to 3000 mcs.  
 Power Range: 0 to 300 watts  
 Power Scales (5):  
 0-3 watts  
 3-10 watts  
 10-30 watts  
 30-100 watts  
 100-300 watts

VSWR (max. over frequency range): 1.1 to 1000 mcs.  
 1.2 to 3000 mcs.

RF Connector: Type N, mates with UG21B/U.

Accuracy: Plus or minus 2% of full scale on any scale, using the supplied calibration curves.

This instrument can be calibrated by the user at DC or 60 cycles for more precise measurement at a particular power level.

Repeatability: Within 1%

Time Required for One Reading: 2 minutes.

Recycling Time between Readings: 20 minutes.

Power Required: 3 watts 105-125V  
 60 C.

Size:  
 Indicator 5 1/2" x 6" x 13 1/2"  
 Load 5 1/2" x 6" x 14 1/4"

Weight:  
 Indicator 8 pounds  
 Load 16 pounds

a new Ionic high potential power supply for electrostatic paint spraying. Model HV-140 is supplied as a 2-piece, remote-controlled unit. The new electronic power supply unit is capable of producing a peak of 140 kv. For complete technical information, contact the company.



## NULL INDICATOR features high sensitivity

SHALLCROSS MFG. Co., Collingdale, Pa. Unlike spotlight galvanometers, the type 1965 null indicator is unaffected by mechanical vibration of any sort. This, coupled with its high sensitivity and a response time of less than 1 second, allows measurements to be made rapidly and accurately under many adverse conditions. Current sensitivity is greater than  $2 \times 10^{-10}$  ampere. Voltage sensitivity is better than  $1 \mu\text{v}$  per mm scale division. Input impedance is 5,000 ohms. The null indicator and its integral 115 v, 60-cycle, power supply are housed in a cabinet only 17 in. deep by 6 in. wide by 8 1/2 in. high. Weight is 14 lb. Complete technical details are given in engineering bulletin L-42.

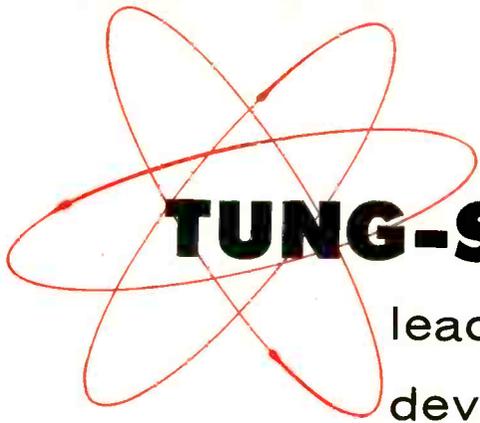


## OVERLOAD RELAY is fast acting, precise

MORROW PRODUCTS, INC., 3339 Forbes St., Pittsburgh 13, Pa., an-



**M. C. JONES ELECTRONICS CO., Inc.**  
**BRISTOL, CONNECTICUT**



# TUNG-SOL

Acknowledged quality leadership . . . in research, design, development and manufacture . . . of all the basic components on which the science of electronics is founded.



Research



Design



Development



Manufacturing



Aluminized Picture Tubes

Color Picture Tubes

Special Purpose Tubes

Radio and TV Tubes

Semiconductors

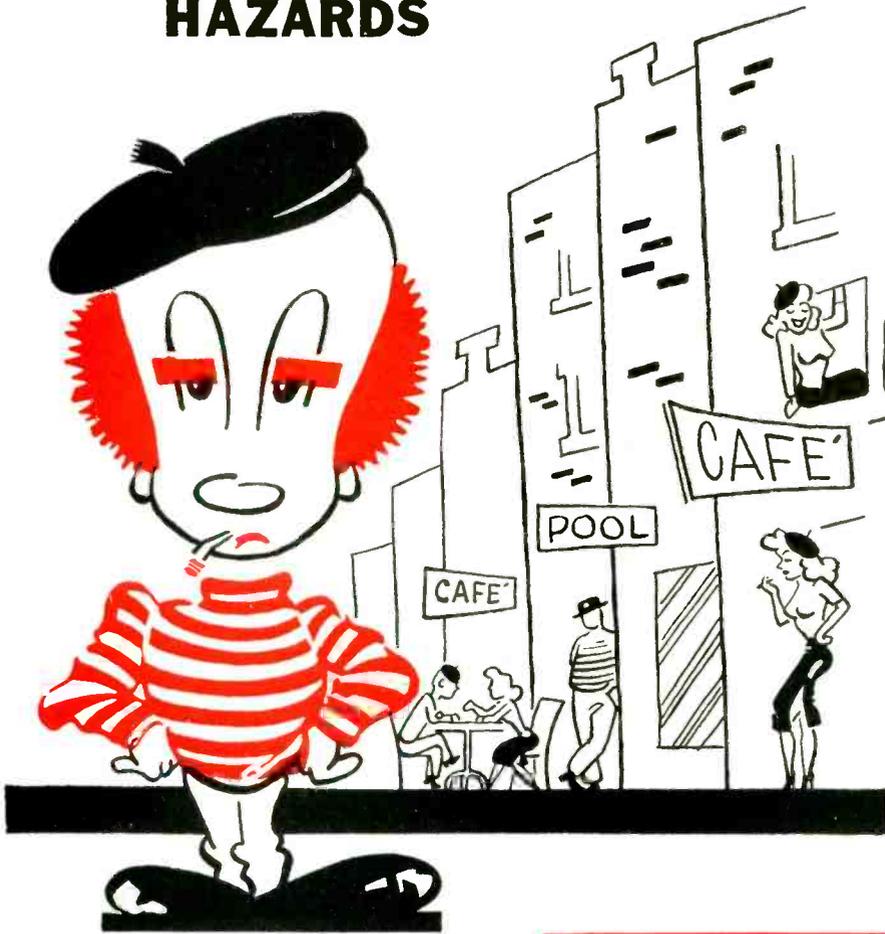


**TUNG-SOL ELECTRIC INC.,** Newark 4, New Jersey

**SALES OFFICES:** ATLANTA, CHICAGO, COLUMBUS, CULVER CITY, DALLAS, DENVER, DETROIT, NEWARK, SEATTLE.

# Environmental

## HAZARDS



**FOR ROTATING ELECTRO-MECHANICAL ASSEMBLIES TO WITHSTAND SEVERE ENVIRONMENTAL HAZARDS . . . CALL P M I**

Slip Ring (Collector Ring) Assemblies we have made surpass severe shock, vibration, and water test conditions of MIL-E-2036A and MIL-T-17113; trouble-free operation at 60,000 feet; resists fungus and corrosion; passed 200-hour salt spray test. Call P M I for free estimate.



### PROJECT 268209

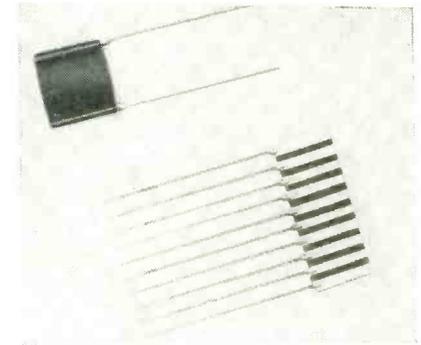
Internal components of S.R.A. designed to withstand high and low temperature range — humidity — salt spray — fungus — shock and still have long life at 390-490 R.P.M.



**P M INDUSTRIES, INC.**

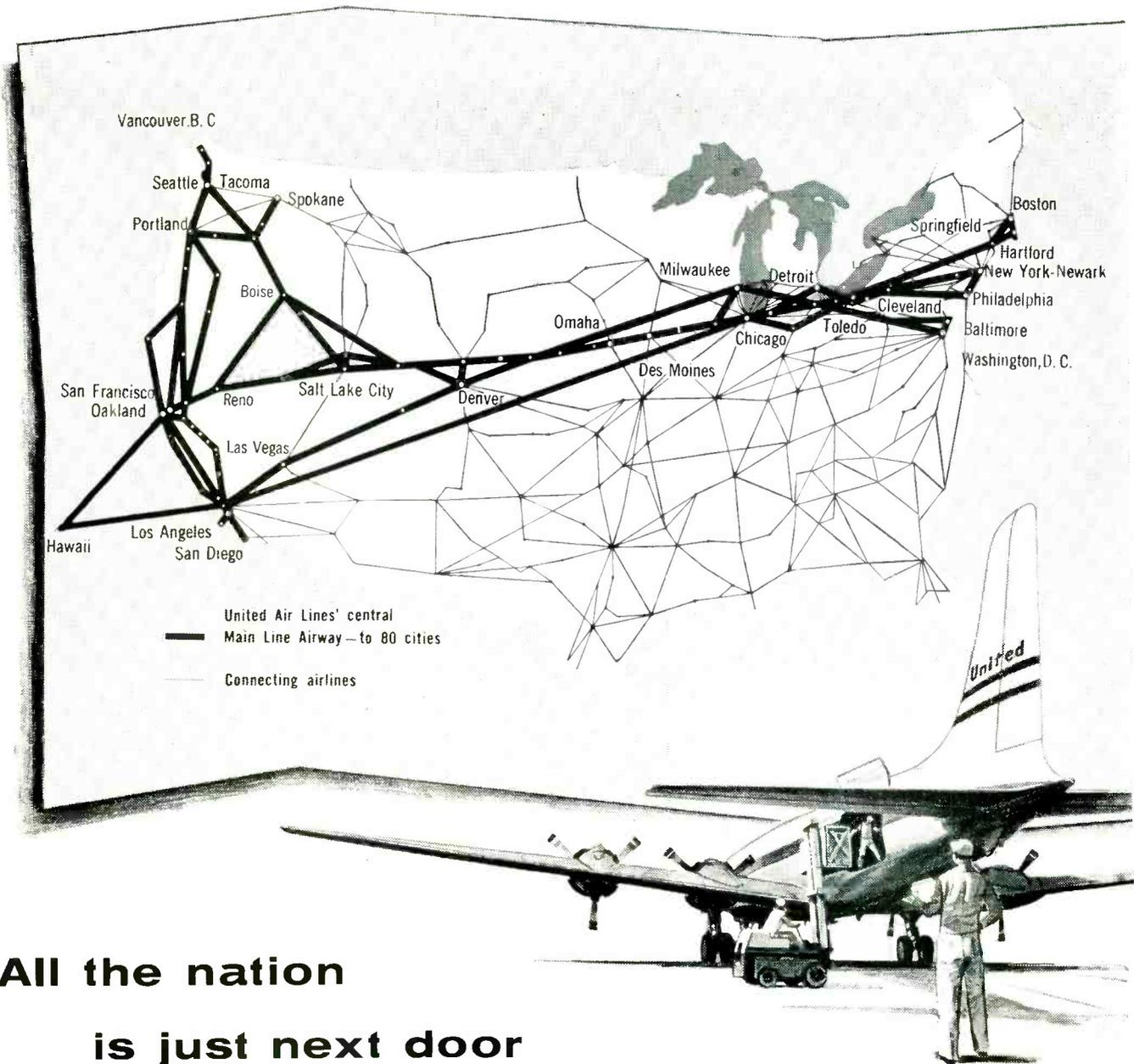
270 FAIRFIELD AVENUE  
STAMFORD, CONNECTICUT

nounces an electronic relay intended for use wherever fast acting and precise electrical overload protection is desired. It may be adjusted to operate reliably with a current differential as small as 0.05 ampere, or if intended for use on over voltage, the voltage differential would be of the order of 50 mv. The unit drops out within 10  $\mu$ sec. This model is available in ratings to 600 v at 1,000 amperes for a-c or d-c loads. The heart of the unit is a thyatron control tube with an spdt relay connected in its plate circuit. The operating characteristics of this tube may be varied by the control dial which is suitably calibrated in volts or amperes so that the thyatron will fire only after a certain voltage is applied to its grid circuit. Time delay apparatus is not required with this electronic relay.



### PRECISION RESISTOR is single-section, card-type

THE DAVEN Co., 191 Central Ave., Newark 4, N. J., announces availability of a new single-section, card-type, precision resistor, series 1300. The new series is wafer-thin and is specifically designed for applications where there is a lack of space for the ordinary round precision wire-wound resistor. The new unit is completely encapsulated for protection against humidity and extremes of temperature, and is especially adaptable for circuits using transistors, in guided missiles and airborne communication and navigation equipment. On values up to 100,000 ohms, the resistor is  $\frac{1}{2}$  in. by  $\frac{1}{2}$  in. by  $\frac{1}{8}$  in. thick. On values from 100,000 ohms to 1 megohm, the card is  $\frac{3}{8}$  in. by  $\frac{3}{8}$  in. by  $\frac{1}{8}$  in. thick. Operating characteristics feature precise operation from  $-55^{\circ}$  C



**All the nation  
is just next door  
when you ship by United Air Freight**

United's Main Line Airway follows the bustling business belt across the nation. No matter where you ship you are only a few hours away, sometimes merely minutes, from cities along this strategic route.

United can furnish fast connections, too, at any of these cities with other air carriers, truck lines and rail transportation to reach all sections of the country. And United offers Reserved Space Air Freight on all

flights—not only over its own routes but world-wide through connecting airline agreement.

Speed, service unmatched by any other air carrier, convenience—these are among the money-saving benefits you get when you ship by United. And remember, too, the great cargo power United offers. There are more than 254 Mainliner® flights daily, with air cargo on every one.



Learn the advantages of United Air Lines' Air Freight Service—call the nearest United representative or write for free booklet, "Industry's Flying Partner." Cargo Sales Dept. V10, United Air Lines, 5959 S. Cicero Avenue, Chicago.

to +125 C. Wattage rating on each section is 0.6 w and standard tolerance is  $\pm 1$  percent. Accuracies can be obtained to  $\pm 0.1$  percent.

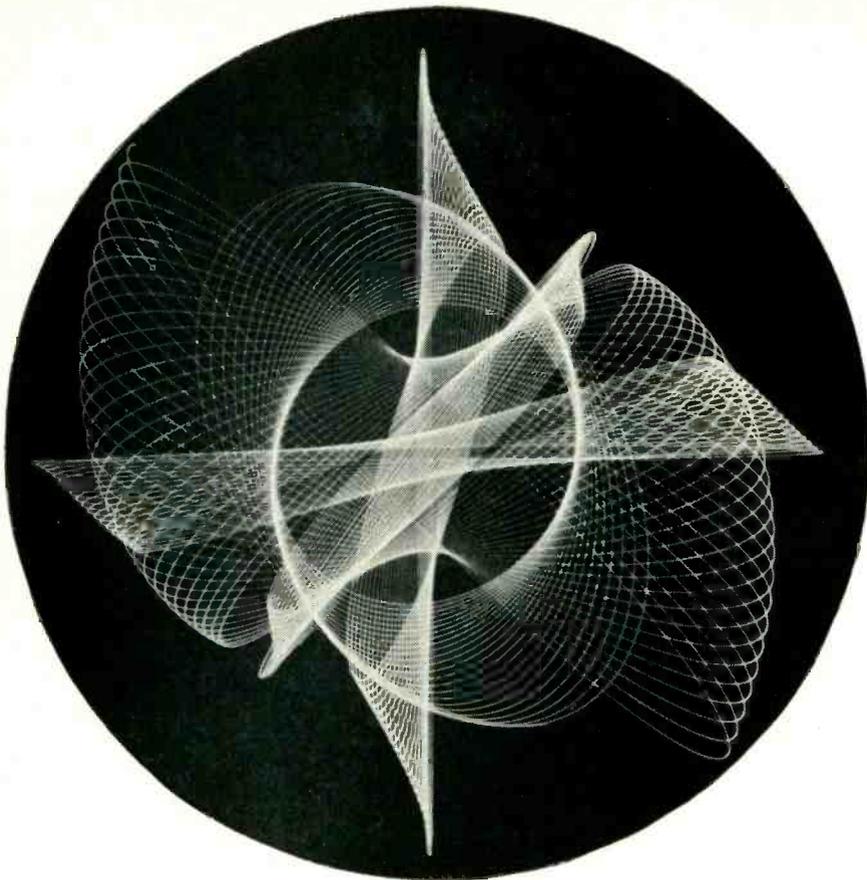


### **BANDPASS FILTER** adjustable 20 cps to 200 kc

KROHN-HITE INSTRUMENT Co., 580 Massachusetts Ave., Cambridge 39, Mass., announces model 310-AB continuously adjustable band-pass filter with unity passband gain and 24 db per octave slopes outside the passband. Both the high and low cutoff frequencies are independently adjustable from 20 cps to 200 kc. This provides maximum flexibility of adjustment of both the band center frequency and the bandwidth. By using power supply regulation the internal hum and noise has been reduced to less than 1 mv. Calibration accuracy is  $\pm 10$  percent. Model 310-AB is especially useful in the audio and ultrasonic frequency range for noise measurements, harmonic and frequency analysis, and for psychoacoustics and electromedical research. The unit measures 12 by 7 by 8 in. overall and sells for \$275.

### **CERAMICONS** for miniaturized circuitry

ERIE RESISTOR CORP., Erie, Pa. The new high capacitance Ceramicons are rectangular, have a phenolic dipped coating, wax impregnated No. 22 hot tinned copper leads, and are made in 3 sizes: style 892, 034 in by 0.34 in.; style 893, 0.58 in. by 0.43 in.; and style 896, 0.75 in. by 0.56 in. Life test is 400 v d-c 1,000 hr at 85 C; flash test, 600 v d-c; and power factor, 2.5 percent maximum at 1 v rms 1 kc. These Ceramicons are designed especially for use in transistor and other min-



**are you**  
**"lost"**  
**in**  
**electronics?**

Developments have been so rapid in the horizonless science of electronics that many creative engineering talents lie hidden "under a bushel" of non-creative detail work.

*If your ability exceeds the use that is now being made of it, you'd do well to learn what's happening at Martin.*

For there are—and always will be—excellent opportunities at Martin for electronics engineering talent in the fields of aircraft, missiles, rocketry, nucleonics and space vehicle development.

Contact J. M. Hollyday, Dept. E-10, The Martin Company, Baltimore 3, Maryland.

**MARTIN**  
BALTIMORE

from **Transitron**

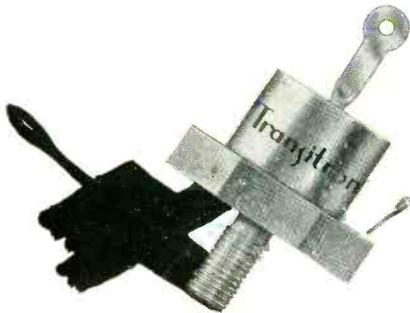
# SILICON RECTIFIERS

... Three power ranges now in production

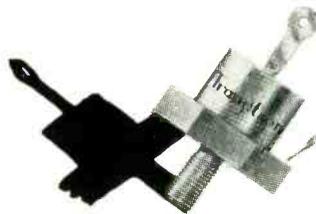
Transitron's silicon rectifiers are designed for reliable operation up to 150°C. They offer major savings in both size and weight and long term stability through hermetic sealing.

Because of their high forward conductance and high inverse resistance, Transitron's silicon rectifiers are extremely efficient. They are ideally suited for high temperature power supply and magnetic amplifier applications.

Write now for bulletin TE 1321!



**HIGH POWER**



**MEDIUM POWER**



**POWER**

TYPE	Peak Recurrent Inverse Voltage (Volts)	Maximum RMS Voltage (Volts)	Maximum Average Forward Current (Amperes)
1N411	50	35	10
1N412	100	70	10
1N413	200	140	10

RATINGS AT 135°C

TYPE	Peak Recurrent Inverse Voltage (Volts)	Maximum RMS Voltage (Volts)	Maximum Average Forward Current (Amperes)
SR-10	50	35	5
SR-11	100	70	5
SR-12	200	140	5

RATINGS AT 135°C

Power Supply Types			Magnetic Amplifier Types		
TYPE	P.I.V. (volts)	I <sub>dc</sub> (ma)	TYPE	P.I.V. (volts)	I <sub>dc</sub> (ma)
1N341	400	400	1N332	400	400
1N343	300	400	1N334	300	400
1N345	200	400	1N336	200	400
1N347	100	1000	1N338	100	1000

RATINGS AT 135°C

**Transitron**  
electronic corporation  
melrose 76, massachusetts



Glass Diodes



Transistors



Power Transistors



Silicon Diodes

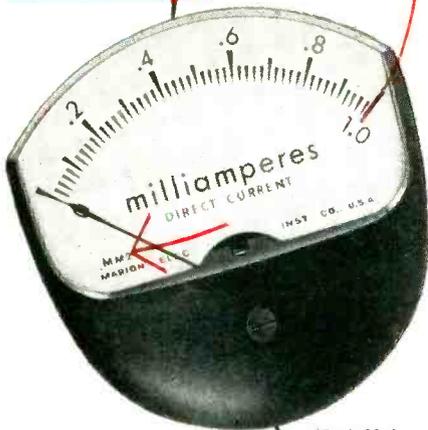


Silicon Rectifiers



**marion**  
 advancement  
 in instrument  
 design

new  
**MEDALIST\***  
 meters



Greater readability and modern styling in minimum space. Interchangeable with ASA/JAN 2½ and 3½ inch sizes. Up to 50% longer scale in same space as ordinary type. Available in various colors. Complete data on request.

\*Trade Mark  
 Patents Pending



**marion meters**

marion electrical  
 instrument company



GRENIER FIELD, New Hampshire's NEW Air-Industry Area  
 MANCHESTER, N. H., U. S. A.

copyright 1956 M. E. I. Co.

**THE NEW MODEL 201A  
 STROBO-  
 SYNC**



Automatically synchronizes stroboscopic light sources with high frequency shakers to permit inspection in slow motion from zero to two cycles per second. This visual frequency is adjusted with a front panel control, and once adjusted remains constant over the entire shake frequency range of 20 to 2000 cps. No adjustment of input level is required over a 40 db range. No other adjustments exist or are required. Write for bulletin to:

**Winkler Laboratories**  
 5225 N. 20th St. • Phoenix, Arizona

NEW PRODUCTS

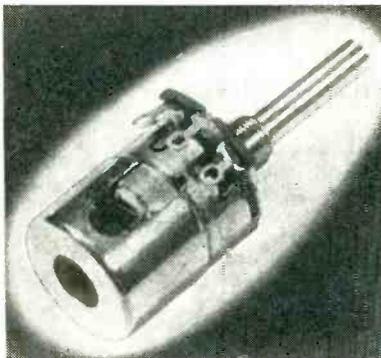
(continued)

aturized circuitry. They have a value range from 0.0022 to 0.1  $\mu$ f and a 200-v rating. A data sheet giving complete specifications is available.



**MINIATURE CELL  
 uses indium as an anode**

ELGIN NATIONAL WATCH Co., Elgin, Ill., has developed a button-size expendable battery that will not leak, swell or gas. It packs enough energy to operate special military miniature electronic devices at virtually standard voltage for 2 years. The cell uses indium as an anode. Use of new type of cathode makes it possible to increase working volume of the cell by eliminating bulky barriers and separators. The cell delivers about 1.15 v. A typical industrial application might be for portable electronic monitors. It is also particularly useful as a low-voltage source of energy for transistorized circuitry.



**SHIELDING COVER  
 for power switch terminals**

CLAROSTAT MFG. Co., INC., Dover, N. H., has developed a positive-lock-



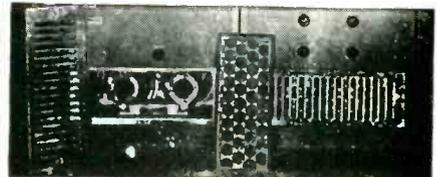
**Use McLEAN  
 Electronic Cabinet  
 COOLING FANS**

Now for the first time, a rack-mounted, self-contained unit is offered for cooling electronic cabinets. Twin blowers mounted side by side, provide maximum filtered air with minimum panel height. Specially designed to fit standard 19" racks, this unit pressurizes cabinet with filtered air, keeping dust out. Complete in one unit and ready for use. No cutting or fitting necessary. Smart stainless steel grille adds beauty and eliminates matching of cabinet finish. Made in two sizes:

Small Size (7" high x 19" wide with 4¼" blower wheels). Delivers 300 CFM.

Large Size (10¾" high x 19" wide with 6" blower wheels). Delivers 600 CFM.

Send for literature.



**McLEAN ENGINEERING**  
 PRINCETON, N. J.

new **VIKING**  
 pressurized  
 MINIATURE CONNECTORS

Note these Viking features:

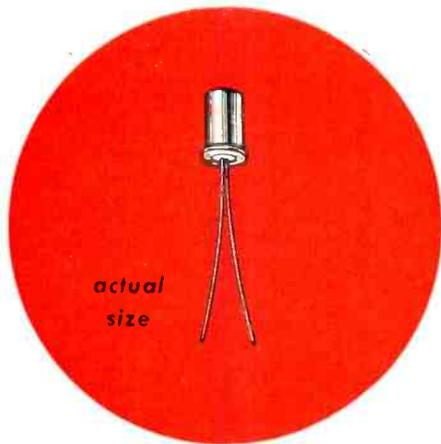
- FUSED BEAD pressurizing for sealing around contacts
- MS GASKET for panel sealing
- POSITIVE POLARIZATION
- LOCKING DEVICE, simple and fool-proof
- PLATED SHELL... gold over silver
- AUTOMATIC ALIGNMENT



Available in 2  
 shell sizes:  
 1-4 CONTACTS AND  
 5-9 CONTACTS

**VIKING**  
 ELECTRIC

DIVISION OF VIKING INDUSTRIES, INC.  
 21343 ROSCOE BLVD., CANOGA PARK, CALIF.



actual  
size



ONE COMPLETE PLANT

OF SPECIALISTS

DEVOTED TO

DIODE PRODUCTION

# siliconductors<sup>®</sup> \*

## \* SILICON JUNCTION DIODES

### Specific Applications:

- High Temperature Operation
- Matched "Quads"
- Matched Pairs
- Function Generators
- Diode-Capacitor "Memory" Units
- Magnetic Amplifiers
- Diode as Constant Voltage Source
- Surge Protection
- Clipping and Limiting

### IN 29 RANGES . . . maximum reverse working voltage

TYPES	eb	max. V	TYPES	eb	max. V
IN138A		18	A3B		3.3
IN137A		36	A4B		3.9
IN200		6.8	A5B		4.7
TO		TO	A6B		5.6
IN222		470			

(Licensed by Western Electric Co., Inc.)

Immediate  
Delivery  
in all  
Quantities



**NATIONAL SEMICONDUCTOR PRODUCTS,** 930 Pitner Avenue, Evanston, Illinois  
Semiconductor Division Phone: Davis 8-0800

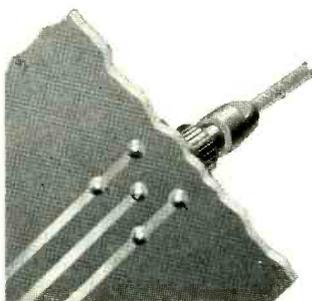
**NATIONAL FABRICATED PRODUCTS, INC.,** Chicago 47

Manufacturers: sockets, plugs, terminal strips, receptacles, contacts, lugs, and other electronic components



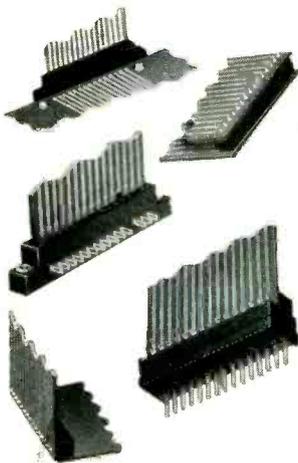
...an outstanding source  
for all types printed circuit connectors

## INTRODUCING NEW MINIATURE EC COAXIAL CONNECTOR



HHB Miniature EC Coaxial Connector in mounted position on card.

## MORE THAN 75 PRINTED CIRCUIT CONNECTOR DESIGNS AVAILABLE



Every prospect and user of printed circuitry can rely upon the vast background of research and design-engineering experience of H. H. Buggie, Inc., regarding connectors for this specialized field. Since the introduction of printed and etched circuit methods, HHB personnel have worked closely with company engineers to develop connectors for special applications.

Today these designs include latest engineering advancements, such as the new HHB miniature connector for coaxial cable, featured above.

If you are a user of printed circuits, or contemplate the use of printed circuit designs in the future, H. H. Buggie, Inc., invites your inquiry regarding connector needs.

Write—for HHB EC Series Printed Circuit Connector bulletin.

Skilled in

- RESEARCH • DESIGN
- ENGINEERING • MANUFACTURING

of Electronic Components and Connectors  
for Communications and Industry



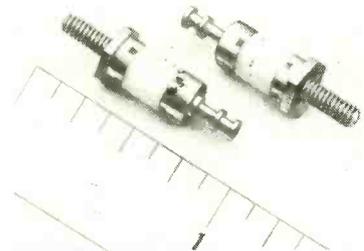
# H. H. BUGGIE, Inc.

726 STANTON STREET

TOLEDO 4, OHIO

Sales-Engineers in All Principal Cities

ing, snap-on type terminal-shielding cover, which is available with its factory-mounted series AE power switches. This metal cover, insulated by a fiber liner, is designed to meet UL approval on sets utilizing above-chassis-mounted controls with switches. The cover not only acts as a mechanical guard, but also has the effect of shielding inductive fields. For further information, request new product announcement form No. 753798.



## TEFLON TERMINALS are vibration-proof

CAMBRIDGE THERMIONIC CORP., 445 Concord Ave., Cambridge 38, Mass. The X-2168 Teflon insulated terminal has high dielectric strength and low capacitance. When mounted, the overall height of the assembly is  $\frac{3}{8}$  in. The 3-48 threaded mounting stud is  $\frac{1}{4}$  in. in length. The solder terminal is brass with copper flashing on which 24-carat gold has been applied. Both stud and terminal are attached to the Teflon by a unique method that makes the terminal vibration-proof. Complete specifications and prices are available from the company.

## TIME DELAY RELAY permits electrical interlock

AGA DIVISION, Elastic Stop Nut Corp. of America, Elizabeth, N. J. An electrical interlock in a circuit which allows pushbutton control can now be obtained by use of an instant action auxiliary switch in a new model Agastat time delay relay. The model NEL Agastat is for operation on energization. Time delay of the NEL is pneumatically controlled and provides a readily adjusted and accurate timing interval from 0.1 second to 10 or more minutes. The unit measures  $2\frac{1}{2}$  in. wide.

NEW.... SIGNIFICANT....

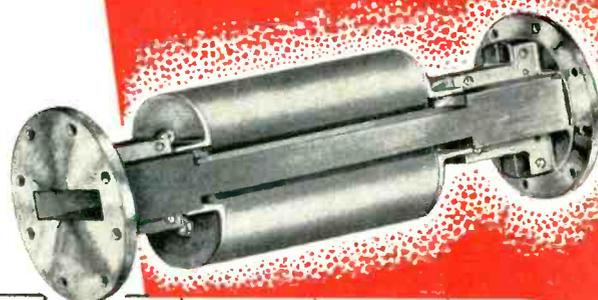
*Uniline*<sup>®</sup>

The important load isolation functions of Unilines are now available to designers and users of microwave systems and test equipment operating in the S-Band.

New, inherently rugged mechanical designs permit safe operation at substantial peak and average powers. Cascade Research has designed these units to optimize isolation-to-insertion loss-ratio. Special techniques have made possible a reduction in size and weight of the integral permanent magnets. As in all Unilines, no external power source is required.

These Unilines can also be furnished as an integrated part of a microwave circuit and may include such elements as directional couplers, hybrid junctions, twists, bends, mixers and crystal holders. Unilines with even greater power ratings are now under development.

# S band SERIES OF MICROWAVE LOAD ISOLATORS



MODEL	28-32A	28-32B	28-32C	28-32D	SL-132	SL-133	SL-131
FREQUENCY RANGE	2.8-3.2 KMC	2.8-3.2 KMC	2.8-3.2 KMC	2.8-3.2 KMC	2.0-2.4 KMC	2.0-2.4 KMC	1.7-2.0 KMC
FORWARD ATTENUATION (TYPICAL)	1.6 DB	1.2 DB	0.8 DB	0.4 DB	1.0 DB	1.0 DB	1.0 DB
REVERSE ATTENUATION (TYPICAL)	27 DB	20 DB	13 DB	6 DB	20 DB	20 DB	20 DB
V.S.W.R. (TYPICAL)	1.20	1.20	1.20	1.20	1.20	1.20	1.20
AVER. TRANSMITTER POWER INTO V.S.W.R. OF 2:1	350 WATTS	350 WATTS	350 WATTS				
PEAK POWER INTO V.S.W.R. OF 2:1	400 KW	400 KW	400 KW	400 KW	150 KW	400 KW	150 KW
WAVEGUIDE SIZE	RG-48/U	RG-48/U	RG-48/U	RG-48/U	—	RG-105/U	—
WAVEGUIDE FLANGES	UG-53/U	UG-53/U	UG-53/U	UG-53/U	COAX TYPE "N" OUTPUT	UG-437/AU	COAX TYPE "N" OUTPUT

### APPLICATIONS

**LOAD ISOLATION:** Will provide substantial isolation between source and load with negligible loss in transmitted power.

**ELIMINATES LONG LINE EFFECTS** present where antennas are located remotely.

**REDUCES PHASE DISTORTION** by eliminating multiple reflections.

**PROVIDES SMOOTHER TUNING,** greatly reduces mismatch presented to a magnetron by the antenna, eliminates tendency of magnetrons to lock on some frequencies or fail to operate on others.

**SMOOTHS OUT POWER VARIATIONS WITH TUNING:** Magnetron power output to Uniline is maintained at maximum despite changes in line parameters due to changes in frequency.

**KLYSTRON, OSCILLATOR-AMPLIFIER BUFFER:** Addition of Uniline between oscillator and amplifier can markedly reduce possible pulling and power incanstantcy.

## CASCADE RESEARCH CORPORATION

53 VICTORY LANE,  
LOS GATOS, CALIF.

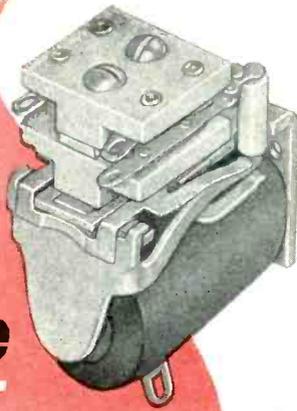


WRITE FOR DETAILED  
TECHNICAL LITERATURE

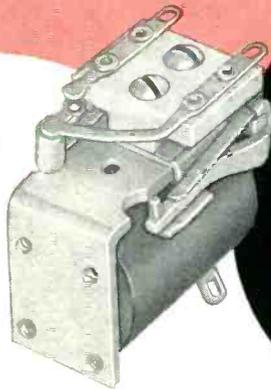
# NEW

MINIATURE

## Low Capacitance SWITCHING RELAY



TYPE MIC



Low Capacity Blades  
For  
**HIGH FREQUENCY  
SWITCHING**  
SWITCHES MOUNTED  
ON  
CERAMIC SEPARATORS

**Capacitance** (with 1 Form "A" switch):

Capacitance between open contacts .75 mmfd;  
Capacitance between closed contacts 2.0 mmfd;  
Capacitance from contact to ground 1.25 mmfd.

**Coil Resistance:** Up to 6500 ohms (No. 44 AWG wire).

**Contact Rating:** 3 amps. @ 28 VDC max. Suitable for low level audio or r.f. loads. Contact material dependent on application.

**Contact Combination:** Standard, up to 1 Form "C".

**Shock:** Meets requirements of MIL-R-5757B.

**Vibration:** 10G up to 500 CPS.

**Size:** 2 $\frac{3}{32}$ " wide, 1 $\frac{1}{32}$ " long, 1 $\frac{1}{16}$ " high with 1 Form C.

**Applications:** For guided missiles, h.f. communications equipment, etc.

AVAILABLE  
CUSTOM-  
MANUFACTURED  
TO EXACTLY  
FIT YOUR NEEDS

SEND FOR  
DETAILS  
NOW

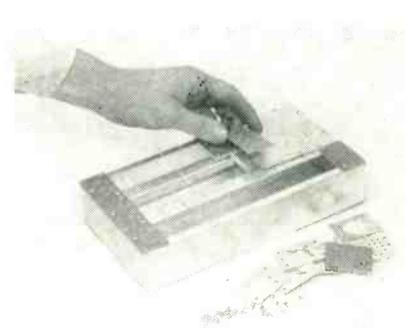


**ELECTRIC COMPANY**  
3349 ADDISON STREET  
CHICAGO 18, ILLINOIS



RELAYS • SOLENOIDS • COILS • TRANSFORMERS • SWITCHES • HERMETIC SEALING

3 $\frac{1}{2}$  in. deep and 4 $\frac{1}{2}$  in. high. Affixed to its front is a normally closed double-throw Micro Switch. Contacts of this switch are kept in open position by a lever connecting the auxiliary switch and the core of the Agastat. When the Agastat coil is energized, the core jumps up and these contacts close instantly allowing interlock. Simultaneously the time delay period starts and continues to the preadjusted time delay at which the main switch trips transferring contacts. In deenergization, auxiliary switch contacts change to open position and the main contacts transfer.



### EXPANDABLE CHASSIS for lab breadboard use

UM & F MFG. CORP., 10929 Vanowen St., N. Hollywood, Calif., has developed a new type of expandable chassis design for laboratory breadboard use. Almost any size chassis may be assembled by using the various parts available in the patented SeeZak line which includes side and end rails, tops and bottoms, rail extenders, prepunched prototype panels and rail feet. Novel interlocking corners make assembly easy and give strength to the entire chassis, whether screwed together or not. These chassis have been designed for maximum adaptability to circuit design.

### PRESSURE SENSITIVE TAPE for wiring diagrams

LABELON TAPE CO., INC., 450 Atlantic Ave., Rochester 9, N. Y. Many manufacturers now use wiring diagrams printed on pressure sensitive tape and affixed directly to apparatus, instead of diagrams printed separately in booklets or instruction sheets. The affixed dia-

**Which one of these  
Genisco centrifuges meets  
your requirements for testing  
components under simulated  
operational G-loadings?**

*... as required by Mil 5272A, procedure II*

Genisco G-Accelerators provide a quick, precise means of testing components in an acceleration environment similar to that encountered in actual operation.

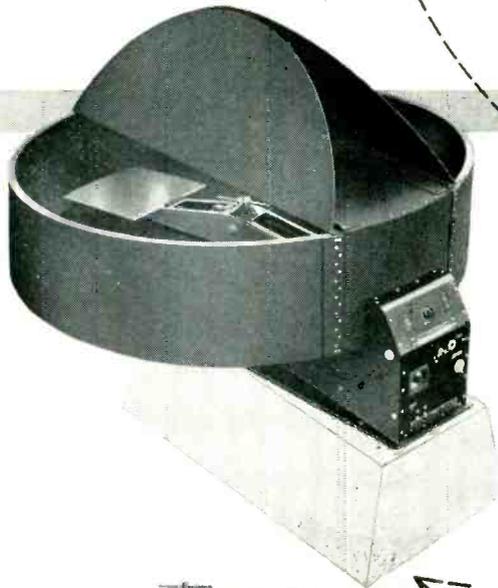
They are extremely accurate machines, easy to operate and built to withstand years of hard use.

These features particularly suit them for large volume testing programs, as well as for precise laboratory prototype development.

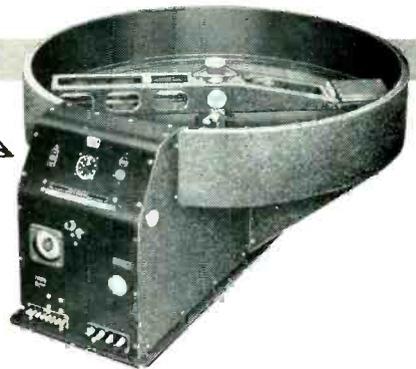
More than 100 Genisco G-Accelerators of various capacities are now in use throughout the world.

Complete technical information on all models and accessories is available. Please direct your inquiry to: Contracts Manager, Genisco, Inc., 2233 Federal Avenue, Los Angeles 64, California.

**MODEL C159** The larger capacity of this machine permits whole system components and complete packages to be tested. Two objects, each weighing 100 pounds and 24" x 24" x 18" in size, can be accommodated simultaneously. G-range of the machine is 0.024 G to 75 G's. Maximum centrifugal capacity is 2000 G-pounds. Nominal radius of gyration 48".



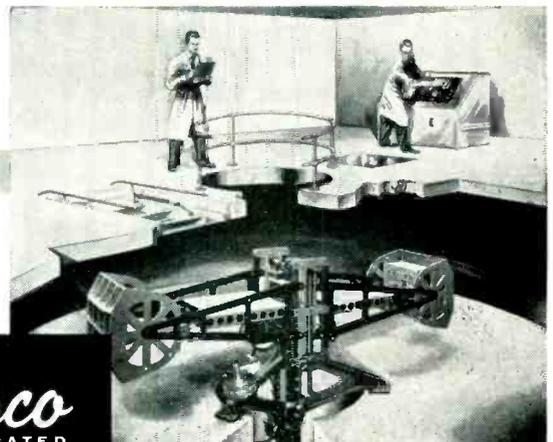
**MODEL B78** Used primarily for testing relays, switches, tubes, motors, valves, and other small components, and to calibrate and evaluate accelerometers. Accommodates objects weighing up to 25 lbs.; has G-range of 0.017 G to 120 G's. Maximum centrifugal capacity is 1200 G-pounds. Nominal radius of gyration 24".



**MODEL D184** A high-speed machine, designed to test accelerometers and other instruments under acceleration forces from 1 to 850 G's. Full centrifugal capacity is 1000 G-pounds. Nominal radius of gyration 12".



**MODEL E185** This newest and largest Genisco centrifuge was recently built for the U.S. Air Force. Two mechanical or electronic packages, each weighing up to 300 pounds, can be subjected to an acceleration environment of up to 65 G's simultaneously. Nominal radius of gyration of the machine is six feet. An automatic dynamic balancing system automatically compensates for any excessive unbalance in the machine during test runs.



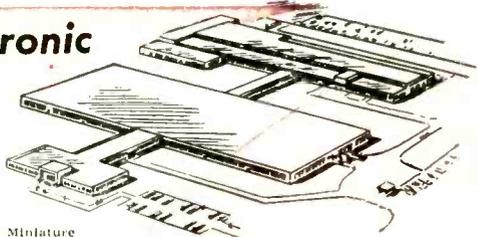
**ACCESSORIES ADD TO OPERATING EASE** A number of accessories including a strobe system, air system, optical system, tub cover, access doorway, and slip ring systems, designed to give greater operating convenience, are available for Genisco G-Accelerators, Models B78 and C159.

Modifications in any basic machine or accessories to meet your particular requirements will be carefully considered.



**RELIABILITY FIRST**

# Sub-miniature Assemblies To Gigantic Electronic Systems . . . . .



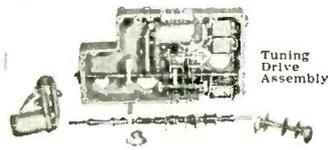
Miniature Solenoid Drive



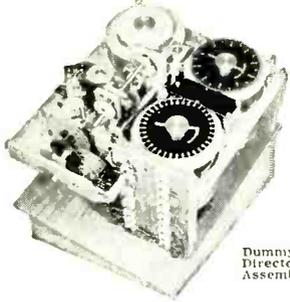
Miniature Gear Reduction Unit



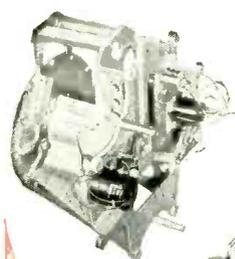
Sub-miniature Circuits — Transistorized Application



Tuning Drive Assembly



Dummy Director Assembly



Antenna Drive Housing



Alternate Fire Control



## ... For the NAVY

Radar Fire Control Systems, Mine Detecting Devices, Anti-Submarine Attack Directors, Catapult Speed Indicators, Servo Control Systems, Torpedo Assemblies.



## ... For the AIR FORCE

Capacitance Testers, All-Altitude Servo Indicators, Transistorized Receivers, R F Switches, Potentiometers.



## ... For the ARMY

Mechanical Fire Control Systems, Fuzes, Communication Systems and other instrumentation for all branches of the Army.



## ... For INDUSTRY

Test Equipment, Computing Devices, Radar Equipment, Nuclear Equipment, Gyro Mechanisms, Electronic and Electro-Mechanical Devices.

Write For Our Facilities Report

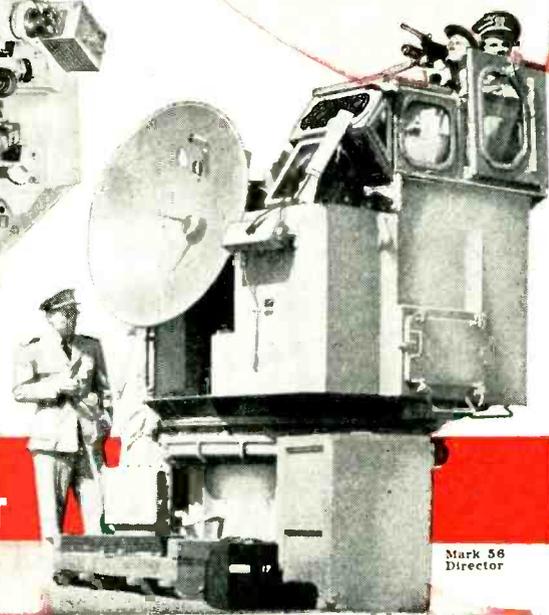


grams cannot become misplaced or lost, thus providing an obvious advantage to the ultimate user and eliminating requests to the manufacturer for new wiring diagrams to replace those that cannot be located. Samples of diagrams printed on both acetate film and flatback pressure sensitive tape are available.



## MICROWAVE GENERATOR is code modulated

POLARAD ELECTRONICS CORP., 43-20 34th St., Long Island City 1, N. Y., has announced a new code modulated microwave generator with 5 independently adjustable pulse channels, equipped with 4 interchangeable r-f microwave oscillator heads, and providing a precision oscilloscope. The model B was designed to provide code modulated carrier from 950 to 10,750 mc for beacons, missiles and radar. Each of the pulse channels has variable pulse width and delay, and also has an external ptm input. Repetition rate is variable. The entire instrument operates from a built-in a-c line voltage regulator to insure stability. The modulator is equipped



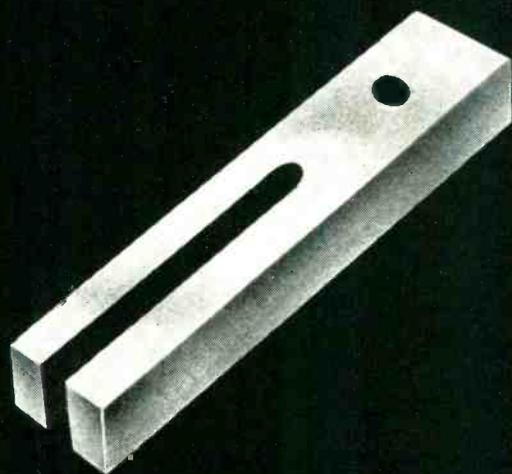
Mark 56 Director

**DAYSTROM INSTRUMENT**

ARCHBALD, PENNA.

Div. of Daystrom, Inc.

*Tuning Fork Resonators,  
the ultimate in precision audio  
frequency control...*



*... phone or write*

for complete information regarding component type  
**Tuning Fork Resonators**, or variously pack-  
aged **Tuning Fork Frequency Standards**.



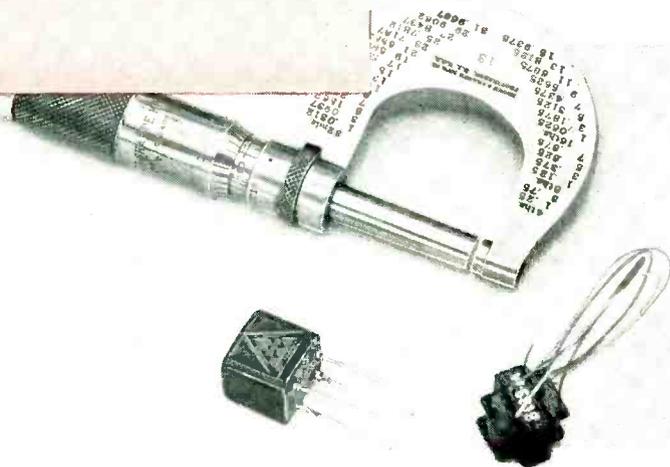
*Philamon Laboratories Inc.*

30 HOPPER STREET, WESTBURY, LONG ISLAND, N. Y.

EDgewood 3-1700

**"HOW SMALL  
CAN YOU GET?"**

**. . . is a thought  
our engineers  
like to play with**



## WHEELER

Since **WHEELER** has had long experience in manufacturing precision-controlled insulated magnet wire so fine you can barely see it, it is only natural that our engineering people have been working with miniature and sub-miniature coil and transformer units from the inception of miniaturization.

The important NEW TINY-MITE series of transformers is one result of this work. Tiny-Mite Transformers, with unusually excellent typical characteristics, are ideal for use in transistor and printed circuits, control, guided missile, and similar applications where space, weight, and size are prime factors.

Tiny-Mite Transformers are assembled with nickel alloy laminated cores, with fine wire coils wound on nylon bobbins. Windings are terminated with special care and technique to insure maximum protection to leads.

Tiny-Mite Transformers are varnish-treated and can be supplied open frame with 3" color coded leads, or in metal shells, hermetically sealed, and with #22 tinned leads soldered to header terminals to facilitate assembly.

Tiny-Mite Engineering Data Sheets are available on request to Wheeler — producers of fine gauge magnet wire, specialized coils, and transformers. Your own special needs can almost certainly be met by standard units in this new series, or by possible modifications. We will welcome your inquiry.

### THE WHEELER INSULATED WIRE COMPANY, Inc.

Division of Sperry-Rand Corp  
1101 East Aurora Street, Waterbury 20, Connecticut



## WHEELER

TRANSFORMERS • COILS • AMPLIFIERS  
CUSTOM ELECTRONIC AND WIRING ASSEMBLIES  
COMMUNICATIONS EQUIPMENT • MAGNET WIRE

**WHEELER MAKES THESE PRODUCTS A** *Specialty*

Wheeler is constantly adding to its staff of engineers. If you are available and qualify in this field, call us now.

with electronically regulated low voltage d-c supply. The universal regulated klystron power unit automatically selects the proper voltage for any of the plug-in microwave oscillator units.



### MAGNETIC AMPLIFIER for airborne servo systems

SPECIALTIES, INC., Skunks Misery Road, Syosset, L. I., N. Y. Part No. T1616JC, a 6-w, 115-v, 400-cycle magnetic amplifier is designed specifically for instrument type airborne servo systems. The unit operates directly from a synchro control transformer or potentiometer, without preamplifier or demodulator. A 3-stage fast response half-wave bridge circuit is used which is capable of a 20-cycle bandwidth when driving a BuOrd servo motor Mk7 in a closed-loop system using simple circuitry. This hermetically sealed amplifier features less than a 0.07-v drift with respect to wide changes in line voltage and frequency or temperature.

### RELAY to 10-k ohm coil resistance

KURMAN ELECTRIC Co., 35-18 37th St., Long Island City, N. Y. A newly designed coil and magnetic structure is featured in the series 23C relay. Coil resistances up to 10,000 ohms are now available and standard adjustments are as low as 7 mw for an spdt contact arrangement. The new relay weighs only 1½ oz and occupies 1.5 cu in. It is well suited for use with cadmium sulphide photocells (as both a-c and d-c versions are operated directly

**E**ngineering

**D**esign

**R**esearch

**D**evelopment

**cu. ri. os i. ty** (kyoor. i. os' i. ti), n.,  
the desire to learn or know about anything; inquisitiveness.

This is, quite frankly, a bid for inquisitive engineers—creative men who desire to learn more about the future and what it may hold for them.

For at Goodyear Aircraft we have a policy of “progressive curiosity”—a continuous pioneering into new fields, new materials, new methods, new structures—and it has paid off in a host of new advancements important in the progress of missiles, jets, airships, helicopters, radar, plastics, metals and electronics.

It has paid off because this forceful, creative thinking has attracted engineers really *seeking* the challenge of new concepts.

The challenge at Goodyear Aircraft—and the security that goes with it—can spell a rewarding future for you.

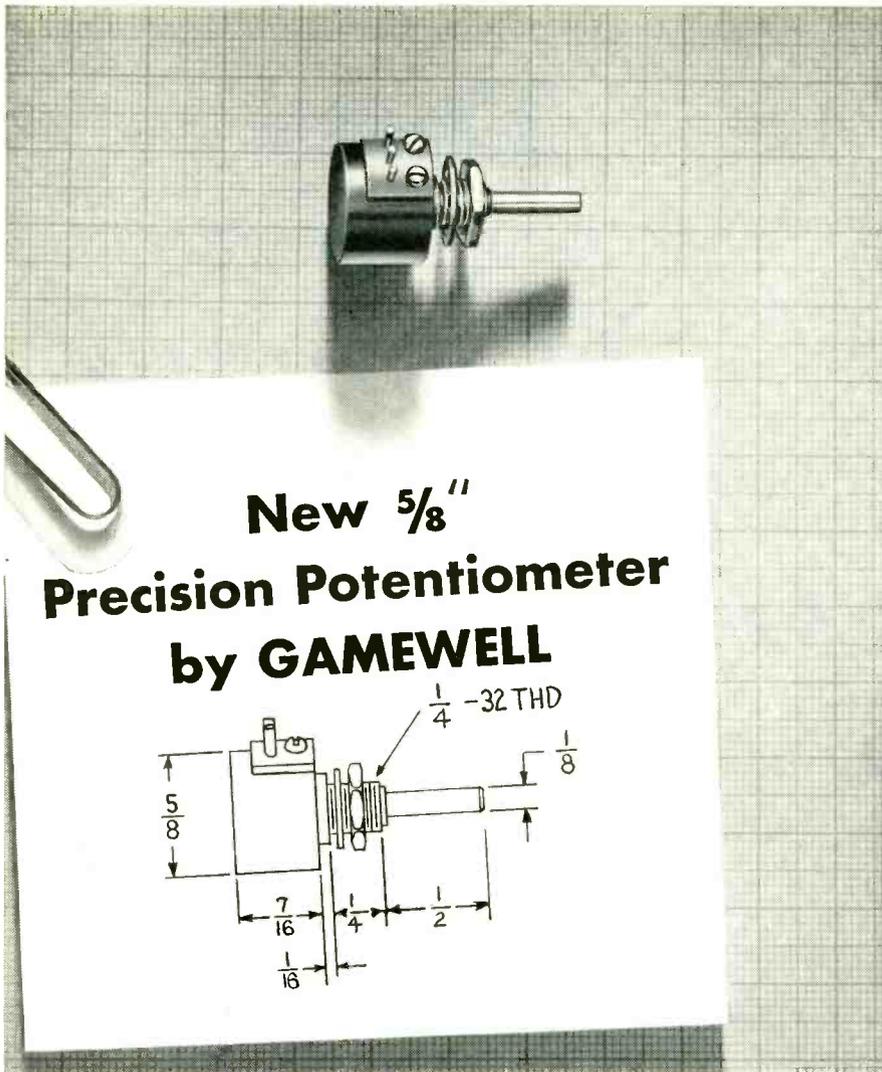
The fields are as broad as the challenge. Goodyear Aircraft is unique in its scope, rock-solid in its stability—contributing importantly in virtually every phase of aeronautics and related fields, backed by the resources of the world's largest rubber company.

Whatever your engineering experience, *you owe it to yourself to get the facts on Goodyear Aircraft.* Write for application form or send your resumé to: C. G. Jones, Personnel Department, Goodyear Aircraft Corporation, Akron 15, Ohio. Plants in Akron and Litchfield Park, Arizona.

**T**hey're doing big things at

**GOOD YEAR AIRCRAFT**

THE TEAM TO TEAM WITH in AERONAUTICS



Here is a  $\frac{5}{8}$ " potentiometer that offers you the extreme precision found in larger sizes of Gamewell Potentiometers.

Body is of anodized aluminum and the shaft is made of stainless steel. Kohlrausch type winding provides excellent linearity and the unit meets MIL-E-5400 specifications as they apply.

The unit can be modified for special mounting, Multiple gangs, higher operating temperatures, and other special features upon request. Write for additional information about this miniature precision potentiometer.

**CONDENSED TECHNICAL DATA:**

Resistance . . . . .	*30K $\pm$ 5%
Min. Resistance . . . . .	20 ohms
Linearity . . . . .	*0.25
Electrical Angle . . . . .	345°
Resolution . . . . .	*0.09% (1100T)
Test Voltage . . . . .	1000 RMS
Temperature . . . . .	105°C
Watts . . . . .	1
Size . . . . .	$\frac{5}{8}$ " OD $\frac{7}{16}$ " long
Torque . . . . .	0.2 oz.-in.

\*Maximum Values

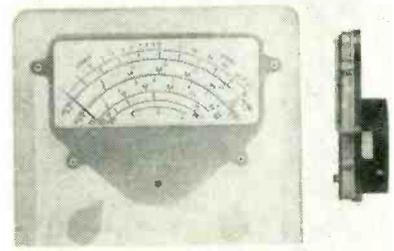
**THE GAMEWELL COMPANY**  
NEWTON UPPER FALLS 64, MASS.



**PRECISION POTENTIOMETERS**

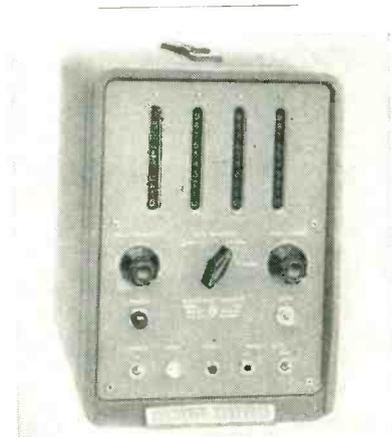
Manufacturers of Precision Electrical Equipment Since 1855

from the photocells with minimum current drain), also for all control applications, in either plate circuit or battery operated circuitry.



**LARGE-SCALE METER**  
has 6 in.  $\times$  2 $\frac{1}{2}$  in. dial face

MARION ELECTRICAL INSTRUMENT Co., Manchester, N. H. Model SS56 meter is especially useful where rapid, accurate readings must be made from a distance or where several scales must be combined in one instrument. It is available as a moving coil permanent magnet type in all d-c ranges. It has a nominal 2 percent accuracy, available to  $\frac{1}{2}$  percent as the application requires. A variety of scale ranges permits its use as a basic component in many types of test equipment. Although the Plexiglas cover allows for exterior or edge lighting, the SS56 is also supplied with provision for internal scale illumination.



