electronics

AUGUST · 1954
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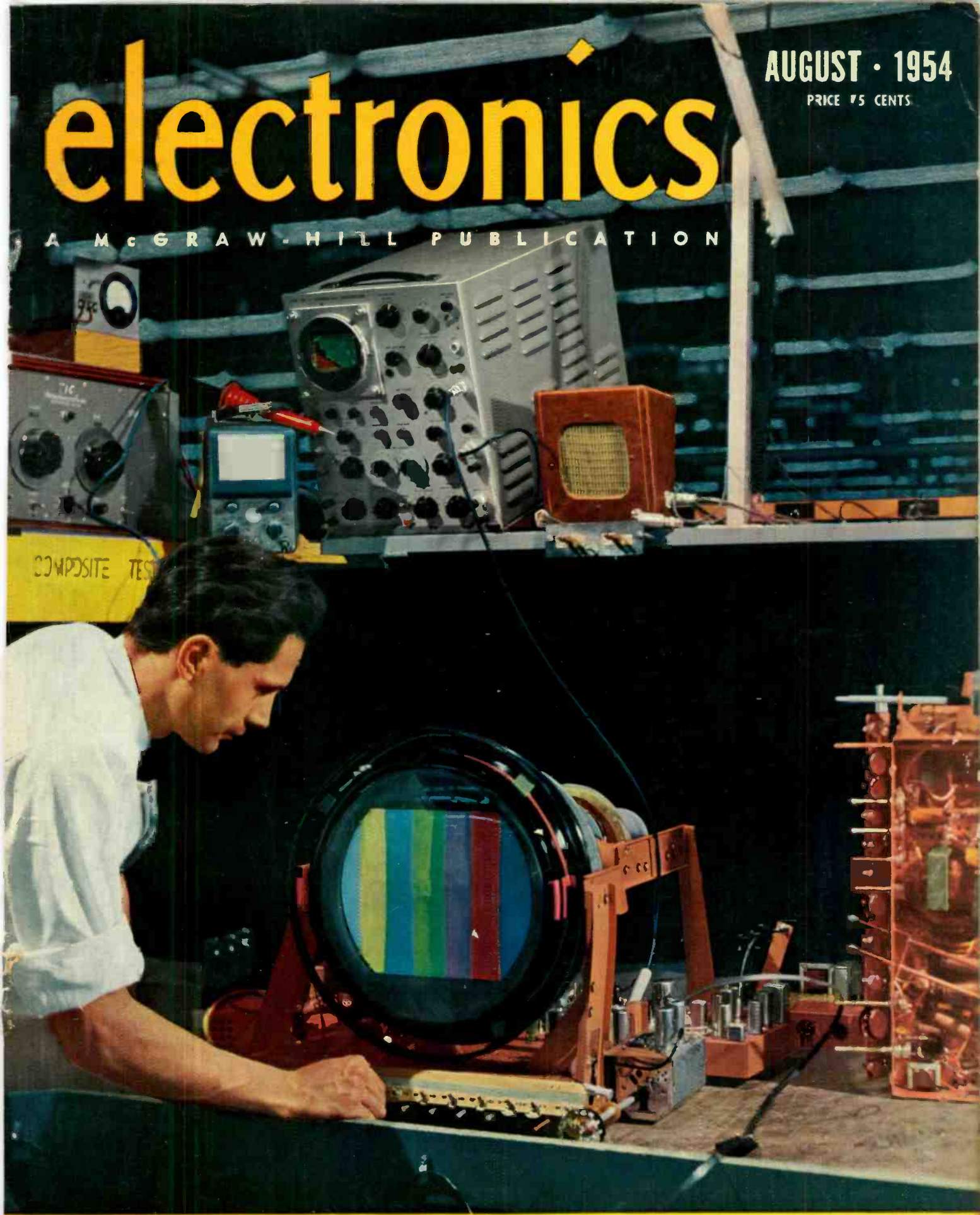


IN THIS ISSUE

Adjustment Procedures for Color TV Production

NEW "M" TYPE TOROIDS Maximum Q Minimum Size

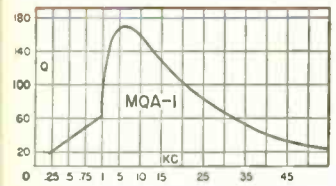
UTC Permalloy Dust Toroids have been the standard of the industry for over 15 years. The MQ series of coils provide the highest Q factor in their class (see curves below), with miniaturized dimensions. All units are **hermetically sealed** to MIL-T-27 Specifications.

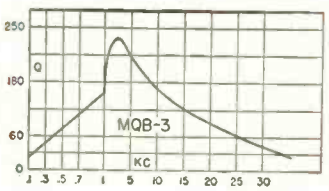
The **stability** is excellent. For the MQE-7 the inductance change is less than 1% for voltages from .1 to 3 volts. The MQA-13 change is less than 1% for applied voltages from .1 to 20 volts. The MQB-5 change is less than 1% for applied voltages from .1 to 50 volts. DC is permissible through the coil (values listed below). Inductance is virtually independent of frequency temperature and vibration.

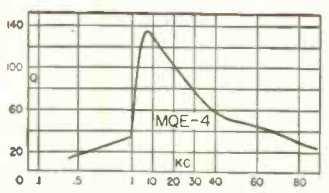
Hum pickup is extremely low due to the toroidal winding structure, with windings uniformly spread over the core. The case is of high permeability, affording additional shielding such that close spacing of units can be effected, the coupling attenuation being approximately 80 DB.

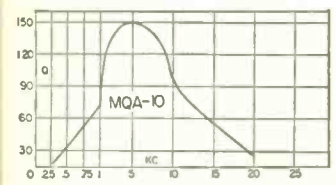
Other values of inductance than those listed are available on special order at the price of the next higher listed value.

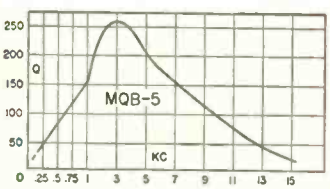
TYPICAL Q CURVES

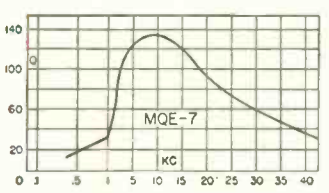


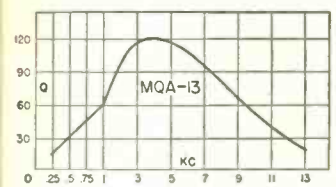


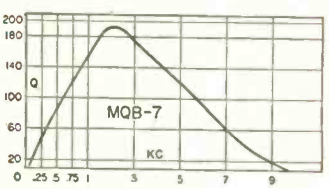


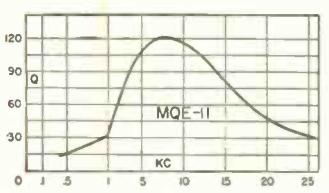


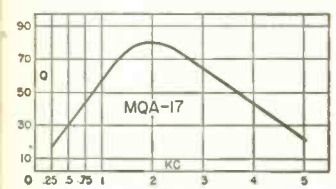


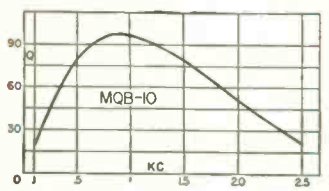


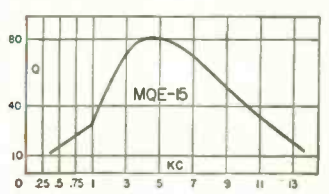












MQA TYPES

Type No.	Inductance	*DC Max.
MQA-1	7 mhy.	250
MQA-2	12 mhy.	200
MQA-3	20 mhy.	150
MQA-4	30 mhy.	125
MQA-5	50 mhy.	100
MQA-6	70 mhy.	80
MQA-7	120 mhy.	60
MQA-8	.2 hy.	50
MQA-9	.3 hy.	40
MQA-10	.5 hy.	30
MQA-11	.7 hy.	25
MQA-12	1 hy.	20
MQA-13	1.5 hy.	17
MQA-14	2.5 hy.	13
MQA-15	4 hy.	10
MQA-16	6 hy.	9
MQA-17	10 hy.	7
MQA-18	15 hy.	5
MQA-19	22 hy.	4

*This value of D.C. (MA) will drop the coil inductance 5%. Values of D.C. below this will show proportionately (linear) less inductance drop. For example, MQE-1 will drop ½% in L with 13.5 MA.

MQB TYPES

Type No.	Inductance	*DC Max.
MQB-1	10 mhy.	400
MQB-2	30 mhy.	250
MQB-3	70 mhy.	170
MQB-4	120 mhy.	120
MQB-5	.5 hy.	60
MQB-6	1 hy.	40
MQB-7	2 hy.	30
MQB-8	3.5 hy.	22
MQB-9	7.5 hy.	16
MQB-10	12 hy.	11
MQB-11	18 hy.	9
MQB-12	25 hy.	8

MQE TYPES

Type No.	Inductance	*DC Max.
MQE-1	7 mhy.	135
MQE-2	12 mhy.	100
MQE-3	20 mhy.	80
MQE-4	30 mhy.	65
MQE-5	50 mhy.	50
MQE-6	70 mhy.	40
MQE-7	100 mhy.	35
MQE-8	150 mhy.	30
MQE-9	.25 hy.	22
MQE-10	.4 hy.	17
MQE-11	.6 hy.	14
MQE-12	.9 hy.	12
MQE-13	1.5 hy.	9
MQE-14	2 hy.	8
MQE-15	2.8 hy.	7.2

MQE CASE

Length ..... 11/16"
Width ..... 1/2"
Height ..... 17/32"
Unit Weight ..... 1.5 oz.

MQA CASE

Length ..... 19/32"
Width ..... 11/16"
Height ..... 123/32"
Unit Weight ..... 4 oz.

MQB CASE

Length ..... 29/16"
Width ..... 113/16"
Height ..... 213/16"
Unit Weight ..... 14 oz.

United Transformer Co.
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EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

electronics

AUGUST • 1954
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ADJUSTMENT PROCEDURES FOR COLOR TV PRODUCTION—Using color bar generator signal for over-all quality check at composite test station near end of tv receiver production line in Metuchen, N. J. plant of Westinghouse television and Radio Division. Photo by Syd Karsen (see p 140) ..... *COVER*

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HIGH CURRENT REGULATED DC SUPPLY

We have been repeatedly advised of the need for a laboratory power supply with current capacity of up to one-half ampere. During the design of the unit it appeared desirable that it should embody characteristics making it suitable for pulse work.

The result is our new Model 600B which we believe merits your attention by its reduced ripple, its internal impedance specifications, and its incorporation of type 5651 tubes to increase long-term stability of output voltage.

Look at these specifications

Output voltage	0-600 VDC
Output current	0-500 Ma
Regulation accuracy	±0.25% above 100 VDC ±0.5% below 100 VDC
Ripple (mV-RMS)	3 maximum
Bias supply	0-150 VDC
Maximum bias circuit impedance	50000 ohms
Internal impedance, maximum	2.0 ohms
Input range	105-125 VAC, 1ϕ; 50-60~
AC voltage unregulated	6.3 VAC, C.T., at 15 amperes

INTERNAL IMPEDANCE
The internal impedance of 2.0 ohms is determined by making measurements in accordance with I.R.E. specifications for the measurement of power supply internal impedance (cf. *The Proceedings of the I.R.E.*, January, 1951). However, this can be expressed in a slightly different manner. The 2.0 ohms impedance applies for frequencies above 20 cycles. Typical measurements indicate that at 10 kc impedance is 0.5 ohms in series with 18 microhenries, and at 20 kc it is 0.5 ohms in series with 8 microhenries.

RECOVERY TIME
Typical measurements indicate a recovery time of 1 millisecond when a load of ½ ampere is applied. It is approximately 0.5 milliseconds when load is decreased from full to no load, and is in the order of 0.2 milliseconds when load is decreased from full to 1/10 load.

REGULATION ACCURACY
The regulation accuracy applies where there is load change from zero to full at a fixed input voltage within the rating, or against an input change between 105 and 125 volts at a fixed load within rating. This accuracy applies down to 30 VDC. Below 10 volts the changes due to circuit instability are greater than those due to line or load conditions.

BIAS SUPPLY
The bias supply accuracy is ±0.5% at maximum output voltage and from 0-5 ma.

TUBE COMPLEMENT
OD3 (2), 5651 (3), 5R4 (3), 6L6 (7), 6BQ6 (1), 6SL7 (1), 5Y3 (1).

MECHANICAL SPECIFICATIONS
The instrument is 17" long, 10½" high, and 14⅞" deep. Net weight is 85 pounds. The unit is self-contained, but a panel is available; its dimensions are 19" long by 12¼" high.

PRICE
$395.00 f.o.b. Stamford, Conn.

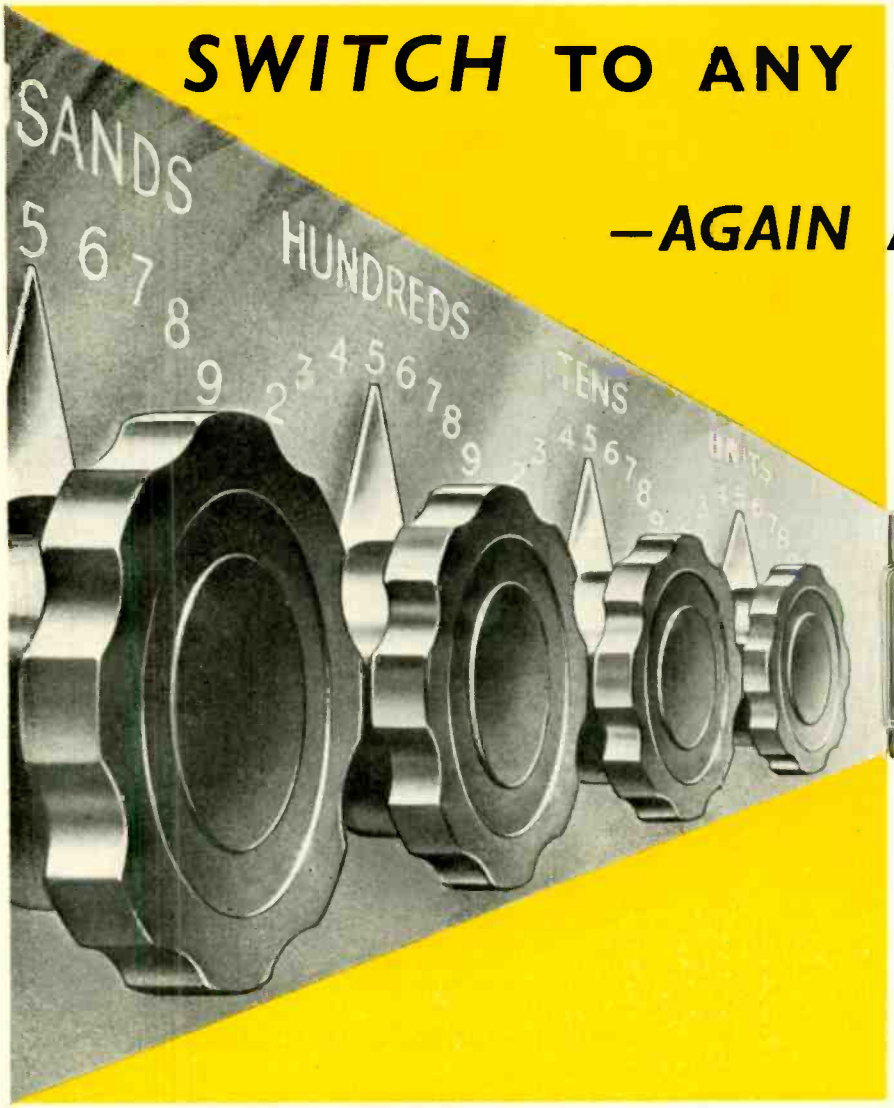
Other B Supplies are available in the standard Sorensen line, as well as Nobatrons* (low-voltage, high-current regulated DC sources), AC regulators, frequency changers, and other power regulating equipment. Write for the new general catalog to Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn. In Europe, please correspond directly with Sorensen A.G., Gartenstrasse 26, Zurich 2, Switzerland.

SORENSEN

Sorensen & Company, Inc., 375 Fairfield Ave., Stamford, Conn.

*Reg. U. S. Pat. Off. by Sorensen & Co., Inc.

SWITCH TO ANY FREQUENCY —AGAIN AND AGAIN!



ON OUR NEW DECADE OSCILLATOR

Not only can you select any frequency between 1c/s and 111kc/s simply by setting to the required value on four rotary switches, but you can repeat this setting — precisely — as often as you wish.

The frequency accuracy at any setting is ±0.2% ±0.5c/s, improving between 20c/s and 50kc/s to ±0.1% ±0.25c/s. Moreover, if the oscillator is standardized at any frequency between 1kc/s and 10kc/s an even higher accuracy can be obtained over a range of ±500c/s from the selected value, thus enabling the instrument to be used as a variable frequency sub-standard.

BRIEF SPECIFICATION

D-650 MUIRHEAD-WIGAN DECADE OSCILLATOR

FREQUENCY RANGE	1-11,110c/s and 10-111,100c/s
FREQUENCY ACCURACY	±0.2% or ±0.5c/s
HOURLY STABILITY	±0.02%
MAXIMUM OUTPUT	2W into 8,000 ohms above 20c/s 50mW into 8,000 ohms below 20c/s
HARMONIC CONTENT	1% at 1W above 20c/s
HUM LEVEL	80db below maximum output at 1,000c/s
POWER SUPPLY	100-120V 60c/s or 200-250V 50c/s
DIMENSIONS	17¼in. wide x 10½in. high x 13in. deep (43.8cm x 26.7cm x 33cm)
WEIGHT	83lb (38kg)

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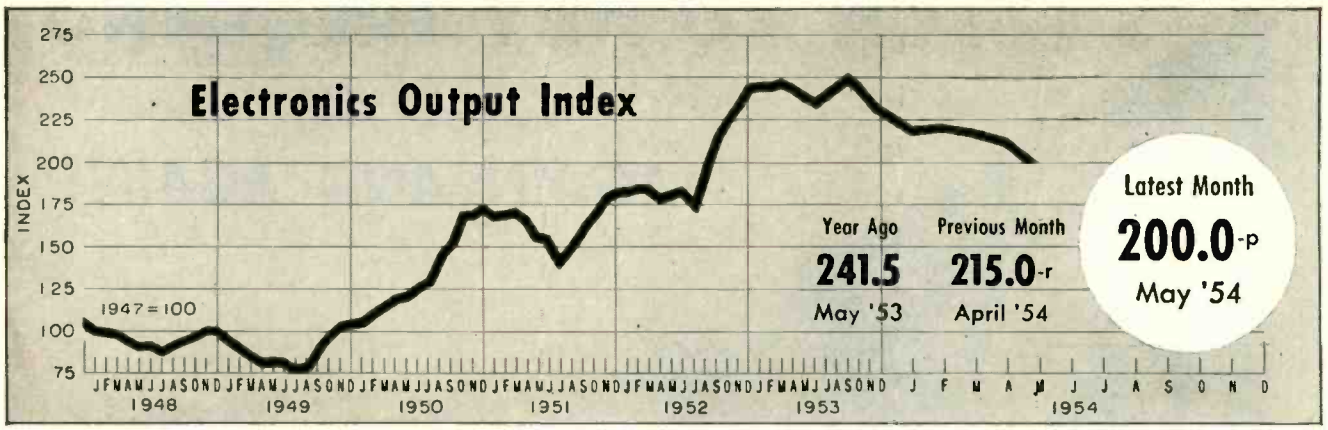
MUIRHEAD

MAKERS OF HIGH GRADE PRECISION ELECTRICAL INSTRUMENTS

WRITE UNDER YOUR BUSINESS LETTERHEAD FOR DESCRIPTIVE BROCHURE

MUIRHEAD & CO. LIMITED · BECKENHAM · KENT · ENGLAND



FIGURES OF THE MONTH

RECEIVER PRODUCTION (Source: RETMA)	Year Ago May '53	Previous Month Apr. '54	Latest Month May '54
Television sets, total	481,936	457,608	396,287
With UHF	.....	112,833	86,790
Color Sets	.....	.....	7,713
Radio sets, total	1,108,991	745,235	722,104
With F-M	41,275	14,008	9,819
Home sets	278,156	165,232	173,480
Clock Radios	129,391	73,590	57,370
Portable sets	204,065	175,424	174,735
Auto sets	497,379	330,989	316,519

RECEIVER SALES (Source: RETMA)	May '53	Apr. '54	May '54
Television sets, units	244,191	371,720	308,728
Radio sets (except auto)	716,407	427,911	386,152

RECEIVING TUBE SALES (Source: RETMA)	May '53	Apr. '54	May '54
Receiv. tubes, total units	35,267,762	29,640,942	28,650,825
Receiv. tubes, value	$21,065,607	$21,697,489	$20,465,451
Pic. tubes, total units	579,332	727,655	584,782
Picture tubes, value	$12,124,090	$14,994,779	$12,062,269

SEMICONDUCTOR SALES (Source: RETMA)	May '53	Apr. '54	May '54
Germanium Diodes / Silicon Diodes	1,466,362	994,949-r	1,001,905

Quarterly Figures

INDUSTRIAL TUBE SALES (Source: NEMA)	Year Ago 1st '53	Previous Quarter 4th '53	Latest Quarter 1st '54
Vacuum (non-receiving)	$10,400,000	$9,467,331	$8,971,335
Gas or vapor	$3,300,000	$4,854,222	$4,589,239
Phototubes	$700,000	$405,000	$405,000*
Magnetrons and velocity modulation tubes	$10,500,000	$13,073,095	$16,135,274
Gaps and T/R boxes	$1,700,000	$1,707,730	$1,517,426

*4th quarter 1953

TV AUDIENCE (Source: NBC Research Dept.)	Year Ago May '53	Previous Month Apr. '54	Latest Month May '54
TV Homes, total	23,930,000	29,495,000	30,083,000

BROADCAST STATIONS (Source: FCC)	June '53	May '54	June '54
TV Stations on Air	198	397	402
TV Stns CPs—not on air	285	176	171
TV Stns—Applications	572	45	14
A-M Stations on Air	2,458	2,575	2,583
A-M Stns CPs—not on Air	126	111	114
A-M Stns—Applications	250	158	158
F-M Stations on Air	580	549	553
F-M Stns CPs—not on Air	21	18	16
F-M Stns—Applications	8	5	5

COMMUNICATION AUTHORIZATIONS (Source: FCC)	May '53	Apr. '54	May '54
Aeronautical	42,213	42,998	41,374
Marine	40,076	45,132	45,762
Police, fire, etc.	13,238	15,241	15,438
Industrial	16,850	21,029	21,313
Land Transportation	5,830	6,829	6,887
Amateur	111,011	120,581	122,283
Citizens Radio	2,124	5,664	5,706
Disaster	189	271	283
Experimental	439	550	567
Common carrier	1,193	1,549	1,613

EMPLOYMENT AND PAYROLLS (Source: Bur. Labor Statistics)	Apr. '53	Mar. '54	Apr. '54
Prod. workers, comm. equip.	433,800	361,900-r	354,100
Av. wkly. earnings, comm.	$66.67	$67.55	$66.86
Av. wkly. earnings, radio	$64.24	$66.59 -r	$65.91
Av. wkly. hours, comm.	40.9	39.5	39.1
Av. wkly. hours, radio	40.4	39.4 -r	39.0

STOCK PRICE AVERAGES (Source: Standard and Poor's)	June '53	May '54	June '54
Radio—TV & Electronics	271.5	305.3	308.7
Radio Broadcasters	266.0	322.1	325.9

p—provisional; r—revised

FIGURES OF THE YEAR

	1953 Total	TOTALS FOR FIRST FIVE MONTHS 1953	1954	Percent Change
Television set production	7,214,787	3,309,757	2,301,005	—30.5
Radio set production	13,368,556	6,102,711	4,048,904	—33.6
Television set sales	6,375,279	2,344,811	2,453,875	+ 4.6
Radio set sales (except auto)	7,064,485	2,568,080	1,873,399	—27.0
Receiving tube sales	437,091,555	187,913,848	134,677,745	—28.3
Cathode-ray tube sales	7,582,835	3,633,288	3,275,301	— 9.8

INDUSTRY REPORT

Silicon Diode Handles 1,200 Watts

New semiconductor device envisioned as replacement for scarce selenium units

POWER output of more than 1,200 watts is claimed for a silicon rectifier recently announced by Westinghouse.

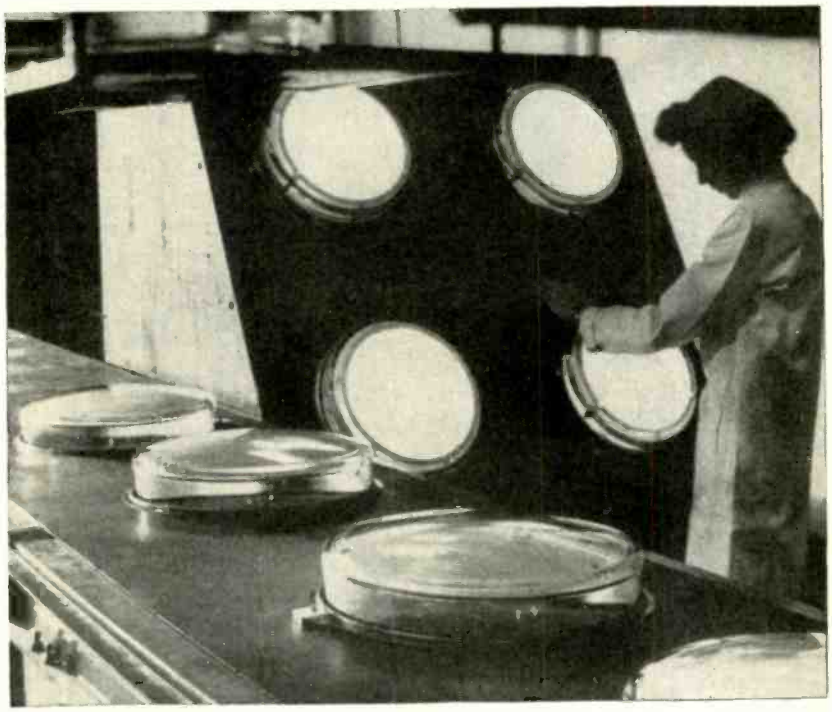
The new semiconductor device will function efficiently at ambient temperatures as high as 392 F. Efficiency of close to 98 percent is claimed. Although not commercially available at present, Westinghouse indicates that it could accept orders.

► **Applications**—Outstanding virtue of the new rectifier is its power-handling ability. Previous silicon diodes could handle only a fraction of a watt. Important also is its resistance to temperature, which fits it particularly well for aircraft and guided-missile applications.

The unit is described as a junction diode about half the size of a cigarette pack. Engineers indicate that the silicon is being "grown" and that supply sources are adequate.

► **Selenium Substitute**—Development of a successful silicon power rectifier would do much to dispel fears of a selenium shortage should defense production go to much higher levels. (See "Planners Fear Selenium Shortage," ELECTRONICS, p 8, May 1954.)

An acute shortage of selenium might see silicon rectifiers used also in products for the civilian market such as radio and television sets, computers and industrial equipment.



PHOSPHOR-COATED faceplates for CBS-Hytron picture tubes are exposed to light in photographic printing process as large screen . . .

Color Tubes Get on Assembly Line

MASS PRODUCTION of picture tubes for color television has been started at the CBS-Hytron plant in Newburyport, Mass. Present production rate of 150 tubes per day is expected to be stepped up to over 400 per day by the end of September.

The new 19-inch tube, which will have a manufacturer's price of $175, has been adopted for portions of the 1954 tv set output of Capehart-Farnsworth, CBS-Columbia, Westinghouse, Motorola, Pacific-Mercury and Warwick Mfg. Co. The latter two companies are suppliers to Sears-Roebuck.

Construction of the new tube uses the photographic process to place the color dot pattern directly on the face of the tube. The tubes own shadow mask is used as the negative for printing the pattern, thus simplifying the problem of obtaining proper registration of the dot structure with the tube's mask.

A new plant is under construction at Kalamazoo, Michigan for black and white picture-tube manufacture. The production line is designed for quick change-over to color tubes when demand reaches a level where this plant's output will be required.

Du Mont recently demonstrated a 19-inch color picture tube of similar construction.

RCA has announced it will show a 21-inch color tube in September. It will contain a curved mask and have the phosphor dots on the face plate, unlike the older 15-inch tube. Introductory price to equipment manufacturers will be $175.

A 21-inch rectangular tube

has been demonstrated in an experimental Zenith set. The tube is the product of the experimental color production line of Zenith's Rauland tube division.

Tubes Aid Allergies

ELECTRONIC in their high-voltage power supplies, two electrostatic air cleaners have hit the home equipment field.

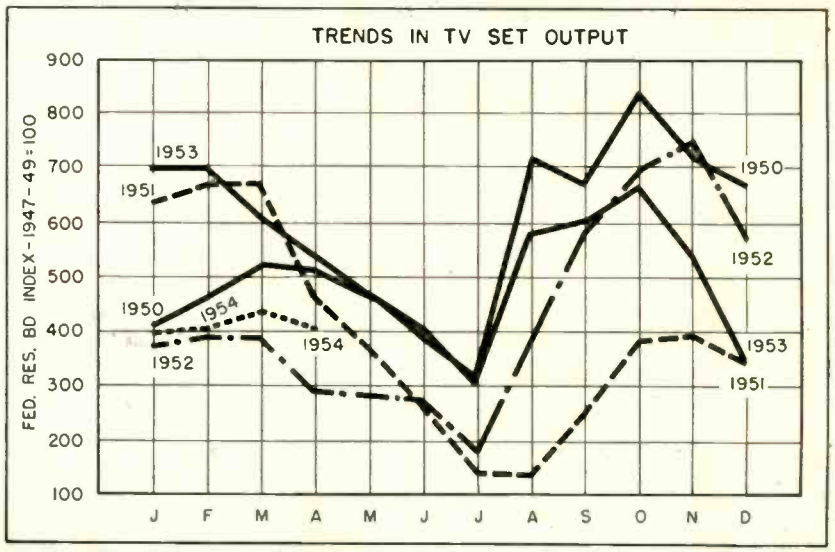
► **Market**—It is estimated that 10 percent of all people suffer from an allergy condition and that 2.5 percent of these or 6 million people have allergies caused by air-borne particles. Some 800,000 people are bed-ridden as a result.

Heretofore, electrostatic air cleaners have been of the large type such as those used in Madison Square Garden, in pharmaceutical manufacturing houses and other large buildings. Few maintenance problems are expected with the new units and those that do occur may be taken care of by a radio-tv serviceman.

One unit, built by Raytheon, weighs 60 pounds and is 30 inches high, 15 inches wide and deep. The other unit is built by the Radex Corp., weighs 30 pounds and measures 25 inches high by 16 inches wide by 13 inches deep.

► **Works**—The Raytheon unit uses approximately the same amount of current as a 40-watt electric light bulb. Air is drawn into the machine by a fan and is ionized by a nonuniform electrostatic field. Ions accumulate on dust particles charging them. The charged particles are then acted upon by the uniform electrostatic field between closely spaced collector plates and are deposited on electrodes of opposite polarity.

The Radex air cleaner uses a fan to pull the air through a mechanical filter. Particles which filter through this barrier pass through a series of eight electrostatic plates which are charged to high voltage. Charged particles are attracted to and held by oppositely charged plates. A germicidal plate coating is designed to destroy virus, fungi and bacteria.



TV Set Output Changes Patterns

Despite similarities in each years' production trends, new twists color the picture

VAGARIES of the tv set business are indicated in the Federal Reserve Board's revised output index for the product.

► **Trend**—As shown in the chart, the ups and downs of the business in the past four years have followed a fairly consistent course and the seasonal pattern of the field seems well defined in general. Yet, as can be seen, each year has had important variations and even summer slumps have been different.

For example, in 1952, the sizable output dip that would be expected in June actually cut only slightly into May production. FRB figures, which are based on RETMA production estimates, also show that in March of this year, contrary to past trends, the output index for tv sets went up more substantially than it had in the past three years even though the total reached was far below that for the month in 1953.

Last year the index actually dropped in March. In April of this year, it dropped only 29 points compared to 97 points last year and for May, tv set production fell by 61,321 units, much less than the decline of 141,998 units in April. According to RETMA, the May drop was caused by the usual seasonal downward trend coupled with labor difficulty in the plant of at least one large set producer.

► **Rise**—The traditional upswing in tv set output that usually occurs in the last five months of the year has also varied considerably. For example, in 1951, instead of the usual sharp increase in August, output actually decreased in that month for the first time in the four-year period. In 1950, output decreased in September, contrary to past performances. Last year the continued sharp drop through November and December was unlike previous experience.

Oil Forces Interest In Radiolocation

NEED for better air navigation systems and requirements of undersea oil drilling regularly bring to public view the work of engineers in the field of radiolocation.

Latest summary of electronic air navigation systems (which are also useful for surface travel) to be printed soon is entitled "Electronic Systems of Air Navigation" and will be available from Office of Technical Services, Department of Commerce. Summaries of unclassified

(Continued on page 8)

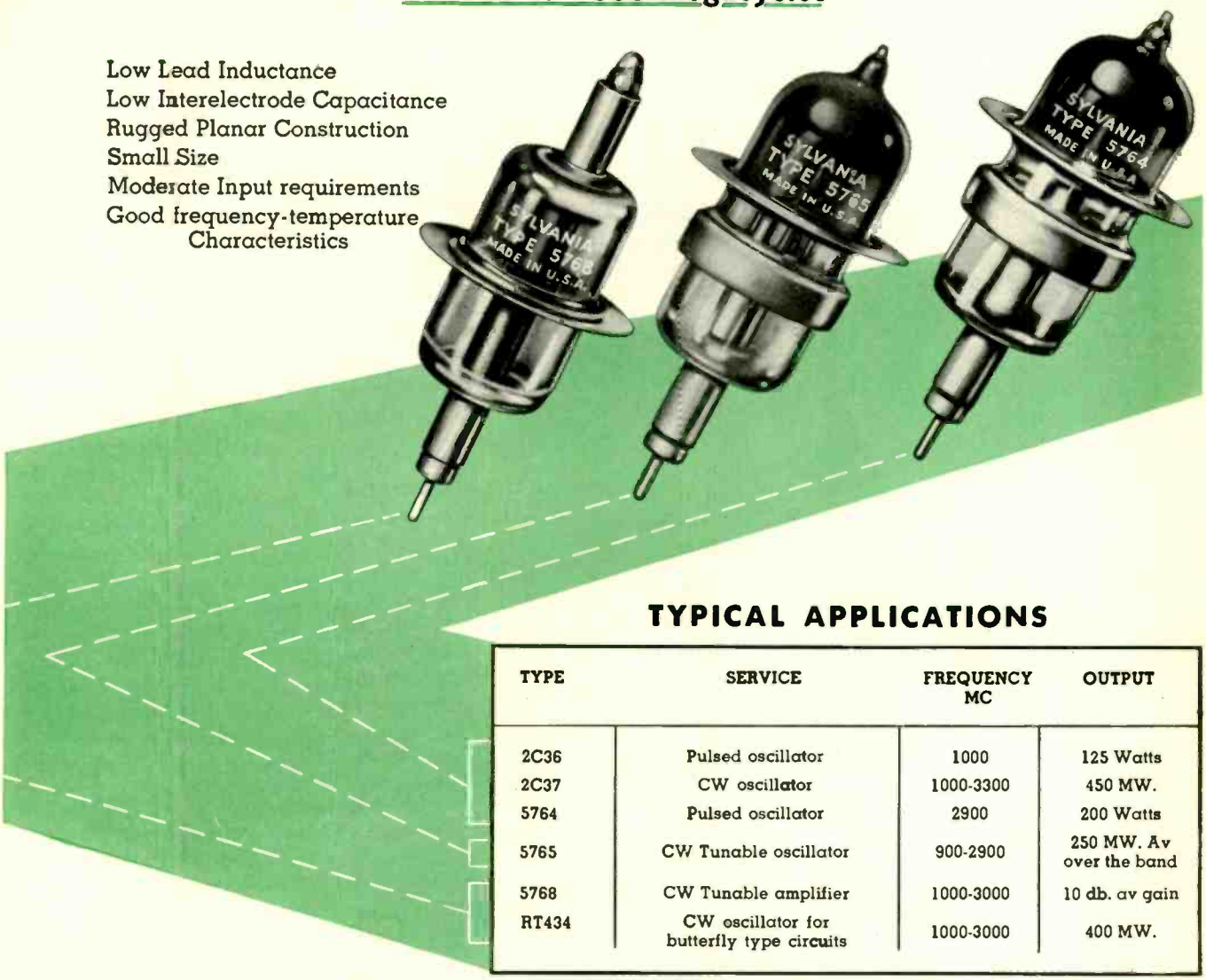
SYLVANIA

ROCKET TUBES

(PLANAR TRIODES)

The Answer to Efficient Power at 1000 to 4000 Megacycles

- Low Lead Inductance
- Low Interelectrode Capacitance
- Rugged Planar Construction
- Small Size
- Moderate Input requirements
- Good frequency-temperature Characteristics



TYPICAL APPLICATIONS

TYPE	SERVICE	FREQUENCY MC	OUTPUT
2C36	Pulsed oscillator	1000	125 Watts
2C37	CW oscillator	1000-3300	450 MW.
5764	Pulsed oscillator	2900	200 Watts
5765	CW Tunable oscillator	900-2900	250 MW. Av over the band
5768	CW Tunable amplifier	1000-3000	10 db. av gain
RT434	CW oscillator for butterfly type circuits	1000-3000	400 MW.

Still more reasons why it pays to SPECIFY SYLVANIA

For complete information concerning Sylvania Rocket Tubes or other electronic tubes write to Sylvania, Dept. 4E-1608.

SYLVANIA

Sylvania Electric Products Inc. 1740 Broadway, New York 19, N. Y.

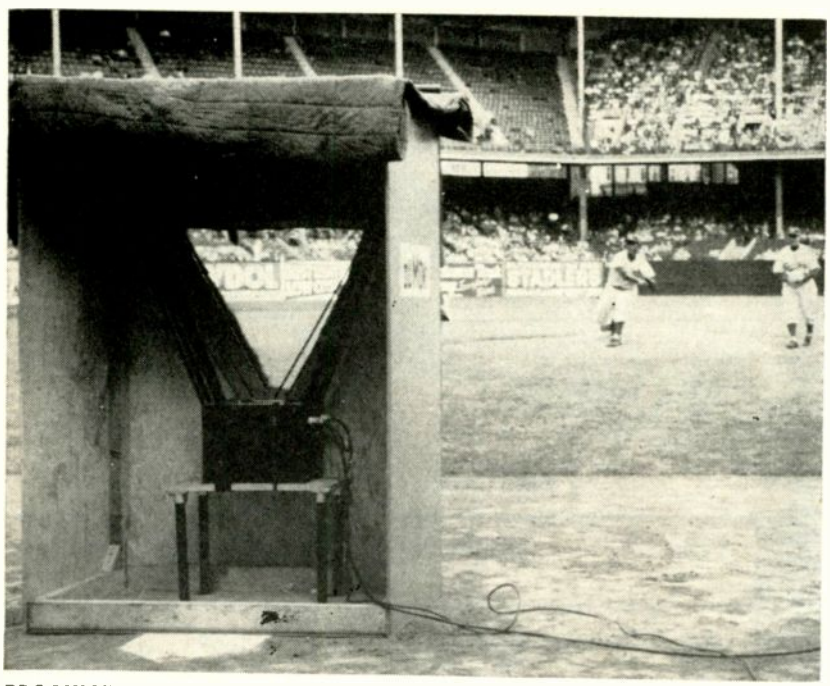
LIGHTING · RADIO · ELECTRONICS · TELEVISION

In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg., St. Catherine St., Montreal, P. Q.

systems include standard loran, low and medium-frequency nondirectional beacons, Consol, Navarho, Decca, Gee, the four-course radio range, vhf omnidirectional range (VOR) and distance measuring equipment (DME).

▶ **L-F Development**—Chief difficulty with existing unclassified systems is that, for the most part, they either operate on the higher frequencies, with resultant limited range, or else they fail to employ the lower frequencies assigned by international agreement for ultimate long-distance systems.

Just as a war emergency sped the development of radar and loran, the push for undersea oil reserves makes it interesting to develop long-wave radiolocation systems that can be used in the Gulf of Mexico. Because of the interest of Hastings Instrument Co. (Raydist) and Seismograph Service Corp. (Lorac), FCC has proposed that the bands 10 to 14 kc and 90 to 110 kc now assigned to radio navigation service be opened to development of radiopositioning equipment. Comments pro and con have been made.



BROOKLYN DODGERS use a scope to measure fast ball speed as . . .

Oscilloscope Business Steps Up

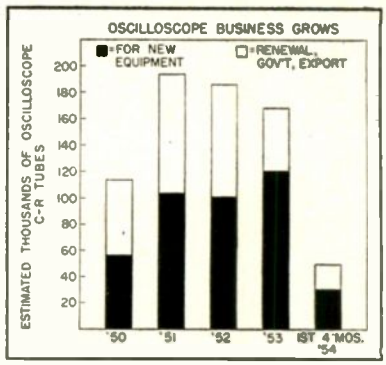
Volume has doubled since 1950 as applications in business and industry increased

SCOPE manufacturers seem to agree that their business has risen steadily in the past few years despite some disagreement on the level of the volume. Estimates range from 15,000 to 50,000 units sold in 1953.

The upward trend of the business is indicated in the chart by the unit sales of oscilloscope c-r tubes for new equipment which includes camera, pickup and other tubes. It is estimated that oscilloscope unit volume represents about 40 to 50 percent of initial equipment c-r tube volume shown.

▶ **Companies**—There are about 55 manufacturers of oscilloscopes in the U.S. making scopes ranging from multiple channel types to portable and portable projection models. It is estimated that about 10 companies account for the bulk of the business. Kit manufacturers do a large unit volume in the field, an estimated 20,000 units a year. One kit firm is estimated to produce 1,000 units monthly.

In terms of dollar volume, it is



the factory-made sets that cash in. This is indicated by the range of scope prices. Kits with 5-inch tubes are sold for as little as $45 to $50. On the other hand, low-priced factory built oscilloscopes sell at around $140 to $150 and go on up to several thousand dollars.

▶ **Market**—Kit manufacturers find a sizeable market for their product in the school or technical institute field in addition to the service field. The low price of kits and the fact that they allow students to learn by doing has made the market important.

Factory-made oscilloscopes find their main market in industry. The electronics field itself represents a major market and the automotive industry is becoming increasingly important. The government is also a large customer for the instruments. About 30 percent of the output of one large scope maker goes to the military.

▶ **Future**—One manufacturer is developing special designs, expected to be ready next year, for greater use in the automotive field. Applications in the computer field are also increasing along with those in medical electronics.

Printed circuits are being used for certain circuits and may become a permanent part of oscilloscope production techniques.

Wireless Transistor Microphone Bows

STEP toward removing some of the restrictions that conventional microphones using cables and booms have placed on tv performers and directors was taken recently when

(Continued on page 10)

only Sprague makes them all!

YOU CAN CHOOSE FROM 5 DIFFERENT STYLES OF TANTALEX* CAPACITORS

Looking for tantalum electrolytic capacitors? You'll save time and trouble by checking Sprague's complete selection *first*. Sprague makes more types of tantalum capacitors than *any other manufacturer*.

Sprague Tantalex capacitors provide maximum capacitance in minimum space . . . exhibit no shelf aging under long testing periods . . . have extremely low leakage current. And most important, they give unusually *stable* performance, because they're made with tantalum, the most stable of all anodic film-forming materials.

There's a complete range of sizes and ratings available in Tantalex capacitors . . . from the ultra-miniature 10 mf, 4 volt unit in a case only ⅛" in diameter by 5/16" long . . . to the 7 mf, 630 volt unit in a case 1⅝" in diameter by 2 19/32" long. As for case styles, Sprague makes them all, from tiny tubular and cup units to the large cylindrical types.

For complete details relating to your miniaturization or high temperature problems, write Sprague Electric Co., 35 Marshall St., North Adams, Mass.

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

NEW! TYPE 101D for low-cost transistor circuitry

Especially useful for filter, coupling, and by-pass applications in transistor electronics, these foil type miniature Tantalex capacitors were intended for use in hearing aids, pocket radios, and similar uses. Operating temperature range is —20 to +65°C. Request Engineering Bulletin 353.

NEW! TYPE 102D for −55°C to +85°C operation for military use

Here are tubular capacitors hermetically sealed in cases of silver plated copper. Intended for applications from 3 to 150 vdc, their small capacitance drop-off at extremely low temperatures, extremely low leakage current, and low power factor are of particular interest. Request Engineering Bulletin 351.

NEW! TYPE 103D ultra-miniature capacitors for transistor circuitry

Only ⅛" in diameter, and from ¼" to ½" in length, these are the smallest electrolytics made. Providing relatively large values of capacitance in the very minimum of space in bypass, coupling, and filter applications, they are ideally suited for transistor hearing aids and military amplifiers in which small size is all-important.
Request Engineering Bulletin 352.

NEW! TYPE 104D miniature "cup" capacitor for military use

These low-voltage units consist of a sintered porous tantalum anode housed in a miniature silver thimble, which serves as both cathode and container for the electrolyte. Volume is less than 1/10 cubic inch; operating temperature range —55 to +85°C, and up to 100°C with a voltage derating of 15%. Request Engineering Bulletin 354.

TYPE 100D for −55 to +125°C operation for military use

These hermetically sealed capacitors are available in voltage ratings up to 630 volts at 85°C or 560 volts at 125°C. They are of the sintered porous tantalum anode type, with internal construction to withstand high g shock, severe vibration, and thermal cycling. Request Engineering Bulletin 350A.

WORLD'S LARGEST CAPACITOR MANUFACTURER

SPRAGUE

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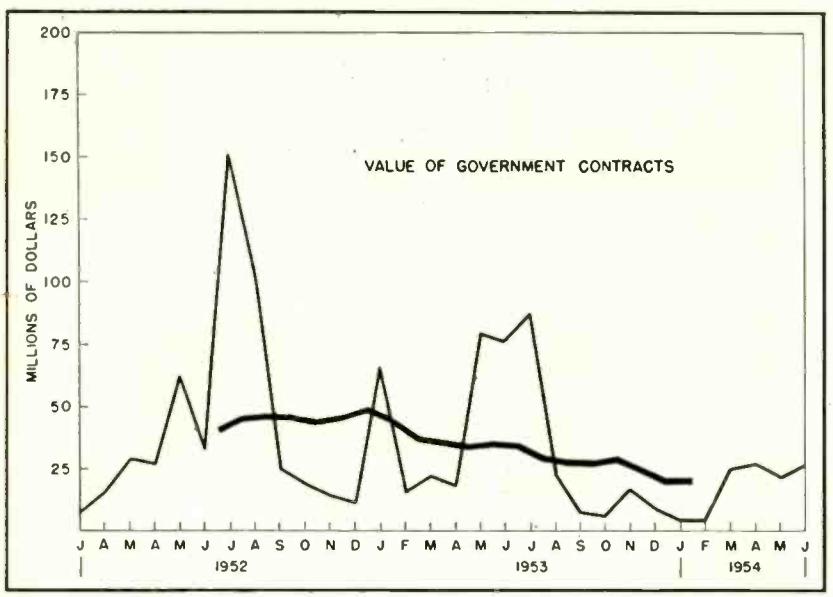
NBC engineers demonstrated an experimental wireless microphone. The entire assembly of microphone, transmitter with battery and loop antenna weighs less than eight ounces and can be hidden in a performer's clothing.

► **Unit**—The transmitter, when design is finalized, will be little larger than a pack of king-sized cigarettes with dimensions of ⅝ by 2 by 3¾ inches. Eight transistors are used in the unit. It is powered by an alkaline-cell battery which is expected to furnish five hours of continuous transmission. The unit develops approximately 50 milliwatts of power at about 530 kc of which less than 100 micro microwatts is radiated.

► **Signal**—The transmitter's signal is picked up by a loop of wire encircling the work area. The range of reception has not yet been fully determined, but tests have shown coverage of an area of 5,000 sq. ft.

According to NBC engineers, the system is not vulnerable to most sources of interference but in areas where interference may be a problem, an increase in received signal can be achieved by reducing the area covered by the receiving loop, thereby improving the signal to noise ratio. Because of the low power and frequency used by the unit, it does not require an FCC license.

Military Purchases Show Upturn



DOWNWARD TREND in government buying appears to be checked, as . . .

End-of-fiscal-year boom fails to materialize but monthly buying is higher

GOVERNMENT purchases of electronic equipment during the second quarter of 1954 are up sharply over first quarter totals but still much lower than for corresponding months last year. A general downward trend in electronic purchases appears to have leveled off, however.

Figures shown in the curve are taken from the consolidated synopsis of contract awards issued daily by the Department of Commerce and includes only formally advertised and unclassified contracts of $25,000 and over. Only contracts for electronic equipment and components are included. This excludes, for example, electronic gear supplied as part of military aircraft.

► **Trend**—The trend is more important than the actual totals.

This trend is established by averaging out sharp peaks that arise from an apparent tendency of procurement officers to concentrate their buying around the beginning and end of the federal fiscal year in July.

The sharp increase noted in 1952 and 53 did not materialize at the end of the 1954 fiscal year although daily buying during the first days of July was averaging $3.6 million. A breakdown of the midsummer boom in 1952 shows large expenditures for services, facilities and materials for research, design and manufacturing of items such as transistors, hydrogen thyratrons, miniaturized components and reliable tubes that are unlikely to be repeated.

► **Future** — By 1960, electronics purchases will constitute 10 to 15 percent of all defense spending according to Don Mitchell, Sylvania's board chairman. Annual outlay for electronics will then be about $3.8 billion. Mitchell pegs present spending at $2.8 billion—against a 1951 figure of $1.5 billion. Predictions on future defense spending assume no all-out war meanwhile.

Analog Computer Men See Rising Market

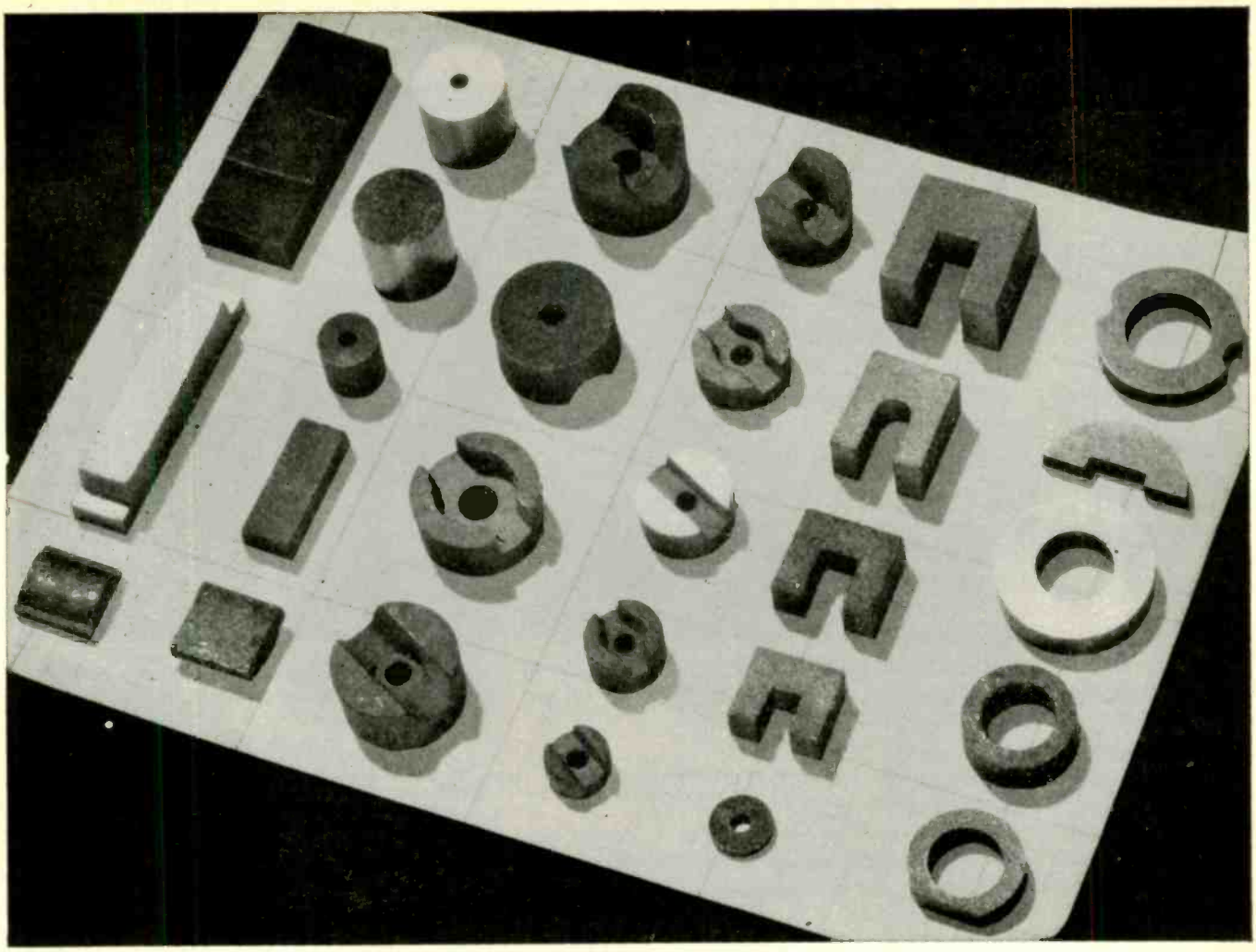
Industrial firms, government and colleges buy machines; computation centers appear

BUSINESS in the analog computer field is by no means as big as in the digital field but it is nonetheless sizable and growing rapidly. Annual sales are running more than $8 million and manufacturers expect them to double by 1955.

About $40 million worth of analog computers are in use. Customers include manufacturers of aircraft, jet engines, automobiles, cameras, chemicals, petroleum products and even digital computers as well as defense agencies, colleges and universities.

► **Analog vs Digital**—The analog computer is a kind of calculus

(Continued on page 12)



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"MAGNETIC MATERIALS CATALOG"

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Contains handy data on various types of Alnico Magnets, partial lists of stock items, and information on other permanent magnet materials. Also includes valuable technical data on Arnold tape-wound cores, powder cores, and types "C" and "E" split cores in various tape gauges and core sizes.

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machine whose elementary prototype is the slide rule as opposed to the digital computer which is an arithmetic machine whose elementary prototype is the abacus or simple adding machine.

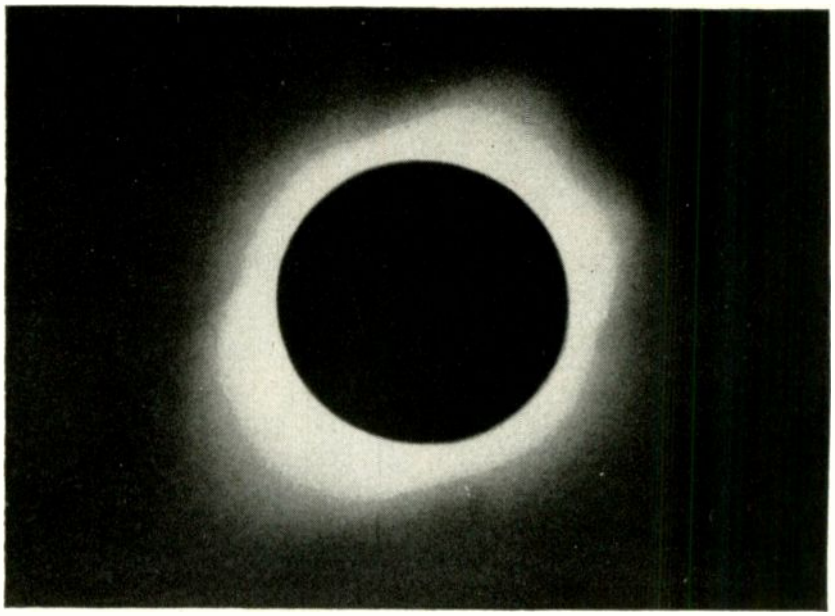
A king-size analog computer costs about $500,000 and can fill more than two dozen standard equipment racks. Many such units are installed at establishments connected with the guided-missiles program. An average-size computer may cost about $70,000, fill eight equipment racks and use nearly 1,000 electron tubes. A small or poor man's computer can be contained in a desk-size console and costs about $15,000.

▶ **Applications**—The analog computer's prime function is solving differential equations encountered in problems of dynamic analysis. This means studying systems with several variables each of which varies in some particular way with time. Even the poor man's computer can usually solve differential equations of the tenth degree.

Computer's generally use d-c amplifiers for addition, subtraction, differentiation and integration and servomechanisms for multiplication and division. Electronic circuits can also be used for multiplication.

▶ **Manufacturers**—Three manufacturers are producing precision computers with accuracies of from 0.01 to 0.1 percent. Three others are building machines whose accuracy is 10 percent or more. Two analog computation centers are now open to businessmen and manufacturers for the civilian market. Many computers at colleges, government labs and in defense plants are available to government agencies and their contractors.

At the 7,000-sq ft center run by Engineering Associates in Princeton, N. J. a medium-sized computer can be rented for $90 an hour; half the machine can be had for $55. Take-home problem boards are provided so that a problem can be set up before the customer comes to the center.



TOTALITY, seen at an altitude of 13,000 feet during the American Airlines-Hayden Planitorium Eclipse Expedition, shows the sun's outer shell of gas as . . .

Electronics Covers The Eclipse

Commercial television, radio telescopes and photoelectric eyes watch the event

IMPORTANT part that electronics plays in the field of astronomy was pointed up during the solar eclipse on June 30. The event was shown on television and, in various locations throughout the world, electronic gear aided scientists in recording the eclipse.

▶ **Where**—In Minnesota, balloons carried electronic gear aloft to measure cosmic rays. Television cameras there were trained on the eclipse using a specially designed ground-glass plate attached to the University of Minnesota's 10.5-inch telescope.

The U. S. Airforce Cambridge Research Center, in cooperation with other agencies, had personnel and equipment at 15 observation sites in Canada, Labrador, Greenland, Iceland, Faeroe Islands, Sweden and Iran. Electronic scientists and technicians were among the personnel covering the event. Nearly 600 individual pieces of scientific equipment ranging from telescopes to audio equipment were used by Air Force observation teams alone.

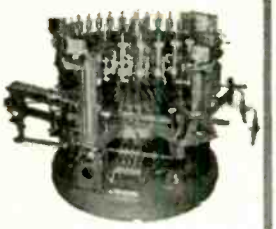
▶ **Eyes**—At the four major Air Force observation sites, in Quebec, Greenland, Labrador and Iran, the minimum light intensity observation method was used. The method utilizes a highly sensitive photoelectric cell to make a graphic record of the changes of intensity during the eclipse. The method was especially useful in Iran where clouds obscured the eclipse. The photometer linked to an oscillograph operated satisfactorily to record the event.

Radio telescopes also were trained on the eclipse. Two in use were operated by French Astrophysical groups and by the Royal Observatory of Belgium.

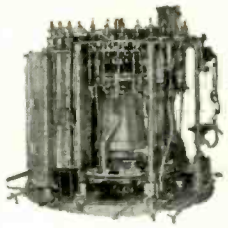
▶ **Computers**—According to the Air Force, electronic computers will probably be used to calculate observation results. However, such results will not be forthcoming for several months.

Pre-eclipse calculations were made at computer centers in the U. S. The instruments have been used for some time for astronomical calculations by various observatories.

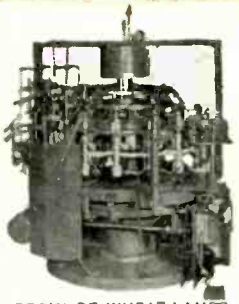
(Continued on page 14)



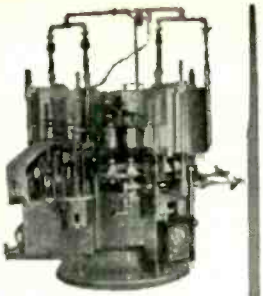
MERCURY SWITCHES



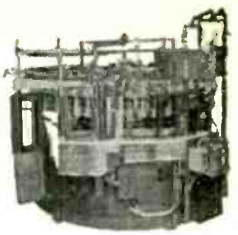
FLUORESCENT LAMPS



GRAIN-OF-WHEAT LAMPS



VACUUM BOTTLES

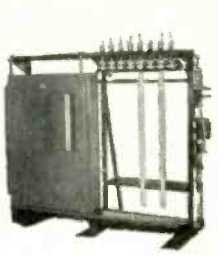


MINIATURE RADIO TUBES

FOR VACUUM

kahle

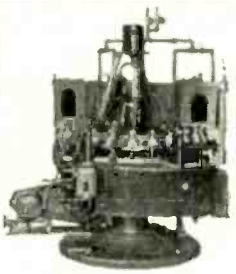
largest producer of EXHAUST MACHINES



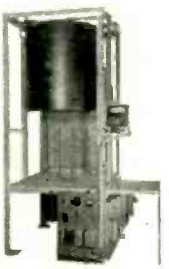
FLUORESCENT LAMPS

SPECIAL TUBES

MINIATURE RADIO TUBES



INCANDESCENT LAMPS



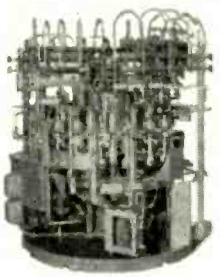
CATHODE RAY TUBES

X-RAY TUBES

covers the most complete range of products to be vacuumized...

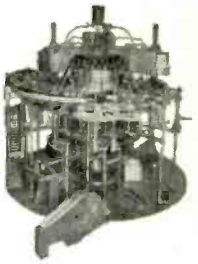
Kahle makes exhaust machines to vacuumize lamps smaller than a grain of rice for use in cystoscopes—and for eight feet long fluorescent lamps

Kahle makes exhaust machinery that is stationary, automatic and combination (machines that exhaust and seal in one operation, machines that exhaust, vacuum metallize and mercury feed simultaneously, etc.). Kahle machinery will fit into any operation whether small scale or demanding outputs up to 2000 units each hour!



RADIO RECEIVING TUBES

POWER TUBES



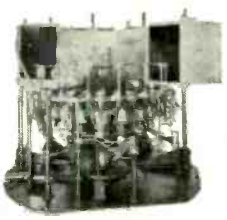
TRANSMITTING TUBES

Among various items for which Kahle has made exhaust machinery are:

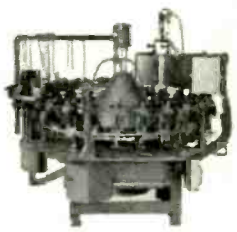
LAMPS gas-filled, miniature, photo-flash, incandescent, fluorescent and special lamps

ELECTRON TUBES sub-miniature, miniature, cathode-ray, standard, power, X-ray

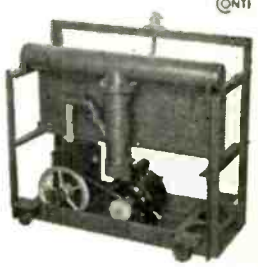
MERCURY SWITCHES **VACUUM BOTTLES**
INSTRUMENTS **TRANSISTORS**



CATHODE RAY TUBES



POWER TUBES



INSTRUMENTS

Regardless of what product is to be exhausted, write KAHLE, largest exclusive manufacturer of custom machines for the glass, lamp and electronics industries.

Kahle ENGINEERING COMPANY
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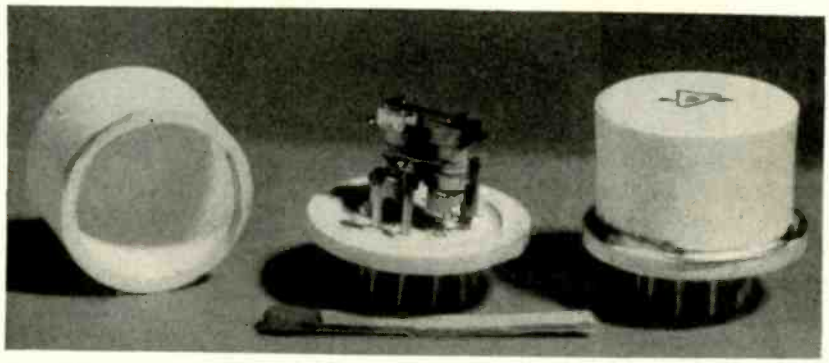


STACKING elements simplifies assembly so . . .

Ceramic Tube Fits Automation

Experimental units first use will be for the military but tube holds commercial promise

ADAPTABLE to assembly by automation, a new electron tube features a ceramic envelope and mount instead of the usual glass and mica. The design has been developed by Sylvania under contract with Navy's Bureau of Ships. (See p 162, this issue).

More compact than the conventional tube, it is said to have a higher degree of stability under temperature extremes, shock and vibration, and also to be capable of automatic production.

▶ **Assemble**—The tube elements are stacked one atop the other in the assembly process. The unusual ruggedness is attained in part by the use of ceramic spacers instead of mica. The complete mount of the tube is assembled on two small pins. First, a plate, then a spacer ceramic, a grid, a spacer ceramic, a cathode, a spacer ceramic and so no until the top is reached.

The ceramic tube can be directly strapped to equipment chassis or it can be socketed. The new tube is not interchangeable with the glass tube now used in electronic equipment, except in rare cases where a stacked tube may be tailored to a particular use. Since the tube design has not been frozen, equipment has not been redesigned yet to make use of it. However, much preliminary work has been done.

▶ **Cost**—Unofficial government opinion is that for approximately the next ten years the new tube will be more expensive than glass because of the special manufacturing facilities required and because the ceramic material for envelops is more expensive than glass.

The lesser cost of putting together the tube by automatic means will not offset these other cost factors for some time. It will take a number of years to amortize the cost of equipment.

▶ **Advantages**—The stacked tube can operate at a much higher temperature than a glass tube, it is more rugged, more uniform from tube to tube and capable of being manufactured by automatic means.

The disadvantages are higher cost, factory renovation necessary for equipment, new physical configurations calling for a different type of equipment packaging and somewhat lower cathode efficiency.

Theater-Sound Market Rapidly Expands

Stereophonic-sound motion pictures open new field for theater equipment sales

WITH THE ADVENT of numerous wide-screen film processes and their accompanying stereophonic sound systems, a nationwide market has been created for new sound equipment sales.

A stereophonic sound system costs approximately $3,500 (including installation) compared to $1,200 to $1,800 for a regular sound system for an average theater with a seating capacity of 600. To date, approximately 4,000 theaters have been equipped for 3-D sound.

Installations are currently being made at a rate of 75 to 100 theaters per week. There are about 18,000 indoor and 4,000 drive-in theaters in the United States, and, at the present rate of installations, the market shouldn't be saturated until 1957.

Stereophonic equipment is being supplied by at least six manufacturers. These companies manufacture either the magnetic sound heads and amplifiers used alone, or complete packages including loud speakers and other accessories.

Financial Roundup

PROFIT reports and security transactions reported in the past month by companies in the electronics field show the continued activity of the industry on the financial front.

The following firms reported net profits for fiscal periods indicated ending in 1954 compared to the period ending in 1953:

Company	Net Profit 1954	1953
AT&T 4 m	$109,986,629	$100,764,949
Avco 6 m	2,827,894	3,315,897
Daystrom 12 m	1,459,000	.....
Raytheon 12 m	3,523,316	.....
Remington Rand 12 m	12,257,778	14,150,842

▶ **Securities** — Daystrom authorized an increase in its authorized capital stock from 1.25 to 2.2 million shares consisting of 200,000 shares of cumulative preferred stock without par value and 2 million shares of common stock with par value of $10 per share. Also authorized was the issuance of convertible securities at the discretion of the board of directors.

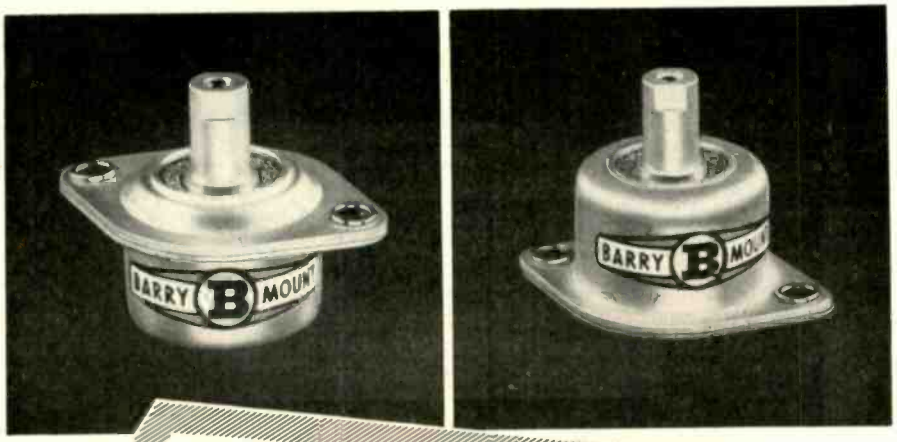
The new stock authorized will be used to increase the firm's financial potential, allow for further expansion and provide additional working capital. According to the company, while no

(Continued on page 16)

the **NEW** *miniature* **... ALL-METL**

BARRY B MOUNT

UNITS SHOWN ACTUAL SIZE



for all-temperature vibration protection of airborne equipment

These new isolators are the latest addition to the famous Barry ALL-METL line.
They are specifically designed to help you meet miniaturization demands under toughest environmental conditions.

Temperature range — from −60°C to +175°C

Weight — only ½ ounce per unit isolator

Height — only 1¼ " free, 25/32" bottomed

Load ratings — 0.1 to 3.0 lbs. per unit isolator

Performance — meet all relevant requirements of JAN-C-172A/MIL-C-172B

Ruggedized — to meet shock tests under specifications AN-E-19, MIL-E-5272, MIL-T-5422B, and MIL-C-172B.

Mounting styles — available in plate and cup types, as illustrated, for 2-hole or 4-hole mounting.

For complete information, ask for your free copy of the new Barry Product Bulletin 542, containing full installation and performance data. And for greatest benefits with these new isolators, let our Field Engineering Service help in the early stages of your equipment design.

THE BARRY CORP.

707 PLEASANT STREET
WATERTOWN 72, MASS.

SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

British Licensee: Cementation (Muffelite), Ltd., London, England

specific project has crystalized, it plans to continue its program of expansion and development with emphasis on electronics. The company recently acquired Weston Instrument stock and now has voting rights to about 189,000 of the 428,221 Weston shares outstanding.

General Electric registered with SEC covering 4.2 million shares of its $5 par common stock to be offered to key employees who may from time to time hold options granted under GE's stock option plan.

Gray Manufacturing registered with SEC covering 58,119 shares of its capital stock, $5 par, to be offered to stockholders on the basis of one new share for each four held. Net proceeds are to be added to the general treasury fund for general corporate purposes.

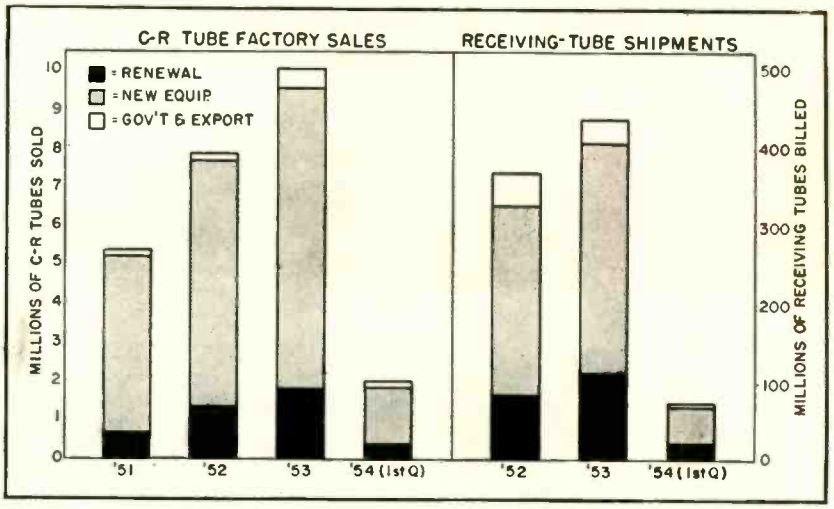
IT&T's International Standard Electric Corp. plans the sale abroad of $17.5 million of unsecured debentures for public distribution in Switzerland. International Standard will apply the net proceeds against its current debt to the parent company with a resulting increase in the working capital of IT&T.

Sprague Electric has raised $3,607,500 for working capital by selling a block of 48,100 shares of its common stock, par $2.50, privately to 12 buyers at a price of $75 per share.

Telecomputing Corp. offered 95,000 shares of capital stock, par $1, at $13.25 per share. Principle purpose of the offering is to provide funds for the manufacture of its recorder and further development and production of the firm's automatic business controls project. The company also contemplates construction of a new $350,000 plant.

Total of 16,000 shares of Texas Instrument common stock, par $1, was offered at the market price. Net proceeds will go to selling stockholders.

Ultrasonic Corp. registered with SEC covering 200,000 shares of common stock, par $5. Proceeds will be used to finance new business the firm has on hand.



Replacement Sales Keep Gaining

Growth in quantity and age of equipment has steadily increased renewal business

RENEWAL parts and equipment sales are continuing to gain.

▶**Tubes**—Although renewal tube sales both for c-r tubes and receiving tubes are not nearly as large as new equipment business for both types, they have represented from 20 to 30 percent of total sales for the past few years, as is shown in the chart.

▶**Sizes**—Renewal sales for picture tubes show that in the first quarter of this year approximately 44 percent of total renewal sales were for the 19 to 21-inch tubes and 42 percent for the 16 to 18-inch type. Tubes 15 inches and smaller accounted for 11 percent and those over 21 inches accounted for the remaining 2 percent.

In contrast, in the first quarter of 1953, 31 percent of total renewal sales were accounted for by 19 through 21-inch tubes while 58 percent were represented in the 16 to 18-inch classification.

For the yearly comparison, 51 percent of total c-r tube renewal sales in 1953 were for the 16 to 18-inch tubes and 33 percent represented sales of 19 to 21 inch.

In 1952, 26 percent of total renewal sales of c-r tubes was in the 16 to 18-inch size and only 8 percent was represented by 19 to 21-inch tubes.

▶**Future**—In pointing out opportunities in television and radio servicing, RETMA estimates the servicemen's billings for components and accessories reached nearly $400 million dollars in 1953. Billings of about $500 million for this year, nearly $600 million in 1955, over $900 million in 1956 and nearly 1.1 billion in 1961 were foreseen.

The serviceman's bill for replacement tubes, both receiving and picture was estimated at over $200 million in 1953; $300 million in 1954; nearly $400 million in 1956 and over $500 million in 1961.

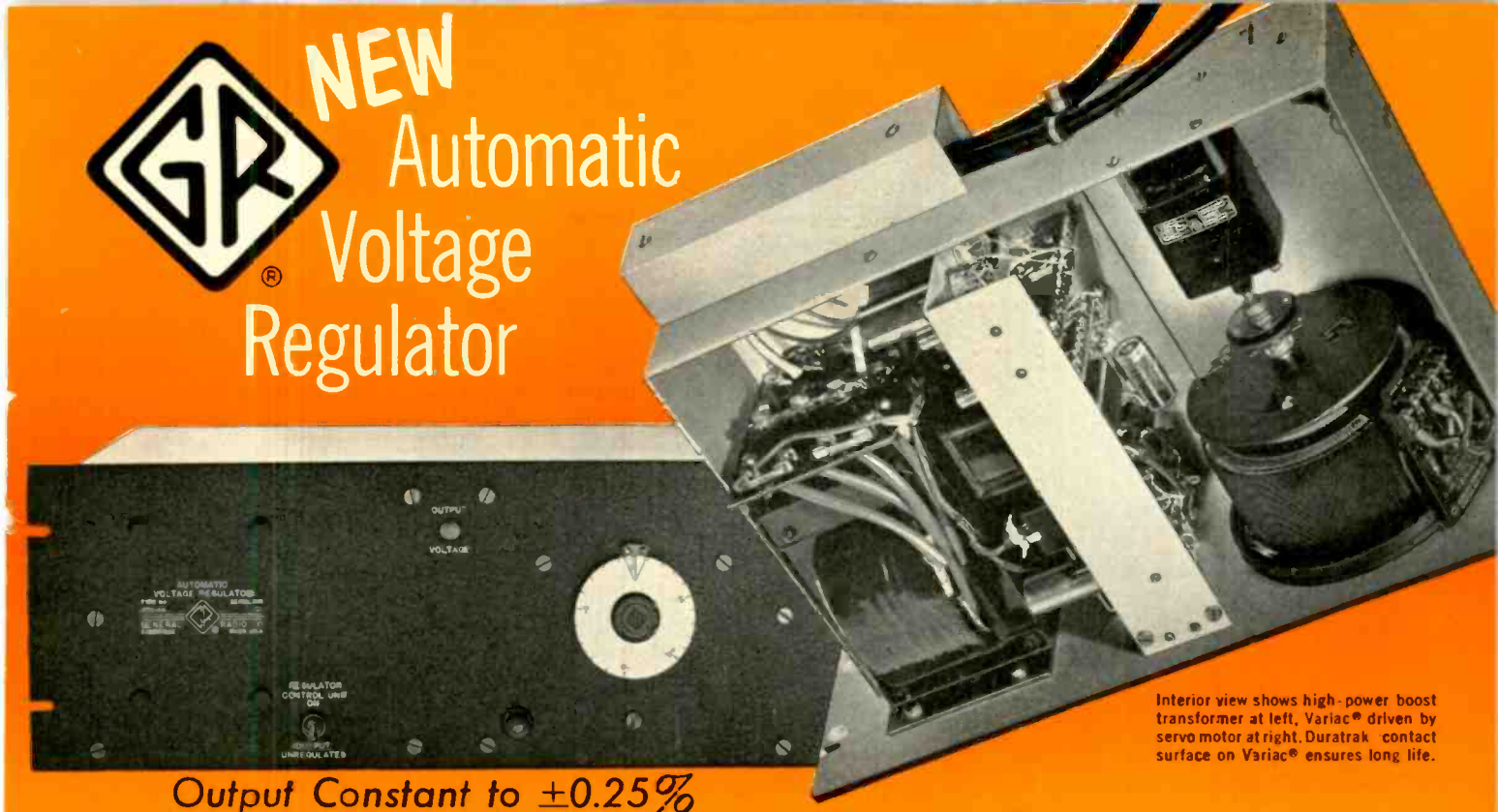
Other estimates of the replacement business have painted an equally rosy picture for parts and tube manufacturers. One of the largest tube companies estimates that manufacturers sales of replacement tubes and parts totaled $630 million in 1953 and that they will increase by approximately $200 million this year. In 1960 to 1962 the company sees replacement tube and parts sales of $2.2 billion quadrupling present volume and exceeding new equipment dollar volume.

Electronics Employment Increase Due in August

UNEMPLOYMENT in the communications equipment field is set for a sharp decrease this month if past hiring trends of the industry hold true for this year. With inventor-

(Continued on page 18)

NEW Automatic Voltage Regulator®



Interior view shows high-power boost transformer at left, Variac® driven by servo motor at right. Duratrak contact surface on Variac® ensures long life.

Output Constant to ±0.25%
Extra Fast Response: 0.1 sec. per volt
Handles up to 6 KVA

For a Detailed Description of this New Instrument, write for the July Issue of the General Radio Experimenter

The Type 1570-A Automatic Voltage Regulator combines *Accuracy* for laboratory use with *High Power-Handling Capacity* for control of industrial processes.

The application of proportional-control servo-mechanisms to voltage regulator design has resulted in a unique, highly-efficient instrument which should prove of considerable value to those requiring constant a-c line voltage.

This Regulator consists essentially of a Variac® continuously-adjustable autotransformer, a servo-mechanism sensing circuit which samples the output voltage, and a servo-motor which varies the Variac to correct for input line-voltage changes. This instrument is rugged, requires minimum maintenance, — the G-R trademark guarantees it's been *engineered and built right.*

Features you get with the G-R 115-volt, 60-cycle Automatic Voltage Regulator . . .

SPEED *This instrument does things in fractions of a second — response is 10 volts per second*

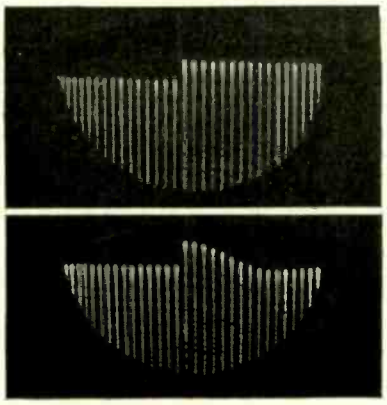
HIGH ACCURACY *Output held constant to within ±0.25% of voltage selected*

±10% SELECTION IN OUTPUT VOLTAGE *Output may be set for any desired value from 104 to 127 volts*

CORRECTS LINE VOLTAGE FLUCTUATIONS OVER WIDE RANGE *±10% of selected output voltage, ±20% or ±40% at reduced accuracy and power rating*

HIGH POWER *Handles 50-amps (6 KVA)*

EXCELLENT TRANSIENT RESPONSE *Adjustments permit setting response characteristic desired — adjustable for no overshoot (see oscillograms)*



Oscillograms illustrate high-speed response of typical G-R Automatic Voltage Regulator. Illustrated at top, is sudden 1% change in 60-cycle voltage input to Regulator. Bottom oscillogram shows instrument correcting for this change in 8 cycles (0.13 seconds)

ADDS NO HARMONIC DISTORTION *Unlike most saturable-core reactors*

SUPPLIES ANY LOAD *No restrictions on power factor*

EFFICIENCY *Better than 98%*

VOLTAGE CORRECTION INDICATED *Panel dial provides continuous indication*

USEFUL FOR CONTROL OF THREE-PHASE POWER *three of these instruments in conjunction will control both amplitude and phase of three-phase systems*

WEIGHT *55 lbs* DIMENSIONS *19" x 7" x 12⅞"*

Type 1570-A Automatic Voltage Regulator
. . . supplied in either 115-v or 230-v model

Type 1570-ALM (115v)
Type 1570-AHM (230v) Table-Top **$470.**

Type 1570-ALR (115v)
Type 1570-AHR (230v) Relay-Rack **$465.**

We sell direct. Prices shown are NET, f.o.b. Cambridge or W. Concord, Mass.

GENERAL RADIO Company
275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

90 West Street NEW YORK 6
8055 13th St., Silver Spring, Md. WASHINGTON, D.C.
920 S. Michigan Avenue CHICAGO 5
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ADMITTANCE METERS
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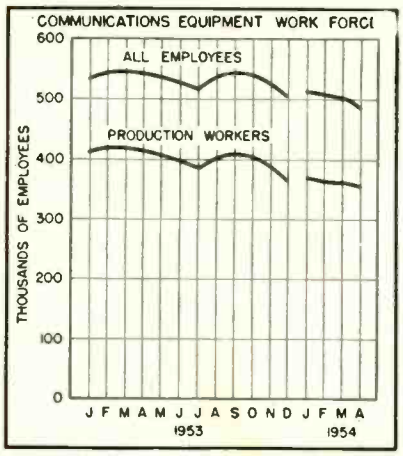
IMPEDANCE BRIDGES
LIGHT METERS
MEGOHMMETERS
MODULATION METERS
MOTOR CONTROLS
NULL DETECTORS
OSCILLATORS
PARTS & ACCESSORIES
POLARISCOPES
PRECISION CAPACITORS
PULSE GENERATORS
R-L-C DECADES
R-L-C STANDARDS
SIGNAL GENERATORS
SOUND & VIBRATION METERS
STROBOSCOPES
TV & BROADCAST MONITORS
U-H-F MEASURING EQUIPMENT
UNIT INSTRUMENTS
VARIACS
V-T VOLTMETERS
WAVE ANALYZERS
WAVE FILTERS



ies for many companies now in lower positions and with the fall selling season approaching an employment increase is due.

► **Decline**—As expected, the sharp employment drop in the past months of the year, as shown in the chart, has coincided with production declines in the industry. Radio and tv set production were off over 30 percent for the first four months compared to the period last year and the ELECTRONICS output index was down 45 points from last year's level. Production-worker employment in April was nearly 80,000 below April of 1953 and total employment in communications equipment was down 73,000. Workforce figures for May, June and July are expected to show further employment declines because of the industry's seasonal nature.

► **Revision**—As shown in the chart, level of employment for the industry is higher beginning in January of 1954 compared to last year. The increase is due to an adjustment in the reference point or benchmark that has been made by the Bureau of Labor Statistics and other government bureaus that are responsible for the figures and not to increased employment. Without such periodic adjustments employment estimates tend toward understatement according to BLS, which becomes larger as the distance from earlier bench marks increases. In the case of communications equipment, the reference point has been changed from the first quarter of 1951 to the first quarter of 1953. The change has raised the level of employment estimated for the industry. For example, with the 1951 reference point an estimate of 488,000 was made of all employees for January 1954. With the adjusted benchmark, total employment for the industry is estimated at 514,000, an increase of 26,000. For production workers in January the estimate was raised from 352,000 to 372,000, an increase of 20,000.

► **Where**—Despite the ups and downs of employment in the industry, within each year, the electronic work-force is continuing to grow in size. In 1951, an average of 405,800 workers were employed during the year. In 1952, the annual employment average increased to 474,200. Last year it reached 559,700.

Indication of the size of the firms that have been responsible for the growth in the industry's employment between 1951 and 1953 is shown in the following percentage increases in total employees for electronic firms of various sizes. For firms in the 0 to 99 employees class the increase was 71.4 percent; 100 to 249, 52.9 percent; 250 to 499, 31.8 percent; 500 and over, 33.2 percent. For the industry as a whole, the percentage increase in employment in the period was 37.4 percent.

Plants Expand for Defense in 1954

Company	Product or Service to be Produced	Estimated Cost of Facility	Percent Allowed
AMF	Electronic equipment	$139,408	65
Baldwin Piano	Electronic products	867,486	40
Bell Aircraft	Research and development	450,000	60
Bendix Aviation	Military electronic equipment	24,451	65
Bird Electronics	Electronic test equipment	11,751	70
Boesch Mfg	Electronic equipment	85,759	80
Central Sales & Mfg	Electronic tubes	1,200	70
Collins Radio	Electronic equipment	94,790	65
Control Instrument	Military electronics	150,689	65
Dumont—Airplane & Marine Instruments	Military electronics	85,759	60
Eitel-McCullough	Electronic tubes	388,850	70
Electronic Associates	Electronic equipment	16,000	40
Electronic Associates	Military electronics	40,000	70
Gaertner Radio	Electronic products	5,599	70
GE	Military electronics	303,767	75
Gibbs Mfg	Electronic equipment	70,149	70
Hughes Tool	Military electronics	402,108	65
IBM	Electronic equipment	9,300,000	60
Land-Air	Military electronics	15,950	70
Land-Air	Military electronic comp	2,830	70
Litton Industries	Military electronic comp	140,000	45
W. L. Maxson	Military electronics	12,840	65
Motorola	Research and development in military electronics	18,273	65
North Amer. Av	Electronic equipment	697,707	60
North Electric Mfg	Military communications equipment	430,000	40
Potter Company	Electronic components	14,900	70
Potter & Brumfield	Electronics	90,000	45
Premier Instrument	Electronic parts	9,878	70
Sperry Corp	Electronics	961,475	65
Western Electric	Electronics	16,099	65
Western Electric	Electronics	406,008	65
Western Electric	Electronics	116,317	65
Western Electric	Electronic components	22,176	65

Fewer firms are expanding with the help of fast tax aid but growth is still substantial

ELECTRONIC manufacturers who have been granted accelerated tax amortization certificates in the first six months of this year for plant expansions are shown above.

► **Aim**—Main purpose of the government's fast amortization program is to expand private industry productive capacity to meet mobilization goals.

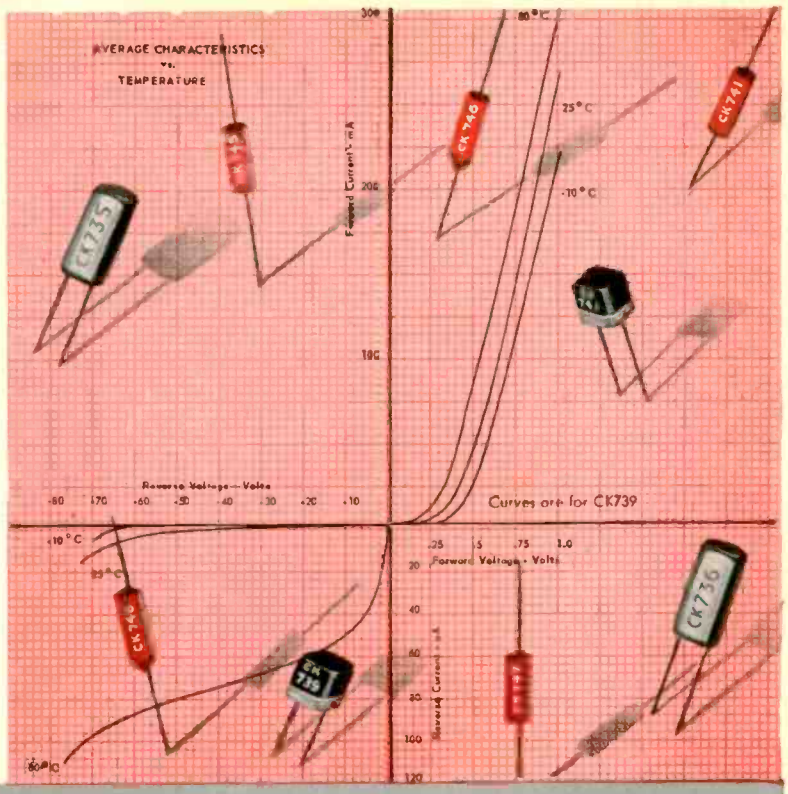
Under the program, a firm applies for a certificate of necessity for accelerated tax amortization which allows depreciation for tax purposes of new facilities for as short a time as five years. The dollar value given of the new or expanded facilities refers to the

(Continued on page 20)

RAYTHEON

GERMANIUM AND SILICON JUNCTION DIODES

precision produced to RAYTHEON standards of stability and uniform excellence of performance



RAYTHEON JUNCTION SILICON DIODES

providing extreme stability, wide temperature range, high back resistance (100 megohms or more), and high ratio of back to forward resistance.

Type	Minimum Forward Current at +1 Volt (ma.)	Maximum Reverse Current at −10 Volts (μa.)	at Voltage Shown μa.	volts	Maximum Avg. Rectified Current (ma.)	Maximum Peak Rectified Current (ma.)	Peak Inverse Voltage (volts)	Max. Avg. Power Dissipation (mw.)
CK735	5	0.01	—	—	30	150	15	125
CK736	3	0.1	.5	−50	20	150	70	100
CK738	1	0.1	1.0	−100	20	150	125	100
CK746	2**	2.0	50	−50	15	125	60	100

RAYTHEON JUNCTION GERMANIUM DIODES

providing extreme stability, fast switching (CK741 and CK747), high forward current and high ratio of back to forward resistance.

Type	Minimum Forward Current at +1 Volt (ma.)	Maximum Reverse Current at −10 Volts (μa.)	at Voltage Shown μa.	volts	Maximum Avg. Rectified Current (ma.)	Maximum Peak Rectified Current (ma.)	Peak Inverse Voltage (volts)	Max. Avg. Power Dissipation (mw.)
CK739	100*	2	20	−50	125	300	60	125
CK740	100*	2	—	—	150	300	15	150
CK741	300	—	500	−8	100	350	8	50
CK742	100	5	20	−100	50	300	125	50
CK745	15	20 at −20 volts	100	−100	40	100	125	40
CK747	100	-	100	−20	100	300	40	100

*Measured at 0.8 volt maximum. **Measured at 1.5 volts maximum.
All of the above ratings are at 25°C

RAYTHEON®
Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

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

face value of the certificate. Of this amount, which is the estimated cost of the facility stripped of extraneous items such as the cost of land, only a certain percentage determined by the Office of Defense Mobilization may be depreciated at the rapid rate. So far the percentage for all amounts certified has averaged 60 percent.

▶ **Portion**—The percentage authorized for actual amortization depends among other factors on the type of facility, the amount of expansion required for the emergency, the probable usefulness of the plant for other than defense purposes after the emergency and the degree of financial aid necessary as an incentive to encourage the expansion.

Congress Eyes Guided Missile Production

HOUSE Armed Service Committee has asked Defense Secretary Charles Wilson for a complete review of the billion dollar per year U. S. guided missile program and set a deadline of January 1, 1955 for its submission.

The Defense Department may appoint a new guided missiles chief to review and report the status of development and production of the items to the congress. K. T. Keller, president of Chrysler was previously the U. S. missiles chief.

▶ **Confusion**—The House committee told Wilson that testimony from the three military services had been confusing and conflicting and that it was difficult for the committee to know just what was actually going on. Secretary Wilson told the committee that he would certainly comply with its request but that he personally thought the entire program was "proceeding nicely."

To the Air Force, guided missiles are pilotless bombers, but the Army and Navy consider them natural extensions of artillery.

Fire Wardens Adopt Electronics

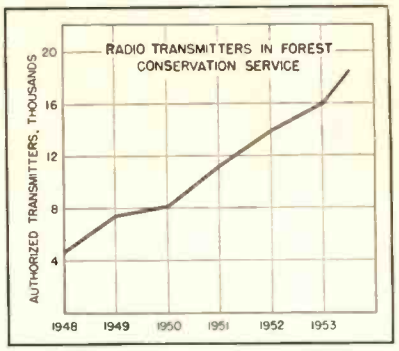
Mobile radio, television and microwave all play roles in protecting natural resources

FOREST conservation services are constantly finding new applications for electronic equipment in their effort to protect the country's natural resources.

Very-high-frequency radio forms the backbone of forest communications. In 1953 there were 2,425 licensed stations with 18,600 authorized transmitters. Most of the sets were licensed to state and local governments although a few were licensed to private organizations for use in privately owned forest areas.

Also active in use of radio is the U. S. Forest Service, which maintains a radio laboratory at the U. S. Department of Agriculture Research Center, Beltsville, Maryland.

In addition to base stations located in fire watchers' towers and at area headquarters, transmitters are mounted in fire-fighting vehicles or carried by hand. Specially designed units are used by smoke jumpers who parachute to the scene of fire-fighting operations.



Rotating camera on top of unattended fire tower scans surrounding area and sends image through Raytheon microwave link to central observing stations

Now industrial tv is entering the field. The unattended tv units can spot fires 20 miles away and transmit images by microwave link to a central station 50 miles away.

The tv camera, rotating continuously in a plastic dome mounted on top of a forest-fire tower, has been successfully tried by the Louisiana Forestry Commission.

If the system becomes an accepted practice, 3 to 5 cameras will operate in each county of that state and a monitor for each camera will be centrally located where one operator can watch all sets.

▶ **How**—Compass markings are engraved on a transparent strip around the dome so that the camera picks up degree readings at the same time that it scans the landscape.

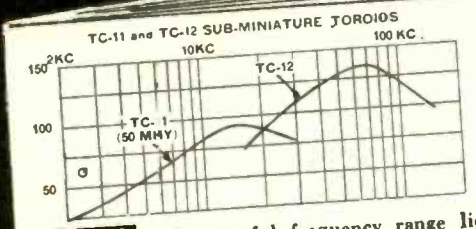
A secondary lens is used to pick up the degree readings unblurred. After a fire is spotted with the long-focus lens, the technician stops the camera by remote control, flips the secondary lens to focus on the compass markings and takes the readings.

By obtaining bearings on a fire from two sets, a technician can locate the exact position of the fire by triangulation.

▶ **Other Systems**—Microwave communications systems have been tried experimentally by at least two forest conservation services—the Ohio Natural Resources Board and the Arkansas Fish and Game Commission.

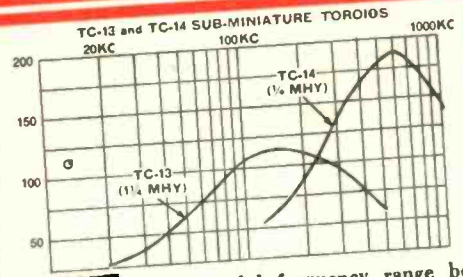
(Continued on page 22)

In Filter Networks & Toroids Your Specialist is "Burnell"



TC-11 Most useful frequency range lies between 2KC and 25KC. Maximum available inductance 1 HY for lower end of frequency range.

TC-12 Most useful range between 15KC and 150KC, maximum inductance 500 MHYS at the lower frequencies.



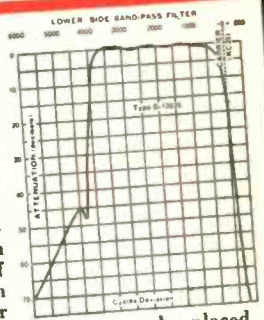
TC-13 Most useful frequency range between 40KC and 400KC. Available up to 100 MHYS with best optimum characteristics below 10 MHYS.

TC-14 Recommended for 200KC to 1 megacycle. This is best employed at inductances less than 1MHY.

WE ARE PROUD OF OUR RECORD AS A MOST PROGRESSIVE FIRM IN THE ENGINEERING AND MANUFACTURING OF FILTER NETWORKS AND RELATED COMPONENTS. ENGINEERS AND ENGINEERING BUYERS AUTOMATICALLY THINK OF 'BURNELL' IN RELATION TO FILTER DESIGN PROBLEMS AS WELL AS PRODUCTION REQUIREMENTS FOR FILTERS OR TOROIDS.

TO ACHIEVE THIS ENVIABLE POSITION WE CONSTANTLY STRIVE FOR THE DEVELOPMENT OF NEW AND BETTER PRODUCTS THAT WOULD BEST SERVICE OUR CUSTOMER'S NEEDS.

LOWER SIDE BAND FILTERS



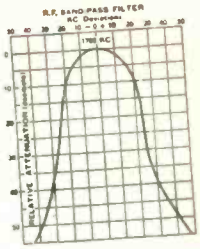
Shortly after these side band filters were introduced to the communications industry by Burnell & Company, a new interest in side band reception arose. Although other types of side band filters have been manufactured for some time, their use was limited because of extremely high cost, limited availability, and excessive volume. In attempting to overcome all of these disadvantages, our engineering staff concentrated on the development of a set of filters which would employ high quality toroids instead of crystal elements previously employed in such filters. As the effectiveness of a side band filter depends primarily upon how close the cut off frequency can be placed to the carrier frequency (and still provide sufficient attenuation) it was necessary first to determine the optimum carrier frequency at which the high Q of the toroids could permit a sharp enough rate of cut off and high enough attenuation to the opposite side band. It was for this reason that a choice of the 25kc carrier was made.

MINIATURE TELEMETERING FILTERS

In view of the large number of filters that are employed in telemetering equipment, the size of the filters is a major contributing factor to the size of the equipment. As the approximate volume of a set of twenty standard telemetering band pass filters is 1500 cubic inches, even for ground based equipment this bulk can be objectionable. This is particularly true of mobile station. Our cognizance of this led to the development of a series of miniaturized filters that necessitates practically no sacrifice of desired attenuation characteristics.

The tremendous advantage of these new filters can be seen from the fact that a set of the same twenty filters would have a volume of less than 300 cubic inches representing a reduction by volume of 80%. Every telemetering filter now being supplied in the standard case is also available in the new miniaturized version.

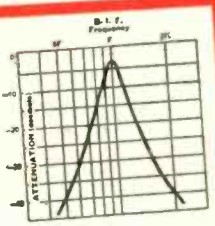
R. F. BAND PASS FILTERS



Until quite recently toroidal band pass filters were not too practicable at frequencies beyond the I. F. range. However, since developing toroids with much higher Q at radio frequencies than hitherto obtainable, we have extended the range of our filters to as high as two and three megacycles. A number of these attenuation filters have been able to replace types formerly employing expensive crystal elements. An additional important factor is the great reduction in size over R. F. filters, usually constructed with air core or "iron slug" coils.

Write for new and enlarged 16 page catalog 102A

INTERSTAGE FILTERS

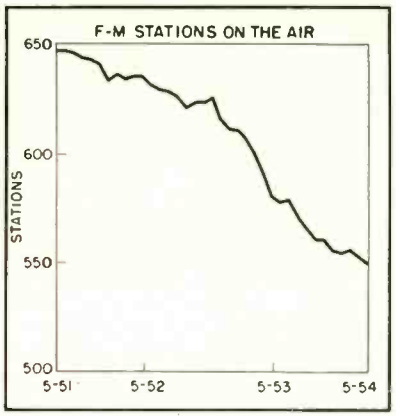


These are economical band pass filters designed to operate either from a triode plate or cathode follower to the grid of a tube. A voltage gain of ten or more can be provided depending upon the desired band width. Range of center frequencies available lies between 60 cycles and 50,000 cycles.

Base dimensions: 1-3/16 x 1-11/16

Burnell & Co., Inc.
YONKERS 2, NEW YORK
CABLE ADDRESS "BURNELL"

Exclusive Manufacturers of Communications Network Components



SOME f-m broadcasters fade away but . . .

F-M's "Egg" May Prove to Be Golden

Operators see functional music, storecasting & hi-fi possible sources of profit

LONG the sick man of the broadcasting field, f-m may soon find in multiplexing the revitalization it needs. Multiplexing involves slicing an f-m channel to provide two or more separate channels.

The technique is well understood technically and has recently been under study by the FCC. Indications are that the commissioners will give multiplexing their collective blessing.

▶ **What It Means**—With multiplexing, the f-m broadcaster can continue to furnish high-quality broadcasting service while simultaneously providing commercial services to subscribers like in storecasting.

Storecasting can be profitable in two ways. The station can lease receivers to the store, then sell time to manufacturers who can present their commercial message right at the point of sale.

Cost of adding single-channel multiplexing equipment will be $2,500-$3,500 while a multiplex adapter for an f-m receiver will cost about $100. A good f-m receiver with multiplex circuits built in will run $150.

A new field for f-m may be opened by a manufacturer who announces early availability of a low-cost f-m car radio.

MEETINGS

AUG. 10–13: Associated Police Communication Officers National Conference, William Penn Hotel, Pittsburgh, Pa.

AUG. 24–SEPT. 4: National Radio Show of Great Britain, Earls Court, London, England.

AUG. 25–27: 1954 Western Electronic Show & Convention, Los Angeles, Calif.

SEPT. 1–16: Golden Jubilee Meeting of the International Electrochemical Commission, University of Pennsylvania, Philadelphia, Pa.

SEPT. 13–24: 1954: First International Instrument Congress And Exposition, Commercial Museum and Convention Hall, Philadelphia, Pa.

SEPT. 8–11: Symposium on Propagation, Standards and Problems of the Ionosphere, Laboratories of the National Bureau of Standards, Boulder, Col. sponsored by the NBS Central Radio Propagation Lab.

SEPT. 15–17: Symposium on Information Theory, MIT, Cambridge, Mass., Sponsors, IRE, AIEE, URSI, ONR, ARDC, SCEL.

SEPT. 16–18: Joint Electron Tube Engineering Council, General Conference, Chalfonte-Haddon Hall, Atlantic City, N. J.

SEPT. 1954: International Scientific Radio Union, Amsterdam, Netherlands.

SEPT. 30–OCT. 1: Fifth Annual Meeting of the IRE Professional Group On Vehicular Communications, Rice Hotel, Houston, Texas.

SEPT. 30–OCT. 2, 1954: Second Annual International Sight and Sound Exposition, Palmer House Hotel, Chicago, Ill.

OCT. 4–6: National Electronics Conference, Hotel Sherman, Chicago.

OCT. 13–17: 1954 Annual Convention, Audio Engineering Society, Hotel New Yorker, New York, N. Y.

OCT. 14–17: Audio Fair, Hotel New Yorker, New York, N. Y.

OCT. 18–20: Radio Fall Meeting, Hotel Syracuse, Syracuse, N. Y.

OCT. 21–23: Eighth New England Conference of the American Society for Quality Control, Ten Eyck Hotel, Albany, N. Y.

OCT. 26–28: The Second National Conference on Tube Techniques, Western Union Auditorium, New York, N. Y. Sponsor, Department of Defense.

OCT. 27–30: Thirtieth Annual Convention, National Association of Educational Broadcasters, Hotel Biltmore, New York, N. Y.

NOV. 4–5: East Coast Conference on Airborne and Navigational Electronics. IRE, Sheraton-Belvedere Hotel, Baltimore, Md.

NOV. 9: First International Automation Exposition, 242nd Coast Artillery Armory, New York, N. Y.

NOV 10–11: Conference on Electronic Instrumentation and Nucleonics in Medicine, Morrison Hotel, Chicago, Ill.

NOV. 12–13: National Symposium on Quality Control Methods In Electronics, IRE and American Society for Quality Control, Hotel Statler, New York, N. Y.

NOV. 18–19: Sixth Annual Electronics Conference, Kansas City IRE, Hotel President, Kansas City, Mo.

DEC. 8–10: Eastern Joint Computer Conference & Exhibition, Bellevue-Stratford Hotel, Philadelphia, Sponsors, IRE, AIEE, ACM.

Industry Shorts

▶ **Foreign** shipments of U.S. electronics equipment of $247.8 million during calendar year 1953 represent an 18-percent increase over 1952 exports, according to RETMA.

▶ **Painless** ultrasonic dental drill has been developed by Columbia University and will be produced by Cavitron Equipment in New York.

▶ **Photoconductive** cell of the lead sulphide type which is highly sensitive to infrared radiations has been developed by Mullard of London.

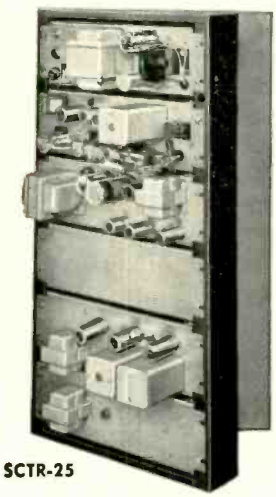
▶ **More** than 200 million 45-rpm records have been sold, 50 percent of all single records sales, and 13 million homes now have turntables capable of playing them, according to RCA.

▶ **Color** tv receivers manufactured in the first five months of this year totaled 7,713, according to RETMA. Of these, 2,982 were turned out in May.

▶ **Volume** of business done by mica fabricating industry dropped sharply in November of 1953 and then leveled off at a rate 40 percent lower than the level of the previous two years.

Improve Your Communications Service With Hammarlund Selective Calling

ADD PRIVACY • SPEED • QUIETNESS • CONVENIENCE



SCTR-25

FOR FIXED STATIONS

Decoder Unit
SCM-30T

Coding Unit
SCPB-30

FOR INDIVIDUAL MOBILE UNITS

Receiver Unit
FRC-1

Transmitter Unit
FTC-1

FOR FLEET CONTROL

Speeded operations, better manpower utilization, and elimination of confusion are a few of the advantages achieved through the selective channeling of voice communications.

Hammarlund has available a wide range of tone-dialing and push-button operated systems for contacting fixed stations, individual mobile units, or fleets.

With the SCTR-25 fixed station equipment, for example, it is possible by means of coded audio frequency tone signals activated by a simple dialing operation, to selectively ring any single station on a system with as many as 126 stations. This is particularly advantageous when many individual telephones are connected to the same speech transmission channel, such as with a long micro-wave radio relay network. The bell at each station operates only when that station is called.

Efficiency is increased for 2-way radio equipped individual or fleet mobile units when Hammarlund Selective Calling equipment is added, since confusion caused by today's overcrowded radio spectrum and skip-distance signals are eliminated. Each receiver is activated only when it is called.

For detailed information on Hammarlund Selective Calling systems, write to The Hammarlund Manufacturing Co., Inc., 460 West 34th St., New York 1, N. Y. Ask for Bulletin 85

HAMMARLUND

SINCE 1910

MB cycling system runs vibration tests automatically

Versatile electronic "brain" for MB Vibration Exciters saves manpower and manhours—performs a variety of cycled shake-tests unattended!

A vibration test that involves a continuous cycle of changes from 10 to 500 cps along with constant displacement or constant acceleration can now be done with great simplicity, accuracy and minimum supervision. Simply set up the specimen on an MB Shaker—set the controls for the desired actions—and let the cycling system take over.

This electronic unit varies shaker frequency at any sweep speed, and between any two preset frequency limits. It controls the exciter's amplitude or acceleration within ±10% for a dead mass or resonant type of loading and for cycled tests to satisfy MIL-E-5272 and other specifications.

For maximum flexibility of operation, this cycling system also provides for automatic transfer of constant amplitude to constant "g" at any preselected frequency setting.

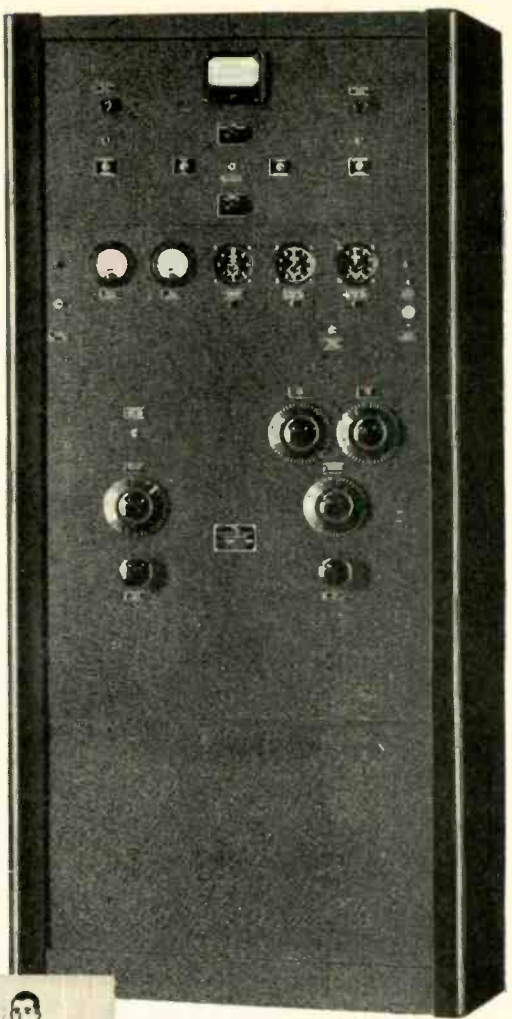
The system can be operated manually when desired. It's also protected against control failure or conditions of extreme load resonances through use of an automatic structural strain control.

SHAKE TESTING PAYS

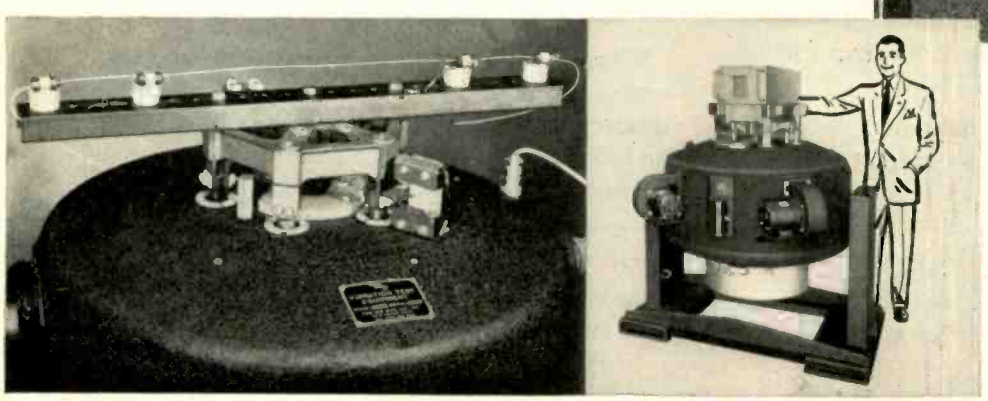
Vibration testing tells how well a product will bear up in service, reveals design faults, determines fatigue strength.

Designed for heavy duty service, MB vibration exciters such as the Model C-5, rated at 750 pounds force, and the Model C-25 rated at 3500 pounds force, deliver maximum performance, pure table motion and dependable operation.

Send for detailed specifications on MB cycling systems. Also for Bulletin which gives data on vibration exciters.



MB MODEL T-25 MC CONTROL CABINET with automatic cycling system developed to control the action of vibration exciters to a specified cycle of events, and with little or no supervision.



A VIBRATION TEST set up on the Model C-5 MB Vibration Exciter—and also one on Model C-25—two of the models which can be automatically controlled by MB's cycling systems.

THE MB MANUFACTURING COMPANY, INC.
1060 STATE STREET, NEW HAVEN 11, CONN.

BULLETIN TELLS MORE
Contains specifications, operating information and helpful hints on usages of the complete line of MB Exciters. Write for Bulletin 1-VE-5.

PRODUCTS AND EQUIPMENT TO CONTROL VIBRATION • TO MEASURE IT • TO GENERATE IT

ML-200 Series
Crystals for color television are available to your specific calibration for either the ringing or oscillator circuit. This new design provides hermetic seal at an economical cost.

NOW IN PRODUCTION . . .

Newly-Designed CRYSTALS for COLOR TELEVISION

MIDLAND is ready *now* to supply you in quantity with color TV crystals to your exact specifications . . . and to advise with you on any phase of this subject.

MIDLAND MINIATURES
Midland has developed, and is expanding, a new series of crystal units which will comprise the MIDLAND MINIATURE line. Their small glass enclosures insure true hermetic seal and long-term stability.

Type ML-6 Range
1.0 mc—100 mc. supplied per mil Type CR-18, CR-19, CR-23, CR-27, CR-28, CR-32, CR-33, CR-35, CR-36, CR-48 when specified. Hermetically sealed metal holder with glass and metal base. Height of can is ¾ in. Pins are .050" dia., spaced .486".

Type ML-6A
Identical to Type ML-6 except provided with .093" diameter pins.

Type ML-6S Range
5.0 mc.—100 mc. for those applications in which long-term stability is the paramount requisite.

Type ML-6W Range
3.0—15.0 mc. This unit is same as Type ML-6 except wire leads are provided, eliminating need for crystal socket.

Midland CRYSTALS

PAY OFF IN PERFORMANCE

The quality of Midland Crystals—which is another way of saying the completely dependable job they will do for you—is assured by exacting tests and controls through every step of processing. The finest precision equipment and most advanced techniques known to the industry are used by Midland from selection of raw quartz to final sealing of the crystal.

That's a big reason why Midland has climbed to its present position as the world's largest producer of quartz crystals for use in 2-way communications and other electronic devices.

Midland's engineering staff is ready to help in any project involving the use of crystals.

Type ML-4 Range
1.0 - 10.0 mc. Supplied per mil Type CR-5, CR-6, CR-8, CR-10 when specified. Holder is phenolic, gasket sealed. Holder size is 1⅛ x 13/16 x 7/16 with .093" diameter pins ½" long spaced .486".

Type ML-13
Units of this type are currently undergoing tests on experimental basis. The unit is hermetically sealed. Pin dimensions are the same as our Type ML-6. Height of can is 1½-inch.

Type ML-1A Range
2.0 - 15.0 mc. Supplied per mil Type CR-1A when specified. Holder is phenolic, gasket sealed. Holder size is 1¼" x 1⅛" x 27/64" with .125" diameter pins ⅝" long, spaced at .500".

Type ML-10 Range
15.0 - 50.0 mc. Supplied per mil Type CR-24 when specified. Over-all length is 1.055". Pin contacts, .062" diameter.

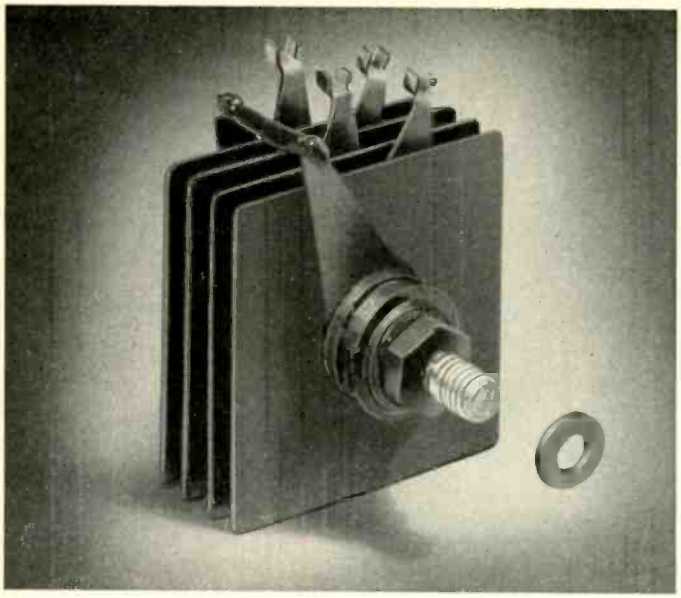
SEE US AT WESCON!

BOOTH 212, Western Electronic Show & Convention, August 25-26-27, Pan-Pacific Auditorium, Los Angeles.

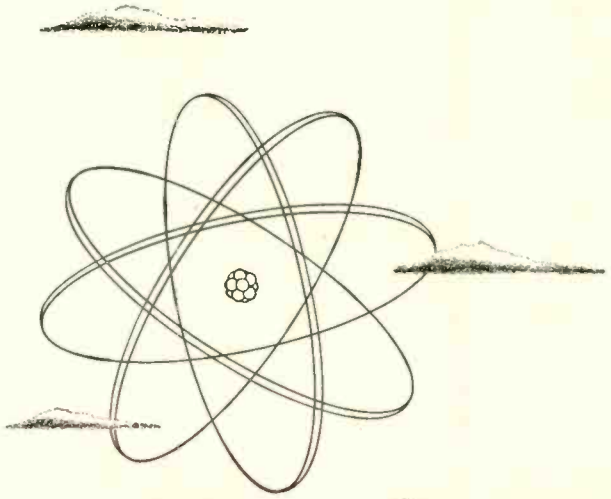
Midland

MANUFACTURING CO., INC.
3155 Fiberglas Road Kansas City, Kansas

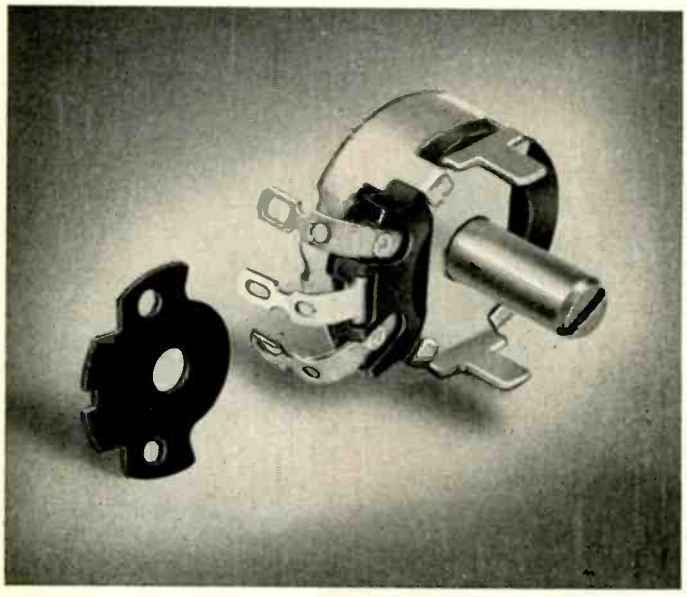
WORLD'S LARGEST PRODUCER OF QUARTZ CRYSTALS



DC FROM AC. *In this selenium rectifier for TV use, washers made from Grade 353 give dependable, long-lasting insulation of the current-carrying plates . . . are dimensionally stable . . . provide good mechanical strength at all operating temperatures.*



Progress in electronics— profits by plus

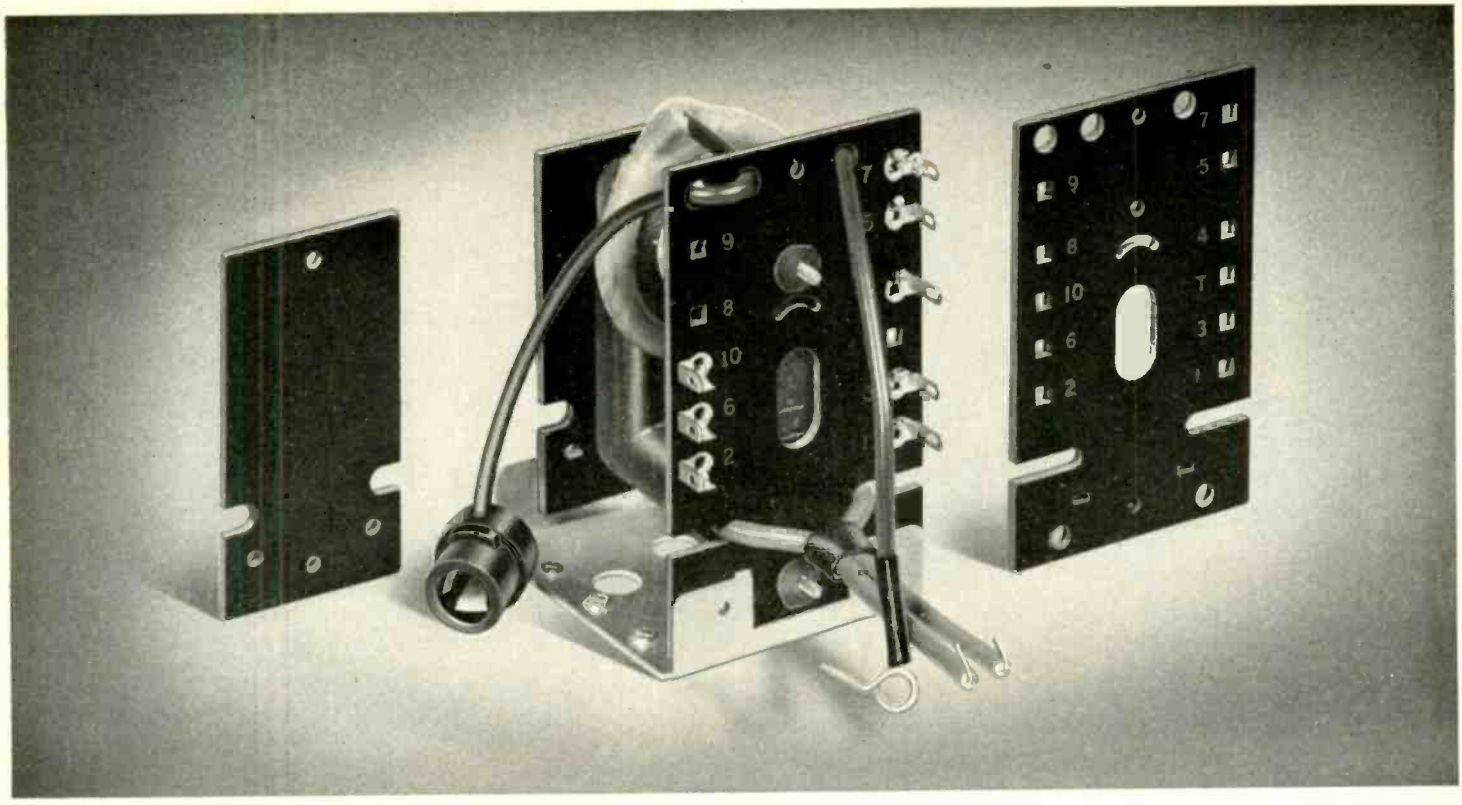


STABLE CONTROL. *The rotor spacer in this volume control, punched from Taylor XXXP-301 laminate, keeps the critical electronic circuit insulated from ground regardless of humidity and high temperatures . . . contributes to stability and long life of the component.*

TECHNOLOGICAL advancement in electronics is proceeding at breath-taking speed . . . demanding new and higher standards for insulating materials. To meet these increasingly stringent requirements, Taylor has developed a revolutionary family of hot-punch laminated plastics that offer *premium properties without premium prices.*

You are invited to investigate these new laminates for applications in products now in the development stage. You'll find their superior combination of electrical, physical and fabricating properties will speed the transition of laboratory ideas into production line realities. Investigate them, too, for use in existing products, as a means of effecting real production savings and performance improvements.

For complete specifications on these new materials, and technical assistance in their application to your products, write or call . . . . **TAYLOR FIBRE CO.**



LIGHT ON THE TV PICTURE. *This flyback transformer for well-known television sets is literally surrounded by the new Taylor laminates. The front panel, which must withstand high voltages, is punched from top quality grade XXXP-301 laminate to assure high insulating properties under humid conditions. The back plate, which has a less demanding electrical job to do but an equally difficult structural responsibility, is punched from economy-priced Grade 354.*

properties of new Taylor laminates

These new Taylor laminates are like nothing you've ever used before. They're uniform all the way through . . . no surface overlay of resin. They offer you insulation resistance, water absorption, power factor and dimensional stability that meet or exceed the tightest specifications . . . plus exceptional ease in punching and staking with no cracking or checking . . . *and Taylor's unique method of manufacture assures these characteristics consistently.* Four different grades were specifically developed to serve the wide range of requirements of the electronics industry.

XXXP-301—Top Grade Laminate—the ultimate in electrical qualities . . . unusually high insulation resistance under all conditions . . . low water absorption . . . excellent punching and staking . . . phenomenal recovery properties . . . premium in every way but price.

XXP-351—a high grade laminate second only to XXXP-301 in quality, with closely comparable characteristics at a lower price.

Grade 353—a quality laminate with outstanding electrical and physical properties, priced for economy.

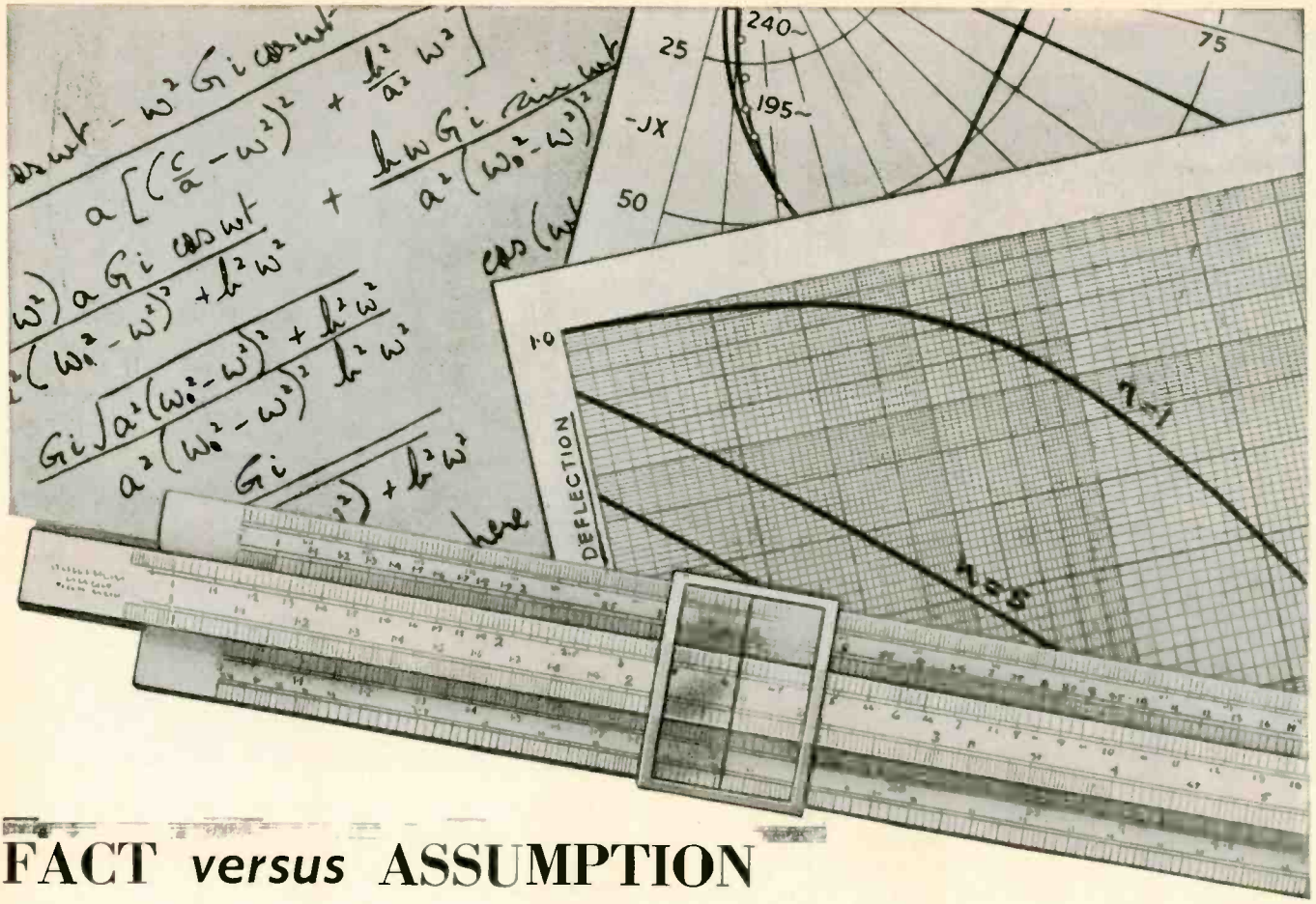
Grade 354—easily fabricated laminate with good stability, low water absorption . . . at an economical price.

All grades are available in the big, convenient standard Taylor sheet size of 49″ by 49″.

Branch offices in Atlanta; Boston; Chicago; Cleveland; Dayton; Detroit; Indianapolis; Los Angeles; Milwaukee; New York City; Philadelphia; Rochester; San Francisco; St. Louis; and Tolland, Connecticut. Distributors in Grand Prairie and Houston, Texas; Jacksonville, Florida; New Orleans, Louisiana; and Toronto, Ontario.

Plants in Norristown, Pa. and La Verne, Calif.

TAYLOR
Laminated Plastics
Vulcanized Fibre

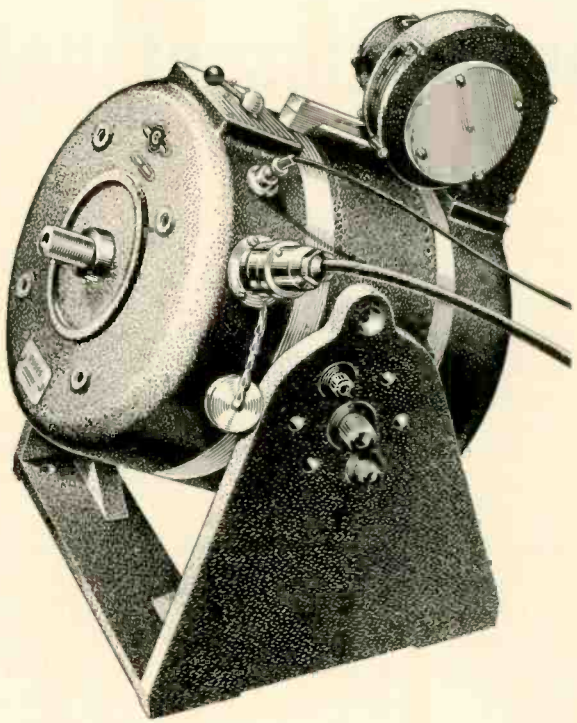


FACT *versus* ASSUMPTION

Vibration effects can be assessed by assumption, estimation and long calculation. Prototypes can be built on those assumptions, but with many anxious moments awaiting operational test results—results which may nullify months of patient effort. It is much simpler, and certainly more economical, to conduct preliminary tests in the laboratory by creating vibrations under controlled conditions—and so obtain the facts. That is the precise function of Goodmans Shakers. They provide vibratory sinusoidal forces at controlled frequency and amplitude, by which specific vibratory conditions over a wide frequency range can be accurately simulated, to assess their effects on materials, structures and components.

Applications include FATIGUE TESTING, ELECTRICAL COMPONENT TESTING, VALVE MICROPHONY TESTING, TORSIONAL VIBRATION TESTING, FLEXURE TESTING OF METALS AND PLASTICS ETC., and MECHANICAL STRUCTURE TESTING.

The range includes models from the 8/600 illustrated, developing a force of ±300 lbs to the midget model with a force of ±2 lbs.



GOODMANS

PERMANENT MAGNET SHAKERS

------- MAIL THIS COUPON -------

TO GOODMANS INDUSTRIES LIMITED
AXIOM WORKS, WEMBLEY, MIDDX., ENGLAND

Please mail me your catalogue and technical data sheets in connection with your PERMANENT MAGNET Shakers.

Name .....

Company .....

CITY ..... ZONE ..... STATE ..... E/U

GOODMANS INDUSTRIES LTD.
AXIOM WORKS • WEMBLEY • MIDDX • ENGLAND
Cables: GOODAXIOM WEMBLEY, MIDDX.