**INDUSTRIAL COUNTER**  
features high accuracy

HEWLETT-PACKARD Co., 275 Page Mill Road, Palo Alto, Calif., has announced an industrial counter that can measure frequency, speed, rpm, random events, weight, temperature, pressure, acceleration and

# Riveting With a Hammer in Blind or Open Applications

Elimination of special riveting tools can mean faster production, lower costs, no down time.

J. K. BARRY, M. E.

The use of blind rivets installed with only an ordinary hammer from one side of the job offers a highly simplified method of fastening. Speed, convenience and *low installed cost* make Drive Riveting preferable not only for blind joints, but for fastening many parts that can be reached from either side.

The Southco Drive Rivet has a cored, slotted body with a grooved pin pro-

truding from its head. When the rivet is inserted through parts to be fastened, the pin is driven flush with the rivet head causing the expanding prongs to form a blind head behind the rear sheet. No further finishing is necessary, since the pin seats itself permanently to complete the smooth head contour.

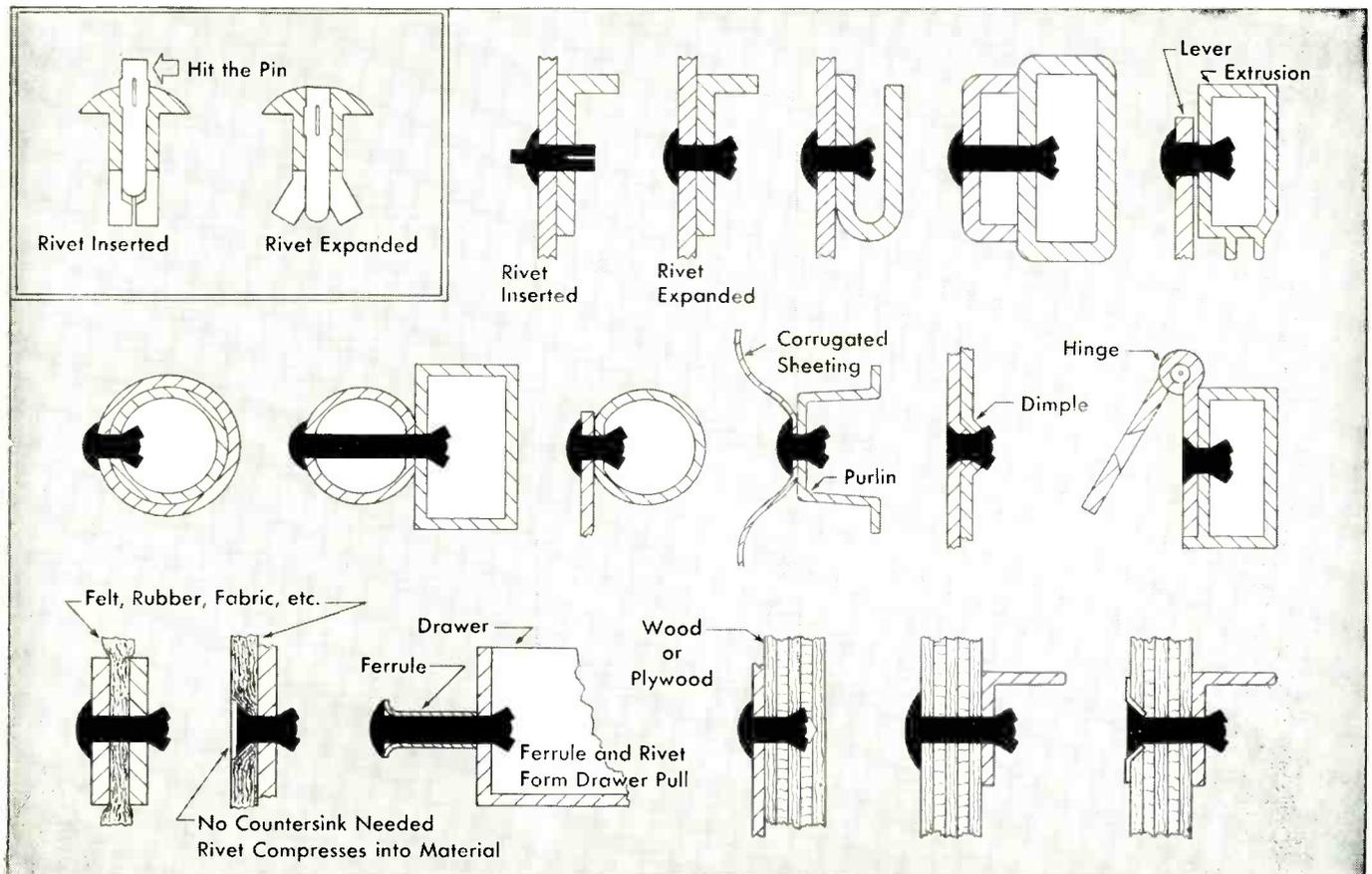
Drive Riveting has five major advantages:

1. No investment in special tooling.

2. No lost time for tool repairs.
3. No limitation on the number of men who can install rivets.
4. Speed comparable to nailing.
5. Only one man is needed.

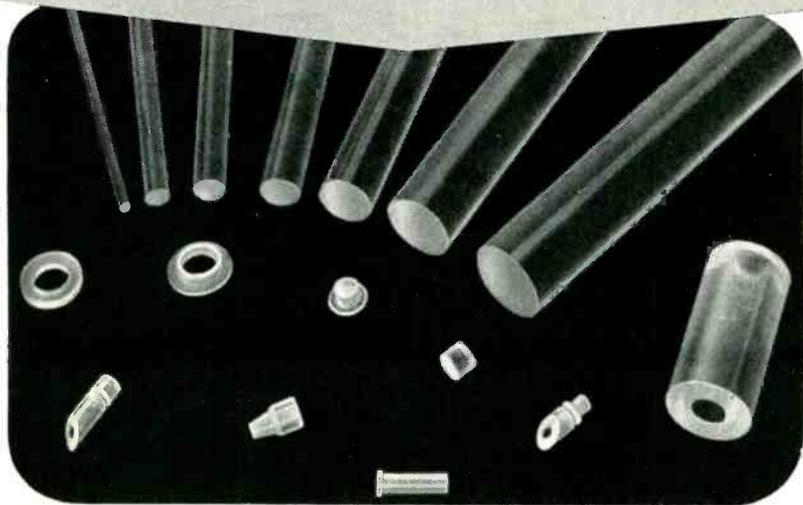
Widely used in truck bodies, storm doors, metal buildings and hundreds of other industrial applications, Southco Drive Rivets make a secure, vibration-proof joint. A wide range of head styles, diameters and grip lengths is available.

## RECOMMENDED APPLICATIONS FOR DRIVE RIVETING



SOUTHCO Division, South Chester Corporation, 233 Industrial Hwy., Lester, Pa.

## USE POLYPENCO® Q-200.5 for UHF Installation Components



### STANDARD LENGTHS OF 6-8 FT. ASSURE LOW MACHINING COST

For low cost production machining of coaxial spacers, connector beads, stand-off insulators and many similar UHF components, POLYPENCO Q-200.5 is available now in centerless ground rod with diameters up to 1" and lengths of 6 to 8 feet.

### LOOK AT THESE DIELECTRIC PROPERTIES!

- Dielectric Constant: only 2.4 to 2.5
- Dissipation Factor: 0.0002 at 30 mc (remains practically constant over entire frequency range)
- Dielectric Strength: about 350 volts per mil

### CHECK THESE OTHER FEATURES

- Dimensionally stable up to 400° F
- Rigid and transparent
- Easily machinable on standard metalworking equipment
- Good mechanical strength
- Chemically resistant

Get the full facts on POLYPENCO Q-200.5. Write for technical bulletin.

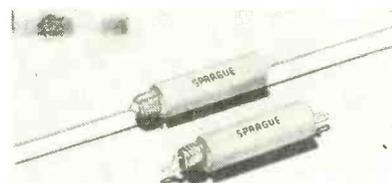
**P**  
**POLYPENCO**

THE POLYMER CORPORATION of Penna. • Reading, Penna.  
In Canada: Polypenco, Inc., 2052 St. Catherine W., Montreal, P.Q.

nylon, teflon\* and other non-metals

\*DU PONT TRADEMARK

many other phenomena. Model 521A provides direct numerical readings in cps, rpm or rps from 1 cps to 120 kc. Period of count is either 0.1 or 1 second, and the count display time can be varied at will. The instrument uses conventional power line frequency for counting time base; or is available with a plug-in crystal time base for measurements of more precise accuracy. Model 521A includes three accessory power supplies of -150 v d-c, +300 v d-c and a 6.3 v a-c filament supply. Connections are also supplied for photocells and an external standard.



### CAPACITORS

rated for 125 C operation

SPRAGUE ELECTRIC Co., 35 Marshall St., North Adams, Mass. Type 118P metallized paper capacitors are rated for operation at 125 C without voltage derating and with high insulation resistance. The capacitors withstand dielectric test of twice rated voltage. Other features include self healing dielectric, complete hermetic sealing with glass-to-metal solder-seal terminals, and corrosion-resistant cases. Both standard wire leads and solder tab terminals are available. These capacitors are finding widest application in military electronics and in allied industrial applications such as control devices, where both reliability of service and economy of space are important. They meet environmental tests of MIL-C-25A. Complete details regarding sizes, ratings, performance characteristics, and mounting and terminal styles available are given in engineering bulletin 224.

### MICROWAVE POWER METER

reads direct in mw or dbm

HEWLETT-PACKARD Co., 275 Page Mill Road, Palo Alto, Calif. Direct, automatic readings of microwave power levels from 0.1 to 10 mw or

*Lockheed* **MISSILE SYSTEMS DIVISION**

LOCKHEED AIRCRAFT CORPORATION • VAN NUYS, CALIFORNIA

To Physicists and Engineers:

The new science of guided missiles is contributing importantly to changing man's concept of the Planet Earth in terms of time and space.

Continents will be only minutes apart in the foreseeable future. The upper atmosphere is now being effectively explored. To the missile systems scientist, there is no such thing as a remote area of this planet.

Guided missile technology is also significantly affecting other areas of scientific endeavor. The impact of nuclear science upon guided missiles alone promises major achievement. Present advances are but a prelude to future progress. Past accomplishments must be multiplied a hundred-fold to visualize growth during the next decade.

To scientists and engineers, missile systems technology presents unlimited scope for personal development. Those desiring to participate in a scientific effort of utmost importance are invited to address inquiries to our Research and Engineering Staff.

*E R Quesada*

Elwood R. Quesada  
Vice President and  
General Manager

# Precision Components for Microwave Systems

Unequaled experience in the design and manufacture of both simple and complex test components makes Technicraft your best and most economical source of supply.

Technicraft research has led to the development of new and better designs for such equipment as traveling detectors, slide tuners, movable shorts, stub tuners, VSWR calibrators and oscillating joints.

Our field representatives will be glad to provide assistance or information to help solve your microwave problems — contact us at Thomaston.

*For complete details and characteristics ask for our specification sheets.*

## TECHNICRAFT LABORATORIES

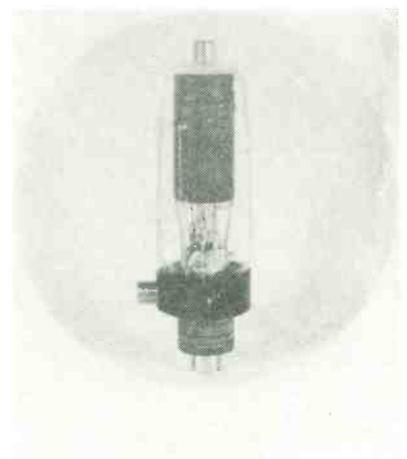
INCORPORATED

1550 THOMASTON RD. • THOMASTON, CONNECTICUT

Designers and Manufacturers of Rigid and Flexible Waveguide Assemblies, Microwave Test Plumbing and Components, Waveguide Systems.



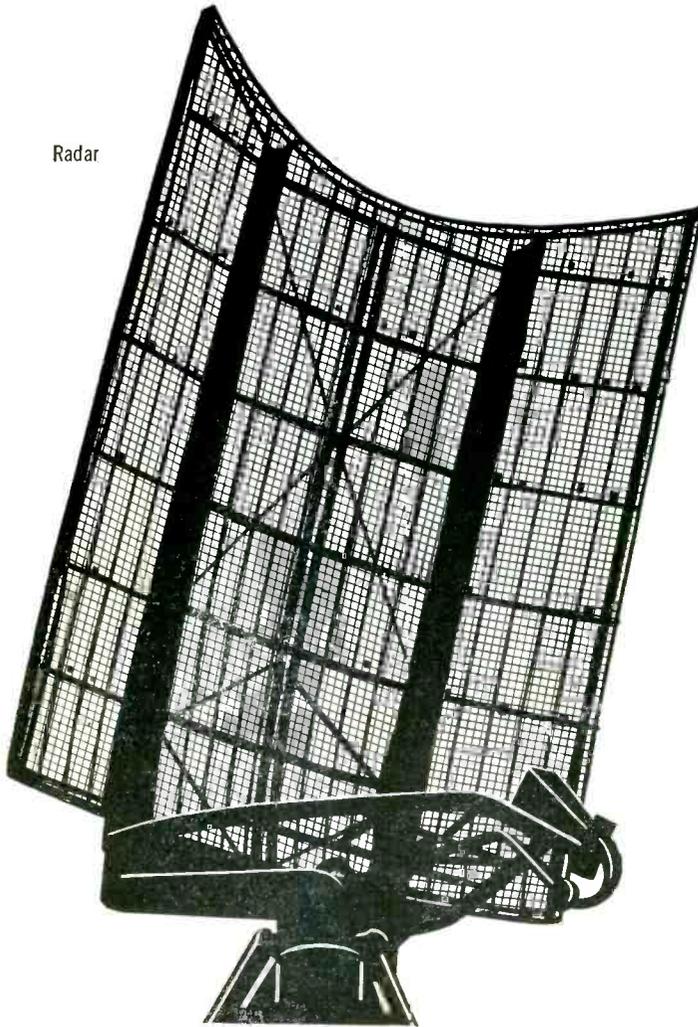
from  $-20$  to  $+10$  dbm are now available in the model 430C microwave power meter. It eliminates computation and adjustment during measuring. Operation of the instrument is entirely automatic, and it may be used with a wide variety of bolometer mounts having either positive or negative temperature coefficients. Frequency range depends on the bolometer mount employed, and either an instrument fuse, barretter or thermistor may be employed. Price of the unit is \$250.



### THYRATRON is mercury-vapor filled

NATIONAL ELECTRONICS, INC., Geneva, Ill. An indirectly heated cathode, shield grid, 2.5 amperes d-c thyatron, NL-5560, has been developed. It is mercury-vapor filled for long life. Ratings are: heater volts, 5; heater current, 4.5 amperes; peak inverse and forward volts, 1,000; average anode current, 2.5 amperes; peak anode current, 15

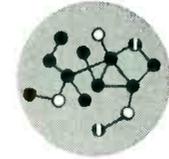
Radar



Navigation



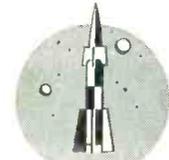
Timing



Nucleonics



Geophysics



Ordnance

## PRECISION DIGITAL DELAY GENERATOR

FOR GENERAL-PURPOSE LABORATORY USE

Generates pulses accurately spaced in time with respect to an internally generated reference pulse—range 0 to 100,000 microseconds

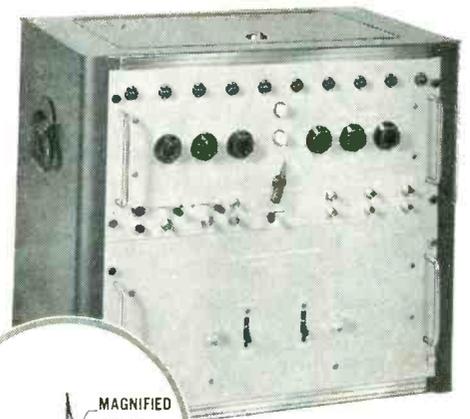
Complete generality permits numerous and varied uses such as radar range calibration, target simulation, generation of secondary frequency standards, elapsed time measurements, phase measurements, etc. Fields of application include Radar, Navigation, Telemetry, Nuclear Studies, Computer Research, Geophysics, Ordnance, and any other fields in which timing is significant.

The ability to generate a specific delay at accurate variable repetition rates sets this instrument apart from any other pulse or delay generator in the field today. Write for full details.

Pulses can be supplied under either one-shot conditions or at variable repetition rates. Both pulse delay and repetition period can be established in increments as small as 1 microsecond.

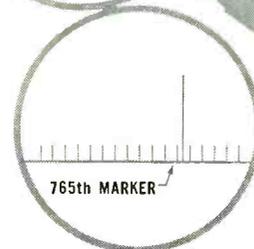
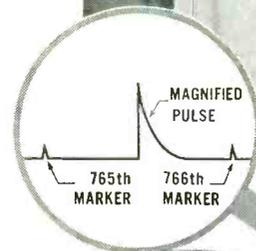
The repetition period can also be externally triggered, in which case two inde-

pendently variable delayed pulses are available. Accuracy of both repetition period and pulse delay are held to one part in  $10^6$  by the thermostatically controlled crystal oscillator. The digital circuitry and the built-in self-checking features make continuous calibration unnecessary.



MODEL 743

Observed pulse as viewed on a suitable synchroscope



**KAISER METAL PRODUCTS, INC.**  
BRISTOL, PA.

More Engineers on A-N and civilian projects are proving—

# It pays to specify AMPERITE DELAY RELAYS and BALLAST REGULATORS

... they're finest



... cost less!



STANDARD

## Thermostatic DELAY RELAYS

**MOST COMPACT, HERMETICALLY SEALED**

Provide delays ranging from 2 to 150 seconds.

- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.
- Hermetically sealed. Not affected by altitude, moisture, or other climate changes.
- Circuits: SPST only — normally open or normally closed.

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from  $-55^{\circ}\text{C}$ . to  $+70^{\circ}\text{C}$ . Heaters consume approximately 2 W. and may be operated continuously. The units are most compact, rugged, explosion-proof, long-lived, and — inexpensive!



MINIATURE

TYPES: Standard Radio Octal, and 9-Pin Miniature.

**PROBLEM? Send for Bulletin No. TR-81**

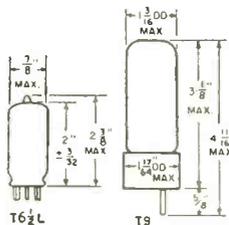
Also — a new line of Amperite Differential Relays — may be used for automatic overload, over-voltage, under-voltage or under-current protection.



T9 BULB

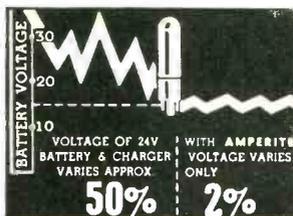
## BALLAST REGULATORS

- Amperite Regulators are designed to keep the current in a circuit **automatically regulated** at a definite value (for example, 0.5 amp).
- For currents of 60 ma. to 5 amps. Operates on A.C., D.C., Pulsating Current.
- Hermetically sealed, light, compact, and most inexpensive.



Amperite Regulators are the simplest, most effective method for obtaining automatic regulation of current or voltage. Hermetically sealed, they are not affected by changes in altitude, ambient temperature ( $-55^{\circ}\text{C}$ . to  $+90^{\circ}\text{C}$ .), or humidity. Rugged; no moving parts; changed as easily as a radio tube.

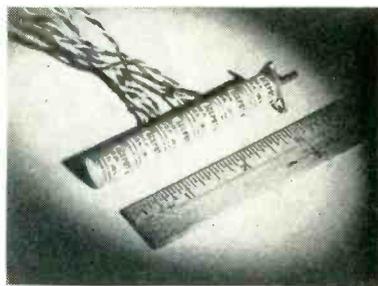
Write for 4-page  
Technical Bulletin No. AB-51



NEW PRODUCTS

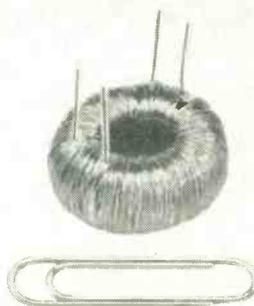
(continued)

amperes; anode averaging time 15 seconds; and cathode heating time, 5 minutes. A data sheet is available.



## SMALL POTENTIOMETER is space and weight saving

ACE ELECTRONICS ASSOCIATES, 125 Rogers Ave., Somerville 44, Mass. The No. 500 Acepot, subminiature wire-wound precision potentiometer only  $\frac{1}{2}$  in. in diameter, is now being made in special ganged control units of high precision and accuracy. These ganged Acepots have the accuracy required by many computer and servo control applications. They are available in the resistance range from 200 to 100,000 ohms. Due to the large number of turns of fine resistance wire in the element and the precision accuracy with which they are spaced, standard accuracy of linear units is  $\pm 0.3$  percent independent linearity. A further advantage is the small torque required. Standard torque is 0.035 oz./in. at 20 C. Complete specifications, application data sheet and prices are available from the company.



## TOROID COILS used with transistor boards

FORREST MFG. Co., 5962 Smiley Drive, Culver City, Calif., announces a line of toroid coils for use with transistors in both sub-miniature and printed circuits. The coils are designed for quick inser-



**AMPERITE CO. Inc., 561 Broadway, New York 12, N. Y.**

In Canada: Atlas Radio Corp., Ltd., 560 King St. W., Toronto 2B



# NEW Tektronix Portable Oscilloscope

gives you Laboratory Performance  
...in the FIELD!



The Tektronix Type 310 is fully capable of performing much of your laboratory work, yet has the physical characteristics desirable for work away from your bench. It handles easily and fits into tight spots, simplifying field maintenance of complex electronic equipment. The high performance of the Type 310 can help you speed up your field work... its low weight and small size can ease your equipment handling problem.

Complete accessibility to tubes and components is maintained by a unique step-chassis construction, hinged at the rear. Accurate calibration and excellent linearity permit reliable quantitative measurements—you read time and amplitude directly from the screen. Functional panel design and versatile control system contribute to operator convenience, making this new oscilloscope an easy-to-use field and lab instrument.

## TYPE 310 CHARACTERISTICS



**IN THE FIELD**



**IN THE LAB**

### Portability

Overall dimensions—6 $\frac{3}{4}$ " wide,  
10" high, 17" deep.  
Weight—only 23 $\frac{1}{2}$ " pounds.

### Transient Response

Risetime—0.09  $\mu$ sec.

### Sensitivity

DC to 4 mc—0.1 v/div to 50 v/div in 9 calibrated steps, 0.1 v/div to 150 v/div continuously variable. AC-Coupled—3 db down at 2 cycles. AC-Coupled only, 2 cycles to 3.5 mc—0.01 v/div to 0.1 v/div in 3 calibrated steps.

### Versatile Triggering

Internal, external, line... ac- or dc-coupled, and AUTOMATIC TRIGGERING.

### Flat-faced CRT

3WP with 1.8-kv accelerating potential.  
Edge-lighted graticule with  $\frac{1}{4}$ " divisions.

### Wide Sweep Range

0.5  $\mu$ sec/div to 0.6 sec/div, continuously variable.  
18 calibrated sweeps from 0.5  $\mu$ sec/div to 0.2 sec/div. Accurate 5-x magnifier extends calibrated sweep range to 0.1  $\mu$ sec/div.

### Horizontal Input

Sensitivity—1.2 v/div.

### Voltage Calibrator

Square wave, approximately 1 kc—  
0.05 v to 100 v in 11 steps.

### Jewel Warning Light

Indicates when controls are at non-calibrated settings.

### Power Requirements

105 to 125 v, 60 to 800 cycles, 175 watts.

### DC-Coupled Unblinking

All DC Voltages Electronically Regulated

**Type 310 Cathode-Ray Oscilloscope — \$595**

f.o.b. Portland (Beaverton), Oregon

Please call your Tektronix Field Engineer or Representative for complete specifications, or write to:

# Tektronix, Inc.

P. O. BOX 831 • PORTLAND 7, OREGON  
CYPRESS2-2611 • CABLE: TEKTRONIX

# memo

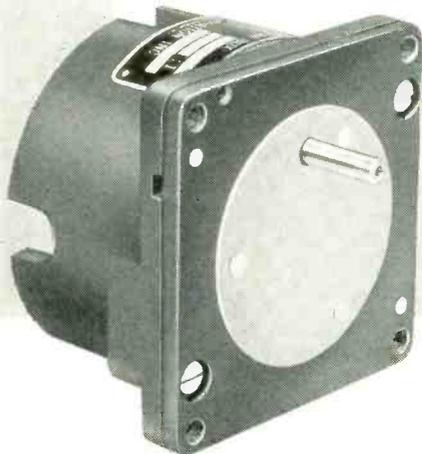
## to: Servo Designers

HOW YOU CAN SAVE COSTLY ENGINEERING  
TIME ON GEAR SYSTEMS

There's no reason to spend costly engineering time on custom-built gear systems in your servos. Now, there is a gear box ready-made for a wide range of servo applications—the Link Model 012. Thousands of them are now providing hour after hour of dependable operation in nuclear controls, computers, radar and communications controls, instruments, industrial controls, simulators and training equipment.

The Model 012 Gear Box is recognized as "tops" by many servo designers for its efficient design, compactness, and adaptability. It fits all commonly available servo motors. Its backlash is less than .25° at slow turning shaft and its torque output, under the same conditions, is 120 oz./in. At the input shaft, its friction is .004 oz./in.

*catalog tells full story*



Link Hi-Precision Gear Box  
Model 012 for use on Servo  
Mechanisms • Computers •  
Control Equipment • Motor  
Drives • Instruments

Find out how you can use the Model 012 in your servo design. It is available in ratios from 10:1 to 3125:1. Write today for a new eight page catalog on the gear box and adapters.

**LINK**  
AVIATION, INC.

BINGHAMTON, NEW YORK

A SUBSIDIARY OF  
GENERAL PRECISION  
EQUIPMENT CORPORATION



tion through transistor terminal boards—the windings are terminated in lugs, or solid wire leads. Leads can be tinned for dip soldering, or brought to any pin arrangement. Sizes range from  $\frac{3}{8}$  in. o-d  $\times$   $\frac{1}{4}$  in. to  $\frac{7}{8}$  in. o-d  $\times$   $\frac{3}{8}$  in.; inductance values up to 2 henrys. Units are finished with hard-setting epoxy resin, or are sealed in cans to meet MIL specifications.



### VIDEO LINE MONITOR for station camera chains

KAY LAB, 5725 Kearney Villa Road, San Diego 12, Calif., has developed a new broadcast video monitor, model ARM-13A, which provides complete monitoring facilities for broadcast station camera chains at a competitive price. The monitor is complete with A scope and illuminated calibrated scale which allows direct measurement of the height of the composite video signal. By means of a switch two lines or two fields of video information may be viewed on the A scope. Separate h-v power supplies are used for both the 10-in. kinescope and 3-in. A scope. The 1-v power supply is fully electronically regulated. The 10-in. kinescope is a flat-faced, tinted, aluminized crt. Video amplifiers provide an 8-mc bandwidth resulting in an extremely fine resolution of 600 lines. A special control provides for synchronization on sync pulses stripped from the composite video or by synchronization with pulses taken directly from the station sync generator at the choice of the operator.

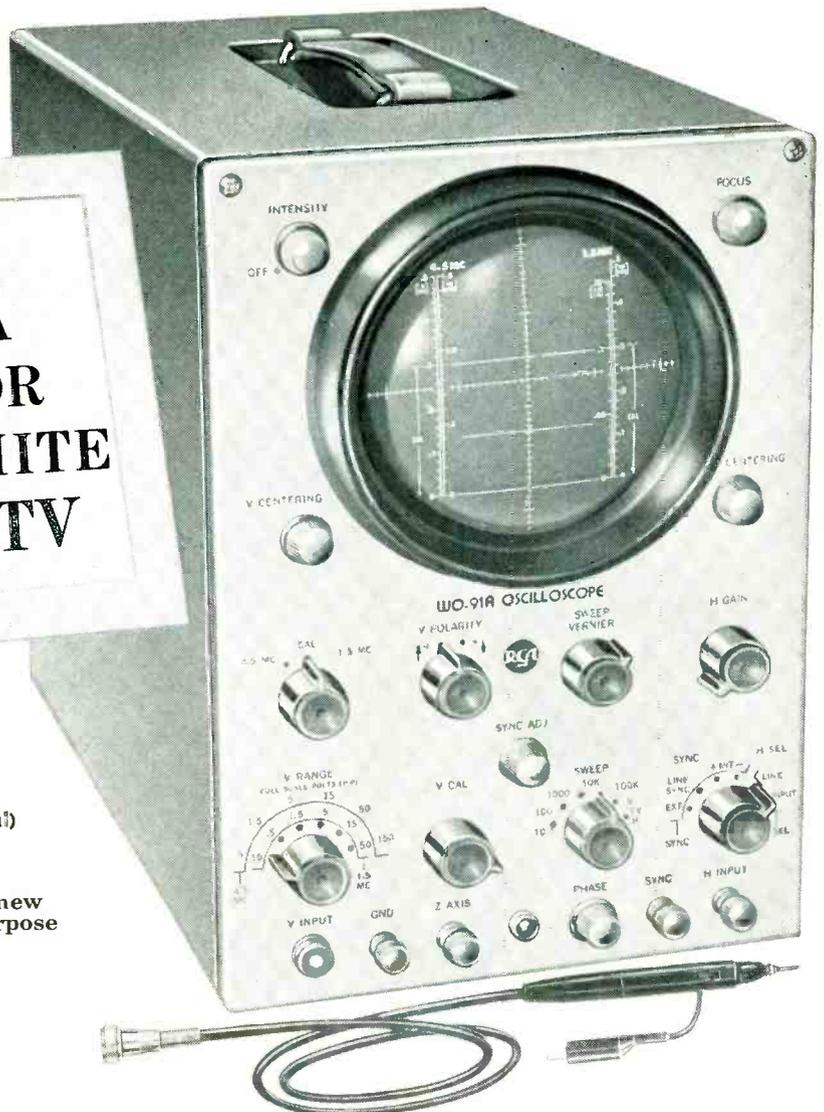
### DYNAMOMETER has several improvements

WESTERN GEAR, Electro Products Division, P. O. Box 182, Lynwood,

*All New!*  
**RCA WO-91A**  
**5" 'SCOPE FOR**  
**BLACK and WHITE**  
**and COLOR TV**

**Only \$229<sup>50</sup>**  
 User Price (Optional)

**RCA WO-91A 5" OSCILLOSCOPE**  
 Complete, ready-for-use, including new  
 WG-300A low-capacitance, dual-purpose  
 probe, shielded input cable and  
 instruction book.



**N**OW—AN ALL-NEW OSCILLOSCOPE with features usually found only in more expensive instruments. It has all the 'scope functions you need to do both black-and-white and color TV service work . . . speedily and with top-grade results! Check a few of these work-simplifying features . . . "low-capacitance/direct" probe . . . preset "V" and "H" sweep positions . . . automatic probe-disconnect calibration control. And look at the added features of this instrument:

- *Dual-band response. Response flat to 4.5 Mc in wide-band position.*
- *Voltage-calibrated, frequency-compensated, 3-to-1 step attenuator for "V" amplifier.*
- *Simplified, semi-automatic voltage calibration for simultaneous voltage measurement and waveshape display.*
- *VTVM-type graph scales marked in peak-to-peak volts—read voltage amplitude directly from screen.*
- *Vertical-polarity reversal switch for "upright" or "inverted" trace display.*
- *Sturdy one-piece low-capacitance/direct probe minimizes circuit loading.*
- *Z-AXIS input facilities permit direct modulation of the cathode-ray tube grid.*
- *Preset "V" and "H" sweep positions for speedy, automatic lock-in at "vertical" and "horizontal" frequencies.*
- *"Plus" or "minus" internal-sync selector.*
- *Shielded vertical-input connector and shielded cable for minimizing hum and stray field pick-up.*
- *Positive-lock internal sync.*

**FREQUENCY RESPONSE:** Wide-band position, within-1 db from 10 cps to 4.5 Mc; Narrow band position, within-1 db from 10 cps to 0.5 Mc; within-6 db at 1.5 Mc.

**SENSITIVITY:** 0.05 volt peak-to-peak per inch (0.018 volt rms) in narrow-band position; 0.15 volt peak-to-peak per inch (0.053 volt rms) in wide-band position.



**RADIO CORPORATION of AMERICA**  
 TEST EQUIPMENT  
 HARRISON, N. J.

See the ALL-NEW  
 WO-91A at your  
 RCA Distributor.  
 Order now for  
 early delivery.

# HIGH VOLTAGE RESISTORS — UP TO 125,000 VOLTS !



## RESISTANCE VALUES TO 1 MILLION MEGOHMS !

Widely renowned for stability and reliable performance, RPC's High Voltage resistors are successfully used as VT voltmeter multipliers; high resistance voltage dividers; bleeders in high voltage power circuits; corona resistors and standards of high resistance value. They are eminently suitable for use in television transmitters and receivers, cathode ray tube circuits, X-ray equipment, Van de Graff generators, electro-meter tube circuits, pulse circuits, dust precipitators, photo cell applications and high voltage circuit equipment. Leading laboratories, manufacturers and many government agencies specify RPC High Voltage Resistors.

**TYPE B.** From 1 to 6½ inches long; diameter ⅝ to ¾ inches. Voltages to 40 KV. High stability carbon coating on strong non-hygroscopic steatite rod. Very long effective resistor length in small space is due to application of coating as a helix on rod's surface. Thus, resistance coating of relatively low specific resistance produces stable resistors of high resistance value. Ends of resistors permanently connected with silver contact coating.

Type B resistors are readily mounted on panel or stand-off insulators. Can be assembled as tapped resistors and matched pairs. Temperature and voltage coefficients are low.

**TYPE D.** Provide voltage rating up to 125 KV and load capacity up to 90 Watts. From 6½ to 18½ inches in length. Made on steatite tubes and can be supplied with silver contact bands, band type terminals or lug ferrules.

In both types, B and D, standard resistors tolerance is ±15%. Tolerances of ±10%, ±5%, or ±3% can be supplied. A tolerance of ±2% can be supplied in matched pair resistors.

Write for additional details and catalog.

Hermetically sealed and encapsulated resistors available. For special assemblies, special types and sizes consult our Engineering Department.

## RESISTANCE PRODUCTS Co.

914 South 13th Street Harrisburg, Penna.

Makers of Resistors—High Megohm, High Voltage, High Frequency, Precision Wire Wound.

NEW PRODUCTS

(continued)

Calif. Incorporating several improvements, a new model Dyna-Chek dynamometer, model DM-4, has been announced. It checks hp, torque and rpm of electric motors in continuous duty from 1 hp or less. It can also be used for testing motors rated at more than 1 hp and up to 2 hp in intermittent service and handles motors in these power categories turning as high as 15,000 rpm.



### FEEDBACK VOLTMETER measures from -70 to +36 dbm

THE SOLARTRON ELECTRONIC GROUP LTD., Thames Ditton, Surrey, England. Type BM.519 precision feedback voltmeter is of use in communications establishments. It features a wide coverage of input levels, provision for measurement at all common characteristic impedances, and display on a clearly scaled 6-in. meter. A coaxial output for cro is available, enabling waveform monitoring to be carried out simultaneously with measurement. With a normal frequency coverage of 15 cps to 100 kc the instrument may be usefully employed at frequencies up to 400 kc, with little reduction in accuracy.

### MERCURY JET SWITCH features low noise

DETROIT CONTROLS CORP., 1650 Broadway, Redwood City, Calif. A new multiposition high-speed switch for commutating, sampling or chopping functions utilizes a jet stream of mercury in a unique fashion as the pole or wiper arm. No brushes or slip rings are involved. Absence of spring-loaded contacts allows long life at high speeds with no contact bounce. Noise is less than 10 μv into 100 ohms. Speeds up to at least 10,000 rpm can be achieved,



**NEW**  
**17**  
**POUNDS OF**  
**PRECISION:**

## DU MONT TYPE 331 CATHODE-RAY OSCILLOGRAPH

- Developed in close cooperation with a leading manufacturer of computers
- DC to 4 mc vertical bandwidth (Transient response, 0.08  $\mu$ sec)
- Precise measurement of time intervals (from 2.5 seconds to 0.08  $\mu$ sec)
- Accurate voltage calibration over range from 0.4 to 400 volts full scale
- Flat-face, tight-tolerance Du Mont Type 3WP- Cathode-ray Tube provides excellent deflection linearity and freedom from field distortions
- Three-times undistorted sweep expansion of *any* calibrated sweep. Any expanded portion may be positioned on screen

### ADDITIONAL FEATURES

Illuminated calibrated scale  
High impedance test probe supplied  
May be continuously operated horizontally or vertically  
Beam-gate output at front panel for triggering external devices  
Swing-away chassis construction assures accessibility of all components for convenient maintenance  
Probe, instruction manual, and other accessories stored in front panel cover

**AND BEST OF ALL, THE PRICE IS ONLY \$585**

Never before has so much high-quality performance been compressed into so small a package. Here, in well under a cubic foot, (7 $\frac{7}{8}$ " x 9" x 17 $\frac{1}{2}$ ") are *complete* facilities for high-precision observation and measurement of signals from d-c to 4 mc and beyond.

With its wide-band features and excellent pulse response (0.08  $\mu$ sec) the Type 331 is particularly well suited for maintenance of computers and radar systems, or wherever portability—without sacrifice in performance—is required.

And in this day of cluttered work benches, the compact design of the Type 331 means that for general applications, you have laboratory performance in half to a quarter the surface area occupied by other instruments of comparable function.

*For complete details, write to the address below for the technical bulletin.*

### IMPORTANT SPECIFICATIONS

**Cathode-ray Tube:** Type 3WP.

**Deflection Factor:** (full gain) a-c or d-c input, 0.2 p-p volts full scale (1.8").

**Frequency Response:** (any control setting) flat from d-c to down not more than 30% at 4 mc.

**Calibrated Sweeps:** 0.5 second to 0.5  $\mu$ sec per major scale division (0.45"); expansion of 3X available on all ranges.

**Amplitude Measurement:** 0.4 to 400 volts full scale in 7 ranges.

**Size:** 7 $\frac{7}{8}$ " x 9" x 19 $\frac{1}{2}$ " overall including cover; weight without cover, 17 $\frac{1}{2}$  lbs.; with cover 19 $\frac{1}{2}$  lbs.

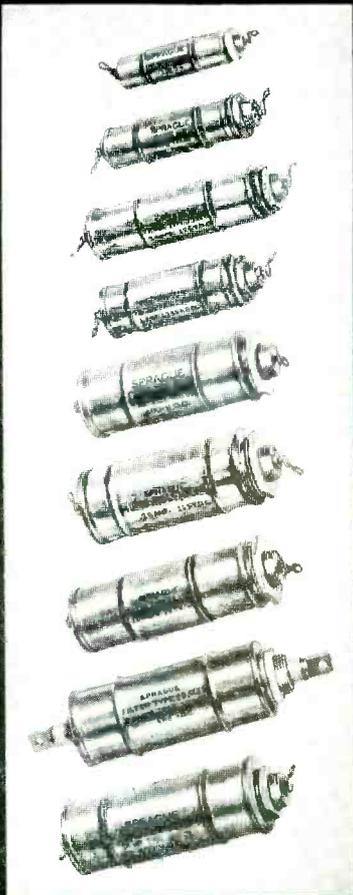
# DU MONT

TECHNICAL SALES DEPARTMENT • ALLEN B. DUMONT LABORATORIES, INC.  
760 BLOOMFIELD AVENUE, CLIFTON, N. J.

# New HIGH INSERTION LOSS NOISE FILTERS

Now Sprague brings you a complete series of miniaturized, bulkhead-mounting interference filters for aircraft and mobile electrical and electronic equipment in ratings from 0.1 ampere to 20 amperes for both 125 volt dc and 125 volt ac, 400-cycle service. These filters meet all pertinent MIL and AN requirements for operation at temperatures from  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . All designs are hermetically sealed with glass- or ceramic-to-metal solder seal terminals.

These filters are available to meet your production schedules from the West and East coast plants of a reliable, old-line manufacturer. For Engineering Data Sheets on the units in which you are interested, write today to the Technical Literature Section, Sprague Electric Company, 12870 Panama St., P. O. Box 66507, Los Angeles 66, California, or 35 Marshall St., North Adams, Massachusetts.



## SPECIFICATIONS

RATING		CATALOG NUMBER	CHARACTERISTICS							
CURRENT (AMPS)	VOLTAGE FREQUENCY		WEIGHT (OZS.)	SIZE (DIA. X LENGTH)	INSERTION LOSS (DB) AT GIVEN FREQUENCIES (MC) (50 OHM SYSTEM)					
					.15	.5	1	10	100	400*
0.1	125VDC	1JX54	1.5	$\frac{5}{8} \times 1\frac{1}{8}$	63	100	100	112	>84	>80
1	125VDC	1JX36	2	$2\frac{3}{32} \times 2\frac{1}{4}$	56	81	>100	86	>90	>73
1	125V/400CY 400VDC	1JX42	5	$2\frac{1}{32} \times 2\frac{1}{32}$	50	79	96	97	80	>56
5	125V/400CY 400VDC	5JX15	6.5	$1\frac{1}{2} \times 3$	60	90	>112	100	>70	>70
5	125VDC	5JX18	3.7	$2\frac{1}{32} \times 3\frac{1}{8}$	59	89	>95	>105	>90	>73
10	125V/400CY 400VDC	10JX15	8.5	$1\frac{11}{32} \times 3\frac{1}{32}$	59	88	>100	87	>80	>79
10	125VDC	10JX16	7.5	$1\frac{1}{2} \times 3\frac{1}{4}$	74	106	>109	>113	>93	>81
20	125VDC	20JX14	9	$1\frac{11}{32} \times 2\frac{1}{16}$	57	88	>103	>99	>90	>83
20	125V/400CY 400VDC	20JX15	10	$1\frac{1}{2} \times 3\frac{1}{32}$	56	88	>100	>114	>83	>60

\*Beyond the range of measurement

you can depend on

# SPRAGUE<sup>®</sup>

WORLD'S LARGEST CAPACITOR MANUFACTURER

and as many as 120 circuits per revolution can be sampled. Thousands of hours of maintenance-free operation can be expected.



## POWER SUPPLY has new construction

BECKMAN INSTRUMENTS, INC., Shasta Division, P. O. Box 296, Richmond, Calif. Model 702A power supply is a regulated power source of conventional circuitry featuring a compact method of mechanical construction. It provides output voltages from 0 to 600 v, continuously variable, with currents up to 200 ma. Regulation is maintained at  $\pm$  percent or better with ripple less than 10 mv peak to peak. A variable negative output of 0 to 150 v is also provided for bias, as well as 6.3 v at 8 amperes. Positive and negative terminals are insulated from the chassis, permitting high voltage to be used above or below ground. Price is \$205.



## PULSE OSCILLATOR features wide range

ELECTRO-PULSE, INC., 11811 Major St., Culver City, Calif. Model 3420A pulse oscillator features a wide

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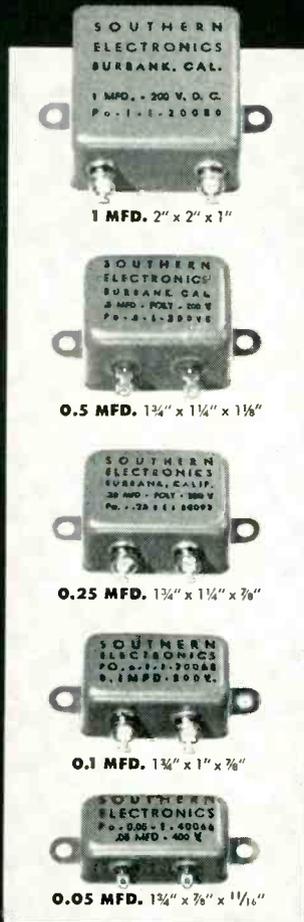
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## SOUTHERN ELECTRONICS Corporation

239 West Orange Grove Ave., Burbank, Calif.

range of pulse spacing from 0.3  $\mu$ sec (3.3 mc repetition rate) to 11,000  $\mu$ sec (90 cycle repetition rate) in 5 ranges. The basic oscillation period is set up by a specially designed multivibrator which has several feedback paths. Two output blocking oscillator pulses—either of which can be positive or negative—are available from the front panel, spaced by the half period of the multivibrator oscillator. These pulses are 0.1  $\mu$ sec wide above 100 kc and widen out to approximately 0.5  $\mu$ sec below 100 kc, with an impedance level of 250 ohms, or below, and with variable amplitude to 25 v open circuit. Typical applications for the instrument include flip-flop resolving time studies, clock pulse generators, test and development of high speed circuitry, magnetic core set and reset triggers, and wide range trigger source.

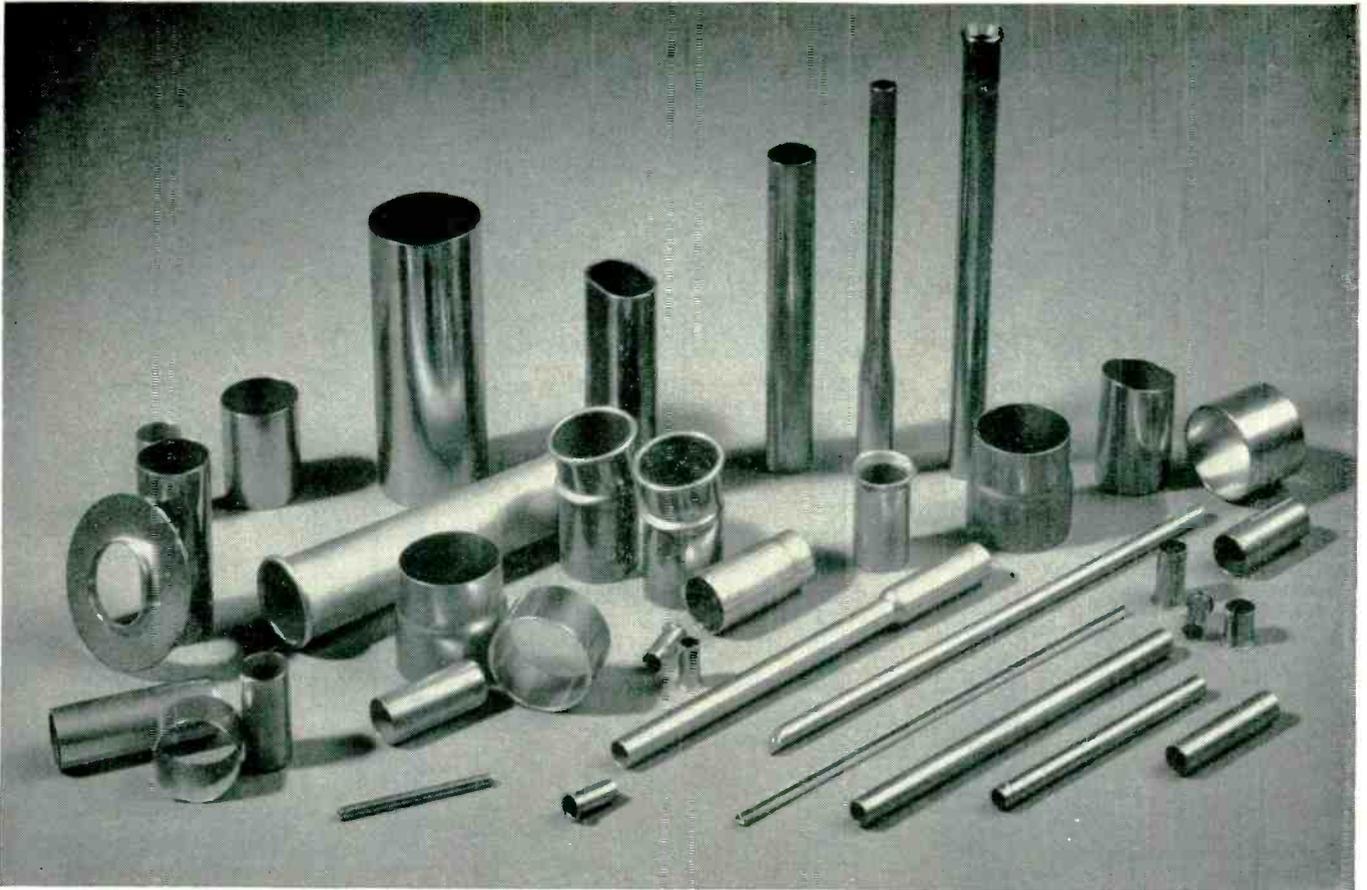


### TAPER-PIN RELAYS in 2, 3, and 4-pole models

ELECTRO-MECHANICAL SPECIALTIES Co., INC., 6819 Melrose Ave., Los Angeles 38, Calif., has introduced a new series of relays hermetically sealed with taper-pin terminals for solderless connection. They are available in 2, 3 and 4-pole models, and surpass MIL-R-5757B and MIL-R-6106A specifications. They are especially designed for use in jet aircraft, guided missiles and other airborne equipment.

### FIELD INTENSITY METER covers 14 to 250 kc

STODDART AIRCRAFT RADIO Co., INC., 6644 Santa Monica Blvd., Hollywood 38, Calif. The NM-10A radio interference and field intensity meter covers a frequency range of 14 to 250 kc. It is designed for lab



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Glass-to-metal seals for conductor leads into vacuum tubes, hermetically sealed chambers, or controlled atmospheres. Typical uses are shown above, left to right: voltage regulator, capacitor, capacitor cap, button terminal, recording pen, refrigeration sniffer. Superior offers six standard uniform-expansion alloys cold drawn to close tolerances in Seamless or WELDRAWN\* tubing.

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Precise, self-contained unit for laboratory and production use. For DC instrument calibration from 25  $\mu$ a full scale to 10 ma full scale, and 0-100 V DC; sensitivity and resistance measurement; DC current-voltage source; limit or Wheatstone bridge measurements from 0-5000 ohms. Regulated Power supply. Stepless vacuum tube voltage control. Accuracy exceeds 1/4% (current), 1/2 ohm or 1/2% (resistance). For 115 V, 60 cycle AC. Complete — needs no accessories.



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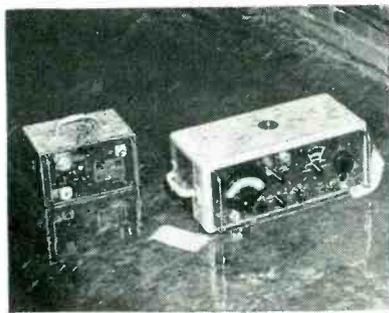
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NEW PRODUCTS

(continued)



or field use for field intensity measurements of carrier current systems, the signal level at points along the system, and for surveys of conducted or radiated interference. A complete selection of accessories is available, expanding its utility. The a-c power supply permits operation from 105 to 125 v or 210 to 250 v a-c, 50 to 1,600 cps. The NM-10A is identical to the Navy AN/URM-6B, a class 1 instrument, as shown in MIL-I-16910 (SHIPS).



**L-F AMPLIFIER**  
available in two models

WHITE INSTRUMENT LABORATORIES, 203 E. Riverside Drive, Austin 4, Texas. Models 211 and 212 amplifiers, when used with matching twin-T feedback networks, become size and weight saving filters or band-pass amplifiers in the 5 cps to 500 cps range. The amplifier and feedback network are separate plug-in units, with all units completely interchangeable. The one tube model 211 has a voltage gain of 15 and a Q of 8, when used with a type 552 network. Model 212, using two tubes, has a gain of 80 and a maximum Q of 40 with the type 542 network. Power supply requirements are 200-300 v d-c regulated

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**Strip Heaters**

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One-piece rust-resisting sheath

Heater coil of nickel chromium wire, insulated from inner sheath wall with a refractory selected for best thermal conduction and stability at elevated temperatures

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Two sheaths (1) for temperatures up to 750° F max and (2) up to 1200° F. max.

See 8-page Vulcan catalog in Sweet's Product Design File for 1955

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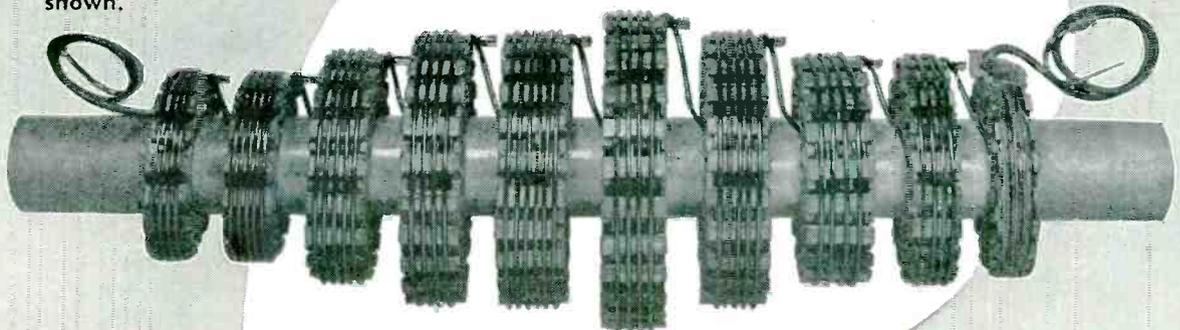
### NWL Air Core Reactors

Capacity of ¼ to 2000 Amperes and 25 to 400 cycles.

For lowest possible capacitance and non-resonating peaks —

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Available in sizes 1 ampere and larger. In illustration below terminal is not shown.



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**WINDING LABORATORIES, INC.**

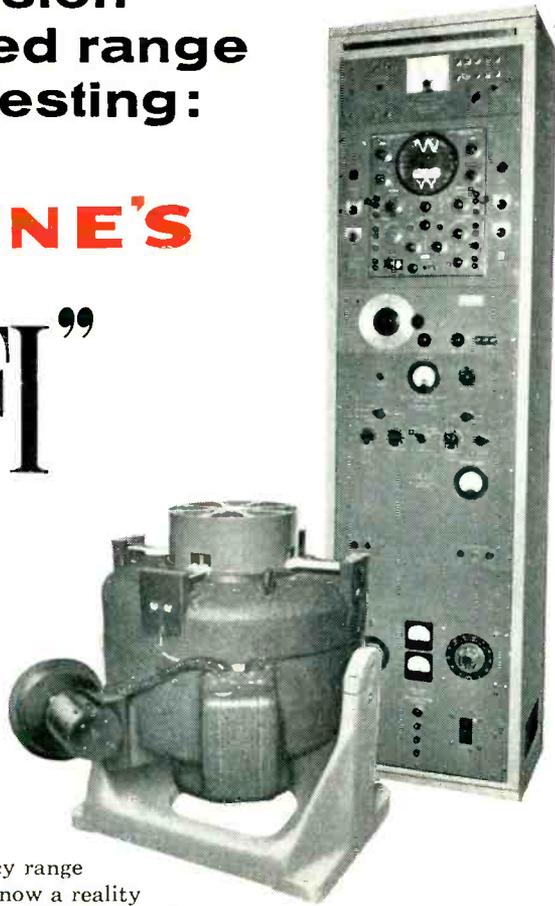
P. O. Box 455, Dept. 107 TRENTON, N. J.

# new precision in extended range vibration testing:

## CALIDYNE'S

# "HI-FI"

## SHAKER SYSTEM



Precisely controlled vibration testing — over the 5 to 5000 cps frequency range at full rated output — is now a reality with Calidyne's new Series 8000 Shaker System. The Shaker itself incorporates an extremely rigid armature structure, designed to eliminate all secondary structural resonance in the operating frequency range. Actual frequency response values obtained by test are  $\pm 1$  db, 7 to 2000 cps;  $\pm 3\frac{1}{2}$  db, 5 to 5000 cps (bare table). Full  $\frac{1}{2}$ " peak-to-peak displacement or 600 pounds force output is maintained at all frequencies, *without* power factor correction or use of changeable impedance matching taps.

A control console incorporates all operating controls, and associated monitoring and cycling equipment. Switch selected inputs consist of single frequency, sweep cycling or complex waveform signals. Special features include a dual beam scope for comparing input and Shaker table acceleration signals, and five adjustable circuits to compensate for decrease in transfer function (g output/volts input) as frequency increases.

Complete Engineering Data and Specifications on Request



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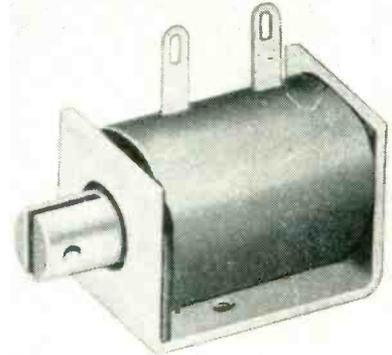
CANADA  
Measurement Engineering Ltd.  
Arnprior, Ont., Phone 400  
Toronto, Ont., Mayfair 8860

EXPORT  
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Murray Hill 9-0200

NEW PRODUCTS

(continued)

plate supply and 6.3-v filament supply.



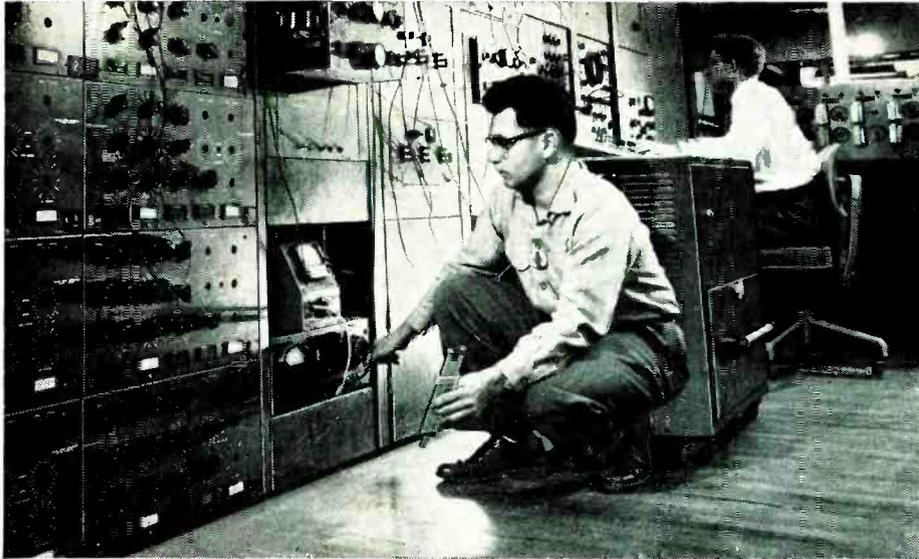
## SOLENOID is small and rugged

DORMEYER INDUSTRIES, 3418 N. Milwaukee Ave., Chicago 41, Ill., has available a new compact solenoid for limited space applications requiring high power and rugged performance. The shading coil is embedded in the plug for greater efficiency and high seated pull. It operates in any position and is supplied as standard with solder terminals or can be furnished with flexible leads. Regularly rated at 115 v, 60 cycle, a-c, it is available on special order for any other a-c, voltage or frequency.