C-A-C

H S — Herm(etically) Sealed, (Mu)um Shielded, High Stability

ERM UM IGH — EALED HIELDED TABILITY

HS SERIES TOROIDS

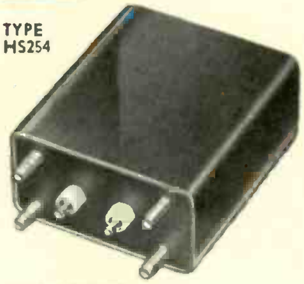
For IMMEDIATE Delivery

TYPE HS715

DIMENSIONS

Length ..... 2-9/16"
Width ..... 1-5/16"
Height ..... 2-13/16"
Weight ..... 14 oz.
Mounting ..... 2-1/16 x 11/16"
Screws ..... 6/32" studs
Cutout ..... 7/8 x 1/2"

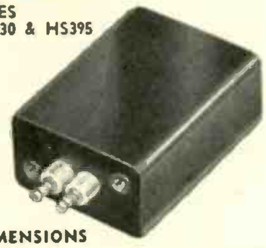
TYPE HS254



DIMENSIONS

Length ..... 1-29/32"
Width ..... 1"
Height ..... 2-1/4"
Weight ..... 8 oz.
Mounting ..... 1-5/16 x 9/16"
Screws ..... 6/32" studs
Cutout ..... 7/8 x 1/2"

TYPES HS930 & HS395



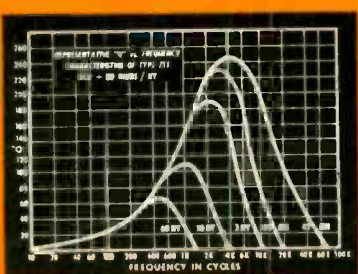
DIMENSIONS

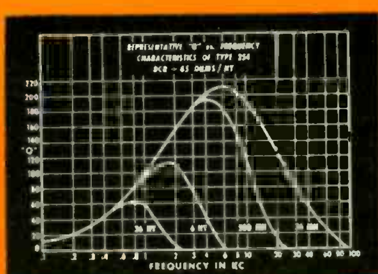
Length ..... 1-9/32"
Width ..... 11/16"
Height ..... 1-23/32"
Weight ..... 4 oz.
Mounting ..... 7/8 x 9/32"
Screws ..... 4/40" studs
Cutout ..... 1/2 x 5/16"

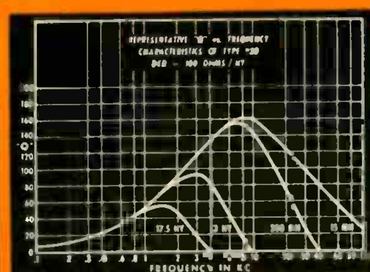
TYPES HS206, HS848, HS608 & HS073

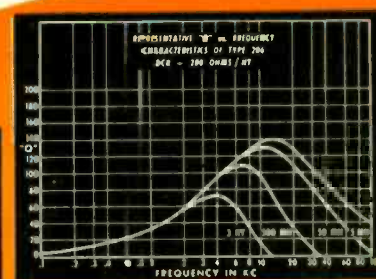
DIMENSIONS

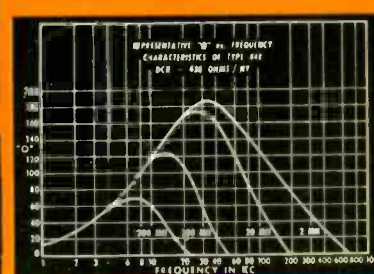
Length ..... 1-1/16"
Width ..... 1/2"
Height ..... 1-1/4"
Weight ..... 1.5 oz.
Mounting ..... 3/4"
Screws ..... 4/40" studs
Cutout ..... 1/2 x 5/16"

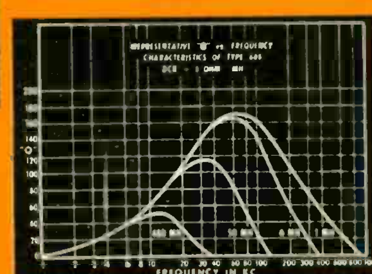


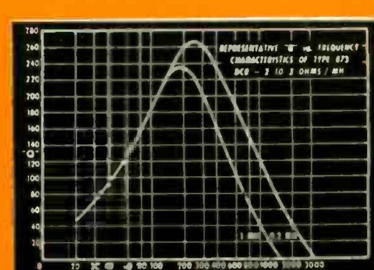












LIST OF STOCKED UNITS

All other values and types on Special Order

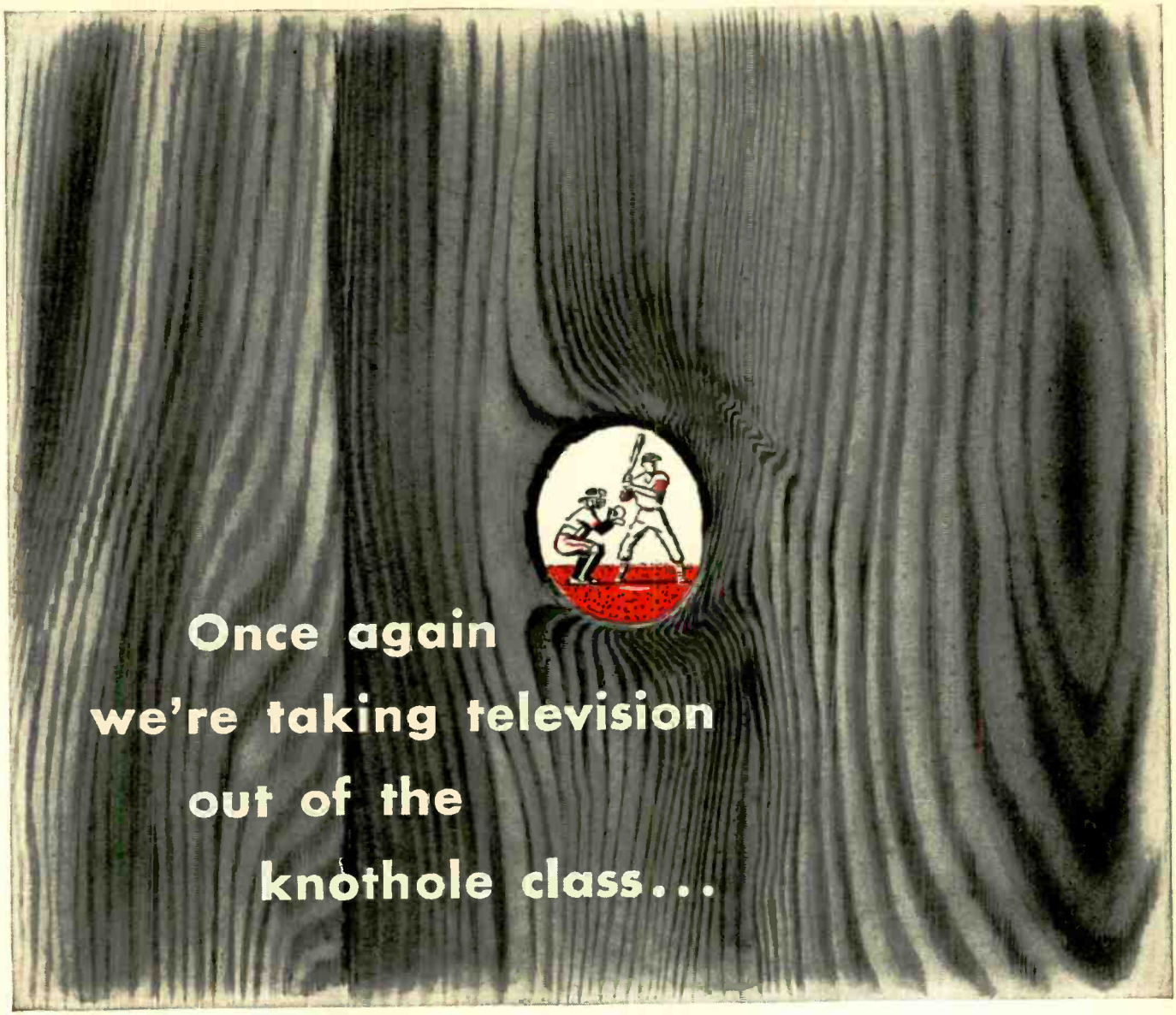
Suffix Number	HS 206—	HS 930—	HS 254—	HS 715—
—1	5.0 MH	5.0 MH	20 MH	24 MH
—2	6.0 MH	6.0 MH	24 MH	30 MH
—3	7.2 MH	7.2 MH	30 MH	36 MH
—4	8.6 MH	8.6 MH	36 MH	43 MH
—5	10 MH	10 MH	43 MH	50 MH
—6	12 MH	12 MH	50 MH	60 MH
—7	15 MH	15 MH	60 MH	72 MH
—8	17.5 MH	17.5 MH	72 MH	86 MH
—9	20 MH	20 MH	86 MH	100 MH
—10	24 MH	24 MH	100 MH	120 MH
—11	30 MH	30 MH	120 MH	150 MH
—12	36 MH	36 MH	150 MH	175 MH
—13	43 MH	43 MH	175 MH	200 MH
—14	50 MH	50 MH	200 MH	240 MH
—15	60 MH	60 MH	240 MH	300 MH
—16	72 MH	72 MH	300 MH	360 MH
—17	86 MH	86 MH	360 MH	430 MH
—18	100 MH	100 MH	430 MH	500 MH
—19	120 MH	120 MH	500 MH	600 MH
—20	150 MH	150 MH	600 MH	720 MH
—21	175 MH	175 MH	720 MH	860 MH
—22	200 MH	200 MH	860 MH	1.00 HY
—23	240 MH	240 MH	1.00 HY	1.20 HY
—24	300 MH	300 MH	1.20 HY	1.50 HY
—25	360 MH	360 MH	1.50 HY	1.75 HY
—26	430 MH	430 MH	1.75 HY	2.00 HY
—27	500 MH	500 MH	2.00 HY	2.40 HY
—28	600 MH	600 MH	2.40 HY	3.00 HY
—29	720 MH	720 MH	3.00 HY	3.60 HY
—30	860 MH	860 MH	3.60 HY	4.30 HY
—31	1.00 HY	1.00 HY	4.30 HY	5.00 HY
—32	1.20 HY	1.20 HY	5.00 HY	6.00 HY
—33	1.50 HY	1.50 HY	6.00 HY	7.20 HY
—34	1.75 HY	1.75 HY	7.20 HY	8.60 HY
—35	2.00 HY	2.00 HY	8.60 HY	10.0 HY
—36	2.40 HY	2.40 HY	10.0 HY	12.0 HY
—37	3.00 HY	3.00 HY	12.0 HY	15.0 HY
—38		3.60 HY	15.0 HY	17.5 HY
—39		4.30 HY	17.5 HY	20.0 HY
—40		5.00 HY	20.0 HY	24.0 HY
—41		6.00 HY	24.0 HY	30.0 HY
—42		7.20 HY	30.0 HY	36.0 HY
—43		8.60 HY	36.0 HY	43.0 HY
—44		10.0 HY		50.0 HY
—45		12.0 HY		60.0 HY
—46		15.0 HY		
—47		17.5 HY		

SEE YOUR CAC MAN

NEW YORK—Harold Gray Assoc.—LA. 4-4258
286 Fifth Ave., New York, N. Y.
PHILADELPHIA—Charles R. Hile Co.—Elgin 6-2266
Hillview Rd., Box 144, Paoli, Pa.
BALTIMORE—Charles R. Hile—Boulevard 1202J
(L. G. Korman) 5006 Kenwood, Baltimore 6, Md.
CHICAGO—Gassner & Clark Co.—Rogers Pk. 4-6121
6349 N. Clark, Chicago, Ill.
KANSAS CITY—E. W. McGrade Co.—Delmar 9242
6315 Brookside Plaza, Kansas City, Mo.
LOS ANGELES—Samuel O. Jewett—State 9-6027
13537 Addison St., Sherman Oaks, Calif.
HAMBURG—Cooper-Morgan, Inc.—Emerson 3405
P. O. Box 152, Hamburg, N. Y.
SYRACUSE—Naylor Electric Co.—2-3894
State Tower Bldg., Room 317, Syracuse 2, N. Y.
MERIDEN—Henry Lavin Assoc.—7-4555
(Henry Lavin) P. O. Box 195, Meriden, Conn.
NEEDHAM—Henry Lavin Assoc.—3-3446
(Robt. V. Curtin) 82 Curve St., Needham, Mass.
CLEVELAND—Ernie Kohler Assoc.—Olympic 1-1242
8905 Lake Ave., Cleveland 2, Ohio

COMMUNICATION ACCESSORIES COMPANY

Hickman Mills, Missouri
Phone Kansas City, Mo., SOuth 5528



From a knothole—to a box seat . . . That was Du Mont's big contribution to black and white television . . . Now, again, Du Mont leads the way in practical, big-screen color television.

Out of Du Mont cathode-ray tube research comes the dramatic Chroma-sync Teletron . . . a **bigger-screen, shorter-length, lower-cost** color picture tube featuring electrostatic "Mono-Convergence".

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*Teletrons**

FEATURING "MONO-CONVERGENCE"

ALLEN B. DU MONT LABORATORIES, INC. *T M.

Cathode-ray Tube Division • 750 Bloomfield Avenue • Clifton, N.J.

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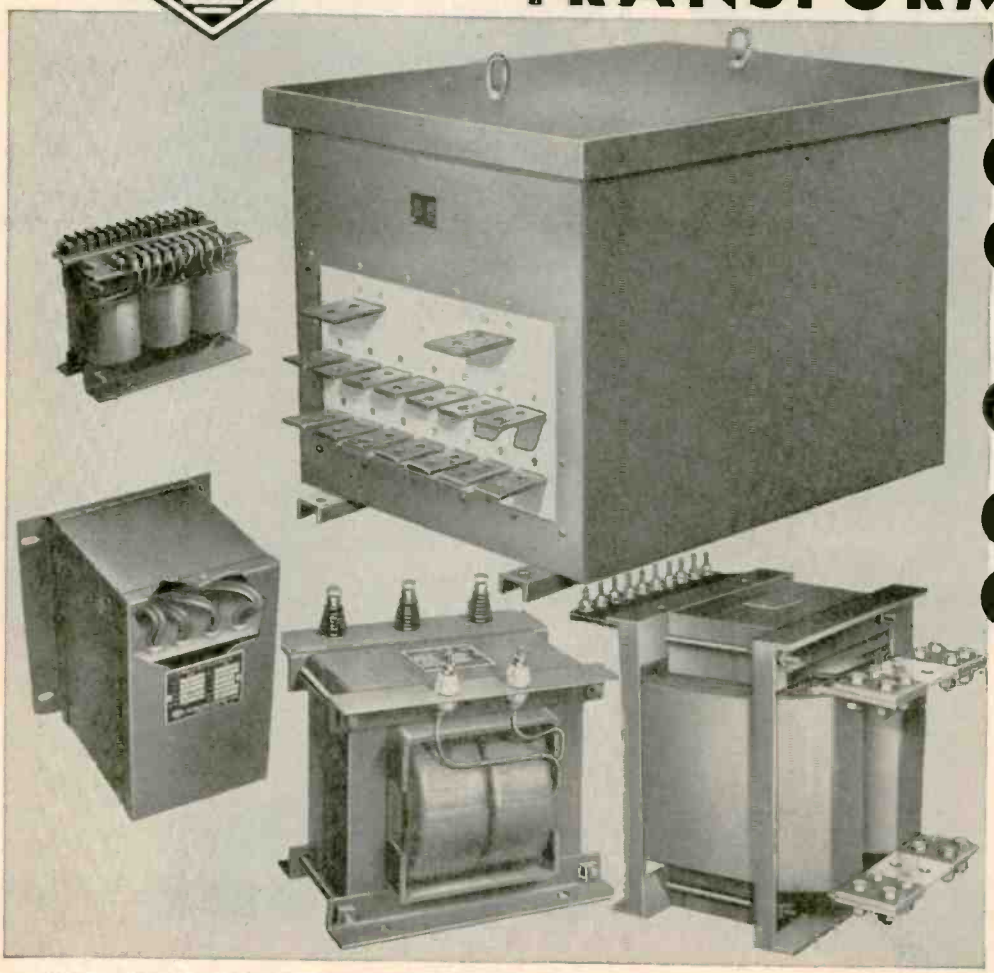

1. All coils vacuum pressure impregnated.
2. All connections over 5 Amperes silver soldered.
3. Grain Oriented Steel in sizes above 1 KVA, and conservative copper assures high efficiency and low losses.
4. All units individually tested to assure quality performance.
5. Only the highest quality materials used.
6. We sincerely believe NWL Transformers are superior, and we have built our business on this policy.

TRANSFORMERS FOR:

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ELECTRICAL ENGINEERING NEWS

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

NO. 4 — 1954

Reference Electrodes With Caps of Du Pont "Zytel"* Resist Nine Months' Boiling in Corrosive Solutions

Du Pont TEFLON® suggests new ideas for electronic and electrical designs

Du Pont "Teflon" tetrafluoroethylene resin offers a combination of electrical, thermal and mechanical properties *unmatched by any other single material.* It is particularly outstanding for use as electrical insulation at high frequencies and temperatures.

Even a glance at these features of "Teflon" will suggest new and better ways to solve electrical design problems.

Properties of "Teflon":

Excellent Dielectric Characteristics over a wide range of temperatures and frequencies.

Heat Resistance. "Teflon" is capable of continuous service at 500°F.

Toughness and Strength over a wide range of temperatures, from —450°F. to 500°F.

Chemical Inertness. "Teflon" is inert to all chemicals and solvents, except molten alkali metals and fluorine at elevated temperatures and pressures.

Zero Moisture Absorption by A.S.T.M. test D570-42.

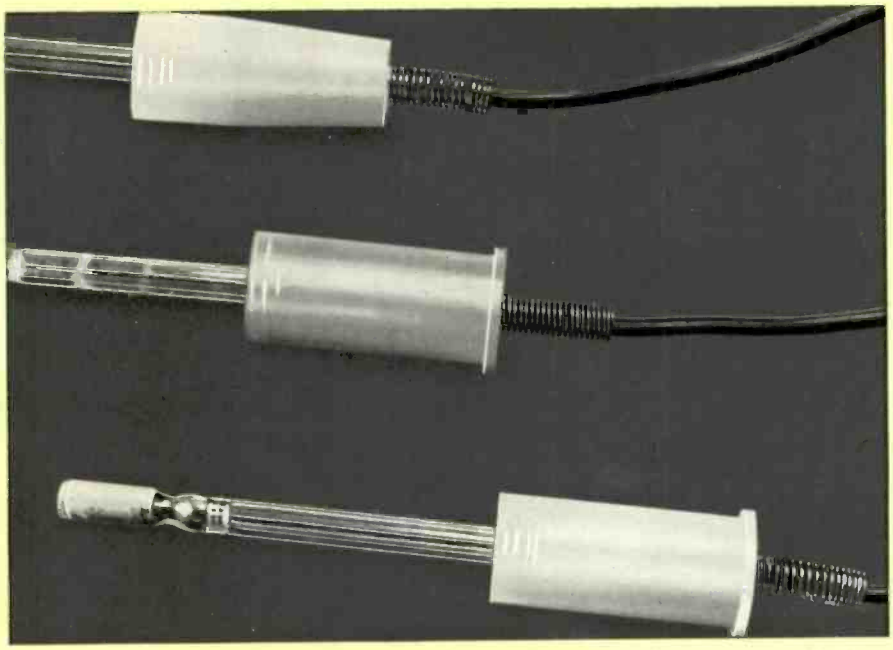
Outdoor Durability. "Teflon" is unaffected by years of outdoor weathering.

Advantages of "Teflon":

"Teflon" can be used as thin, flexible insulation—in many cases where the use of such insulation might have been impossible with other materials.

For many types of electrical and electronic equipment, "Teflon" permits simplified, compact design.

Corrosion-resistance, strength, excellent dielectric qualities of "Zytel" nylon resin give long service life to electrodes



Caps molded of Du Pont "Zytel" are used on reference electrodes made by Leeds and Northrup. Center cap was boiled steadily for nine months with only slight discoloration.

"Teflon"— continued

"Teflon" can be fabricated into component parts, or produced in tape form, or applied as a coating.

The electrical uses of "Teflon" are numerous. Examples include: spacers for coaxial cables; inserts for coaxial connectors; insulation for high-voltage wires and cables; wrapping tape for insulation in motors, generators and conductors.

Send for more information showing how "Teflon" can help improve electrical designs. Fill out and mail the coupon on other side.

Du Pont "Zytel" nylon resin offers many advantages in the electrical design field. Consider, for instance, its outstanding performance as reference electrode cap material.

The Leeds and Northrup Company, of Philadelphia, makes reference electrodes for use with its Speedomax® pH controllers for industrial measurements and its pH indicators for laboratories. Some time ago it was decided to test caps of "Zytel" for these electrodes.

"Zytel" is the new trade-mark for Du Pont nylon resin.

(*Continued, column 1 back side*),

OVER

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ELECTRICAL ENGINEERING NEWS

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

NO. 4 — 1954

Reference Electrodes
(Continued)

In one series of tests, electrodes capped with "Zytel" nylon resin were boiled steadily for nine months in solutions with pH varying from 3 to 14. The boiling had absolutely no effect on the "Zytel", except for slight discoloration.

Other tests confirmed the toughness and strength of "Zytel" nylon resin, its stability at high temperatures, and its insulating ability at commercial frequencies.

So Leeds and Northrup adopted caps of "Zytel" for use with both flow-type, and immersion-type electrodes. For the company determined that these caps greatly lengthen the electrodes' service life.

Perhaps "Zytel" can serve *you* well in your electrical design applications. Find out more about the properties of this unique engineering material. Fill out and mail the coupon below, today.

Investigate Du Pont engineering materials in your product development programs

One of the family of these versatile engineering materials is often a key factor in product improvement or new product design.

The wide range of properties available with "Alathon"* polyethylene resin, "Lucite"* acrylic resin, "Teflon"* tetrafluoroethylene resin, and "Zytel"† nylon resin are helping solve industrial design problems.

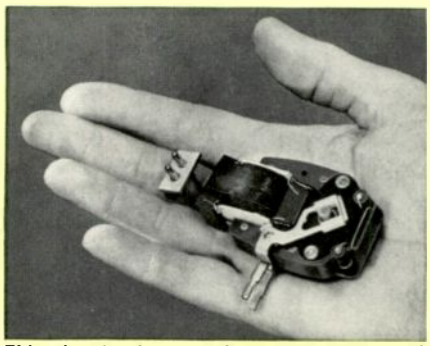
NEED MORE INFORMATION?

Clip the coupon for additional data on properties and applications of these Du Pont engineering materials.

Shaver parts molded of Du Pont "Zytel" nylon resin cut wear and noise

The rotor of this electric shaver spins 8,500 times a minute. To help provide long, efficient service, four key parts were molded of Du Pont "Zytel" nylon resin—the coil form, oscillator bushing, oscillator insulation and contact lever insulators.

The unique properties of Du Pont "Zytel" meet the varying demands of each of these parts. The flexibility, lightness of weight, strength in thin sections and dielectric properties of "Zytel" provide maximum coil form efficiency. The toughness, abrasion resistance and good bearing characteristics of "Zytel" insure long service life of all moving parts, without lubrication.



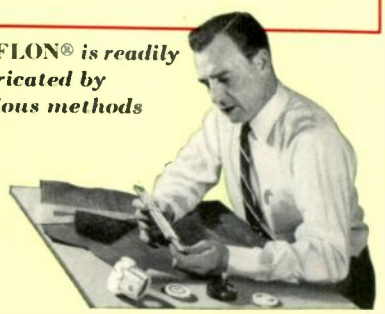
This electric shaver utilizes four parts—coil form, oscillator bushing, oscillator insulation, and contact lever insulators—molded of versatile Du Pont "Zytel" nylon resin.

Parts molded of Du Pont "Zytel" will operate continuously—and retain their form stability—at temperatures to 250°F. These parts of resilient "Zytel" help damp noise for quieter shaving operation. These parts are economically mass-produced by rapid injection molding.

Clip the coupon for further information about Du Pont "Zytel" nylon resin and its unusual properties.

POINTERS ON PROCESSING

TEFLON® is readily fabricated by various methods



Several techniques have been developed for rapid fabrication of Du Pont "Teflon" into various shapes.*

One new extrusion method permits mass production of parts with section thicknesses as low as 5 mils, or as high as ¼ of an inch. This process is ideal for producing tape, tubing and wire insulation. And it can readily be adapted to the manufacture of monofilament and irregular shapes.

The new process is a simple one, requiring only four easy steps:

(1) A composition of Du Pont "Teflon" is preformed by compression, then placed in a ram-type extruder. The composition consists of a fine powder of "Teflon", suitably lubricated, and if desired, mixed with coloring pigments.

(2) The composition is ram-squeezed through a die to produce the desired shape.

(3) The extrusion aids are removed from the shaped part by volatilization.

(4) The part is then sintered and quenched.

Laboratory tests show that, by the above method, ½"-diameter tubing of "Teflon" can be extruded at 10 feet per minute. Production speed increases as the tubing diameter decreases. Also, a 15-mil insulation has been extruded on Number 16 AWG copper wire at 12 feet per minute.

Even with such production speeds, shapes of "Teflon" made by the above process have the excellent physical and dielectric strength characteristics for which "Teflon" is noted and which no other material can match.

There are alternate methods of fabricating "Teflon": molding, coining, hobbing and screw-extruding, for example. "Teflon" can also be machined with ease, to tolerance of ±.001 inches.

**Conventional molding and extruding techniques for plastics are not applicable to "Teflon", because it does not melt and flow. Nor can it be dissolved.*

E. I. DU PONT DE NEMOURS & CO. (INC.)
Polychemicals Department
Room 228, Du Pont Building, Wilmington 98, Delaware

Please send me more information on the Du Pont engineering materials checked: ☐ *"Zytel"*; ☐ *"Alathon"*; ☐ *"Teflon"*; ☐ *"Lucite". I am interested in evaluating these materials for:*

NAME _____ POSITION _____

COMPANY _____

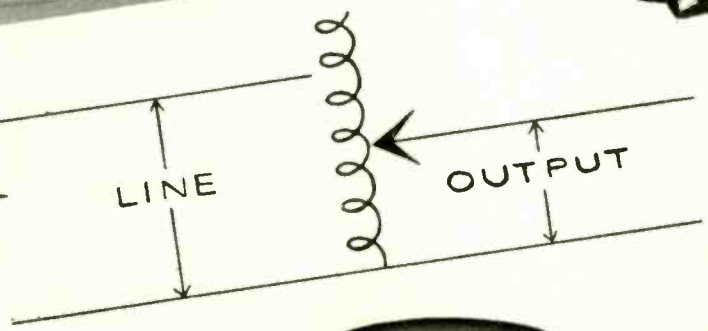
STREET _____

CITY _____ STATE _____

TYPE OF BUSINESS _____

*"Alathon", "Lucite", "Teflon" are registered trade-marks of E. I. du Pont de Nemours & Co. (Inc.)
†"Zytel" is the new trade-mark for Du Pont nylon resin.*

For Designs that Require Adjustable A-C Voltage



Put this symbol in your circuit and a POWERSTAT Variable Transformer in your products and you'll get:—

...Cool operation

...Power savings.. high efficiency

...Does not have to be tailored to the load

...Smooth control—glass smooth commutator surface

...Conservative ratings and easy, simple mounting

In many applications where you might usually use a rheostat, *investigate Powerstat variable transformer to do a better job* — and you can get a Powerstat for as little as $8.50.

You'll find Powerstats are superior. Their dimensional and physical characteristics make them easier to "design into" a product. Their conservative ratings, smooth operation and long life make them a "plus" feature of value.

For the best in continuously-adjustable voltage control use variable transformers. For the best in variable transformers always specify POWERSTATS.

Be sure to see Superior Electric's Mobile Display when it is in your area.

THE SUPERIOR ELECTRIC COMPANY

208 CLARKE AVENUE, BRISTOL, CONN.

Manufacturers of: Powerstat Variable Transformers • Stabiline Automatic Voltage Regulators • Voltbox A-C Power Supplies • Powerstat Light Dimming Equipment • Variacell D-C Power Supplies • Superior 5-Way Binding Posts

You can choose from a complete standard line of Powerstat variable transformers. Units are offered in manually-operated and motor-driven assemblies for 120, 240 and 480 volt duty in capacities from 150 VA to 100 KVA.

THE SUPERIOR ELECTRIC CO.
208 Clarke Avenue, Bristol, Conn.

Please send complete literature on Powerstat variable transformers.

Name.....

Position.....

Company Name.....

Company Address.....

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

Presenting...

VHF

-*hp*- 608C VHF Signal Generator

-*hp*- 608D VHF Signal Generator

New premium-quality performance

Wide range, direct calibration

Residual FM less than 1 kc

Drift less than 0.005%

High power output

All types of modulation

Models 608D and 608C are designed to be the best commercial instruments of their type, and to set new standards of VHF generator convenience, applicability and performance. They are the redesigned and improved successors to over 3,000 -*hp*- 608A/B VHF generators now in use throughout the world.

The premium quality -*hp*- 608D

-*hp*- 608D is the ultimate in VHF signal generators. It offers the highest stability attained in production equipment of its type. There is almost complete absence of incidental FM or frequency drift. There is a calibrated output from 0.1 μv to 0.5 v throughout the frequency range, 10 to 420 mc. A built-in crystal calibrator provides a frequency check accurate within 0.01% every 5 mc throughout range.

These unique advantages are made possible in large part by new master oscillator, intermediate and output amplifier circuit design. Other features to improve stability include a regulated filament supply, a new variable condenser design and a completely new coil turret and circuit housing. The result is the most convenient, accurate and effective instrument available for testing and aligning VHF aircraft communications and other receivers having extreme selectivity.

The all-purpose -*hp*- 608C

The -*hp*- 608C is a high power, stable and accurate VHF signal generator for general laboratory and field use. Employing a master oscillator–power amplifier circuit, -*hp*- 608C offers 1 v maximum power and a broad frequency coverage of 10 to 480 mc. The instrument provides outstanding convenience for measuring gain, sensitivity, selectivity and image rejection of receivers, IF

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two completely new

SIGNAL GENERATORS

amplifiers, broad band amplifiers and other VHF equipment. Its 1 v output is more than sufficient to drive bridges, slotted lines, transmission lines, antennas, filter networks and other circuits.

Outstanding features in both

Both *-hp-* 608D and 608C have broadest possible modulation capabilities. There is AM modulation to 80%, and flat response 20 cps to 1 mc which provides high quality internal and external pulse modulation. RF leakage is negligible, and sensitivity measurements to 0.1 μv are possible. Internal impedance is 50 ohms constant, and VSWR is a maximum of 1.2.

Both instruments also feature new mechanical design and quality construction throughout. New aluminum castings and cabinets reduce weight. Circuitry is particularly clean and accessible. Dial, condenser and turret drives are ball-bearing. Variable condensers are specially manufactured by *-hp-* and feature electrically welded Invar low temperature steel plates to minimize drift. Sealed transformers are used throughout, and construction is militarized.

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

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3099A Page Mill Road • Palo Alto, California, U.S.A.

SALES AND ENGINEERING REPRESENTATIVES THROUGHOUT THE WORLD

SPECIFICATIONS

-hp- 608D VHF Signal Generator

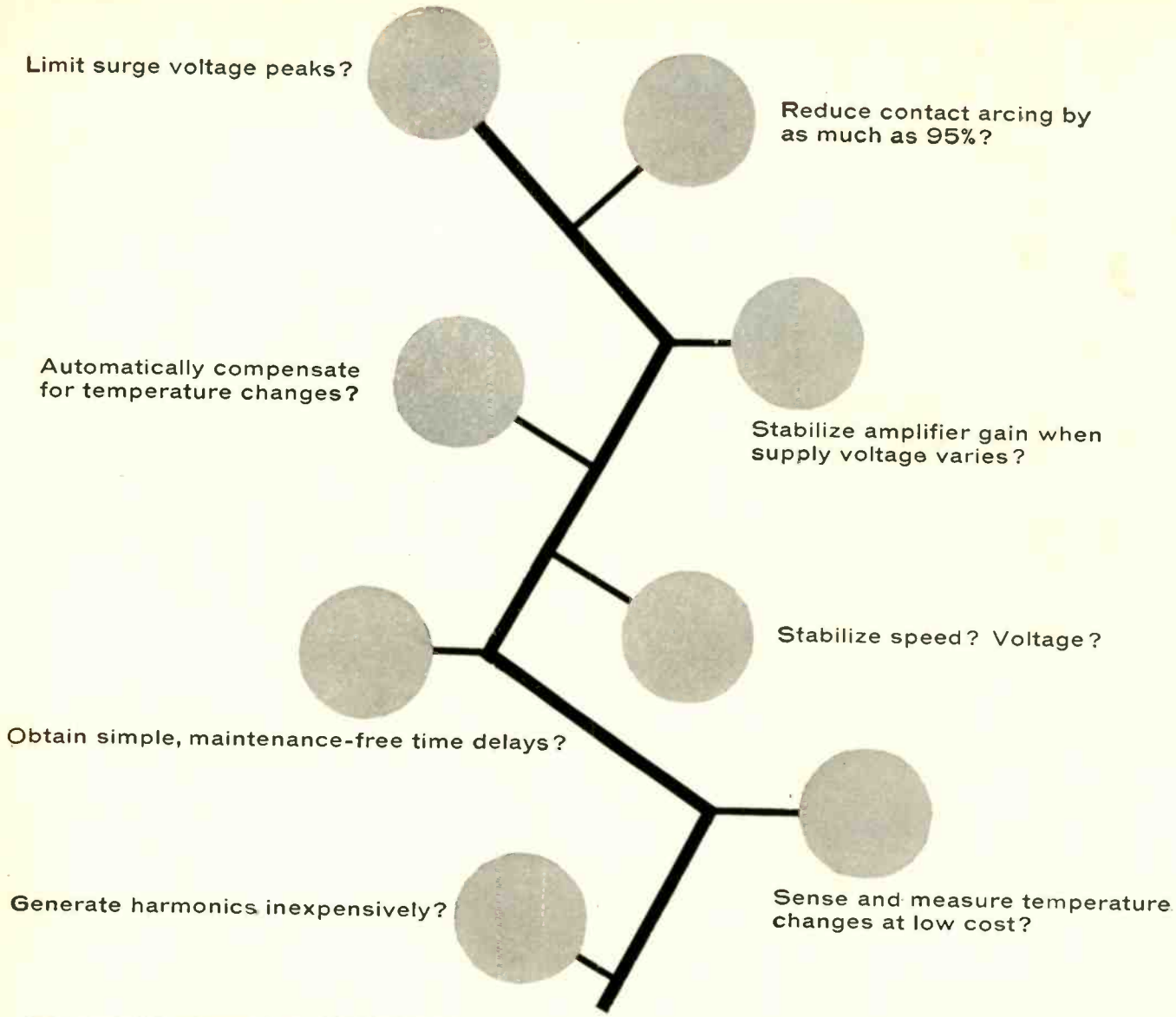
Frequency Range: 10 to 420 mc, 5 bands.
Calibration Accuracy: ±1% full range.
Resettability: Better than ±0.1% after warm-up.
Crystal Calibrator: Frequency check points every 5 mc through range. Headphone jack for audio frequency output.
Frequency Drift: Less than 0.005% over 15 minute interval after warm-up.
Output Level: 0.1 μv to 0.5 v into 50-ohm load. Attenuator dial calibrated in v and dbm. (0 dbm equals 1 mw in 50 ohms.)
Voltage Accuracy: ±1 db full range.
Generator Impedance: 50 ohms, maximum VSWR 1.2.
Modulation Percentage: 0 to 80% indicated by meter.
Envelope Distortion: Less than 2.5% at 30% sine wave modulation.
Internal Modulation: 400 cps ±10% and 1,000 cps ±10%.
External Modulation: 0 to 80%, 20 cps to 100 kc. For RF output above 100 mc, 0 to 30% to 1 mc.
External Pulse Modulation: 10 v peak pulse required. Good pulse shape at 1 μsec.
Residual FM: Less than 1,000 cycles at 30% AM for RF output frequencies above 100 mc. Less than 0.001% below 100 mc.
Leakage: Negligible; permits sensitivity measurements to 0.1 microvolt.
Filament Regulation: Provides highest possible oscillator and amplifier stability for line voltage change.
Power: 115/230 volts ±10%, 50/1,000 cps. Approx. 150 watts.
Size: 13⅜" wide x 16" high x 20½" deep.
Weight: 70 lbs. Shipping weight. approx. 100 lbs.
Price: $950.00.

-hp- 608C VHF Signal Generator

Same as *-hp-* 608D, except:

Frequency Range: 10 to 480 mc, 5 bands.
Crystal Calibrator: In Model 608D only.
Frequency Drift: Less than 0.05% over 15 minute interval after warm-up.
Output Level: 0.1 μv to 1.0 v.
Residual FM: Less than 0.0025% at 30% amplitude modulation for RF output frequencies 21 to 480 mc.
Filament Regulation: In Model 608D only.
Price: $850.00.

hp INSTRUMENTS | **COMPLETE COVERAGE**



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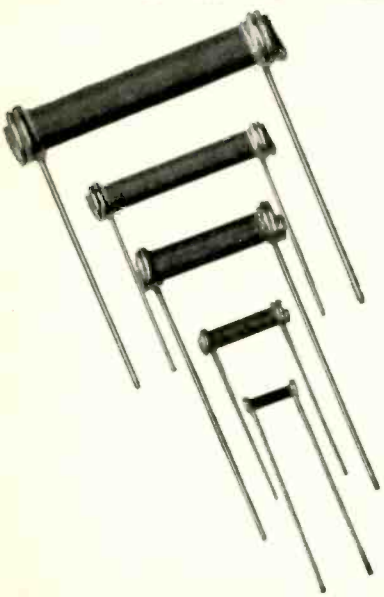

These are but a few of the jobs handled effectively, dependably by GLOBAR® Ceramic Resistors in electrical and electronic circuits. What's *your* resistance problem? Chances are there's a GLOBAR Resistor, Varistor or Thermistor which can help you solve it. Send circuit details to The Carborundum Company, Dept. E 87-411, Niagara Falls, New York, for expert advice—without obligation.

GLOBAR® **Ceramic Resistors**

VOLTAGE SENSITIVE • CONVENTIONAL
TEMPERATURE SENSITIVE

by CARBORUNDUM

REGISTERED TRADE MARK

WRITE FOR engineering bulletins—no cost—just specify the type of resistors which interest you: conventional, temperature sensitive, or voltage sensitive.

87-411

G.E. CONTINUES INDUSTRY LEAD WITH NEW GOLD BONDED GERMANIUM DIODES

- **High Forward Current Characteristics**
- **High Peak Inverse Voltage**
- **High Back To Forward Resistance Ratio**
- **High Frequency Response**

EXACTING military specifications provided the impetus for G-E's design of these new gold bonded germanium diodes. But, their application is certainly not limited to government use. Each superior characteristic points up a potentially broad market in commercial equipment.

Here, then, you have an indication of General Electric's planned program to supply *high quality germanium products for every conceivable user requirement.* It will benefit you to examine not only these new units but to become familiar with all of the many diodes, rectifiers and transistors G.E. manufactures. Call us or mail the coupon below for detailed information.

DIMENSIONS:

CASE: Diameter .220 ± .005 by ½ inch maximum length.

LEADS: 1 inch minimum with .020 diameter.

PINS: ⅛ inch length with .079 ± .001 diameter.

ACTUAL SIZE

Germanium Products

TRANSISTORS • DIODES • RECTIFIERS

G-E Type Number	1N139	1N140	1N141	1N142	1N143
Forward Cur. (a) +1v (MA)	20	40	20	5	40
Maximum Reverse Cur. (a) −50v (μa)	1500	300	50	—	—
(a) −100v (μa)	—	—	—	100	100
Peak Inverse Voltage (Volts)	50	85	85	125	125
Cont. Reverse Voltage (Volts)	40	70	70	100	100
Cont. DC Forward Current (ma)	70	85	70	60	85
Peak Oper. Cur. (ma)	250	350	250	200	350
Surge Cur. for 1 Second (ma)	500	750	500	400	750

Ambient Temperature Range	−50°C to +80°C
Derating above 25°C	10mw/10°C
Average Shunt Capacitance	0.9 μμfd
Average 100mc Rect. Eff.	46%

General Electric Company, Section X484
Electronics Park, Syracuse, New York

Please send me complete specifications on the new G-E Gold Bonded Diodes.

NAME.....

ADDRESS.....

CITY.....STATE.....

GENERAL ELECTRIC

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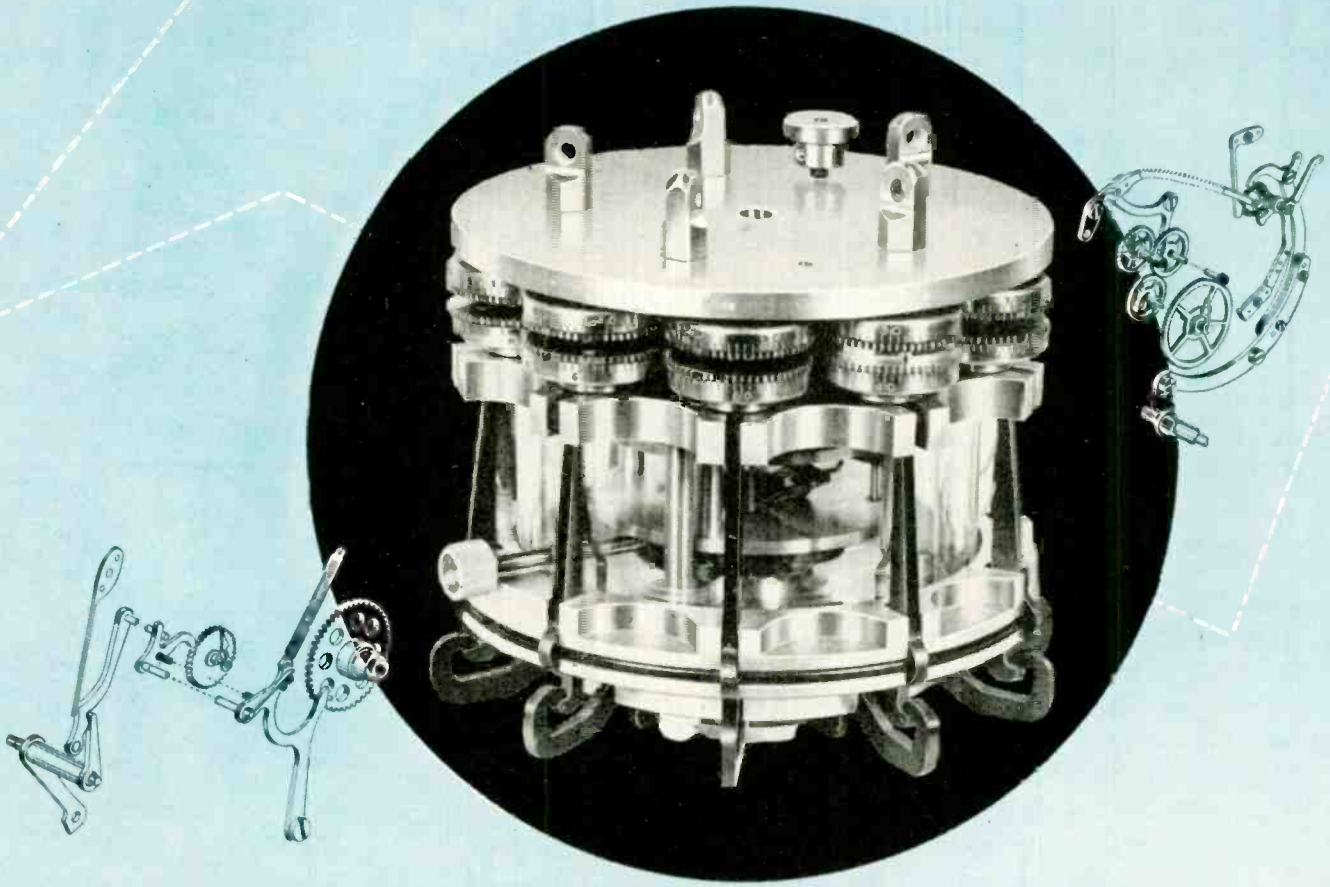

with the help of Hamilton's COMPLETE Precision Production Facilities

Developing a new product? Planning to improve an existing one? When your problem involves a complex mechanism, like the ones shown above, or precision components—the complete production facilities that make America's finest watches and produce vital defense material—are available to help solve your problems.

You are invited to investigate this *complete* source for screws, springs, flat and recessed shapes, jewel bearings, investment castings, pinions, wheels, assemblies, or any other "problem parts" to help improve *your* products. Send us your prints . . . of course, there's no obligation.

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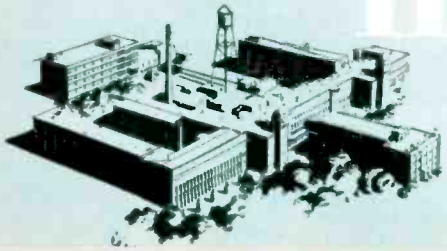

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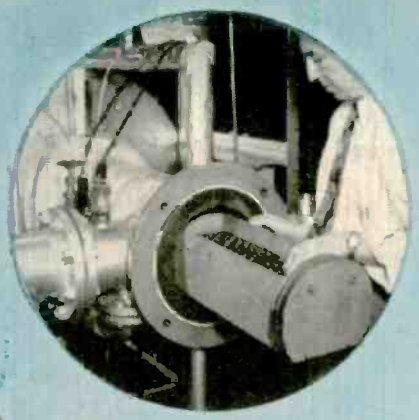
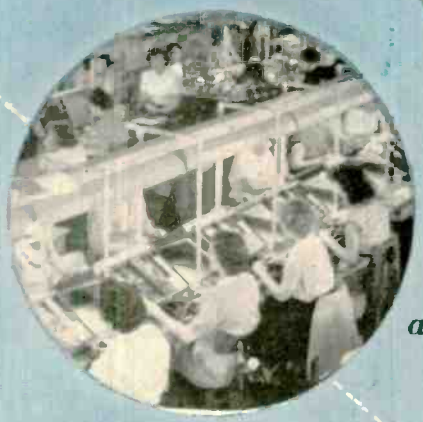
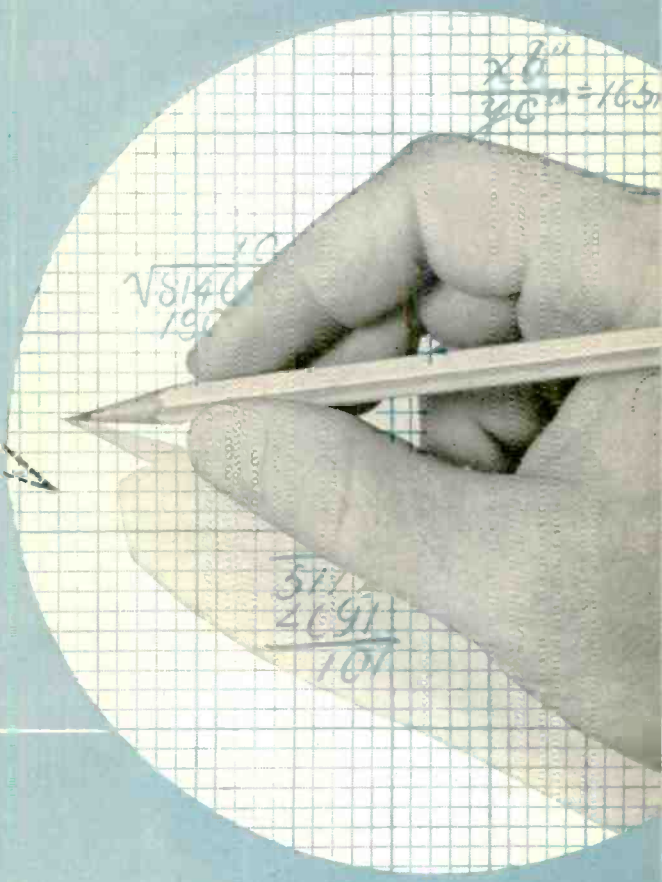


heat treating

fabrication



assembly

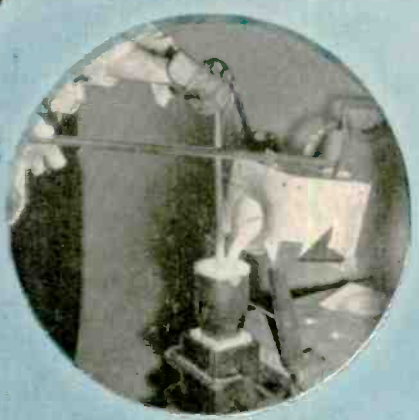


gauging and inspection

backed by

engineering

metallurgy



physical & chemical testing

TUNG-SOL TUBES FOR

2AF4
(Prototype—6AF4)
Heater Volts 2.35
Heater Current 0.6 A

3AL5
(Prototype—6AL5)
Heater Volts 3.15
Heater Current 0.6 A

3AU6
(Prototype—6AU6)
Heater Volts 3.15
Heater Current 0.6 A

3AV6
(Prototype—6AV6)
Heater Volts 3.15
Heater Current 0.6 A

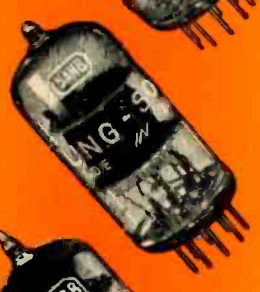
3BC5
(Prototype—6BC5)
Heater Volts 3.15
Heater Current 0.6 A

3BE6
(Prototype—6BE6)
Heater Volts 3.15
Heater Current 0.6 A

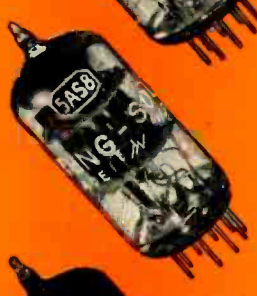
3CB6
(Prototype—6CB6)
Heater Volts 3.15
Heater Current 0.6 A

4BQ7A
(Prototype—6BQ7A)
Heater Volts 4.2
Heater Current 0.6 A

4BZ7
(Prototype—6BZ7)
Heater Volts 4.2
Heater Current 0.6 A

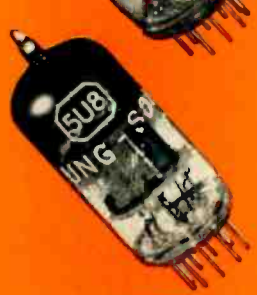


5AN8
(Prototype—6AN8)
Heater Volts 4.7
Heater Current 0.6 A



5AS8
(Prototype—6AS8)
Heater Volts 4.7
Heater Current 0.6 A

5T8
(Prototype—6T8)
Heater Volts 4.7
Heater Current 0.6 A



5U8
(Prototype—6U8)
Heater Volts 4.7
Heater Current 0.6 A

*Using heaters parallel connected

. . . designed and engineered to highest performance requirements

These are the new Tung-Sol Receiving Tubes for television sets having all of the heaters series-connected across the power line. Thermal characteristics of all the heaters are controlled so that heater voltage surges during the warm-up cycle are minimized, provided of course, that these tubes are used with other types similarly controlled.

Heater ratings are based on 600 milliamperes of current with the heater voltage adjusted for the same power as in the prototype. All other characteristics and ratings are identical to those of the prototype. Use of these tubes provides completely satisfactory receiver characteristics during warm-up.

All of the statistical quality control methods which make the performance of Tung-Sol tubes so outstanding, are utilized in the manufacture of these new types. In performance, uniformity and dependability they will be found fully reliable. For more detailed information, write Commercial Engineering Department, Tung-Sol Electric Inc., Newark 4, New Jersey.

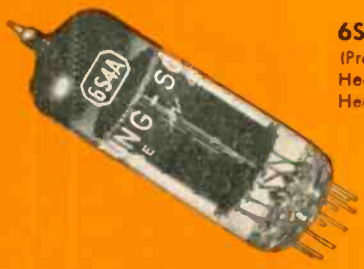
Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Philadelphia, Seattle.

Tung-Sol All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.

SERIES STRING TV SETS

6AU7
(Prototype—12AU7)
Heater Volts 3.15*
Heater Current 0.6 A

6AX7
(Prototype—12AX7)
Heater Volts 3.15*
Heater Current 0.6 A



6S4A
(Prototype—6S4)
Heater Volts 6.3
Heater Current 0.6 A

6SN7GTB
(Prototype—6SN7GTA)
Heater Volts 6.3
Heater Current 0.6 A

12AX4GTA
(Prototype—12AX4GT)
Heater Volts 12.6
Heater Current 0.6 A

12B4A
(Prototype—12B4)
Heater Volts 6.3*
Heater Current 0.6 A

25CD6GA
(Prototype—25CD6G)
Heater Volts 25
Heater Current 0.6 A

12BQ6GT
(Prototype—6BQ6GT)
Heater Volts 12.6
Heater Current 0.6 A

12BH7A
(Prototype—12BH7)
Heater Volts 6.3*
Heater Current 0.6 A

12L6GT
(Prototype—25L6GT)
Heater Volts 12.6
Heater Current 0.6 A

12BY7A
(Prototype—12BY7)
Heater Volts 6.3*
Heater Current 0.6 A.

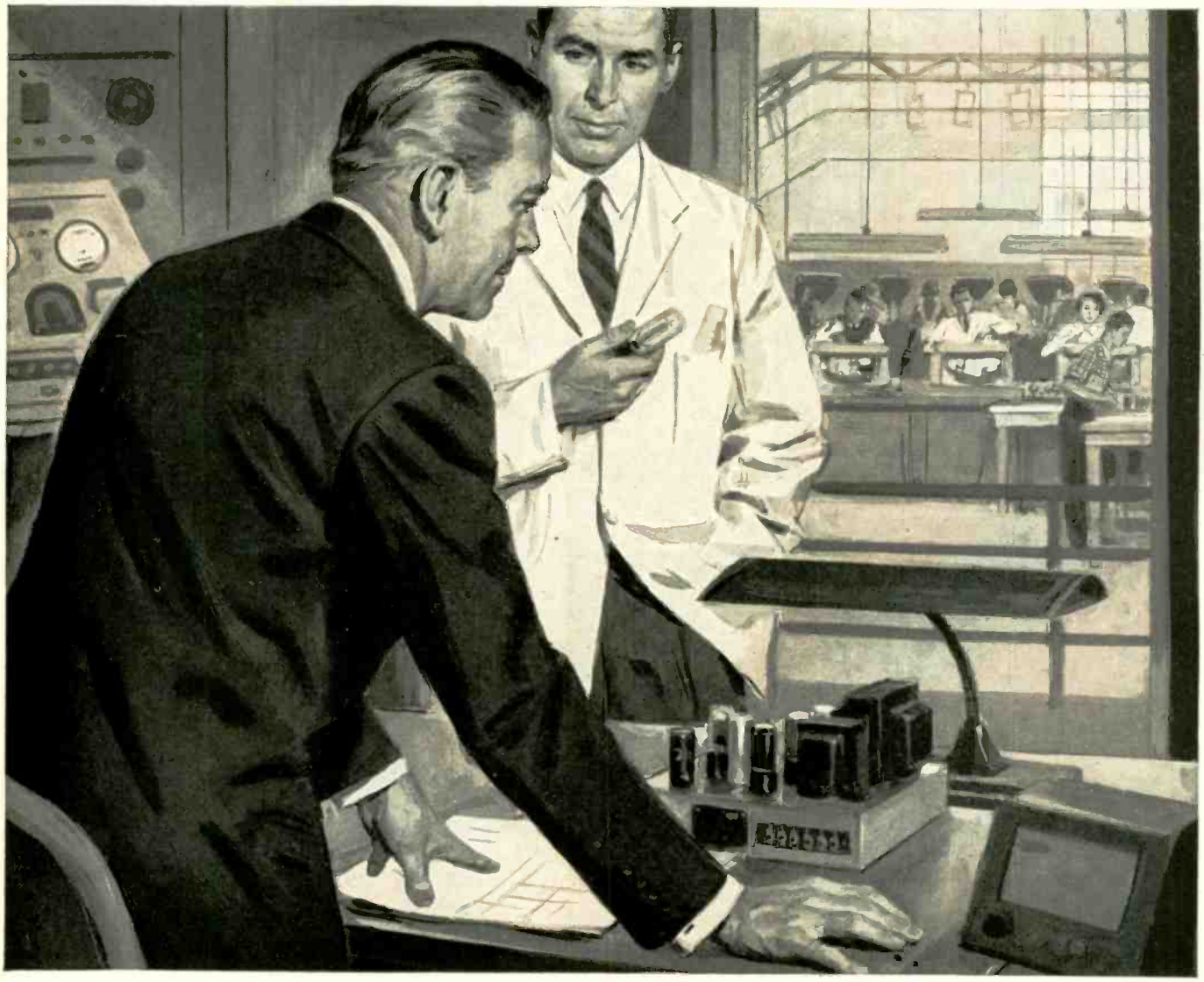
12W6GT
(Prototype—6W6GT)
Heater Volts 12.6
Heater Current 0.6 A

19AU4
(Prototype—6AU4GT)
Heater Volts 18.9
Heater Current 0.6 A

*Using heaters parallel connected

TUNG-SOL RADIO AND TV TUBES, DIAL LAMPS

How you can make sure PARTS COME IN ON TIME



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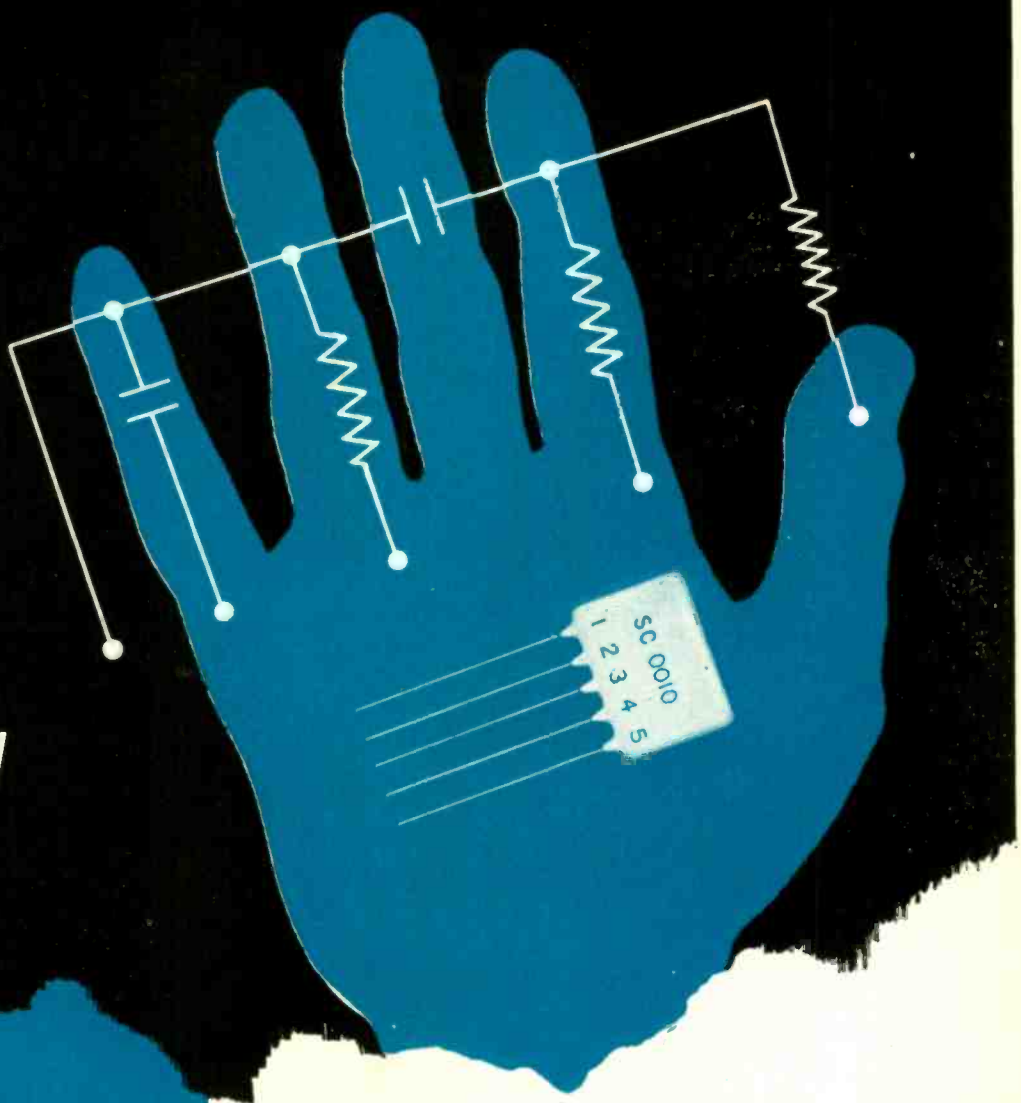
America's Leading Airline **AMERICAN AIRLINES INC.**

a handful of components in one tiny package



Stupakoff Printed Circuits

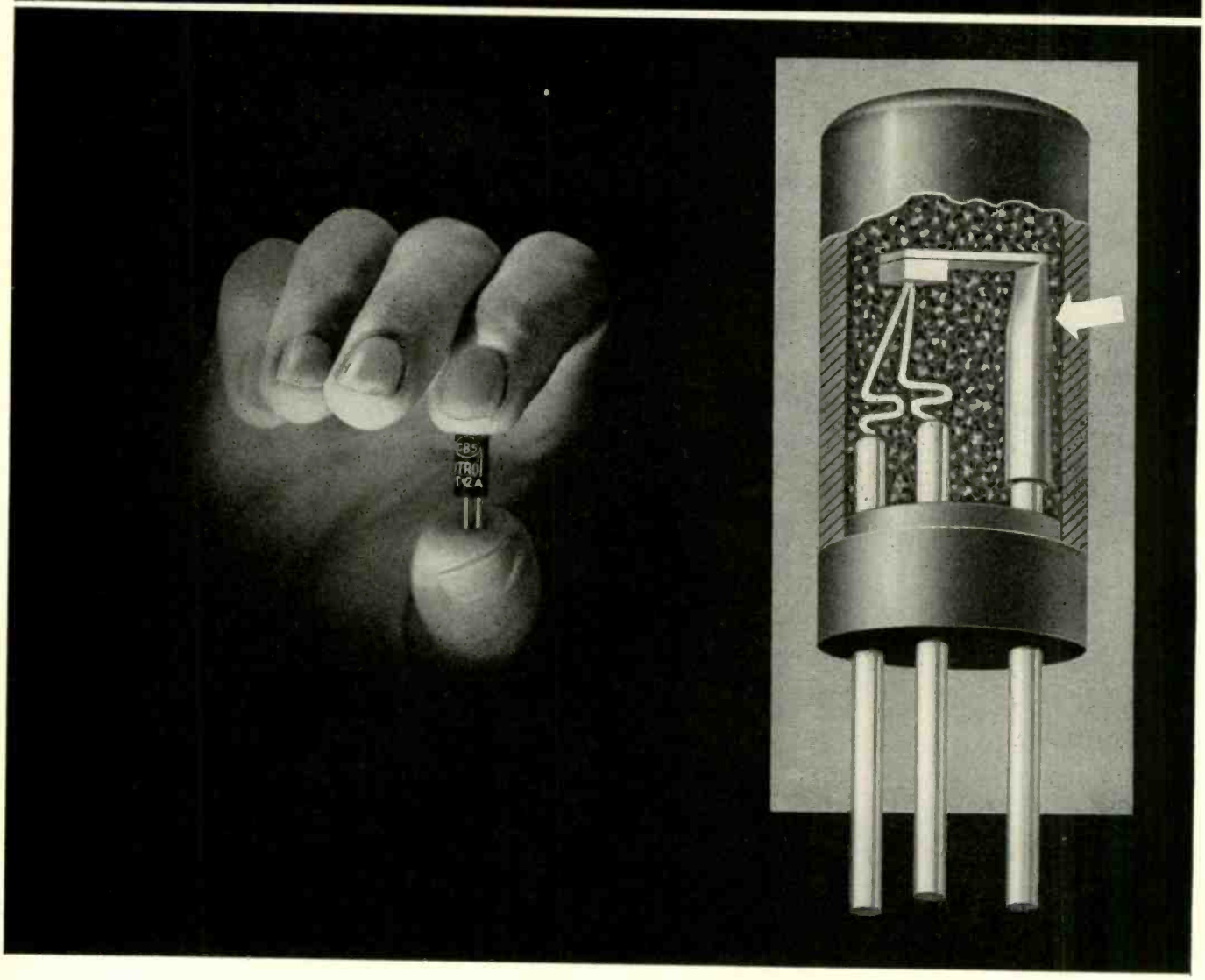
Space is saved, assembly time reduced and errors eliminated when sturdy, compact Stupakoff Printed Circuits are used. In one tiny package—half the size of a book of matches—few or many accurately rated components—resistors and capacitors—are permanently assembled according to specifications. The only connections to be made are the external leads.

Stupakoff excels in the development and manufacture of Printed Circuits, and today is equipped with modern facilities for the mass-production of dependable units made to your specifications. Write for Bulletin 1151-A.

STUPAKOFF CERAMIC & MANUFACTURING COMPANY

LATROBE, PENNSYLVANIA

Look what's happened to the "cat's whiskers"

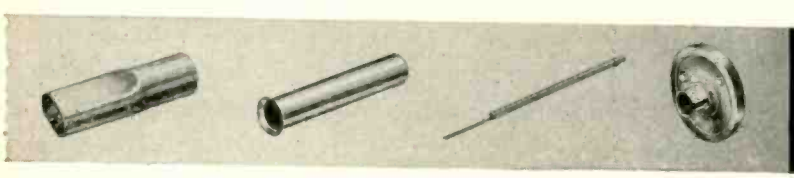


A miracle that can hide behind your thumb-nail is the hottest electronics news in years. Modernized descendant of the Twenties' crystal diode with its cat's whisker, the transistor threatens to send many vacuum tubes the way of old head sets.

No matter which ultimately gets the nod—tube or transistor—Superior will be in there pitching. Superior seamless and Lockseam* nickel cathodes, anodes and grid cups are familiar to you in vacuum tubes. Now Superior tubing is going into transistors.

CBS-Hytron, a division of Columbia Broadcasting System, Inc., uses Superior tubing for the L-shaped bracket that holds the germanium crystal in their PT-2A point-contact transistor. For this purpose they purchase tiny tubes—.032" I.D. x .003" wall, .193" long, drawn from seamless nickel. Added to the good welding, soldering and formability characteristics of the metal, Superior manufactures the brackets to the close tolerances CBS-Hytron must have.

Whether you are for the old or new order in electronics, if you need an idea or an analysis in small tubing, Superior is the first place to look. Superior Tube Company, Electronics Division, 2500 Germantown Ave., Norristown, Pa.



Superior
THE BIG NAME IN SMALL TUBING

All analyses .010" to ⅜" O.D.
Certain analyses in Light Walls up to 2½" O.D.

Seamless Nickel Anode. Flattened one end. .500" O.D. x .025" Wall x 1.625" long.

Seamless Nickel Cathode. Round, flanged one end, .070"/.072" I.D. x .0025" Wall. .295" long.

Lockseam* Nickel Cathode. Round, tabbed, single bead, .045" O.D. x .0021" Wall. 27 mm long.

Disc Cathode .121" O.D. .312" long.

Many types of nickel cathodes—made in Seamless and Lockseam* from nickel strip, disc cathodes, and a wide variety of anodes, grid cups and other tubular fabricated parts are available from Superior. For information and Free Bulletin, address Superior Tube Company, Electronics Division, 2500 Germantown Avenue, Norristown, Pa.

*Manufactured under U.S. Patents.

GENERAL CERAMICS FERRAMIC* CORES

*REG. TRADE MARK

Now available in standard types that simplify design and speed delivery!

STANDARD TOROID CORES

PART NO.	FIG. NO.	A	B	C
F-394	1	.080	.050	.025
F-259	2	.230	.120	.060
F-262	2	.375	.1875	.125
F-109-1	2	.870	.540	.093
F-109-2	2	.870	.540	.156
F-109-3	2	.870	.540	.250
F-226-1	2	1.125	.750	.125
F-226-2	2	1.125	.750	.500
F-268-1	2	1.250	.750	.187
F-268-2	2	1.250	.750	.375
F-268-3	2	1.250	.750	.250
F108	1	1.875	1.375	.250

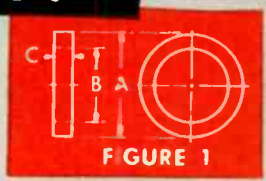
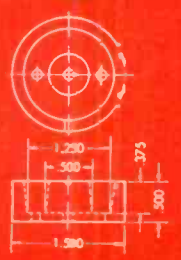


FIGURE 1

FIGURE 2

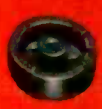
STANDARD CUP CORES

TYPE F-269



TYPE F-270

TYPE F-280 (ILLUSTRATED)
TYPE F-281 NO HOLE OR STEP
TYPE F-261 WITH HOLE, NO STEP



TYPE F-283 (ILLUSTRATED)
TYPE F-240 NO HOLE OR STEP
TYPE F-260 WITH HOLE, NO STEP

TYPE F-289

TABLE OF MAGNETIC PROPERTIES OF FERRAMICS®

PROPERTIES	UNIT	A	B	C	D	E	G	H	H-1	I	J	N	O	Q
Initial Perm. at 1 mc/sec.	–	20	95	250	410	750	410	850	550	900	330	200	1000	125
*Max. Perm.	–	100	183	1100	1030	1710	3300	4300	3800	3000	750	500	2000	400
*Sat. Flux Dens.	GAUSS	1500	1900	4200	3100	3800	3200	3400	2300	2000	2900	3000	3600	3300
*Residual Mag.	GAUSS	1000	830	2700	1320	1950	1050	1470	1500	700	1600	2300	1100	1050
*Coercive Force	OERSTED	5.0	3.0	2.1	1.0	.65	.25	.18	.35	.30	.80	.50	.35	2.0
Temp Coef. of Initial Perm.	%/°C	.15	.04	.40	.30	.25	1.3	.66	.80	.30	.22	.14	.48	.10 max
Curie Point	/°C	300	260	330	165	160	160	150	125	70	180	290	140	350
Vol. Resistivity		High	Med.	Med.	High	Med.	High	Med.	Med.	Med.	High	High	Med.	High
Loss Factor: $\frac{1}{\mu_o Q}$														
At 1 mcs/sec.	–	.0005	.00016	.00007	.00005	.00008	.00008	.00030	.0004	.0003	.000055	.000035	.00025	.000024
At 5 mcs/sec.	–	.0007	.0011	.0008	.0012	.0020	.00075	.00155	.0010	.0050	.0004	.00012	.0030	.00004

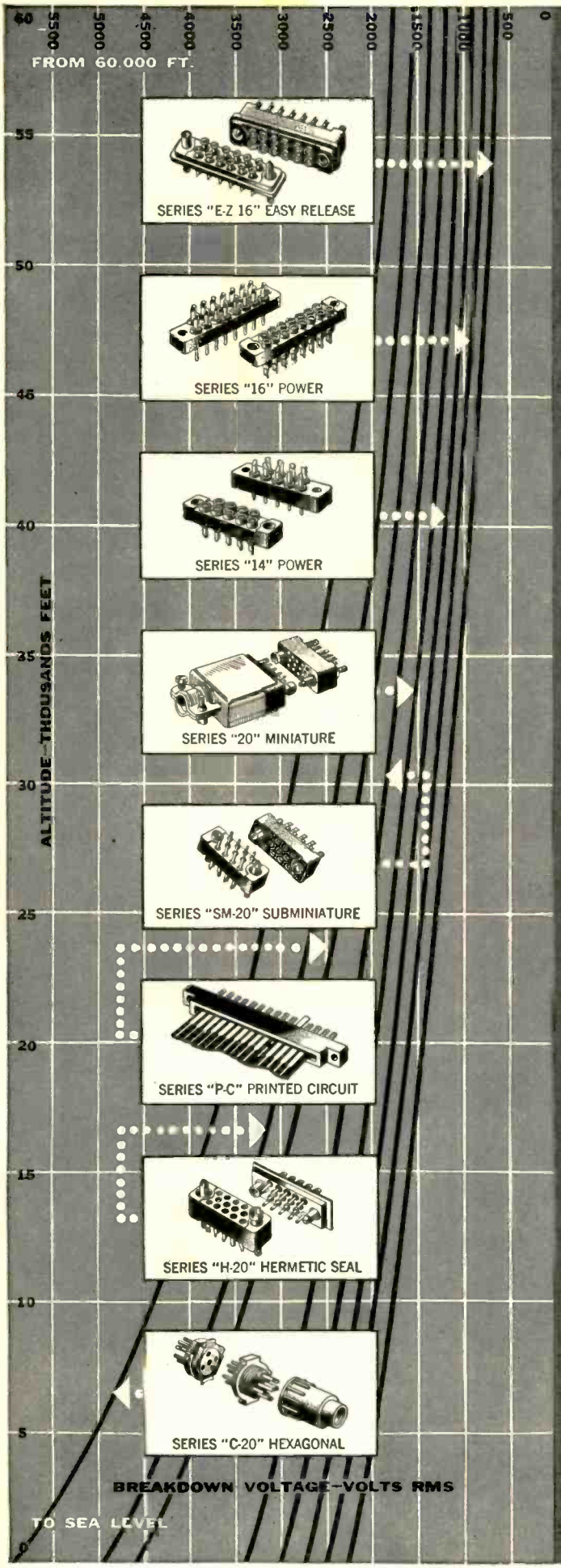
*Measurements made on D.C. Ballistic Galvanometer with Hmax = 25 oersteds. Above data is based on nominal values.

The above standard items are available in all of the types of Ferramic material shown in the table of properties. Other shapes and sizes of cores can be made of the above materials to your design. For further details or quotations call, write or wire today.

GENERAL CERAMICS CORPORATION

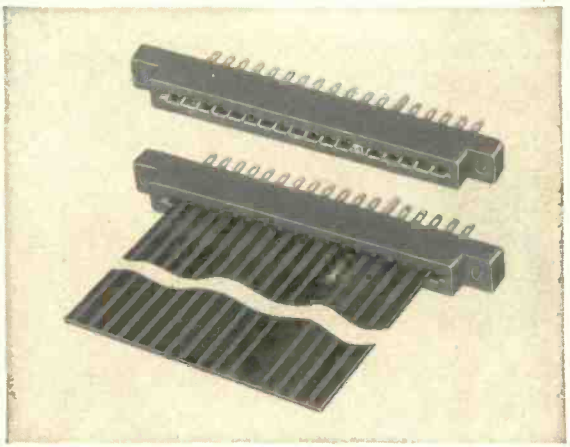
General Offices and Plant: KEASBEY, NEW JERSEY

MAKERS OF STEATITE, ALUMINA, ZIRCON, PORCELAIN, SOLDERSEAL TERMINALS, LIGHT DUTY REFRACTORIES, CHEMICAL STONEWARE, IMPERVIOUS GRAPHITE & FERRAMIC MAGNETIC CORES



new... precision Continental Connectors*

simplify your connector problems



Printed Circuit Connectors

Series P-C—With 6, 10, 15, 18, 22, and 28 contacts in single or double rows

Answers the need for a positive, space-saving connection between printed circuitry and conventional wiring. Permits direct connection to a printed circuit "plug" mounted sub-assembly. By specifying 28 contacts in a double row connector and using both sides of the printed circuit card you have provision for up to 56 individual connections for #16 AWG wire.

Series P-C Connectors can be custom built to suit any card thickness, and are available in Mineral filled Melamine, Plaskon Reinforced (glass) Alkyd type 440-A, and Diallyl Phthalate (blue) insulating materials.

Write for Engineering Literature, Series P-C, to Department EPC-8, DeJUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

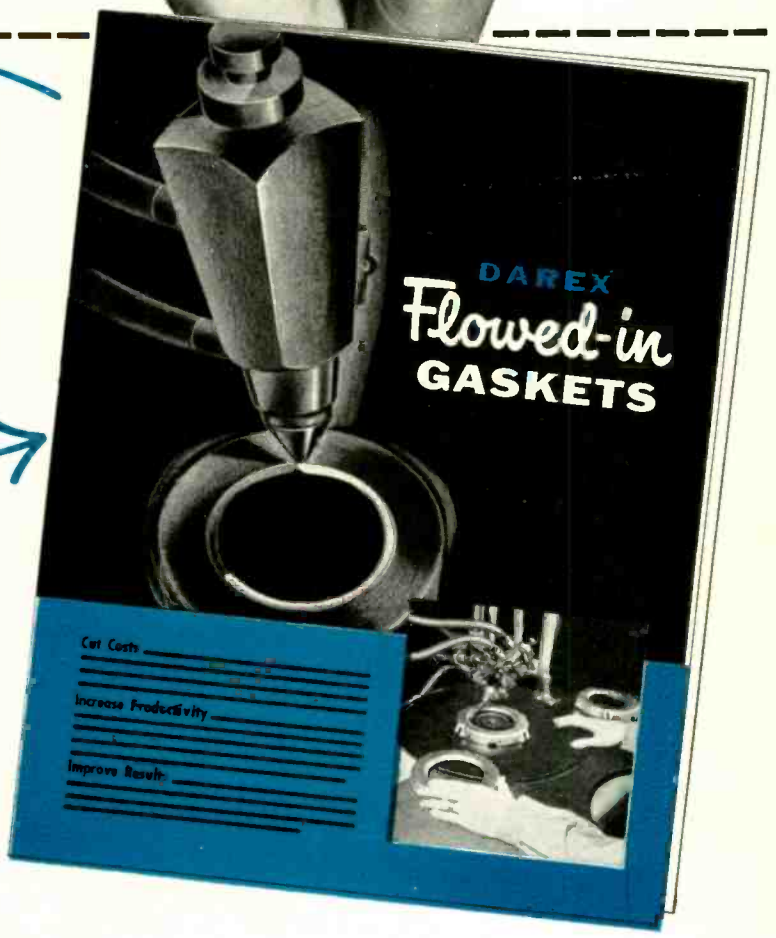
Electronic Sales Division **DeJUR**

45-01 Northern Blvd., Long Island City 1, N. Y.

*WORLD'S LARGEST MANUFACTURERS OF MINIATURE PRECISION CONNECTORS

For gasketed parts like these . . .

This FREE BOOK CAN HELP YOU CUT COSTS!



There's something new in electronics this year . . .

IT'S THE DAREX Flowed-in GASKET PROCESS!

And this fact-filled brochure gives you the whole Flowed-in Gasket Story. Here are a few samples of the things you'll read in this informative new book:

ABOUT COSTS

Using the DAREX Flowed-in Gasket Process, a major electronics manufacturer is saving $50,000 per year in labor and materials on a single gasketing operation. As a result of this striking cost reduction, the firm has recommended the DAREX Process for several more gasketing operations.

ABOUT THE PROCESS

The Flowed-in Gasket Process is a new application of a method of sealing developed by Dewey and Almy researchers over 30 years ago, and successfully used in food container manufacture ever since.

The DAREX Flowed-in Gasket Process is more than a sealing compound . . . more than a machine . . . more than an engineering service . . . *it's a complete Process!* So when you switch to Flowed-in Gaskets, you get all three.

Compounds— Over 800 formulations available to meet most needs. Or Dewey and Almy chemists will develop a "job-tailored" compound for you.

Machines— To apply the compound, Dewey and Almy designs and builds machines based on more than 30 years' field experience.

Service— Every machine is precisely adjusted to your specifications before it leaves the shop. When it arrives, a Dewey and Almy Engineer is on hand to install and adjust the machine. Then he trains your operators to full proficiency. And whenever you need him, the Dewey and Almy Man is at your service.

DEWEY and ALMY
Chemical Company
Cambridge 40, Mass..

Offices or subsidiaries in Buenos Aires, Chicago, Copenhagen, London, Melbourne, Milan, Montevideo, Montreal, Naples, Paris, San Leandro (Calif.), Sao Paulo, Tokyo.

Discover what DAREX "Flowed-in" GASKETS can do for YOU

MAIL THE COUPON TODAY!

DEWEY and ALMY Chemical Company
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Please send me the new DAREX Flowed-in GASKET Book.

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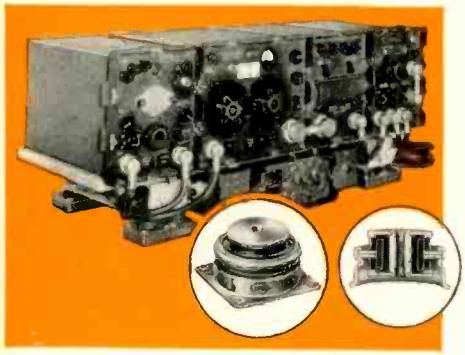
JUST A MATTER OF CONTROL

LORD ENGINEERING CONTROLS VIBRATION . . . anywhere!

Your continuing effort to improve your products and reduce their maintenance cost may be entirely A Matter Of Control . . . the control of destructive vibration and shock. To help you to accomplish your objectives, Lord Engineering recommends the correct design, selects the most suitable elastomer and metal, and uses precision manufacturing for all Vibration Control Mountings and Bonded Rubber Parts. Your vibration and shock control problems are our business. We welcome the opportunity of placing our wide experience in many diversified industries at your disposal.

Over 27,000 designs and their variations from which to choose.



The sensitivity of many commercial and military radio transmitters is protected . . . their accuracy is insured against vibration and shock damage by Lord Vibration Control Mountings. Ask for complete details.

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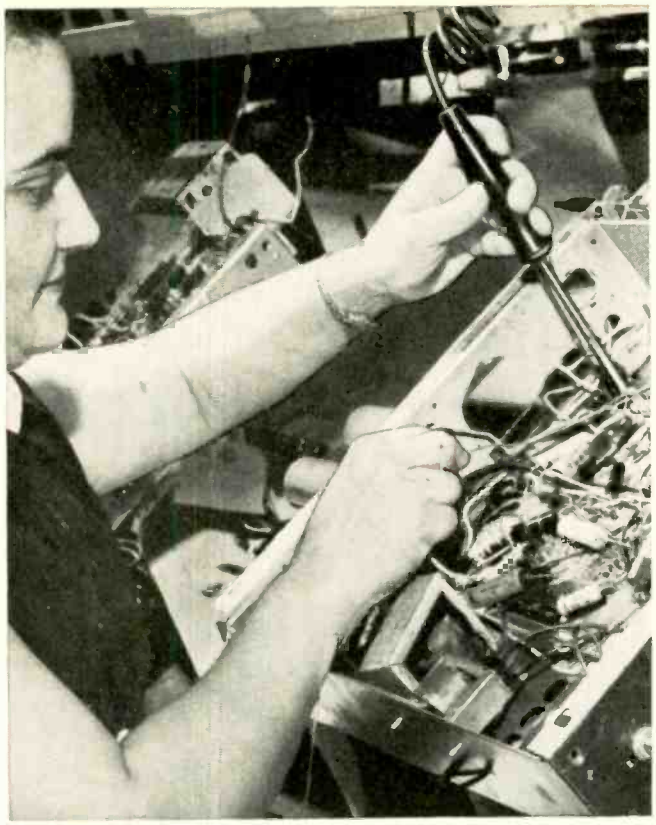
LORD BONDED RUBBER

Headquarters for **VIBRATION CONTROL** FOR 30 YEARS



LIGHT-AS-A-PENCIL G-E MIDGET reduces operator fatigue, has longer-lasting Ironclad tip. The Midget solders like a pencil dots an "i."

EXTRA-HEAVY-DUTY G-E IRON with long-life calorized copper tip is ideal for soldering heavy-gage cans and armature windings.

You get lower costs, faster soldering with the complete line of long-life G-E irons

Select a soldering iron from General Electric's complete line for easier, faster, cost-cutting soldering. You can choose from 24 different irons with ratings from 25 to 1250 watts.

Long-life G-E Ironclad Copper Tips last up to *ten times as long* as ordinary tips. Ironclad tips combine the durability of iron and excellent heat-transfer of copper.

For Soldering Small Connections, you'll want to try the G-E Midget iron with easily interchangeable ¼-in., ⅛-in., and $\frac{3}{16}$-in. Ironclad tips. This 1¾-ounce, 25-watt iron reduces operator fatigue, makes pinpoint connections. And because the Calrod* heater is *built right into the tip,* you get maximum heat transfer, amazing heat recovery for an iron of this size.

For Medium-sized Jobs, try G.E.'s sturdy Lightweight iron. This high-speed iron for continuous soldering takes plenty of hard use. Because the iron has a thin shank and interchangeable ¼-in. or $\frac{3}{16}$-in. Ironclad tips, you can solder tight joints without damaging small connections.

For the Bigger Soldering Jobs, General Electric has larger irons ranging from the 75-watt, ½-in. tip unit to the heavy-duty 1250-watt, two-inch-copper-tipped model. With a G-E Calrod heater *cast into the heating head,* you get unusually quick heating and high efficiency.

Contact Your General Electric Sales Office or Distributor to solve your soldering problems. Start cutting costs *and* increasing production with long-life, high-speed irons from the complete General Electric line. And for more information mail the coupon at right.

*Reg. Trademark of the General Electric Co.

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Schenectady 5, N. Y.

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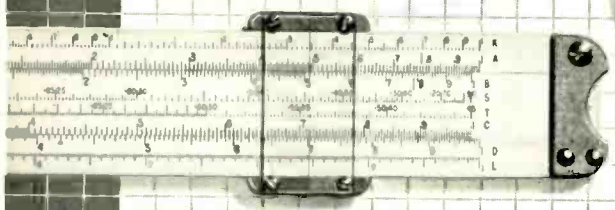
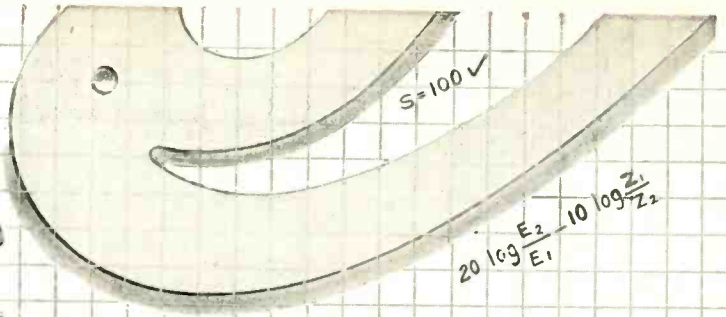
GENERAL ELECTRIC

RCA





FROM THE RCA TUBE DIVISION

TECHNICAL NEWS FOR DESIGNERS

New, Small UHF Power Triode
(Liquid and Forced-air cooling)

RCA-6383 is designed primarily for transmitter applications in aircraft where compactness, light weight, and high power output are important. Although it weighs only 8 oz. the tube can handle up to 600 watts of plate dissipation. It can be operated with full plate voltage and plate input at frequencies up to 2000 Mc.

Max. length, only $4\frac{1}{4}$"

The Versatile "Special Red" Rectifier . . . RCA-5690

Featuring two separate indirectly heated cathodes to give you two separate half wave rectifiers in one envelope, the RCA-5690 "Special Red" Tube provides dependable long life and permits simple and economical designs for circuits such as:

- voltage doubler
- reference and signal comparator
- bridge and polyphase circuits
- high-power phasing and sensing circuits
- full-wave negative supplies

For industrial and aircraft circuits where the accent is on long life and dependability coupled with maximum safety and minimum maintenance, you can rely on RCA "Special Red" Tubes.

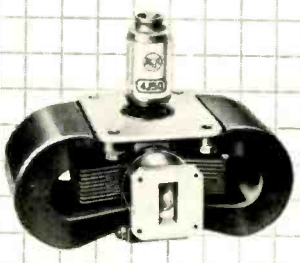
The 10,000-hour line—
RCA-5690, 5691, 5692, 5693

New Flying-Spot Tube for COLOR

RCA-5AUP24 is a 5" cathode-ray tube intended for use as the flying-spot scanner in color-video-signal generators. It features a metal-backed phosphor which has a spectral-energy emission characteristic with peak in the blue-green region and with sufficient range to provide usable energy over the visible spectrum required for generating color-TV signals from color transparencies.

Max. length, $12\frac{7}{8}$"

"Packaged" Magnetron
(Forced-air cooled)



The RCA-4J50 3-centimeter magnetron is intended for use as a pulsed oscillator in radar service. Full anode voltage can be applied directly after heater warmup. The RCA-4J50 incorporates a getter to maintain high vacuum and good arc stability during life.

Frequency 9375±30 Mc

For a 1μ sec. pulse duration and duty cycle of 0.001

Max. Peak Input	635 Kw
Typical Peak Output	240 Kw

For technical data, write RCA Commercial Engineering, Section H19R, Harrison, N. J.

ELECTRON TUBES • SEMICONDUCTOR DEVICES • BATTERIES • TEST EQUIPMENT • ELECTRONIC COMPONENTS

RADIO CORPORATION of AMERICA
TUBE DIVISION HARRISON, N. J.

NEW AMP

PATENTED "F" CRIMP

TAPER PINS FOR WIRING AN TYPE CONNECTORS

AMP Taper Pins tested in AN type connectors exceed the applicable performance requirements of Military Specifications for AN connectors and solderless terminals. Taper Pin Connections are even more secure and show no change in contact resistance after vibration, temperature cycling, salt spray, and thermal shock tests. Copies of these test reports are available on request.

IMPROVE RELIABILITY SAVE TIME REDUCE COST

Now AN type connectors can be wired 5 to 10 times faster ***with even superior performance reliability.*** There are no cold solder joints, burned insulation, embrittled wire and breakage at solder cups or short circuits due to loose strands and excess solder.

For many years the Aircraft, Electronics and Communication industries have awaited this new and simpler method, since the soldering of wires to conventional AN connector contacts is a slow and painstaking process involving much skill and repeated inspection checks.

With AMP's new Taper Technique, a special AMP Patented "F" Crimp Taper Pin is attached to the wires by high speed automatic machines. This pin is then installed in the connector with one easy and positive stroke of AMP's new "measured energy" CERTI-LOK insertion tool. The result is uniformly better connections, produced in much less time with tremendous cost savings.

Tests prove that AMP Taper Pins provide a greater degree of uniformity than soldered connections. Reliability is actually increased because the possibility of human error in assembly has been greatly reduced.

Leading Connector manufacturers are now supplying AN and other types of multiple contact connectors for use with AMP Taper Pins. Write today for further information.

AMP

AMP Trade-Mark Reg. U.S. Pat. Off. © AMP

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In Canada—AIRCRAFT-MARINE PRODUCTS OF CANADA, LTD.
1764 Avenue Road Toronto 12, Ontario

KEPCO VOLTAGE REGULATED POWER SUPPLIES

MODEL 750

MODEL	VOLTS	CURRENT	REGULATION	RIPPLE
750	0-600	0-750 Ma.	0.5%	10 Mv.
760	0-600	0-1.5 Amp.	0.5%	10 Mv.
770	0-600	0-2.25 Amp.	0.5%	10 Mv.
780	0-600	0-3 Amp.	0.5%	10 Mv.

VOLTS	CURRENT	REGU-LATION	RIPPLE	6.3 V.† AC. CT.	MODEL
0-1500	0-200 Ma.	0.5%	20 Mv.		1520
0-1200	0-20 Ma.	0.1%	10 Mv.	10 Amp.	1220
0-1000	0-500 Ma.	0.5%	20 Mv.		1350
200-1000	0-500 Ma.	0.5%	20 Mv.		1250
0-1000	0-50 Ma.	0.1%	10 Mv.	10 Amp.	1020
0-600	0-3 Amp.	0.5%	10 Mv.		780
0-600	0-2.25 Amp.	0.5%	10 Mv.		770
0-600	0-1.5 Amp.	0.5%	10 Mv.		760
0-600	0-750 Ma.	0.5%	10 Mv.		750
0-600 0-150 Bias	0-300 Ma. 0-5 Ma.	0.5% *	10 Mv. 5 Mv.	10 Amp.	615
0-600	0-300 Ma.	0.5%	10 Mv.	10 Amp.	500R
#1 0-600 #2 0-600	0-200 Ma. 0-200 Ma.	0.5% 0.5%	5 Mv. 5 Mv.	10 Amp. 10 Amp.	800
0-600 0-150 Bias	0-200 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	10 Amp.	815
#1 200-500 #2 200-500	0-200 Ma. 0-200 Ma.	0.5% 0.5%	5 Mv. 5 Mv.	6 Amp. 6 Amp.	510
200-500	0-200 Ma.	0.5%	5 Mv.	6 Amp.	245
0-400 0-400 0-150 Bias	0-150 Ma. 0-150 Ma. 0-5 Ma.	0.5% 0.5% *	5 Mv. 5 Mv. 5 Mv.	10 Amp. 10 Amp.	2400
0-400 0-150	0-150 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	10 Amp.	400
0-400	0-150 Ma.	0.5%	5 Mv.	10 Amp.	141
100-400	0-150 Ma.	0.01%	1 Mv.	10 Amp.	2000
0-350	0-3 Amp.	0.5%	10 Mv.		730
0-350	0-2.25 Amp.	0.5%	10 Mv.		720
0-350	0-1.5 Amp.	0.5%	10 Mv.		710
0-350	0-750 Ma.	0.5%	10 Mv.		700
100-325 0-150 Bias	0-150 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	10 Amp.	131
0-300 0-150 Bias	0-150 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	5 Amp.	315
0-150	0-50 Ma.	0.5%	5 Mv.		150
3-30	0-30 Amp.	0.5%	0.1%		3030
1-13	0-10 Amp.	0.5%	10 Mv.		3200

DC POWER SUPPLY SPECIFICATIONS

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 SUPPLIES:** 10 millivolts for line 105-125 volts. ½% for load at 150 volts.

†All AC Voltages are unregulated.

WORKMANSHIP

Workmanship is of a quality with the highest existing production standards and best instrument electronic practices consistent with the intended use of the item as a continuous duty voltage regulated power supply. Oil filled paper condensers and resistor-board construction are included in the design.

FOR NEW POWER SUPPLY CATALOG — WRITE DEPT. No. 789

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Now you can get ALL Good-All Capacitors

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impregnated with "Marbelite" plastic

● Practically unaffected by humidity or climatic conditions. ● Eliminates troublesome field failures. ● Low capacitance change with temperature. ● Thermo setting, hard-as-marble, "Marbelite"* plastic end-fill provides life-time sealing —eliminates costly pull-outs. ● Extremely durable. ● So Superior they are being used extensively by leading TV and Radio manufacturers of America.

Use GOOD-ALL METAL LINED CAPACITORS for every Requirement

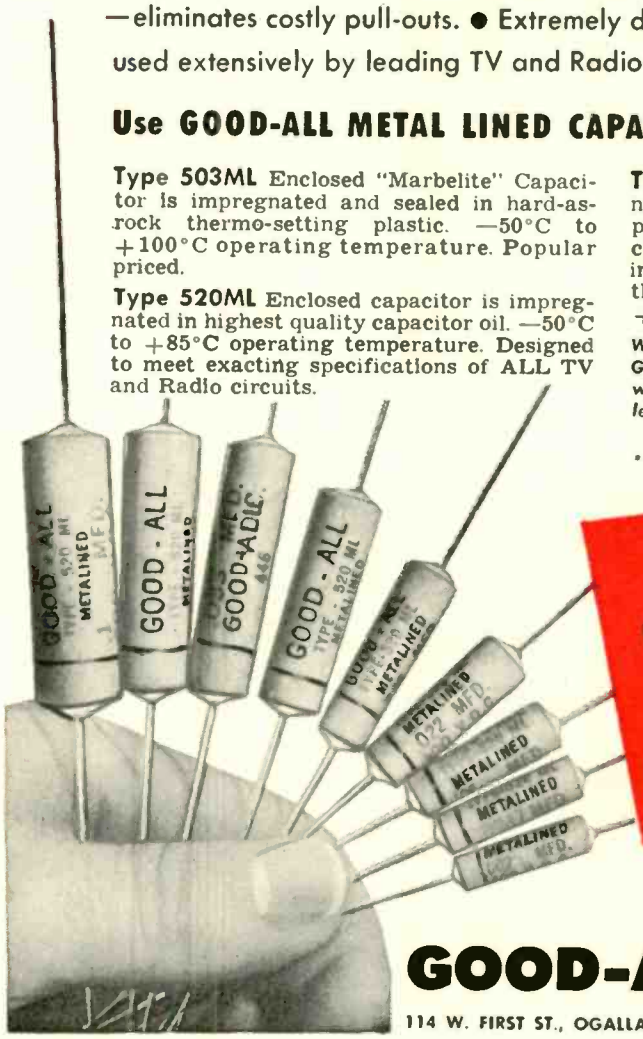
Type 503ML Enclosed "Marbelite" Capacitor is impregnated and sealed in hard-as-rock thermo-setting plastic. —50°C to +100°C operating temperature. Popular priced.

Type 520ML Enclosed capacitor is impregnated in highest quality capacitor oil. —50°C to +85°C operating temperature. Designed to meet exacting specifications of ALL TV and Radio circuits.

Type 522ML Enclosed capacitor is impregnated in Miracle"X." (Same high quality impregnant used in more expensive hermetically sealed capacitors.) Extremely high insulation resistance. Capacity change less than 5% over operating range of —55°C to +125°C.

Write for complete catalog covering all types of Good-All long-life capacitors. Our engineers are always ready to work with you on any capacitor problems. We invite sample orders for your evaluation.

*Trade Mark Registered



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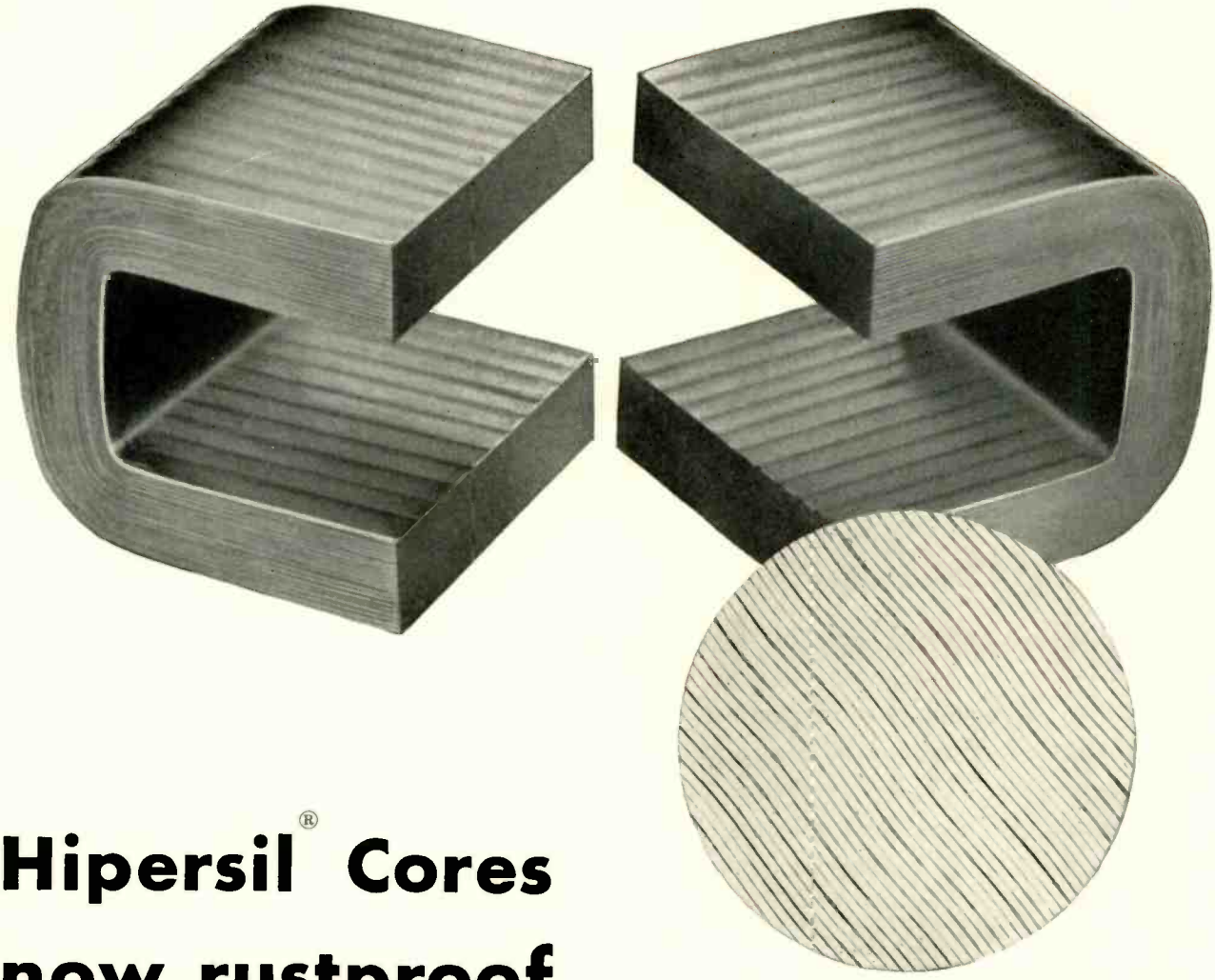

Hipersil® Cores now rustproof

Butt joint section of 5-mil Hipersil Core, magnified 10 times. Distinct separation between the laminations channels the flux, increases core efficiency.

A new process now coats a microscopic film of rustproof iron phosphate on all Westinghouse Hipersil Cores. This coating will not chip, scratch or flake, nor will it affect core performance.

Rustproofing eliminates all possibility of deterioration. This means you can safely carry samples or a stock of cores in advance of immediate production needs . . . keep your assembly lines flowing smoothly.

This thin coat prevents any loss of the inherently high flux carrying capacity . . . another reason why Hipersil Cores make it unnecessary to design excess core material, and, therefore excess size and weight, into your transformer assemblies.

Advancements like this continue to make the Westinghouse Hipersil Core the best on the market today. Because they are 100% active in carrying flux, they solve size, weight and loss problems for you. The simple, two-piece assembly helps cut your transformer fabricating costs. Get a more complete story by writing today for Booklet B-5402. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70694

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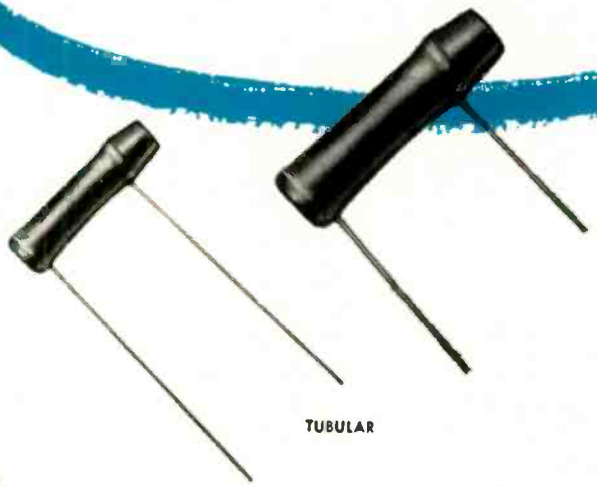
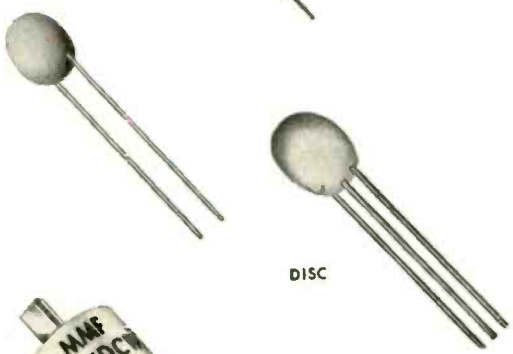
Consistently Dependable Cornell-Dubilier ceramic capacitors



TUBULAR



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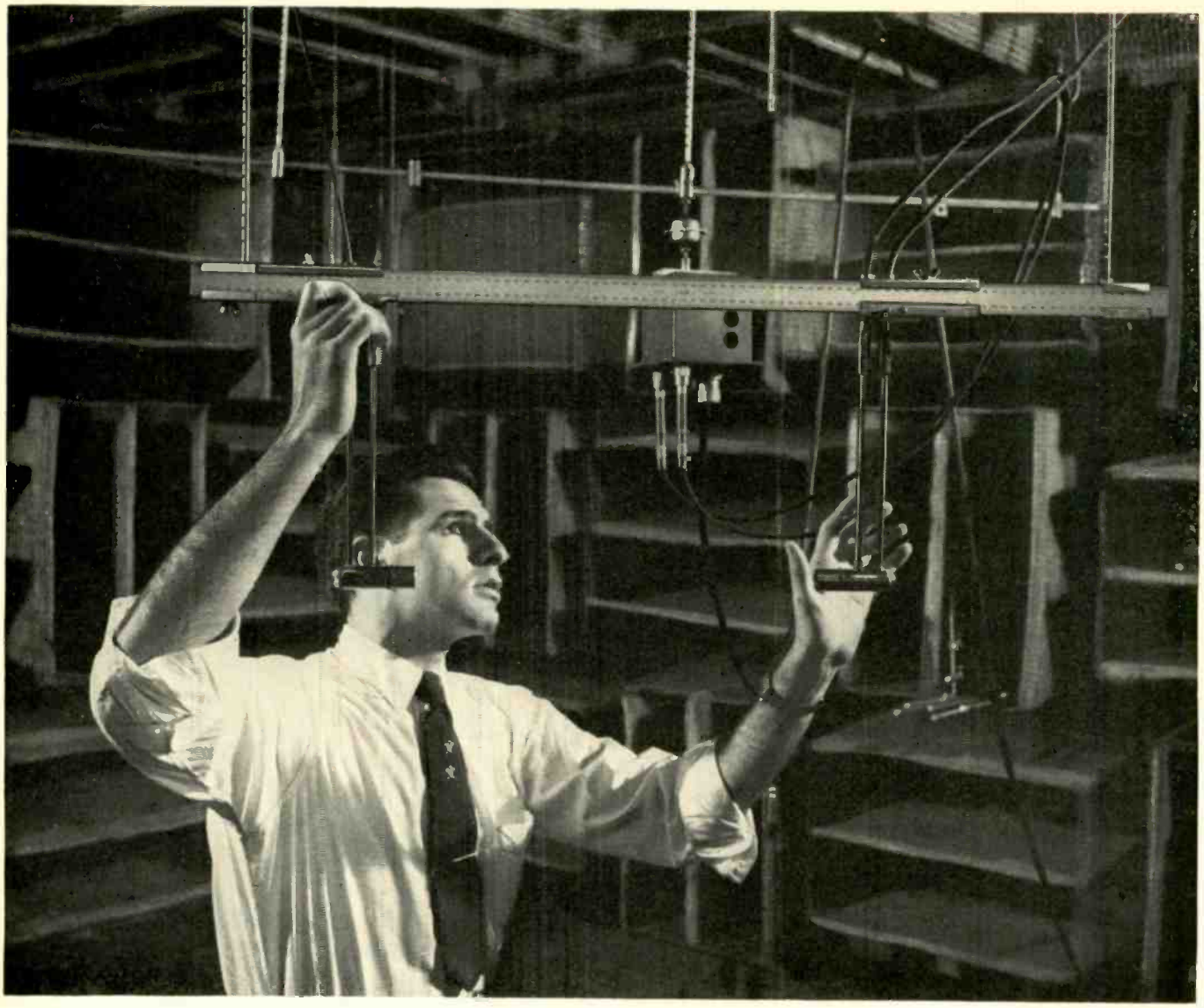
THERE ARE MORE C-D CAPACITORS IN USE TODAY THAN ANY OTHER MAKE

CORNELL DUBILIER *Capacitors*

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



In a quiet room at Bell Laboratories an engineer scales off the distance between two condenser microphones during a calibrating test. Able to measure air pressure variations of a few billionths of an atmosphere, such microphones play a crucial role in the scientific study of telephone instruments.

SOUND STEPS ON THE SCALES

Those small cylinders facing each other are condenser microphones—measuring tools that play a vital part in making your telephone easier to hear and talk through.

They are being calibrated by an engineer at Bell Telephone Laboratories to give extremely accurate information on the kind of sound your telephone company handles. Armed with these vital fundamental data on what sound *is*, Bell Laboratories scientists devise the instruments and equipment that transmit it best.

At Western Electric, manufacturing unit of the Bell System, a condenser microphone "listens" as your ear would listen to every telephone before it goes into service. The condenser microphone is but one of many precise tools that Laboratories scientists have developed to make telephone service better and more economical.

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Improving America's telephone service offers careers for creative men in scientific and technical fields.

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Invariably this question is brought up by seasoned buyers. Experience has taught them that no amount of good intentions can compensate for inadequate production machinery. To such practical and fore-sighted men, the following facts are presented for consideration:

To meet customer requirements for quality tested AlSiMag ceramics, American Lava Corporation maintains lineups of modern high speed presses which can produce ***in one three-shift working day over 9,000,000 uniform, accurate AlSiMag pieces*** (more than enough, laid end to end, to reach from Philadelphia, Pa., to Washington, D. C.)*

Why risk dole delivery when you can command AlSiMag production facilities ready to serve you?

* Based on an AlSiMag part 1" square. Our presses can produce pieces up to 14" x 14" and, of course, much smaller parts than the size mentioned.

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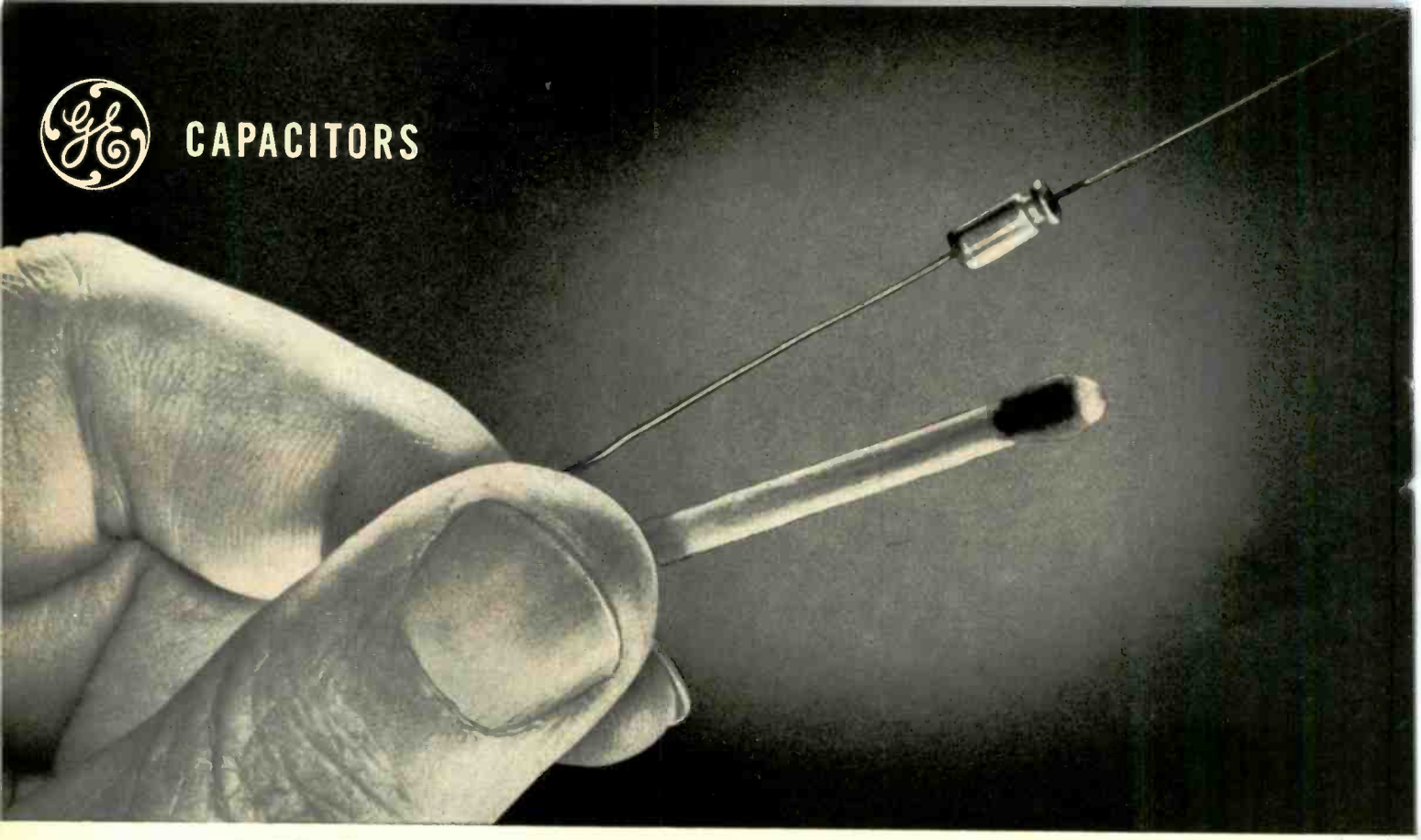
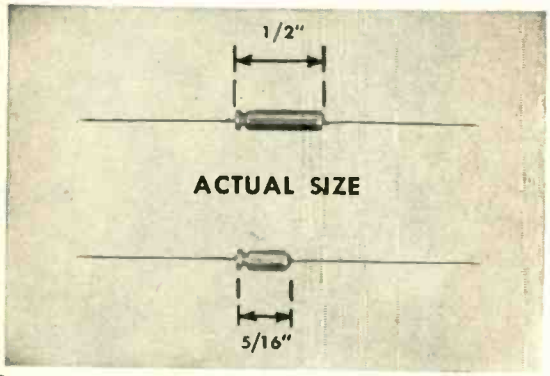


THIS 8-MICROFARAD, 4-VOLT UNIT IS NOW AVAILABLE WITH −0% TO +125% CAPACITANCE TOLERANCE.

Announcing HIGHER RATINGS for Micro-miniature Tantalytic Capacitors



LARGE CAPACITANCE and small size make Micro-miniature Tantalytics valuable where space is at a premium. Diameters are .125 inches.

We can now supply up to 20 volts, or, up to 8 microfarads in the $\frac{5}{16}$" case size, higher capacitance in the ½" case size . . . and with −0% to +125% capacitance tolerance!

Higher ratings are now available in General Electric's new *Micro-miniature* Tantalytic capacitor line. Eight microfarads at four volts can now be obtained in the $\frac{5}{16}$ inch unit, higher capacitance in the ½ inch unit. Designed for low-voltage d-c circuits, they are particularly adaptable to transistorized subminiature assemblies, where space is at a premium, such as hearing aids.

SUPERIOR PERFORMANCE. *Micro-miniature* Tantalytic capacitors outperform aluminum electrolytics in electrical stability, operating and shelf life, because of the inert characteristics of tantalum metal and the stability of its oxide. They gain added reliability from the use of silver cases, a non-acid electrolyte, and complete sealing that prevents leaking and contamination of the interior.

WIDE TEMPERATURE RANGE. *Micro-miniature* Tantalytics can operate over a −20 C to +50 C range—may be stored at −65 C. With some capacitance derating, they can operate well below −20 C. They also perform above +50 C with some life limitations.

AVAILABILITY. Designed especially for non-resonant, non-critical applications such as coupling, by-pass and filtering, *Micro-miniature* Tantalytics can be obtained in sample lots in 2 to 3 weeks, production lots can be shipped in 6 to 8 weeks. For more information, see your G-E Apparatus Sales Representative or write for bulletin GEA-6065 to General Electric Company, Section E442-14, Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Money-Saver Switches *that* Boost Product Efficiency

The right type—at the right price—
FOR INSTRUMENTS, RADIOS, APPLIANCES,
TOYS, SMALL MOTORS and dozens of other uses.

Tops FOR FRACTIONAL H.P. MOTORS
3-ampere types—SP-ST or SP-DT

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a hot new electronic idea with important uses but involved transformer **problems** which threaten to bog down the ultimate mass production . . . but schedules must be met. A smart engineer turns to KEYSTONE'S **reply sheet** . . . quickest way to filling the most exacting transformer requirements of all military and commercial units. KEYSTONE evaluates the conditions and custom engineers the correct type transformer . . . putting it into immediate **production** . . . exclusive KEYSTONE techniques and internal flexibility cut your costs through faster deliveries of precision custom-built units . . . which have proven to be the economic **solution** to leading electronic manufacturers' most difficult applications.

"KEYSTONE is correct for every application."

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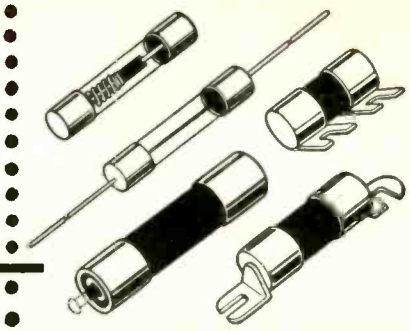
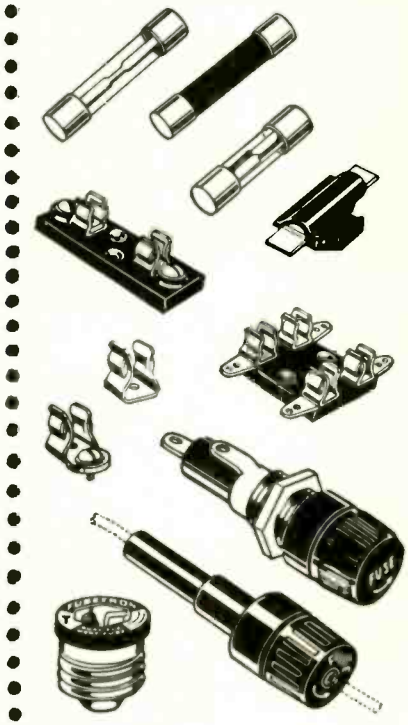
For "Trouble-Free" Electrical Protection—



You can rely on BUSS FUSES!



Accuracy and dependability are built in every BUSS fuse at the factory and will be there no matter when the fuse is called upon to operate.

For every BUSS fuse normally used by the Electronic Industries is tested in a sensitive electronic device that rejects any fuse that is not properly constructed, correctly calibrated and right in all physical dimensions.

Proper construction prevents poor contact heating, correct calibration makes certain that the fuse will carry its rated current.

This insistence on perfection results in quality, 'trouble-free' fuses. That's why manufacturers and service organizations rely on BUSS fuses for dependable electrical protection under all service conditions.

If at any time you have an electrical protection problem, let BUSS save you engineering time. At your service are the facilities of the world's largest fuse research laboratory and its staff of engineers ready to help you select the right fuse or fuse mounting . . . and if possible, one already available from local wholesalers' stocks.

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Please send me bulletin SFB containing facts on BUSS small dimension fuses and fuse holders.

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How to pass a physical exam

CTC's coil forms pass their physical exams in great shape — thanks to precision manufacture.

The basic materials of these forms are certified, then checked again by us, before the forms are made. Each manufacturing detail is quality controlled to the high quality standards that enable us to offer *guaranteed* electronic components, custom or standard.

Forms then get these physical checkups: *mounting studs* checked for internal and external threads, for general size and electroplating; *form* checked for I.D., O.D. and concentricity; *slug* checked for threads, dimensions, electroplating and checked electrically for Q and permeability; *final assembly* checked for tightness, chips and cracks.

Other CTC components benefiting from CTC precision manufacture include terminal boards, terminals, capacitors, swagers, hardware, insulated terminals and coils. For all specifications and prices, write to Cambridge Thermionic Corporation, 437 Concord Avenue, Cambridge 38, Massachusetts. West Coast Manufacturers contact: E. V. Roberts, 5068 West Washington Blvd., Los Angeles 16 and 988 Market St., San Francisco, California.

Coil Form Data: Made of grade L-5 silicone impregnated ceramic. Winding diameters from .205" to ½". Mounted heights from $1^{9}/_{32}$" to $1^{11}/_{16}$". Certain forms, known as Type C, are also available with silicone fibreglas terminal retaining collars permitting 2 to 4 terminals. These are excellent for bifilar windings and advantageous for single pie windings because they permit terminals to be located above or below winding, thus shortening wiring to circuit elements.

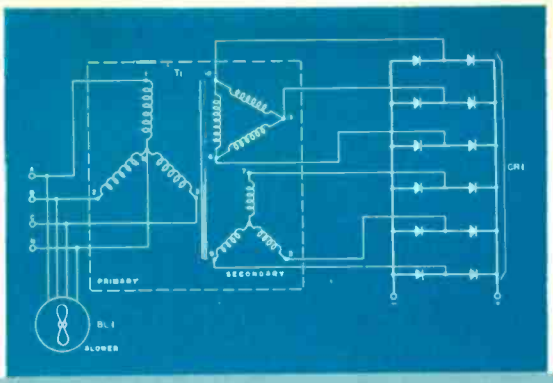
Laboratory Coil Kit. Type X2060 aids in developing prototypes and pilot models. Contains 10 slug tuned coils of L86 size Type C, ranging from 2 Microhenries to 800 Microhenries, each slightly overlapping next coil in scale. Kit contains mounting hardware and lists such information as inductance range, wire size, number of turns, Q value. Coils are color-coded to chart for easy quantity-order.

CTC

CAMBRIDGE THERMIONIC CORPORATION

makers of guaranteed electronic components, custom or standard

What FORM FACTOR do you want for your DC POWER?



Here's evidence of Federal's Design Flexibility:

ONE specification— THREE packages!

HERE is a striking example of how Federal engineers can modify standard units to fit your form factor requirements . . . to provide the *same* output and performance in a *different* package!

No. 1 is Model 3431-BS Airborne Power Supply, delivering 100 amp., 24 to 31 VDC, full load to no load; input, 195 to 210 VAC, 380 to 420 cy, 3-phase; ripple, 2.5% max.

Then, without varying the electrical characteristics, the same unit was redesigned as No. 2—Model 3431-CS—to solve a difficult problem of mounting and control requirements.

Once more, another complete change in physical design—but still the *same* components and characteristics. Now it's No. 3—Model 3446-AS—adapted to fit specific space requirements while meeting Spec. MIL-P-7212 for use by the U. S. Air Force.

Other form factors—for any field—could easily be produced from the original specification!

Designing and building dependable DC power into specified size and space is a Federal specialty for:

• AIRCRAFT • MARINE • RAILROAD
• AUTOMOTIVE • PRODUCTION
• LABORATORY • TEST EQUIPMENT

To meet unusual and exacting electrical characteristics . . . varying physical requirements of shape, size and weight . . . special placement of component parts . . . environmental and other conditions of service.

AIRBORNE POWER SUPPLY

AC Input: 195 to 210 volts; 380 to 420 cycles; 3 phase	① 3431-BS
DC Output: 100 amperes; 24 to 31 volts, full load to no load	② 3431-CS
Ripple: 2.5% maximum	③ 3446-AS

Design Problems Solved Every Day

Federal engineers design completely *new* power supplies. They *modify* standard units. In fact, meeting *any* specification is the foundation of their work . . . to carry out *your* ideas . . . to fulfill *your* requirements.

Special Facilities Help You

Federal engineering and production facilities are thoroughly equipped to undertake a wide variety of power supply projects . . . to conduct tests under special service conditions . . . to provide strict production and quality control. A staff with years of experience in every field of applied science mans these facilities. All this adds up to *one* dependable source for *any number* of dependable DC conversion units designed to do what you need.

Got a Power Problem . . . Need Data?

Federal wants to help you solve your problems, quickly and efficiently. Just call or send the details to our "Application Engineering Department." Federal also offers free helpful literature on Power Supplies, Selenium Rectifiers, Cables for all purposes, and other electronic components. Just write to Dept. E-713.

Federal Telephone and Radio Company

A Division of INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
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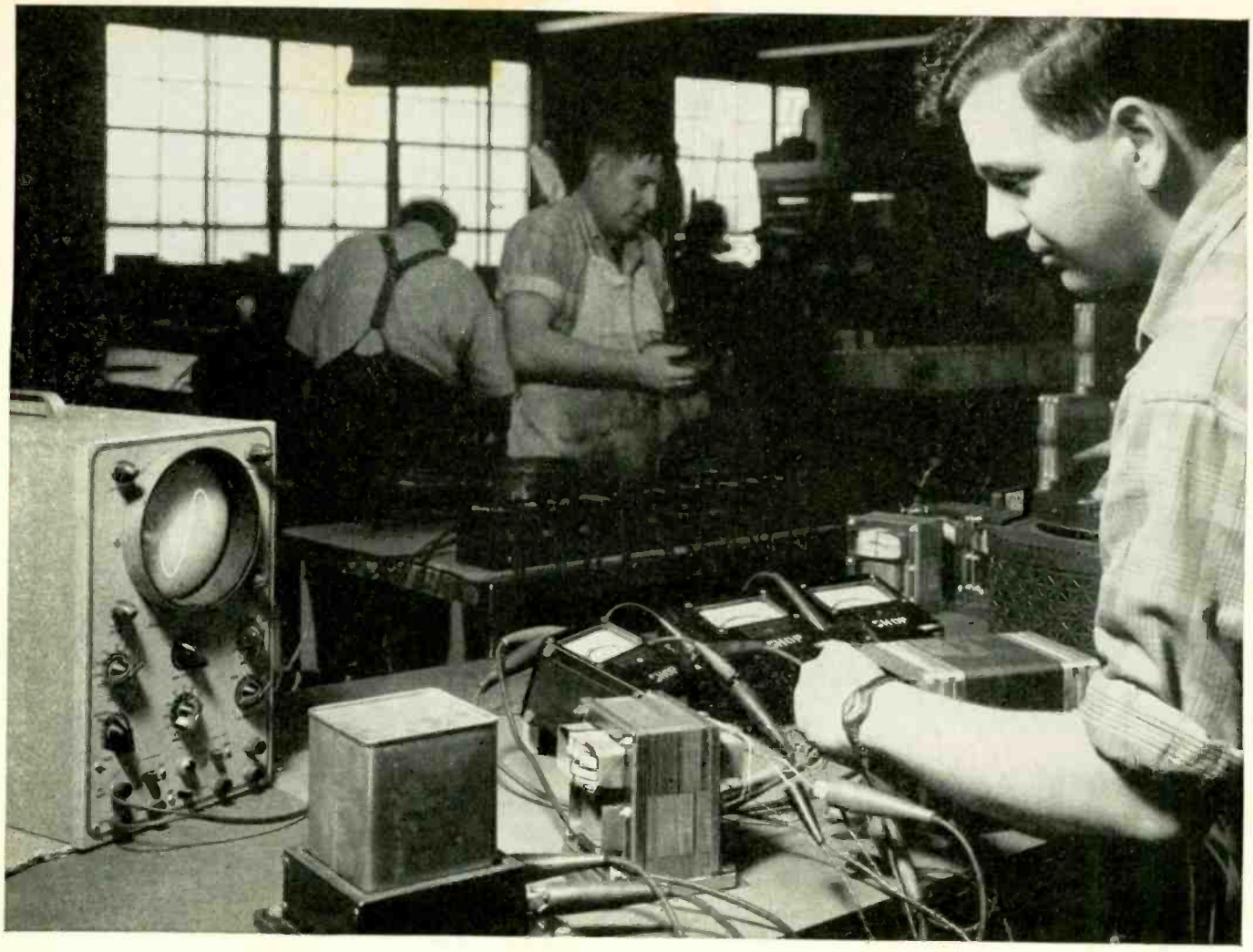
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

Be sure to investigate and specify Federal Quality-Controlled Cables for every electronic application



Individual adjusting of neutralized, magnetic voltage regulators guarantees less than 3% harmonic distortion

You can provide a stabilized source of undistorted voltage with a Sola Harmonic Neutralized Constant Voltage Transformer (Type CVH). Like Sola Standard Type CV stabilizers, each harmonic neutralized unit is individually adjusted during manufacture to regulate within ±1% regardless of voltage fluctuations as great as 30%. In addition Type CVH regulators deliver sinusoidal output with less than 3% distortion. Operation is automatic and instantaneous. There are no moving parts, no manual adjustments, no maintenance.

They are available from stock in the following va output capacities: 60, 120, 250, 500, 1000 and 2000. Input voltage range of 95-125v with regulated output of 115v. Custom units made to specification for production quantity orders.

Sola type CVH regulators may be used for the most exacting applications with equipment having elements which are sensitive to power frequencies harmonically related to the fundamental. They are especially suitable for input to a rectifier when close regulation of the dc output is required. Available from your electronic distributor.

SOLA *Constant Voltage* **TRANSFORMERS**

Write for literature describing these and other Sola Constant Voltage Transformers. Ask for Bulletin 7H-CV-200.

Transformers for: Constant Voltage • Fluorescent Lighting • Cold Cathode Lighting • Mercury Vapor Lighting • Plastic Signs
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DESIGN and PRODUCTION NEWS

FOR ELECTRICAL AND ELECTRONIC ENGINEERS

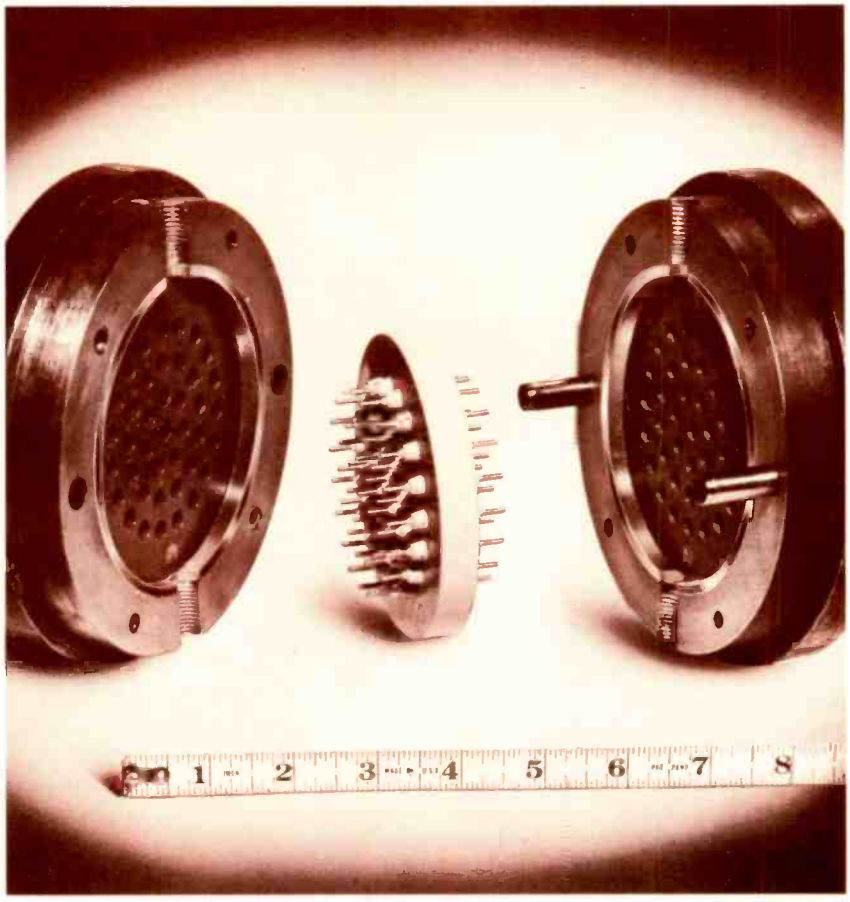
Published by TECHNICAL SERVICE, Chemical Manufacturing Division, The M. W. KELLOGG Company AUG.-SEPT. 1954

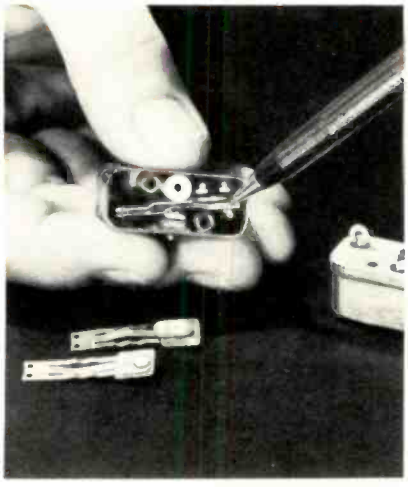
Casting Molds of KEL-F® Polymer Replace Plated Metal Molds... Cut Costs, Finishing and Rejects!

Complex electrical terminal boards, made of an especially abrasive epoxy compound, are now cast in molds of KEL-F polymer, replacing former metal molds. Advantages include lower original mold costs, lower maintenance costs, fewer rejects and higher product precision without extensive machining.

Excellent wear characteristics of the new molds result in longer mold life despite high silica content of the casting resin. The non-hesive properties of KEL-F polymer prevent pitting by the resin, result in damage-free release of the product without special coatings. Penn-Plastics Manufacturing Company, Glenside, Pa., produce these intricate new molds by transfer methods. Molded of KEL-F polymer Grade 300, they are designed to hold 40 terminal pins and to impress forty 1/16" numerals in both faces of the finished part. Terminal boards are manufactured by Penn-Plastics in conjunction with Woodmont Products, Inc., electronic parts manufacturers of Huntingdon Valley, Pa.

For further information ask for Application Report P-101





Wafer-thin Insulator Mount of KEL-F® Polymer Increases Life of Miniature Switch to 5-Million Cycles!

A wafer of KEL-F polymer provides a tough, insulated mount for a contact bar, guards the performance of this sealed precision switch under severe thermal cycling. Currents up to 10 amps are handled for a life of from 1 to 5 million cycles.

This fluorocarbon plastic is molded directly to the beryllium-copper switch blade. It insulates the switch blade against arc-heat damage and its dimensional stability guarantees positive contact position for service between minus 90°F and plus 200°F... without shorting. Haydon Switch, Inc., Waterbury, Conn., utilizes insulation molded of KEL-F polymer Grade 300 in single- and two-circuit snap switches for automatic equipment used in aircraft, marine and industrial applications.

For further information ask for Application Report E-125

(SEE REVERSE SIDE)

® *Registered trade-mark for The M. W. Kellogg Company's fluorocarbon Polymers.*

CONTINUED FROM PRECEDING PAGE

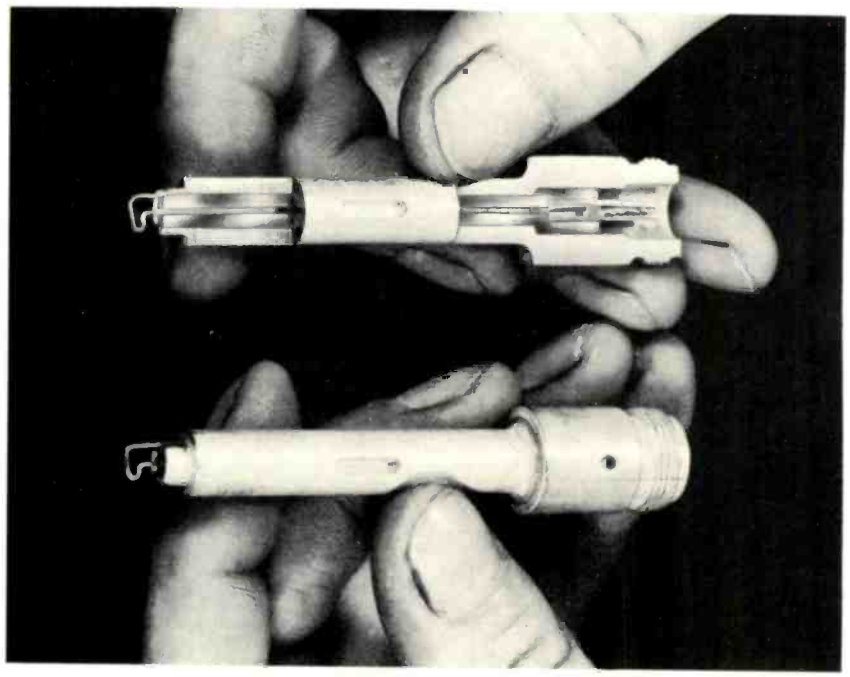
Only One RF Signal Probe, Insulated with KEL-F® Plastic, Now Needed for Entire 500 to 5,000 Mc Range

Specification of KEL-F polymer plastic as the insulation for this wavemeter probe resulted not only in a widened instrument range and accuracy, but increased efficiency and life as well.

This readily-molded fluorocarbon plastic permits complete, "tight" insulation of the vital filaments in a single operation. Excellent electrical properties of KEL-F polymer under high humidity and thermal cycling eliminate leakage and shorts. High strength and dimensional stability prevent insulation failure from cracking or shrinkage in service.

Thompson Products, Inc., Cleveland, Ohio, insulates the probe by injection molding, using KEL-F polymer Grade 300. It is used in the company's Model WIN6AA Wavemeter.

For further information ask for Application Report E-126



Molders & Fabricators of the Month

Leading molders, extruders and fabricators specialize in the production of materials and parts made of "Kel-F" . . . each month this column will spotlight several of these companies with their principal services and products.

Consolidated Molded Products Corp.
Scranton, Pa.
Compression & transfer molding
Injection molding

Cortland Industries, Inc.
Chicago, Ill.
Sealing of film
Production machining

General Plastics Corporation
Paterson, N. J.
Dispersion Coating

United States Gasket Company
Camden, N. J.
Extrusion
Forming & machining
Injection, compression & transfer molding
Rod, tube and sheet; tube sockets
Gaskets, gauge glasses & tower packing

The William Brand and Company, Inc.
Willimantic, Conn.
Insulated wire

Recent Significant KEL-F Polymer Developments . . .

Pyrex-to-steel seal is effected in a new centrifugal pump with a resilient O ring of KEL-F plastic. Damage to the glass observation plate, leaks at high pressures have been eliminated.

Electronic tubes used at high altitudes are now hermetically sealed in new sockets made of fluorocarbon plastic. Consistent hermetic seal over a wide temperature range, low "arc-over" and shock damage are major features.

Conductivity cell-valve units for testing potable water use KEL-F polymer as a structural and electrical insulating member. Immersed continuously in water at temperatures up to 250°F, machined insulator maintains critical electrode gap.

Pump vanes of molded glass-filled polymer have been found to have the necessary strength as well as complete chemical inertness to stand up under hot, extremely corrosive chemicals in a new transfer pump.

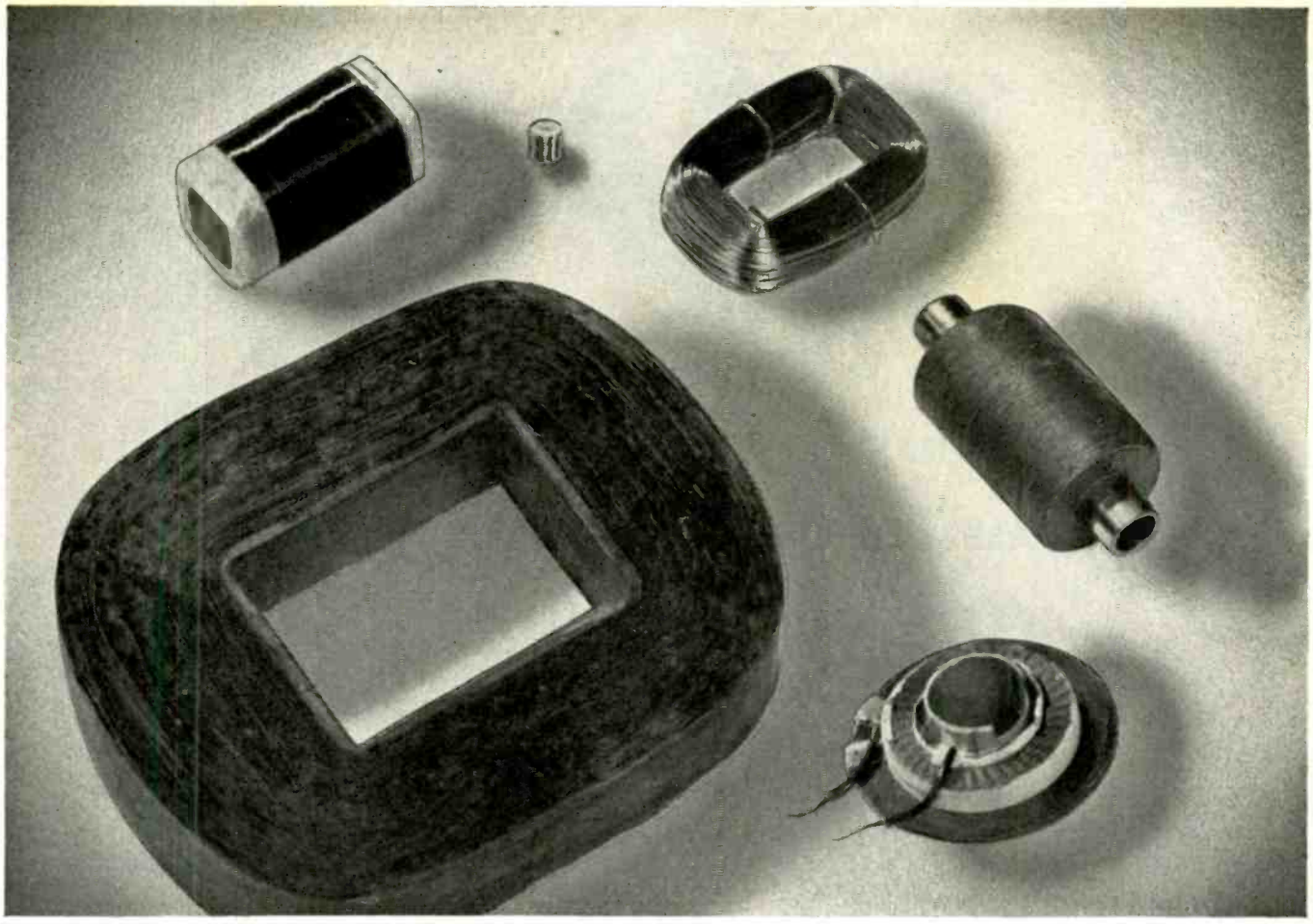
OFF THE PRESS . . .
Revised "BUYERS GUIDE" listing KEL-F polymer products, molders and fabricators.

For complete information regarding any item mentioned in DESIGN AND PRODUCTION NEWS, ask for detailed APPLICATION REPORTS, write

Technical Service
CHEMICAL MANUFACTURING DIVISION
THE M. W. KELLOGG COMPANY
P. O. Box 469, Jersey City 3, N. J.
or offices in Boston, Chicago, Dayton, Los Angeles and New York

KELLOGG — SUBSIDIARY OF PULLMAN INCORPORATED

® *Registered trade-mark for The M. W. Kellogg Company's fluorocarbon Polymers.*



Want more per hour . . .
or more accuracy . . . or less cost?

However you want your coil winding *improved* . . . there's likely to be a Universal Coil Winder that will do the job.

Higher-production machines. More versatile machines. Machines that will give you greater accuracy.

See for yourself by visiting the Universal Demonstration Room nearest you — in Cranston, R. I. or Chicago, Ill. Watch how coils are turned out at top speed, see how convenient the machines are for operators, observe how accurately the coils are wound.

Write us to set up a date for a visit. Address UNIVERSAL WINDING COMPANY, P. O. Box 1605, Providence 1, R. I., or 9 South Clinton St., Chicago, Ill.

And use the coupon to obtain information on latest developments in coil winding.

FOR WINDING COILS
IN QUANTITY . . . ACCURATELY
. . . AUTOMATICALLY . . . USE
UNIVERSAL WINDING MACHINES

UNIVERSAL WINDING COMPANY

P. O. BOX 1605, PROVIDENCE 1, RHODE ISLAND

Please send me

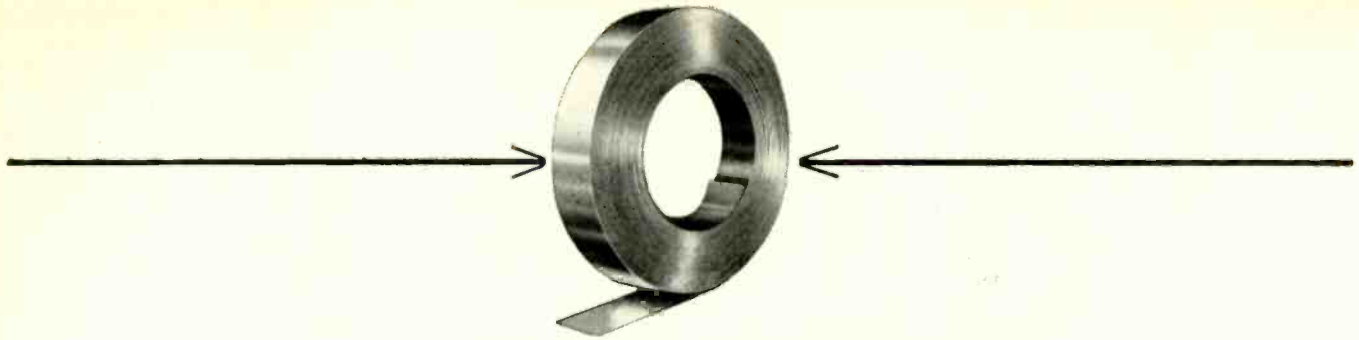
☐ Condensed Catalog of Universal Winders

☐ Information on Universal Winders for coil types that meet my particular needs. I enclose specifications and production requirements.

Name.....Title.....

Company.....

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



Conversion from Copper to ALCUPLATE® can Reduce Your Cost up to 30%

What is ALCUPLATE?

ALCUPLATE is a solid layer of copper permanently clad on one side or both sides of less expensive aluminum.

This gives you solid copper performance at a lower cost over solid copper.

In addition to its lower cost, ALCUPLATE has virtually the same physical and electrical properties as pure copper. This permits fabrication of many parts and products from ALCUPLATE at savings of from 15%–30% over solid copper.

Can ALCUPLATE be worked?

ALCUPLATE can be fabricated by stamping, drawing, spinning and forming. The copper provides an ideal surface for soft-soldering operations and electroplated or other finishes.

In what sizes is ALCUPLATE stock available?

In coils or flat stock up to 1/16" thick x 13" wide and in a choice of thickness ratios and tempers.

ALCUPLATE FEATURES:

- Natural copper appearance
- High electrical conductivity
- Excellent heat dissipation
- Soft-soldering surfaces
- Easy fabrication
- Light weight

ALCUPLATE®

For further information, write or wire

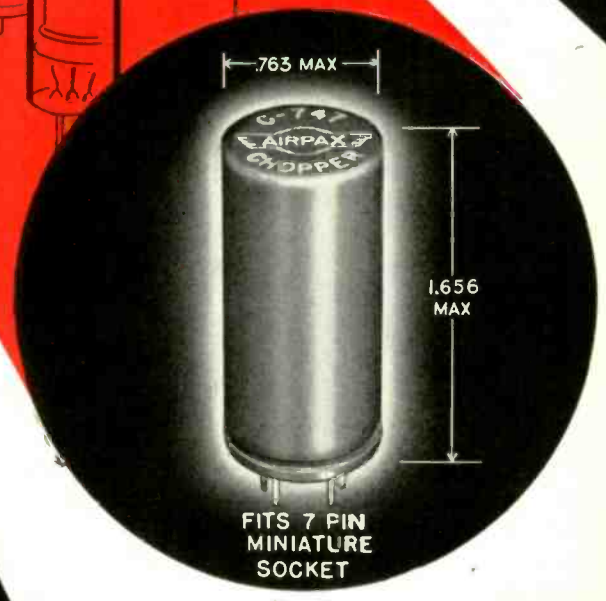
METALS & CONTROLS CORPORATION
GENERAL PLATE DIVISION
38 FOREST STREET, ATTLEBORO, MASS.

AIRPAX
C747 MIDGET
400 CYCLE CHOPPER

PROVEN PERFORMANCE in large volume production is your best guarantee of quality!

✓ note these facts...

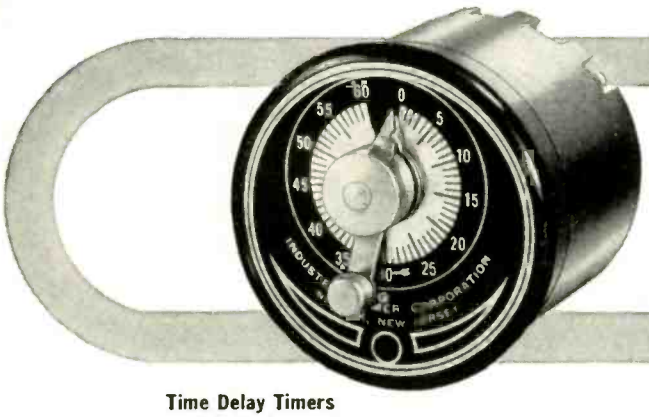
- AIRPAX has built nearly ¼ million choppers
- AIRPAX maintains an engineering staff constantly striving to improve choppers
- AIRPAX has ample capacity for large volume production of choppers
- And AIRPAX choppers have proven performance life and reliability



Weighs less than 1 oz.

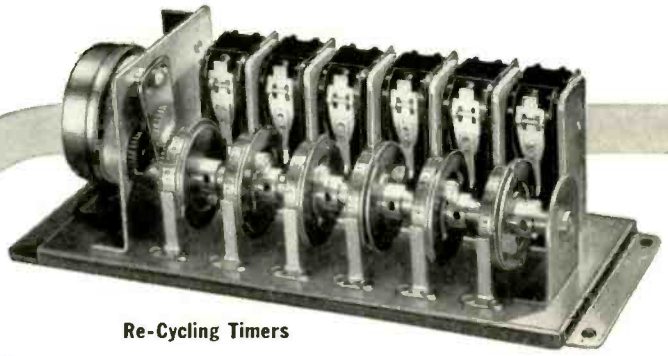
AIRPAX PRODUCTS COMPANY
DESIGNERS ENGINEERS

MIDDLE RIVER BALTIMORE 20, MD.

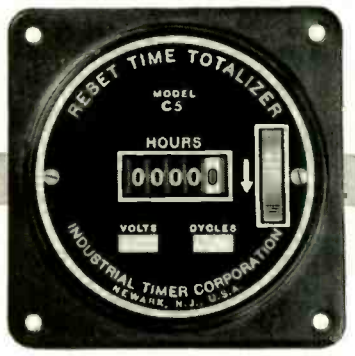


Time Delay Timers

Interval Timers



Re-Cycling Timers



Running Time Meters

MOST COMPLETE LINE OF INDUSTRIAL

TIMERS for automation

The individual requirements of each automation problem are best met by selecting timers designed to perform specific functions. Whatever your timing-control problem, Industrial Timer Corporation can meet it with one of its standard timers, a combination of its standard units, or by designing an entirely new timing element. Our Engineering Department not only originates new designs, but also develops modifications to meet our customers requirements.

We manufacture a complete line of timers in these 4 broad classifications:

TIME DELAY TIMERS • RE-CYCLING TIMERS
INTERVAL TIMERS • RUNNING TIME METERS

Our large stocks of 17 basic types from which we have developed over 660 combinations to date, enables us to make rapid deliveries in most cases . . . and excellent deliveries on special orders. Our automation timer specialists will be happy to discuss your automation timer requirements. Your inquiries will receive prompt attention.

Timers that Control the Pulse Beat of Industry

INDUSTRIAL TIMER CORPORATION

INDUSTRIAL TIMER CORPORATION
131 OGDEN STREET, NEWARK 4, N. J.

an Ampex tape recorder for as little as $498

($545 with portable case as shown)

the new AMPEX 600

At a price that's a real surprise, here is the kind of performance that has made AMPEX the supreme name in tape recorders. The new Ampex 600 has been simplified to reduce its size and price. But it retains full Ampex precision and performance.

As a portable recorder, the Ampex 600 is in a class by itself. It weighs only 28 pounds. You can carry it anywhere. The recordings you make "on location" will match those made on the finest studio equipment.

As a studio recorder, the Ampex 600 out-performs many others twice its size. It serves ably in all these needs: studio recording—line recording—dubbing and editing—broadcast playback.

To assure long service, major components of the Ampex 600 have been subjected to tests equaling more than 10 years normal use. An Ampex pays for itself.

Performance

- 40 to 15,000 cycles at 7½ in/sec.
- Signal-to-noise ratio over 55 db.
- Flutter and wow less than 0.25%
- 3 heads for monitoring tape while recording

For further specifications, write today for descriptive bulletin to Dept. E-1701

AMPEX CORPORATION

934 Charter Street • Redwood City, California

Distributors in principal cities; Canadian distribution by Canadian General Electric Company

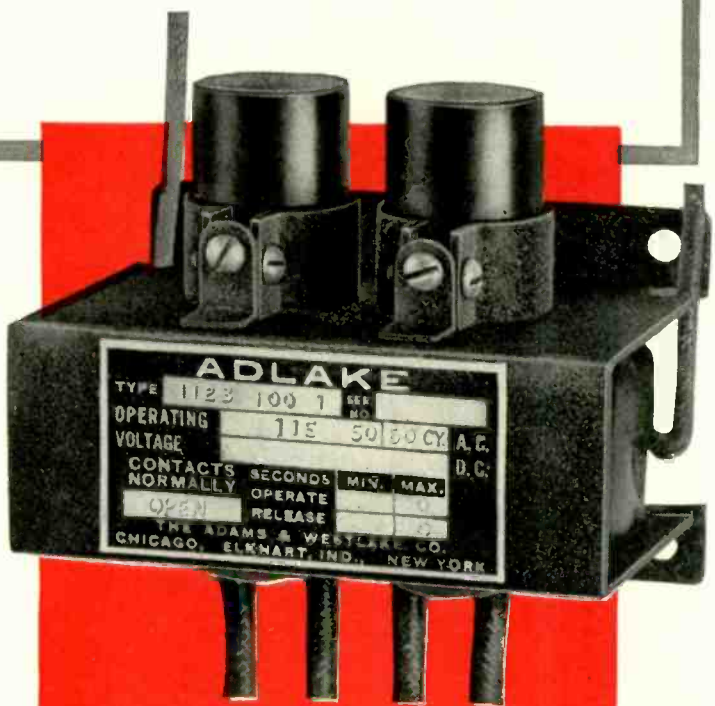
Think

of all the ways ADLAKE Mercury Relays can save money in your business!

In any installation that requires both sensitivity and lasting dependability . . . from traffic control systems to chick incubators to long range navigation . . . ADLAKE Mercury Relays can do the jobs that conventional relays do in an uncertain manner at best!

For instance, ADLAKE Relays have proved their ability to stand up under the most adverse conditions of temperature and moisture. Their time-delay characteristics are fixed and non-adjustable . . . normal line voltages and ambient temperatures from –38.8° to 200° have little effect on these characteristics. They require no maintenance whatever . . . are silent and chatterless . . . and their mercury-to-mercury contact prevents burning, pitting, and sticking.

If you don't find the relay you need in the ADLAKE catalog, it will be custom-built for you. Write for full information today: The Adams & Westlake Company, 1171 N. Michigan, Elkhart, Indiana. In Canada, address Powerlite Devices, Ltd., Toronto.



Type 1123 ADLAKE double pole load relay
Contacts Normally Open

EVERY ADLAKE RELAY IS TESTED
—AND *GUARANTEED*—
TO MEET SPECIFICATIONS!

Adlake 97th year of serving the transportation and building industries

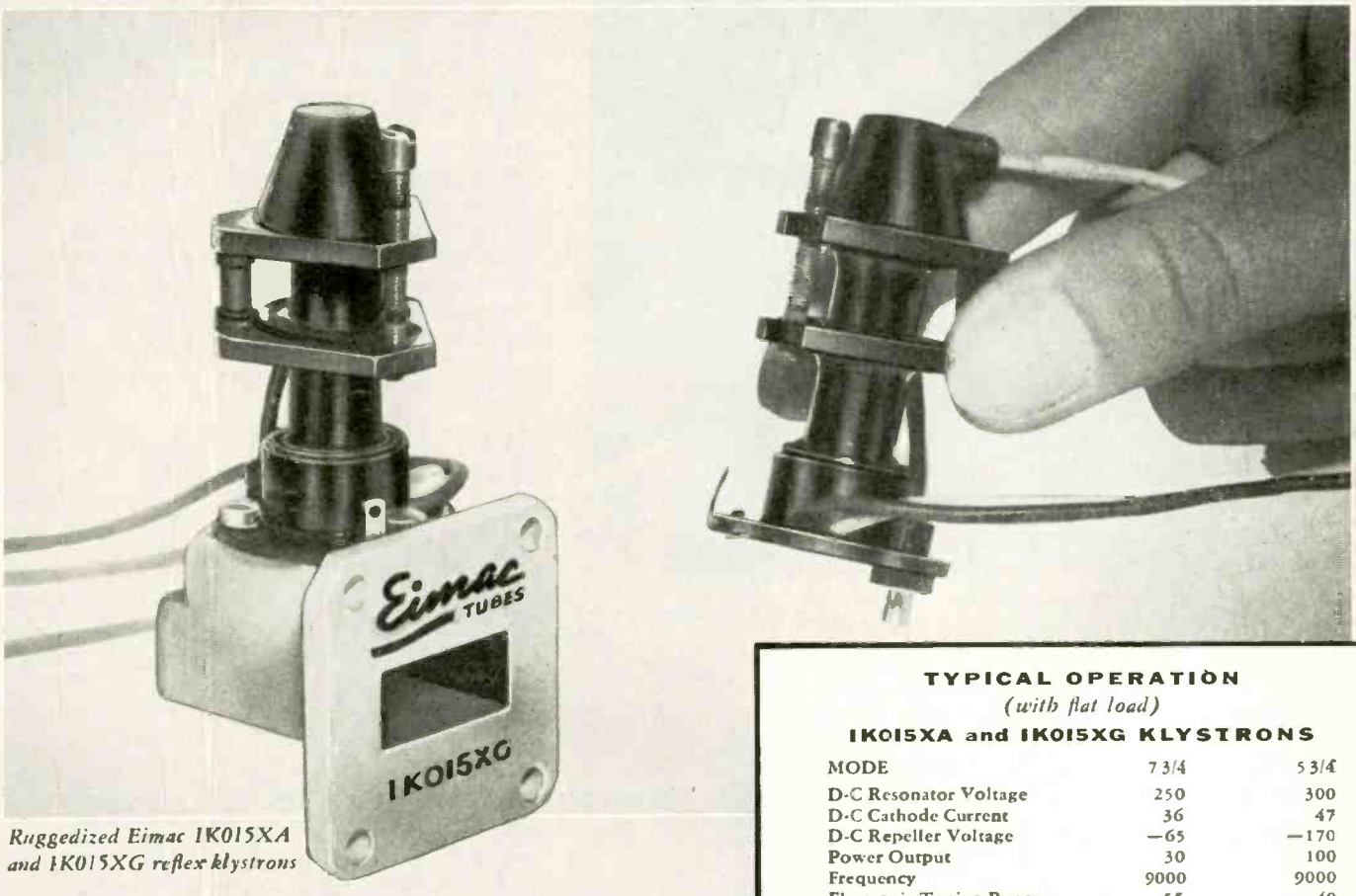
THE Adams & Westlake COMPANY

Established 1857 • ELKHART, INDIANA • New York • Chicago
Manufacturers of ADLAKE Hermetically Sealed Mercury Relays

imac Klystron Report

Ruggedized X Band local oscillator reflex klystrons

1K015XA · coaxial output
1K015XG · waveguide output



Ruggedized Eimac 1K015XA and 1K015XG reflex klystrons

TYPICAL OPERATION
(with flat load)
1K015XA and 1K015XG KLYSTRONS

MODE	7 3/4	5 3/4
D-C Resonator Voltage	250	300
D-C Cathode Current	36	47
D-C Repeller Voltage	−65	−170
Power Output	30	100
Frequency	9000	9000
Electronic Tuning Range	55	40

Reliable X band performance through the **VAST*** punishment of airborne environment plus the features of single adjustment tuning and rapid production are offered only in Eimac 1K015XA and 1K015XG local oscillator reflex klystrons.

*__VIBRATION__—withstands 10G's of continuous vibration.

*__ALTITUDE__—arc-guard protection of leads eliminates possibility of flash-over at extremely high altitudes.

*__SHOCK__—withstands 100G's of impact shock.

*__TEMPERATURE__—maintains frequency stability through a temperature variation of −20° to 80°C.

RAPID PRODUCTION—simplified design permits rapid, low cost production.

RELIABLE PERFORMANCE—25 to 100 milliwatts power output from 8400 to 9600mc with low power consumption—plus assurance of uncompromising Eimac quality proved through 20 years of electron-power tube design and manufacture.

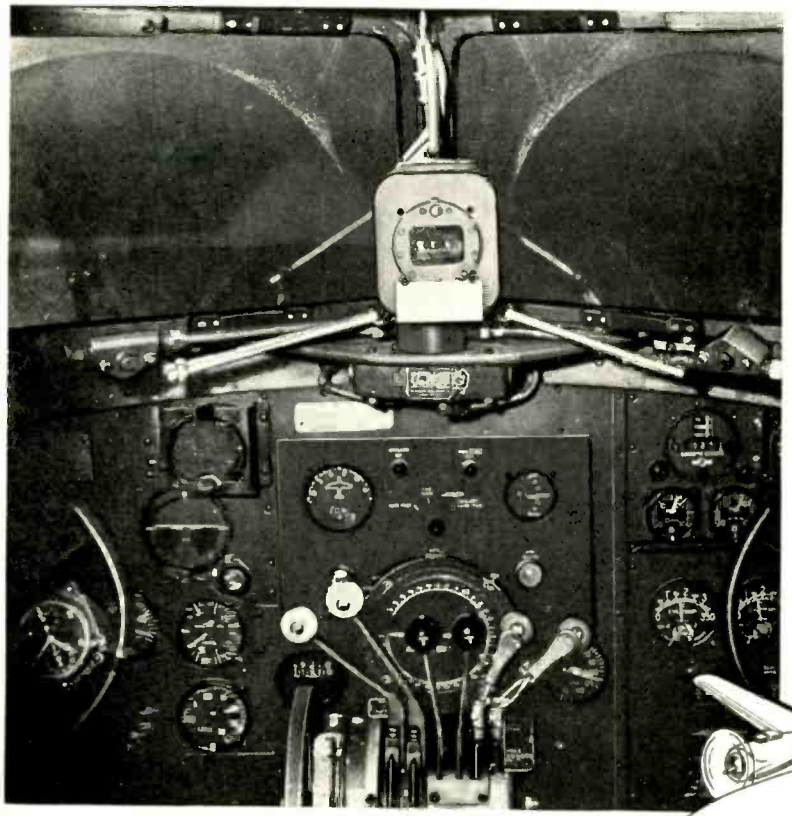
SINGLE TUNING—one-adjustment tuning without the use of lock nuts.

●*For further information about the 1K015XA, 1K015XG or any of the complete line of Eimac klystrons, including high power UHF-TV amplifiers, contact our Technical Services department.*

EITEL-McCULLOUGH, INC.
SAN BRUNO • CALIFORNIA

Eimac
THE WORLD'S LARGEST MANUFACTURER OF TRANSMITTING TUBES

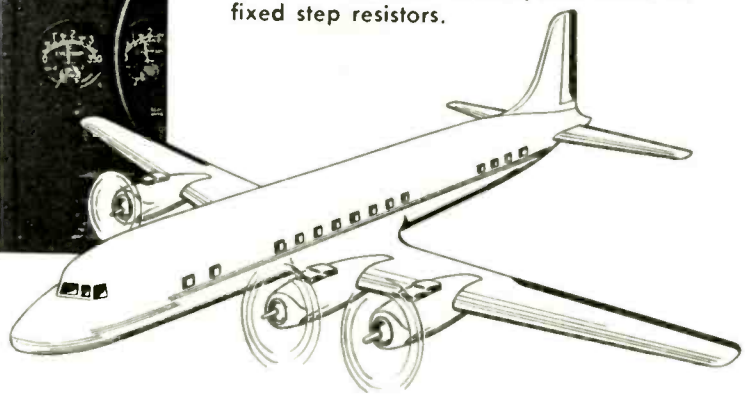
ECLIPSE-PIONEER AUTOMATIC PILOT *equipped with A-B resistors*
. . . brings plane down safely and automatically on glide path



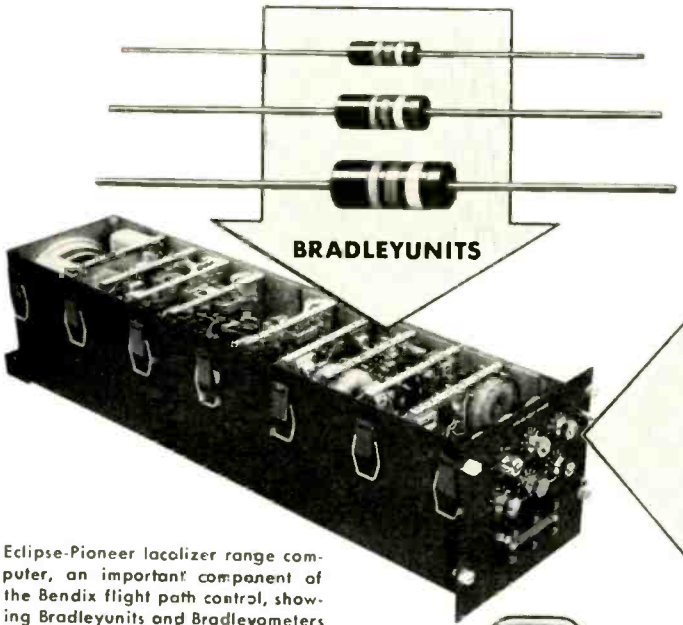
The plane in this picture is automatically controlled to the glide path by computer signals fed to the Automatic Pilot. As may be seen by the sweep of the windshield wipers, rain is coming down heavily, obscuring the runway which is dimly visible through the left windshield.

Despite these adverse landing conditions, the human pilot . . . with the plane only a few hundred feet above the runway . . . displayed his complete confidence in the Automatic Pilot by stepping aside during its descent to permit the photographer to snap this remarkable action shot.

Such precision and accuracy call for QUALITY electronic components, like the Bradleyometers used for adjustable resistance controls and Bradleyunits used for fixed step resistors.



Each computer, located in the rear of the pilot-copilot area, and not visible in the above photograph, has six Bradleyometers and 130 Bradleyunits. For critical applications, where accuracy and permanence of resistor values and ratings are of vital importance, Allen-Bradley fixed and adjustable resistors are the logical choice of experienced radio and electronic engineers.



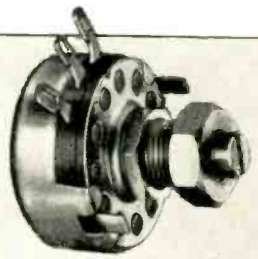
Eclipse-Pioneer localizer range computer, an important component of the Bendix flight path control, showing Bradleyunits and Bradleyometers on cards and in end of coupler case.

BRADLEYUNIT FIXED RESISTORS ½, 1, 2 WATT

Their world-wide reputation for high quality is due to the fact that Bradleyunits are rated at 70C ambient . . . not 40C. When used according to published ratings, Bradleyunits will not open circuit nor exhibit large erratic changes of resistance. Standard RETMA values in ½, 1, and 2 watt ratings.

TYPE J BRADLEYOMETER

The stability of Bradleyometer resistance is due to the solid, circular resistor that is molded to produce any resistance - rotation curve. Not affected by temperature or humidity. Made in ⅓ and 2 watt sizes.



Allen-Bradley Co.
110 W. Greenfield Ave., Milwaukee 4, Wis.

In Canada — Allen-Bradley Canada Limited, Galt, Ont.

ALLEN-BRADLEY

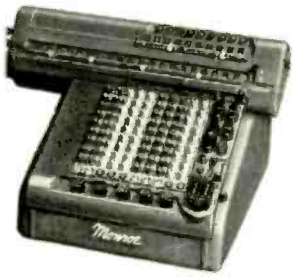
FIXED & ADJUSTABLE RADIO RESISTORS

QUALITY

Sold exclusively to manufacturers of radio and electronic equipment

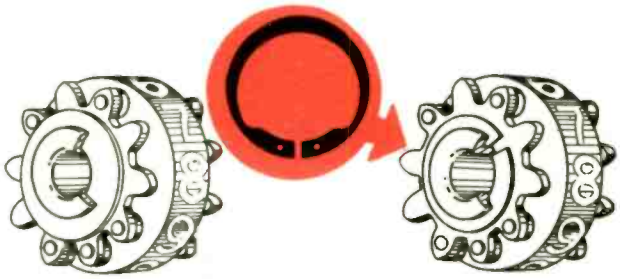
Waldes Truarc rings replace old-fashioned fasteners . . . save assembly time...end scrap loss...increase operating efficiency

This is the Monroe Calculator



...precision-engineered business machine made even more efficient, and less costly to manufacture through the use of Waldes Truarc Retaining Rings.

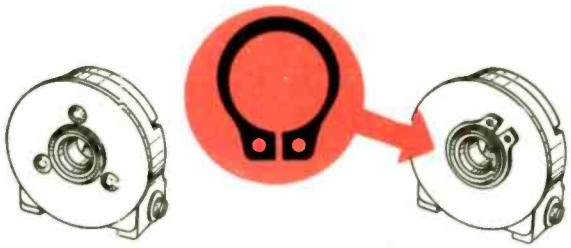
Multiplier Dial Assembly



Old Way. One-piece assembly was spun together. Spinning operation was costly, resulted in high scrap loss.

Truarc Way. Two-piece assembly is held together by one Truarc Ring (series 5108). Rejects: practically zero.

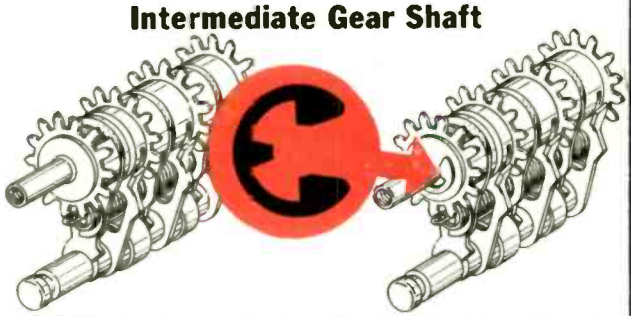
Electric Motor Governor



Old Way. Collector Disc assembly was formerly riveted, requiring skilled labor. Riveted Collector Disc could not be removed in the field.

Truarc Way. Truarc Ring (series 5100) replaces rivets, saves labor, material...improves Collector action. Collector Disc is easily replaced.

Intermediate Gear Shaft



Old Way. Washer rivated on end of assembly for zoning control. Costly, troublesome, hard to obtain critical zoning required.

Truarc Way. Truarc E-Ring (series 5133) cuts assembly time, virtually eliminates rejects and final assembly and zoning problems.

Monroe Calculating Machine Company, Orange, N. J. uses various types and sizes of Waldes Truarc Retaining Rings. Use of Truarc has helped eliminate scrap losses, saved on material and labor, and resulted in increased operating and servicing efficiency of the product. Monroe plans to use Truarc Rings for every possible fastening operation on their entire line!

You, too, can save money with Truarc Rings. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better, more economical job. Waldes Truarc Rings are precision-engineered...quick and easy to assemble and disassemble.

Find out what Waldes Truarc Retaining Rings can do for you. Send your blueprints to Waldes Truarc Engineers for individual attention, without obligation.

SEND FOR NEW CATALOG

WALDES

TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,362,947; 2,362,948; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,848; 2,485,165; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING

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

E086

Waldes Kohinoor, Inc., 47-16 Austel Pl., L. I. C. 1, N.Y.

Please send me the new Waldes Truarc Retaining Ring catalog.

(Please print)

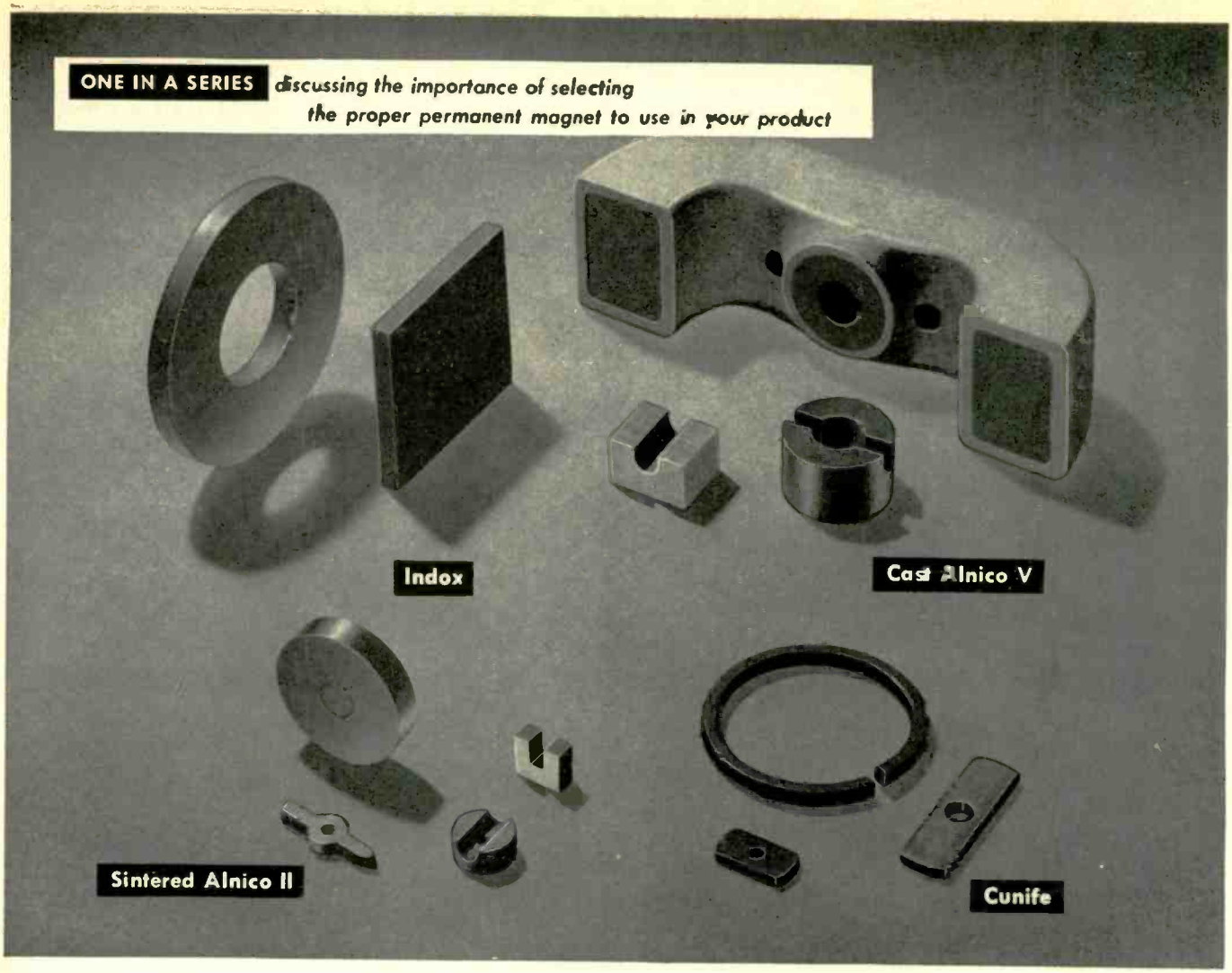
Name .....

Title .....

Company .....

Business Address .....

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



How the Right* Permanent Magnet Material Can Benefit Your Product

Of the many permanent magnet materials available—a few of which are shown above—only *one* will permit your product to *function best at the lowest possible cost.*

Which one is it? To help you answer that question properly is part of our job. As specialists in permanent magnets, we have helped to provide manufacturers with the answers for over 35,000 applications. The case of the telephone equipment manufacturer is typical. Perhaps we can assist you, too.

There is no charge . . . or obligation . . . for this service. Just write us, today, giving the details of your particular design problem. Or, ask for our Engineering Design Manual No. 4-A8. We'll be glad to provide both.

A Typical Case

. . . is that of a prominent telephone equipment manufacturer who changed from a chrome steel magnet to the use of Alnico III in his polarized relay. The results:

- **70% Savings in initial cost**
- **Simplified design**
- **Reduced weight**
- **Flux increase of 27% —improved performance**
- **Saving in space**
- **Less maintenance**

** The one which will permit your product to function best at the lowest possible cost.*

THE INDIANA STEEL PRODUCTS COMPANY • Valparaiso, Indiana

World's Largest Manufacturer of Permanent Magnets

INDIANA PERMANENT MAGNETS

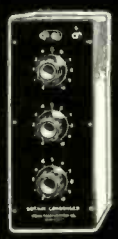
FREED Instruments & Transformers

Famous For

QUALITY • DEPENDABILITY • ACCURACY

No. 1030
Low Frequency
"Q" Indicator

No. 1020B
Megohmmeter



Decade
Inductors

No. 1040
Vacuum Tube Voltmeter

FREED
MILITARY PULSE TRANSFORMERS
IN STOCK FOR IMMEDIATE DELIVERY

HERMETICALLY SEALED PULSE TRANSFORMERS for use in blocking oscillators, low level interstage coupling, and modulator outputs. Made in accordance with MIL-T-27 specifications. These pulse transformers are designed for maximum power, efficiency and optimum pulse performance. Balanced coil structures permit series or parallel connection of windings for turn ratios other than unity. Pulse characteristics, voltages and impedance levels will depend upon interconnections made.

DM–12

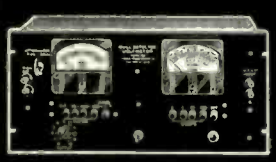
DM–18

DM–8

DM–01

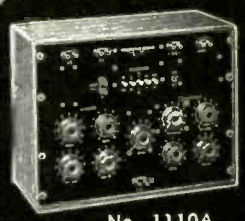
CATALOG NUMBER	APPLICATION	PULSE VOLTAGE KILOVOLTS	PULSE DURATION MICRO-SECONDS	DUTY RATIO	TEST VOLTAGE KV., RMS	CHARACTERISTIC IMPEDANCE OHMS	CASE SIZE
MPT-1	Blocking oscillator or interstage coupling	0.25/0.25/0.25	0.2-1.0	.004	0.7	250	DM-12
MPT-2	Blocking oscillator or interstage coupling	0.25/0.25	0.2-1.0	.004	0.7	250	DM-12
MPT-3	Blocking oscillator or interstage coupling	0.5/0.5/0.5	0.2-1.5	.002	1.0	250	DM-18
MPT-4	Blocking oscillator or interstage coupling	0.5/0.5	0.2-1.5	.002	1.0	250	DM-18
MPT-5	Blocking oscillator or interstage coupling	0.5/0.5/0.5	0.5-2.0	.002	1.0	500	DM-12
MPT-6	Blocking oscillator or interstage coupling	0.5/0.5/0.5	0.5-2.0	.002	1.0	500	DM-12
MPT-7	Blocking oscillator, interstage coupling or low power output	0.7/0.7/0.7	0.5-1.5	.002	1.5	200	DM-18
MPT-8	Blocking oscillator, interstage coupling or low power output	0.7/0.7	0.5-1.5	.002	1.5	200	DM-18
MPT-9	Blocking oscillator, interstage coupling or low power output	1.0/1.0/1.0	0.7-3.5	.002	2.0	200	DM-18
MPT-10	Blocking oscillator, interstage coupling or low power output	1.0/1.0	0.7-3.5	.002	2.0	200	DM-18
MPT-11	Blocking oscillator, interstage coupling or low power output	1.0/1.0/1.0	1.0-5.0	.002	2.0	500	DM-01
MPT-12	Blocking oscillator, interstage coupling or low power output	0.15/0.15 0.3/0.3	0.2-1.0	.004	0.7	700	DM-8

SEND FOR COMPLETE CATALOG OF
FREED INSTRUMENTS AND TRANSFORMERS



No. 1210
Null Detector &
Vacuum Tube Voltmeter

No. 1010
Comparison Bridge



No. 1110A
Incremental Inductance
Bridge

FREED TRANSFORMER CO., INC.

WEIRFIELD ST. (RIDGEWOOD) BROOKLYN 27, N.Y.

BORG ... NEW STANDARD for precision multi-turn potentiometers

BORG MICROPOTS

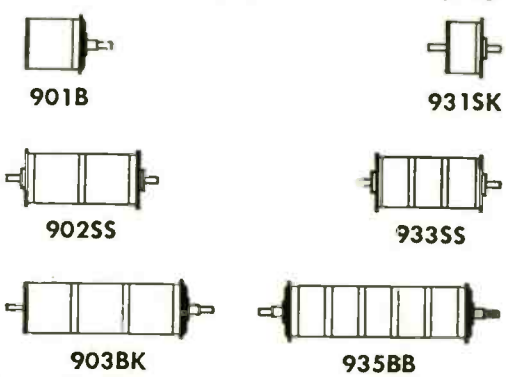
MODELS 901-903 TEN-TURN POTENTIOMETERS

Designed for the utmost versatility and adaptability, Borg Micropots eliminate the need for special design. New Standard Borg Micropots are available in single or double shaft models with exceptionally rigid servo-mount or bushing-mount at either or both ends.

- One-piece centerless-ground stainless steel shaft
- One-piece lead-screw and servo-mount permits rigid mounting and maintains true shaft alignment
- Servo or bushing mountings of exceptionally rigid design available at either or both ends of any 900 series Micropot
- Drive assembly gives higher accuracy in the four basic types of linearity without additional modification
- Contact carrier assembly design permits no backlash between shaft rotation and electrical rotation
- Coupling band provides accurate alignment between mounting surface and housing
- 49" Kohlrausch wound resistance helix permits finer resolution
- Dual Spring contacts assure accurate transmission of voltages from carrier assembly to terminal

MODELS 931-935 THREE-TURN POTENTIOMETERS

All potentiometers are available with double end support to assure efficient operation where subjected to excessive vibration. Precision ball bearings and precision rolled lead-screw provide higher accuracies and longer life. Ganged units are accurately phased before coupling.



MICRODIAL BORG INSTRUMENT DIALS
MICROPOT BORG PRECISION POTENTIOMETERS

BORG EQUIPMENT DIVISION
THE GEORGE W. BORG CORPORATION
JANESVILLE, WISCONSIN

See us at Philadelphia—Booths 260 and 262, Instrument Congress and Exposition

Why You in Particular Should Know about

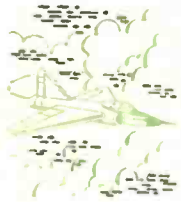
Greenleaf...

where quality control works on the production line!

As a reader of Electronics, you're interested in flight-inspired *precision* manufacture. You want to know companies with the skill and ingenuity required in the exacting engineering and production of aircraft and armamert instrumentation.

Along this line, Greenleaf has something special to offer you. In our factory, the most modern production techniques are combined with the ideal of individual craftsmanship. Every man is master of his job. Every job is quality-checked continuously —*right on the production line.* Our production people actually use laboratory testing instruments in their daily work.

As a result of this approach to manufacturing, Greenleaf has established a successful record as prime and subcontractor for the U. S. Air Force . . . for such companies as McDonnell Aircraft, Eastman Kodak, Boeing, Avco, Emerson Electric. Among the products manufactured are Gyros (Rate and Integrating), Pressure Transmitters, Accelerometers, Synchros, Air Speed Indicators, Actuators, and many others.



Consider Greenleaf in your future production plans. Write today for detailed information. Our facilities and working record have produced for many others. We're sure we can produce for you, too.

See our exhibit at the National Aircraft Show, Dayton, Ohio, September 4, 5, 6, 1954.

Engineering • Development • Production

Greenleaf MANUFACTURING COMPANY

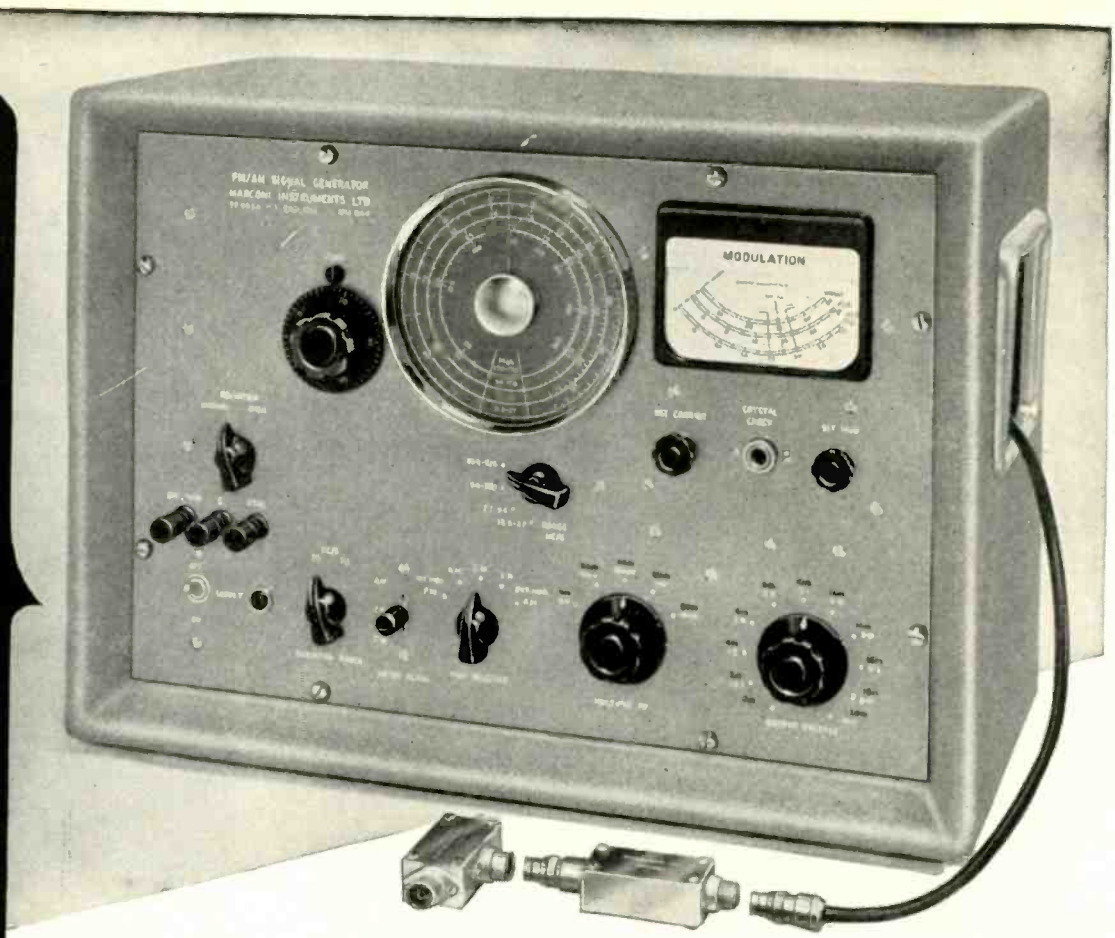
7814 Maplewood Industrial Court — St. Louis 17, Missouri

CONTINUOUS WAVE

F.M.

A.M.

SIMULTANEOUS F.M. and A.M.



F.M./A.M. SIGNAL GENERATOR TF 995A

The Marconi Signal Generator Type TF 995A is a compact, transportable, a.c. operated instrument covering from 13.5 to 216 megacycles in four crystal-standardized ranges. It has an open-circuit output level variable, in 1-db steps, from a minimum of 0.1 microvolts to a maximum of 100 millivolts at 52 ohms, and 200 millivolts at 75 ohms. The output may be c.w., 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.

Full data and prices of any of the items listed below will be mailed immediately on request:

FM/AM SIGNAL GENERATOR TF 995A · UNIVERSAL BRIDGE TF 868
FM DEVIATION METER TF 934 · STANDARD SIGNAL GENERATOR TF 867

ALSO

VACUUM TUBE VOLTMETERS · FREQUENCY STANDARDS · OUTPUT METERS
WAVEMETERS · WAVE ANALYSERS · Q METERS · BEAT FREQUENCY OSCILLATORS

MARCONI INSTRUMENTS

23-25 BEAVER STREET · NEW YORK 4

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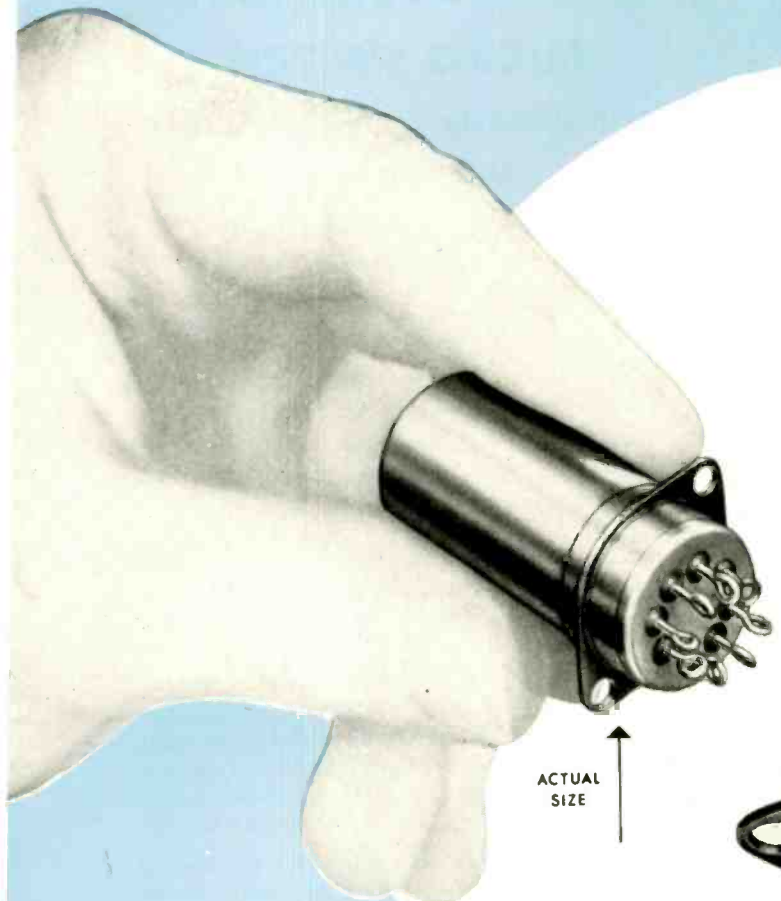
ENGLAND: Head Office: MARCONI INSTRUMENTS LIMITED, ST. ALBANS, HERTFORDSHIRE
Managing Agents in Export: MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, MARCONI HOUSE, STRAND, LONDON, W.C.2

TC 47

New 3/4" Sensitive Relay

APPLICABLE TO PRINTED CIRCUITS



ALLIED TYPE RSH
has sensitivity of
40 milliwatts in D.P.D.T.
and 22 milliwatts in
S.P.D.T.

ELECTRICAL SPECIFICATIONS

CONTACTS: Up to D.P.D.T. rated at 2 amperes at 26.5 volts DC or 115 volts AC resistive load

COIL: Sensitivity—40 milliwatts D.P.D.T.
22 milliwatts S.P.D.T.
Resistance—up to 14,000 ohms

TEMPERATURE: Minus 60° C to plus 125° C

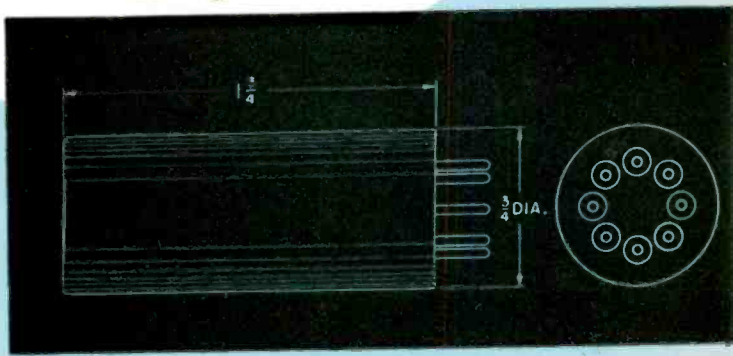
VIBRATION: 10G up to 500 cycles

SHOCK: 50G plus (operating)

ALTITUDE: 80,000 feet or 1.3 inches of mercury

TERMINAL TYPE: Solder and plug-in printed circuit.

WEIGHT: 2 ounces



Write for catalog sheet giving complete information

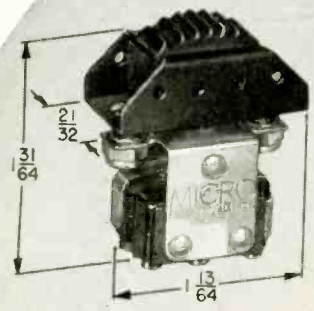
ALLIED CONTROL

ALLIED CONTROL COMPANY, INC., 2 EAST END AVENUE, NEW YORK 21, N.Y.

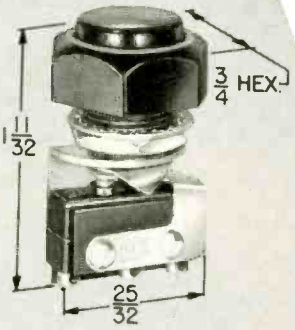
AL 126

MICRO SWITCH Precision Switches

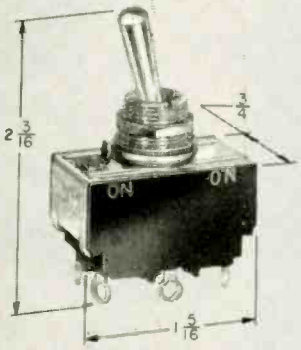
A PRINCIPLE OF GOOD DESIGN



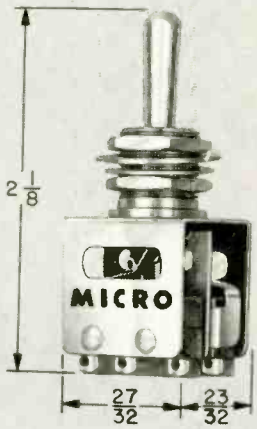
A Slide Button Switch



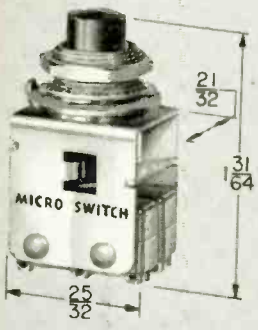
B Push Button Assembly



C Sealed Toggle Switch

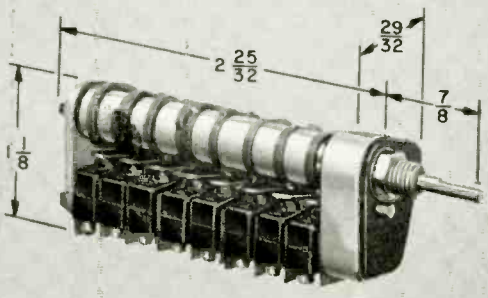


D Toggle Switch Assembly



E Push Button Assembly

F Rotary Selector Switch



Why

electronic designers turn to MICRO SWITCH

for manually operated switch components

• Wide variety • Small size
• Light weight • Utmost reliability

MICRO SWITCH precision switches shown here are typical of hundreds of switches developed to meet the specific requirements of the electronics industry. Whether your requirement is for a slide switch, a push switch, a toggle switch, or a rotary selector switch, consultation with MICRO SWITCH engineers can save you time and money.

A **Slide Button Switch.** Designed for two-circuit control. Two subminiature switches mounted in a three-position, maintained contact, slide-button assembly. Both switches can be wired normally-open, both normally-closed, or one in each position.

B **Push Button Assembly.** For panel mounting with push-button plunger mechanism sealed at the panel, thereby protecting subminiature switch on inside of panel. Extremely small—complete assembly weighs only .04 lb. Operating force may be from 3 to 6 lbs.

C **Sealed Toggle Switch.** Supplied with external panel seal and internal bushing seal below the bat handle. Has bushing for panel mounting and may be equipped with keying tab where desired.

D **Toggle Switch Assembly.** For panel mounting and provides control of as many as 4 circuits. One of two single-pole, double-throw subminiature switches is actuated in each extreme toggle position. Require minimum space behind mounting panel.

E **Push Button Assembly.** Composed of two single-pole, double-throw subminiature switches. Switch provides an improved "feel" and simultaneous make and break of the two circuits.

F **Rotary Selector Switch.** Uses from 2 to 8 single-pole, double-throw subminiature switches to control multiple circuits. It permits 2 to 8 switching positions with spring or manual return to neutral position.

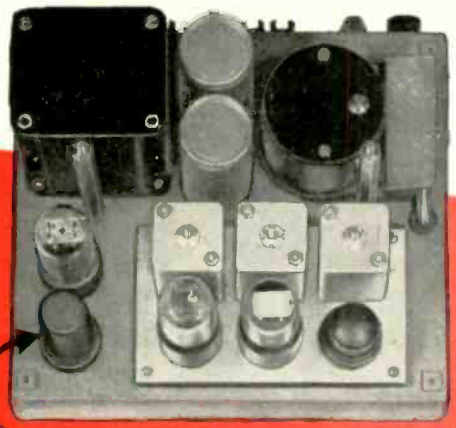
For complete information on these switches —or the complete MICRO SWITCH *line call your nearest* MICRO SWITCH *branch office. Why not do it NOW?*

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

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
FREEPORT, ILLINOIS

New WESTON Inductronic® D-C AMPLIFIER Measures Millivolts to 0.1%!...



The new Weston Inductronic D-C Amplifier measures both millivolts and microamperes to an accuracy previously unheard of. A product of Weston Electrical Instrument Corp., Newark, N. J.

Its resistor network uses D-H ALLOY to assure HIGH STABILITY and ACCURACY

The Weston Resistance Network (Actual size) is wound with D-H Manganin wire to achieve a high degree of stability with extreme accuracy.

When it's millivolts or microamperes you are measuring, you talk in terms of accuracy in the order of 0.1%. Here is the most accurate measuring instrument yet developed — the Weston Inductronic D-C Amplifier. This amazing instrument makes potential measurements down to microvolts, current measurements to fractions of a microampere.

By using this 200 kc frequency shift amplifier in connection with thermocouples, radiation receivers, bolometers, strain gages, pressure transducers, resistance thermometers, photocells, ionization gages, etc., related physical quantities can be measured with speed and accuracy far superior to any other method previously known.

The amplifying system is essentially an automatic potentiometer, wherein an output current is maintained in balance against the input through a method of accurately adjusted resistors determining the balanced ratio of output to input. With a high gain in the amplification of error unbalance, the accuracy of amplification ratio is of course dependent almost entirely upon the *stability* and *precision* of the resistor network.

For this most exacting function Weston uses Driver-Harris MANGANIN, an alloy of such fixed stability that maximum change in resistance between 15°C. and 35°C. is less than *15 parts per million per degree Centigrade.*

If fixed stability and constant resistance under normally variable operating conditions are "musts" in *your* resistor designs, let us have your specifications. We'll gladly put at your disposal 50 years of alloy manufacturing experience to help solve your problem.

*Sole producers of world-famous Nichrome**

Driver-Harris Company

HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco, Louisville

In Canada: The B. GREENING WIRE COMPANY, Ltd., Hamilton, Ontario

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

MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD

VISIT DRIVER-HARRIS AT PHILADELPHIA INSTRUMENT SHOW—BOOTH 559-561

NEW ATOMIC CANNON

Added Evidence that—

Everyone Can Count on VEEDER-ROOT

This mobile 280 mm. atomic cannon has *two* recoil motions. The primary recoil absorbs the cannon's "kick". The secondary recoil (something new in artillery) absorbs the forces created by the primary recoil. And each recoil motion is recorded by this special Veeder-Root Counter designed with a plunger-action shaft . . . which keeps the score on the cannon's use and indicates approaching need for maintenance.

This again points up the fact that "Anything Worth Making — or Worth Doing — *Is Worth Counting*." And Veeder-Root has the experience and resources *you* can count on, to give you any counter you need . . . for any mechanical or electrical application . . . in any field from Atomics to Automation. Write:

VEEDER-ROOT INCORPORATED
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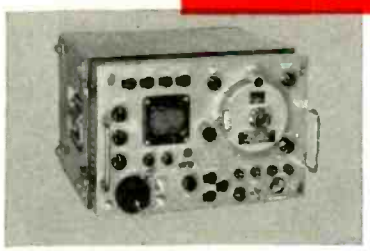
"The Name that Counts"

12,800 TO 50,000 MC

integrated equipment for Extremely High Frequencies

SIGNAL GENERATORS

SIGNAL SOURCES



SPECTRUM ANALYZERS

Now, Polarad has applied its advanced-engineering techniques to produce **fully self-contained** microwave test equipment for use in the Extremely High Frequency region--12,800 to 50,000 MC.

This new line of Signal Generators, Signal Sources, and Spectrum Analyzers is designed to save engineering manhours in the laboratory and on production lines—obviating experimental test set-ups.

The Extremely High Frequency Polarad Signal Generator, for example, furnishes monitored power output as well as measures external signal strength and frequency.

Highest accuracy and reliability of operation are assured by careful engineering and the use of highest quality components. For complete information write to your nearest Polarad representative or directly to the factory.

	SIGNAL GENERATORS		SIGNAL SOURCES		SPECTRUM ANALYZERS		
Frequency Range	Model Number	Output Power	Model Number	Power Output (Average)	Model Number	Sensitivity (Signal=Noise)	Dispersion (Average)
12.8 to 17.5 KMC	SG 1218	—10 DBM	SS 1218	15 mw	SA 1218	—70 DBM	30 MC
15.75 to 16.25 KMC	SG 1516*	—6 DBM	SS 1516	5 mw	SA 1516	—70 DBM	45 MC
16.25 to 16.75 KMC	SG 1617*	—6 DBM	SS 1617	5 mw	SA 1617	—70 DBM	45 MC
18.0 to 22.0 KMC	SG 1822	—10 DBM	SS 1822	10 mw	SA 1822	—60 DBM	40 MC
22.0 to 25.0 KMC	SG 2225	—10 DBM	SS 2225	10 mw	SA 2225	—60 DBM	40 MC
24.7 to 27.5 KMC	SG 2427	—10 DBM	SS 2427	10 mw	SA 2427	—60 DBM	40 MC
27.27 to 30.0 KMC	SG 2730	—10 DBM	SS 2730	10 mw	SA 2730	—60 DBM	45 MC
29.7 to 33.52 KMC	SG 3033	—10 DBM	SS 3033	10 mw	SA 3033	—60 DBM	45 MC
33.52 to 36.25 KMC	SG 3336	—10 DBM	SS 3336	9 mw	SA 3336	—50 DBM	45 MC
35.1 to 39.7 KMC	SG 3540	—10 DBM	SS 3540	5 mw	SA 3540	—50 DBM	45 MC
37.1 to 42.6 KMC	External Source Power Measurement Range: +6 to +30 DBM Accuracy with Correction: ±2 DB		SS 3742	Approx. 3 mw	I.F. Gain Control: 0 to 40 DB I.F. Band Width: 50 KC Sweep Frequency: 5 to 40 CPS		
41.7 to 50.0 KMC			SS 4150	Approx. 3 mw			

Modulation: All units except the SG 1516* and SG 1617* can be modulated as follows:

1. Internal
   1000 CPS Square Wave
2. External
   a. Pulse
      Pulse Width: 0.5 to 10 Microseconds
      PRF: 100 to 10,000 CPS
      Pulse Amplitude: 10 volts Pk to Pk Min.
      Polarity: Positive
   b. Sawtooth or Sinusoidal
      Frequency: 100 to 10,000 CPS
      Amplitude: 15 Volts RMS Min.

*Internal variable pulse and FM modulation

Polarad ELECTRONICS CORPORATION 100 METROPOLITAN AVENUE, BROOKLYN 11, NEW YORK

REPRESENTATIVES • Albuquerque • Atlanta • Boston • Chicago • Cleveland • Fort Worth • Kansas City • Los Angeles • New York • Philadelphia • San Francisco • Seattle • St. Paul • Syracuse • Washington, D. C. • Canada, Arnprior—Export: Rocke International Corporation

MILLIONS OF VARIABLE

COMPLETE MILITARY LINE AVAILABLE.

POPULAR MILITARY TYPES ILLUSTRATED.

CORRESPONDING COMPLETE LINE FOR COMMERCIAL APPLICATIONS ALSO AVAILABLE.

5 acres of plant area . . . over 1000 employees . . . making ALL TYPES of variable resistors by the million. . . . for ALL your requirements. CTS SPECIALIZES in precision mass production of variable resistors and associated switches . . . makes nothing else.

Most controls available with switches and in concentric shaft tandems or with two controls operating on one shaft. Also available with locking bushing, water sealed bearing and many other special features not illustrated.

Immediate delivery from stock on many JAN-R-94, JAN-R-19 and other types.

WRITE FOR ILLUSTRATED CATALOG—
Describes Electrical and Mechanical characteristics, Special Features and Constructions of a complete line of variable resistors for military and civilian use. Includes dimensional drawings of each resistor

REPRESENTATIVES

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McClatchy Bldg.
69th & Market St.
Upper Darby, Penna.
Phone: Flanders 2-4420

W. S. Harmon Company
121 No. Robertson Blvd.
Beverly Hills, California
Phone: Bradshaw 2-3321

John A. Green Company
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CHICAGO TELEPHONE SUPPLY *Corporation*

ELKHART • INDIANA

1/2 watt 70°C, 3/4" diameter miniaturized variable composition resistor.

TYPE 65
(Miniaturized)

1 watt 70°C, 15/16" diameter variable composition resistor.

TYPE 90

Meets JAN-R-94 type RV4

2 watt 70°C, 1-1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94.

TYPE 95

TYPE C90-65
Tandem

TYPE GC-90
With Switch

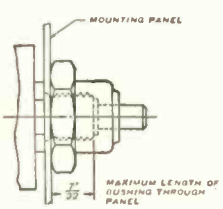
TYPE GC-95
With Switch

UNPRECEDENTED PERFORMANCE CHARACTERISTICS

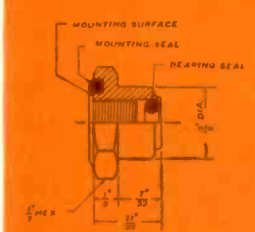
Types 65, 90 and 95 are specially designed for military communications equipment subject to extreme temperature and humidity ranges: −55°C to +150°C ...aridity to saturation.

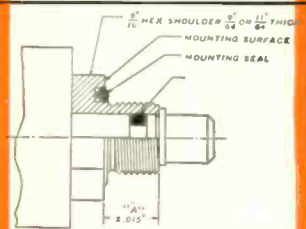
TYPE C2-90
Tandem

TYPE C2-95
Tandem



WATER SEALED MOUNTING AND BEARING FOR TYPE 65





(CAN BE SUPPLIED WITHOUT THE WATER SEALED MOUNTING SHOULDER)

WATER SEALED MOUNTING AND BEARING FOR TYPES 45, 35, 90, 95, 25, 252.

Burton browne advertising

RESISTORS...FOR EVERY NEED

Meets JAN-R-94
type RV3

1/2 watt 1-1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94.

Meets JAN-R-94
type RV2

1/4 watt 15/16" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94.

Meets JAN-R-19
types RA25 and RA30

4 watt 1-17/32" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19.

Meets JAN-R-19
type RA20

2 watt 1-17/64" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19.

TYPE 35

TYPE 45

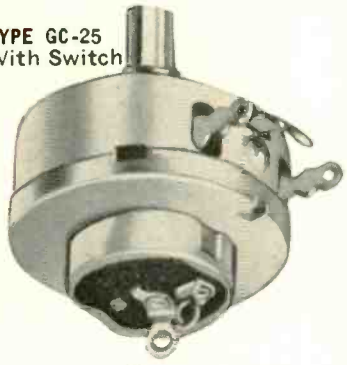
TYPE 25

TYPE 252

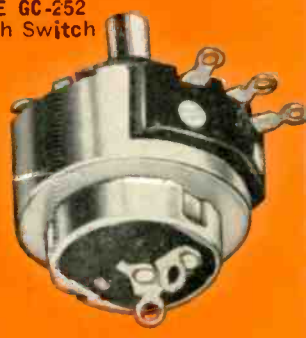
TYPE GC-35
With Switch

TYPE GC-45
With Switch

TYPE GC-25
With Switch



TYPE GC-252
With Switch

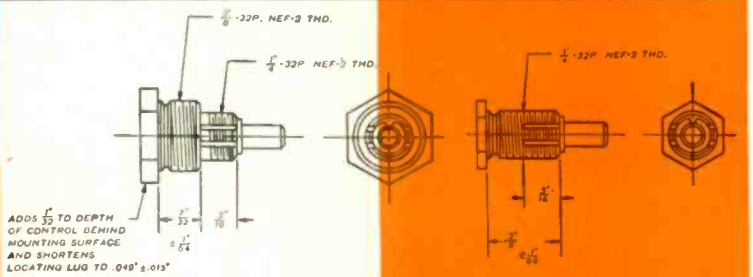


TYPE C2-35
Tandem

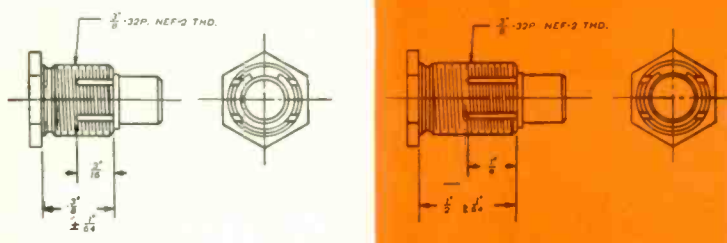
TYPE C2-45
Tandem

TYPE C2-25
Tandem

TYPE C2-252
Tandem



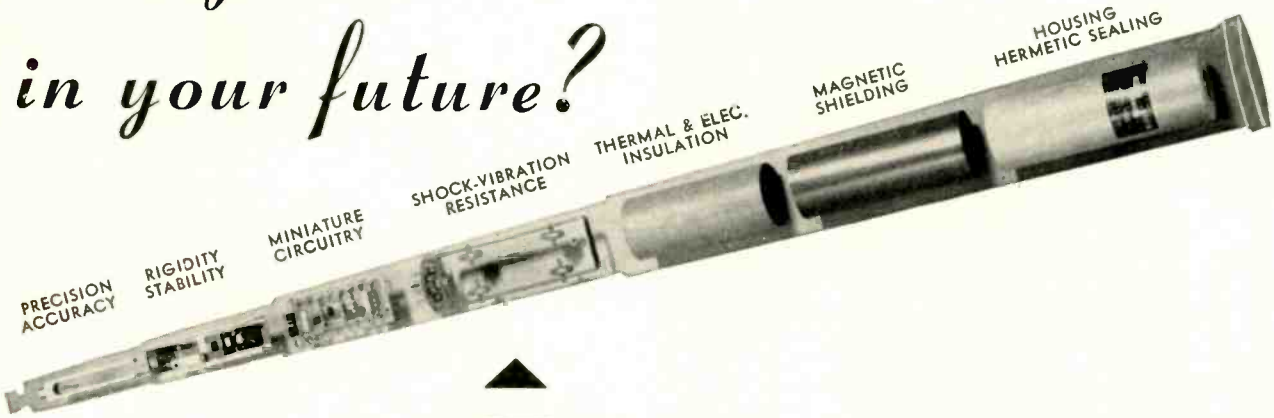
LOCKING BUSHINGS FOR TYPE 65 CONTROL.



LOCKING BUSHINGS FOR CONTROL TYPES 25, 252, 95, 35, 90, 45.

Specialists in Precision Mass Production of Variable Resistors • Founded 1896

Can you see this in your future?



400.00 CYCLES

Also available in—

240
500
1,000
2,000 cycles

ACCURACY: 1 PART IN 50,000

FREQUENCY STANDARDS

IN QUANTITIES

PRECISION WITH RUGGEDNESS

TYPE 2003. Temperature-compensated tuning fork with most of the circuitry sealed inside. Requires a miniature double triode and 6 pigtail components in your circuit.

TYPE 2007. Temperature-compensated tuning fork with ALL circuitry, including sub-miniature double triode, sealed inside.

FEATURES — Plug in
Interchangeable
Shock-vibration resistant
Hermetically sealed
Light weight. (7 ounces)
Small size (1½" x 4½")
Meets JAN-MIL specifications

WRITE FOR DESCRIPTIVE LITERATURE, TYPE 2003-7 OR SEND BRIEF OUTLINE OF REQUIREMENTS.

Manufacturers of a wide variety of timing equipment used in such fields as Aviation, Navigation, Ordnance, Ballistics, High-speed Photography, Viscosity Measurement, Fluid flow, Nuclear Physics, Telemetering, Chemical Reaction, Radiation Counting, Computers, Facismile, Fire control, School and Industrial Research Laboratories. Accurate speed control.

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For The ELECTRONIC INDUSTRY

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This means a better product backed by years of Moldite leadership in engineering and research. No one has done more than Moldite to give the industry a superlative core or coil form for every electronic application. *So Design with Moldite Core Standards.*

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MOLDITE MAGNETIC IRON CORES

FERRITE CORES
MOLDED COIL FORMS
(iron and phenolic)
MAGNETIC IRON CORES
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THREADED CORES
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Samples promptly submitted upon request for design, pre-production, and test purposes

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Arnold Andrews, 521 Cumberland Ave., Syracuse, N. Y.
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Jose Luis Ponte, Cardoba 1472, Buenos Aires

Arthur Marquis
Design and Application Engineer

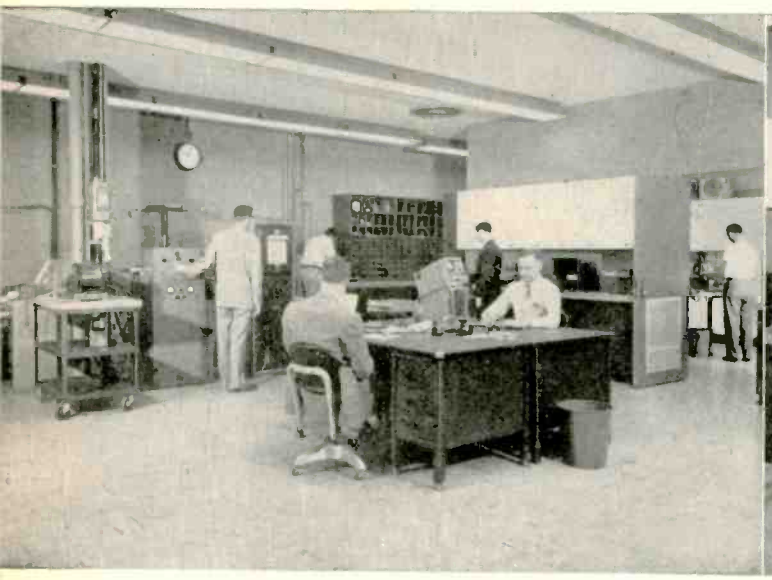
Arthur R. Kozlowski
Design and Application Engineer

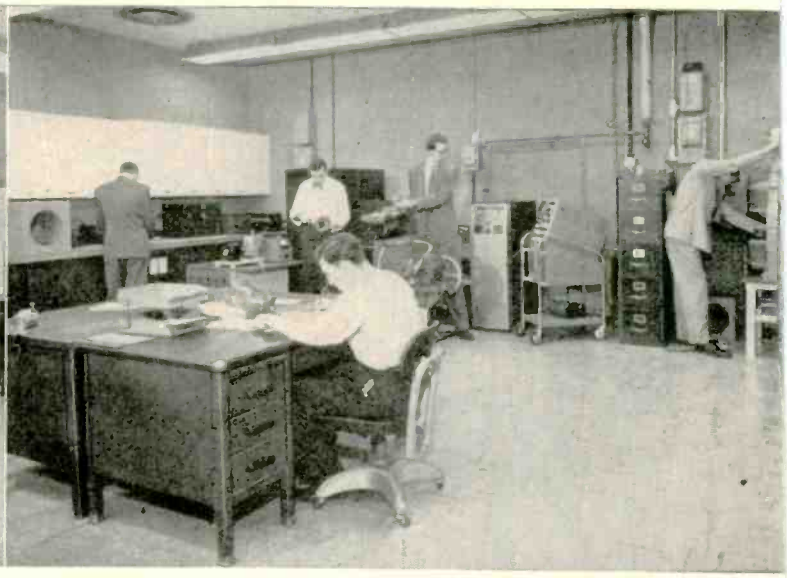
John H. Smedley
Design and Application Engineer

George D. Barcus
Design Engineer

Rollin J. Parker
Supervisor—Magnetic Products Design and Application

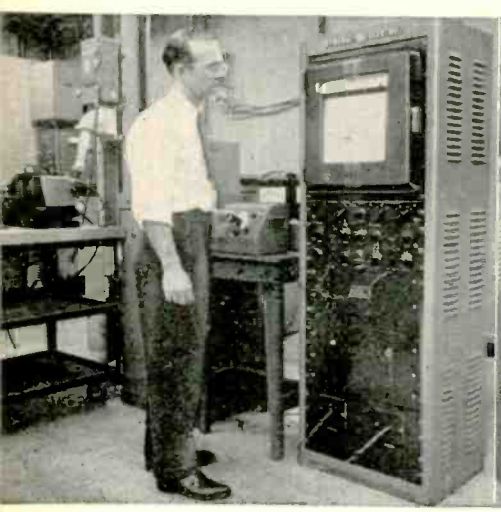
These Carboloy® permanent



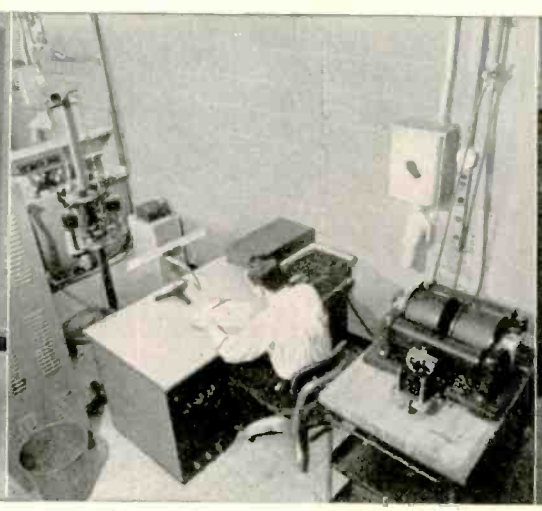


At the modern Carboloy magnet laboratory, in Detroit, trained engineers work with the finest equipment. Where necessary, special instruments are often designed by the engineers.

With such complete facilities, Carboloy magnet engineers can give you accurate information, quickly. And, they can thoroughly test their designs and the performance of the magnets in your products.

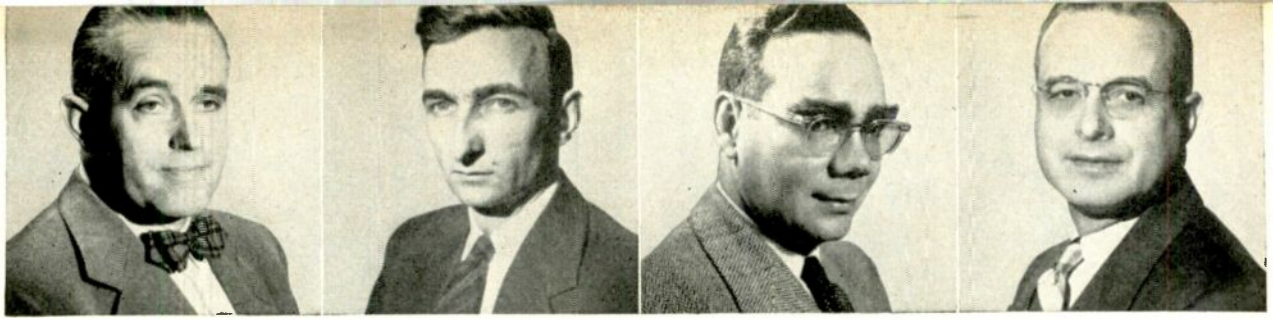


DC Recording Hysteresigraph. Simultaneously plots magnetic force and resulting magnetic induction. Produces complete hysteresis loops, not ordinary point-by-point readings.



High H-Permeameter. Provides point-by-point readings of magnetizing force and induction. Control table and Ballistic Galvanometer also used for general flux measurements.

Condenser Discharge Magnetizer. Produces very large current impulse for magnetizing magnet configurations that can best be accomplished with special field shapes.



Ernest E. George
Mgr.—Design and Application Eng.neering

Robert J. Studders
Supervisor—Magnetic Materials and Process Development

Edgar W. Engle
Mgr.—Product and Process Development Engineering

Edgar L. Hubbard
Sales Mgr.—Permanent Magnets

magnet engineers can help improve products, cut costs

Experienced magnet engineers, using the latest test and development equipment, will provide complete engineering appraisal service

You can get valuable technical assistance, without obligation, on the design and application of permanent magnets, from Carboloy magnet engineers . . . men who are leaders in the field.

Only at the Carboloy Department can you obtain engineering appraisal service and sample magnets from separate laboratory facilities devoted exclusively to helping you determine the design and optimum size, shape and strength magnets to fit your particular application. Your product will be tested in the modern Carboloy magnet laboratories, on the latest test instruments, to assure the maximum operating efficiency of the magnets.

PROVED RESULTS

The assistance Carboloy engineers have given other designers and manufacturers has paid off time and again in lower production costs, improved product efficiency, simplified assemblies and reduced product size.

You can rely on their solutions because these engineers, many of whom worked on the original development of Alnico, are specially trained and experienced in all phases of permanent magnet design and application.

You can depend on Carboloy magnet sales engineers, too, for authoritative and intelligent answers to your questions. These men have intensive, special training in permanent magnets, supporting their engineering and technical backgrounds.

A COMPLETE SERVICE

Together with the engineers who are working on the development of new magnetic materials and on the improvement of existing Alnico grades, *these men make a complete permanent magnet team.* Their sole job is to help you utilize the tremendous potential of permanent magnets for new and improved products.

This team can start working for you, today. Just fill out the coupon and attach to it your company letterhead, and where possible, blueprints or sketches of the job. Or, if you prefer, the coupon will bring a call by your local Carboloy magnet sales engineer.

Three typical, successful appraisal projects:

INSTRUMENTS. Working with Thomas A. Edison, Inc., Carboloy engineers provided the magnet design that made possible a revolutionary fire detection relay. Use of the proper magnets simplified the design of the relay and reduced its size and weight.

CONTROLS. The development of the hysteresis brake was pioneered by Carboloy magnet engineers. Now widely used in the textile and wire rope industries, this brake eliminates friction, while maintaining the necessary constant tension.

TELEVISION. Carboloy magnet engineers collaborated with tube engineers on the design of a new magnetic internal focusing device. They designed the smaller, more efficient magnets that helped eliminate focusing dials and external assemblies.

CARBOLOY
DEPARTMENT OF GENERAL ELECTRIC COMPANY

CARBOLOY
Department of General Electric Company
11139 E. 8 Mile Street, Detroit 32, Michigan

☐ I would like magnet engineering assistance; I am enclosing necessary information and blueprints.

☐ Have a Carboloy magnet salesman call.

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Company_____

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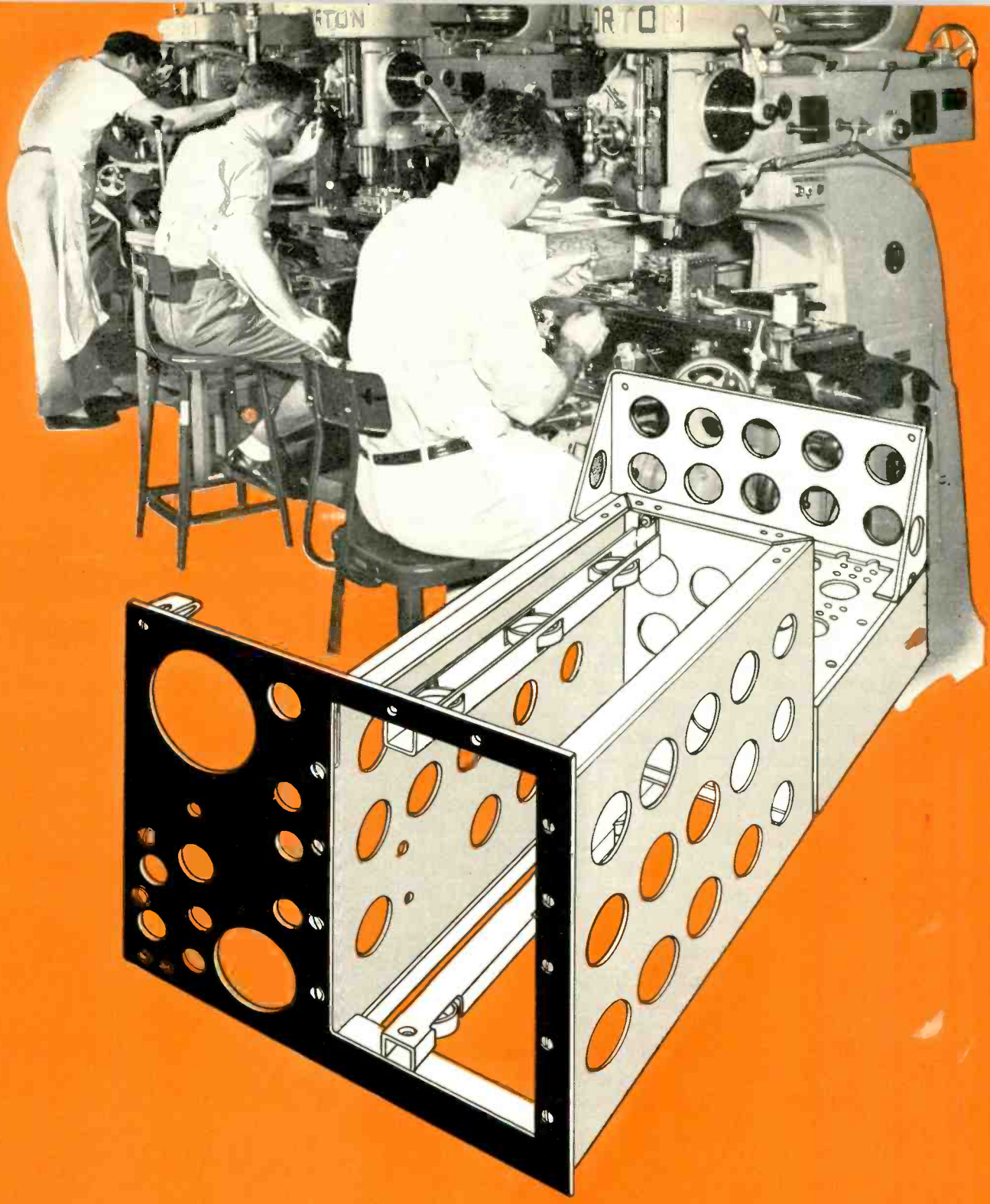
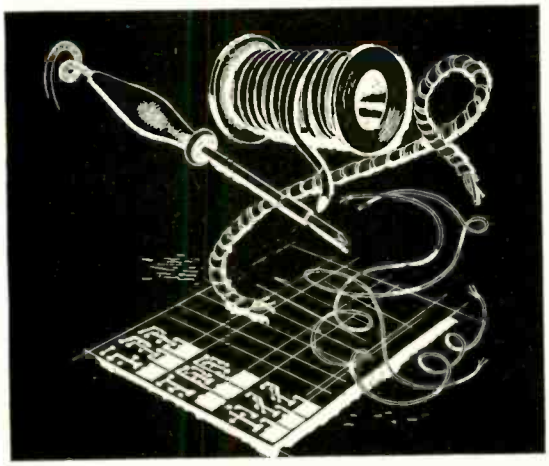


The Place of Mechanical Design in the Electronic Industry

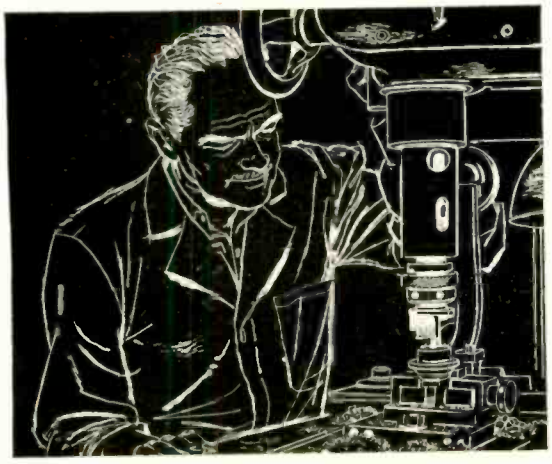
. . . in the electronics October

Mechanical Design Special Issue

The Importance of Mechanical Design



Wiring and Soldering



Making Small Parts

There has always been an intense need, in the electronic industry, for detailed knowledge of the place of mechanical design in the creation and construction of electronic equipment.

At long last, it is here! It will be available to you in the form of a 64 page textbook in the OCTOBER Electronics MECHANICAL DESIGN SPECIAL ISSUE.

Here is the issue that engineers and production men and all those with any interest in electronics have needed . . . and wanted . . . the PRACTICAL LINK between electronic engineers and mechanical engineers who work side by side in most plants within the field. Here is the 64 page insert (an addition to the regular issue) that renders a specific service by providing neatly packaged information intended to help solve mechanical problems peculiar to electronic design.

THE MECHANICAL DESIGN ISSUE will contain 9 sections written by 9 painstakingly-selected specialists

Each author has developed an authoritative thesis on his own subject. No axes are ground. No specific products are emphasized. Factual, informative methods, short cuts, modern usages, ways to improve, ways to save material and man hours—increase efficiency.

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THE MECHANICAL DESIGN ISSUE

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Complete Plates:
September 1

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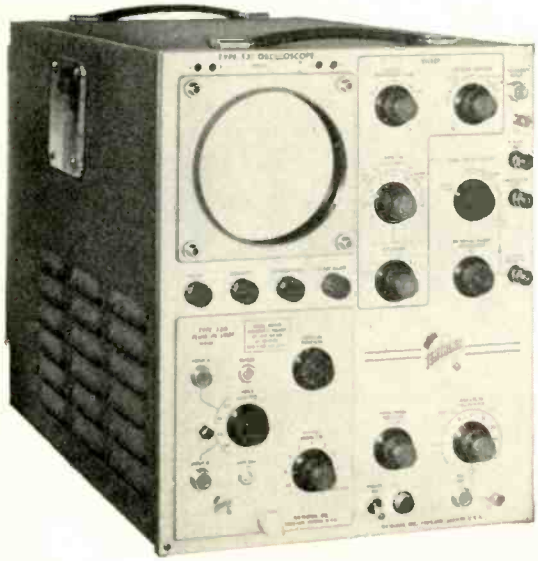
NEW *Multi-Purpose* Oscilloscope



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- 600,000,000 to 1 Sweep Range
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TYPE 531

You just plug in the proper vertical preamplifier to have at your service a wide-band dc oscilloscope, a wide-band high-gain oscilloscope, a wide-band dual-trace oscilloscope, or a differential-input high-gain dc oscilloscope. The Type 53-Series Plug-In Units are small, weigh less than 6 lbs. each, and you can change them in a few seconds.

This new instrument is designed to make your oscilloscope dollar go farther. Development of additional plug-in units already in progress will increase the versatility of the Type 531, and assure its modernity well into the future. *But your greatest gain is the many hours of valuable engineering time you save through its use.*

OSCILLOSCOPE CHARACTERISTICS

24 Calibrated Sweeps
0.1 μsec/cm to 5 sec/cm. Accurate 5-x magnifier permits calibrated sweep times to 0.02 μsec/cm. Sweep continuously variable from 0.02 μsec/cm to 12 sec/cm. Sweep calibration accurate within 3%.

New Cathode-Ray Tube
Tektronix T51P metallized CRT has helical post-accelerating anode; deflection-plate leads are brought out at the neck.

DC-Coupled Vertical Output Amplifier
Designed for use with any of the Type 53-Series Plug-In Units.

Balanced Delay Network
Provides 0.25-μsec vertical signal delay.

Horizontal Input Amplifier
Sensitivity 0.2 v/cm to 20 v/cm, continuously variable.

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Amplitude level selection or automatic triggering.

Amplitude Calibrator
Square wave, 0.2 mv to 100 v in 18 steps, accurate within 3%.

DC-Coupled Unblanking

CRT Beam Position Indicators

Electronically Regulated Power Supplies

Price $995 plus price of desired plug-in units

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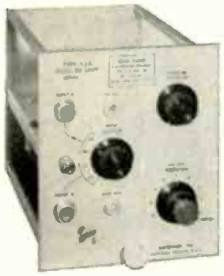
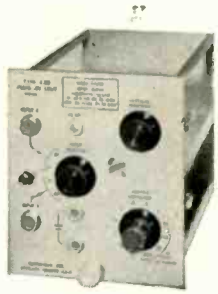
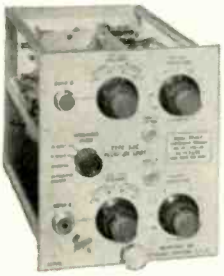
PLUG-IN UNIT CHARACTERISTICS



Type 53A Wide-Band DC Plug-In Preamplifier—dc to 10-mc passband, 0.035-μsec risetime. Sensitivity 0.05 v/cm to 50 v/cm, ac or dc, continuously variable, with nine calibrated steps from 0.05 v/cm to 20 v/cm. Two input connectors with 80-db isolation. Price $85.



Type 53B Wide-Band High-Gain Plug-In Preamplifier—same as the Type 53A with the addition of an ac-coupled input stage providing three additional calibrated sensitivity steps, 5 mv/cm, 10 mv/cm and 20 mv/cm. Passband 5 cycles to 9 mc, 0.04-μsec risetime. Two input connectors with 80-db isolation. Price $125.



Type 53C Dual-Trace Plug-In Preamplifier — two identical amplifier channels, each with dc to 8.5-mc passband, 0.04-μsec risetime, sensitivity 0.05 v/cm to 50 v/cm continuously variable with 9 calibrated steps from 0.05 v/cm to 20 v/cm. Electronic switching triggered by oscilloscope sweep, or free running at about 100 kc. Polarity reversal switches. Price $275.

Type 53D Differential High-Gain DC Plug-In Preamplifier—sensitivity 1 mv/cm at dc to 250 kc—with passband increasing to 750 kc at 50 mv/cm and lower. Sensitivity in calibrated steps—1 mv/cm to 50 v/cm, or continuously variable—1 mv/cm to 125 v/cm. Differential input. Price $145.

ALL PRICES F.O.B. PORTLAND (BEAVERTON), OREGON

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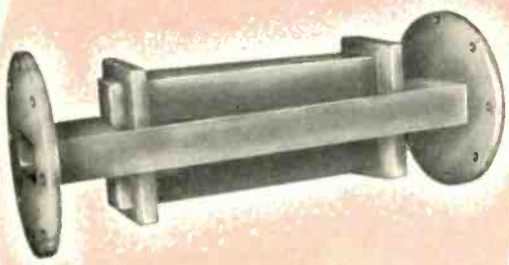
Phone: CYpress 2-2611 — Cable: TEKTRONIX

FOR EVEN GREATER UTILITY

SIGNIFICANT NEW Uniline DESIGNS

The adaptability of this now widely accepted unidirectional transmission line element is enhanced by several recent additions to the UNILINE family. Two such additions, illustrated here, meet important new requirements, retain the desirable characteristics of the original UNILINE design, namely, substantial isolation between source and load with negligible loss in transmitted power.

MODEL 38-42



The new Model 38-42 answers the frequent requests for UNILINES at still lower frequency ranges, covers 3800 to 4200 megacycles.

"RUGGEDIZED" UNILINE

This compacted, thoroughly ruggedized new design broadens the field of application for UNILINE . . . makes possible its use in equipment subject to severe shock and vibration. Same frequency range as Model 88-96 but under 3" in length.

MODEL R88-96

ITEM	MODEL NO.	FREQUENCY RANGE
UNILINE	96-104B	9600-10,400 Mcs.
UNILINE	88-96B	8800-9600 Mcs.
UNILINE	R88-96	8800-9600 Mcs.
UNILINE	69-74	6900-7400 Mcs.
UNILINE	64-69	6400-6900 Mcs.
UNILINE	59-64	5900-6400 Mcs.
UNILINE	38-42	3800-4200 Mcs.

UNILINE applications.

- Provides substantial isolation between source and load with negligible loss in transmitted power . . . . . .
- Eliminates "long line" effects on klystrons or traveling wave tubes . . .
- Ensures adequate isolation between multiple coupled circuits . . . . .
- Minimizes frequency "pulling" effects due to varying load impedance . .

GYRALINE	1000	9600-11,200 Mcs.
GYRALINE	920	8500-9900 Mcs.
GYRALINE	720	6900-7400 Mcs.
GYRALINE	670	6400-6900 Mcs.
GYRALINE	620	5900-6400 Mcs.

and . . . GYRALINE

The GYRALINE is essentially a continuously variable microwave attenuator controlled by an applied magnetic field. It can provide an amplitude modulated microwave signal without undesirable frequency modulation and double moding when used on the output of a CW operated klystron. The GYRALINE may also be used as an excellent level set attenuator or as the direct control element in an AGC system.

D-92 GYRALINE DRIVER — An audio driving unit for GYRALINES #920 and #1000. Adjustable output level, frequency variable 800 to 1200 cps. Self-contained power supply.

Write for descriptive literature

CASCADE RESEARCH CORPORATION
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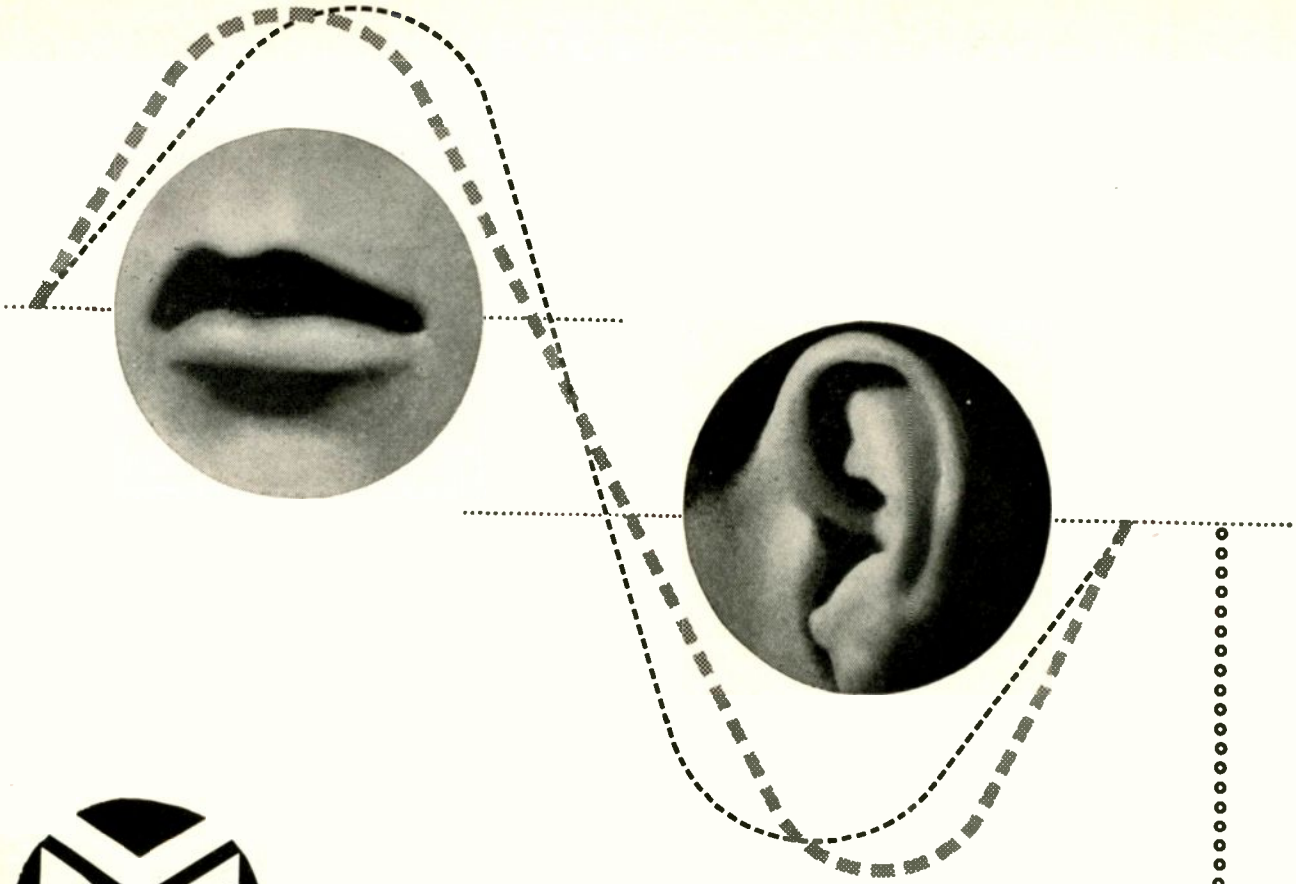
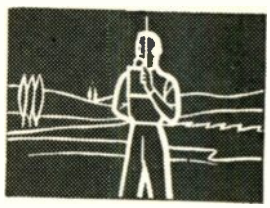


RADIO-TELEPHONE SCHEMES

In more than fifty countries Pye V.H.F. Radio-Telephones are providing an economical and reliable means of instantaneous communication between fixed points, between mobile units, and between fixed points and mobile units. Over two-thirds of the equipment in use in Great Britain alone has been produced by Pye. The Pye Systems Department will be pleased to advise you on your communications schemes whilst Pye agents and representatives overseas will demonstrate, install and maintain the equipment.



Telecommunications

Pye (New Zealand), Ltd., P.O. Box 2839, Auckland C.1., New Zealand.

Pye Canada, Ltd., Ajax, Ontario, Canada.

Pye-Electronic Pty., Ltd., 65 Park Street, Abbotsford, Melbourne, Victoria, Australia.

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Let KARP prove that your initial and production costs on cabinets, enclosures, chassis, and housings can be low, whether you need ten or ten thousand units. There is no obligation for quotations on your blue prints, samples or sketches. Write or phone, today!

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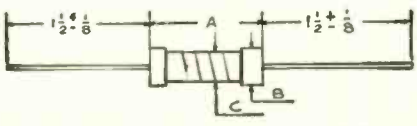

#20 AWG Tinned Copper Leads, 1½" long

A	B	C
15/16"	.160"	.130"

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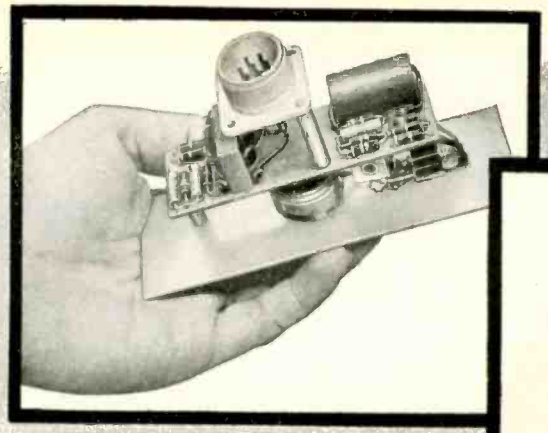

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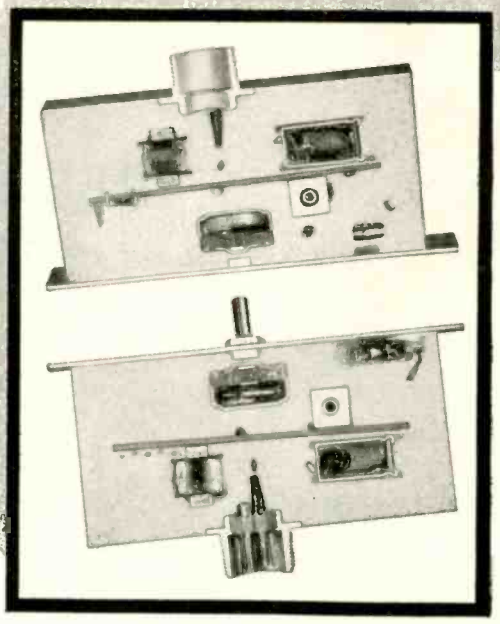
result: a complete barrier against vibration, corrosion, dampness, fungi



Hamilton Standard Division, United Aircraft Corporation, needed a potting material for the electronic temperature control unit that governs cockpit air-conditioning—found Nopco Lockfoam ideal for the purpose.

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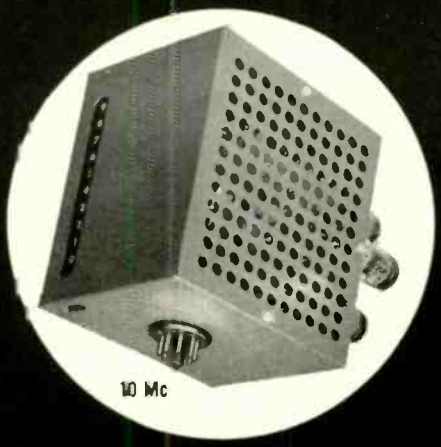
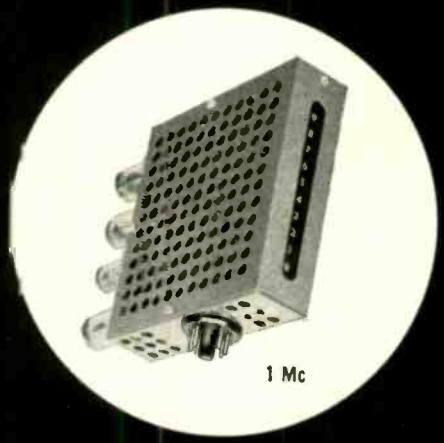
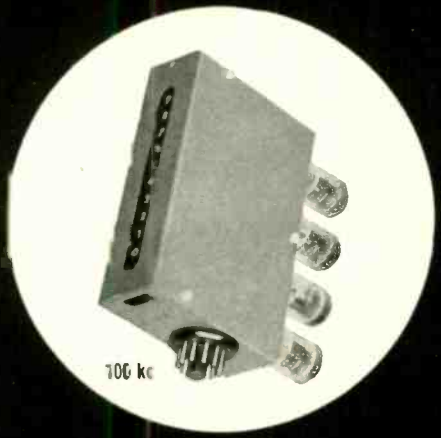
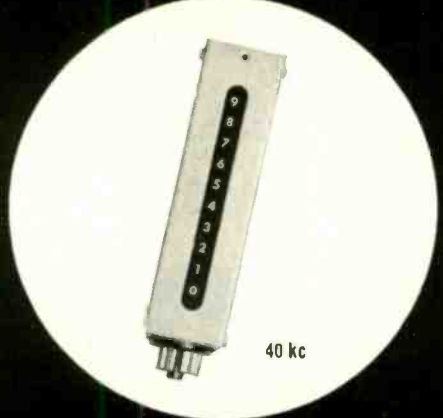

10 Mc


1 Mc


100 kc



40 kc

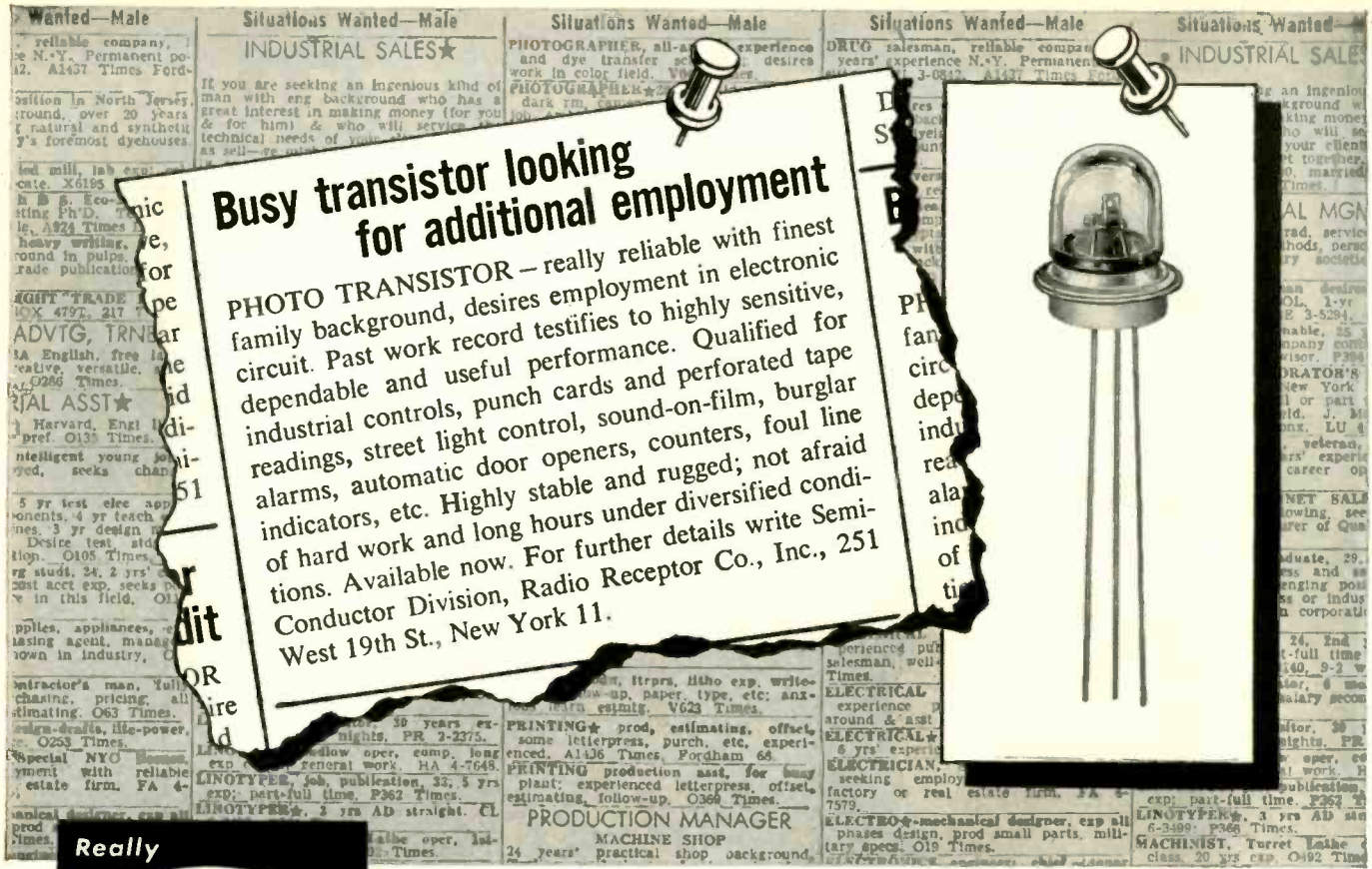
- 0 to 10 Mc covered in four ranges, 40 kc, 100 kc, 1 Mc and 10 Mc Max.
- Direct Decimal Display throughout, including 10 Mc.
- Light in Weight.
- Plug-In Construction for all 4 ranges:
  Decade Output with 8 pin base
  Individual Stage Outputs for remote readout with 11 pin base optional on 40 kc, 100 kc and 1 Mc models.
- Zero Reset; "9" Reset optional on 40 kc and 100 kc models.
- Reliabilized Tubes.
- Low Power Consumption.
- Wide operating voltage Range:
  approximately ±30% *on 40 kc and 100 kc Models*
  ±20% *on 1 Mc Model*
  ±5% *on 10 Mc Model*

Dimensions, approx.	40 kc	100 kc	1 Mc	10 Mc
Width	1⅜"	1⅜"	1⅜"	4"
Height	5⅛"	5¼"	5¼"	5¼"
Depth (including tubes)	5⅛"	5¼"	6⅝"	6⅝"
Weight	10 oz.	10 oz.	13 oz.	24 oz.
Nominal Current	9 Ma.	14 Ma.	75 Ma.	125 Ma. 45 Ma.
Nominal Voltage	300 V.	300 V.	300 V.	200 V. 275 V.
Tube Complement	4-5963	4-5963	4-5965 (or 12AV7)	6-5687

L/E®

LABORATORY FOR ELECTRONICS

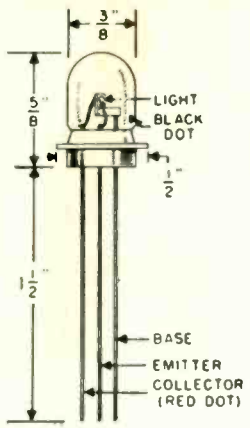
75 PITTS STREET, BOSTON 14, MASS.



Really

Reliable.

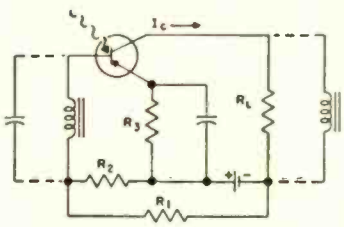
RR66 PHOTO TRANSISTORS



RR66 PHOTO TRANSISTOR

- Hermetically sealed in glass.
- Miniature size; low cost.
- High optical sensitivity.
- Available base connection permits thermal stabilization.
- Spectral response includes visible range with greatest sensitivity in infra-red region making it useful for invisible light applications.
- Response embraces practically the complete spectrum of a tungsten filament lamp.
- Operates at low voltage and low impedance levels.

RR66 Photo Transistors are headed for a long and important career in electronic circuits. Perhaps we can discuss this new device with you now!

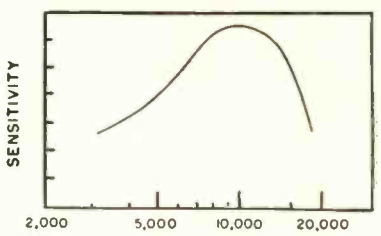


RECOMMENDED PHOTO-TRANSISTOR CIRCUIT FOR MODULATED LIGHT

TYPICAL OPERATION

$R_L = 10K$; $R_1 = 20K$; $R_2 = 1K$; $R_3 = 1K$

Collector Supply Voltage..12 volts
Collector Current .....0.5 Ma.
Sensitivity .....0.16 volts/ft. candle



TYPICAL SPECTRAL RESPONSE

Semi-Conductor Division

RADIO RECEPTOR COMPANY, INC.

In Radio and Electronics Since 1922

SALES OFFICES: 251 WEST 19TH STREET, NEW YORK 11, N. Y.
TELEPHONE: WATKINS 4-3633 • FACTORIES IN BROOKLYN, N. Y.

are you fighting space?

connect with cannon!

Are you looking for complete electrical circuit dependability in a very, very small space?

If so, you should use Cannon carefully engineered miniature and sub-miniature multi-contact connectors. In ½ or ⅓ the usual space, they give you up to 50 contacts, the same number as a standard connector, and still retain all the factors of utility, reliability, and mechanical strength found in Cannon's standard size connectors. They are very rugged, easy mating, unusually versatile, neat and compact.

Miniatures—Maximum Dimensions Only 1" x 2"!

High dielectric insulation. Rack, panel, chassis types . . . receptacles and plugs, standard, pressurized, or hermetically sealed . . . box, wall, or cord mountings . . . for audio, control, and instrument use. D and U sub-miniatures have steel shells. DPA and K miniatures have die-cast shells. Five-ampere gold plated contacts are found in all miniatures and sub-miniatures, excepting U receptacles, which have steel contacts. Larger contacts having higher current ratings, and co-ax contacts, are in process of development

Sub-Miniatures—Only 2-5/8" x 39/64"!

first in connectors

CANNON PLUGS

Write for Cannon Miniature and Sub-Miniature Bulletins

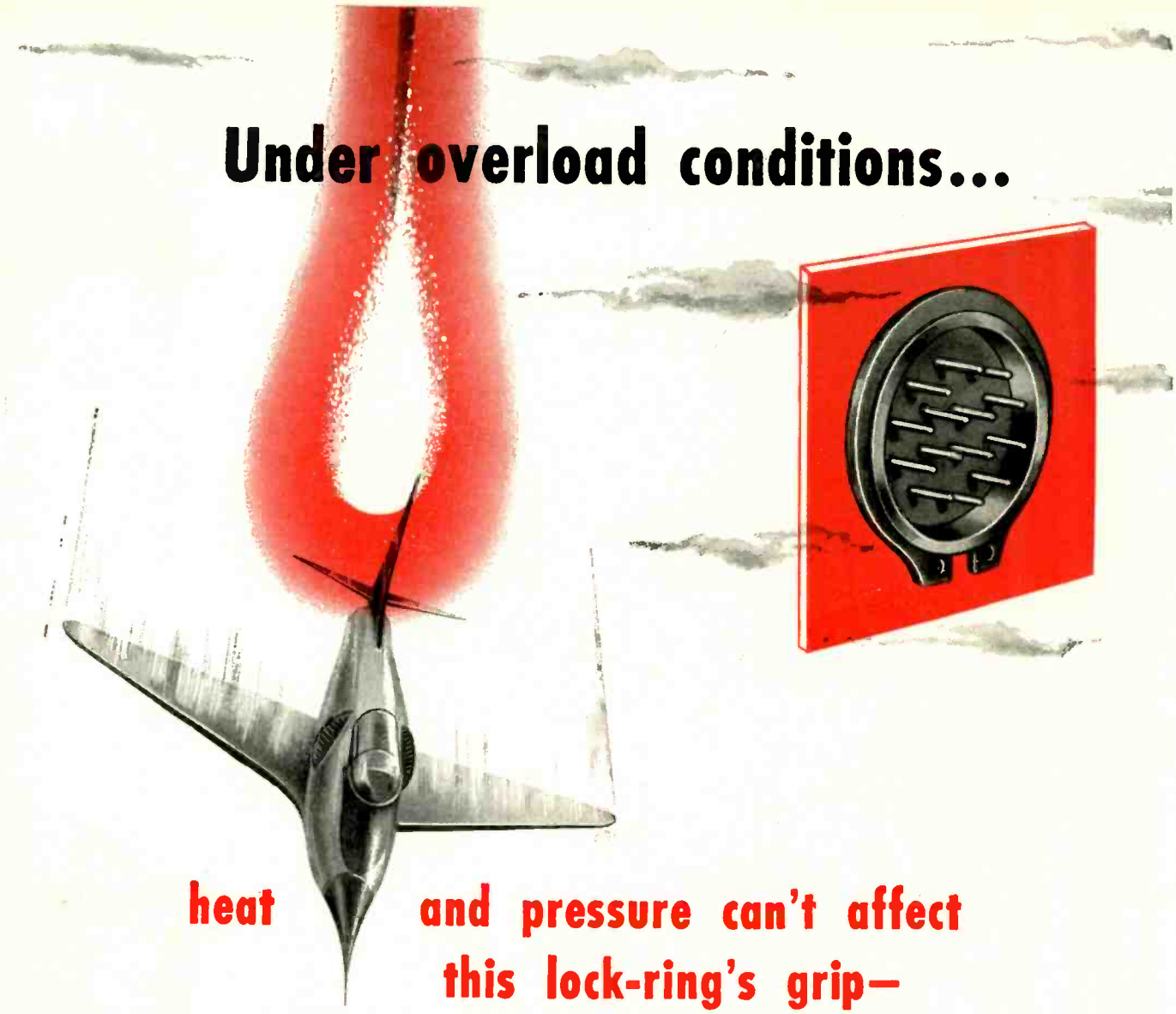
Please refer to Dept. 120

CANNON ELECTRIC COMPANY, 3209 Humboldt Street, Los Angeles 31, California.

Factories in Los Angeles, East Haven; Toronto, Canada; London, England.

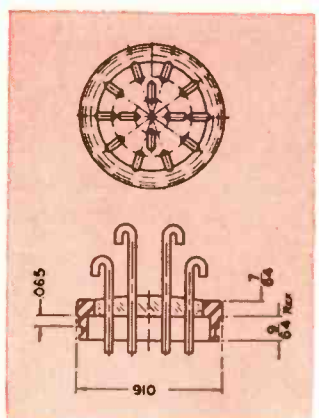
Representatives and distributors in all principal cities at your service.

Under overload conditions...



heat and pressure can't affect this lock-ring's grip—

HERMETIC'S new lock-ring for mounting hermetically sealed headers gives maximum mechanical security at lower cost!



A simple hole is all you need to mount this VAC-TITE* glass-metal bonded header. Hermetic's new lock-ring design assures mechanical security without requiring shaped recesses. The ring will hold against internal pressures far in excess of any which can be encountered in service, and all the advantages and flexibility of round headers are retained.

Stripping and re-use of headers is facilitated by the lock-ring and by the intrinsic nature of the VAC-TITE* seal.

In co-operation with the Armed Services, Hermetic has developed a variety of other header and plug types which do not depend on solder alone for mechanical security of headers.

*VAC-TITE is HERMETIC's new, vacuum-proof, compression-construction, glass to metal seal. In addition to special shapes, many standard sizes such as .800 O.D. and .900 O.D. multi-terminal headers and a large variety of individual terminals are available in VAC-TITE Compression Seals.

Write to Hermetic for assistance and samples to meet your problems.

See Us at the Western Electronic Show and Convention in Los Angeles — Booth 905.

Hermetic Seal Products Co.

31 South Sixth St., Newark 7, New Jersey

SEALED IN by HERMETIC HEADERS

FIRST AND FOREMOST IN MINIATURIZATION

Allen B. Du Mont
Laboratories, Inc.,
cordially invites you to examine the
superb operating characteristics,
high precision, and
unique convenience of the new
Du Mont Type 329
Cathode-ray Oscillograph
at your own laboratory
under your own conditions.

R.S.V.P.*

Do you believe your own eyes? Accept our invitation to see the new Type 329, right in your own lab.

Operate it yourself. See how easily you can stabilize a hard-to-sync signal on the screen for measurement. Give it a "tough" signal like a short pulse of low repetition-rate or a long, slowly-rising wavefront and watch the Type 329 perform. Compare the Type 329 with any cathode-ray oscillograph in your lab, with any signal you have to offer.

When you have put the Type 329 through its paces on your own terms, you'll undoubtedly agree with us that this is the best general-purpose cathode-ray oscillograph available.

Some specific reasons why...

- The Du Mont Type 5ATP- Cathode-ray Tube used is the most precise, distortion-free cathode-ray tube ever used.
- High-level, linear sweeps permit accurate front-panel-reading time calibration.
- Revolutionary new Notch expansion permits a ten times, calibrated expansion of any 5% of the sweep, leaving the remaining signal unexpanded.
- The linear wideband amplifier extends with full response to d.c. and 3db down at 10mc, a response commensurate with a seven-decade sweep rate of 1 second to 0.1 usec/major division.
- Accurate, direct, amplitude calibration makes the Type 329 a precise cathode-ray voltmeter, with eleven full-scale ranges of 0.2 to 400 volts.
- Use of printed wiring throughout assures product uniformity, ease of access, and neat appearance.

*For your demonstration or for more complete information on the Type 329 send postcard to Technical Sales Department, 760-9 Bloomfield Ave., Clifton, New Jersey. Or, better still, phone MUlberry 4-7400, Clifton, N. J., for a prompt demonstration.

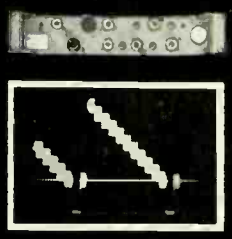
DU MONT®

See the Du Mont exhibit at Booth 536-537 at the WESCON Show.

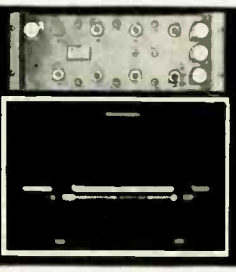
NEW

TELECHROME INCORPORATED

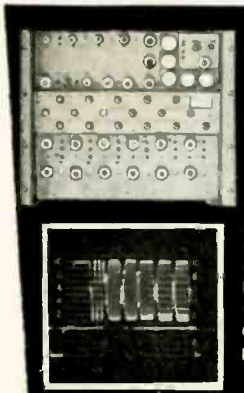
VIDEO TRANSMISSION TEST EQUIPMENT



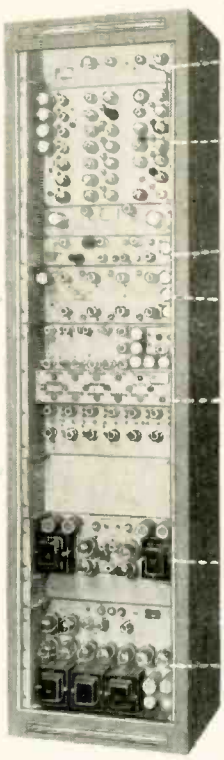
1041-BR STAIR STEP GENERATOR (Variable)
Checks lineary and grey scale output relationship in linear or non-linear system. Built-in color carrier generator may be added to steps. Back porch burst allows lock-in to 3.58 MC color equipment.



1071-AR WINDOW GENERATOR (Variable)
Determines ringing, smears, steps, low frequency tilt, phase shift, mismatched terminations, etc. in TV signals or systems.



1070-BR MULTI-BURST FREQUENCY GENERATOR (13 freq. selectable from .5 to 6 MC)
Checks wide band coaxial cables, microwave links, individual units, and complete TV systems for frequency response characteristics. Produces six frequencies simultaneously plus white bar reference. Switchable color burst on back porch.



AUTOMATIC FREQUENCY CONTROL 304AR

COMPOSITE SYNCH GENERATOR 303BR

STAIR-STEP GENERATOR

WINDOW GENERATOR

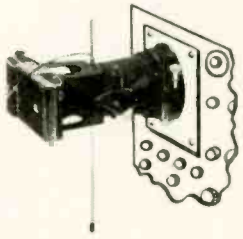
MULTI-BURST FREQUENCY GENERATOR

REGULATED POWER SUPPLY 512AR

REGULATED POWER SUPPLY 613BR

New Telechrome equipment designed to provide test signals for precise checking of video facilities.

This equipment is now in use by major networks, TV stations, and the Bell Telephone System. This type of equipment was recently described by H. Gronberg of NBC before the NARTB Engineering Conference in Chicago. These units are available individually or as an integrated system with 75 ohm or 110 ohm balanced output.



OSCILLOSCOPE CAMERA
MODEL 1521-A (Polaroid Land Type)

for instantaneous 1-to-1 ratio photo-recording of these or other test signals.

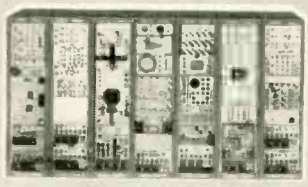
MODEL 608-A HI-LO CROSS FILTER

MODEL 524-D OSCILLOSCOPE

Chromalyzer

Chromascope (Signal Certification)

Phase Slope (Envelope Delay) Curve Tracer



Full facilities
Transmits, receives, monitors, analyzes composite color pictures

Literature on these and more than 100 additional instruments for color TV by TELECHROME are available on request.

TELECHROME INCORPORATED

The Nation's Leading Supplier of Color TV Equipment
88 Merrick Road Amityville, N. Y.
AMityville 4-4446

Distributor plate, molded of Monsanto's new Resinox 3700 thermosetting material by Specialty Insulation Manufacturing Company, Hoosick Falls, N. Y. for American Bosch Corporation, Springfield 7, Massachusetts.

Before you choose an electrical-grade material...

See how new Resinox 3700 improves electrical parts two ways

Resinox 3700 is a special thermosetting arc-resistant material developed by Monsanto research for low-cost *superior* performance in magneto ignitions, motor control and power transmission circuits, and other electrical applications. This new mineral-filled molding powder stands out from other materials because:

1. **It delivers high arc-resistance with outstanding dimensional stability . . . eliminates undesirable after-shrinkage.**
2. **It imparts relatively good impact strength . . . and has excellent moldability (very good transfer molding properties).**

Another advantage of Resinox 3700 is its good heat resistance. You'll find Resinox 3700, in short, an all-around better material for electrical parts. Why not write *today* for full information as related to your own product. The coupon is for your convenience.

Resinox: Reg. U. S. Pat. Off.

MONSANTO

SERVING INDUSTRY... WHICH SERVES MANKIND

MONSANTO CHEMICAL COMPANY, Plastics Division, Room 2504
Springfield 2, Mass.

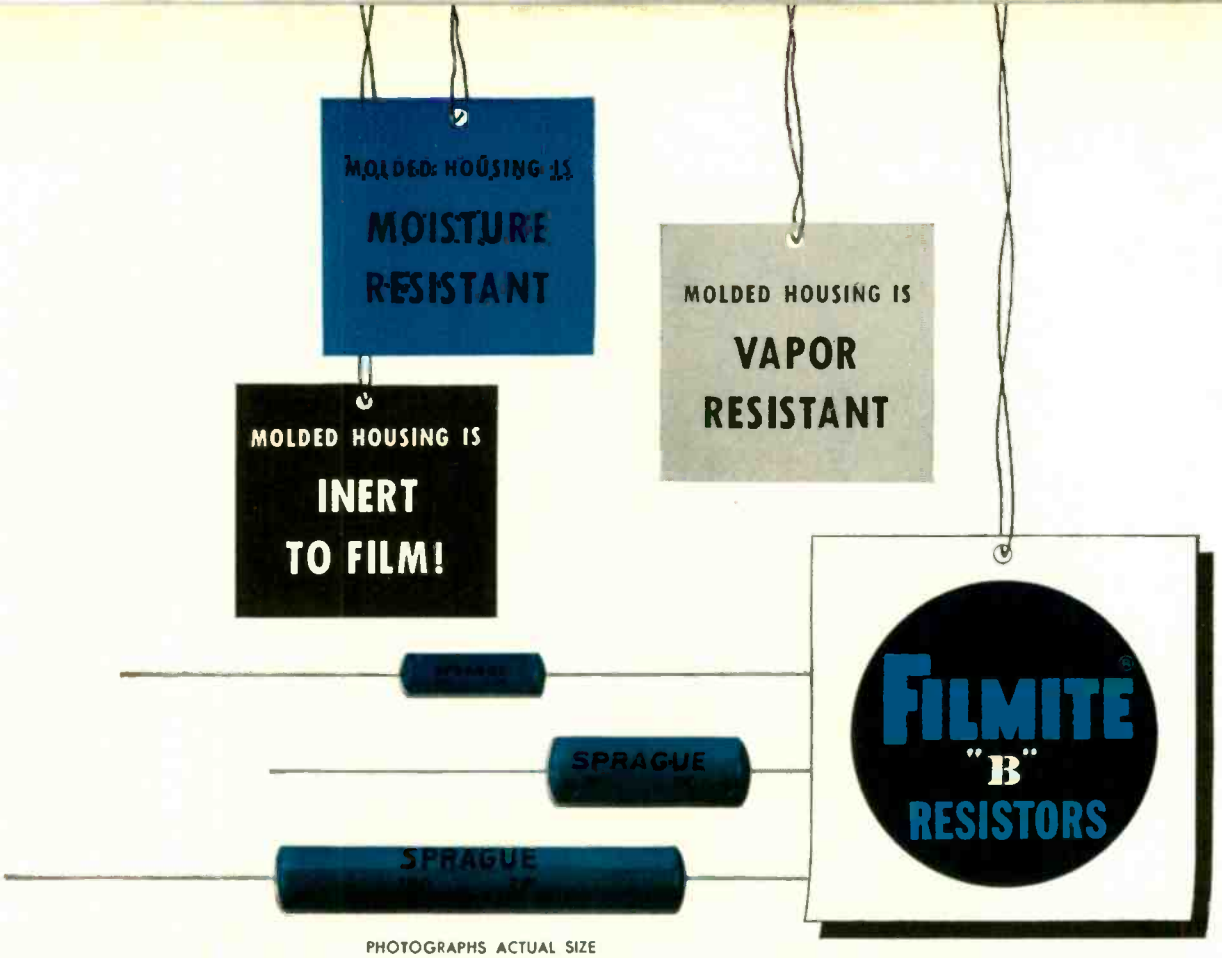
Please send me full information on Monsanto's new Resinox 3700 arc-resistant material.

Name & Title _____

Company _____

Address _____

City, Zone, State _____



PHOTOGRAPHS ACTUAL SIZE

...DEPENDABLE...LOW COST BORO-CARBON FILM RESISTORS

IN ½, 1, AND 2 WATT RATINGS

Now for the first time you can obtain a superior yet relatively low cost film-type resistor for military electronic gear—resistors that not only meet the severe performance requirements of Military Specification MIL-R-10509A, but are capable of full wattage dissipation at 70°C ambient!

Sprague Type 4E, 5E, and 6E Filmite B resistors are housed in a dense molded jacket which not only provides unexcelled physical protection for the film resistance element but serves as a barrier to moisture and vapor, the twin enemies of all film-type resistors.

Boro-carbon films are unusually sensitive to moisture. Protection against moisture in any form is a primary requirement for successful long term stability of resistance. The low-loss phenolic housings on molded Filmite resistors not only shed water but are vapor resistant and inert to the film material. There is minimum possibility of field failure through electrolytic action and penetration of moisture or vapor through the dense molded jacket.

Other features of molded Filmite B resistors are special low-contact-resistance, low noise end terminations held rigidly in place on special ceramic cores, extremely low temperature and voltage coefficients of resistance, and excellent load-life and high frequency characteristics.

For complete engineering data, write for Engineering Bulletin No. 130 to:

SPRAGUE ELECTRIC COMPANY,
35 Marshall Street, North Adams, Mass.

SPRAGUE TYPE NO.	WATTAGE RATING	DIMENSIONS (INCHES) L	D	RESISTANCE (OHMS) Min.	Max.	VOLTAGE (Max.)
4E	½	¾	¼	100	1 Meg.	350
5E	1	1 1/16	⅜	100	2½ Meg.	500
6E	2	2 3/16	⅜	200	10 Meg.	750

Standard Resistance Tolerances: 1, 2, and 5%

SPRAGUE

PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

NORTH ADAMS, MASSACHUSETTS

EXPORT FOR THE AMERICAS: SPRAGUE ELECTRIC INTERNATIONAL LTD., NORTH ADAMS, MASS. CABLE: SPREXINT

Let's face it!

HAVE YOU A DISASTER PLAN FOR YOUR PLANT?

BOMBS...OR FIRE...OR FLOOD...OR TORNADO ...you can handle them if you act now.

Let's face it... the threat of war and the atomic bomb has become a real part of our life—and will be with us for years. Fires, tornadoes and other disasters, too, can strike without warning.

Whatever the emergency is, everybody's going to want help at the same time. It may be hours before outside help reaches you. The best chance of survival for you and your workers—and the fastest way to get back into production—is to know what to do and be ready to do it. Disaster may happen TOMORROW. Take these simple precautions TODAY:

☐ **Call your local** Civil Defense Director. He'll help you set up a plan for your offices and plant—a plan that's safer, because it's integrated with community Civil Defense action.

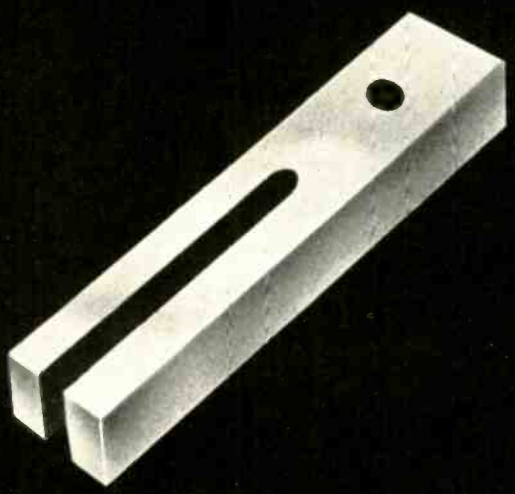
☐ **Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

☐ **Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.

☐ **Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads and official CD films or literature that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

Act now . . . check off these four simple points . . . before it's too late.

Tuning Fork Resonators, the ultimate in precision audio frequency control . . .



. . . phone or write

for complete information regarding component type **Tuning Fork Resonators,** or variously packaged **Tuning Fork Frequency Standards.**

Philamon Laboratories Inc.

5717 THIRD AVENUE, BROOKLYN 20, NEW YORK HYacinth 2-4800

he's working for you

THIS FELLOW IS TRAINED IN YOUR BUSINESS. His main duty is to travel the country — and world — penetrating the plants, laboratories and management councils . . . reporting back to you every significant innovation in technology, selling tactics, management strategy. He functions as your all-seeing, all-hearing, all-reporting business communications system.

THE MAN WE MEAN IS A COMPOSITE of the editorial staff of this magazine. For, obviously, no one individual could ever accomplish such a vast business news job. It's the result of many qualified men of diversified and specialized talents.