## TRIMMING POT for aircraft requirements

BOURNS LABORATORIES, 6135 Magnolia Ave., Riverside, Calif. Model 160 Trimpot was designed to meet the aircraft and missile industries' demand for a subminiature trimming potentiometer having high temperature and power rating characteristics. It has a  $-65$  F to  $350$  F operating temperature range. Power rating is 0.6 w at 100 F and 0.4 w at 200 F. Resolution as low as 0.25 percent is obtained over the 25-turn adjustment range. Resistance elements, precision wound with Evan-



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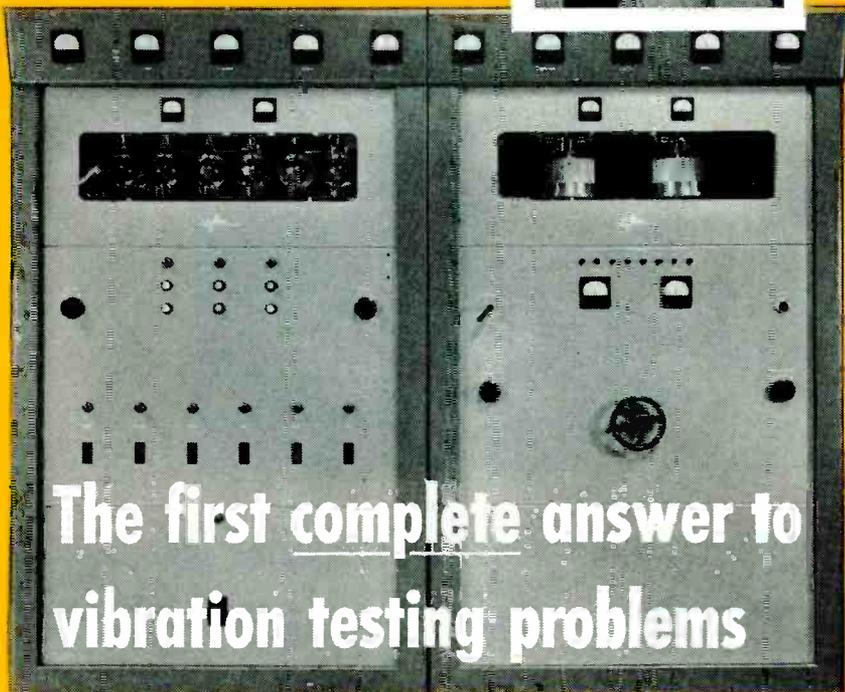
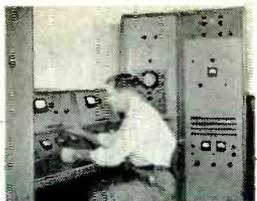
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Engineering Personnel Office, Attention: Mr. L. W. Stevenson, Department 56-EL, Los Angeles 45, California

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FROM LM ELECTRONICS . . .



## The first complete answer to vibration testing problems

Pictured above is the 30,000 watt electronic power supply unit—heart of the LM vibration test system. Top inset photo shows the operating console.

Here is LM's newest complex wave vibration test system . . . an integrated equipment "package" that offers unmatched operating flexibility in a variety of applications. Engineered by electronic design specialists, LM vibration test systems and matching electronic power supplies are offered in 12 sizes, with outputs ranging from 250 to 125,000 watts . . . ample power to drive shakers up to 12,500 force-pounds. Built to exacting performance standards, these completely integrated systems offer simplicity of operation, accuracy and reliability over a wide range of operating conditions.

### ACCURATE DUPLICATION OF ANY FREQUENCY SPECTRUM . . .

LM's complex wave vibration test systems produce—from a voltage input signal—acceleration on a mechanical part at the shaker table. This acceleration has a frequency spectrum whose distribution is identical to that of the input signal, permitting exact, electronically-controlled test conditions to which the mechanical part may be exposed. A full-view operating console controls

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### NOTE THESE ADVANTAGES . . .

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**WIDE CHOICE** of accessories and optional equipment to cover the *full range* of complex and sine wave vibration testing.

WRITE FOR TECHNICAL DATA and specifications on LM Vibration Test Systems . . . a complete line, engineered for every application . . . unmatched for performance and reliability.

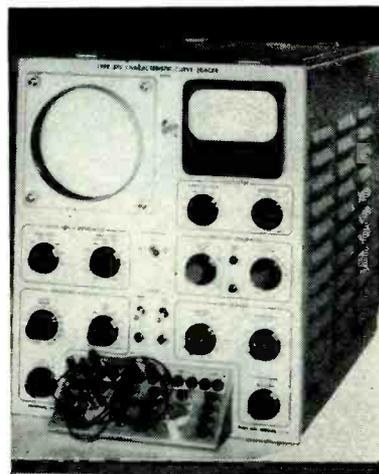


**LM ELECTRONICS INC.**  
5017 EXPOSITION BLVD., LOS ANGELES 16, CALIF.  
REpublic 2-6618

NEW PRODUCTS

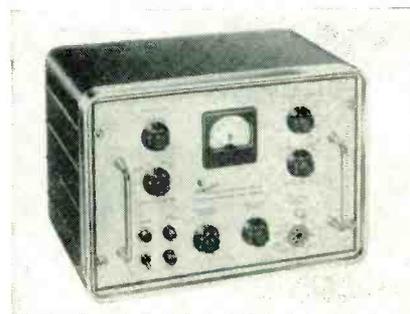
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ohm wire, provide excellent temperature coefficient characteristics in standard resistances from 10 ohms to 10,000 ohms. Electrical settings are securely maintained during severe shock, vibration and acceleration. Size is  $\frac{1}{4}$  in.  $\times$   $\frac{5}{16}$  in.  $\times$   $1\frac{1}{4}$  in. Acceleration is 100 g. Standard resistance are 10, 20, 50, 100, 200, 500, 1,000, 2,000, 5,000 and 10,000 ohms.



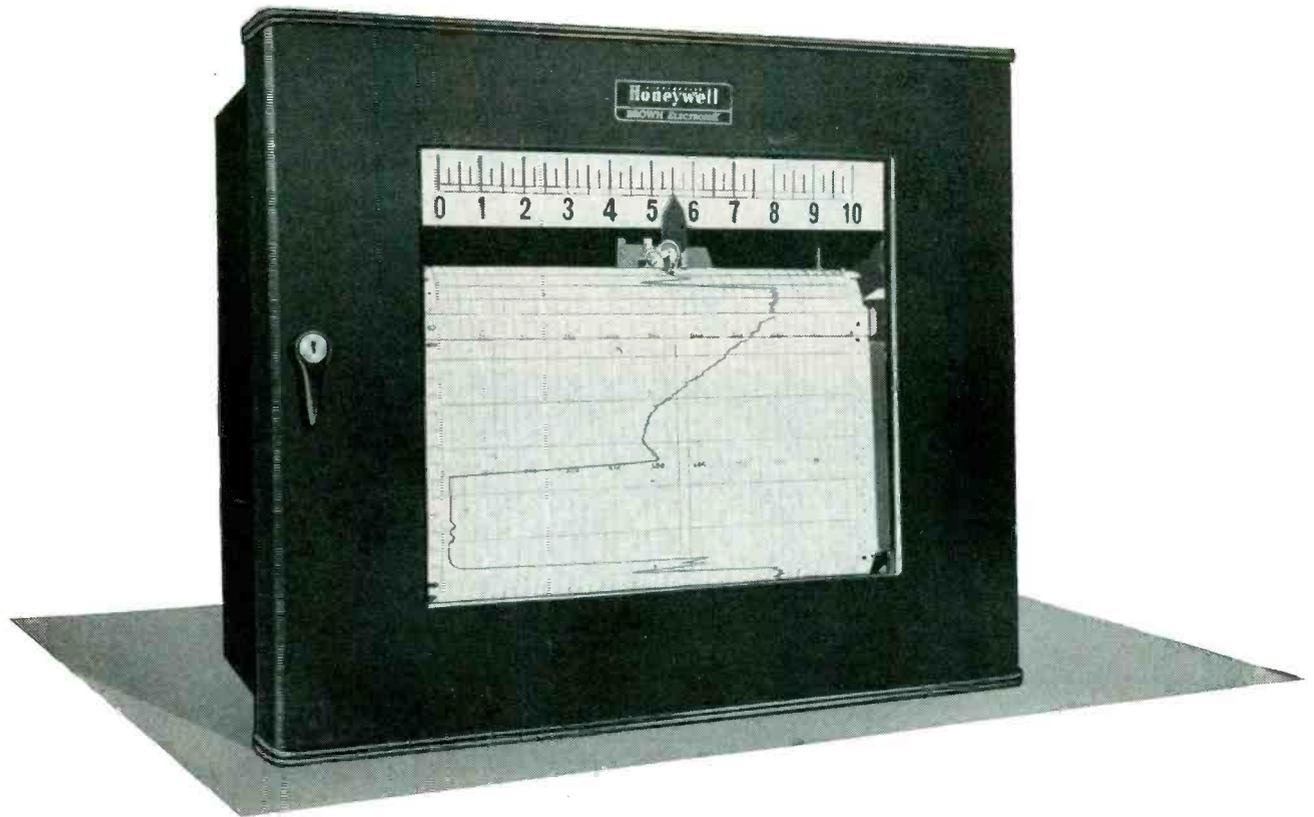
### TRACER plots v-t characteristics

TEKTRONIX, INC., P. O. Box 831, Portland 7, Oregon. Type 570 characteristic curve tracer presents an accurate graphic analysis of v-t characteristics. It displays families of characteristic curves on the face of a crt, calibrated to permit accurate current and voltage readings directly from the screen. Curves per family are adjustable from 4 to 12; and 6 different characteristic curves are plotted. Weight is 67 lb. Price is \$925.



### POWER SUPPLY for klystron tubes

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BY MEANS of a recently developed model of the widely used *ElectroniK* instrument, d-c voltage and current data can be recorded from high impedance sources . . . with excellent sensitivity, speed and precision. This recorder needs no external pre-amplifier. Designed to have high input impedance, it causes negligible loading effect on high impedance circuits or sensing elements.

It is also applicable to low-level current measurements in conjunction with spectrographs, photo-cells and other current-producing devices.

It records at high speed, with negligible damping effect by the source. Standard pen speeds are 24, 12, 4½ or 2 seconds for full scale travel.

It has high sensitivity . . . is supplied for ranges of 2 or 10 mv full scale.

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Your nearby Honeywell sales engineer will be glad to discuss the many possibilities this *ElectroniK* instrument offers for your research. Call him today . . . he's as near as your phone.

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### Approximate Maximum Sensitivities

	3x Amplifier	1x Amplifier
Span	2 mv	10 mv
Voltage sensitivity	1x10 <sup>-6</sup> volts	3x10 <sup>-6</sup> volts
Current sensitivity	8x10 <sup>-12</sup> amperes	2.5x10 <sup>-11</sup> amperes

● REFERENCE DATA: Write for Instrumentation Data Sheet No. 10.0-14.

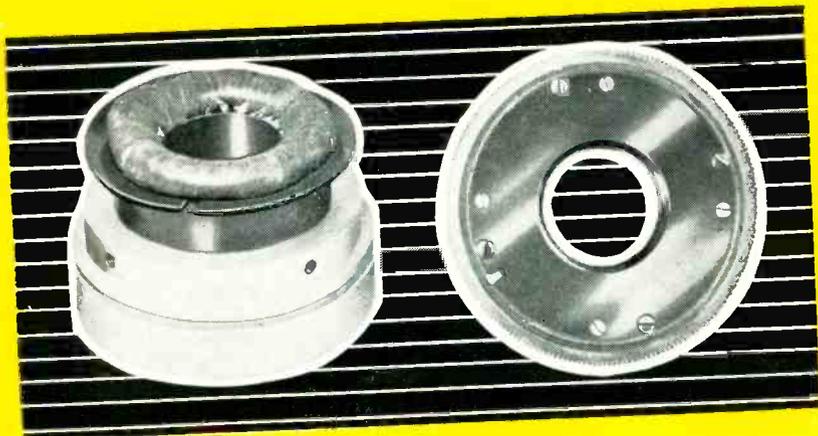
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## New!



## Celco RADAR DEFLECTION YOKES

Brooklyn 1, N. Y. Type 809 klystron power supply provides beam voltages from 250 v to 600 v at 65 ma, reflector voltages from 0 to -900 v at 50  $\mu$ a, square wave modulation between 400 and 2,000 cps, and sawtooth modulation at line frequency. By the use of improved circuitry, ripple and regulation are kept within tolerances comparable to much more expensive units. A special feature is the ease of changing from c-w to square wave modulation for peak power measurements because the top of the square wave is automatically clamped to the previously chosen reflector voltage. The klystron reflector is protected against positive voltages by a clipper. Price is \$350.

### SILICONE TAPE features rigidity

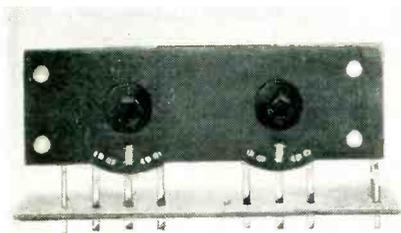
MINNESOTA MINING AND MFG. CO., 6 Argyle Terrace, Irvington 11, N. J. Especially designed for the manufacture of dry type transformers, the SG-300 special silicone resin treated tape is also available in full 36-in. roll form, or in sheets. It has high dielectric strength, good compatibility with varnishes, good mechanical strength, and the tough coating prevents cut through. This material provides for a reduction in space, and because of its special type of coating, can be formed around a small radius. Four thicknesses are available at present, but others are being developed. Samples and preliminary data are available.



### TIMING RECEIVER has 6-7 db noise figure

WEST COAST ELECTRONICS CO., 5873 W. Jefferson Blvd., Los Angeles, Calif., has developed a receiver designed especially for missile and

aircraft test range instrumentation. Model 2 PCM timing receiver is a highly sensitive, low-noise figure, superheterodyne designed for reception of pulsed signals in the 152 to 174 mc range. It accepts and reproduces pulses from 1 to 20  $\mu$ sec long. The receiver noise figure is 6 to 7 db, and its bandwidth is 1 mc. Its fully automatic gain control, which maintains essentially constant output with input signals whose levels vary from 5  $\mu$ v to 10,000  $\mu$ v, and its frequency stability of  $\pm 0.005$  percent make manual adjustments unnecessary. The receiver mounts in a standard 19-in. relay rack, and is 10 1/2 in. high. It requires a power supply delivering 100 ma, 200 v regulated d-c and 6.3 v a-c.



**CARBON CONTROLS for printed circuits**

P. R. MALLORY & Co., INC., Indianapolis, Ind. Strip-type carbon controls, with the resistance wafers mounted directly on a phenolic panel, are now available in a design specifically intended for printed circuit applications. The controls have straight, tinned terminals which project through punched slots in the printed sheet for dip soldering. They are mounted at right angles to the chassis by means of shouldered tabs. To save space, multiple sections can be mounted about 1/2 in. behind each other. The shafts of the rear section extend through holes factory-punched in the front strip. Single, dual and triple sections are available, in resistance values from 250 ohms to 10 meg-ohms.

**ANTENNA BRIDGE is accurate and sensitive**

JAMES MILLEN MFG. Co., INC., Malden, Mass. The 90672 antenna bridge is an accurate and sensitive bridge for measuring impedances in the range of 5 to 500 ohms at



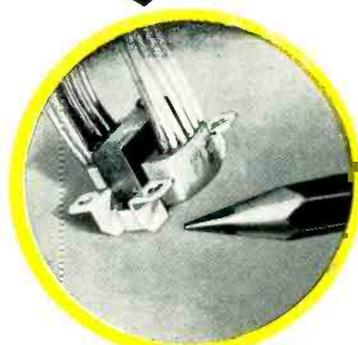
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**AT Celco**

"Advanced" means the smallest, most modern and most efficient miniature components it is possible to make today . . . built to the most precise, demanding specifications of the electronics industry.

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- Saturable Reactors
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- Pulse



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*Constantine Engineering Laboratories Co.*

Island Avenue

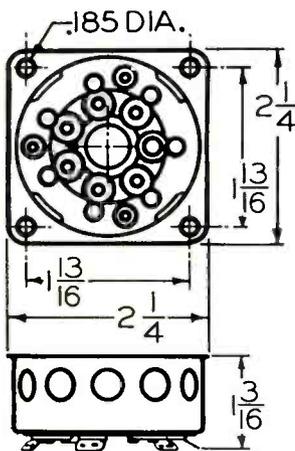
Mahwah, N. J.



takes  $\frac{1}{3}$  less space  
than previously  
available types

**NEW!**

smaller socket for  
septar based tubes such  
as the 5894, 6524, 6252



Considerably smaller than previously available types, this new 7-pin VHF septar socket permits compact design in mobile, aircraft, and other types of transmitting equipment. Bases on all three types are grade L4 steatite, glazed on top and sides—underside DC200 impregnated. Available in three grades to meet all applications:

Standard—122-105-1  
Industrial—122-105-100  
Military—122-105-200

Contacts on the standard grade are cadmium plated, with brass clips and steel springs. Contacts on industrial and military grades consist of phosphor bronze clips with beryllium copper springs. Contact plating on industrial type, .0005 silver; military, .001 silver. Aluminum shell finish is etched on standard; Iridite No. 14 on industrial and military types.

#### Additional Features

- Molded recesses in base for each contact—prevents turning
- Contact cushion washers of fungus resistant glass base melamine
- Sockets molded with pin circle groove and recessed tube pin holes for easy tube insertion
- Aluminum shell submounts tube for optimum input and output shielding,  $\frac{3}{8}$ " hole provides adequate ventilation.

#### Special Types Available

Wafer socket alone, without shield base. Sockets with special grid terminal for direct mounting of components.

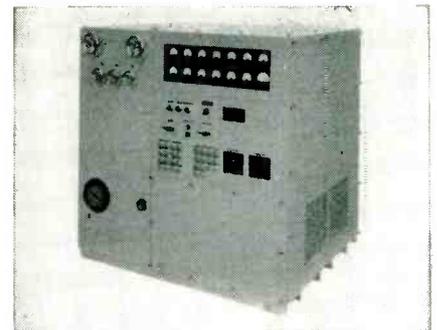
Write today for prices or further information.

**E. F. JOHNSON COMPANY**

2334 Second Avenue Southwest • Waseca, Minnesota



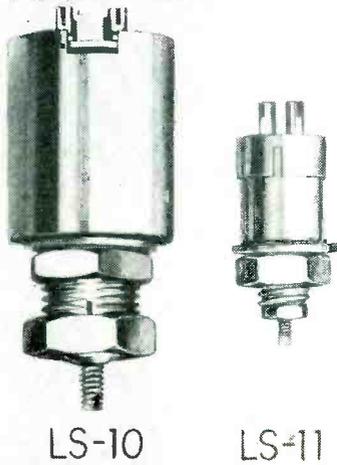
radio frequencies up to 200 mc. It employs no variable resistors. The variable element is an especially designed differential variable capacitor capable of high accuracy and permanency of calibration over a wide range of frequencies. A grid dip meter such as the 90651 may be used as the source of r-f signal. The bridge may be used to measure antenna radiation resistance, antenna resonance, transmission line impedance, swr, receiver input impedance and other r-f impedances. By the antenna bridge, an antenna matching unit may be adjusted so as to provide the minimum swr on the radiation system at all frequencies.



#### UHF AMPLIFIER uses 100-w driving power

AIR ASSOCIATES, INC., Teterboro, N. J. Model 23A, a 1-kw vhf/uhf amplifier, amplifies 100 w to over 1,000 w. The new unit will be used for ground-to-aircraft communications. It measures only 4 ft wide, 4 ft high and 3 ft deep. The amplifier operates over a frequency range of 225 to 400 mc. Modulation frequency is 200 cps to 20 kc. The unit's modulation capability is sufficient to produce 320 w of sideband power. Distortion characteristic is less than 3 percent at full modulation. The r-f output and in-

put impedance are each 52 ohms. Frequency response is within 2 db of the 1,000 cycle reference level; carrier-noise characteristic is 50 db below full modulation. Spurious radiation value of the unit is 60 db below carrier power. Model 23A's power input requirement is 208 v, 3 phase, 4 wire, 60 cycles. The unit is completely self-contained including the heat exchanger for the r-f tube.



### SHIELDED COIL FORMS in two new sizes

CAMBRIDGE THERMIONIC CORP., 445 Concord Ave., Cambridge 38, Mass., has introduced two new shielded coil forms. The LS-10 is  $\frac{5}{8}$  in. in diameter, by  $1\frac{1}{8}$  in. in overall height when mounted, including terminals. The LS-11 is  $\frac{5}{16}$  in. in diameter and has an overall height when mounted of  $1\frac{1}{2}$  in. Each mounts by a single mounting stud. Both are highly shock resistant, with mechanically enclosed, protected coil windings. These assemblies are ideal for such applications as i-f strips, r-f coils and oscillator coils. They are available as coil form assemblies, or wound to customer specifications.

### SPECTROPHOTOMETER indicates color on 3 meters

TELECHROME INC., 632 Merrick Road, Amityville, N. Y. Model 1602-A tristimulus spectrophotometer is designed for use by tv stations, electronic laboratories and others interested in precise color measurements from various light sources. Its sensitivity is insured by the

**NEW!**



actual  
size

**41%**

*lighter... shorter,  
same capacity,  
a.c. or d.c.*

## AXIAL BLOWER

*only 2" long... weighs only 5 ounces!*

Globe . . . pioneer precision motor manufacturers and leaders in miniaturization . . . now offers the latest in axial blower design! A further miniaturization of existing equipment for high air delivery in smaller space! Units consist of a Globe sub-miniature a.c. or d.c. motor, a dynamically balanced 2-blade aluminum fan, mounted in a rigid one-piece aluminum housing.

A.C. blowers are for 400 and 60 cps operation. Other frequencies available. D.C. blowers are available up to 90 volt operation. Air flow in a.c. up to 50 cfm free air. Back pressure up to 0.8" H<sub>2</sub>O. Both types a.c. or d.c. provide air flow in either direction, and meet military specifications. Write today for bulletin 520.



**GLOBE INDUSTRIES, inc.,** dayton 4, ohio

*manufacturers of precision miniature  
motors and motorized devices*

# SAR PULSESCOPE

by

# Waterman

MODEL S-4-C

**DIRECT-READING  
DELAYED SWEEP  
ACCURATE TO  
0.1%**



Size:  
9 1/8" x 11 1/4" x 17 1/4"  
31.5 Pounds

## ANOTHER EXAMPLE OF *Waterman* PIONEERING...

The SAR PULSESCOPE, model S-4-C, is JANized (Gov't Model No. OS-4), the culmination of compactness, portability, and precision in a pulse measuring instrument for radar, TV and all electronic work. An optional delay of 0.55 microseconds assures entire observation of pulses. A pulse rise time of 0.035 microseconds is provided thru the video amplifier whose sensitivity is 0.5V p to p/inch. The response extends beyond 11 mc. A and S sweeps cover a continuous range from 1.2 to 12,000 microseconds. A directly calibrated dial permits R sweep delay readings of 3 to 10,000 microseconds in three ranges. In addition, R sweeps are continuously variable from 2.4 to 24 microseconds; further expanding the oscilloscope's usefulness. Built-in crystal markers of 10 or 50 microseconds make its time measuring capabilities complete. The SAR PULSESCOPE can be supplied directly calibrated in yards for radar type measurements. Operation from 50 to 400 cps at 115 volts widens the field application of the unit. Countless other outstanding features of the SAR PULSESCOPE round out its distinguished performance.

## WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PA.

CABLE ADDRESS: POKETSCOPE

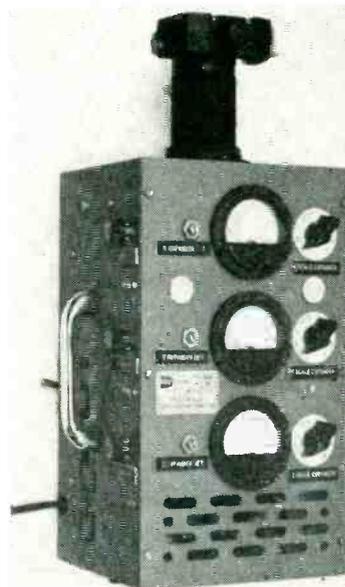
### WATERMAN PRODUCTS INCLUDE

S-4-C SAR PULSESCOPE®  
S-5-A LAB PULSESCOPE  
S-6-A BROADBAND PULSESCOPE  
S-11-A INDUSTRIAL POKETSCOPE®  
S-12-B JANized RAKSCOPE®  
S-14-A HIGH GAIN POKETSCOPE  
S-14-B WIDE BAND POKETSCOPE  
S-15-A TWIN TUBE POKETSCOPE  
RAYONIC® Cathode Ray Tubes  
and Other Associated Equipment

MEMO  
Write for details today!

# Waterman

**WATERMAN PRODUCTS**



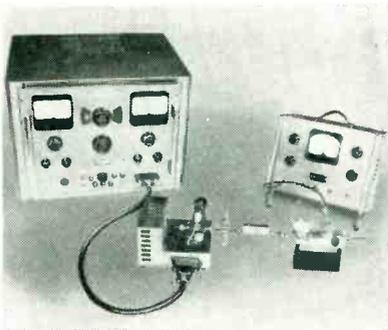
use of 3 built-in high-gain amplifiers having gains of over a million times. Light is split by semitransparent mirrors and special filters into 3 multiplier phototubes producing characteristics which closely approximate the X, Y, Z distribution curves. Contained in a 6 in. x 7 in. x 12 in. housing, the instrument contains its own optical system, beam splitters, optical filters, multiplier phototubes, meters and regulated power supply.



### SMALL RESISTORS are vitreous-enameled

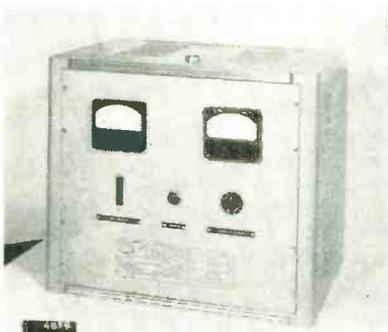
OHMITE MFG. Co., 3678 Howard St., Skokie, Ill., has announced a line of small, power-type resistors with axial leads. These are wire-wound units with steatite cores and a special-formula vitreous-enamel coating. The resistance wire and terminal lead are both welded to the end cap, thus assuring perfect and permanently stable electrical connections. All parts are thermally balanced, so as to expand and contract as a unit. The axial-lead re-

sistors are available in an extensive range of sizes and wattage ratings. The smallest resistor is only  $\frac{1}{4}$  in. diameter by  $\frac{1}{8}$  in. long overall and is rated at 3 w. Two sizes, rated at 5 and 10 w, are carried in stock in a wide range of resistance values.



**FIVE-MM EQUIPMENT**  
operates over 50 to 75 kmc

THE ELECTRONICS & X-RAY DIVISION, F-R Machine Works, Inc., 26-12 Borough Place, Woodside 77, N. Y., has developed a new and completely specified line of 5-mm equipment that operates over the full waveguide frequency range of the RG-98/U waveguides: 50 to 75 kmc. A slotted section flap attenuator, tunable detector mount, E/H tuner, frequency meter, termination, sliding short, horn, harmonic generator, bends, tees, transmission line stand, klystron tube mount and power supply are available. Equipment is also available for RG-97/U waveguide. Literature will be sent on request.



**D-C POWER SUPPLY**  
for computer applications

BART-MESSING CORP., 229 Main St., Belleville 9, N. J., has announced development of a new lightweight, compact regulated d-c power supply unit, known as the Sel-Rex Re-actronic, designed specifically for

**NEW...**

**The SHURE "Micro-Gap"**

**MAGNETIC RECORDING HEAD**

—so versatile it can be used for specialized precision applications, as well as in professional and fine quality tape recorders.



This new, versatile, high output magnetic recording head offers you these important advantages—

- **Excellent response** over an extremely wide frequency range.
- **Product uniformity.** Advanced Statistical Quality Control techniques assure strict adherence to close mechanical and electrical tolerances. Your design and production problems are considerably reduced.
- **Convenient, versatile mounting.** The "Micro-Gap" is available as a base-mounted (Model TR30) or as a rear mounted (Model TR35) unit.
- **Ease of adjustment** for proper gap alignment and angularity. Track and gap location procedures are greatly simplified.
- **Small size.** The "Micro-Gap" Model TR-35 measures only  $45/64$ " from face to the mounting shoulder. Model TR30 measures only  $9/16$ " from top to mounting shoulder. Both models are  $31/64$ " from top to bottom and  $21/32$ " from side to side. The "Micro-Gap" is ideal for miniaturization applications—it is one of the smallest commercially-available magnetic recording heads on the market.
- **Hum Shielding.** The "Micro-Gap" is shielded in a seamless, drawn high-permeability metal case which provides excellent hum reduction.
- **Stability.** Highly resistant to variations of temperature and humidity, being embodied in a stable, synthetic resin.

Write now for complete specifications on the "Micro-Gap" magnetic recording head. Shure research and development engineers can assist you with your specific magnetic recording problems.

**"MICRO-GAP"**

For all types of data gathering and recording equipment which require the use of a precision-quality recording head.

**Magnetic Recording**

**Dictating Equipment**

**Pulse Width Recording**

- Strain gauges
- Pressure gauges
- Velocity indicators

**Direct Recording**

- Noise analyses
- Vibration analyses

**FM Recording**

- Transient Phenomena
- Analog data
- Vibration-strain-stress

**Direct Pulse Recording**

- Computers
- Precision Systems

**ENGINEERS:—**

Excellent employment opportunities available for men having Research and Development ability in Magnetic Recording, Microphones, Transducers, Phonograph Reproducers. Write Chief Engineer, Shure Brothers, Inc.



*The Mark of Quality*

**SHURE BROTHERS, INC.**

225 W. HURON STREET • CHICAGO 10, ILLINOIS

# NOW... Perfect Repetitive Soldering



## ZEPHYR Electronic MICROBRAZER

**THE SECRET'S** in the timing. Accurate adjustable timed heat cycle is set by leadman. Then operator presses foot switch to start cycle; heat shuts off automatically, assuring perfect solder connection even on smallest electronic components. No more burned insulation or cold joints. Exactly the correct amount of heat available, time after time. Timer range of 1/60 to 3 seconds. Silver solder brazing to 1250°. Zephyr representatives will be glad to show you how the MicroBrazer can save time and reduce rejects—in your plant, on your assembly line.



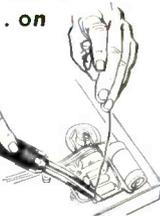
### ZEPHYR

MANUFACTURING COMPANY, INC.

### FREE Demonstration

in your own plant . . . on your own work

Write for free catalog No. K-1



ZEPHYR MANUFACTURING COMPANY, INC.  
Electronics Div., Dept. E4A, Inglewood, Cal.

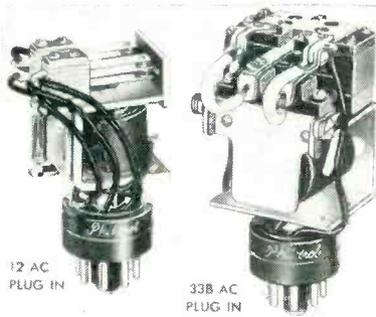
- Send catalog K-1.  
 I'm interested in demonstration.

Name \_\_\_\_\_  
Company \_\_\_\_\_  
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#### NEW PRODUCTS

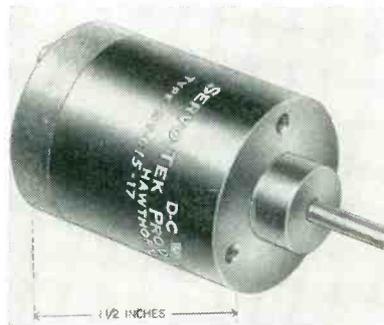
(continued)

computer and similar applications requiring close voltage regulation. Features include: automatic voltage regulation with magnetic amplifier control for smooth adjustment over the entire range; static regulation  $\pm 1$  percent from no load to full load; ripple voltage limitation of 1 v peak to peak; and maintenance free operation with nonwearing static components—no vacuum tubes or moving parts. Equipped with time-tested and proven selenium rectifiers, the units are available from 4 to 300-v capacities, at all current values from 1 ampere.



### PLUG-IN RELAYS in two new models

PHILLIPS CONTROL CORP., Joliet, Ill., has added to its relay line two new plug-in models. One is the Phil-trol 33B general purpose power relay available in either a-c or d-c, 2-pole, 3-pole or 5-pole models. The other is the smaller type 12 Phil-trol relay available in a-c or d-c, for operation up to 230 v. Performance characteristics, specifications and data sheets on both relays are available.



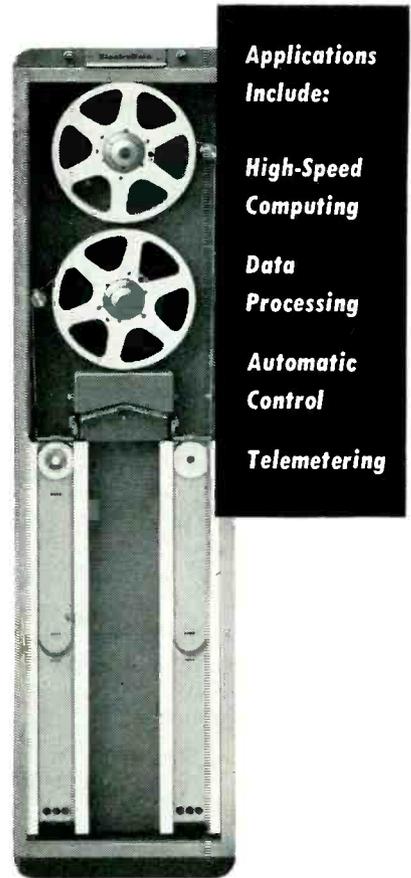
### P-M MOTORS noted for small size

SERVO-TEK PRODUCTS Co., INC., 1086 Goffle Road, Hawthorne, N. J. A new line of 4 d-c motors, incorpo-

## DataReader

Model 546

A transport unit for high speed searching, reading and recording of data on magnetic tape.



Applications Include:

High-Speed Computing

Data Processing

Automatic Control

Telemetry

### PERFORMANCE:

**RAPID START—STOP—REVERSE**—from stop to full speed in 6 milliseconds.

**HIGH TAPE SPEED**—optional single speed of 30, 40, 50, 60 or 75 in/sec.

**TWO-DIRECTION SEARCH**—either direction, automatically at full speed.

**REMOTE OPERATION**—forward, reverse, stop, rewind and selection of reading and writing.

**VACUUM COLUMN TAPE CONTROL**—provides strain-free tape feed over entire length of tape.

**END-OF-TAPE SENSING**—stops automatically at either end of tape.

**RAPID REWIND**—2400 ft. of  $\frac{1}{2}$ " or  $\frac{3}{4}$ " tape in 3 minutes.

FOR FURTHER INFORMATION WRITE

ElectroData Corporation  
Component Sales Division  
717 No. Lake St., Pasadena 6, Calif.

## ElectroData

An Affiliate of  
CONSOLIDATED ENGINEERING CORPORATION  
OF PASADENA, CALIFORNIA  
ElectroData Corporation maintains a nationwide sales and service organization.

rating a permanent-magnet field assembly, have an overall body length of less than 1½ in., with a weight of less than 3 oz. The new line incorporates a housing which is fully machined from solid aluminum, low torque ball bearings, an anodized finish and improved mechanical construction. It has a rotatable brush holder which can be adjusted for best commutation and power output. Other mechanical features include a flat wafer-type commutator with brushes removable from the rear of the motor. A close control is held on all dimensional tolerances which permits their incorporation into precision servo devices, gear trains and similar devices. Various electrical characteristics are available with a range of operating voltages from 6 to 80 v, no load speeds from 3,000 to 20,000 rpm and power output up to 11 w, or approximately 1/70 hp.



**SAMPLING SWITCH with 1, 2 or 3 poles**

GENERAL DEVICES, INC., P. O. Box 253, Princeton, N. J., has announced a new high-speed precision sampling switch with integral motor and planetary gear reduction. It is available with 1, 2 or 3 concentric poles, 60 contacts per pole, utilizing their exclusive semimolded contact plate construction for longer service-free life and greater dimensional stability. Connections to each pole are made by convenient length wire leads molded into the plate and attached to compact multipin connectors. This provides plug-in connection and greater ease of inspection. The switches are available

# DRY BY *ThermoJet*

- ★ Printed Circuits
- ★ Nameplates
- ★ Dials

The General Thermo-Jet Dryer reduces to seconds the drying time of many inks, resists and coatings by greatly accelerating evaporation. Large quantities of warm air at high velocity are blown through a perforated metal plate directly above the work on a conveyor. This produces many tiny jets of air which rapidly blast away the solvent vapor being evaporated.

Thermo-Jet Units can be assembled to required width and length. They can be operated independently or attached to presses, coaters or other equipment. They use either electric or gas heat.

*Write for complete information.*

**PRINT CIRCUITS BY SILK SCREEN—AUTOMATICALLY**

General Decarator Presses (Series B) are specially designed for the efficient, volume production of silk screen printed electronic circuits.

**GENERAL RESEARCH AND SUPPLY COMPANY**  
572 S. Division Avenue  
Grand Rapids 3, Michigan

## STANDARD SIGNAL GENERATOR

**2 Mc. - 400 Mc.**

**Model 80**

The MODEL 80 is completely self-contained, with built-in power supply and modulator. An extremely stable and accurate instrument for laboratory use, production testing or servicing.

*Complete data on request*

**MEASUREMENTS CORPORATION**  
BOONTON NEW JERSEY



now presents  
America's Finest

## Collet-fitting **KNOBS**

Dalohm design permits positive locking on all standard shaft diameters full round or flatted with no damaging effect so frequently found when using set-screw type knobs.

**FIVE SIZES**  $\frac{3}{8}$ "  $1\frac{1}{16}$ "  $1\frac{1}{4}$ "  $2\frac{1}{4}$ "  $3$ "

### COLLETS INTERCHANGEABLE...

accommodate all shaft sizes from  $\frac{1}{8}$ " to  $\frac{3}{8}$ "

- Precision cast of thermo setting plastic in easy grip shapes. Pleasing appearance to match modern styling
- Knobs fit concentrically on shaft and can be positioned accurately and easily on full 360° radius
- Standard escutcheons, pointers and indicators available
- Highest quality at low price

Write, Wire, Call

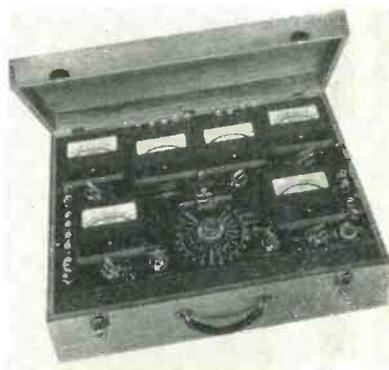
**DALE PRODUCTS, INC.**

1300 28th Ave. Phone 2139  
Columbus, Nebraska, U.S.A.



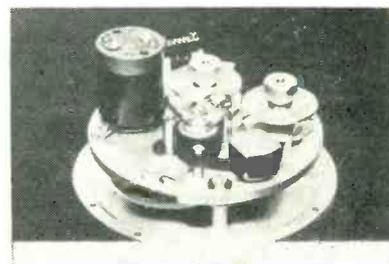
Ask for Bulletin K-29

with constant force Perma Brush for extended life and more predictable performance. They are equipped with 60 or 400 cycle a-c, 6 to 115 v d-c motors and gear reduction assemblies. They measure  $3\frac{3}{8}$  in. in diameter  $\times$  2 in. long, with  $\frac{3}{4}$  in. diameter by 1 in. long hub.



### MAGNETIC TESTER for core loss measurement

SENSITIVE RESEARCH INSTRUMENT CORP., 9-11 Elm Ave., Mt. Vernon, N. Y. The new universal magnetic testing set is a complete unit designed to make measurements that conform to the methods and specifications of the ASTM. Functions are: the determination of B-H curves; the determination of hysteresis loops; core loss testing using Epstein frame or standard E and I cores; measurements of total flux of hard magnets; measurements of magnetic field strength; and a-c and d-c permeability tests. Instrumentation consists of a d-c ammeter, a-c ammeter, rms voltmeter, flux voltmeter, low power factor wattmeter, multirange fluxmeter and Epstein frame. Price is \$2,475.



### ACCELEROMETER SYSTEM with tape playback unit

GULTON MFG. CORP., Metuchen, N. J. A new tape-recording ac-

**SOLID** *ULTRA-SONIC* **DELAY LINES**  
**RUGGED . . . RELIABLE**  
 DELAY TIME: to 4500 microsec.  
 TEMPERATURE: -65° to +85°C

**AT andersen Laboratories**  
 INCORPORATED

*Research Design Production*

solves the toughest delay line problems. produces rugged, efficient, reliable delay lines able to withstand wide temperature variation. meets delivery schedules.

#### Characteristics of typical radar delay line:

- ◆ 2780 microsec.  $\pm$  0.1% at 20°C
- ◆ 20 Mc. carrier frequency
- ◆ 6 Mc. bandwidth
- ◆ Less than 56 db insertion loss into 200 ohm load
- ◆ -46 db spurious response ratio

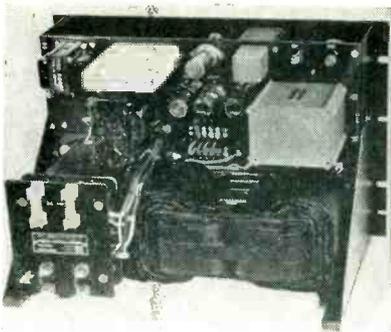
Do you have a delay line problem? Write for Technical Bulletin 55 or call us today. Your inquiry will receive prompt attention.



39 Talcott Road  
West Hartford 10, Conn.

ADams 3-4491

celerometer system can reliably measure accelerations up to  $\pm 60$  g in guided missiles, air, sea and land vehicles, underwater devices and ordnance equipment without the use of direct cable or wireless connections. The Glennite model KAT1 is comprised of two basic units—a self-contained self-recording accelerometer and a tape playback unit—and provides for an instantaneous 30-second permanent tape recording of vibration and shock accelerations in moving devices which can be read through any standard recording instrument such as a galvanometer, oscilloscope, meter or direct-writing recorder. The accelerometer, containing a miniaturized electronic circuit, weighs only 3 lb and is housed in a rugged aluminum cylinder  $4\frac{1}{2}$  in. in diameter and 3 in. high.



### VOLTAGE REGULATOR with 220-v output

NORTH AMERICAN PHILIPS CO., INC., 750 South Fulton Ave., Mt. Vernon, N. Y., has announced a new voltage regulator designed for use with the company's diffractometer and spectrograph units as well as for other applications. It utilizes a 6V6, two 6SL7's and a magnetic amplifier. The unit operates on a line voltage of 185 to 250, 60 cycles at an ambient temperature of 40 C maximum. Output voltage is 220; output current, 12.5 amperes maximum; output load, 2.75 kva maximum. Load power factor is 0.7-1.0 inductive; regulation is 0.05 percent; harmonic distortion, less than 5 percent; and time constant, 0.2 sec. When the line switch is turned on, voltage will stabilize in approximately 1 minute. If the overvoltage protective relay operates, output falls to less than 150 v. Overvoltage relay



**ALSO NEW!** "Soft Wound" Spools — a Resinite exclusive — insure delivery of even thin-wall tubing without flattening.

**NEW!** Simplify your vinyl sleeving requirements with one grade . . .



### FOR GENERAL PURPOSE USE

Brand new Resinite EP-69A embodies all the necessary properties for a "general purpose" insulation sleeving . . . good dielectric characteristics, oil resistance, a wide, effective temperature range and a satisfactory price.

### FOR SPECIFICATION USE

Resinite EP-69A is designed specifically to *exceed* all requirements of specification MIL-I-631B (Type F, Form U, Grades A and B, Class I and II, Category 1 and 2). It provides a working temperature range from  $-48^{\circ}\text{C}$  to  $+90^{\circ}\text{C}$  and a dielectric strength of 750 volts/mil. In addition, it is corrosion, fungus, oil and flame resistant beyond specifications.

Simplify your vinyl sleeving requirements with one grade — Resinite EP-69A. Write for samples and performance data.



## LARGE CAPACITY IN SMALL SPACE



# Fansteel TANTALUM Capacitors

The tantalum oxide film employed in Fansteel Capacitors is the most stable dielectric, chemically and electrically, yet discovered. Fansteel Tantalum Capacitors have a practically unlimited life, either in use or on the shelf; have a maximum d-c leakage of only 0.000008 ampere; and stable characteristics are unchanged over a wide temperature range.

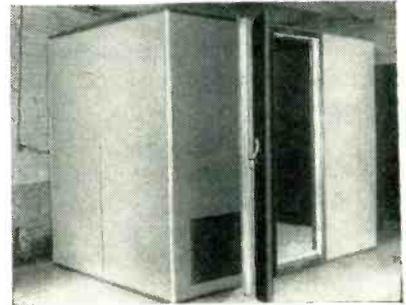
Fansteel offers Tantalum Capacitors in 87 sizes and ratings. A partial listing is shown here. All sizes are available from stock.

Send for  
bulletin 6.100

CATALOG NUMBER	CAPACITY MFD*	WORKING VOLTAGE D-C	MAXIMUM D-C LEAKAGE §
PP30B6A1	30	6	1.0
PP25B8A1	25	8	1.0
PP20B10A1	20	10	1.0
PP15B15A1	15	15	1.5
PP10B25A1	10	25	2.0
PP8B30A1	8	30	2.0
PP5B50A1	5	50	3.0
PP4B60A1	4	60	3.0
PP3.5B75A1	3.5	75	3.0
PP2B100A1	2	100	3.0
PP1.75B125A1	1.75	125	3.0
PP140B6A1	140	6	2.0
PP100B10A1	100	10	2.0
PP70B15A1	70	15	3.0
PP40B30A1	40	30	4.0
PP25B50A1	25	50	5.0
PP20B60A1	20	60	5.0
PP15B75A1	15	75	6.0
PP11B100C1	11	100	7.0
PP9B125C1	9	125	7.0
PP325B6A1	325	6	3.0
PP250B10A1	250	10	3.0
PP175B15A1	175	15	4.0

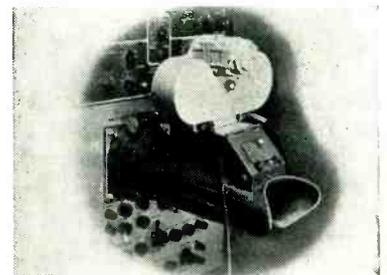
\*—15% +20% at 120 cps, 25°C  
§ Microamperes, at 25°C

is reset by turning the regulator off and waiting 10 seconds before turning it on again. Two screwdriver adjustments are provided at the rear of the chassis. One is for waveform and is set at the factory. The other is for output voltage and provides 220 v  $\pm$ 2 v.



### SHIELDED ENCLOSURES for microwave applications

ACE ENGINEERING & MACHINE CO., INC., 3644 North Lawrence St., Philadelphia 40, Pa., has announced a new series of versatile enclosures for microwave and rfi applications. Additional microwave absorption characteristics are achieved by incorporating two new especially designed materials into the basic structure. Lightweight McMillan hair-mat type 8 is used on walls, doors and ceiling. Floor absorption is provided by McMillan plastic foam block type B, which can be walked on without any loss of electrical characteristics. Major application of the new rooms is expected to be simulation of free space for microwave testing in the electronics, aviation and allied industries.



### HIGH-SPEED CAMERA records oscilloscope traces

BREA INSTRUMENTS, P. O. Box 248, Brea, Calif., has announced the model OC-1, a new high-speed 35-mm camera for continuous record-

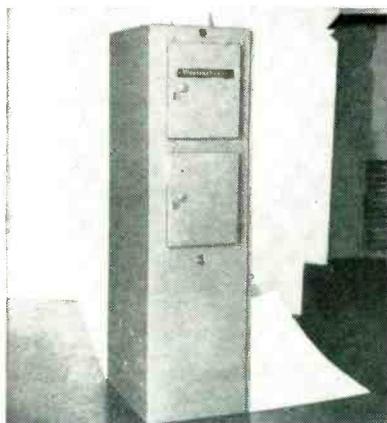


FANSTEEL METALLURGICAL CORPORATION  
North Chicago, Illinois, U. S. A.

C556A

TANTALUM CAPACITORS . . . DEPENDABLE SINCE 1930

ing of oscilloscope traces. Weighing only 6 lb, with a film capacity of 100 ft, the camera may be mounted directly on the bezel of any 5-in. oscilloscope. The illustrated installation features simultaneous binocular viewing and recording, illuminated identification card and flashing lamp time reference. Film transport rate may be set between 1 and 300 ips by a continuously variable remote motor control. Lower speeds can be achieved by gear substitution and higher speeds up to 400 ips can be reached with special starting acceleration control. An f/1.5, 50-mm coated lens with iris diaphragm is offered, giving an image reduction ratio of 4.5 in the usual 5-in. oscilloscope installation.



### RESISTANCE WELDING CONTROLS

feature printed circuits

WESTINGHOUSE ELECTRIC CORP., P. O. Box 2099, Pittsburgh 30, Pa. A new line of resistance welding controls feature printed circuits and a weld-safe circuit for the protection of equipment and work in process. Circuit components and tubes have been reduced to the minimum number necessary for proper functioning. This reduces panel weight by 30 percent. Heavy-duty, long-life components are used for maximum operating life. Capacitors, for example, are rated at 600 v even though circuit voltages are normally 115 v. The ignitron tubes are protected from excessive operating heat by a thermostatic switch snap mounted on the outer water jacket which locks out welding current at a preset tempera-

## LARGE OUTPUT IN SMALL SPACE



# Fansteel

## HIGH-TEMP SELENIUM Rectifiers

CATALOG NUMBER	CIRCUIT	INPUT A-C VOLTS	CONT. D-C OUTPUT AT 100°C	
			VOLTS	AMPS.
TADL35L	1-35-1-H	455	402	0.004 <sup>(1)</sup>
TEUH315 <sup>(2)</sup>	2-8-1-D	132	254	0.020 <sup>(1)</sup>
TBU100L	1-100-1-H	2600	1090	0.020
TEB328L <sup>(3)</sup>	2-11-1-D	363	297	0.150
TEW066L	4-4-1-B	132	108	0.180
TEC070L	4-5-1-B	165	135	0.300
TEX034L	4-1-3-B	33	27.8	1.59
TED200LN	2-13-1-C-N	214	175	0.600
TBY060L	4-3-1-B	78	62.7	1.0
TBY060L	4-3-1-B	41	62.7	1.0 <sup>(1)</sup>
TEEW334L <sup>(4)</sup>	2-7-1-D	231	295	2.3 <sup>(2)</sup>
TEFW332L <sup>(4)</sup>	2-13-1-D	429	548	4.6 <sup>(2)</sup>
TBG084L	2-1-1-C	13	10.4	5.2
TET050L	4-2-1-B	66	53.9	4.6
TEP314L <sup>(3)</sup>	2-7-2-D	231	189	14.0
TER020L	6-3-1-B	66	79.5	12.9 <sup>(2)</sup>
TER034L	4-1-3-B	33	27.8	25.8
TBR008L	6-1-4-B	26	32.5	51.6 <sup>(2)</sup>

<sup>(1)</sup> Capacitive Load. Ratings unmarked are for resistive or inductive loads.  
<sup>(2)</sup> Hermetically Sealed.  
<sup>(3)</sup> Two stacks required.  
<sup>(4)</sup> Three stacks required.  
<sup>(5)</sup> Resistive, inductive or capacitive load.

Operating at 100°C (212°F) Fansteel High Temperature Rectifiers deliver full rated power output, continuously, with no derating whatever. At temperatures up to 150°C (302°F), only moderate derating is necessary.

Fansteel High Temperature Rectifiers are available in all standard cell sizes and all standard circuit arrangements and with all standard protective finishes — moisture resistant, fungus resistant and a salt-spray resistant finish that meets MIL specifications. The table indicates a partial list of over 100,000 available types.

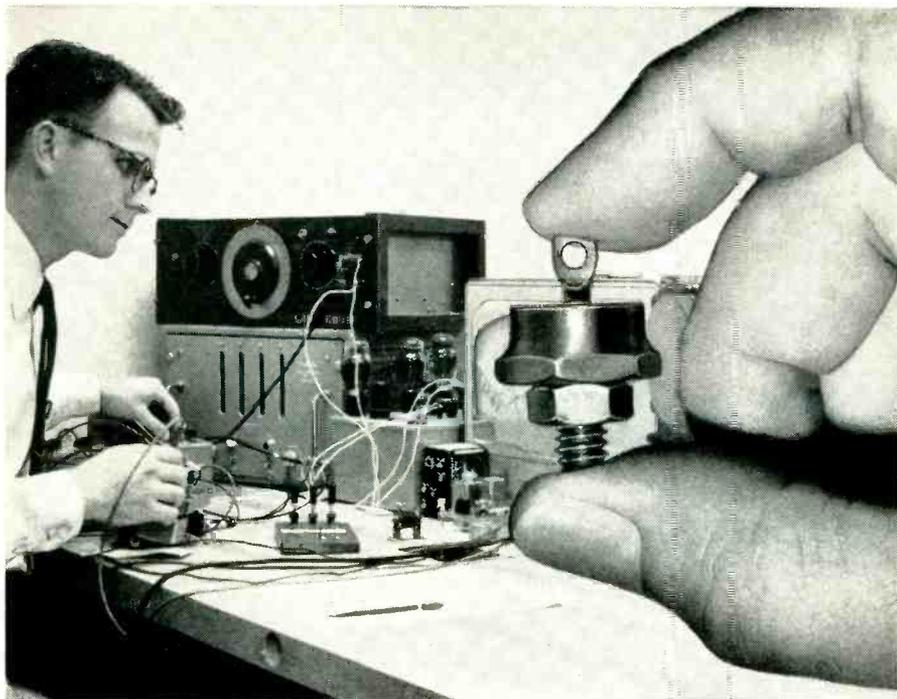
Send for  
bulletin 6.401

FANSTEEL METALLURGICAL CORPORATION  
North Chicago, Illinois, U.S.A.

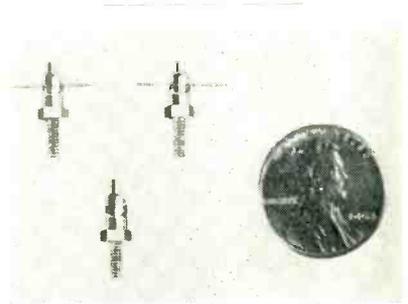


E 568A

DEPENDABLE RECTIFIERS SINCE 1924



ture. The inside sheet of the water jacket is constructed so that thermal contact with the thermostat is maintained.



**DIODE CLIP**  
is spring loaded

CAMBRIDGE THERMIONIC CORP., 445 Concord Ave., Cambridge 38, Mass., announces a new spring loaded diode clip that securely holds fragile diode pig-tail leads from 0.005 in. to 0.35 in. in diameter. The clip is made of brass and is finished in 0.0002 in. bright alloy plate. When mounted it is  $\frac{1}{8}$  in. in overall height. Mounting stud is  $\frac{1}{2}$  in. long, hexagonal with a 2-56 threaded stud. For further specifications, information and prices write direct to the manufacturer.

WESTINGHOUSE  
**NEW** SILICON POWER  
RECTIFIER puts you ahead...

High-temperature operation. Exhaustive tests have shown that these units are capable of operation up to 200°C with *no* detectable aging in their characteristics.

In rectifier efficiency. Forward voltage drop reaches only 0.85 volts at 40 amperes, 190°C junction temperature. Efficiency is over 99%. Ratings up to 200 volts maximum peak inverse are available in four classifications: 50, 100, 150 and 200 volts.

In compact design. Westinghouse silicon power rectifier (shown actual size above) takes only 1/50th the volume of the comparable selenium rectifier.

Write today for your free application *Facts Folder* describing the full range of silicon power rectifier characteristics. These rectifiers are available for immediate delivery. Call your local Westinghouse sales office, or write: Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa. J-80002



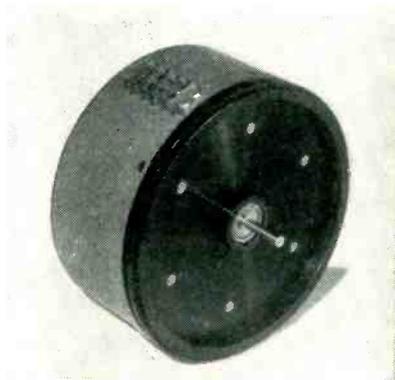
YOU CAN BE SURE...IF IT'S  
**Westinghouse**



**COMPONENT TESTER**  
a direct-reading unit

INDUSTRIAL TEST EQUIPMENT CO., 55 E. 11th St., New York 3, N. Y. Model 1010 impedance comparator is particularly suited to the rapid testing of resistors, capacitors and inductors. The circuit consists of a bridge, two arms of which are precision matched resistors. The two remaining arms are the standard and the component under test. Any voltage resulting from bridge unbalance is amplified and fed to a phase discriminator. The percent-

age deviation of impedance is then read directly in both sign and magnitude on a large zero-centered meter. Three full-scale ranges are provided:  $\pm 5$ ,  $\pm 10$  and  $\pm 20$  percent. Impedance limits are: resistance, 5 ohms to 5 megohms; capacitance, 50  $\mu\text{f}$  to 20  $\mu\text{f}$ ; inductance, 100  $\mu\text{h}$  to 80 henry. Two operating frequencies are available: 1,000 cps and 10,000 cps. Special circuitry provides a low time constant and eliminates the necessity for operating pushbuttons.



**POTENTIOMETER**  
is a comparison standard

ANALOGUE CONTROLS INC., 37 W. 20th St., New York 10, N. Y. The MP-10 potentiometer is a comparison standard rotation-to-voltage transducer for basic measurement, potentiometer testing and calibration, and analog multiplication. It features linearities to 0.002 percent. The unit is not susceptible to torque overloads or burnout. A Teflon shaft seal and high leakage construction prevent internal loading. Resistance range is 5,000 to 200,000; resistance tolerance, 5-percent standard; temperature coefficient of resistance,  $\pm 20$  ppm per deg C. The o-d is 10 in., facilitating extremely high resolution.

**CAPACITORS**  
for 125 C operation

SPRAGUE ELECTRIC CO., 35 Marshall St., North Adams, Mass., has announced new hermetically sealed, Vitamin Q impregnated ceramic case capacitors for operation at temperatures up to 125 C. Use of a ceramic shell instead of a metal one on the new Pacer capacitors

One of These

Might Save You

Many of These

PHALO

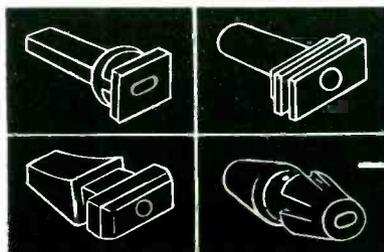
**"Trouble Saver" Custom Strain Reliefs**

You are well aware of the super-strains power supply cords are called upon to face day after day and you know even the best quality cord sometimes succumbs to these strains.