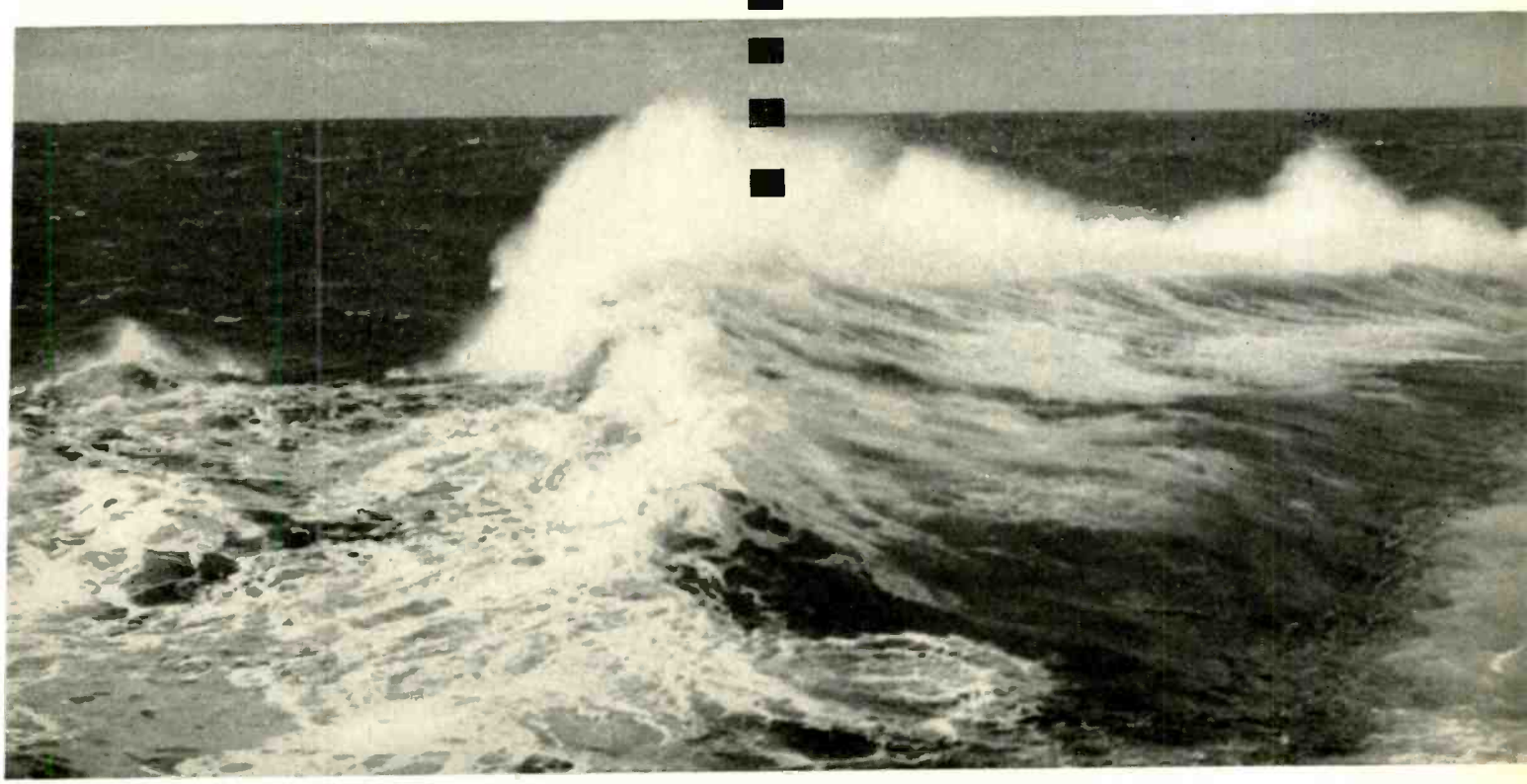
AND, THERE'S ANOTHER SIDE TO THIS "COMPOSITE MAN," another complete news service which complements the editorial section of this magazine — the advertising pages. It's been said that in a business publication the editorial pages tell "how they do it"—"they" being all the industry's front line of innovators and improvers — and the advertising pages tell "with what." Each issue unfolds an industrial exposition before you—giving a ready panorama of up-to-date tools, materials, equipment.

SUCH A "MAN" IS ON YOUR PAYROLL. Be sure to "listen" regularly and carefully to the practical business information he gathers.

McGRAW-HILL FOR BUSINESS

McGRAW-HILL PUBLICATIONS

TOP SECRET



You see here the next great area in the rocketing progress of flight . . . a study in deep blue of three-fourths of our world.

To those behind the scenes, the picture says this:

Today at Martin, one of the most important developments in the world of aviation is under way—and under wraps. When the champagne is swung, it may well launch a new era. For the next Martin flying boat will be a giant step forward of unprecedented dimensions, both in its importance to naval airpower and in its implications to commercial aviation.

The rivers, lakes and seas of the world offer limitless landing and take-off areas to most cities, at no cost. And tomorrow's flying boat, free of the tons-heavy weight of landing gear, is the most logical aircraft for atomic power.

As top authorities on hydrodynamics, the technologies of water-based aircraft development, and the waters of the world, Martin's role in the coming new air era is inevitable.

You will hear more about Martin!

MARTIN

BALTIMORE · MARYLAND

A FEW OF MANY EDO SONAR
EQUIPMENTS FOR COMMERCIAL AND NAVAL USE

EDO

finest name in

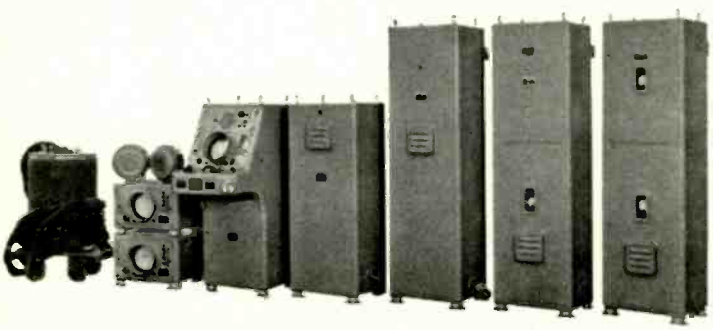
SONAR

Ingenuity of design, proven performance and superior range with accuracy are the main reasons why EDO is now regarded and recognized as the outstanding leader in the development of echo-ranging equipment.

From deep depth sounders for navigation, survey, and ocean bottom exploration to a wide variety of under water detection systems, Edo equipment has made its mark and proven its superiority.

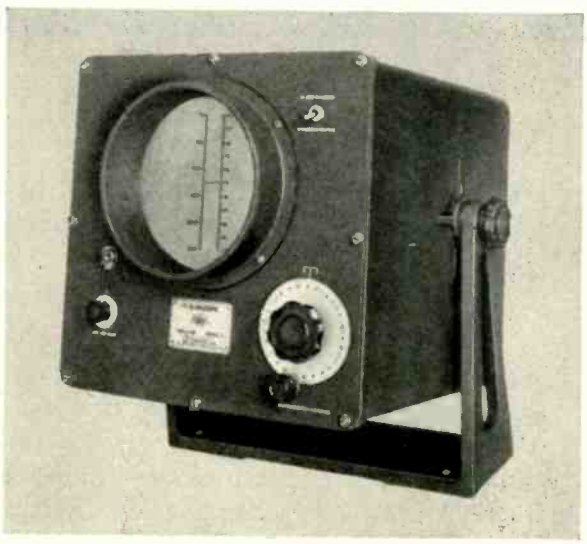
That's why when you see the Edo flying fish emblem on a sonar equipment you can confidently recognize it as a product of brilliant engineering and masterful workmanship—reliable beyond question.

Just off the press! "The Story of Edo"—24 page book describing Edo's diversified facilities and the company's 29-year old history. Send for your copy today.



EDO SCANNING SONAR a typical example of a complex naval sonar system, developed and built for the U. S. Navy by Edo.

0 TO 6000 FATHOM DEEP DEPTH SOUNDER in wide use with U. S. Navy (AN/UQN-1b) now available commercially (Model 185). Gives clear indication of depth on cathode-ray tube in two scales: 0 – 100 feet; 0 – 100 fathoms. Records continuously in three scales: 0–600 feet; 0–600 fathoms; 0–6000 fathoms. The finest deep depth sounder available. For complete details send for Model 185 brochure.



EDO FISHSCOPE. Most advanced fish finding device available today. Spots fish on cathode-ray tube in 0 – 250 fathom range, then magnifies any 10-fathom sector 25 times for clearer view. Commercial fishing boats equipped with the Fishscope report better than average hauls in far less time thanks to this Edo development. For full details send for Fishscope brochure.

EDO CORPORATION • COLLEGE POINT, L. I., N. Y. Since 1925

HOW TO WIN THE SERIES

You can't play baseball with recording discs . . . nor, do baseballs provide an adequate surface for recording.

On the other hand, a cheap, poorly balanced baseball is useless in a professional game. And, a second rate, unevenly coated recording disc can spell doom for any professional recording job.

In recording, the risk is removed when you choose PRESTO. For here is a disc made with the same care and perfection that go into the world's finest recording equipment. Produced in the world's most modern disc manufacturing plant, PRESTO Green, White, Orange and Brown label discs are outstanding in quality, unbeatable in performance.

Whether you're recording one program, or an entire series, you're always on the winning side with PRESTO discs.

PRESTO RECORDING CORPORATION
PARAMUS, NEW JERSEY

Export Division: 25 Warren Street, New York 7, N. Y.
Canadian Division: Walter P. Downs, Dominion Square Bldg., Montreal

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISCS

Save money on high permeability needs with ARMCO TRAN-COR A-6

Are you paying for low core loss to gain high permeability? Then investigate Armco TRAN-COR A-6, which is made for high permeability at low and moderate inductions. It is tested to meet permeability requirements at 100 gausses, rather than for core loss at high inductions. Yet it has core losses at high inductions similar to the best grades of hot-reduced high-silicon steels.

Replaces More Expensive Material

TRAN-COR A-6 has high permeability in all directions. This is an advantage in certain applications like servo-mechanisms, where high permeability is required without strongly directional properties. In designing instrument transformers, phase angle and ratio errors can be kept low without using considerably higher priced magnetic material.

Punching quality and ductility are excellent. Armco TRAN-COR A-6 is made in 29 and 26 gages in welded coils or cut lengths, in full or slit widths.

Here are typical magnetic properties of Armco TRAN-COR A-6:

INDUCTION (gausses)	PERMEABILITY (gausses/oersteds)	CORE LOSS (in watts per lb. for 0.0185" thickness at 60 cps)
20	1,300	
50	1,800	0.000014
100	2,300	0.000064
150	2,500	0.00016
1,000	6,000	0.0086
2,000	9,000	0.032
4,000	12,000	0.118
6,000	13,000	Similar to the better grades of hot-rolled, high silicon steels
10,000	9,000	
12,000	4,400	
14,000	630	

For further information, write for our catalog, "Armco Hot-Rolled Electrical Steels." Included are such data as incremental permeability, reactive volt-amperes, and core loss at frequencies from 50 to 10,000 cps. If you will tell us your requirements we will quote you promptly.

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There has long been cable easy to install.

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HELIAX will be on display in Booth 532 at the Wescon Show.

Ease of installation (HELIAX can be pulled through conduit and bent repeatedly without changing its characteristics) means substantial savings in installation costs.

HELIAX is crush proof, may be removed from one installation, coiled and reinstalled. Now available in 7/8" size in continuous lengths. Soon available in larger sizes. Send the coupon for detailed specifications.

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COMPANY_____

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electronics

W. W. MacDONALD, Editor

AUGUST • 1954

CROSS TALK

►**ECONOMIC SIGNPOSTS . . .** A top-flight executive with unique access to men considered expert in a wide variety of fields was recently asked to name factors most likely to exert major influence upon future American business. He listed them in the following order:

For the short term—*military equipment needs, automobile sales and demand for capital goods.* For the long term—*household durables, entertainment and construction.*

If this is so the electronic industry is in a very healthy economic position indeed; almost all modern military equipment involves electronics, and both radio and television sets are household durables that provide entertainment.

We know of no other industry that dovetails into the future quite so promisingly as our does.

►**DISTRIBUTION DECISION . . .** In Atlantic City last month we discussed the rapid rise of the so-called discount house with many distributors and several manufacturers of radio and television receivers. It may be that this part of our industry is on the verge of an important decision concerning household appliance distribution; whether it be a short-term or long-term decision remains to be seen.

It seems that price is king on the retail front. Manufacturers are doing most of the market promotion, with distributors essentially providing just warehousing and financing and dealers giving away their margins. Under these circumstances it has occurred to many sales managers that they might save money by doing their own warehousing and financing and further cut retail discounts.

Several unanswered questions serve as a deterrent. Among them are these: Can the manufacturer alone keep the marketplace pump primed? Would as much merchandise be sold by fewer retailers, even though they were larger? And what about service at the consumer level?

►**POWER TRANSISTORS . . .** Addressing machine-tool builders, R. L. Bright of Westinghouse has pointed out two inherent differences between the conventional electron tube and the transistor that are not widely appreciated. The tube uses practically no power from the signal source to control, while the transistor requires a small but still appreciable amount of power. On the other hand, the tube is a device having relatively high internal resistance while the transistor's is inherently low.

The Doctor thinks the first-mentioned difference largely explains why the transistor has not yet successfully competed with the tube in many applications, and feels that his second point may mean that transistors will play a particularly important part in the power field because of their high overall efficiency.

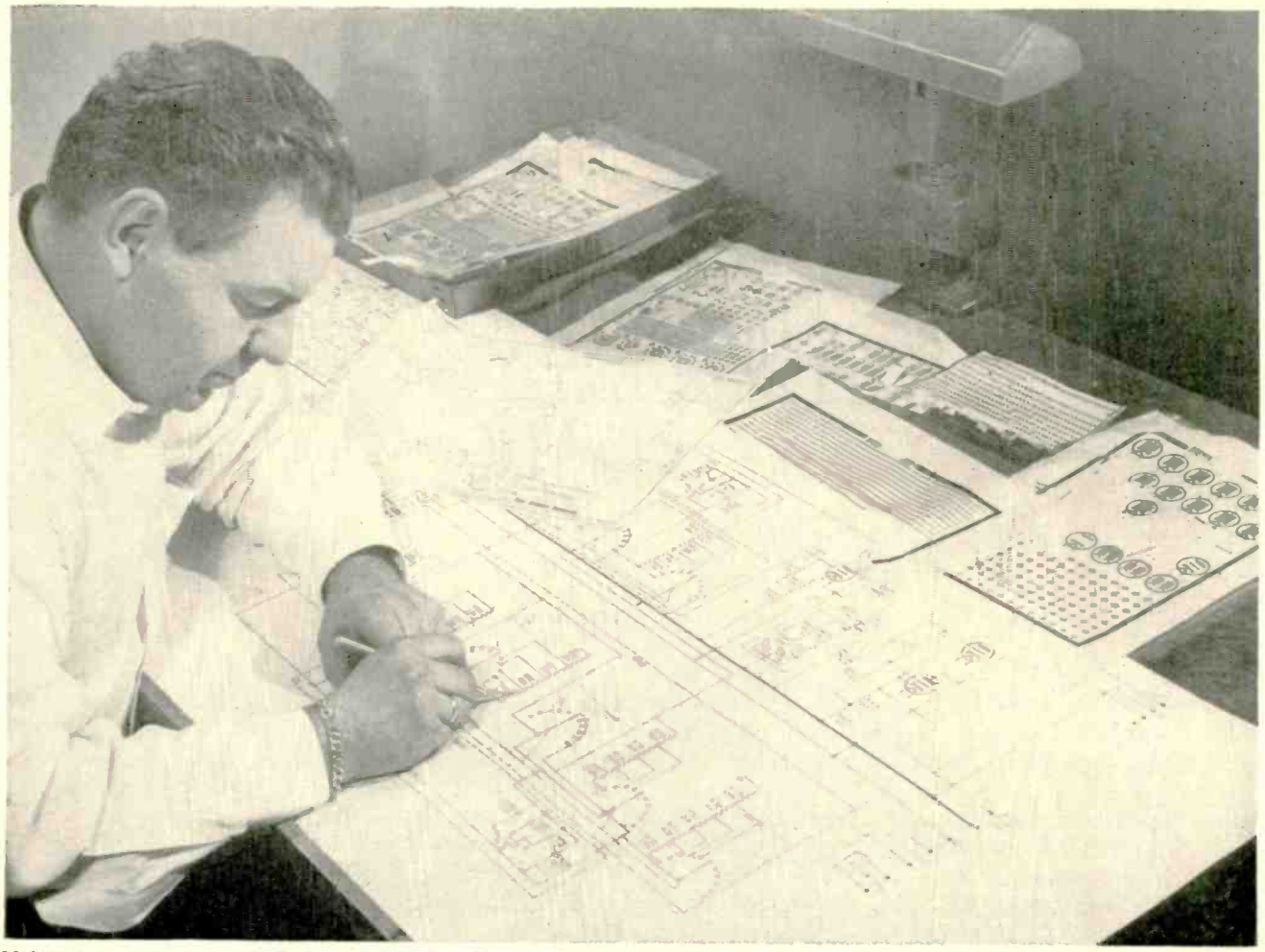
►**RELIABILITY . . .** We have it on good authority that 40 fire-control devices employing transistors have been tested for an average of 4,000 hours apiece, and that only two equipment failures occurred. One was caused by a defective battery. The other was caused by a poor *connection* to a transistor!

►**BROADCAST MARKET . . .** Despite the phenomenal growth of television, radio continues to be good business—for the broadcaster and for his equipment supplier.

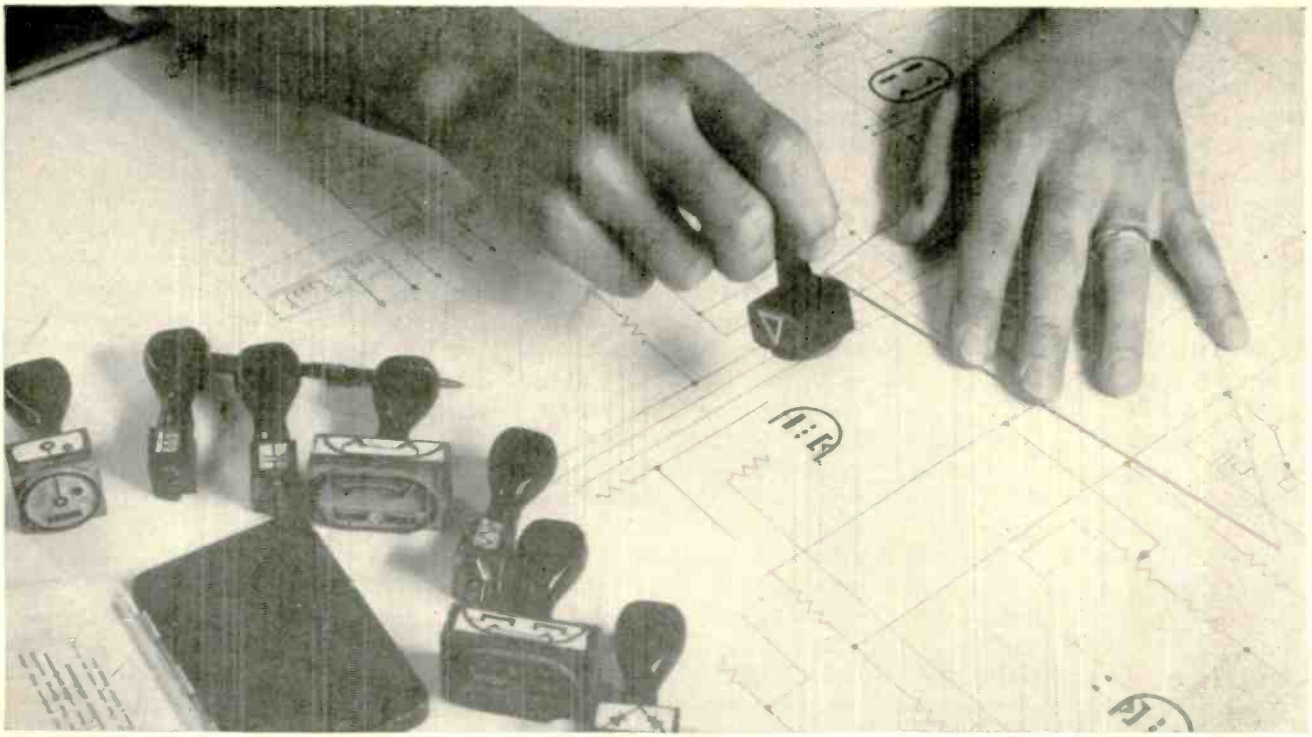
This year, new a-m stations are neck-and-neck numerically with tv starters. There is a growing market for transmitters and studio equipment to replace gear often as much as 20 years old. Prospects are particularly good for manufacturers of remote-control equipment.

Just over the horizon we think we see possibilities of automatic studio control, possibly achieved by recording inaudible control tones along with program material on 8-hour tape.

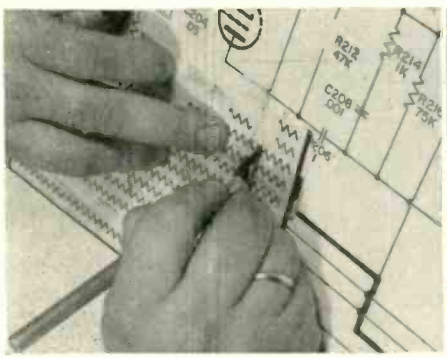
►**UHF . . .** A Washington wag recently spelled out the abbreviation uhf as "ulcer" high frequency.



Making large schematic entirely from wax-backed Artype printed acetate symbols at Barnard Studios, Indianapolis. Draftsman cuts desired symbols or lengths of circuit lines from stock sheets and presses them onto drawing paper with frisket knife. Printed blue cross-hatching on paper eliminates need for T-square and triangles. Circuit nearing completion here, of new high-fidelity preamplifier and equalizer, is being made for Regency Division of I.D.E.A.

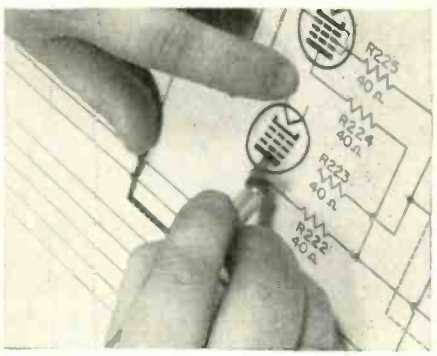


Using rubber stamps to speed production of schematics for military and commercial instruction manuals in drafting department of McGraw-Hill Technical Writing Service. Fountain-type ruling pen is then used conventionally to connect symbols together



Cutting desired length of resistor symbol from printed acetate sheet

Placing symbol on drawing. Guideline squares are ⅜ inch



Positioning tube symbol. Connecting lines will be put on next

New Electronic Drafting Tools and Techniques

Neater, clearer schematics and wiring layout diagrams are obtained in less time through use of such shortcuts as preprinted acetate symbols, adhesive-backed paper for lettering, rubber or plastic symbol stamps, photographic templates and plastic stencils

By JAMES R. McDERMOTT
McGraw-Hill Technical Writing Service
New York, N. Y.

ALTHOUGH ELECTRONIC equipment is getting smaller, the size, complexity and number of schematic and wiring diagrams required is increasing. As just one example, the blueprints for a complex transistorized subminiature unit actually weighed more than the finished product. This increase in demand for diagrams often produces an added burden and strain on already overloaded electronic drafting departments.

The principal increased demand for drafting time occurs in making the initial and other trial layouts that are essential for a readable and intelligible final schematic. With the increasing complexity of equipment, a good schematic layout is of vital importance to the manufacturer in the design, manufacture and servicing of his equipment. In addition, the modern electronic equipment sold to the Government requires instruction books and circuit drawings drawn to exacting specifications. These specifications usually require the clearest, most understandable type of layout, which by the very requirements demands an additional amount of time, over and above that devoted to drawings used by factory personnel.

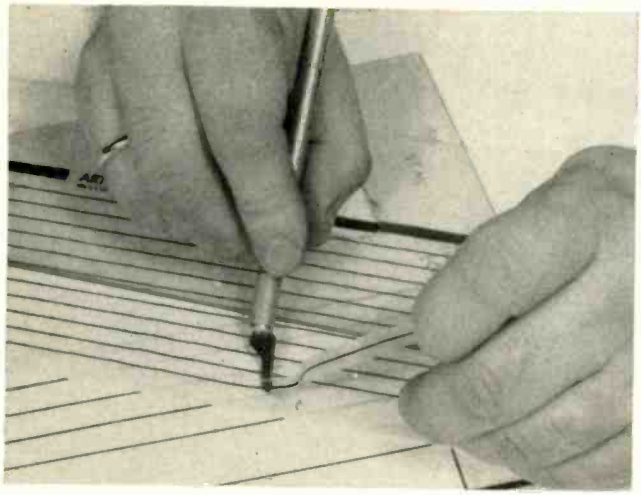
In laying out a schematic conventionally, the designer or draftsman first sketches a tentative arrangement of the tubes, transformers and other major components. The interconnecting lines and symbols for small components are drawn to complete the diagram.

The layout is then analyzed. If it is found to be satisfactory, all is well. If the layout is partially or completely unsatisfactory, it is necessary to erase a good part of the drawing, or even to make an entirely new one. This process is repeated until the desired clear logical layout is obtained. Rearranging and redrawing in pencil at least once is generally unavoidable for complex new circuitry.

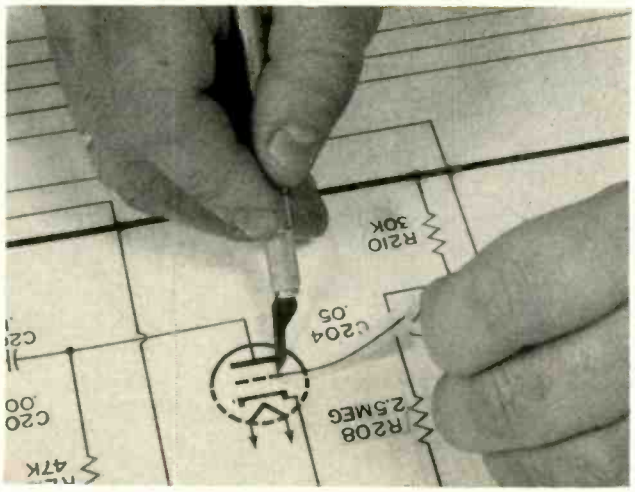
The problem of expediting the layout of schematic drawings has been attacked by a number of concerns. All take advantage of the fact that electronic diagrams contain a multitude of repeated standard schematic symbols. The various new tools and techniques being used as shortcuts for this part of electronic drafting will be taken up one by one. First, however, a unique method of producing either preliminary or final schematics without ink will be described. This is particularly advantageous in preparing reproduction copy for technical instruction manuals.

Printed Acetate Symbols

Complete elimination of inked lines and lettering, constituting a close approach to automation in electronic drafting, is being achieved in a number of plants through the use of symbols, letter-



Separating wiring line from backing sheet after cutting out line with frisket knife



Applying circuit line to control grid of tube. Surplus length of line will be cut off

ing and rules printed on transparent wax-backed acetate film. Sheets containing various assortments of standard symbols can now be obtained, and sheets of special symbols can readily be made to order.

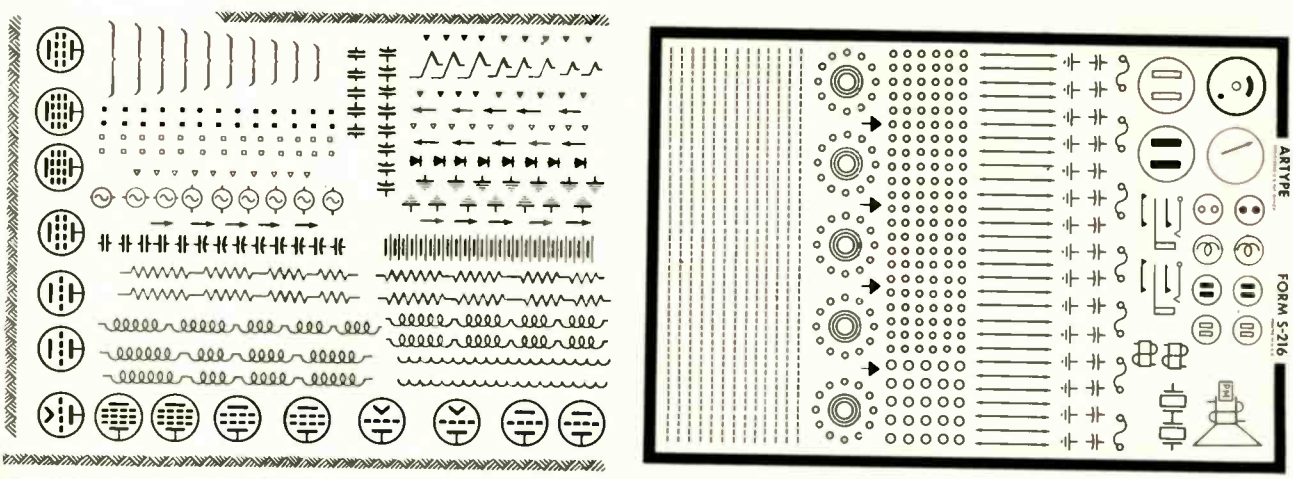
With symbols printed on acetate, the only tool needed is a sharp scalpel or frisket knife. With this, the draftsman cuts around the desired symbol on the stock sheet with a few quick strokes, slips the knife under to pull the symbol up from the protective heavy backing paper then places the symbol on the drawing and applies pressure with a quick stroke of the flat of the knife to lock the symbol in position. The drawing paper used has printed light blue lines ⅛ inch apart horizontally and vertically to serve as guides for positioning symbols. This completely eliminates the need for T-square and triangles.

Circuit lines are printed on acetate sheets as ruled lines and are cut out the same as symbols. Generally the draftsman cuts out a line long enough for several connections, applies one end to a previously applied symbol, runs the line as far as he needs and makes a quick cross cut there. The remaining acetate piece is then picked up and used similarly for the next connection. With just a bit of practice, a man can place connecting lines on a schematic even faster this way than with a ruling pen. There is no waiting for ink to dry, no refilling of the pen and no erasing of mistakes. If an error is made, the line is lifted by slipping the knife under, then moved and pressed down again in the correct position. Most circuit lines are, for convenience, placed directly on the guide lines.

Where lettering for schematics is standardized, much of it can be printed up beforehand on acetate sheets. Standard sheets are already available having parts numbers from R-1 through R-200, C-1 through C-175 and many other combinations of numerals with or without letters.

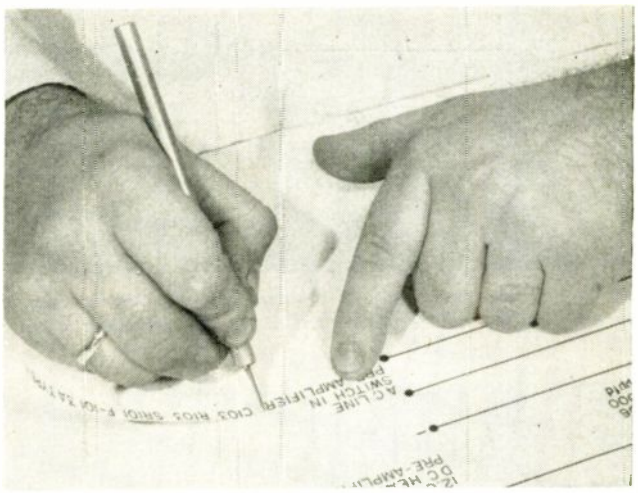
Values of parts must be lettered conventionally, because of the great variety of values employed. Printed rules, arrow lines and arrow heads can be applied directly to glossy photos along with printed lettering to speed preparation of callouts and other identification on photos for instruction manuals.

When lettering varies so much that any preprinted notations would be more of a nuisance than an aid, another lettering technique is available for speeding up application of lettering while still keeping ink off the master drawing. This involves placing all the lettering on a



Examples of two stock sheets of Artype, now available from The Barnard Studios, Indianapolis. Symbols are repeated in varying numbers according to needs; entire sheets are devoted to most popular symbols, such as resistors, inductors, ground symbols, capacitors, circuit lines, crossover loops and tubes. Symbols are printed on clear acetate that peels easily from the heavy backing sheet

All lettering is done consecutively on Kleen-Stick drawing paper (Kleen-Stick Products, Inc., Chicago), then cut apart as shown



Method of placing lettering on drawing and separating notes. Changes in positions of notes are easily made

drawing paper having a pressure-sensitive adhesive backing, using mechanized or freehand lettering as preferred. The designations are then cut out from the sheet with the frisket knife and applied to the drawing in much the same way as were the symbols. Lettering the notes consecutively on one sheet makes for greater lettering speed. Notes that don't fit in the available space in one line can readily be cut into two or more lines without re-lettering. Any errors in placement of notes are easily corrected by picking off the note and putting it down in the new location.

Comparative tests have indicated that drafting time for schematics can be cut approximately in half by using printed symbols. This can be bettered if it is feasible to print all lettering beforehand except parts values. With receiver schematics, for example, one firm using printed symbols can turn out in 3 hours a diagram that takes 8 hours conventionally.

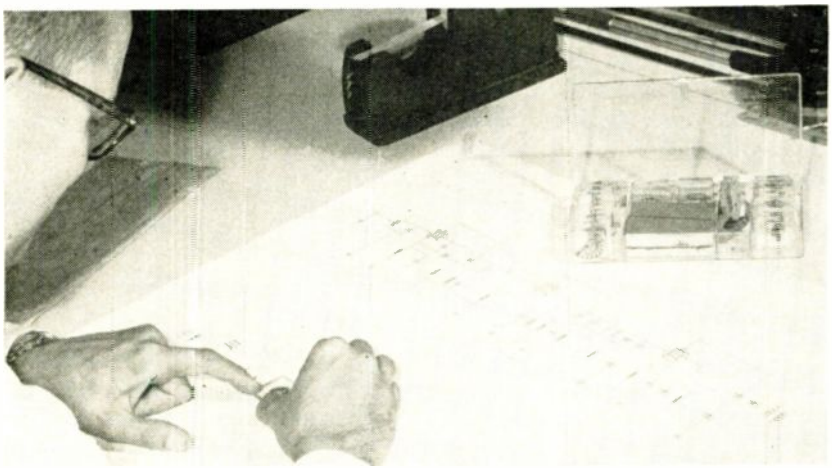
Some symbols are not needed often enough to warrant preparation of a printing plate. Here it is possible to cut out parts of existing printed symbols and recombine them. Special rotary switches can thus be formed from open dots, lines, arrows and arcs of circles on acetate stock sheets.

Rubber and Plastic Stamps

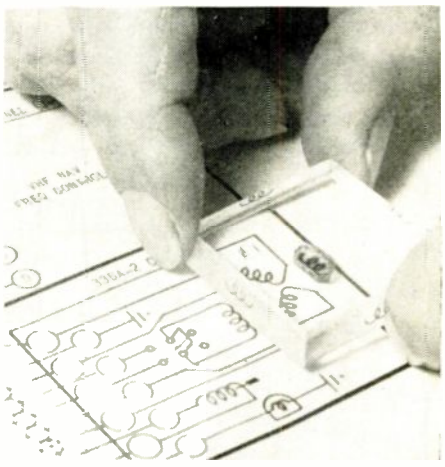
One popular solution to the preliminary schematic layout problem involves the use of individual rubber or plastic stamps for schematic symbols. The rubber stamps can be made up conventionally by any supplier of rubber stamps in the various sizes required if an inked sample of a desired symbol is furnished. To help the draftsman align the stamp properly when stamping a symbol on the layout paper or cloth, guide marks are placed on two or more sides of the wood block at points where the symbol has its circuit corrections. A special opaque black stamp pad ink is used with a conventional stamp pad to secure impressions comparable to inked lines.

At least two firms are now making available to the electronic industry special stamps made from vinyl plastic mounted on clear acrylic plastic, rather than rubber mounted on wood. With these plastic stamps the draftsman can see exactly where he is placing a symbol on the diagram and thereby secure much more precise register of symbol imprints with lines already drawn or stamped on a diagram. These require special pads and printer's ink for best results, since plastic characters are harder.

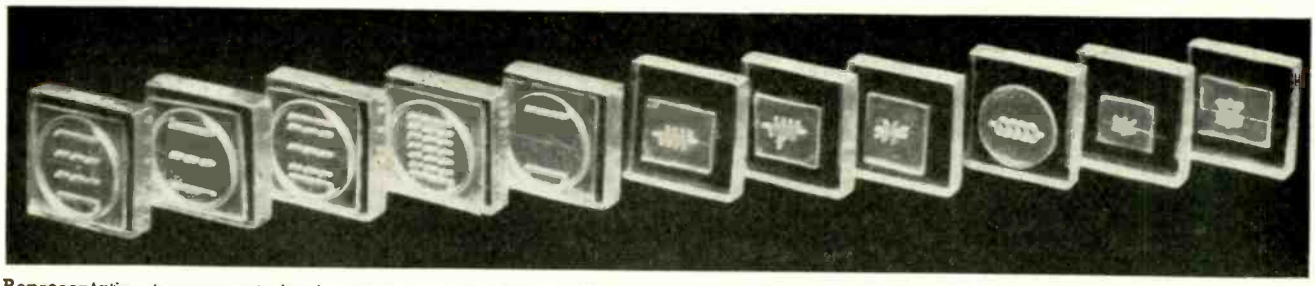
Plastic stamps can be obtained



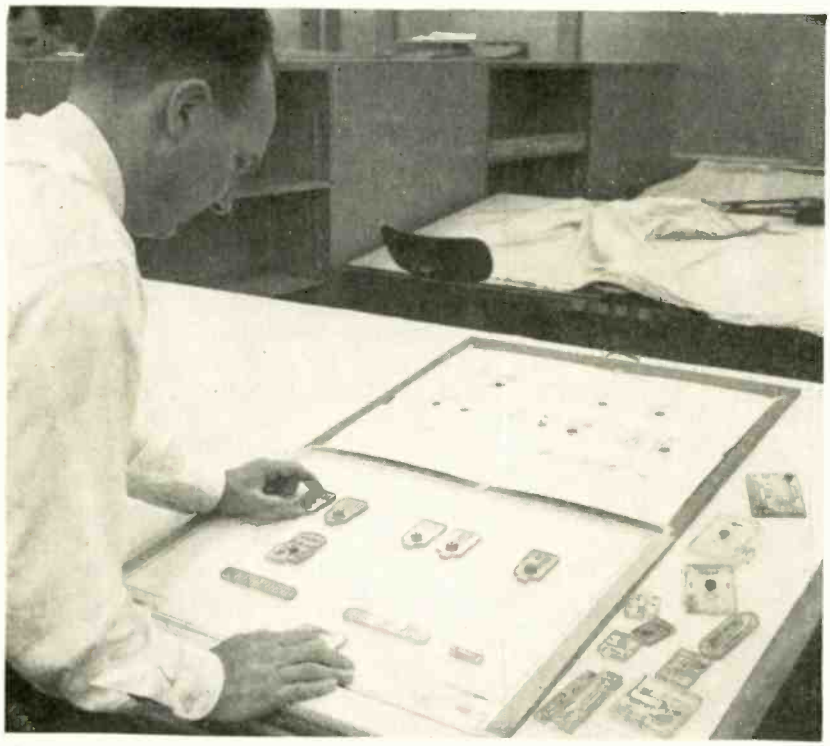
Using transparent plastic symbol stamps made by John Griffin Co., St. Paul, Minn. in drafting department of Northwest Airlines. Plastic box at right holds set of 27 standard ASA electronic symbols and two facing ink pads



Transparency of plastic stamp permits precise alignment of new symbol with those already printed on diagram



Representative transparent circuit stamps made by Precise Measurements Co., Brooklyn, N. Y. Built-in cross hairs at different level from printing surface aid in placement of stamp, particularly when symbol is small like those at right

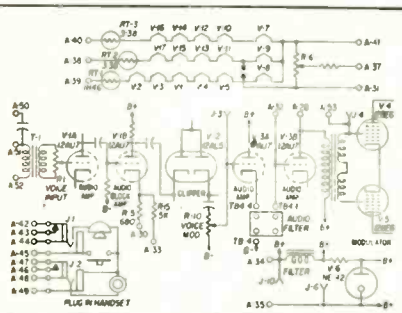


Arranging magnet-bearing templates on photosensitive paper taped to metal drawing board. Slowness of photosensitive coating permits use under normal drafting room lighting conditions yet gives desired exposure under intense lights of blueprinting machine in plant of Reliance Electric and Engineering Co., Cleveland, where process was developed

Template arrangement on board is exposed in light box behind draftsman. This Ree-Copy template drafting process has increased efficiency of draftsmen by 30 percent, with similar saving in time

individually in stock patterns and sizes, as well as in complete assortments of electronic symbols. In addition, special designs can be made to order from drawings for complete frequently-repeated stages or amplifiers as well as individual symbols. Still another timesaver in plastic stamps is one incorporating lettering frequently used on diagrams; as an example, a plastic stamp costing around five dollars can be made up that will in three seconds place on a drawing all of the following lettering, in exactly the same size and style of Leroy or other lettering used elsewhere on the drawing:

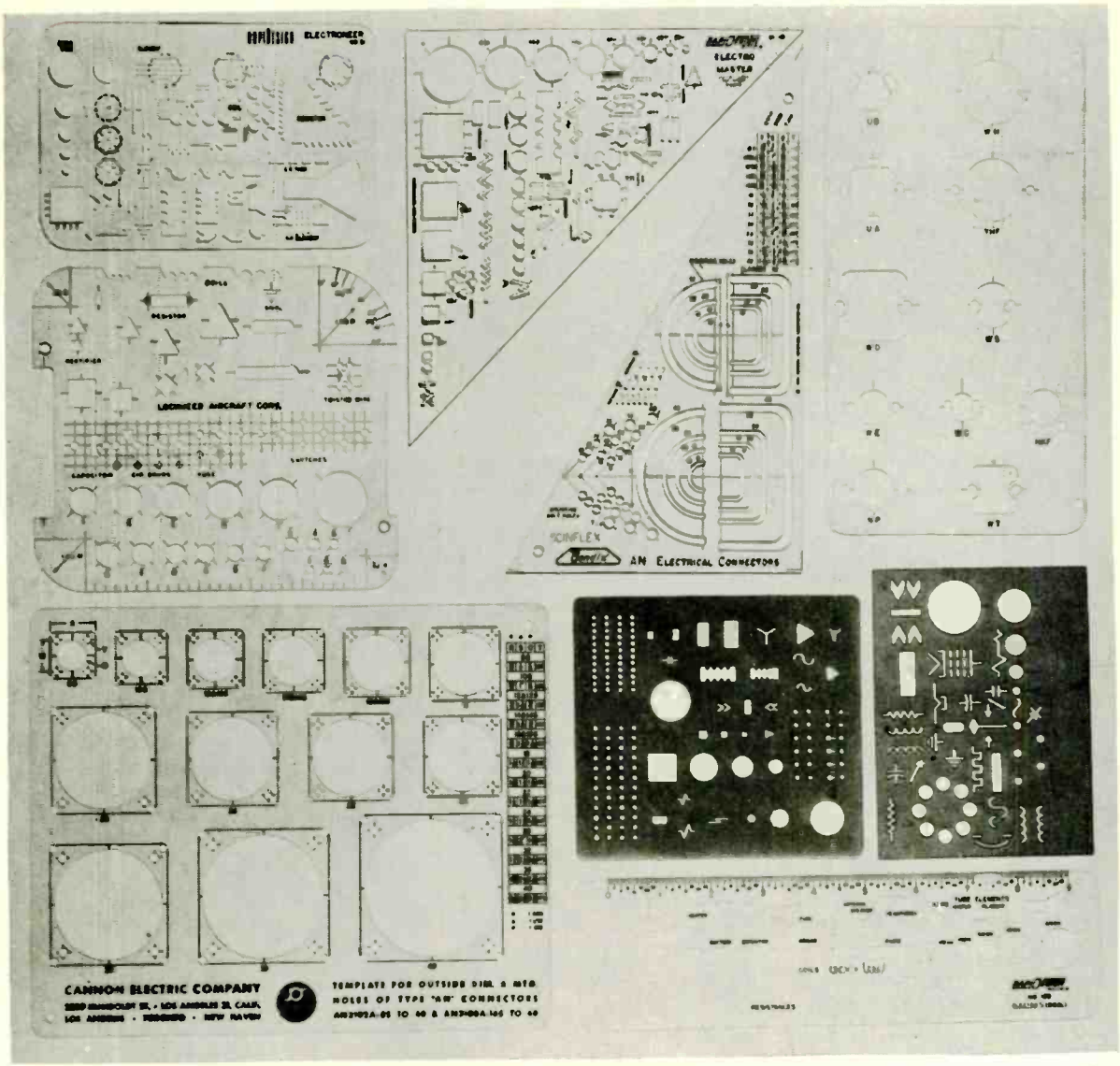
1. RESISTORS ½ WATT UNLESS OTHERWISE SPECIFIED.
2. RESISTANCE IN OHMS UNLESS OTHERWISE SPECIFIED.
3. CAPACITANCE VALUES ONE AND OVER IN MICROMICROFARADS, LESS THAN ONE IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.



Example of diagram made with one impression of special 48-square-inch Symbostamp. This saves approximately 12 hours of drafting time and insures that frequently repeated portions of large schematics will be identical and accurate. Checking time is also saved

Opaque-Line Symbols

A mechanized approach to electronic drafting makes use of a photographic process for preliminary schematics and wiring layouts. The various symbols required are made up as opaque lines on transparent templates. A small round permanent magnet is attached to



Representative examples of electronic symbol stencils. Punched-hole layout stencil at lower left is supplied by Cannon Electric Co. to users of its AN connectors. All others are made by RapiDesign, Glendale, California, as custom or stock designs. Unit at left center is used by Lockheed for electronic drafting, and 30-60 triangle is a Bendix design for its Scinflex electrical connectors. Parts-mounting stencils like that at upper right are made up in punch press department of the Berkeley Division of Beckman Instruments Inc. for use by its drafting department

each template in an open area not interfering with the symbol. The drawing board contains a magnetic metal face to which the templates will cling.

In operation, a photosensitive sheet of blueprint paper is placed on top of the board and fastened securely in place with masking tape to avoid wrinkles. The photosensitive material can be any ordinary blueprint or whiteprint paper which requires no special handling under normal drafting room lighting conditions. On top of this, if desired, is placed a thin transparent master sheet which bears standard notations such as borders, titles and boundary marks.

The draftsman then sets the templates in place, moving them around until he gets the best initial arrangement. The permanent magnets hold the templates in position on the board while it is carried over to a blueprint machine and exposed.

The templates and border sheet are then removed and the photosensitive material is developed conventionally. The resultant print is a rough layout on which the draftsman can draw in the circuit lines connecting the individual terminals of the components or parts represented by the photographically printed symbols. In this fashion the draftsman can quickly determine whether or not the initial layout is satisfactory. If a change is necessary, he easily and quickly repeats the procedure with a different arrangement of templates on a fresh sheet of blueprint paper.

Symbol Templates

Another type of drafting aid, used in increasing qualities by manufacturers both for their own drafting departments and as give-aways to customers, is the plastic template. These have been available for some time with various combinations of symbols.

A variation of this technique, used for parts layout diagrams, involves punching in a sheet of heavy clear plastic each of the hole sizes and arrangements used in chassis production. The sheet is placed on each punch press in turn.

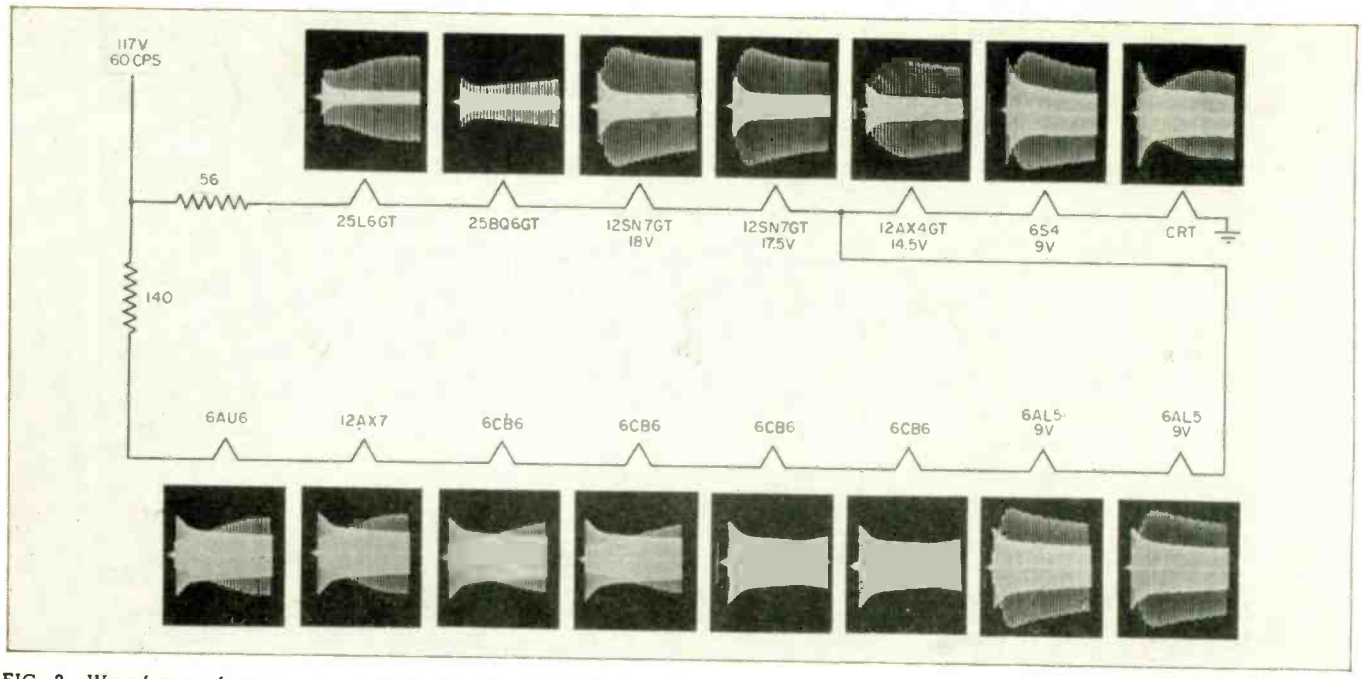


FIG. 2—Waveforms of warm-up transients in series string having tubes arranged on basis of operating voltage

Series Heater Strings

USE OF SERIES heater strings in television receivers has potential advantages in cost, size and weight reduction.

Many manufacturers have attempted to use such strings in commercial receiver designs. In many cases the results have been far from satisfactory due to an excessive number of heater failures.

Causes

One of the outstanding causes of heater failure in series circuits has been attributed to high power surges during warm-up. These surges arise due to inequalities in the rate of heater resistance change immediately following power application.

To examine the initial heater transients that occur in the first few seconds of warm-up the circuit of Fig. 1 was constructed. The oscilloscope sweep is adjusted to approximately 1/15 of a cycle or 15 seconds per sweep.

The relay contact oscillates from voltage to current at a rate of 0.4 seconds per cycle thus providing a record of both voltage and current surges as well as a calibrated time base.

If all tubes warmed up at the same rate, and if the initial resistances were in the same ratio as the final, the resistance distribution in the string would be the same at all times and no voltage surges could exist. It would seem logical to use tubes of similar characteristics throughout each section of the string. The series string of Fig. 2 was set up with the 12 and 25-volt tubes grouped on one side, and the lower-voltage tubes on the other side in anticipation of similar heating characteristics. The tubes were chosen from a variety of manufacturers.

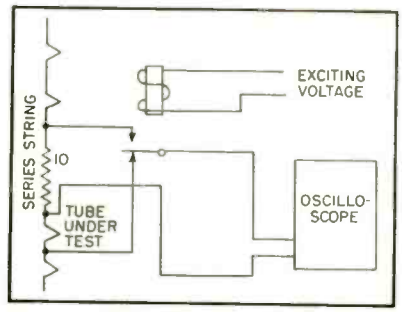


FIG. 1—Circuit used to obtain oscillograms of voltage-current surges during heater warm-up

A study of the voltage-current oscillograms shows that serious surges exist. The 6AL5 tubes take an excessive surge of 9 volts during the first few seconds while the 6CB6 tubes are warming up very slowly. On the other side of the string the 12SN7GT tubes are surged to about 18 volts while the 25BQ6GT is underheated. The 6S4 and the 12AX4GT tube take surges of 9 volts and 14.5 volts respectively.

The tubes were then regrouped as in Fig. 3. The slow-heating 6CB6 tubes were combined with the slow-heating 25BQ6GT tube, and the fast-heating 12SN7GT tubes were combined with the fast-heating 6AL5 tubes.

Some improvement results. The 6AL5 surge has been reduced to 7.8 volts and the 12SN7GT surge has been eliminated. At the same time the 6CB6 and 25BQ6GT tubes are heating at a much faster rate. However, the 6S4 surge has been raised to 9.5 volts and the 12AX4GT surge to 15.1 volts.

Figure 4 is identical to Fig. 3 except that the original 6AL5 tubes have been replaced. The 6AL5 surges (7.8 volts in Fig. 3) have

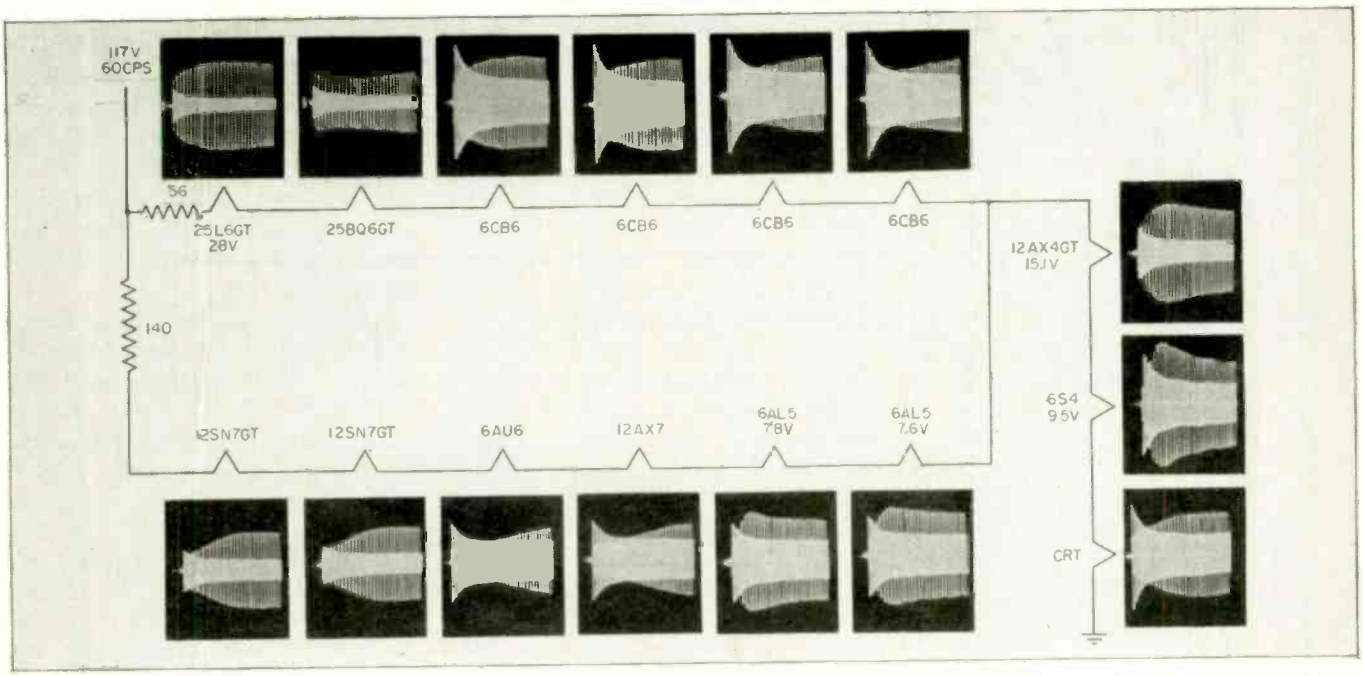


FIG. 3—Transient surges with tubes regrouped with respect to heater warm-up time

for TV Receivers

Current and voltage surges during heater warm-up are minimized by evaluation of tubes and placement in string on basis of warm-up time. Tube sample testing provides reliable method of equalizing surges in original equipment

By FRANK ROBERTS

Emerson Radio & Phonograph Corp.
New York, N. Y.

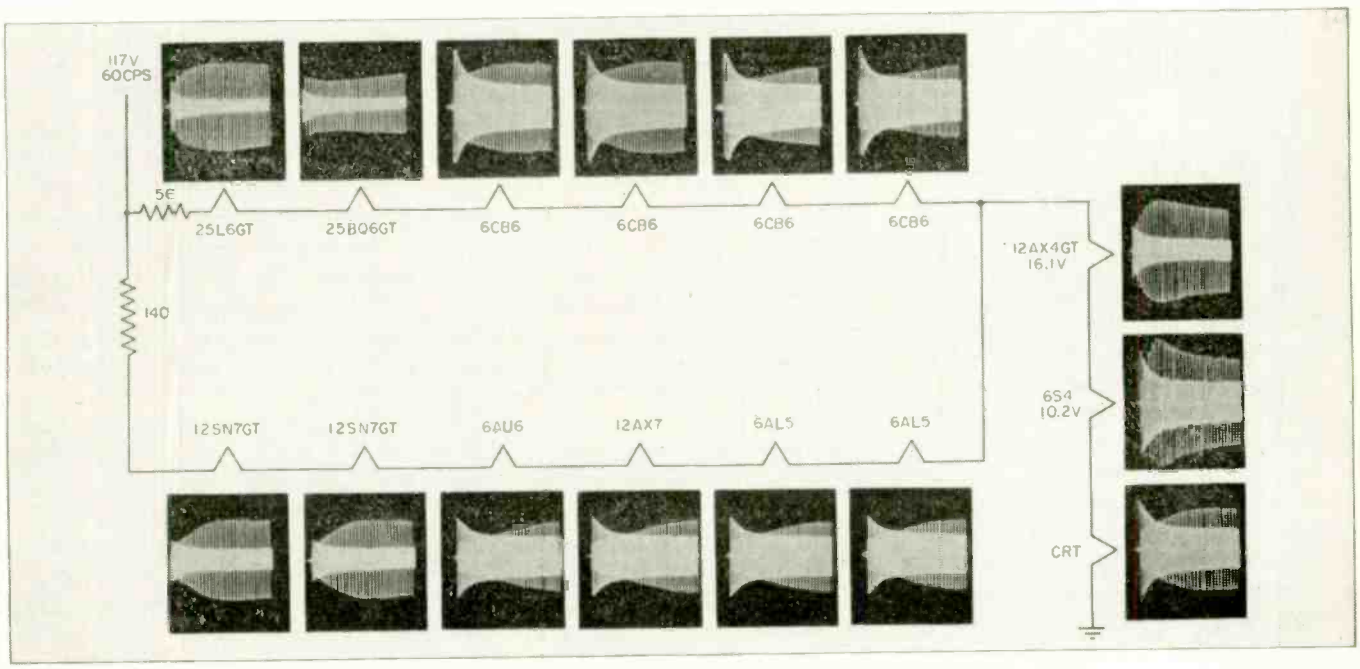
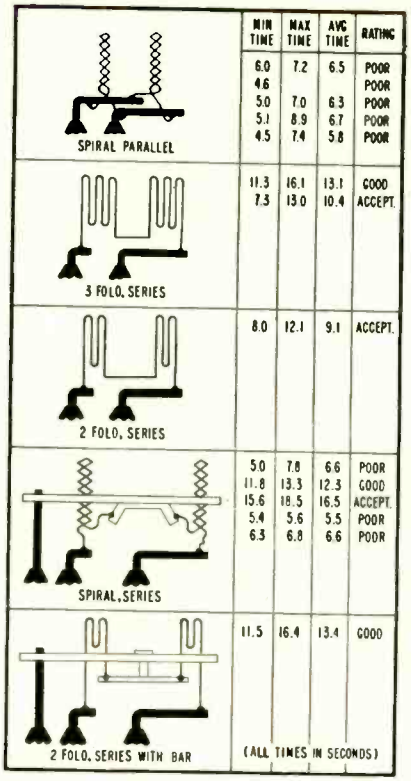


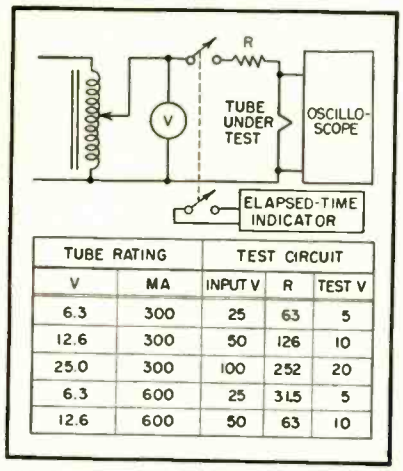
FIG. 4—Replacement of original 6AL5 tubes in circuit of Fig. 3 increased surge voltages on 6S4 and 12AX4GT



MIN TIME	MAX TIME	AVG TIME	RATING
6.0	7.2	6.5	POOR
4.6			POOR
5.0	7.0	6.3	POOR
5.1	8.9	6.7	POOR
4.5	7.4	5.8	POOR
11.3	16.1	13.1	GOOD
7.3	13.0	10.4	ACCEPT.
8.0	12.1	9.1	ACCEPT.
5.0	7.8	6.6	POOR
11.8	13.3	12.3	GOOD
15.6	18.5	16.5	ACCEPT.
5.4	5.6	5.5	POOR
6.3	6.8	6.6	POOR
11.5	16.4	13.4	GOOD

(ALL TIMES IN SECONDS)

FIG. 5—Variation of heating times with method of heater construction



TUBE RATING		TEST CIRCUIT		
V	MA	INPUT V	R	TEST V
6.3	300	25	63	5
12.6	300	50	126	10
25.0	300	100	252	20
6.3	600	25	31.5	5
12.6	600	50	63	10

FIG. 6—Thermal-characteristic test circuit. Values of *R* and input voltage are given for various tube operating voltages and currents

been eliminated. The 6S4 surge has increased from 9.5 volts to 10.2 volts and the 12AX4GT surge has increased from 15.1 volts to 16.1 volts. This indicates that tube replacement can radically change voltage distribution during warmup.

Evaluation of large groups of 6AL5 tubes revealed that in most cases all tubes of a given manufacturer behaved in like manner. Examination of the tubes revealed many variations of heater construction. Various 6AL5 heaters are shown in Fig. 5 together with data on maximum and minimum heating times.

A controlled test current can be used to measure the rate of thermal rise from room temperature. The circuit of Fig. 6 was devised for measuring thermal characteristics. The value of R is chosen to be three times the hot heater resistance and the input voltage is four times the heater rating. These values were found to give consistent results in all tests. Smaller values of R result in a more nearly correct duplication of string operation but require a far more accurate timing method. Larger values of R tend to eliminate the tube variations. Supply voltage and resistance are varied to provide correlation between tubes having different rated heater voltages and currents.

A large sampling of tubes was tested using this method. In almost all cases all tubes of one supplier, assuming no construction changes, fell within a very narrow range of timing. It was found that an internal construction change by a manufacturer from parallel to series connection does not necessarily change the timing, while a change of coating thickness without a change in construction has a major effect on timing. This shows that the manufacturer can exercise some control over the warm-up characteristic.

Selection by Time Groups

The data indicates that it is almost impossible to construct a string in which all tubes have similar time ratings. However, since the steady-state voltages require two 300-ma legs, it seems entirely possible to use two time-rating groups. Two basic times of 14 and 17 seconds were chosen for this particular application. A string was set up around these nominal figures as shown in Fig. 7. The tube locations were chosen to make maximum usage of available tubes. There are no surges on any tube in the string. Major surges have been eliminated as well as the minor inequalities.

A number of tubes with various time ratings were entered into the string one at a time and the actual voltage surges noted. There were essentially no surges for tubes rated between 12 and 16 seconds in the 14-second leg and between 14 and 21 seconds in the 17-second leg. The three tubes fed from both legs are not as clearly determined but experience has indicated that times between 14 and 18 seconds are safe.

Acceptance of these time limits does not assure safe operation in the event of field replacement. This is partially provided for since tubes are usually designed to withstand intermittent life-test surge conditions slightly in excess of normal voltages. Typical intermittent life-test voltages are 8.0 volts for types 6AL5, 6CB6, 6AU6, 12AX7, 16 volts for 12SN7GT, 12AX4GT and 29 volts for types 25BQ6GT and 25L6GT.

A range of heater times can be found which will result in operation with surges not exceeding these voltages. The limits of this range are approximately 9 to 12 seconds for the 14-second leg and 10 to 14 seconds for the 17-second leg. This should be a fairly safe condition. Tubes which average within these time groups have been designated acceptable and should be used only where good rating tubes are not available. Tubes that have time ratings faster than allowed by the acceptable categories will have surges in excess of the intermittent life-test figures.

There is also a top limit time on both the good and acceptable categories. A tube having too slow a heating time will not have any heater surges and is not in danger. However, any voltage drop which does not occur across the slow tube must be distributed somewhere else in the string tending to raise the surge on the fastest tube in the string. For this reason an upper acceptable category has been set up with the same limits as the lower section.

The correlation between time and voltage that has been determined is not exact. Some variation about the stated values can be expected. This can be explained by the difference in starting voltage or cold resistance of the tube under test, and the variations in the shape of the test-circuit transient.

A tube with a fast initial slope

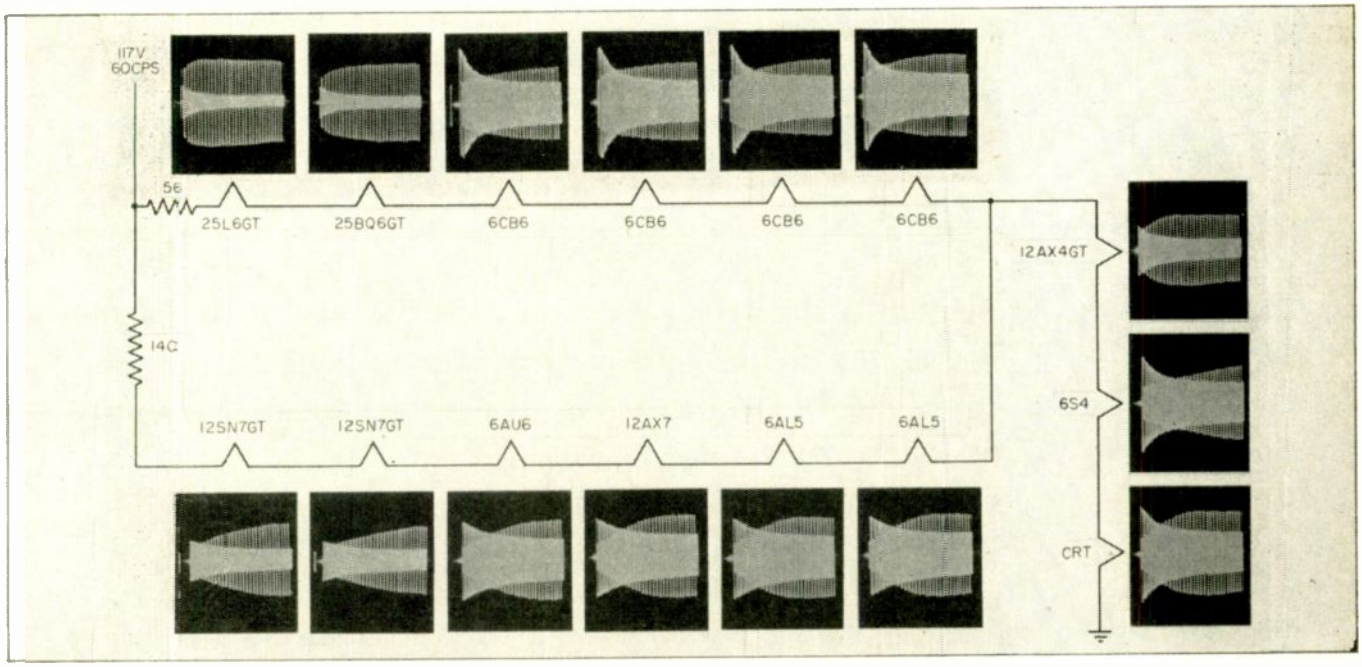


FIG. 7—Voltage and current transients for circuit using tubes selected on basis of two heating-time groups

and decreasing slope as it nears 5 volts in the test circuit will have a higher surge than a tube that has a slow initial slope with increasing slope near 5 volts, even if the time rating is identical. However, the many tubes tested all indicate somewhat similar curves and the basic approximation is sufficiently accurate.

Heater Power Surges

All of the preceding work has been predicated upon voltage surges. Some question exists that the important factor is heater power rather than heater voltage. Figure 8 demonstrates the direct relation of power and voltage surges. Power input versus time has been plotted for two 6AL5 tubes, one with a fast time rating and one with a nominal time rating excited from a normal low-impedance heater transformer.

The power curve is also shown for the same two tubes in the series string. The fast tube exhibits a much longer surge above the nominal power line when used in the string as compared to transformer operation. The nominal tube shows almost no power surge in string operation and the input is at all times below the power input for transformer operation. If the tube has adequate heater life under transformer operation it will certainly be satisfactory in series string operation.

Fixed resistances in both legs introduce a certain amount of surge reduction that is important in the final results. There is a consistent relation between time rating and the voltage surge that can be expected in a given series string. Use of smaller fixed resistors will result in narrower ranges of good and acceptable ratings.

At the same time, the longer the basic time group around which the string is determined, the less critical the time variations become. An extension of the time technique to other strings for either television or radio requires only a re-evaluation of the correlation factors between time and voltage surge. If the tube types required are different, it is necessary to measure the thermal rise in the test circuit and then choose a nominal time value that allows the use of as many tubes as possible.

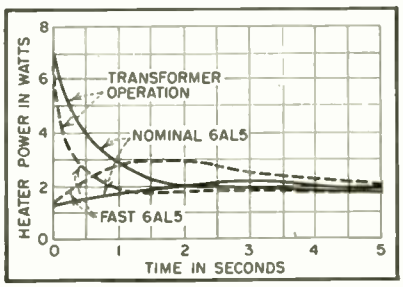


FIG. 8—Power transients for fast and nominal heating-time tubes

The method of tube evaluation described has been applied to heater arrangements other than the examples used here. The results have justified the technique, particularly in strings with smaller fixed resistors where the surge conditions are more severe. The receiver manufacturer can readily determine a set of tubes that will give adequate results in production.

The only way in which all tubes can be used interchangeably is to establish industry standardization of heater characteristics. This standardization should not dictate the mechanics of heater construction but would require a nominal range of heater warm-up time.

If such standardization is possible the entire industry will find one source of series-string trouble eliminated. Many tube manufacturers are already acutely aware of this problem and are undoubtedly willing to cooperate in establishing a reasonable requirement.

The author acknowledges the valuable assistance of W. Lukas, chief television engineer; I Horowitz, senior engineer; A. Franceschina, junior engineer; M. Sedacca, junior engineer and A. Harde, technician, in accumulating and analyzing the data required to develop the test procedures.

COMPONENT DESIGN TRENDS

New Variable Capacitors

Part II of a series interpreting recent developments in basic components. Survey of over 200 different variable capacitors and trimmers in current production reveals many new mechanical techniques for lowering minimum capacitance, increasing maximum capacitance, adapting for uhf, miniaturizing and pressurizing

By FRANK ROCKETT

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STRIPPED down to bare essentials, the variable air capacitor continues to be the most popular tuning device up to about 1,000 mc. A wide range of capacitors is available from tubular trimmers with a minimum capacitance of 1 μμf to pressurized variable tank capacitors with a maximum capacitance of 10,000 μμf.

The popular method for changing the frequency of a resonant circuit has for years been the variable air capacitor. As operating frequencies moved upstairs, units were made smaller but the basic construction has remained unchanged. A frame carries one or more sets of stators and at least one set of ball bearings in which rides a shaft that carries rotor plates. Most of the special design features of these capacitors are directed toward overcoming the inherent limitations of minimum shunt capacitance and of series inductance and resistance of the spring wiper or other means for assuring positive contact to the rotor.

Although aluminum plates are conventionally used for both stator and rotor, at the higher frequencies copper plates or silver-plated plates are used for low loss. For most applications, plastic is used for insulated supports; miniature capacitors for vhf operation are mounted on ceramic insulators, which may be coated with silicon fluid for protection against condensation. The rotors are contoured to produce various capacitance characteristics as a function of rotor position.

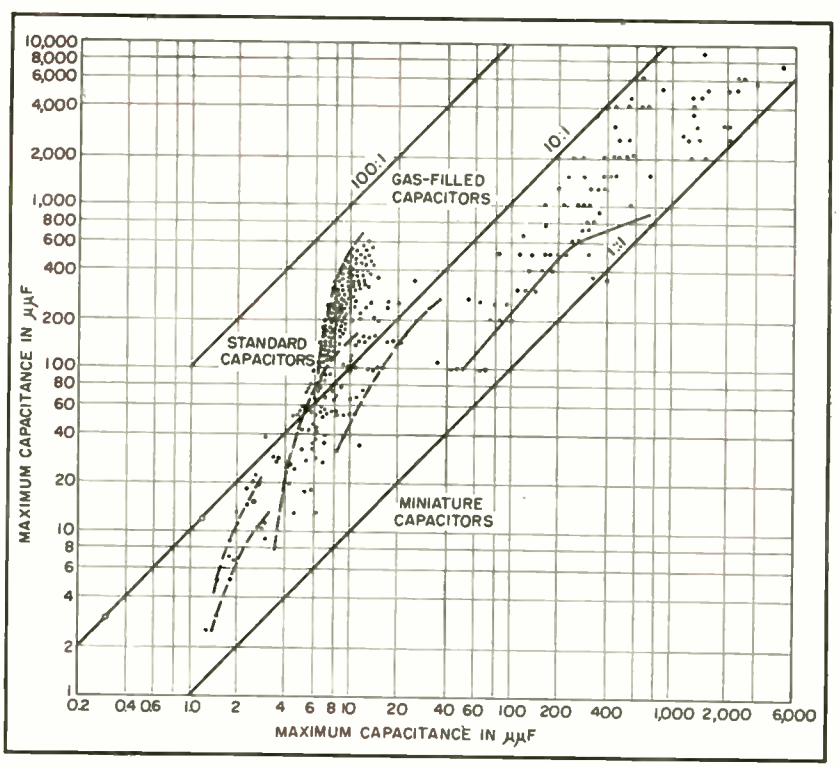
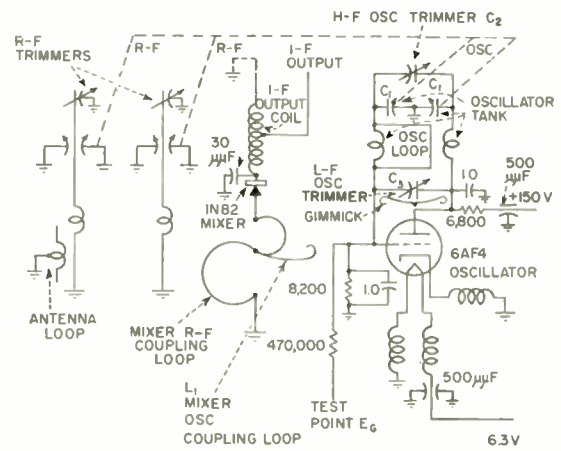


FIG. 1—Ratio of maximum to minimum capacitance for representative commercially available variable capacitors. Curves are for different families of capacitors in which numbers of plates are changed

Tuning Range

A primary consideration in selecting a capacitor for a particular function is the capacitance range over which the component can be varied. Figure 1 shows this characteristic for over 200 commercially available capacitors representative of current practice. The diagonal lines indicate the capacitance variation. The lower right-hand insert is a portion of the plot transposed from beyond the left-hand edge of the grid area. The upper left-hand insert is transposed from beyond the right-hand edge of the grid. The several curves drawn through the plotted points show the manner in which the characteristic varies for a family of capacitors of like construction as the number of plates is changed.

Extend Tuning Range



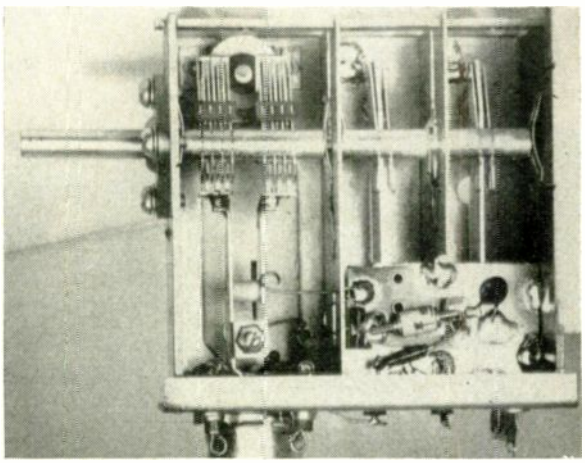


FIG. 2—Techniques used by Radio Condenser Co. for adapting variable air capacitors to uhf tv tuner. From left to right on tuning shaft are rotors for preselector input preselector output and oscillator tank. In preselector, flat center conductor of quarter-wave line is stator. Wire loop above oscillator stator is gimmick, with rectangular oscillator loop back of it

In general, one can expect that stray circuit capacitances will about double the actual minimum capacitance of a circuit so that, realistically, the diagonal lines ought to be shifted to the left. A compression flat-spring trimmer such as conventionally shunts a variable capacitor has a minimum capacitance of about 2 μμf and a variation of some 12 μμf. The open circles on Fig. 1 locate three such units. Their effect should also be taken into consideration.

Television Tuner

The adaptability of the variable air capacitor is illustrated by the uhf television tuner shown in Fig. 2. This continuous tuning unit covers channels 14 through 83 in 159 degrees of shaft rotation. The tuned circuits are modifications of end-tuned quarter-wave shielded lines the center conductors of which form the stators. This tuning method lends itself to variation by means of conventional capacitor structures with comparable simplicity of manufacture and quality control.

Sufficient tuning range is obtained for low-end and high-end adjustment. Tuning elements are readily shaped to provide uniform frequency distribution. The ratio of loaded to unloaded Q is high.

The oscillator operates on the high-side fundamental frequency in a basically Colpitts circuit using a 6AF4, as shown schematically in Fig. 2. For tracking, C_2 adjusts the high end by controlling the minimum capacitance across variable differential capacitor C_1; C_3 adjusts the low end and also aids in reducing drift during warmup by adding a relatively stable capacitance across the grid-plate capacitance.

Oscillator injection is maintained reasonably constant and high for low conversion loss in the 1N82 crystal mixer by a combination of inductance L_1 and a capacitance gimmick, a gimmick being the smallest type capacitor that is distinguished as such from stray capacitance; one plate is usually a short wire placed near a portion of the circuit which constitutes the other plate.

Miniature Variable Capacitors

To achieve as small a minimum capacitance as possible in variable capacitors that are built as separate units rather than as integral parts of the electrical and mechanical structures of circuits, miniature air-dielectric capacitors are mounted on ceramic bases. Even so, in the smaller units a 10-to-1 variation is difficult to obtain. The dotted curves on Fig. 1 show that each half of a differential capacitor has substantially the same variation characteristic as a single-section capacitor; the butterfly capacitor has slightly less available variation.

In one style of miniature capacitor, a ceramic soldering technique is used to assemble bushing, stator rods and mounting posts on the ceramic base. This is done by first metallizing the ceramic where the metal parts are to be soldered to it; the parts are then positioned and soldered firmly in place. The ceramic soldered joints are stronger than the ceramic itself so that the

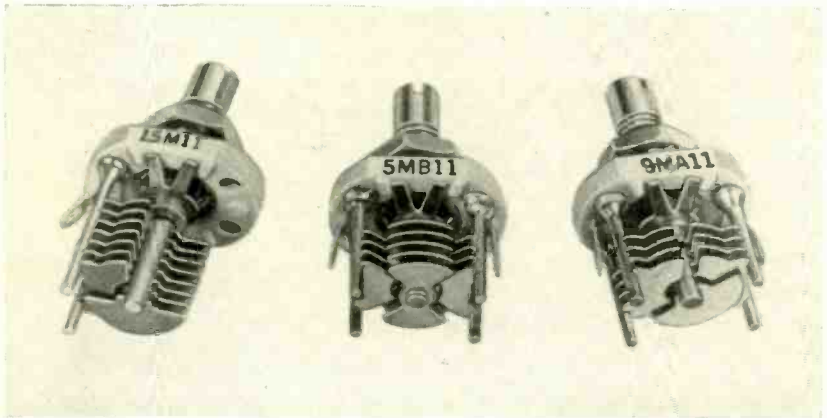
Previous Article in Series

Part I: Fixed Capacitors Undergo Miniaturization, p 120, July 1954

COMPONENT DESIGN TRENDS

- Machining rotors from solid blocks of metal
- High-Stability slug-tuned coaxial trimmers
- Pressure-plate adjustment for hermetically sealed plastic-dielectric bathtub capacitors
- Pressurizing with dry gas to boost voltage rating

Example of unit using gas pressurizing technique to boost voltage rating. Unit shown here, made by Lapp Insulator Co., is variable water-cooled capacitor rated to carry 70 amperes at 1 mc. Gas inlet is below gage near bottom, and water inlet and outlet fittings are at top. Tuning rod projects upward at top center



Examples of common types of miniature variable air capacitors. Left to right: Single-section, butterfly and differential units, made by E. F. Johnson Co.

capacitor withstands shock and vibration well. This construction also results in a small temperature coefficient of capacitance; less than 30 parts per million is achieved in one design.

With 0.032-inch-thick plates rounded at their edges for maximum voltage rating and spaced 0.045 inch apart, such capacitors have an approximate peak breakdown voltage at sea level of 2,000 volts. For a plate spacing of 0.03 inch, such capacitors are rated at 1,500 volts peak at sea level and at over 500 volts at 50,000 feet altitude.

Additional design features include silver-plated beryllium-copper spring wiper contacts to provide constant torque and relatively noise-free capacitance variation. Double stator contacts provide a low-inductance connection.

A wide variety of configurations can be assembled from the basic parts of these capacitors. This possibility has led at least one manufacturer (F. W. Sickles Division) to carry in stock substantial quantities of capacitor parts, such as mounts for all major designs. Any particular capacitor, even special designs to meet individual requirements, can then be supplied on a short delivery cycle.

The trend toward miniaturized equipment, both military and civilian, is reflected in the requirement for smaller components of all types. One variety of air trimmer, developed to meet a specific need for a smaller trimmer than previously available, occupies less than one square inch of mounting space and is thus especially suited to compact circuit arrangements for portable equipment. Rotor and stator assemblies are of brass, soldered to supporting members to assure mechanical stability and silver-plated to assure electrical conductivity. The rotor spring is also silver-plated to assure positive contact. The low-loss steatite base can be treated with DC 200 silicon fluid if necessary. Mounting plate, bushing, shaft extension and locking nuts are of nickel-plated brass. Stator support rods are soldered into eyelets which have been spun rigidly into the steatite mount. An eight-plate unit, with four rotor

and four stator plates to give a capacitance variation from 2 to 11 μμf, has a depth from its front mounting face of approximately $\frac{13}{32}$ inch and is rated at 1,000 volts d-c at sea level.

For special measurement capacitors that require high mechanical stability, General Radio mills both rotor and stator stacks from solid extruded aluminum stock. To obtain full advantage from this construction, cross-linked polystyrene is used for the supports and a glass-reinforced polyester for the shaft to assure low loss.

Tubular Trimmers

Where a small adjustable capacitor is needed, the tubular trimmer construction is finding wide application, especially at vhf. One such trimmer consists of an outside cylindrical stator supported on a polystyrene tube through which a plunger is driven by a screw. An important feature, shown in Fig. 3, of this trimmer is the nearly uniform relationship between turns of adjustment and capacitance, a characteristic that is particularly valuable in television tuners. The simplicity of design and the ribbon-type leads result in low inductance; the form factor facilitates mounting it close to associated circuit elements to further minimize lead inductance. The unit is rated at 500 dcwv.

A related tubular trimmer uses glass as the dielectric; the stator is metal-bonded directly to Corning glass to give the unit practically zero temperature coefficient. This design is particularly suited to applications where stability in the presence of vibration is required. To further increase stability for such critical applications as oscillators, the trimmer is fitted with a direct-traverse brass or Invar slug that moves in and out without turning. For general high-frequency applications, the capacitor is furnished more economically with a rotating slug. Constant r-f contact is maintained during tuning by a bushing that incorporates a bearing spring loaded against the core shaft. Both types are produced with tuning ranges of 10 to 1 and a minimum capacitance as small as 0.3 μμf; they can be designed to meet particular requirements including split stators. The compact coaxial shape simplifies multiple installations as in fixed-tuned multichannel high-frequency circuits. These capacitors also make excellent neutralizing capacitors in transmitters. One of this type capacitor has an effective capacitance range at 50 mc of 1 to 12 μμf, a power factor of 0.16 percent and a d-c breakdown of 2,000 volts.

The tubular configuration has been adapted to a piston-type capacitor having a range of 5 to 50 μμf. Quartz dielectric, an Invar piston and a Silvar fixed electrode provide thermal stability up to 200 C. Silvar alloy made by JFD Manufacturing Co. combines low h-f resistance with low thermal coefficient of expansion.

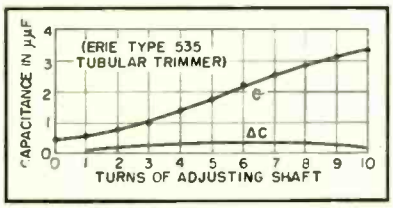


FIG. 3—Manner in which capacitance varies with rotation in representative tubular trimmer (Erie type 535)

An unusual adjustable capacitor has recently been marketed by Southern Electronics Corp. This consists of a tub capacitor with a normal capacitance of 1, 2, 3, 4 or 5 μf rated at 200 dcwv. It uses a polystyrene dielectric, has a dielectric absorption of 0.0001 and a dissipation factor of 0.0002. Each capacitor is adjustable with a key over a range of ±1.5 percent of the rated capacitance.

Construction

The mechanical adjustment, consisting of an aircraft-type stop nut counterbored to receive a ball bearing, is located in the center of a heavy-gage bathtub can. The ball rides on a Teflon cover and applies pressure to a hardened metal diaphragm that is soldered to the inside of the can to hermetically seal the capacitor compartment. Under the diaphragm is a pressure plate to distribute pressure evenly over the Teflon-covered flat windings. A layer of acrylic plastic at the bottom of the windings insulates them sufficiently from the bottom cover so that the tub can be sealed by soldering.

Although the adjustment screw can be rotated a complete revolution and reversed several hundred times without producing noticeable wear, this adjustment is designed primarily to zero out small initial increments of error in capacitance standards as well as to compensate for aging over long periods. A one-year check of three units showed a maximum deviation of 0.03 percent of rated capacitance without correcting for temperature coefficient, which would have reduced this deviation. After a full excursion of adjustment, the capacitor requires 8 hours to stabilize after which a fine adjustment is necessary. With care, the capacitor can be set to better than one part in 100,000. After fine adjustments, the capacitor has a long-term accuracy of one part in 100 parts of change.

Pressurized Capacitor

For high-voltage operation, air capacitors become excessively large; therefore, variable capacitors are sealed in a container with dry gas at high pressure so that they operate at high voltage without breaking down. An outside protective gap is set to break down at a lower voltage than the internal structure. In pressurized capacitors such as the one shown, all gasket seals are adjustable from the outside; thus, in the event of a slight leak, as indicated by the permanently attached pressure gage, they can be tightened in the circuit.

These units are manufactured with minimum capacitances of about 50 μμf; the largest units have a maximum capacitance of 10,000 μμf. Voltage ratings vary from 6 kv to 85 kv peak. Current ratings at 1 mc vary from 70 to 130 amperes for air-cooled types and up to 400 amperes for water-cooled types.

The movable plate stack is mounted on a current-carrying ball race that is the full diameter of the stack. This eliminates the need for wiper contacts when the ball race is the diameter of the shaft. The wiper contacts usually limit the current rating of a variable capacitor.

Digital Servomechanism

By L. T. THOMASSON
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Seattle, Washington

UNTIL RECENTLY, little work has been published concerning equipment for transferring information from digital to analog form. Results of laboratory work on two experimental systems which convert binary-digital input signals into precise shaft-angle output positions are herewith described.

The converter system functions basically as a digital computer which calculates in binary form the difference between new and old information, as evidenced by the position of an output shaft. The system is essentially a closed-loop servomechanism in which the error-sensing portion is a digital computer.

The binary system allows a choice of but two symbols in each binary place, a zero or a one. These symbols can be expressed by open and closed switches, by low and high voltages or by the absence or presence of a voltage pulse in a discrete time interval.

The accuracy of analog data expressed by digital notation is a direct function of the number of places used in the selected number system. Nine binary places in the number system of this converter permit an accuracy of one part in 2^9 or 512 parts.

Complements

This computing system uses complementary numbers.

Two values will be defined for the binary system complements which correspond to the decimal system complements. Let P be designated as the total number possible when each binary place is filled with a one symbol, $P = 2^n - 1$. Let Q be the quantity which is one bit greater than P, which means a one symbol in the next higher binary place than the last place in our restricted binary number system, $Q = 2^n$. Then the P-complement of a binary number is that number which results when the original number is subtracted from the quantity P corresponding to the nines complement and the Q-complement is that number which results when the original number is subtracted from the quantity Q corresponding to the tens complement. The P-complement of a binary number can be obtained by substituting a one symbol for each zero symbol and by substituting a zero symbol for each one symbol. The Q-complement is then obtained by adding one bit to the P-complement.

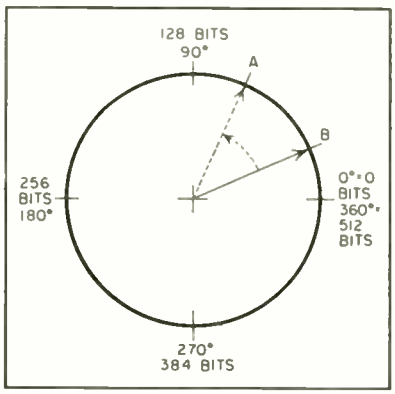


FIG. 1—Angular relationship of output shaft to information content

There are two major parts to the converter system, an electronic comparator and an electro-mechanical transducer.

The Adding Method

Three modes of conveying digital information in the form of electrical voltage pulses are voltage amplitude, relative time and number of transmission paths.

Four forms of digital information transmission will be defined. It is assumed that the presence of a voltage pulse represents a one and that the absence of a voltage pulse, at a given time and on a given transmission path, represents a zero. Parallel digital information is conveyed by means of n parallel channels in one unit of time, where n represents the maximum number of places in the limited numbering system. Digit-sequential information is conveyed by means of n parallel channels spaced in n units of time. Pulse-sequential information is conveyed by means of one channel with pulses spaced in $(2^n - 1)$ units of time for the binary system. Serial information is conveyed by means of one channel in n units of time. The comparator in this system utilizes all four forms of conveying the digital information.

The new binary-digital input information will be designated by the letter A. The old binary-digital information, as represented by the present position of the commutator segments of the shaft output transducer, will be designated by the letter B. Subsequently the P-complements of the new and old information are expressed by $P-A$ and $P-B$ respectively.

The comparator calculates the difference between the new and old information and thus commands the output shaft to move in the proper direction to reduce the error signal to zero through the shorter of two possible paths. These requirements indicate the need for the operations of subtraction, information transfer and shaft sense or rotation-direction command.

The subtraction process is accomplished by adding the P-complement of the subtrahend and adding one bit. The P-complement of the old information, $(P-B)$, is injected into the adder as parallel-digital information. The new information is injected into the adder in the form of digit-sequential information to permit each stage to transfer its carry-one if necessary. The resulting sum in the adder is now

Controls Shaft Position

Binary output of digital computer translated into precise angular positional information at remote location with accuracy of better than 0.1 percent. System is useful in digital-to-analog computers, data-translating systems and precision remote-indicating applications

the quantity $S = (P-B) + A$.

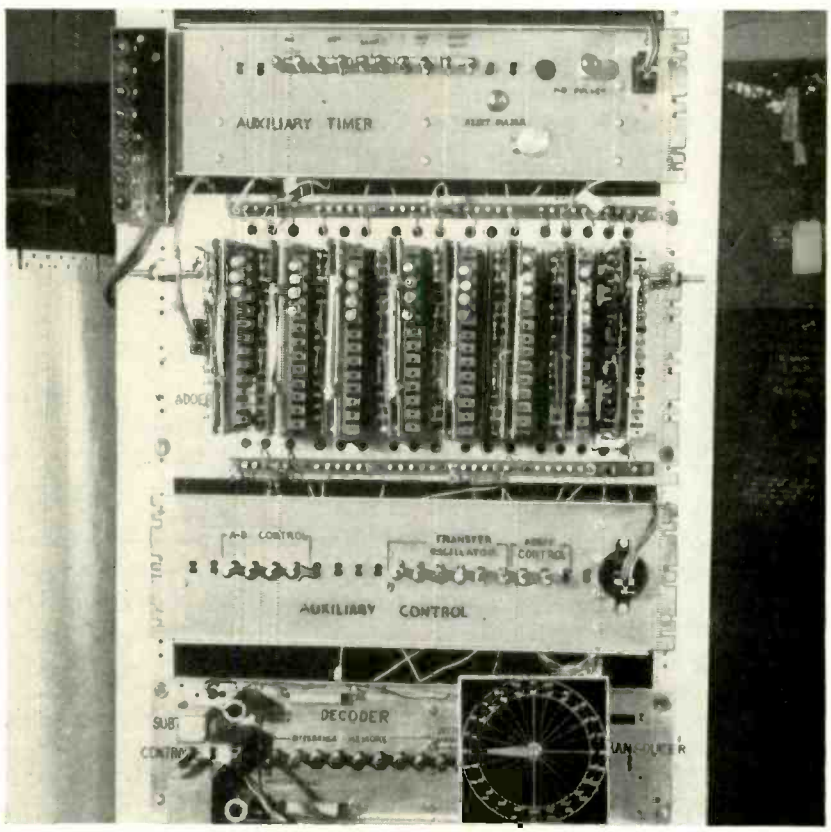
The major digit position of the adder is next examined by a sampling pulse to determine if it contains a zero or a one. If there is a zero in the major-digit position, the absolute value of the difference between A and B is less than one-half Q, and the shaft rotation shall be counterclockwise.

The output shaft is polarized so that increasing binary numbers represent counter-clockwise rotation, using the polar coordinate system of angular measurement as shown in Fig. 1. If the quantity $|A-B|$ is less than $Q/2$, the required direction of rotation for the shaft to move through the smaller angle from position B to the new position corresponding to A will be in the counter-clockwise direction.

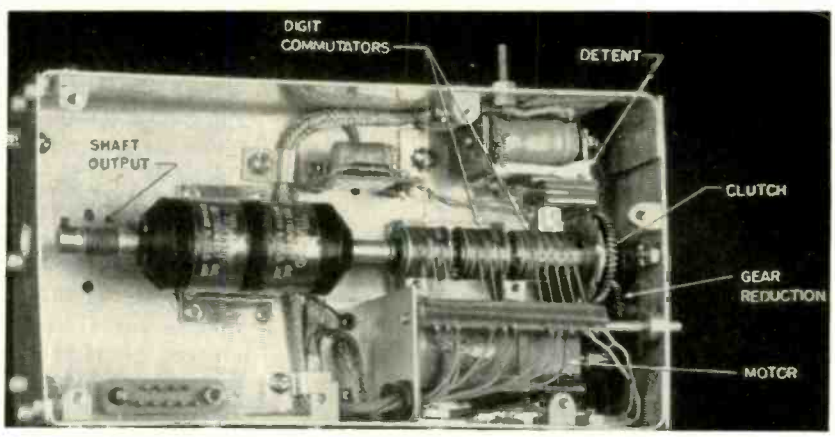
The same zero in the major-digit position will control the condition of the adder so that it will change to the subtract condition while it is controlling transfer of the error magntiude to the output shaft. The motor-stop signal is derived when the major-digit position next changes its condition.

If there is a one in the major-digit position, it signifies that the quantity $|A-B|$ is greater than $Q/2$. Thus, the direction of rotation for the output shaft must be clockwise so that B can turn to A by the shorter path. With the quantity $|A-B|$ greater than $Q/2$ in the adder, the adder is left in the add condition during the transfer of the error magnitude to the output shaft.

After the major-digit position is examined and if there is a one standing in it, an add-one pulse is



Binary digital-to-shaft analog converter breadboard system



Electromechanical transducer has three drums about one-half inch in diameter and three-quarters inch long

gated into the adder so that the resulting sum now becomes

$S = (P-B) + A + 1 = Q - B + A = A - B$

The limited number capacity of the adder makes Q identical to zero. The add-one pulse is necessary only when the adder is left in the add condition for the transfer of the error magnitude to the output shaft. This result is derived from the manner in which the motor-stop signal is obtained from the major-digit position.

In the unique and frequent condition of no change in input data, a special treatment must be given to the computed error signal. This condition exists when the new number is the same as the old number or $A = B$. The $A = B$ condition must be detected and the information utilized to disable the motor-start circuit so that no shaft motion will result.

The $A = B$ coincidence detector solves the problem by sensing two simultaneous inputs at the time when the add-one pulse is sent to the adder. When there is a condition of $A = B$ the sum in the adder just prior to the add-one pulse will always be the quantity P. There will be a one standing in the major-digit position and previous rules determine that the adder will be left in the add condition. When the add-one pulse is gated into the adder the sum in the adder will change from P to Q which is identical to zero in this computer. The $A = B$ detector senses the resulting change from one to zero in the major-digit position causing the motor-start signal to be inhibited.

The Output Transducer

The second major unit of the converter system is the output transducer, an electromechanism from which the accurately positioned shaft output information is obtained. The output shaft is designed so that there are a total of 512, ($Q = 2'' = 2^9$), discrete positions for each 360-deg of shaft rotation. The transducer also provides the source of the present shaft position, previously identified by the letter B. In addition, the transducer generates a series of pulses which are fed back to the comparator during the time that the output shaft is moving from the old to the new position.

The transducer shown in the photograph consists of three drums. The second and third drums have three metal disks separated by an insulating plastic. The disks have been formed so that tooth-like projections lie on the surface of the drum. The number of these disk projections is determined by the position of the disk in the drum, which in turn determines the binary number which is to be formed by that disk. All of the disks are connected to ground through the transducer shaft mechanism.

The first disk has four projections spaced evenly around the circumference, so that this disk represents the minor-digit position for that drum. The second disk has two projections equally spaced on the circumference, and represents the next digit position. The third disk has one projection extending over one-half the circumference and represents the major-digit position for the drum. Commutator brushes ride in grooves in each of the commutator segments and connect segments with the electronic circuits.

The three disks representing the binary places are oriented so that there are 2^3 uniquely defined positions to which the brushes can be connected. These are arranged so that the commutator segments produce the successive binary numbers from zero to seven. Each drum contains the proper number of contacts required for counting in the octal system where the base is 2^3.

The transducer is made up of three of these drums, thus providing 2^9, or 512, uniquely defined shaft positions. To produce this result a counter-type of stepping mechanism is used between the three drums. These coupling mechanisms are similar to the type used in an automobile mileage indicator, but the increment of rotation for each drum is one-eighth of a revolution.

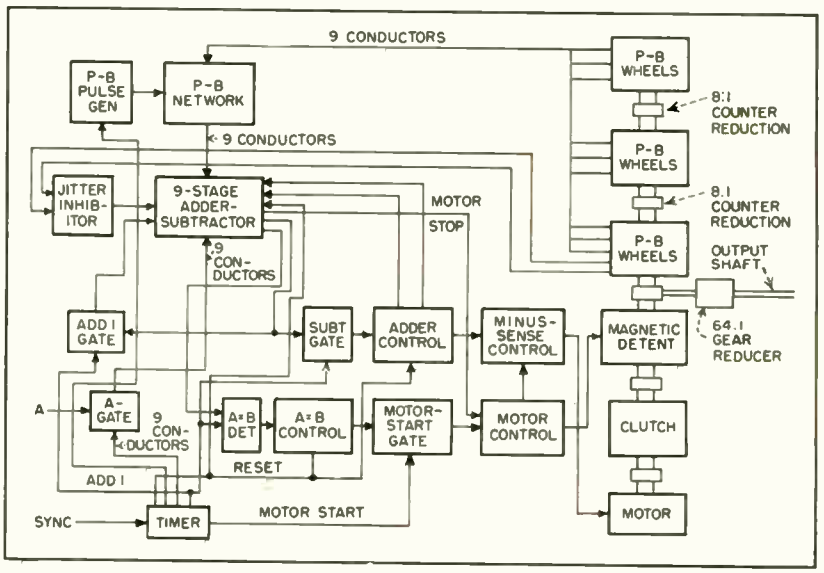


FIG. 2—Nine-stage adder subtractor determines difference between new binary-digital information, *A*, and old information as indicated by position of output

The first drum, which rotates at the highest speed, has two extra contact disks and brushes which are used to count back the A-B difference to the comparator. These disks have eight segments each, but are displaced to give a start-stop signal for each of the eight positions. The combination of the two sets of contacts produces a series of eight switch positions per revolution, with control over the start and finish of each contact interval. These contacts are connected into the electronic system so that the effects of contact bounce can be eliminated during the operation of sending pulses back to the adder.

A small d-c motor drives the high-speed drum through a friction clutch and an electromagnetic stopping mechanism. The stopping mechanism ensures that the highest-speed drum always stops on one of

the eight unique positions, and the clutch allows the motor rotational energy to be expended without excessive wear on the stopping mechanism.

In order that the output shaft may have a smooth rotational characteristic, the output torque is taken from the highest-speed drum and passed through a 64-to-1 gear reduction to give the desired angular output, corresponding to the major-digit drum rate.

The transducer will operate at a speed up to 85-bits per second with capability of stopping at the next angular position after it has been commanded to stop. This corresponds to an angular velocity of 60-degrees per second for a nine-digit binary system.

The stages of the converter system are shown in the block diagram of Fig. 2, and the schematic diagram of Fig. 3, shown below.

The heart of the comparator unit is the nine-stage adder. The adder is composed of nine modified bistable-multivibrator circuits with a pair of crystal-diode gating networks between each stage. The gating networks are controlled by two buses so that the adder can be controlled to count-up or count-down.

One diode network of each pair is connected to a common add bus which, when properly energized, causes the adder to perform in normal fashion as a scaling or counting chain. The second diode network of each pair is connected to a common subtract bust which, when energized in place of the add bus, causes the adder to perform as a subtractor so that pulses are counted down instead of up.

The circuit of one stage of the reversible adder is shown in Fig. 4. The controlling diodes, D_1 and D_2, are connected through their associated networks to the add and subtract bus respectively. The buses are controlled so that only one diode gate at a time is biased into the conducting state. A negative-going transition from the preceding stage is differentiated and passed by the enabled diode gate circuit. The add-carry output and subtract-carry output are taken directly from the two plates of the bistable multivibrator.

Multivibrator

The grid circuits of the bistable multivibrator have been modified to accept trigger pulses which will trigger the circuit into but one condition on receiving a negative pulse. The grid circuit of V_1 causes the circuit to be reset to the initial zero condition at the beginning of each

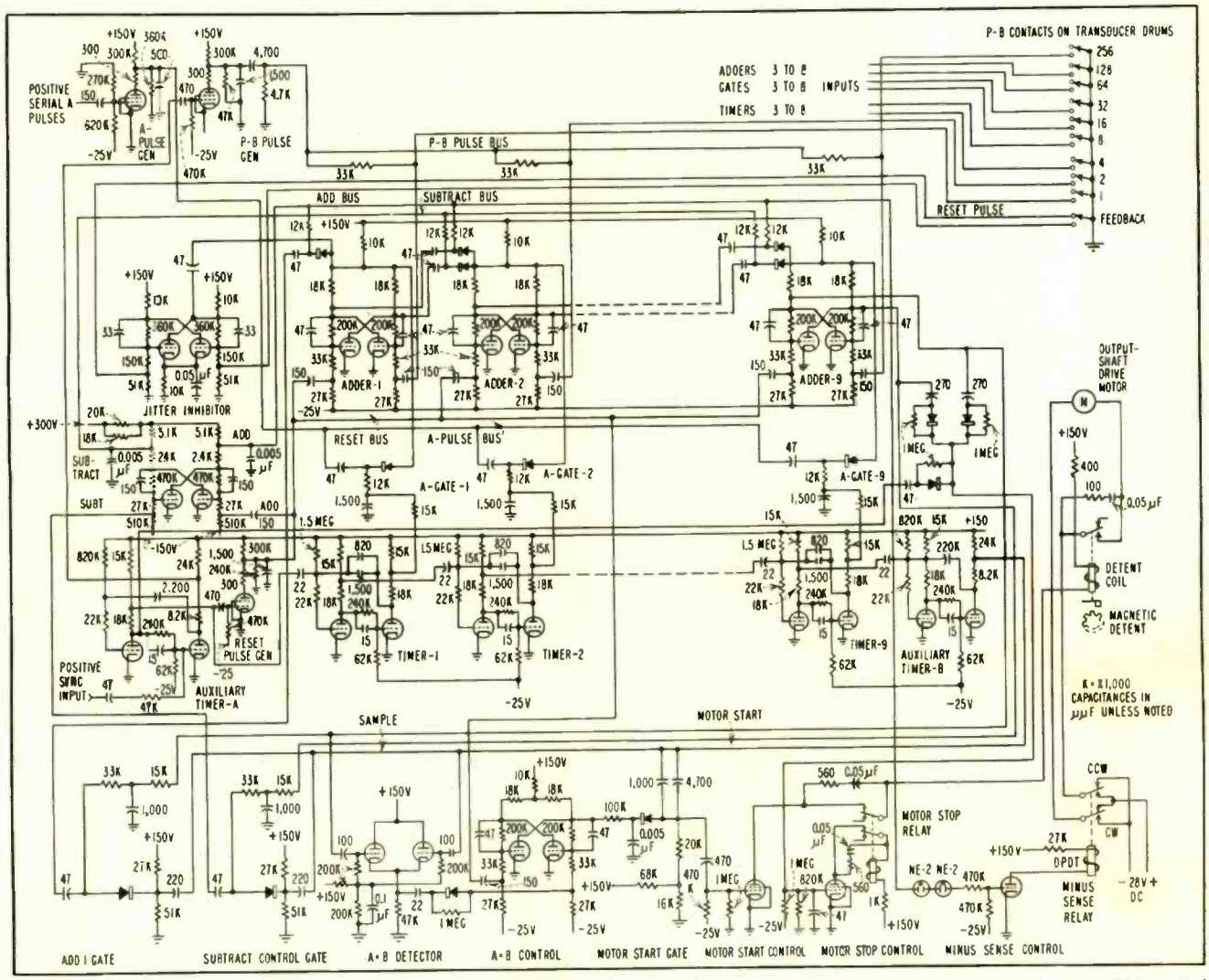


FIG. 3—Binary digital-to-shaft angle analog converter uses nine-stage adder. All triodes are type 5703, thyratron tubes are 5696's and crystal diodes are 1N38A's

comparison cycle. The grid circuit of V_2 controls the circuit so that a one count is injected into the stage when a negative pulse is received from the *P-B* gating network.

The fifth signal input at the adder stage is through the gating diode, D_5. This diode will trigger the multivibrator to the opposite condition when a negative pulse is received from the *A*-gate in synchronism with an enabling waveform from the timer. The timer unit synchronizes and clocks the various operations of the comparator.

The *A*-gate is composed of nine crystal-diode gating circuits. Each gate in time sequence receives an enabling pulse from the timer during the time that the new information in serial form is injected into the system. The *A*-gate and the timer thus change the input information from serial form into the digit-sequential form required by the comparator. This form allows the proper carry forward to be accomplished when a one pulse must be added to a stage of the adder which already holds a one count.

The *P-B* network is a resistance-divider network which shunts or passes a pulse from the *P-B* pulse generator. It depends on the position of the segments for the respective digits on the transducer drums, which are stationary during the tranfer of the P-B information. The *P-B* pulse generator is a thyratron-discharge pulse generator which forms a high-amplitude, low-impedance pulse to transfer the simultaneous *P-B* information from the transducer into the adder.

The add-one gate and the subtract gate are crystal-diode circuits which are controlled by the voltage condition of the major-digit position of the adder. When the respective gate is enabled, a pulse is passed from the timer to the following circuit. The adder control is a bistable circuit with two unistable input triggers. A unistable trigger input causes the bistable circuit to go into one particular condition. Additional trigger pulses applied to that input point will have no further effect on the circuit condition. The adder control generates a pair of d-c control voltages which enable and inhibit the diode-gate networks in the adder.

The minus-sense control is a d-c amplifier with a relay in the plate circuit. The relay reverses the polarity of the d-c voltage supplied to the transducer motor when the minus sense of shaft rotation is required. The $A = B$ gate is a duotriode coincidence circuit which produces an output pulse only when two simultaneous negative-input pulses are received. The $A = B$ control is a bistable circuit similar to the adder-control circuit. It enables or inhibits the crystal-diode motor-start gate. The motor control is composed of two thyratron circuits with a plate relay and the electromagnetic stopping mechanism which start and stop a d-c motor in the transducer.

The last block in the diagram of Fig. 2 to be described is that of the jitter inhibitor. This is another bistable circuit similar to the adder control. The jitter inhibitor is a buffer between the mechanical switches of the transducer and the electronic input of the adder. It nullifies the effects of contact bounce in the transducer by producing one pulse for each pair of pulses from the out-of-phase contacts on the high-speed drum.

System Cycle

The timing sequence, Fig. 5, is controlled by the timer circuits which must be synchronized with the serial *A* information. The speed of operation of the digital comparing circuits is not critical, because the mechanical shaft-output movement requires hundreds of milliseconds for operation. The time per operation in the comparator is restricted only by the time for reliable triggering of the tube circuits.

Referring to Fig. 5, a synchronizing pulse triggers the first monostable multivibrator. The leading edge of the waveform generated returns the comparator to its initial starting condition, with the adder in the add condition, the minus-sense control deenergized and the $A = B$ control in its uninhibiting condition. The same waveform sends a motor-stop pulse to the motor-stop pulse to the motor control unit. The quasistable time of the first multivibrator is adjusted so that the following multivibrator stages will produce waveforms timed so that they center about the corresponding *A* input pulses.

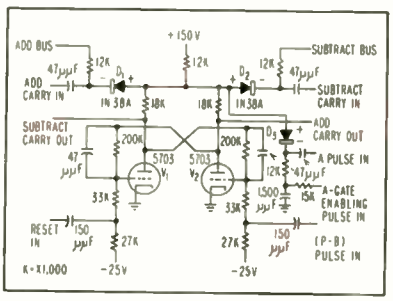


FIG. 4—One stage of reversible adder employing bistable multivibrator

The positive-going trailing edge of the waveform from the first multivibrator is differentiated to form the trigger of the $P-B$ pulse generator. The $P-B$ pulse generator produces a high amplitude, low-impedance pulse which passes through the $P-B$ network, under the control of the transducer drums, and injects the $P-B$ information from the drums into the adder stages. The negative-going trailing edge of the first multivibrator waveform is also differentiated and triggers the second multivibrator in the timer.

The positive waveform of the second multivibrator is used as an enabling signal to gate the first *A* pulse through the *A* gate, and into the first stage of the adder. The *A* information is transmitted as serial information, with the minor digit transmitted first. Sufficient time must elapse between the first and second *A* pulse so that carry pulses may be transferred in the adder before a second input pulse is injected into the adder. The succeeding *A*-input pulses are injected through the *A* gate one at a time under the control of the timer. The tenth multivibrator generates the enabling waveform for the ninth *A*-input pulse.

The negative-going leading edge of the eleventh multivibrator is differentiated to form the sample pulse which passes through the add-one gate, if there is a one in the major-digit position, under the control of the major-digit position of the adder and into the first (minor-digit position) stage of the adder.

The sample pulse also is transmitted to one input of the $A = B$ detector. Coincidence between this pulse and a negative-going pulse

from the major-digit position of the adder to the second input of the $A = B$ detector is indication that no change in the shaft position is required. In this event, the coincidence pulse triggers the $A = B$ control. This inhibits the motor-start gate for the rest of the cycle.

The sample pulse is also transmitted to the subtract gate, which is controlled by the condition of the adder major-digit position. The add-one gate and the subtract gate are enabled by inverse waveforms so that the sample pulse will pass through one or the other but not both. If there is a zero in the major-digit position of the adder, the sample pulse will pass through the subtract gate and trigger the adder control to its subtract condition. This reversal changes the enabling voltages on the add and subtract buses to the adder so that the adder will count down, or subtract, when input pulses are applied during the remainder of the system cycle. The reversal of the adder control also changes d-c input to the minus-sense control, causing it to energize the minus-sense relay and reversing the polarity of the d-c voltages to the transducer motor.

The positive-going trailing edge of the eleventh multivibrator is differentiated to form a positive pulse which passes through the motor-start gate if not inhibited by an $A = B$ condition and triggers the thyratron motor-control circuit. The single-pole single-throw relay combined with the magnetic detent mechanism, applies power to the d-c transducer motor. As the motor turns the output shaft, pairs of pulses are transmitted from the special contacts on the first drum to the jitter inhibitor. One standard pulse is generated for each pair of pulses or pulse trains if serious contact bounce exists. These standardized pulses trigger the first (minor-digit position) stage of the adder.

The adder or subtractor will count up or down until the major-digit position changes its condition. When the major-digit position changes from one to zero during addition or from zero to one during subtraction, the positive-going output waveform is differentiated and the positive pulse triggers the thyration motor-stop control. The

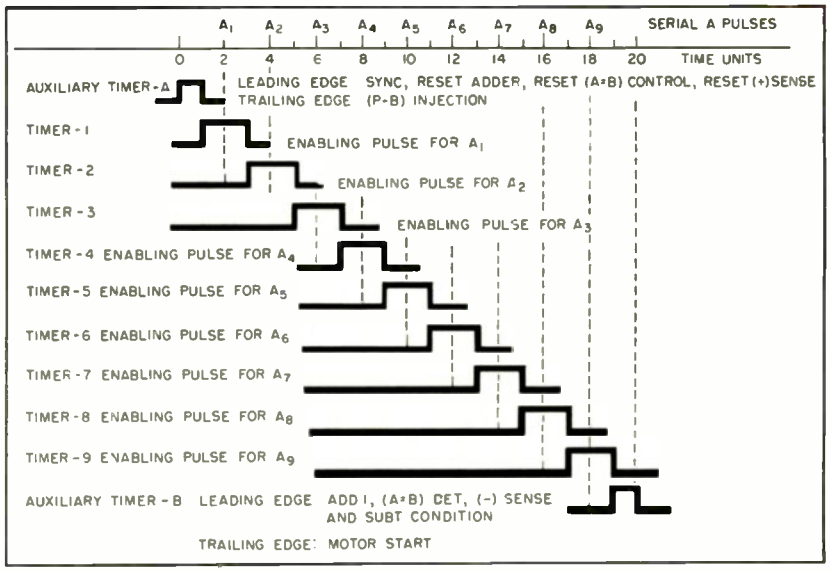


FIG. 5—Timing sequence of converter controlled by timer circuits

motor-stop thyratron energizes a double-pole single throw relay, one contact of which extinguishes the motor-start thyratron and opens the motor-start relay and magnetic detent. The second contact extinguishes the motor-stop thyratron after the relay has picked up.

When the motor is turned off and the magnetic detent stops the rotation of the drums on the next binary position, the digital comparing cycle has been completed.

Performance

The accuracy of the output-shaft indication is within one bit out of 512 bits, or better than ± 0.1 percent. If the transducer should fail to stop at the correct position, or if the input data is changed before the shaft has time to reach it, the converter system will recalculate the new error signal.

Improved accuracy is limited only by the electromechanical shaft output transducer. Greater accuracies could probably be obtained by adding another drum unit, with a possible accuracy of one bit in 4,096 or approximately ± 0.01 percent. This accuracy would result in correspondingly slower speed of response and extreme mechanical tolerances in the transducer.

The shaft output speeds attained with the breadboard equipment reached a maximum rate of approximately 60-deg per second. Because of the torque-to-inertia ratio of the d-c motor and transducer, the shaft speed is a function of time during the first half second. Typical times measured for the output shaft to reach the new position are 100 milliseconds for a 2-bit, 1.4-deg change, and 720 milliseconds for a 50-bit, 35-deg change in position.

The input signals used in the converter described were serial in nature. By modifying the A-input circuits and the $P-B$ feedback circuits, along with the timer, the converter can be made to operate on parallel-input information. The basic operating principles are the same, but the A information is changed into digit sequential form in a different manner. Assuming that parallel signals are present on nine conductors as d-c voltages in a given time interval, the voltages can be made to enable the respective A-gate circuits that control the sequentially differentiated pulses from the respective timer stages to the corresponding adder stages.

The author acknowledges the assistance of his associates at the Boeing Airplane Company Physical Research Unit. The output transducer was developed primarily by F. Hamilton and major contributions were made by S. G. Forbes and R. P. Abbenhouse. The original system theory was conceived by J. E. Maynard and W. A Hane, as part of the work performed under contract number AF 33(038)-19589.

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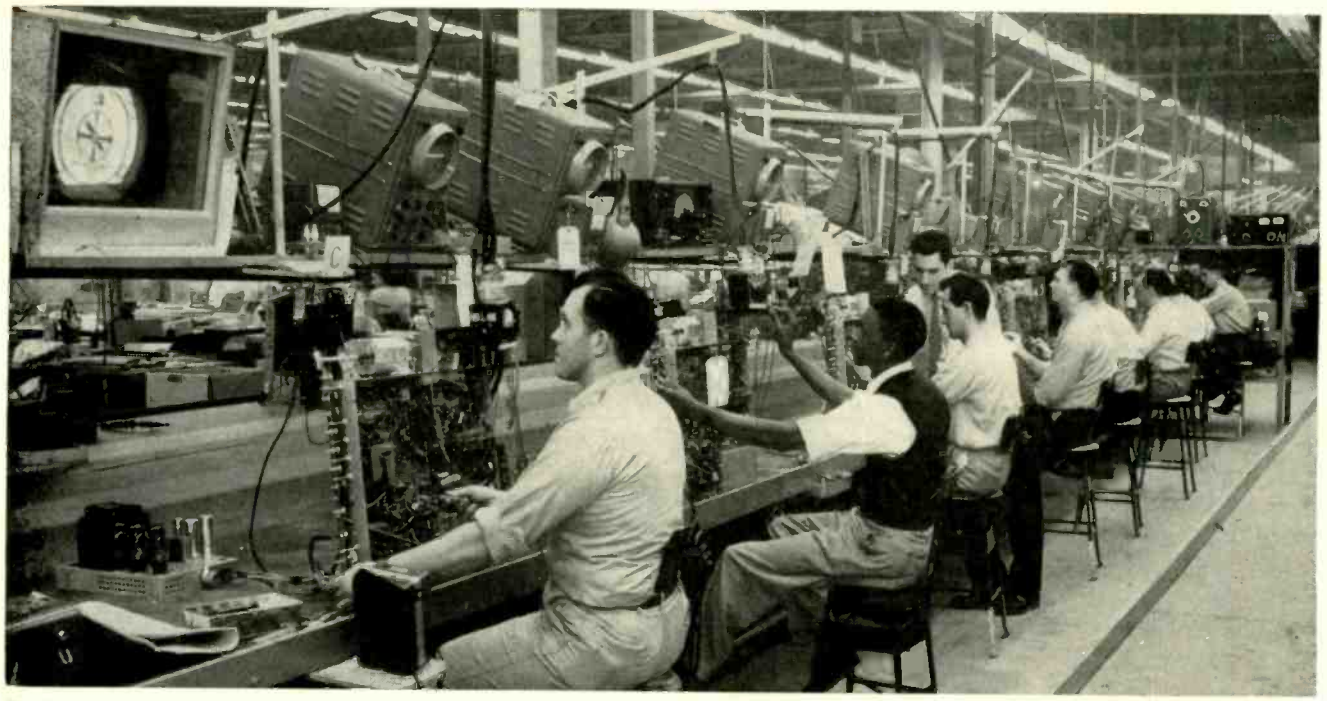
Adjustment Procedures



Final testing section, arranged so that test equipment on overhead shelf can face either side of line. Sets can be passed under shelf to other side. Test signal outlet on overhead cable at each position receives standard in-plant black-and-white and color test patterns from central signal cage. Picture tube and subassemblies are tested before reaching chassis

Chart gives signal sources, indicating devices and step-by-step tabulation of adjustments made at each of the 15 test positions on a color tv production line, with corresponding procedures for black-and-white receivers shown alongside for comparison

DIFFERENCES between factory test procedures for color and monochrome television receivers are shown in the accompanying chart. Straight-line testing procedures are used in both cases, with the exception that color convergence adjustments require three test stations operating in parallel. Such operation was necessary since it was not found practical to break this time-consuming operation down into smaller elements.

The sequence of test operations for both monochrome and color was selected because of circuitry in some instances and for convenience of station balance in others. Several adjustments are repeated in succeeding test stations. The first adjustment is a rough adjustment to assure proper operation of a circuit prior to final adjustment.

The monochrome portion of the color receiver is very much like any monochrome receiver and the same general test methods apply to both, as indicated in the chart. One difference is that some circuits require just a little more care and precision in adjustment for color than for monochrome.

Color Subcarrier Problems

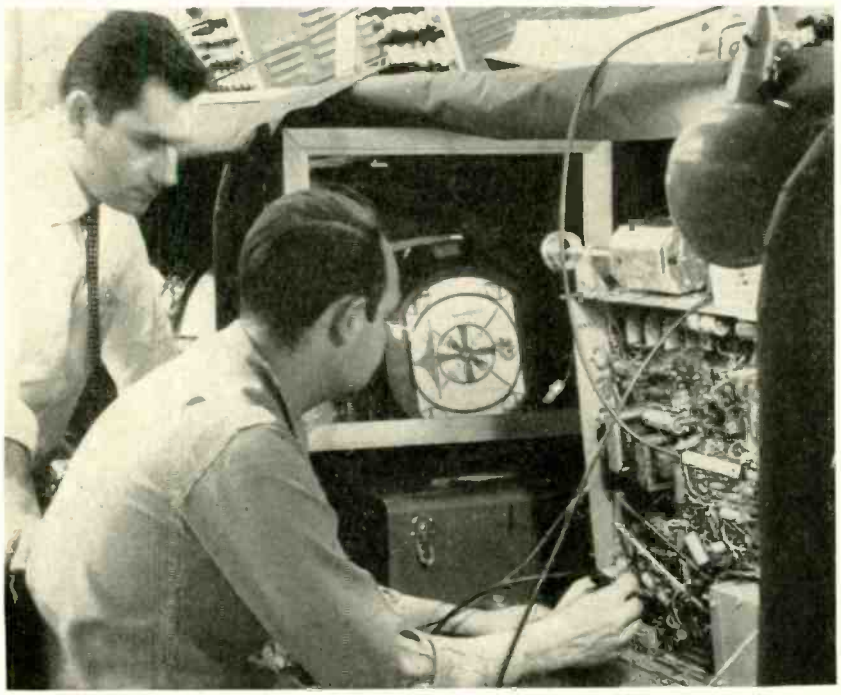
For example, in the color receiver the r-f and i-f amplifiers are designed to produce a wider passband to amplify the color subcarrier. These amplifiers must be adjusted with care and precision, as a narrow or tilted passband may result in loss of color definition, reduction of saturation or even complete loss of color.

The sound carrier must be attenuated accurately so no visible beat pattern between the sound carrier and the color subcarrier will occur (920 kc), without attenuating it to such a point that the sound sensitivity will be adversely affected. A potentiometer is provided in the i-f circuit to set this attenuation level after the trap frequency has been adjusted.

The chrominance channel adjustment procedure, although not common to regular monochrome, is similar and straightforward. A 3.58-mc crystal-controlled signal is used to adjust the frequency of the electron-coupled subcarrier local oscillator and to resonate selective circuits and traps. A video sweep generator is used to adjust the video circuits for proper passband so that the combination of the r-f,

For details of

for Color TV Production



THE FRONT COVER—Test position on color tv line. Black curtains rolled back on overhead shelf can be lowered to darken test booth for critical study of color test patterns

By CHARLES T. McCLANE

Supervisor, Color TV Testing
Westinghouse Television-Radio Division
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i-f and video passbands will result in a minimum of attenuation of the color sidebands. Accuracy of adjustment is important.

The last test station prior to the installation of the color picture tube is provided to check the overall passband from the antenna to the kinescope grids, using a video sweep-modulated r-f generator. No adjustments are made at this station, whose purpose is to check the composite result of the r-f, i-f and video passbands. This double check on previous adjustments is desirable to assure proper operation after the tube is installed and adjusted. Any incorrect overall response requires analysis as to which section is responsible before correction can be made.

The major difference between color and monochrome test procedures occurs after the tricolor kinescope is installed in the completed color chassis. Many of the adjustments to the tube and associated circuits are interdependent and adjustment of one may affect the other. Height, width, linearity and high-voltage regulation may affect both purity and convergence so these adjustments are made first, using a composite monochrome video signal. After purity adjustments are made the picture size and centering are rechecked, as a change in the yoke and purity coil fields may cause a shift in these adjustments.

The convergence adjustments are made using a video dot signal. The fields of the convergence magnets, when adjusted for proper convergence at the center of the screen, can affect purity and hence purity must be rechecked.

The chart shows that monochrome balance adjustments are made prior to and again after convergence adjustments. The adjustments made prior to convergence are only approximate in order to have the red, green and blue gains approximately correct so that white will be produced when the three color dots are converged. This balance adjustment is made with more precision in the station after the convergence adjustments.

Use of Color Bar Signal

The screen controls, background controls and gain controls are adjusted so that white will track from highlights to low lights at various settings of the contrast and brightness controls. The chrominance channel phasing and gain balance adjustments, which were previously made at the sound i-f alignment station, are repeated using a color bar r-f signal. The sequence of the transmitted bars is white, yellow, cyan, green, magenta, red and blue. The only reason these adjustments are checked previously is to determine if the associated circuits are functioning properly before the picture tube is installed.

The final test station before the chassis is installed in a cabinet is an overall quality operation check using color bar r-f, monochrome r-f and a color scan picture produced by a flying-spot scanner. No adjustments are made at this station except customer controls. Any incorrect operations that are noted require analysis and the necessary correction prior to cabinet installation.

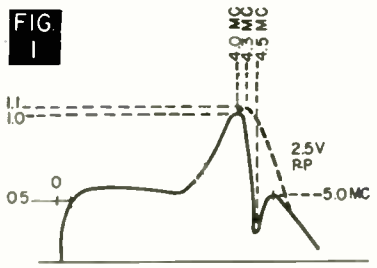
A final test after cabinet installation, an operating heat run and a second final test are performed before the finished product is shipped.

how color tv sets are aligned on mass-production basis, see chart on next pages ➟

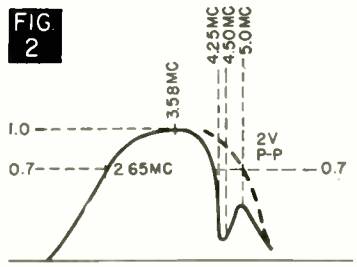
THE COMPLETE PICTURE — Final alignment and test procedures for both types

Test Position	COLOR TELEVISION RECEIVER			MONOCHROME TELEVISION RECEIVER		
	Signal Source	Indicating Devices	Adjustments Made	Signal Source	Indicating Devices	Adjustments Made
1		Special circuit tester meter	Continuity and resistance check		Special circuit tester meter	Continuity and resistance check
2		VTVM	Voltage check	None	None	None
3	Composite video	Scope VTVM Kinescope Electrostatic Microammeter	Adjust horiz frequency and ringing coil Check vertical scan, height and linearity Adjust high-voltage regulation Adjust dynamic convergence amplitude and phase	Composite video 4.5-mc signal	VTVM Scope Kinescope	Adjust horizontal frequency and ringing coil Check operation vertical scan, height and linearity Check operation video amplifier and contrast control Adjust 4.5-mc video trap
4	3.58 mc	Scope VTVM	Adjust master phase control for subcarrier Adjust phase detector balance control Adjust local oscillator quadrature transformer Adjust local oscillator frequency Adjust phase detector a-c balance	None	None	None
5	3.58 mc Video sweep	Scope VTVM	Adjust burst amplifier take-off coil Adjust line driver cathode trap Adjust R-Y demodulator trap Adjust B-Y demodulator trap Adjust chroma amplifier grid and plate Adjust 4.5-mc trap	None	None	None ←NOTE FOR COLOR AT POSITION 5: See Fig. 1, 2, 3 and 4. Solid curves show response with trap in circuit. Dotted curves are for trap shorted
6	4.5 mc (a-m/f-m mod) Color bar video	Scope	Adjust sound i-f grid coils Adjust f-m detector quadrature coil Adjust quieting control Adjust hue and saturation controls (see Fig. 5) Adjust B-Y gain and buffer transformer (see Fig. 6) Adjust G-Y gain and G-Y matrix (see Fig. 7)	4.5 mc (a-m and f-m mod)	Scope	Adjust sound i-f grid coils Adjust f-m detector quadrature coil Adjust quieting control
7	41.25 mc (a-m mod) 44-mc sweep	Scope	Adjust two 41.25-mc sound traps in 4th i-f output Adjust 4th i-f transformer and shaper (see Fig. 8) Adjust 41.25-mc sound trap in grid of 4th i-f Adjust 3rd i-f transformer (see Fig. 9)	44-mc sweep 47.25 (a-m mod)	Scope	Adjust 3rd video i-f (see Fig. 14) Adjust 2nd video i-f (see Fig. 15) Adjust adjacent sound trap
8	47.25 mc (a-m mod) 44-mc sweep 39.75 mc (a-m mod)	Scope	Adjust adjacent sound trap Adjust 2nd video i-f (see Fig. 10) Adjust adjacent picture trap	44-mc sweep	Scope	Adjust 1st video i-f (see Fig. 16) Adjust associated sound trap
9	44-mc sweep 41.25 mc (a-m mod)	Scope and detector probe	Adjust 1st video i-f (see Fig. 11) Adjust associated sound trap Adjust mixer plate and 1st i-f grid links Readjust associated sound trap	13-channel sweep	Scope	Adjust 1st i-f grid link and mixer link Readjust associated sound trap Adjust channel 13 oscillator Check r-f pass band (see Fig. 17)
10	13-channel sweep r-f sig gen (a-m mod 30%)	Scope	Adjust oscillator on all channels Adjust r-f bandpass if necessary Adjust associated sound trap (set atten control for 32 db) Check overall bandpass (see Fig. 12)	13-channel sweep	Scope	Adjust oscillator on all channels
11	13-Channel Video sweep	Scope	Check overall chroma bandpass on all channels (see Fig. 13)	None	None	None
12	Monochrome video	Kinescope High-voltage meter	Adjust width, height, linearity and centering Check and/or adjust high-voltage regulation Adjust purity	Monochrome r-f	Kinescope	Adjust ion trap magnet Adjust deflection yoke
13	Monochrome video Video dots	Kinescope	Rough-adjust b-w screens, background and gain controls Adjust magnets for center convergence Adjust vertical dynamic convergence Check and/or adjust dynamic phase Adjust horizontal dynamic convergence Recheck purity	None	None	None ←NOTE FOR COLOR AT POSITION 13: Since convergence adjustments are time-consuming, three similar test stations are operated in parallel
14	Monochrome r-f Color bar r-f	Kinescope	Adjust screens for white raster Adjust blue and green gains for white on highlights Adjust background controls for white on low lights Adjust color phase and matrix	Monochrome r-f	Kinescope	Adjust height, linearity, width and centering Readjust ion trap magnet
15	Monochrome r-f Color bar r-f Color scan r-f	Kinescope Loudspeaker	Check monochrome operation and sound Check color bar pattern Check color scan picture Check convergence and purity	Monochrome r-f	Kinescope Loudspeaker	Check overall operation of picture and sound

of television receivers, along with oscilloscope patterns seen at each test position



IST VIDEO GRID TO LINE DRIVER GRID



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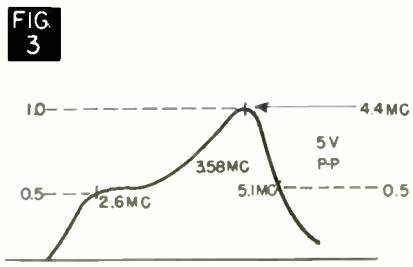
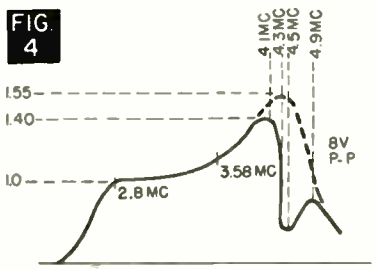
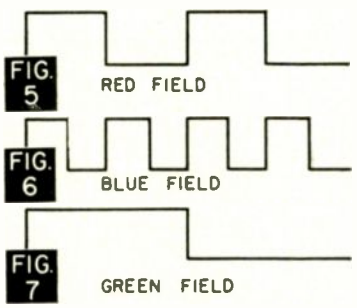
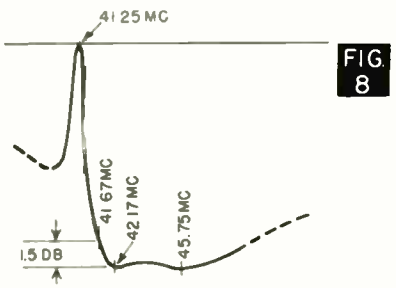


CHROMA GRID TO DEMODULATOR GRID

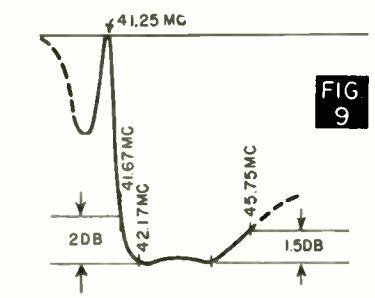


IST VIDEO GRID TO DEMODULATOR GRID

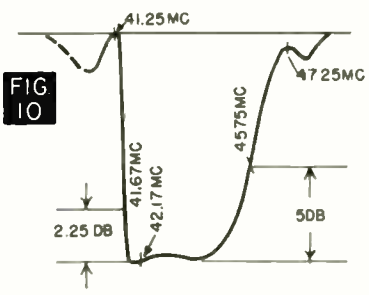




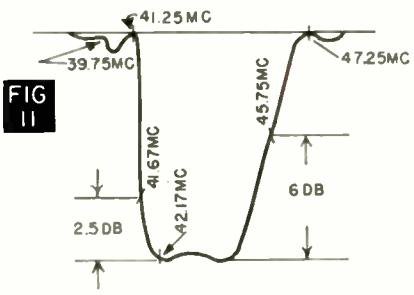
4TH I-F GRID TO VIDEO DETECTOR



3RD I-F GRID TO VIDEO DETECTOR



2ND I-F GRID TO VIDEO DETECTOR



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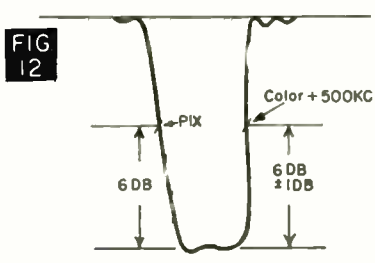
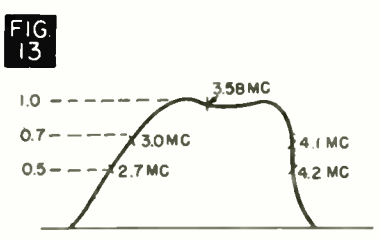
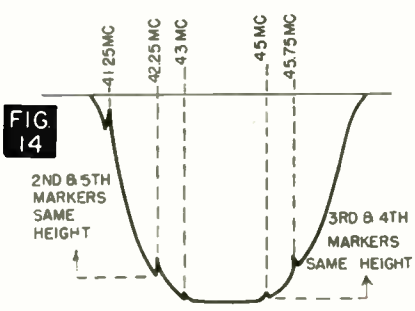


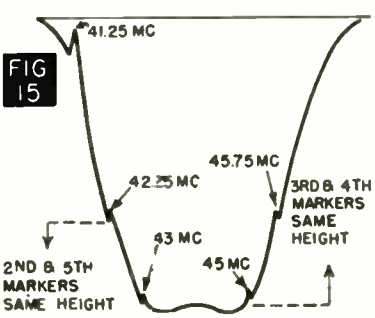
ANTENNA TO VIDEO DETECTOR



TUNER TO RED KINESCOPE GRID



3RD I-F CURVE



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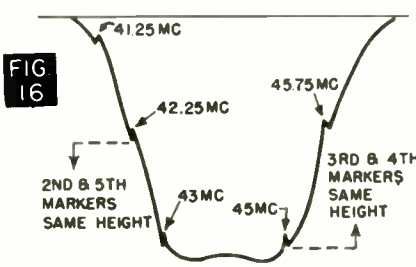

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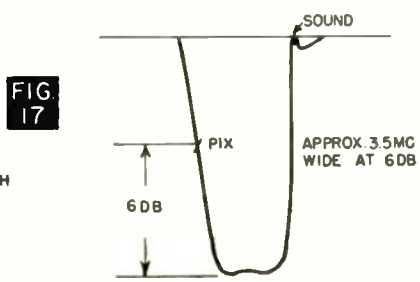

ANTENNA TO VIDEO DETECTOR

Transistor Power Supply for Geiger Counters

Power unit operating from 3-volt battery supplies 5μa at 700 volts for portable radiation. detectors. Use with additional transistor in counting circuit makes possible low power-drain unit having no tubes other than Geiger tube

By ALAN R. PEARLMAN

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West Newton, Mass.

CONVENTIONAL means for obtaining a high-voltage low-current supply for portable radiation detectors either necessitate the use of relatively bulky, expensive high-voltage batteries or the expenditure of a considerable fraction of a watt of power to operate a vibrator or vacuum-tube oscillator power supply from low-voltage batteries. Since Geiger-counter tubes usually operate at power levels below one milliwatt, an unfavorable ratio exists between power expended to develop the high voltage and power consumed by the detector. Several high-voltage supplies using point-contact transistors in an inductive-kick circuit which consume less than 50 mw have been described.[1] Thermionic rectifiers were used, and no attempt was made to regulate output voltage.

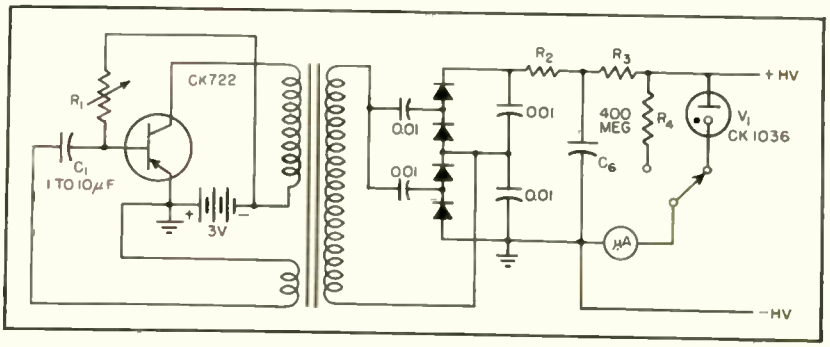

FIG. 1—High-voltage transistor power supply. Resistor R_1 is adjusted to obtain proper operating point; R_2 and R_3 can be from 100,000 ohms to 2.2 megohms.

Design

In designing a regulated high-voltage supply using point-contact transistors in a similar circuit, it was found that to develop sharp short-duration pulses for inductive-kick operation, peak collector currents in the range from several-hundred milliamperes to almost an ampere might be encountered. At these levels of I_e excessive collector forming occurred and transistor failure was usually encountered after a few hours of operation.

To avoid the problems inherent in short duration high-intensity pulse operation, a high-voltage supply was developed using junction transistors operated as class-C amplifiers, where collector efficiencies of over 90 percent could be expected.

Calculations indicated that a transformer step-up ratio of 50 to 1 or greater would be necessary and that the impedance presented to the collector should be sufficiently high to enable the collector to swing nearly the entire supply voltage without requiring currents beyond the ratings of the transistor. Losses in the transformer should be only a few milliwatts to achieve reasonably efficient operation.

Since a survey of available audio and geophysical transformer types failed to reveal the existence of a unit meeting the requirements, a special unit was constructed.

Operation

The circuit of the power supply is shown in Fig. 1. Current bias is supplied to the emitter through R_1. The operating frequency is determined by both R_1 and C_1; the oscillator output by $I_e \approx V_{cc}/R_1$ and by V_{cc}. In general, the oscillator will function well over a wide range of frequencies below the self-resonant frequency of the transformer, and as a consequence a fixed value of C_1 can be used with various values of R_1 over a range of about 5 to 1 Regulators.

A corona voltage-regulator tube can be used across the output of the rectifier filter circuit to provide constant output voltage over a wide range of currents for operating Geiger counters or multiplier phototubes. A typical subminiature 700-volt or 900-volt regulator will keep the output voltage constant to within ±15 volts between 2 μa and 50 μa.

The quadrupler rectifier using four small selenium units enables efficient operation with collector supplies as low as 3 volts.

The 600-turn primary of the transformer has a d-c resistance of less than 10 ohms and provides a voltage step-up of 50 to 1 with the 30,000-turn secondary.

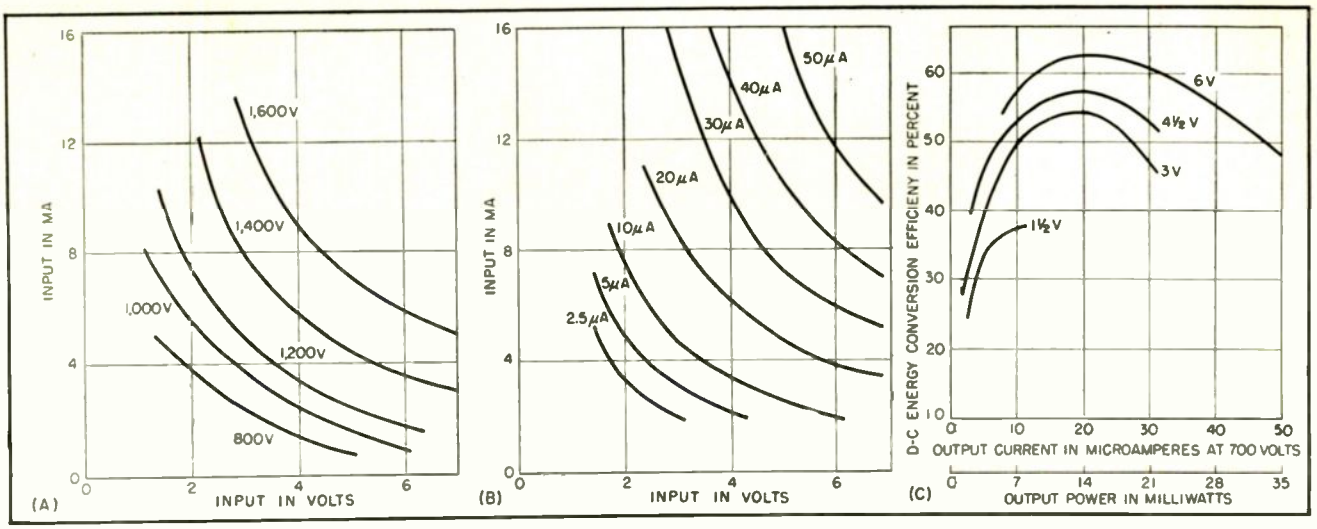

FIG. 2—Voltage curves for 400-megohm resistive load (A), output current at 700 volts (B) and d-c energy conversion efficiency (C)

Figure 2 shows performance curves for constant-resistance loading and 700 volt constant-voltage output conditions. The efficiency of d-c energy conversion is good when operating from a supply of 3 volts or greater and reasonably good even when operating from a single 1.5-volt cell.

An illustration of efficiency and low power consumption of the transistorized circuit in comparison with a vibrator circuit is the fact that the driving coil alone of a typical miniature vibrator consumes about 30 milliwatts, whereas the entire transistor circuit operating at an input of only 10 milliwatts (3 volts, 3.33 ma). It can achieve at 42 percent efficiency while producing 6 μa at 700 volts, more than enough to operate a 700-volt G-M tube for most counting applications. As a consequence of this low-power feature it is possible to increase by more than tenfold the operating time of standard batteries.

Two mercury cells, rated at 3,600 ma-hours at 1.25 volts each, could provide 1,000 hours of operation at a drain of 3.6 ma, and produce 5 μa output current at 700 volts. Two size-D flashlight cells would provide about the same life. With vibrator supplies a battery life of 100 hours would be considered good and 50 hours considered acceptable.

Low-Alpha Transistors

With regard to transistors, less-expensive low-alpha types seem to work as well as high-alpha units. The CK722 and CK723 *pnp* junction units were tested in this application and found to be satisfactory. While the present collector current ratings of the CK722 and CK723 are only 10 ma there seems to be considerable evidence that at low collector supply voltages the current ratings can be increased to 10 or even 20 ma without adverse effect.

Although the transistorized high-voltage supply can be used as a space-weight-power saving component in vacuum-tube portable equipment, its greatest advantages would be offset by the power requirements of the tubes. Maximum advantages can only be obtained when the equipment with which the high-voltage supply is used is designed to eliminate vacuum tubes.

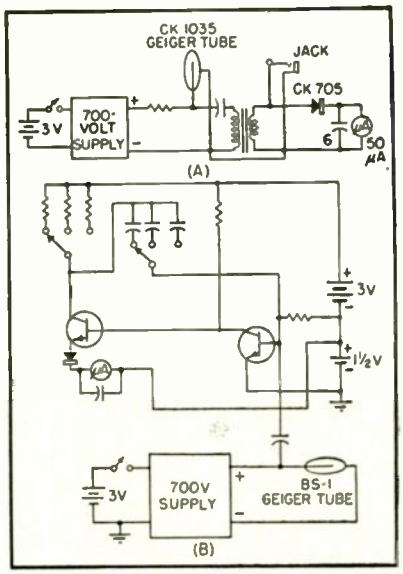

FIG. 3—Rough-indication counter (A) using 700-volt transistor power supply. Three-range count meter (B) uses npn transistors.

Figure 3 shows two typical Geiger-counter circuits which avoid the need for tubes other than the Geiger tube. Both circuits use halogen-quenched G-M tubes which provide considerably more energy per pulse than do conventional organic-vapor-quenched tubes. Figure 3A is a simple arrangement, using no additional transistors, capable of providing audible indication of low levels of radiation, and a quasi-logarithmic visual indication of higher levels. Figure 3B is a three-range linear counting-rate meter using two additional *npn* junction transistors, and capable of accuracy comparable to that obtainable from vacuum-tube circuits. The power required by the counting-rate meter is about 4 mw, less than ¼ the power required by the filament of a low-drain hearing-aid tube.

Most of the experimental work on which this article was based was performed under U. S. Army Signal Corps Contract DA-36-039 SC-42-482 at Technical Operations, Inc., Arlington, Mass. The author wishes to express his thanks to Technical Operations, Inc. and the Raytheon Mfg. Company for their cooperation and assistance.

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RPM Indicator

By A. J. STRASSMAN

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WHEN a normal-size meter scale is used to show the rate of rotation of high-speed devices it becomes difficult to determine incremental speed changes to any degree of accuracy. To increase the ability to measure small changes, it is possible to expand the scale of the meter indications. This is done by keeping the meter in a nonindicating condition until such time as the speed of the unit being measured reaches a preselected lower limit. The incremental change between this speed and maximum speed is then presented so that each meter division indicates a smaller rpm change. By the addition of a timing circuit and relay, decay rates can be measured and presented automatically.

Figure 1 shows a block diagram of the unit. A calibration oscillator is incorporated for setting the upper and lower speeds as indicated by full-scale and zero readings respectively on the meter.

The input voltage can be derived from any type of pickup that will develop a signal or pulse frequency proportional to speed. The unit has direct control over motor speed by the insertion of variable resistance in series with each leg of the motor supply. These rheostats are ganged together on a single shaft so that all legs are controlled simultaneously. The rheostats are held shorted out by the relay system so that the preset lower level of speed is reached rapidly. When this speed is attained the rheostats are placed in the circuit by the relay system. The rheostat control is then used for adjustment of the final desired speed.

Relay Number and Condition		Result
Apply power to unit	1—Open	
	2—Closed	
	3—Open	
	4—Closed	
	5—Closed	
SPEED MEASUREMENT		
Apply control voltage	3—Closed	Place −300v on thyratron grid. Remove +300v from thyratron plate. Closes relay 5. Turns on power-indicator light.
	5—Closed	Turns out time-delay indicator light. Connects circuit to provide voltage to motor.
	2—Open	Closes circuit between integrator tube and vtvm circuit, charges C_3.
	1—Open	Closes relay 4.
	4—Closed	Disconnects meter circuit (prevents meter from indicating) Shorts out motor control rheostats.

Relay Number and Condition		Result
Apply signal voltage	1—Closes when up to speed	Opens relay 4.
	4—Open	Places meter in circuit. Removes short across rheostats placing them in motor circuit.
DECAY RATE MEASUREMENT		
Remove control voltage	3—Open	Places +300v on thyratron grid. Opens relay 5. Turns off power-indicator light. Places +300v on thyratron plate.
	5—Open	Turns on time-delay indicator light. Opens circuit to motor.
2D21 begins to conduct, causing relay 2 to operate after 20-sec delay	2—Closed	Opens circuit to vtvm grid and meter maintains reading due to charge on capacitor C_3. Closes relay 4.
	5—Closed	Turns off time-delay indicator light. Closes circuit to motor.

Table I—Sequence of Relay Operation

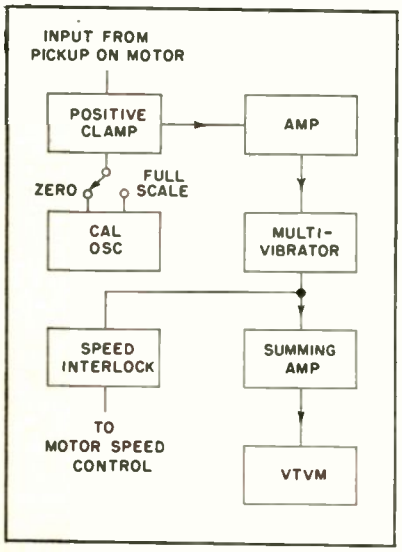


FIG. 1—Tachometer system obtains expanded scale by indicating rpm only over operating portion of device's speed range. Calibration oscillator is used to set upper and lower indicating limits

The pulse from the pickup is applied to an amplifier having a gain of approximately ten. The output of this stage is applied to the grid of a cathode-coupled multivibrator.

The output-pulse repetition rate of the multivibrator is proportional to the frequency of the pulse received. The multivibrator output is fed to the grid of a tube that operates as a speed-interlock relay. When the speed approaches the minimum level this tube actuates a relay, closing the circuit to the meter. The output of the multivibrator is also applied to another amplifier which integrates the pulses providing a d-c voltage proportional to speed to a vacuum-tube voltmeter. The vtvm is calibrated to indicate the actual speed. Potentiometers in the integrator circuit calibrate the meter for minimum and maximum speed.

Multivibrator

In the circuit diagram, Fig. 2, the output of amplifier V_3 is a positive pulse, as shown in Fig. 3, which

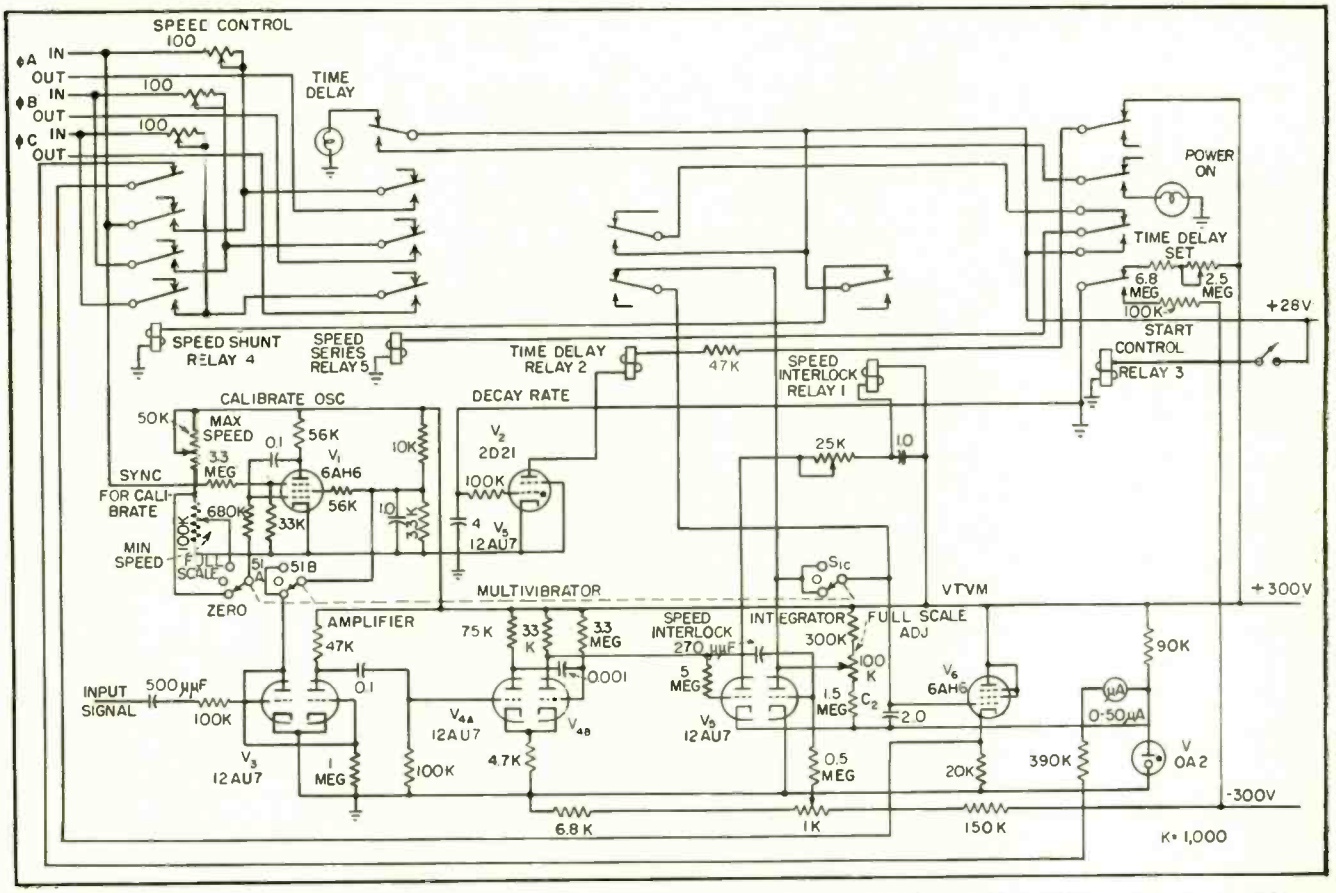


FIG. 2—Meter starts to indicate speed when integrated multivibrator output reaches level high enough to overcome bias on speed-interlock tube; relay then places meter in circuit to indicate rpm

Provides Expanded Scale

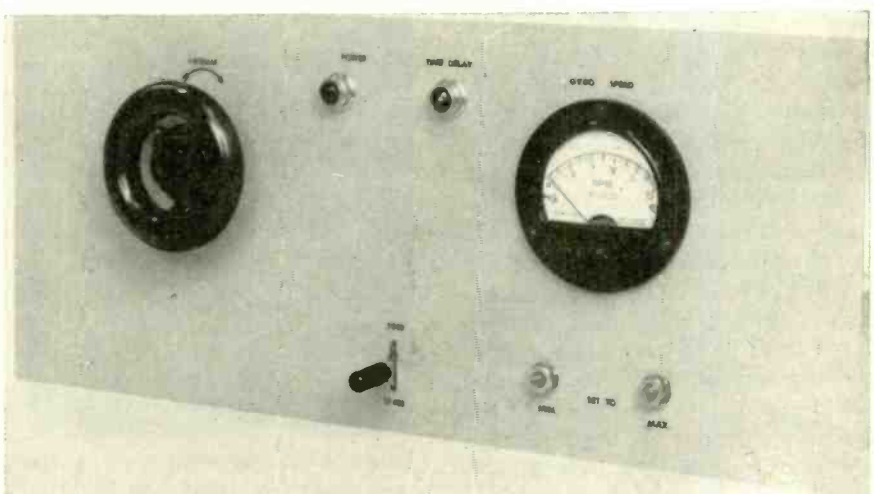
Measuring system reduces scale compression by indicating only over operating portion of machine's speed range. Time-delay circuit measures decay in speed of shaft over specified period while machine is decelerating

is applied to the grid of V_{4A}. When V_{4A} begins to conduct V_{4B} is cut off and the output voltage at the plate of V_{4B} rises and remains at this level until the multivibrator returns to its normal condition. This time can be determined by

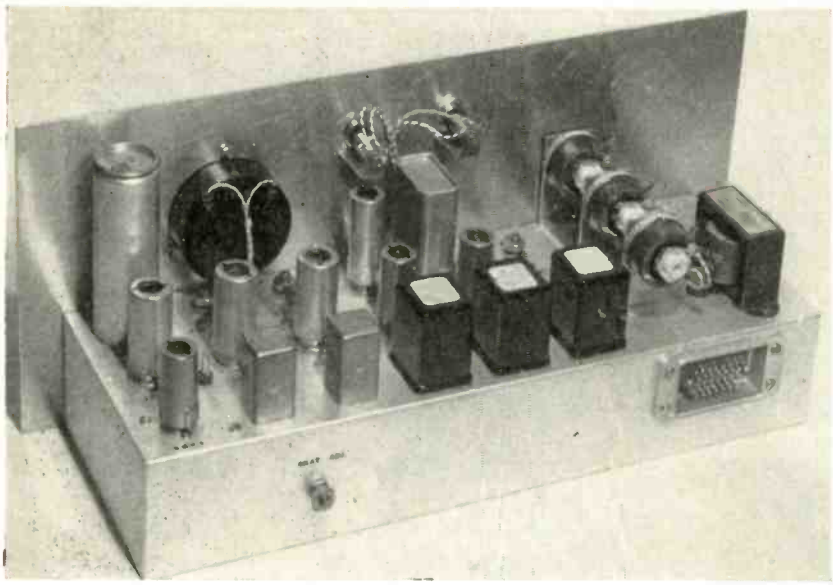
$$T = CR\,2\ln\frac{2E_{bb} - E_{b1} - E_{k2}}{E_{bb} - E_{k1} - E_{o2}}$$

Where E_{bb} = supply voltage, E_b = plate voltage, E_k = cathode voltage and E_o = cutoff voltage. Figure 4 shows the variation of pulse output with frequency.

The output of the multivibrator is first applied to the speed-interlock



Front panel of tachometer has speed control at left. Switch at lower center injects calibration signal for setting upper and lower dial points



Three ganged rheostats at right of tachometer chassis are inserted in motor power line for speed control when motor approaches operating speed

tube, V_5, whose cathode is biased at a reference level so that the relay is not activated until the speed reaches a desired level. When activated, the relay places the indicating meter in the circuit. The meter then reads the preset low level at zero.

The multivibrator output is also applied to an integrating circuit and this output voltage is applied to vtvm V_6.

Figure 5 shows how the output voltage varies with frequency. Since the vtvm meter has been calibrated to give full-scale reading at maximum speed all incremental readings are magnified.

Time Delay

With the addition of a delay circuit, decay rates can be measured easily. When operating as a speed indicator, a negative potential of −300 v is applied to the grid of thyratron V_2 cutting off the tube, so that the relay in the plate circuit is deactivated.

When the decay-rate measurement is initiated, power to the motor is disconnected and a positive potential of 300 v is applied to the grid of the thyratron V_2. Components R_1 and C_1 determine the delay between application of the 300 v and the firing of the thyratron. At the end of the delay time the thyratron fires, closing relay 2. This disconnects the vtvm from the integrator circuit and capacitor C_2 maintains the voltage on the grid at the value at the end of the time-delay period. This reading subtracted from the original reading gives the decay in speed over a 20-second period. The time delay is equal to 0.607 RC.

Calibrator

The calibration oscillator, V_1, provides two frequencies proportional to the upper and lower speed limits to be read on the meter. Potentiometers allow for setting of the frequencies to be used as calibrating speeds.

A sine-wave signal can be used as the synchronizing voltage to insure proper frequency output from the calibrator. The output signal, Fig. 6, is derived from the screen grid and is shaped to approximate the signal received from the pickup. The output signal derived from the calibrator is applied to the clipping diode and amplified by the following stage as is the normal input signal from the pickup unit on the machine.

A regulated source was used to supply both positive and negative voltages. All relays used in the tachometer other than the two sensitive relays are of the standard 28-volt aircraft type.

Acknowledgement is made to H. E. Howard who designed the original model.

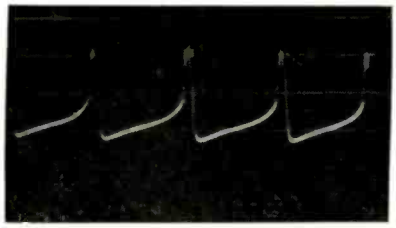


FIG. 3—Pulse input to multivibrator

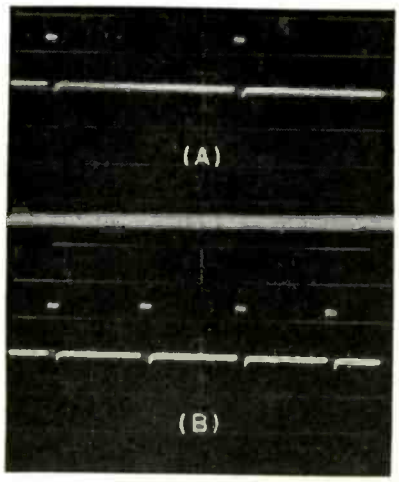


FIG. 4—Output of multivibrator at 600 rpm (A) and at 12,000 rpm (B). Both oscillograms were made at sweep speed of 2,000 μsec per cm

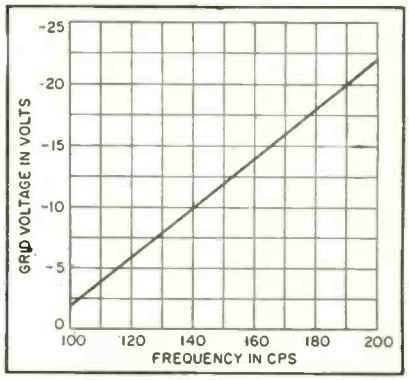


FIG. 5—Relationship of pulse frequency to grid voltage on vtvm

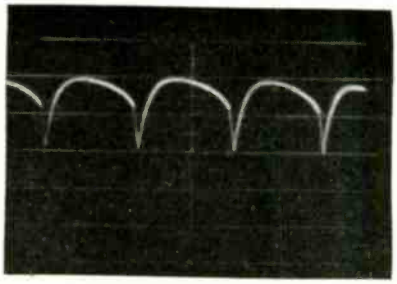


FIG. 6—Calibrator output wave is shaped to duplicate output of pickup device

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Radar Duplexer Uses Dual T-R Tubes

Low voltage-standing-wave ratio over 12-percent of frequency band, ease of pressurization and elimination of design difficulties inherent in use of atr tubes are among the features of radar duplexer that uses dual t-r box and short-slot couplers

By HAROLD HEINS
Bomac Laboratories, Inc.
Beverly, Massachusetts

BROADBAND operation of pulsed radar may be achieved using a duplexer that consists of a dual t-r tube with appropriate short-slot couplers. In contrast to conventional broadband designs, the dual tube duplexer lends itself well to simple mechanical layout.

The short-slot coupler[1] is an extremely compact broadband hybrid that provides an accurate power split similar to that of a magic T or hybrid ring although with different phase relations. Physically, the short-slot coupler consists of two waveguides that share a common narrow wall in which a coupling section is provided. This coupling slot together with suitable matching devices provides the hybrid properties.

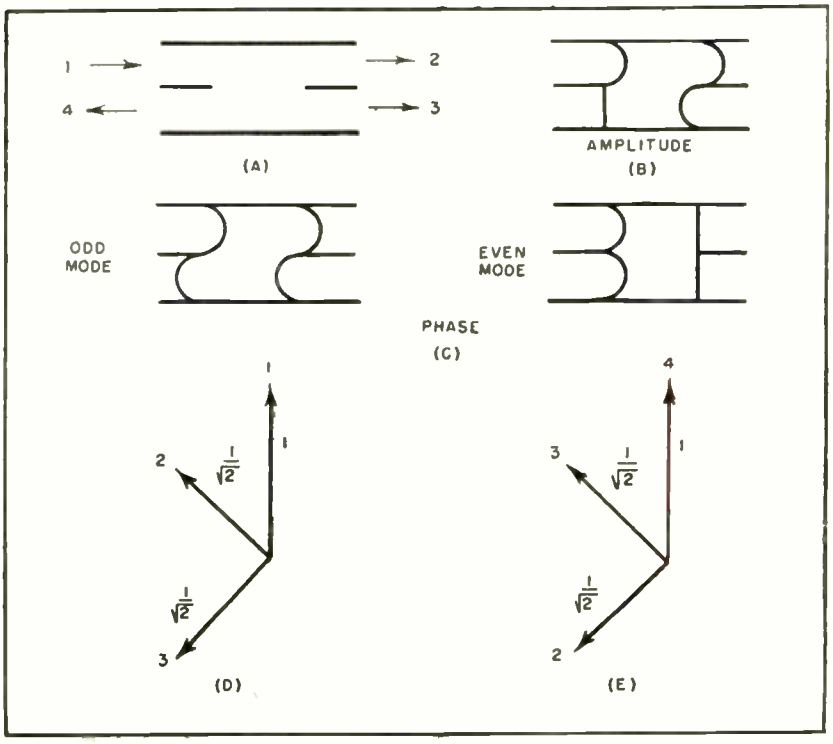


FIG. 1—Phase and amplitude relations in a short-slot coupler

Coupler Operation

Figure 1A schematically illustrates the coupler. Assuming incident power on arm 1 with matched loads on all other arms, the wave excites two modes, one even and one odd, at the coupling slot. The amplitude and phase relations (Figs. 1B and 1C) are such that the power is split evenly between arms 2 and 3 with no power coupled into arm 4. A 90-deg phase shift exists between the waves in arms 2 and 3. The junction input has a low vswr with either matched or balanced loads on the output arms, including the case of short circuit loads. These properties of the coupler are maintained over a wide band, approximately 12 percent.

Assuming a unit-voltage vector incident on arm 1, the voltage vectors in arms 2 and 3 are $\sqrt{1/2}$ with the phases as shown in Fig. 1D, where the phase of the unit vector is the phase that would have resulted from the unit incident vector if no coupling slot existed in the main guide. Conversely, two unit-voltage vectors, 2 and 3, with a 90-deg phase difference will result in a vector of amplitude $\sqrt{2}$ in arm 1. If the phase relations of the vectors on arms 2 and 3 are reversed, then the resultant of amplitude $\sqrt{2}$ is incident on arm 4, Fig. 1E.

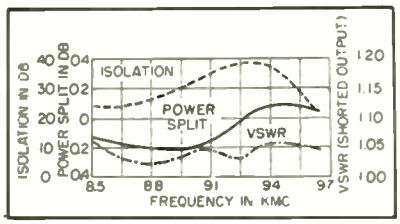


FIG. 2—Characteristics of a short-slot coupler

The performance of an X-band coupler is shown in Fig. 2. The power split, isolation and input vswr are shown over the frequency range 8,600-9,500 mc with matched and shorted output loads. Isolation is defined as the ratio of incident

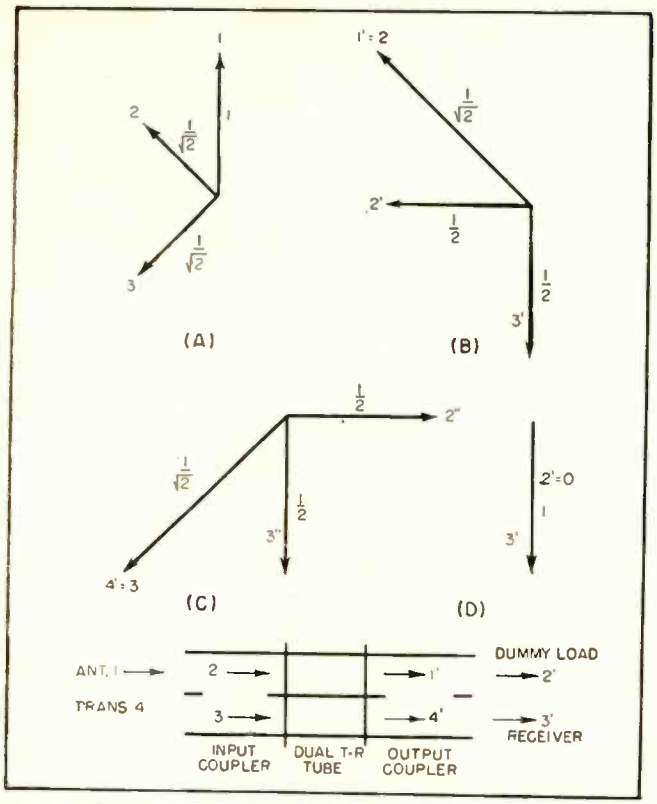


FIG. 3—Vector relations of a short-slot coupler while receiving

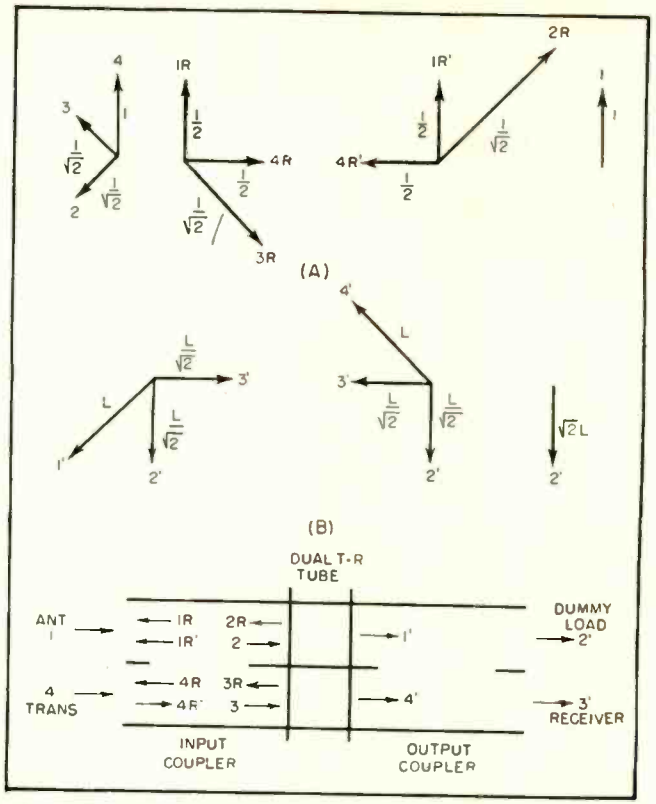


FIG. 4—Vector relations of a short-slot coupler while transmitting

power to power in arm 4 with matched loads on the output arms, P_3/P_4.

A short-slot duplexer consists of two couplers with suitable tubes, preferably a dual t-r tube, connected between them. While it is possible to use conventional single t-r tubes, this requires a complicated system of four bends. The dual t-r tube was specially designed to mate directly with the couplers.

Receiving

Consider first the receiving condition; that is, the condition at which the power levels are of the order of target signals, which are too low to fire either the gaps or the input windows of the t-r tube. The vectors involved are shown in Fig. 3. A unit vector incident on arm 1 results in vectors 2 and 3 of amplitude $\sqrt{1/2}$ with phases as shown in Fig. 3A.

Neglecting any reflections, loss or phase shift in the t-r tube, vectors 2 and 3 traverse the t-r tube with no change in amplitude and no relative phase shift, and are the input vectors to the output coupler. Vector 1′ or 2 splits into vectors 2′ and 3′ upon traversing the output coupler. Similarly, vector 4′ is resolved into vectors 3″ and 2″, Fig. 3B and 3C. Upon summing the components in the output, 2′ and 2″ cancel since they are out of phase, while 3′ and 3″ add to produce a unit vector in arm 3′, the receiver arm, Fig. 3D.

Theoretically, there is no power into arms 4 (transmitter) or 2′ (dummy load). In actual practice, the couplers do not have a perfect power split; the phase shift is not exactly 90-deg. The t-r tube has small reflections and absorption losses and some relative phase shift. Nevertheless, these factors can be minimized and the overall performance of a complete duplexer is close to theoretical over a wide frequency band.

Since no power is returned to arm 4, the transmitter arm is effectively decoupled from the antenna and receiver, which eliminates the need for atr tubes.

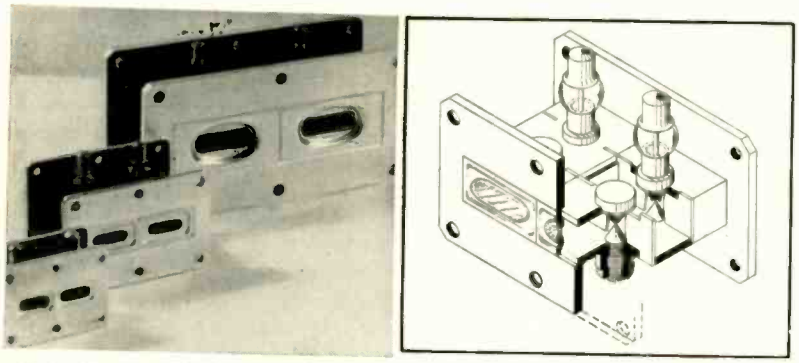


FIG. 5—Three dual t-r boxes and cutaway view of dual t-r box

Transmitting

Turning to the high-level or transmitting condition, Fig. 4, the input windows of the t-r tube fire and the gaseous discharge behind the windows behaves as a short circuit. Assuming a unit-voltage vector on arm 4 (transmitter), the power split and 90-deg phase shift of the input coupler result in vectors 3 and 2. These are each reflected with 180-deg phase shift

from the input windows of the fired t-r tube. These reflected vectors again traverse the input coupler and recombine to a unit vector in antenna arm 1, Fig. 4A with no reflection presented to the transmitter arm. The vswr at the transmitter is thus quite low.

Since the t-r is not a perfect switch, some power is transmitted through it producing leakage power consisting of a spike, the transient switching power, and a quasisteady-state flat. Assuming a magnitude L of the leakage-power voltage vector for either the spike or the flat, the vectors as shown in Fig. 4B recombine to cancel in the receiver arm and add in the dummy arm. Ideally, no leakage power is incident on the receiver arm and all of the leakage power is incident on arm 2'. A low-power matched termination is provided on the dummy arm to absorb this power.

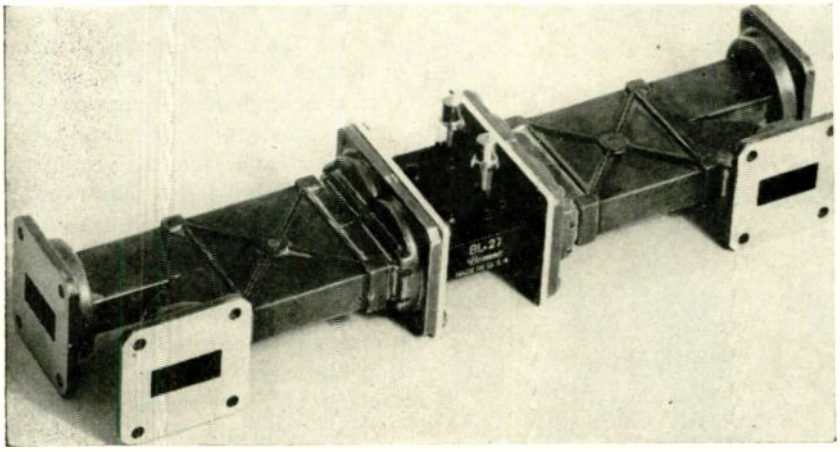
Here again, imperfections in the short-slot couplers with respect to power split and durations in theoretical phases together with inherent reflections and losses in the t-r tube, result in some leakage power incident on the receiver arm. However, in practice, a cancellation of the spike of 4-6 db and a cancellation of 6-10 db of the flat power are achieved providing an increase in the safety factor with respect to crystal burnout protection.

T-R Tube Construction

A cutaway view of a typical dual t-r tube is shown in Fig. 5. Each section of the dual t-r tube is similar to the single-tube prototype. At high frequencies the two sections share a single wall thickness, while at the lower frequencies a double wall thickness is used.

A small aperture in the common wall serves to maintain equality of gas pressure and composition. This helps to insure uniformity between sections of those properties that depend upon the nature and pressure of the gas fill, such as leakage power, recovery time, arc loss and ignitor voltage drop. Each section is provided with its own ignitor terminal, although future designs may incorporate current-balancing resistors with only a single ignitor terminal.

The development samples of the couplers were designed with a special double choke flange to mate with the tube flanges. This was made by slicing two standard chokes in the direction of the narrow wall and butting them together. For pressurization, a special rubber gasket somewhat like a figure 8 was inserted into the resulting pressurization groove. This arrangement was replaced by the improved design shown in Fig. 6. This utilizes a composite metal-rubber gasket which fits into a rectangular groove provided on the outer periphery of the waveguide of the mating flange on the coupler.



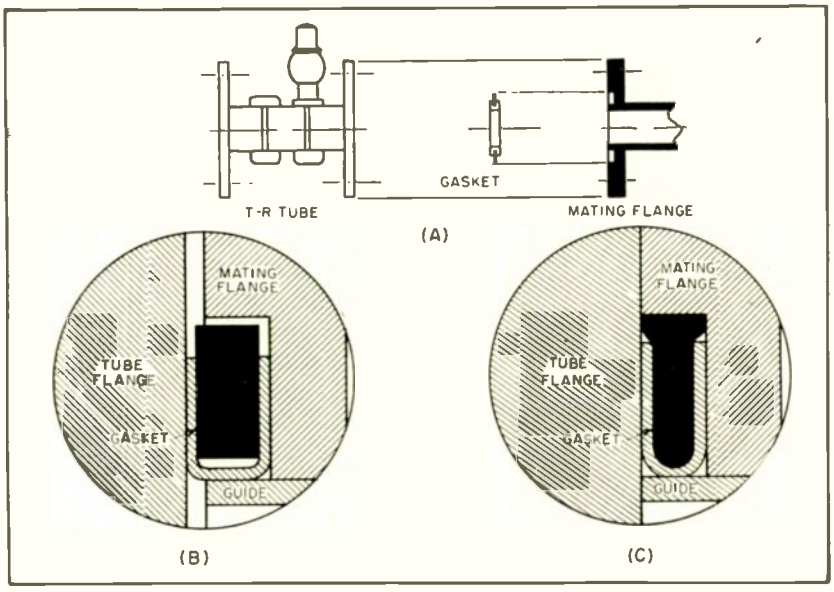


FIG. 6—View of complete duplex, above, and detail of gasket assembly for t-r tube and mating flange, below. Basic components (A) are assembled (B) then compressed to form tight seal (C)

ATR System

One of the most difficult problems in the design of a broadband duplexer is that of the atr system. The inherent Q of conventional atr tubes is too high to permit a reasonable protection from excessive branching loss over a wide frequency band. Thus, 2, 3 and 4 tubes with various spacings and resonant frequencies have been utilized. These multiple-tube circuits introduce an appreciable loss in antenna power and often have excessive branching loss at a particular frequency within the band depending on the magnitude and phase of the transmitting tube.

These problems are eliminated with the short-slot duplexer, since the isolation between receiver and antenna arms is sufficiently high to insure that no value of phase and impedance of the transmitter tube will increase the duplexer loss by more than a fraction of a db.

Reference

(1) Henry J. Riblet, The Short-Slot Hybrid Junction, *Proc IRE*, 40, p 180, Feb. 1952.

Continuous Film Scanner

Optical features and electronic circuitry of rotating-polygon flying-spot scanner, originally developed as a high-quality color signal source, now adapted for broadcast applications. Avoids problems of color synchronization, registration and shading effects

TELEVISING of film programs is complicated by the fact that standard sound films are recorded at 24 frames per second, whereas television images are scanned in the United States at 30 frames per second.

In current monochrome broadcast practice, this discrepancy is resolved by projecting the film images into a storage camera tube (iconoscope or image orthicon) which retains the image of each film frame until scanning takes place. A flash of light occurring at the end of each scanning field passes through the film to the camera tube.

The flashes are so synchronized with the film motion that two such flashes occur while one film frame is present in the gate, and three flashes occur during the dwell time of the succeeding film frame. Thus, during the scanning of five fields (5 × 1/60th sec = 1/12th sec) two film frames are projected (2 × 1/24th sec = 1/12th sec) and the two processes are brought into synchronism.

It is required only that the film transport mechanism shall be synchronized to the field scanning rate; in practice this is accomplished by locking the projector motor and the synchronizing signal generator to the local 60-cps power source.

Disadvantages

In monochrome practice, this method is open to two objections. The local power supply frequency may differ slightly from the nominal scanning standard of 60 fields per second. Also, the storage properties of the camera tube may produce deleterious effects such as variations in shading over the image. As a result, great pains are necessary through such techniques as edge-lighting of the iconoscope, to produce a high-quality image.

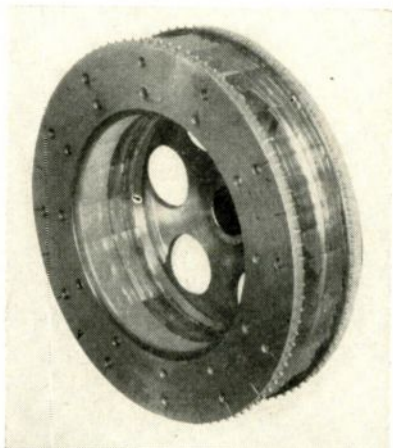


FIG. 1—Polygon has 24 sides; rotates once per second

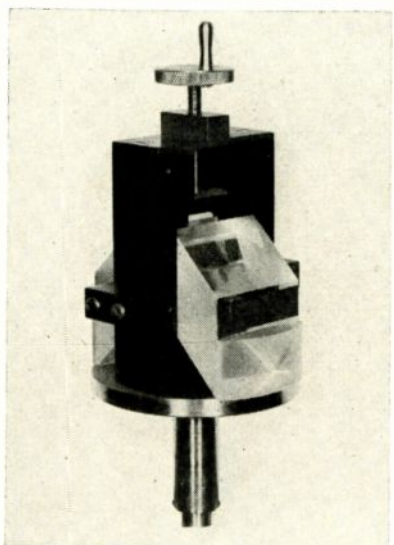


FIG. 2—Optical elements of core that fits inside polygon

When compatible color transmissions are contemplated, the storage tube method of scanning is open to two additional objections. The field scanning rate is synchronized, in FCC color standards, to an accuracy of three parts in a million. To avoid immediate or eventual loss of synchronism in this case, the projector motor must be driven by a crystal-controlled power supply having the requisite precision and tied to the color-sync generator.

Three images, in the primary colors, must be laid down in precise registry on three camera tubes to secure simultaneous red, green and blue signals that are later encoded according to NTSC specifications.

Continuous Scanning

All these problems may be solved by use of continuous flying-spot scanning in conjunction with a nonstorage multiplier phototube pickup. The film moves continuously through the gate and an optical compensator arrests the relative motion of the film image. As one frame moves out of the gate, its image fades while that of the next frame comes into view, superimposed on the first.

If the sum of the brightnesses of the two superimposed images remains constant during the transition between frames, flicker is avoided and the scanned image is present continuously, no matter what the speed at which the film moves through the scanner.

Light from the spot on the c-r tube face passes through the optical compensator of the continuous projector, which effectively arrests the film motion while an image of the spot scans the continuously present film frame. The modulated light then enters a multiplier phototube, where it generates the video signal.

For obtaining compatible color, the light beam, after passage through the color film, is passed through a beam splitter consisting of dichroic mirrors and filters. The splitter separates the beam into three components, one in each of the primary colors. These pass individually into three multiplier phototubes, which produce the three simultaneous primary-color signals.

for Monochrome or Color

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Research Division
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Since there is only one light source, the three signals arise at any instant of time from identically the same spot on the film image and there is no registration problem. It is relatively simple to secure uniform light from each point on the raster of the flying-spot tube and the three phototubes display unvarying sensitivity to the light, so there is no uneveness of shading.

Scanner Signal Source

Of several[1] possible types, that adopted for the Philco scanner is the prism compensator. One form consists of a polygon of glass, having an even number of parallel faces. The film is wrapped around the polygon so that adjacent film frames cover adjacent faces of the polygon. The polygon is rotated about its axis of symmetry, while the light from the flying-spot tube passes through the polygon, entering one face and departing through the parallel face at the opposite side of the polygon and thence through the film.

Optical Compensation

The optical compensator* finally adopted makes use of a twenty-four sided polygon. At 24 film frames per second, it rotates once per second. In the 35-mm scanner, its diameter is about 5½ inches as shown in Fig. 1.

As the polygon rotates, and the angle of each face changes, refraction of the light in passing through the polygon causes the spot to adhere to a particular point on the film, thus effectively arresting the film motion.

The complete system is so arranged that an image of the spot falls not only on one film frame, but also another image of the spot falls on the same point of the adjacent frame. During transition from one frame to the next, there is no interruption, one spot image taking over as the preceding spot fades away.

The polygon has a large cylindrical, polished hole cut in it. The film can be wrapped partially around the polygon, so that each film frame is optically and mechanically registered with each corresponding facet of the polygon. This arrangement, termed isotransport, enables the velocities of film and polygon to be kept automatically in phase synchronism.

Contained within the rotating polygon is a stationary optical system, the core, Fig. 2. This is a stationary platform that carries a number of optical elements essential to the system. Two planoconvex cylindrical lenses form a zero-focus air gap between the rotating polygon and the other optical components that constitute the core. Two prismatic rhombs serve as path length extenders, in the optical sense. Without such path length extension the diameter of the polygon could not be reduced sufficiently to enable it to be contained within the diameter of a film sprocket. The core contains an adjustable optical shrinkage compensator. A sectional view of the optical system is shown in Fig. 3.

An inherent feature of all machines using continuously moving film is that their operation depends on the degree of shrinkage of the film and provision for shrinkage compensation must be made. In a prismatic polygon-type of optical compensator, the best way to compensate for film shrinkage is effectively to vary the optical diameter

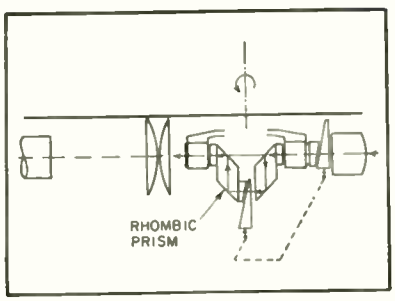

FIG. 3—Path through lenses and prisms of the optical system

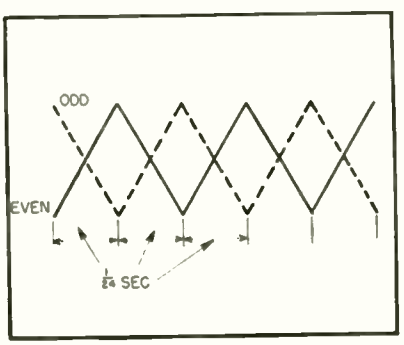

FIG. 4—Fade in and out of successive frames for lap dissolve

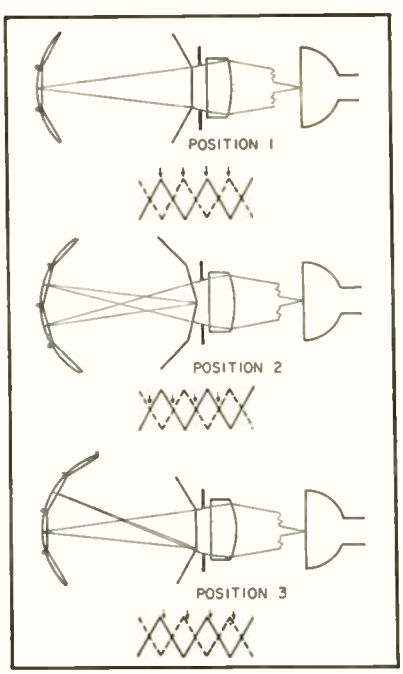

FIG. 5—Simplified diagram showing manner of flying-spot scanning

* An invention of Dr. John C. Kudar. The Philco Corporation has the exclusive license under Dr. Kudar's applicable patents and applications, but only for the television field.

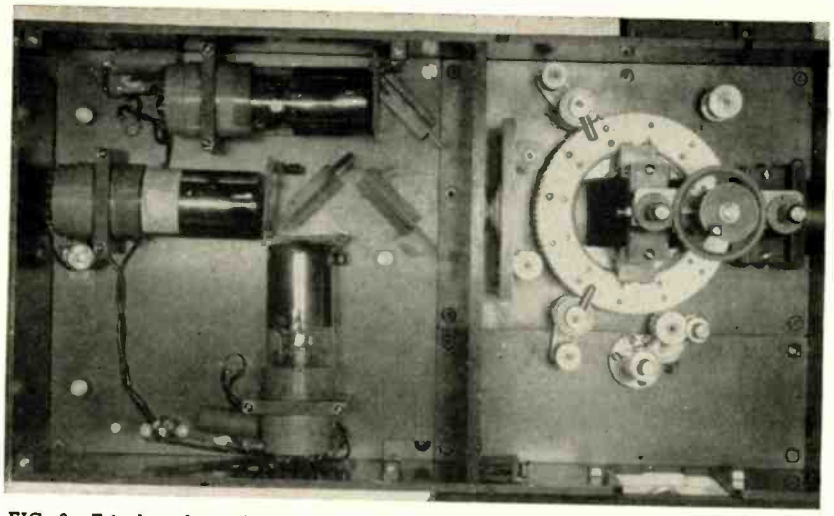

FIG. 6—Tricolor phototube assembly and film traction mechanism of picture head

of the polygon arrangement.

Compensation is accomplished by introducing into the optical path between opposite pairs of facets of the polygon the optical equivalent of a parallel plate of variable thickness. Such a plate is formed by sliding a thin wedge against a stationary wedge having the same slope angle. The in-and-out movement of this wedge against its corresponding mate, separated by a small air gap, varies the optically effective path length through the polygon and thus compensates for film shrinkage.

To maintain proper focus, a second plane parallel plate of variable thickness is introduced into the optical system between the projection lens and the polygon. The sum of the thicknesses of the shrinkage compensator and refocus compensator is kept constant by push-pull operation of the respective wedges.

Picture Transition

In continuously moving film devices, a method of picture transition from one film frame to the next must be provided in place of the intermittent pull-down. The method used in the scanner described is lap dissolve, the alternate fading in and fading out of successive film frames (Fig. 4).

While a given film frame is fading from maximum to minimum light intensity on the screen, the successive film frame fades in from zero to maximum intensity and the sum of the two light intensities must be constant. Thus, two successive film frames are superimposed on the screen, except at the instant when one film frame appears on the screen, the preceding frame having faded down to zero intensity and the succeeding frame not yet having risen to a finite level of intensity.

The dynamic manner of operation is shown in Fig. 5, which relates the position of rotation of the polygon to the lap-dissolve diagram. The first view shows the polygon in the normal position, that used to transmit one stationary film frame (T_o). The second view shows the polygon in a position of rotation one-half frame-time later (T_o + 1/48 second). At this instant the light from the raster is evenly divided between two successive film frames.

The third view shows the polygon an instant later (T_o + 1/24 second + δ). This view demonstrates that, when only one facet is illuminated by the projection lens, the action of the optical compensator causes the raster to move over a height of three film frames. In other words, a gate three film frames high is required even though no more than two film frames are utilized simultaneously.

The heart of the scanner, the optically compensated film-traction mechanism, is shown in Fig. 6. The main picture sprocket is not motor driven, but is driven by the film.

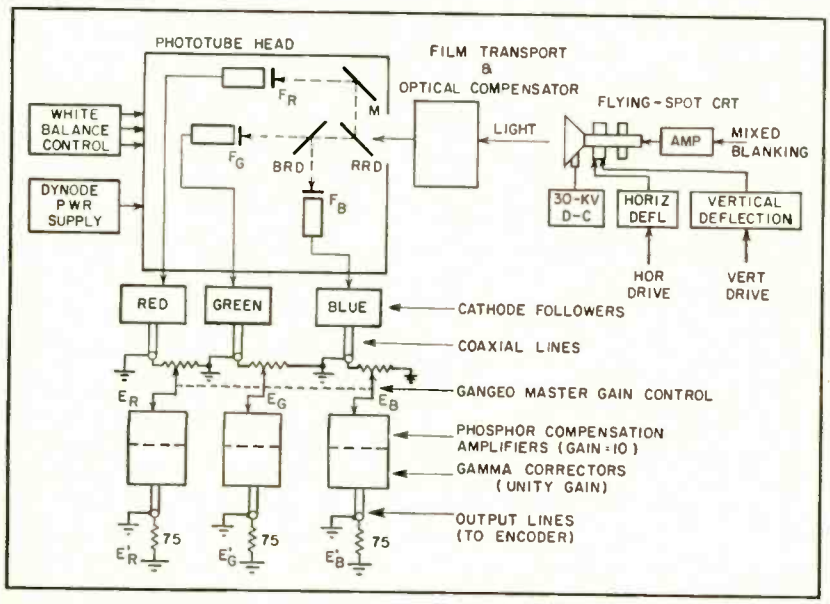

FIG. 7—Arrangement of elements of the scanner

Circuits

The block diagram of Fig. 7 shows the major units of the equipment. The source of the scanning beam of light is a flat-faced five-inch diameter cathode-ray tube, using magnetic deflection and focus and having a zinc oxide phosphor. The scanned raster on the face of the flying-spot tube has a standard 4 × 3 aspect ratio, with a diagonal equal to 3.75 inches. The tube, employing a fine-grain, short-persistence phosphor developed by Lansdale Tube Co., is operated at an anode potential of 30 kv and a beam current of 250 μa.

Deflection

The deflection circuits are driven from horizontal and vertical signals obtained from a standard sync generator. Since the film transport

provides constant velocity film motion with optical compensation, the machine is completely nonsynchronous with respect to deflection sync.

If used to generate a standard NTSC color signal, the sync generator must be locked to a 31.5-kc pulse derived from the 3.58-mc crystal subcarrier generator.

When black and white film is run through the scanner, the sync generator may be locked either to the 3.58-mc subcarrier generator, an internal crystal in the sync generator, or to the 60-cycle power line.

The raster on the face of the flying-spot tube is standard, 60 fields per second interlaced and 525 lines per frame. To establish a definite black level in all three channels, the flying-spot electron beam is blanked during the horizontal and vertical blanking periods when no picture information is transmitted. This is accomplished by feeding a mixed blanking signal, obtained from a standard sync generator, to a blanking amplifier. Negative blanking pulses of sufficient amplitude to cut off the electron scanning beam are applied to the control grid of the flying-spot c-r tube. For a vertical blanking time of 8 percent this would leave 483 active scanning lines per television frame.

Light Splitting

The phototube head consists of three multiplier phototubes, types 5819 and 6217, two dichroic mirrors, a plane mirror and three color trim filters. The intensity and spectral distribution of the light entering the phototube assembly at a given instant of time depends on the density and color of the picture element on the film that is being scanned. The first mirror, which is a red-reflecting dichroic type *RRD* reflects red light toward the plane mirror *M* and transmits green and blue light. The second dichroic mirror *BRD* reflects blue light towards the blue phototube and transmits green light.

Suitable color filters in front of the phototubes take into account the spectral output of the flying-spot tube, the reflectance and transmission of the dichroic mirrors and the spectral response of the phototubes to obtain the three channel signals E_R, E_G and E_B.

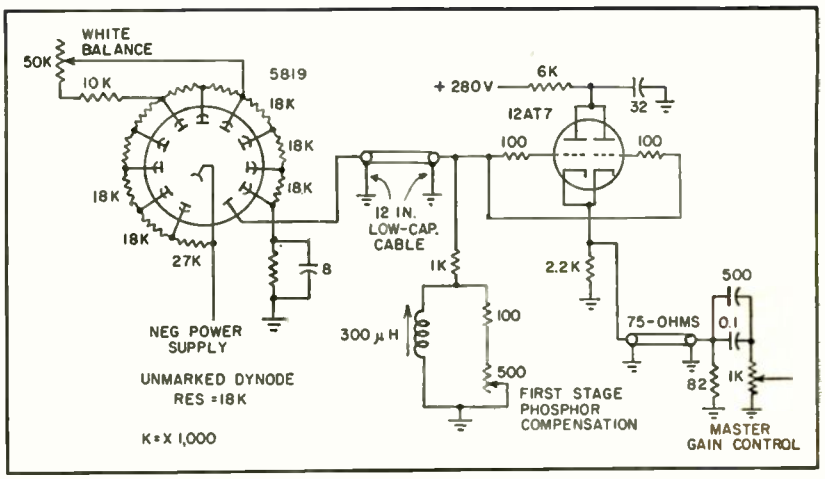

FIG. 8—Phototube circuit includes phosphor compensation

Since in some applications it may be desirable to separate the phototube head from the channel amplifiers, the phototube outputs are connected to cathode followers by short lengths of low-capacitance cable. The cathode followers feed coaxial lines that terminate in the master gain control. The signal level at this point in the system is approximately 0.1 volt peak to peak with black level positive.

The phototubes are head-on multiplier type and the d-c dynode voltages are obtained from 18K resistors. A master dynode power supply, which may be varied from −500 volts to −1,200 volts d-c is connected to the photocathodes of all three phototubes. To improve the signal-to-noise ratio, by achieving good collection efficiency, the resistor between the photocathode and the first dynode is higher in value than the resistors used between the other dynode stages.

White balance requires that the three channel voltages E_R, E_G and E_B be set equal when white is being transmitted. To achieve white balance by inserting neutral density filters in the light paths would decrease the signal-to-noise ratio for the attenuated channels.

The white-balance controls consist of 50,000-ohm rheostats connected between dynodes 5 and 7 of the red, green and blue phototubes. Controlling gain of each channel in this manner makes it possible to realize an optimum signal-to-noise ratio and still prevent overloading of the latter dynode stages.

Figure 8 shows the phototube circuit, cathode follower and master gain control for one channel. Similar circuits are used in the other channels and the master gain control consists of three matched ganged potentiometers.

When the peak plate current of a multiplier phototube is held to approximately 300 μa or less, the output current is directly proportional to the incident illumination. The dynode voltage supply is adjusted to a voltage which, with the master gain control turned almost to maximum, will provide standard output with dense film. This adjustment will vary some with multiplier phototubes of different sensitivity, and generally need only be changed when phototubes are changed.

The white balance is adjusted by changing the gain of the individual phototubes, by means of rheostats connected across dynodes 5 and 7, so that the voltages E_R, E_G, E_B are equal when a film containing a white reference against a black background is inserted in the film aperture. Once white balance has been established in this manner it will not vary with different settings of the master gain control.

Phosphor-Compensation Amplifier

Shown in Fig. 9 is the circuit of the phosphor compensation amplifier. This unit serves to increase the signal level from 0.1 volt to 1.0 volt and also, to compensate for the afterglow of the zinc oxide phosphor.

The phosphor has a fast

decay time and the light decays to approximately 30 percent of its initial value in 1.5 microseconds. However, it is necessary to correct for this finite decay time with video peaking networks, to obtain a high-definition picture without smear.

The circuit of the first compensating stage is illustrated in Fig. 8. A stage of cathode peaking, V_2 in Fig. 9, is also used. A fast-acting keyed clamp V_4 is used in the output circuit of the phosphor-compensation amplifier to insure optimum low-frequency response and also to remove any 60-cycle hum that may be picked up in the input circuits. The clamp driving pulses, which are approximately 2-μsec wide, are delayed 7 μsec from the start of horizontal blanking.

In alignment, both phosphor-compensating stages are removed and the frequency response of the amplifier is adjusted by means of the shunt peaking coils for V_1, V_2 and V_3, resulting in a uniform response to 5 mc and good transient response. A test film, such as the standard RTMA resolution chart, is inserted in the film aperture and the phosphor compensation circuits are adjusted to produce a high-resolution picture without smear.

This results in an overall frequency response, as measured between input to the first compensating stage and the output of the phosphor-compensation amplifier, which is flat between 60 cycles and 25 kc and then rises to a five-to-one peak at 3.5 mc and remains flat to over 5 mc. The resultant picture has good horizontal resolution to 400 lines (fundamental frequency of 5 mc) which is more than adequate for standard television transmission in which the combination of the transmitter and receiver limits the horizontal resolution to 320 lines (4 mc) or less.

When the frequency response is measured by means of line-selector techniques[2] from the test chart film, the detail contrast at 400 lines is approximately 50 percent of that at 100 lines. If desired, the detail contrast may be made equal at 100 and 400 lines by means of an aperture-correcting network, which has a frequency response with a gradual two-to-one rise between 1.25 mc and 5 mc and a linear phase

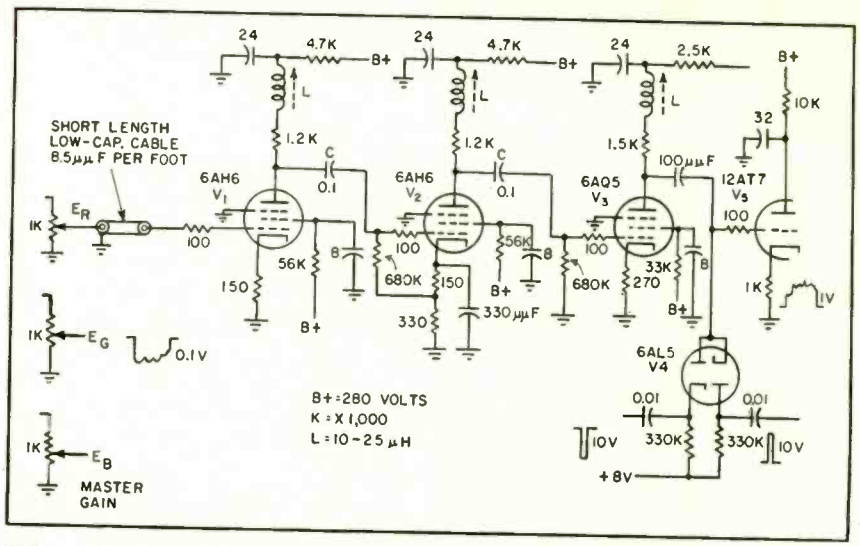

FIG. 9—Circuit of phosphor compensation amplifier

characteristic. Ordinary peaking networks produce a bad following white after a black-to-white transition.

The phosphor compensation amplifier and the gamma corrector for each channel are built on a single chassis. A unity gain cathode follower couples the two units.

Gamma Correction

Gamma correction must be applied to the individual red, green and blue channel voltages to correct for the power-law distortion of the color picture tube in a receiver. When the transmitting equipment is white balanced, as required by NTSC specifications, voltages E_R, E_G, E_B are equal on white; and a color picture element in the film will produce unequal voltages in the red, green and blue channels. The ratio between these voltages must be maintained in terms of light output from the three phosphors of a color tube if the luminosity, hue and saturation of the color on the film are to be reproduced faithfully.

Color display tubes have a gamma characteristic of approximately 2.2 relating brightness to grid drive. Without correction at the transmitter the light output of the color picture tube would show compression for signals near black level and expansion for signals of maximum amplitude. In this case, the ratio between the channel voltages would not be maintained in terms of light output from the individual phosphors and the color reproduced would be in error.

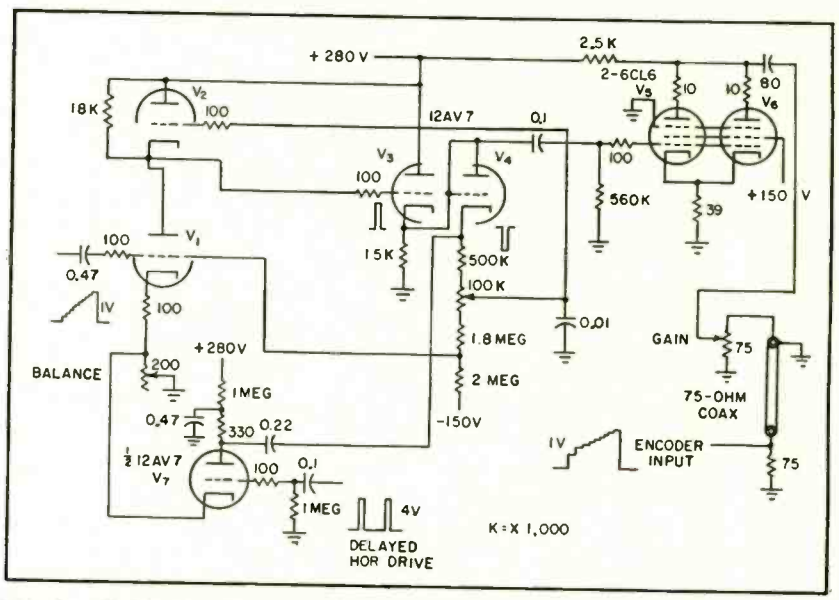

FIG. 10—Circuit of gamma corrector stages

The gamma correctors used with the film scanner are designed to have a gamma characteristic that is the reciprocal of the gamma of the reproducer. The gamma corrector, therefore, expands the signals near black level and compresses the signals in the highlights.

Contrast range of a tv color display device may not be as great as that obtained by theater projection. Also, there are distortions in luminosity and saturation in producing positive color film prints.

Gamma Corrector

A circuit for gamma correction[3] is shown in Fig. 10. It is best analyzed by ignoring tubes V_4 and V_7, which are used for black level clamping, and considering the grid of tube V_2 pegged to a fixed direct voltage. Tube V_1 approximates a linear current amplifier because of cathode degeneration and the signal impressed on its grid has a peak-to-peak amplitude of one volt with black level negative. Tube V_2 acts as a plate load for tube V_1, and has a resistance equal to 1 g_m. Since the g_m of tube V_2 is a function of its operating bias, its value will vary as the dynamic plate voltage of tube V_1 changes with video signal.

Tube V_2 is biased at an operating potential so that a small increase of input video voltage near black level applied to tube V_1 will cause a large change in the g_m of tube V_2. The effective plate load of tube V_1 will then increase and give greater amplification for signals near black level than it does for signals near maximum amplitude. In effect, tube V_2 becomes a varying resistor having its largest value when the video signal impressed on the grid of V_1 is near black level and its smallest value when the impressed video signal is large.

By selecting the proper operating bias for tube V_2, the circuit may be adjusted to provide the correct amount of gamma correction. Tube V_3 is a unity-gain cathode follower between the nonlinear stage and the output stage. Its main purpose is to minimize capacitance loading on the plate of V_1.

For a gamma corrector circuit of this type to operate correctly, black level must be held at a definite d-c potential on the grid of V_1. Tubes V_4 and V_7 accomplish this and also maintain stable drift-free operation.

Positive horizontal drive signals, which are obtained from a standard sync generator and delayed about 7 μsec, are applied to the input of tube V_7. Negative pulses are applied to the cathode of V_4, while positive pulses are applied to the cathode of V_1. Positive pulses are therefore obtained at the plate of V_1 and applied to the diode plate of V_4 by cathode follower V_3. By means of the balance control in the cathode circuit of V_1, pulses on the plate and cathode of V_4 are adjusted to be of equal magnitude but opposite polarity and hence do not appear in the output signal.

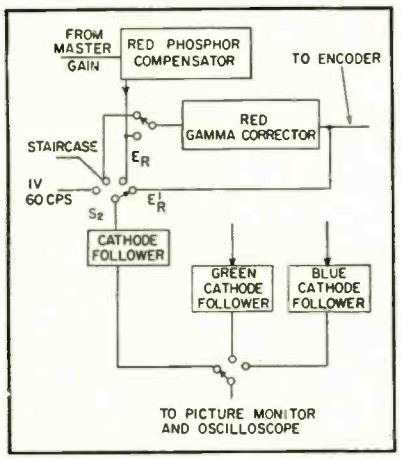

FIG. 11—Block diagram of monitoring equipment. Top switch is S_1

When the average value of the video signal impressed on the grid of V_1 changes, d-c is fed back from the cathode circuit of V_4 to re-establish black level at the correct operating voltage on the grid of V_1. In addition, the d-c potential applied to the grid of the nonlinear tube V_2 is also obtained from the cathode circuit of diode V_4. This helps greatly to maintain correct operating conditions with slight changes of B+ voltage or changes in plate current of V_1.

Calibration

Switching circuits, shown in Fig. 11, have been incorporated so the equipment may be calibrated and white-balanced rapidly. By means of S_2, the arm of which is connected to a unity-gain cathode follower, any one of four signals may be applied to both a picture monitor and an oscilloscope. These four signals are: a one-volt peak-to-peak 60-cycle calibrating voltage; a one-volt peak-to-peak ten-step linear staircase signal operating at a repetition rate of 15.75 kc; the output signal from the phosphor compensation amplifier and the output signal from the gamma corrector.

Either the output signal from the phosphor compensation amplifier or the staircase signal may be applied to the input of the gamma corrector by means of S_1. Separate switches are provided in each of the red, green and blue gamma correctors. Each unit, therefore, has a single low-capacitance output monitoring cable that connects to a three-position red, green, blue switch, the arm of which feeds the monitor and test oscilloscope.

The gamma correctors are most easily calibrated by applying the one-volt ten-step linear staircase signal to the input and then adjusting the stretch and gain controls so the various steps line up with calibration marks on the oscilloscope. A calibration that has worked very well with many color films results in a ratio of gain of eight to one between step one, which is nearest black level, and step ten.

White balance is adjusted by setting voltages E_R, E_G, E_B equal at the output of the phosphor compensation amplifiers when a black and white test film is inserted in the film aperture. To white-balance on equal-energy white, an opaque mask having a small horizontal slit may be placed in front of the flying-spot cathode-ray tube and the pulse voltages obtained in the three channels may be adjusted to be of equal amplitude by means of the white-balance controls. If it is desired to white-balance for a different reference white, an appropriate filter may be inserted in front of the slit on the opaque calibrating mask.

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(1) D. G. Fink, Continuous Film Scanner for TV, Electronics, p 114, July 1951.
(2) J. F. Fisher, Television Picture Line Selector, Electronics, p 140, Mar. 1952.
(3) R. C. Moore, The Specification and Correction for Non-Linearity of Cathode Ray Tubes, Paper presented at 1952 IRE National Convention, New York, N. Y.

Single-Channel System of

Fading due to multipath transmission may be overcome by system that produces frequency diversity within a single channel. Technique is simple, economical and may find wide application in line-of-sight communications

AVAILABLE frequency diversity systems provide improved signal reception under multipath transmission conditions by using two or more communications channels. Duplication of receiving and transmitting equipment, however, makes such systems quite expensive.

The current trend towards uhf communications makes wider bandwidths available and suggests use of a single-channel frequency diversity technique in which the r-f energy is spread within a single channel. Such a system avoids the expense of duplicating equipment for separate channels and the use of special circuits for selecting the stronger channel.

This article describes a single-channel frequency diversity system for a-m voice communication. The effectiveness of the system is described in terms of the parameters of the diversity signal and transmission paths.

Single-Channel System

The single-channel frequency diversity system for a-m voice communication produces the spread of r-f energy over the channel by frequency modulating the carrier with a tone before amplitude modulating with intelligence. The resultant f-m carrier and sidebands act as separate carriers of the a-m intelligence and must remain within the passband of the equipment. The frequency diversity signal is described by Eq. 1 and its spectrum plotted in Fig. 1A

$$e = E(1 + m \sin 2\pi\alpha t) \sin [\omega t + (D/\mu) \sin 2\pi\mu t] \quad (1)$$

where ω = r-f carrier frequency α = a-m speech frequency, μ = f-m tone frequency, m = percentage a-m, and D = f-m peak frequency deviation.

The effect of multipath transmission on a single frequency for a fixed geometry of signal path is plotted in Fig. 1B and 1C with amplitude versus frequency. This is essentially a plot of the magnitude of the transfer function of the transmission medium with multiple transmission paths.

$$|Y| = (1+x^2 + 2x\cos\omega t_o)^{1/2} \quad (2)$$

where E_1 = direct path signal voltage, E_2 = indirect path signal voltage, $x = (E_2/E_1) < 1$ and t_o = delay of E_2 in traveling the longer path with respect to E_1. The two signals are seen to cancel or give a null in the transfer function at frequency intervals of $1/t_o$.

The effects of frequency diversity may be visualized by observing Fig. 1 and considering first an a-m signal without diversity. If this signal falls on a null of the cancellation pattern it may be completely lost. With the diversity signal of Fig. 1A, while a few carriers may be lost by the cancellation pattern others will be reinforced such that no matter where the cancellation pattern falls with respect to the signal spectrum the entire signal will never be completely cancelled.

Dynamic Fading

The condition of dynamic fading may be observed in a tv picture when an aircraft passes overhead and the signal fades in and out. This effect is equivalent to the cancellation pattern of Fig. 1B sliding along the abscissa; or the peaks and nulls passing the carrier frequency. Under this condition Fig. 1 illustrates how the diversity signal tends to average over the cancellation pattern and smooth the signal fluctuation.

The effects of the parameters of the diversity signal and the multipath transmission conditions may likewise be observed. The indirect signal delay t_o is proportional to the difference in multipath signal path lengths. Figure 1C shows how the cancellation pattern spreads as t_o becomes small. The diversity signal, spanning a smaller portion of the cancellation pattern, will have less effect in averaging over the pattern.

The diversity signal width may be increased, however, by increasing D to increase the diversity signal effectiveness up to channel bandwidth limits. Essentially, the larger values of t_o and D give the greater effectiveness of the frequency diversity system.

Theoretical Analysis

The frequency diversity system is analysed mathematically by summing the direct and indirect signals

$$e_1 = E_1(1 + m \sin 2\pi\alpha t) \sin [\omega t + (D/\mu) \sin 2\pi\mu t] \quad (3)$$

$$e_2 = E_2[1 + m \sin 2\pi\alpha(t - t_0)] \sin [\omega(t-t_0)+(D/\mu) \sin 2\pi\mu(t-t_0)] \quad (4)$$

The indirect signal is shifted an amount t_o in time to account for its delay in traveling the longer path.

It will be assumed that t_o will be small with respect to the period of the maximum speech frequency α_{max} such that t_o in the a-m term of e_2 may be neglected. This assumption is valid for most line-of-sight communication. Where the assumption is not valid frequency-selective

Frequency Diversity

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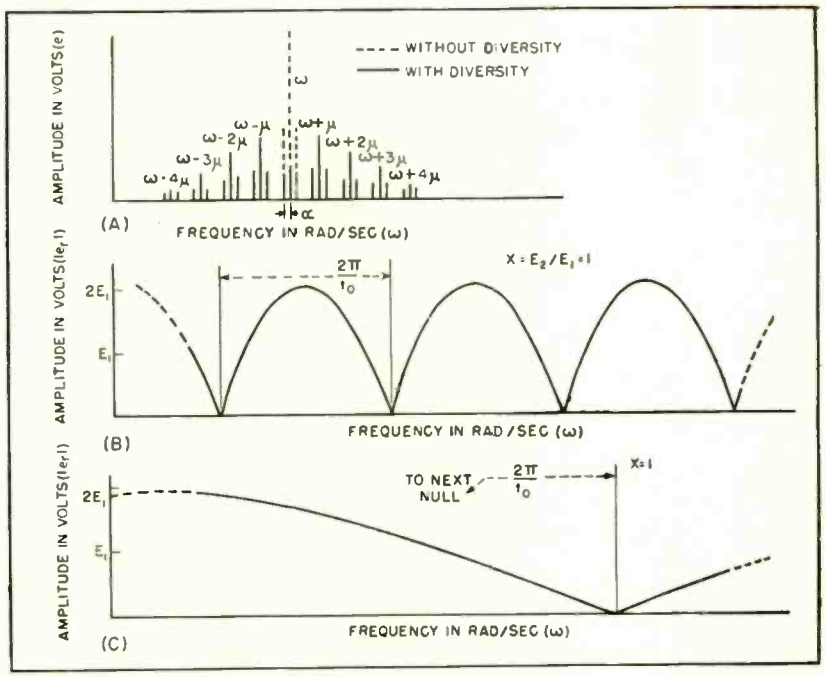

FIG. 1—Frequency spectrum of signal with and without diversity (A). Effects of multipath transmission on signal without diversity are shown for short time difference in path (B) and long path difference (C)

distortion of the speech will be observed as in overseas short-wave broadcasts where portions of the speech spectrum are attenuated and others reinforced.[1,2] This effect will rarely be significant in line-of-sight communication.

The two signals are summed and reduced to the form of Eq. 5 where e_s is the resultant received signal

$$e_s = E_1(1+m\sin 2\pi_a t)\cdot \left\{1+x^2+2x\cos\left[\frac{2D}{\mu}\sin\pi\mu t_0\right)\cos(2\pi\mu t-\pi\mu t_0)+\omega t_0\right\}^{1/2}\cdot \sin\left[\omega t+\frac{D}{\mu}\sin 2\pi\mu t - \tan^{-1}\frac{x\sin\beta}{1-x\cos\beta}\right] \quad (5)$$

where $\beta = [(2D/\mu)\ sin\ \pi\ \mu t_0)\ \cos\ (2\pi\mu t\ -\ \pi\mu t_0)\ +\ \omega t_0]$.

The speech amplitude-modulation function remains in its transmitted form. The second major part is the carrier frequency function. This function contains the carrier frequency, the transmitted frequency-modulation function and a distortion term of the frequency-modulation function caused by multipath transmission.

In a practical a-m receiver, the received signal passing through tuned r-f circuits will cause some amplitude-modulation of the signal as a result of the frequency-modulation functions.[3]

This addition to the signal envelope will appear in the second detector output consisting of only the tone frequency μ and its harmonics.[4]

The remaining portion of the resultant signal is the product of E_1 and the radical. The radical contains a d-c component, plus components of the tone frequency μ and its harmonics which will appear on the signal envelope.

Undesired Components

The a-c components in the signal envelope of the frequency μ and its harmonics are undesirable and must be removed from the second detector output.

This second-detector output is removed by choosing μ sufficiently high to be readily removed from the receiver audio output by a low-pass filter.

Allowing for intermodulation between speech and tone, μ must be chosen greater than twice the maximum speech frequency with some additional space for practical low-pass filtering.

The useful part of the radical is the d-c component that determines the effective received signal level under multipath transmission. This d-c component may be found by averaging the radical over a period of the tone μ as shown in Eq. 6

$$b = \mu\int_{-1/2\mu}^{+1/2\mu}\left\{1+x^2+2x\cos\left[\frac{2D}{\mu}\sin\pi\mu t_0\right)\cos(2\pi\mu t)+\omega t_0\right\}^{1/2}dt \quad (6)$$

The low-pass filter performs this integration in the receiver. The values of b were computed graphically for the the following theoretical data.

The term b although referred to as a d-c component may change with time when the geometry of the propagation paths change with time. This term causes the rise and fall of signal resulting from multipath transmission as the signal paths and t_0 change. Figure 2 shows a plot of signal level b as t_0 changes to cause a 2π-radian rotation of ωt_0 or a full fading cycle.

Simplified Equation

A simplified form of Eq. 6 results when the argument of the sine function is sufficiently small to replace the sine function by the argument reducing the effective received signal to

$$b = \mu \int_{-1/2\mu}^{1/2\mu} \left\{1+x^2+2x\cos\left[(2Dt_0)\pi\right.\right.$$
$$\left.\left.\cos(2\pi\mu t)+\omega t_0\right]\right\}^{1/2} dt \quad (7)$$

This function is plotted in Fig. 2 for the worst multipath transmission condition where the two signals arrive with equal amplitude or where x is unity. Since $\omega >> 2\pi D$, the change in t_0 required to rotate ωt_0 thru 2π radians or a full cancellation cycle will cause negligible change in the value of $2Dt_0$. The curves in Fig. 2, for a fixed value of t_0 describe the multipath transmission fading cycle for different values of D, which is a measure of the spread of r-f energy of the diversity signal.

When D is zero there is no diversity, and the severe fading cycle shown in Fig. 2 is experienced for $2Dt_0$ equal to zero. As the r-f energy of the diversity signal is spread by increasing D, it is observed that frequency diversity raises the fading cycle null and smooths the overall signal level fluctuations over the multipath transmission fading cycle.

In most multipath transmission problems the problem is to maintain the highest minimum signal over the fading cycle. However, in line-of-sight communication, reduction of the overall peak signal fluctuation over a fading cycle can also be important where signal fading approaches rates high enough to cause audible flutter in the receiver audio output. This flutter causes a garbled effect upon the speech with loss of intelligibility.

An example of rapid fading in line-of-sight communication is the reception of a tv picture while an aircraft passes overhead. The aircraft provides a moving reflecting surface for the indirect signal causing a rapid flicker of the picture which is too rapid to be controlled by avc circuits. The picture flicker can be annoying and cause loss of visual information to the viewer even when the signal remains well above readable level over the fading cycle.

Improvement

The two effects of frequency diversity that improve communication under multipath transmission are plotted in Fig. 3 using the complete function of Eq. 6. Each point in Fig. 3 is derived from a separate plot of the fading cycle like the three curves in Fig. 2.

The minimum value of b over a complete fading cycle is plotted in Fig. 3 giving the minimum signal level where the direct signal level E_1 is normalized or set equal to unity. The peak signal fluctuation over the fading cycle is also plotted in volts for an E_1 of unity.

To visualize the significance of these graphs, consider first the condition where t_0 is small and the abscissa reduces to $2Dt_0$. The curves are for only the worst multipath transmission condition where the signals arrive with equal amplitude; x is unity. With no diversity, D equal to zero, b_{min} drops to zero, or the signal is completely lost in the fading cycle null.

Also the peak signal fluctuation is at its maximum value of 1 v. As the r-f energy of the diversity signal spreads over the channel or as D increases, b_{min} is raised and peak fluctuation decreases to improve signal reception.

Signal Path Difference

The multipath transmission parameter t_0 is proportional to the difference in signal path lengths. Since the abscissa is the product $2Dt_0$, small values of t_0 require a large D or diversity signal bandwidth to remain within the effective region of the curve. Therefore, when multipath transmission problems involve small differences in signal path lengths it is necessary to consume greater bandwidth with the diversity signal by increasing D for the diversity signal to remain effective.

The significance of the complete abscissa function with the sine term is that when t_0 becomes very large or equal to the period of μ, the abscissa function returns to zero and frequency diversity effectiveness is lost. By choosing μ at its lower limit, t_0 will be allowed its maximum range of values before reaching the point of loss of diversity effectiveness.

If μ is chosen at 10 kc, t_0 may increase to 100 microseconds corresponding to a difference in signal path lengths of 18.6 miles. For most multipath transmission problems in line-of-sight communication, significant fading will rarely occur for a difference in path length above approximately 10 miles, and the 18.6 mile limit will seldom be significant.

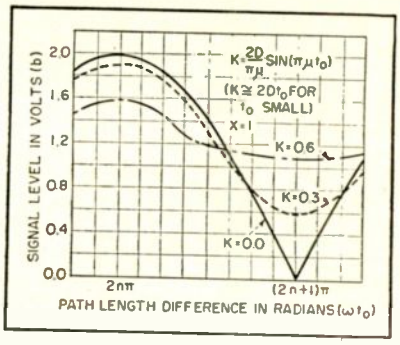

FIG. 2—Variation of signal level with path length in radians; K parameter is proportional to f-m tone frequency

To show how Fig. 3 may be used to analyse a particular single-channel frequency diversity system, a sample set of parameters is chosen to reduce the effectiveness of the diversity system to only one variable, t_0. The f-m tone frequency μ is chosen at 10 kc and peak f-m frequency deviation at 27 kc requiring approximately 60-kc bandwidth. With these values of μ and D the abscissa function of Fig. 3 reduces to 1.72 sin $(10{,}000\ \pi t_0)$. By choosing t_0 at discrete intervals, points on the curves of Fig. 3 may be located and replotted versus t_0.

The abscissa function t_0 of the new plot may be changed to more easily visualized units by converting to difference in path length of the direct and indirect signal which is equal to 186,000 t_0 miles. This plot is made in Fig. 4. Other methods of displaying the effectiveness of the frequency diversity system may be more desirable depending upon the particular application of the system under consideration.

Experimental Verification

The two-path transmission problem was set up experimentally with a multipath transmission simulator to verify the results of the theoretical analysis. The simulator divides a transmitted signal into two paths where one signal is delayed by a continuous delay line. To observe a full fading cycle, the delayed signal phase was shifted by a motor-driven capacitive phase shif-

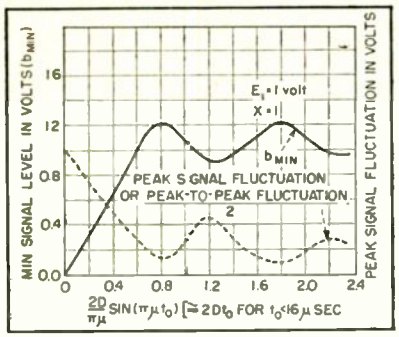

FIG. 3—Variation of minimum signal level and peak fluctuation with f-m tone frequency for a difference in path length

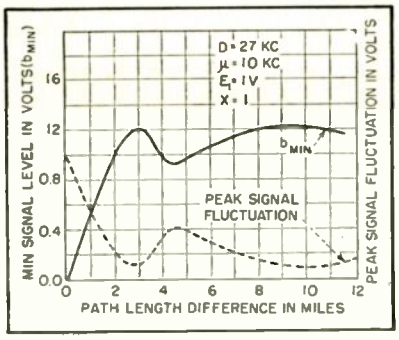

FIG. 4—Variation of minimum signal level and peak fluctuation with path length for a given f-m tone frequency

ter, which continuously rotates the phase through 360 deg.[5]

It was necessary to beat the indirect signal down to a frequency where practical delay lines could be used. By use of the same local oscillator to beat the delayed signal back up to its original frequency, no change in frequency was caused by the two conversions.

The rotating phase shifter does change the indirect signal frequency by an amount equal to the velocity of rotation of the phase shifter in cycles per second. This change in frequency is a true simulation of actual multipath transmission where, for example, if the reflection surface is in motion, Doppler effect causes a small shift in the indirect signal frequency where the beat frequency between the direct and indirect signals is the fading cycle rate observed in the receiver output.

Data was taken from the simulator for different values of t_0 or different lengths of delay cable. The experimental data agreed closely with the theoretical data.

Application of the System

Multipath transmission problems in line-of-sight communication will normally involve short difference in path lengths since the longer the indirect signal with respect to the direct signal the more it is attenuated with respect to the direct signal level. Including attenuation of the indirect signal at its reflection surface, the difference in path length need not be very great to reduce the indirect signal to an insignificant level. In Fig. 4 as the difference in path length becomes small the effectiveness of the diversity system decreases rapidly. To increase the effectiveness in this region, it is necessary to increase D which increases the signal bandwidth.

Problems involving very short difference in path lengths require considerable bandwidth which may be limited by equipment bandwidth. The diversity system effectiveness is independent of carrier frequency and it may be practical to use higher frequency ranges where wider bandwidths are available.

Determination of the most probable values of difference in path length causing multipath transmission problems may be difficult depending upon the particular problem. In some cases, it may be possible to calculate the difference in path length such as the ocean surface reflection problem in ship-to-plane communication, in terms of antenna heights and and separation. In other cases, as line-of-sight commuication in the vicinity of structures or rugged terrain, a great number of possible reflection surfaces are present requiring extensive measurements to determine difference in path length. If it is desired to evaluate the frequency diversity system where the most probable values of difference in path length is difficult to determine, actual trial of the diversity system may prove most convenient and economical since it involves only simple modifications of existing communication equipment.

Other effects causing signal fluctuations, which are not significantly affected by frequency diversity limited to a single channel, may also be present in line-of-sight communication. For example, shadowing from terrain, structures and antenna pattern lobes may cause rapid signal fluctuations when a communication terminal is in motion. In consideration of application of the frequency diversity system, it is necessary to distinguish between these effects and multipath transmission fading.

Conclusions

The single channel frequency diversity system is not a cure-all for line-of-sight communication, but offers a simple and economical method of improving signal reception under some multipath transmission conditions. This analysis is made for only two transmission paths, although intuitively similar results may be expected with a greater number of signal paths.

Improvements in signal reception are paid for by greater space in the frequency spectrum which is fundamental for any frequency diversity system. However, in uhf communications greater channel space is available. The cost of modifying equipment for use of the single-channel frequency diversity system is normally small, and may require as little as a triode tone oscillator and triode phase modulator in the transmitter r-f oscillator output.

Other methods of obtaining single channel diversity may be used including the use of other forms intelligence modulation.

This material is taken from a thesis submitted by the author to the faculty of the University of Maryland in partial fulfillment of the requirements for the degree of Master of Science. The author wishes to express appreciation for suggestions by J. D. Wallace of the Naval Research Laboratory.

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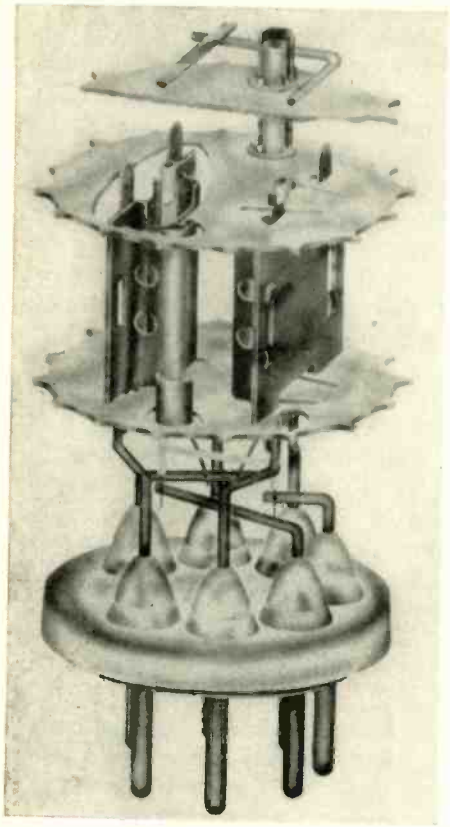

FIG. 1—Conventional mount assembly as used in type 6045 tube

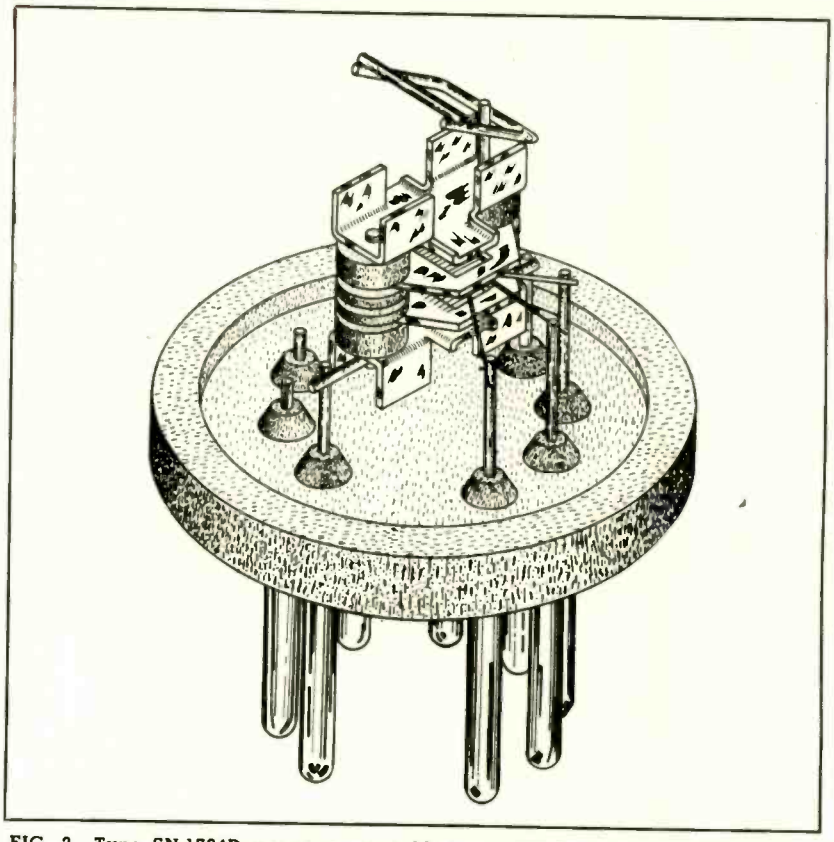

FIG. 2—Type SN-1724D mount as assembled on ceramic stem. All elements are stacked on two vertical pins and positioned by ceramic spacers

Ceramic Tube Mount

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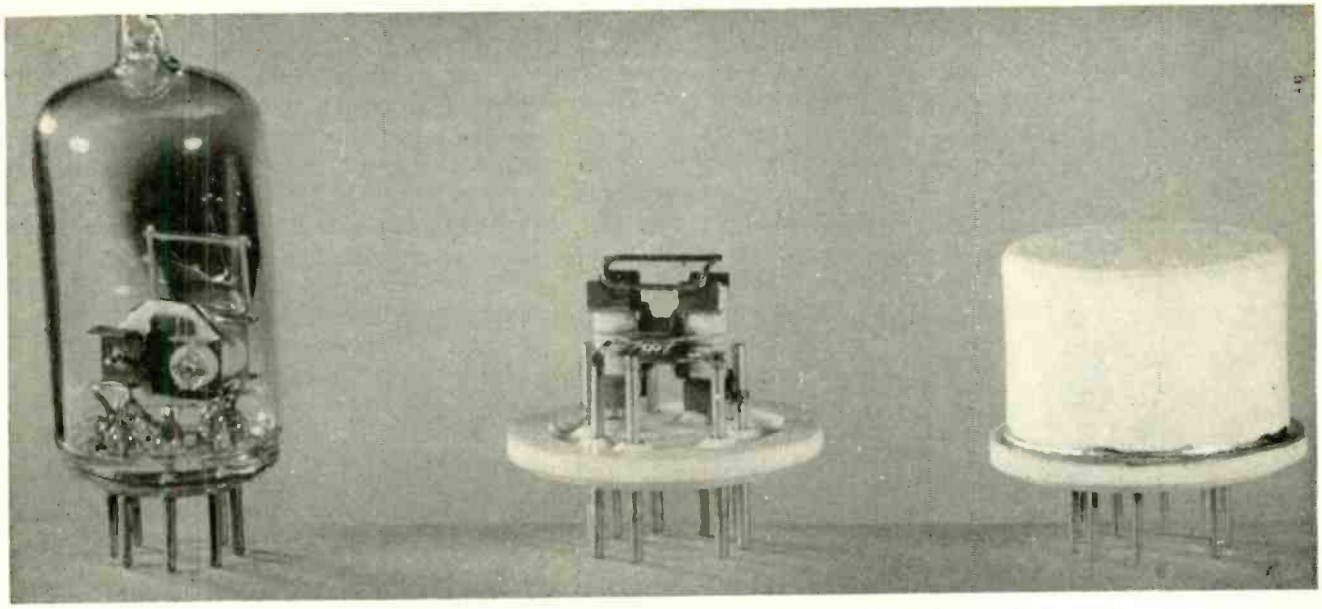
THE RECEIVING-TUBE mount described in this paper was designed and developed for machine assembly under a Navy contract with the Bureau of Ships. Every consideration in the design of the mount has, therefore, taken into account the feasibility of building machines to assemble it automatically.

Figure 1 shows a conventional 6045, which is the military version of the 6J6 in that it has been ruggedized and redesigned for more reliable service. One of the most difficult parts to cope with when adapting a mount of this type to machine assembly is the mica. There are two support holes at both the top and bottom where the plate is to be inserted into the mica. There are also two for the grid, one for the cathode and one for each of the supporting members. The total for both of the dual structures is twelve insertions. Inserting these one at a time into the bottom mica is not difficult. When applying the top mica, however, these twelve elements are free and loose at the ends and extremely difficult to insert. To avoid this insertion problem, it was necessary to find some other means of spacing the elements. Consequently, the design of the new SN-1724D tube uses a ceramic washer as the element spacer.

Design Approach

Figure 2 shows the radically new approach to mount assembly. One of the chief differences is the elimination of mica. The elements are stacked one upon the other. The complete mount is assembled on two small pins. First a plate, then a spacer ceramic, a grid, a spacer ceramic, a cathode, a spacer ceramic and any remaining pieces are put on the pins until the top is reached. When the stack is completed, the small pins are hot upset, giving a compact and tight mount assembly. Other overall objectives were to improve reliability and ruggedness, reduce microphonism, achieve high-ambient-temperature operation and achieve long life with greater uniformity. Therefore, it was decided to incorporate not only ceramic spacers between the elements but also a stem and envelope of alumina ceramic.

The method chosen for making the ceramic-to-metal seals and the ceramic-to-ceramic seals is a simple, single-step process using titanium-cored BT solder. Since no



Stacked mount in glass envelope, stacked mount on ceramic stem and same mount enclosed in ceramic envelope

Heat-sensitive mica insulators and glass envelopes of conventional receiving tubes are replaced by ceramic alumina in new stacked design using frame grids positioned precisely by ceramic spacers that can be dropped over support wires by automatic machinery

for Automatic Assembly

mica is used in the mount, it can be placed on a ceramic stem and sealed in a ceramic envelope. This type of structure is possible because the high temperatures needed for sealing have no ill effect on the ceramic spacers. Had mica been used it would deteriorate and break down, resulting in the liberation of water vapor.

Ceramic-to-metal seals and ceramic-to-ceramic seals are made at a temperature of about 900 C. Because of this high baking-out temperature, which glass could not withstand, the finished tubes have less gas to begin with and therefore have a longer gas-free life.

Figure 3 shows how the tube elements are stacked. At the bottom is the plate, and above it the spacers, the frame grid spacer, cathode, frame grid and plate with its corresponding spacers. There is much greater area of support with the frame grid and this type of cathode than there is with a mica support. The only critical dimension is the thickness of the ceramic spacers, because comparatively wide tolerances in the horizontal direction will not disturb the grid-to-cathode or cathode-to-plate spacing.

No active element is inserted into anything. The pieces are merely stacked one upon the other. The grid-to-cathode spacing can easily be changed by changing the thickness of the grid-to-cathode spacer.

Figure 4 compares a conventional mica with the ceramic spacer. The mica itself is easily deformed and broken. When the numerous necessary holes are punched, the mica is weakened further. The hole tolerances themselves can be held to only about 0.001-inch accuracy. An in-line, off-center accuracy can be punched to only about 0.001 inch also. In addition to this, the mica is temperature-limited. As it rises to high temperatures it breaks down and releases water vapor which attacks the cathode and shortens the life of the tube.

On the other hand, the ceramic spacer used in the stacked mount is extremely rugged and tough. The only dimension that need be maintained accurately is the thickness, and this can readily be held to 0.0005 inch.

Cathode Structure

Figure 4 shows also the cathode support assemblies as used in a conventional tube and in a SN-1724D stacked tube. The cathode in the conventional mount is supported only at the end. The mica must be punched so as to be a little larger than the cathode itself to allow for insertion. The tolerances of the hole in the mica

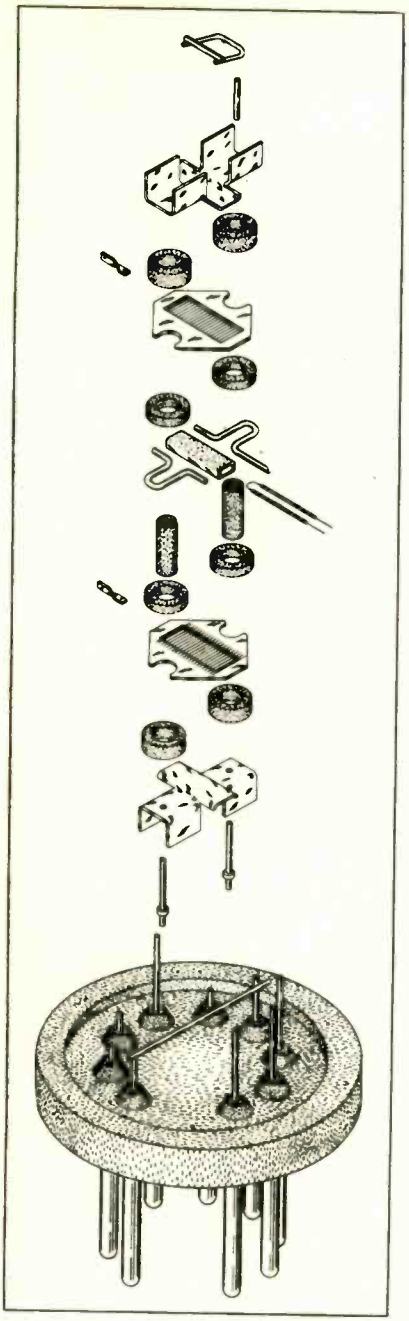


FIG. 3—Exploded view of mount, showing order of stacking

are about 0.001 inch and the cathode tolerances are about the same value. When the cathode is inserted in the mica, the fit may be loose and contribute to microphonism. In addition, the heating and cooling of the cathode gives a sawing action due to the expansion and contraction. This in turn enlarges the cathode hole, making a still looser fit.

The cathode coating must start somewhat above the mica on the bottom of the cathode and below the mica on the top, which means that actually only about 60 percent of the cathode length is used for the emission coating. The rest is unused except for structural support. The high temperature of the cathode, particularly during processing, can and sometimes does break down the mica, liberating water vapor which in turn results in tube loss.

In the stacked tube cathode assembly, loops are welded to the side to give a larger support area. Tolerances are not critical except that these loops must be accurately welded so that the proper spacing between grid and cathode is obtained. The cathode is held extremely tightly; the loops are placed over the ceramic supports and all are compressed together in the final hot upsetting at the top. These design features contribute to a less noisy tube. The whole length of the cathode is used for the cathode coating area. There is no loss of space or coated area as required in the mica-supported conventional cathodes.

Grid Assembly

Figure 4 likewise compares the conventional and stacked tube grid assemblies. With the conventional type of grid, the lateral wires are spaced by notches in the side-rod supports. These notches are then swaged over to hold the laterals in place. This operation enlarges the side-rod material. If the nicking and swaging are done along the inactive ends of the side-rods, there is again a sawing action when inserted into the mica which enlarges the mica hole and contributes to microphonism.

In addition, the side-rod grid is extremely fragile. If it is picked up with too much compression by the fingers, the minor dimension is changed and distorted. For the same reasons it is extremely difficult to measure this dimension and keep it accurate. The frame grid is perfectly flat and because of the mass of the frame will have no variation of major dimension. The minor dimension is controlled entirely by the spacer ceramics. There is no nicking and no swaging on this type of grid.

The lateral wires of the frame grid are wound on two frames back to back and the whole assembly is then brazed. This frame material is molybdenum and is brazed with gold. The fact that there is no nicking or swaging allows the use of smaller lateral wires and higher tension. The whole frame grid is much more rugged than the side-rod grid. The frame grid can be handled easily without distortion and the separate grids can be stacked into piles for later assembly. The result is greater uniformity of tube characteristics.

Tube Performance

The improvement in uniformity, shown in Fig. 5, illustrates what happens when a conventional type of structure has its regular side-rod grid replaced by a frame grid. With the conventional grid, the mutual conductance spread was from 800 to 2,000 micromhos. These measurements were made right off the exhaust machine with no culling out and no previous testing. When this grid was replaced with a frame type of grid and the tubes were again tested right off exhaust without any sorting or culling, the

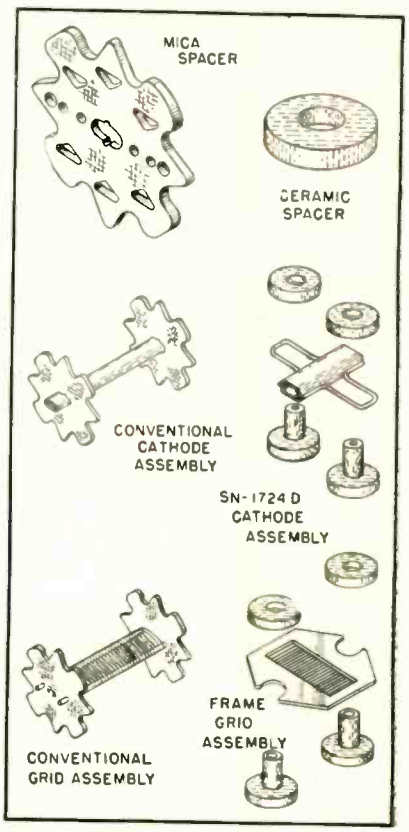


FIG. 4—Comparison of conventional assemblies with ceramic assemblies

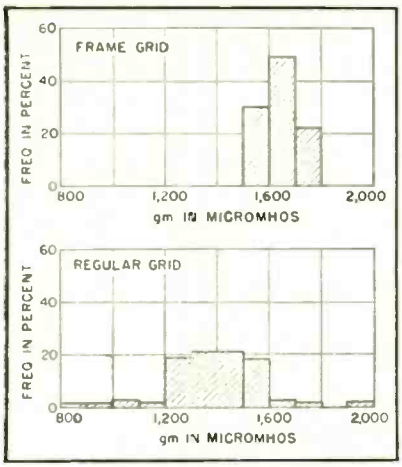


FIG. 5—Comparison of transconductance characteristics, showing reduced spread achieved with frame grid

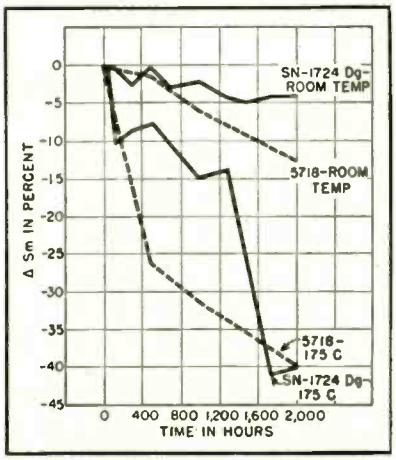


FIG. 6—Comparison of life test results at both room and high ambient temperatures

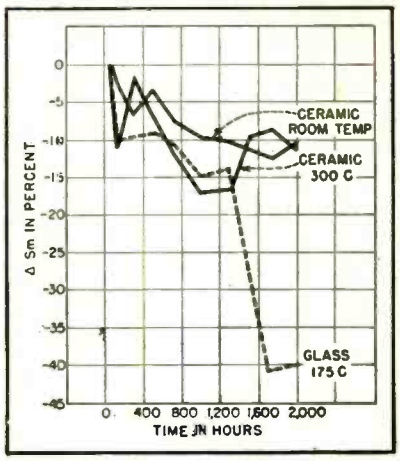


FIG. 7—Comparison of life test results for stacked mount in glass and in ceramic envelopes

spread was considerably reduced, being only between 1,500 and 1,800.

A sealed-in ceramic envelope and stem with the ceramic mount inside is much stronger than a glass envelope. It can be handled, dropped and shipped without breakage. In fact, it is extremely difficult to open. The ceramic envelope is also extremely rugged under thermal shock conditions. It has been removed from liquid nitrogen at —195 C and immersed in boiling water at 100 C, a range of almost 300 degrees, without fracture. This envelope structure has also been placed in an air furnace at room temperature and raised to 450 C for more than 100 cycles without fracture.

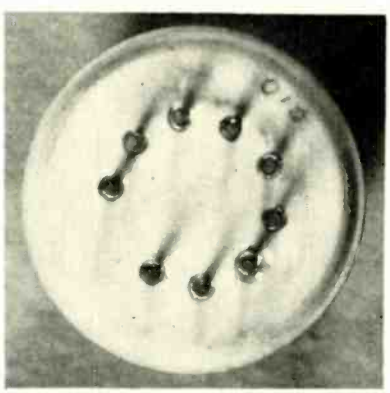
The ceramic envelope can be strapped directly to the chassis or it can be socketed. The basing arrangement allows for insertion into a jumbo miniature socket. Lead wires can also be soldered directly to the pins. The ceramic envelope permits high-temperature outgassing on exhaust, a fact which also permits high bake-out temperature and high-ambient-temperature operation.

Life Tests

Figure 6 shows life test results of the SN-1724Dg. The g indicates that the stacked mount has been placed in a T5½ miniature glass envelope. The top curve shows that at room temperature the mutual conductance dropped off less than 5 percent at the end of 2,000 hours, whereas for the conventional 5718 subminiature triode it fell off about 13 percent at the end of 2,000 hours.

These two types were then placed on life test at an ambient temperature of 175 C. The 5718 immediately began falling off; at the end of approximately 450 hours its mutual conductance was down by about 25 percent, and at the end of 2,000 hours was down by about 40 percent. The stacked mount assembly held up fairly well for a little more than 1,200 hours, with mutual conductance dropping off only about 15 percent. At that time it began to drop off rapidly and reached about the same point as the 5718. This rapid dropping off is attributable to electrolysis which is set up in the glass due to the high temperatures.

Figure 7 shows some life test results on the SN-1724Dc, the c indicating a stacked mount in a ceramic envelope. At room temperature the mutual conductance had dropped off at the end of 2,000 hours to about 10 percent, which is not as good as the stacked mount in the glass envelope and is attributed to early difficulties in processing a ceramic enclosed mount.



Bottom view of ceramic stem

Some of these tubes were also put on 300 C ambient life test, which is believed to be higher than any glass tube can withstand. At the end of 2,000 hours, the mutual conductance of the ceramic-envelope tube has about the same value as those on room-temperature life. Life test results at 175 C for the SN-1724 sealed in glass are also plotted in Fig. 6; these show the effect of electrolysis of the glass, which caused a rapid slump in mutual conductance after about 1,200 hours.

At the present time some life tests are under way at 400 C ambient temperature. These tubes have reached about 1,000 hours and are still satisfactory.

To determine the high dissipation capabilities of this type of structure, tests were run with the plate dissipation raised so that the plate temperature equalled that of the cathode. Tubes were run under this condition for well over 200 hours with no deterioration and no gas evolution.

Most of the tubes made have had about 1 millivolt noise output at 20 G. The electrical characteristics are more uniform than conventional tubes at normal life. The tubes are certainly better at high ambient life, and performance on 400 C ambient life after about 1,000 hours is still satisfactory.

Pulse Distribution in TV

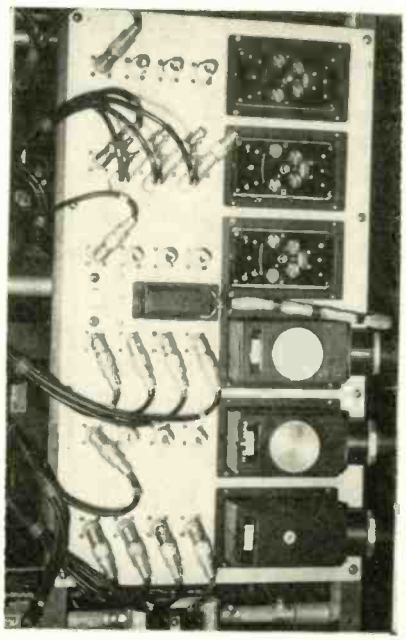
Master control, pulse distribution and switching system for key network television station combines efficient operation with maximum emergency protection. Any pulse-source output can be fed to any picture source within the facility

TELEVISION-NETWORK studio centers require elaborate systems for feeding synchronizing and blanking pulses to the various studios, projection rooms, monitoring and video recording locations. Such a system must be fully flexible, yet protected for emergencies. It must also be capable of being locked with synchronizing information received from network lines or other remote locations. The operation of the system also requires that accessible test points and provision for future expansion be included.

Equipment

First to be considered in equipment selection is the number of synchronizing generators necessary. This information when collated with the number of picture sources will determine how many pulse distribution amplifiers are needed.

An important factor in the determination of the number of pulse generators for a network originating station is the necessity of locking the sync generator at the station with both remotes originating locally and programs received from network lines (genlocking). This type of operation is becoming more prevalent, especially with the increased programming of national events which are handled as pool telecasts or else under a joint sponsorship with each sponsor controlling a regional network. An example of this was a telecast of a football game having five sponsors requiring five separate audio pickups at the field. A single video pickup without commercials was made. The video was split at telephone company test boards and fed with its associated audio to certain key stations who would genlock the signal, insert commercials and feed a regional network. The ability of



Camera control console pulse distribution panel at WABD

the individual sponsor to superimpose his commercial over the signal from the playing field increased the intimacy of the program and kept each region oblivious of the joint sponsorship.

The simplest form of pulse distribution system would utilize one generator to feed all picture sources and one spare generator. Also included would be a single genlock unit switchable to either generator. This system's disadvantage is that whenever a program is genlocked the entire station facilities become controlled by the incoming remote signal. This practice is undesirable. If the remote pickup equipment is operating on a primary power other than that used by the station and the station is not equipped with synchronous-type projectors, the station will be unable to roll film locally due to phase bar. Also, stability of genlock equipment can be influenced by variation in signal levels, too low a pedestal level or switching transients.

The situation becomes more predominant in the design of a pulse distribution system for a network originating center. Networks utilize theaters remotely located from their studios for theater-type productions and audience-participation shows. The commercials for these productions are at times handled in a studio with film and slide inserts originating from a centrally located projection room. This makes the use of genlock equipment a necessity. Network operation must have an arrangement whereby only the facilities required by the particular program are controlled by the genlocked generator thereby entailing a more intricate switching system.

Figure 1 is a block diagram of the master control pulse distribution and switching system recently installed. It is built around two units, one a studio synchronizing generator which furnishes both positive and negative outputs of RETMA standard: horizontal drive, vertical drive, sync and blanking pulses. The generator monitors all of the count-down circuits simultaneously on two three-inch oscilloscopes mounted in front of the unit. The other unit is a pulse distribution amplifier, having four inputs that can accept either positive or negative pulses. For each input there are four positive and four negative outputs.

Refering to Fig. 1, note that four generators are used. The generator outputs feed to a special synchronizing generator pulse patch panel where three of the generators are normaled through to groups of distribution amplifiers. The ability to normal through circuits, see Fig. 4, is realized by the use of audio jacks, equipped with bridging jacks,

Network Origination

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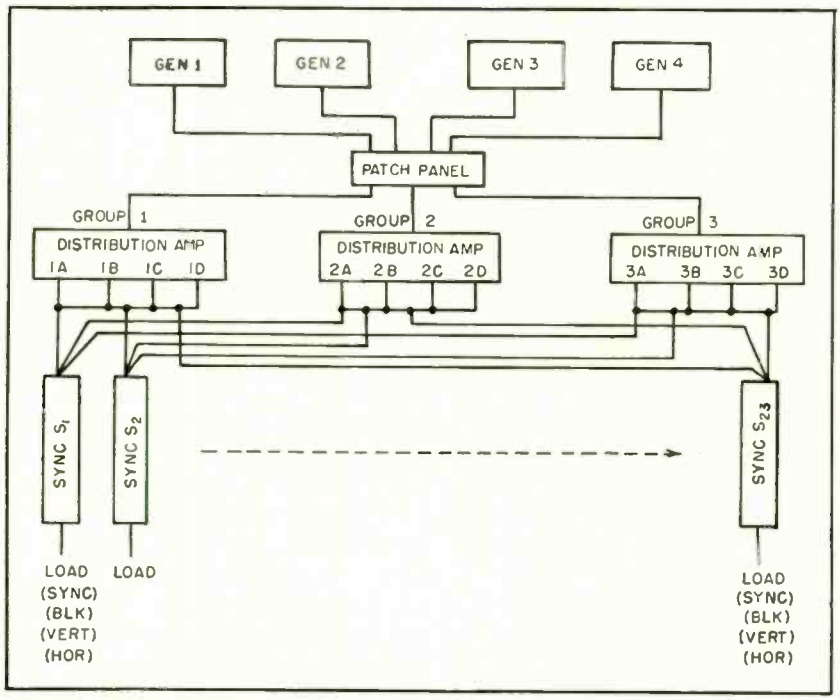


FIG. 1—Master-control pulse distribution and switching system

for all pulse jackfields. The fourth generator is a spare and its pulses are terminated in 75 ohms at the patch panel. The terminating resistors are placed between the A contact and ground on each jack, so that double termination is avoided if a patch is made. The spare generator may be patched into any distribution-amplifier group in a minimum of time in case of failure of one of the other units.

Genlock

Although it is not shown in Fig. 1, each generator has an associated stabilizing amplifier for stripping sync from an incoming signal and a genlock device which allows this remote synchronizing information to control the timing sequence of the generator. Figure 2 shows how this equipment is connected.

The afc voltage output of the genlock, derived by comparing the horizontal pulses of the generator with the incoming horizontal pulses by a discriminator circuit, is used to control the master oscillator of the generator. The vertical-pulse output controls the generator's 60-cps blocking oscillator. The use of this unit entails some slight modifications of the synchronizing generator's internal circuits.

Remote controls have been provided for the stabilizing amplifiers and genlocks to conserve front rack space in master control while maintaining the required ease of operation. An additional panel also has been provided containing four single-pole double-throw switches. These switches control a 24-volt relay in each synchronizing generator allowing it to be switched from genlock to line-lock operation. The accessibility of this switch can save time in case of failure of a genlock or its associated stabilizing amplifier.

Each pulse distribution amplifier provides 32 outputs (16 positive and 16 negative) for 4 positive or negative inputs. Twelve of these units divided into three groups of four, are utilized. By feeding each group from a single synchronizing generator it is possible to obtain fifteen positive and fifteen negative outputs of each pulse type. A pulse distribution amplifier group is associated with each of the three regular generators.

Switching

Once the number of feeds has been established and the necessary distribution amplifiers provided, the best method for routing pulses to the various picture sources is determined. A television pulse-distribution system must be able to route any of the pulse source outputs to any picture source within the facility. To accomplish this a special sync switch assembly was designed, one of which is used in conjunction with each picture source.

A single switch proved impractical due to bulkiness and wiring difficulty. Therefore, two individual but identical three-position switches were utilized. These switches are denoted as S_1 and S_2 in Fig. 3. The output of S_1 is fed through the first position of S_2. Therefore, any one of five pulse sources may be selected depending upon the juxtaposition of the switches.

Each switch has six decks; four

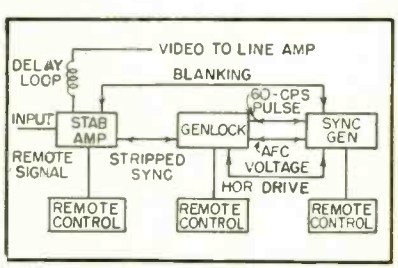


FIG. 2—Genlock system has provision for switching sync generator from genlock to line-lock operation

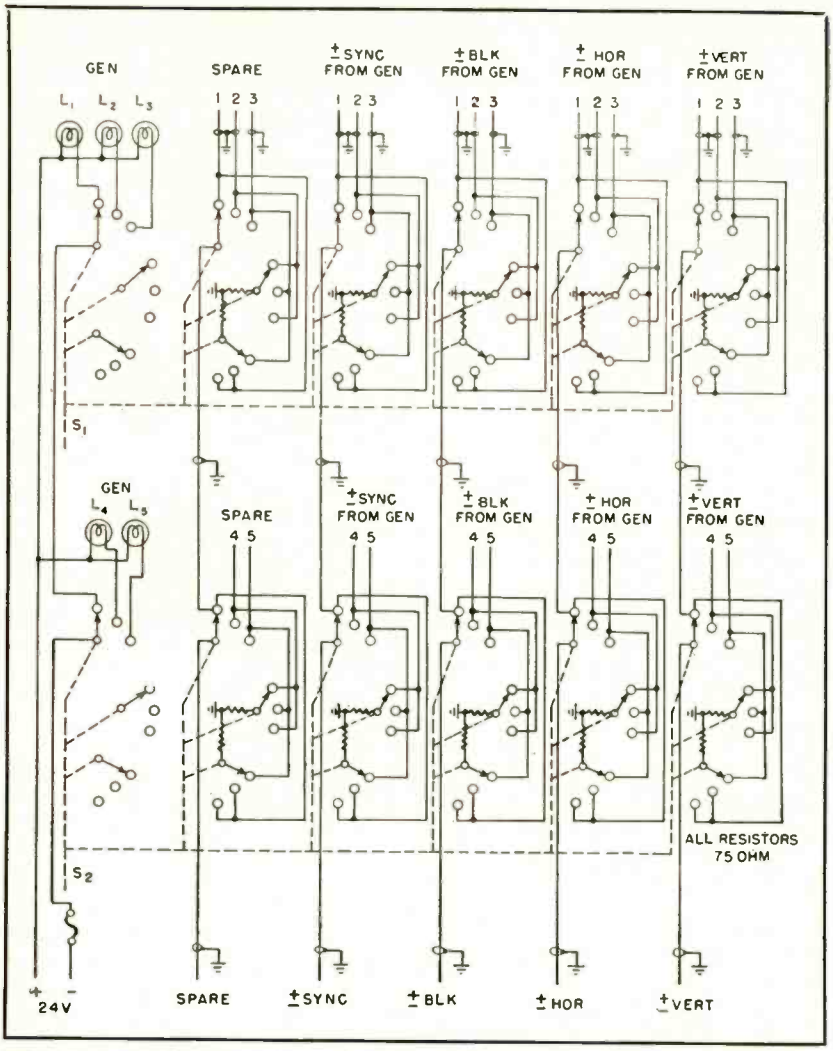


FIG. 3—Sync switch assembly consists of two three-position switches, each made up of six decks

to switch pulses, one spare and one for indicator lights. These indicator lights are actually controlled by relays located in the equipment associated with the particular switch. The master-control transmission technician is thereby informed of what facilities are in operation and by which generator they are being fed. All unused pulses are terminated in 75-ohm resistors mounted on the second and third arms of the switches.

The sync switch is mechanically compact. This can be partially attributed to the use of Teflon-73 for the internal switch assembly wiring. Teflon-73 is more flexible yet retains all of the electrical characteristics of RG-59/U.

Refering once again to Fig. 1, note that 23 switch assemblies are used. They are mounted in two front-row racks in master control. To keep the interconnecting RG-59/U to minimum length the distribution amplifier groups supplying the pulses are located directly behind. Figure 3 shows the interconnecting wiring for a typical distribution amplifier group.

One switch assembly is assigned to each studio, film chain, slide scanner and the other sources of video information. To check each pulse before it leaves master control the outputs of each switch are brought to a normaled through patch panel with bridging jacks.

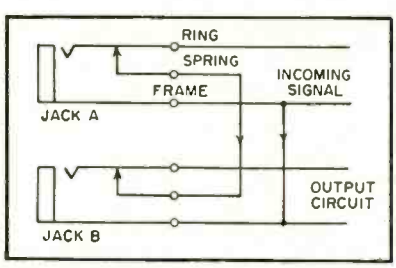


FIG. 4—Schematic of two jacks normalled-through. Circuit of jack *B* can be opened by inserting male plug in jack *A*

A problem in the design of a pulse distribution system is the establishment of proper time relationship between the pulses used in the various studios. This situation is aggravated in large network-originating centers where the distance between master control and the individual studios may vary by several hundred feet. It may be corrected by cutting all the pulse lines to the length of the longest run or by the use of lumped constants in artificial delay lines. The former method was chosen.

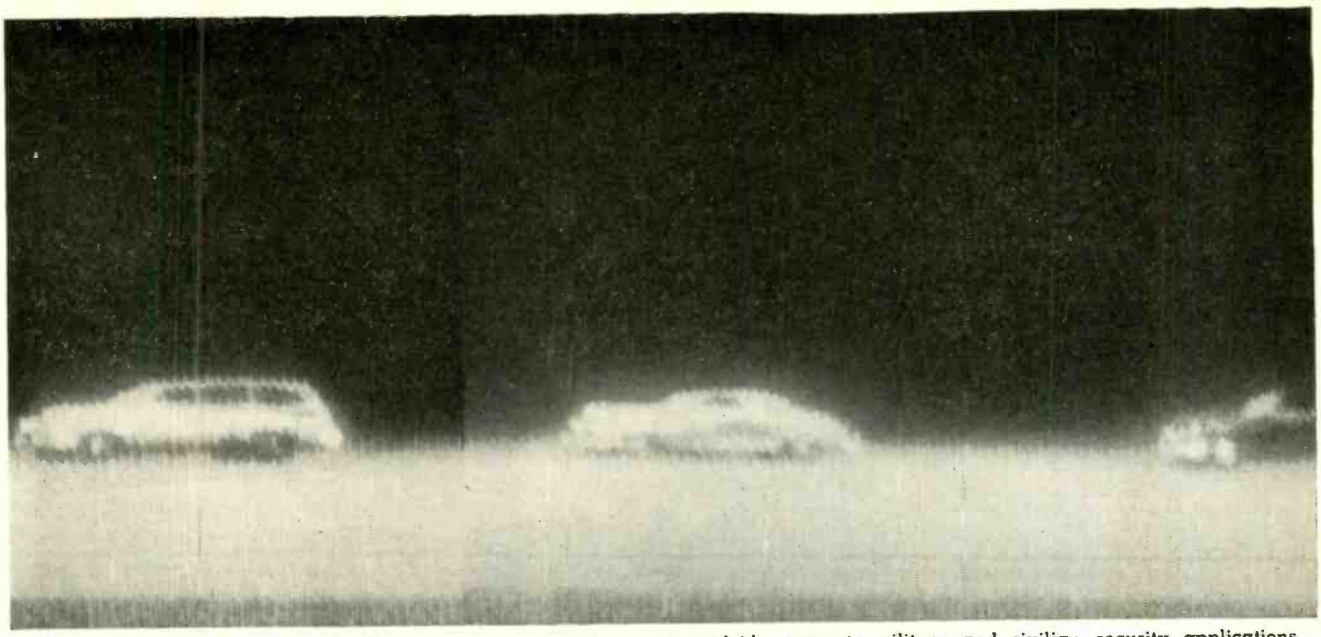
The longest cable run was determined and these cables were pulled first and their length measured. Since the sync and blanking pulses return to master control for insertion into the mixing amplifiers, this figure was doubled and in this instance totaled 430 feet. It then was a simple task to subtract the round-trip distance to each of the other locations from 430 feet and add the difference to the sending end of the pulse cable to these locations. The excess cable forming the delay line was coiled in the trenchwork.

The pulse cables from master control terminate in patch panels in each studio. From there the horizontal and vertical driving pulses pass through a sync adapter where the horizontal pulse is delayed one-half line and then combined with the vertical drive to form a mixed driving pulse.

A three-pole double-throw switch transfers the driving, sync and blanking pulses to either of two distribution amplifiers similar to those used in master control. These amplifiers have their outputs in parallel. A plate supply switch incorporated as part of the pulse switch determines which amplifier will supply the pulses for the studio.

From the sync distribution amplifiers the pulses are routed to the special panel shown in the photograph. This panel is mounted on the rear of the camera control console. The large cables carry the pulses to the appropriate camera circuits.

The system was designed and installed under the overall supervision of R. D. Chipp, director of engineering, and R. F. Bigwood, manager of general engineering.



Composite photograph of cars passing moving-target detector at roadside suggests military and civilian security applications

Moving-Target Detector

Image dissector using mechanical scanning and phototube pickup provides convenient and inexpensive monitoring means for remotely viewing moving objects. Applications include assembly-line and freight-yard surveillance and intruder detection

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MONITORING activity at a remote location is important on assembly lines where parts move past an inspection station, in railroad yards where boxcars pass certain check points, in military operations where guard must be maintained at road junctions and where entry of intruders must be detected.

In such applications, where the object to be monitored is in motion, the moving-target detector can perform the monitoring function more economically and more conveniently than can available industrial television systems.

Principle of Operation

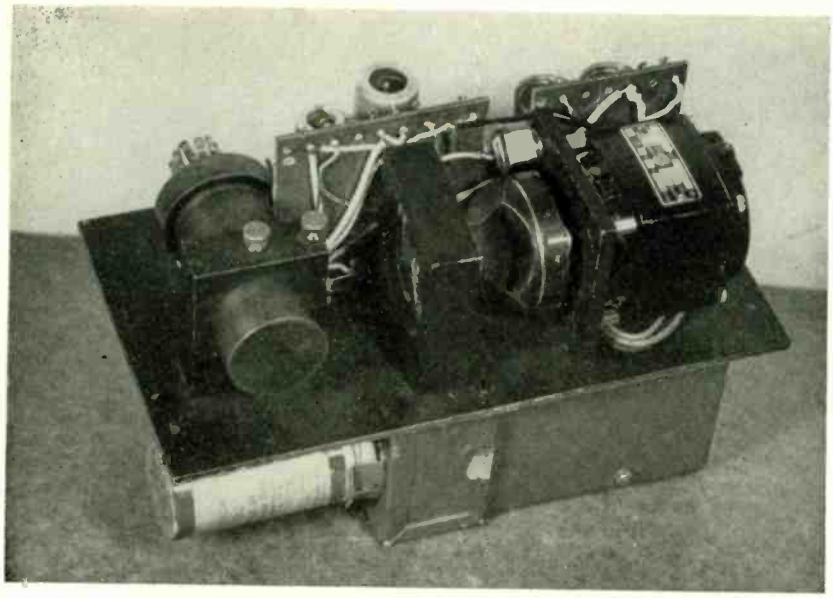
The scanner of the moving-target detector is shown in Fig. 1. A rotating shaft carries a 45-deg mirror that scans a vertical strip in front of the device. Light is imaged onto a multiplier phototube by an optical system. As the motor shaft rotates, light from successive elemental areas falls on the sensitive detector.

As long as the target is stationary, the scanner sees the same signals on successive scans and no picture is created. If the target moves past the scanner, different vertical strips in the object plane will be imaged onto the detector so that, after the target has moved completely past the scanner, its image has been completely dissected. This image is reconstructed at the viewing point and the operator there sees a picture of the target.

The viewing device is a cathode-ray oscilloscope on which a raster is created having vertical bars instead of horizontal ones as in tv. The vertical bars correspond to the vertical scan lines of the scanner and are synchronized with the scan lines. In a typical case 60 scans or bars will be traced a second.

To create the raster, a horizontal sweep must be added. This sweep is relatively slow compared to the vertical sweep since only one raster is required during the time the object moves past the scanner. In typical situations about one raster per second suffices. The scan rates in both directions are variable.

The cable connecting scanner and



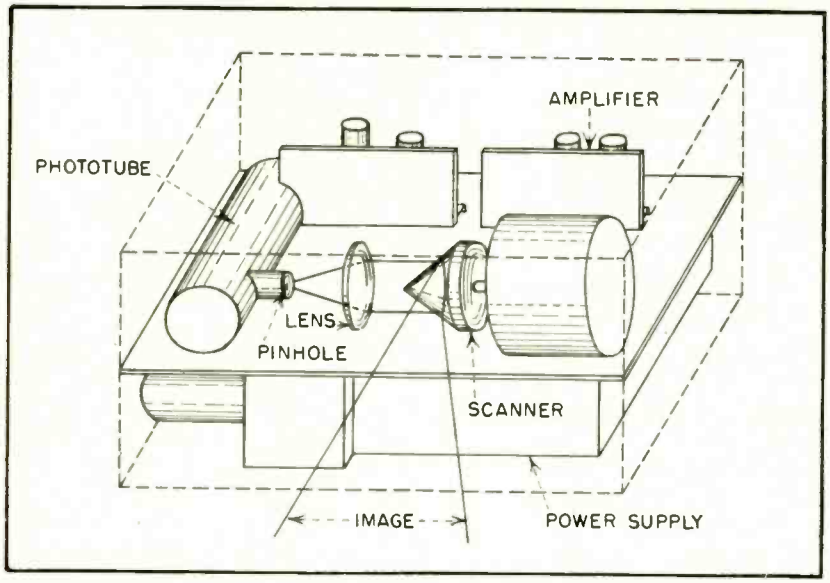


FIG. 1—Photograph showing details of scanner unit and corresponding drawing with important parts labeled. Rotating scanner has four scanning faces and is driven by 3,600-rpm motor

viewer need not be of high quality since the signal bandwidths are much less than in industrial tv. As an example, suppose it is desired to count the cars and trucks passing a given point on a highway. If resolution of six inches is required for easy identification and if the vehicles pass the scanner at 80 feet per second, then the scanner must perform 160 scans per second.

If the scanner is 30 feet from the side of a road 30 feet wide, about 40 elements per 20 feet or about 120 elements per radian must be resolved to achieve 6-inch resolution vertically from the road level to a height of 20 feet. The number of elements to be scanned per second is $160 \times 40 = 6{,}400$.

Field telephone wire, such as used by the military, can handle bandwidths up to several kilocycles and this is sufficient for relatively short runs. For long runs, a telephone wire of somewhat better quality can be used.

Tape Recording

If a permanent record is required for later use or to allow the operator to store information at a slow rate for a long period and then play it back rapidly to see if any action took place in his absence, a magnetic tape recorder can be used. Tape recordings using quarter-inch tape running at a few inches per second can be used to actuate the oscilloscope.

If a particular sequence of scans appears interesting, the operator can cut off the desired section of tape and form a loop that keeps repeating the picture on the scope.

Infrared

In many applications infrared detectors are more advantageous than the multiplier phototube. Hot objects such as ingots at a steel plant may require monitoring where the heat emitted is a better indication than the light reflected from them. The infrared emitted by exhausts from trucks, tanks and other vehicles can serve to make them detectable at night so that such a detector may be more practical than one requiring visible light. Railroads can detect hotboxes with an infrared detector.

The infrared reflection characteristics of some surfaces are more indicative of various phenomena than their visible light reflection characteristics. Such a case arises if newly-painted objects must be inspected to determine if the paint is still wet on any part of an object.

Circuit Operation

Figure 2 gives circuit details of the moving target detector. The scanned object produces a varying light intensity at the photocathode of the phototube. To obtain good resolution of the scanned object, an aperture is inserted in the optical path at the image plane. This reduces the light incident on the cathode and therefore large amplification is necessary to bring the signal up to a usable level. This amplification is available in the 1P21 multiplier phototube. A negative potential of approximately 730 volts is applied to the photocathode and to a voltage divider that allows each successive dynode in the phototube to become more positive.