The time to solve strain problems is when your power supply cord is "built". The custom factors that make a successful strain relief are best *engineered* when the cord is made.

PHALO custom *engineers* both cord and strain relief . . . the end-advantages of this coordinated effort are very obvious to PHALO customers and to *their* customers.

Ask For The Complete Phalo Catalog



PHALO

PLASTICS CORPORATION

*The Custom Cord Set House*  
Corner of Commercial St.  
WORCESTER, MASS.

Insulated Wires, Cables - Cord Set Assemblies

# Davies

## MAGNETIC TAPE DATA RECORDING AND ANALYSIS

Davies Laboratories—the foremost producer of magnetic tape data recording and analysis systems can reduce, to its simplest terms, your data problems. Their standard and specially designed equipment is being successfully used throughout industry. Whatever your problem is—compactness, extreme environmental conditions—for use in aircraft, mobile or field, consult Davies first for the correct, economical solution.

### • STANDARD DAVIES EQUIPMENT •

#### RECORDERS

Send for Bulletins 54D-54E

From 7" cube, 6-channel affairs to 14-channel, 10½" reel equipment, standard models of Davies airborne and portable recorders will fulfill almost every requirement. They feature a wide range of recording speeds, extreme flexibility as to recording technique, plug-in electronic circuitry, and "batleshop" construction to withstand severe environmental conditions. The same plug-in electronic units provide equivalent flexibility in laboratory recording applications. Flutter and wow compensation provides topnotch performance, unattainable otherwise.

#### REPRODUCERS

Send for Bulletin 54D

Single or multi-speed tape transports for rack mounting, combined with unitized playback amplifiers for direct recording, pulse reconstituting amplifiers for pwm systems, and wide frequency range high output FM discriminators especially designed for wow and flutter compensation, complement in reproduction the unequalled flexibility of our recording equipment, and provide the necessary tools for data reproduction, processing, and analysis for modern instrumentation systems.

#### ANALYZER

Send for Bulletin 54C

First of a line of automatic data processing equipment is the time-tested Davies Automatic Wave Analyzer for completely automatic frequency analysis of tape recorded or "live" data. Capable of clearly delineating components as low as 3 cps, with bandwidth variable from ½ cps to 45 cps, this analyzer provides data otherwise unobtainable, and saves untold man hours.

#### SPECIAL DATA REDUCTION EQUIPMENT

*Davies engineers will design and build equipment to handle any unusual data reduction requirement. Tell us your problem—we'll come up with an answer—quick.*

**NOW AVAILABLE**

The multi-channel, completely shielded, precision alignment instrumentation heads which had to be developed for full utilization of the vast potentialities of magnetic tape recording. Excellent resolution, negligible crosstalk, and precise interchannel time and phase relationships are inherent in the design of these heads. 20 tracks on 2" tape, all gaps in line, for general instrumentation work, 42 tracks for digital recording applications, can be packed in these heads.

THE

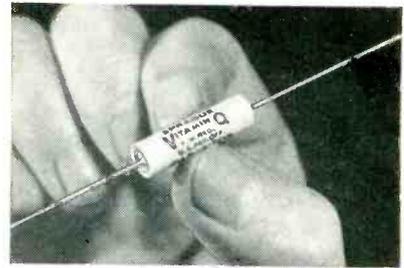
# Davies

PIONEER MANUFACTURERS OF AIRBORNE MAGNETIC  
TAPE DATA RECORDING SYSTEMS AND EQUIPMENT

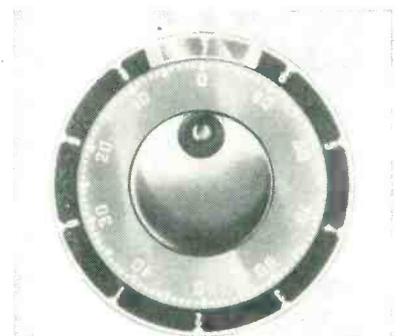
LABORATORIES INCORPORATED

4705 QUEENSBURY ROAD • RIVERDALE, MARYLAND

TELEPHONE: WASHINGTON, D. C., APPLETON 7-1133



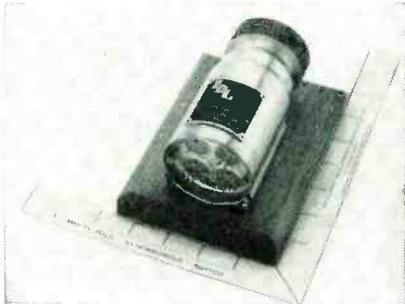
keeps capacitance between the capacitor section and ground at an absolute minimum. The hermetically sealed ceramic shell, with glass-to-metal solder seals, provides excellent resistance to the effects of humidity and temperature, and extreme stability under all operating conditions. Impregnation with Vitamin Q, the company's inert synthetic impregnant, means top performance at high temperatures—with no voltage derating necessary for continuous operation at temperatures up to 125 C. Complete performance characteristics, ratings and sizes are in engineering bulletin 226.



### URNS-COUNTING DIAL increases readability

HELIPOT CORP., 916 Meridian Ave., South Pasadena, Calif. The 900 series Duodial turns-counting dial permits greater sensitivity of adjustment and increases readability. The diameter and overall dimensions remain the same as the superseded W series. In the new series the index has been changed from a solid bar to a triangle which zeroes in on the outer-dial number. The lines formerly between numbers have been replaced by a triangular index located over each numeral. It is available in 4 models, identical except for calibration of the outer dial, and is designed for use with all Helipot multiturn precision potentiometers, and other

devices having a  $\frac{1}{4}$ -in. diameter shaft. The Duodial consists of two coaxial dials—the inner counting hundredths of each turn; and the outer, the number of completed turns.



### ROTARY SWITCH is high-speed device

INSTRUMENT DEVELOPMENT LABORATORIES, INC., 163 Highland Ave., Needham Heights 94, Mass., has available a high-speed rotary synchronous multiple-pole switch commutator for missile and aircraft applications such as telemetering, switching radar data presentation and commutating thermocouple signals. A 12,000-rpm, 115-v, 400-cycle, single-phase motor drives the brush assembly at 10 rps with only 7 w of power. Three sets of carbon-type brushes bear on precious metal segments to provide BBM operation without riding on filler material yielding low noise and long life. The case is hermetically sealed and provided with radiating fins for motor cooling. The switch can carry 0.1 mv to 100 v from  $3 \mu\text{a}$  to 50 ma current. Life is in excess of 500 hr, meeting MIL-STD-202 specification requirements. Size is  $2\frac{1}{2}$  in. in diameter  $\times$   $5\frac{1}{2}$  in. long. Weight is  $2\frac{1}{2}$  lb.

### GANGING POTS are completely enclosed

DEJUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City 1, N. Y. A new series of fully enclosed ganging potentiometers are economically priced for electronic applications that do not require the extended refinement of more expensive high precision types. The 3-in. independent phasing potentiometers have a power rating of 8 w. They feature precise 360-deg external phasing,

# ERIE FIRST AGAIN!

*electronics*

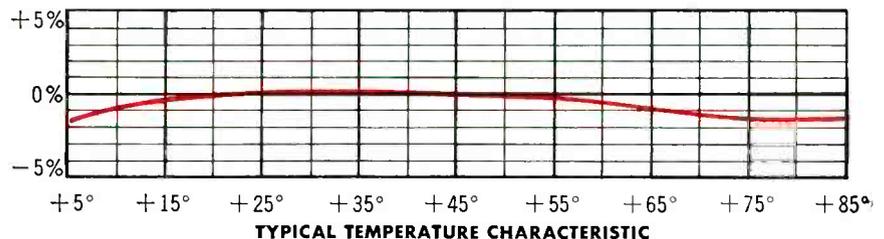
## TEMPERATURE STABLE Hi-K DISC CERAMICONS® TYPE "H-A"

A NEW HIGH  
IN STABILITY

NOT ~~7½%~~ — NOT ~~5%~~  
**ERIE OFFERS 3%**  
MAXIMUM CAPACITY CHANGE over  
temperatures ranging from +10° to  
+85°C. on this new Hi-K dielectric.



As a result of ERIE's continued basic research in Ceramics, another outstanding Hi-K ceramic dielectric has been created from ERIE laboratories known as TYPE "H-A". This dielectric exhibits the flattest temperature characteristic Hi-K material ever offered to industry at non-premium prices.



TYPE "H-A" Temperature Stable Ceramicons are available in production quantities in any nominal capacitance value ranging from 150 mmf. to 4,250 mmf. with tolerances of  $\pm 10\%$  and  $\pm 20\%$ . Diameters of the "H-A" Ceramicons range from  $\frac{5}{16}$ " to  $\frac{3}{4}$ ". Maximum thickness on all units is  $\frac{5}{32}$ ". Available in 22 gauge wire leads; also with 20 gauge wire leads or spade leads for automatic insertion in printed circuit boards.

Because of their small size and convenient shape, the TYPE "H-A" disc is ideally suited for critical applications that formerly required the use of expensive capacitors of other types.

For further information write for ERIE Bulletin 449.

**ERIE ELECTRONICS DIVISION**  
**ERIE RESISTOR CORPORATION**  
 Main Offices and Factories: ERIE, PA.  
 Manufacturing Subsidiaries  
 HOLLY SPRINGS, MISSISSIPPI • LONDON, ENGLAND • TRENTON, ONTARIO

# CLIFTON PRECISION OFFERS A SIZE 15 SYNCHRO TRANSMITTER

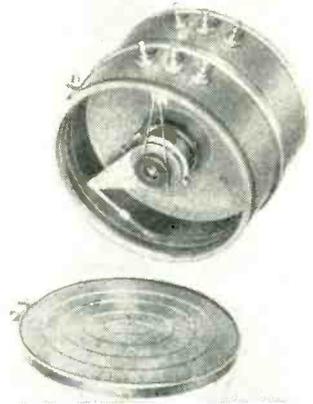
identical to BuOrd type 15CX4a

# Except

## ACCURACY SPREAD GUARANTEED 10' or LESS

NEW PRODUCTS

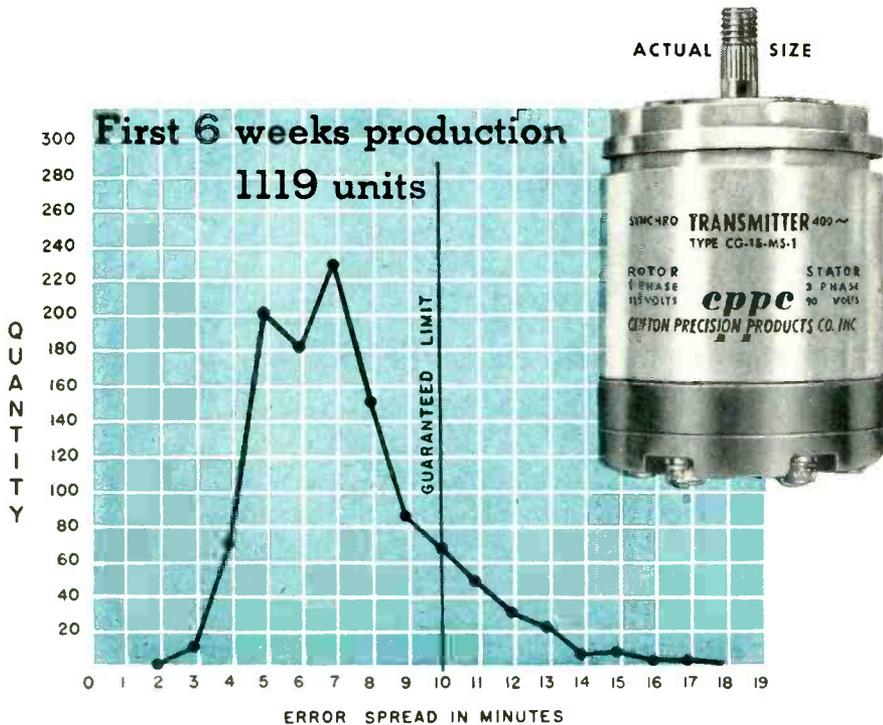
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adjustable or fixed taps and linear or nonlinear resistance elements. Contacts are made from precious metals. Specifications and diagrams are given in technical bulletin 360-455.

### REFERENCE DIODES available in 2 new types

NATIONAL FABRICATED PRODUCTS, INC., 2650 W. Belden Ave., Chicago 47, Ill. Two new Silicon reference diodes, types 1N429 and 1N430, have been introduced. These silicon junction diodes are designed for use in reference voltage sources wherever the absolute value of an electrically sensed variable is important such as the control and indication of gas turbine temperature; for fire control and aircraft autopilot systems; for guided missile and computer applications, and for other applications in a variety of equipments. Voltage reference units employing the diodes have been temperature cycled for more than 1,000 hours and show a stability of better than 1 percent.



The CG-15-MS-1 transmitter is interchangeable part for part with the U.S. Navy Bureau of Ordnance type 15CX4a synchro transmitter (Mark 22 Mod. 1) in every respect.

Because of quality workmanship in this unit we are able to guarantee accuracy spreads not to exceed 10'. From the chart it will be noted the majority of production units have error spreads between 5' and 8'—yet price remains exceedingly low.

Stainless steel bearings are provided for better environmental resistance.

#### FOR SALES INFORMATION, CONTACT:

*New England:* The Darbury Corp., 99 Elm St., W. Newton 65, Mass.

*Southwest:* Ammon & Woods Asso., 4163 Glenwick Lane, Dallas, Tex.

*West Coast:* Enright Engineering Co., 988 W. Kensington Rd., Los Angeles

*Home Office:* T. W. Shoop, Sales Mgr., Telephone (Phila.) MADison 6-2101

LOOK TO CPPC FOR SYNCHRO PROGRESS

## CLIFTON PRECISION PRODUCTS CO. Inc.

CLIFTON HEIGHTS  
PENNSYLVANIA



### Literature

**Parabolic Antennas.** Prodelin Inc., 307 Bergen Ave., Kearny, N. J. A new 2-color 14-page bulletin describes parabolic antennas used for radio and tv microwave relay. Antennas described are of the mesh-reflector, dipole-feed type in

4, 6 and 10-ft sizes. Catalog data, complete with applications, photos and ordering information, are contained in bulletin 428. Bulletins 428-1, 2 and 3 include radiation patterns for the 4, 6 and 10-ft sizes respectively.

**Switch Catalog.** Unimax Division of the W. L. Maxson Corp., 460 W. 34th St., New York 1, N. Y. A new 24-page catalog describes numerous types of Unimax switches: high-sensitivity, metal-cased, immersion-proof, general-purpose, AN-type, JAN-type, direct-current and subminiature switches. A complete pictorial index aids in quickly selecting the right switch for any application. This new catalog presents each switch type with photographs and detail drawings, shows the many types of actuators available, gives base and terminal data, physical dimensions, operating characteristics and electrical ratings.

**Universal Magnetic Testing Set.** Sensitive Research Instrument Corp., 9-11 Elm Ave., Mt. Vernon, N. Y. Volume 22 No. 1 of *Electrical Measurements* covers the universal magnetic testing set which contains six 4-in. scale length multirange indicating instruments, a separate Epstein frame, and the necessary internal switches to set up core loss and hysteresis measurements. Included are a description of each of the instruments, mechanical details of the testing set and prices.

**Subminiature Relay.** Luther Mfg. Co., 7312 Varna Ave., North Hollywood, Calif. has available a brochure dealing with the model M-1000 hermetically sealed subminiature relay. Basically the design of the relay described consists of the incorporation of a permanent magnet in an electromagnetic circuit of high efficiency and performance. With this arrangement it is possible to achieve the high armature torques necessary to overcome high contact pressures and actuate large contacts in a subminiature configuration.

**TV Wobbulator.** Campagnie Generale De Metrologie, Annecy, France. Type 210 wobbulator, in-

**NEW 1/2 watt-type DCM 1/2**  
**MOLDED**  
**deposited carbon resistor**

a  
growing name

*Electra*

in the  
electronics  
industry

**Doubly insulated to give you . . .**

**Complete Mechanical Protection**

**Longer Load Life**

**Better Electrical Insulation**

**Greater Moisture Resistance**

**Performance That Exceeds All Electrical Requirements of MIL-R-10509A**

**H**ere's the right resistor for rugged duty. It gives you stability, precision, and small physical size, plus double insulation. The completed resistor has several layers of baked-on, moisture-resistant insulating coatings and, in addition, is encapsulated in a molded plastic case. The result is complete mechanical protection and better operating characteristics. Electra also manufactures a complete line of standard and hermetically-sealed deposited carbon resistors.

**FILL OUT AND MAIL THIS COUPON TODAY FOR FULL DETAILS**

I am interested in the following type of deposited carbon resistor:

- Molded
- Hermetically-sealed
- Standard

● Name \_\_\_\_\_

● Company \_\_\_\_\_

● Street \_\_\_\_\_

● City \_\_\_\_\_ State \_\_\_\_\_

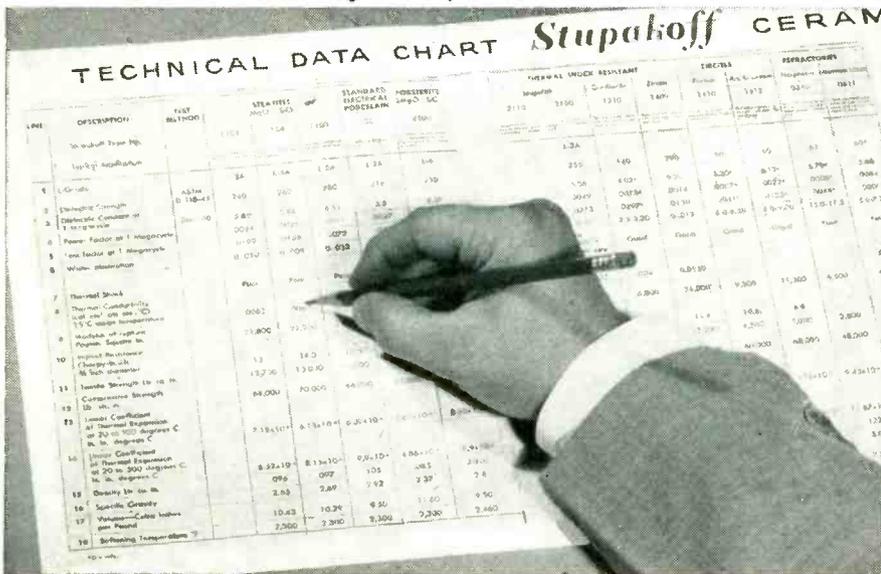


**ELECTRA**  
**MFG. CO.**  
**4051 Broadway**  
**Kansas City, Mo.**  
**Westport 6864**

# Stupakoff

## CERAMIC MATERIALS

*At your fingertips...*



## NEW TECHNICAL DATA on Stupakoff CERAMIC MATERIALS

The very latest technical information on a wide range of ceramic materials is given in the new Stupakoff Technical Data Chart. Electrical and physical characteristics and the chemical composition of various grades of the following ceramic materials are included:

ALUMINA  
ALUMINUM SILICATE  
STEATITE

PORCELAIN  
STUPALITH  
CORDIERITE  
MAGNESIA

ZIRCON  
ZIRCITE  
FORSTERITE

Valuable design and application suggestions included in the Stupakoff Data Chart help you engineer your ceramic parts for lowest cost and greatest satisfaction.

*Send today for your free copy of the new Stupakoff Data Chart. Arranged for ready reference.*



Write Dept. E

# Stupakoff

Division of The CARBORUNDUM Company

LATROBE, PENNSYLVANIA

NEW PRODUCTS

(continued)

tended for design adjustment and checking of wide-band amplifiers such as are used in tv and f-m, is illustrated and described in a single-sheet brochure. Information on accessories and technical characteristics of the instrument are included.

**Potentiometer.** DeJUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y. Two pages in color give features and specifications on the new 1 $\frac{1}{8}$  in. precision ganging potentiometer designed for applications requiring high accuracy in limited space. Write for technical bulletin C150-455.

**Electronic Measuring Instrument.** Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. Fourth St., Philadelphia 33, Pa. The proximity meter, a precision electronic instrument that measures without touching the specimen, is described in a new 28-page booklet. The instrument discussed can detect a change in temperature of 0.001 deg C, or variations as minute as one millionth of an inch. A variety of applications are described.

**Adjustable Range Recorder.** Leeds & Northrup Co. 4934 Stenton Ave., Philadelphia 44, Pa. A two-page data sheet E-ND46(4) describing the Speedomax adjustable zero, adjustable range recorder is available. Complete specifications of stocked and special purpose recorders are given together with a description of the instrument and the operation of the range and zero dials. Optional features including reversible chart drive, pen lifters, optional range dial calibration and multiple point recording are cited and complete ordering instructions are given.

**Fasteners.** Shakeproof, Division of Illinois Tool Works, St. Charles Road, Elgin, Ill. Volume 4, No. 1 of *Fastening Forum* deals with Keps preassembled nut and lockwashers that feature free-spinning, spring-action and uniform quality. The bulletin illustrates and describes Mastic-Seal Keps for protection against moisture and dust. Included are tabular

data on machine screw and hexagon nut series Keps. Also discussed are special products such as a sealing lock washer, a Plasti-Rokut and a new anvil-type molding clip.

**Precision Measuring System.** Hewlett-Packard Co., 275 Page Mill Road, Palo Alto, Calif. Volume 6, No. 12 of the *Journal* deals with a simple precision system for measuring c-w and pulsed frequencies up to 12,400 mc. The 6-page bulletin includes illustrations and specifications of the model 540A transfer oscillator.

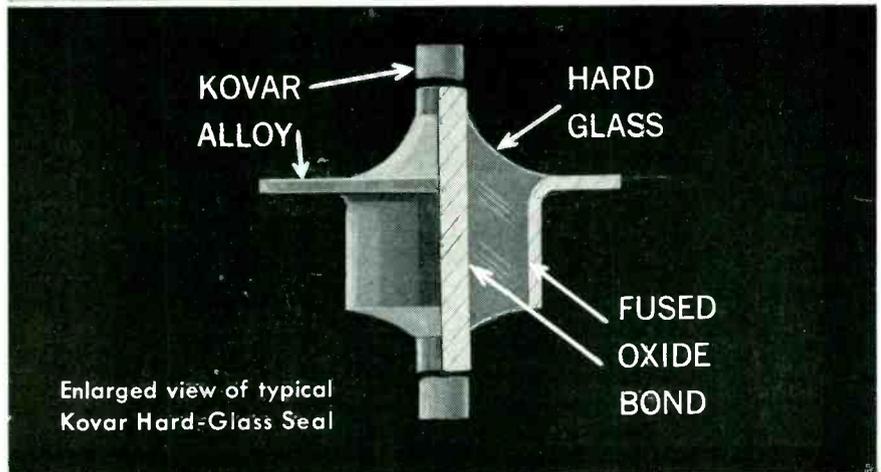
**Tape Recording Equipment.** A-V Mfg. Corp., 730 Fifth Ave., New York 19, N. Y. A new 16-page brochure fully describes and illustrates 9 basic building-block components and a series of accessories functionally designed to make up A-V magnetic tape recording systems of from 2 to 14 channels for instrumentation data. Block diagrams show methods of planning desired systems by interconnecting the various A-V plug-in units and components. The equipment, designated type 7, is for direct recording in the range of 300 to 100,000 cps. Request bulletin 103.

**D-C Power Supply.** Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif. Bulletin MR2432-100X describes the extremely compact 28-v 100-ampere regulated and filtered power supply now available. The bulletin lists the unit's specifications and also contains operating curves showing the response time, load and line regulation characteristics. The bulletin also shows a circuit block diagram and the theory of operation of this tubeless magnetic amplifier regulated d-c power supply.

**Germanium Power Rectifiers.** International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif. Bulletin GPR-1 lists ratings and specifications on germanium power rectifiers. It describes two styles: Style C—natural convection cooled, and Style F—fan cooled. Also included in this bulletin are the complete operating instructions and the typical dynamic characteristic curves for these two styles. A

# Stupakoff

## Kovar **HARD GLASS** Seals



Enlarged view of typical Kovar Hard-Glass Seal

Here are 5 practical reasons why  
**KOVAR AND HARD GLASS**  
 make the Best hermetic seals

### **BEST** for thermal endurance

—because the thermal expansion of Kovar matches exactly that of hard glass over the entire working range.

### **BEST** for insulating value

—because of the high dielectric strength of hard borosilicate glass. No silicone treatment is required.

### **BEST** for hermetic tightness

—because the fused oxide bond is a chemical bond, forming a true hermetic seal, free from strains at all working temperatures.

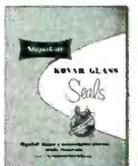
### **BEST** for miniaturization

—because insulating efficiency and high mechanical strength of hard glass permit the use of seals of minimum size and weight.

### **BEST** for your product

—because Stupakoff's broad experience, engineering skill and modern manufacturing methods provide hermetic seals that are right for your product. You get all the advantages that can be secured *only with Kovar and Hard Glass*.

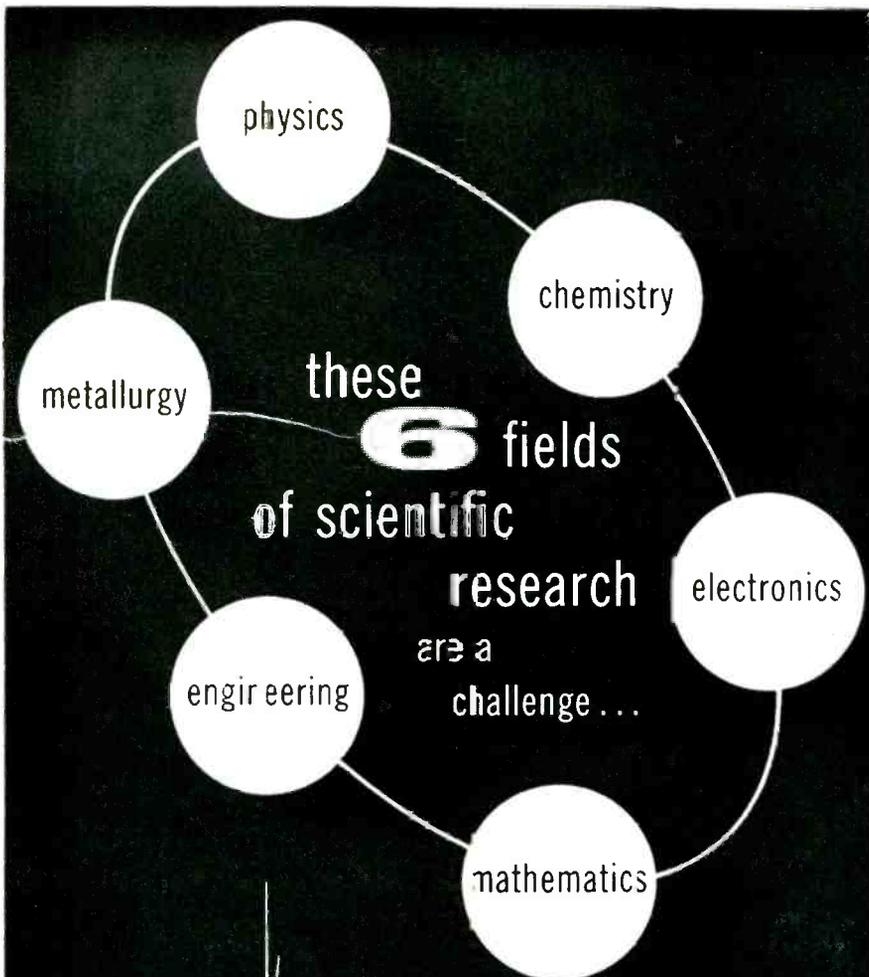
WRITE DEPARTMENT E  
 for Catalog 453A, which shows  
 all the standard and many of the  
 special types of Stupakoff Her-  
 metic Seals.



# Stupakoff

Division of The **CARBORUNDUM** Company

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... and the scientific and engineering personnel of the Los Alamos Scientific Laboratory working with some of the Western World's finest equipment and facilities—are meeting the challenge with independent and original research application and development work.

Excellent opportunities now exist at Los Alamos for qualified men wishing to further their scientific careers.

The nation's most important institution for the development of atomic weapons, offers unlimited opportunity for individual growth and development. In addition to its continuing and ever expanding achievement in nuclear weapons research, the Laboratory is now pioneering in the fascinating fields of nuclear power and nuclear propulsion.

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RESUME TO  
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OF  
SCIENTIFIC PERSONNEL  
Division 103

los alamos  
scientific laboratory  
OF THE UNIVERSITY OF CALIFORNIA  
LOS ALAMOS, NEW MEXICO

typical example of the small compact unit assembly is the type 53-0383, which occupies an approximate volume of 4 in. by 10½ in. by 10½ in. and is rated at 42 v d-c, 1,500 amperes, connected in a dual three-phase, half-wave circuit with interphase transformer.

**Two-circuit Limit Switch.** Micro Switch, a division of Minneapolis-Honeywell Regulator Co., Freeport, Ill. Preliminary data sheet 104 illustrates and describes the 1LS1 small two-circuit limit switch designed for all types of industrial applications where space limitation is a prime factor in switch selection. Dimensional drawings, characteristics, contact arrangement and price are included.

**Dosimeter Reader.** Specialty Engineering & Electronics Co., 79 Clifton Place, Brooklyn 38, N. Y. A single page bulletin illustrates and describes the model 95A phosphate glass dosimeter reader. The instrument discussed incorporates the necessary ultraviolet lamp, multiplier phototube, v-t amplifier, indicating meter, optical filters and reference standard. Specifications are given.

**Switches and Governors.** Synchro-Start Products, Inc., 8151 North Ridgeway Ave., Skokie, Ill., has issued an 8-page bulletin with full information on their line of speed sensitive switches and overspeed governors. It includes dimensional drawings of the overspeed, under-speed, one, two and three switch governors with explanations of the various types of take off and connectors. Ask for bulletin 504S.

**Cable Connectors.** Communication Products Co., Inc., Marlboro, N. J. Catalog No. 255A is a 36-page, well-illustrated booklet dealing with Magicseal and flare-type connectors for Styroflex cable. The connectors described are positive seal, pressure tight, weatherproof, and require minimum tooling. Included is a technical data table on Styroflex and Spirafil coaxial cable.

**T-W Amplifier.** Raytheon Mfg. Co., Waltham 54, Mass. A 4-page technical information bulletin illus-

trates and describes the type QK-523 traveling-wave tube power amplifier designed for use with an electromagnetic solenoid in c-w operation over the 6,400 to 7,200 mc range with an average gain of 15 db and a maximum power output of 4 w. Characteristics are outlined tabularly and diagrammatically.

**Subminiature Potentiometer.** DeJUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y. Two pages in color describe and illustrate the series C-078 precision potentiometers with only  $\frac{3}{8}$  in. diameter and weighing only  $\frac{1}{2}$  oz. The subminiature potentiometers discussed feature many of the advantages of full-size potentiometers. For complete information, write for bulletin C078-455.

**Radar Transformer Bulletin.** General Electric Co., 1 River Road, Schenectady 5, N. Y. Oil-filled transformers and inductors for radar and other electronic applications are described in bulletin GEA-5963. The bulletin cites the radar transformer model shop, where prototype units can be designed and built in a hurry. Design features of the regular production models are described: smaller, lighter and more efficient coils of Formex insulated wire with embedded-layer winding; improved cores of cold-rolled, grain oriented silicon steel; and alumina solder-sealed terminals.

**D-C Power Supplies.** Opad Electric Co., 69 Murray St., New York 7, N. Y., has issued a 2-page catalog sheet describing a line of low-cost general-purpose d-c power supplies. Twenty-two standard models are covered with unfiltered outputs ranging from 6 to 230 v d-c and 0.6 to 150 amperes. All models feature continuously adjustable outputs, 2-percent accuracy panel meters, input and output overload protection, compact, portable design. In addition to listing the electrical ratings and their corresponding model numbers, the bulletin also includes detail information on the minimum general specifications to which all



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CUSTOM  
PANEL  
INSTRUMENTS**

Pictured here are two typical examples of why the name Phaotron is so rapidly gaining enthusiastic acceptance wherever and whenever truly fine Panel Meters are admired, required and specified.

They are the latest additions to the Phaotron line of "Custom" Panel Instruments which include 2 1/2", 3 1/2" and 6" sizes.

Built to the exacting standards of excellence that identify every Phaotron product.

**BUILT TO HIGHEST QUALITY . . . SOLD UNBELIEVABLY LOW**  
Metal Case . . . won't chip, shatter or warp.

**Large Clear Scales . . .** Increments and numerals can be read at a distance of 10 feet.

**Permanent Accuracy . . .** plastic cased meters often vary up to 35% . . . these metal cased meters . . . never.

**Anti Magnetic . . .** shielded by their metal case from stray magnetic fields.

**Insulated Zero Adjustments . . .** large, easy-to-use . . . safer.

**Two Models:**

"Custom" Chrome: Die cast bezel is finished in gleaming polished chrome and black.

"Custom": This instrument is identical, but is finished in solid color.

Both are available with self-contained 5,000 hour lamps where illuminated scales are desirable.

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# UHF

... Ultra High Frequencies



• **RADIO INTERFERENCE**  
• **and FIELD INTENSITY\***  
• **measuring equipment**

• **Stoddart NM-50A • 375mc to 1000mc**

• **Commercial Equivalent of AN/URM-17**

**ULTRA-HIGH FREQUENCY OPERATION**... Frequencies covered include UHF and color television assignments and Citizen's Band. Used by TV transmitter engineers for plotting antenna patterns, adjusting transmitters and measuring spurious radiation.

**RECEIVING APPLICATIONS**... Excellent for measuring local oscillator radiation, interference location, field intensity measurements for fringe reception conditions and antenna adjustment and design.

**SLIDE-BACK CIRCUIT**... This circuit enables the meter to measure the effect of the peak value of an interfering pulse, taking into account the shaping due to bandwidth.

**QUASI-PEAK FUNCTION**... An aid in measuring pulse-type interference, the Quasi-Peak function is just one of the many features of this specially designed, rugged unit, representing the ultimate in UHF radio interference-field intensity equipment.

**ACCURATE CALIBRATION**... Competent engineers "hand calibrate" each NM-50A unit. This data is presented in simplified chart form for easy reference.

**SENSITIVITY**... Published sensitivity figures are based on the use of the NM-50A with a simple dipole antenna or RF probe. However, the sensitivity of this fine instrument is limited only by the antenna used. The sensitivity of the NM-50A is better than ten microvolts across the 50 ohm input.

**Stoddart RI-FI\*** Meters cover the frequency range 14kc to 1000mc

**VLF**

NM-10A, 14kc to 250kc  
Commercial Equivalent of  
AN/URM-6B. Very low frequen-  
cies.

**HF**

NM-20B, 150kc to 25mc  
Commercial Equivalent of  
AN/PRM-1A. Self-contained  
batteries. A.C. supply optional.  
Includes standard broadcast  
band, radio range, WWV, and  
communications frequencies.  
Has BFO.

**VHF**

NM-30A, 20mc to 400mc  
Commercial Equivalent of  
AN/URM-47. Frequency range  
includes FM and TV bands.

units conform. Request bulletin No. 178.

**Power and Gas Tubes.** Radio Corp. of America, Harrison, N. J., has available a completely revised edition of the power and gas tubes booklet. The 24-page booklet, Form No. PG-101B, contains technical data on 178 vacuum power tubes including forced-air-cooled and water-cooled types ranging in output capability up to 500 kw; gas, mercury-vapor and vacuum rectifier tubes; gas and mercury-vapor thyratrons; ignitrons; magnetrons; and vacuum-gage tubes. Each tube type is covered by a text description, tabular data, and a base or envelope connection diagram. Photographs are shown for representative tube types. Copies of the booklet are available at 20 cents.

**Z-Y Bridge.** General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. Volume 30 No. 2 of the *Experimenter* covers the type 1603-A Z-Y bridge, a new approach to audio-frequency impedance measurement. The bridge described can be balanced for any impedance connected to its terminals. A panel view, diagrams, applications and specifications are included.

**Connectors and Cable for A-M Broadcasting.** Communication Products Co., Inc., Marlboro, N. J. Bulletin 355 is a 4-page folder describing Styroflex connectors and cable for a-m broadcasting. Included are descriptions, charts and a line drawing showing a typical a-m installation.

**Relay Catalog.** Magnecraft Electric Co., 3350 B West Grand Ave., Chicago 51, Ill. A new relay catalog includes a range of short and long form telephone type relays for a-c and d-c, subminiature d-c relays, improved versatile latch-in relays, relays with bifurcated (twin) contacts, miniature relays with heavy current contacts, relays with time delay, plug-in relays, relays with snap-action contacts, and 400-cycle relays of exceptional reliability. The catalog also illustrates and gives dimensions of many popular her-

**STODDART AIRCRAFT RADIO Co., Inc.**  
6644-A Santa Monica Blvd., Hollywood 38, California • Hollywood 4-9294

metically sealed and dust proof enclosures.

**Ministrip Resistor.** Ward Leonard Electric Co., Mt. Vernon, N. Y. Catalog No. 15, supplement A, illustrates and describes the 20-w Stripohm type Ministrip resistor. Included is information on chief features, application, construction, watt ratings and dimensions.

**Indicating Pyrometers.** Barber-Colman Co., Rockford, Ill. Bulletin F6048-1 describes Wheelco indicating pyrometers. The instruments described are available in two styles in ranges up to 3,600 F. Instrument scales of the units described are mirrored to avoid parallax errors. The baked and processed coil is supported by two pivots, resting in two sapphire jewels. A combination indicating pyrometer and multiposition switch is also described in the new bulletin.

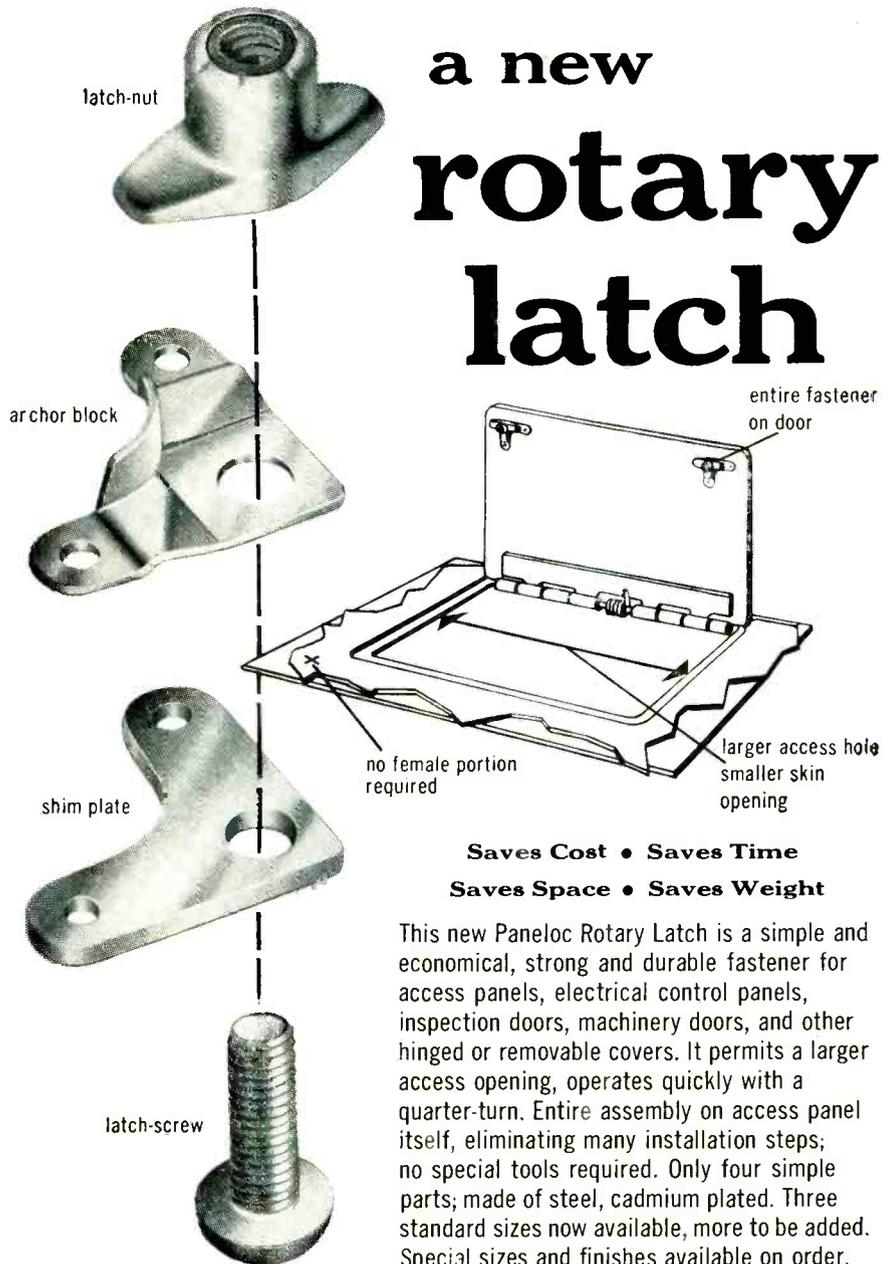
**Ultrasonic Gage.** Branson Instruments, Inc., 430 Fairfield Ave., Stamford, Conn. A new 4-page folder on the Vidigage ultrasonic resonance thickness gage describes operating principles, typical applications and features. The unit discussed measures a wide range of thicknesses, detects laminar discontinuities and internal defects, and is easily operated by nontechnical personnel. The folder is well illustrated and specifications are included.

**Ruggedized Panel Instrument.** De-JUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y. Two pages in color describe and illustrate the new 1½-in. series of ruggedized panel instruments (model 131) designed for size and weight reduction in electronic equipment subject to shock, vibration or temperature extremes. Features include watertight seal, D'Arsonval movement, and high flux density magnets. Write for bulletin R131-455.

**Test Set Data.** Baird Associates, Inc., 33 University Road, Cambridge, Mass. Data sheets on two new types of test sets are available. Bulletin TP-103 outlines the

# PANELOC announces

## a new rotary latch



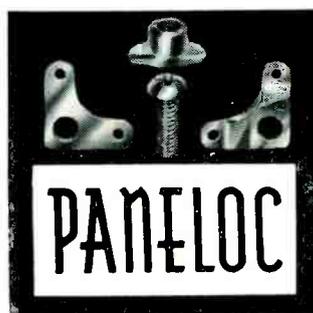
**Saves Cost • Saves Time  
Saves Space • Saves Weight**

This new PaneLoc Rotary Latch is a simple and economical, strong and durable fastener for access panels, electrical control panels, inspection doors, machinery doors, and other hinged or removable covers. It permits a larger access opening, operates quickly with a quarter-turn. Entire assembly on access panel itself, eliminating many installation steps; no special tools required. Only four simple parts; made of steel, cadmium plated. Three standard sizes now available, more to be added. Special sizes and finishes available on order. Cost very low, performance unsurpassed. Write for a catalog and price list for your file.

**PANELOC**...America's most versatile line of aircraft fasteners... Rotary Latches, Styles 1, 2, and 3 Panel Fasteners, High Performance Fasteners, Snap Fasteners.



**PANELOC—A product of Scovill**



Scovill Manufacturing Company, Aircraft Fastener Div.  
46 Mill Street, Waterbury 20, Connecticut

Please send me fastener catalogs checked:

- Rotary Latch                       Style 3 (MIL-F-5591A)
- Styles 1 & 2 (MIL-F-5591A)       High Performance (NAS-547)
- Snap Fasteners (AN 227)

Send to:

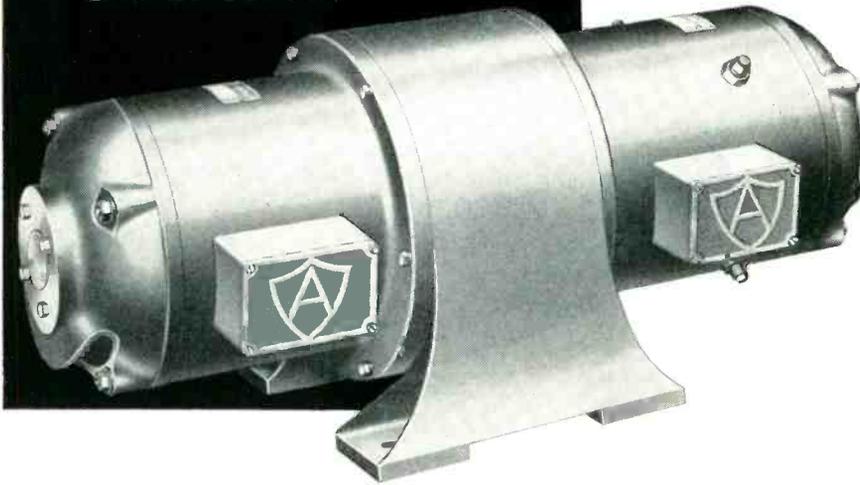
Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

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# A New Approach To Precise 400 Cycle Frequency Control

with  
American  
Electric's  
Unique  
"MIC"  
DRIVE!



Here's the answer to *exceptional 400 cycle frequency control regardless of input frequency variations or changes in load!* It's the result of American Electric's "MIC" drive... a MOTOR-INDUCTION COUPLING which produces a new standard of *automatic speed control!* No belts, no gears... speed changes are instantly sensed and automatically corrected electronically.

400 cycle output is held to  $\pm 1/4\%$  despite input frequency changes or load variations which ordinarily affect alternator rpm. *Even closer control is available for special applications!*

All other advantages of American Electric's proven alternator designs are retained... low overshoot, fast transient voltage recoveries, low harmonic content, minimum maintenance.

**Capacities:** Single phase, 1/2 KVA to 40 KVA  
Three phase, 1/2 KVA to 100 KVA

*Write for quotations on your specific requirements*

Application  
Engineering  
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## American Electric Motors, Inc.

Electric Machinery & Equipment Division of



2112 Chico Avenue, El Monte, Calif.

characteristics of the company's semiconductor minority carrier lifetime test set. A block diagram describes operation in detail. Data are included on the following components: shutter pulser, pulsed light source, bias supply and other units. Bulletin TP-104 discusses the company's semiconductor resistivity test set, designed especially for measurement of the resistivity of semiconductors in the range of 0.1 to 100 ohm-centimeters. Method of operation is explained, with a block diagram of a typical installation.

**Coaxial Cable.** Communication Products Co., Inc., Marlboro, N. J. Bulletin CT covers Spirafil semi-flexible coaxial cable for broadcast, communications, microwave and community antenna. The cable discussed consists of a solid copper center conductor, a solid polyethylene filament helix and a tubular outer aluminum conductor. Included in the bulletin are a description, a cutaway section of the cable, attenuation vs frequency charts and a table of nominal characteristics.

**Cable Joints.** Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y. Complete, step-by-step pictorial directions for making all types of cable joints in the company's neoprene-jacketed Dura-sheath cables are contained in a pocket-size booklet. Prepared for use by both engineers and cable splicers, the booklet tells its story in nine clear photographs supplemented by simple 1-2-3 written instructions. Complicated drawings and tables are eliminated.

**Power Supply.** The Geri Specialty Co., P. O. Box 103 Upland, Calif. An illustrated data sheet covers the model 140 precision voltage-regulated electronic 400-cycle power supply and frequency standard. Applications, specifications and typical performance curves are given.

**Tone Signaling Units.** Hammarlund Mfg. Co., Inc., 460 W. 34th St., New York 1, N. Y., has available a 6-page brochure describing in detail the operating features

and performance of the company's supervisory tone equipment of modular design. The brochure describes how these audio tone signaling units transmit and receive signaling, dialing, telemetering, supervisory controls and other information, over wire lines, telephone or power line carrier, and radio microwave communication circuit.

**Vulcanized Fibre & Laminated Plastics.** Taylor Fibre Co., Norristown, Pa., has available a sheet embodying the most up-to-date information on standard NEMA grades of vulcanized fibre and laminated plastics and their corresponding government grade designations.

**Signal Generator.** Hewlett-Packard Co., 275 Page Mill Road, Palo Alto, Calif. Volume 6, No. 10 of the *Journal* covers the 15 to 21-kmc 10-mw signal generator. Illustrations, specifications and charts are included.

**Instrumentation for Laboratory and Industry.** Berkeley division of Beckman Instruments Inc., 2200 Wright Ave., Richmond 3, Calif. Short form catalog C-701 is now available. It describes a line of frequency meters and extenders, universal counters and timers, digital recorders and data converters, preset counters, and controllers, and electronic analog simulating equipment. The company's systems engineering facilities and nuclear instrumentation are noted.

**Electron Microscopes.** North American Philips Co., Inc., 750 South Fulton Ave., Mt. Vernon, N. Y., has available an 8-page booklet titled "Questions and Answers on Electron Microscopes." The booklet explains such things as shadow casting, use of the same instrument for electron diffraction, resolution, visual and camera work, specimen preparation, negative and positive replicas, as well as electron and lens theory.

**Ganging Potentiometers.** DeJUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y. A 2-page

*In the newest computers...*



**BRUSH MAGNETIC HEADS**

*help provide system flexibility—accuracy—high storage density*

**IN DRUM MEMORY SYSTEMS...**

Several basic Brush multichannel and single channel heads (and their modifications) permit flexibility in Magnetic Drum design. Low loss materials provide greater magnetic head efficiency.

**IN TAPE MEMORY SYSTEMS...**

Precision construction of Brush multichannel heads with close tolerances on gap and track alignment permits greater pulse packing and closer track spacing. Equipment can be designed with increased storage capacity and faster access with Brush heads

For specifications on standard products or designs to your requirements, write Brush Electronics Company, Dept. K-10A, 3405 Perkins Avenue, Cleveland 14, Ohio.

**BRUSH ELECTRONICS COMPANY**

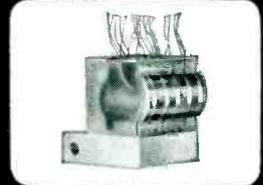
*Division of Clevite Corporation*



BK-1300 series—up to 25 interlaced channels per inch.



BK-1500 series—ultimate in precision-made multichannel heads.



BK-1605 series—simple mounting and adjustment, ideal for drum computers.



BK-1501 series—compact, wafer-thin, permit individual adjustment.



BK-900, BK-1000, BK-1200 series—variety of types for single channel applications.

the pioneer is the leader



NOW

WAVEFORM  
ANALYSIS  
1 cps to  
2000 cps

with the NEW  
PANORAMIC

SUB-SONIC  
ANALYZER

MODEL

LF-1

featuring  
 $\frac{1}{2}$  cps  
resolution

**SUMMARY SPECIFICATIONS:**

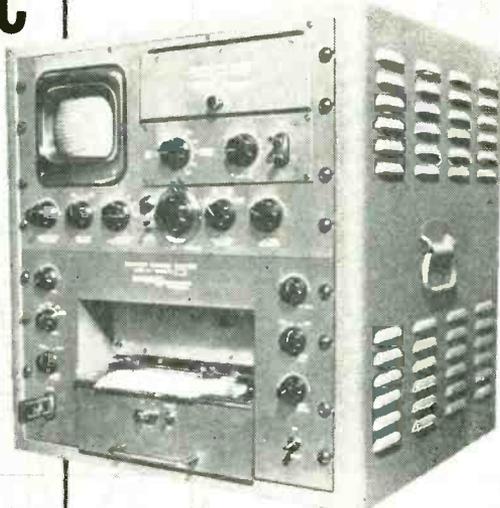
Overall Frequency Range: 1 cps—2000 cps

Voltage Range: 10 mv to 100 v for full scale linear deflection.

Voltage Scale: Linear or two decade log.  
Recorder Paper Speed: 4"/min and 16"/min selectable.

WRITE TODAY  
for Complete Specifications.

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the makers  
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tor Pan-  
alyzer, Pan-  
oramic Sono  
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Ultrasonic  
Analyzer



**FACTS:** The Model LF-1 Panoramic Sub-sonic Analyzer is designed specifically for applications demanding exceptionally high resolution of waveform components between 1 and 2,000 cps. The LF-1 operates as an adjunct to the widely accepted Panoramic Sonic Analyzer, Model LP-1 which provides detailed magnified views of spectrum segments either 100, 500 or 1500 cps wide anywhere between 20 cps and 20 kc. A calibrated center frequency control permits selection of the mid-frequency of the expanded portion to be examined.

The Panoramic Sub-sonic Analyzer, Model LF-1 features spectral displays which are either 1/10 or 1/100 of the presentation width of the LP-1, that is 10 cps, 50 cps and 150 cps or 1 cps, 5 cps and 15 cps. Scan intervals of 15 seconds or 60 seconds are selectable. Spectral distributions are permanently recorded on paper.

**APPLICATIONS:** • Vibration analysis of large structures or of devices in which members rotate at approximately the same or multiples of the same speed. • Noise analysis. • Medical studies. • Servo analysis. • Geophysical investigations.

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Mount Vernon 4-3970

See us at Booth 128 at the National Electronics Conference

illustrated color bulletin describes features and specifications of the new 3-in. fully-enclosed ganging potentiometer for applications requiring high precision at relatively low cost. Write for technical bulletin 360-455.

**Electronic Digital Computer.** Logistics Research, Inc., 141 S. Pacific Ave., Redondo Beach, Calif. The ALWAC III, a high-speed, low-cost fully-automatic electronic digital computer is described in detail in a 4-page, 2-color illustrated brochure. The instrument described reduces design time, eliminates the need for expensive pilot plant operation, and provides answers to routine calculations with speed and accuracy. The brochure contains a table of specifications.

**Miniature Sensitive Relay.** Magnadyne Co., 84 So. Water St., Port Chester, N. Y. A 1-page catalog sheet gives technical data, specifications and dimensional drawings of a dpdt miniature sensitive (40 mv) hermetically sealed relay. The model No. 10 described is built to comply with MIL-R-5757-B specifications.

**Para-Flux Reproducers.** Radio Music Corp., 84 So. Water St., Port Chester, N. Y. A 4-page catalog shows a new microgroove head, made to plug in a standard Para-Flux tone arm, which automatically provides correct record pressure for l-p records. No changes in arm are necessary for any of the 4 reproduction heads—universal, vertical, lateral, or microgroove; just plug into tone arm. The new head described is presently being used by many radio and tv stations where top quality reproduction is necessary.

**Insulating and Jacketing Materials.** Bakelite Co., A Division of Union Carbide & Carbon Corp., 30 E. 42 St., New York 17, N. Y. Issue No. 83 of Kabelitens reprints a paper delivered on quality control of vinyl and Polyethylene electrical insulating and jacketing materials. Raw materials and properties desired in ultimate application of the material are listed.



# ABC... and the Reader

**B**ACK IN 1914—forty-one years ago—a group of advertisers, advertising agencies and publishers joined in a project that has come to mean a great deal to the millions who, like you, read business magazines. The project, initiated at a time when circulation claims were rarely verified, was intended to achieve and maintain higher standards of integrity in publishing and advertising practice by providing means to audit paid circulation. Out of that effort came an organization known as the Audit Bureau of Circulations, a voluntary, non-profit, cooperative association, known for short as ABC. Its symbol appears at the head of this page.

We are proud that McGraw-Hill publications were among the founders and charter members of the Audit Bureau of Circulations.

Today the Bureau numbers 3,670 members. These include advertisers, agencies, and publishers of newspapers, farm papers, general magazines and business journals such as this one. These publisher members hold their memberships and their right to display the ABC symbol in their publications only so long as they live up to the circulation standards that are established through the Bureau.

It is one thing to set up high standards; it is another to see that those standards are maintained. This latter and all-important function is performed by a staff of auditors maintained by ABC to check periodically on the circulation practices of the publisher members. When a business magazine, such as this one, joins the Bureau it agrees that the ABC auditors shall have "the right of access to all books and records." Their inspection may dig into the files of original subscription orders, payments from subscribers, paper purchases, postal receipts, arrears of payments, editorial expenses and many other significant items. Sometimes the auditors go behind the records and seek verification of purchase and payment from subscribers themselves.

The information thus obtained and certified by the Bureau then becomes available to the public

and constitutes an authoritative report on the publication's circulation practices.

The advertisers and agencies benefit directly from the ABC because it provides a generally recognized factual yardstick by which the circulations of member publications can be measured and appraised. Every paragraph in an ABC report on a business publication gives the advertisers data that help them make intelligent use of the publication as an advertising medium.

But the ABC renders a service of vital concern to the *reader* as well. The Bureau audits paid circulation only, and it is through this payment, whether by subscription or newsstand purchase, that the reader keeps the editorial policy of a publication responsive to his needs. His decision to buy or not to buy records his judgment on each publication, and the ABC-audited and certified circulation reports make the sum of these judgments known to all concerned.

So the editors of ABC publications must constantly keep their editorial services up to the mark if they are to survive a competition in which the reader's right to buy or not to buy is paramount. Each paid magazine or newspaper will prosper or fail as it wins or loses the voluntary patronage of thousands or millions of readers. And—the ABC is scorekeeper in this vital contest.

Thus the publisher who submits his publication to the supervision and discipline of ABC affirms in the strongest possible manner his recognition that his primary obligation is to his readers and that he owes the standing of his publication to a voluntary demand by those readers.

All this is what makes the ABC brand on a publication so important to its readers. That respected symbol, testifying to the advertising value of the publication, serves also as a constant reminder to all concerned that the reader's willingness to pay for an ABC publication is the basic reason why it stays in business.

*McGraw-Hill Publishing Company, Inc.*

# Plants and People

Edited by WILLIAM G. ARNOLD

Manufacturers enlarge engineering staffs and promote personnel to new positions. Plant and facility expansions continue as companies make acquisitions or begin new construction. Industry associations continue activities

## U. S. Color Television Shown At German Fair

AT THE International Trade Fair held in Hannover, Germany, a demonstration of color television was presented by Telechrome of Amityville, N. Y.

The exhibition was visited by U. S. Secretary of Commerce, Sinclair Weeks. Shown at the Telechrome exhibit are, left to right: Sinclair Weeks; Lower Saxony Finance Minister, Alfred Kubel; H. Charles Riker, vice-president; J. R. Popkin-Clurman, president of Telechrome.

More than 3 tons of the firm's color tv equipment were flown to Hannover where closed-circuit color programs were shown to engineers,



industrialists, scientists and other visitors attending the fair.

More than 2 million visitors came to Hannover from 80 countries.

## Texas Instruments Names Owens Transistor Chief

HARRY L. OWENS has joined Texas Instruments as chief engineer of the semiconductor products division.

Previously, he was chief of the solid state devices branch at the Signal Corps Engineering Laboratories at Fort Monmouth, N. J.

Owens has been associated with the Army Signal Corps for 13 years, four years on active duty and nine years in civil service, and is currently a major in the Signal Corps reserve. In his most recent position, he supervised the re-



search, development, and standardization of semiconductor devices—including transistors, diodes, and microwave crystals—for military application. He was responsible for technical surveillance of industrial preparedness contracts in the semiconductor field.

At Texas Instruments, he will be responsible for the development and engineering of germanium and silicon semiconductor products.

Owens is co-author of the McGraw-Hill book, *Transistors, Theory and Applications*.

## Olympic Radio, Victoreen Instrument Drop Merger Plans

PLANS for the merger of Olympic Radio & Television and Victoreen Instrument Co. into Nuclear Electronics Corp. at this time have been terminated pending further study by the companies involved.

Victoreen announced that Earl M. Pollock has been named chief

engineer of the instruments division.

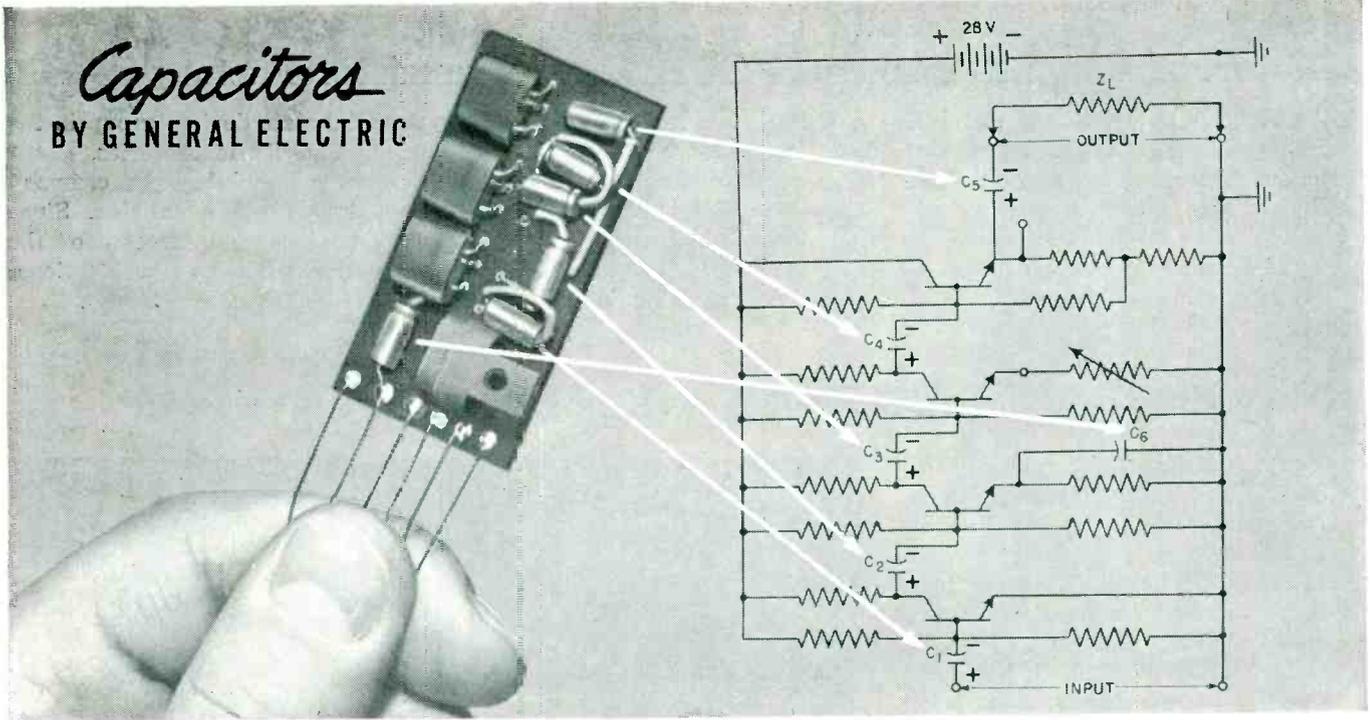
He was associated with E. I. DuPont's Deepwater, N. J. laboratory for several years.

He joins Victoreen after six years with El-Tronics of Philadelphia where he was first a re-

search physicist, then vice-president in charge of sales and later technical director.

In his new post Pollock will assume responsibility for carrying through a part of Victoreen's expansion in the medical, government and prospecting fields.

# Capacitors BY GENERAL ELECTRIC



New RC coupled, silicone transistor servo amplifier was developed for aircraft and guided missile applications. Small size of six G-E Micro-miniature Tantalitic\* capacitors permitted size reduction to .68 cubic inches.

**COMPACT SIZE, DEPENDABILITY, CREATE . . .**

## New use for tiny G-E Tantalitic capacitors in subminiature plug-in servo amplifier

Six G-E Micro-miniature capacitors rated at 8 microfarads and at 4 volts are used by the engineers at Plastics and Electronics Corp., Buffalo, N. Y., in their new RC servo amplifier. The  $\frac{1}{8}$  by  $\frac{5}{16}$  inch dimensions of the tiny capacitors enable the amplifier to be assembled and encapsulated in plastic in a 1 by  $\frac{1}{3}$  inch space.

Five of the capacitors (C1 to C5 above) are used for coupling while the sixth (C6) is for bypassing.

Because the amplifier was designed for critical aircraft and missile applications, capacitors were needed which combined small size, high ratings, and reliability.

**"We chose G-E Tantalitic capacitors because they were the smallest, most dependable units with the**

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**high capacitance required for low impedance transistor devices,"** said Plastics and Electronics' chief engineer, Thomas L. Robinson.

If you have a design problem calling for an extremely small, high microfarad capacitor (particularly for transistorized circuits) fill out the coupon below. We will send you complete specification data and descriptive information on G-E Micro-miniature Tantalitic capacitors. For specific application information, contact your nearest G-E Apparatus Sales Office.

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**GENERAL  ELECTRIC**

## Motorola Appoints Managers Of Arizona Transistor Factory

AT MOTOROLA'S transistor plant in Phoenix, Ariz., John T. Hickey was named general manager, Virgil E. Bottom was named director of research and development and Edmund G. Shower was named product production manager.

Hickey, with Motorola since 1948, has been functioning in Phoenix as staff assistant to D. E. Noble in charge of the transistor operation since its inception.

Bottom, since 1953, has been development physicist in charge of

the solid-state devices group in the firm's Phoenix laboratories.

Shower is joining the company to assume his new position. Since 1952 he has been director of the transistor division at National Union Electrical in Hatboro.

## Navy Electronics Heads Visit New Kay Lab Plant

VISITORS at Kay Lab's new plant in San Diego, Calif. included heads from the U.S. Navy Electronics Laboratory in San Diego. With Richard T. Silberman, second from left, president and general manager of Kay Lab are, left to right, Comdr. William B. Bernard, N.E.L.'s senior program aide; Capt. Henry E. Bernstein, commanding officer and director; Dr. F. N. D. Kurie, technical director in charge of the scientific department, and G. T. Lorance, deputy technical director.



## International Resistance Acquires Iowa Branch



INTERNATIONAL Resistance Co. has acquired a new branch plant in Burlington, Iowa.

Transfer of operations and actual production is expected on or about December 1, 1955.

The plant has 56,000 sq ft of floor space situated on a six and one-half acre site. Initially, only a portion of the available manufacturing space will be utilized, and the company will employ about 75 people during the first six months.

Ultimately, employment is expected to increase to 500—approximately 80 percent women. Other than key personnel who are being transferred from the Philadelphia plant, these employees will be sought in the Burlington area.

This will be IRC's fifth branch plant, in addition to its seven wholly-owned subsidiary companies and five overseas licensees. All manufacture resistors and related electronic components.

## CBS Expands, Selects Semiconductor Operations Manager

APPROXIMATELY one-fourth of CBS-Columbia's manufacturing facility in Long Island City, New York, has been converted to government and industrial operations.

Conversion of this space to government and industrial operations was completed in August.

The additional space will permit the firm to increase its government and industrial electronics design, development and manufac-

turing operations.

Robert K. Hartman has been appointed director of industrial and defense contracts of CBS. He will be in charge of the administration of research, developmental and production contracts for CBS-Columbia, CBS-Hytron and CBS Laboratories.

Prior to this appointment, Hartman was vice-president in charge of industrial and military manu-

facture of CBS-Columbia.

At CBS-Hytron, B. H. Alexander has been appointed as manager of semiconductor operations. Dr. Alexander will be responsible for all semiconductor development, engineering and manufacturing. His office will be located at the Lowell, Mass. plant where the firm's transistors and crystal diodes are manufactured.

The appointment of Leo E.

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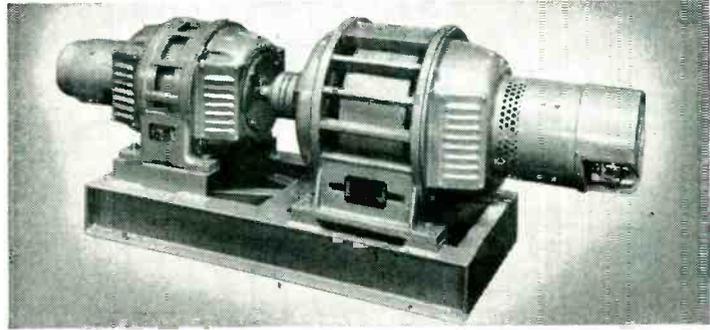


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Hertner also manufactures high frequency motor generators that can be either synchronous motor-drive, induction motor-drive, or direct current motor-drive.

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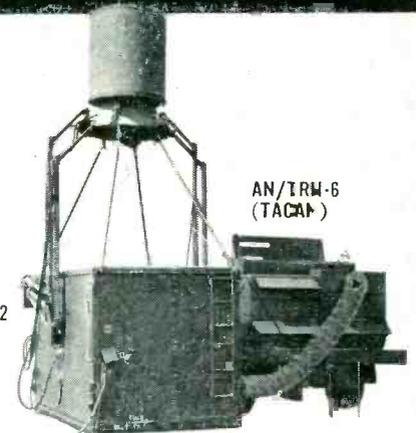
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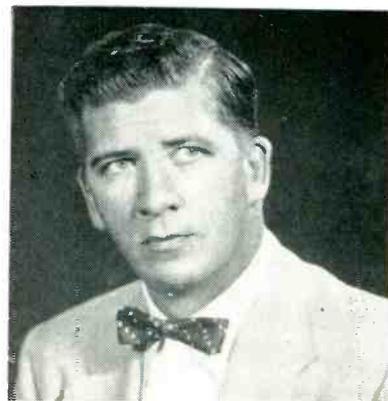
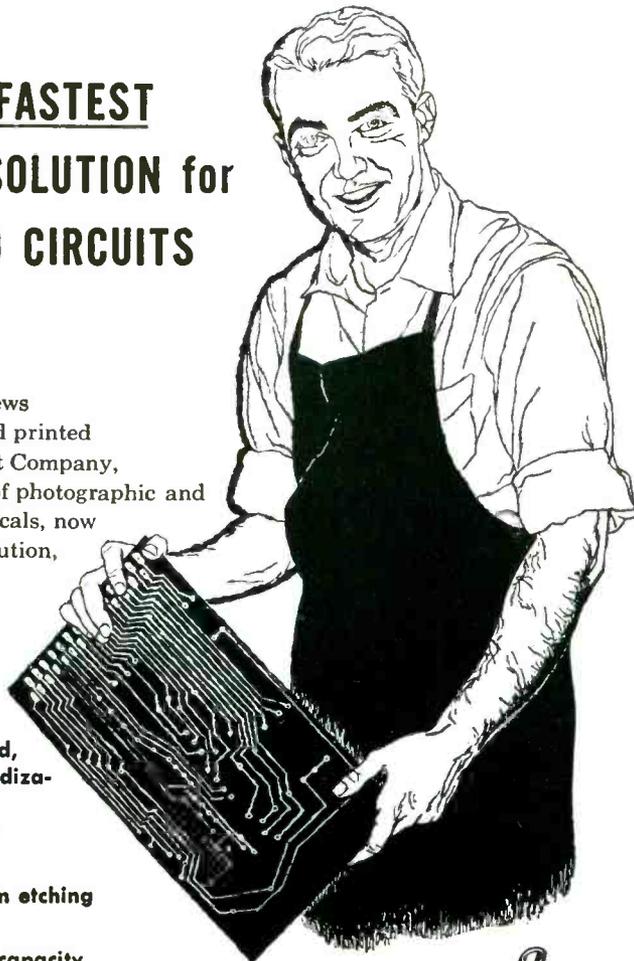
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Benjamin H. Alexander

Dwork as chief engineer of the Lowell semiconductor plant was also announced.

Dr. Alexander has participated in classified work for the Atomic Energy Commission. Before coming with CBS-Hytron, he was engineering manager in charge of semiconductors at Sylvania Electric.

At Carnegie Institute of Technology he was awarded a metals research laboratory fellowship and later became an assistant professor. He was also an adjunct professor at Brooklyn Polytechnic Institute and New York University.

Dwork, the newly appointed chief engineer, has had broad experience in semiconductor engineering. He is the author of several papers on transistors.

Albert J. Harcher has been appointed plant manager for CBS-Hytron at Kalamazoo, Mich. He replaces Leonard A. Freeman, who has resigned. Harcher will be responsible for all manufacturing and



Albert J. Harcher

engineering activities at the Kalamazoo works.

Harcher has been active in cathode-ray tube engineering for over 20 years. In 1941, at CBS Laboratories, he assisted Peter Goldmark in early research on field-sequential color television.

He joined CBS-Hytron in 1948 as chief engineer of the Newburyport tv picture-tube plant. In 1953 he was promoted to plant manager of this activity, responsible for both color and black and white tube manufacturing.

Previous to his employment at CBS-Hytron, he served as chief engineer for the Lansdale Tube Co. His earlier experience also included employment at Westinghouse research laboratories and at RCA.

## Bendix Constructs Research Lab

A MILLION-DOLLAR laboratory will be constructed in the Detroit area by the Bendix Aviation Corp. for its research laboratories division.

The new building, on which construction has begun, will provide 85,000 sq ft of floor space. It is expected the building, to be located on a 46-acre site, will be ready for occupancy next August.

The research laboratories division is engaged in work in guided missiles, nuclear technology, machine-tool control, industrial instruments, computers and applied physics.

The division was formed in 1942 as a central research laboratory to serve all divisions of the corporation, and to maintain basic research in industrial science.

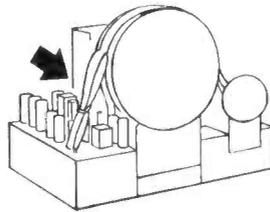
## Sylvania Selects Microwave Lab. Head

GERALD C. RICH of Los Altos, Calif. has been appointed manager of the microwave tube laboratory of Sylvania Electric Products at Mountain View, Calif.

Rich, manager of technical liaison at the electronic defense laboratory, a sister installation of MTL at Mountain View, succeeds

# Give your equipment these FLEXIBLE SHAFT advantages

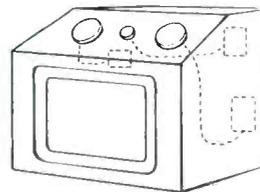
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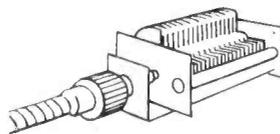
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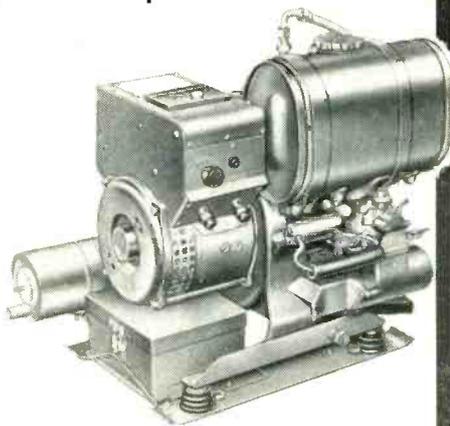
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**Dry Weight** — approx. 80 lb.

**Dimensions** — 20" x 17" x 18½"

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Gerald C. Rich

Richard B. Leng who resigned.

He joined the tube engineering section of Sylvania in 1935, and was transferred five years later to Kew Gardens, N. Y. as a technical group leader.

After spending four years in Phoenix as a research project leader with a firm there, he joined Sylvania's electronic defense laboratory as head of the microwave section. Subsequently he was moved up to head the technical liaison section.

### Datamatic Names Two, Buys New Factory

JOSEPH J. EACHUS has been appointed as systems director and J. Ernest Smith as director of engineering for Datamatic Corp.

Datamatic is engaged in the development and production of large, high-speed data processing equipment for business and government use. The company is owned jointly by Minneapolis-Honeywell Regulator Co. and Raytheon Manufacturing Co.

The newly formed firm has purchased a new one-and-a-half-story factory building in Newton Highlands, a suburb of Boston, Mass.

Dr. Eachus, a former member of the faculty at Purdue University, has been engaged in research and development work for the Department of Defense. Smith was formerly assistant vice-president and director of engineering for Raytheon. He holds numerous patents relating to modulating systems, radio-relay control systems

and other communication systems. He will be responsible for Data-matic's research, design and development engineering.

At present the company is carrying on its operations in leased facilities in Waltham. It expects to complete transfer of operations to the new 40,000 sq ft location by October 1.

### General Electric Promotes Engineers

GE has reorganized the manufacturing section of its radio and television department.

Franklin Greene, Jr., formerly manager of the department's Bleeker Street radio plant at Utica, N. Y., is appointed manager of television manufacturing.

William N. Maddox, formerly manager of the department's Auburn, N. Y. plant, is appointed manager of radio manufacturing.

The Auburn plant, formerly used by the department for making high fidelity components and television sub-assemblies, has been taken over by the company's electronic components department, and the radio and television department activities carried on there have been moved to the Syracuse plant.

In GE's cathode ray tube sub-department Channing Dichter has been named as manager of industrial and military product engineering.

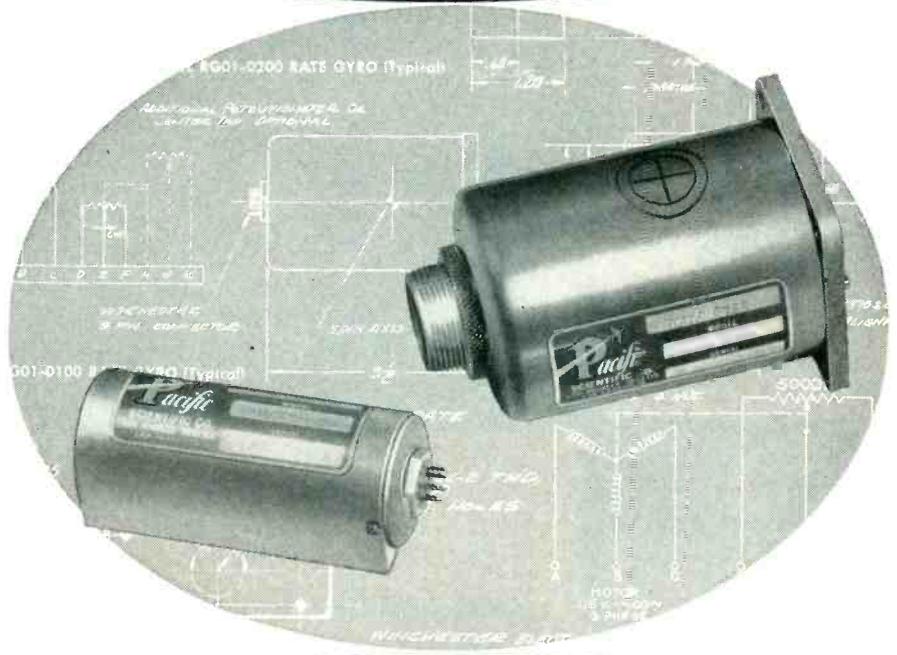
He will be responsible for development, design and production of industrial and military cathode ray tubes.

He joined G.E. in September 1951. Since that time, he has held various positions in the cathode ray tube sub-department. He first served as a physicist in the engineering section until he was appointed supervisor of new products engineering in September 1952. In September 1953, he was named supervisor of materials and processes development, a position he held until his recent appointment.

Joseph W. Dreher was named manager of engineering administration in the cathode ray tube sub-department.

Previous to his present position, he had been employed in employee relations since September 1946,

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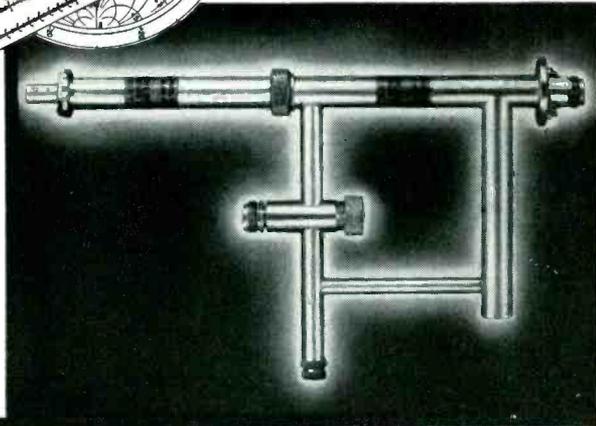
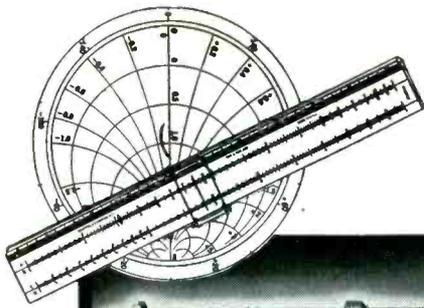
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where he was concerned with the procurement of technical personnel.

Lloyd E. Swedlund was appointed manager of monochrome tube product engineering in the cathode ray tube sub-department. He joined G.E. in February 1954 in the cathode ray tube engineering section where he has been employed until his present appointment.

### Westinghouse Air Brake Expands, Appoints Two

THE WESTINGHOUSE Air Brake Co. has purchased the capital stock of Corvey Engineering Co. of Alexandria, Va. Westinghouse Air Brake entered the electronics field in 1951 with its purchase of Melpar. The acquisition of Corvey further broadens Westinghouse activities in the electronics industry.

Corvey engages in electronics research and development and also provides specialized engineering services to industry and government. J. M. Cryer is president of the company. He is assisted by H. W. Riley, Colonel, USA, Ret., and by A. A. Varela.

Corvey currently employs about 150 people and its sales for the past year exceeded \$1 million. The company has plants in Alexandria, Va. and Washington, D. C. The firm is in the process of acquiring additional space in Alexandria so that it can concentrate all its activities there.

Melpar announced that Robert S. Butts has been promoted to the position of assistant chief engineer.

Prior to joining the firm, he was



Robert S. Butts

associated with the Crosley Radio Corp. and Federal Telecommunication Laboratory. He joined Melpar in 1947, and has held a number of technical managerial positions within the organization since that time.

Robert E. Miller was promoted from section head to project manager of a group of sections dealing with electronic research and development resulting in complete systems for the armed services.

Prior to joining Melpar, he was associated with several defense agencies as chief of a technical division. He also served on a technical management board and as an associate member of the acoustics-in-air and electronic counter-measures panels of a research and development board.

## Hycon Plans Plant Expansion

CONSTRUCTION in LaVerne, Calif. of three new buildings for Hycon Manufacturing Co. of Pasadena at a cost of approximately \$1 million is expected to get under way by January, 1956, pending anticipated approval of site planning by LaVerne city officials.

The project will include a 24,000 sq ft administration building, to house the special products division and administrative personnel; and two 48,000 sq ft manufacturing units, to contain the military electronics, electronic test equipment, and photographic products divisions.

The buildings are expected to be completed around June 1, 1956.

Plans for future development of the 67-acre site call for construction of 4 more manufacturing plants in the next five years.

## Du Mont Schedules Corporate Change

REVISION of its capital and corporate structure is planned by Allen B. Du Mont Laboratories.

The plans, to be submitted to stockholders for approval in October, cover the following:

Creation of the Du Mont Broadcasting Corporation to own and operate television stations WABD in

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New York and WTTG in Washington, and the Du Mont 67th Street Tele-Centre. Stock of the new corporation will be distributed to the parent company's common stockholders on a ratio of one share of the new corporation to 2½ shares.

Reclassification of class A common stock and class B common stock, authorized and outstanding, to one class of common stock.

Increase of the number of directors from 8 to 10.

Creation of the office of chairman of the board and election of all company officers by the board of directors.

Reservation of 90,000 shares of common stock on which purchase options may be granted to company executives.

In addition, the stockholders will be asked to approve a long-term contract with Dr. Du Mont which provides, in addition to salary, options to purchase 35,000 shares of the company's common stock. It also is understood that Dr. Du Mont shall be elected chairman following approval of plans by the stockholders.

**Brown Instrument Names Gray**



TRUMAN S. GRAY, associate professor of engineering electronics at MIT, has been named consultant on nuclear energy by the Brown Instruments division of Minneapolis-Honeywell Regulator Co. In 1949 he supervised the installation

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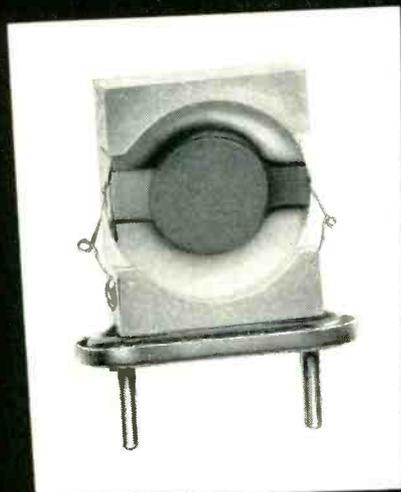


TYPE	μμF/ft	IMPED.Ω	O.D.
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C11	6.3	173	.36'
C2	6.3	171	.44'
C22	5.5	184	.44'
C3	5.4	197	.64'
C33	4.8	220	.64'
C4	4.6	229	1.03'
C44	4.1	252	1.03'

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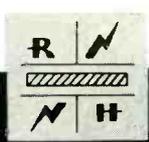
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of the instrumentation for the control of the Brookhaven National Laboratory reactor.

Previously he was employed as consultant to the Army Quartermaster Corps and a number of industrial firms.

## General Dynamics Expands in the West

A BROAD expansion of the West Coast activities is planned by the Stromberg-Carlson Division of General Dynamics Corp.

In San Diego, Stromberg-Carlson will take over from the Convair division the production of the Charactron tube.

In Los Angeles, Stromberg-Carlson has acquired the former Electronic Control Systems, which specializes in automation, electronic computers and data handling systems. Stromberg-Carlson previously was a part owner.

Production of the Charactron tube will continue at the present plant in San Diego, but under Stromberg-Carlson management.

The division's Charactron staff will be augmented and other electronic work will be undertaken. Cathode ray tube and electronic personnel will be added.

Convair has had patent rights to the Charactron tube since 1950. The tube converts data in electrical form into legible message symbols at speeds of 10,000 characters per second.

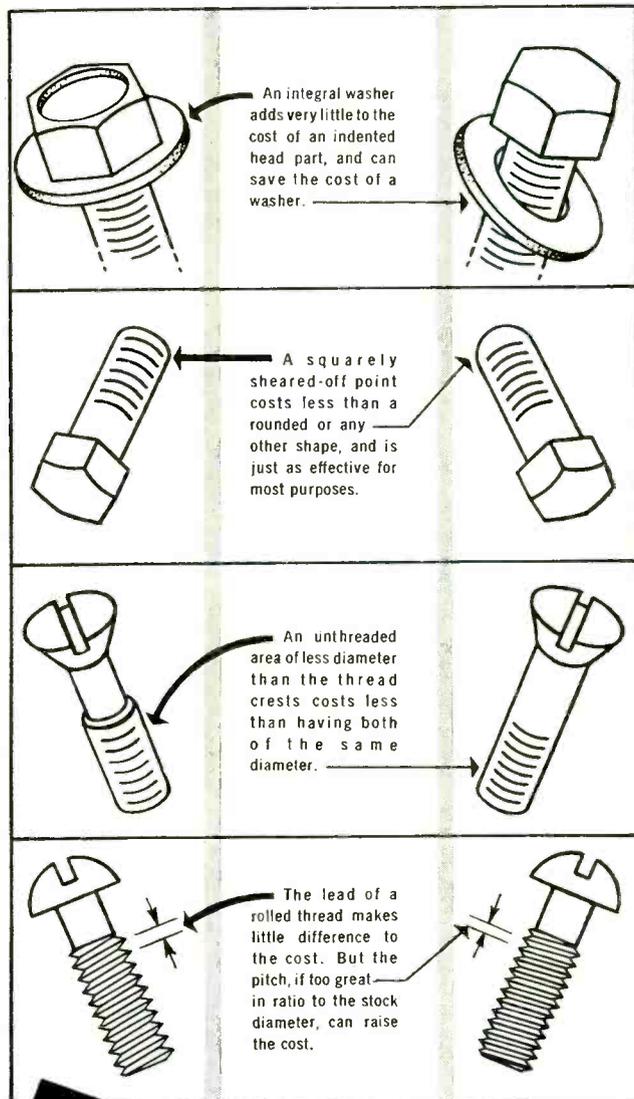
Leonard Mautner, assistant vice-president of Stromberg-Carlson, will be in charge of Stromberg-Carlson-West Coast, and resident manager of the firm's San Diego facilities. Alexand F. Brewer, also an assistant vice-president of Stromberg-Carlson, will be resident manager of Electronic Control Laboratories at Los Angeles. Both Brewer and Mautner have been associated with Electronic Control Systems since its inception two years ago as a West Coast affiliate of Stromberg-Carlson.

Howard L. Foote has been appointed staff assistant to A. H. Bergeson, vice-president in charge of engineering at Stromberg-Carlson.

In his new capacity, he will act as executive secretary of the new

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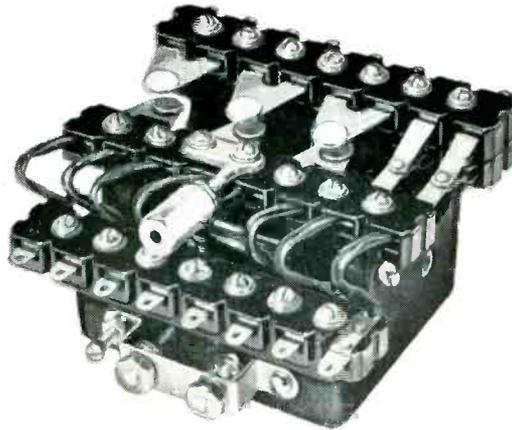
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② A new Heathkit sweep generator covering all frequencies encountered in TV service work (color or monochrome). FM frequencies too! 4 Mc — 220 Mc on fundamentals, harmonics up to 880 Mc. Smoothly controllable all-electronic sweep system. Nothing mechanical to vibrate or wear out. Crystal controlled 4.5 Mc fixed marker and separate variable marker 19-60 Mc on fundamentals and 57-180 Mc on calibrated harmonics. Plug-in crystal included. Blanking and phasing controls — automatic constant amplitude output circuit — efficient attenuation — maximum RF output well over .1 volt — vastly improved linearity. Easily your best buy in sweep generators.



research and development technical committee. In addition, he will be responsible for project analysis and various technical matters of the office.

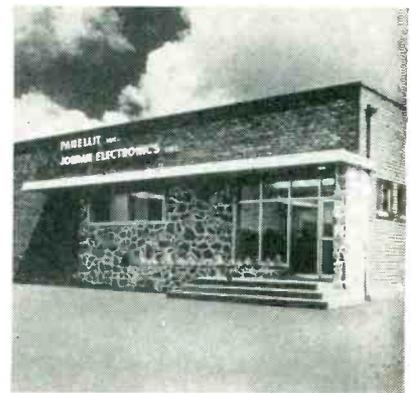
He has been a member of the Stromberg-Carlson research laboratory doing work on a miniaturized, hermetically sealed range receiver for the U.S. Navy, and an airborne wire recorder for the Air Force. He also spent three years as technical publications editor. Recently he has worked with the wire communications group in the development of toll ticketing equipment, with emphasis on toll charge computers.

Charles D. Perrine, Jr. will re-join Convair division of General Dynamics Corp. as assistant division manager-engineering at its guided missile plant in Pomona, Calif.

He first was employed by Convair in October, 1950, as staff assistant in the San Diego division's electronics and guidance section. Named assistant chief engineer for electronics and missiles June 1, 1951, Perrine was made assistant division manager-engineering at Pomona in September, 1952. He resigned 11 months ago to accept a position as director of engineering for the Bendix pacific division at North Hollywood.

From 1945 until 1950 Perrine was manager of the electronics department of Fairchild Engine and Airplane Corporation's guided missiles division at Farmingdale, N. Y.

### Jordan Electronics Moves To New Plant



JORDAN Electronics, manufacturers of radiation monitoring instruments completed a new building to

house the company's administrative offices and manufacturing facilities. It is located in Alhambra, Calif. and contains about 12,000 sq ft, more than double the size of former facilities in Pasadena. The site allows for eventual expansion to about 40,000 sq ft.

Jordan is a wholly-owned subsidiary of Panellit, of Skokie, Ill., manufacturers of control centers, data handling and information systems for industrial processing.

### Gross Named Raytheon Engineering Head

FRITZ A. GROSS has been appointed manager of Raytheon's equipment engineering division. He was formerly chief engineer of the division.

He assumes the responsibilities formerly held by J. Ernest Smith, who will continue in his present capacity as vice-president and director of engineering for Data-matic Corp., which was recently formed under joint ownership of Raytheon and the Minneapolis-Honeywell.

Gross joined Raytheon in 1933 to work on special vacuum tube development. Later, he was transferred to the firm's equipment operations on design and development. His new assignment places him at the head of the firm's largest single group of engineers.

Raytheon also announced plans to expand its equipment engineering force in the Chicago area.

The firm already has tripled the space available to the engineering personnel at the Chicago division.

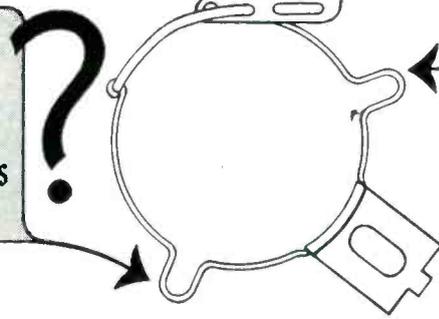
The division will concentrate all its efforts on applied research and engineering development programs in the general fields of electronic and infrared equipment. H. N. Beveridge is manager of the division.

### Lewyt Buys Ford Instrument Plant

LEWYT CORP. has purchased a six-story manufacturing plant in Long Island City, N. Y.

Formerly occupied by Ford Instrument Co., a division of Sperry-

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AUGAT'S NEW TWO TENSION LOOP CLAMPS

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New Vo-Tron dual-purpose pins can be used with either printed or wired circuits. Maximum of 6 pins on .156 centers; 1 or 2 ground-lugs.



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Vo-Tron IF Transformers have Q up to 200—but are only  $\frac{1}{2}'' \times \frac{1}{2}'' \times \frac{5}{8}''$ ! Ready now for production to your specifications:

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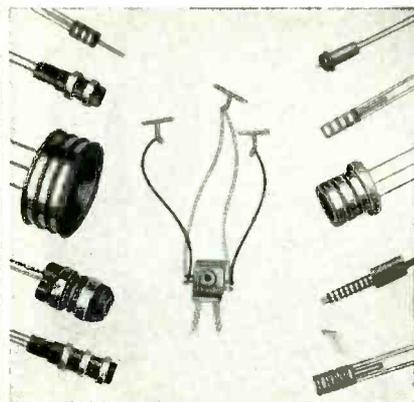
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SPRINGFIELD, OHIO

Rand Corp., the building was purchased in a \$2 million cash transaction.

In addition to the building, which has 315,000 sq ft of manufacturing and office space, an adjacent parking lot of 11,000 sq ft was also purchased. The building, it was said, has expansion facilities for about 25 percent of its present space. The firm plans to consolidate its electronics plant, air conditioning plant and vacuum cleaner plant in the new location.

## Mossman to Head Industrial Electronics



JOHN E. MOSSMAN has been elected president of The Industrial Electronics Co., of Hanover, Mass. Industrial Electronics purchased Monitor Controller Co., manufacturers of motor controls, and will operate that company as a division. Mossman resigned as president of Phillips Control Corp. of Joliet, Ill., and as a director of Thor Corp. to accept the new assignment.

He started in the field in 1929 with Automatic Electric Co. of Chicago. In 1937 he helped form and was vice-president of C. P. Clare and Co. of Chicago leaving that post in 1945 to start Phillips Control Corp.

## New Firm Formed In Princeton, N. J.

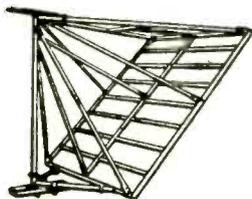
HAMNER Electronics Co. has been formed in Princeton, N. J. The corporation represents an association of Princeton physicists, chem-

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Station WOAY-TV is an example of how TOWER'S engineering and experience can solve your unusual tower problems. This 600 ft. tower supports an 83 ft. TV antenna, an FM antenna, an 8 ft. x 12 ft. Microwave Passive Reflector, and serves as an AM radiator. From coast to coast you'll find installations where TOWER'S "know how" has paid off.

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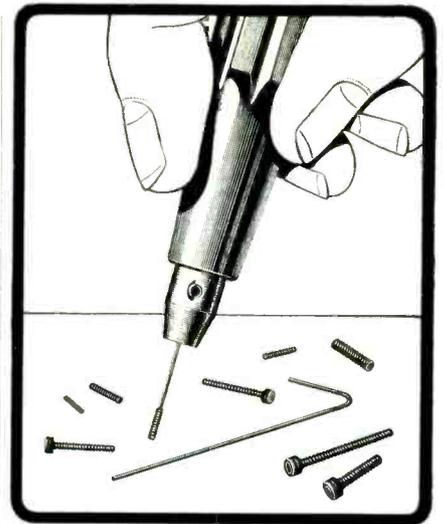
## Emerson Labs Appoints Nine Engineers

NINE principal electronics engineers have been appointed by Emerson Research Labs division of Emerson Radio, in Washington, D. C. They are Paul B. Arnstein, formerly electronics engineer with the guided missile fuze laboratory of the Diamond Ordnance Fuze Laboratories; Richard F. Blake, formerly a senior project engineer at the Naval Research Laboratory; William S. Carley, who was senior research associate at the Naval Ordnance Laboratory; Samuel K. Fagin, who was computer group leader with the engineering and research division of ACF Industries; Harvey D. Faram, who was formerly an electronics engineer with the guided missile fuze laboratory of the Diamond Ordnance Fuze Laboratories; Morten Gale of Ryan Aircraft Corp. where he was employed as electronics engineer; Nick George, Jr., who was formerly associated as an electronics engineer with the guided missile fuze laboratory of the Diamond Ordnance Fuze Laboratories; Chester C. Kurinsky, formerly senior mechanical engineer with the Aircraft Transformer Corp. and Robert E. Morrison, who was an electronic scientist with the guided missile fuze laboratory of the Diamond Ordnance Fuze Laboratories.

## RCA Selects TV Head, Readies New Warehouse

CHARLES P. BAXTER has been appointed general manager of the RCA Victor television division. He has served as assistant general manager of the division since 1949.

Henry G. Baker, who has been vice-president and general manager of the division, will serve in a staff advisory capacity on sales and merchandise policies and programs relating to consumer prod-



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ucts. He will continue as vice-president and report to Mr. Seidel. He has been with RCA since 1943.

Baxter joined the firm in 1939 as an analyst and consultant on field operations. He was promoted in 1941 to operations manager of commercial research in Chicago, and in 1945 was named controller of the Home Instrument Department of RCA Victor. Four years later, he was appointed assistant general manager under Baker.

The RCA tube division announced that plans have been completed for occupation of a modern tube warehouse and office building in Los Angeles. It will provide 5,000 sq ft of office space and 50,000 sq ft for warehousing.

### Standard Coil Sets Up in Canada



J. R. Johnson

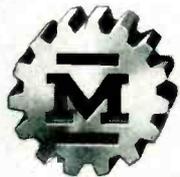
STANDARD COIL Products Co. has formed a wholly-owned Canadian subsidiary, Standard Coil Products (Canada).

The new company has acquired a 30,000 sq ft plant in Toronto for the manufacture of its television tuner lines and general purpose coils. Standard Coil has been supplying the Canadian market from its plants in Chicago, Ill. and North Dighton, Mass.

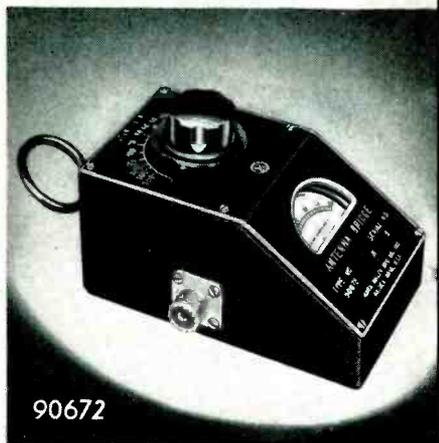
Jere Cavanaugh has been appointed general manager of Standard Coil Products (Canada) Limited and Edward Swanson as assistant general manager.

The firm also announced that J. R. Johnson has been appointed

Designed for



Application



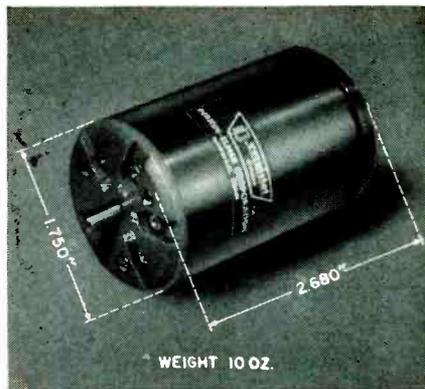
90672

### The No. 90672 ANTENNA BRIDGE

The Millen 90672 Antenna Bridge is an accurate and sensitive bridge for measuring impedances in the range of 5 to 500 ohms at radio frequencies up to 200 mc. It is entirely different in basic design from previous devices offered for this type service inasmuch as it employs no variable resistors of any sort. The variable element is an especially designed differential variable capacitor capable of high accuracy and permanency of calibration over a wide range of frequencies. A grid dip meter such as the Millen 90651 may be used as the source of RF signal. The bridge may be used to measure antenna radiation resistance, antenna resonance, transmission line impedance, standing wave ratio, receiver input impedance and many other radio frequency impedances. By means of the antenna bridge, an antenna matching unit may be adjusted so as to provide the minimum standing wave ratio on the radiation system at all frequencies.

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MASSACHUSETTS



## NEW...the 400 cycle vernistat\* a.c. Potentiometer you asked for!

The 400 cycle Vernistat is an a.c. potentiometer-type voltage divider that combines high linearity and low output impedance. It is essentially a non-dissipative element adaptable to high temperature operation. Size and mounting dimensions are designed to the BuOrd specification for a size 18 synchro.

Here are the details:

- high linearity, inherent in the design principle, is maintained over the life of the unit.
- low output impedance eliminates need for isolation amplifiers in many applications.
- high output current capability.
- low phase shift — less than 90 seconds, depending on model.
- can be coupled with synchros, resolvers and other components — as well as ganged.
- nonlinear functions can also be generated.

Class 5 ball bearings, centerless ground shaft, and an aluminum housing machined to close tolerances combine to make the Vernistat a precision instrument. Shaft seals will be supplied where they are required by environmental conditions.

check these specifications:

Linearity Tolerance	..... ±0.05%
Minimum Output Voltage Increment	..... 0.01%
Output Impedance	... less than 130 ohms
Input Voltage	..... 130 v max.
Input Impedance	... up to 75,000 ohms

\*Trademark

# vernistat division

PERKIN-ELMER CORPORATION  
Norwalk, Connecticut

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as technical assistant to the president of Standard Coil. Johnson, who has been with the company for seven years, most recently as general manager of the Los Angeles plant, will assist G. E. Swanson in coordinating engineering development, production and sales.

## Westinghouse Elects Top Officers

**GWILYM A. PRICE**, president of the Westinghouse Electric Corp. since January, 1946, was elected chairman and president of the firm. The board chairmanship at Westinghouse has not been occupied since 1951.

**Mark W. Cresap, Jr.**, was elected executive vice-president and deputy chief executive officer. Since April, 1951, he has been vice-president and assistant to the president of Westinghouse.

**Latham E. Osborne**, whose 45-year career at Westinghouse has covered all the distance between a tool clerk's job and the executive vice-presidency, was elected vice-chairman of the board.

**John K. Hodnette**, formerly vice-president in charge of the apparatus products divisions, was elected vice-president-general manager responsible for supervision of the operations of all of the company's product groups.

**A. C. Monteith** was appointed to fill the position left vacant by Hodnette's promotion, directing manufacture and distribution of basic electrical equipment for utility and industrial applications. Since 1948 he has been vice-president in charge of engineering and research. Succeeding Monteith in that post is **John A. Hutcheson**, director of the Westinghouse research laboratories since 1949, and a vice-president since 1950. A new director of research will be appointed later.

Westinghouse also announced that **Louis Martin** has been appointed general sales manager of the tube division.

Martin came to the firm from Standard Coil Products Co. where he was general sales manager during the past four years.

He has been in the television and

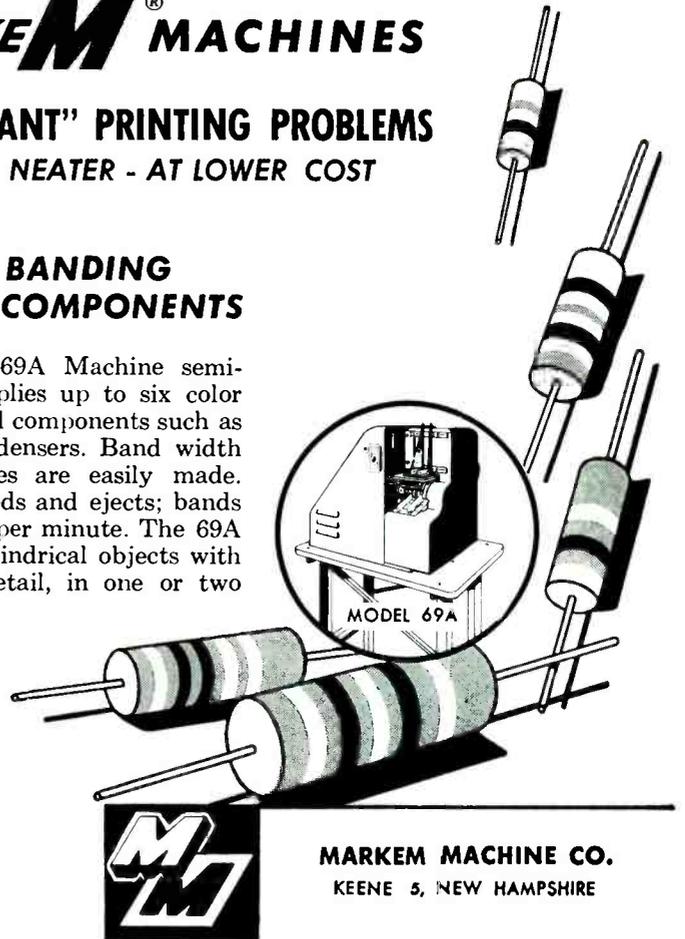
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## COLOR BANDING WIRE LEAD COMPONENTS

The Markem 69A Machine semi-automatically applies up to six color bands to wire lead components such as resistors and condensers. Band width and color changes are easily made. Automatically feeds and ejects; bands about 50 objects per minute. The 69A will also mark cylindrical objects with complete label detail, in one or two colors.

Other Markem machines available for marking electrical parts and products of all sizes and shapes. Write for detailed information.



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**POWER**  
PACKAGE



DEPENDABLE  
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Phone, wire or write.

### SPECIFICATIONS

Dimensions: W - 28; H - 48; L - 77½  
Weight: 2380 lbs.  
Capacity: 25 KW.8 P.F. 60-cycle  
Temp. Range: -65° F to +131° F  
Voltage Regulation: ± 2.0%  
Speed Regulation: ± 3.0%

Operates on Diesel or JP-4 fuel.

Other military units available with ± 1.0% volt regulation and zero speed regulation.



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### Model DS-8600 Series (5 Models)

Designed to control any operation after a preselected total count has been reached. Used to count pills, bottles, cans, machine parts, etc. for automatic packaging. If an event can be converted to an electrical impulse, it can be counted and controlled with a Detectron Preset Counter.

Count Capacity: 100 to 1,000,000 (depending on model); Counts per second: 0-100,000 (as a straight counter); Recycling rate: 35,000 per sec. (as a preset counter); Input Sensitivity: 0.1 V RMS; Output Signal: 50 volt positive pulse; Relay Contacts: 5 amps., 115 v. 60 cycle, non-inductive load.

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- 1 Versatility — 1 to 5 gang models, single or double shaft, servo or bushing mount.
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- 4 Dependability — Mechanically and electrically stable. Effectively sealed against dust and moisture.
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- 6 Specifications — Meets extreme commercial and military requirements for all applications.
- 7 Availability — Quick deliveries on production quantities.

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Accurate, dependable, long-lived. Has 9 inch coded leads for easy installation. Offers your products a competitive price advantage.



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radio industry for the past 31 years, including 15 years with RCA. He served there in tube application engineering, technical writing, set design engineering, commercial tube sales and finally manager of equipment sales for the tube division.

Martin replaces John Curtis, who has been named a staff assistant to R. T. Orth, vice-president.

In another move, Westinghouse unveiled its privately-financed factory designed to produce parts for atomic power plants. The plant is located in Cheswick, Pa.

An instrumentation laboratory has been installed at the plant to advance the art of reactor instrumentation and control.

The Cheswick plant itself, which is part of the Westinghouse atomic power division, currently has a manufacturing area of about 87,000 sq ft. About 200 persons, including shop and office personnel, currently are employed in the operation.

## Di Toro Joins Polytechnic Research



MICHAEL J. DI TORO has joined the Polytechnic Research & Development Co. in Brooklyn, N. Y. as chief electronic engineer.

He will be responsible for the planned expansion into different electronic fields. He has formerly been connected with several major electronic laboratories where he was instrumental in the development of electroacoustical transducers, telemetering, delay lines, speech compression, noise reduction, submarine detection and long-

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**THE PROBLEM:** to produce, economically, a projection horn of superior tone quality . . . capable of projecting sound over a wide area, with extreme clarity . . . suitable for either indoor or outdoor use.

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**THE RESULT:** an exceptionally fine projection horn with excellent tone qualities . . . strong as metal . . . completely weather-proof (can be used indoors or out) . . . produced economically.

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ELECTRONICS — October, 1955

range radio communication systems. He has presented over 30 papers and holds over 40 patents in the above fields. For a time he was associate director of the microwave research institute of the Polytechnic Institute of Brooklyn.

Dr. Di Toro is also adjunct professor at the graduate school of electrical engineering of the Polytechnic Institute of Brooklyn, where he teaches evening courses in communications.

**RCA, Seeger Whirlpool Merger Planned**

THE BOARD of directors of Seeger Refrigerator, RCA and Whirlpool Corp. plan a new company to be formed under the name Whirlpool-Seeger Corp. It will own and operate the businesses now carried on by Seeger and Whirlpool and the stove and air conditioning divisions of RCA. The new company will have total assets of approximately \$130 million and a net worth of about \$85 million.

Sears Roebuck is a stockholder in both Whirlpool and Seeger and plans to continue as such in the new company. RCA will have a stock interest in the new company but the total stock holdings of RCA and Sears will constitute less than 50 percent of the total outstanding stock. By agreement between RCA and Sears, the common stock owned by each in excess of 20 percent of the total outstanding stock will be voted by the president of Whirlpool-Seeger. It is proposed that Walter G. Seeger, chairman of the board of Seeger, will be chairman of the board of the new company, and that Elisha Gray, president of Whirlpool, will be the president and chief executive officer of the new company. The balance of the new company's management personnel will be selected principally from the merging businesses and both Sears and RCA will have minority representation on the board of directors.

RCA will enter into an agreement covering the use of the RCA trademark in combination with Whirlpool on products of the new company. Commencement of the use of this combined trademark



536K Multimeter Kit \$12.90  
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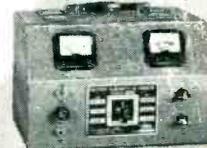
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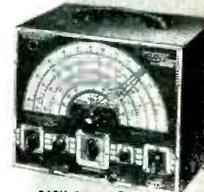
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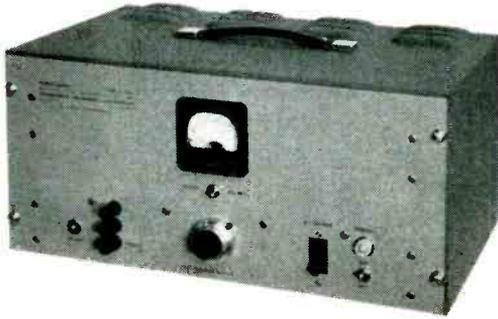
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- Stability . . . . . Less than 5 mv/hr drift
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Sales and Service Offices Located in: Albuquerque, Atlanta, Buffalo, Chicago, Dallas, Detroit, New York, Pasadena, Philadelphia, Seattle, Washington, D. C.

will be timed with the introduction of new merchandise lines during 1956.

The merger is subject to approval by the stockholders of the merging companies.

## Lovins Joins Photovolt Corp.



PHOTOVOLT CORP. of New York, makers of photoelectric and electronic measuring instruments, has added Gerald H. Lovins, to its staff. He has had over 21 years' experience in the laboratory instrument field, including 15 years as research director of American Instrument Co. Lovins will devote most of his time to the development of new products.

## Stanford Expands, Names Terman

A \$90,000 expansion of the Stanford University electronics research laboratory is underway, financed with gifts from two electronic manufacturers.

The donors are Gilfillan Brothers of Los Angeles and Hewlett-Packard Company of Palo Alto. Construction of a new Gilfillan wing on the north end of the laboratory and extension of its Hewlett-Packard wing on the south has begun. Completion is expected before the end of the year. The laboratory's floor space will increase by nearly 8,000

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sq ft, or by approximately one-fourth its present size.

The heads of both companies are alumni of Stanford.

Earlier gifts from Gilfillan have provided engineering scholarships at Stanford, and funds for a program of instruction and research in transistors.

In addition to building the laboratory's student instruction wing in 1951, Hewlett-Packard supports two engineering fellowships.

Stanford also announced that Frederick E. Terman, dean of the Stanford school of engineering, has been appointed provost of the University.

Dr. Terman, who will also continue as engineering dean, will succeed Douglas M. Whitaker, provost since 1952, who has resigned to become vice-president for administration of the Rockefeller Institute for Medical Research in New York.

Dr. Terman will be the second ranking administrative officer of the University.

The appointment caps his 30th year on the Stanford faculty. He was appointed instructor in electrical engineering in 1925. In 1937 he became full professor and head of the electrical engineering department and in 1945 dean of the school of engineering.

During World War II he headed the Radio Research Laboratory set up at Harvard University by the Office of Scientific Research and Development.

In 1941 he was elected president of the IRE and was awarded its Medal of Honor in 1950.

### Ford Instrument Appoints Essex

ALOIS B. ESSEX has been appointed administrative engineer of Ford Instrument Co., division of Sperry Rand Corp.

He joined Ford in 1933 as production clerk. Prior to his appointment he was project supervisor on U. S. Army fire control equipment.

In his new post, he will be responsible for planning the engineering department work load, inter-departmental liaison, establishment of departmental procedures and policies

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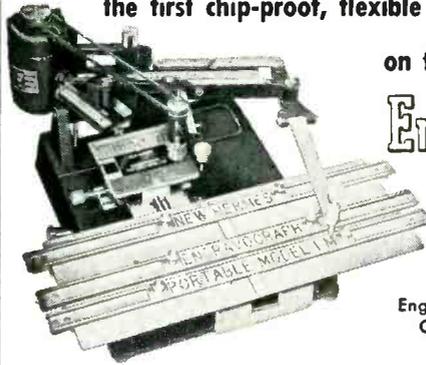
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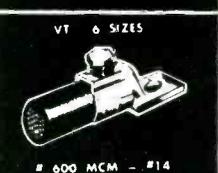
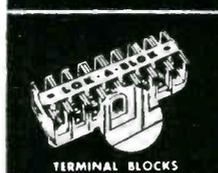
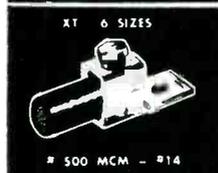
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50 ohms DC to 4000 mc—5 watts to 2500 watts

The constant resistance (Low VSWR) of the THERMALINE resistor make it the ideal dummy load and standard resistor at UHF and VHF. Design is such that normal reactance is put to work producing a pure resistance over an extremely wide frequency range. Acting as a "bottomless pit" for RF energy, thousands of THERMALINE units are in daily use in high frequency applications.

Model	Cont. Power Rating	Input Connector
80F	5 watts	UG-23B/U
80M	5 watts	UG-21B/U
80A	20 watts	UG-23B/U
81	50 watts	UG-23B/U
81B	80 watts	UG-23B/U
82	500 watts	} Adaptor to fit UG-21B/U supplied
82A	500 watts	
82C	2500 watts	

Adapters or cable assemblies for standard coaxial line available.

ALL THERMALINE units, except Model 82C, are self-cooled. Substantial quantity discounts.

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MODEL 80F FEMALE  
MODEL 80M MALE } Size 3 3/8" x 3/4" dia.

VERY HANDY in lab and production test. At signal generator levels and below 5 watts, this is the last word for low VSWR.

MODEL 82

6" x 8 1/2" x 17"



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affecting sales proposals, delegation of responsibility through various stages of each engineering project and evaluation of new techniques to determine the feasibility of patent application.

## EP&EM Elects New Officers



W. L. Larson

WILFRED L. LARSON, president of Switchcraft, of Chicago, was elected chairman of the Association of Electronic Parts and Equipment Manufacturers at the midsummer meeting of the trade group, composed of 120 midwest electronics firms.

Larson, who had been vice-chairman of EP&EM, succeeds Theodore Rossman, of Pentron Corp., Chicago, as chairman.

J. Wayne Cargile, sales manager of Permo, of Chicago, was elected vice-chairman, and Helen Staniland Quam, of Quam-Nichols Co. of Chicago, was re-elected for her eighteenth annual term as treasurer.

## Howling Joins T. A. Edison

DENNIS HOWARD HOWLING has joined the staff of the Edison Research Laboratory of Thomas A. Edison Incorporated, West Orange, New Jersey. He will work on the development of heat measurement and control.

While at St. Andrews University in Scotland Howling was the recip-

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(Type L3-01) Askarel immersed Filter Reactor.