Electrons comprising the signal information are collected at the anode which operates at ground potential. The video signal thus appears across the 100,000-ohm grid-load resistor of V_3, a 6AK5 pentode operated as a resistance-coupled amplifier.

A synchronizing signal is derived from the rotation of a small permanent magnet imbedded in the

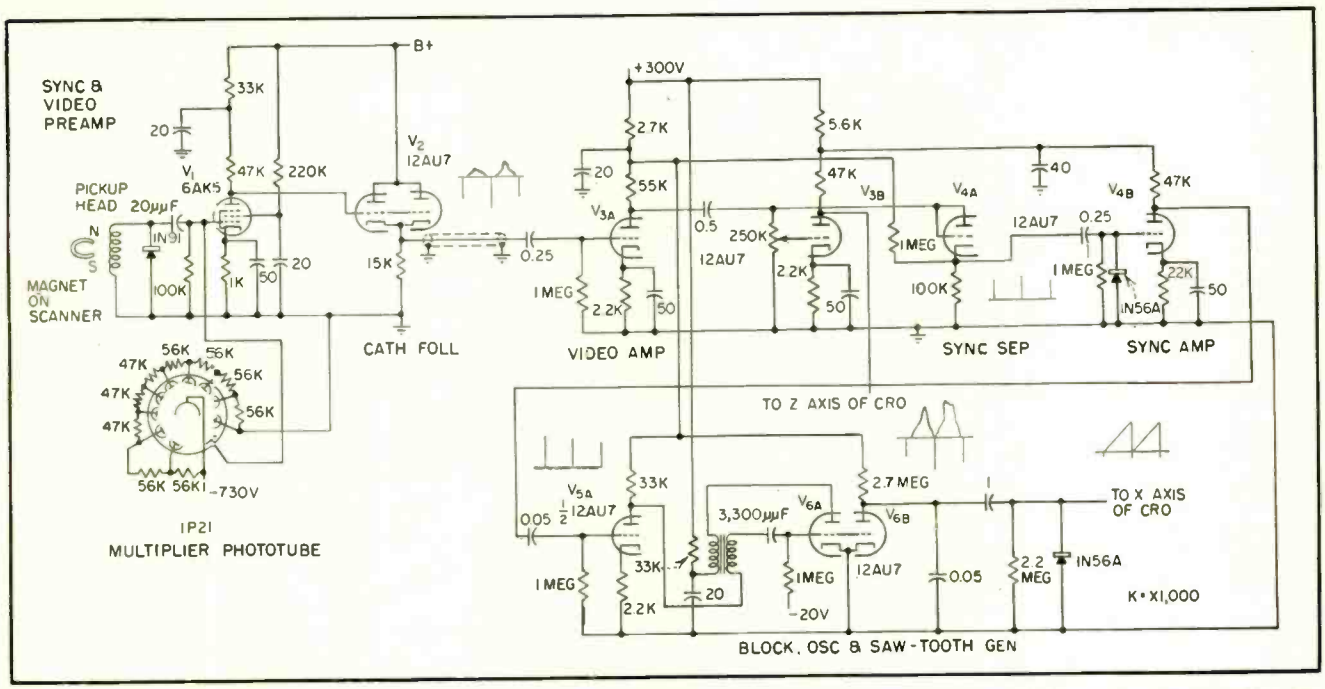


FIG. 2—Complete schematic diagram of moving target indicator. Phototube and preamplifier are mounted in remote scanner while amplifiers and sweep generator are in indicator unit

scanning head that contains the mirrors. Since there are four mirrors there are also four magnets to supply one sync pulse for each scan. The pickup coil that intercepts the magnetic flux from these magnets is located on the motor mounting plate immediately to the rear of the rotating scanner.

Since there are four mirrors, each one should contribute 90 deg of scan but because of the mounting arrangement and protective cover the scan is limited to 45 deg. This means that with a motor running at 3,600 rpm and a four-mirror scanner, the effective scan time is about 2,085 microseconds.

If the pickup coil is moved relative to the fixed magnets in the scanner head, the sync pulse will also move relative to the video signal. This permits placing the video immediately after the sync pulse or at any convenient point on a time scale. The resulting dead time or the time during which no video information is being received can be used to clamp this level to any desired voltage or to derive a blanking pulse to disable the indicator unit.

The pulses derived from the rotating magnets are bidirectional. Since only the positive excursion at the grid of V_1 is desired, a diode shunts the negative portion to ground. The positive pulse is broad and requires sharpening before being mixed with the video to form a composite signal. Sharpening by differentiation and mixing are accomplished by coupling the sync pulse through a small capacitor into the grid circuit of V_1. The video and sync form a composite signal that is amplified by V_1.

The plate of V_1 is direct-coupled to the grid of V_2, a 12AU7 that has both sections in parallel to insure a low output impedance. The cathode resistance of V_2 is chosen to give the proper operating bias for the cathode follower. Direct coupling eliminates R-C charging effects and saves space in the scanner unit.

Indicator Unit

Reconstruction of the scanned scene requires a sweep on a cathode-ray tube screen that is synchronized with the video information for that particular scan. The intensity of the trace varies with that of the object's intensity. The composite signal is amplified in V_{3A} and V_{3B}. The output of V_{3B} is fed to the intensity modulation grid of Z axis of the display oscilloscope. The composite signal that appears at the plate of V_{3A} is also fed into the biased diode V_{4A} where clipping at a predetermined level takes place. Amplifiers V_{4B} and V_{5A} further amplify and limit the sync pulses and present them as triggers for the next stage.

The positive triggers are then inserted into a blocking oscillator whose control grid is biased negatively to prevent operation except when triggered by the incoming pulses. The switching waveform generated by the blocking oscillator is applied to the grid of V_{6B} and produces a saw-tooth voltage at the plate. This sweep waveform is coupled to the X-axis deflection plates. By pulling strip film vertically past the intensity modulated horizontal line trace, the moving object is reconstructed as shown in the photographs.

If a television raster scan is desired, the sweep waveform generated by the blocking oscillator is put on the Y-axis deflection plates and a very slow sweep put on the X-axis plates. The video signal is still inserted into the intensity grid of the cro. This method requires a long persistence phosphor such as P7 in the c-r tube.

The authors acknowledge the assistance of W. B. Birtley and J. B. Cannon, Jr. who cooperated in the development of this device.

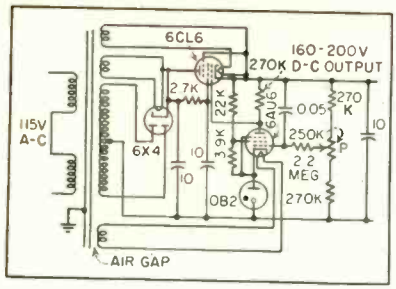


FIG. 1—Electronically regulated circuit used in model A power supply

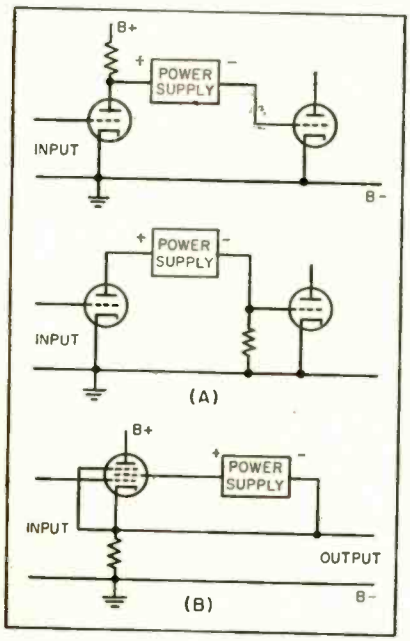


FIG. 2—Two methods of using power supply for interstage coupling (A) and a pentode cathode-follower circuit with good high-frequency response (B)

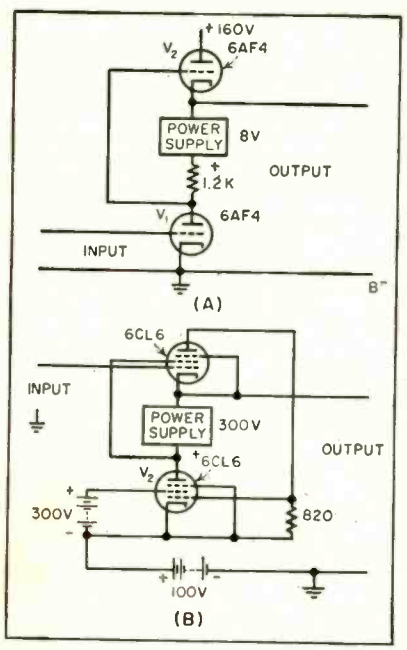
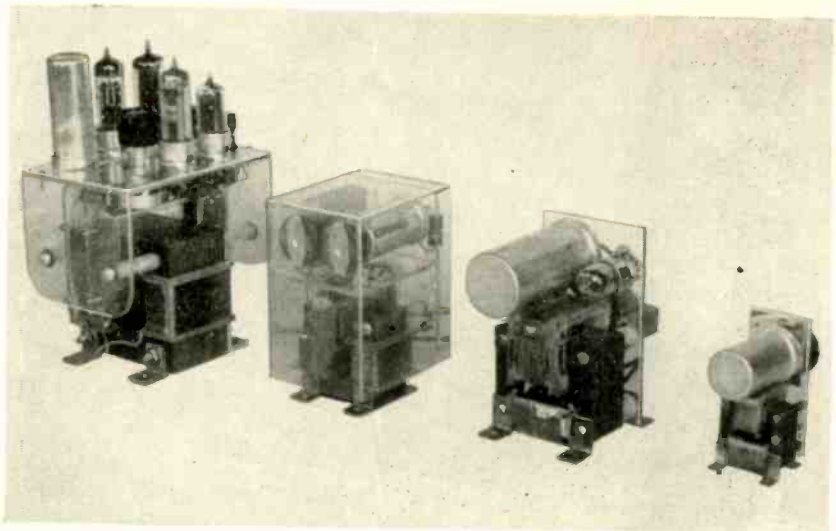


FIG. 3—Amplifier at (A) has low output impedance and good linearity. Cathode follower circuit (B) has better operating characteristics than conventional circuit



Low shunt capacitance power supplies left to right, model A, 4.7 w; model B, 1.3 w; model C, 1.74 w and model D, 0.143 w. Plexiglass is used for mechanical support of the secondary circuit

Bias Supplies for

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Washington, D. C.

OF VARIOUS METHODS of direct coupling, one of the simplest consists of inserting a bias battery in series with the signal source. The main disadvantage of this method is the periodic replacement or servicing required of the battery. A conventional power supply cannot be used because of its large shunting capacitance to ground.

This article describes four power supplies having low shunt capacitance usable in circuits requiring the power supply to operate at varying potentials with respect to ground.

The construction of the power transformers can be seen in the photograph. In each transformer the secondary winding has been separated from the core leaving as much air gap as the geometry permits. This lowers the capacitance of the secondary winding to the core and primary.

Isolation of the secondary causes the efficiency of the transformer to be lowered somewhat, partly because of the poorer magnetic coupling, and partly because of the increased circumference of the windings. For low-power applications poor power efficiency is not serious but the accompanying increase in percentage voltage drop under load is important. By employing electronic stabilization good regulation of the output voltage can be achieved.

Data relating to the construction of the transformers are given in Table I. The cores were constructed of transformer steel, the lamination thickness being 0.017 in. for the transformer used in the model A power supply and 0.014 in. for the others. Enameled wire is preferred for all windings because of its compactness. The three heater windings in the transformer used in model A were put on top of the high-voltage winding. A primary consisting of two aiding series-connected coils on opposite sides of a square-periphery core was employed in models A and B to reduce magnetic leakage while giving maximum clearance for the secondary.

Data on the complete power supplies and their performance are

Table I—Mechanical Data for Construction of Special Transformers

	Power Supply Model			
	A	B	C	D
Core Dimensions				
Cross-section	$\frac{3}{4}\times1\frac{7}{8}$	$\frac{1}{2}\times1\frac{1}{4}$	$\frac{1}{2}\times1\frac{1}{4}$	$\frac{1}{4}\times\frac{5}{8}$
Outside, assembled	3x3×1⅞	2×2×1¼	2×2½×¼	1⅛×1⅜×⅝
Primary Windings				
Turns	2 coils 500 each	2 coils 800 each	1,480	4,270
Wire size	28	32	30	37
Form Dimensions				
Cross-section	$\frac{13}{16}\times1\frac{15}{16}$	$\frac{9}{16}\times1\frac{5}{16}$	$\frac{9}{16}\times1\frac{5}{16}$	$\frac{5}{16}\times\frac{11}{16}$
Length	$1\frac{7}{16}$	$\frac{13}{16}$	$1\frac{7}{16}$	$\frac{13}{16}$
Secondary Winding				
Turns	5,200 center-tapped	1,300 center-tapped	2,000	2,416
Wire size	34	34	36	37
Form Dimensions	$2\frac{3}{4}\times1\frac{5}{8}$	1×1¾	1×1¾	$\frac{9}{16}\times\frac{15}{16}$
Length	¾	⅜	$1\frac{1}{16}$	$\frac{9}{16}$

Table II—Characteristics of Low Shunt Capacitance Power Supplies

	Power Supply Model			
	A	B	C	D
Rectifier Circuit	full-wave	full-wave	half-wave	half-wave
Rectifier Tube	6X4	G10C	6AL5	G10C
Filter Circuit	electronic reg	cap. input	cap. input	cap. input
Input Cap.	.....	40 μf	40 μf	10 μf
Filter Choke	.....	8h	8h	5,000-ohm resistor
Filter Capacitor	.....	40 μf	40 μf	10 μf
D-C Output				
No load	160 v 200 v	94 v	186 v	80 v
Max load	30ma-156v 20ma-199v	21ma-63v	14ma-124v	2.7ma-53v
Shunt Capacitance	18 μμf	10.6 μμf	11.7 μμf	8.2 μμf
Figure of Merit	260	125	149	17

Direct-Coupled Circuits

Special low shunt capacitance transformer designs permit bias supplies to operate above ground potential in d-c amplifier circuits. Capacitance to ground is only 18 μμf for 5-watt supply as compared to 700 μμf for conventional power supply unit

given in Table II. Model A was built in a 20 ma and 30 ma size. The d-c output voltages are for an input of 115 v a-c. Capacitances were measured with the power supplies in an upright position on a grounded metal plate with the primary winding grounded. The capacitance of the largest supply is only 18 μμf. Shunt capacitance of a conventional supply measured approximately 700 μμf.

Figure of Merit

To determine the relative merits of the power supplies, a figure of merit was assumed to be the ratio of maximum power output in milliwatts to total shunt capacitance in micromicrofarads. For the unregulated supplies, the maximum power output was determined on the basis of 50-percent regulation.

Maximum current, power and figure-of-merit values for each supply are given in Table II. A comparison of the figure-of-merit values shows model A to be superior. This is partly due to the use of electronic stabilization, but large transformer core size and high output voltage are also significant factors.

Usefulness of the low-capacitance type of power supply is shown by several circuit applications. In Fig. 2A the power supply is used in two different ways for direct interstage coupling. The first method has the advantage of not requiring current from the supply, and the second method has the advantage that the magnitude of the voltage is not as critical. Use of the supply to provide screen-grid potential in a pentode cathode follower is shown in Fig. 2B.

Two direct-coupled circuits in which these power supplies have been found particularly useful are shown in Fig. 3. These circuits were designed to supply a relatively high-frequency square-wave signal. With a predominantly capacitive load and a signal that has a high duty factor, either of these circuits gives better high-frequency response for a given plate current than a conventional single-tube amplifier or cathode follower.[2,3,4]

The amplifier circuit of Fig. 3A has, in addition to low output impedance, good linearity and a voltage gain very nearly equal to the amplification factor of V_1. An improved version of this circuit uses a pentode in place of a triode for V_2. In this case the power supply is connected to supply screen-grid potential as in Figure 2B.

The two-tube cathode-follower circuit of Fig. 3B has higher input impedance, better linearity, nearer unity gain and lower output impedance than the conventional single-tube cathode follower. This circuit with the component values shown will supply peak charge and discharge currents of 80 ma with an average plate-circuit current as low as 15 ma when driving a capacitive load.

REFERENCES

(1) H. B. Brooks, "Information for the Amateur Designer of Transformers for 25- to 60-Cycle Circuits", National Bureau of Standards Circular C408.

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(3) P. G. Sulzer, Survey of Audio Frequency Power-Amplifier Circuits, *Audio Eng.* 35, p 15, No. 5, May 1951.

(4) C. M. Hammack, Cathode-Follower of Very Low Output Resistance, ELECTRONICS, p 206, Nov. 1946.

Table I—Comparison of Design Data with Measurements

	Measured	Calculated
Half-coil inductance	———	4.78 μh
f_{01} for 150 μμf	6.1 mc	5.93 mc
f_{02} for 14 μμf	18.7 mc	19.42 mc
k_{et}	———	0.175
K_2	———	1.75
K_1	———	0.574
K_2/K_1	3.02 & 3.15	3.05
Band *A*	3.45–11.4 mc	3.41–11.15 mc
Band *B*	10.4 –35.9 mc	10.4 –34.0 mc

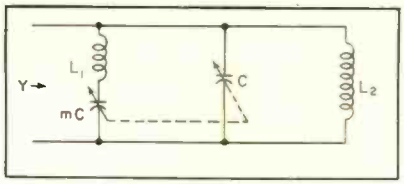

FIG. 1—Basic wide-range tuning circuit

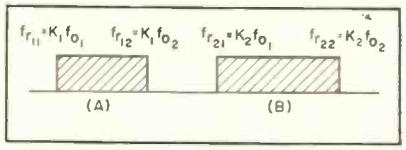

FIG. 2—Tuning range representation

Designing Wide-Range

Summary of design criteria for continuously tuned transmitter includes method of using tapped coil. Representative circuit developed has desired coverage in 3.5 to 30 mc spectrum with gap designed for region from 8.6 to 12.2 mc

By R. W. JOHNSON

Pasadena, Calif.

WIDE-RANGE tuning circuits, for which design relations were introduced by King[1] in 1948, are sometimes subject to simplification for specific uses. Such circuits have many advantages in elimination of coil switching in multiband transmitters, the most recent application being described by Chambers[2]. A simplified version of the tuning circuit, showing its derivation from the basic design, is presented below.

Basic Relations

The circuit of King is shown in Fig. 1. In certain commercially available units the parameter m is unity, coupling is inductive into coil L_2 and construction is for push-pull operation. Assuming the more general case, where $m = 1$ is not a necessary condition, input admittance is

$$Y = \frac{1}{j\omega L_1 + 1/j\omega mC} + j\omega C + 1/j\omega L_2 \quad (1)$$

Introducing normalizing variables

$$\omega_0^2 = 1/L_2C;\ \omega_1^2 = 1/L_1C;$$
$$p = (\omega_1/\omega_0)^2 = L_2/L_1;\ x = \omega/\omega_0 \quad (2)$$

and setting $Y = 0$ for antiresonance

$$x^4 - x^2\left(p\frac{1+m}{m} + 1\right) + p/m = 0$$

the solution of which is

$$x^2 = \frac{1}{2}\left[p\frac{1+m}{m} + 1 \pm \sqrt{\left(p\frac{1+m}{m}+1\right)^2 - 4p/m}\right] \quad (3)$$

or

$$\omega_r^2 = \frac{\omega_0^2}{2}\left[\frac{L_2}{L_1}\cdot\frac{1+m}{m} + 1 \pm \sqrt{\left(\frac{L_2}{L_1}\frac{1+m}{m}+1\right)^2 - 4\frac{L_2}{mL_1}}\right] = K^2\omega_0^2 \quad (4)$$

From Eq. 4 it is apparent that two antiresonant frequencies exist simultaneously and that one value of K is greater than unity, thus providing a constant multiplying factor for the antiresonant frequency of L_2C. Thus where ω_0 has a tuning range fixed by range of adjustment of C, usually limited to about 3 to 1 owing to a 9-to-1 limitation on range of C for practical circuits, this tuning range can be extended considerably by choice of the value K.

Lettering subscripts 1 and 2 refer to lowest and highest respectively. There are two bands on a frequency scale (not capacitance scale) that are simultaneously covered, as shown in Fig. 2.

By proper choice of K values in Eq. 4, bands A and B can be made to overlap, be exactly adjacent on the frequency scale or be separated. The maximum possible continuous coverage (all frequencies covered between f_{r11} and f_{r22}) occurs in the second case when

$$K_1f_{02} = K_2f_{01} \text{ or } K_2/K_1 = f_{02}/f_{01} = (C_{MAX}/C_{MIN})^{1/2} \quad (5)$$

Tuning ratio for this case is

$$f_{r22}/f_{r11} = (K_2f_{02})/(K_1f_{01}) = (f_{02}/f_{01})^2 = C_{MAX}/C_{MIN} \quad (6)$$

It can be seen from Eq. 6 that the maximum continuous tuning ratio with this circuit is the square of the ratio for an ordinary circuit, assuming L_2C in the latter case. Thus frequency ratios of 9 to 1 are possible with this circuit.

It is important that ratio K_2/K_1 be other than an integer. This is to avoid response to harmonics. The desired tuning range, the available capacitance range and the requirement for K_2/K_1 not an integer are then the principal factors affecting choice of parameters m and L_2/L_1. In Fig. 3 are shown curves

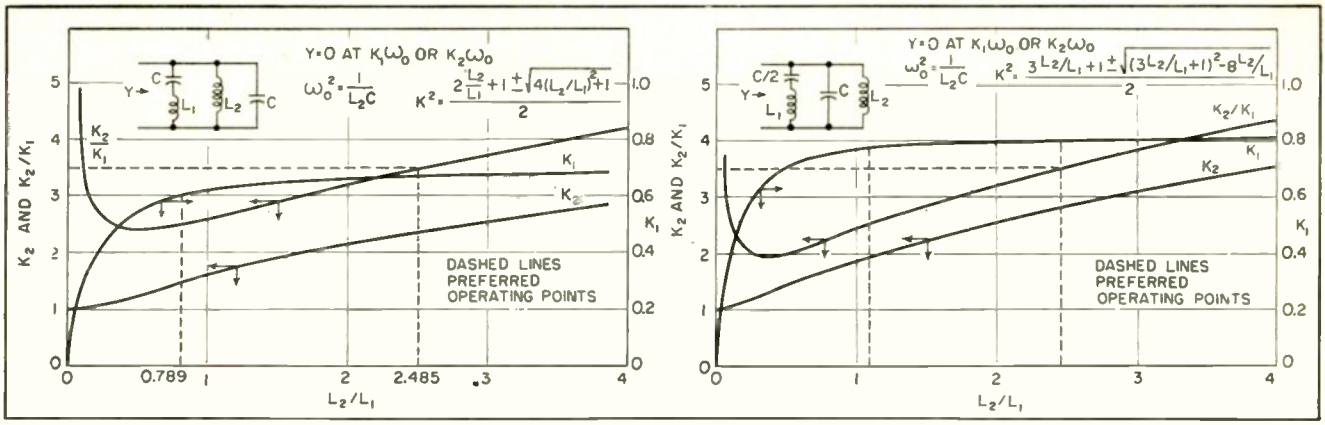

FIG. 3—Curves of K_1 and K_2 versus L_2/L_1 for m equal to 1

FIG. 4—Curves similar to those of Fig. 3 with m equal to 0.5

Tuning Circuits

of K_1 and K_2 versus L_2/L_1 for the case $m = 1$ (equal capacitors). Ratio K_2/K_1 is also shown and preferred operating points indicated. Figure 4 shows the same curves for $m = 0.5$. Comparison between Fig. 3 and Fig. 4 shows the advantage of varying m; there is more freedom in choice of L_2/L_1. Inductance of L_1 and L_2 can be made identical if desired and still maintain K_2/K_1 as 2.5, for example, by choosing $m = 0.789$.

Inductance ratio L_2/L_1 can be found in terms of K and m by rearranging Eq. 4 and solving for L_2/L_1. This gives

$$L_2/L_1 = mK^2(K^2-1)/[(1+m)K^2-1] \quad (7)$$

For the special case $m = 1$, Eq. 4 for K and Eq. 7 reduce to

$$K^2 = \tfrac{1}{2}(2L_2/L_1+1 \pm \sqrt{4(L_2/L_1)^2+1}) \quad (8)$$

and

$$L_2/L_1 = K^2\,\frac{K^2-1}{2K^2-1} \quad (9)$$

Series Resonance

Series resonance occurs at $\omega_s^2 = (p/m)\omega_0^2$, where reactance of L_1 equals that of mC. This series-resonant frequency falls between the two antiresonant frequencies and can be chosen advantageously to provide zero impedance for a particular order of harmonic from band A. For example, setting $\omega_s = 2K_1\omega_0$ and using Eq. 4

$$L_2/L_1 = (12m)/(4m+3) \quad (10)$$

For series resonance at the third harmonic of band A frequencies

$$L_2/L_1 = (72m)/(9m+8) \quad (11)$$

Equation 10 or Eq. 11 can be substituted in Eq. 4 to find the K values and an explicit solution for both m and L_2/L_1 obtained for a specified ratio K_2/K_1.

The circuit in Fig. 5A is of particular interest as it has some advantages over that of Fig. 1. Inductors L_1 and L_2 are assumed to have positive mutual inductance $M = k\sqrt{L_1L_2}$ between them. This circuit can be reduced to that in Fig. 5B. Input admittance for the circuit of Fig. 5B can be written and normalized using Eq. 2. Setting

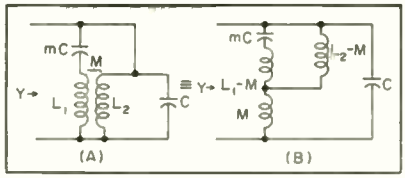

FIG. 5—Coupled circuit (A) and equivalent (B)

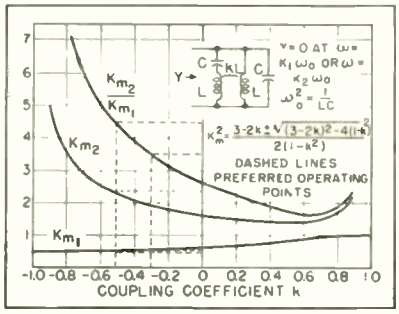

FIG. 6—Values of K_m and their ratio plotted against k

$Y = 0$, the antiresonant frequency relation is

$$\omega_r^2 = \left[\omega_0^2\left(p\,\frac{1+m}{m}+1-2k\sqrt{p}\right) \pm \sqrt{\left(p\frac{1+m}{m}+1-2k\sqrt{p}\right)^2-4\frac{p}{m}(1-k^2)}\right] /[2\,(1-k^2)] = K^2{}_m\omega_0^2 \quad (12)$$

It will be noted that for $k = 0$, Eq. 12 reduces to Eq. 4. For the useful special case $m = 1$, $p = 1$ (equal coils and capacitors) Eq. 12 becomes

$$\omega_r^2 = \omega_0^2\,\frac{3-2k\pm\sqrt{(3-2k)^2-4(1-k^2)}}{2\,(1-k^2)} = K_m^2\omega_0^2 \quad (12A)$$

The two values of K_m and their ratio from Eq. 12A are plotted in Fig. 6. With only reasonable values of negative mutual inductance, appreciable tuning ratios can be obtained. This observation leads to the important case of the tapped coil, which will be treated later.

Equation 12 can be solved for coupling coefficient k in terms of p, m and K_m. In more convenient form, this gives

$$k = \sqrt{p} \pm \sqrt{\frac{\left(K_m^2-1\right)\left(K_m^2-p\,\frac{1+m}{m}\right)}{K_m^2}} \quad (13)$$

The series resonant frequency for the circuit of Fig. 5 is given by

$$\omega_s^2 = \omega_0^2\,\frac{p/m}{1-k^2} \quad (14)$$

This relation could be used to measure k if necessary. Combining Eq. 14 with Eq. 12, and setting

$\omega_s = 2K_{m1}\omega_0$ to cancel the second harmonic, it is required that

$$m = \frac{3p}{12 - 4p - 16k^2 + 8k\sqrt{p}} \quad (15)$$

This relation reduces to Eq. 10 for $k = 0$. To cancel the third harmonic, it is required that

$$m = \frac{8p}{72 - 9p - 81k^2 + 18k\sqrt{p}} \quad (16)$$

which reduces to Eq. 11 for $k = 0$.

Tapped Coil

As noted above, Fig. 6 shows that negative mutual inductance can be useful in the wide-range circuit. A circuit using but one tapped coil can therefore be used. Such a circuit is shown in Fig. 7A and its equivalent in Fig. 7B. Equations 12 through 16 apply, as well as Fig. 6, using the negative sign for k.

Coupling coefficient k between two sections of a tapped coil can be calculated with fair accuracy for single layer coils where the formula applies, from the Nagaoka formula $L = n^2dF$, where n is the number of turns, d is the diameter and F is a factor[3] depending on length-diameter ratio.

Coupling coefficient can also be calculated using the Wheeler formula and is made in the following way.

Assume uniform winding pitch and diameter. Lengths of each section of the tapped coil then are in proportion with the number of turns for each section. Considering the tapped coil and its T equivalent as shown in Fig. 8, three inductances can be calculated based upon coil dimensions. These are

$$L_1 = (n - n_2)^2 dF_1$$
$$L_2 = (n_2)^2 dF_2$$
$$L_1 + L_2 + 2k\sqrt{L_1L_2} = n^2dF$$

where n is the total number of turns. Combining these three relations and solving for k (already negative)

$$k = \frac{F - (1 - N)^2F_1 - N^2F_2}{2N(1 - N)\sqrt{F_1F_2}} \quad (17)$$

wherein $N = n_2/n$. For the special case of a center-tapped single-layer coil, $N = \frac{1}{2}$ and $F_1 = F_2$ so that Eq. 17 becomes

$$k_{ct} = (2F/F_1 - 1) \quad (18)$$

Also for the special case of a center-tapped single layer coil, the Wheeler-formula for inductance

$$L = \frac{r^2n^2}{9r + 10(l)}$$

can be applied conveniently. When this is done, the coupling coefficient between two halves of a center tapped coil is found to be

$$k_{ct} = \frac{9}{9 + 20(l/d)} \quad (19)$$

where l/d is the total length-diameter ratio, in consistent units.

Curves of both Eq. 18 and 19 for the center-tapped case are shown in Fig. 9. These relations are not accurate below about (l/d) = 0.8. Reasonable coupling coefficients (0.2 to 0.4) can be obtained with realistic coil dimensions.

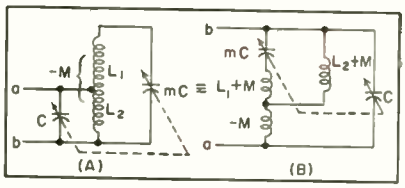

FIG. 7—Wide-range circuit using tapped coil (A) and equivalent circuit (B)

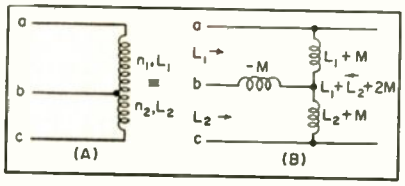

FIG. 8—Tapped coil and equivalent circuit

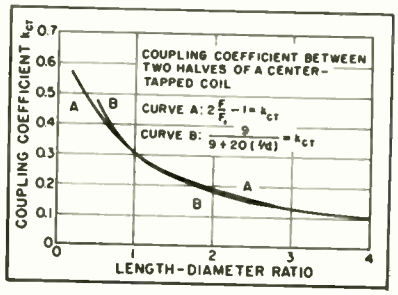

FIG. 9—Length-diameter ratio versus coupling coefficient

Design Example

As a typical example, suppose it is desired to provide in an amateur transmitter coverage of all amateur bands between 3.5 and 30 mc. The frequency tuning ratio 30/3.5 = 8.58 would require, from Eq. 6 and Eq. 5, a ratio $K_2/K_1 = (8.58)^{1/3} = 2.93$, if continuous frequency scale coverage were necessary. This is dangerously close to 3.0, which should be avoided for low harmonic response.

Choice is made of $K_2/K_1 = 3.5$, allowing a gap to exist in the coverage. Continuous coverage for $K_2/K_1 = 3.5$ requires $(C_{MAX}/C_{MIN}) = 12.25$, which is inordinately high. Reference to Fig. 6 gives $k = -0.3$, $K_2 = 1.92$, $K_1 = 0.55$. So $f_{o1} = 3.5/0.55 = 6.36$ mc and $f_{o2} = 30/1.92 = 15.63$ mc. Required capacitance tuning ratio is $(15.63/6.36)^2 = 6.03$. From Fig. 9 for $k = 0.3$, coil $l/d = 1.05$.

The two bands then extend from $0.55 \times 6.36 = 3.5$ mc to $0.55 \times 15.63 = 8.6$ mc and $1.92 \times 6.36 = 12.2$ mc to $1.92 \times 15.63 = 30$ mc. No coverage is obtained between 8.6 mc and 12.2 mc, but this spectrum does not include any amateur bands, so the original specification is met. A suitable coil is designed to resonate with the desired capacitor at a frequency of 6.36 mc (maximum capacitance). This is actually half the total coil (by definition of f_o), so the number of turns should be figured using $l/d = 0.525$. Then the actual coil has twice that many turns and twice that much length. Circuit is that of Fig. 7A, with $m = 1$.

Experimental Verification

A B&W type 3015 coil (1-in. diameter, 16 turns per inch) was used in a test circuit like that of Fig. 7A with $m = 1$. The coil had 34 turns total and was center-tapped and conected with 150-μμf ganged capacitors. Resonant frequencies were measured with a grid dip meter, using the calibration of the meter which is approximate. The results obtained are shown in Table I.

Scope of this article does not permit analysis of loaded Q, resonant impedance, bandwidth and similar important factors. It is believed that the possible arrangements using a single-tapped coil and two unequal capacitors have many applications where it is desired to eliminate coil switching, yet maintain basic simplicity of circuit.

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(1) Allen King, Jr., No Turrets — Just Tune!, *QST*, p 59, Mar. 1948.

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(4) Same as Reference 3, p 55.

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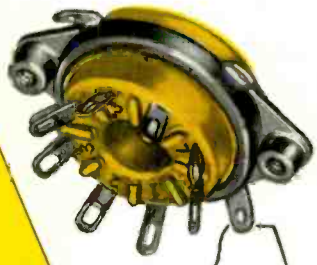

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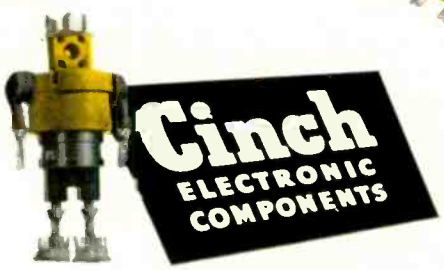

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Thermistor Nomograph

Chart gives rapid solution of exponential equation describing nonlinear resistance-temperature characteristics of thermistors. Results are well within accuracy limits of measurements and are equivalent to slide-rule accuracy

BY VICTOR W. BOLIS

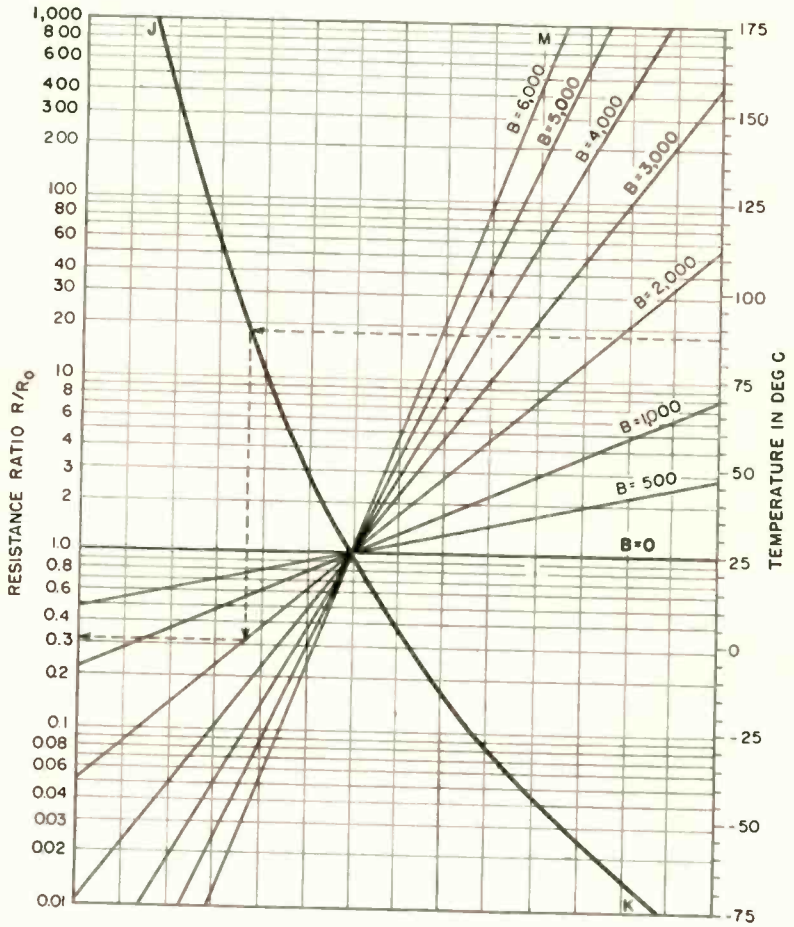
Scientific Staff
Collins Radio Company
Cedar Rapids, Iowa

BASICALLY the thermistor is a resistor whose resistance decreases in a nonlinear fashion with increasing operating temperature. Thermistors obey the empirical formula

$$\frac{R}{R_o} = e^{B\left(\frac{1}{273+T} - \frac{1}{273+T_o}\right)}$$

where R is the resistance (ohms) of the thermistor at the operating temperature T (centigrade), R_o is the resistance at the reference temperature T_o and B is a resistance-temperature constant.

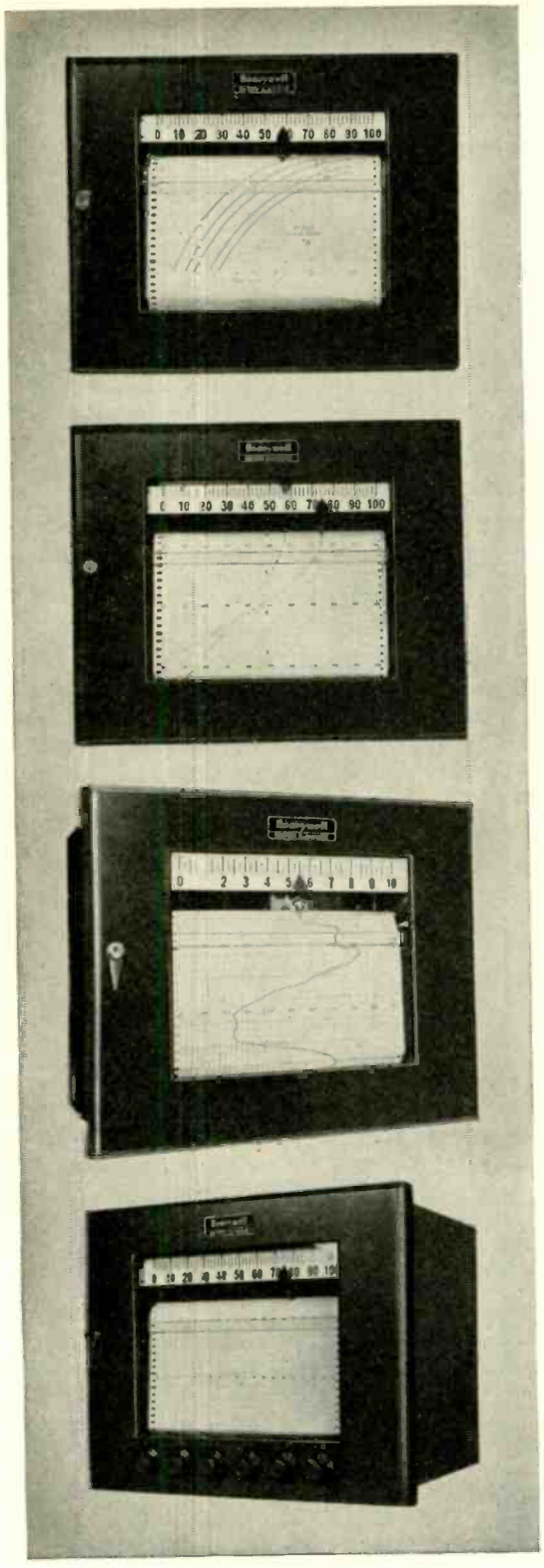
The nomogram described in this paper is designed for a reference temperature $T_o = 25$ C and provides a rapid solution of the above formula for any one of the quantities R, B or T in terms of the other two. Accuracy obtained is nearly equivalent to that of a slide rule and is within the limits of accuracy of the measuring instruments.



A linear temperature scale appears on the right side and a logarithmic resistance-ratio scale on the left side of the nomograph. Straight lines corresponding to the family B = constant intersect at a common point near the center of the nomograph. Passing through this same point is a curved line JK which is used in passing between the logarithmic resistance-ratio scale and the linear temperature scale.

Additional B = constant lines can be drawn in as required. Such lines must pass through the point of common intersection and must intersect the vertical line LM at a point which is horizontally opposite the number exp $B/1{,}000$, as read on the logarithmic R/R_o scale. For example, the line $B = 2{,}000$ intersects the vertical line LM at a point opposite exp $(2{,}000/1{,}000) = 7.39$ on the R/R_o scale.

To find R/R_o given B and T, enter the T scale on the right side of the nomograph and proceed horizontally to the left until intersecting the curved line JK. Then proceed vertically (up or down, as required) until the correct B = constant line is intersected. Then proceed to the left horizontally, coming out on the logarithmic resistance-ratio scale and read R/R_o.



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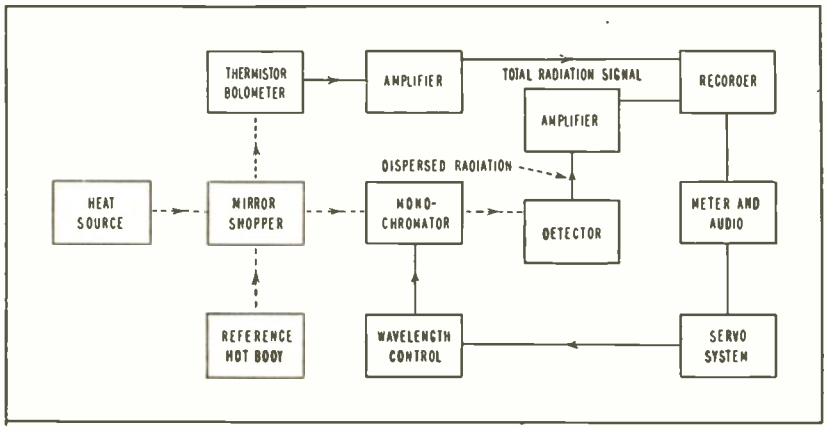

FIG. 1—Simplified block diagram shows essentials of airborne double monochromator that detects airplanes

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Piano Roll Programs Driving Conditions

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TEST ENGINES used for research in fuels and lubricants require careful control and recording of operating conditions to produce a meaningful record.

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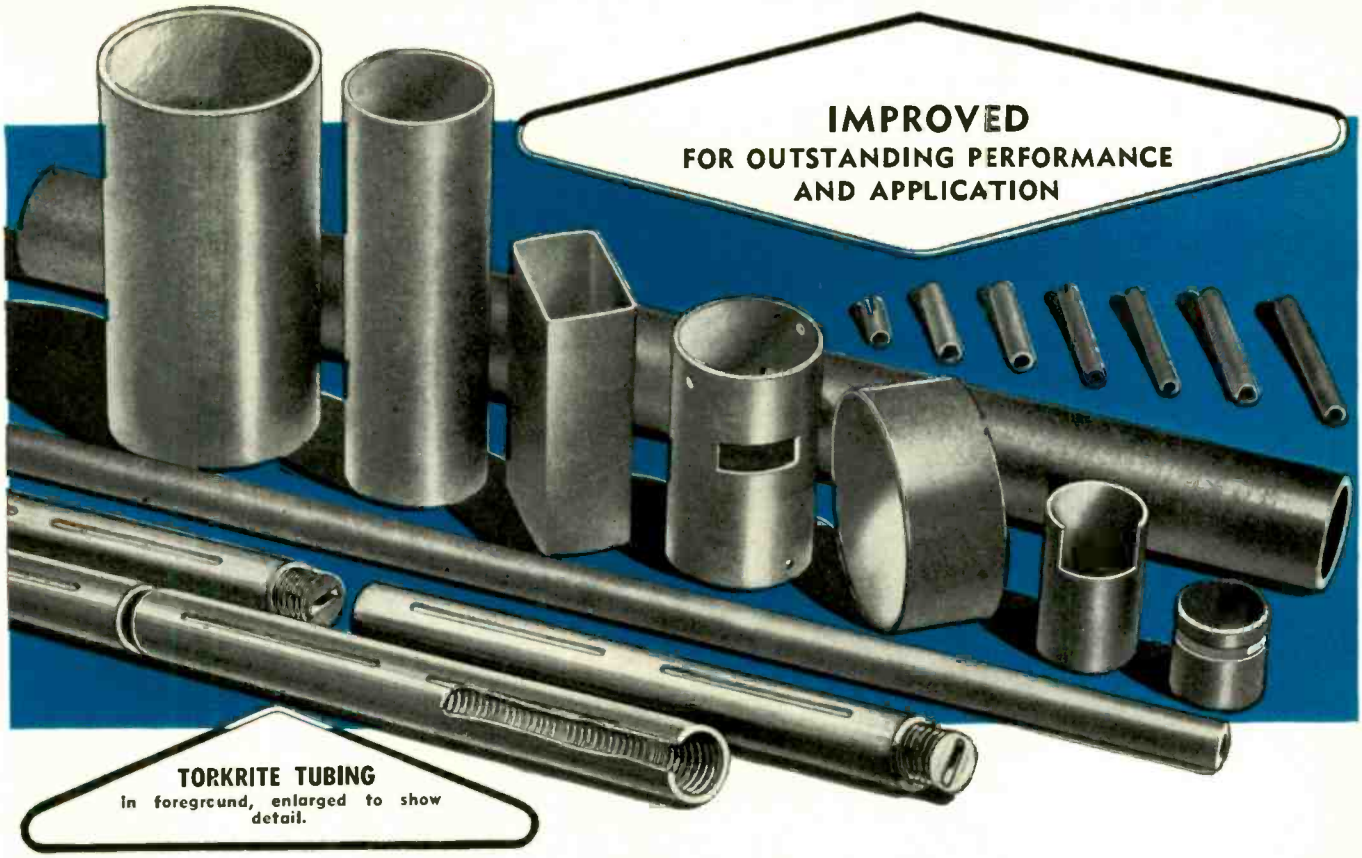
In a typical test, a 15 to 30-minute sequence on the tape is run through the electronic control mechanism so it repeats for several hours. Control tapes reflect actual driving conditions. A recorder is installed in a car with contacts to record activity. Later a master tape is punched out by hand, duplicating this activity.



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tion is detected with moderate ease. Actual measurement of frequency and intensity is somewhat more complex, but can be accomplished with the techniques suggested in Fig. 1.

The heat source, which might be an aircraft, radiates a spectrum of energy that usually varies in intensity for different points of the spectrum. Total energy is picked up by a thermistor bolometer and compared with a reference heat source that is arranged to eliminate the effects of ambient temperature variation.

Intensity of the total radiation is recorded and likewise indicated aurally (in operator's headphones) and on a meter.

Self-stabilized spectrum ray servoscanner is mounted in nose of airplane

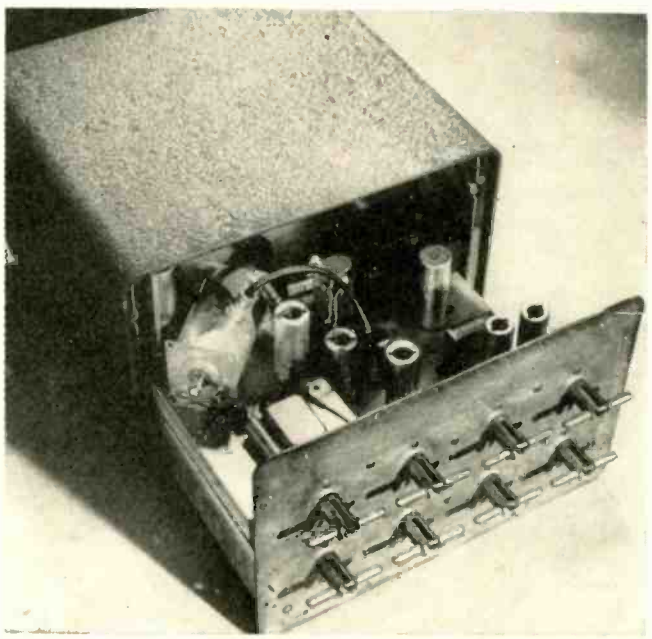
The mirror chopper allows incoming radiation from the target to pass through a monochromator after which it is likewise detected, amplified and recorded.

Various small slices of the infrared spectrum are sampled in turn under direction of the wavelength control and the wavelength information is fed to the recorder as well as to a visual dial. The signal strength recorded is therefore presented as a function of wavelength. Each body has its own special pattern that is identifiable.

Because the monochromator has an extremely small field of view, it is necessary to mount the infrared detector and a conventional optical viewer on a stabilized platform to keep it pointed directly on target.

Radar Cop Smoothes Traffic Flow

Typical radar traffic-control installation shows equipment mounted on long bracket over street. Echoes from approaching cars keep traffic signal green



Radar unit removed from protective case with antennas uncovered. Impulses sent from this unit acting as transmitter are returned and detected as street traffic

RADAR, used by some police departments to measure the speed of vehicles, is now being developed into a traffic control device. In the past, switches set into the pavement have been employed to operate traffic controls that allow occasional vehicles on side roads to enter main highways. An alternative system, used at main intersections, operates on a timing sequence.

In this application, radar impulses reflected from vehicles moving close to an intersection are returned to a receiver contained in the same cabinet, which is customarily mounted on a pole or bracket above the roadway. The receiver feeds the reflected signals to a simple electronic computer. Output signals dispatch traffic according to density rather than on a time basis. However, if the flow of vehicles is continuous, the computer is equipped to recognize this condition and introduce a modified time cycle to take care of cross traffic.

First commercial installation of the device has been made by Eastern Industries, Inc., Norwalk, Conn., in that city.

(*Continued on Page* 184)

The first characteristic which the user has a right to expect in a precision potentiometer is accurate performance... and in precision potentiometers, performance depends upon the coil.

In an accurate linear potentiometer, any given amount of slider travel must result in a corresponding voltage change... no matter which portion of the coil is traversed.

To achieve this, a potentiometer manufacturer is careful to select resistance wire of uniform thickness ...and to space it as accurately as possible when winding it around the core.

Like all manufacturers of precision potentiometers, we select our resistance wires from the good ones available from several sources... picking the proper alloy and size to meet your requirements.

Up to this point, making precision potentiometers is not particularly difficult.

The first critical phase is the series of operations involved in coil winding... and Helipot Corporation engineers have developed a special machine... unique in the industry ...which performs the coil-making operations in continuous sequence.

First the core wire travels through pressure rollers which take out all kinks. Next...in a dustfree chamber ...the resistance wire is wrapped around the core. To insure even spacing, the rate of travel of the core wire and the speed at which the resistance wire is wound are both minutely controlled.

The wire travels on... through a small pre-heater... then past jets which coat it with just the right amount of insulating varnish... and through an infrared oven to dry the varnish. Finally, the wire is coiled into a helix of the correct diameter by another set of rollers... and cut to the desired length of one to forty turns.

All this is done by the machine in a continuous operation... carefully controlled at each step... followed by microscopic inspection and rigorous testing of the completed coils.

At Helipot's Pasadena plant, a battery of these high-speed coil-winding machines assures full-scale production of high-quality coils... produced automatically with considerable saving of time and effort.

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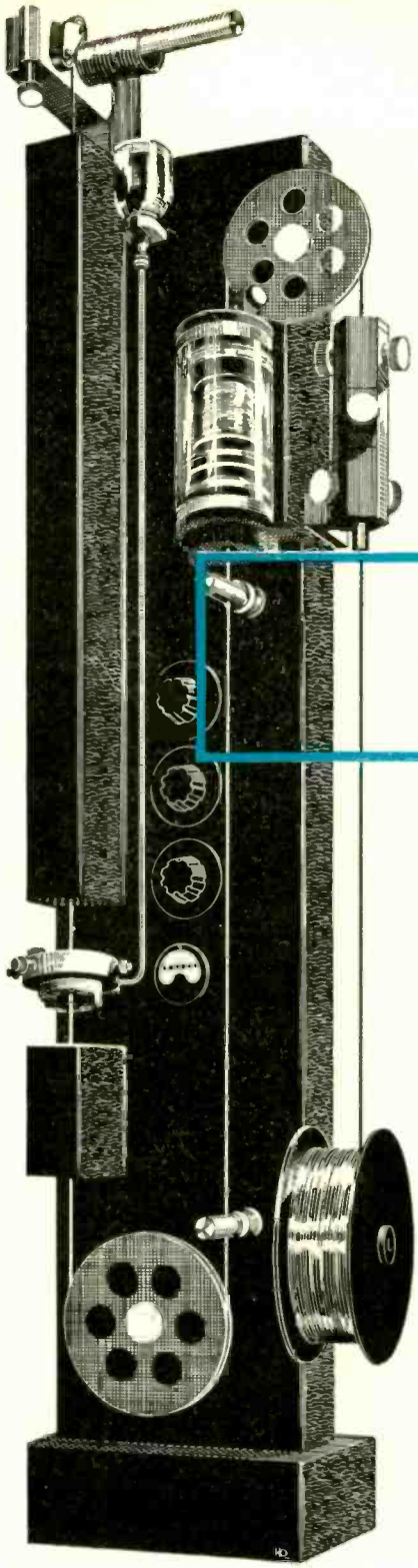
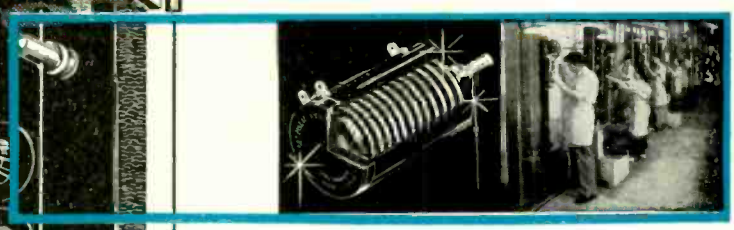


HOW TO **WIND UP** WITH A BETTER COIL!



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The coil winding machine is another example of how Helipot has applied mass-production techniques to delicate operations requiring extreme accuracy ... insuring the lowest price consistent with the high quality you expect in Helipot products.

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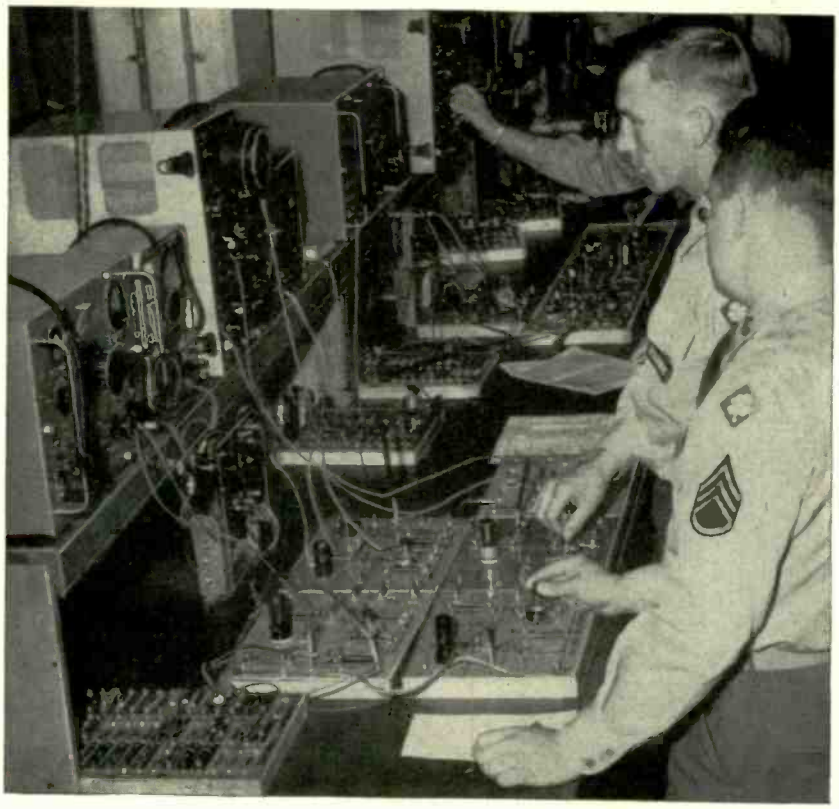

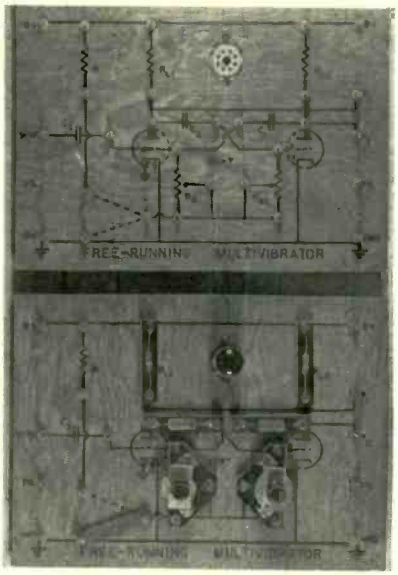

FIG. 1—Schematic of multivibrator circuit is silk screened on plywood board, top. Operating circuit is constructed by installing mounted parts on board as shown below

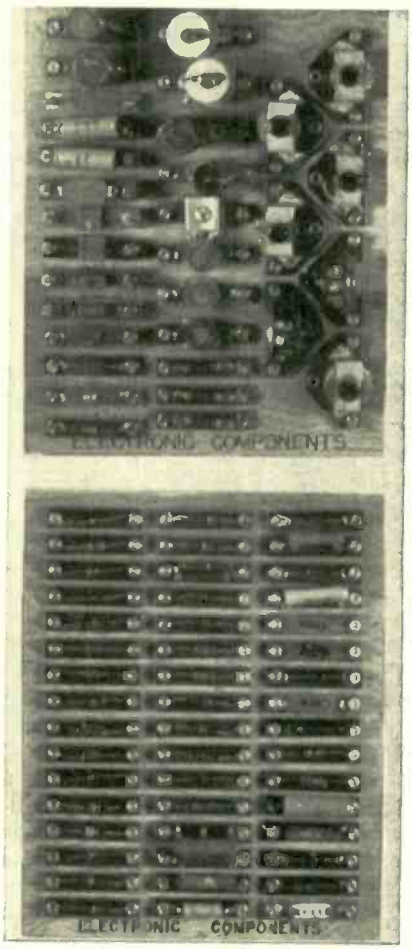

FIG. 2—Components that may be used on any breadboard are stored in racks

Low-Cost Breadboards for Electronic Training

By EDWARD J. MCGRANE and WILLIAM C. MARTIN
Lieutenant Colonel, USA
The Artillery School
Fort Bliss, Texas

Field Engineer
Philco Corp.
Philadelphia, Pa.

PRACTICAL CIRCUIT EXPERIENCE is a necessary and valuable aid in teaching electronics. This requires laboratory equipment that is flexible and versatile, yet reasonable in cost if a large number of students is to be trained.

Some type of breadboard system is desirable since the student's time should not be taken up with laborious mounting and soldering of components. One solution is to mount permanently circuits on breadboards and provide test points and switches for changing component values. The disadvantage of this system is that the cost for a set of breadboards is high because each breadboard requires a complete set of components and a particular board is used only a small percentage of the time.

A solution to this problem is to provide versatility of components by using snap fasteners or Fahnestock clips. This approach allows the use of the same components in more than one circuit, but requires considerable replacement because of leads broken in repeated connection and disconnection.

A system devised in the Electronics Department of The Artillery School, Fort Bliss, Texas, overcomes these disadvantages.

A typical breadboard is shown in Fig. 1. The board is constructed of one-quarter-inch plywood, 14 inches by 10 inches, mounted on one-inch-square pine stripping. The circuit schematic is placed on the surface of the plywood by a silk-screen process. The plate supply, plate, grid, cathode and ground circuits are painted red, blue, green, yellow and black respectively thus familiarizing the student with the wiring color code used in actual equipment.

After the circuit schematic has been silk-screened on the board, the entire surface is varnished for protection. Wires are connected on the underside of the board corresponding to the solid lines shown on the silk-screened schematic diagram. The wires are connected to one-inch

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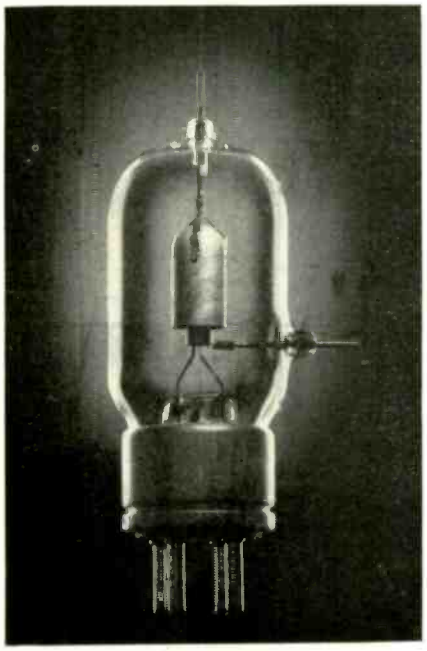

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6-32 machine screws, which provide both electrical contact and a means of mounting the physical components that are shown on the schematic. The only permanently mounted hardware on the majority of the breadboards is a tube socket and the 6-32 screws.

Used in conjunction with the breadboards are two component boards, shown in Fig. 2. One contains resistors of standard values and varying wattage ratings. The other contains capacitors, inductors and potentiometers of various sizes. These components may be used with any one of the more than 50 breadboards, thus keeping costs to a minimum. Each component is mounted on a Bakelite strip, three-inches long, $\frac{5}{8}$-inch wide and $\frac{1}{8}$-inch thick. Brass eyelets are mounted through two holes in the strip, which facilitate the mounting of the components on both the component board and the breadboards. The leads of each component are soldered to the eyelets to insure good electrical contact.

Measuring Waveforms

Proceeding with the practical exercise, the student takes measurements and observes waveforms at various points in the circuit. Then, by changing values of the circuit components he may observe the effects on the circuit operation. Changes in components are made in a few seconds and alteration of the complete circuit may be made with a minimum of effort. Each laboratory has approximately 25 positions, each equipped with test instruments.

Two students are assigned to each position thus providing close contact with the equipment for each.

Power is supplied to the breadboards by means of individual power panels connected to a central power supply. A harness is used to connect from the panel to the screws on the left side of the board. Boards may be placed in cascade by simply connecting shorting bars from the terminals on the right side of one board to those on the left side of the following board.

In using the laboratory bread-

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TABLE A
BASIC PHYSICAL CONSTANTS OF COMMON MAGNETIC MATERIALS

Trade Name	% Ni	% Fe	Other	Grain Structure	Satur. Flux Density Gausses	Resistivity Microhm-Cm	Curie Point °C	Dens. Grams per cc
Hy Mu 80	79	17	4 Mo	"random"	8,700	57	420	8.72
48 Alloy	48	52	....	"random"	16,000	45	500	8.3
Orthonol	50	50	....	oriented	15,500	45	500	8.25
Magnesil	..	97	3 Si	oriented	20,000	48	700	7.65

TABLE B
TRADE NAMES OF SIMILAR MATERIALS

Hy-Mu 80	48 Alloy	Orthonol	Magnesil
4-79 Permalloy	Carpenter 49	Orthonik	Armco Oriented T
Mo-Permalloy	Allegheny 4750	Permeron	Hypersil
Mu Metal*	Hyperrik	Deltamax	Orthosil
		Hypernik V	Silectron

Typical of the unusual scope of the material contained in Catalog TWC-100 are Tables A and B, reproduced from Page 4 of "Performance-Guaranteed Tape Wound Cores."

GET THE COMPLETE STORY

A wealth of new and unusual material on Tape Wound Cores is available to you in Catalog TWC-100, "Performance-Guaranteed Tape Wound Cores." Tables A and B of the catalog, reproduced on this page, present a striking illustration of material not to be found compiled together elsewhere.

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board the student first selects components of optimum value from the component boards according to a practical exercise instruction sheet. The components are then mounted in their indicated positions on the breadboard by means of the 6-32 screws and knurled nuts. The components are thereby electrically connected to the wiring beneath the board. Copper shorting bars are placed over the broken lines on the schematic showing no electrical components.

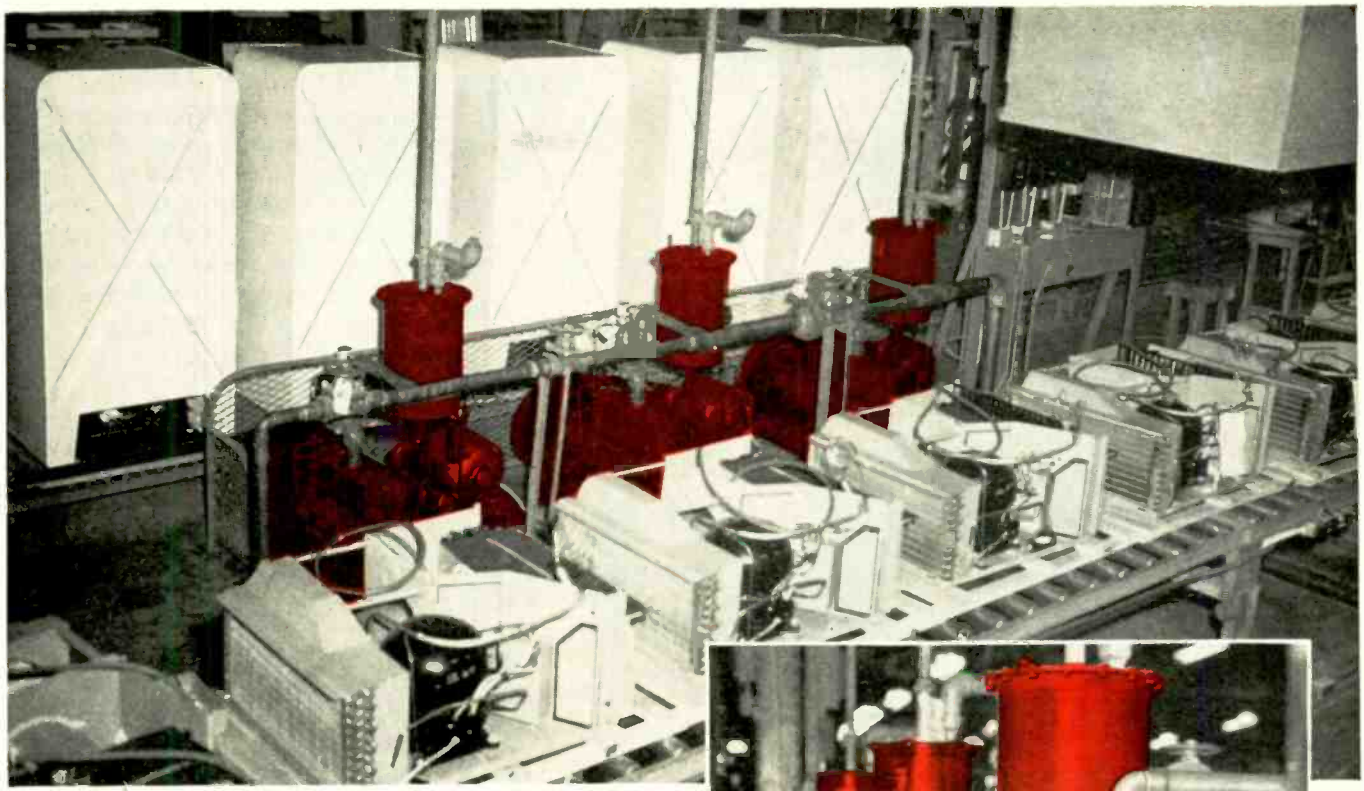
The versatility of the breadboard can be seen in Fig. 1. It is possible to return the grids of the multivibrator to ground or B plus through either a fixed resistor or potentiometer. The same board may be operated as a free-running or synchronized multivibrator or a frequency divider.

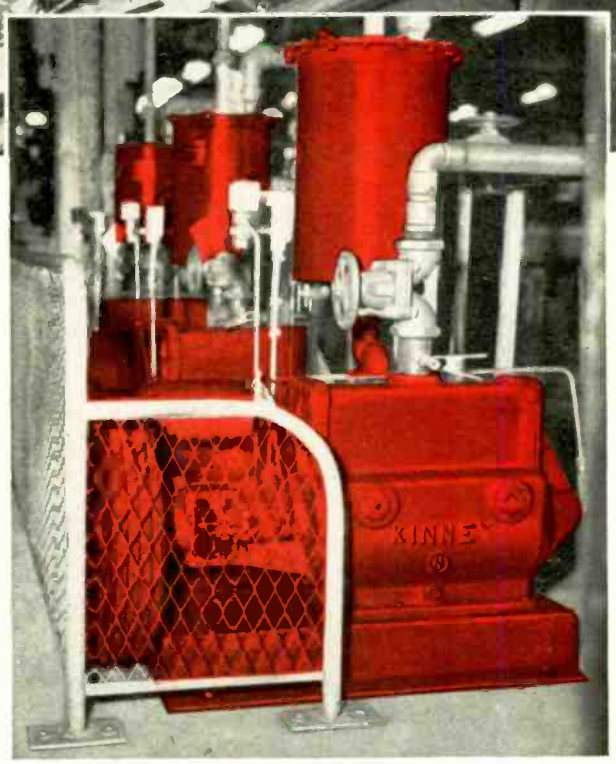
Types of Circuits

Some of the more than 50 breadboards now in use are a-c d-c circuit connectors that contain conductors and mounting screws situated so that practically any series, parallel or series-parallel circuit may be constructed using the mounted components. Also included are rectifier and filter circuits; audio, video, and power amplifier circuits, a-m and f-m circuits; oscillators; sweep generators; multivibrators and pulse-shaping circuits.

Excellent systems experience is provided for the student when he connects a number of boards to simulate radar operation. For example it is possible to produce a triggered sweep, movable range step and target echo on one oscilloscope using a hard-tube sweep generator, cathode follower, two one-shot multivibrators and two oscilloscope-amplifier boards connected in the proper manner.

The laboratory breadboards referred to in this article have been completely fabricated at Fort Bliss. The material cost per breadboard including lumber, hardware, connecting wire, lacquer, paint and varnish is approximately $0.98. Boards that require large components such as transformers have them permanently mounted thus increasing the cost of that particu-





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lar board. Cost of components and vacuum tubes for one laboratory position to perform sixty different experiments is about $70.00.

This type of breadboard system could be applied not only to large groups but also small classes whose amount of practical training is determined by a limited budget.

Thyratron-Type Transistor Circuit

By T. A. Prugh and J. W. Keller
Diamond Ordnance Fuze Laboratories
Washington, D. C.

Performing functions similar in certain respects to conventional gas thyratrons, the circuit in Fig. 1 acts as an amplitude comparator in that it changes from a non-oscillating to an oscillating state when the input signal rises to ground level. It continues oscillating until reset by external means.

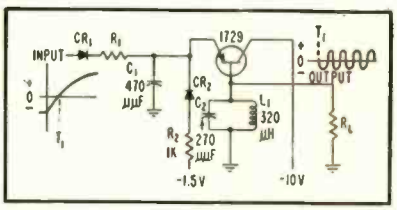

FIG. 1—Amplitude comparator uses tuned circuit with resonant frequency of 400 to 500 kc

Major factors guiding the development of the circuit are as follows: operation up to a temperature of 70 deg C or higher; supply voltages of +10 and —10 volts; noncritical parameter values; threshold level independent of temperature; amplitude of output level greater than 10 volts peak-to-peak; and high input impedance or minimum loading of the input signal.

Earlier circuits made use of a conventional resistance-coupled, single-transistor, bistable stage[1]. However, difficulty was encountered in the performance of the circuit at high temperatures. Increase of current with temperature made it hard to maintain accurate threshold levels and constant output signals. Inductance coils in the base and col-

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lector circuits have eliminated these problems.

Basically the circuit consists of a transistor oscillator with a tuned circuit C_2 L_1 in its base. If normal bias is applied to the emitter, the stage oscillates continuously at approximately the tuned-circuit resonant frequency of 400 to 500 kc. However, additional components are added in the emitter circuit to permit accurate control of the state of the oscillator.

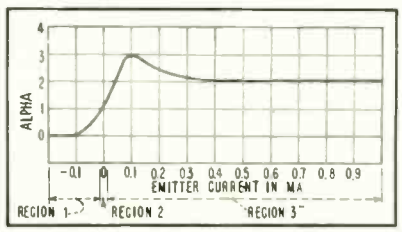


FIG. 2—Typical point-contact transistor showing alpha as function of emitter current

Figure 2 shows the effect of emitter current on the alpha of a point contact transistor. Three regions are easily recognized as: alpha below unity; alpha near unity but slightly greater; and alpha considerably larger than unity.

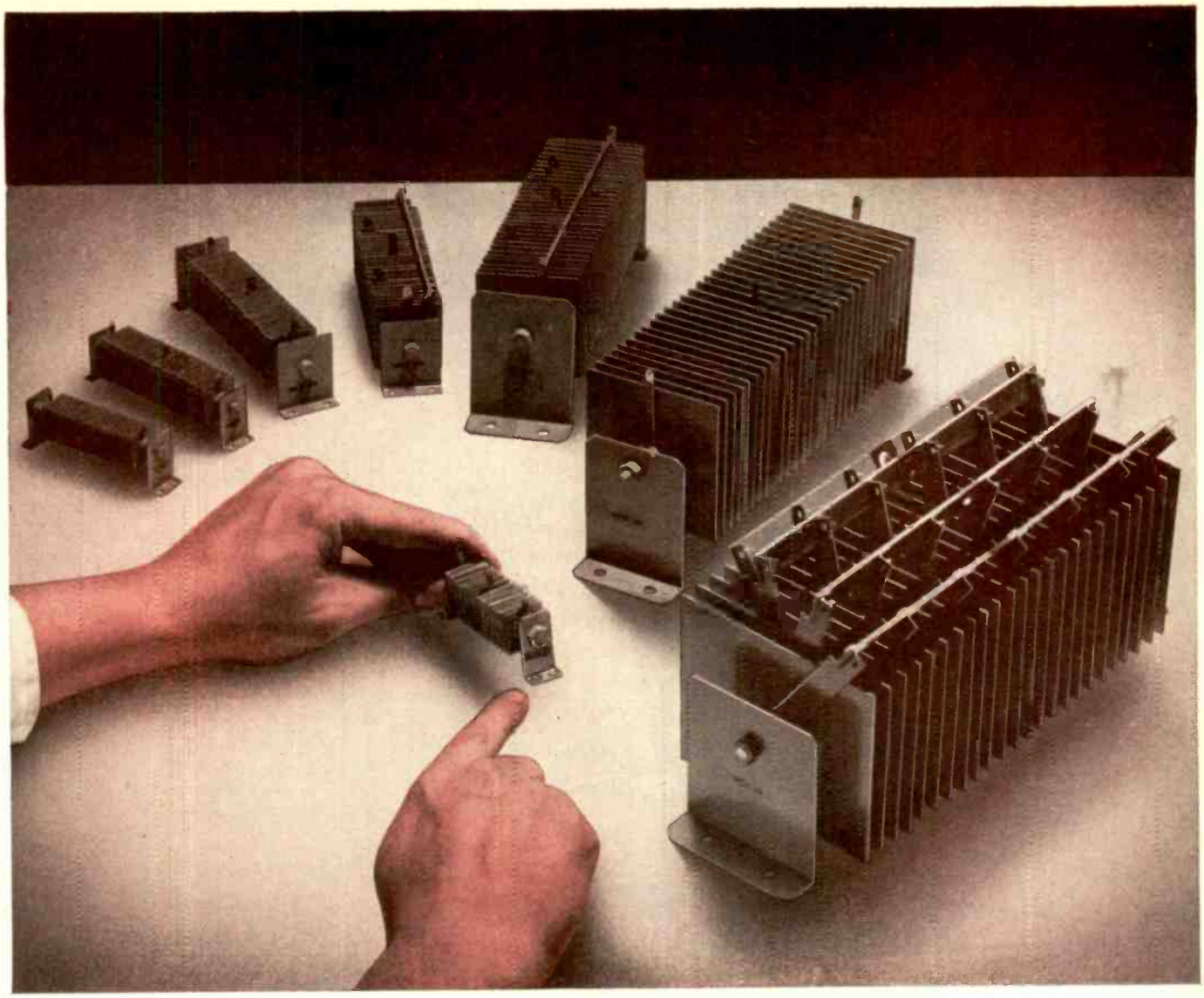
These three regions correspond to three separate conditions of the circuit: transistor cutoff with no oscillations possible; circuit just able to oscillate; and circuits oscillating at high ampltiude (class C).

The first condition exists as long as the input voltage is below zero. The fixed voltage of —1.5 volts applied to the emitter bias-resistance, R_e, assures that the emitter is biased to cutoff.

As the input level approaches zero the critical emitter current is reached where oscillations can start and the second condition exists. The criterion for instability[2] of a transistor circuit is as follows

$$\alpha > 1 + r_e/R_b + r_e/r_e$$

where the R_b refers to the base resistance of the transistor plus the total external resistance in the base circuit. Near the resonant frequency of the tuned circuit R_b becomes large with respect to r_e where r_e is generally much larger than r_e. Accordingly, alpha need only be slightly greater than unity for the circuit to start oscillating. As shown in Fig. 2 the region of rapidly increasing alpha is covered by



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DUTY: Continuous _____ Intermittent _____ On _____ Off _____

COOLING: Convection _____ Forced _____ Ft. Per Min. _____

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a rather small change of emitter current near zero current. Tests on the type 1729 indicate that region 2 is within less than five microamperes of zero emitter current. It is seen that the start of oscillations is fundamentally a current-controlled effect.

Oscillations continue to build up as the oscillator shifts to class C operation. In the last condition large-signal oscillations exist. Resistor R_2, diode CR_2 and capacitor C_1 provide a low-impedance path for drawing heavy emitter current during the conducting portion of the cycle. Capacitor C_2 and R_2 correspond to the grid bias network in many vacuum-tube oscillators. Circuit waveforms for condition 3 are shown in Fig. 3.

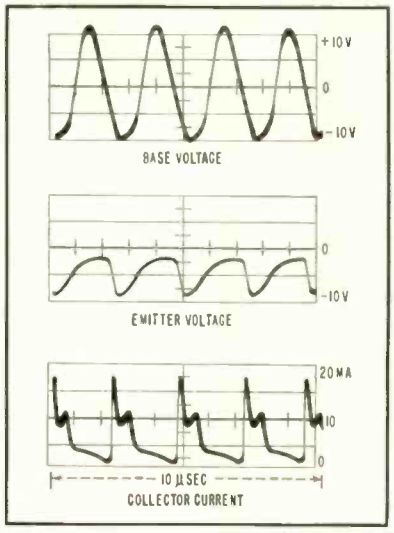
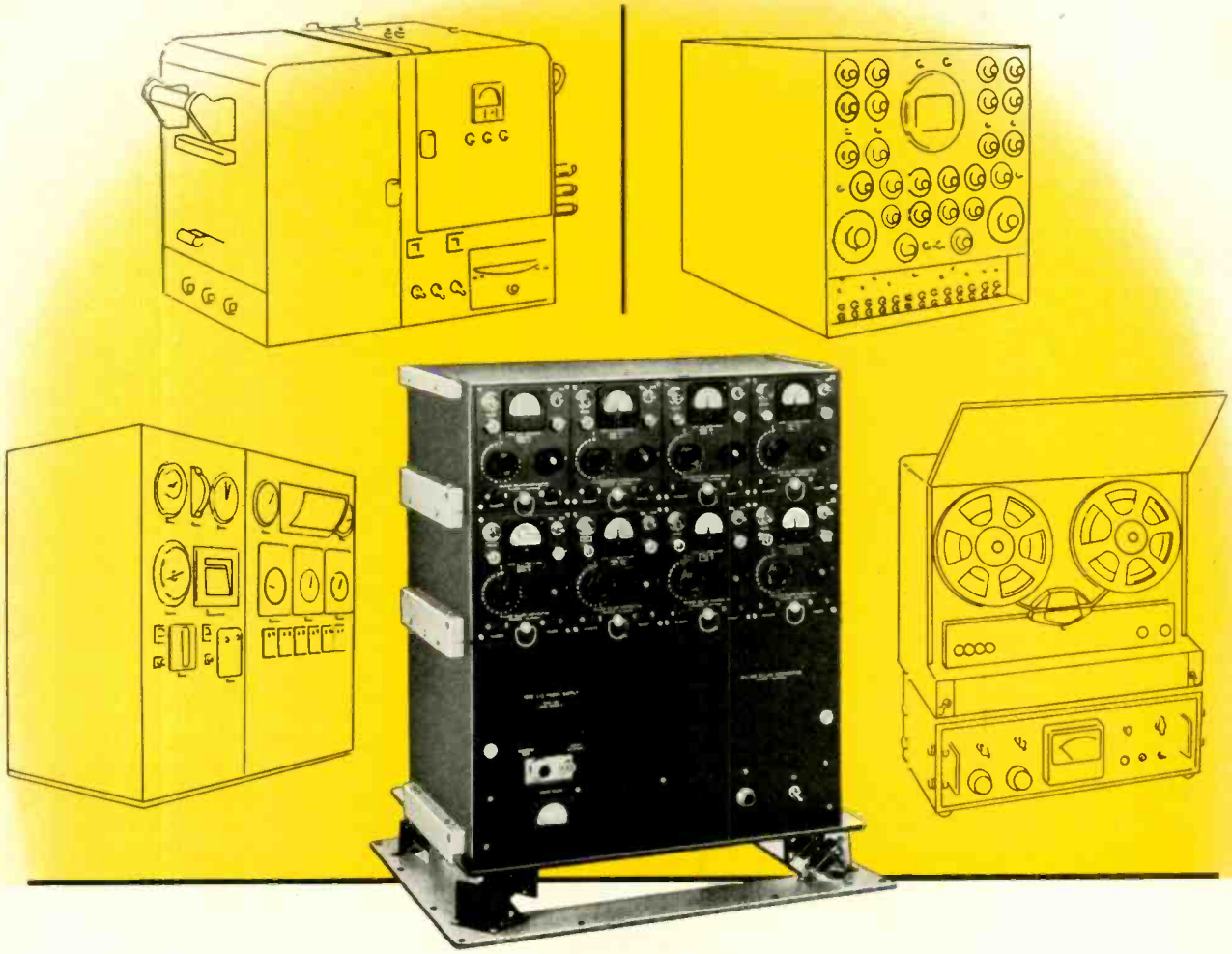


FIG. 3—Waveforms of circuit oscillating at high amplitude (class C)

Returning to the basic factors previously listed for the circuit noncritical component values and insensitivity to temperature are the most important. With regard to the first requirement the choice of a tuned-circuit L/C ratio was necessary. Figure 4 shows the effect on output amplitude of variation in L_1 keeping the resonant frequency constant at approximately 500 kc. This curve was taken with no additional load on the tuned circuit and with a slightly different emitter bias arrangement. Coil Q was approximately constant. The general trend of Fig. 4 shows that the output level increases as the logarithm



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of the inductance L_1 increases.

The theoretical shape of this curve has not been worked out in detail. A simplified analysis, assuming that the transistor supplies a constant power to the tuned circuit and that resonant frequency and coil Q are constant, shows that

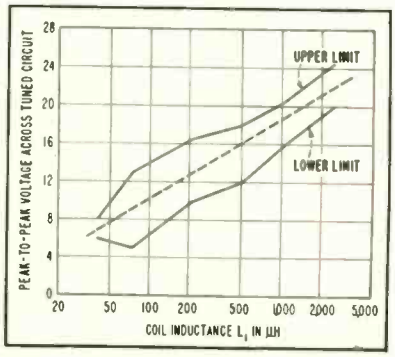

FIG. 4—Output level increases as the logarithm of inductance L_1 increases

the tuned-circuit voltage should be proportional to the square root of the inductance. As a result of the lack of close agreement between the actual and theoretical relations, the asumptions should be re-examined in a more detailed analysis. A value of 320 μh was used for all the following measurements.

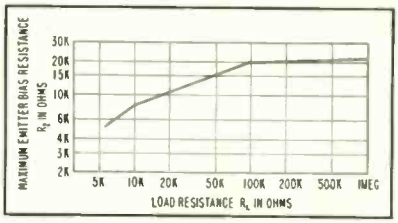

FIG. 5—Effect of load resistance on maximum emitter bias resistance that will sustain oscillations

The effect of load resistance R_L on the maximum value of the emitter-bias resistor R_2, which will sustain oscillations, is shown in Fig. 5. As the output level increases with decreasing R_2 it is desirable to make R_2 small. However, in order that a voltage divider from —10 volts that includes R_2 may draw the least amount of power R_2 should be high. Also, the diode forward resistance adds to R_2. A compromise value of 1,000 ohms for R_2 was chosen that is reasonably high but which assures that a majority of the transistors will oscillate at satisfactory amplitudes.

The most critical component to choose is diode CR_2. Being a non-

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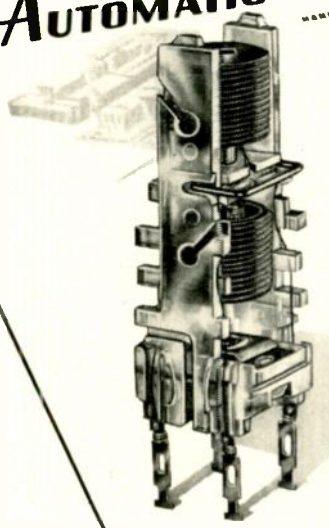

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linear semiconductor device, temperature effects are extremely important. This diode can radically effect the critical input current that starts oscillation. A low reverse-resistance diode would act as an additional load on the input signal source. High temperature aggravates this effect to a considerable extent. Figure 6 illustrates the effect of several diode arrangements on the critical current for the complete circuit as a function of temperature.

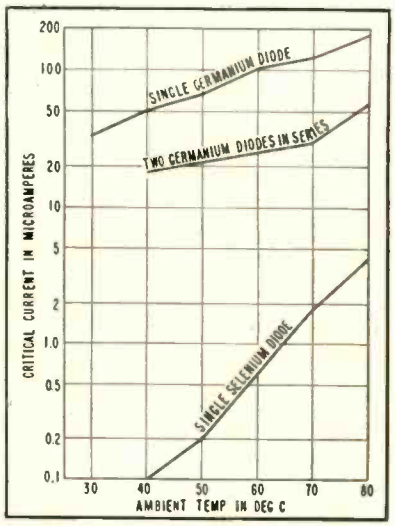
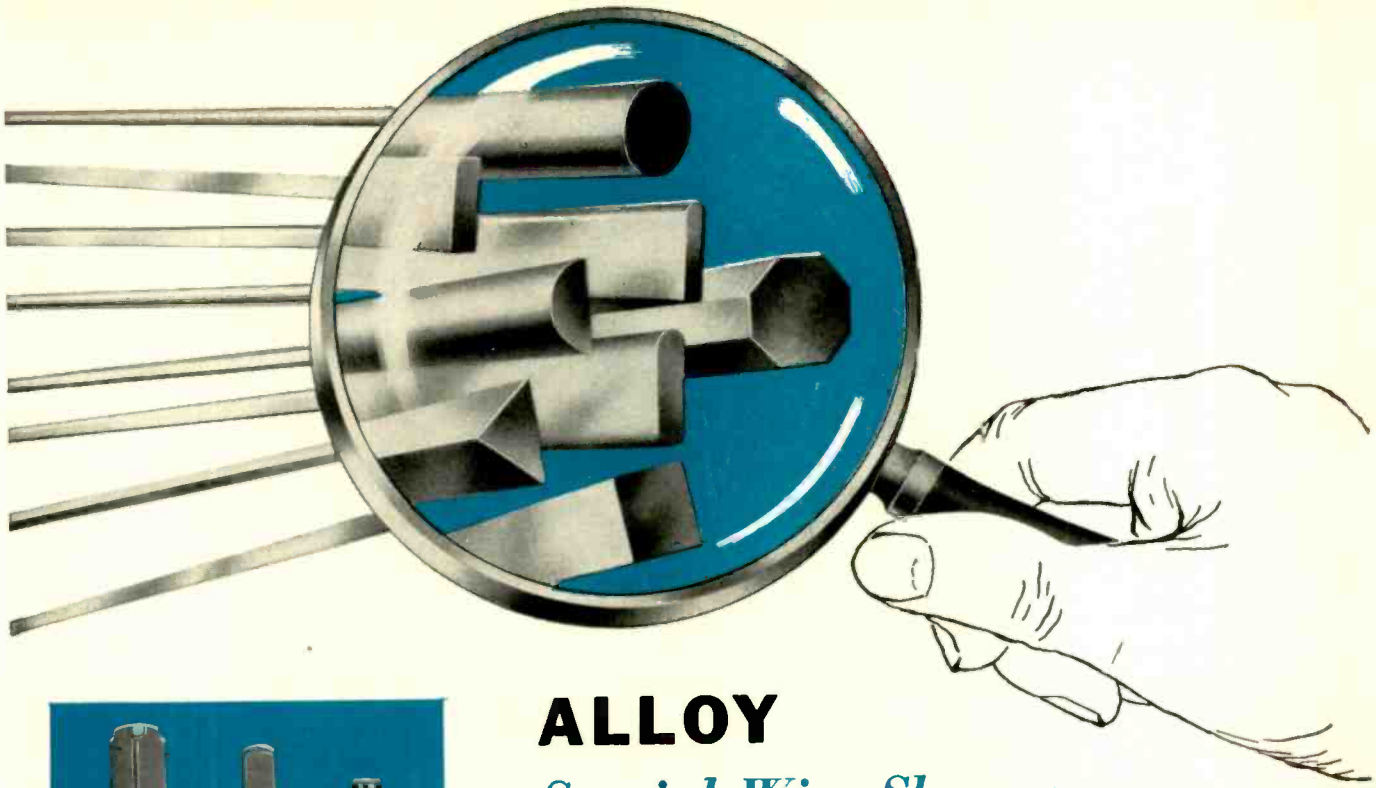
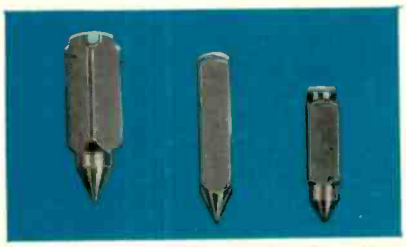


FIG. 6—Proper diode arrangement emphasized by wide range of threshold current

The top curve shows the effect of a typical point-contact germanium diode. Deterioration is rapid as temperature rises. Two diodes of the same type are an improvement as shown by the middle curve. By far the most satisfactory diode is a small selenium unit (bottom curve). The circuit with this latter diode is still better (in the sense of the threshold current being near zero) at 80 deg C than either of the other diode arrangements at room temperature. One added comment on the bottom curve is that the current is of opposite polarity from that required for the other diode arrangements.

Some variation with voltage in the trigger point is experienced with different transistors and at different ambient temperatures. These are caused by I_{co} changes creating an additional voltage drop in the base-resistance of the transistor. For a type 1729, I_{co} can vary approximately 1 ma from 25 to





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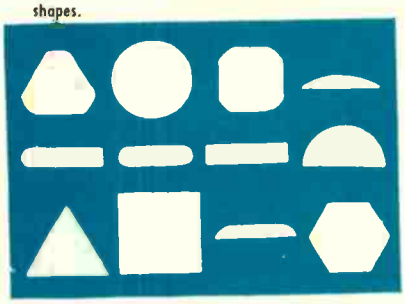

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80 deg C. Through a base resistance of 100 ohms this represents 100 millivolts. This voltage effectively acts in series with the input signal. As in most circuits of this type, the input signal amplitude should be made as large as possible to swamp these small undesirable voltages.

Most of the data for this article were obtained by E. Harrison.

REFERENCES

(1) A. E. Anderson, Transistors in Switching Circuits, *Proc IRE*, **40**, p 1541, Nov. 1952.

(2) R. M. Ryder and R. J. Kircher, Some Circuit Aspects of the Transistor, *Bell System Technical Journal*, **28**, p 367, July 1949.

Visual Aid for Music Training

By V. Ronald Nelson

Dept. of Physics
Augustana College
Sioux Falls, South Dakota

An electronic instrument that may be used for the perfection of pitch, volume and quality control in vocal and instrumental music education and for the demonstration of many of the phenomena of the physics of music gives a picture on an oscilloscope screen of the note being played. The main elements of this device are shown in the block diagram of Fig. 1.

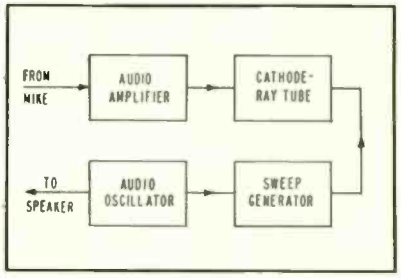

FIG. 1—Block diagram of audio viewing unit

The oscillator, which is resistance-capacitance tuned by means of the pitch-selector switch, emits through the speaker any one of the thirteen pitches of the chromatic equally tempered scale. The tone to be compared with the reference note, whether it be vocal, instrumental or otherwise generated, is picked up by the microphone, amplified and applied to the vertical deflection

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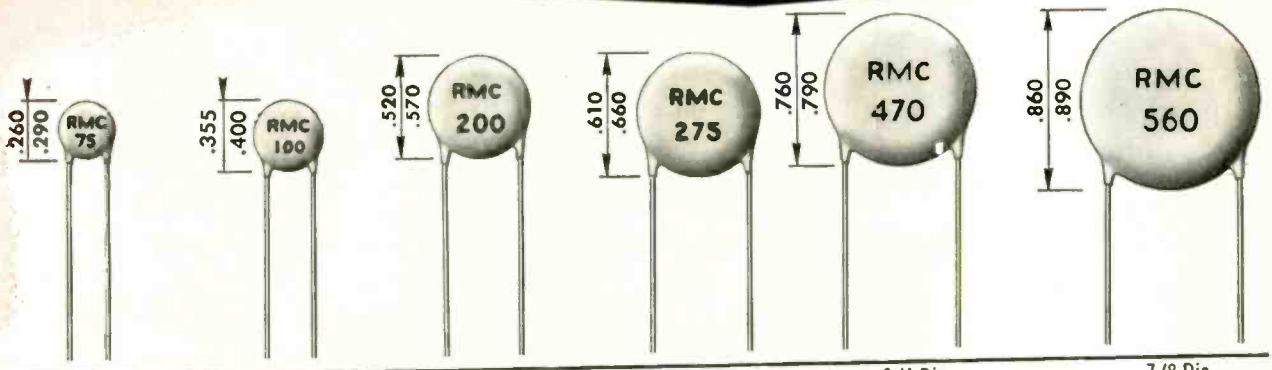

TC	1/4 Dia.	5/16 Dia.	1/2 Dia.	5/8 Dia.	3/4 Dia.	7/8 Dia.
P-100	1- 3 MMF	4- 9 MMF	10- 20 MMF	—	—	—
NPO	2- 12	13- 27	28- 47	48- 62 MMF	63-100 MMF	101-150 MMF
N- 33	2- 12	13- 27	28- 47	48- 62	63-100	101-150
N- 75	2- 15	16- 27	28- 56	57- 68	69-110	111-150
N- 150	2- 15	16- 30	31- 60	61- 75	76-140	141-150
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
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plates of the oscilloscope.

Because the sweep generator is synchronized at one-fourth the frequency of the oscillator, four complete cycles of the incoming tone appear on the screen of the oscilloscope as shown in Fig. 2, if the incoming frequency is the same as that of the reference tone. Drifting of the pattern to the right or left indicates an off-frequency condition, either flat or sharp, respectively.

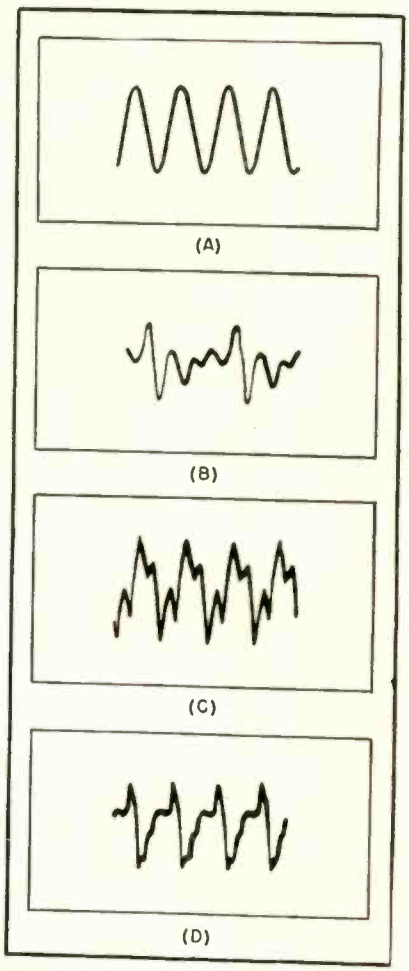

FIG. 2—Waveforms produced by tuning fork (A) trombone (B) baritone voice (C. and signal from loudspeaker of viewing unit (D)

The speed of drift is proportional to the degree of sharpness or flatness. Undesirable variations in the amplitude of the pattern reveal a lack of volume control of the sound source. The shape and complexity of the pattern is a manifestation of the quality or color of the tone—in other words, of the number and relative strengths of the overtones present. Since the tendency toward the end of a long sustained note is to change pitch, volume, or quality,

the unit may be used to detect and correct these usually undesirable variations.

If the incoming frequency is an octave below the frequency of the reference note, only two complete cycles will appear as in Fig. 2B. If it is two octaves below the reference note, only one cycle of the incoming frequency will appear on the screen.

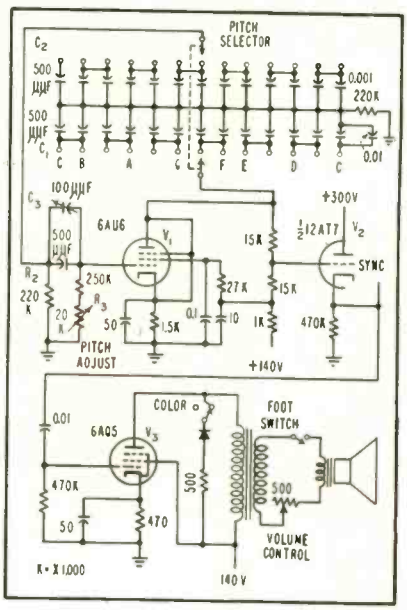

FIG. 3—Oscillator circuit for producing reference notes in audio viewing system

Conversely, if the incoming tone is an octave higher than the frequency of the reference tone, eight cycles will appear. This feature allows the musician to listen to one reference note, perhaps A_4 (440 cps), and to practice playing that same note or any of its octaves, higher or lower.

Referring to Fig. 3, the oscillator frequency varies inversely with C_1, C_2, C_3, R_1 R_2 and R_3. Capacitors C_1 and C_2 provide coarse frequency adjustment while the trimmer across C_3 and the potentiometer adjacent to R_3 provide fine-frequency adjustment. Each note of the chromatic scale is tuned by its own individual trimmer capacitor across C_1 or C_2. The above network produces a phase shift of 180 degrees at the frequency to which it is tuned. Amplifier V_1 furnishes another phase shift of 180 degrees, resulting in self-sustaining oscillations if the tube has sufficient gain. Cathode follower V_2 isolates the oscillator from the circuits that follow.

The sweep generator in Fig. 4 is

a conventional gas-tube type. Resistor R_4 provides the coarse sweep-frequency adjustment. Its value is so chosen that the free-running sweep frequency is approximately one-fourth the oscillator frequency. The output of the oscillator is coupled to the grid of the sweep generator tube V_4. This synchronizes the sweep frequency at exactly one- fourth the oscillator frequency.

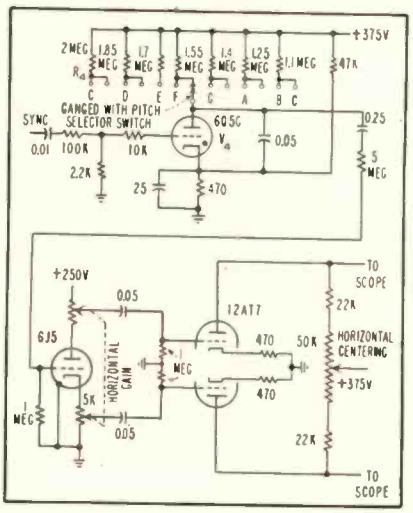

FIG. 4—Sweep-frequency generator synchronizes crt sweep with note being produced

Because the frequency of the audio oscillator is a function of the plate voltage on the oscillator tube V_1, this voltage must be regulated. Other voltages are not critical. Line voltages should be within the limits of 105 and 125 volts.

An *A* may be selected ranging from 434 cycles per second to 446 cycles per second by means of the pitch-adjust control in Fig. 4. The pitch of the other tones of the scale are varied proportionately. The loudness of the reference note is adjusted by the volume control (Fig. 3). The effect of changes in the quality of the reference note may be heard and seen by manipulating the color switch, which will select one of two tonal qualities. Variations in the quality of the speaker output is achieved by placing a diode rectifier across the output transformer. The diode clips the output voltage resulting in the introduction of many of the odd harmonics. The foot switch allows the operator to turn the reference note on or off at will. The microphone pickup and its connection to

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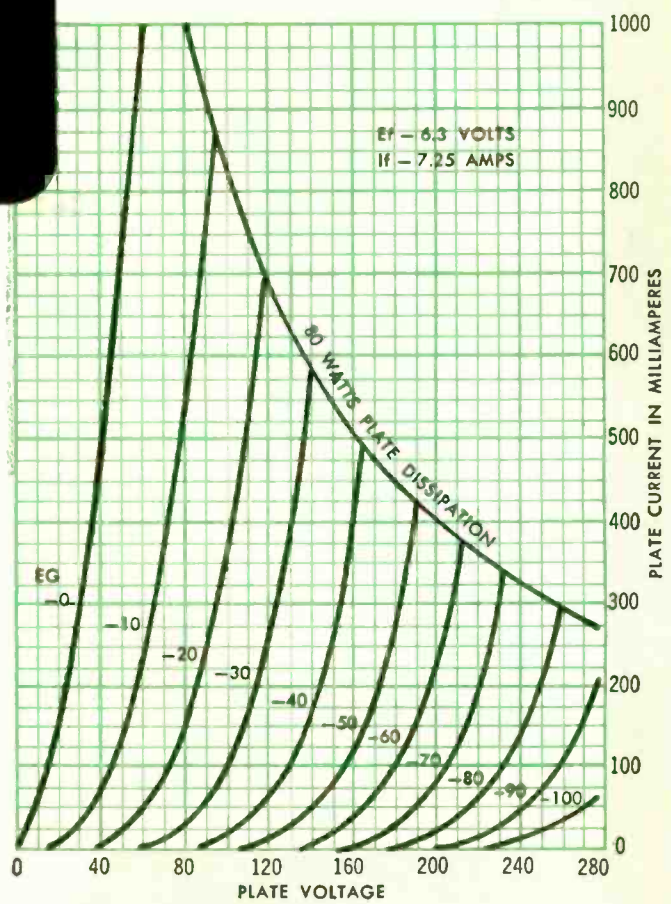

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the viewing oscilloscope is shown in Fig. 5.

In addition to its applications in the production and variation of the pitch, volume and quality of musical sounds, the unit will show

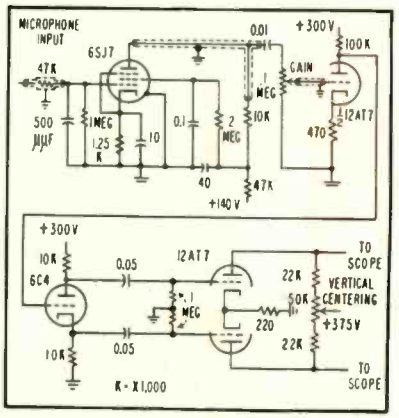


FIG. 5—Input amplifier feeds sound pickup to vertical plates of crt

the effects of posture, relaxation, controlled breathing, vibrato, tongueing and embouchure. It will likewise show the inherent imperfections and distinguishing characteristics of the tones produced by various sources.

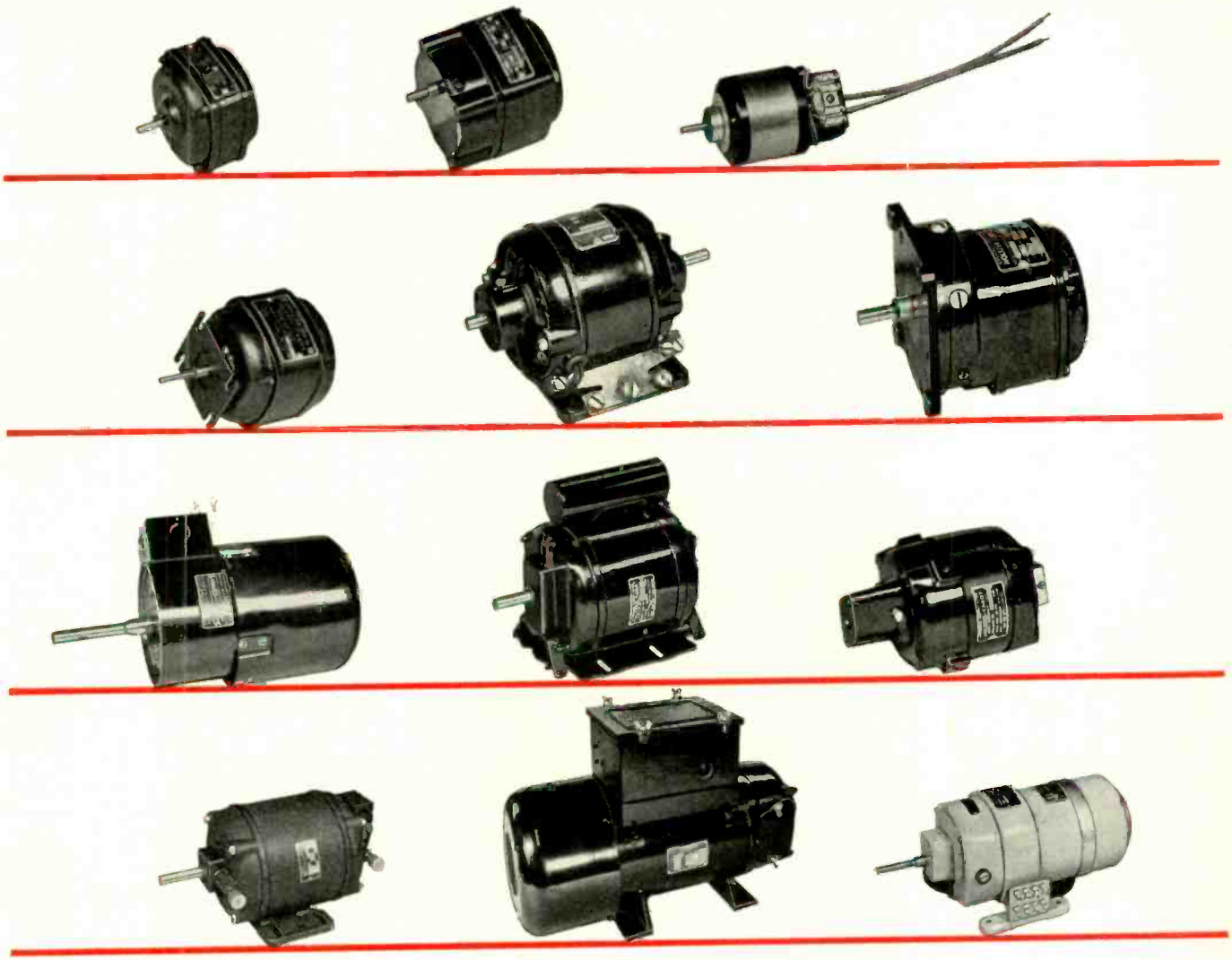
Time Interval Go-No Go Gage

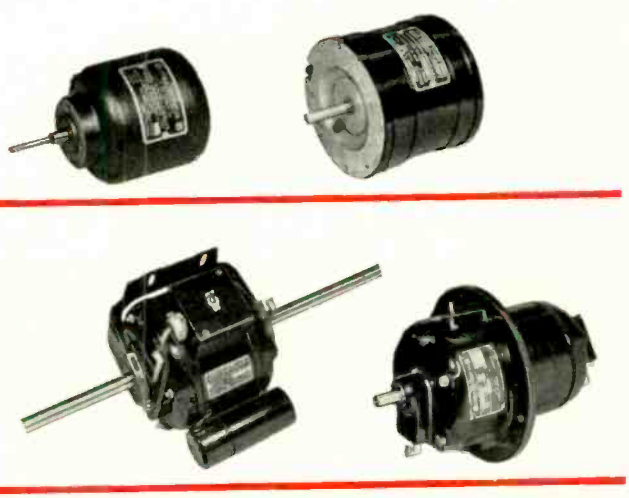
By John H. Porter
Rochester, N. Y.

In statistical control of production quality, it is often more desirable to know whether a quantity falls between two prescribed limits rather than to obtain an exact reading of the quantity. A circuit that will provide a positive indication of whether an event occurs within a certain interval of time is shown in the diagram.

If an event, for example, is to occur at a time greater than t_1 seconds and less than t_2 seconds after zero reference time, the RC constants can be set to these limits with $(RC)_1$ simulating the lower limit, t_1, and $(RC)_2$ the upper limit, t_2. Zero reference time is established by closing switch S starting the timing action.

Four miniature thyratrons are used as follows: At time t_1 following the closing of S, the C of $(RC)_1$ has charged to a potential that just





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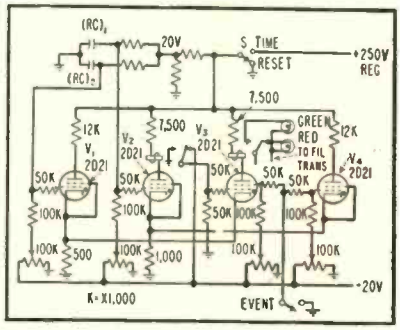
fires V_2. This tube acts as a relay tube to remove hold-off bias on grid 1 of V_3 and if the event to be timed now comes along on grid 2, V_3 fires and operates the indicating light relay.

During this time, C of $(RC)_2$ is also charging and at time t_2 fires V_1, thus providing a large positive voltage on the cathode of V_3. Hence, if the event has not triggered V_3 after time t_1 and before time t_2, V_3 is rendered inoperative. If the event should occur before time t_1, V_3 cannot fire owing to hold-off bias on grid 1, but as soon as this is overcome by V_2 at time t_1, the indication is that of correct timing.



Thyratron-triggered relays indicate timing of event happening in time interval controlled by two R-C circuits

Hence V_4 is also fired by the event and serves to render V_2 inoperative by putting a large positive signal on the cathode of V_2. Therefore, positive indication can be obtained only if the event lies between times t_1 and t_2. Switch S also opens the thyratron plate circuits and discharges the RC combinations to reset the timer.

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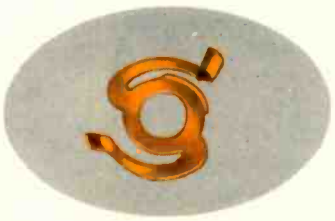

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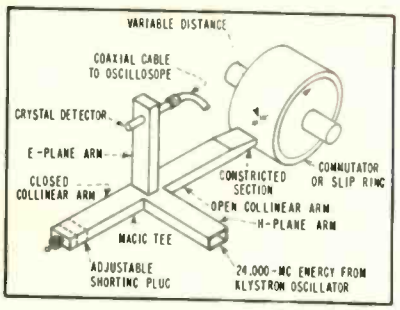


FIG. 1—Arrangement of magic-T for measuring surface irregularities on commutators

ing plug is adjusted in relation to the distance to the commutator surface, the reflected wave will return 180-degrees out of phase and produce a maximum signal in the *E* plane where it is picked up by a crystal-diode detector. Variation in the distance between the end of the magic-T and the commutator surface will cause a change in the phase relationship of the reflected waves and a corresponding reduction in the signal entering the *E*-arm to the crystal detector.

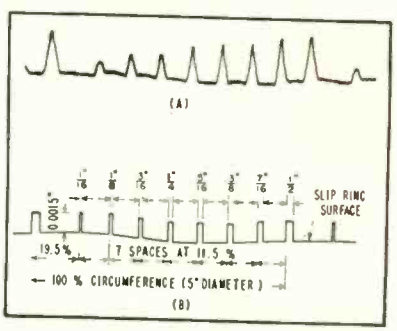
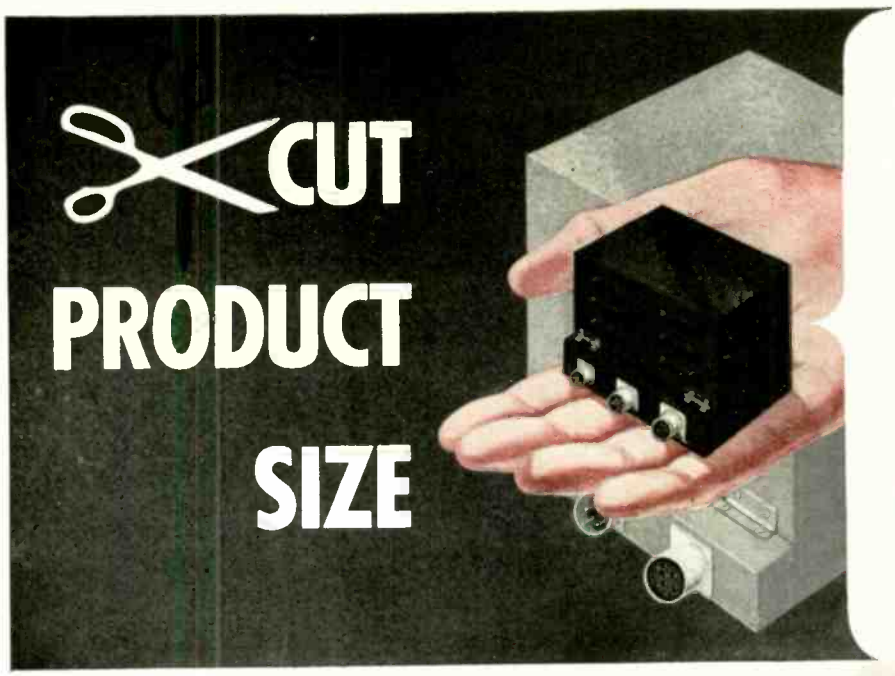


FIG. 2—Oscillogram (A) produced by test slip-ring having surface dimensions as in (B)

Figure 2A shows the oscilloscope pattern produced by a test commutator strip having the surface characteristics shown in Fig. 2B. As the width of the test strip bars decreases the pulse pattern becomes less distinct. To show the narrower bars more clearly it is necessary to constrict the open-ended collinear arm or use a matching stub as shown in Fig. 3. A beam-width approximately equal to the width of the bar being measured will give a good pattern.

This article was abstracted from a paper entitled "Microwaves Used to Observe Commutator and Slip Ring Surfaces During Operation" by A. H. Ryan and S. D. Summers,



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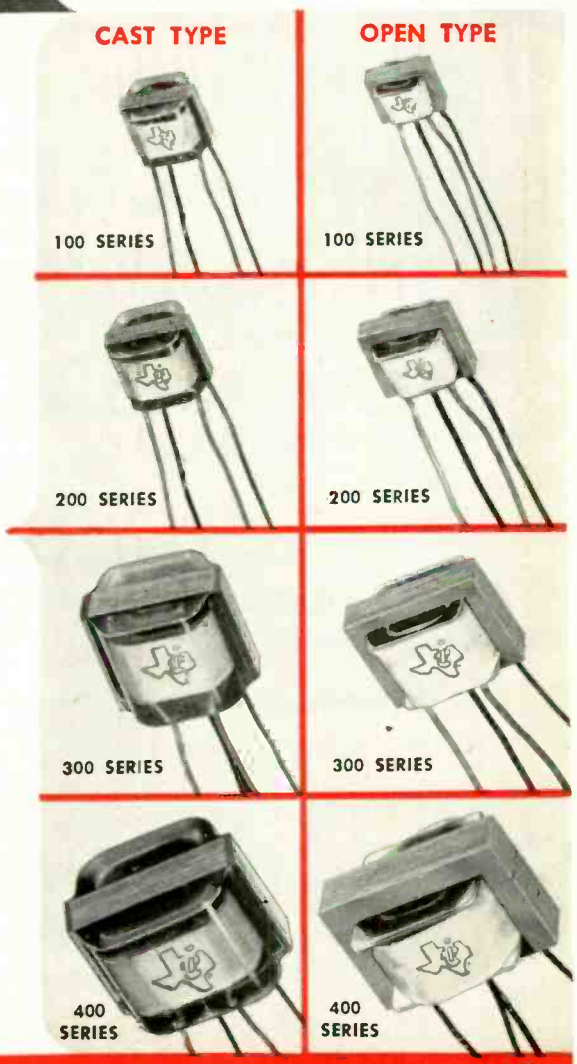

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Input, interstage, choke, and output types are available in four size series ranging from less than 3/8 inch cubed (one milliwatt output) to slightly less than one inch cubed (over 100 milliwatts). Each series is manufactured in both open and cast construction, making a total of 16 basic types . . . 32 models. Designed for use in the audio and ultrasonic frequencies, these subminiatures will operate over a temperature range of —25° C to 100° C, with the cast units being particularly resistant to moisture and other environmental contamination. For your special applications, our engineers will design models to your detailed specifications.

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Toroids

appearing in the March 1954 issue of *Electrical Engineering*.

In a private communication from the authors, it was indicated that they propose trying a waveguide standing-wave indicator as the bridge rather than a magic-T. They

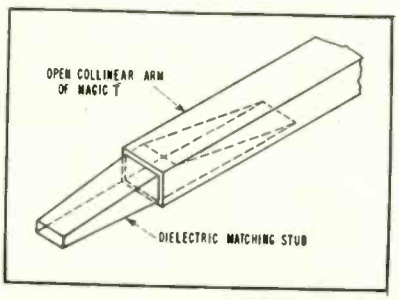


FIG. 3—Polystyrene matching stub used to reduce microwave beam width to dimension approximating width of irregularities being measured

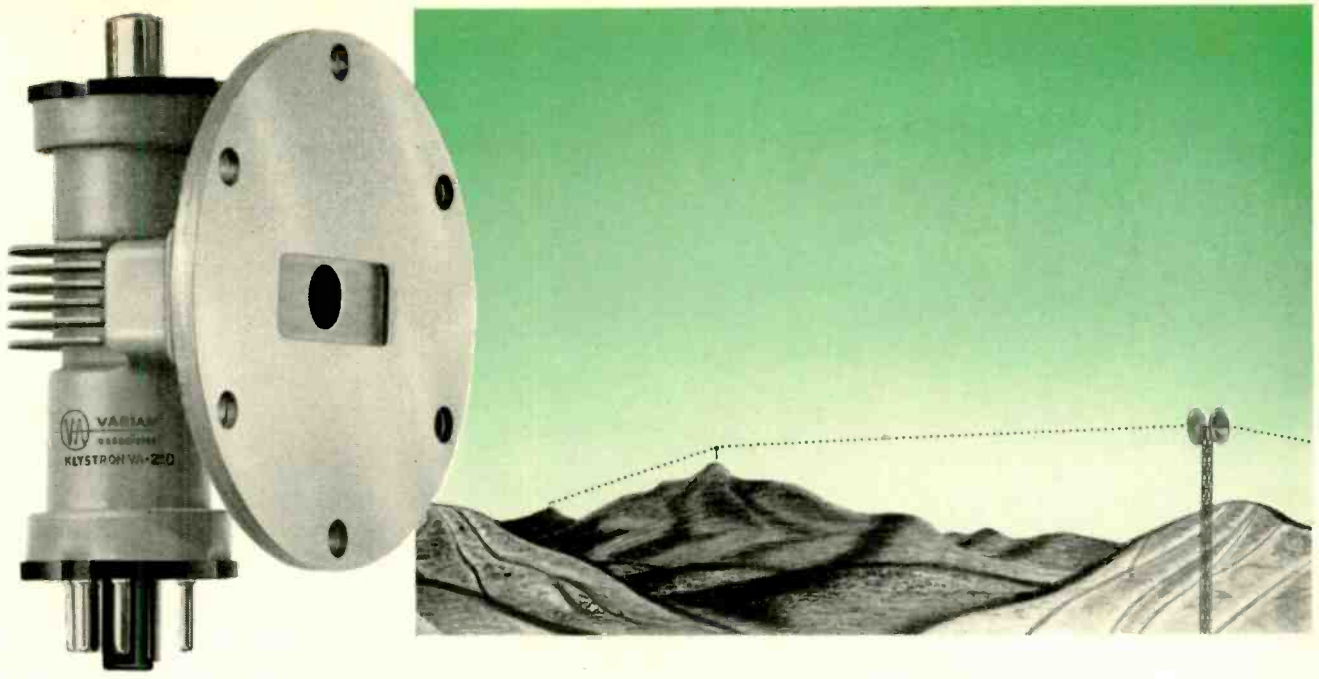
believe that using a standing-wave indicator in place of a T will permit the operator to line up the equipment more easily, although it may result in a slight loss of sensitivity.

Frequency Deviation Indicator

By J. L. Harned and J. J. Shorkey
Vickers Inc.
Detroit, Mich.

In designing a 400-cps deviation indicator it was desired to obtain an instrument that would effectively measure alternator speed with a fair degree of accuracy and yet be light and compact enough to be easily portable. In the indicator circuit (Fig. 1) the input variable, frequency, passes through a high-pass filter and a low-pass filter. The output voltages from these two filters are then rectified. The two resultant d-c voltages correspond to two functions proportional to the input variable. A sensitive galvanometer is bridged between the output of the two rectifiers such that it only responds to the difference between the two d-c voltages.

When the operating points of the filters are set so their outputs are equal at normal operating speed, the galvanometer indicates zero deviation. As the frequency changes



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- **Greater Power**—VA-220 high power klystrons are conservatively rated. They will deliver more than rated power without failure.
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- **Greater Uniformity**—Varian mass production techniques assure uniformity — every klystron is as reliable as a nut and bolt.
- **Longer Life**—VA-220 klystrons can be operated at full power for thousands of hours, at low power for years.
- **Less Distortion, Less Noise**—FM distortion and inherent noise are negligible — 60 db below a 1-megacycle deviation.
- **Lower Cost**—VA-220 klystrons cost far less than any other relay klystron with comparable performance characteristics.

TYPE	FREQUENCY RANGE	RESONATOR VOLTAGE	POWER OUTPUT	BANDWIDTH	MODULATION SENSITIVITY
VA-220*	5925 - 7425 mc	750 v	1.2 watts	35 mc	375 kc/v

*VA-220 B, C, D, E and F each cover a frequency range of approximately 300 mc

FOR COMPLETE SPECIFICATIONS . . . . and technical data on the VA-220 and other Varian klystrons, write to the Varian Application Engineering Department today.

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high-pass filter functions as the zero adjustment and is used to adjust the output amplitude of the filter so that it is equal to the output of the low-pass filter at 400 cps. A 75-0-75 microampere galvanometer is used as the indicating meter. Transformer T_1 isolates the indicating circuit from the high voltage of the alternator. The voltage-divider network in the primary of T_1 functions as the calibrating and range switching circuit.

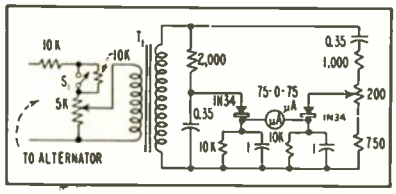


FIG. 1—Frequency-deviation indicator uses two R-C filters. Meter balance is adjusted with 200-ohm potentiometer

The 5,000-ohm potentiometer is used to calibrate the galvanometer by adjusting the amplitude of the input voltage to obtain proper deflection of the meter for a predetermined deviation in frequency. Switch S_1 changes the range of the instrument from ±50 cps to ±100 cps by reducing the amplitude of the input voltage the correct amount. The voltage across the primary of the transformer should be approximately 32 volts on the ±50-cps range and 15 volts on the ±100-cps range for proper calibration.

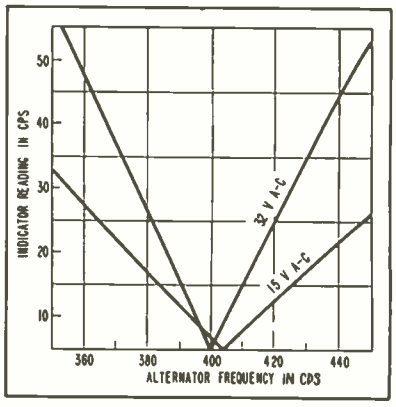
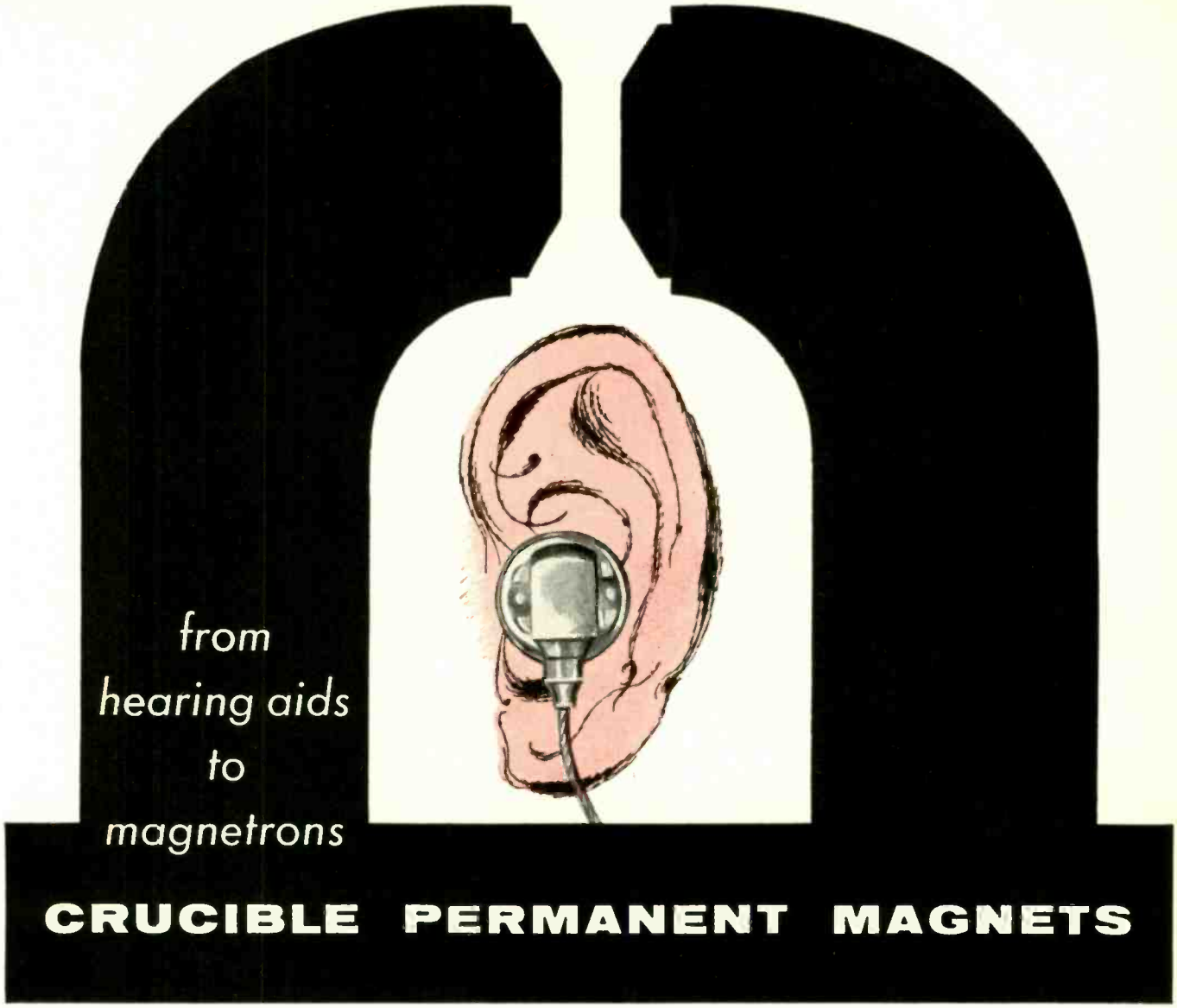


FIG. 2—Plot of frequency-deviation meter indication against alternator frequency for two different input-voltage levels

Accuracy of absolute speed readings is very good providing that the 400-cps point has been accurately established. With the 400-cps point adjusted with an accuracy of 0.25



provide consistently higher energy product

When buying or specifying permanent magnets, consider these Crucible advantages. Crucible alnico permanent magnets are made to meet practically any size requirement from 0.01-pound hearing aid magnets to several-hundred-pound magnetron magnets—and everything in between. Crucible magnets are sand cast, shell molded or investment cast to meet your every size, tolerance, shape and finish need. And their magnetic quality is unsurpassed . . . they *consistently* provide the maximum energy from a minimum volume of magnet material.

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percent the following absolute accuracies can be obtained. On the ±50-cps range the accuracy of the reading for either 350 cps or 450 cps is 1.2 percent while on the ±100-cps range the accuracy of the reading for either 300 cps or 500 cps is 3.5 percent. As the frequency decreases toward 400 cps the accuracy of the reading on either range continually improves. Two other factors that affect the accuracy of the readings are harmonic content and amplitude variations of the input signal. With an input frequency of 450 cps a 10 percent change in voltage will cause the deviation indicator reading to change 5 cps which amounts to a 1.1 percent change in the absolute reading. No quantitative figures are available regarding the effect of waveform distortion on the accuracy of the readings. However, it has been observed that changes in the harmonic content of the waveform will produce changes in the instrument readings.

Modulator for Low-Frequency Tape Recording

By Edwin R. Kolb
Research Assistant
Case Institute of Technology

The transistor modulator described below was developed to record signals in the frequency range from d-c to 40 cps, which is below the range of direct tape recording.

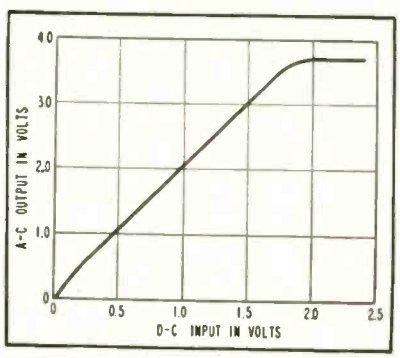

FIG. 1—Linearity of oscillator output in relation to d-c modulating voltage

Basically, the modulator consists of a transistor oscillator[1] whose collector power-supply voltage is directly proportional to the signal input. Thus, the amplitude of oscillation can be considered directly

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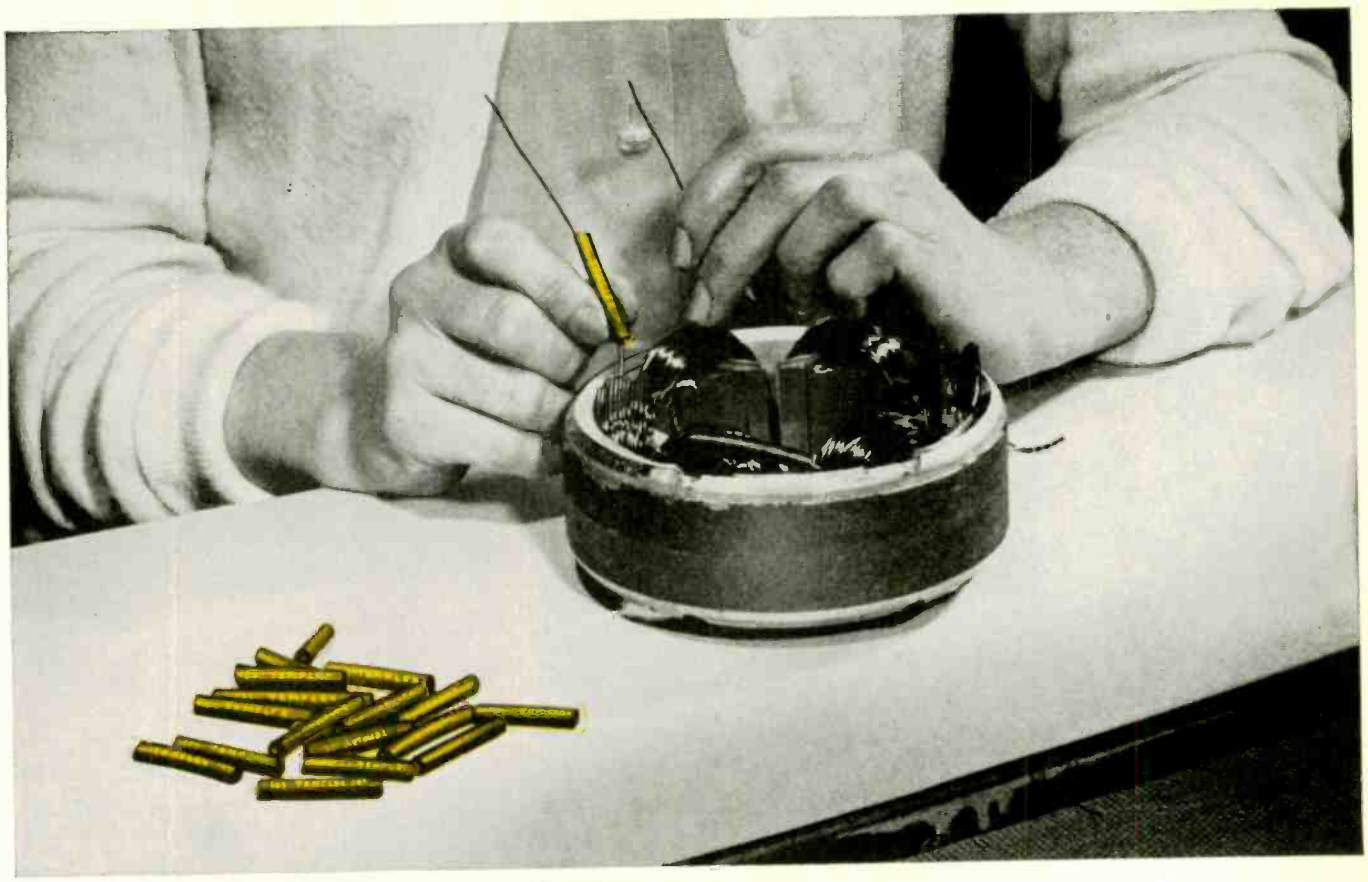

says Redmond Company of TEMFLEX® 105 Tubing

In making the field connections for the unique TRI-FLUX shaded pole micromotors built by Redmond Company, Inc., Owosso, Mich., a 1¼" length of Irvington's Temflex 105 Tubing is slipped over the lead from one field coil, and the lead is twisted together with the connection from the next field coil. Twisted wires are then welded and bent back, and the Temflex tubing drawn over the welded joint. The entire field is then varnished and baked.

In addition to abrasion resistance and retained flexibility, "resistance to baking heat and high dielectric strength are other reasons for using this material," says Redmond about this flexible plastic tubing. Temflex 105 also carries Underwriters' Laboratories approval for continuous operation in air at 105° C. — and for 90° C. operation *in oil*.

Temflex 105 Tubing is produced by Irvington's Plastics Division in all standard colors, to fit all standard wire sizes. It's identified by the continuously printed name on the tubing surface — look for it when you buy high-temperature tubing. Send for literature and samples.

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proportional to the incoming signal with two limitations Since the process of starting and stopping oscillation is not linear, the oscillator must be kept running at some low level. The oscillator has a maximum a-c output. These limitations and the linear range of the unit are shown in Fig. 1.