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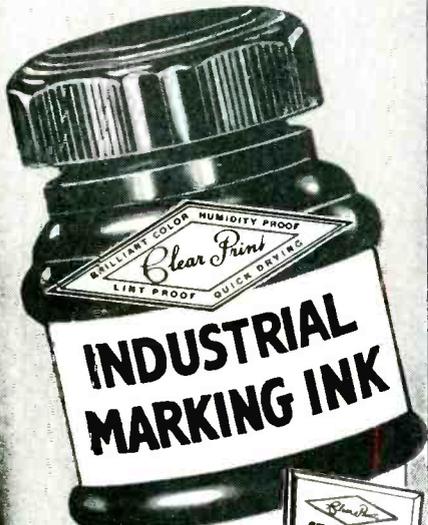
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"Magnatran components have contributed considerably to the fact that REL now makes more beyond-the-horizon FM multiplex relay equipment than all other manufacturers combined. They have been proven in use to be very dependable, both in performance and maintenance. Join the ranks and enjoy reliable Magnatran magnetic components for the electronics industry."

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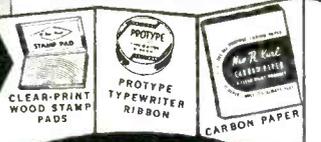
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ient of the Rosen prize, the Neil Arnot prize and three honor medals in physics. The firm also announced that Donald Tuomi has joined the lab as a research engineer.

He was previously with Baird Associates of Cambridge, Mass; MIT as research staff member engaged in government sponsored semiconductor research; Ohio State University Research Foundation as a research associate investigating the chemistry of the formation of photoemissive surfaces; the SAM Laboratory, Manhattan District, New York, and from 1943 to 1954 he was employed as a research scientist at Columbia University and Carbide and Carbon Chemicals Corp.

## Carrier Division Plans Expansion

A PLANT expansion is planned for the Spectrol Electronics division of Carrier Corp. in San Gabriel, Calif. The move is expected to increase production of the division by about 300 percent. Spectrol produces precision potentiometers.

All of the assembly and testing of potentiometers will be done in the new building which is to be completed by September, 1955. The present building will be used solely for administration, engineering and product development. Spectrol was part of the former Affiliated Gas Equipment, which was merged into Carrier Corp. earlier this year.

## Consolidated Engineering Names Nunan

J. KNEELAND NUNAN, president of Consolidated Vacuum Corp., has been named to the newly created post of vice-president and staff advisor to the president of Consolidated Engineering Corp.

In his new position, Nunan will act as a special advisor to president P. S. Fogg on company policy matters relating to management, marketing, and public and stockholder relations.

Succeeding Nunan as president of the Rochester, New York, high-vacuum equipment subsidiary is Hugh F. Colvin, who will also continue in his present post as vice-

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The "clop-clop" of "Old Bess" gave Grandma's buggy ride more vibration than the smooth Rotary Power of today's modern automobiles. **ROTARY POWER** is best for mobile radio, too . . . and for all DC to AC conversion . . . smoother . . . more dependable.



### DC TO AC CONVERTERS

For operating tape recorders, dictating machines, amplifiers and other 110-volt radio-audio devices from DC or storage batteries. Used by broadcast studios, program producers, executives, salesmen and other "field workers".

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The preferred power supply for 2-way mobile radio installations. Operates from either 6 or 12-volt batteries. Carter Genemotors are standard equipment in leading makes of auto, aircraft, railroad, utility and marine communications.



### CHANGE-A-VOLT DYNAMOTORS



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0.001 volt input d-c gives 70 mm. deflection with this high-speed direct writing oscillograph, many times that for competitive units. The Dynograph with one amplifier is used for all types of inputs for measuring speed, temperature, position, vibration, and other variables. Patented, chopper amplifier design makes it sensitive, stable, and versatile. Available in



both 6 channel console model and single and dual channel portable models. Get bulletin L742—compare the Dynograph with all competitive models—it combines sensitivity with absolute stability.

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president and general manager of Consolidated Engineering.

Thomas H. Remington, member of a Rochester legal firm, was appointed to fill the vacancy created by Nunan's resignation from the board of directors of the vacuum-equipment company.

Nunan joined Consolidated Engineering as vice-president in charge of sales in January, 1953, was made executive vice-president of Consolidated Vacuum in March of the same year, and in December, 1954, was named president.

### English Firm Appoints Tube Chief



A. V. Krause

20TH CENTURY Electronics of England has appointed A. V. Krause as head of cathode ray tube development. He was formerly senior engineer in the vacuum tube development section of Cinema Television. He had previously been with Standard Telephones and Cables valve division and Mullards.

### Smith-Vaniz Named CGS Vice-President

WILLIAM Reid Smith-Vaniz, assistant chief engineer for CGS Laboratories of Stamford, Conn., has been named vice-president of the firm.

He was largely responsible for the development of the all-electronic

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tronic computer that converts International Morse code signals from a regular radio receiver into suitable electric pulses for a standard teleprinter, producing a printed message exactly as transmitted at point of origin.

He joined CGS in 1952. His work in the company has largely been in the field of analog and digital computer techniques.

### Waldorf Instrument Elects Vice-President

SIEGFRIED SUSSKIND has been elected vice-president in charge of engineering and electronic products for Waldorf Instrument Corp. of Huntington, N. Y. He will be in charge of the engineering division and in addition assume direct responsibility for the electronic products of the company.

### Gladden Forms Lincoln Electronics

GLADDEN Products Corp. of Glendale, Calif., manufacturers of hydraulic and pneumatic components for aircraft, has formed a new wholly-owned subsidiary, Lincoln Electronics.

The new subsidiary will concentrate on the manufacture of sub-miniature permanent-magnet motors, electrical actuators, servo motors and blowers, chiefly for use by the aircraft industry.

The firm, now located in Vernon, Calif., expects to move to the Glendale area.

Keith Sorenson, formerly president of Technical Industries of Los Angeles, is manager of the new subsidiary and vice-president of Gladden Products.

### Republic Foil to Make Etched Foil

REPUBLIC FOIL and Metal Mills of Danbury, Conn., producer of aluminum foil for non-electrolytic types of capacitors, has formed Republic Etched Products, for the purpose of etching extra high purity aluminum foil for use in electrolytic types of capacitors. John W. Douglas, president of Re-

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*Perfect compromise between precision wire wound—and composition types*

This new precision film type resistor is hermetically sealed, highly stable, and has a temperature coefficient independent of resistance value. The Davohm Series 850 is available in 1/2, 1 and 2 watt sizes; to tolerances of  $\pm 1.0\%$ ,  $\pm 0.5\%$ ,  $\pm 0.25\%$ ; and, to any desired value.

*Compare these performance figures!*

	MIL-R-10509A ALLOWABLE CHANGE	Series 850 TYPICAL CHANGE
Temperature Cycling	1.0%	0.02%
Low Temperature Exposure	3.0%	0.04%
Short Time Overload	0.5%	0.02%
Effect of Soldering	0.5%	0.02%
Moisture Resistance	5.0%	0.08%
Voltage Coefficient	0.002%	0.00%
Load-Life (per 1000 hours)	1.0%	0.20%
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WORLD'S LARGEST MANUFACTURER OF ATTENUATORS



public Foil and Metal, is president of the new company.

Construction of a plant in Danbury and installation of equipment will commence under the supervision of Republic Foil and Metal Mills, in cooperation with the engineering staff of Societe Pour Le Traitement Des Metaux Et Alliages, Froges, France, whose manufacturing techniques will also be employed. This company, which is better known as SATMA, is European producer of etched foil and is a supplier of domestic users.

Basic metal will be furnished by Ets. Charles Coquillard, Froges, France, and will be rolled by Republic Foil and Metal Mills, Inc., using methods employed by Coquillard.

Republic Etched Products has replaced the International Selling Corp. of New York, as sole distributor for SATMA etched foil in the western hemisphere, and will furnish the French product until the transition to domestic production has been completed.

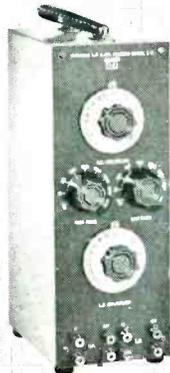
Actual sales of the extra high purity products will be handled by the sales department of Republic Foil and Metal Mills.

## A NEW ALLISON FILTER... RANGING FROM 10KC TO 640KC the model 2C CONTINUOUSLY VARIABLE PASSIVE NETWORK AUDIO FREQUENCY FILTER

Another significant engineering achievement... the model 2-C Allison Filter has been designed for telemetering and general electronics applications in frequencies ranging from 10kc to 640kc. It offers unprecedented technical advantages through precise performance, range and versatility of application and easy maintenance-free operation.

**FEATURES**

- Low Pass, High Pass and Band Pass with Continuously Variable low cut-off and high cut-off (independently controlled) from 10kc to 640 kc.
- Passive Network... No Power Supply, No Vacuum Tubes.
- Low Loss... Approximately 1 db. in Pass Band.
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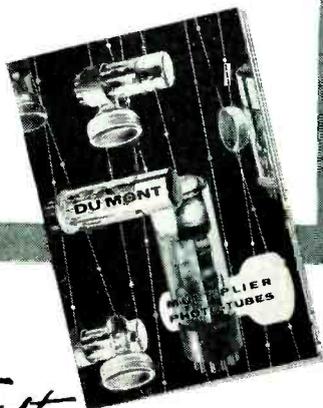
14189 SKYLINE DRIVE • PUENTE, CALIFORNIA

## Rugby Radio Extension Opened in England



A LARGE extension of Rugby Radio station in England has been officially opened. At a luncheon given by Marconi's Wireless Telegraph Co. at the official opening were C. S. Franklin, center, who, working in collaboration with Guglielmo Marconi, was responsible for the Marconi-Franklin short wave beam

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In 64 pages, this manual gives you:

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- Applications
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The new Du Mont multiplier phototube reference manual will be helpful not only in choosing the proper tube for a specific task, but also in obtaining the best possible results through selection of optimum operating conditions.

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760 Bloomfield Avenue, Clifton, N. J.

# DU MONT

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ELECTRONICS — October, 1955

system; left, R. J. Kemp, deputy engineer-in-chief of Marconi and right, L. H. Harris, engineer-in-chief of the General Post Office. The new station has taken three years to build. The cost is estimated at more than \$2.8 million. Twenty-eight high-power radio transmitters will ultimately be surrounded by about 100 antennas. The station can work on most of the systems of telephony and telegraphy transmission used in different parts of the world. Each transmitter can handle several messages at the same time. The transmitters can be started, stopped, changed to different frequencies and connected to different antennas as required.

### Waveforms Selects Research Head

B. W. ST. CLAIR has been appointed director of research of Waveforms. Dr. St. Clair will be responsible for the company's contract research program and instrument development. He was formerly with Freed Electronics & Controls Corp. and Syracuse University's radio isotopes laboratory.

### Air Associates Plans Merger

AIR Associates and Great American Industries have signed an agreement providing for the merger of the two companies pending stockholders' approval. Great American, a Connecticut corporation, manufactures cellular rubber products, intercommunication systems and specialized electrical devices.

### Sprague to Expand Carolina Plant

THE SPRAGUE ELECTRIC Co. will build an additional 25,000 sq ft of manufacturing space at its West Jefferson, N. C. plant.

Of the total, 20,000 sq ft of assembly space will be added to the main building of the one-story

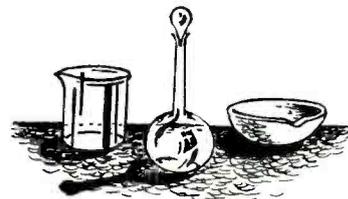
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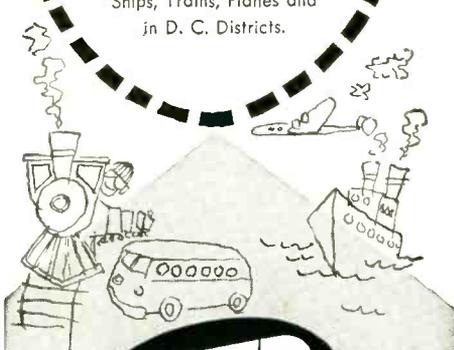
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plant and a separate 5,000 sq ft building will also be constructed. The plant manufactures electrolytic capacitors.

**City College  
Elects Froehlich**



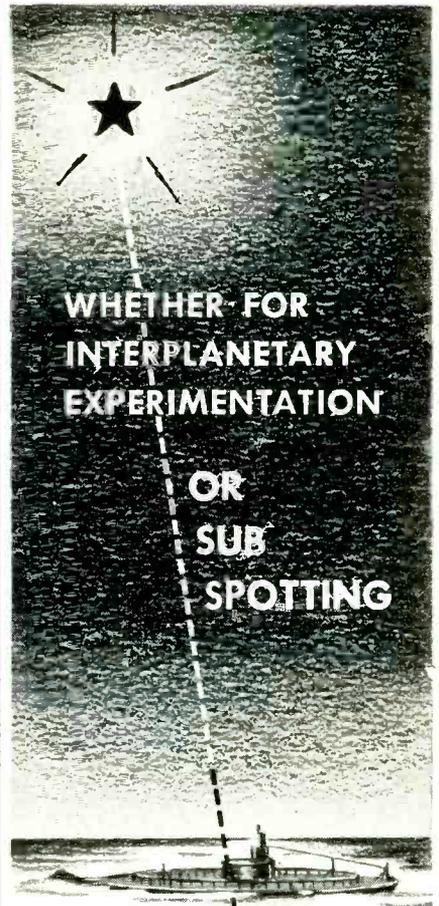
PROFESSOR Cecile Froehlich has been elected chairman of the electrical engineering department of the City College of New York. She is the first woman to become a department chairman in the 108-year history of the college and is the only female instructor of electrical engineering in New York City, according to the school.

Before coming to the United States in 1941 from Germany, she worked for engineering concerns in Germany and Belgium. She has taught graduate courses at New York University and lectured before the AIEE in addition to her City College duties. Dr. Froehlich has also served as technical research consultant to the Federal Telecommunications Laboratories of IT&T.

At the college, she was instrumental in founding the Society for Women Engineers.

**Universal Winding  
Names Morlok**

UNIVERSAL Winding Co. appointed Edward Morlok as superintendent of assembly. Prior to joining Universal, he headed up the manufacturing engineering department of



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GE in Bloomfield, N. J. Prior to that, he was assistant factory manager for Bendix Aviation Corp. In his present capacity, he will be responsible for all of Universal's assembly departments.

### Litton Adds Medical Electronics Firm

LITTON Industries has acquired the Automatic Seriograph Corp. of College Park, Md. producers of specialized electronic equipment used in conjunction with X-ray machines.

The company, acquired through transfer of an undisclosed amount of stock, is the tenth to be integrated into Litton Industries in the past twenty months.

### Resistor Firm Moves To New Plant

EASTERN Precision Resistor Corp., formerly located in Richmond Hill, N. Y., has moved to a new, larger plant in Brooklyn, N. Y.

### General Instrument Appoints Engineers

RESPONSIBLE for planning and execution of the new semi-conductor production program at Automatic Manufacturing Corp., subsidiary of General Instrument Corp., are Maurice Friedman, Paul S. Heflin and Robert W. Hull. First of the firm's new products in semi-conductor field is a silicon power rectifier.

### J. B. Rea Acquires Another Company

J. B. REA Co. of Santa Monica, Calif., acquired the equipment, inventory and personnel of the Robey Rotor Co. of Culver City, Calif. manufacturers of gyroscopes, blowers and miniature motors for aircraft and guided missiles.

The move adds a new division to the Rea Company, an electronics firm now engaged in research, development and manufacturing in the automatic control and data pro-

## Where to get transformers for atomic submarines

Like General Dynamics' Stromberg-Carlson Division, you may at times need transformers that operate in a new circuit design under unusual and rugged conditions.

The shipboard announcing equipment Stromberg designed for the U.S.S. Nautilus, for example, must be 100% trouble-free because of the sub's ability to remain submerged indefinitely. It must also be able to withstand the terrific shock of depth bombs during battle.

Stromberg asked us to design and produce transformers that fit the system's advanced circuitry. The transformers we supplied them meet all the high standards of both Stromberg and the US Navy. They are now operating on the Nautilus and the second atomic sub, the U.S.S. Sea Wolf.

*Just off the press! 16-page, illustrated brochure describing Caledonia's services and facilities for custom-designing and manufacturing transformers.*

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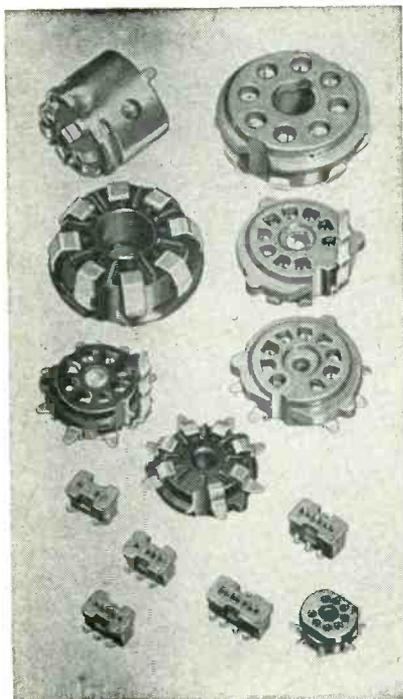
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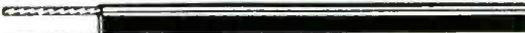
### PRINTED-CIRCUIT TUBE SOCKETS

First and still foremost with printed circuit sockets, Elco's contribution to printed-circuitry now includes 7 and 9 pin miniature; octal; 3 to 7 pin inclusive in-line subminiature tube or transistor; and octal subminiature sizes for top or bottom solder. Miniature types can also be supplied with base shield for use with bayonet-type shield. Insulators are molded General Purpose or Low Loss Mica phenolics. Contacts are brass, phosphor bronze, beryllium copper, and specially plated for maximum solderability after long term storage. Elco printed-circuit sockets have fine mechanical retention, yet avoid strain on solder joints. Contact-shape is designed for peak reliability and positive contact. Jumpers can be provided from center rivet to any contact. Shield grounding strap contact with locking bands also provided when required. Write, phone, wire for complete specifications and prices.

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**INTERCOMMUNICATION CABLES**   
These quality cables are made in various constructions, utilizing plastic insulation for both conductors and jacket

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When installation conditions dictate, shielded cables are recommended. Made with internal or external shield—2 and 3 conductors

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cessing fields. The division will supply Rea with specialized equipment for use in its automatic control and business data processing systems. Oscar Robey, founder of Robey Rotor, will continue as manager of the new division.

Recently, the Rea Co. added a subsidiary firm, the J. L. A. McLaughlin Corp. of La Jolla, a research and manufacturing firm in the long-range communications field.

### Ampex Establishes Research Department

AMPEX CORP. has established a separate research department directed by Walter T. Selsted.

Formerly, research activities at Ampex were carried on by engineers from two product divisions, audio and instrumentation. These engineers will continue applied research in specific engineering problems related to present equipment being manufactured.

The new research department will be engaged in the study of basic principles in the new fields now associated with magnetic recording.

Selsted joined Ampex in 1949 and was one of four original engineers employed. Previously, he worked with the Pacific Broadcasting Co. and the University of California Radiation Laboratory.

Ampex also announced that Arthur P. Kromer has been added to the manufacturing engineering



Walter T. Selsted

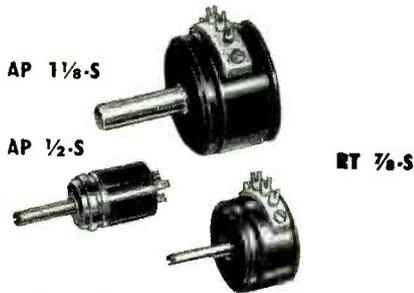
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For minimum-torque uses in computer, servo, and selsyn service. Stainless-steel precision ball bearings. Maximum torque is 0.01 inch-ounce. Dissipates one watt at 80°C. Resistances—100 to 100,000 ohms. Weight is only 1/2 ounce. Ganging to six decks; internal clamps hold 7/8" diameter. Standard linearity 0.5%; on special order 0.25%; toroidal winding allows winding angles to 360°; standard 354°.



### MICRO-MINIATURE and MINIATURE

**Series AP 1/2-S**—2 watts continuous at 80°C; resistances 10 to 20,000 ohms, 5% tolerance standard; diameter 1/2", depth 5/8", weight 1/2 ounce; sealed well enough for potting.

**Series RT 7/8-S**—3 watts continuous at 80°C; resistances 10 to 100,000 ohms; diameter 7/8", depth 3/4", wt. less than 1/2 oz.; standard linearity 2%.

**Series AP 1 1/2-S**—4 watts continuous at 80°C; resistances 10 to 150,000 ohms; diameter 1 1/8", depth 1 1/8", wt. less than 1/2 oz.; standard linearity 1%.

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ELECTRONICS — October, 1955

PLANTS AND PEOPLE

(continued)

group as chief industrial engineer.

He was previously associated with the Lincoln Laboratories of MIT in charge of the production coordination office for their digital computer division.

Before that he was 12 years with the Western Electric as assistant superintendent of manufacturing engineering for electronic equipment and for government contract work on radar and guided missiles.

### Otarion Appoints Engineering Director

WILLIAM H. GREENBAUM has been appointed director of engineering for Otariion, hearing aid maker of Dobbs Ferry, N. Y.

He had been associated, for 13 years, with another manufacturer of hearing aids.

### IT & T Purchases Kuthe Laboratories

IT & T HAS purchased Kuthe Laboratories, of Newark, N. J. The purchase price covers all outstanding capital stock of the company, which will be integrated into the IT & T System. Herman Kuthe, who founded the company, will continue as president.

### Constantin Opens Second Plant

L. L. CONSTANTIN & Co., manufacturers of glass to metal vacuum seals and other electronic components, has opened a second plant in Clifton, N. J.

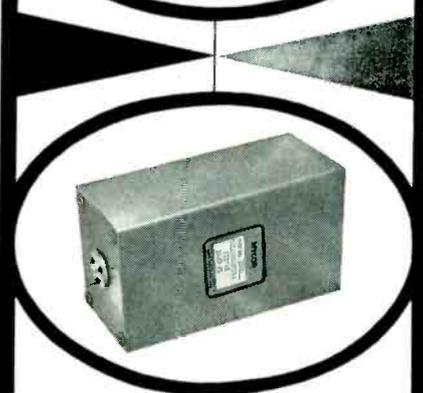
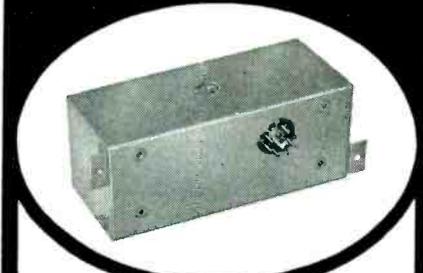
The new plant of 15,000 sq ft is equipped for volume manufacture of glass to metal vacuum seals.

### Plastics Lab Expands Plant

DEBELL & RICHARDSON, plastics research and development laboratories, have purchased the mill and water power of the A. W. Dolge Co. in Hazardville, Conn.

The acquisition will nearly double present floor space with the addition of 20,000 sq ft of working area. The space will be devoted to new chemical and engineering laboratories.

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### Features...

- HYCOR telemetering filters have excellent characteristics due to the use of high "Q" toroid inductor elements. The filters may be used in low level circuits with negligible hum pickup resulting.
- In addition, only the finest capacitors are employed to assure stability.
- Available in standard RDB frequencies.

### GENERAL SPECIFICATIONS Impedance 500/500

TYPE	BANDWIDTH	ATTENUATION	FREQUENCY RANGE
1500	±7 1/2%	-3 db or less	400 cps to 14.5 kc
	±20%	-30 db or more	
4300	±7 1/2%	-3 db or less	400 cps to 960 cps
	±20%	-40 db or more	
4000	±7 1/2%	-3 db or less	400 cps to 960 cps
	±15%	-45 db or more	
	±15%	-3 db or less	1300 cps to 14.5 kc
	±28%	-45 db or more	

Other frequencies and impedances available on request.

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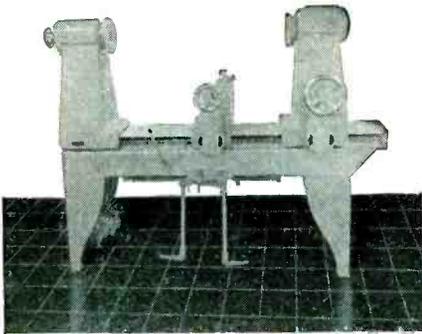
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Especially useful for handling  
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#### GENERAL SPECIFICATIONS

Maximum length overall	84"
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Maximum length, spindle nose to spindle nose	47"
Height, floor to spindle	52 5/8"
Radial clearance above apron	21 1/4"
Spindle hole diameter	3 7/8"
Approximate shipping weight	1800 lbs.
Net weight	1600 lbs.

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Standard spindle speeds approx. 30-  
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That a first class glassblowing job requires accurate alignment of rotational axes between the headstock and footstock?

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That simple chucking attachments supply versatility for wide varieties of applications?

That special chucking for your industrial procedures, or laboratory practices are available?

That Litton jet-mix fires are universally used in glassblowing to prevent reducing conditions?

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323B



**Litton Engineering Laboratories**  
Grass Valley, California - P. O. Box 949

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## New Books

### Automatic Feedback Control System Synthesis

By JOHN G. TRUXAL.  
McGraw-Hill Book Co., Inc., New  
York, 1955, 675 p, \$12.50.

THIS text on advanced servomechanisms is a distinct contribution to the available books on the subject. It differs from almost all current books in its attention to exclusively advanced topics. In this reviewer's opinion, it is the first book presenting the popular advanced topics, hitherto described in widely scattered papers, in an integrated and lucid manner, equally suitable as a graduate text or a reference for servomechanisms engineers.

Elementary servomechanisms theory, as presented in most current volumes, has become standardized in its coverage, which implies that a generally accepted approach to this topic has evolved. This approach, based upon the experience of instructors and practicing engineers, has emphasized frequency response methods, which in the past have resulted in the most rapid development of synthesis techniques. In contrast to the frequency response approach, transient methods have been relatively neglected. However, the final performance of a critical servomechanism must generally be judged by its response to a nonsinusoidal input and it is here that one must return to transient methods. Similarly, in problems relating to sampled data systems, nonlinear systems, etc, the transient approach becomes almost an essential tool. Thus, in advanced servomechanism theory, the transient analysis methods naturally occupy a more essential role, and one which Prof. Truxal has fully recognized.

#### Arrangement

The author divides his presentation into five principal areas: (1) A complete coverage of the Laplace transform from an advanced (engineering) viewpoint, emphasizing the relation between shifting pole and zero positions, and the effect in the time and frequency domains. (2) A coverage of feedback theory,

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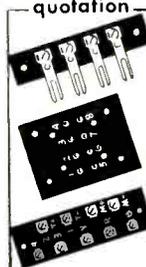
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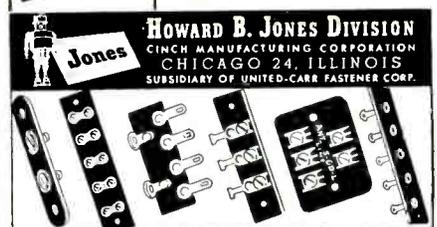


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October, 1955 — ELECTRONICS

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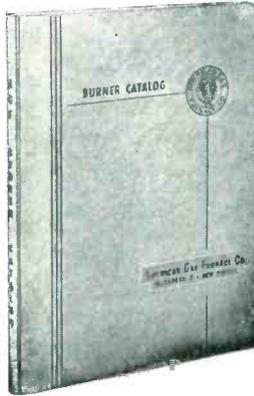
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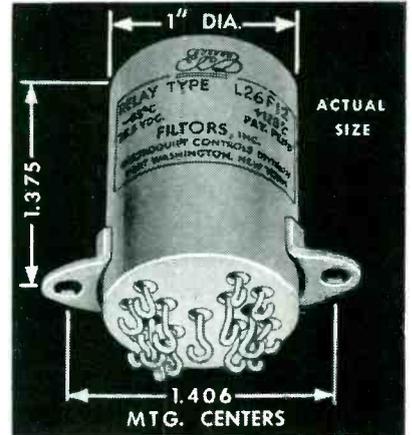
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### SHOCK:

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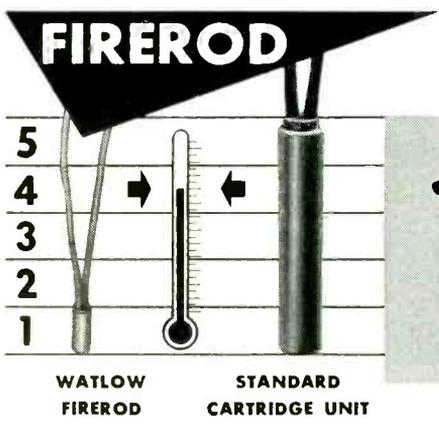


including signal-flow diagrams and system design methods for most easily controlling desired characteristics with feedback. (3) The synthesis of networks for shaping frequency response, going much further than the standard popular lead, lag and lead-lag networks. (4) Statistical methods and systems, including random noise. (5) The basic techniques of nonlinear system analysis and the synthesis of nonlinearities to improve dynamic performance.

Some of the specific topics included in the above five general headings are Evans' root-locus method applicable network synthesis techniques, statistical design principles, sampled data systems, and nonlinear systems.

The unique character of this book and its excellent organized treatment of the above topics should make it an invaluable reference work for student and advanced systems designer.—SIDNEY A. DAVIS, Chief Development Engineer, Servomechanisms, Inc., Long Island, New York.

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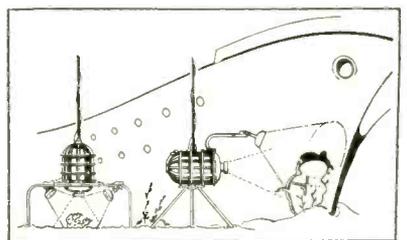
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**Underwater Photography and Television**

By E. R. CROSS.  
 Exposition Press Inc., New York, 1954, 258 p., \$6.00.

PROBLEMS related to the use of underwater closed-circuit television gear are numerous and often difficult. Much has been accomplished but there are still many problems left unsolved. This hand-



Underwater tv in action

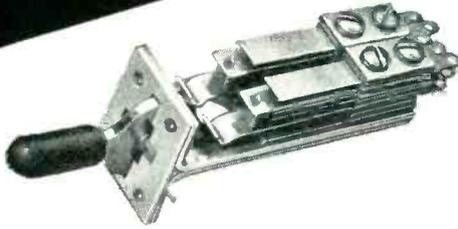
book of equipment and techniques is an attempt to gather and collate existing knowledge in the field, something that has not been done heretofore.

Unfortunately, just one chapter is specifically devoted to the subject

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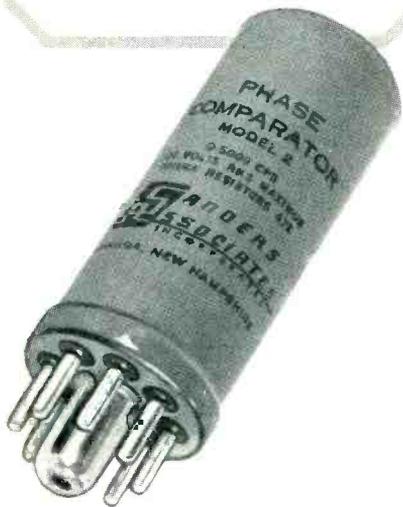
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**Size:** 1" dia. x 3"; **Weight:** 2 ozs.

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NEW BOOKS

(continued)

of underwater television. However, other chapters cover water pressure and the attendant necessity for adequate camera housings and waterproof seals, underwater visibility and the related lighting difficulties, as well as the proper selection of lenses and filters. These are an integral part of the entire picture involved in the use of underwater tv equipment. The main part of the text covers photography, diving and a rather comprehensive bibliography, which should prove extremely valuable.

The underwater tv chapter goes into detail concerning applications of tv equipment in underwater work with specific mention of actual salvage operations. It also touches on problems directly related to tv cameras and their use, such as: moisture condensation, photosensitive tubes and spectral sensitivity. Much attention is given to the lighting problem underwater. The author's diving experience has resulted in the presentation of valuable information relating to f/stops, distances and foot candles of illumination needed when using image-orthicon cameras.

This reference text should prove of some value to those desiring to know: how far the state of the art has progressed; what the present-day problems are and where the future of underwater tv lies.—E.B.P.

## Fundamentals of Radar

By STEPHEN A. KNIGHT. *Pitman Publishing Corp., New York, 1955, 150 p., \$3.00.*

A BRIEF and highly readable description of the principles and operation of the major units of a radar set. The book is written on the technician's level and is nonmathematical in its approach.

The author describes principles of echo ranging, triggering and sweep circuits, cathode-ray-tube indicators, pulse transmitters and receivers, transmission lines, waveguides and directional antennas. Some details of modern radar systems such as servo systems range-marker presentations, moving-target indicators, identification friend or foe, t-r and atr tubes etc are omitted. But this does not diminish

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NEW BOOKS

(continued)

the value of the book as an introduction to the subject or as a quick review for someone not currently in the field.—J. M. C.

## Introduction To Nuclear Engineering

By RICHARD STEPHENSON. McGraw-Hill Book Co., New York, 1954, 387 p., \$8.00.

THIS BOOK is the second text on nuclear engineering to be published within the year and evidences the need for an organized presentation of the declassified material on nuclear reactor design, and the engineering developments that accompany the successful operation of a reactor. It is a tribute to the efforts of the AEC and nuclear engineers of this country that such a good overall picture can be presented. Stevenson states that this book was written for engineers, and he wisely concentrates on the nuclear field leaving out material that can be found in conventional engineering text books. It would seem to me that the first chapter, which is a brief review of nuclear physics, might also better be left to the texts on nuclear physics, of which there are now a number appropriate to nuclear engineers.

### Content

He starts off in Chapter II with a discussion of fission and nuclear chain reactions. This is followed by a chapter describing a number of reactors which are typical of the various ones that have been built. Chapter IV develops the theory of thermal reactors to the point where critical size can be calculated. The next two chapters, on shielding and reactor materials, consider the interrelations between radiation, both gamma and neutron, and materials used in the internal and external structure of reactors. Some idea of the way a reactor behaves and means for controlling its behavior follow. The separation of fissionable material is covered in the chapter on isotope separation. The chemical processing of ores for uranium and spent reactor fuels for fission products, unconsumed fissionable fuel and converted fertile material is indicated in Chap-

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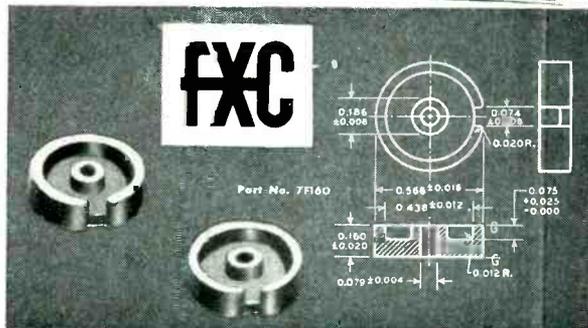
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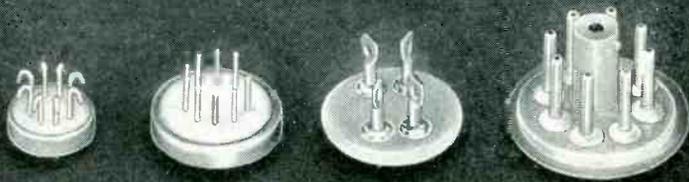
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ter IX. The final chapter describes some of the techniques needed for handling radioactive material.

### Problems

The problems at the end of each chapter are excellent. The writing is clear, and I would recommend the book for use in a class for senior or graduate engineers interested in preparing themselves for intelligent understanding of the nuclear engineering field.

It should be clear that a thorough mastery of the material of the book will not qualify a student to design a workable power reactor. However, it does convey an understanding of the problems in nuclear engineering and some methods of attacking them.—CLARKE WILLIAMS, *Chairman, Nuclear Engineering Dept., Brookhaven National Lab., Upton, L. I., N. Y.*

## Astronomical Photo-Electric Photometry

EDITED BY FRANK BRADSHAW WOOD. *American Association for the Advancement of Science, Washington D. C., 1953, 141 p, \$3.75.*

THIS 141 page monograph is a collection of papers presented at a symposium of the Astronomy Section of the American Association for the Advancement of Science in Philadelphia on December 31, 1951.

The great sensitivity of multiplier phototubes makes them extremely valuable for measuring the light of faint astronomical objects. Nine authors contribute from their experience to bring the reader a range of phototube techniques. A bibliography of 575 papers is included and a short treatise on the basic theory and limits of sensitivity is given by Whitford.

The book will be of value to research workers interested in phototube applications. — JOHN D. KRAUS, *Ohio State University, Columbus, Ohio.*

## Scientia Electrica

S. HIRZEL VERLAG, ZURICH, SWITZERLAND. *Issues of about 40 pages each appear in irregular sequence, No. 1 & 2—4 Swissfranco, No. 3-4, 80 Swissfranco.*

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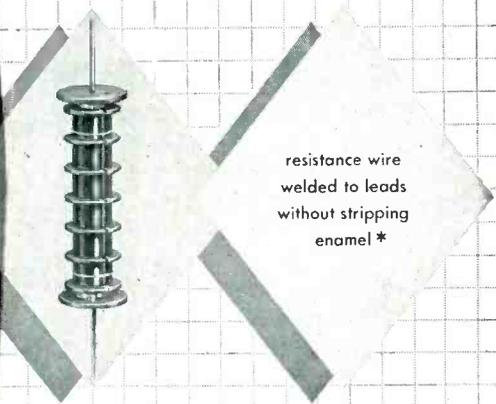
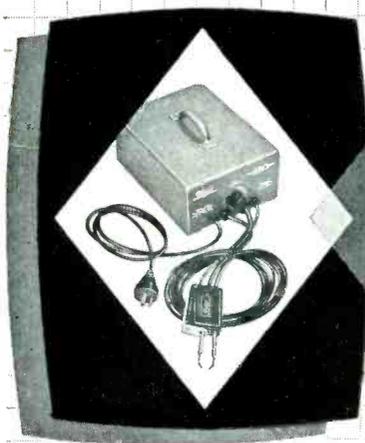
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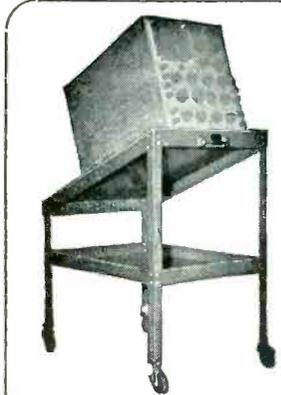
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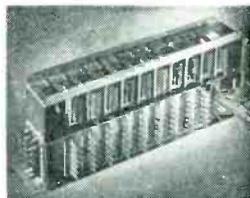
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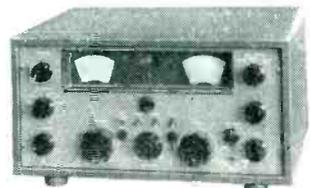
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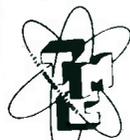
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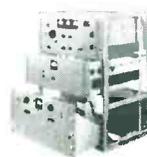
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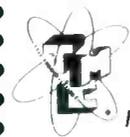
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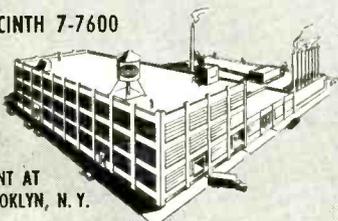
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NEW BOOKS

(continued)

trical engineering at the Swiss Federal Institute of Technology in Zurich. Some of the authors are active at the university, others in industry. Each of the first three issues contains three papers; further issues are scheduled to appear in irregular sequence, and some later ones may already be available but have not reached this reviewer.

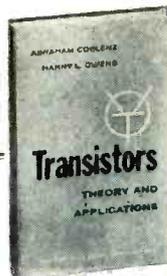
### Subjects

The papers deal with a wide variety of subjects in electrical engineering, with considerable emphasis on power transmission. Here are the first nine titles: transistors in power stages; fine migration on switch contacts; corona losses on high-voltage lines; absolute voltage measurement; plastic insulation at high voltage; equivalent circuits for the loss-free transformer; progress report on some insulating materials; audio control pulse transmission over power systems; statistics of arc-back in thyratrons. Papers scheduled for later issues deal with control systems for electrical drives, behavior of electrical machinery with periodically varying voltage and frequency, selected problems of current or voltage stabilization, etc.

### Transistors and Fine Migration

Among all the papers mentioned, only the one on transistors belongs in the electronic field; this one was written by M. J. O. Strutt who leads the seminar and edits the publication.

To this reviewer who cannot qualify as an expert on any of the subjects listed, some of the papers seem unusually stimulating. One excellent example is the paper on fine migration between contacts. Knowing very little about the subject, we are first reminded that there is course migration—caused by arcing—and fine migration—metal migrates from anode to cathode even when no visible sparks are produced. Next we learn that fine migration occurs because just as the contacts part, the last tiny bridge of metal liquefies. This in itself would not account for the asymmetry observed; we are now reminded of the Thomson effect: current through a homogeneous



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By Abraham Coblenz, Transistor Products Co. Inc., Waltham, Mass., formerly with Signal Corps Engineering Laboratories, and Harry L. Owens, Chief, Solid State Devices Branch, Signal Corps Engineering Laboratories. 313 pages, 115 illus., \$6.00

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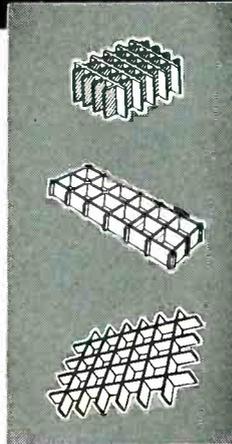
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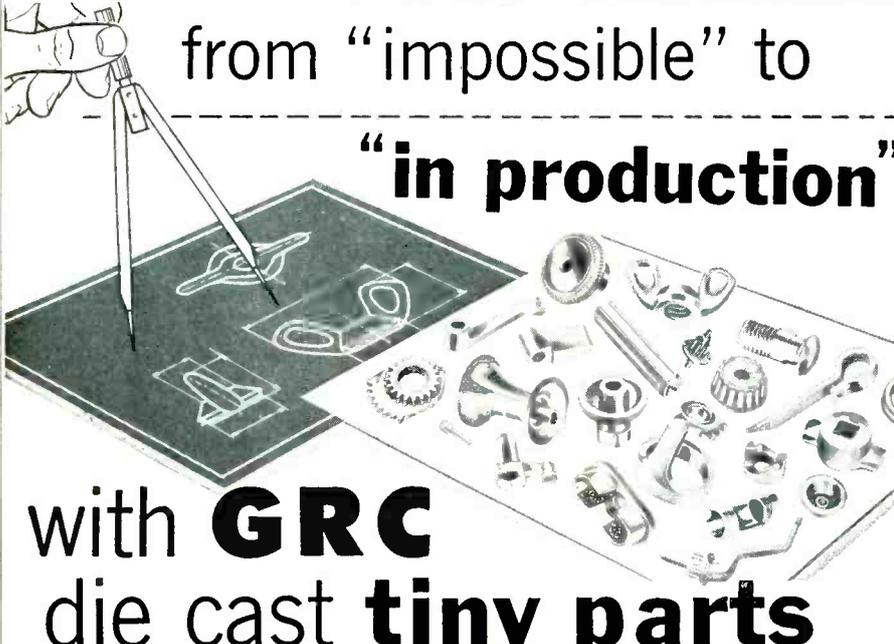
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conductor produces extra heat in regions where a temperature gradient exists, and this extra heat is positive or negative depending on the polarity of the gradient. Thus the location of the hottest point on the liquid bridge is shifted. Available data for the Thomson effect indicate that the metal should migrate in the opposite direction, but the authors show through measurements that the effect changes polarity at elevated temperatures, and they finally prove their point by compensating for the effect through introducing an artificial asymmetry which successfully suppresses fine migration.

#### Evaluation

These papers were evidently written for an audience composed of specialists in many different fields; every author had to make his point with greater clarity than might have been necessary in a group of listeners thoroughly familiar with his subject. For this reason, perhaps, and also because these papers often go back to fundamental physics, they seem more interesting to this reviewer than many articles in electrical engineering journals.

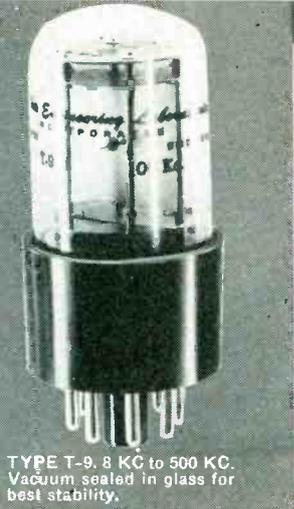
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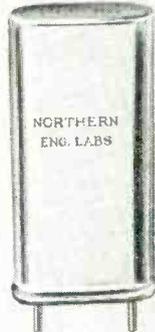


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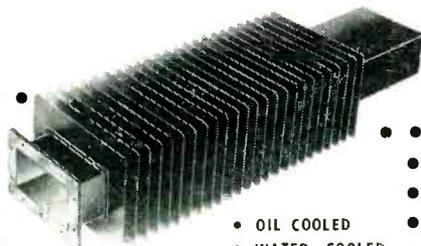
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## Zur Theorie Der Elektronenstrahlrohren Mit Periodischem Aufbau

By DR. HEINRICH DERFLER, *Verlag Leemann Zurich, Zurich, Switzerland, 1954, 54 p., 6.25 Swiss francs.*

THIS SMALL 53-page booklet on the theory of periodic traveling wave tubes must remain a book for specialists in a rather narrow field of endeavor, for although the mathematics and even the physical background of pertinent electromagnetic theory are explained at length, the tubes themselves are barely described.

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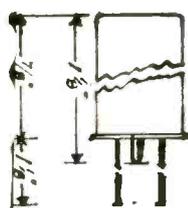
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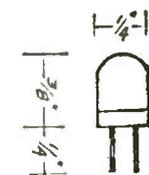
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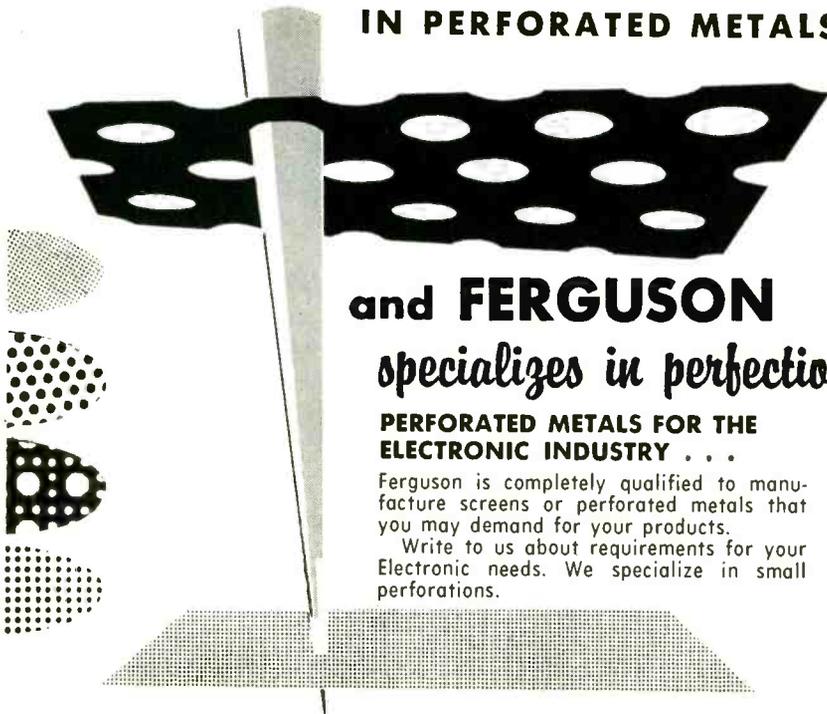
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The theory is applied to the multicavity klystron, the disk-and-rod structure and the space harmonic amplifier. By choosing to represent the three types of structures by simple quadrupoles well suited to show the analogies and differences between the structures, the author obtains a clear and concise representation of the basic properties of those tubes.

The book, although published in 1954, was written in 1952 which may account for the lack of mention of the backward wave properties of space harmonic amplifiers and oscillators. This omission is regrettable in view of a lengthy discussion on the stability of a forward space harmonic amplifier which closes the book.—PHILIPPE A. CLAVIER, *Research Department, Zenith Radio Corp., Chicago, Ill.*

**Elements of  
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BY WILLIAM MARCUS AND ALEX LEVY.  
*McGraw-Hill Book Co., Inc., New York, 2nd Edition, 1955, 566 p, \$6.00.*

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described with a fair amount of elementary radio theory in this book. The dynamic servicing technique is stressed with the authors giving the reader an early introduction to the signal generator. The book winds up with an outline of servicing procedure augmented by case studies of receiver faults and a chapter of tips on setting up the service bench.

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The book is written on the vocational school level and will be useful to anyone desiring a practical knowledge of radio servicing. It is designed to correlate with a series of six McGraw-Hill text films.—

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## Thumbnail Reviews

**Abstracts of the Literature on Semiconducting and Luminescent Materials.** By the Electrochemical Society. John Wiley & Sons, Inc., New York, 1955, 169 p (paper), \$5.00. Bibliography with brief summaries prepared by staff of Battelle Memorial Institute covering literature from Jan. 1, to Dec. 31, 1953. Subject and author indexes are included.

**Multipole Fields.** By M. E. Rose. John Wiley & Sons, Inc., New York, 1955, 99 p, \$4.95. Application of group theory methods in the description of the electromagnetic field. A general knowledge of quantum mechanics and electromagnetic theory is assumed.

**Conversion Factors and Tables.** By O. T. Zimmerman and Irvin Lavine. Industrial Research Service, Dover, N. H., 2nd Edition, 1955, 501 p, \$5.00. Main section of book is alphabetical list of conversion factors recently recalculated in line with latest accepted fundamental values. New material includes foreign conversion factors and monetary equivalents, table of physical constants and expanded conversion table section.

**28 Uses for Junction Transistors.** Sylvania Electric Products, Buffalo, New York, 1955, 48 p, 25¢ (paper). Manual of practical applications for junction transistors. Theory is held to a minimum but a bibliography of more detailed transistor theory is included.

**Bibliography and Abstracts on Electrical Contacts.** ASTM, Philadelphia, Pa., 1955, 80 p, \$1.00 (paper). Supplements original work published in 1944, republished in 1952. Includes all new references collected up to January 1,

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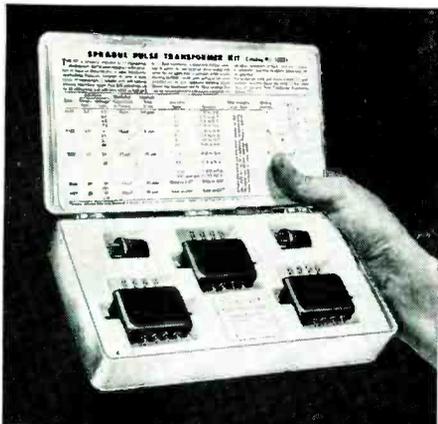
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**NEW BOOKS**

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1954. Subject and author indexes are given together with brief abstracts of papers.

**Electricity.** By Eric de Ville. Penguin Books Inc., Baltimore, Maryland, 1955, 159 p, 65¢ (paper). Traces development of science of electricity and magnetism from early discoveries to television, radar and atomic. Written for the layman.

**Elements of Television Servicing for Bench and Field.** By Abraham Marcus and Samuel E. Gendler, Prentice-Hall, Inc., New York, 1955, 587 p, trade \$7.95, text, \$5.50. Designed for classroom teaching, this book describes techniques for servicing television receivers both in the shop and the customer's home. Includes material on uhf circuits and theory and practice of servicing color tv receivers.

**Operation TV.** By Stephen E. Madas. Vantage Press, New York, 1955, 81 p, \$2.50. Written for the television viewer without technical knowledge, this book explains how the set works and how to adjust it for the best picture. This is not a fix-it-yourself book. Portions are included on color receivers.

**Elementary Theory of Nuclear Shell Structure.** By Maria Goeppert Mayer and J. Hans D. Jensen. John Wiley & Sons, Inc., New York, 1955, 269 p, \$7.75. Discusses topics such as nuclear spins and magnetic moments, quadrupole moments, beta decay and isomeric transitions. Contains extensive tables and graphs of nuclear data.

**Bibliography on Hearing.** By Psycho-acoustic Laboratory, Harvard University. Harvard University Press, Cambridge, Massachusetts, 1955, 599 p, \$7.00. Contains well over 10,000 titles including all entries in earlier work. Entries are listed alphabetically by author. A classification by subject is also included.

**Tables of Sines and Cosines for Radian Arguments.** By National Bureau of Standards. Government Printing Office, Washington, D. C., 1955, 278 p, \$3.00. Extended and corrected reissue of mathematical tables published in 1940. Table of conversion factors from degrees to radians and conversely is provided.

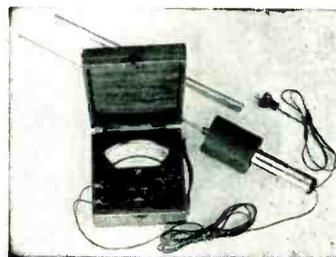
**TV Field Servicing Manual, Vol. 4.** By Harold Alsberg. John F. Rider Publisher, Inc., New York, 1955, 160 p, \$2.40 (paper). Servicing data for General Electric, Hallicrafters and Hoffman television receivers.

**Picture Book of TV Troubles, Vol 3.** By John F. Rider staff. John F. Rider Publisher, Inc., New York, 1955, \$1.80 (paper). Abnormal waveforms and pictures for various video i-f and video amplifier circuit troubles.

**Almost Periodic Functions.** By A. S. Besicovitch. Dover Publications, Inc. New York, 1955, 108 p, \$3.50 (cloth), \$1.75 (paper). Reprint of summary of two stages of development in Bohr's theory of almost periodic functions.

**The Continuum and Other Types of Serial Order.** By Edward V. Hunting-

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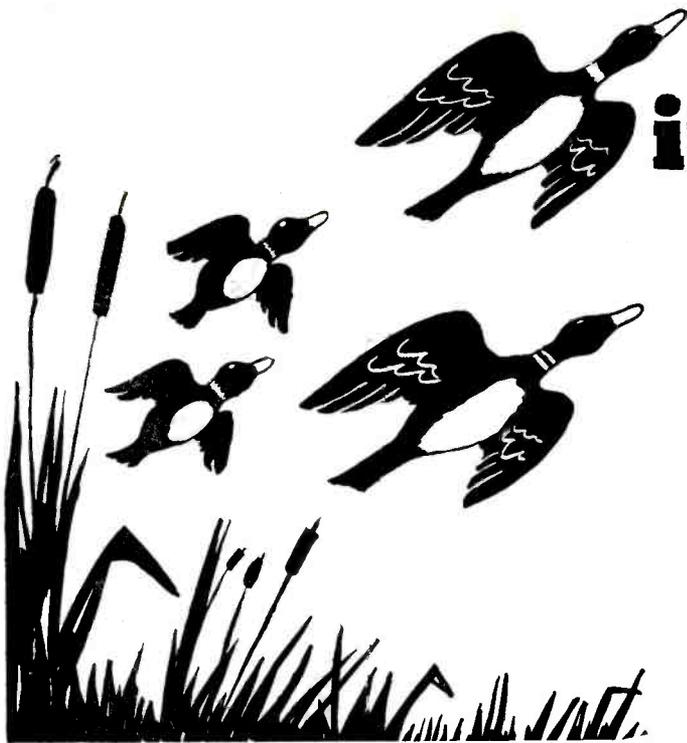
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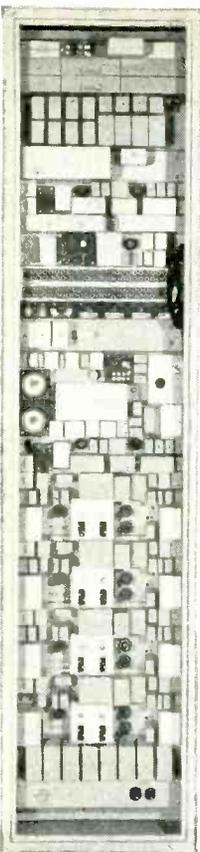
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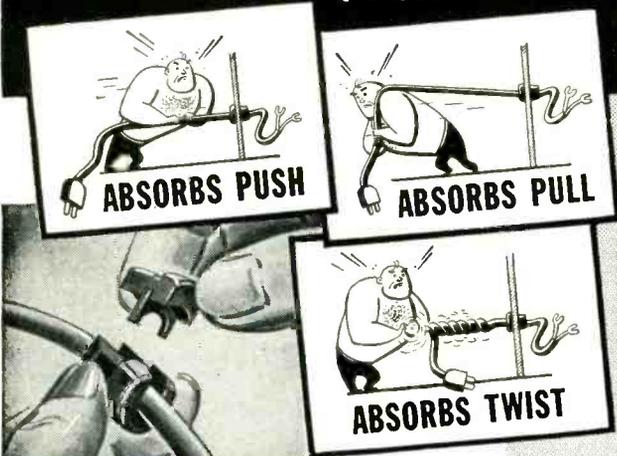
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NEW BOOKS

(continued)

ton. Dover Publications, Inc., New York, 1955, 82 p, \$2.75 (cloth), \$1.00 (paper). Reprint of a book which appeared first in 1905 as a reprint from the *Annals of Mathematics*.

**Basic Vacuum Tubes and Their Uses.** By John F. Rider and Henry Jacobowitz. John F. Rider Publisher, Inc., New York, 208 p, \$3.00 (paper), \$4.50 (cloth). Explains function of diodes, triodes and multielectron tubes in non-mathematical terms. Cartoons are used to illustrate flow of electrons. A few basic circuits are given.

**Biennial Report 1953 and 1954.** By National Bureau of Standards. Government Printing Office, Washington, D. C., 162 p, 60¢ (paper). Electronic developments reported include Dyseac high-speed computer, x-ray televising and automatic production of electronic equipment.

**TV Repair Questions and Answers (Front Ends).** By S. Platt. John F. Rider Publisher, Inc., New York, 1955, 128 p, \$2.10 (paper). Includes material on antennas, transmission lines, mechanical and electrical details of tuners, uhf converters and boosters.

**Some Characteristics of Image Orthicon Camera Tubes.** H. L. Wuerffel and D. E. Webb. Naval Research Laboratory, 1955, 43 p, distributed by Office of Technical Services, Washington, D. C., \$1.25 (paper). Highly technical discussion illustrates how image orthicon tubes may be operated in a variety of ways which differ from standard television operation.