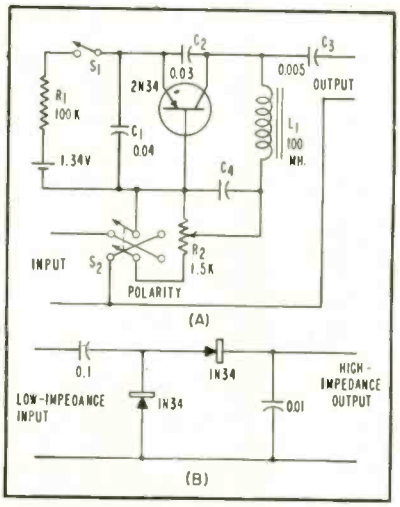

FIG. 2—Circuit of amplitude-modulated oscillator (A). Demodulator (B) is half-wave voltage doubler

The collector power-supply voltage can be provided by using the voltage drop across a 1,500-ohm resistor placed in the output of a d-c amplifier. By controlling the balance on the d-c amplifier, a quiescent transistor voltage can be obtained so that the modulator can be

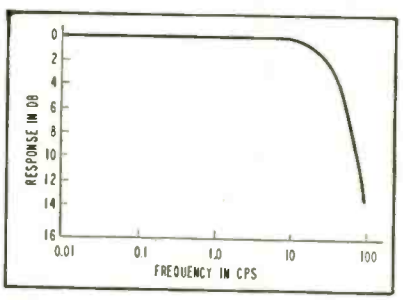

FIG. 3—Frequency response

operated about any point in its linear range. For entirely positive or entirely negative signals, the unit should be operated from the lowest possible modulator output to some higher value. For a-c signals, the modulator would be operated near the center of its range. Figure 2A illustrates the modulator circuit. Demodulation is accomplished by feeding the modulated signal into a half-wave voltage doubler

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such as shown in Fig. 2B.

Tests have shown that noise in the system results almost entirely from the tape itself. Different tapes have different signal to noise ratios, but when using a particular tape, the signal-to-noise ratio remains essentially constant over the normal recording range. Frequency response of the modulator system is

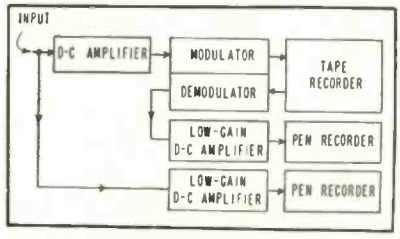

Fig. 4—Transistor modulator used in low-frequency tape recorder setup

shown in Fig. 3. The complete setup for comparing direct and indirect low-frequency recording is given in Fig. 4.

The research described was supported by the United States Air Force through the Office of Scientific Research of the Air Research and Development Command.

REFERENCE

(1) R. F. Shea "Principles of Transistor Circuits", p 281, John Wiley and Sons, Inc., New York, 1953.

Laboratory Power Supply

BY L. FLEMING
Falls Church, Va.

ACTUAL POWER SUPPLIES have several properties besides voltage, that are important to the circuits they serve, particularly those of ripple and internal impedance. In developing circuits that form part of a unit device such as a radio receiver or an oscilloscope, it is important to know the power-supply requirements of each building-block circuit, in order to arrive at a mature design.

In oscilloscopes for example, the output stages of the deflection amplifiers are tolerant of hum in their plate supply, but the sweep oscillator is critical. In amplifiers, triode stages in cascade will tolerate considerably more internal impedance in a common plate supply than will pentode stages.

The power supply described be-

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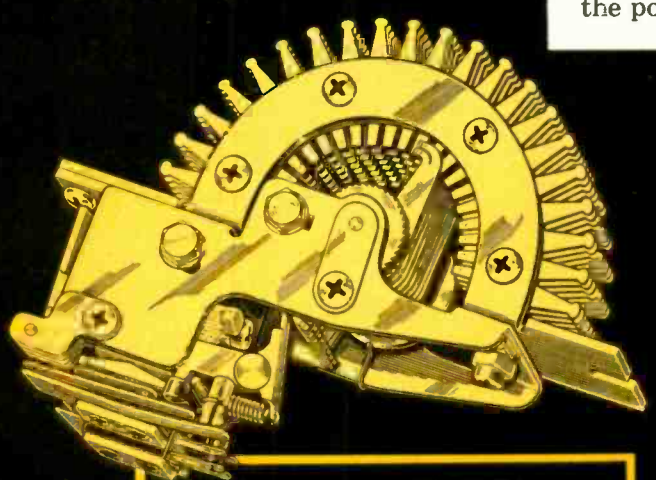
Stepping Switches meet wide range of circuit selection and control problems

CLARE Spring-Driven Stepping Switches are uniselectors, or rotary switches, for completing, interrupting, or changing the connections in, a succession of electric circuits in response to momentary impulses of current.

The switch consists essentially of one or more wiper springs, fixed to a shaft, rotated by a pawl and ratchet mechanism, actuated by an electro-magnet which responds to current impulses. These impulses may be from an external pulsing device or produced by the switch itself, by interrupter springs operated by the magnet armature. Additional contacts may be included in this spring assembly to perform other desired control or signal functions. Remote control operation speed is 30 steps per second maximum. Automatic operation may be as high as 60 steps per second on 48 volts dc or 115 volts ac (with rectifier).

CLARE Direct-Drive Stepping Switches are operated as the stepping magnet drives the pawl into the ratchet to move wiper assembly. Wipers are held in place by a detent when magnet is de-energized. Pawl is returned to normal by a spring. Circuit may be held closed for any desired time after final step. Pawl is normally disengaged from ratchet, and wiper assembly can be returned to normal by a reset magnet. Maximum operating speed: 35 steps p. s. under ideal pulsing conditions. Release time is 0.030 to 0.070 second depending on voltage and the position from which wipers are released.

CLARE Spring-Driven Stepping Switch



TYPE	CAPACITY
20	1 to 8 levels, 20-point
26	1 to 10 levels, 26-point
40	1 to 4 levels, 40-point
52	1 to 5 levels, 52-point

A versatile, high-speed switch for—
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CLARE Direct-Drive Stepping Switch

Designed for such control functions as—
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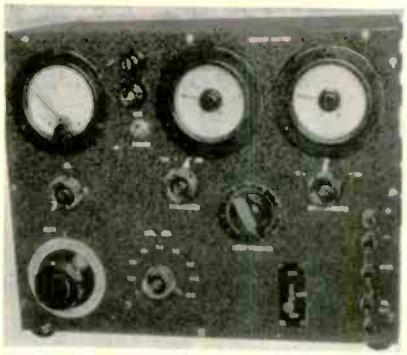
Send for Engineering Bulletin No. 103 for a discussion of stepping switch operation and applications. For full technical data ask for Engineering Bulletin No. 101. Address C. P. Clare & Co., 3101 West Pratt Blvd., Chicago 45, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable Address: CLARELAY

CLARE RELAYS

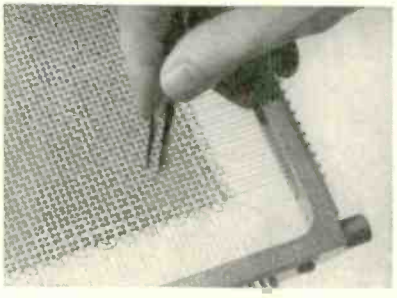


Front panel of laboratory power supply shown in Fig. 1

low has been found to help considerably in the development of reliable and economical circuitry, because it combines in one cabinet a number of functionally related features and because it was planned from a viewpoint opposite to that which underlies most laboratory supplies. It is intended not to provide power in a manner approaching the ideal, but rather to simulate in a controlled manner the shortcomings of practical supplies, down to the poorest.

The following characteristics are built into the design: plate voltage variable down to zero, with multiple-range voltage and current metering; alternating filament voltage variable over a narrow range and metered; calibrated provision for introducing 60-cycle a-c in series with the plate voltage output, over the range 0.001 to 1 volt; provision for switching various resistances in series with the output.

The maximum voltage obtainable



Whirlwind Memory

Looking somewhat like a minuscule bedspring, the digital memory device shown will increase speed and reliability of computers. It was designed for the Whirlwind I machine at Massachusetts Institute of Technology. The unit of which a corner is detailed is less than a foot square and comprises more than 1,000 tiny magnetic rings strung on a criss-cross of wires

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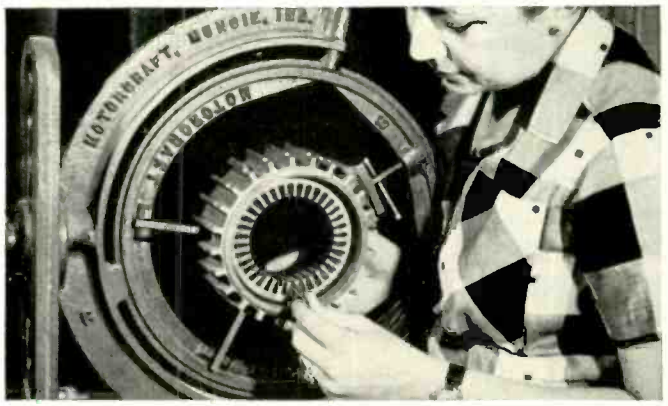
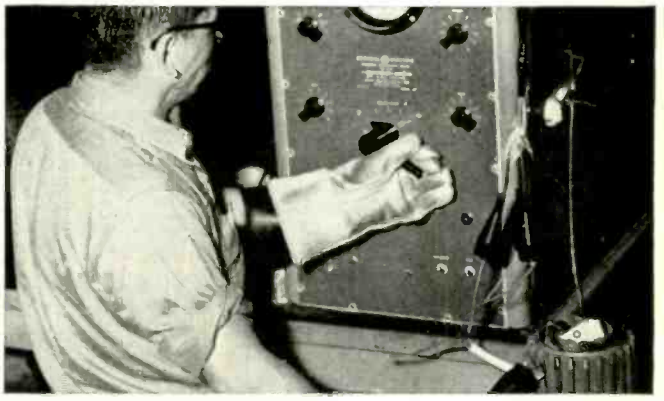
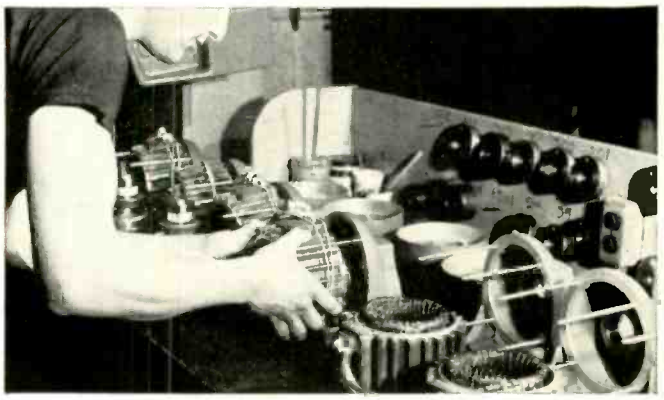


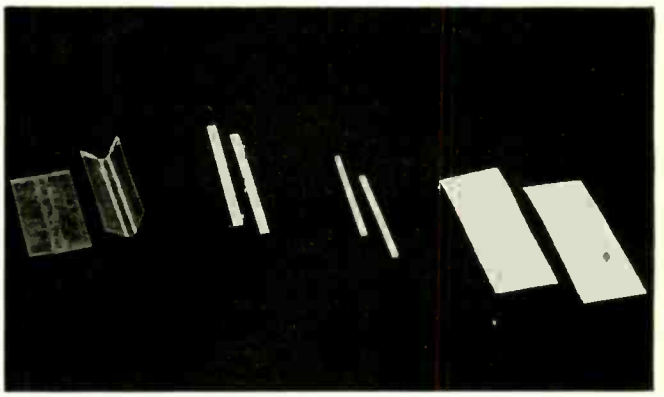
1. Cell wall made of ISOMICA® Flexible Plate being inserted into stator slot. Before insertion, the cell wall is cut to size and given a double crease to facilitate assembly.



2. Wound stator shown being subjected to surge test at 1000 V. Any weak spots, cross phasing, unbalanced winding or wrong connections can be detected by oscilloscope pattern.



3. After winding, surge testing and treating, wound stator is assembled into motor. Units pictured are of the totally-enclosed, explosion-proof type with integral gearing, used for powering pumps, compressors, actuators, hoists.



4. Mica Insulator Company parts used to insulate U. S. Aircraft Motors. Left to right: Cell Wall—ISOMICA Flexible Plate; Center Stick—LAMICOID® thermosetting plastic-silicone-glass laminate; Top Stick—LAMICOID; Phase Insulation—ISOMICA.

One of the big problems in aircraft motor insulation is altitude. Lowered air pressure reduces effective cooling by convection and radiation, creates higher operating temperatures. That's why U. S. Aircraft Motors use ISOMICA—a Class H silicone-bonded processed mica with silicone-treated glass cloth on both sides—for phase insulation and cell walls... and silicone-glass LAMICOID—a Class H laminate—for center and top sticks. These superior insulating materials enable U. S. Aircraft Motors to withstand higher temperatures while still retaining minimum weight per horsepower.

We'll be glad to work with you on *your* electrical insulation problems. Whatever electrical insulation material you need—Class A to Class H—MICO makes it best. We manufacture it, cut it to size, or fabricate it to your specification. Write today.

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can be limited to any convenient low value such as 50 volts by plugging the power cord into a continuously variable autotransformer known in some laboratories as a covat, since there are no tubes in the supply to require a constant heater voltage. This procedure is useful in working with transistors.

The metering and series-resistance features make the supply a convenient device for finding the operating currents of relays and for checking thermistors and varistors.

The 6.3-volt source is center-tapped with a pair of resistors, so that the center is normally grounded to B—, but either side can be grounded if desired without changing any connections.

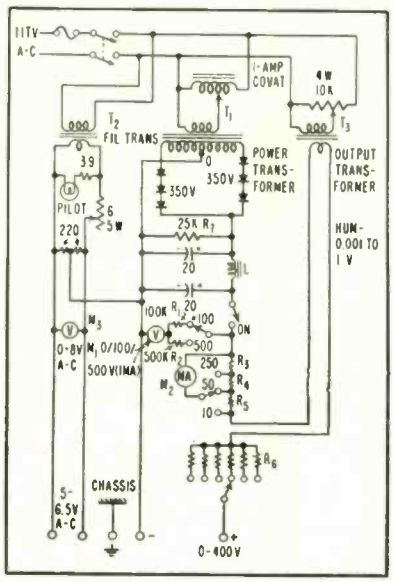

FIG. 1—Circuit of the laboratory power supply

The circuit, shown in Fig. 1, is completely straightforward. The voltages are not regulated, because in circuit development it is much more important to have them variable over a wide range and to know what they are.

The high-voltage supply comprises a small covat and an ordinary replacement-type power transformer. Selenium rectifiers of the replacement type are used in series, followed by an ordinary filter. The B-voltage switch, a telephone key-type unit, is connected after the filter, so that it is not necessary to wait for the filter capacitors to discharge through the load.

Two voltmeter scales are pro-

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To help you with any problems you may have in selecting and buying just the right hook-up wire or electronic cable, we have recently published Bulletin TR-5. It will provide you with complete information on the full range of hook-up wires and electronic cables Rome Cable regularly produces. Or, if you have a special problem, involving application of an unusual nature, Rome Cable engineers are qualified, and ready, to work with you . . . in the design of the type of conductor you need. Below is a quick rundown of the Rome hook-up wires and electronic cables which are completely described in Bulletin TR-5.

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Rome Hi-Temp: Underwriters approved for 75°C. A heat-resistant rubber insulated wire, available either with plain rubber or with lacquered braid of cotton or rayon.

Rome Synthinol: Underwriters approved for 80°C. Insulated with a polyvinyl chloride thermoplastic compound, has wide industry acceptance for its high heat resistance and workability.

Rome Synthinol 901: Underwriters approved for 90° and 105°C. Newly developed as a resin plasticized polyvinyl chloride type of thermoplastic insulation. This hook-up wire has increased heat resistance and resistance to oils and chemicals.

Rome Multiple-Conductor Cables—In addition to single-conductor wires, Rome Cable produces cables made up of varying numbers and sizes of the individual conductors. These special cables have been supplied in increasing quantities to manufacturers of electronic, radio and television equipment.

Sheaths are supplied in the form of thermoplastic or rubber jackets, or fibrous braids.

Electrostatic shielding is supplied in the form of metallic braids or metallic tapes.

Cables are designed for portable or fixed installation.

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

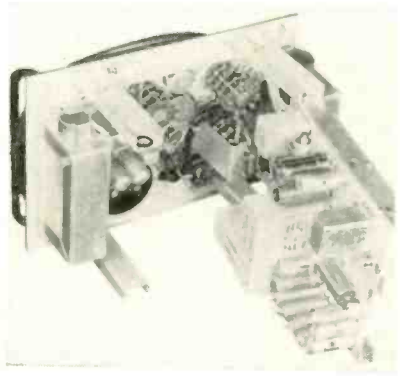
vided, and three current-meter scales. For a 0-to-1 milliampere, 200-ohm meter at M_2, the values of the resistors in the Ayrton shunt R_3, R_4 and R_5 are respectively 0.80, 3.2 and 18.2 ohms.

The filament supply consists merely of a suitable filament transformer T_3, a meter, center-tap resistors and a power rheostat. A variable transformer may be used instead.

The hum-introduction circuit employs a small radio output transformer of the universal type fed from a 10,000-ohm, 4-watt potentiometer. Secondary taps are chosen to give a step-down ratio of about 100-to-1 and the potentiometer dial is calibrated in secondary volts. The impedance looking into the secondary is less than 1 ohm.

Appropriate values for the series resistors R_n depend on the application. Convenient values used here are 100, 200, 500, 1K, 2K, 5K, 10K and 25K ohms.

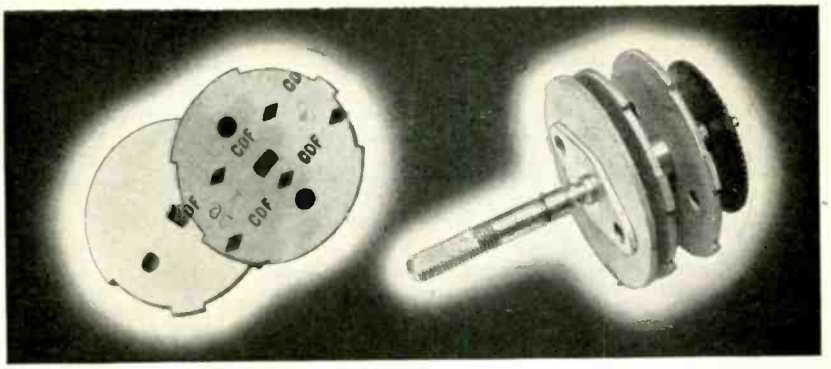
Controls are arranged with a view to locating the most-used controls conveniently and grouping related items together, for example, the meters and their range switches.



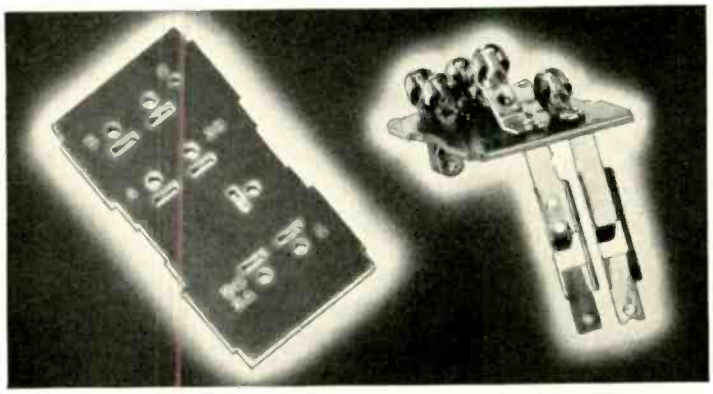
Military Equipment Design

New military multichannel carrier telephone equipment developed by Bell Labs for operation over spiral-four cable is characterized by compactness, ruggedness and portability. The test unit shown has been designed for use under adverse weather conditions. Inside, emphasis is upon accessibility for maintenance and repair. The swinging subchassis type of construction makes every component quickly available without sacrificing reliability or minimum size

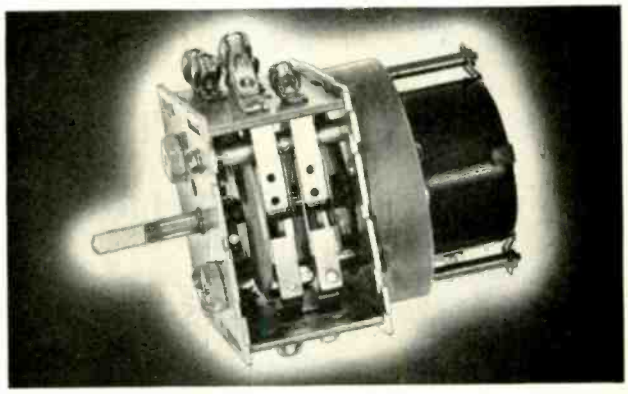
What makes the miracle of automatic washdays? What gadget turns water on and off; starts spinners, agitators, fans; regulates heat . . . all on a precise timing schedule? Chances are it's a P. R. Mallory timer switch.



Special paper-base Dilecto laminated phenolic cams are the heart of the switch. If the corners are not sharp, if tolerances are not held, if the laminated plastic fails, the timing schedule would go haywire. But it doesn't happen with Dilecto cams *fabricated by C-D-F*, now definitely identified for performance comparison.



C-D-F also supplies these Dilecto insulating side boards. Dilecto Grade X-13 was chosen for its ability to withstand severe riveting and staking impact, for its sturdiness in holding up under the strain of plugs being inserted and removed from terminals mounted on the board.



Look inside the smart, small, tough Mallory timer switch. The shaft revolves; with the switch operated by a manual clock which is wound or set whenever the switch is turned over to complete the entire cycle. *Switch accuracy depends entirely on the degree of accuracy in which the cam is manufactured.*

C-D-F and DILECTO® LAMINATED PLASTIC helped Mallory

improve design . . . simplify purchasing . . . speed production

Two C-D-F Dilecto laminated plastic parts play small but vital roles inside P. R. Mallory's timer switches used to control the washing, drying, rinsing cycles.

Most important, the timing cams must be precisely fabricated to odd, notched shapes, with very close dimensional tolerances. In the design stage, it was first thought that there was no practical way to obtain the desired pieces.

But engineering-supplier teamwork always pays off. Good basic design . . . a quality material from an alert, interested fabricator . . . selective purchasing resulted in a solution.

C-D-F WORKS WITH DESIGNERS

A father and son team, in Mallory's Switch Division, Arthur and Harry Hall, began 15 years ago to make this timer switch. Cam material after material was tested . . . none worked satisfactorily.

C-D-F sales engineer Robert Tappan was called in. He says, "After 18 months, the design was adaptable to Dilecto laminated plastic. The first cam did not work, but showed promise. Looking back, it was a crude punching compared to the ones now furnished by the C-D-F Valparaiso plant."

A BIG, RELIABLE SOURCE

Mallory makes thousands of timer switches, naturally has several suppliers for laminated plastic insulation. But C-D-F keeps working hard to further improve the product: Special tools have been designed to increase the accuracy of C-D-F cams, to provide Mallory with *lower rejection* rates. Resin-penetrating and laminating techniques have improved Dilecto grades. Inspection and quality control have been modernized.

When you have a problem in laminated plastics, think of improved, Dilecto and C-D-F. Send us your print for technical advice and quotation. Write for free test samples. The C-D-F catalog is in Sweet's Design File and the IRE Directory. Best of all, call your C-D-F sales engineer . . . He's a good man to know!

CDF Continental-Diamond Fibre

CONTINENTAL-DIAMOND FIBRE COMPANY

NEWARK 16, DELAWARE

Production Techniques

Edited by JOHN MARKUS

OTHER DEPARTMENTS featured in this issue

Air-Operated Lift Tables for Television Consoles

AIR LIFT tables are used to lower television receivers from a roller conveyor to floor level for polishing operations, in the plant of E. K. Cole Ltd., Southend-on-Sea, England. Other identical lifts are used to raise the sets onto another conveyor for transfer to packing.

The receivers travel on platens on the roller conveyor to a position opposite the air lift table, and are then slid onto the air lift platform. The air lift table descends to its lowest position when the lever of the air valve is operated. The receivers are then wheeled out of the platens (which have one side open) on their casters, down a metal slide to floor level. The slope of the slide is very slight, to merge with floor level.

Operating lever of air valve for lift table, to lower console to floor

After the polishing operations have been completed, the receivers are wheeled onto another air lift table of the same design and raised to a roller conveyor which delivers them via the mist spray booth to the packing conveyor. The lift table makes it possible to handle both table model and console receivers on the same conveyor line, regardless of their size and weight.

The tables were designed and constructed by the production engineering department of the plant. Each uses a standard air valve in conjunction with levers and linkages to obtain smooth up and down movement of the metal-surface table.

Knob Setscrew Inserter

A SIMPLE jig designed by Hewlett-Packard, Palo Alto, Calif. speeds insertion of setscrews into tuning knobs. The knob is placed on a stud on a horizontally moving table, with the screw hole facing the operator. The Allen-type setscrew is then placed on the corresponding straight Allen wrench held in the chuck of a horizontally mounted hand drill. Turning the drill handle as the knob slide is pulled toward the operator then serves to insert

Indifference—whether it's under the "big top" or on the production line—is inexcusable and often fatal. You simply can't afford to take chances with a hard won reputation for quality performance. That's why we say it's a pretty good rule to stick to a solder you know and trust . . . time-proved Kester Solder, constant in solder alloy and always a consistent flux formula.

Be sure your soldering is satisfactory with one of these well known solder products: "44" Resin, "Resin-Five" and Plastic Rosin—all made only by KESTER . . . Key Name in Flux-Core Solder for More Than 50 Years.

WRITE TODAY for Kester's ***NEW*** 78-Page Informative Textbook, "SOLDER . . . its fundamentals and usage"

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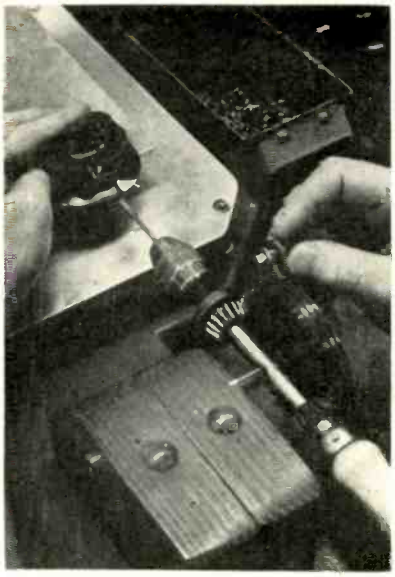
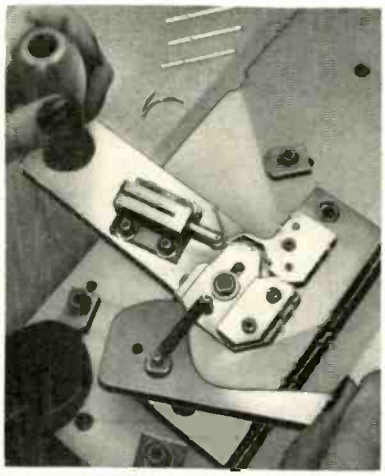


Hand drill setup for inserting setscrews in dial knobs

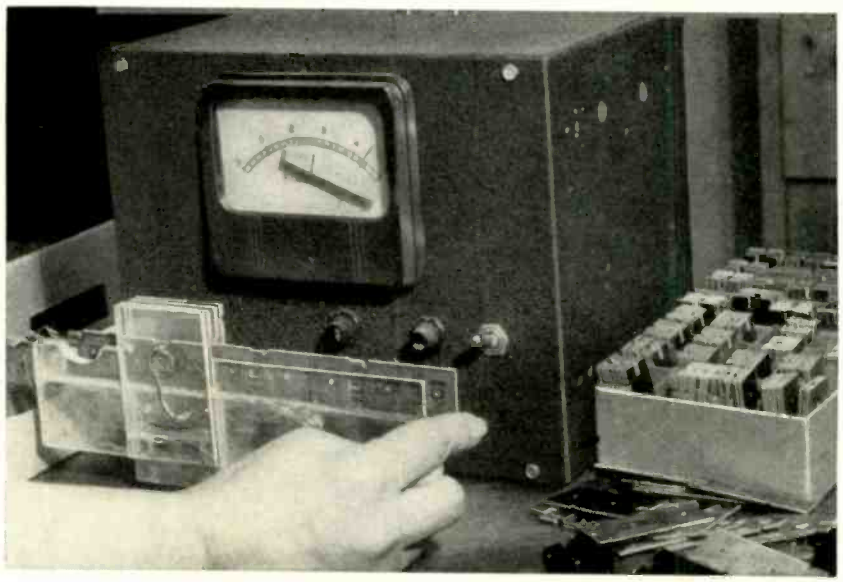
the setscrew rapidly and smoothly. A simple stop on the slide table controls the depth of insertion, so that the knob can later be placed on a shaft without loosening the screw. The arrangement worked so well that it is now being operated by a blind worker.



Bending Tool for Contact Springs

A SPECIAL TOOL is used for forming contact springs of precision potentiometers at Helipot Corp., South Pasadena, California. The contact spring with a precious metal contact welded to its tip is inserted in the jig. The operator pulls the right-hand lever towards her, thus forming the first bend. She then pushes the left-hand lever away from her to complete the forming operation.

Shorted-Turns Tester for Etched I-F Coils



Pushing printed i-f coils through sensing fixture of shorted-turns detector

FLAT rectangular windings etched on copper-clad plastic sheets are quickly checked for shorted turns by pushing the sheets through a clear plastic slide that supports the sensing coil of an electronic shorted-turns detector. A meter on the instrument is connected to read voltage across a tank circuit. A shorted turn is indicated by a lower voltage reading because currents induced in the shorted turn load the oscillating circuit.

A strip of tape affixed to the meter window is marked BAD-GOOD to speed direct evaluation.

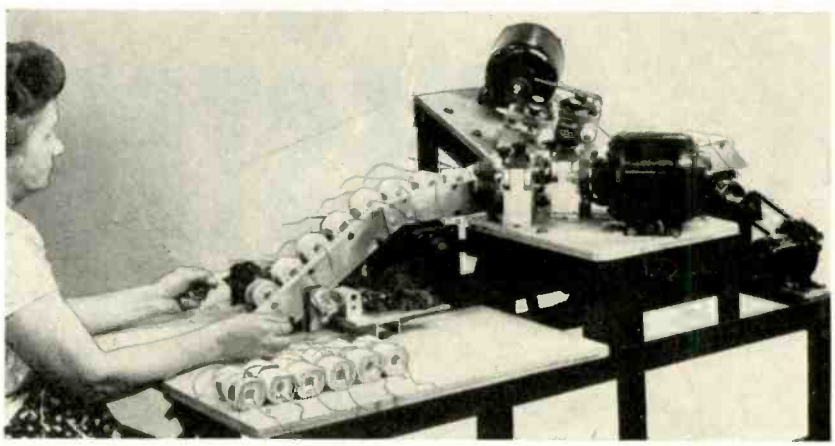
Acceptable printed strips are pushed right through the slides into a tote box. A curved cutout in the slide at the left of the sensing position. permits grasping a defective unit and tossing it out.

Quality Control of Wire Stripping

By W. O. RICHARDS

Technical Adviser
The Eraser Co., Inc.
Syracuse, N. Y.

THE PRINCIPAL CAUSE of failure of electrical connections is the fact that the wire is not absolutely clean at the time the connection is made. The most common reason is



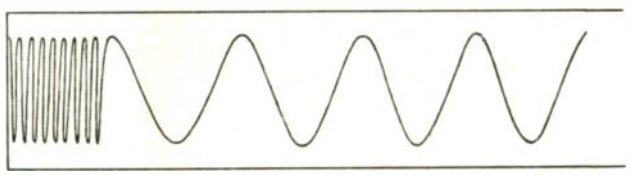
Example of mechanized wire cutter and stripper. Operator places coils in conveyor and holds out both leads until they reach wire clippers, where they are cut from approximately 10 inches to 4 inches in length

For the ultimate in **data recording**

The complexity and cost of many product testing projects places instrument reliability uppermost in importance. In designing the CEC Type 5-119 Recording Oscillograph, reliability was therefore a prime consideration. To assure maximum reliability under environmental extremes, construction of this instrument is extremely rugged throughout. Automatic safety and warning devices, insure against the loss of data. One example is a set of reserve lamps which light immediately in the event of a galvanometer-lamp failure. Convenient grouping of controls; ease of magazine loading; clarity and ease of viewing the scanning system; and many other conveniences help the engineer secure a high percentage of excellent records under adverse conditions. 36 and 50 trace models are available with frequency response flat to 3000 cps, using CEC's newly improved Type 7-300 Galvanometers. Sixteen record speeds provide a 1000 to 1 range from 0.01″ to 100″ per sec.

New JUMP-SPEED feature

By actuating a jump-switch, the speed of the record is instantly increased or decreased 10 times without interrupting the test. Complex wave forms in the high frequency range are thus spread over an extended time base, showing both general trends and detailed changes on the same record. The jump-speed feature also facilitates resolution of transient phenomena through expansion of the time axis. Combining the many proved features of CEC's other world famous oscillographs with numerous important improvements, the Type 5-119 Recording Oscillograph represents today's ultimate in high precision dynamic data recording instrumentation. Write for CEC Bulletin 1536-X17.



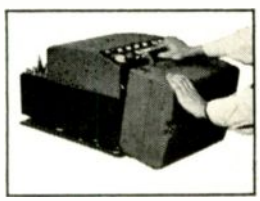
Increasing or decreasing record speed 10 times spreads complex wave forms over extended time base. This feature permits easier, more accurate interpretation of test records, and clarifies resolution of transient phenomena.

CEC's Type 5-119

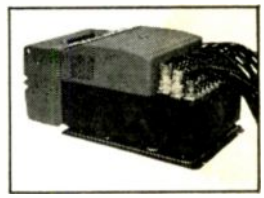
Recording Oscillograph

sets a "new high" in

- reliability
- versatility
- performance



Record magazine, locked in place with a single lever, accommodates 12-inch wide record rolls 250 feet in length.



Convenient grouping of individual galvanometer connectors in recessed panel facilitates use of instrument in limited space.

Consolidated Engineering CORPORATION

ANALYTICAL INSTRUMENTS FOR SCIENCE AND INDUSTRY

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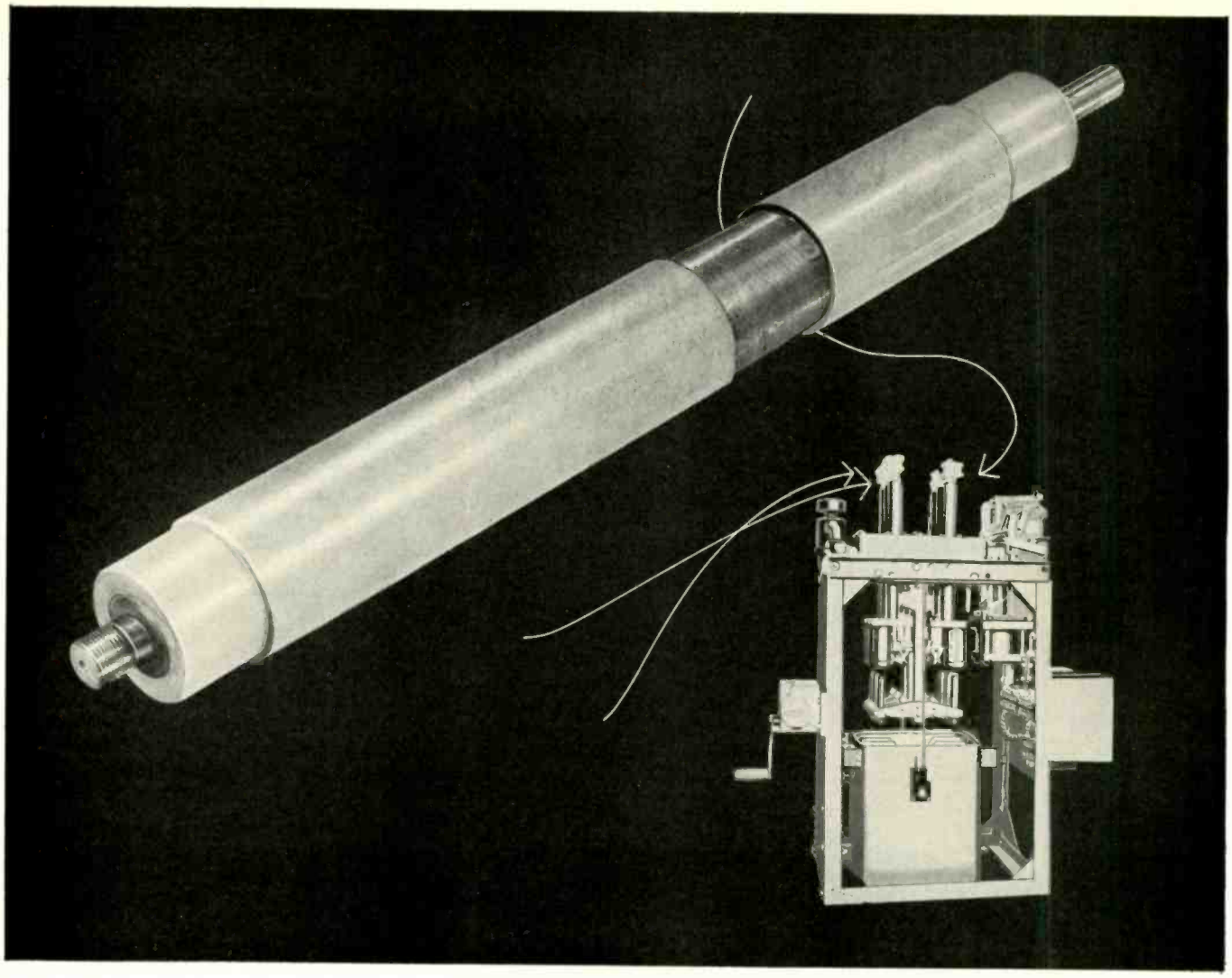


Where two materials are better than one

Properties of Synthane

Among the outstanding properties of *Synthane* are:

1. **Mechanical strength.** Synthane exhibits excellent strength under tension, compression, impact, vibration and mild shock loads. It will not delaminate.
2. **Dielectric strength.** Synthane is widely used as an insulating material in many different applications.
3. **Low moisture absorption.** Most grades of Synthane are highly moisture resistant. Special grades are available for applications where absorption must be at a minimum.
4. **Dimensionally stable.** Synthane is a thermosetting plastic with a minimum cold flow. It holds its shape under normal conditions and at elevated temperatures.
5. **Availability.** In addition to more than 33 grades of sheets, Synthane is also supplied in many grades of rods and tubes. Molded-laminated and molded-macerated parts are also manufactured. A complete fabricating service is available.

● This circuit breaker bushing is a most unusual application for *Synthane* laminated plastics combined with another material. Basically it's a conductor and an insulator—a solid copper bar—to which is bonded a thick insulating shield of *Synthane* laminated plastic.

There is one little joker in the design: each bushing contains a thin copper grid, only .003" thick, buried in the insulating plastic. It is positioned concentric to the copper core as the *Synthane* is being wound before curing. After curing, the bushing goes to our fabricating department. Here precision machinists turn off the *Synthane* over the grid until the delicate grid is fully exposed—yet unharmed.

Synthane—the material—was chosen for this job because of its combination of high dielectric strength, toughness and machinability. *Synthane*, the company, was selected because of its ability to handle a tough job. Our fabricating department is especially equipped to work with laminated plastics.

Look into the advantages of *Synthane* laminated plastics and *Synthane* fabricating service. Write for a free catalog detailing both. Synthane Corporation, 12 River Road, Oaks, Pennsylvania.

Our 25th Year

SYNTHANE CORPORATION, OAKS, PA.

SYNTHANE

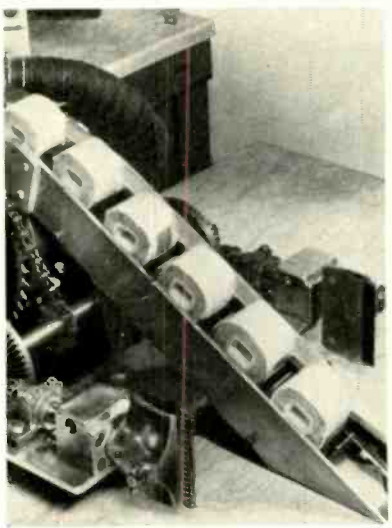
LAMINATED S PLASTICS

that the insulation has not been completely removed. Oxidation of the wire, resulting from a time lapse between the stripping and connection operations, can also be a contributing factor. The result is a connection that is either weak mechanically or high in electrical resistance which causes overheating.

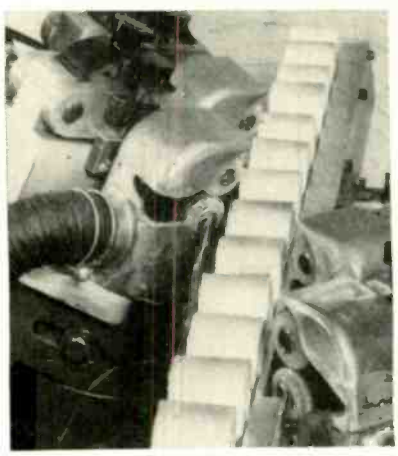
The second major case of failure is the fact that the wire becomes nicked or reduced in diameter during the stripping operation. This increases the resistance at this point, causing a hot spot that results in early failure.

Manufacturers of insulated wire have achieved remarkable success in developing insulations that are tough, tenaceous and extremely durable. Their achievement has created a difficult problem for manufacturers of electric equipment who must remove this insulation without damaging the wire.

Speaking specifically of film-in-



Hair-clipper-type wire shears at front of the machine clip the leads to the desired length. Clippers are designed so that they cannot cut the operator's fingers. Design allows for wide tolerance in vertical position of leads

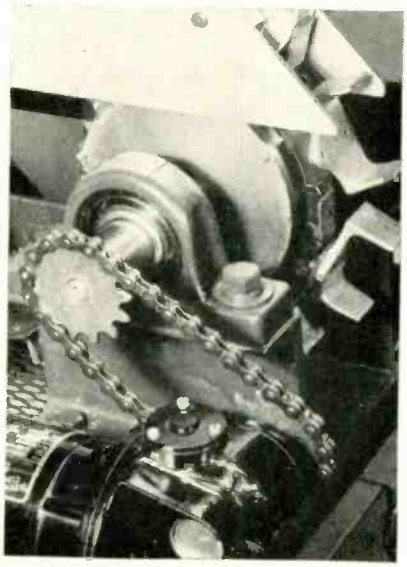


Conveyor carries leads through pair of tandem-driven wheel-type wire strippers, shown here with wheel guards and dust-collector covers in place. Lead at left must be stripped up close to coil, hence stripper on this side is tilted so that edge of coil fits in between wheels. Notched wheel cover guides the lead into the stripping wheels

Tandem-driven wheel-type strippers with wheel guards and dust-collector covers removed. Special fiberglass wheels develop sufficent frictional heat to melt insulation, which is then wiped off by brushes. The double pass insures complete removal of insulation from stripped area. Entire width of wheels is used for stripping, so no low spots are worn in the wheels

Stripper head, without wheels, being placed into position. Black knob in foreground is space regulator screw which maintains proper minimum spacing between wheels so that wire cannot be reduced in diameter or otherwise damaged. Knob at back is pressure regulator, which permits wheels to open up to receive wire and maintains proper amount of frictional heat. Antifriction plates under the arched spring allow free movement of upper spindle. Round part in base is part of dust-collecting system

sulated wires, there is such a wide variety of film formulations applied to such a wide variety of wires that it is impossible to develop a single stripping machine or stripping method which will successfully handle all types and gages of film-insulated wire. Other steps in the processing of the wire, from spool to finished component, also have a direct bearing on the stripping operation. For greatest efficiency, wire stripping must be planned as an interdependent part of the overall wire processing operation.



Detail of conveyor drive which also operates wire clippers and dust-collecting blower. Aluminum coil cups on conveyor are specially designed for the coils in this specific operation

Manual Stripping Methods

There are certain stripping methods and devices which, in theory, appear to be perfect for the specific jobs for which they are being used. Their actual efficiency, however, is limited by the human element. Quite aside from carelessness and indifference on the part of the operator, it is impossible for anyone to do something time after time exactly the same way every time. Honest human error can result in a high number of rejects and costly failures.

Mechanized Methods

One logical means of attaining practical quality control of wire stripping—and hence of the connections and of the equipment itself—

A Hi-Temperature Tested Germanium Diode

The new Hughes type 1N198

Temperatures inside operating equipment usually climb well above the equipment ambient temperature. At these elevated temperatures, you need components with *known* characteristics. Most germanium diodes are tested at room temperature and, as operating temperatures rise, their performance deteriorates. But the new Hughes Type 1N198 is a *realistic* germanium point-contact diode.

That's because this diode is tested 100% *at* 75°C—which is just about as hot as most electronic equipment gets in operation. In addition, samples of the 1N198 are regularly subjected to all standard tests at 25°C. This means that you can use these hi-temperature tested diodes with confidence, can design equipment to take full advantage of the fact that *electrical characteristics at the higher temperatures are specified.*

ACTUAL DIMENSIONS
DIODE BODY:
0.265 by 0.130 inches (maximum)

Type 1N198 Electrical Characteristics

at 75°C	
Forward Current at 1V dc	5 mA (Min.)
Reverse Current at −10V dc	0.075 mA (Max.)
Reverse Current at −50V dc	0.250 mA (Max.)
at 25°C	
Forward Current at 1V dc	4 mA (Min.)
Reverse Current at −10V dc	0.010 mA (Max.)
Reverse Current at −50V dc	0.050 mA (Max.)

Like all Hughes Diodes, the hi-temperature tested 1N198 is fusion-sealed in a one-piece, gas-tight glass envelope which is impervious to moisture or other external contaminating agents. The complete Hughes line of fusion-sealed germanium diodes comprises standard RETMA, JAN, and many special types. We'd like to send our Bulletin SP-2A, which lists and describes these diodes, to you. Just send for your copy, or for additional details concerning the new Type 1N198.

Hughes

SEMICONDUCTOR SALES DEPARTMENT

Aircraft Company, Culver City, Calif.

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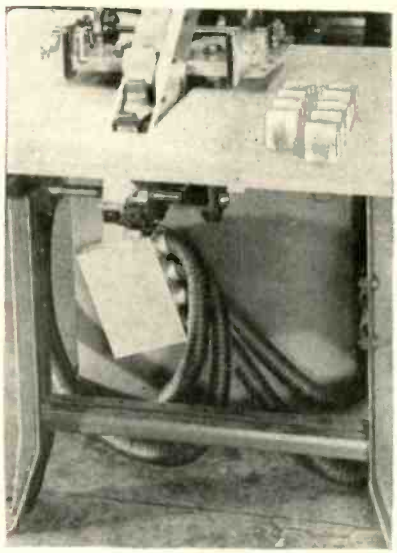


Dust-collecting manifold and lines extending to individual stripper heads. Dust is collected in a container which is easily emptied

has proved to be a mechanized stripper developed for the specific job in hand, which reduces to a minimum the human element and results in uniformly high stripping quality every time.

Many manufacturers are now successfully using this approach to this serious problem. Oftentimes the same method that insures the quality of their connections also has cut their production costs.

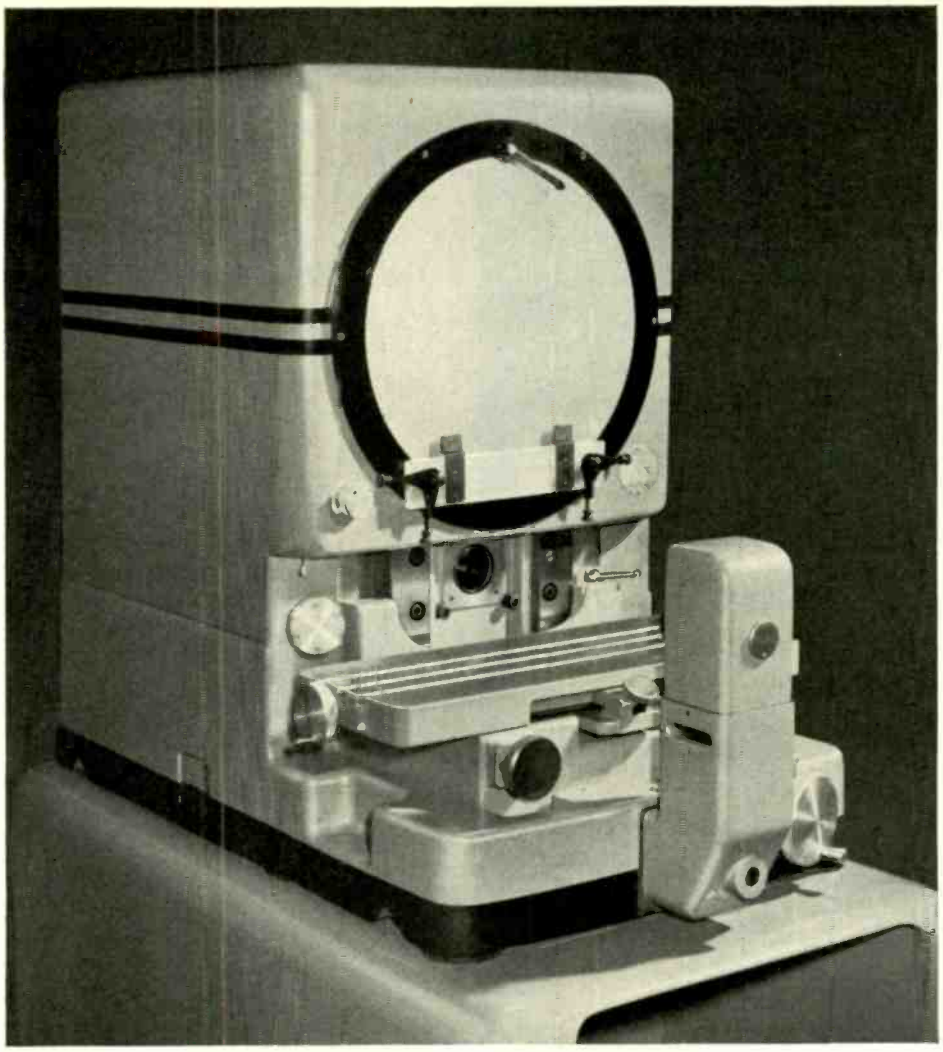
Example

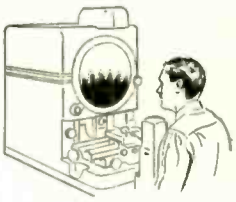
A typical problem is the shunt coil shown, wound with AWG No. 30 Formvar-insulated wire. The starting lead requires 1¼ inches of stripped length extending to within 1 inch of the coil. The finishing lead, on the opposite side of the coil, must be stripped for a length of 1¼ inch and within ½ inch of the coil.

By previous methods, each lead was separately and individually sanded by hand. Control of quality depended upon the adeptness of each individual operator.

To solve this problem, a simple, compact mechanized wire stripper was developed to do a clean, damage-free stripping job to the required specifications and to reduce the human element to the very minimum. The illustrations here show the operation of this mechanized stripper.

As the direct result of the use of this specialized equipment, connec-





For maximum versatility in production inspection...

the NEW KODAK CONTOUR PROJECTOR, Model 4

You'll find setups are faster, fixturing easier when you use the Kodak Contour Projector, Model 4, for routine gaging of precision parts.

Designed for use on the inspection line, it has a movable table with 4 inches of travel in both horizontal and vertical directions. This lets you handle a wide variety of parts with simple fixturing.

The Kodak Contour Projector, Model 4, has the same unique optical system as the famous Kodak Contour Projectors, Models 2A and 3. The 14-inch viewing screen covers a field of 1.4″ at 10× magnification. Vertical illuminator, surface illumination, six-power lens turret, and rotating screen with protractor ring are available as accessories. For complete details, write to:

EASTMAN KODAK COMPANY
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Rochester 4, N.Y.

the KODAK CONTOUR PROJECTOR

Kodak
TRADE-MARK

tion failures have been virtually eliminated. An important secondary saving lies in the fact that 1,620 coils can be stripped per hour by one operator.

Grid Stretcher

GRIDS for vacuum tubes are sized to rigid specifications with a simple stretching tool operated by a foot pedal, in the plant of Tung-Sol Electric Inc., Bloomfield, N. J.

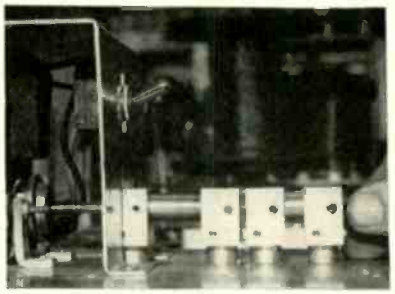
The operator slips a welded grid over the split mandrel that projects upward from the tool, then pushes

Stretched position of tool, with wedge projecting up between the two halves of the mandrel

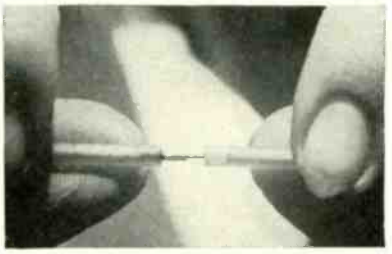
the foot pedal down. This drives a thin tapered wedge between the two halves of the mandrel, to stretch the turns and thereby counteract the deformation due to centrifugal force during winding of grids.

Drilling Soft Insulation

A DRILLING setup devised by Hewlett Packard Co., Palo Alto, Calif., permits counterboring into polyethylene insulation to make room for a soldered joint between coaxial cable and a platinum-coated 4-inch glass pad. This solved the problem



Setup for drilling flexible polyethylene insulation. Fractional-horsepower motor at left drives drill. Sleeving is being pushed in at right, and bottoms against left center block at finish of boring



Operator slips counterbored insulation over soldered joint between wire and platinum-coated glass pad

of insulating the joint without disfiguring the outer diameter of the insulation.

In the first step of the operation, wire is drawn out of a 4-inch section of cable. The insulation is then counterbored to a $\frac{3}{8}$-inch depth. The wire is connected to the glass pad with a brass sleeve and made fast with low-temperature solder. The counterbored insulation then can be slipped over the glass pad and joint.

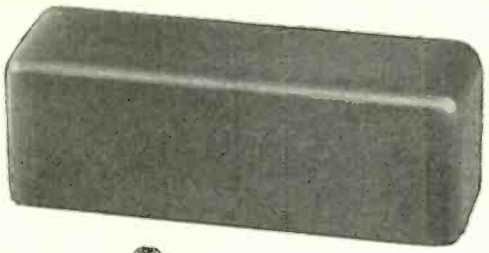
Blast Cleaning Salvages Metal Picture Tubes

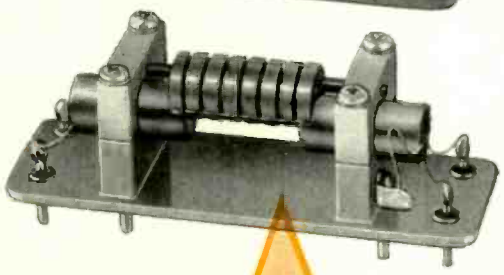
METAL picture tubes which are production rejects or which have been returned due to failure in service can be reconditioned economically with new multitable airless blasting machine manufactured by American Wheelabrator & Equipment Corp., Mishawka, Indiana. The glass, face and neck are first broken off. The metal cones are then placed in the machine and residual glass is blasted off to bright bare metal with size S-230 cast steel shot.

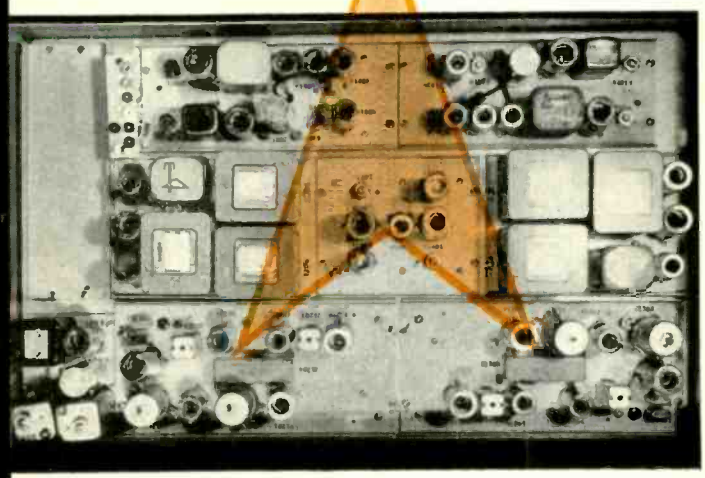
The steel shot is thrown by a rotating bladed wheel in the cabinet roof of the machine. Fixtures keep the cones from being displaced by

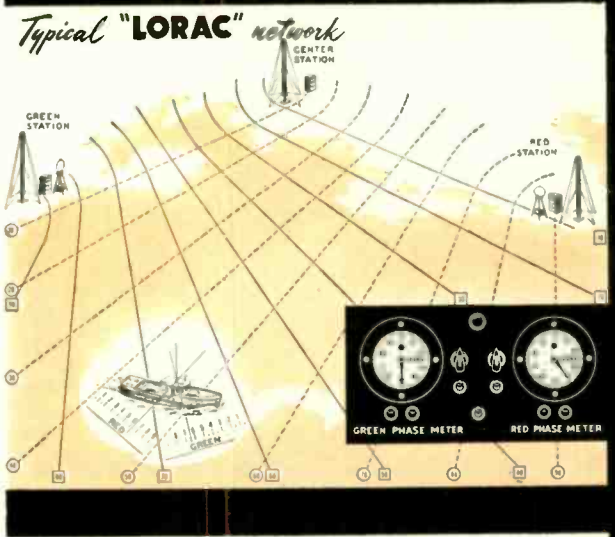
Collins

MECHANICAL FILTERS PROVIDE A MORE DEPENDABLE SIGNAL FOR LORAC RECEIVERS









The Seismograph Service Corporation of Tulsa utilizes Mechanical Filters to narrow the I. F. pass band of their receivers and produce a better signal-to-noise ratio. Two Collins Mechanical Filters are now used in each marine mobile Lorac receiver.

During recent years the oil industry has displayed great interest in the Continental Shelf Area of the Gulf of Mexico. Increased geophysical activity in this area demanded a more accurate determination of the geographic position at which geophysical observations are made. As a result, Seismograph's Lorac radiolocation system, unhampered by poor visibility and line-of-sight limitations, was designed. Today the better signal-to-noise ratio provided by Collins Mechanical Filters in their Lorac receivers aids in providing position information as accurate as ± 2½ feet.

Here is only one use of this compact, permanently tuned I. F. bandpass Filter. It is very probable that the Collins Mechanical Filter will provide the ideal selectivity and better signal-to-noise ratio you require. Collins Engineering Staff is available to assist in your particular application. Ask us today about the many types of standard Mechanical Filters now available for your use.

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Cedar Rapids, Iowa

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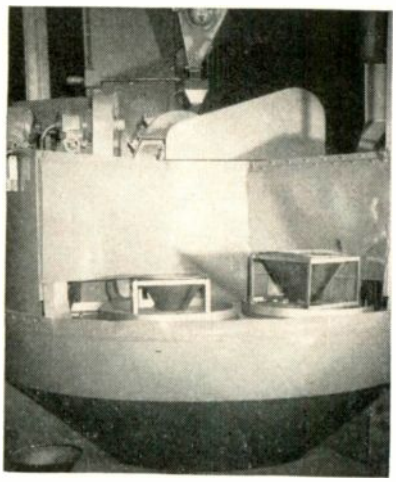
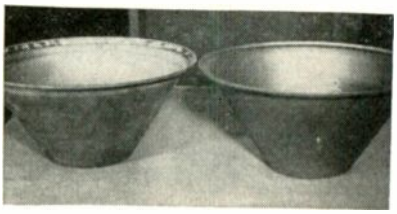
1930 Hi-Line Dr., DALLAS 2
2700 W. Olive Ave., BURBANK
Collins Radio Company of Canada, Ltd., 74 Sparks Street, OTTAWA, ONTARIO

COLLINS



Cleaning insides of metal cones with machine. Rectangular steel frames hold cones in position on their waltzing turntables as the 6-foot spider moves the tables under heavy flexible plastic curtains into the blasting zone. Shot hopper is at top



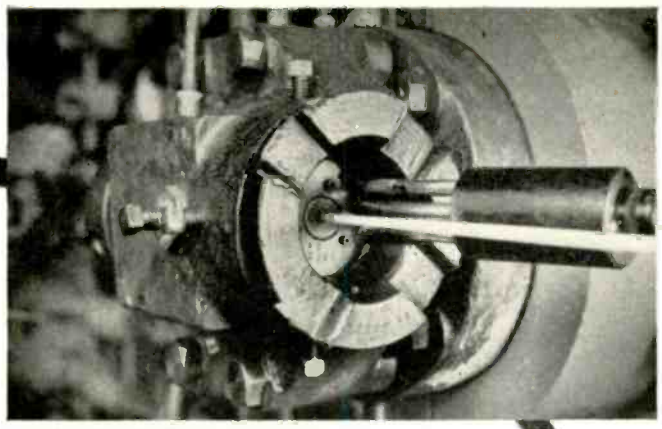
Metal cones before cleaning (left) and after blast-cleaning

the shot. As the main spider rotates the seven individual tables in and out of the blasting zone, the tables themselves rotate so that all areas of the cones are reached by the shot.

The outsides of the cones are cleaned on one pass through the machine. The operator then inverts the cones and puts them through again for cleaning the insides. After cleaning, the cone is ready for a new coat of vitreous enamel and final processing.

Crimping and Stitching Inner Leads of Coils

TO MINIMIZE breaking of leads for inner windings of multilayer coils when using wire gages that are very small, a technique has been developed for crimping separate leads so that they can be stored entirely inside the coils during winding and pulled out later. This eliminates the conventional procedure of sticking the leads down with adhesive tape and wrapping them in such a way that they could

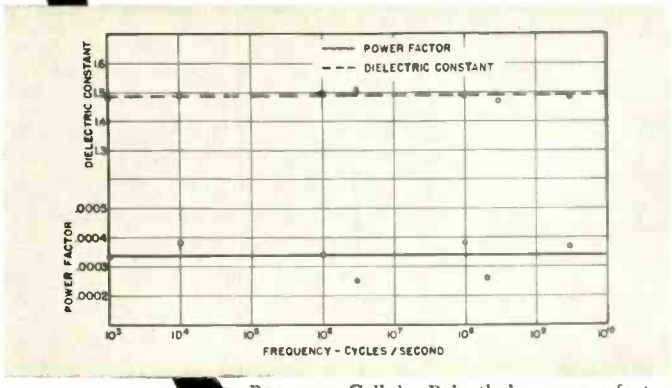


Leaving the die, BAKELITE Ce lular Polyethylene expands to twice its volume as it is extruded on wire.

DOWN COME INSULATION COSTS WITH BAKELITE CELLULAR POLYETHYLENE

TRADE-MARK

Made of natural polyethylene mixed with a blowing agent that yields an inert gas when processed, this new material can be expanded to twice its volume.



BAKELITE Cellular Polyethylene power factor and dielectric constant vs. frequency.

Television lead-in wire with core of BAKELITE Cellular Polyethylene. This construction guards against moisture penetration and provides superior low-loss qualities.

HERE ARE SOME OF THE ADVANTAGES IT OFFERS:

More volume, less weight. As it is being extruded on wire, BAKELITE Cellular Polyethylene expands as much as 100 per cent, bringing lower pound volume costs. Its specific gravity can be as much as 50 per cent less than that of solid polyethylene, which is 0.92.

Lower dielectric constant. The dielectric constant of expanded polyethylene is 1.48. Solid polyethylene has a dielectric constant of 2.3.

Moisture resistance. Structurally, BAKELITE Cellular Polyethylene consists of individual hollow cells separated by walls of polyethylene. Its moisture absorption therefore is of the same low order as that of polyethylene.

Service properties. BAKELITE Cellular Polyethylene has the same chemical resistance as solid polyethylene, and withstands sea water, most acids, alkalies, and oxidizing agents. Varying degrees of expansion are possible.

Write Dept. XZ-79 for copy of KABELITEMS No. 70 "BAKELITE Cellular Polyethylene."

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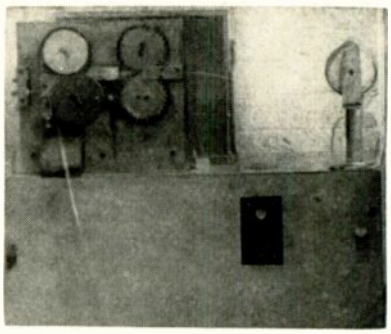
be pulled out after the coil had been parted off and removed from the mandrel.

One machine developed for this problem produces a continuous length of crimped tinned copper stranded wire. The wire is run between two spaced gears having specially shaped teeth for crimping the wire. After passing through these gears the angle in the zigzag wire is approximately 90 degrees.



Machine for crimping stranded copper lead wire. Wire comes from spool at right, passes first between steel forming gears, then through rubber rollers at left

The partially formed wire then runs through a spiral channel that rotates at 90 degrees for feeding between two rubber-faced rollers. These rotate at a slower speed than the forming gears and thereby serve to close up the pitch to approximately $\frac{1}{8}$ inch. At the output of the rollers is a spring-loaded brush that retards the crimped wire, fully closing the pitch until almost parallel.

The crimped wire runs directly into the next machine, where the wire is stapled to Kraft tissue paper or other sheet insulation used between windings of a transformer. This interleaving paper is used in wide strips on multiple winding machines that produce a stick of half a dozen or more coils on a single mandrel simultaneously, for cutting into separate coils.

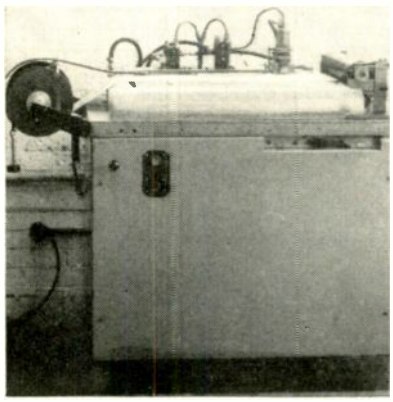
The stitching machine staples the crimped wire to the interleaving paper automatically, with the staples spaced the required distance, then guillotines the paper off in lengths corresponding to the number of coils being wound.

For a twelve-coil winding machine, the guillotine is operated by a solenoid through a snap-action switch actuated by a gear train

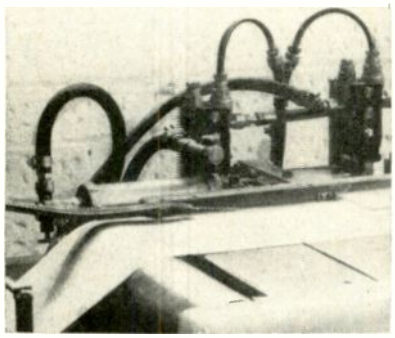
operating at a reduction of 12 to 1 from the main paper feed drive. The paper is thus severed every twelve stitches.

The main drive is a large double-acting air cylinder. This is linked to a reciprocating slide which in turn is linked to an arm on the body of a one-way clutch at one end of the input feed roller. This first feed roller drives the bottom roller at the output end of the machine through a bicycle-type chain. A rubber-covered idling roller directly above the output roller is sprung down to maintain constant drive. The drive mechanism is identical with that used for paper feed in power printing presses.

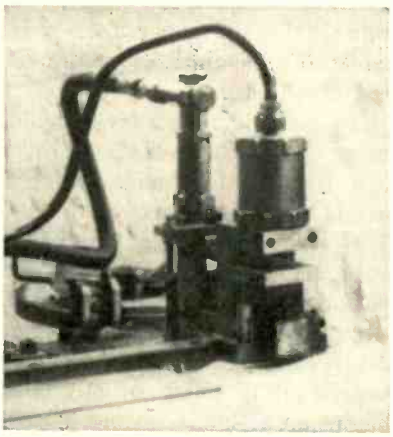
The entire sequence of stitching



Contact stitching machine. Interleaving paper is pulled from large spool at left. Crimped lead wire comes through U channel over this spool, directly from wire crimping machine off to left. Copper ribbon for staples feeds from horizontal spool at rear. Staples made from the ribbon are driven through crimped wire and paper by highest air cylinder. Interleaving paper is chopped to correct lengths for multiple coil winding machine by guillotine blade inside horizontal drum at right end of machine



Input end of contact stitching machine, showing horizontal air cylinder that serves as main drive. U channel guides crimped lead wire into position over paper



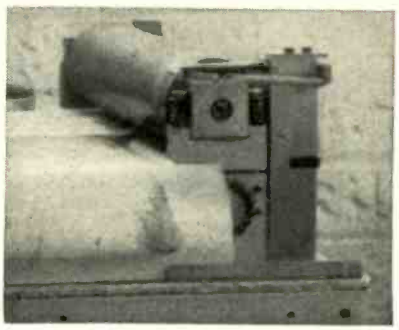
Air-operated progression-type press used for forming staples from half-inch copper ribbon and driving them through crimped leads and paper

and cutting is controlled by a roller air valve which is actuated by a cam on the main feed roller drive. The spacing of the staples is thus controlled directly by the circular movement of the rollers.

The machine produces its own staples for stitching, from a coil of 0.003-inch copper ½ inch wide. A three-stage progression-type press tool, operated by an air cylinder, is used to produce the required notch, bend, crop and clench operations. The sheet copper feeds in at right angles to the paper feed. The last stage clenches the staple in position over a curling die, in exactly the correct position for stapling the crimped wire to the interleaving paper.

Example of Use

For a twelve-coil winding machine, a piece of interleaving paper having the crimped wire stapled at twelve points is attached to the mandrel of the winding machine. The operator then takes each of the

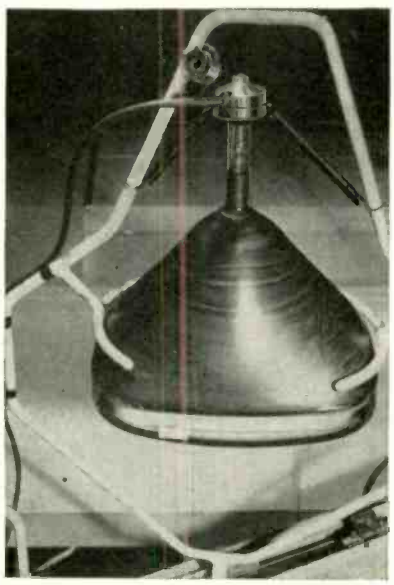


Closeup of output end of machine, showing horizontal drum housing for guillotine blade and rubber idling roller. Chain drive for output drive roller can just be seen below

enameled copper winding wires in turn, cleans its end and solders it to a copper staple. When all twelve wires have been anchored in this manner to the crimped leads, the remainder of the paper is wrapped over the soldering for insulation purposes. Winding of the coils twelve at a time then proceeds normally.

After the coils have been wound, they are parted off conventionally. This serves to cut the crimped lead wires apart also. It is then a comparatively simple matter to locate the cut end of a crimped wire and withdraw as much of it as desired from the interleaving paper. This gives a rugged and flexible inner termination for the coil.

Wiring crimping and stitching machines involved in this technique were developed by the engineering department of E. K. Cole Ltd., Southend-on-Sea, England under the direction of Frank Allen, for use in the production of television components.



Socket Holders for Tube Aging Conveyor

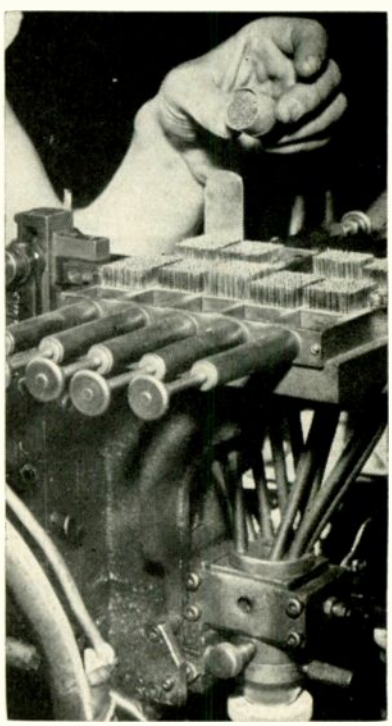
ELECTRICAL characteristics of television picture tubes are stabilized by putting them through an aging cycle on an electrified over head chain conveyor in the GE plant at Electronics Park, Syracuse, N. Y. A trolley system using a series of bus bars and collector trolleys supplies

the required voltages to the tubes while in motion.

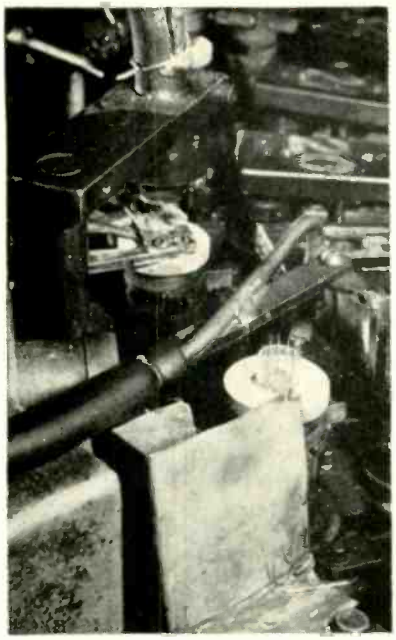
Two coil springs support the molded plastic receptacle containing the picture tube socket, to simplify application and removal of the socket. For the occasional tubes that require a different socket, an adapter is attached to the socket housing with a small metal chain so that it is always at hand. The molded housing is deep enough and wide enough to admit the outboard resistors on the adapter, so as to protect the operator from shock.

Tube Stem Machine

WIRE leads for miniature tubes are dropped nine at a time into position for being fused into glass stems, on an automatic stem machine used in the Bloomfield, N. J. tube plant of Tung-Sol Electric Inc. The wires come in round boxes each holding approximately 300 pieces. The machine has nine loading areas for wire, each having a spring-loaded side that keeps the pins upright as they are used. When the supply runs low, the operator reloads by pulling back the retractable side and inverting a box of pins over the



Pin-loading section of automatic stem machine. Operator holds box of pins preparatory to replenishing supply on machine. Coil springs, below, guide pins down to moving heads of machine



Photoelectric setup for detecting absence of glass sleeve around pins. Light source and phototube are both at left, with reflecting mirror just behind glass stem containing leads. Air-blast pipe can be seen just back of stem on mold

resulting space. Each loading area holds about 900 pins.

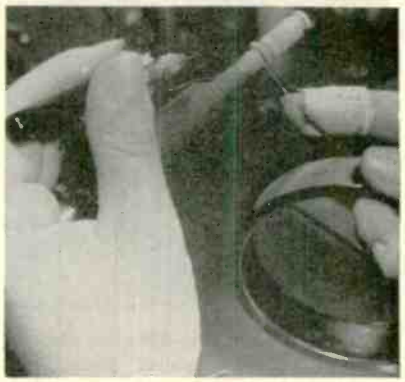
A center slide moves back and forth to pick one pin out of each of the nine loading areas and move it over a drop hole. The pins then drop down the nine flexible spring coils to a head that drops them into position in a stem mold. A glass stem is dropped around the leads at the next stop of the mold. A photoelectric system at the next position inspects for the presence of the glass; if absent or broken, the photoelectric control actuates the valve of a powerful air-blast line to blow out all the leads so they don't fuse to the mold. At later positions, flares will soften the glass and another mold will come down over the wires to form the stem.

Stretching Device for Hand-Wound Grids

GRIDS for Amperex type 4X150A beam tetrodes are precisely wound by hand with gold-plated wire on a fixture that permits stretching after winding. After tying a starting knot in the wire, the operator runs it through marked starting teeth, then loops the wire back and forth in adjacent teeth of the winding tool until all teeth have been filled. A needle-shaped prod

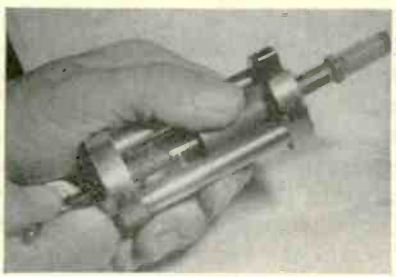
helps to guide the wire into the teeth at the lower bends. A holding fixture clamped to the bench has a cog detent that holds the mandrel in a given position yet permits easy rotation for convenience in winding.

After anchoring the end of the winding with a few loops around the mandrel, the operator transfers



Method of winding parallel-wire grid on mandrel having gear teeth as winding guides. Holding fixture of mandrel is fastened to bench

Using stretching tool on completed grid. End bands and center ring are welded to grid wires before tension is released. Completed grids are placed on plastic studs on plastic sheets in foreground. Grids in background, on wood trays, have been completed but not yet removed from mandrels



Tool used for stretching grid wires

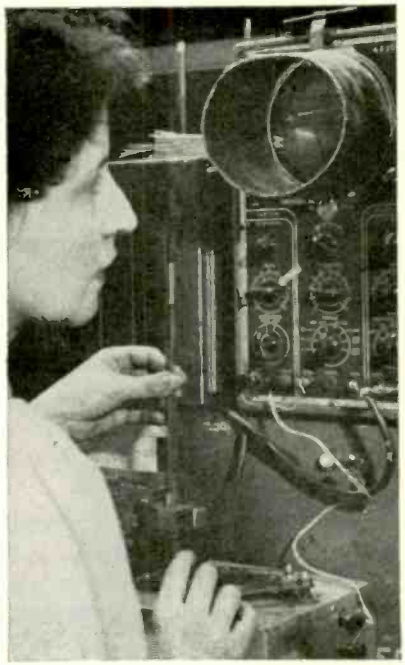
the mandrel to a tool resembling a gear puller. Here a few turns of the threaded shaft of the tool serve to stretch the grid wires about ⅛ inch. This brings each wire deep down into the V of its slot to insure perfect alignment of the wires.

Alignment Checks Quality of Printed I-F Parts

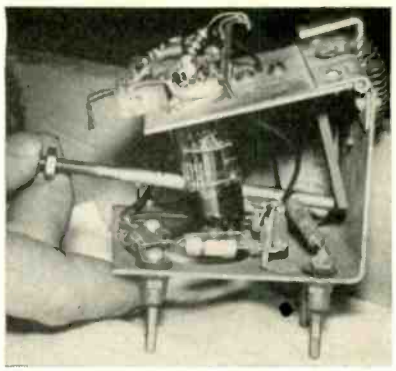
FINAL INSPECTION and rough alignment of etched i-f components is combined in one position on the production line in one printed-circuits parts plant. This gives a final check for shorts or opens and at the same time brings the settings of the two tuning disks very nearly to their correct final positions for use in video i-f amplifiers of television receivers.

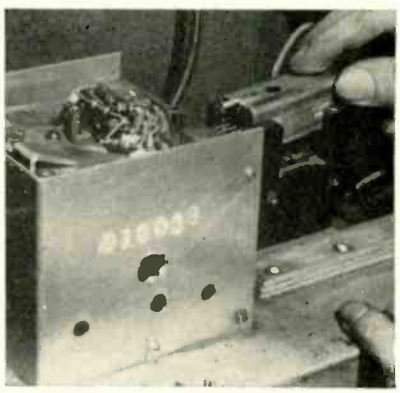
The operator places the transformer, coil or trap in the positioning grooves of a plastic holding fixture, then operates a lever. This lever moves the sliding fixture into the test position and at the same time pushes a hinged chassis with contact blades over the leads of the component.

A rod mounted on the slide and projecting ahead of it pushes against a right-angle stud coming down from the hinged chassis, thereby moving the entire chassis downward to make contact with the



Setup for rough adjustment of printed i-f transformer


Method of inserting component in sliding test fixture


Plug-in preamplifier with hinged upper plate serving as chassis, showing how rod on slide pushes chassis downward to bring contacts (upper left) against leads of component

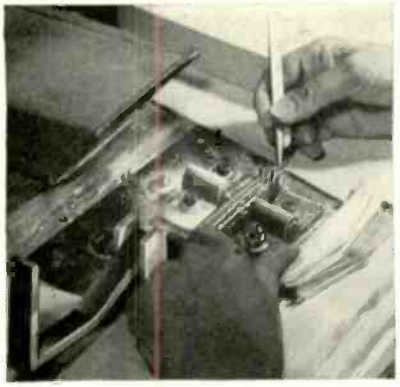
leads of the component.

The actual alignment is done conventionally by using a model WR-59B RCA Television Sweep Generator as the signal source and a standard RCA oscilloscope as indicator. The operator adjusts the two flat metal tuning disks until the trace on the screen coincides with a curve drawn there with black crayon.

The test fixture uses two 6BC6 tubes with a crystal diode as a two-stage preamplifier for the component under test. The preamplifier unit has plug-in terminals underneath, so that it can be changed quickly for testing a different type of component.

Filament Bending Jig

A SIMPLE hand-operated jig bends three coated filaments at a time to the correct contours for use in type 5U4G rectifier tubes, in Tung-Sol's Bloomfield, N. J. plant. The heavy ribbon-shaped filaments for direct-emission use are coated on both flat



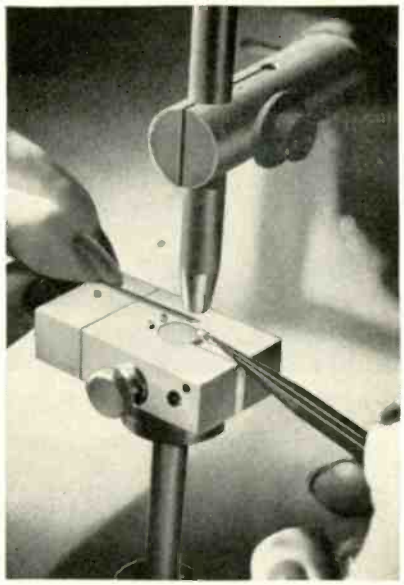
Loading filaments in bending tool

Pushing down lever to produce bending. This brings up side wings that perform the actual bending. After bending, filaments are removed with tweezers and placed in box at rear. Air duct is at upper left

sides and are slightly concave. The operator places three filaments in the tool with tweezers, concave sides down, then brings up a pivoted level and pushes its end down over the filaments. Further pressure pushes down a retractable anvil and brings up wings on each side to produce the desired U-shaped bends. An air duct pulls out loose particles of coating resulting from this bending operation.

Welding Slider Contacts

A SPECIAL SPOT-WELDING machine at Helipot Corp., South Pasadena, California, is used to weld the precious metal slider contact of a precision potentiometer to its contact spring. The contact is registered in a recess in the fixture. The



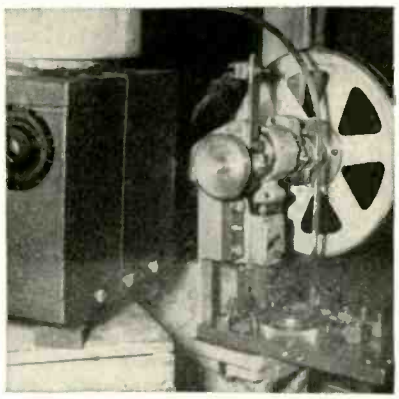
Contact-welding jig

spring flat is registered on the three studs with the rear stud through a hole in the spring flat. The weld is accomplished with a single shot.

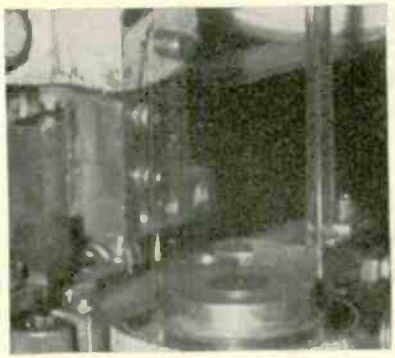
Deburring Miniature Feed-Through Terminals

MASS production of over four million pieces of tubing to dimensions of 0.045 ± 0.002 od by 0.032 ± 0.001 id by 0.265 ± 0.005 inch long involves the design of special tooling to perform the critical deburring operation in the Modesto, Calif. plant of Boudreau Machine Co. The tiny lengths of tubing are used in feed-through terminals made by Bennett Products Co., Palo Alto, Calif. for electronic equipment.

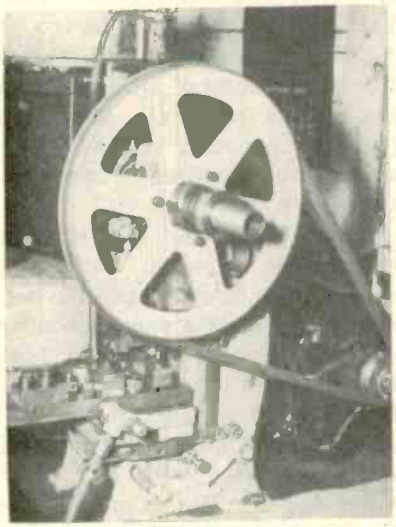
After the tubes are cut to length they are loaded into a Syntron vibratory elevator. This automati-



Deburring punch press, with vibratory elevator at left. Lengths of tubing slide down curved glass tubing from elevator to turntable on press



Closeup of press turntable



Side view of press

cally feeds the parts through a glass tube to the turntable of a specially designed one-ton punch press.

The tubes are literally washed into position in the turntable where they are seated vertically. A tamping mechanism thoroughly seats the part into the drilled hole of the turntable before it is turned for the piercing operation. The 0.032 ± 0.001-inch piercing rod performs its operation, and the part is removed to the next ejecting station. The mechanical ejection is supplemented by a vacuum air pump to insure that all parts are cleared quickly. The press is geared to pierce 320 parts per minute.

Transparent Containers Protect Camera Tubes

SPECIAL TAMPER-PROOF containers are used by RCA Victor Division for image orthicon tubes intended for replacement use. A red seal which encircles each transparent plastic container must be broken

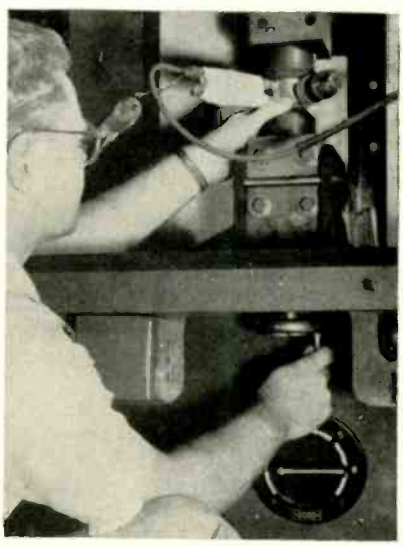
before the tube can be removed. This gives visible assurance that the tube has been untouched, and discourages needless handling.

Resistance Brazing of Magnetron Cavities

PRECISE permanent assembly of a magnetron cavity to its pole pieces and tuning mechanism is achieved by using carbon resistance brazing in the Hicksville, Long Island plant of Amperex Electronic Corp. Vacuum-tight copper to copper seals are achieved, using washer-shaped preforms of silver solder as the brazing material. Mechanical pressure applied during the brazing assures the required precise positioning of the parts.

Source of current for resistance brazing is a power transformer operating at 60 cycles and having a single-turn 8,000-ampere secondary winding of copper straps and sheets, made especially for this purpose by Ecco High-Frequency Corp. This single-turn winding terminates in electrodes faced with carbon, the lower one of which is movable vertically to permit insertion and removal of parts to be brazed.

A glass-windowed enclosure drops down over the electrodes after loading, to permit providing an atmosphere of nitrogen that



Turning hand wheel to move up lower brazing electrode after magnetron parts have been placed in position. Rubber hose feeds nitrogen into cavity of magnetron. Heat-adjusting tap switch is behind right hand of operator

Resistance brazing setup for magnetrons

prevents oxidation during brazing. The nitrogen gas is run through an alcohol bath to remove moisture before it enters the chamber. The gas is fed into the magnetron cavity as well, by means of a separate hose connection.

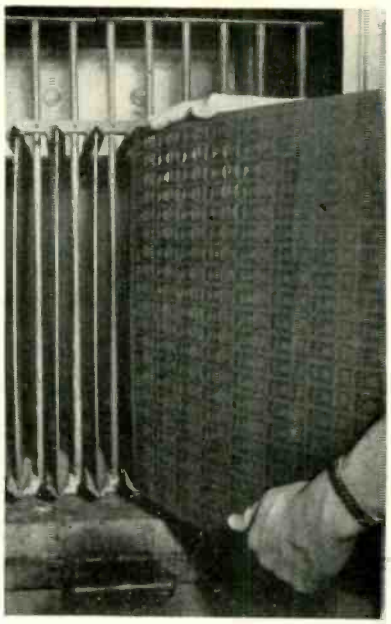
The movable lower electrode is supported by a vertical feed screw, with a hand wheel underneath for raising and lowering the electrode. After the component parts have been placed in position the hand wheel is cranked up and brazing current is applied for approximately 2½ minutes through a timer. Either pushbuttons or a foot-operated switch may be used to initiate the brazing cycle.

A tap switch permits adjusting brazing heat by changing primary turns on the transformer.

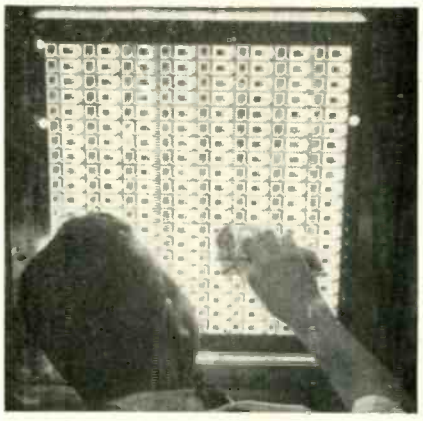
Oven Racks Support Etched Coil Sheets

WELDED angle-iron racks support copper-clad plastic sheets, each containing over 150 identical photo-etched i-f transformers, in a special bake oven. The drying operation follows acid etching of unexposed areas and subsequent rinsing in a large parts plant making printed-circuit components.

The angle irons are welded to horizontal supports. The lower troughs are slanted sufficiently to form V troughs that drain off water. With this arrangement, only the corners of the plastic sheet are



Inserting sheet in drying rack



Cleaning glass negative in printing frame before exposing copper-clad plastic sheets coated with photographic emulsion

in contact with the drying rack.

The horizontal supports can be raised or lowered easily to accomodate different sizes of sheets, by loosening and tightening set screws that go through the supports and bear against vertical rods passing through drilled holes in supports.

The etched components, used for six different types of 40-mc i-f transformers, coils and traps, are produced in quantity from corresponding multiple photographic negatives. The technique eliminates the need for copper wire and for wire-winding operations, since the inductances are provided by flat rectangular windings etched out of the copper covering on the plastic sheets. Circuit changes involve only the making of a new negative.

NEW PRODUCTS

Edited by WILLIAM P. O'BRIEN

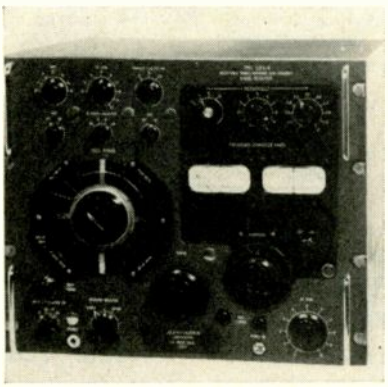
58 New Products and 41 Manufacturers' Bulletins Are Reviewed . . . Control, Testing and Measuring Equipment Described and Illustrated . . . Recent Tubes and Components Are Covered

OTHER DEPARTMENTS featured in this issue:

PRECISION RECEIVER

insures communication through jamming

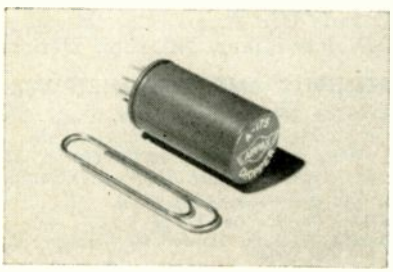
J. L. A. McLAUGHLIN CORP., P. O. Box 529, La Jolla, Calif. Type DDX-R radio receiver is a single-control, dual-diversity, selectable single-sideband, exalted carrier device designed for long-distance reception of double or single-sideband signals. In addition to protection from fading and jamming, the receiver design provides for rapid tuning, high frequency stability and readability in frequency to within 0.5 kc. A feature of the receiver is the frequency computer panel that makes possible accurate tuning, based upon a 1-mc crystal oscillator followed by a multi-



vibrator and harmonic selectors. Output from the dual-receiver vfo is mixed with computer output to show, on a meter, deviation from dial indication. Automatic frequency control is available for unjammed signals. By avoiding the complication of usual tracking procedures, r-f sensitivity has been brought to 18 dbm output with 1 microvolt input. Tuning range is 10 kc to 31 mc with diversity possible from 4 mc to 31 mc. Single-sideband width can be furnished for 3,500 or 6,000 cycles. Exalted carrier is 0 to plus 30 db. Spurious frequency response and noise are both down 60 db.

TINY CHOPPER

is break-before-make type

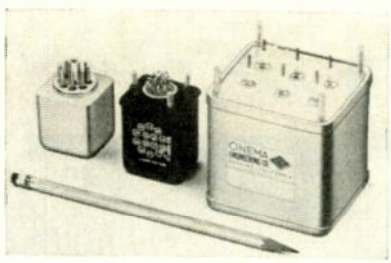


AIRPAX PRODUCTS CO., Middle River, Baltimore 20, Md., has introduced a tiny 60-cycle chopper that is break-before-make, spdt, and withstands 30-g vibration. It will handle signal levels from 100 v down to the μv region at 1 ma. It can be operated at any ambient from −65 C to 100 C, or at any frequency from 30 to 150 cycles, and is hermetically sealed with a 7-pin miniature base. At 6.3 v, 60 cycles the phase angle is 20 deg; the dwell time, 167 deg. Noise level is extremely low. In direct noise measurements with a 200-kc bandwidth amplifier the noise at a megohm impedance was about 50 μv rms, or about 150 μv peak to peak. Life tests on recording equipment show life well in excess of 1,000 hours.

RESISTIVE NETWORKS

are hermetically sealed

CINEMA ENGINEERING CO., Division Aerovox Corp., 1100 Chestnut St., Burbank, Calif., has announced its hermetically sealed resistive networks, embedded in epoxy plastic, and offered in a large number of terminal types, including plug-in and low and high-voltage insulator types. They are available in resist-



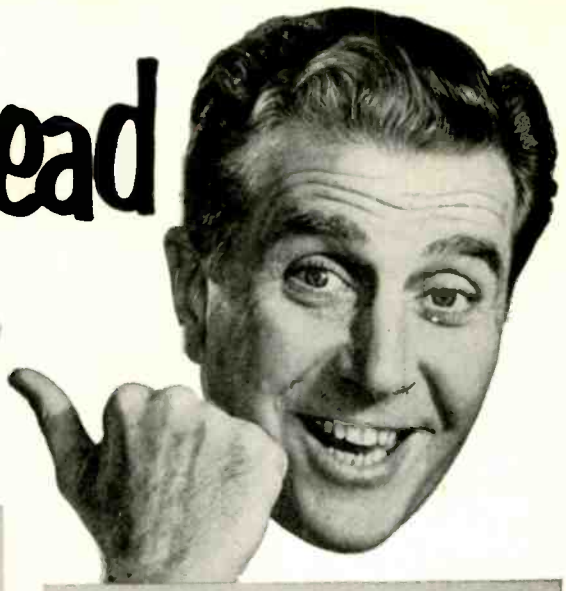
ances of 0.1 ohm to 15 megohms. They are produced with accuracies of 1 percent to 1/40th of 1 percent, and are built to meet and surpass many applicable MIL specifications.

VOLTAGE STANDARD

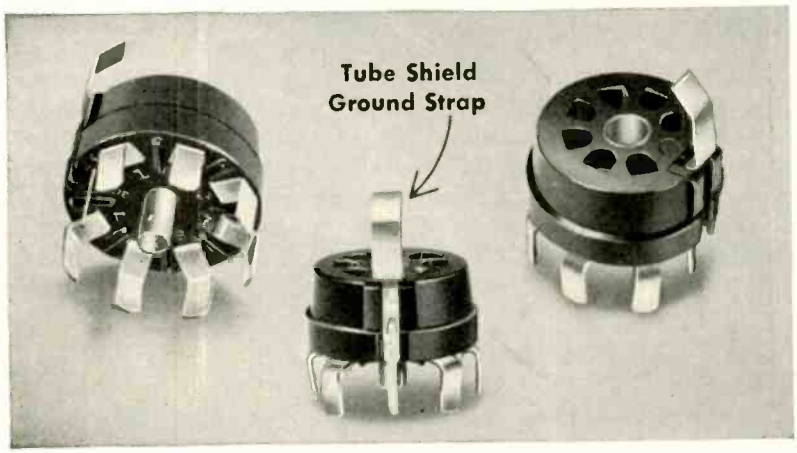
is also a power source

ELECTRONIC MEASUREMENTS CO., INC., Lewis St. and Maple Ave.,

Big Savings Ahead



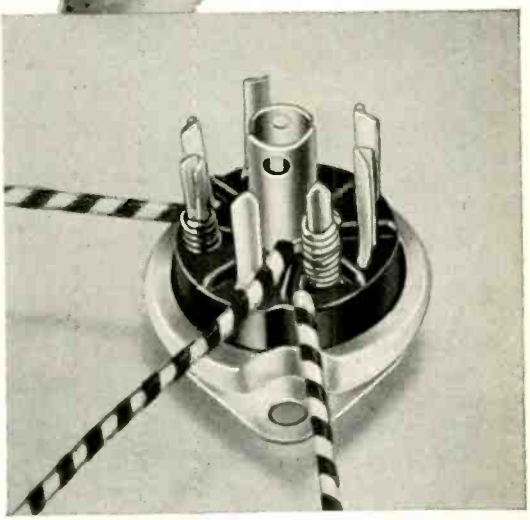
2 New SYLVANIA SOCKETS save Assembly Time... Cut Costs ...Improve Performance!



1. New Sylvania 7-pin Miniature Printed-circuit Sockets. Contacts and center shield are shaped so that sockets can be stacked one upon another for automatic feeding and assembly. Small slots are used on the circuit board to receive the contacts, resulting in stronger chassis construction. Only one socket assembly need be stocked since terminals can be interconnected by printing the circuit on the chassis board rather than using a metallic connector on the socket itself.

Insulator is molded of general-purpose or low-loss phenolic. Contacts are brass or phosphor bronze, plated to suit your specification. Supplied with or without center shield. Now available in 7-pin construction with 9-pin miniature and other types to follow. Tube Shield Ground Strap can also be furnished.

See the full story of Sylvania's Fabricating Services in Sweet's Catalog — Product Design File. Look for 1b/Sy



2. New Sylvania Solderless-type Sockets for wire-wrapped connections are now being made in all 7 and 9-pin miniature sizes. Contacts are shaped to provide reliable connections with the use of present wire-wrapping tools.

***For full information** concerning these or other Sylvania parts, or special quality components engineered to your own specifications, write to Dept. 4A-1608, Sylvania today.*

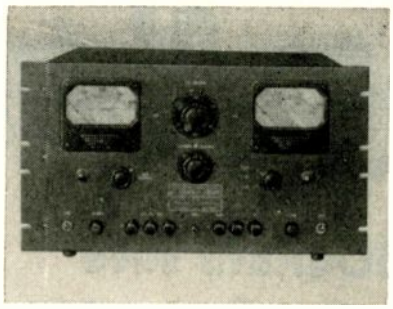
SYLVANIA

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

In Canada: Sylvania Electric (Canada) Ltd., University Tower Building, St. Catherine Street, Montreal, P. Q.

LIGHTING · RADIO · ELECTRONICS · TELEVISION

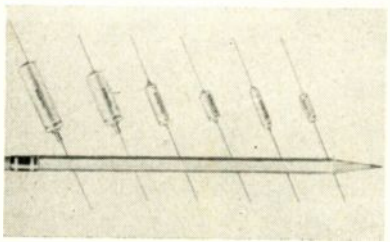
Eatontown, N. J. The new Regatron series provides, in one unit, a variable d-c voltage standard, a high powered super-regulated power supply, and a research voltage source with small signal modulation, in single chassis, standard relay-rack or table models. The d-c voltage is 0 to 600 v vernier calibrated on a 10-turn precision



potentiometer to 0.25 percent (or better where required). Current ratings are 0 to 600 ma or 0 to 1,000 ma. Regulation is 0.05 percent (or better where required). Usefulness of low voltages for transistor work is increased by a 0 to 3-v electrical vernier, and an injection circuit for small signal modulation of the output.

TINY ELECTROLYTICS

operate from —20 C to +65 C

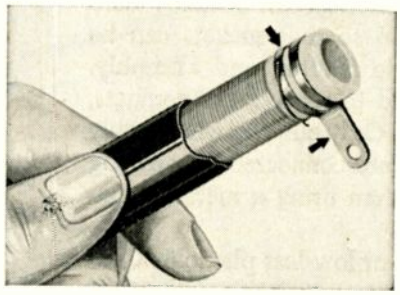


ILLINOIS CONDENSER CO., 1616 N. Throop St., Chicago 22, Ill., has added a new line of miniature and subminiature electrolytic capacitors, designated as the types MT and SMT. These low-cost, low-current-drain capacitors are especially designed for use with transistors, printed circuit applications and hobby models where small size and light weight components are required. They are all-aluminum constructed and hermetically sealed with connecting leads of tinned brass for extra strength. Operating temperature range is —20 C to +65 C. Capacitance range is 0.5 to 100 μf and from 3 to 75 working volts d-c.

WELDED RESISTORS

use no soldering or brazing

OHMITE MFG. CO., Skokie, Ill. The all-welded terminal construction has now been extended to cover the company's entire line of wire-wound resistors. The resistance wire is welded to the terminal band; and the terminal band itself is held permanently around the core by means of welding. No soldering, brazing or mechanical fastenings are used. Fusion of the resistance wire and terminal lug provides a



stable electrical connection which is important in eliminating noise in audio circuits or instability in other highly sensitive circuits. The terminal bands are made of a special, high-strength alloy whose coefficient of expansion is properly related to that of the resistance wire, ceramic core and vitreous enamel coating. This keeps the terminal firmly anchored and prevents cracking of the core and enamel coating. The resistance wire is welded flush to the terminal band, so that the connection and terminal are well covered by the vitreous enamel coating.

VTVM

covers from 10 cycles to 4 megacycles

HEWLETT-PACKARD CO., 395 Page Mill Road, Palo Alto, Calif. Model 400D vtvm covers all frequencies from 10 cps to 4 mc, measures voltages from 0.1 mv to 300 v, and is accurate to within 2.0 percent up to 1 mc. Input impedance is 10 megohms, so circuits under test are not loaded. The instrument has a new amplifier circuit providing approximately 56 db of feedback in midrange for high stability and freedom from calibration changes caused by external conditions. Ranges are selected on a front panel switch which changes sensitivity in accurate 10 db steps. This, plus calibration of the 4-in. meter directly in decibels, means direct readings are available without calculation or conversion between —72 dbm and +53 dbm.

CAVITY OSCILLATOR

uses uhf planar triode tube

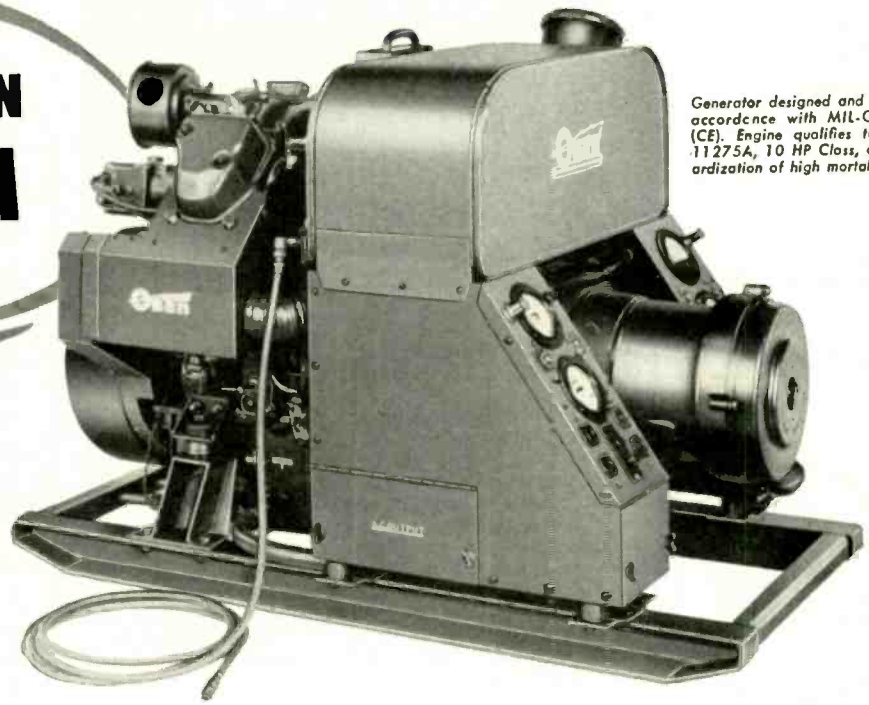
AMERAC, INC., 116 Topsfield Road, Wenham, Mass., announces the No. 192A rocket tube cavity oscillator

First 5KW engine-generator set built to military standard parts specifications!

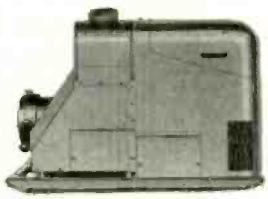
the new ONAN

5VB-4M

5KW, A.C.



Generator designed and tested in accordance with MIL-G-10228 (CE). Engine qualifies to MIL-E-11275A, 10 HP Class, on standardization of high mortality parts.



WINTERIZED MODEL

Equipped with engine heater and rugged sheet-metal housing to protect generating set against wind, rain and snow. Delivers full rated output at ambient temperatures from +125° to —65° F. Weight: 500 lbs.

Built and tested for military service!

The Onan Model 5VB-4M meets all specified test requirements for Military Type II, Class A engine-generator sets. It's built to withstand braking and dropping shocks, to resist high humidity, to start at extreme temperatures and to operate at all angles up to 15° from horizontal.

After 1,000 hours of operation with full rated load, and under test conditions of 107° F. and 5,000-foot altitude, *the Model 5VB delivers more than 150% of rated output at rated voltage, frequency and power factor.*

The skid-mounted set has an actual dry weight of 445 pounds and requires 25% less space than many conventional units. Design of the suction air-cooling system allows the generator set to be "buried" within a large piece of equipment *in space only slightly larger than actual generator-set dimensions.*

Prime mover on the 5VB is a new Onan high-compression, overhead-valve, two-cylinder, V-type gasoline engine delivering 19 H.P. (with accessories) at 3600 R.P.M. It is equipped for manual starting using integral, self-winding rope starter. Electric starting can also be provided.

Designed specially for field service as a source of power for communications, lighting and operating motor-driven equipment, the Onan 5VB combines the portability, rugged construction and dependable performance demanded in military service, *with the all-important advantage of being built with military standard parts.*

GENERATOR DESIGNED TO MIL-G-10228 (CE)

Specially designed direct-connected generator supplies multiple voltages (1 and 3-Phase) with voltage regulation within a total band width of 4%. A single rotary switch selects the required voltage and phase. Rated at 5KW with 60-cycle output, this model is also available with D.C. output up to 7½ KW in standard voltages.

Splash-proof generator is unusually accessible for inspection and adjustment. Equipped with all essential instruments conveniently located and protected from the weather.

OTHER ONAN GENERATING EQUIPMENT

Onan designs and builds engine and motor-generator sets including 400-cycle models for specialized electronic applications in military aircraft, communications, and commercial use. Onan Electric Plants in regular production range from 400 to 55,000 watts in all standard voltages . . . gas, gasoline and Diesel-driven models.

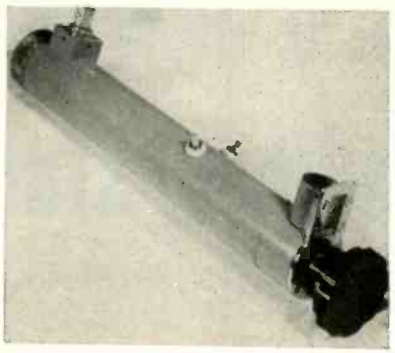
Write for complete specifications

(The Onan VB engine is also available separately as a prime mover in the military Class II, 10 H.P. basic size.)

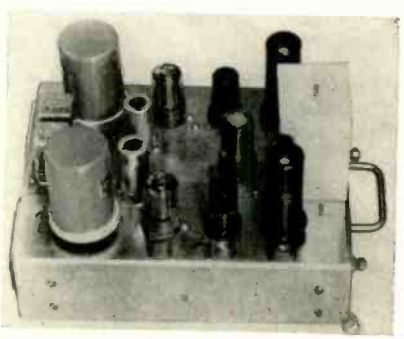
Onan ELECTRIC PLANTS

D. W. ONAN & SONS INC.

7038 UNIVERSITY AVENUE SOUTHEAST • MINNEAPOLIS 14, MINNESOTA



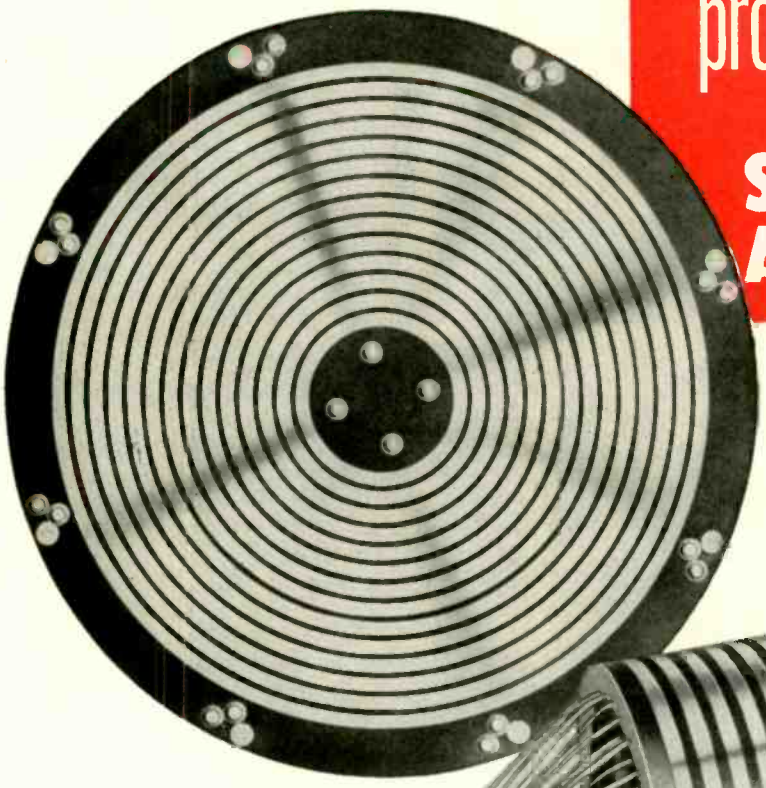
for microwave signal generation. It is a small-size, coaxial line cavity oscillator, employing the Sylvania uhf planar triode tube, which provides a highly stable r-f signal source in both a c-w and a pulse model. The unit features a single knob control and utilizes fixed feedback. It is 8 in. long × 1⅞ in. in diameter and weighs 1 lb, 3 oz (including tuning mechanism), or may be supplied as a cavity alone—4 in. long × 1⅞ in. weighing only ¾ lb. It is available at frequencies from 1,000 to 4,000 mc with a tuning range of 400 mc. Pulse operation is 2,000 peak volts with a peak pulse power of 200 w. Its c-w operation is 175 v with an average output power of 100 mw. Tuning accuracy is ± 0.1 percent with regulated power supply. Output connection is BNC or type N jack. It has a Root counter for calibration. The cavity comes complete with tube and can be furnished with a regulated supply and frequency calibration curves.



AMPLIFIER
is chopper-stabilized

MID-CENTURY INSTRUMATIC CORP., 611 Broadway, New York 12, N. Y. The MC-500-A is a dual channel amplifier mounted on one chassis with each amplifier individually chopper-stabilized. The chassis

Now available the revolutionary ELECTRO TEC process* for your LARGE SLIP RING ASSEMBLIES



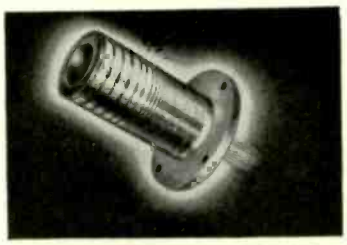
featuring

- LOWER COST
- CLOSER TOLERANCES
- ONE-PIECE CONSTRUCTION
- JEWEL-LIKE FINISH
- UNIFORM RING HARDNESS
- REDUCED WEIGHT

Now a Complete Service in all sizes of 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 area 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 5/8" O.D. with wall thickness less than 1/4".

*PATENTS PENDING

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 24" 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—75-90 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.

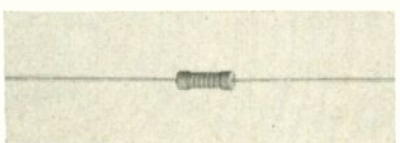
Every user knows the ELECTRO TEC reputation for quality and superiority in miniature and sub-miniature slip ring assemblies.

Our Engineering Department is available for consultation on any of your slip ring problems without obligation.

ELECTRO TEC CORPORATION

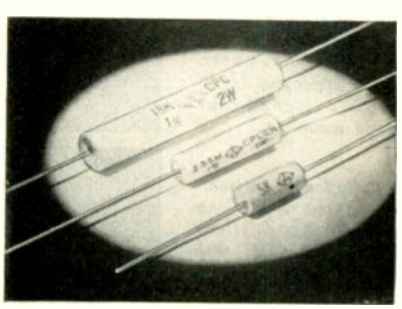
SOUTH HACKENSACK • NEW JERSEY

carries its own filament transformer. Open d-c amplifier gain is 100,000. The a-c chopper amplifier provides an additional gain of 500 to yield a total open-loop gain of 50×10^6. Precision matched 0.1-percent resistors convert the unit into a feedback amplifier with a grid current of less than 75 μμa, a drift of less than 0.2 mv for 8 hours and a bandwidth which is flat to 1,000 cps at full amplitude with less than 1 mv of noise. Phase shift is less than 0.2 percent at 100 cps and 2 percent at 500 cps. Output impedance is less than 0.01 ohm and output voltage range is ± 100 v into a 10,000-ohm load.



FILM RESISTOR
available in 0.5-w ratings

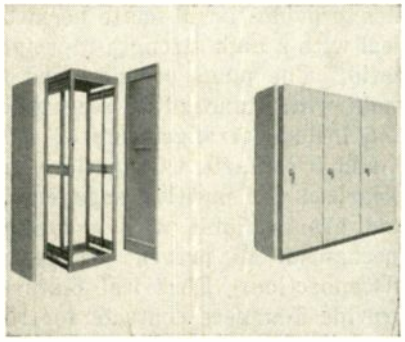
CONTINENTAL CARBON, INC., 13900 Lorain Ave., Cleveland 11, Ohio. A new deposited metal film resistor, measuring 0.160 in. diameter × ⅛ in. long is now available in 0.5-w ratings. First in a series of the Noblette line, it offers excellent stability under high ambient temperatures. A temperature coefficient rating of 0.02 percent per deg C is typical of the characteristics inherent in this resistor. Resistance range is 1 ohm to 3 megohms in tolerances of 1, 2 and 5 percent. Bulletin 287 will be furnished on request.



PRECISION RESISTOR
housed in a ceramic tube

AEROVOX CORP., Hi-Q Division, Olean, N. Y. Type CPC Carbofilm precision resistor is housed in a ceramic tube with metallized

ceramic end-seals for complete and permanent hermetic sealing. There is no capacitance effect between element and casing. The longest leakage path is provided. The insulated resistor can be squeezed in among other components and against metal surfaces without electrical complications. Carbofilm resistors are made to guaranteed tolerance of ±1 percent. They feature excellent stability with regard to temperature and voltage coefficients, ageing and noise, and also withstand extreme humidity and heat. They are available in ½, 1 and 2-w sizes.

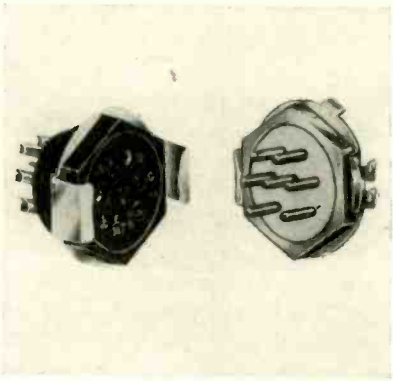


CABINET RACKS
for multiple installations

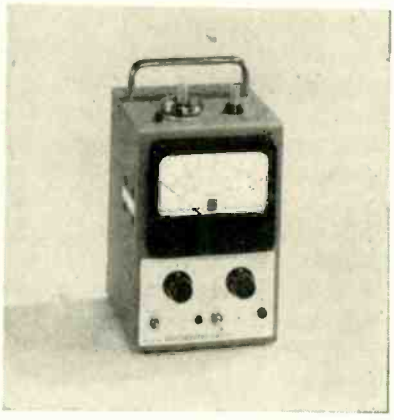
PREMIER METAL PRODUCTS CO., 3160 Webster Ave., Bronx, N. Y. Constructed of heavy-gage steel and welded throughout, these racks have detachable sides, permitting multiple assembly of cabinets in double, triple or larger units by bolting together. Equipped with handle and lock, the front and rear doors are hung on loose jointed hinges that may be hinged for right or left-handed opening by rotating the door 180 deg. Panel mounting angles are ⅜ in. thick, tapped 12/24 on universal spacings, and are adjustable to any position. The racks are 22 in. wide, 18 in. deep, and come in 3 heights—67⅜ in., 76⅛ in. and 83⅛ in.

HERMETIC PLUGS
for miniature connectors

WINCHESTER ELECTRONICS, INC., Glenbrook, Conn. A new design of the series HM hermetic plugs provides contacts fused into a simple one-piece low-expansion glass insu-



lator to allow increased operating voltage for the connectors. The glass insulator is also fused to a special flanged base plate for soldering in a round hole in a metal container or bulkhead. The construction provides an absolute hermetic seal with a high strength-to-weight ratio. The plugs are designed to mate with standard M receptacles and include arrangements of 4, 5, 7 and 9 contacts. Connectors are polarized for positive engagement and are available with a locking mechanism to prevent accidental disconnection. Electrical features provide 5-ampere contacts for No. 20 Awg wire with voltage breakdown between adjacent contacts at sea level, 3,500 v d-c at 60,000 ft altitude, 950 v d-c.



V-T ELECTROMETER
is line-operated d-c vtvm

KEITHLEY INSTRUMENTS, 3868 Carnegie Ave., Cleveland 15, Ohio. Model 210 v-t electrometer is a line-operated d-c vtvm with an extremely high input impedance. Basic specifications include an input greater than 10^{14} ohms, grid current below 10^{-13} ampere, and drift within 10 mv per hour. Five voltage

ranges are provided: zero to 0.8, 2, 8, 20 and 80 v in either polarity. The electrometer has output terminals for driving balanced or unbalanced recorders and recorder amplifiers, oscilloscopes and galvanometers. All the company's electrometer accessories fit the new model. Typical applications of the unit include potential measurements of charged capacitors, v-t electrodes and piezoelectric crystals. Current measurements cover photocell, mass spectrometer and insulation leakage currents.

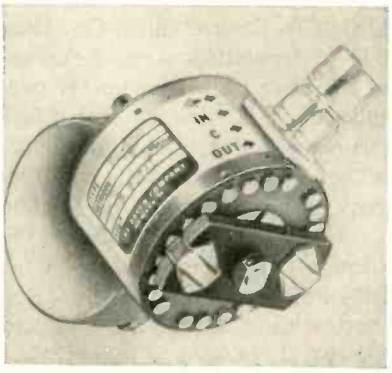
BOLOMETER PREAMP
measures r-f ratios

WEINSCHEL ENGINEERING CO., INC., 10503 Metropolitan Ave., Kensington, Md. Model BA-1 bolometer preamplifier is a linear, low noise instrument for precision measurement of power ratios in the frequency range from 20 to 10,500 mc. Its input noise is below 30 millimicrovolts when operated with a 200-ohm bolometer. Its linearity is better than 0.1 db at 400 and 1,000 cps. It is used to measure r-f ratios from 1 to 30 db with an overall accuracy of 0.1 db. Insertion loss measurements of coaxial or waveguide attenuator pads and measurement of antenna radiation patterns are among the major applications.

VIDEO VOLTMETER
covers 20 cps to 10 mc

MILLIVAC INSTRUMENT CORP., 444 Second St., Schenectady 6, N. Y. Type MV-22B video frequency vtvm has a frequency range from 20 cps

to 10 mc. Sensitivity of the instrument is 70 μv. Its highest range is 1 kv. The excellent, flat freqency response is made possible by a combination of extremely heavy degrees of negative feedback and frequency selective circuitry in the feedback path. The customary but hazardous peaking coils in plate circuits are carefully avoided. The new instrument is expected to expand tv camera and receiver research since it not only covers well the full video range but exceeds it to a sufficient degree to explore the important pulse characteristics of video amplifiers.



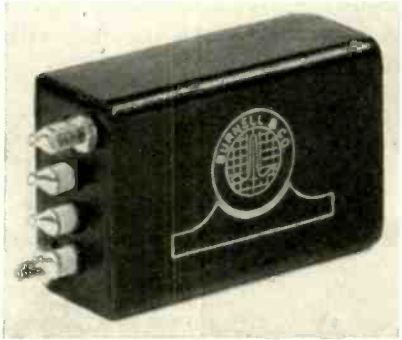
VIDEO ATTENUATORS for wide band use

DAVEN Co., 191 Central Ave., Newark, N. J. The series V-250 video variable attenuators are recommended for use in wide-band equipment where precision and dependability are of prime importance. The V-250's are especially adaptable for tv video circuits where a wide frequency range without change of impedance is of special importance. They may be used with black-and-white or color tv. These units have zero insertion

loss and constant input and output impedance. They have a flat frequency response from 0 to 10 mc. Standard impedance is 75 ohms. Impedance accuracy is ±2.5 percent. These video pads can be obtained in either 10, 20 or 45 steps. Standard lug terminal board or BNC (UG-185/U) connectors are supplied.

RECEIVER-CONVERTER
for the 50 to 200-mc range

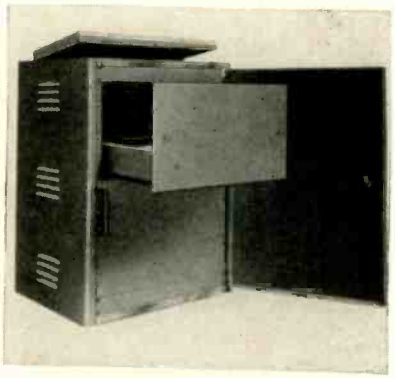
SERVO CORP. OF AMERICA, New Hyde Park, N. Y. The unit illustrated extends the frequency range of a standard h-f receiver into the vhf range of 50 to 200 mc. It has a self-contained power supply and no modification of the receiver is required. The vhf antenna is connected to the converter which in turn is connected to the h-f receiver. Power input is 35 w from nominal 115 v, 50/60 cycles. The small and compact unit weighs only 22 lb.



R-F FILTERS
in various bandwidths

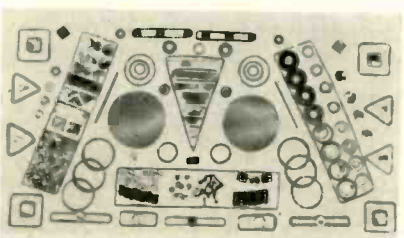
BURNELL & CO., INC., Yonkers, N. Y., announces two additional types of r-f filters now available. Both types employ a combination of crystal and toroidal networks and are designed for operation at standard intermediate frequencies employed

in communications equipment and receivers and can be supplied in various bandwidths. The TX-455-9, for example, provides a 9-kc total passband at 455 kc and the TX-455-SB is a sideband filter. Size of either type is equivalent to an ordinary i-f transformer.



DESK CABINET RACKS
with sliding drawer

PREMIER METAL PRODUCTS CO., 3160 Webster Ave., Bronx, N. Y., has available desk cabinet racks in an 18-in.-deep size which can hold the new sliding drawer. Another improvement is the addition of wall mounting brackets to facilitate mounting the racks on a wall if desired. Available in 10 sizes, the racks are constructed of No. 16-gage cold rolled steel. Panel mounting angles are tapped for 10/32 machine screws on universal spacings. Panels fit into a recess so that the edges are not exposed. Piano-type hinges are used on the top doors which are provided with flush snap catches.



SOLDER PREFORMS
for precision products

ANCHOR METAL CO., 244 Boerum St., Brooklyn 6, N. Y., has designed and manufactured solder preforms so small that they have been put to use in the production of transis-

tors and germanium diodes. Microforms can be made in almost any shape and size—wafers with a diameter of 0.015 in. and thickness of 0.015 in., to spheres of 0.022 in. in diameter. They have been successful as compositions of tin and lead, tin and silver, lead and silver, lead and antimony, fusible alloys, indium and brazing alloys.

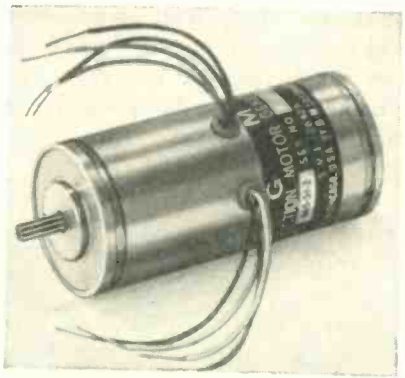
RECORD COMPENSATOR has latest recording curves

PICKERING & Co., Oceanside, L. I., N. Y., has re-engineered its model 132E record compensator to take account of the most recent developments in the recording curves used by the record industry. A new position on the compensator matches the Orthophonic-AES recording curve. The compensator is designed for use between pickup and preamplifier. It requires no power and can be mounted in any position.

METAL NAMEPLATES available in many colors

NORTH SHORE NAMEPLATE CO., Bank of Manhattan Bldg., Bayside, L. I., N. Y., have announced a new type of metal nameplate—Speedy-Cals. They are easily fastened to curved as well as flat surfaces without the need of drilling holes and they permanently adhere to such surfaces as porcelain, glass, Bakelite, wood and metal. Available in many colors, they will not crack, peel, chip or tarnish. Made for nameplates, trademarks, circuit diagrams, terminal designations and many other uses, they are only 0.003 foil and laminated with the

newest and finest transparent bonding material.

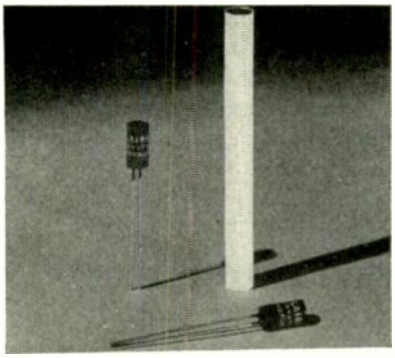


MOTOR GENERATORS
for use in servo controls

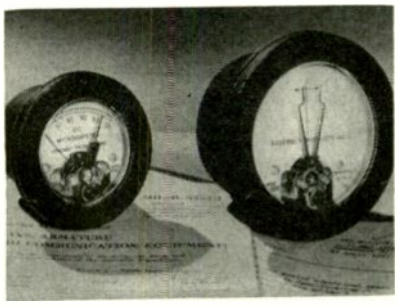
G-M LABORATORIES INC., 4300 North Knox Ave., Chicago 41, Ill., has announced small, lightweight motor generators for use in servo controls. The generator is housed in the same case with the servo motor. Weighing approximately 4 oz, the dual unit measures ⅜ in. in diameter × 5/2 in. long. Both stators are completely embedded in an insulating compound of extreme dielectric strength and very high temperature stability. This material has low mechanical coefficient of expansion and therefore great stability at high ambient temperatures. The motor is a two-phase unit with an input of 26 v per phase at 400 cycles. Power input is 3.75 w per phase. Stall torque is 0.35 oz in. No-load speed is 6,500 rpm. The generator provides an output of 0.32 v per 1,000 rpm.

CRYSTAL PHOTOCELL
is unusually sensitive

CLAIREX CORP., 50 W. 26th St., New York 10, N. Y. Type CL-1 photoconductive cell employs a small cadmium sulphide crystal as the light sensitive element. It has a sensitivity to light flux on the order of one million times the sensitivity of a conventional high vacuum photoemissive cell. The median sensitivity to light intensity is 100 μa at 100 v at 2 foot-candles. It has a very high ratio of light to dark current—on the order of 60 db at 1



foot-candle. It is not a photodiode but conducts substantially the same with both polarities of voltage and thus can be used to modulate an alternating current. At low light levels the output is sufficient to fire a cold-cathode discharge tube and to operate directly meter or electrostatic relays. At high light levels the output is sufficient to operate directly conventional sensitive magnetic relays. Price is $2.50.



METER-RELAYS in two small models

ASSEMBLY PRODUCTS, INC., P. O. Box 191, Chagrin Falls, Ohio. The instruments shown are both indicating meters and relays meeting MIL-R-5757-E and MIL-M-10304 specifications. They are offered in 2½ in. and 3½ in., models 255 and 355. The contact meter-relay is made in all the usual a-c and d-c voltage and current ranges. They have a pair of built-in contacts. The tiny contacts are platinum-iridium and will make and break up to 15,000,000 times before wearing out. They are normally used at 5–25 ma d-c, 75–125 v. The complete movement—coil, pointer assembly, hairsprings, jewels, bracket and magnet—weighs only 0.8 oz compared with 4½ oz for that of a standard contact meter-relay. These contact meter-relays protect com-

puter circuits from voltage overloads, sound or flash warnings when bearings are too hot, give warning and control in radiation measuring equipment and provide aids in many quality control and inspection procedures.

THYRATRON TUBES
for electronic control

AMPEREX ELECTRONIC CORP., 230 Duffy Ave., Hicksville, L. I., N. Y., has announced two standard thyratron tubes, specifically designed for electronic control purposes such as the speed of d-c motors, counting and sorting devices. Designated as types AX-5544 and AX-5545, these tubes are directly interchangeable in every respect with RETMA tubes bearing the same designation. Both are three electrode, Xenon filled thyratrons, with negative control characteristics. The inert gas filling allows reliable operation at maximum ratings over a wide temperature range. Typical applications include: the electronic control of the speed of d-c motors, regulation of current and voltage, counting and assorting devices and electronic switching.

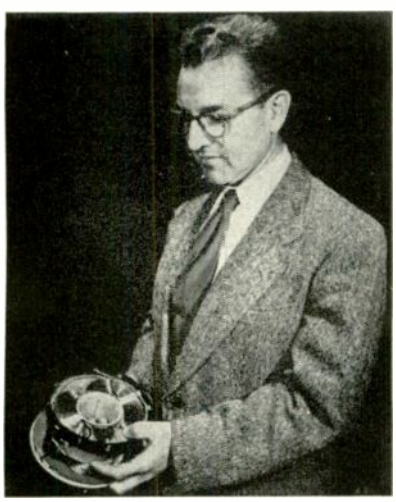
POLYMETER
has consistent stability

SYLVANIA ELECTRIC PRODUCTS INC., 1221 West Third St., Williamsport, Pa. The 302 Polymeter offers a tiny v-t r-f probe, a peak-to-peak scale, a new 7-in. meter movement, a lighted scale, a patented linearity circuit, an input impedance of 17

megohms, shielded a-c and r-f leads, and screw-on connectors. The instrument reads peak-to-peak voltages from 200 mv to 2,800 v; d-c voltages from 200 mv to 2,800 v; d-c voltages of plus or minus polarity from 50 mv to 1,000 v; a-c voltages from 50 mv to 1,000 v; r-f voltages from 100 mv to 300 v in the band of 10 kc to 300 mc; and resistance from 0.5 ohm to 1,000 megohms and decibels from −20 db to +61.4 db. The d-c voltage range may be extended to 30,000 v by using the type 225 (30 kv) d-c voltage- multiplier probe. Type 302 achieves consistent stability.

LOUDSPEAKER MAGNET
has high energy product

THE INDIANA STEEL PRODUCTS CO., Valparaiso, Ind. The RETMA standard No. 9 loudspeaker magnet is available with a minimum energy product of over 6 million B-H max. It is made of Hyflux Alnico V HE (high-energy grain-oriented Alnico V). Immediate advantages offered to users of the speaker magnet are: (1) extremely high sound level; (2) a better transient response that assures a full range of tones and overtones; and (3) truest reproduction of sound.



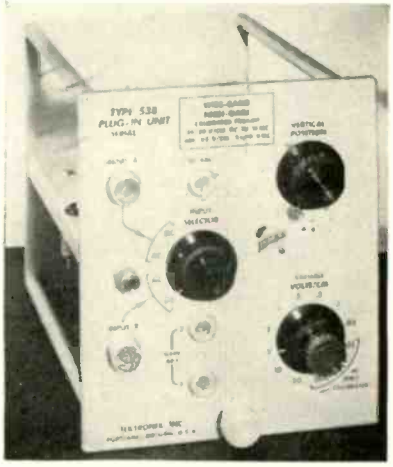
COLOR YOKE
for 19-in. tubes

GENERAL INSTRUMENT CORP., Ridgewood, N. J., has introduced a new magnetic deflection yoke for

19-in., 3-gun color tv tubes, with extraordinarily close convergence characteristics. The yoke governs the convergence of the 3 streams of electrons in the color tube with exceptional accuracy. The yoke is suitable for the 3 major types of color tubes: the planar mask type, the mono-convergence shadow mask type, and the type in which the color phosphors are applied directly to the curved face.

I-F STRIP
has 3.75-mc bandwidth

ALLEN B. CARDWELL ELECTRONICS PRODUCTION CORP., Plainville, Conn., has developed a 40-mc printed circuit i-f strip for monochrome tv receivers using intercarrier sound systems. A feature is the new laminate used on both the base and transformers. Transformer windings are etched on both sides of the laminate, and to provide accurate and reliable tuning aluminum disks are threaded into center-tipped nylon inserts. A new and special design feature of the insert prevents any possibility of shorting of turns. The i-f strip is a compact in-line design featuring extremely high gain and full band-pass response, and is prealigned and tested to the strictest customer specification.



PLUG-IN PREAMPLIFIER
a wide-band high-gain unit

TEKTRONIX, INC., P.O. Box 831, Portland 7, Oregon. Type 53B is the fourth of a series of plug-in units

designed for use with types 531 and 535 oscilloscopes. Characteristics are: 0.05 v per cm to 50 v per cm sensitivity, a-c and d-c, continuously variable, with 9 calibrated steps from 0.05 v per cm to 20 v per cm, d-c to 10-mc passband, 0.035-μsec rise time. Three additional calibrated sensitivity steps are offered —5 mv per cm, 10 mv per cm, and 20 mv per cm, a-c coupled, 5 cps to 9-mc passband, and 0.05-μsec rise time. Weight is 3½ lb and price $125.

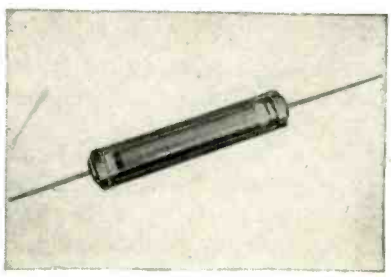
POWER SUPPLY
for mobile transmitters

TECH LABORATORIES, INC., Palisades Park, N. J., has available the RODIC type RO-2 mobile transmitter power supply. Engineered for completely automatic operation, it offers many advantages: 75-percent efficiency, 5 to 8-percent regulation, low starting current with no surge. The rugged, compact unit provides instant starting and stopping, long operating life and ease of maintenance. Operating from a 6-v battery, the RO-2 has two filtered outputs available 520 v at 320 ma, or 330 v at 320 ma.

CAPACITOR
is stable up to 200 C

BALCO RESEARCH LABORATORIES, 49-53 Edison Place, Newark, N. J., has developed a capacitor employing a perfected high-polymer plastic-film dielectric which is stable up to 200 C. Encased in a tubular metal container, the units are hermetically sealed with rugged glass end seals. Cans are floating or grounded and leads are axial. Standard units guarantee insula-

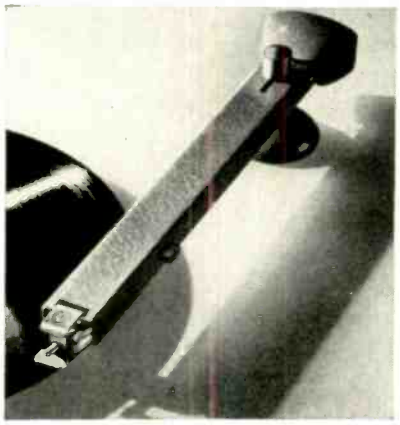
tion resistance of 5×10^9 ohms at 200 C and 5×10^{13} ohms at 180 C. Capacitance ratings are guaranteed within ±10 percent. Special units are available with insulation resistance of 5×10^{15} ohms and tolerances of ±1 percent. Temperature coefficient is less than 75 parts per million from —70 C to 200 C, and power factor is less than 0.0005 even in the vhf band. Tests show no deterioration in this performance after 13,000 hours at 200 C and 140 percent of rated voltage. These characteristics exceed the requirements of MIL-C-5 for micas. Standard ratings are from 0.0003 to 1.0 μf.