**ASTM Standards On Glass and Glass Products.** American Society For Testing Materials, Philadelphia, Pennsylvania, 1955, 136 p, \$1.50 (paper). Supercedes the previous edition published in 1950. Includes specifications for cellular glass insulating block, glass containers, insulators and textiles. Eighteen methods of test, three specifications and one list of definitions are given.

**Picture Book Of TV Troubles—Volume 4—AGC Circuits.** John F. Rider Laboratories Staff. John F. Rider Publisher, Inc., New York, 1955, 96 p, \$1.80 (paper). Photographs of faulty tv test pattern displays and crt waveforms enable the technician to troubleshoot faults in television receiver age circuits.

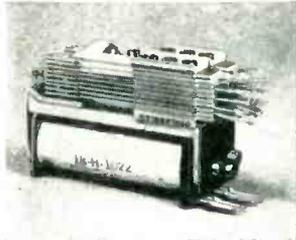
**Selling Your TV-Radio Service.** General Electric Tube Department. John F. Rider Publisher, Inc., New York, 1950, 64 p, \$1 (paper). Deals with the business side of TV-radio service. Methods discussed have increasing sales. Includes direct mail, window and store display and various advertising media.

**TV Repair Questions and Answers—Video Circuits.** Sidney Platt. John F. Rider, Inc., New York, 1955, 128 p, \$2.50 paper. Uses question and answer approach to discuss troubleshooting faults in video circuits of TV home receivers. Book covers video i-f circuits, detectors, amplifiers, d-c restorers and age circuits.

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## Backtalk

### Jeeps and Electrons

DEAR SIRS:

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*Assistant Manager  
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### I-F Transistor Transformers

DEAR SIRS:

I WAS delighted to see the referenced article featured on the cover of the August issue of *ELECTRONICS*, as well as its designation as an *ELECTRONICS* Reference Sheet.

There are, however, some errors in the article as published which should be corrected. Undoubtedly there will be several letters regarding the errors and this will be the easiest way to answer them.

The only serious errors involve the computation of taps and turns ratios, Eq. 3, 4 and line 42, column 3, p 160, which will give incorrect results if used as they stand.

The equations should be cor-

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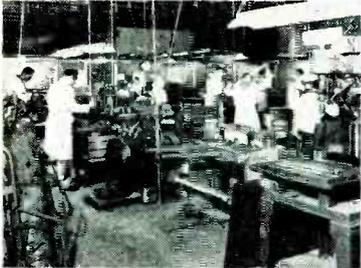
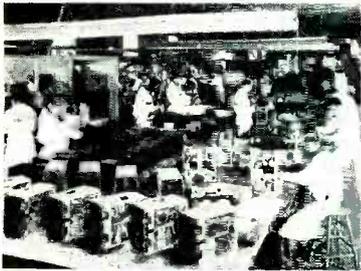
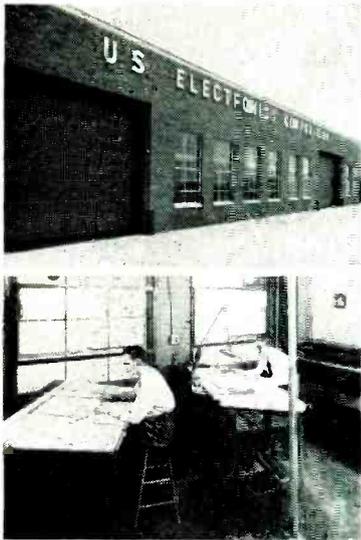
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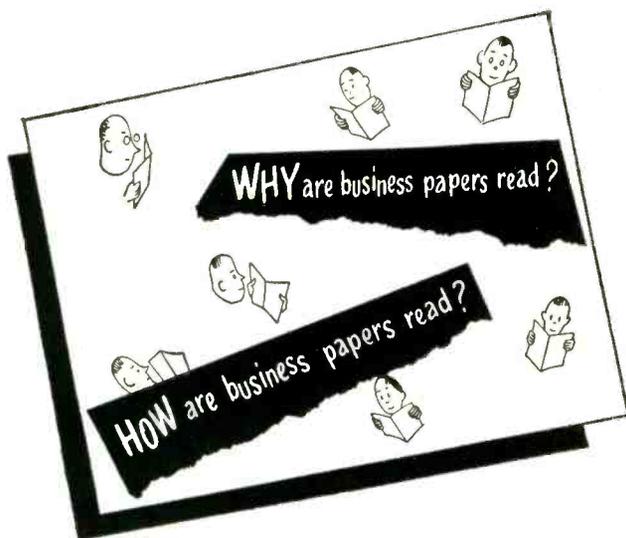
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BACKTALK

(continued)

rected to read:

$$n = \sqrt{R_o/R_o'} \quad (3)$$

$$n' = \sqrt{R_L/R_o'} \quad (4)$$

line 42, column 3, p 160

$$n' = \sqrt{R_L/R_o'} = \sqrt{50/120,000} = 0.0205$$

Other errors, not so serious since they will not result in incorrect end results, are as follows:

(1) In the Summary "Designed" should read "Design"

(2) Lines two and three, column 3, p 157 should be deleted

(3) Line three, column 2, p 158 should read  $\Delta f = BW/2$

(4) Line 23, column 1, p 161 "— Eq. 2 and 4 may be —" should read "— Eq. 2 and 6 may be —"

(5) Line 26, column 1, p 161 "for  $(f_o/\Delta f > 1)$ " should be "for  $(f_o/\Delta f \gg 1)$ "

(6) The denominator of the equation immediately following should read  $2 + (\Delta f/f_o)$  instead of  $2 + (f/f_o)$

(7) The denominator of the next equation should read  $(f_o/\Delta f) + \frac{1}{2}$  instead of  $(f_o/\Delta f) + 2$

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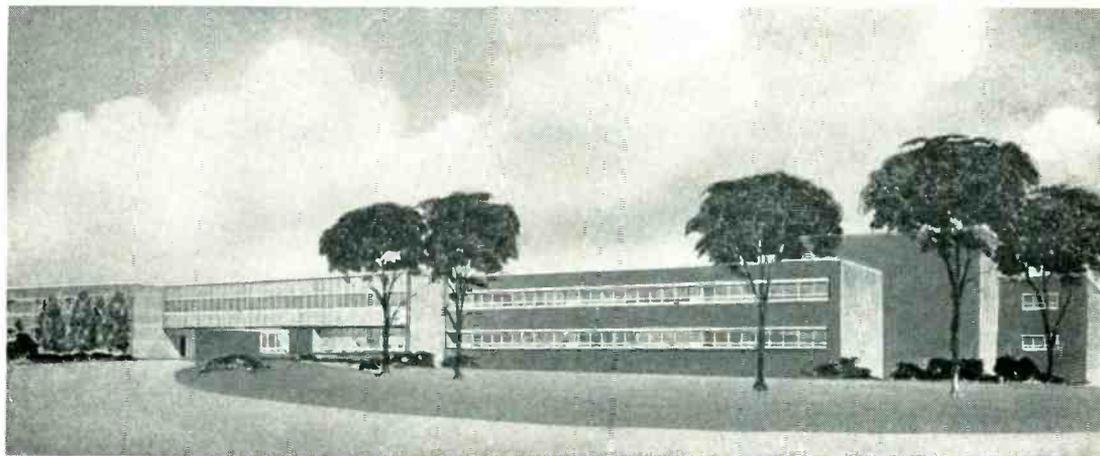
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	1-2	2-3	4+	1-2	2-3	4+	1-2	2-3	4+	1-2	2-3	4+
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<b>DIGITAL DATA HANDLING DEVICES</b>			C			C				C		
<b>MISSILE AND RADAR</b>			M X			M				M		
<b>INERTIAL NAVIGATION</b>			M			M				M		
<b>COMMUNICATIONS</b>			C I							C I		
<b>DESIGN • DEVELOPMENT</b>												
<b>KINESCOPIES (B &amp; W and COLOR), OSCILLOSCOPES</b> —Electron Optics—Instrumental Analysis—Solid States (Phosphors, High Temperature Phenomena, Photosensitive Materials and Glass to Metal Sealing)	L	L	L	L	L	L	L	L	L	L	L	L
<b>RECEIVING TUBES</b> —Tube Design—Test and Application Engineering—Chemical and Physical Development—Methods and Process Engineering—Advanced Development	H	H	H		H	H		H	H		H	H
<b>SEMI-CONDUCTORS</b> —Transistors—Semi-Conductor Devices—Materials	H	H	H				H	H	H			
<b>MICROWAVE TUBES</b> —Tube Development and Manufacture (Traveling Wave—Backward Wave)		H	H		H	H		H	H		H	H
<b>GAS, POWER AND PHOTO TUBES</b> —Photosensitive Devices—Glass to Metal Sealing	L	L	L	L	L	L	L	L	L	L	L	L
<b>AVIATION ELECTRONICS</b> —Radar—Computers—Servo Mechanisms—Shock and Vibration—Circuitry—Remote Control—Heat Transfer—Sub-Miniaturization—Automatic Flight—Design for Automation—Transistorization	M C X	M C X	M C X	M C X	M C X	M C X	M C X	M C X	M C X			
<b>COMPUTERS</b> —Systems—Advanced Development—Circuitry—Assembly Design—Mechanisms—Programming	C	C X	M C X	C	C X	M C X	C	C	M C			
<b>RADAR</b> —Circuitry—Antenna Design—Servo Systems—Gear Trains—Intricate Mechanisms—Fire Control	M C X	M C X	M C X	M C X	M C X	M C X	M C X	M C X	M C X			
<b>COMMUNICATIONS</b> —Microwave—Aviation—Specialized Military Systems	C	C	C		C	C		C	C			
<b>RADIO SYSTEMS</b> —HF-VHF—Microwave—Propagation Analysis—Telephone, Telegraph Terminal Equipment		I	I		I	I		I	I			
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<b>COMPONENTS</b> —Transformers—Coils—TV Deflection Yokes (Color or Monochrome)—Resistors	C	Z C	Z C	C	Z C	Z C	C	C	C		Z	Z
<b>MACHINE DESIGN</b>												
Mechanical and Electrical—Automatic or Semi-Automatic Machines		L	L		L	L		L	L			

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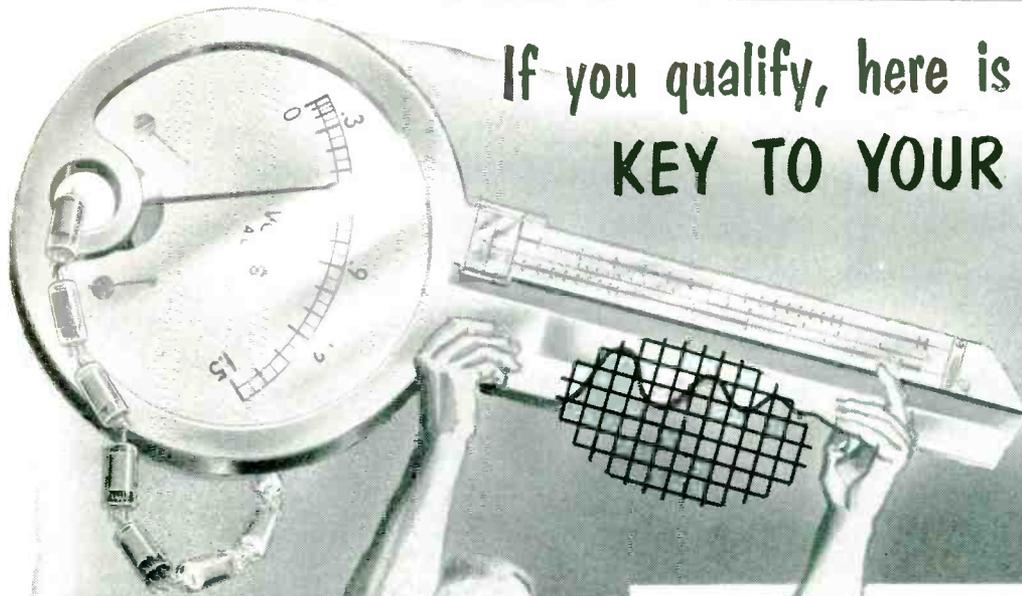
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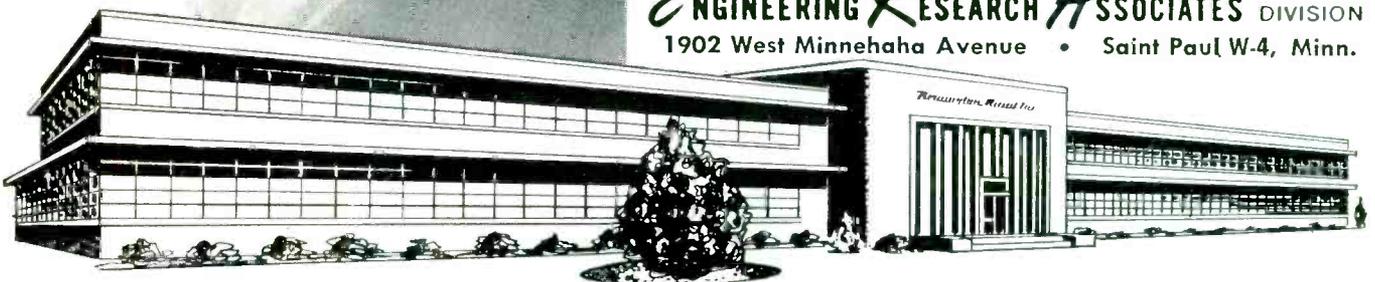
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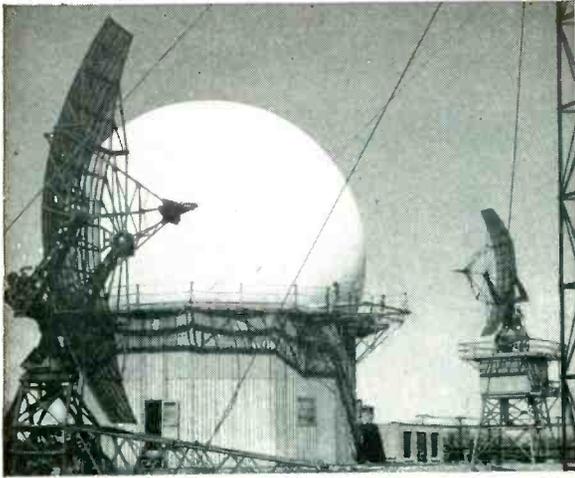
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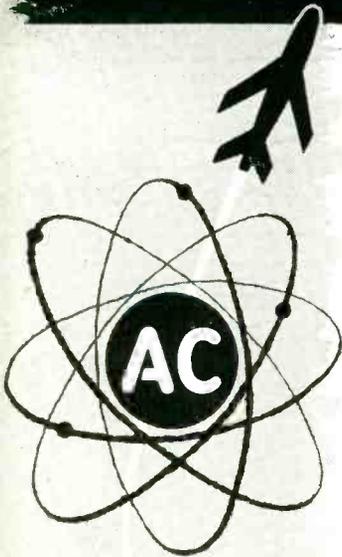
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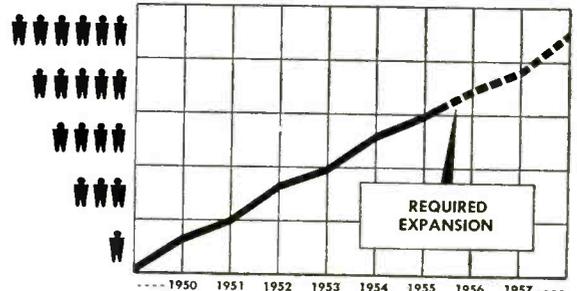
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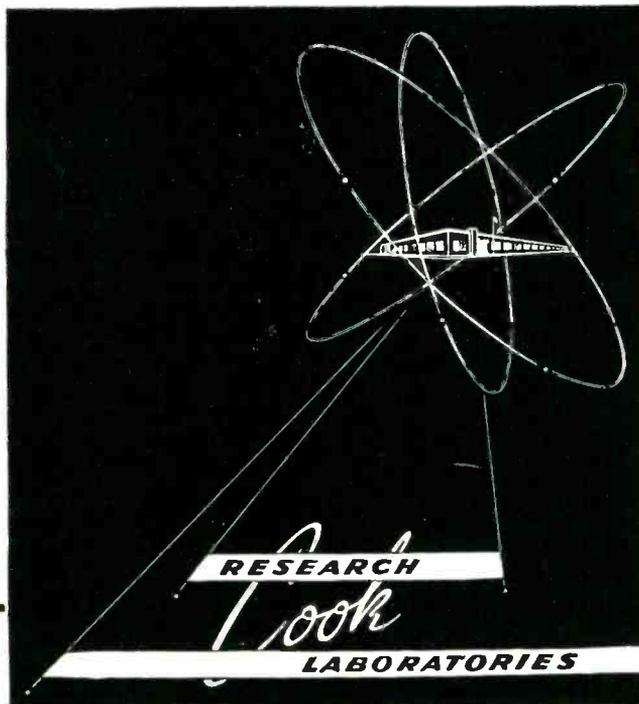
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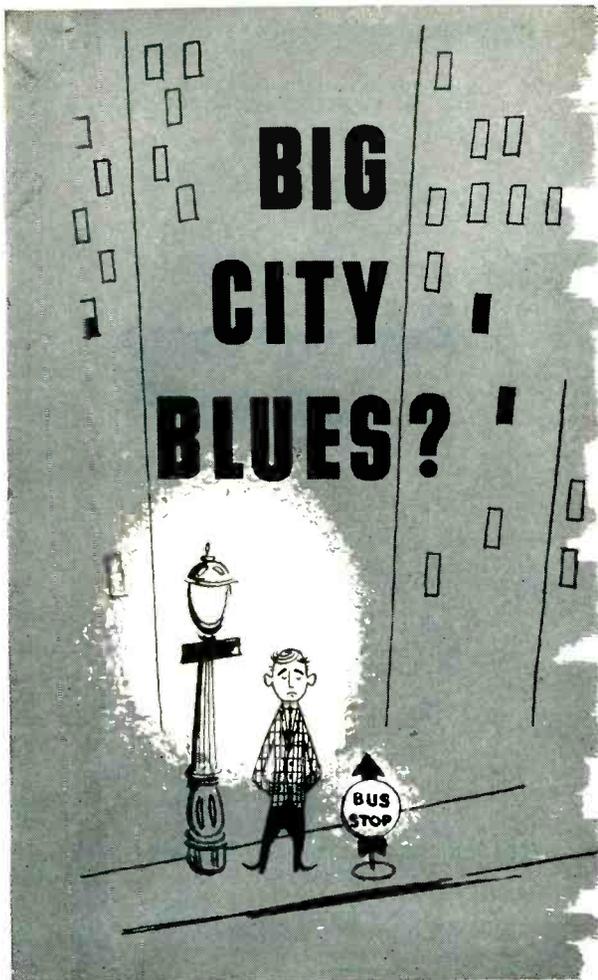
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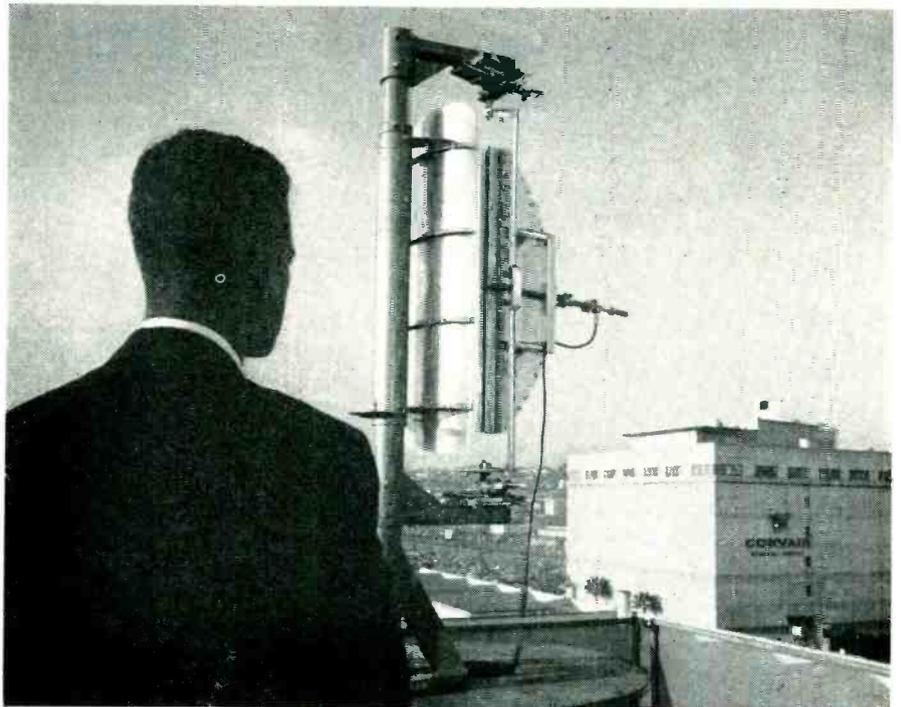
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1B22	1.75	2J56	132.50	4J42	200.00	286A	7.75	721A	3.25	892	write	8014A	55.00
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1B35	6.25	2J62	47.50	4J52	245.00	304TL	8.75	725A	19.50	892R	write	8025	7.00
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2C34	.75	2K29	32.50	5J26	125.00	339A	27.50	807	1.35	892R	write	9006	.35
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NEW YORK 13, N. Y.

**SEARCHLIGHT SECTION**

**WANTED**

**BC-788, T-47A/ART-13,  
BC-348R, R-5/ARN-7,  
RT-18/ARC-1**

**RADALAB**

87-17 124th STREET  
Richmond Hill 18, New York  
Phone Virginia 9-8181-2-3

Prices FOB NYC. Rated firms  
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CABLE: Radalab, NY  
TELETYPE: NY-4-4361

**AN/ASQ-1 and 1A MAGNETOMETERS**

This is an airborne magnetometer used to measure the magnetic flux of the earth and to locate submarines and other metallic objects by their distortion of the magnetic field. Sensitivity 2-3 gamma or better. POR.

**AN/GSQ1-A SPEECH SCRAMBLERS**

Speech scrambler for use on any comm. channel to insure privacy. We can supply complete installations of this equipment 28v DC input. Also 110v 60 cyc.

**SCR-291A DIRECTION FINDER**

Automatic ground direction finder covering 1.5mc-30mc. Provides instant bearings on a C.R. indicator of any signal in its range. This equipment is transportable and can be set up quickly. 110v 60 cyc. POR.

**P.P.I. REMOTE RADAR REPEATERS**

We can supply the following types of remote Radar P.P.I. Repeaters. The main radar provides the Synchronizing, Syncro. and Video. Pulses to operate the Repeaters. These repeaters may be used with any marine ground or airborne.

VC 7" P.P.I. Upright deck mount Repeater. 4 Ranges are provided from 4-200 miles. Input 110 Volt 60 Cyc.

VD 7" P.P.I. Deck mount Repeater. This unit is very similar to the VC but is completely Waterproof and may be used on deck. The ranges are the same as the VC. Input 110 Volt 60 Cyc.

VE 7" P.P.I. Table mount Repeater. This is a very compact set. 4 ranges are provided from 4-200 miles. Input 110 Volt 60 Cyc.

VF 9" P.P.I. Deck mount Repeater. This is a very late model Repeater enabling 20 radars to be fed into it. 4 Ranges from 4-200 miles are provided. Input 110 Volt 60 Cyc.

VG 12" P.P.I. Plotting Table Projection Repeater. This is a very elaborate Remote Indicator. For use in a plotting center. Up to 20 Radars may be fed into it. This set utilizes a Skiatron tube to provide data that can be retained on the screen and can be erased at will. Input 110 volt 60 Cyc.

Accessories are available such as repeater adaptors enabling the set to be used at a greater distance than normal. Input switches to select the radar to be viewed etc.

**SCR-682-A RADAR**

10CM high power long range harbor surveillance and early warning RADAR. This equipment is a 3000 mc mobile search radar that can be transported in a truck. The equipment incorporates a 7" PPI for operation up to 240,000 yards. Azimuth accuracy is  $\pm 1\%$ . Range accuracy is 100 yards at 10,000 yard range and 5000 yards at 240,000 yard range. Trans. output is approx. 225 KW. pulse width is one microsecond. Antenna beam width is 6". Input is 110v 60 cyc. Can be supplied with or without operating shelter or antenna tower. POR.

**We can supply many types of radars, test sets, communications equipments, manufactured after 1947. Write us if you cannot find it.**

**AN/APR-4 38-4000 MC RECEIVER**

This is a precision receiver covering 38-4000 mc. The set utilizes 5 tuning units with direct reading dials in megacycles. The receiver has a wide and narrow band width 30mc. I.F. strip which may be selected at will. An output meter is provided to measure signal strength. Outputs are provided for a pulse analyzer and pan adaptor. Each tuning unit has an automatic sweeping mechanism which enables any portion of the tuning range to be scanned automatically. Input 110v 60 cyc. POR.

**500-1300 MC SIGNAL GENERATOR**

This is a high precision signal generator covering 500-1300 mc. A precision attenuator is built in providing accurate determination of output from 0-100,000 microvolts. Either CW or pulsed carrier output with the following characteristics are provided. Pulse rate 60-2,500 CPS. Pulse length 2-30 microseconds. Output line 50 Ohm impedance. Accuracy better than one percent. Input 110 v 60 cyc. With calibration charts. Price \$249.50

**90-600 MC SIGNAL GENERATOR**

This set covers 90-600 mc. with an accuracy of one percent or better. C.W. or pulse output with the following characteristics are provided. Output from 0-100,000 microvolts 2-30 microseconds long. Pulse rate 60-2500 cyc. Pulse delay 3-300 microseconds. Output 50 ohm line. Input 110v 60 cyc. Price...\$249.50

**CF-3A CARRIER REPEATER**

This is a transportable 3 wire carrier telephone repeater. This set amplifies all signals when used in an intermediate position on a carrier system to extend the range. DC signaling and telegraph communications can be performed to the terminal equipments or to other repeaters. Monitoring and transmission circuits are built in. Power input 110 or 220v or 12v DC. This set can be used with all CF terminals and commercial equipments. Brand New in original cases. POR.

**AN/APA-17 DIRECTION FINDER**

This is an automatic direction finder covering 300-1,000 mc to be used with the APR-1 and APR-4 radar search receivers. The bearing is presented on a cathode ray screen in a cardoid pattern. The set can be used in aircraft or on the ground. Input 110v 480 cyc and 28v DC. POR.

**RADAR BEACONS**

**X and S Band High and Low Power Beacons**

We can supply the following Beacons in Portable and Stationary Models. The X-BAND models will operate with the new Weather Radars AN/CNP-6 X-Band high power Radar Beacon. This is a 40 KW set for use at an Airport. This set will interrogate X-BAND Radars up to 200 miles. Variable Coding is provided as well as monitoring facilities. Input is 110 V 60 CYC.

AN/CPN-8 S-BAND HIGH POWER Airport Beacon. This is a very compact set. This set will interrogate S-BAND Radars up to 200 Miles. Variable Coding and monitoring facilities are provided. Input 110 Volt 60 Cyc.

AN/CPN-17 S-BAND High power version of the CPN-6 with all the latest improvements. Input 110 Volt 60 Cyc.

AN/UPN-4 X-BAND Very lightweight Portable Beacon. This set will interrogate X-BAND Radars up to 60 miles. Variable Coding is provided. Input 12 Volts D.C. and 110 Volts 60 Cyc. Weight Approx. 40 Lbs.

AN/UPN-1 and 2 S-BAND Portable beacons. This set will interrogate a S-BAND Radar up to 60 Miles. Variable Coding is provided. Input is 12 Volts D.C. and 110 Volts 60 Cyc. Weight Approx 50 Lbs.

**BLOWERS:**



12/24 VDC-AC CAST ALUMINUM BLOWER (Pictured at left)-100 CFM; 3" intake; 2" outlet, Shunt Motor 4 1/2" x 2 1/2"; 3000 RPM @ 24 VDC. \$5.95

6 VDC SINGLE-100 CFM-No. 6100 \$4.95

6 VDC FLANGE-150 CFM-No. 6150 \$6.95

24 VDC DUAL-20 CFM-Min-10 CFM BLOWER (Pictured right) 27.5 VDC; 1/100 HP; 7000 RPM; Oster Motor C2BP-1A; L-R Mfg. Co. Bakelite Blower #2, overall size: 3-3/4" x 4-1/2" Price \$5.95

Same as above, 12 VDC operation. Price \$5.95



115 V. 400 CYCLE-10 CFM-Eastern Air Devices Motor 331A-7200 RPM, 1/100 HP. L-R #2 Blower Assy. Overall Size: 4-1/2" x 3-3/4". No. 3110. \$5.95

10 CFM BLOWER (Pictured at left)-28 VDC-.6 A; 5000 RPM. Pioneer Motor SS-2845. Aluminum Blower, Housing. Overall Size: 4-3/4" x 3-3/4". Price \$5.95

**115 V. 60 CYCLE BLOWERS:**

115-VAC 60 cycle SINGLE TYPE-100 CFM; 2-3/4" intake; 2" outlet. Complete size: 5" x 6" No. 1C830 \$8.95

115 VAC 60 cycle DUAL TYPE-100 CFM; 4" intake; 2" Dis. Each side. Complete size: 8" x 6" No. 1C880 \$13.95

115 VAC 60 cycle COMPACT TYPE-108 CFM; Motor built inside squirrel cage; 4-1/2" intake; 3-3/4" x 3" Dis. Complete size: 4-1/2" W x 8-3/8" H x 3-3/4" D-No. 2C067 \$14.95

115 VAC 60 cycle FLANGE TYPE-140 CFM; 3-3/4" intake; 2-1/2" Dis. Complete size: 7-1/2" W x 7-7/8" H x 6-3/4" D-No. 1C807 \$13.95

115 VAC 60 cycle FLANGE TWIN-275 CFM; 4-3/4" intake; 3-3/4" x 3" Dis. Complete size: 11-3/4" W x 3-3/4" H x 8-1/16" D-No. 2C069 \$21.95

115 VAC 60 Cycle BLOWER-200 CFM; 4" intake; 3" x 5" outlet. Overall size: 8" x 7" x 6". Rodine Motor NSI-33. Removed from New Equipment. #BOD-200 \$14.95

115-VAC 60 Cycle BLOWER-100 CFM; 3-3/4" intake; 2" outlet; Rd. Flange with Flap Director. Overall size with bracket; 8" L x 6-1/2" W x 7" H. Removed from New Equipment. Diehl Motor FD-2106-6 No. FDBL-2106 \$6.95

Same as above, but with 12- Curved Director. No. CDBL-2106 \$7.95

Previously Adv. Items Still Available. WRITE!

**RECEIVER-TRANSMITTER**

**F M 20-28 M C.**

BC-500 RECEIVER-TRANSMITTER: FM Crystal Control on 5 Channels, 100 KC separation 20-28 MC.

TRANSMITTER: 25 Watt output. 7 tubes: 1/1625, 1/12A6, 3/12SJ7, & 2/12SA7

RECEIVER: 11 Tubes: 1/12SL7, 2/12A6, 3/12SA7, 3/12H6, 2/12U8, & 1/12SJ7.

DYNAMOTOR SUPPLY: Receiver 28 VDC 1.2 A. input; output 250 VDC 60 MA. Transmitter 28 VDC 4 A. input; output 550 V 120 MA.

CONTROL PANEL: For Local Control and outlets for Remote also. Heavy duty 5" speaker. Size: 12" x 25" x 9 1/2". Weight: 65 lbs. Price: NEW \$59.50

BC-923 RECEIVER-4 Preselected Channels-Freq. Ranges 27-28.5-29.52-31.5-34.4 and 34.4-38.9 MC. Complete w/16 Tubes: 1/12SA7; 3/12SCT; 2/12SG7; 2/12SJ7; 1/VR-150; 1/6H6; 1/6SJ7; 2/8SL7; 1/6V6; 2/6AC7; 1/NE-20; & DC-14 Crystal 1000 KC; Crystal Calibrator, and Speaker. Power required: 12 or 24 VDC & 275 VDC 150 MA. Size: 6-3/4" x 11-5/16" x 11-1/2". Price: NEW \$34.95

12 Volt Dynamotor 1/BC-923 REC. \$5.95-AC Power Supply 115 V 60 cycle 1/BC-923 \$22.50-Plug f/Rear of BC-923. \$1.00

**METERS:**

**WESTON AC AMMETER**

(Pictured in portable leather case, with Test Leads, 2 3/8", 0-15 AC and 0-3 AC Scale \$5.95)

**DC AMMETER HOYT:**

In portable metal case, with Test Leads, 4 1/2", Fan. Mirrored Scale-0-15 ADC. \$4.95

0-3 RF AMMETER IS-128 - 2 1/2" Rd. Flush Mtg. Calibrated F/Non Mag Panel. P/O BC-253 Transmitter. Price: NEW \$2.95

0-8 Amp RF w/Thermocouple IS-89; 2 1/2" Rd. \$4.95

0-15 AC-DC 2 1/2" Rd.; IS-122 \$4.95

0-500 Milliamp DC-2 1/2" Rd.; IS-22 \$4.95

0-250 MA DC-3" Sq. Dialur. \$3.95

0-1 MA DC-Simpson; 3-3/4" Rd. \$3.95

0-2 MA DC-Westinghouse; 3-3/4" Rd. \$2.95

**INVERTERS & GENERATORS:**

AC-DC GENERATOR-Output 115 VAC 800 cycle 10.5 A. & 28.5 VDC; 60 A. at 2400 RPM. 3/8" spline shaft. Bendix Eclipse No. NEA-3. Price: NEW \$18.95

PE-218-Input 28 VDC 100 A.; output 115 V. 400 cycle 1 Phase, 1500 VA. Used; \$14.95-New; \$39.95

PE-115 or PE-206-Input 28 VDC 36 A.; output 80 Volt 800 cycle 7.2 Amps. Like New; \$5.95

TYPE 800-1-D-Input 28 Volt 62 A.; output 115 Volt 7 Amp. 1 Phase 800 cycle. NEW; \$24.95

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**600 VOLT OIL CONDENSERS**

Terrific values—below mfrs. cost on Brand New Stock.

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OA3..... 1.00	2E32..... 1.00	3C45..... 7.00	6AK7W..... 1.50	282B..... 5.00	715A..... 2.00	919..... 2.25	5656..... 7.50
OB2..... .75	2J31..... 14.50	3DP11A..... 7.50	6AR6..... 1.30	QK283A..... 100.00	715B..... 4.75	922..... 1.25	5657..... 125.00
OB2WA..... 3.00	2J32..... 14.50	3D21A..... 5.00	6A57G..... 2.50	QK284A..... 100.00	715C..... 12.30	927..... 1.00	5663..... 1.50
OC3/VR105..... .75	2J33..... 14.50	ELC3J..... 7.00	6D21..... 200.00	287A..... 3.50	717A..... .50	SN930..... 4.50	5667..... 125.00
OD3/VR105..... .75							5670..... 2.00
1B23..... 3.00							5672..... 1.25
1B24..... 5.50							5675..... 7.00
1B24A..... 15.00							CK5678..... 1.00
1B26..... 2.00							5686..... 2.00
1B27..... 10.00							5687..... 3.00
1B29..... 3.00							5691..... 4.75
1B35..... 4.50							5692..... 5.00
1B36..... 4.00							5693..... 4.75
1B40..... 2.50							5696..... 1.00
1B44..... 22.50							5702..... 2.00
1B51..... 6.75							
1B63A..... 22.00							

*This is only a partial inventory. — We stock one of the largest tube inventories in the U. S. Complete inventories purchased. — Quantities large or small — we buy them all!*

1N21..... 7.5	2J34..... 14.50	3DP152..... 5.00	6F4..... 3.25	304TH..... 8.95	719A..... 10.00	931A..... 2.50	5703..... 1.25
1N21B..... 1.50	2J36..... 20.00	3E29..... 8.50	6J4..... 3.00	304TL..... 8.95	720AY-EY..... 50.00	935..... 4.00	5718..... 3.00
1N22..... 7.5	2J39..... 10.00	3FP7A..... 3.50	6K4..... 2.25	305A..... 3.00	721A..... .75	SN944..... 4.50	5719..... 2.50
1N23..... 7.5	2J42..... 60.00	3GP1..... 1.95	6L6WGB..... 3.50	307A/RK75..... 1.00	721B..... 7.50	SN949C..... 4.50	5725..... 2.00
1N23B..... 1.50	2J48..... 35.00	3J30..... 35.00	6SK7W..... 2.00	312A..... 2.95	722A..... .75	SN953D..... 4.50	5726..... 1.00
1N23BB..... 5.00	2J49..... 40.00	3J31..... 45.00	6SL7WGT..... 2.00	313C..... 3.00	723A/B..... 8.50	954..... .35	5727..... 2.25
1N25..... 4.00	2J50..... 35.00	3K30..... 125.00	6SN7W..... 2.00	316A..... .50	724A..... 1.00	955..... .35	5744..... 1.00
1N26..... 4.00	2J51..... 150.00	4B23..... 7.50	6X5WGT..... 1.30	323B..... 5.00	724B..... .75	956..... .35	5750..... 3.10
1N28..... 5.00	2J55..... 35.00	4B24..... 7.50	7C22..... 50.00	327A..... 2.25	725A..... 3.50	957..... .35	5751..... 2.20
1N34A..... .50	2J56..... 50.00	4B26..... 3.50	7C23..... 69.50	336A..... 5.00	726A..... 7.00	958A..... .35	5780..... 199.50
1N35..... 1.50	2J61..... 15.00	4B27..... 3.00	7C24..... 100.00	338A..... 5.00	726B..... 25.00	959..... 1.50	5787..... 4.95
1N42..... 8.00	2J62..... 5.00	4C27..... 3.50	15E..... 1.00	349A..... 7.50	726C..... 25.00	SN977CX..... 4.50	5814..... 1.60
1N47..... 3.00	2J62A..... 50.00	4C28..... 25.00	NE16..... .35	350A..... 3.00	730A..... 10.00	991..... .35	
	2J651..... .50	4C35..... 13.50	RK21..... 1.00	350B..... 2.75	750TL..... 45.00	CK1005..... .35	
		4J22..... 35.00	RX21..... 6.00	354C..... 5.00	801A..... .50	CK1006..... 2.75	
		4J23..... 35.00	HK24..... 3.00	359A..... 3.00	802..... 2.75		
		4J24..... 35.00	D42..... 40.00	368AS..... 2.50	803..... 1.50		
		4J26..... 35.00	HK54..... 2.00	388A..... 1.20	804..... 9.75		
		4J27..... 35.00	QK59..... 30.00	393A..... 4.50	805..... 4.75		
		4J28..... 35.00	QK60..... 25.00	394A..... 3.00	806..... 9.50		
		4J29..... 35.00	RK60/1641..... 1.50	396A..... 3.25	807..... 1.25		
		4J31..... 65.00	QK61..... 30.00	403B/5591..... 2.75	807W..... 4.50		
		4J34..... 50.00	QK62..... 25.00	WL417A3.50	808..... 1.50		
		4J42..... 25.00	HY65..... 2.00	WE418A..... 15.00	808..... 2.75		
		4J50..... 85.00	RK65/5D23..... 10.00	WE421A..... 15.00	811..... 2.90		
		4J52..... 50.00	FG67/5728..... 10.00	WE422A..... 11.00	812..... 2.50		
		4J57..... 100.00	RKR72..... .50	RT434..... 25.00	813..... 11.00		
		4J58..... 100.00	RRR73..... .50	434A..... 3.00	814..... 2.00		
		4X150A..... 24.00	100TH..... 6.50	446A..... .50	815..... 1.50		
		4X500A..... 60.00	FG104..... 29.50	446B..... 2.00	816..... 1.50		
		5BP2A..... 6.50	FG105..... 11.00	450TH..... 35.00	829..... 6.00		
		5BP4..... 2.00	F123A..... 4.00	450TL..... 35.00	829B..... 8.50		
		5CP1..... 1.75	F128A..... 15.00	WL456..... 59.50	830B..... .95		
		5CP1A..... 10.00	HF100..... 7.50	464A..... 2.50	832..... 4.00		
		5C22..... 29.50	FG154..... 17.50	CK512AX..... 1.10	832A..... 6.00		
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		5D21..... 7.00	WL172..... 15.00	559..... .50	837..... 1.00		
		5D23..... 7.50	WL200..... 75.00	559..... .50	838..... 1.00		
		5FP7..... 1.50	203A..... 5.00	HY615..... .50	842..... 2.50		
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		5JP2..... 7.50	207..... 50.00	CU627..... 10.00	846..... 75.00		
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		5JP5..... 7.50	212E..... 17.50	HK654..... 25.00	851..... 12.50		
		5JP11A..... 12.50	217A..... 1.50	WL651..... 30.00	852..... 5.00		
		5J23..... 20.00	217C..... 2.00	WL652..... 20.00	860..... 3.00		
		5J26..... 90.00	WL218..... 25.00	WL681/68620.00	861..... 15.00		
		5J29..... 5.00	QK221..... 125.00	701A..... 1.95	865..... .50		
		5J30..... 5.00	FG235A..... 35.00	703A..... 1.50	866A..... 1.15		
		5J33..... 5.00	QK249..... 150.00	704A..... 1.00	872A..... 1.35		
		5MP1..... 3.95	249B..... 2.50	705A..... 1.00	874..... .60		
		5NP1..... 5.00	249C..... 3.00	706AY-GY..... 15.00	878..... .60		
		5R4GY..... 1.00	250TL..... 15.00	707A..... 3.50	884..... 1.25		
		5R4WGY..... 2.40	251A..... 47.50	707B..... 4.50	889A..... 125.00		
		6CJ..... 6.50	252A..... 10.00	708A..... 1.00	902A..... 3.00		
		6AC7A..... .90	QK253..... 149.50	713A..... .50			
		6AC7W..... 1.25	254A..... 6.00	714A..... 12.50			
		6AJ5-JAN..... 1.25	FG258A..... 120.00				
		6AL5W..... .70	271A..... 10.00				

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Vacuum Capacitors



6 mmfd. 30 KV.....	10.00
50 mmfd. 32 KV.....	9.00
50 mmfd. 40 KV.....	14.50
75 mmfd. 20 KV.....	12.50
150 mmfd. 20 KV.....	14.00

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5" DUAL GUN TUBE

Long persistency face. Value at \$200.00. This tube has been rejected for military use.

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1N63/K63..... 1.75	2K22..... 15.00	5C30/C5B..... 1.50	217A..... 1.50	707B..... 4.50	889A..... 125.00
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1P21..... 25.00	2K26..... 45.00	5D21..... 7.00	WL218..... 25.00	713A..... .50	
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1P28..... 9.00	2K33..... 100.00	5FP7..... 1.50	FG235A..... 35.00		
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1P36..... 2.50	2K34..... 99.50	5JP2..... 7.50	249B..... 2.50		
1P39..... 1.20	2K39..... 100.00	5JP4..... 7.50	249C..... 3.00		
1W5..... 1.25	2K41..... 100.00	5JP5..... 7.50	250TL..... 15.00		
1Z2..... 2.00	2K43..... 125.00	5JP11A..... 12.50	251A..... 47.50		
2AP1..... 5.00	2K44..... 150.00	5J23..... 20.00	252A..... 10.00		
2C26A..... .50	2K45..... 50.00	5J26..... 90.00	254A..... 6.00		
2C34..... .35	2K47..... 125.00	5J29..... 5.00	FG258A..... 120.00		
2C35..... 2.50	2K48..... 90.00	5J30..... 5.00	271A..... 10.00		
2C39..... 7.50	2K54..... 15.00	5J33..... 5.00			
2C39A..... 8.00	2K56..... 50.00	5MP1..... 3.95			
2C40..... 7.50	2V3G..... 1.50	5NP1..... 5.00			
2C42..... 15.00	2X2A..... 1.00	5R4GY..... 1.00			
2C43..... 9.00	3BP1..... 2.00	5R4WGY..... 2.40			
2C44..... .50	3B22..... 1.50	6CJ..... 6.50			
2C46..... 9.00	3B24..... 1.00	6AC7A..... .90			
2C51..... 3.25	3B24W..... 5.00	6AC7W..... 1.25			
2C52..... 3.50	3B26..... 3.50	6AJ5-JAN..... 1.25			
2C53..... 10.00	3B28..... 6.00	6AL5W..... .70			
2D21..... .75	3B29..... 6.95				
2D21W..... 1.50	3C22..... 60.00				
2E26..... 3.25	3C23..... 5.00				
	3C24..... 1.50				
	3C27..... 1.50				
	3C31..... 1.50				

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5%  
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5%  
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.04 ea	2.50/c	20.-M
.08 ea	5.00/c	40.-M
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.09 ea	7.00/c	60.-M
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HP lobing motor (synchronous, 115 vac 60 cy.). Antenna folds up to 46 in. sq. x 18 in. height. Shpg. wt. approx. 200# (as shown) **\$27.50**

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TYPE	INPUT		OUTPUT		Price
	VOLTS	AMPS	VOLTS	AMPS	
DBAR83	14	3.8	375	.150	\$6.50
35X-059	19	3.8	405	.095	4.35
PQ3-15	14	2.8	220	.08	8.95
DM33A	28	7	540	.250	3.95
23350	27	1.75	285	.075	3.55
B-19	12	9.4	275	.100	6.95
DA-3A*	28	10	500	.050	3.95
			300	.260	3.95
			150	.010	
			14.5	5.	
PE 73CM	28	19	100	.350	12.50
BD9	14	2.8	220	.08	8.95
DAG-33A	18	3.2	450	.06	2.50
BDAR 93	28	3.25	375	.150	6.95

\* Less filter.  
 † Used, Excellent.  
 PE 94, Brand New 5.95

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800-1B Input 24 vdc, 62 A. Output: 115 V, 800 cy. 7A. 1 phase. Used, excellent **\$18.75**  
 PE-218H: Input: 25/38 vdc, 92 amp. Output 115V 300/500 cy 1500 V-ampere. NEW **\$32.50**  
 PE206: Input: 28 vdc. 36 amps. Output: 80 V 800 cy. 500 volt-amp. Dim. 13 x 5 1/2 x 10 1/2. New **\$22.50**  
 EICOR-ML 3011-5. Input: 13.75 V; 18.4A. Output: 115 V/400-300. 300. 0.95 PF 100 VA. New **\$59**  
 PU 7/AP. Input: 28 vdc/160A. Output: 115 VAC. 400-200. 100. 500 VA. 21.6 Amp. Volt. and Freq. Reg. Used, Exc. **\$75**

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 7-5E3-1-200-67P. 7.5 KV "E" Circuit. 1 microsec. 200 PPS. 67 ohms impedance 3 sections. **\$7.50**  
 7-5E4-16-60. 67P. 7.5 KV "E" Circuit. 4 sections 16 Microsec. 60 PPS. 67 ohms impedance. **\$15.00**  
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 H-616 10KV. 2.2 usec. 375 PPS. 50 ohms Imp. **\$27.50**  
 H-615 10KV. 0.85 usec. 750 PPS. 50 ohms Imp. **\$27.50**  
 K58865 CHARGING CHOKE: 115-150 H @ .02A. 32 10H @ .08A. 21 KV Test. **\$37.50**  
 G. E. 25E5-1-350-50 P2T. "E". CKT. 1 Microsec. Pulse @ 350 PPS. 50 OHMS Impedance. **\$69.50**  
 K59623 CHARGING CHOKE: 1611 @ 75 MA. 360 Ohms DCR. 9000 Vac Test. **\$14.95**  
 G. E. 6E3-5-2000. 50 P2T; 6KV. "E" Circuit 0.5 usec. /2000 PPS/50 ohms/2 sections. **\$75.00**

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 Airborne RF head, model ASD. delivers 50 Kw peak output at 9000 mc. at .001 duty. Complete with pulser unit and all tubes. Mfd. Sperry. **\$210**

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RAYTHEON WX 4298E: Primary 4KV., 1.0 USEC. SEC: 16KV-16 AMP DUTY RATIO: 001 400 CYCLE PFL TRANS. "BUILT-IN" **\$32.50**  
 WECO: D-163247 Por Modulator of SCR 720. **\$22.50**  
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 Primary: 9.33 KV, 50 ohms Imp.  
 Secondary: 28 KV, 450 ohms  
 Pulse length: 1.05/5 usec @ 635/120 PPS. Pk Power Out: 1.740 KW  
 Bifilar: 1.5 amps (as shown) **\$62.50**  
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1N21	28c	5J23	\$34.50	700B	\$8.75
1P56T	45c	5J30	\$14.50	700D	\$8.75
1P30	\$1.50	5J35	\$14.75	703A	\$1.50
2C21	35c	5B5/5C30	\$1.10	704A	95c
2C22 7193	7c	7C4 1203A	5.18	705A	75c
2C26A	8c	9G7P	\$3.45	706A	\$9.75
2J21A	\$2.25	10Y	10c	706EY	\$14.75
2J22	\$2.50	15R	15c	706EY	\$9.75
2J26	\$2.50	39 44	8c	706CY	\$9.75
2J27	\$3.00	QK59	\$39.50	708A	\$2.10
2J29	\$18.50	QK60	535	709A	\$2.45
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2J32	\$14.50	QK62	\$54	C-722A	90c
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2J39	\$9.50	ML-100	\$69.50	730A	\$8.50
2J39	\$8.25	HY 14B	25c	800	65c
2J48	\$22.50	227A	\$2.50	801	25c
2J56	\$48.50	268A	\$2.25	837	85c
2J62	\$6.75	316A	\$5.00	843	19c
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3EP7	\$2.00	356B	\$10.50	862	19c
4J34	\$23.50	393A	\$4.50	876	75c
4J38	\$85	417A	\$6.10	CK1005	35c
4J42	\$47.50	CL471A	\$2.10	1625	20c
5P27	\$1.10	WLS31	\$2.75	1619	15c
5CP1	\$2.50	32 832	\$1.50	1626	10c
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 For operation on 115V 400-  
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U. S. NAVY type PAE-1 Electric Megaphone equipment is designed for voice reinforcement in much the same manner as, but to a greater degree than, the familiar acoustic megaphone. Consists of Megaphone Unit (which combines a microphone and reproducer in a single assembly.) Portable Amplifier which electrically amplifies the output signal of the microphone section of the megaphone and feeds this amplified signal to the reproducer section. Charging Rack for recharging the self-contained storage battery of the portable amplifier. **\$129.50**  
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## X BAND - 1" x 1/2" WAVEGUIDE



AT-68/UP 3 CM Horn with type N feed for receiver measurements, etc. New (as shown) **\$7.45**  
 ROTARY JOINT (A1S-6) Sperry #658275, 180 deg. rotation, choke-coupled, 1" D-Coupler, 20 dB, with N-Takeoff **\$22.50**

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## 3 CM. TEST SETS

TS 12 AP. For standing wave measurement of plumbing, TR/ATR boxes, crystal mixers, antennas, etc. The TS 12 consists of two basic units: Unit 1 is a high gain stable amplifier followed by a 3-inch meter which reads SWR directly. UNIT 2 consists of waveguide accessories, including a slotted line, probes, dummy load, adapters, etc. Either bolometer or crystal unit may be used. Both units are portable, self contained. Operates from 115 v. 60-800 cps. **\$100.00**  
 TS 13/AP. Signal source 9305-9445 mc. 50 microwatts. Comes with a wavemeter, thermistor-bridge power meter, and calibrated attenuator. Oscillator is a klystron type 723/a-b which may be internally (self-synch) or externally pulsed. Controls are provided for CW operation, variable pulse delay, pulse width and phasing. Operates from 115 v. 600-800 cps. New **\$75.00**  
 \*Send for pricing and delivery schedules

## 10 CM.—RG48/U Waveguide

POWER SPLITTER for use with type 726 or any 10 CM. Shepherd Klystron. Energy is fed from Klystron antenna through dual pick-up system to 2 type "N" connectors **\$12.50**  
 LHTR. LIGHTHOUSE ASSEMBLY. Parts of RT50 A1P-1 & APG 15 Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG. To Bevac. Uses 2C40, 2C45, 1B27. Tunable AMX 2400-2700 MICS. Silver Plated. **\$15.00**  
 BEACON LIGHTHOUSE cavity d/o UPN-2 Beacon 10 MC Type "N" Feed, each. **\$27.50**  
 MAGNETRON TO WAVEGUIDE Coupler with 721-A Duplexer Cavity, gold plated. **\$31.50**  
 721A. TR BOX complete with tube and tuning plungers. **\$12.50**  
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 HOMDELL-TYPE "N" Male Adapters, 17L-1D167281 **\$2.75**  
 BEACON ANTENNA, ASB/APN-7 in Lucite Ball. Type "N" feed. **\$22.50**  
 ANTENNA, AT-94/APR: Broadband Conical, 300-3300 MC Type "N" Feed. **\$12.50**  
 "E" PLANE BENDS 90 deg. loss flanges. **\$7.50**  
 K-Band, X-Band Eqpt. Available. Send for List

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 D-167613 Disk Type DCR: 355 Ohms @ 75 Deg. F. I.M. 2.5%. 1 Watt. **\$1.00**

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Model 15: 30 Mc Center frequency. Bandwidth 2.5 Mc gain figure: 65 db. Uses 3 stages of 6AC7's. Has I.F. Resistor and Video Detector A.F.C. Strip included. Input impedance: 50 Ohms. Less tubes **\$17.50**  
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TS 46/AP wavemeter (micro amps) DC 0-200	15.00
TS 146/UP 115 V. 1 ph. w/horn & coupler	450.00
TS 134/UM wavemeter	25.00
TS 133/UPM wavemeter	20.00
TS 100/AP wavemeter checked	40.00
TS 111/AP wavemeter checked	40.00
TS 297/U wavemeter checked	40.00
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I E 46 w/BC 908 freq. meter 160-220 MC	9.50
BC 1008 Receiver 157-211 MC	3.50
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BC 446J Transmitter 200-400 KC. 100 W, 115-230 V	200.00
400 cy. 1320 MC	4.50
B 357 Receiver w/meter IS 122 Meter	100 @
BC 800 w/FT 416-BD142—cables	40.00
C59/ARC-5	2.50
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FILTERS

FL 15 321800-15 10 A. 30 VDC	.new	1.16
FL 5	.40	
FL 6 Filter power for DM 31	.new	1.50
FL 8 Filter power for DM 21	.new	1.50
FL 10 Filter power for DM 21	.new	1.00

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Sets of 8	4.00	
Sets of 120	5.20	
Misc. type 30,000 per 1000		
FT 241—FT 243—FT 500		
Crystal tube	5000 @	.07
Coil	3C825-20 for SCR 609-610	.15
M359	10	.10
TRC-8		
Chests AB48/TRC-8 w/sledge hammer, ropes, cables, antenna 2A-248-41.1 in chest	12.50	
3Z7702-4/S1 Oak wood support for S4/TPS-3	500 @	1.50
Choke	3C382 for SCR 609-160	.15
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CU 92 Antenna coupling Unit for BC 348	4.50	
Indicator freq. meter model 637	4.50	
Roller turntable Assy 243193	.50	
Radar target reflector has ascent of 1000 ft per min.	.new	.50
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ANB-M-C1	.new	.75
R14 Receivers	.new	.40
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Control box for RL 7 interphone w/relay pots—switches—plugs	1.50	
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IN 608 Insulator	1.50	
Windshield De Icer for Douglas C-47	1.50	
Metal coating to resist heat temp. in cont. w/2 pint solutions: 1 brush, 1 spatula.	100 boxes @	.50
Flagnets w/Bagnetstaf w/panels, used for recognition by friendly a/c.		
MD7/Navy mod. like BC 456 w/tube	3.50	
Oil temp. gage 57 Warmer 412010-108	.35	
Potentiometer 24400 4A2557/24-37	.10	
VJ1 Radio complete	.new	55.00

Modif. bits 2Z5727-38 w/tubes 50C5-35W4-12AT6-12A W6	4.50	
M 290 Microphone adapter	.75	
Vibrator V18-8	.25	
Recorders RC 791	40.00	
Podder cond. Assy 28274N/C4 for MN 26	.75	
MC 203	.new	2.50
BG 81 for BC 221	.new	1.50
Balloons inflate 13 ft	.new	1.50
Balloons inflate 6 ft	.75	
Balloons inflate 2 ft	.25	
JK 23 & JK 24 & JK 48	.34	
SW 225 Switch for ART-13	.20	
MC 211	.75	
Circuit breaker 3H900-0-22 for PE 101	.20	
CPN-8 comp w/case CY 68/CPN-8 w/monitor coder	.75	
TS 121/CPN 8, modified receiver coder T50/CPN-8	325.00	
ARC-1 Autotunes	.new	2.75
ARC-1 Autotunes	.used	1.00
TRC-1 Connector 2Z3063-33	.new	.25
TRC-1 Transf. 2Z9635-23	.new	.75
CS 70 Cases for TC-9 control office for M 205 4C2870	.new	6.50
J 44 keys	.new	.75
Brushes all type motors	.new	.10
JK 48 w/ord	.new	.25
TC 125 Remote control w/dial—crank—filling	.new	.25
Micro switch WZ-7TR	.new	.10
BC 803 Control box	.new	1.50
Marion for J 146-02	.new	.40
Coil Repeater C 114	.new	.75
Oranks GC-9	.new	.15
3 Pins Cook A-5 and A-9	.new	.05
AN II 15 Helmet w/ohin strap & 2 ear cushions large	.new	.30

TRANSMITTER RECEIVER EQMT.

BN-1 105-125 VAC. 50-425 cy w/rec. trans. CT 250 ACW Modulator CFN 43ACB. Antenna CTZ 66AFJ. Cabinet CFN 10238	95.00	
AN/TRT-1 225012-1 Radio Set	new boxed	22.50
GP-7 850-1500 KC. 3000-9050 KC w/3 meters	20 @	11.50
TRT-1 comp. w/separate tubes LM27 C132/TRT-1 crystals	.new	35.00
TA/APQ-2 200-500 MC. 20 Watt	.new	15.00
BC 223	.new	12.50
T15/RAC-5 Xmt. w/crystal-tubes 500-800 KC	.new	25.00
T39/APQ-9 Radar 80/115 V. 400-2600 cy @ 26 V	.new	15.00
T 5 Vacuum tube Xmt. 250-500 KC	.new	25.00
GF 11/RU-16 3000-3675 KC. 3675-4525 KC. 8000-7350 KC. 7350-9050 KC. 4 bands w/antenna current meter	.new	3.25
500 KC Transmitter w/reel of wire copper 300 ft	.new	5.00
ET 8023-D1 HF transmitter 2000-24000 KC. 200 Watt	.new	375.00
GO-9 Transmitter equip. 300-600 KC & 300-18100 KC w/Xmt. CAY 52193. CAY 52192. Rectifier CAY 20194 all built	.new	35.80
ET 224 Mt. for BC 434	.new	1.00
FT 244 for SCR 522	.new	4.00
FT 245 for Lord Mt. for SCR195-2Z6665B	.new	.15
FT 234A for HC457-458-459	.new	1.00
CS 90 Case for SCR 522	.new	2.00
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MT 1	.new	.40
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MT 42	.new	1.00
MT 96/APS-3 for MD 5	.new	1.00

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W. E. D162241	.25	
25 270 42 w/6 tubes 532A. 2 cond. connectors, clamps fuses, insulators 2 cables 15 ft. ea. w/PL 269 tubing Assy. etc.	new boxed	5.50
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Meter Test 0-35 milliamperes DC tripoint #0221-F	.new	.95
Microammeter 0-500 2" scale length DeJury type 210	.new	3.50
J 17/RAC-5	.new	2.00 @
J 84/APS-4 Junction box 225600-84 w/fitting for cables part of APS-4 300 ea.	.new	1.25
J Keys	.new	.75
JK 24 Jack	.new	.05
BC 721 Walkie Talkie Coil & Crystal sets, 3C2610-2	.new	.60
1 ea. Antenna coil C418 550 K		
1 ea. tank coil C419A 5500 K		
1 ea. Crystal FT-243 5500 KC		
1 ea. Crystal FT-243 3550 KC		

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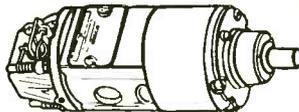
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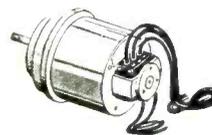


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**TYPE 12121 INVERTER**

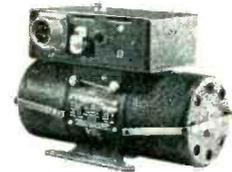
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**SIMPLE DIFFERENTIAL**

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**SIMPLE DIFFERENTIAL**

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\$7.50 ea.

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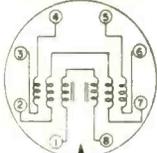
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1C21	2.00	3J21	50.00	NE-16	.30	204A	25.00	WE-404A	10.00	832A	5.00	1964	.50
1P3	2.00	3J31	35.00	FG-17	3.25	WE-205B	410R	100.00	833A	30.00	1984	10.00	
1P30	2.00	3K27	150.00	RK-19	.85	207	50.00	WE-417A	12.00	834	5.75	9000T	150.00
1P32	1.00	3KP1	7.25	RK-20A	8.00	210	.50	WL-417A	3.85	835	5.00	9050	1.00
1P34	1.75	3RP1	7.25	TZ-20	1.75	WE-211C	10.00	WE-418A	12.50	837	2.00	9051	.65
1P36	2.50	4-400A	40.00	CE-21C	3.00	WE-211D	8.00	WE-421A	14.00	838	.90	9172	12.50
1Z2	.90	KC-4	75.00	RK-21	.85	WE-212E	25.00	GL-434A	10.00	842	2.25	ZB-3900	75.00
VG-2	10.00	4AP10	3.75	RK-22	3.50	217A	1.50	446A	.95	843	.35	R-4100	6.25
2AP1	4.50	4B92	6.50	CE-23C	1.40	217C	3.00	450TH	35.00	845	5.00	R-4330	10.00
2AP1A	5.00	4B93	9.00	PJ-23	2.00	WL-218	20.00	450TL	35.00	845W	8.50	5598	3.75
2AS15	5.00	4B94	5.50	RK-23	2.50	CE-220	.50	451	5.00	846	100.00	5550	25.00
2B21	1.00	4B95	8.00	HK-24	2.85	CE-221	8.00	WL-460	10.00	849	22.50	5551	25.00
2B26	1.50	4B96	3.00	HK-24G	2.00	221A	2.00	464A	9.25	851	10.00	5553	100.00
2C21	.50	4B27	3.50	CE-25A/B	2.00	CE-222	1.50	WL-468	15.00	852	5.00	5556	6.75
2C22	.35	4B28	3.00	RK-25	2.50	CE-224	5.50	RH-507	35.00	860	3.00	5557	3.25
2C24	.75	4B30	.75	25T	2.85	CE-225	3.00	CK-510AX	.50	861	15.00	5560	20.00
2C25	.35	4B32	10.00	25TG	1.40	CE-226	3.00	WL-525	12.50	864	.35	5610	1.00
2C26A	.50	4C22	7.50	FG-27A	12.00	WE-231D	2.00	527	25.00	865	5.00	5625	75.00
2C33	.75	4C25	3.00	CE-28D	2.50	RX-233A	.75	WL-530	25.00	866A	1.10	5632	7.50
2C34	.35	4C27	3.50	RK-28	2.50	CE-235A	5.00	WL-531	7.50	866 JR	1.50	5645	6.50
2C39	7.00	4C30	1.50	28D7	.75	235R	50.00	WL-532A	1.00	868	2.00	5650	85.00
2C39A	10.00	4C35	15.00	28D7W	1.50	WE-242A	5.00	WL-535	10.00	869B	24.50	5651	1.35
2C40	7.50	4E27	8.75	CE-29	1.25	WE-242C	8.00	WL-538	5.00	GL-872A	2.50	5654	1.00
2C42	13.50	4J52	35.00	CE-30C	1.25	WE-249B	2.85	GL-553	2.00	CE-872A	1.50	5656	7.00
2C43	7.50	4X100A	20.00	Twin 30	7.50	WE-249C	2.85	559	.50	872A	1.35	5670	1.85
2C44	.35	EL-5BHD	9.00	HY-30Z	2.65	250R	4.75	GL-564	20.00	874	1.50	5687	2.50
WE-2C51	3.00	EL-5B2.5	6.50	CE-31V	2.40	250TH	9.00	575A	15.00	876	.75	5691	4.75
2C53	10.00	5AP1	2.00	FG-32	6.00	250TL	15.00	WL-579B	10.00	878	5.00	5696	1.00
2D21	.65	5B21	2.00	FG-33	15.00	WE-251A	47.50	KU-610	4.75	879	.35	5703	1.15
2D21 W	1.40	5BP1	2.50	RK-33	.50	WE-252A	9.50	HY-615	.50	884	1.00	5720	11.50
2E22	2.00	5BP1A	10.00	RK-34	.35	WE-253A	5.00	WL-689	1.25	885	1.00	5725	1.90
2E24	2.25	5BP2A	6.00	35TG	3.00	WE-254A	6.00	WL-630	1.00	902P1	3.25	5726	.75
2E25	1.85	5BP4	2.50	RK-38	6.50	HK-257B	9.00	631-P1	6.25	905	2.00	5728	9.00
2E26	3.25	5C21	6.00	RK-39	1.50	WE-257A	3.50	WL-632A	17.50	913	15.00	5740	44.00
2J21A	2.75	5C22	28.00	T-40	2.35	FG-258A	100.00	WL-655/658	100.00	917	2.50	5763	1.00
2J26	4.75	5C30	1.00	TZ-40	3.50	WE-259A	12.50	WL-670A	8.00	918	2.00	5801	2.50
2J27	4.75	5CP1	2.00	CE-29C	1.50	WE-261A	10.00	WL-681/686	25.00	919	2.40	5827	2.50
2J29	15.00	5CP1A	10.00	RK-44	1.00	WE-262B	7.00	WE-701A	1.85	920	3.00	5829	1.00
2J30	15.00	5CP7	7.00	OK-47	50.00	WE-264C	3.00	702A	.50	921	1.00	5842	12.00
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2J36	15.00	5GP1	5.00	FP-54	44.00	WE-274A	4.75	707B	4.50	927	1.00	5981/5650	85.00
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2J39	10.00	5J30	6.75	RK-57	4.50	WE-275A	5.00	710A	.50	930	1.25	6013	10.00
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2J50	35.00	5JP1	15.00	OK-59	25.00	WE-282A	7.50	714AY	25.00	954	.30	R-6160	2.00
2J51	150.00	5JP2	7.00	OK-60	25.00	WE-283A	4.00	715A	2.00	955	.35	R-6175B	1.00
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2J55	50.00	5JP5A	7.00	HY-61	1.25	WE-286A	6.00	715C	12.00	957	.35	R-6210	15.00
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CD 59 w/PL 11		new 1.50
CD 335 cable 14 ft. w/SO 300 plug for SCR 399		new 10.00
CD 605 6 1/2 ft. lg. w cond. cord coded 6000 ea.		new .04
CD 346 w/2 PL 108 for R5/ARN 7		new 7.50
CD 820 Cord for HS-30		new .10
CD 411 Cable w/PL-114 for RC 191-BC 375-SCR 210		.75
C) 358 Cable w/PLS 64 for RC 191-BC 375-SCR 210		.75
CD 410 Cable w/PLS 64 for RC 191-BC 375-SCR 210		.75
CD 747 w/2 plugs-2 clamps for SCR 268		65
IF 50-G1-4 Cable 5 cond for PE 157		1.25
CD 814 Cable for RC 109		new .60
Cable 3E1571A/139' for SCR 511		new .40
Cable 3E1571A/237' for T 39		new .60
CC 65 38' w/PL-47		new .20
CC 65 38' no plug.		new .05
CD 604 w/O 410 and PL-54		new .25
CX 170/A1C coiled cord microphone extends to 10 ft.		new 1.50
TF 4H1-3130 Cable stud Bendix.		2.50
BE 1605-1-1C CD 605 w/PL 55 & CD 410		.50

CONDENSER		
3DH 500-28	500 MFD 200 V for GR-8	new .40
CA 00	3 MFD	new .40
CA 59	3 MFD 150 V	new .40
CA 270	1000 MFD 500 V for BC 222	new .40
CA 275	1 MFD 50 V	new .40
CA 276	3X0.1 MFD 200 V for BC 312	new .40
CA 277	for BC 312	new .40
CA 281	5000 MFD for BC 312	new .40
CA 325	for BC 223	new .75
CA 326	3 sect. for BD 87	new 1.00
CA 328	for BC 312	new .40
CA 335	for EE 8	new .25
CA 349	25000 MFD 200 V for RM 29	new .15
CA 411	25000 MFD 200 VDC for BC 620	new .10
C 182	25 MF 80 V for BC 653	new .15

Headset Wireless #19 w/hand micro.	new	3.50
HS-33 w/plug & cushions.	used	2.50
HS-33 w/plug & cushions.	used	5.00
HS-23 w/plug & cushions.	used	2.00
HS-23 w/plug & cushions.	used	4.00
HS-38 w/2 Rec. ANB11 cord & Plug	new	1.00
HS-1 w/2 Rec. R-14 cord & Plug	new	1.00
HS-30	new	1.50
11 1/8" w/2 Rec. Plug PL 55 & cord	new	1.50
HS 23 w/cord & PL 55 w/receivers.	new	1.50
Head & Chest sets EE 70 w/2 receivers. Transmitter Cord	new	1.00
TS 531-327 impedance matching kit MX 337/UR	new	.35
Headset Adapter MC 38A	new	.20
Headband W.E. 11A w/padding for W.E. 716	new	.75
Receiver 700 ea.	new	.25
W. E. Headset 716 w/11A Headband	new	.75
Cushions, rubber	new	.15

HANDSETS		
TS 15 w/cord & plug PL-55 & PL 55	new	4.50
TS 9 w/cord & push to talk switch	new	3.50
Receiver Caps	new	.10

R5/ARN-7 MATERIALS		
Capacitor		
3D 2-338	C 103	new .50
3DB 2-338	C 105 3 sect.	new .50
3DB 2-339 F	C 106 3 sect.	new .50
3DB 18 5-1	CA 325	new .50
3DB 60-27	CA 325	new .50
3DB 50-35	C 104	new .50
3DB 5-9	C 65	new .50
3DKA 25 10.1		new .35
Dehydrator	223608 4	new 1.00
Relay	227968 8	new 1.00
Cable	CD 365 1 AC06889-1	new .75

TUNING ASSY for R5/ARN-7		
Ref 600 Strk. #2C 3035-5/T3		3.50
603	2C 3035-5/T7	2.50
608	2C 3035-5/T5	3.75
Transformer	221968 8	new 2.50
Tuning Assy. Ref. 603		new 2.50
Tuning Assy. Ref. 608		new 3.50

R5/ARN-7 MATERIAL		
Transformer		
T-13 2C3010A/T3		new .30
2C3014A/T2		new .75
T-58 221968 8		new 2.00
Terminal Hon. 2C3014A/T4		new .75
Contact Distr. 2A270A/8		new .75
Tuning OSC 2C3010B/112		new 1.00
Tuning Assy. 2C3014A/T39		new 1.25
Tuning Assy. 2C3014A/T40		new 1.50
Tuning Assy. 2C3014A/T41		new 2.50
Coil RF C1081C Ref 170		new 1.00
MC 124 Cable		new .50

BC 610 MATERIAL		
C 417 B tank coil		new 3.00
TU-47, TU-48, TU-49, TU-50, TU-51, TU-52		new 4.00
Test Sets		new 6.50
Speaker Phone Hallifier 14166		new .75
J44 Keys		new .15
Channel strip rubber 222300 6		new .15
Relay 227350-4		new 1.25

BC 611 MATERIAL-WALKIE TALKIE		
C 360 Coil		new .10
C 363 Coil		new .10
C 365 Coil		new .10
C 366 Coil		new .10
C 369 Coil		new .10
C 372 Coil		new .10
C 374 Coil		new .10
223351-A/2 Capacitor		new .15
Cap. microphone & earphone, blk. anodized, Alvin.		new .15
31 holes 2000 ea.		new .15
cover plate.		new .75
Cover top assy. 2C3351C/A2.1 com.		new .75

BC 348 MATERIAL		
CU 92 Antenna coupling unit		new 4.50
Transformer output		new 1.50
Tuning assy. Ref. 190		new 2.50
Tuning assy. Ref. 193		new 2.50
Capacitor 3DB6-10. 6 MFD. 400 V ref 70		new .75
Detector Unit assy. Ref. 192		new .40
RF Unit assy. Ref. 191		new 2.50
Tube Sockets 228678-20		new .40
Tube Sockets 228670-3		new .65

SCR 522	Kits of 18 Brushes & 3 lamp Indicators	new .25
SCR 522	Receiver w/tubes	20.00
SCR 522	Transmitter w/tubes	20.00
SCR 522	Case CS 80	1.00
SCR 193	Bracket 2A 1250-11	2.00
SCR 609-610	Rec.-Xmtr. 6 to 12 V	12.50
BC 959	Case	3.50
CS 79	Inverter 6-12 or 24 V out 90/145 V	5.50
PE 120	sets of 120	5.50
Crystal		new .05
Cable clamps		new .15
Coils	3C 625-20	new .15
Capacitor	3DA 5-53.1	new .15
Coil choke	3C 362	new .15
223351-1	Cover neev. chain & gasket.	new .15

TUBES		
3B24		1.75
B32/332A		.50
3PF 7		.75
2J 21		1.50
2J 22		2.00
829H		4.50
2J 26		3.00

TRANSFORMER		
2C9643-189 for SCR 610-BC 1335		new 1.00
2C-6494/T3 for RC 604		new .75
2C9638-5 for R5/ARN-7		new .35
T 201 229841-196 COL 55020 for ARC-3		new .35
T 202 229841-198 COL 55135 for ARC-3		new .35
T 203 229841-198 COL 55135 for ARC-3		new .35
T 204 229841-198 COL 55135 for ARC-3		new .35
T 205 229841-197 COL 55135 for ARC-3		new .35
KS 8716 2C9494A/T3 for BC 604		new .75
229843-32 TRC 1		new .40
T 201 Plate transf. for G09 120/3500 V. 600/800 cy		new 1.00
T101 WEMCO 382533		new .40
C 68 4A 2989		new .15
Relay Leach 51054 6A @ 115VAC		new .50
227968-1 Relay for R5/ARN-7		new 1.00
227650-4 Relay for BC 610		new 1.00
228760-51 Relay for BC 600		new .35
SW 172 Leitch Relay		new .50
SW 182 Leitch Relay		new .50
Switch rotary 229825 80.3 6 pos. 5 sec 6 pole for SCR 543		new .75
Switch assy. rotary 4 cont. 5 pins ARC-3030-2 for BC 231		new 1.10
Tube Socket 228678-20		new .10
Tube Socket 228670-3		new .05
GN 33 Generator 12 V DC. 15 VAC. 375-870 cy		new 1.50
GN 38 Generator		new 3.50
GN 37 Generators, hand driven 8 V. 3.25 A & 500 V @ 0.1 ADC		new 5.00
O 1 ADC		new 5.00
SCR 289F Instruction Book		new 1.50
Pump Unit-Air mileage-position AN 5843-1		new 4.50

RECEIVER		
R 32/ARW-3		20.00
110 V. 1 ph. 60 cy. 1.38 A. 140 W		new 40.00
BC 494 3 bond receiver 200-1750 KC		15.00
RL-7 w/tubes & motor		3.50
RA4ARR-1 234-258 MC w/CKT for 6 channel opt. on 540-830 KC		7.50

ANTENNAS		
C/F 69083 for DAQ. Radio cross loop & sense		new 17.50
2A 29991-85/21 for FT 1		new 50.00
AN 104 Copper		1.25
SA 102 w/hardware 8 ft high		new 15.00
AS-4 2' Parabolic antenna 24 VDC w/motors cables		new 40.00
SA 132 U S or D change over antenna & capacitor type		new .75
2A 294-1 Telescope 44" Antenna		new .75
A 62 Phantom Antenna		new .75

Coil 2C8005 V/D6 for BC 191-BC375		new .40
Coil 3C362-24 for SCR 511		new .25
Coil 3C362-25 for SCR 511		new .25
Coil 3C361-26 for SCR 511		new .25
Coil 3C362-34 for RC 610		new .25
Coil 3C362-35 for RC 510		new .25
Coil 3C336-11 Ohmite coil choke for SCR 522		new .20

COIL		
3C 338 2 for PA2		new .25
3C 328 3 for SCR 625		new .25
3C 328 28 for BC 800		new .25
3C 299-360 C360 for BC611		new .10
3C 299-363 C363 for BC611		

# TEST EQUIPMENT

**FLUXMETER.** Measures magnetron magnets from 500 to 4000 gauss. New... \$14.95  
**FREQ. METER, TS-127/U.** Range 375-725 Mcs. New with manual... \$34.50  
**PANADAPTER, AN/APA-10.** For 115v., 60 cy. operation. New with manual... \$145.00  
**TEST OSC. TS-47/APR.** 40-500 Mc. on fundamentals and 2000 Mcs. and above on harmonics. Pulse and sine wave mod. New with manual... \$149.50  
**FREQ. STANDARD.** Tetrad 18A. Puts out 1000/100/10 crystal check points. New... \$23.95  
**RECEIVER, MX-24/APR-1.** For use with tuning units TX-1, 2, 3. Nice condition... \$97.50  
**RECEIVER, BC-108A.** Tubes 158 to 210 Mcs. Includes 14 tubes. For 115/60/1... \$29.50  
**PULSE TIMER.** Navy Type CUZ-50AGD. For 115/60/1. Includes tubes... \$65.00  
**OSCILLATOR, AN/AIT-2.** Radar Jammer. Tubes 450-710 Mcs. inc. tubes... \$29.75  
**OSCILLATOR, AN/APT-3.** Radar Jammer. Tubes 300-1600 Mcs. Brand new, with PT-104/APT-5 Power Supply Tubes, etc... \$169.50  
**TEST SET, S Band.** Navy Type LZ. Complete setup including Srg. Gen. Scope, Power Meter, Ant. Cables, Etc. Brand New... \$250.00  
**MODULATOR, Type BC-1203.** For 115v., 60 cycle operation. With tubes... \$125.00  
**MODULATOR, Type BC-423B.** Radiates 205 Mc. signal pulsed at 4,098 cps. For 115/60/1. New... \$19.50  
**PULSE ANALYZER.** Airborne model ID-59/APA-11. New... \$149.50

# HI-VOLT OIL CAPACITORS

ALL TOP BRANDS					
Mfd.	KV	Price	Mfd.	KV	Price
.001	50	22.50	.2	50	29.50
.01	5	4.25	15	15	9.95
.02	8	4.40	20	20	15.95
.02	20	6.75	25	25	44.50
.025	50	17.95	.5	50	35.50
.025/.025	50	34.50	1.	7.5	6.95
.1	3	1.75	1.	15	29.50
.1	4.5	3.50	1.	20	42.50
.135	7.5	6.95	2.	5.5	9.50

# TRANSFORMERS

**STEPDOWN, G.E.** 6kva. Pri: 230/460. Sec: 115/125, 60 cy. 1ph. New... \$49.50  
**HI-POT.** Westhse. Pri: 115/60/1. 15,000 v.c.t. @ 60 ma. Oil filled. Sec. c.t. ungrounded. New... \$29.50  
**PLATE POWER.** Raytheon. Pri: 440/220/60/3. Sec: 1310v. @ 0.67 amp. New... \$39.50  
**RESONANT CHARGING, G.E.** Type Y-3502-A. Output peak 22,800v. Kva. 2.18. Linear within 3% from 0.195 to .195 Amps. New... \$79.50  
**PLATE POWER.** Kenyon #S-10716. Pri: 220/60/1. 3 sec. coils. 1420-0-1420, 1420-0-1420, 1300-0-1300. Each 350 ma. New... \$35.00  
**FILAMENT.** Raytheon U-5819. Pri: 440/220/60/1. Sec: 5 v.c.t. @ 30 amps. New... \$9.75  
**CHOKO.** Oil-filled. 16 II @ 450 ma., 125 ohms. Insulation 6,000 v. New... \$9.75  
**SCOPE.** Pri: 115/60/1. Sec: #1-4400v. rms. @ 4.5 ma. Sec. #2: 5 v.c.t. @ 3A. Insu. 15 KV. \$6.75  
**MODULATION.** For RCA type 250K transmitter, which uses a pair of 828 tubes to modulate a pair of 810's. Weight 143 lbs... \$49.50

# INVERTERS

Leland Elec. Co. IE206A. Input: 28DC at 38 Amps. Output: 80V. 800 cy. 1 Ph. 485VA. New... \$16.50  
**PE 218 H.** Input: 28DC. Output: 115, 400 cy. 1 Ph. 1.5 KVA. New... \$32.50  
**G.E. 5AS13551A.** Mod. 218L. Input: 28 DC. Output: 115, 400 cy. 1 Ph. 1.5 KVA. Regulated. New... \$89.50

# 15,000 VOLT RA-38 RECTIFIER

Adjustable output from zero to 15,000 VDC @ 500 MA. Input 115V 60 cy. 1 Ph. Size 63 x 53 x 56 in. Write for detailed information.

# NEW SCR-522A EQUIPMENT

Complete BC-624C receivers and BC-625AM Transmitters including mounting racks, plugs, connectors, dynamotor. Brand new equipment with instruction manuals. Write for full details.

# G.E. SERVO AMPLIFIER

Used in B29 planes for Central Station Fire Control Systems B2, B3 and B4. Used to drive Amplidyne 5AM31N9A and Control Motor 5BA50LJ2A listed below. New less tubes... \$29.50

# AMPLIDYNE

G.E. 5AM31N9A. 530 Watts. 7500 RPM. Input: 27 VDC. Output: 60 VDC. Weight 34 1/2 lbs. \$23.50

# CONTROL MOTOR

G.E. 5BA50LJ2A. Armature 27VDC at 8.3 Amps. Field 60 VDC at 2.3A RPM 4000. H.P. 1/2. New... \$27.50

# 9 CONDUCTOR CABLE

**VINYL JACKETS**  
**ARMED COY. SERVO**  
 Army spec. CO-215. Weather-proof 9 Cond. No. 20 AWG stranded tinned copper, plastic ins., color coded, double vinyl jackets with tinned copper braid between Dia. 9/16" made by G.E. Available 1000, 1500, 2000 ft. reels. Price \$.10 ft. Sample 100 ft. roll... \$10.00  
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**ELECTRONICRAFT**  
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# WESTERN ELECTRIC METERS—NEW!



**A.** 50-0-50 amperes. Diam. 5 1/2 in. Individually boxed. With shunt... \$15.00  
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 40-0-40 amperes. Diam. 4 1/4 in. Individually boxed. With shunt. Only... \$11.50

**S-BAND RADAR RECEIVER & WAVEMETER**  
**REF CDE 16 ADZ.** 2500-3500 MC. with National Velvet vernier dial and calibration chart on front panel. Broad band absorption-type wavemeter for measuring the incoming signal. Has sensitivity control. Output is from video amplifier. 115 V., 60 cy. input. With tech. manual... \$97.50

# MINIATURIZATION SPECIALS

**902 TWO-INCH CATHODE RAY TUBE**  
 First time in surplus! Overall length only 7 1/4 inches! Octal base. Electrostatic deflection. Operates on normal B+ voltages. A natural for modulation monitor, TTY-converter indicator, phase-angle indicator, etc. New in original carton. Guaranteed... \$2.95  
**ONE-INCH PANEL METER**  
 O-1 MA. Mounts through 1 1/2 inch hole in panel. Flush or with 1 1/2" square black bakelite face outside of panel. Depth of case: 1 3/4". New... \$3.95

# 46 ACJ UHF RECEIVER

13 tube double conversion receivers. Frequency range 450-600 MC. This unit employs 46A lighthouse tubes in the RF section, mixer and oscillator circuits. First IF frequency of 55 MC has two stage of amplification, second IF frequency of 16 MC has 4 stages of amplification. Two video stages follow the second detector. With schematic and tubes 8-6AC7, 3-446, 16AG7, 1-6H6. New Condition... \$9.95

# HIGH-POWER VHF SIGNAL GENERATOR

**AN/TPR-T2.** 90-250 MC. More than 1/10 W. power output with calibrated attenuator to -80 db. Input 105/125 V., 50/60 cy. Output is CW or sine-wave modulated with 8 different AF's; or RF pulses with no residual carrier at 3 different widths and rates; or noise modulated 2 MC wide. Has adjustable attitude loop radiator or standard SO-type output. Contains internal zero-beating system for comparisons. Has input for external modulation, so can be used as an emergency standby xmit. Brand new, with cords, antenna and tech. manual. Wt. 85 lbs... \$97.50

# CAA GLIDE-PATH TEST OSCILLATOR

**TS-170/ARN-5.** Xtal-controlled to .02%. 332.6, 333.8, 335.0 MC modulated 90 or 150 cy. Output 50 ohms. Calibrated attenuator 10 to 1,000 dB. Checks sensitivity, AVC and AF channels in Glide Path Receivers. New with tubes and cord. ONLY... \$97.50

# TS-182/UP

**SIGNAL GEN. & SYNCHROSCOPE**  
 Complete. For checking power output, receiver sensitivity, pulse shapes and recovery time. Equipment consists of a pulsed RF oscillator with calibrated attenuator built-in power supply which operates from 110 V. 60 to 1200 cps. Unit has a 2AP1 Scope Tube and 10 other tubes. Freq. range: 150-240 MC. Like new... \$42.50

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Latest model for testing FM radio altimeters. Complete with cables and indicator. New condition... P.U.R.

# NEW CATALOG NO. 114

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# CONDENSERS

## TRANS. MICA CONDENSERS

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.00001	600	.20	.001	8000	3.98
.000024	2500	.35	.0015	600	.23
.000025	2500	.29	.0015	2500	.55
.00003	600	.24	.0015	5000	2.25
.00003	1200	.28	.002	600	.27
.00003	1200	1.25	.002	1200	.39
.00003	2500	.35	.002	2500	.63
.000047	2500	.30	.002	5000	2.25
.00005	600	.23	.002	4000	2.40
.00005	1200	.29	.0024	5000	2.25
.00005	2500	.33	.0025	600	.28
.00005	2500	1.25	.0025	1200	.43
.000051	5000	1.75	.0025	2500	.65
.00007	2500	.26	.003	600	.31
.000075	5000	1.45	.003	1200	.52
.0001	600	.24	.003	2500	.73
.0001	1200	.27	.003	3000	1.65
.0001	2500	.36	.003	5000	2.25
.0001	5000	1.95	.004	600	.29
.00015	600	.23	.004	1200	.49
.00015	2500	.33	.004	2500	.91
.00015	5000	1.95	.005	600	.35
.0002	600	.23	.005	1200	.45
.0002	2500	.34	.005	2500	.98
.0002	5000	1.95	.006	600	.36
.00025	600	.25	.006	1200	.55
.00025	1200	.19	.006	3500	1.65
.00025	2500	.35	.0062	2500	1.74
.00025	5000	1.95	.0075	2500	1.95
.00027	1200	.27	.008	600	.35
.00027	2500	.36	.01	600	.48
.0003	600	.23	.01	1000	.50
.0003	2500	.36	.01	1200	.69
.0004	600	.22	.01	2500	.94
.0004	2500	.29	.012	1200	.64
.0004	5000	1.95	.014	600	.45
.00047	1200	.28	.014	1200	.67
.0005	600	.23	.015	600	.55
.0005	1200	.29	.015	2000	1.75
.0005	2500	.39	.02	600	.21
.0005	3000	1.25	.02	1200	.59
.0005	5000	2.45	.02	2000	1.60
.0005	2500	4.95	.03	600	.65
.00062	3000	1.25	.03	1200	1.15
.00068	3500	.28	.03	2500	.57
.00089	1200	.28	.03	600	.57
.001	600	.23	.25	250	1.95
.001	1200	.32	.4	600	3.25
.001	2500	.49	.21	1250	1.38
.001	4500	1.65	.115	2000	4.65
.001	5000	2.25			

## OIL CONDENSERS

Mfd	Volts	Price	Mfd	Volts	Price
.001	50KV	24.95	2	5000	12.50
.0023	10KV	6.95	2	7500	21.9
.01	5000	7.9	2	10KV	35.95
.01	10KV	4.95	2	12.5KV	59.50
.012	25KV	12.95	2	20KV	89.75
.02	40KV	4.20	2X2	600	.85
.02	10KV	5.25	2	1000	9.90
.02	20KV	10.95	3	4000	8.99
.025	600	22.95	2X3	150	.29
2X.025	50KV	34.50	3X3	400	.68
.03	7500	4.50	1	500	.59
.035	19KV	5.95	4	600	.79
.05	7500	2.95	4	1000T LA	.58
.08	12.5KV	8.95	4	1000	1.89
.1	3500	3.9	4	1500	2.65
.1	2000	.45	4	2000	2.95
.1	2000	.89	4	2500	3.85
.1	2500	.98	4	3000	6.99
.1	3000	.69	4	4000	13.95
.1	3000	1.19	4	5000	24.95
.1	7500	.95	4	7500	39.95
.1	7500	4.25	4	10KV	59.95
.1	10KV	6.35	4	15KV	13.99
.1	12KV	6.95	4	30KV AC	1.39
.1	2000	.89	5	600	1.19
2X.1	7000	3.95	5	1000	1.89
2X.1	6000	2.29	5	1500	1.98
.2	10KV	8.50	5	400	.89
.2	16.4KV	13.95	5	600	1.19
.2	50KV	39.50	5	1000	1.89
3X.2	4000	2.85	2X5	400	.89
.25	1500	1.89	3X5	400	1.29
.25	2000	.98	6	600	1.69
.25	3000	1.45	6	1000 AC	1.99
.25	4000	1.98	6	1000	2.30
.25	6000	.85	6	1100 AC	2.95
.25	20KV	18.95	7	600	.93
.25	25KV	40.00	7	800	1.35
.25	32KV	49.50	7	5000	29.95
.25	50KV	62.95	8	800	1.89
.35	2000	.59	8	1000	2.78
.35	3000	1.19	8	1400	3.05
2X.25	10KV	1.10	8	1800	3.65
.4	10KV	10.95	8	2000	5.95
2X.4	7500	5.25	8	2500	6.50
.5	1500	.59	8	3000	8.89
.5	2000	1.19	8	600A C	4.25
.5	2500	1.49	8	800	1.89
.5	3000	2.19	8	1000	2.78
.5	5000	3.09	8	1400	3.05
.5	7500	6.25	8	1800	3.65
.5	2000	.39	8	2000	5.95
2X.5	600	.59	8	2500	6.50
2X.5	900	1.25	8	3000	8.89
.5	25KV	45.95	10	50A C	.65
.65	12.5KV	13.95	10	600	1.19
.65	500	1.0	10	1000	3.75
.65	1000	.69	10	1500	5.25
.65	1500	.99	10	2000	5.95
.65	2000	1.85	10	3000	9.50
.65	2500	2.20	10	4000	13.95
.65	3000	2.95	10	5000	22.50
.65	4000	6.45	10	6000	34.95
.65	6000	5.95	10	7500	49.50
.65	8000	6.50	10	10000	65.50
.65	7500	8.95	10	15000	95.50
.65	10000	14.50	10	20000	135.50
.65	15KV	22.50	10	30000	205.50
.65	20KV	45.95	10	40000	275.50
.65	25KV	49.50	10	50000	345.50
.65	25KV	65.00	10	60000	415.50
.65	25KV	75.00	10	70000	485.50
1.75	300A C	.69	10	80000	555.50
.65	600	.55	10	90000	625.50
.65	800	.65	10	100000	695.50
.65	1000	.79	10	110000	765.50
.65	1000T LA	1.29	10	120000	835.50
.65	1500	1.15	10	130000	905.50
.65	2000	2.80	10	140000	975.50
.65	2500	3.45	10	150000	1045.50
.65	3000	4.25	10	160000	1115.50
.65	4000	7.50	10	170000	1185.50

### WANTED

Oil & Mica Condensers in any quantity.  
Also other Standard Components.  
Write: Art Hankins

# MONMOUTH RADIO LABS.

BOX 150 OAKHURST, N. J.  
Capitol 2-2776

Other Items Available  
Mica Conds.  
Bathin. Conds.  
Channel Conds.  
Rheostats  
Potentiometers



CONSISTENTLY HIGH QUALITY  
**ELECTRONIC TUBES**  
Guaranteed • Unused • Boxed  
• SPECIALISTS IN JAN  
WESTERN-ELECTRIC,  
SUBMINIATURE, 5000/6000  
SERIES AND RECEIVING TYPES

FULL-WAVE  
BRIDGE  
TYPE

## DIRECTRON SELENIUM RECTIFIERS

Max. Amps.	18VAC 14VDC	36VAC 28VDC	54VAC 42VDC	72VAC 56VDC	130VAC 100VDC
1	\$1.35	\$2.35	\$3.75	\$4.50	\$7.45
2	2.00	2.75	5.35	5.90	9.15
3	2.95	4.15	5.85	7.85	12.75
4	3.50	6.45	11.35	14.35	21.75
6	4.00	7.75	12.85	17.30	29.75
10	5.90	11.45	19.50	24.80	41.35
12	7.25	14.35	22.10	29.75	44.25
20	13.05	25.05	37.25	48.75	78.50
24	14.25	28.75	44.50	57.65	81.00
30	17.95	34.35	56.50	71.00	109.00
36	22.45	42.35	65.00	86.95	134.00
50	29.50	54.35	105.45	115.75	174.00
100	59.50	119.00			

We build other Selenium Rectifiers, Transformers, and Chokes to your specifications.  
Buy from the Direct Source for Quick Delivery.

### NEW RECTIFIER TRANSFORMERS

Continuous Ratings	1 Amp.	55.75
Pris 115V 60 cycles input	2 Amps.	6.75
SEC: 9, 12, 18, 24, and 36 volts.	12 Amps.	16.65
	24 Amps.	35.65
	50 Amps.	59.00
	100 Amps.	108.00

### NEW RECTIFIER CHOKES

Continuous Ratings	1.5 ohm	54.95
1 Amp . . . . . 1 Hy	.9 ohm	5.95
2 Amps . . . . . .07 Hy	.6 ohm	7.95
4 Amps . . . . . .04 Hy	.4 ohm	14.95
12 Amps . . . . . .01 Hy	.25 ohm	29.95
24 Amps . . . . . .005 Hy	.1 ohm	54.00

### FILTER CAPACITORS

Capacity	W. Voltage	Each
500 MFD	200 V.	\$1.95
500 MFD	50 V.	.85
1000 MFD	15 V.	.35
2000 MFD	50 V.	2.25

### SUPER GLOSS RED & BLACK TUBE CARTONS

SIZE EACH	SIZE EACH
1"x12" . . . . . 1/2	1 1/2"x1 3/4" . . . . . 1/2
6AL6, 6AL5, etc.	1B3, 6B6GT, etc.
GT . . . . . 1/4	LARGE G
1 1/2"x1 3/4" . . . . . 1/2	5U4G, 6B6GG, etc.

Also in White Coated—No Printing  
Both types with new safety partitions— they meet U. S. Government specifications! Attractive discounts for quantity users. Minimum order 100 of a size. Be sure to specify white or color when ordering.

### TRANSMITTING TUBE CARTONS

Small Jumbo White Only	Large Jumbo White Only
3"x3"x7" . . . . . 100	4"x4"x10" . . . . . 100
FOR809, 866A, etc.	FOR 813, 872A, etc.
\$7.50 PER 100	\$10.00 PER 100
50 TO THE CASE	300 TO THE CASE

### MINIATURE WHITE TUBE STACKERS

HOLDS 10 MINIATURE CARTONS SPECIFY—MINI STACKERS 1 1/2" EACH

### GT WHITE TUBE STACKERS

HOLDS 10 GT TYPE CARTONS SPECIFY—GT-STACKERS—2 1/2" EACH

### U. S. NAVY INFRA-RED SNOOPERSCOPE

BRAND NEW—ORIGINAL CARRY- IN CASE USES 1P25 . . . . . \$150.00

Terms: F O B—N Y C—25% Deposit with order— or send full remittance to save C O D charges— D & B Rated Firms (F2 1/2 or Better) Net 10 days  
CABLE: BARRYLECT, N. Y. TELEGRAPH: BARRY ELECTRONICS, FAX, N. Y. C.

Phone: Walker 5-7000

• Critical Types Lab Tested for Your Protection

0A4C	\$1.00	10	.75	814	2.00
0B3 VR90	.85	V45		836	1.15
0C3 VR105	.85	Klystron	525.00	818	1.00
0D3 VR150	.85	RK6A	1.00	845	5.50
1R74	4.95	RK1	2.75	851	9.50
1B24A	15.00	OK6A	25.00	860	1.25
1B26	1.50	OK6L	25.00	866A	1.25
1B32	2.00	QK52	25.00	872A	1.50
1B35	6.50	FG67	12.00	872A (G.E.)	2.75
1B63A	22.50	QK69	25.00	874 (RCA)	.60
1B85	9.95	QK72	25.00	876 (RCA)	.85
1B86	7.75	RRR-72	.50	891	125.00
1N21	.06	RRR-73	.50	902, 902P1	6.00
1N21A	.50	90-NE		931A	3.00
1N21B	1.50	Amperex	7.00	932	1.25
1N22	.50	FG98A	20.00	958A	.50
1N23B	1.50	100R Surplus	5.00	100T	137.50
1N27	.75	100TH Surp.			

# "TAB" THAT'S A BUY

## High Current Power Supplies



**ONE YEAR GTD**  
Variable 0-28VDC. Completely Built Ready to Go. Full Wave Selenium Rectifier, Transformer, Variable Volt & Amp Meters, Switch, Terminals & Full Duty Steel Cabinet Std 115V/60cy Input or 220V1 (3 phase) to order.

Stock Number	Continuous	With Meters
T28V5A	0-28 VDC at 5 Amp	\$45.00
T28V5AC	5 Amp (1% Ripple)	75.00
T28V5AC2C	5 Amp 0.01% Ripple	129.00
T28V12A	0-28 VDC at 12 Amp	100.00
T28V12AC	12 Amp (1% Ripple)	145.00
T28V12AC2C	12 Amp 0.01% Ripple	199.00
T28V24A	0-28 VDC at 24 Amp	135.00
T28V24AC	24 Amp (1% Ripple)	195.00
T28V24AC2C	24 Amp 0.01% Ripple	279.00
T28V50A	0-28 VDC at 50 Amp	260.00
T28V50AC	50 Amp (1% Ripple)	370.00
T28V100A	0-28 VDC at 100 Amp	469.00
T28V100AC	100 Amp (1% Ripple)	650.00

## New Variable 0 to 6 & 12 Volt/12 Amp

DC POWER SUPPLY  
Battery Eliminator Charger  
Model RR Patent Aircraft  
Machine or any DC Reg. Extra Heavy Duty Selenium Rectifier, Meter, V. & A. Dgnd for Cont. Service and up to 20 Amp intermittent overload. New Model T1312AC SPECIAL \$29.95

**FILTER CAPACITORS**  
CE156M 6000MFD 5V \$1.25; 2 for \$2  
CE603M 3000MFD 10V \$3.98; 2 for \$7

## NEW SONIC SOUND GENERATOR 115 VAC Input Cleans! Agitates! Washes & Mixes

"TAB" SPECIAL \$19.99  
Write For Complete Details

## PLANETARY DRIVE

6:1 & 1 to 1 RATIO  
H.P. \$8.29 "TAB" \$2 SPECIAL 3 For \$5

## INFRARED SNOOPSCOPE

SEE IN DARK TUBE  
Image Converter Tube Hi-Sensitivity simplified design 2" dia. Willemite screen - Resolution up to 160 lines/in. Tube & Data "TAB" Special - \$6.98; 2 for \$11  
Snoopscope Pwr Supply 1800 C 3/4" Beam Doubler Crkt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram 115V/60cy Opr. \$6.98

## FENWAL THERMOSWITCH

#17300-24 Precision Adjustable Knob Air Control -100 to +400°F/10A/118VAC Special @ \$2.95 ea 2/58

\$1.25 ea 4 MFD 12000VDC or 10 MFD 600VDC  
Lots of 24  
Lots of 12 @ \$1.10 Ea.  
Solid State \$1.79 Ea. Any Ass'mt

## SPECIAL "TAB" BUYS

MINIATURE DIEHL PM MOTOR  
Type FD6-21, RPM 10,000, 27.5VDC  
Excellent mtr for Fan cooling, "TAB" Special @ \$2.95; 12 for \$30.00  
HANS, INDUSTRIALS-COOL THAT TUBE!  
Diehl Miniature mtr & Fan. \$3.95; 12/\$42  
Bourne Miniature Precision "Tri-Precision" 2000 Ohms-Special @ \$3.15 ea 4 for \$10  
Fairchild Type 736 Five Gang Precision Potentiometer, 3 units 160 Ohm, one 25,000 Ohm one with 2 taps accy ±0.5%, 3.5 Watts, SERVO Crkt. Reg \$100.00-"TAB" Special \$12 ea; 3/30  
Thermistor W.E. 81A/CUO \$2.49 ea; 3/54  
Varistor W.E. 17A/CUO \$1.49 ea; 3/54  
Varistor W.E. 38C/CUO \$2.49 ea; 3/54  
Varistor W.E. D9766 1/2W 50V SPL \$1.50 ea; 3/54  
Miniature Hi-Q Inductor -0.5H, Hi-Qey Mu metal core. Only \$1.25; 6 for \$5

## PRECISION RESISTORS

1% ACCURACY GTD  
Special 28c Ea. 15¢ ea.  
10 of One Value \$2.50  
100 of One Value \$10  
10 Ass'd Values \$2.50

## NEW OIL CONDENSERS

1.2MFD/2400V VDC 69¢ ea; 12/\$7  
1.8MFD/3000V VDC \$1.69; 4/\$5  
20MFD/2000V VDC \$5; 4/\$15  
23MFD/1000V VDC \$1.50; 4/\$5  
48MFD/1000V VDC \$10; 2/\$15  
1.4 & 0.3MFD/1800V VDC \$1.50; 5/\$4

## "JJ" POTENTIOMETERS

25¢ ea  
DUAL 35K/5K 60K/5K  
Shaft: K' Bushing  
Write for Complete Listings

## POCKET AC-DC MULTITESTER

Hi-accy precision VOM, 1000 Ohms per V  
READS AC & DC Volts: 0.5, 2.5, 25.0, 100V  
DCMAI: 0.1, 1.0, 100MA. Ohms: 0.10, 100K-1M  
1 1/2" x 4 1/4" x 1 1/4" Test Leads  
Singly @ \$9.95; Lots of 3 @ \$24.95 ea

## THOR ELECTRIC DRILLS

2013 1/2" Electric Speed Drill 2400 RPM 115VAC/DC \$14.95  
4003 1/2" Electric Speed Drill 2400 RPM 115VAC/DC \$19.95  
4003 1/2" Electric Speed Drill 650 RPM 115VAC/DC \$29.95

# NEW "TABTRON" SELENIUM RECTIFIERS

ENGINEERED for INDUSTRY



"TAB" manufactures power rectifiers to your specifications. From one amp up to and above 1000 amps, convection or fan cooled, single or 3 phase. "NEMA" & JAN. Specs. Write for catalog.

## FULL WAVE BRIDGE • DATED & ONE YEAR GTD

Amp	18VAC	36VAC	54VAC	72VAC	130VAC	266VAC	217VDC	217VDC	AC/DC	3 Phase	Bridge
1	\$1.30	\$2.30	\$3.70	\$4.45	\$7.40	\$12.25	\$2.25	\$2.10	\$14.50	\$14.50	\$28.95
2	1.95	2.70	5.30	5.85	9.10	28.85	2.35	15.90	30.90	30.90	30.90
3	2.90	4.10	7.75	7.90	12.70	38.85	2.65	17.40	33.50	33.50	33.50
4	3.15	6.40	11.10	13.30	21.70	38.85	2.85	18.50	36.95	36.95	36.95
6	3.95	7.70	12.35	17.25	29.65	54.85	3.75	20.90	39.95	39.95	39.95
12	5.85	11.35	19.20	24.65	41.10	84.85	4.75	36.90	71.95	71.95	71.95
12	7.20	14.25	21.75	28.75	43.75	98.85	5.95	41.90	81.95	81.95	81.95
20	12.95	24.85	36.85	47.25	77.00	160.85	7.95	50.90	97.95	97.95	97.95
24	14.05	28.55	43.25	56.00	88.25	190.95	8.95	89.90	159.95	159.95	159.95
30	17.75	31.50	51.50	69.00	106.50	235.95	9.95	117.90	229.95	229.95	229.95
36	22.10	41.50	64.75	84.25	131.00	235.95	11.95	134.90	269.95	269.95	269.95
50	29.40	54.00	97.35	106.35	171.00	405.35	23.95	179.90	399.95	399.95	399.95

## RECTIFIER & XFMR COMBO, Up to 28VDC at 24 Amps Cont. Duty. \$60

## WRITE FOR OUR NEW RECTIFIER & POWER SUPPLY CATALOG PR655

## "TABTRON" Rectifier Xfms

Sec'd Volts (DUAL) 18-15-9-0-15-18V

5 Amp \$8.65; 2 for \$15.75  
12 Amp \$16.50; 2 for \$32  
24 Amp \$35.50; 2 for \$70  
50 Amp \$58.50; 2 for \$117  
100 Amp \$107; 2 for \$210

18 Volt 2 Amp \$1.98; 2 for \$3.50  
1 Wdps in Series at Ratings shown: Parallel  
2Amps: Voltage one half max.  
Dual Pk 115 & 220V 60cy. Tapped 36VCT

## "TABTRON" Rectifier Chokes

CR6001/1 Amp/0.1 HY/1.4 Ohm \$4.50; 2 for \$8  
CR6002/2 Amp/0.1 HY/4.7 Ohm \$5.75; 2 for \$11  
CR6003/3 Amp/0.1 HY/6.0 Ohm \$7.90; 2 for \$15  
CR6004/4 Amp/0.1 HY/1.0 Ohm \$14.50; 2 for \$28  
CR6005/24 Amp/0.04 HY/0.25 Ohm \$29.50; 2 for \$58

DISCOUNTS TO INDUSTRIALS, SCHOOLS & COLLEGES

## DC Power Supply

Full Wave Rectification  
6000A Pk Condens. Filter  
Ready to Operate Input  
115V 50/60 Input 6.3V or  
12.6V AC

Model 20CF (2 amp) \$12.98  
Model 50CF (5 amp) \$29.98  
Model 100CF (10 amp) \$58.98

## Heavy Duty Battery "Fast" Charger Rectifier

13-0-13VCT 100 Amp Fan Cooled or 34 Amp Air Cooled. Reptmt 6V Booster Charger. \$10; 3 for \$27  
Model CR15 Fan Cooled for 12V/60 and 8V/100A Booster Chargers. \$11; 3 for \$30

# TUBES "TAB" TESTED INSPECTED GUARANTEED!!!

0A2	5.74	4J30	99.55	HY615	4.46	5663	1.06	5980	6.48
0A3	.98	4J47	485.00	701A	1.48	5670	2.24	5999	37.25
0B2	.84	4J52	649.95	704A	.98	5672	1.55	5965	1.76
0C3/V90	84	4X150A	35.00	801A	.98	5676	1.55	6027	179.95
0C3/V105	82	4X150	35.00	710A	1.18	5686	2.36	6127	3.99
0D3/V150	78	5D21	9.48	715B	11.90	5687	3.59	6080	5.99
1A4A	3.95	5U4G	1.46	717A	3.98	5692	6.48	6099	1.55
1A4B	1.48	5U4G	1.46	717A	3.98	5692	6.48	6101	1.55
1AX2	1.25	6AS6	1.60	723AB	9.98	CK5694	3.70	6110	6.55
1B3	.66	6AS7G	2.98	724A	2.94	CK5697	3.70	CK6111	8.95
1B24	4.98	6J6	.48	724B	4.96	CK5702	2.20	6119	6.48
1B25A	1.88	6J7	.56	725A	4.96	5704	2.25	6121	9.00
1B25B	42.50	6V6GT	.86	807	1.18	5715	173.50	GL6136	1.89
1D21	3.49	6X4	.42	807W	4.98	5718	5.99	6146	4.87
1Q23	150.00	7C25	125.00	814	2.48	5719	5.99	6164	64.95
1X2A	6.42	7C31	9.00	815	3.98	5721	189.95	6199	49.99
2C39A	16.90	12AU7	.54	829B	8.49	5722	6.39	6201	3.99
2C51	2.50	12AX7	.58	832A	8.49	5727	1.77	6270	199.95
2D21	75	7G17	3.01	864	.34	5732	3.94	6271	159.95
2E22	1.89	19B6G	1.38	927	1.36	5736	159.95	6273	199.95
2E24	2.48	24G	1.96	954	.18	5744	2.39	6005	4.97
2E26	3.78	HK24	4.90	955	.65	5749	1.72	8012	1.09
2E32	2.07	35Z25	.46	986	.32	5750	3.10	8013	4.91
2E42	1.49	47Z60	4.49	987	4.49	5811	3.09	8014	59.15
2J30	50.50	50L6	.60	CK1005	.56	5764	55.99	8020	2.95
2J42	99.50	71A	.74	1612	1.98	5765	55.99	8025A	2.95
2K28	29.50	71A	.74	1612	1.98	5765	55.99	8025B	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025C	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025D	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025E	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025F	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025G	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025H	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025I	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025J	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025K	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025L	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025M	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025N	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025O	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025P	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025Q	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025R	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025S	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025T	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025U	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025V	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025W	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025X	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025Y	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025Z	2.95
2K29	29.50	71A	.74	1612	1.98	5765	55.99	8025AA	2.95
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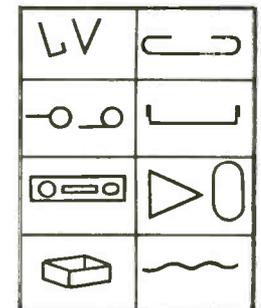
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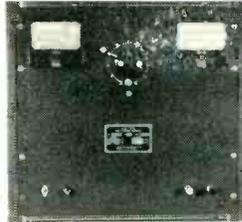
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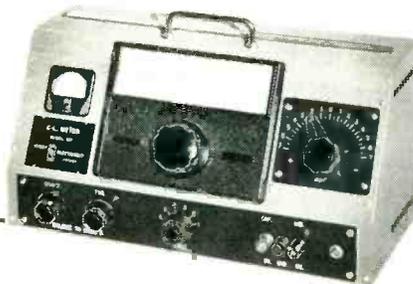
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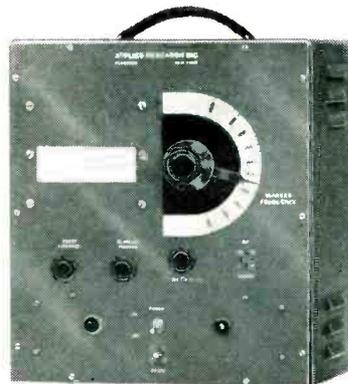
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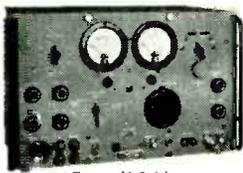
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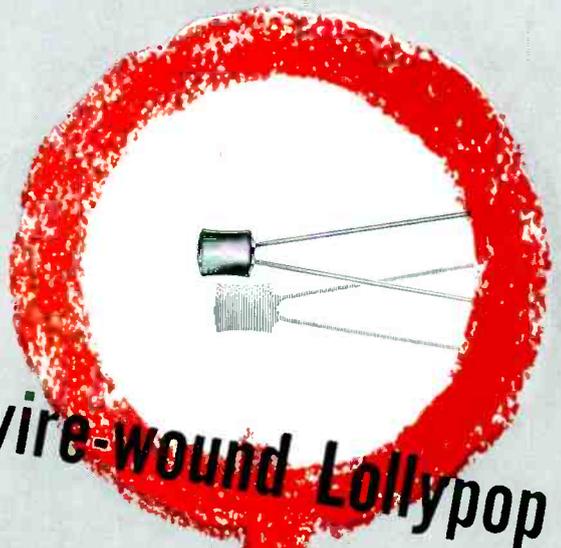
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For maximum resistance in minimum space!

## NEW Lollypop Precision Resistor Davohm Type 1273

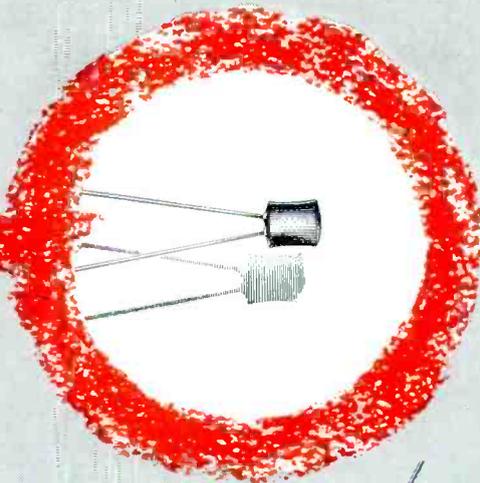
It's no trick at all with Daven's unique and extremely small size resistor to achieve ease of mounting in new printed circuit and transistor assemblies. The trick is inside this tiny unit... it's a completely new specialized winding technique developed by Daven, which enables them to use extremely fine sizes of resistance wire to obtain two or three times the resistance value that was previously supplied on a bobbin of this size.



You can't lick Daven's new wire-wound Lollypop Resistor

Only 1/4" in diameter by 5/16" long, yet is available in values as high as 400,000 ohms:

- \* Fully encapsulated
- \* Exceeds all humidity, salt water immersion and cycling tests as specified in MIL-R-93A
- \* Operates at 125°C continuous power without de-rating
- \* Can be obtained in tolerances as close as  $\pm 0.02\%$
- \* Standard temperature coefficient is  $\pm 20$  PPM/°C. Special coefficients can be supplied on request



Below are other miniature encapsulated Daven resistors, part of the largest selection of precision wire-wound resistors available:

	Type 1250	Type 1170	Type 1195
Max. Ohms	450K	2 Meg.	760K
Dia.	1/4	1/2	1/4
Length	1/2	1/2	3/4
Max. Watts	1/8	1/3	1/4

All Daven resistors can be operated at 125°C continuous power without de-rating.



Type 1250

Type 1170

Type 1195

Write for complete resistor catalog.

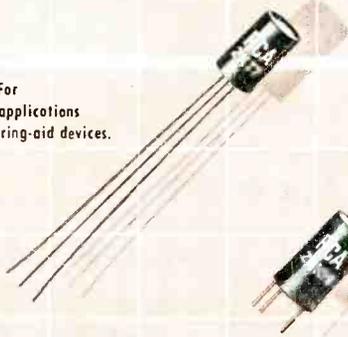


THE **DAVEN** CO.

191 Central Avenue, Newark 4, New Jersey

WORLD'S LARGEST MANUFACTURER OF ATTENUATORS

RCA-2N77. For low-power applications such as in hearing-aid devices.



RCA-2N109. For amplifiers and class B p-p power output stages of battery-operated portable receivers. Two 2N109's in class B p-p circuit will give a power output as high as 150 mw.



RCA-2N104. For low-power of service in communications and other types of electronic equipment.



RCA-2N105. For low-power applications, such as in hearing-aid devices and other applications where extremely small size is required.



Shown actual size

## Exceptional Uniformity Extreme Stability -throughout life!

RCA

**HIGH-QUALITY**

TRANSISTORS

For applications where extreme stability is paramount . . . for circuits where very low collector cutoff current is essential . . . for services that require exceptional uniformity of characteristics . . . RCA-developed transistors provide consistent high-quality and dependable performance. *Closely-controlled processing and manufacturing techniques assure high-level performance initially and THROUGHOUT LIFE!*

Here again is specific technical evidence of RCA's continuous effort to provide advanced-quality products. For a quick rundown on the ratings and characteristics of the four transistors pictured here, see the chart. For complete technical data, call your RCA Field Representative—or write RCA, Commercial Engineering, Harrison, New Jersey.

The RCA-2N77, -2N104, -2N105, and -2N109 are hermetically sealed, germanium p-n-p alloy-junction types—and each carries the RCA one-year warranty!

	RCA-2N77	RCA-2N104	RCA-2N105	RCA-2N109
<b>MAX. RATINGS</b> (Absolute Values):				
Collector Volts	-25	-30	-25	-20
Collector Ma.	-15	-50	-15	-50
Collector Dissip. (mw)	35	up to 150*	35	50
Operating Temperature (°C)	50	70	50	50
<b>TYPICAL OPERATION: †</b>				
Collector Volts	-4	-6	-4	-4.5
Collector Ma.	-0.7	-1	-0.7	-13
Alpha (Collector-to-base connection)	55	44	55	70**
Power Gain (db)	41	41	42	30**
Power Output (mw) approx.	—	—	—	75**
Source Imped. (ohms)	2450	1400	2300	375 per base connection
Load Imped. (ohms)	20,000	20,000	20,000	100 per collector
Noise Factor (db)	6.5 av.	12 max.	4.5 av.	—
Cutoff Freq. (kc)	700	700	750	—
Figure of Merit for High Frequency Performance (Mc)	1.7	1.6	2.6	—

\* Depends on temperature and circuit parameters †† Large-Signal

† In common-emitter circuit at 25°C, ambient temp.

\*\* For 2 transistors in class B of circuit, and maximum distortion at 10 percent



**RADIO CORPORATION of AMERICA**  
ELECTRON TUBES

HARRISON, N.J.