RESISTORS
of deposited carbon type

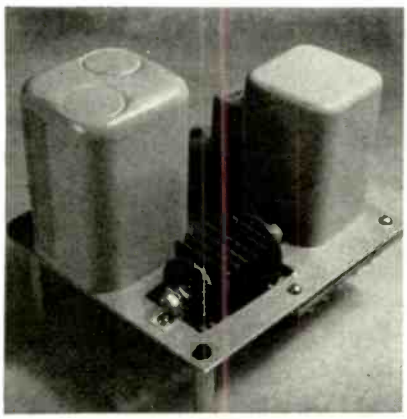
PHAOSTRON CO., 151 Pasadena Ave., South Pasadena, Calif. Carb-Ohms are ideal for high-frequency applications, particularly where high values of resistance are essential. They also answer the need for closely matched units for computer network and other applications. These resistors are available hermetically sealed in glass, in a specifications series conforming to MIL-R-10509, and clad in humidity-impervious Kel-F and vinyl casings. These precision-engineered resistors provide stability over time and freedom from variations due to

climatic changes. Wattage rates range from ¼ to 2 w, with a resistance range of 20 ohms to 200 megohms.



PICKUP ARM
takes less mounting space

PICKERING & Co., Oceanside, L. I., N. Y. Model 190 pickup arm has been re-engineered to require less mounting space, while fully retaining the low vertical mass, static and dynamic balance, lack of arm resonance and low friction of the original design. The new and smaller arm, when combined with a typical high-quality manually-operated turntable, requires a 17 in. × 17 in. motor board. It is designed to overcome the disadvantages of all conventional arms, the shortcomings of which are accentuated by long-playing microgroove records.



RELAY AMPLIFIER
for use in aircraft

THE GOLDAK CO., 1544 W. Glenoaks Blvd., Glendale 1, Calif., has available the model 200 relay amplifier for use in aircraft, missiles and any

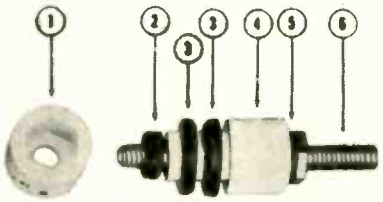
installation where heavy-duty, vibration resistant relays must give positive triggering from low input currents. It provides 28 v at 400 to 600 ma d-c for driving stepping switches or 250 ma continuously for the operation of 50-ampere aircraft relays. The input signal can be either positive or negative or alternating current (approximately 60 to 5,000 cps). Input operating current is less than 1 ma. The fact that a-c can be used as a triggering voltage is convenient in that conventional audio circuitry can be used. With an a-c trigger, the relay should be adapted easily to telemeter applications. The same circuit will also trigger with a d-c input voltage of either polarity. Weight of the amplifier is 32 oz and it measures $3\frac{1}{2} \times 4\frac{1}{2} \times 4\frac{1}{2}$ in.

IMPULSE COUNTER
resists shock and vibration

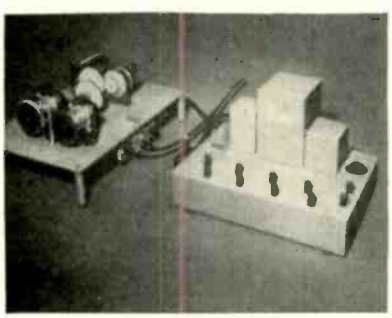
UNIMAX SWITCH DIVISION OF THE W. L. MAXSON CORP., 460 W. 34th St., New York 1, N. Y. The dynamically balanced mechanism of the new electromagnetic impulse counter effectively prevents miscounts due to shock or vibration, thus suiting it to use in aircraft and in mobile equipment. This impulse counter, with 4 dials (nonreset) reading up to 9,999, is only $1\frac{5}{8} \times 1\frac{1}{2} \times 5\frac{7}{8}$ in. and weighs less than $1\frac{3}{4}$ oz. It counts at speeds up to 40 cps, on actuation by interruption of a 28-v d-c circuit.

BUSHING
is hermetically sealed

HELDOR MFG. CORP., 238 Lewis St., Paterson, N. J. An improved non-



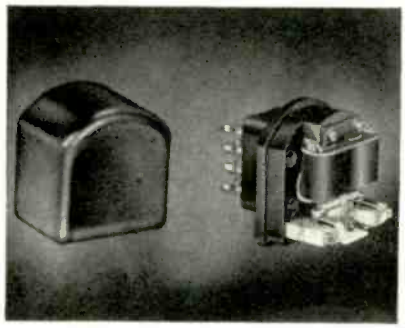
turning, hermetic seal bushing meets MIL-T-27 specifications and conforms to the MIL-T-27 twist test. The HLI-5000 bushing consists of a stud with a hexagon shoulder (6) which cushions on a neoprene gland (5) and seats into a hexagon counterbore in the top steatite (4). This top steatite has a hexagon-shaped shaft fitting through a neoprene washer (3), through the panel opening and through another neoprene washer (3) and into a hexagon counterbore in the bottom steatite (1), and is cushioned against neoprene gland (2). This forms a nonturning hermetic seal with greatly improved mechanical and electrical characteristics. The insertion of steatite (4) into the counterbore (1) gives additional electrical insulation.



SERVO DEMONSTRATOR is an educational tool

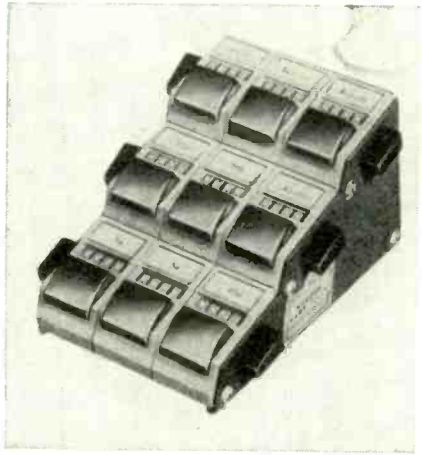
MAGNETIC AMPLIFIERS, INC., 632 Tinton Ave., New York 55, N. Y. Model MA-93001 servo demonstrator unit consists of two assemblies, a gear train unit including motors, synchros, and tachometer and an amplifier assembly containing magnetic amplifier, demodulator, stabilizer and terminals making different parts of the circuit readily accessible. This unit is designed as an educational tool for teaching and research at undergraduate and graduate level. It is

also well suited for industrial training courses.



POLAR RELAY
is fast and sensitive

AUTOMATIC ELECTRIC SALES CORP., 1033 W. Van Buren, Chicago 7, Ill. The PTW polar relay features exceptional sensitivity for high-speed pulse repeating and dependable performance where low current is transmitted over long lines. It has performed billions of operations without readjustment. The relay is recommended for line current direction indication or as a differential relay in the Wheatstone-bridge type of control. It measures only 2 7/8 in. × 2 1/4 in. × 3 5/8 in. The snap-on cover is easily removed for visual inspection. Circular 1821 gives specifications.



RESET COUNTER
has many industrial uses

VEEDER-ROOT, INC., Hartford 2, Conn. The Vary-Tally counter has been used for quality control, inventory control, traffic control, sales analysis, laboratory analysis and many other uses in a wide variety of industries. The equipment is

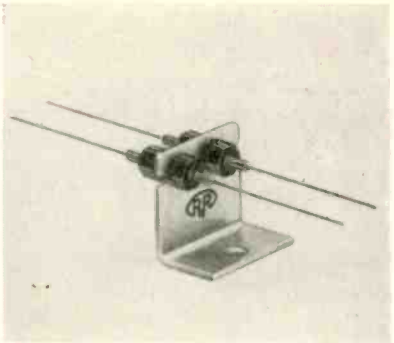
available in any of 66 combinations, up to 6 banks high and 12 units wide, with a minimum of 2 units wide, arranged compactly on stands in tiers. Fingertip pressure on the front lever of a unit registers each count from 1 to 9,999. A reset knob returns all counters in any tier to zero instantly with one complete turn of the reset shaft. The name, color, denomination, quality or size of the item to be counted is inserted in a panel over the reading line on each Vary-Tally. Features include no-glare, easy readability and rugged construction.

A-C AMPLIFIER
has built in preamp

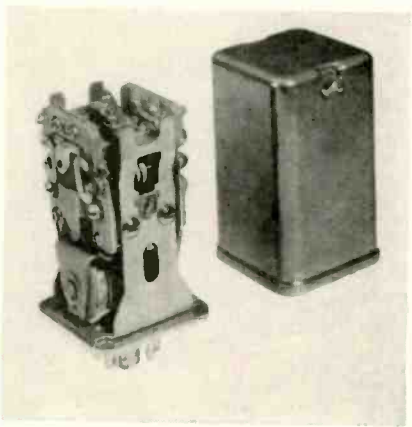
ELECTRONIC CRAFTS CO., 74 Cortlandt St., New York, N. Y., has introduced a new, 5-w a-c amplifier with a built-in preamp for use with reluctance or crystal type phonographs. The small, compact unit may be used for paging systems, intercoms, record players or other sound systems. Consisting of 3 tubes (6X5, 6V6GT and 6SL7), it also features a power outlet for a motor, a simplified and sturdy two-connection terminal strip for a 3.2-ohm voice coil speaker and a built-in output transformer. The model RL-5 amplifier features fine tonal qualities. It lists for $29.95.

MOUNTING BRACKET
for matched pairs of diodes

RADIO RECEPTOR CO., INC., 251 W. 19th St., New York 11, N. Y., is now supplying type 1N35, a matched pair of diodes, mounted in a single bracket. This improvement supersedes the common type of double



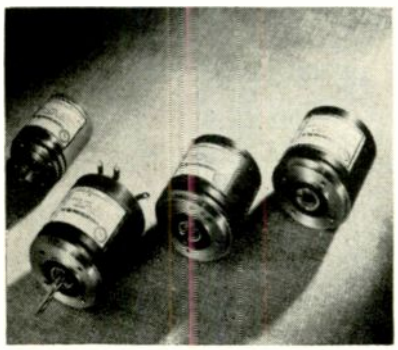
bracket mount which is more difficult and costly to handle and apt to cause undue strain on the diodes. The mount takes advantage of a hexagonal tapered case construction, which readily permits the diode to be mounted securely in the one bracket. Uses for the 1N35 are in f-m discriminators, ratio detectors, phase detectors, industrial control circuits and other applications requiring matched pairs of diodes. Matched pairs of mounted or unmounted diodes with other characteristics than 1N35 can be built to specification.



OUTPUT RELAY
for 2-way control systems

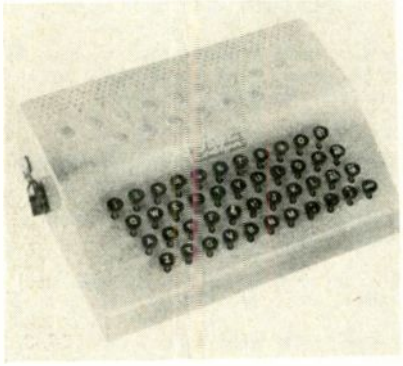
SIGMA INSTRUMENTS, INC., 170 Pearl St., South Braintree, Boston 85, Mass. This new 3-position relay has either a single or double pole switch of 2-ampere rating. With current balanced in two windings, or zero in a single winding arrangement, all switch circuits are open. One polarity of coil current or unbalance current closes one throw of the switch; opposite polarity closes the other. Rated double pole sensitivity is 12 mw. The relay measures 2⅜ in. high above octal or magnal socket by 1⅜ in. square. Bulletin

and application notes on the type 23JOXCC relay are available on request from the manufacturer.



SERVO MOTORS
for high-temperature use

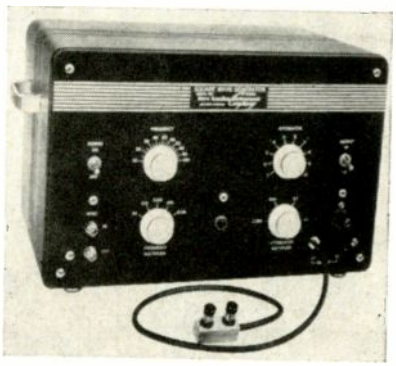
AMERICAN ELECTRONIC MFG., INC., 9503 W. Jefferson Blvd., Culver City, Calif., has available new high-temperature servo motors that can operate in regions of 160 C. These include Bu Ord Mark V11 and Mark V111 as well as 15 other variations available with a wide choice of plain or pinion shafts. These high torque to inertia ratio units have been qualified to meet all military humidity, salt spray and fungus requirements.



CODETYPER
has small tube complement

CODETYPER LABORATORIES, 550 Fifth Ave., New York 19, N. Y., announces the improved model EBC2 electronic brain Codetyper which has had its tube complement reduced from 40 tubes down to only 12 tubes. The instrument is a small computer that automatically sends the Morse code as the buttons on its typewriter-like keyboard are touched, at any speed from 10 to 75

words per minute. No typing skill is needed. One-finger operation is adequate for the most used code speeds. Output of the Codetyper is simply clipped across the hand key formerly used. Subminiaturized to a unit smaller than a portable typewriter, it uses printed circuits and plug-in embedment cells throughout and operates on a-c or d-c.

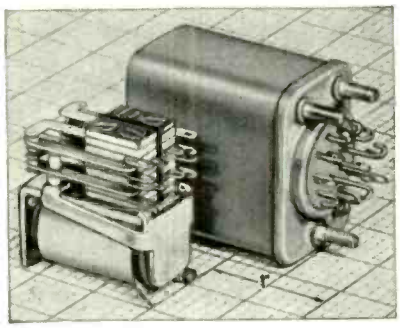


GENERATOR
provides square waves

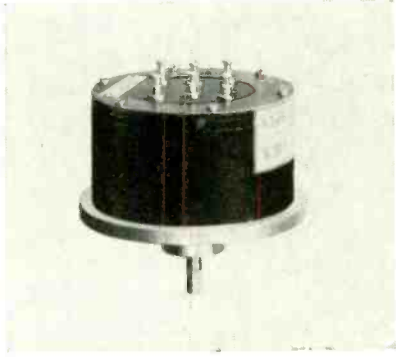
NEW LONDON INSTRUMENT CO., P.O. Box 189, New London, Conn. Model 183 is a high quality precision instrument. It provides square waves suitable for testing the transient and frequency response of wide-band amplifiers, and accurately measures their amplitude. Frequency range is from 10 cps to 1 mc continuously variable over decade steps. Model 183 has a low impedance output which provides 10 v peak-to-peak. At high impedance 100 v peak-to-peak is available. A 60-db step attenuator and a 20-db continuous attenuator (which do not affect wave shape) provide means of using the generator as a voltage calibrator.

MIDGET RELAY
has magnetic structure

MAGNECRAFT ELECTRIC CO., 1442 W. Van Buren St., Chicago 7, Ill. Class 33 subminiature d-c relay meets requirements for reliable relay operation in limited space. The open type model with dpdt contacts is only 1$\frac{1}{32}$ in. long, $\frac{1}{8}$ in. wide and 1 in. high. Hermetically sealed base dimensions are $\frac{31}{32}$ in. × 1$\frac{1}{32}$ in., height, 1$\frac{1}{4}$ in., with 14-pin solder terminal header and 6 contact



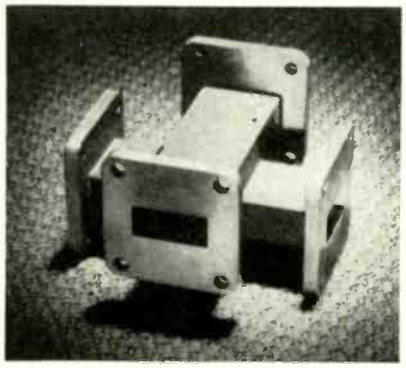
springs per stack, 12 springs total per relay. The new relay, featuring well proportioned magnetic structure, is available to meet military specifications for shock and vibration and also withstands wide temperature variations. It is furnished for any voltage to 110 v d-c and with up to 6 contact arms per stack, 12 arms total.



POTENTIOMETER
of the sine-cosine type

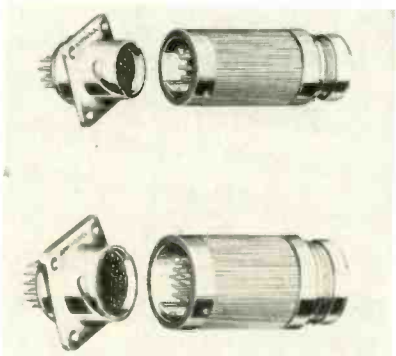
RAWSON ELECTRICAL INSTRUMENT CO., 110 Potter St., Cambridge, Mass., announces production of the RL11C sine-cosine potentiometer. This precision wire-wound potentiometer has many applications in radar, computer and servomechanism work. It is especially useful for slow circular sweep on oscilloscopes or for l-f sine-wave generation. The RL11C provides two output voltages, accurately proportional to the sine and cosine of the angle of shaft rotation. It has a 360-deg continuous mechanical rotation; standard winding resistance, 16,000 ohms (±10 percent); rating, 1.5 w at 65 C; and life expectancy, 350,000 revolutions, minimum. The output wave is pure sine or cosine, with an average deviation less than 0.5 percent. Its overall diameter is 2⅝ in., with a case diameter of 2⅛ in. The mounting shoulder is

¾ in. in diameter, and the stainless steel shaft is 33/4 in. long. Price is $35.00.



COUPLERS
with new design concept

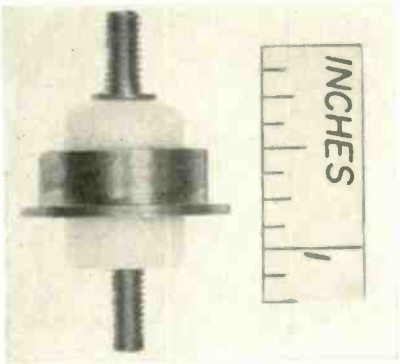
MICROWAVE DEVELOPMENT LABORATORIES, INC., 220 Grove St., Waltham 54, Mass., announces a new series of cross-guide couplers introducing a new design concept. These couplers make it possible to provide higher minimum directivity over the waveguide band, less coupling variation with frequency and higher breakdown power. Model X126E has the following characteristics: directivity—approximately 22 db or more; coupling accuracy—mean coupling level within 0.4 db of 30 db; coupling variation—less than ±0.6 db over the frequency range.



TINY CONNECTORS
feature reduced weight

AMERICAN PHENOLIC CORP., Chicago 50, Ill. A marked reduction of weight is a feature of the new 165 series of miniature AN connectors. The new line is designed for use in modern aircraft, rockets and missiles. They are available in two sizes, six configurations—with 5,

9, 11, 12, 14 or 24 gold plated contacts. They are pressurized but not hermetically sealed and will far exceed the government required 50-hour salt-spray test. Female connectors feature a sandwich type construction for the inner seal with the containing cartridge spun over, thus being sealed at the factory with no chance of leakage. The outer seal is accomplished with a silicone 0 ring. Contact sizes are No. 20 and No. 16.

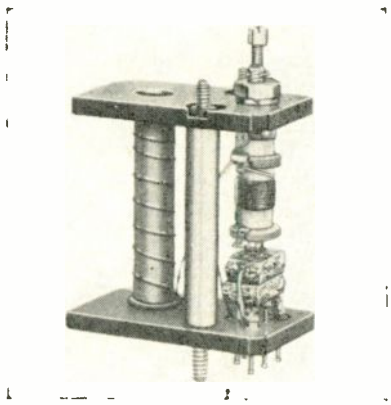


TEFLON SEAL
helps to conserve space

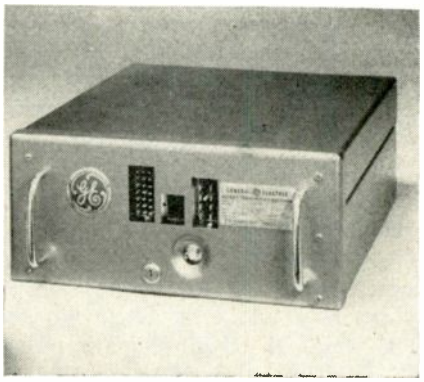
THE JOCLIN MFG. CO., 2964 Whitney Ave., Hamden, Conn., has developed a new Teflon hermetic seal that solves many problems of space conservation. It may be made in a number of different contours, one of which is illustrated. The chemical inertness of Teflon, its high dielectric strength and temperature resistance to 500 F make it very suitable for the sealing portion. The flanged bushing surrounding the Teflon is so designed that it accommodates the differing coefficients of expansion between the metal and the Teflon, to assure a positive seal. Installation is simplified by soldering or welding the bushing into position. This lead-through may be obtained in a number of sizes to meet different operating conditions.

TRANSFORMERS
for commercial and military

I-T-E CIRCUIT BREAKER CO., 19th and Hamilton Sts., Philadelphia 30, Pa. Antenna transformers, r-f output transformers, stage turners, buffers, doublers, mixers, r-f



chokes, linearity coils or peaking coils can be custom-made to the user's particular requirements. Dependable service of components is assured because of qualified fabricating, controlled production, and coil-winding experience. Critical L, C and Q electrical tests are carried out in the company's laboratories for quality control purposes. Prototypes are stable under time, temperature variation and in humid atmospheres.



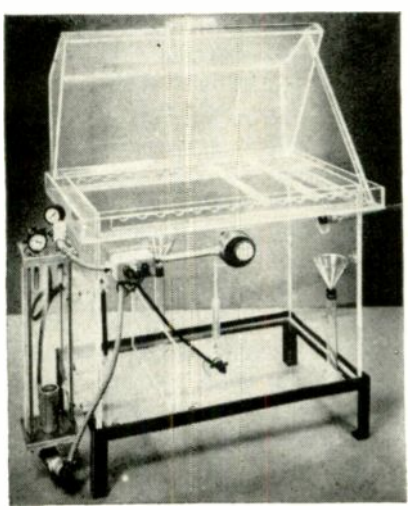
TWO-WAY RADIO for 450-470-mc operation

GENERAL ELECTRIC Co., Syracuse, N. Y., has announced new radio transmitter-receiver combination units for operation at recently authorized frequencies between 450 and 470 mc. The new radios are expected to be most useful in big city police and fire departments, taxicabs and some industrial applications, where the lower frequency channels have become seriously crowded. Mobile models will function from either 6 or 12-v batteries, with no adjustments necessary to convert from one to the other. Nominal output of mobile units is 20 w. All station units have 40-w output, and are

rated for continuous duty. Receivers in the new combinations feature 6-coil i-f transformers, which provide a stability of selectivity for the life of the equipment. The low i-f used is 290 kc. High Q cavities at both receiver input and output insure against tv interference.

WIRE MARKERS
resist heat up to 400 F

NORTH SHORE NAMEPLATE CO., Glenwood Landing, L. I., N. Y., has announced the Speedy-Marx Hi-Temp wire markers. They can be used for marking selenium rectifiers, electric motors, transformers or any application where temperature rise is considerable over ambient. The special pressure sensitive tape made to rigid specification insures permanent identification on various surfaces with no effect from cold, humidity, vibration or heat up to 400 F. A catalog is available on request.



TEST CABINET
meets ASTM specifications

THE G. S. EQUIPMENT CO., 5317 St. Clair Ave., Cleveland 3, Ohio. The H-T Sincolite salt-spray test cabinet meets ASTM specification B-117-49T and the intent of other Government specifications for similar equipment. It has no parts of contaminating materials susceptible to corrosion exposed to test solutions or vapors. Completely transparent, the cabinet affords clear visibility for observing and controlling progress

of tests, and examining specimens from all sides without opening lid. Fusion-welded construction provides permanent no-leak seams, and complete elimination of deterioration and maintenance extends service life indefinitely.

D-C POWER SUPPLY
has 3 decade switches

JOHN FLUKE MFG. CO., INC., 1111 W. Nickerson St., Seattle 99, Wash. Model 301B is a super-regulated, ultrastable d-c supply capable of delivering ½ ampere of current at any voltage from 5 to 815 v. Three decade switches permit selection of output voltage in 1-v steps while a 1.1-v vernier calibrated in 1-v increments affords resolution of 2 mv at any output voltage. Calibration accuracy is better than ¼ percent. Regulation of the 301B is 0.002 percent for 20-percent change in line voltage and 0.002 percent for load current change from no load to full load. These figures obtained over the entire output voltage range. Long-term stability is 0.01 percent or better.

Literature

Transfer Voltammeter. Charles Engelhard, Inc., 850 Passaic Ave., East Newark, N. J. A 4-page brochure illustrates and describes the new Hermach-Engelhard transfer voltammeter, a precision, a-c, multirange instrument with an accuracy

of 0.05 percent through a frequency range from 20 to 20,000 cps. Included are chief features, how-to-use information and a block diagram showing the unit in operation with accessories.

Germanium Phototransistors. Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Texas. Type 800 bulletin describes a line of germanium phototransistors that perform a phototube's functions with the further advantages of smaller power demand, space and weight. The series discussed are *npn* grown junction germanium transistors manufactured with glass-to-metal hermetic seals. They operate essentially as grounded emitter transistor amplifiers, displaying great sensitivity to the direction as well as the amount of light received through the optical glass window.

Microwave Test Equipment. F-R Machine Works, Inc., 44-14 Astoria Blvd., Long Island City 3, N. Y., has a catalog showing a full line of precision microwave test equipment. The FXR line described includes all the wanted units and components for operation in the microwave region. The company has available catalogs bound in multiring leatherette binders.

Record-Playback Control. General Electric Co., Schenectady 5, N. Y. A system of recording motion on magnetic tape and playing it back for automatic programming of production machines and processes is described in bulletin GEA-6092. The two-color six-page publication explains the principle of the new control that incorporates a magnetic tape recorder. Well-illustrated, it explains how record—playback control is especially valuable in bringing to small-lot manfacture many of the advantages of special, mass-production machines.

TV Distribution Systems. Jerrold Electronics Corp., 26th & Dickinson Sts., Philadelphia 46, Pa., has available a 32-page illustrated specifications book covering the planning of tv distribution systems. The advent of color tv gives it special value to architects,

engineers, contractors and others concerned with the problems of designing, specifying and supervising the installation of tv systems.

A-C Electrolytic Capacitors. Micamold Radio Corp., 1087 Flushing Ave., Brooklyn 37, N. Y. A 4-page bulletin on Motorlytic a-c electrolytic capacitors for motor starting and other intermittent-duty service is available. Bulletin 109 describes molded-plastic encased units suitable for duty cycles up to 20 starts per hr, temperatures from −20 C up to + 65 C, and altitudes up to 6,000 ft. Capacitors in the series described are offered in ratings of 110 v and 125 v a-c. Units are listed according to rated capacitance, part number and case dimensions in a convenient reference chart of standard ratings. End cap and mounting bracket information is provided by means of line drawings and photographs. Also included are applications and ordering information.

Panel Instruments. General Electric Co., Schenectady 5, N. Y. A 12-page bulletin describes the company's line of panel instruments. Designated GEC-368F, the 2-color publication contains description, construction, and application details of both d-c and a-c instruments. Well illustrated, it also includes complete dimension and price information, as well as physical, operational and electrical data.

Delay Lines. Andersen Laboratories Inc., 39 Talcott Rd., West Hartford 10, Conn. Solid ultrasonic delay lines with particular reference to the superiority of quartz to mercury and metal lines are the subject of the 12-page technical bulletin 54 just published. Theory, performance, circuitry and specification data are also included.

High-Voltage Resistors. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. Catalog data bulletin G-1 discusses type MV high-voltage resistors. Comprehensive data on 45 different types, characteristics,

construction, individual specifications, applications, installation—charts, graphs and photos—are given in 8 pages.

Magnetostriction. The International Nickel Co., Inc., 67 Wall St., New York 5, N. Y. Bulletin A-169 (28 pages) contains 11 graphs and an extensive selected bibliography. The report discusses ferromagnetic metals and alloys, giving data on some of their magnetostrictive properties. Numerous devices employing this phenomenon are described and explained.

Instruments and Accessories. Burlington Instrument Co., 153 N. Third St., Burlington, Iowa. Catalog N-1 has assembled the outstanding characteristics of instrument design in respect to size, type of material of the case and style of mounting. Under various column headings are listed the prices for the different types of instruments such as microammeters, milliammeters, ammeters, voltmeters and other units. The catalog will help to visualize for the user the best combination of factors related to design and price that will improve his own design practices.

Components Catalog. Jan Hardware Mfg. Co., Inc., 75 North 11th St., Brooklyn 11, N. Y. A data chart listing the stock magnetic shields and bezel combinations which fit most standard c-r tubes is a feature of the new 6-page catalog. The brochure also contains complete data on the company's other electronic components, including h-v insulated couplings, insulated universal couplings, panel bearings, jack covers, shaft locks, bushing extenders, shock testers and controlled torque knobs.

Ring Ceramic Capacitors. Sprague Electric Co., 35 Marshall St., North Adams, Mass. Engineering bulletin No. 610 fully describes a line of ring ceramic capacitors that are available in voltage ratings from 100 to 500 v d-c. The capacitors discussed are designed to provide neat physical layout of electronic and tv chassis

while occupying a minimum of space.

Tetrode Transistors. Texas Instruments Inc., 6000 Lemmon Ave., Dallas 9, Texas. Type 700 bulletin contains detailed information on a line of tetrode grown junction transistors especially suitable for use in audio amplifier agc circuits. Amplification factor (alpha) of the tetrode through the amplifier section is guaranteed to be 0.95 or better. Output signal attenuation of over 20 db can be secured with less than 100 μa applied to the second base lead.

Capacitor Microphones. Frank L. Capps & Co., Inc., 20 Addison Place, Valley Stream, N. Y., has available literature on a new series of capacitor microphones. Data and characteristics are given on three new models, as well as descriptions of the associated power supplies and cables.

Cutter-Splicer. Yale Industries Corp., 82-09 251 st St., Bellerose 26, N. Y., has released a catalog page that fully describes the construction and operation of its model TS-4 cutter-splicer for magnetic recording tape. The model described cuts rounded indentations in the tape edges, giving the tape a "Gibson-Girl" shape, leaving the edges of the tape entirely free of adhesive.

H-F Resistors. International Resistance Co., 401 North Broad St., Philadelphia 8, Pa. Catalog data bulletin F-1 covers the type MP high-frequency resistors. Comprehensive data on 43 different types show characteristics, construction, individual specifications, applications and installation. Charts, graphs and photographs are included in the 8 pages.

Power Plants. Katolight Corp., First Ave. at Chestnut, Mankato, Minn. A new brochure describes the highly portable 3,600 rpm, manually starting power plants in sizes of 650, 1,350 and 2,000 w. Also covered is an 1,800-rpm series driven with air-cooled engines in sizes from 500 w through 5,000

w. Larger units to 50,000 w are shown with both air and water-cooled engines showing a series of 1,200-rpm as well as 1,800-rpm speeds. The brochure describes each individual unit in considerable detail along with ratings, general features and accessories.

Electrical Insulating Materials. Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6, Ill. A new 32-page catalog has descriptive information, photos, prices and ordering data on electrical insulating materials. A table of contents and an alphabetical product index are quick guides to: cords and twines, woven tapes, tubings and sleevings, mica plates, slot wedges, varnishes, solvents, paper, vulcanized fiber, slot insulation, fiber washers, varnished fabrics, pressure-sensitive tapes and class-H silicone insulating materials.

Transformer Catalog. Halldorson Transformer Co., 4500 Ravenswood Ave., Chicago 40, Ill. Catalog No. 22 features an expanded line of transformers, with special emphasis on tv components. Both specific and multipurpose replacements for thousands of popular tv models and chassis are thoroughly described and illustrated. The catalog also contains a complete and comprehensive range of power, audio, reactors and varivolts. For quick reference, the table of contents has been displayed on the front cover. For added convenience, a special index listing part numbers in numerical sequence is shown with list prices and page numbers on the inside front cover. The back cover carries a chart of audio-amplifier tubes versus output transformers.

Electron Microscopes. Research & Control Instruments Div., North American Philips Co., Inc., 750 South Fulton Ave., Mt. Vernon, N. Y., has available a 4-page folder titled "Some Reasons Why The EM-75 and EM-100 Electron Microscopes Deserve Your Consideration." Forty-four typical applications are listed together with design and operating information on two types of electron micro-

scopes. Data cover viewing screen, accelerating potential, magnification, electron diffraction, focus determination and control, image stability, resolution and other features of this equipment.

Fluorothene Resins. Bakelite Co., a Division of Union Carbide and Carbon Corp., 260 Madison Ave., New York 16, N. Y. Recent property and fabrication data on the company's fluorothene resins is compiled in a new 16-page booklet. Much information on the new, high heat resistant resins, now in commercial production after 5 years of process development, is contained therein. Included are graphs, tables and text indicating their high softening temperature, resistance to burning, chemical inertness, weathering and moisture resistance, electrical characteristics, and good low temperature properties. Also given are recommendations on extrusion, injection and compression molding of the resins, as well as many applications.

Silicon Transistors. Texas Instruments Inc., 6000 Lemmon Ave., Dallas 9, Texas, has announced descriptive literature on its commercially available silicon transistors. Bulletins may be obtained on both the types 900 and 901 (general purpose) and the X-15 (medium power) silicon transistors. The devices described will operate up to 150 C, with current amplification factor being essentially independent of temperature change. The X-15 is conservatively rated at 1 w power dissipation. All three types discussed are *npn* grown junction units manufactured with glass-to-metal hermetic sealing.

Interference Filters and Suppression Capacitors. Micamold Radio Corp., 1087 Flushing Ave., Brooklyn 37, N. Y. Engineering bulletin No. 107 is a 4-page brochure illustrating 11 types of r-f interference filters and noise suppression capacitors. It describes each unit by means of a photograph and dimension drawing, plus a table of specifications showing type number, power ratings and r-f attenu-

ation characteristics. Three curves of typical attenuation characteristics, as measured per MIL-STD-220 in a 50-ohm system, are also contained.

Transformer Catalog. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif., has available catalog TR-54 listing more than 500 transformers of which over 60 are new items. It features 11 new amplifier kits for high-fidelity reproduction, an expanded line of tv components, plus additional items in the hermetically sealed power components, instrument power supply, choke, filament, power and audio transformer lines. Two new photo-flash transformers are included in the list of new items. A complete line of geophysical transformers are shown in a special section of the catalog.

Laminations Catalog. Magnetics, Inc., Butler, Pa., has issued a catalog describing its standard line of laminations, laminated cores and dies. Catalog ML101 includes many pages of lamination specification sheets, showing both the individual laminations to actual scale, as well as properties of square cross section core stacks, and weights and counts for different materials. Catalog sections are devoted to laminated core assemblies, mechanical and magnetic parameters and lamination tolerances. The catalog also includes a section on the proper information needed in determining and ordering quantities of magnetic laminations.

Industrial Components. Collins Radio Co., Cedar Rapids, Iowa, has available a reprint telling how its line of industrial components can be of help. Illustrated descriptions are given for the company's mechanical filters, hysteresis motors, variable frequency oscillators, Autotunes and Autopositioners.

Variable Inductance Coils. North Hills Electric Co., Inc., 246-32 54th Ave., Douglaston 62, N. Y. A recent mailing piece announces the series 120 variable inductance coils designed for commercial and

government equipment. The series described covers the 2-μh to 2-mh range with eleven coils. They have a wide variety of applications such as color tv circuits, filter networks, video peaking, and r-f and i-f amplifiers.

Cabinets. Artisan Metal Works Co., 11400 Madison Ave., Cleveland 2, Ohio, has published a 4-page folder on its line of cabinets for the electronics industry. Folder EC-354 ilustrates representative type metal fabrication jobs produced by the company for manufacturers; gives the wide range of facilities available; and discusses the company's capacity to follow through on a job from original design stages to full finishing operations.

High-Reliability Pentode. General Electric Co., Schenectady 5, N. Y. A 4-page, 3-color brochure (ETD-892) describes the new GL-6265 type, the high-reliability version of the 6BH6, for critical applications in two-way communications systems. Technical data are included, as well as block diagrams showing application of the new type along with other Five-Star types in existing aircraft and mobile receivers, and a block diagram showing a 152 to 174-mc mobile receiver with every socket filled with the Five-Star tubes.

Deposited Carbon Resistors. Campbell Industries Inc., St. Elmo Station, Chattanooga 9, tenn. A 6-page technical data bulletin covers Fixtohm deposited carbon, 1-percent resistance tolerance, precision resistors. The resistors described have power ratings from ½ to 2 w, and resistance from 10 ohms to 100 megohms. Included in the brochure are performance test results, electrical and mechanical characteristics, material and construction details, protective finishes and enclosures available.

Tube Shields. International Electronic Research Corp., 175 W. Magnolia Blvd., Burbank, Calif. Two recently published booklets entitled "Effect of Tube Shields on Miniature Electron Tubes" and

"An Evaluation of Shields for Subminiature Electron Tubes" contain factual test result data, comparison charts on tube shield clamps and their heat dissipating effects, conductivity and vibration effects as applied to advanced electronic and guided missile development.

Magnetic Relays. R-B-M Division, Essex Wire Corp., Logansport, Ind., has issued a quick-reference 4 page bulletin showing the various types of open and hermetically sealed a-c and d-c relays in its line. The bulletin readily indicates general characteristics including maximum coil resistance and power requirements, contact forms available, approximate weight and dimensions. Write for bulletin 560A.

Subminiature Receiver. Lehigh Valley Electronics, 215 So. Third St., Allentown, Pa. A single-sheet bulletin describes and illustrates a tiny receiver (no longer than a pack of cigarettes) that is designed to operate between 25 and 60 mc and has an effective range of about 20 miles. It outlines chief features and some of the unit's many possible applications. A price list is included.

Automation. T.A.B. Engineers, Inc., 767 N. Milwaukee Ave., Chicago 22, Ill., has prepared a new, condensed and highly practical brochure on automation. It will help top executives understand the present day significance of the term and determine whether their factories can be adapted to complete or partial automation.

Computer Components. Feedback Controls, Inc., 503 Rhode Island Ave., N. E., Washington 2, D.C. An 8-page folder discusses a line of computer components and packaged servo systems. It contains illustrated descriptions and specifications for closed systems, servo amplifiers, precision gear trains and data output gearings.

Standard and Power-Type Potentiometers. De JUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y. Six basic models of

standard and power-type potentiometers with a wide range of functional and mechanical variations are described in a new 8-page brochure. These linear and nonlinear instruments provide a full 360-deg mechanical and 356-deg electrical rotation angles.

Beryllium Copper Strip. Penn Precision Products, Inc., 501 Crescent Ave., Reading, Pa. Bulletin 1 makes available complete data for specifying beryllium copper precision strip. A discussion of available alloys, conditions and tempers is included together with tables covering available sizes and properties.

Reference Cavities. General Electric Co., Schenectady 5, N. Y. A 12-page, 3-color booklet (ETD-885) describes three new reference cavities: types GL-1Q26-A, GL-6301, and GL-6452, for use as frequency-determining references in microwave systems. The booklet covers application information, adaptation to existing equipments and technical data.

Isolated-Pulse Voltmeter. Shepard Laboratories, 480 Morris Ave., Summit, N. J. A single-sheet bulletin gives an illustrated description of the PPM-1, a precision transient peak voltmeter applicable to many uses where the quantity to be measured is represented by a voltage change. The unit discussed includes a capacitative voltage-divider element adjustable over a 1,000-to-1 range in its input circuit to facilitate high level measurements and, with an associated preamplifier, it may be used with low-level voltage sources such as strain gages. The instrument described is ideal for field as well as laboratory service.

Standby Electric Plants. D. W. Onan & Sons Inc., Minneapolis 14, Minn. Technical bulletin T-O11 covers the installation of emergency standby electric generating plants and automatic line transfer controls, in simple language. Typical installations of both water-cooled and air-cooled standby electric plants are pictured clearly for easy understanding.

PLANTS AND PEOPLE

Edited by WILLIAM G. ARNOLD

Electronic manufacturers continue plant expansions . . . Associations announce convention plans and activities . . . Engineers and management executives are promoted . . .

OTHER DEPARTMENTS featured in this issue:

RETMA Elects Officers, Honors Sprague At Annual Meeting

Attending RETMA's annual meeting were, left to right, C. F. Stromeyer of CBS-Hytron, M. F. Balcom of Sylvania and new RETMA board chairman, R. E. Carlson of Tung-Sol, R. C. Sprague of Sprague Electric receiving Medal of Honor from president Glen McDaniel

MAX F. BALCOM, who was president of RETMA from 1947 to 1949, was elected chairman of the Association's board of directors.

Balcom succeeds Robert C. Sprague who, upon the conclusion of his third term as board chairman, was awarded the 1954 RETMA Medal of Honor by president McDaniel for his outstanding contributions to the advancement of RETMA and the radio-tv-electronics industry.

Re-elected officers included president and general counsel Glen McDaniel, treasurer Leslie F. Muter, executive vice-president and secretary James D. Secrest, engineering department director W. R. G. Baker and general counsel emeritus John W. Van Allen. Vice-presidents Robert S. Alexander, R. E. Carlson, H. J. Hoffman and R. G. Zender were re-elected, and Floyd W. Bell was elected to succeed Sidney Harman as vice-president of the amplifier & sound equipment division.

Director H. L. Hoffman was elected chairman of the radio-television industry committee, succeeding Balcom. Director F. R. Lack was re-elected chairman of the electronics industry committee.

Following are the new and re-elected chairmen and new directors elected by the five divisions:

Set Division—Robert S. Alexander, chairman (re-elected), and John C. Marshall of Arvin Industries, director.

Tube Division—John Q. Adams, chairman (re-elected); John L. Hanigan of Corning Glass Works and Charles F. Stromeyer of CBS-Hytron, directors.

Parts Division — Herbert W. Clough of Belden Manufacturing, chairman; Edward C. Tudor, Industrial Development Engineering Associates and W. A. Nicely, Chicago Telephone Supply, directors.

Technical Products Division—James D. McLean of Philco, chairman, and William C. Jordan of Hughes Aircraft, director.

Amplifier & Sound Equipment Division—A. K. Ward of RCA Victor, chairman, and Lester Bogen of David Bogen Co. director.

C. B. Thornton of Litton Industries was elected a director-at-large.

The following 16 directors were re-elected for new terms at division membership meetings:

Set Division—Benjamin Abrams,

It's the MAGIDISK

that does it!

Automatically handling 10 Records 7", 10" and 12", with 3 seconds changeover, providing uninterrupted armchair entertainment for up to 5 hours—that's the Monarch 'Magidisk' performance! Tested and proved reliable by radiogram manufacturers, applauded by gramophone experts, this unique feature is only one of the many attributes for enthusiasts in the Monarch Record Changer. It is the leading automatic electrical high fidelity record reproducer which is giving pleasure to millions all over the world.

10 IMPORTANT ATTRIBUTES

★Plays 10 mixed diameter records at 33⅓, 45 or 78 r.p.m.
★'Magidisk' automatically selects 7", 10" and 12" discs.
★Pick Up returned and motor switched off after last record.
★Extended frequency range dual sapphire styli Pick Up.
★Simple unit control 'ON', 'OFF', 'REJECT' and speed switch.
★Fitted anti-acoustic feed back suspension springs.
★Compact overall dimensions ideal for radiogram, T.V. console and portable player.
★Turntable rim driven by vibration damped induction motor eliminating rumble and 'wow'.
★10" diameter heavy steel recessed turntable with rubber mat.
★Beautifully styled smooth, modern lines; faultless finish.

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H. C. Bonfig, Leonard F. Cramer, E. G. Fossum and Fred D. Wilson.

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Parts Division — A. Blumenkrantz, Herbert W. Clough, Russel E. Cramer, Jr., J. J. Kahn, W. Myron Owen, A. D. Plamondon, Jr., and L. S. Racine.

Technical Products Division—E. K. Foster, F. R. Lack and W. A. MacDonald.

The radio-television industry committee received a lengthy report on industry response to the proposals of the spurious radiation committee, and approved the recommendations of chairman W. R. G. Baker. Dr. Baker proposed that a further effort be made to obtain replies from set manufacturers who have not responded to the committee's questionaire and that thereafter complete information be presented to the Federal Communications Commission.

Baker also proposed that representatives of RETMA and the FCC confer on certain provisions of the Commission's Notice of Further Rule Making on set radiation limitations and that the proposed establishment of a RETMA certification laboratory be deferred until after this conference.

The board of directors, upon recommendation of the RETMA labor legislation subcommittee, adopted a resolution authorizing the Association's officers to support the principle of "pay as you go" in social security financing and an extension of social security coverage to a greater number of persons through the endorsement of pending Administration bill H. R. 9336 which has just passed the House and is now before the Senate Finance Committee. The action was taken following a brief report by subcommittee chairman Robert C. Sprague, Jr.

Fifty committee and section meetings were held during the three-day convention. These included sessions of the division membership and executive committees and regular general and division committees.

The principal subject of discussion at the set division meeting was the removal of the 10 percent excise tax on television sets capable of uhf reception.

Ramo-Wooldridge Forms Transistor Firm

RAMO-WOOLDRIDGE Corp. has organized a new subsidiary, Pacific Semiconductors, in Los Angeles. Harper Q. North, center, president of the new firm, discusses building plans with Dean E. Wooldridge, left, and Simon Ramo, right, president and vice-president, respectively, of Ramo-Wooldridge.

The new company will be engaged in the development, manufacture, and sale of semiconductor devices such as diodes and transistors of advanced design. It is a wholly-owned subsidiary of Ramo-Wooldridge and is also receiving $3 million in financing from Thompson Products.

Dr. North, who was previously director of the semiconductor division of Hughes Aircraft, said that Pacific Semiconductors should be in commercial production within a year from now.

WESCON Outlines Technical Program

More than 100 technical papers will be presented in approximately 27 separate sessions during the 1954 WESCON, August 25–27.

WESCON is sponsored jointly by WCEMA (West Coast Electronic Manufacturers Association) and the Los Angeles and San Francisco Sections of IRE.

Convention activities for this year's event will center around the Ambassador Hotel, Los Angeles, with several sessions also taking place in the Institute of Aeronautical Sciences Building near Pan Pacific Auditorium.

Plans for the technical program are still subject to minor changes, shifts, and additions. The overall schedule calls for three sessions each on telemetering, antennas and propagation, computers and electron devices; two sessions each on component parts, circuit theory, management, vehicular communication, airborne electronics and microwave theory and one session each on broadcast and tv receivers, information theory and audio.

Sessions will be held both mornings and afternoons all three days, and one or two sessions of general interest may be scheduled for an evening. The average session will consist of four papers.

Papers on the schedule include: An Input-Output System for a Digital Control Computer by L. B. Retzinger of Librascope; A Transistorized FM/FM Telemetering

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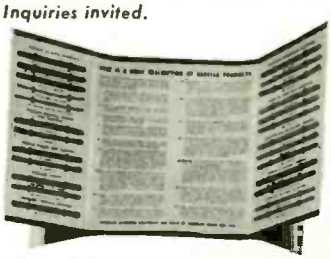

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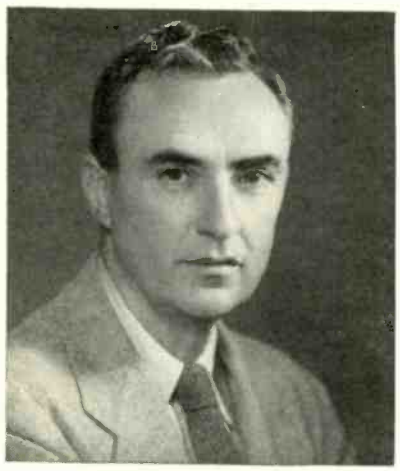
System by R. E. Colander and C. M. Kortman of Bendix Aviation, Pacific division; The User Looks at the Component Parts Problem by A. M. Okun of Bell Aircraft; The Planning and Performance of a Completely Integrated Source of Television Signals From Film by A. D. Emurian of Philco; Are Engineers People by A. M. Zarem of Stanford Research Institute and several papers on travelling wave tubes, klystrons and semi-conductor devices.

Gabriel Electronics Names Engineers

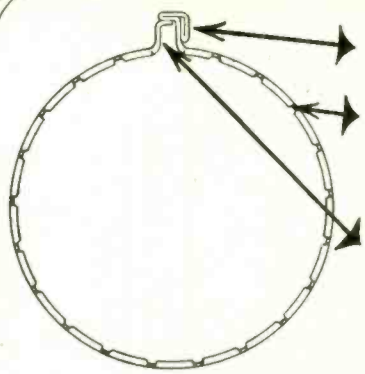


William P. Short

WILLIAM P. SHORT was appointed general manager of the Gabriel electronics division in Norwood, Mass. John Martin was named chief engineer.

John Martin

Short continues in his new post as assistant to the president of the parent firm. Previously he was vice-president in charge of piezoelectric and acoustic development



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After the war he was assistant technical director in charge of microwave commercialization at Federal Telecommunication Laboratories. Previously, as manager of radio engineering and development at Crosley early in World War II, he organized the design and production facilities for proximity fuzes, military radio, and radar equipment. He was chief engineer of RCA's receiver division during the period prior to 1940. While serving at the Radiation Laboratory of M.I.T. during World War II, he was awarded the Presidential Certificate of Merit.

John Martin, previously director of research of Gabriel Laboratories, will direct the division's new product development program as well as head its product and electrical engineering operations. He served as head of development with Canadian Aviation Electronics and during World War II was with the British Admiralty.

RCA Promotes Engineers, Reorganizes Division

TO COORDINATE the research and engineering activities of the RCA organization as part of an over-all plan adopted earlier this year to meet the needs of the corporation's steadily expanding business, the following promotions were made:

Elmer W. Engstrom, executive vice-president of RCA Laboratories, has been elected executive vice-president of research and engineering and continues as head of the RCA Laboratories. In his new capacity Dr. Engstrom will have broad responsibility for all research and engineering activities of the corporation.

Irving Wolff, who has served as director of research, has been appointed vice-president of research for RCA Laboratories.

D. H. Ewing has been appointed administrative director of RCA Labs. He was previously director of the physical and chemical research laboratory.

O. B. Hanson, heretofore vice-president and chief engineer of NBC has been elected to the RCA

staff as vice-president of operations engineering. He will have responsibility for engineering matters pertaining to broadcast and communications operations and will direct the activities of the RCA Frequency Bureau. Hanson will report to the executive vice-president of research and engineering as will D. F. Schmit, vice-president of product engineering, who continues in that capacity.

Robert E. Shelby has been elected vice-president and chief engineer of NBC succeeding O. B. Hanson.

He has been associated with NBC since 1929 and in recent years served as director of color television systems development. H. W. Leverenz, has been appointed director of the physical and chemical Research Laboratory at RCA Laboratories. Leverenz was previously a senior member of the technical staff heading the chemico-physics research group and in charge of RCA's phosphor research program.

To achieve greater specialization, RCA Victor has divided its home instrument division into a separate division devoted solely to the manufacture and sales of home television receivers and a new division for radios and phonographs.

Henry G. Baker, vice-president and general manager of home instruments, will serve as vice-president and general manager of the new television division. James M. Toney, former director of distribution for consumer products, has been appointed general manager of the new division for radios and phonographs.

Bendix Radio Names Engineering Heads

NORMAN CAPLAN has been named manager of commercial engineering at the Bendix Radio Communications division of Bendix Aviation.

He replaces Douglas M. Heller who has been appointed director of engineering at the Bendix missile plant in Mishawaka, Ind.

Heller, with Bendix Radio for the last seven years, was responsible for the development of several of the firm's most important communication and navigation devices.

Caplan was formerly chief en-

gineer of communications and navigation engineering, hub of the division's production design and development projects for the military. In his new position he will be responsible for the design and development of commercial products in the aviation, automobile and mobile radio fields. Previously, he was deputy director of the technical staff of the Air Navigation Development Board.

J. H. Taylor, veteran of 14 years of engineering service with Bendix Radio, will move into the position vacated by Caplan.

Burgess Named By Eitel-McCullough

JAMES BURGESS has been appointed head of the newly-formed product engineering department for Eitel-McCullough. His new duties will include directing plant activity in design testing, quality control and special engineering assignments arising from plant or customer requirements.

Burgess has been with the Eimac research laboratories since 1949.

General Instrument Sets Canadian Subsidiary

General Instrument has organized a Canadian subsidiary, General Instrument—F. W. Sickles of Canada. The new firm has purchased Watt Electronic Products, with a plant in Kitchener, Ont., near Toronto.

Edgar Messing, vice-president of the company's F. W. Sickles Division, will be responsible for initiating and coordinating Canadian ac-

Edgar Messing

Hugh T. Watt

tivities, which will include the manufacture of deflection circuit components, auto radio tuning devices, television tuners, converters, transformer windings of various types and ultimately transformers themselves.

Eventually, all manufacturing operations for Canadian customers will be transferred from General Instrument's four domestic plants to Kitchener.

Hugh T. Watt, former president of Watt Electronic Products, will remain in charge of this operation.

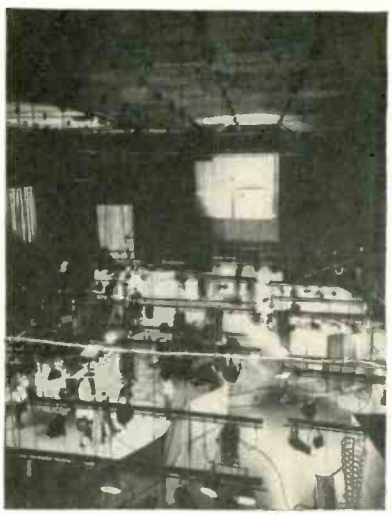
Stupakoff Named Carborundum V-P

SEMON H. STUPAKOFF, formerly president of Stupakoff Ceramic and Manufacturing was elected vice-president of The Carborundum Co. of Niagara Falls, N. Y.

Stupakoff Co. was acquired by

Carborundum in early 1954 and was recently made a division of Carborundum. As a vice-president of Carborundum Stupakoff will continue to direct the activities of the division.

Stupakoff made many contributions in the development of high temperature ceramics to insulate the white hot tungsten filaments from the nickel cathodes in radio tubes. He developed methods of manufacture of pure alumina insulators of extremely small dimensions precisely made and fired at temperatures of about 3200° F. He developed improvements in the insulators of tungsten filaments which reduced the starting time of a radio set from 90 seconds to 30 seconds. Stupakoff's experimentation in this field led to other developments which now form the principal basis of the company's operations.



Du Mont Tele-centre Formally Opened

THE $5 million Du Mont Telecentre in New York City was formally opened in June.

A new system of isolated control booths is used throughout the Telecentre. The audio technicians, the video technicians and the director and his staff are isolated from each other. Although they can communicate with each other through an intercom system, their mutual isolation is said to eliminate a great deal of the noise and confusion attendant on tv studio operations and to allow each man to concentrate fully on his own job.

All five control rooms are located

in a vertical bank through the building. The cables connecting each studio with the master control are in a straight line for shortest possible cable runs.

The Tele-centre contains five major studios. The largest measures 110 ft x 80 ft in area and 40 ft in height.

One studio is devoted exclusively to color telecasting.

Amphenol Canada Organized in Toronto

A new company chartered as Amphenol Canada Limited, under the presidency of J. R. Longstaffe has been formed in Toronto. The undertaking is to be a Canadian operation with its manpower, management, and engineering being reinforced and aided by American Phenolic of Chicago to whatever extent may be necessary at the outset and for only as long as conditions demand.

A close liaison is to be maintained between the two companies which will permit adequate stocks of Amphenol components to be kept on hand for prompt delivery from the Canadian plant to all Canadian customers.

To house the new firm's operations, 30,000 sq ft of manufacturing and office facilities have been acquired in Toronto, Ontario. Sales offices are to be maintained in leading cities from coast to coast.

Magnecord Appoints Two Chief Engineers

As part of a general reorganization and expansion program at Magnecord in Chicago, Erwin M. Weiss has been named chief en-

gineer in charge of instrumentation and Michael G. Seidl heads the technical section of the new commercial music division as chief engineer.

Prior to joining Magnecord, Weiss was chief engineer in charge of color television of Muntz TV. Previously he was senior engineer for the Chicago division of Raytheon and in the research division of Admiral.

Seidl joined Magnecord in August, 1953, as chief engineer. He was formerly with Boeing in Seattle, Wash., where he directed research, design and development of electronic equipment.

The company has entered into an agreement to buy two buildings in Chicago with a total of 72,000 sq ft of floor space.

Donald Rogers Joins Jerrold

DONALD H. ROGERS has joined the engineering department of Jerrold Electronics of Philadelphia. He was formerly chief engineer of Blonder-Tongue Labs and has been with Western Electric.

Golenpaul Elected Head of Radio's Old Timers

AT THE ANNUAL gathering of Radio's Old Timers, held in conjunction with the Electronic Parts Show, Charles Golenpaul, right, vice-president of Aerovox, was elected president of the group succeeding Ray L. Triplett, left,

founder and president of Triplett Electric Instrument. Triplett, who is celebrating his fiftieth anniversary as a manufacturer of radio-electronic equipment, was presented with the testimonial plaque shown on which an original Triplett tube tester of 25 years ago is mounted. Sam Poncher, president of Newark Electric, was named secretary of the group.

McGraw-Hill Book Co. Appoints Schiff

LEONARD I. SCHIFF, professor of physics at Stanford University, has been appointed consulting editor of McGraw-Hill's International Series in Pure and Applied Physics. He succeeds G. P. Harnwell, who resigned the editorship upon his recent acceptance of the presidency of the University of Pennsylvania.

Roberts Elected President of Philharmonic

LESLIE ROBERTS was elected president and chief executive officer of Philharmonic Radio and Television.

Roberts, who has been executive vice-president of the firm since 1950, replaces B. H. Lippin who stepped up to board chairman.

Gramer Names Vice-Presidents

Gramer Transformer has recently appointed three vice presidents.

Ralph L. Weber, secretary, was named executive vice-president; Burt Anderson, vice-president in

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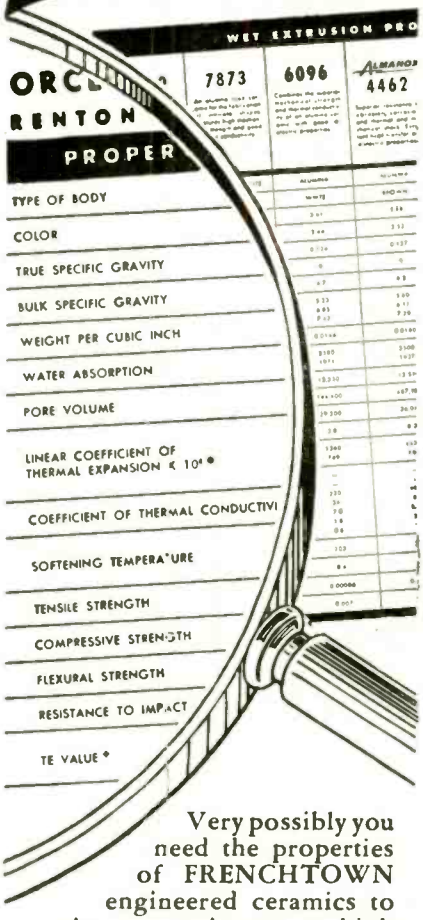

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OUTPUT: 6 to 500 VDC at 5 to 200 Amps. continuous.

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Designed to meet the most exacting requirements of the Electronics industry, INET Precision Power Supplies combine the long-life performance of selenium rectifiers with the rugged dependability of magnetic amplifier controls.

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Requires minimum space, housed in steel cabinets with meters and controls mounted for quick visibility and operation. Available in wall, floor-standing or caster mounted models.

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—another IN-RES-CO solution for CIRCUIT DESIGNERS

SEALED IN MOLDED BAKELITE PLUS LIGHTWEIGHT

The dependable resistive elements that combine positive sealing with the important advantage of lightweight. Molded Bakelite core reduces weight by one-half compared to ceramics. Positive seal effectively protects the winding against harmful climatic conditions. Additional IN-RES-CO features include long life stability, hard soldered connections to terminals and extra-sturdy, vibration proof terminal leads. Both CX and BX Resistors include space-saving terminal supported axial terminals of tinned wire.

IN-RES-CO TYPE CX NON-INDUCTIVE RESISTOR

IN-RES-CO TYPE BX NON-INDUCTIVE RESISTOR

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Ralph L. Weber

charge of sales and Fred R. Cooper, vice-president in charge of engineering.

Weber, who retains his position as secretary, has been general works manager. With 21 years background in metal finishing and transformer manufacture, he joined Gramer in 1951.

Cooper, who has been chief engineer, has been in the transformer field for twenty years, with ten years experience in design and production of transformers for the armed forces. He has been with Gramer since 1949.

Pinkerton Joins Airborne Instruments Lab

HARRY PINKERTON has been appointed manager of engineering applications by Airborne Instruments Lab. of Mineola, N. Y. He will direct the laboratory's activities toward

increasing the application of electronics techniques to the needs of government, commerce and industry.

Prior to joining AIL, Pinkerton operated his own development laboratories at Oyster Bay, New York. He was also affiliated with Specialties Incorporated as chief production engineer; Higgins Aircraft in New Orleans as assistant director of mechanical operations and Martin Aircraft at Ft. Cook, Nebraska as supervisor of facility maintenance.

Professional Engineers Name Officers

THOMAS M. LINVILLE, manager of GE's research operation services department, was named president of the New York State Society of Professional Engineers. He succeeds Carl M. Gilt of Brooklyn.

Other Society officers for the year beginning June 1 are: Herbert F. Roemmele, first vice-president; Lewis J. Sforzini, second vice-president; Patrick M. Corry, treasurer and Richard B. Richardson, financial secretary.

A. D. Little Acquires Merrill Laboratories

ARTHUR D. LITTLE, INC. has acquired the research and development division and laboratories of The Merrill Company, metallurgy and engineering firm in San Francisco.

The acquisition of Merrill laboratories, now to be known as the Western Laboratories Division of Arthur D. Little, will make research and product development by ADL conveniently available to West Coast industry

Charles G. Harford of ADL has

been transferred to San Francisco to be technical director of the Western Laboratories Division. He joined the staff in 1925 and has been in charge of many of the company's leading product development cases.

Raymond E. Byler, who has been responsible for the technical activities of the Merrill Company, has been named business manager of the division.

Central Research Names Rickett

ROBERT J. RICKETT has been appointed as a physicist on the staff of Central Research Laboratories, a scientific instrument firm in Red Wing, Minn.

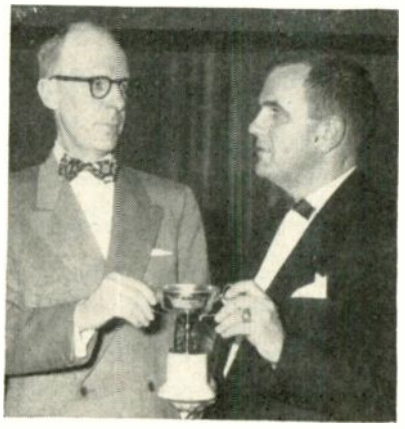
Rickett was formerly employed in the radio instrumentation department of Sperry Gyroscope.

Standard Coil Elects Executive Vice-President

JAMES O. BURKE was elected executive vice-president of Standard Coil Products Co. Jere H. Cavan-

augh was appointed financial administrator for the company and will work directly under Burke.

Burke, who founded Standard Coil with president Glen E. Swanson in 1935, is also treasurer and a director of the company.



TV Station Chief Engineer Is Honored

RAYMOND C. RODGERS, right, chief engineer of WDTV in Pittsburgh, received the first Channel Master Award for "outstanding contributions resulting in the betterment of television transmission and reception." Harry Johns, executive director of the Electric League of Western Pa. presented the gold cup award. The antenna firm has established the award as an annual honor.

Radio Receptor Changes Division Name

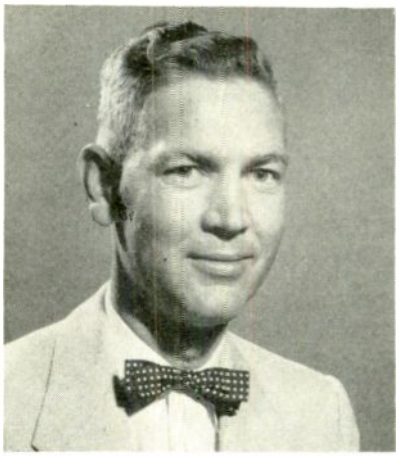
RADIO RECEPTOR has changed the name of its seletron & germanium division to semi-conductor division, to better identify the complete range of products manufactured under its expansion program.

Electronic components now produced by the division include selenium rectifiers, germanium transistors and diodes, and silicon diodes. Silicon transistors will be next.

Industrial Electronics Lab To Be Established

A $27,500 GIFT from the faculty of Case Institute of Technology has been made for a Glennan Laboratory in Industrial Electronics, in honor of T. Keith Glennan, presi-

dent of Case. The lab will be in the electrical engineering building now under construction at the Institute. It is scheduled for completion next February. It is expected that the gift will be used to equip the laboratory.



Dempsey Promoted By Convair

JAMES R. DEMPSEY was appointed program director of one of Convair's guided missile projects.

Dempsey joined Convair in 1953 as assistant to vice-president T. G. Lanphier Jr. For the previous ten years he was with the Army and Air Force.

In 1951, he was sent to the Air Force Missile Test Center at Patrick Air Force Base, Fla., as operations officer for a Missile Test Wing. He held the rank of lieutenant colonel when he left the Air Force last year.

Larson Appointed WCEMA Manager

DON LARSON has been named to the post of general manager of WCEMA, West Coast Electronic Manufacturers' Association. The position was recently established by the group to meet the increasing need for coordination of the activites of the 165 member companies.

According to E. P. Gertsch, WCEMA president, the electronics industry of the West in the fastest growing field in the area and will maintain a volume this year of more than three-quarters of a billion dollars, principally in complex

gear for the military.

Larson has been active in the electronics industry in California for the past eight years, serving with Hoffman Radio Corp. During that time he has held various offices in WCEMA, including director and secretary.

Clevite-Brush Elects Fraser

FRANK FRASER has been named administrative vice-president of Clevite-Brush, the product development unit of Clevite Corp.

Fraser has been weapons director of Brush Electronics, also a Clevite unit. He worked with Libbey-Owens-Ford Glass Company for 22 years until the end of World War II, serving in several executive positions. He is an inventor and holds 28 patents in this country and abroad.

Army Electronic Proving Ground Grows

A LARGE-SCALE housing development is one of the first steps in reactivating Fort Huachuca, site of the army's new electronic proving ground in Southern Arizona.

The army has designated the fort a permanent post.

Brig. Gen. Emil F. Lenzer, Huachuca's commanding officer, has indicated he will apply for 500 units of Wherry housing. These are homes built on permanent bases by private contractors then supervised for rentals and utility services by the government.

Huachuca's ultimate work force

will be 8,500, including about 1,000 civilians and specialists.

The army has announced that as an electronics proving ground, Huachuca will provide facilities for developing operational doctrine, procedures, and techniques for communication systems and equipment. It also will serve as testing ground for electronic warfare and battlefield surveillance technique and equipment, combat operations, research, and Signal Corps activities.

Hammarlund Names C. L. White

C. L. WHITE has been appointed chief liaison engineer of Hammarlund Manufacturing of N. Y. C. He will coordinate engineering and sales activities relating to industrial applications of telemetering and remote control to petroleum refineries, pipe lines, railroads, public utilities and other heavy industries.

White came to Hammarlund from R. B. Barnhill Associates of Baltimore, who represent Hammarlund. Previously he was associated with the Brown Instrument Co. in Baltimore, Chicago and Detroit.

GE To Build New TV Set Warehouse

A NEW 91,450 sq ft warehouse is being built for GE's radio and television department at Electronics Park.

The expansion is to permit increased production and a speed-up of shipments of television receivers to the department's customers.

The new warehouse will be an ad-

dition to the present radio and television department building and will increase the capacity of the present warehouse by about five and a half times. The structure and its equipment will cost in excess of $1,500,000, and will be used for warehousing of up to 40,000 tv receivers.

Total available manufacturing and warehousing space, after completion of the new warehouse, will be 393,678 sq ft. The building also houses the engineering, sales and administrative functions of the department.

Block Joins Burroughs Division

I. EDWARD BLOCK has been appointed computer consultant by Burroughs' Electronic Instruments Division, Philadelphia.

The mathematical specialist, who two years ago co-founded the Society for Industrial and Applied Mathematics (S.I.A.M.), will serve as technical liaison to customers who rent the services of Burroughs Unitized Digital Computer.

Block also will establish a computer training course planned by Burroughs for scientists and engineers from firms who make use of the UDEC computer.

Dr. Block comes to Burroughs from Philco where for three years he worked in the research division as mathematical consultant on electronic problems.

Previously Block worked on the development and testing of radar devices for the Naval Research Laboratory in Washington, D. C. Block is now secretary of S.I.A.M.

and an editor of the society's quarterly journal.

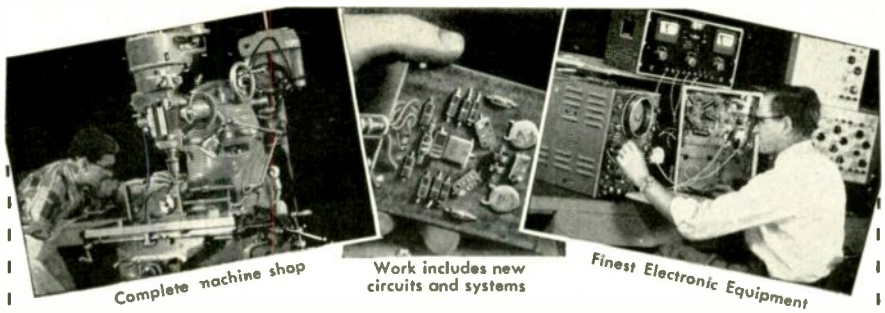
Engineers Attend Education Meeting

LEO A. DUBRIDGE (center), president of the California Institute of Technology, inspects the original betatron at the 50th anniversary exhibit commemorating the founding of the University of Illinois and Iowa State College engineering experiment stations. George Town (left), associate director of the Iowa station and F. Wheeler Loomis of the University of Illinois look on. DuBridge was a main speaker at the 62nd Annual Meeting of the American Society for Engineering Education held at the University of Illinois, Urbana.

More than 1,400 engineers—mostly teachers from colleges in every state of the union and many foreign countries—registered for the A.S.E.E. meeting. They urged the devotion of more time to the basic sciences, engineering science and the humanities—at the expense of engineering art or practice.

Nathan W. Dougherty, dean of engineering at the University of Tennessee, was elected president for the coming year of the American Society for Engineering Education.

Leo J. Lassalle, dean of the College of Engineering at Louisiana State University, was named vice-president for the Society's instruc-



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Senior engineers to handle design and development projects and provide technical direction of other top-level engineers working on microwave circuits and microwave plumbing in the development of military airborne electronic equipment. Should have 5 years' experience in such work and at least a BS degree.

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INTERVIEWS BY APPOINTMENT

Don Bradley, Personnel Manager, Boston Engineering Lab.

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- Ball Bearing Swivel Rubber tired Casters.
- Constructed of Aluminum. Features 2 Shelves for Equipment and a pan for test leads, notebooks, etc.
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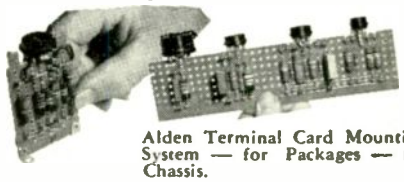
Alden Components for Plug-in Unit Construction enable you to design to these Bold New Standards —

1. Circuitry subdivided function by function into plug-in units.
2. Tiny Tell-Tales spot troubles instantly.
3. Plug in replacement spares in 30 seconds.
4. All leads brought to single accessible point of check, numbered and color coded so layman can make first-level tests.

It's as simple as this —

1 **Organize your circuitry function by function in compact vertical planes using Alden Terminal Mounting Cards, Ratchet-Slot Terminals and Card-mounting Sockets.**

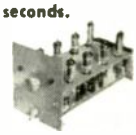


Alden Terminal Card Mounting System — for Packages — for Chassis.

2 **Mount the circuitry planes in Alden Plug-in Packages and Basic Chasses which can be yanked out and replaced in 30 seconds.**

ALDEN PLUG-IN PACKAGES 7, 9, 11 & 20-PIN

ALDEN BASIC CHASSIS 2", 4", 8" & 17" WIDTHS



3 **Monitor each plug-in unit with tiny Alden Tell-Tales that spot trouble instantly, permit checks while operating, from front of panel.**

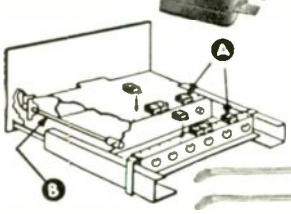
ALDEN MINI-TEST POINT JACK #110BCS

ALDEN MINIATURE PAN-I-LITE #86L

ALDEN MINIATURE FUSE-LITE #440-4FH

4 **Centralize unit interwiring at a single accessible point of check, with Alden Back Connectors and Serve-A-Unit Lock which allow color coding and symboling that "reads like a book".**

A — ALDEN BACK CONNECTORS bring all leads to single accessible check point.



B — ALDEN SERVE-A-UNIT LOCKS pilot, draw in, lock, eject chassis with half turn of the wrist.

ALL THIS CAN BE ACCOMPLISHED WITH STANDARD ALDEN COMPONENTS

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tional division activities, and Harold K. Work, director of the research division in the College Of Engineering at New York University, vice-president in charge of the Engineering College Research Council.

Continuing as association vice-presidents are William L. Everitt, dean of the College Of Engineering at the University of Illinois, and B. R. Teare Jr., dean of the College Of Engineering And Science at Carnegie Institute Of Technology and as treasurer, Prof. G. W. Farnham, editorial director for engineering and technical books at Ronald Press.

Automation Firm Formed In New York

AUTOMATION ASSOCIATES, a consulting organization primarily concerned with printed circuits, has been organized in New York City by Paul L. Anderson and John A. Zagusta.

Anderson was previously sales manager of Circuitron and also involved in production. Before that, he was with Spaulding Fibre in printed circuit materials, design and application work. Zagusta was formerly chief engineer of Circuitron.

Sylvania Opens New Warehouse

SYLVANIA has begun operations in the new 110,000-sq ft warehouse and sales offices it has leased in Teterboro, N. J. The new facility consolidates several sales and service facilities that previously had

been situated in various locations in the metropolitan New York City area.

The facility contains 99,000 sq ft of warehouse space and 11,000 sq ft are devoted to sales offices.

American Phenolic Promotes Soria

RODOLFO M. SORIA has been appointed director of engineering of the American Phenolic Corp. succeeding Richard M. Purinton, recently resigned vice-president who is representing the company in the New England area.

Dr. Soria, head of the development division of the company, assumes full responsibility for all Amphenol engineering functions. He joined Amphenol in August 1946. He is the 1954 president of the National Electronics Conference.

Symposium For Applied Solar Energy Planned

A WORLDWIDE SYMPOSIUM on applied solar energy will be conducted at Phoenix, Ariz., Jan. 12 through 15, 1955 with at least 50 scientists and 100 businessmen integrating ideas.

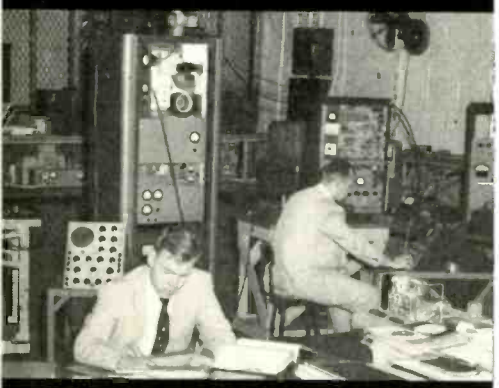
The whole project is the idea of Henry B. Sargent, president of Arizona Public Service Co. In collaboration with the Phoenix branch of the Stanford Research Institute, Sargent interested a group of Arizona business leaders in forming the Association for Applied Solar Energy. Lewis W. Douglas, former ambassador to Great Britain, now an Arizona rancher, is general chairman.

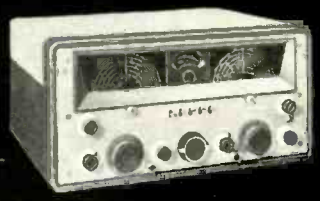
A fund of $25,000 was raised to bring top-flight scientists of the world to Phoenix to meet with business research men.

Lennox Transfers Production To Park

LENNOX ENGINEERING Associates of Cleveland, Ohio, transfers all high production manufacturing to Park Products in Cleveland. The products transferred include the dual ring centering device and ion traps.

Lennox will continue to do con-





sulting, research and design work in the electronic and electro-mechanical field.

The following Lennox personnel are also being transferred to Park Products: Leonard T. Leonard, Charles MacFarland, Anthony Snyder, James Anderson, Janet Manburg and Theodore Rusnak.

Federal Laboratories Names Valentine

JAMES M. VALENTINE was appointed sales manager of Federal Telecommunication Labs' television branch in Lodi, N. J.

Valentine has been associated with IT&T since 1951. From 1951 to 1952, he made his headquarters in Buenos Aires, where he was in charge of the installation and operation of LR-3-TV, the first television station in Argentina. For the past year, he has been with International Standard Electric supervising the planning and installation of foreign television stations.

From 1945 to 1947, he was a member of the color television development group of CBS and was in charge of the development and construction of color television cameras and studio equipment. From 1947 to 1948, he was television sales engineer in the Transmitter Division of Du Mont Laboratories. From 1948 to 1951, he was television engineering manager for the central division of ABC.

Kellogg Names Engineering V-P

ROY S. REDMON, chief engineer for the Kellogg Company since 1944, was appointed vice-president in charge of engineering for the firm.

Redmon joined Kellogg in 1938 as plant engineer for the Battle Creek plant. Prior to that he was associated with Stone & Webster Engineering in both its construction and engineering divisions.

R. R. Jenner Named By Micro Switch

R. R. JENNER, formerly chief radio and electronics engineer for Beech Aircraft, has been appointed to the

newly created post of director of airborne products for Micro Switch, a division of Minneapolis-Honeywell.

He will be directly responsible for the design and production of all products destined for use in the aircraft industry.

He served 14 years as chief radio and electronics engineer for Beech. In that capacity he was in charge of the research, design and development of all electrical and electronic components for aircraft which that firm manufactures.

Horrocks Heads Aerovox Special Products Division

STANLEY W. HORROCKS was named general manager of the special products division of Aerovox Corp. at New Bedford, Mass.

He is responsible for the engineering, manufacturing, market analysis and development for products of the division which include printed-wiring and a new line of ceramic power and transmitting capacitors. The purpose of the division is to develop and produce new materials and products. Horrocks is also general manager of Precision Ceramics, an operation jointly owned by French interests and Aerovox.

Before joining Aerovox, Horrocks was with RCA for 18 years in various managerial, supervisory, and engineering positions. The last few years he was manager of the component products operation of RCA Victor and earlier progressed in various positions at RCA electron tube plants.

Rensselaer Presented Automatic Equipment

AUTOMATIC CONTROL equipment worth $14,000 has been donated to the electrical engineering department at Rensselaer Polytechnic Institute, at Troy, N. Y. by Servomechanisms, Inc. of Westbury, N. Y., and Technology Instrument Corp. of Acton, Mass.

The sets of apparatus are expected to prove a valuable asset in both teaching and research at the Institute.

The units donated by the two

companies are sufficient for setting up 12 different complete automatic control systems.

It includes 300 precision gears of varying sizes, 12 linear potentiometers, 12 servo motors, 12 amplifiers, 12 power supplies, 130 bearing blocks, 60 mounting blocks, 12 dial assemblies, 12 terminal boards and 12 foundation boards. These are enough parts to set up 12 complete units, with 10 to be used in teaching or research and two to be held in reserve.

New Philadelphia Company Formed

WINSTON ELECTRONICS of Philadelphia, has been organized to design, produce and market quality test instruments for electronic service and industry. The company is currently introducing a line of color television test instruments. It is also engaged in research and development on techniques to simplify the servicing of color tv and reduce the cost of color service instruments.

Baldwin-Lima Acquires Peters

BALDWIN-LIMA-HAMILTON Corp. of Philadelphia acquired all outstanding stock of the O. S. Peters Co. in Washington, D. C., manufacturers of devices for materials testing equipment and electronic specialties.

No changes are contemplated in the personnel or location of Peters.

The addition of these product lines in the electronics field expands Baldwin's business to 40 product lines with more than 100 markets.

Officers Elected By AIEE

A. C. MONTEITH, vice-president in charge of engineering and research at Westinghouse, was elected president of the AIEE. He succeeds Elgin B. Robertson and will serve until Aug. 1, 1955.

Vice Presidents elected by the Institute included: G. J. Crowdes, of Simplex Wire & Cable; J. P. Newbauer of Consolidated Edison;

Claude M. Summers of GE; S. M. Sharp of Southwestern Gas & Electric and John R. Walker of U. S. Bureau of Reclamation.

Directors, elected for four years, were: L. F. Hickernall of Anaconda Wire & Cable; Roy E. Kistler of Pacific Telephone & Telegraph and Edwin S. Lammers, Jr. of Westinghouse.

Walter J. Barrett of New Jersey Bell Telephone was re-elected treasurer for one year.

United-Carr Fastener Acquires Palnut

ALL OF THE CAPITAL stock of the Palnut Co. of Irvington, N. J. has been acquired by United-Carr Fastener of Cambridge, Mass., on a share for share basis. A total of 38,710 shares is involved.

The Palnut management, headed by J. R. Hotchkin, president, will continue in their present positions. Palnut, maker of a line of lock nuts, will be operated as a one hundred percent owned subsidiary of United-Carr.

New Transistor Company Formed

STANLEY WEBSTER Laboratories of Elmhurst, Ill. has been organized to manufacture speech and hearing aid devices and a line of transistor products. Products are expected to be ready for early fall delivery.

Stanley Webster, president of the new firm, is formerly director of research and engineering of Beltone Hearing Aid Co. and former vice-president of Otarian in charge of engineering and manufacturing.

Stewart-Warner Elects Archambault

BENNETT ARCHAMBAULT was elected president and a director of Stewart-Warner.

J. S. Knowlson was re-elected chairman of the board and other incumbent officers of the company were re-elected. The new president has been vice-president and general manager of M. W. Kellogg and was with Kellogg for nine years.

During World War II Archambault headed activities in the

European Theater of Operations for the Office of Scientific Research and Development, which, under the direction of Dr. Vannevar Bush, had responsibility for development of new weapons and equipment for the three armed services.

Hughes Expands Arizona Plant

HUGHES AIRCRAFT is spending $1.6 million to expand its guided missiles plant at Tucson, Ariz. The project calls for 22 buildings on a square mile of desert.

This will bring to more than $14 million, the amount the government has allotted Hughes plants at Tucson for manufacture of the top-secret F-98 Falcon, an air-to-air missile carried by the delta-wing F-102, Consolidated Vultee's supersonic fighter-interceptor.

The Tucson electronics plant has a work force of nearly 3,000.

New Instrument Firm Formed in California

FORMATION of Electro-Instruments of San Diego, California was announced by Jon Edwards, formerly vice-president and chief engineer of Non-Linear Systems. The new company will manufacture electronic instruments for the data processing field as well as instrumentation for automatic testing and control. It is currently manufacturing digital voltmeters at its new plant in San Diego.

Universal Winding Acquires Patterson, Moos

UNIVERSAL WINDING of Providence, R. I., manufacturers of coil winding machinery for the electric and electronic industries and textile twisting and winding machinery, have acquired the business and personnel of Patterson, Moos and Co's a research and development organization.

The activities of Patterson, Moos, which now becomes the Patterson, Moos division of Universal Winding, have been in the fields of nuclear physics and electronics. For the past six years they have been

doing basic research and development for the Department of Defense and bring with them a backlog of contract and development work that will be continued under Universal's management.

Universal plans to continue the operations of the new division at its present location in Jamaica, New York, and will retain present personnel.

The activities of the Patterson, Moos division will continue in the same fields as previously and under the guidance of Anthony M. Moos, David F. Doody and their subdivision heads.

I-T-E Acquires Bulldog Electric

THROUGH an exchange of common stock, BullDog Electric Products of Detroit has become a subsidiary of I-T-E Circuit Breaker. BullDog will continue to operate under its own corporate name with William H. Frank remaining as president of BullDog and with the same personnel and policies. William H. and Henry E. Frank of BullDog will shortly join the board of directors of I-T-E.

New Brazilian Plant For RCA

RCA reportedly plans to build a $1.5 million Brazilian factory which will produce 6 million radio tubes per year. The company also plans to increase its production of records, tv sets and radios in Brazil. The goal is to double its present output in that country within 3 years.

Electronic Engineering Forms New Subsidiary

THE EECO PRODUCTION Company, a wholly-owned subsidiary of the Electronic Engineering Co. of California, has been officially incorporated.

Organized to manufacture plug-in electronic circuits, electronic counters plus other products for the industry, the new company was formerly operated as a division of Electronic Engineering.

T. E. Coalson will serve as manager of the new company. He was formerly manager of the division.

NEW BOOKS

Transistors, Theory and Practice

BY RUFUS P. TURNER, *Gernsback Library No. 51., Gernsback Publications, Inc., New York,* 1954, 144 *pages, paper cover,* $2.00.

IN THIS book, Rufus P. Turner has managed to anticipate many of the questions that arise in the minds of engineers and technicians trying to absorb enough information about transistors to put them to use in practical circuits.

The theoretical discussion is simple, and yet quite accurate. Useful equivalent circuits are explained, and actual transistor amplifiers and oscillators are described complete with component descriptions, operating voltages and transistor types.

Separate sections are devoted to transistor trigger and switch circuits, and to methods and equipment for determining characteristics and testing. A complete list of transistors currently on the market, along with pertinent information regarding their intended purposes and operating characteristics, is included.

The transistor beginner will especially appreciate the one-page section entitled, "Care and Feeding of Transistors". The veteran's reaction to this section will probably be, "Why didn't somebody tell *me* that." This section lists 16 suggestions for preventing damage to transistors through improper connections. The book is recommended for those who have not had the opportunity to study transistor literature. Aside from providing a great deal of useful data itself, the book contains a good list of recommended reading for those who require additional details.—J. D. FAHNESTOCK, *Potter Instrument Co., Inc.*

Low Frequency Amplification

BY DR. N. A. J. VOORHOEVE. *Philips' Technical Library, Elsevier Press, Inc., Houston, Texas,* 1954, 497 *pages,* $9.00.

A COMPREHENSIVE exposition of the many facets of low-frequency amplification. More precisely, the

subject is concerned with amplification of frequencies in the audio spectrum. There is no concern with the still lower frequencies, as employed, for example, in such applications as geological survey. Its presentation, although somewhat pedantic in nature, covers an extensive field.

In addition to the basic principles of vacuum tubes and audio amplification, attention is given to their utilization with transducers for the recording and reproduction of sound in disc, magnetic and sound-on-film recording systems. It is illustrated throughout with electronic equipment of European origin, probably of slight familiarity to U. S. readers. Similarly, its extensive bibliography, while including many of our publications, consists largely of foreign references ordinarily not accessible to readers on this side of the Atlantic. Performance characteristics, such as for vacuum tubes, phonograph reproducers, microphones, etc, are concerned entirely with European products unfamiliar if not practically unavailable to U.S. markets.

Although the preparation of this textbook was excellent and thorough, by European standards, it cannot be enthusiastically recommended to the audio engineer engaged in his profession in this country. There is little to substantially advance his interests or increase his knowledge over the present state of the art as currently presented in the more familiar idiom of U. S. technical publications.—PRICE FISH, *CBS Television, New York, N. Y.*

Inventions and Their Protection (2nd Edition)

BY GEORGE V. WOODLING, *Matthew Bender and Co., Inc., Albany, New York*, 1954, 495 *pages*, $10.00.

AS A what to do and what not to do reference manual relating to inventions and their protection by patents this volume will make a valuable addition to the library of executives and engineers alike. The usefulness of the book is not limited to patent attorneys.

The chapters of the book are arranged so as to provide needed information on such matters as

patent law, exploitation, prosecution, infringement, licensing and the like. A chapter on the ownership of patents with respect to employer-employee relationships includes a discussion of such matters as employee incentive plans to stimulate invention, and the legal questions of ownership of inventions in the patent office and in the courts.

The new patent codification act of 1952 is extensively discussed with relation to its provisions regarding patentability and the tests therefor. In addition suggestions are presented as to how to avoid such delays as may lose an inventor his right to a patentable invention under the new act. In particular various factors which create a statutory bar to obtaining a patent are presented. These include such things as prior publication, wrong inventors, improper joinder of inventors, one year of public use, prior use in foreign countries, and so on and on. These details of what constitute statutory bar are most important in the patent protection of industrial property. From the author's wide experience in both the electrical engineering fields and his patent practice he has promulgated a set of rules to follow in preparing patent applications to obtain the strongest patent protection.

Copyrights and trade marks are also covered in their relation to the legal protection of this type of industrial property.

Whatever problems come up in relation to patent protection of inventions, the engineer or executive seeking a how-to- and how not-to-proceed answer is likely to find it in this valuable book.—NORMAN L. CHALFIN, *Patent Engineer, Hughes Aircraft Company, Culver City, Calif.*

The Law of Electrical Invention

BY FRANK GROOM KIRTZ, *Matthew Bender & Co., Inc., Albany, New York*, 1954, 742 *pages*, $16.50.

AN ATTEMPT to review fully a work so large as this and so needed in the field of electrical patents would require a small volume in itself.

Since 1953, in so far as the

Official Gazette of the U. S. Patent Office is concerned, separate attention has been given to "Electrical" patents, "Chemical" patents and "General and Mechanical" patents. This separate listing is significant of the importance of electrical technology (readers of ELECTRONICS may substitute "electronic technology") in industrial and scientific development.

It has been pointed out by Dr. Kirtz in his introduction that electrical and chemical patents constitute about 75 percent of those litigated in current practice and the greater number of these appear to be electrical. The courts presently concern themselves more with the mental processes that inventors go through in the development of their inventions than in the final result.

The first section of this book provides a detailed analysis of what constitutes invention. The second discusses the conditions which distinguish electrical invention and the granting of patents for them.

A third section of the book is of particular value to the engineer because in it are included data relating to disclosure of electrical inventions. The drawings, the claims and the many little "tricks" of the patent "triode" so to speak are pointed up so as to avoid improper patent coverage.

In the final sections of the book details of the writing of claims to electrical patents are discussed with extensive reference to what has been decided in the courts as to the validity of various types of claims.

Especially valuable are the discussions of infringement of patent claims and how they are handled by the courts.—NORMAN L. CHALFIN, *Patent Engineer, Hughes Aircraft Company, Culver City, California*

Elliptic Functions

BY F. BOWMAN, *Head of the Department of Mathematics, College of Technology, Manchester, England, John Wiley & Sons Inc., New York, N. Y.*, 115 *pages*, 1953, $2.50.

THIS small volume is a compact and concise introduction to the rather complicated class of mathematical tools known as elliptic functions. It

is restricted to the Jacobian forms. The text and examples are suited to a one-semester course on this subject for graduate students in physics having some preparation in the theory of functions of real and complex variables.

The presentation in this book is aided by some diagrams, often neglected in treatises on mathematics. The principal emphasis is directed to conformal mapping of polygons, a fascinating branch of field geometry that is still advancing in its general familiarity and applications. As compared with Oberhettinger and Magnus (in German) on this subject, the present volume covers much less territory. However, it does present a few of the author's specialties seldom found elsewhere, such as the case of two concentric squares.

The author achieves his objective of presenting an introduction to the subject. This will serve as a nucleus for the student or researcher who may wish to expand his knowledge and practice in other current works such as Oberhettinger and Magnus (a well illustrated intensive reference on conformal mapping), Byrd and Friedman (an extensive collection of elliptic integrals) and Milne-Thompson (a short numerical table of elliptic functions). The graphical presentations by Jahnke and Emde are always helpful in comprehending this subject.—HAROLD A. WHEELER, *Wheeler Laboratories, Inc., Great Neck, New York*

Proceedings NEC, 1953

AVAILABLE FROM NATIONAL ELECTRONICS CONFERENCE, 84 *East Randolph St., Chicago, Ill.*, 958 *pages*, 1954, $5.00.

ANNUALLY the papers of this important conference represent a bird's eye view of progress in the many-sided electronics art. From the publishing standpoint this book is a good buy from any aspect.

As customary the volume is divided into broad subjects with all the many papers grouped under these broad headings. Thus the natural divisions are Circuits, Magnetic Amplifiers, Audio and Microphonics, Servomechanisms, Ultrasonics, Materials and Components, Filters, Television, Tubes,

Nucleonics, Computers, Networks, Transistors, Instrumentation, Microwaves, Communication, and Engineering Management. In addition the tables of contents of previous volumes are included in an appendix.

While each engineer would find high spots of interest in this book which depended upon his individual field of interest, this reviewer found especially stimulating the paper "Electronic Components, Selecting the Right One for the Job Automatically" by R. A. Corby of the Battelle Memorial Institute. Under contract to the Air Force BMI has developed a most intriguing system for selecting components rapidly by means of punched cards and automatic machines, a system known as ECIC (Electronic Components Information Center).

Another interesting paper describes the induction public address system developed by Shure Brothers and revealed in a paper "Vagabond Wireless Microphone System" by Thomas W. Phinney.

A careful perusal of this big volume will reveal many other interesting aspects of electronics as well as non-technical papers useful to management.—K.H.

Fundamentals of X-ray and Radium Physics

BY JOSEPH SELMAN. *Charles C. Thomas, 301-327 East Lawrence Ave., Springfield, Ill., 340 pages, 1954, $8.50.*

AN ELEMENTARY book for student x-ray technicians, written with the greatest of simplicity and with every attempt to make as painless as possible the acquisition of some knowledge of elementary mathematics, physics and chemistry.

The mathematics portion consists of the elements of arithmetic, algebra, proportion, curves and graphs. This is followed by material on the constitution of matter, data on electric currents, motors, vacuum tubes, and a general background for the greater portion of the volume, which deals with x-ray techniques.

The considerable amount of material on radium and other sources

of radiation, of methods for protection against overexposure and for improving radiographic quality and other highly significant and important aspects of the laboratory technicians work makes the text up to date and eminently useful.—K.H.

THUMBNAIL REVIEWS

History of the School of Engineering, Columbia University. By James Kip Finch, Columbia University Press, New York, N. Y., 138 pages, 1954, $2.75. How the School of Engineering has paralleled in its evolution the growth of this country. Dean Finch has been identified with Columbia for more than fifty years.

Optical Image Evaluation. National Bureau of Standards, Circular 526, 289 pages, 1954, $2.25. Proceedings of the NBS Semicentennial Symposium October 18-21, 1951. Twenty papers from American and foreign scientists covering old and newer methods.

Mathematical Data Book. Lefax, Philadelphia 7, Pa., 176 pages, 1954, $2.25. Looseleaf pocket manual of tables of logs, trigonometric functions, etc.

Bibliography on Filing. Engineering Societies Library, 29 West 39 St., New York 18, N. Y. ESL Bibliography No. 9., 79 references, 18 pages, 1954, $2.00. Selected references for engineers and librarians concerned with organizing their own files and dealing with filing, classification and indexing.

Who's Who in Electronic Distribution. 845 Leader Bldg., Cleveland 14, Ohio, 376 pages, 1954, $7.50. Buyer's guide for purchasers of radio-television-electronic components and equipment.

Zirkonium. By Werner Espe, C. F. Winter'sche Verlagshandlung, Fussen Bavaria, Germany, 75 pages, 1953. In German. Techniques for working with zirconium including its use as a getter.

Standards in a Changing World. American Standards Association, 70 East 45 St., New York, N. Y., 80 pages, 1954, $3. Proceedings of the Fourth National Standardization Conference, New York, October 1953. Sessions on industrial noise, quality control, design and production in electronics.

Statistical Theory of Extreme Values and Some Practical Applications. By E. J. Gumbel, National Bureau Standards Mathematics Series N 33, 51 pages, 1954, 40¢. A monograph resulting from series of lectures at NBS and useful to engineers having problems involving extremes of pressure, temperature, loading and breaking strengths.

BACKTALK

Tube Reliability

DEAR SIRS:

IN THE published version of our article on the reliability of electron tubes in military applications (p 130, March, 1954), we note that certain points have suffered somewhat in the condensation necessitated by publication requirements.

One fact which we particularly desire to call to your readers' attention is the important part played by the Cornell University School of Electrical Engineering in the laboratory analysis of defective tubes collected by Aeronautical Radio, Inc., at military bases. This valuable work, which is still continuing, was carried on under the competent direction of Professor Walter Jones until his untimely death . . .

With respect to other information which could not be included or is not presented as precisely or fully as we might have wished, we hope that interested readers will refer to the full report on which the article is based.

Considering the article as a whole, we feel that you have done a good job of condensing the original version and highlighting the major findings.

E. R. JERVIS
J. SWANGER
Aeronautical Radio, Inc.
Washington, D. C.

Zero Output Impedance

DEAR SIRS:

WITH REFERENCE to Drisko & Darrell's amplifier (ELECTRONICS, p 130, March 1952), and to the correspondence on it (p 420 Oct. 1952; p 362 Jan. 1953), I would offer these comments.

It has been established (and published) that omitting cathode bypass capacitors in push-pull stages is beneficial and helps to achieve better balancing in all classes except class AB_2 and class B equipment.

It is perhaps doubtful whether 12 watts of horn-load tweeter output are beneficial for any use except the concert hall. Most tweeters are of the ribbon form (over here) and they will certainly not take 12 watts.

For baffle-loaded M.C. loud

speakers there is no virtue in zero output impedance. This your authors' admit!

The major criticism against the authors' amplifier is in the use of a very expensive output transformer when comparable results can be obtained at a cheaper cost.

One transformer available here is an excellent job but it costs about 9 to 10 pounds. It was originally meant to give 50 watts with only 0.5-percent distortion without feedback. No wonder it gives virtually zero distortion at only 12 watts and less than 0 db N.F.

This transformer is made so that enhanced feedback (20 db) can be taken from the secondary. It's a waste of its good properties not to do so. Of course it is conceded that the authors' amplifier would not present sufficient gain at the secondary to give 40 db feedback, and primary feedback is the only course open to them.

In their reply (p 362, Jan. 1953), the authors seem unnecessarily sceptical over amplifiers not published in ELECTRONICS. If they will consult *Wireless World* for January, 1948 they will see a 10-watt 6L6 amplifier with 36-db feedback and only 0.1-percent distortion. Moreover the transformer costs only about half as much as the ones previously mentioned.

In their reply, the authors seem to belittle balancing as a device to level out tube life. . . . Williamson stated that his object was to eliminate saturation on d-c magnetization and thereby preserve at low frequencies the results obtained at higher frequencies.

It is to be regretted the authors never gave more details of their screen feed system that keeps anode current constant.

F. B. WHITE
London, England

Tone Compensation

DEAR SIRS:

IN THE May issue of ELECTRONICS, page 184, appears an article by Mr. Ed C. Miller entitled "Signal-Operated Tone Compensation". While it may well be that the circuit described will do what the author

claims, this writer wonders whether the premise upon which the desire to tone compensate by signal control is justified in the first place.

The writer agrees that while tone compensation is desirable to take care of the difference in level between what is heard in the concert hall and the level used in reproduction in the home, the famous loudness control being well established among audio engineers, it is believed that the use of tone compensation controlled by signal level is illogical.

How, in Mr. Miller's opinion, does his circuit discriminate between reduction of home reproducing level versus concert hall level on the one hand and the, say, piano or pianissimo versus forte or fortissimo playing of the performing artist?

ULRIC J. CHILDS
Audio Engineer
New York, N. Y.

Polarity

DEAR SIRS:

THE TRANSISTOR circuit diagram of Fig. 1 on page 169 of the April issue of ELECTRONICS is incorrect. The 4.5-volt base biasing battery is reversed in polarity. In order for the circuit to operate correctly the base must be negative with respect to the emitter.

ROBERT L. RIDDLE
Asst. Prof. of Elect. Engr.
The Pennsylvania State University
State College, Pennsylvania

Silicon Diodes

DEAR SIRS:

WE HAVE noted . . . page 12 of May ELECTRONICS, you indicated "Transistor products of Melrose, Massachusetts" has silicon diodes commercially available . . .

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Sales Engineer
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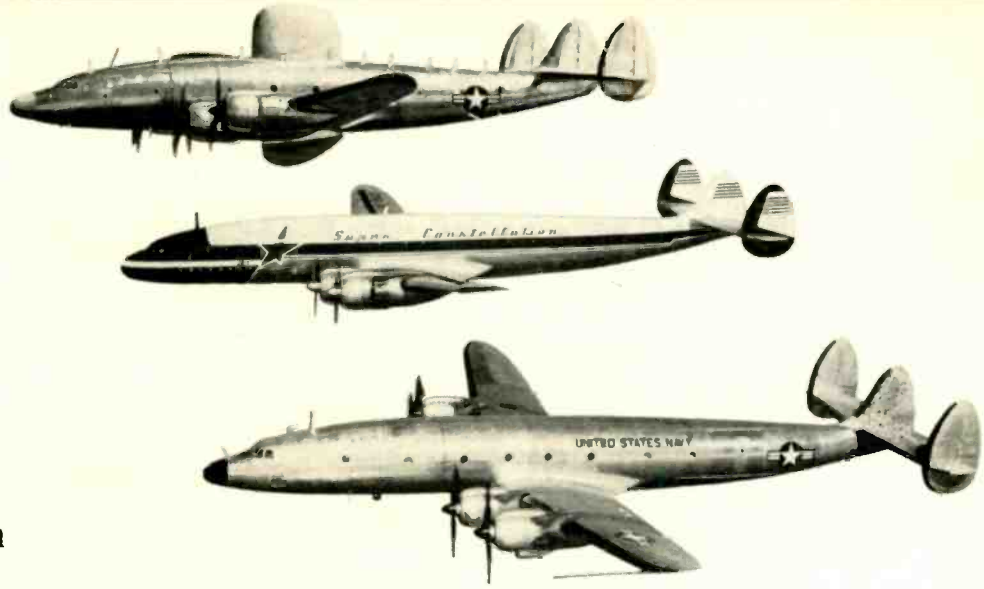

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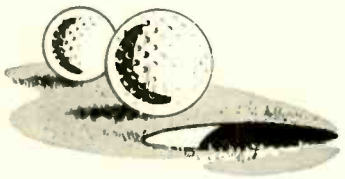

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Desire men with B.S. degree or above. Salary commensurate with education and experience. Free health, accident and life insurance. Free hospitalization. Profit Sharing. Paid holidays. Sick leave. Vacations. Ideal working conditions. Plenty of housing, reasonably priced. Excellent schools. Exceptionally mild and dry winter climate.

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Five or more years' experience on tube development. Familiarity with Microwave Tube development particularly desirable.

Work in Sylvania's expanding Traveling Wave Tube Development Program at the

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1⅛" spur gear. 72 teeth. 1" gear, 31 teeth. Size: 2⅜" long x 1⅛" dia.

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2"—96 teeth—48 pitch gear; 4" of 48 pitch, 12 teeth pinon wire. Size: 8½" long x 4⅜" wide x 2" high.

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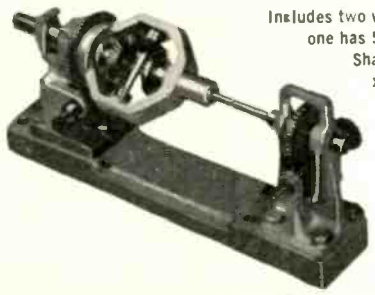
Includes two worm gears, 24 pitch . . . one has 50 teeth, other 40 teeth. Shaft ½". Size: 11¼" long x 3¼" wide x 5½" high.



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Three spur gears. Size: 7½" long x 1¾" wide x 2¾" high.

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1:1 reverse ratio, 60 teeth on large gear; ¼" shaft. Size: 3" long with 1-15/16" dia.

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System includes seven gears and spider. Size: 5¼" long x 3½" wide x 3" high.

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1:1 reverse ratio on both. Size: 3¼" long x 1-7/16" dia. Shaft size: ⅛" and 5/32".

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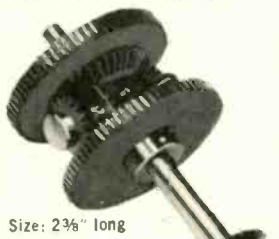
$7.50 ea.

SIMPLE DIFFERENTIAL

Size: 5½" long x 2¼" dia. Shaft size: ⅜" on one end and 11/32" on other end. Hub is 1-3/32" dia. on each end.

$7.50 ea.

SPIDER DIFFERENTIAL



Size: 2⅜" long x 1-3/16" dia. Shaft size: ⅛".

$2.50 ea.

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1:1 reverse ratio, ring gear 3" dia., 120 teeth. Overall length 5¼", shaft dia. 11/32", ⅛" key on one end.

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COMMUNICATIONS EQUIPMENT CO.

MICROWAVE COMPONENTS

10 CM.—RG48/U Waveguide

10 CM ECHO BOX: Tunable from 3200-3333 Mc. For checking out radar transmitters, for spectrum analysis, etc. Complete with pickup antenna and coupling devices. $27.50

10 CM ANTENNA ASSEMBLY: 3000-3300 Mc. Parabolic Dish, 29 inch Diam. Fed from dipole Rotation: 360 Deg. Azimuth at speeds of 20 and 10 RPM. Tilt: 20 deg. above and below horizontal. Motor-Driven by 2-28V motors, 4.5 A Total Drain. Azimuth info. is fed to selsyn mechanism, and elevation data is obtained from Azimuth potentiometer. Net weight 65 lbs. $78.50

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" output connectors ..... $22.50 EACH

DIRECTIONAL COUPLER. Broadband type "N" Coupling, 20 db, with std flanges, Navy #CABV47A-AN-2 ..... $32.50

LHTR, LIGHTHOUSE ASSEMBLY. Parts of IT39 APG 5 & APG 15, Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG. To Recvr. Uses 2C40, 2C43, 1B27. Tunable approx. 2400-2700 MCS. Silver Plated $22.50

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721A TR BOX complete with tube and tuning plungers $12.50

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BEACON ANTENNA, AS31/APN-7 in Lucite Ball, Type "N" feed $22.50

ANTENNA, AT49A/APR: Broadband Conical, 300-3300 MC Type "N" Feed $12.50

"E" PLANE BENDS, 90 deg. less flanges $7.50

3 CM.—RG 52/U Waveguide

FLEX. WAVEGUIDE SECTION, 1 ft. long. With UG-40/UG-39 flanges. Attenuation is less than 0.1 db. at 9375 mc, and VSWR is less than 1.02. Rubber covered $7.50

3 CM ANTENNA ASSEMBLY: Uses 17" paraboloid dish, operating from 24 vdc motor. Beam pattern: 5 deg. in both Azimuth and elevation. Sector Scan: over 160 deg. at 35 scans per minute Elevation Scan: over 2 deg. Tilt: over 24 deg. $85.00

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VSWR Measuring Section: Consisting of 6" straight section, with 2 pick-up. Type "N" Output Jacks, mounted ½ Wave apart $7.50

RG52/U Waveguide in 5' lengths, fitted with UG 39 flanges to UG40. Silver plated ..... per length $5.00

Rotating-Joints supplied either with or without deck mountings. With UG40 flanges ..... each, $17.50

Bulkhead Feed-thru Assembly $15.00

Pressure Gauge Section with 15 lb. gauge $10.00

Directional Coupler, UG-40/U Take off 20db $17.50

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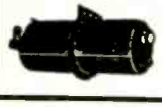
Microwave Receiver, 3 CM. Sensitivity: 10-13g Watts. Complete with L.O. and AFC Mixer and Waveguide Input Circuits, 6 I.F. Stages give approximately 120 DB, gain at a bandwidth of 1.7 MC. Video Bandwidth; 2 MC. Uses latest type AFC circuit. Complete with all tubes, including 723A/B Local Oscillator $175.00

ADAPTER, waveguide to type "N", UG 81-U, p/o TS 12, TS-13, Etc. $14.50

ADAPTER, UG-163/U round cover to special btl. Flange for TS-45, etc. ..... $2.50 ea.

3CM Motor-Driven Echo Box



Cavity Q is 30,000. Tuning range 80 mc. Motor operates from 24 VDC. Type "N" INPUT $32.50

1¼" x ⅝" WAVEGUIDE

VSWR SECTION, 6"L. with 2-type "N" pickups mounted ½ wave apart $7.50

GG 98B/APQ 13 12" Flex. Sect. 1¼" x ⅝" OD. .. $7.50

X Band Wave GD 1¼" x ⅝" O.D. 1/16" wall-aluminum ..... per ft. 75¢

Slug Tuner Attenuator W.E. guide, gold plated .. $6.50

BI-Directional Coupler. Type "N" Takeoff 25 db. coupling $22.50

BI-Directional Coupler. UG-52. Takeoff. 25 db. coupling $17.50

Waveguide-to-Type "N" Adapter. Broadband $17.50

JAN WAVEGUIDE FLANGES

UG 39/U	$1.10	UG 51/U	$1.65
UG 40/U	$1.25	UG 52/U	$3.40
UG 40A/U	$1.65	UG 52A/U	$3.40

CATHODE RAY TUBES

3FP7*	$1.50	5FP7*	$1.50
3EP1*	$2.50	*Mfrs. Quantity	

NOW HEAR THIS!!

U.S. Navy Spkr/amplifier Unit. Contains 4½" Bakelite Cone Speaker (7 lb. Perm. Magnet) ideal for tweeter, response to 18,000 CPS. "Built-In" amplifier uses 2-35L6 and 1-35Z5. Input: 6 mw (in 600 ohms) For 1.75 Watt Output: Used, excellent—Less tubes. **$17.50**

MAGNETRONS

Type	Freq. Range (MC)	Peak Power Out (KW)	Duty Ratio	Price
2J21A	3345-9405	50		$8.75
2J22	3267-3333	265		7.50
2J26	2992-3019	275	.002	7.49
2J27	2965-2992	275	.002	19.95
2J29	2914-2939	275	.002	44.95
2J31	2820-2860	285	.002	24.50
2J32	2780-2820	285	.002	28.50
2J38*	3249-3263	5		16.50
2J39*	3267-3333	8.7		24.50
2J48	9310-9320	50	.001	24.5u
2J49	9000-9160	50	.001	59.50
2J56*	9215-9275	50	.001	132.50
2J61†	3000-3100	35	.002	34.50
2J62†	2914-3010	35	.002	34.50
3J31	24-27KMC	50	.001	85.00
4J34	2740-2780	900		125.00
4J38	3550-3600	750	.001	169.45
4J42†	670-730	30	.003	169.50
5J23	1044-1056	475	.001	49.00
700B	690-700	40	.002	22.50
700D	710-720	40	.002	39.75
706EY	3038-3069	200	.001	32.50
706CY	2976-3007	200	.001	32.50
725-A	9345-9405	50	.001	7.50
QK259†	2700-2900	800	.001	249.50
QK60†*	2840-3005	.100	CW	85.00
QK61†*	2975-3170	.100	CW	85.00
QK62†*	3135-3350	.100	CW	85.00

*—Packaged with magnet.
†—Tunable over indicated range.

KLYSTRONS

723A	$12.50	2K25/723A/B	$27.50
723A/B	19.50	417-A	17.50

400 CYCLE TRANSFORMERS

(All Primaries 115V. 400 Cycles)

Stock	Ratings	Price
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352-7102	6.3V/2.5A	1.45
M-7472426	1450V/1.0MA, 2.5V/.75A, 6.4V/3.9A, 5V/2A, 6.5V/.3A, P/O 1D-39/APG-13	4.95
352-7039	640VCT @ 380MA, 6.3V/.9A, 6.3V6A 5V/6A	5.49
702724	9800/8600 @ 32MA	8.95
KS9584	5000V/290MA, 5V/10A	22.50
KS9607	734VCT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3VO.9A, 6.3V 25.A 6.3V/.08A, 5V/CA	6.95
352-7070	2x2.5V/2.5A (2KV TEST) 6.3V/2.25A, 1200/100/750V. @ .005A	7.45
352-7196	1140/1.25MA, 2.5V/1.75A, 2.5V/1.75A —5KV Test	3.95
352-7176	320VCT/50MA, 4.5V/3A, 6.3VCT/20A, 2x6.3VCT/6A	4.75
RA6400-1	2.5/1.75A, 6.3V/2A—5KV Test	2.39
901692	13V 9A	2.49
901699-501	2.77V @ 4.25A	3.45
901698-501	900V75MA, 100V/.04A	4.29
Ux8855C	900VCT/.067A, 5V/3A	3.79
RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/806MA5V/3A, 6V/1.75A	4.25
352-7098	2500V/6MA, 300, VCT, 135MA	5.95
KS 9336	1140V/50MA TAPPED 625V 2.5V/5A	3.95
M-7474319	6.3V/2.7A, 6.3V/.66A, 6.3VCT/21A	4.25
KS8984	27V/4.3A, 6.3/2.9A, 1.25V/.02A	2.95
52C080	650VCT/50MA, 6.3VCT/2A, 5VCT/2A	3.75
32332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
68G631	1150-0-1150V	2.75
80G198	6VCT/.00006 KVA	1.75
302433A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.5A, 2.5/3.5A	4.85
KS 9445	592VCT/118MA, 6.3V/8.1A, 5V/2A	5.39
KS 9685	6.4/7.5A, 6.4V/3.8A, 6.4/2.5A ALL CT	4.79
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/.027A	4.95
352-7069	2-2.5V Wdgs at 2.5A, Each Lo-Cap., 22Kv Test	5.95
352-7096	2.5V1.75A, 5V/3A, 6.5V/6A, 6.5V/1.2A, D/O BC800	4.95
352-7099	360VCT/20MA, 1500V/1MA, 2.5V/1.75A, 6.3V/2.5A, 6.3V.6A, P/O BC-929	6.45
D163253	5200V.002A, 2.5V/5A	5.35
M-7471957	2.5V/20A, 12KV Test	4.85
352-7179	250V/100MA, 6.5V/12ACT 5V/2A	3.45

TEST EQUIPMENT

TSX-4SE ANALYZER

3 cm. Spectrum analyzer, similar to TS 148, but with greater sensitivity. Freq. range: 8500-9600 MC. Features: Absorption wavemeter, waveguide-Beyond-cutoff attenuator, 20 mc I.F. Strip, 120 db gain. Operates from 115V/220 V, 50-1200 CPS
Price on Request

Sickles Model III Range Calibrator $365.00
TS 98A/AP Voltage Divided ..... $ 75.00
TS 90 Dummy Load, 50 Ohms Impedance will handle 500 watts at peak of 5000 volts divided ratio 50:1 ..... $145.00
TS 235/UP Dummy Antenna 500-1500 MC impedance: 50 Ohms 1000 watts average power $225.00

TSX-4SE	TS-12	TS-159
TS-35A	TS-56	TS-268
TS-47	TS-34	TS-238

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G.E. #3E (3-84-810) (8-2.24-405) 50P4T; 3 KV "E" CKT Dual Unit; Unit 1, 3 sections, 0.84 Microsec. 810 PPS. 50 ohms imp; Unit 2, 8 Sections, 2.24 microsec. 405 PPS 50 ohms imp. $6.50

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

KS8865 CHARGING CHOKE: 115-150 H @ .02A, 32—40H @ .08A, 21 KV Test $37.50

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KS9623 CHARGING CHOKE: 16H @ 75 MA, 380 Ohms DCR, 9000 Vac Test $14.95

G.E. 6E3-5-2000 50 P2T: 6 KV., "E" Circuit 0.6 usec /2000 PPS/50 ohms/2 sections $7.50

PULSE TRANSFORMERS

Westinghouse 4P37; Primary: 50 ohms imp, 750 v. Sec. 15 kv, 1000 ohms imp. Bifilar filament trans. built-in, delivers 12.6 c at 2.5 amp. (pri. 115 v, 400 cy.) $37.50

RAYTHEON WX 4298E: Primary 4KV., 1.0 USEC. SEC: 16KV-16 AMP DUTY RATIO: .001 400 CYCLE FIL. TRANS. "BUILT-IN" $42.50

WECO: KS 9948: Primary 700 ohms; Sec. 50 ohms. Plate Voltage: 18KV. Part of APQ-13 ..... $12.50

K35J45—Pulse Inversion: PRI: 5 KV PK. Pulse Negative. Sec: Pos. Pulse, 4 KV; 1 usec. and .001 DUTY RATIO $6.50

54J318-1 3 wdgs. Ratio: 1:1:1, 1.10 uh./wdg., 2.5 ohms DCR $3.50

GE #K-2449A

Primary: 9.33 KV, 50 ohms Imp. Secondary: 28 KV, 450 ohms. Pulse length: 1.0/5 usec @ 635/120 PPS, Pk Power Out: 1,740 KW Bifar: 1.5 amps. (as shown) ..$62.50

GE #K2748-A. 0.5 usec @ 2000 Pps. Pk. Pwr. out is 32 KW impedance 40:100 ohm output. Pri. volts 2.3 KV Pk. Sec. volts 11.5 KV Pk. Bifar rated at 1.3 Amp. Fitted with magnetron well $39.50

K-2745 Primary: 3.1/2.8 KV, 50 ohms Z. Secondary: 14/12.6 KV 1025 ohms Z. Pulse Length: 0.25/1.0 usec @ 600/600 PPS. Pk. Power 200/150 KW. Bifar: 1.3 Amp. Has "built-in" magnetron well $42.50

K-2461-A. Primary: 3.1/2.6 KV—50 ohms (line). Secondary 14/11.5 KV—1000 ohms Z. Pulse Length: 1 usec @ 600 PPS. PK. Power Out: 200/130 KW. Bifar: 1.3 Amp. Fitted with magnetron well. .$39.75

UTAH X-151T-1: Dual Transformer, 2 Wdgs. per section 1:1 Ratio per sec 13 MH Inductance 30 ohms DCR $5.00

UTAH X-150T-1: Two sections, 3 Wdgs. per section, 1:1:1 Ratio. 3 MH. 6 ohms DCR per Wdg. $5.00

68G711: Ratio: 4:1 Pri: 200V, Sec. 53V, 1.0 usec Pulse @ 2000 PPS, 0.016 KVA $4.50

TR1049 Ratio 2:1 Pri. 220 MH, 50 Ohms, sec. 0.75 H. DCR 100 Ohms $6.75

K-904695-501: Ratio 1:1. Pri. Imp. 40 Ohm, Sec. Imp. 40 Ohms. Passes pulse 0.6 usec with 0.05 usec rise $8.95

RAY UX 7896—Pulse Output Pri, 5v sec. 41v $7.50

RAY UX 8442—Pulse Inversion—40v + 40v $7.50

PHILCO 352-7250, 352-7251, 352-7287

RAYTHEON: UX8693, UX5986, UX-7307 ..... $5 ea.

W.E.: D-166310, D-166638, KS9800, D-163247

UTAH #9262, with Cracked Beads, but will operate at full rated capacity $5.00

UX 8693 (SCS #2Z9627-54); 3 Wdgs. 32 turns #18 wire. DCR is: 362/.372/.4 ohms. Total voltage 2500 vdc $5.00

D-166173: Input: 50 ohms Z. Output: 900 ohms 3 wdgs. Freq. range 10 kc-2mc. P/O AN/APQ*-13 ..... $12.50

K-2450: Pulse-Inversion auto-transformer: primary 13 kv, 4 usec. Output: 14 kv @ 100 kw peak $34.50

PULSE EQUIPMENT

MIT. MOD. 3 HARD TUBE PULSER: Output Pulse Power 144 KW (12 KV at 12 Amp.) Duty Ratio: .001 max. Pulse duration: 5, 1.0, 2.0 microsec. Input voltage: 115 v, 400 to 2400 cps. Uses: 1-71B, 4-89-B, 3-'72's, 1-'73. New ..... Less Cover—$135

ASD Modulator Units, mfd. by Sperry. Hard tube pulser delivers Pk. pulse of 144 kw. Similar to Mod 3 unit. Brand new, less tubes $85.00

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CT-048 350-0-350V/90MA, 5V/3A, 2.5VCT/10A, 6.3V/3.5A 5.68
CT-003 350-0-350V/70MA, 5VCT/3A, 2.5VCT/9A 5.10
CT-007 400-0-400V/110MA, 5VCT/3A, 2.5VCT/ 5A, 2.5VCT/3.5A 5.35
CT-312 290-0-290V/90MA, 5VCT/3A, 6.3VCT/2.8A 3.25
CT-127 900V/25MA PK, 5V/2A, 2V/7.5A 2.79
CT-006 350-0-350V/120MA, 5VCT/3A, 2.5VCT/12.5A, 2.5VCT/3.5A 6.10
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CT-403 350VCT .026A 5V/3A 2.75
CT-931 585VCT .056A 5V/3A, 6.3V/6A 4.25
CT-442 525VCT 75MA 5V/2A, ICT/2A, 50V/200 MA 3.85

FILAMENT—115/60~ INPUT

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FT-140 5VCT @ IDA 25KV Test ..... 22.[illegible]
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FT-38A 6.3V/2.5A, 2x2.5V/7A 2.79
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PT-38-2 37.5/40V AT 750 MA 2.15

THIS MONTH'S SPECIALS

PRESSURE SWITCH. For Art-13, CR2927-B-130. SPST. N.O. 10 AMP AT 24 VDC up to 40,000 ft. Trips at 9.72" mercury; resets at 12.10" Merc. Collins 260N457 (As Shown) ..... $6.[illegible]

S-501 ARC-3 Push-Button Assy. SCS# 3Z9824-83.1 ..... $1.19
C-30 ARC-5 Control Box 1.50
SA4A/APA-1 Motor-driven Yagi Antenna Switch-24 VDC. DPDT 14.50
CHROMALUX Standby Heaters. 115VAC-DC, 150 W. Screw-in Base Std. Socket 1.00
MOD. XFMR Screen For SCR 274-N SCS# 2Z9947-3.2 ..... 1.19
MOD. XFMR Plate, Symbol T-104/ARC-3 ..... 2.15
AN-154-A Antenna For RC145, 148, etc. Consists of 3 Vert. Dipoles Working against a screen reflector. Range 150-200 MC 27.50
C.F.I. UNITS For Art-13, less tubes and crystals ..... 12.[illegible]
SERVO-AMPLIFIER: 2CV3A1, Less Tubes $22.50
MK-12 Pressurizing Unit, for APS-2, etc. 27.50
TRANSTAT: Type TH45BC. Input: 230-130V 2Ph., 60 Cy. Out: 0-260V, 11.7A 45Amp. 165.00
INTERLOCK, Coby Type B986. Safety Type with Lock and Key. Contacts Rated at 20 Amp. DPST ..... 2.8[illegible]
TRANSTAT: Input: 130V/230V. AC 60Cy. Out: 0-260V/6.5A/1.69KVA Amertran TH 6½B. Used, Exc. 15.00
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ANTENNA-AS-38APT-2, for Jammer Transmitter 8.50
CRYSTALS. Type IN45, Western Electric ..... .75
VIBROPACK. PE-204: Input 12VDC/0.58 Amp. Out: 2X4.3V/50MA, 2X45VDC/0.5MA, 2X85VDC/5MA. New. Complete with Spare Vibrator. Well-Shielded and Portable 4.75

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Order No. 1C939

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COMPACT TYPE — 108 CFM, motor built Inside squirrel case. 4-½" Intake; 3-⅝" x 3" Dis. Complete size: 4-¼" W. x 9-⅜" H. x 8-½" D. Order No. 2C067 ..... $14.50

FLANGE TYPE—140 CFM, 3-½" Intake; 2-½" Dia. Complete size: 8-½" W. x 7-¼" H. x 6-¾" D. Order No. 1C807 ..... $13.9[illegible]

FLANGE TWIN—275 CFM. 4-½" Intake: 3-¼" x 3" Dis. Complete size: 11-⅜" W. x 9-⅜" H. x 8-1/16" D. No. 2C069 ..... $21.95

MINIATURE BLOWERS—24 VDC; oblong Outlet 1" x ⅞". Dual 20 CFM $7.95. Single 10 CFM $5.95

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NEW: $49.95
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27 VDC—1-10 HP—3500 RPM. Shaft size: ⅜" x ¼". Motor size: 4" x 3-½". Air Assoc. No. EE-763. $6.95
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6AK5	.55	2E24	1.75	416B W.E.	Write
6AL5	.42	2J21	1.95	421A W.E.	2.45
6AQ5	.39	2J22	1.75	422A W.E.	2.45
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6H6	.29	3BP1	2.75	815	3.75
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6SL7GT	.55	9GP7	6.45	1626	.19
6SN7GT	.55	10	.19	1629	.10
6T8	.64	10Y	.19	164[illegible]	.75
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12SL7GT	.55	FG32	1.25	6038	5.95
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.001	9	.19
.002	9	.25

2500 W. V. D.C.

.00027	9	.19
.00039	A	.19
.0004	9	.24
.004	9LS	.55

600 W.V. D.C.

.0001	1455	.19
.0002	1455	.19
.00025	1455	.19
.0003	1455	.19
.0004	1455	.19
.0005	1455	.19
.0015	1455	.19
.002	1455	.20

.0025	1455	.20
.003	1455	.22
.004	1455	.25
.005	1455	.25
.006	1455	.29

.008	1455	.29
.01	45	.35
.01	XQBW	.37
.01	4LS	.37
.015	1455	.40
.02	1455	.42
.03	1455	.64
.04	1455	.76
.05	4	.83

1200 W.V. D.C.

.0001	4	.24
.0002	4	.24
.00225	4	.24
.0003	4	.24
.0004	4	.24
.002	4	.33
.0022	4	.33
.0025	4	.39
.003	4	.42
.004	4	.45
.005	4	.47
.006	4	.49
.008	4	.50
.01	4	.55

2500 W.V. D.C.

.0001	4	.25
.00025	4	.29
.0003	4	.32
.0004	4	.35
.0005	4	.37
.002	4	.55
.0025	4	.59
.003	4	.65

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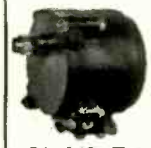

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OA5	$3.25	3DP1	2.00	RK-19	1.50	283A	3.00	702B	2.00	838	2.50
1B24	6.00	3EP1	3.00	RK-21	1.25	286A	5.50	703A	2.00	846	85.00
1B27	8.75	3GP1	1.75	RK-23	3.00	304TH	5.00	707A	3.50	849	15.00
1B42	7.75	4-65A	17.00	28D7W	3.00	304TL	3.75	707B	7.00	850	20.00
2AP1	5.00	4B26	4.50	Twin 30	10.00	305A	3.50	708A	1.00	860	1.50
2C33/RX-233A	2.00	4B27	5.00	FP-54/5740	44.00	307A	1.75	709A	1.50	861	10.00
2C40	4.75	4C22/HF-100	7.50	HK-54	3.50	310A	3.00	715A	2.00	866A	1.00
2D21	1.00	4C27/CV-92	7.50	RK-60/1641	1.75	311A	5.00	715B	3.00	869B	30.00
2E22	1.50	4C35	16.50	RK-62	1.75	313C	2.50	715C	12.50	872A	1.50
2J21A	3.50	4E27	12.00	RK-65/5D23	20.00	316A	1.00	719A	10.00	878	1.00
2J22	3.00	4J34	70.00	RK-73	1.00	323B	4.50	721A	1.25	884	1.00
2J26	4.75	4J35	80.00	FG-95/5560	14.75	328A	3.25	723A/B	14.00	885	1.35
2J27	8.00	4J42	75.00	C-100D	2.00	329A	5.50	724A	1.00	891R	100.00
2J29	25.00	5BP1	2.00	F-128A	35.00	348A	6.00	724B	1.00	892R	150.00
2J30	50.00	5BP4	2.00	HK-154	4.00	349A	6.50	725A	4.00	902-P1	4.25
2J32	14.00	5CP1	3.75	VT-158	15.00	350A	2.50	726A	10.00	913	9.00
2J33	18.00	5C30/C5B	2.00	FG-190	5.00	354A	10.00	726B	30.00	922	1.00
2J34	16.00	5D21	8.00	HF-200	12.50	355A	10.00	726C	30.00	923	1.00
2J36	70.00	5FP7	1.00	C-202	10.00	393A	4.50	803	2.75	931A	3.75
2J37	9.00	5FP14	6.00	203Z	5.00	394A	2.00	805	2.50	959	1.35
2J38	8.00	5JP1	9.00	204A	8.00	417A	6.50	807	1.00	CK-1006	1.00
2J40	22.50	5JP4	9.00	205B	1.00	GL-434A	5.00	808	1.50	1500T	100.00
2J55	55.00	5J26	75.00	F-207	40.00	446A	1.00	810	9.25	1624	1.00
2J56	80.00	5J30	18.50	217A	2.00	446B	2.00	811	2.00	1904	12.00
2J61	20.00	5J32	50.00	WL-218	20.00	WL-460	10.00	811A	3.00	2050	1.00
2J62	7.50	5R4GY	1.00	235R	75.00	464A	3.50	812	2.50	ZB-3200	85.00
2J-B51	1.00	C6A	6.00	250R	6.00	WL-468	15.00	813	8.25	5551/652	60.00
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2K55	35.00	6C21	15.00	252A	15.00	WL-530	8.00	826	1.00	CK-5829	2.25
3AP1	4.50	6G4/X-102B	3.00	253A	5.00	WL-531	4.50	828	8.00	5963	1.25
3BP1	2.50	6J4	4.50	257A	3.00	559	1.00	829B	9.00	8002R	25.00
3B24	3.00	7BP7	2.00	267B	6.00	575A	15.00	830B	1.50	8005	4.00
3B24W	6.75	9GP7	3.75	271A	5.00	WL-579B	12.50	832	5.00	8012	1.50
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3B26	2.50	12GP7	15.00	276A	4.50	701A	2.00	833A	30.00	8013	1.50
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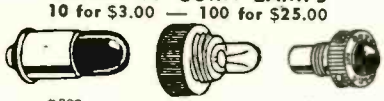

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OB3	1.10	2J21A	12.00	3C22	99.00	5BP4	3.95	249C	4.25	700A/D	10.00	811A	3.75	1603	5.00
OC3	.96	2J22	9.00	3C24	1.50	5CP1	7.50	250TH	19.95	701A	4.50	812A	3.95	1612	1.50
OD3	.89	2J26	15.00	3C31	2.95	5CP7	6.95	266TL	12.00	703A	3.95	813	13.75	1613	1.25
C1B	2.95	2J27	15.00	3DP1	7.50	5D21	18.00	274B	2.75	704A	1.95	814	3.75	1616	1.25
1B21	1.50	2J31	24.00	3DP1A	10.00	5FP7	1.95	304TH	10.00	705A	21.75	815	4.50	1619	.45
1B22	3.50	2J32	29.00	3DP1A-		5JP1	27.50	304TL	10.00	706AY/		816	1.45	1622	1.50
1B23	6.95	2J33	32.00		$2 10.00	5JP2	19.50	307A	3.00	FY	5.00	820	11.00	1624	1.75
1B24	12.00	2J34	36.00	3EP1	5.00	5JP4	27.50	310A	4.50	707A	5.75	829A	12.00	1625	.35
1B26	1.75	2J36	90.00	3E29	15.50	5J23	45.00	310B	4.95	707B	15.00	829B	15.00	1626	.25
1B27	12.50	2J38	8.95	3FP7	5.00	C6A	11.00	311A	6.50	714AY	18.00	830B	2.00	1851	1.80
1B32	2.95	2J39	8.95	3HP7	5.50	C6J	7.50	312A	4.50	715A	9.95	832A	9.95	2000T	150.00
1B38	35.00	2J40	29.00	3GP1	5.00	7DP7	5.00	325A	15.00	715B	9.00	833A	45.00	2050	1.80
1B50	21.00	2J42	135.00	4B26	5.40	7DP4	9.00	327A	3.75	715C	22.50	834	7.50	2051	1.00
1B51	7.50	2J49	60.00	4C27	22.50	12AP4	50.00	323A	6.75	717A	1.50	836	3.95		
1B56	35.00	2J50	55.00	4C28	35.00	12DP7	24.00	350A	10.00	718AY/		837	2.75	Various 5000 and 6000 series of new production	
1B60	35.00	2J55	150.00	4E27	16.00	LM15	225.00	350B	5.95	FY	30.00	838	5.95		
1N21	1	2J56	110.00	4J25	150.00	15E	1.75	352A	3.00	719A	22.50	849	35.00		
1N21A	1.75	2J61	35.00	4J26	150.00	15R	.75	HK354	15.00	720AY/		860	3.50		
1N21B	2.75	2J62	35.00	4J27	150.00	NE16	.59	357A	15.00	GY	150.00	861	25.00		
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1N22	1.00	2K23	15.00	4J29	150.00	KY21A	8.25	371B	1.50	722A	3.50	869B	67.50	8012A	2.50
1N23	1.95	2K25	27.50	4J30	150.00	RX21	8.00	385A	4.50	723A/B	18.00	869BX	50.00	8013	3.00
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1N23B	2.75	2K28	35.00	4J32	150.00	25T	2.95	393A	7.50	724B	2.25	878	1.50	8019	1.75
1N23C	7.60	2K29	35.00	4J33	150.00	45 Special	.35	394A	3.95	725A	9.00	879	.50	8020	1.80
1N24	4.50	2K33A	75.00	4J34	100.00	RK39	2.75	MX408U	.50	726A	18.00	880	250.00	8025	3.75
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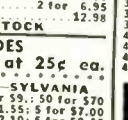

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A	.015	3500	1.25; 3 for 3.35
B	.01	600	30c; 3 for 1.35
B	.01	1000	49c; 3 for 1.25
B	.01	1200	50c; 5 for 2.25
A	.005	2500	60c; 5 for 2.75
B	.004	600	30c; 4 for 1.05
B	.002	1200	30c; 4 for 1.00
A	.002	2500	98c; 3 for 2.25
A	.001	1200	25c; 3 for 66c
C	.0007	3000	89c; 3 for 2.39
A	.0004	2500	39c; 6 for 1.95
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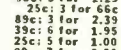

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OB3/VR90	.96	5C21/C6J	9.89	6SN7GT	.68	211/VT4C	.86	1614	1.95
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1B23	8.87	5T4	1.48	6U8	.99	304TH	12.49	1642	.62
1B24	8.98	5U4G	.55	6V6	1.39	304TL	12.49	1644	.92
1B26	2.24	5V4G	.95	6V6GT	.59	371B	.88	2050	1.48
1B27	11.98	5Z3	.99	6W4GT	.52	388A	1.48	5590W	2.48
1B32/532A	2.48	5Z4	1.49	6X4	.49	GL434A	12.69	5618	3.50
1B35	9.15	6A3	.90	6X5GT	.54	446A	1.05	5635	11.57
1B37	14.97	6A4	.85	6Y6G	.88	446B	3.48	5637	6.53
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1L6	1.35	6AJ5	1.40	7N7	.92	CK505AX	1.79	5651	2.24
1LD5	.98	6AK5	.87	7V7	1.06	CK512AX	1.45	5654	1.72
1LN5	.78	6AK5W	2.79	7Y4	.68	CK531DX	1.89	5656	12.08
1P5	.78	6AK6	.92	7ZD21	298.00	531	5.72	RK5657	298.48
1U4	.52	6AL5	.48	12AL5	.54	CK532DX	1.89	5663	1.06
1U5	.54	6AL7GT	.98	12AT6	.54	WL532A	3.68	5670	3.48
1V2	.70	6AN5	3.27	12AT7	.89	CK536AX	.99	CK5672	1.20
1X2A	.98	6AQ5	.52	12AU6	.72	CK539DX	2.19	CK5678	1.28
2C36	27.00	6AQ5W	2.78	12AU7	.69	CK541DX	1.99	5687	3.74
2C39A	26.98	6AQ6	.81	12AV6	.52	CK543DX	.99	5691	8.54
2C40	4.98	6AQ7GT	1.29	12AV7	.98	CK544DX	.99	5692	8.52
2C43	17.48	6AR6	3.27	12AW6	1.18	CK546DX	1.99	5693	6.24
2C44	1.15	6AS5	.79	12AX7	.98	CK571AX/ 5886	2.49	5694	3.65
2C51	3.88	6AS6	2.22	12AY7	.69	CK573AX/ 6029	3.49	CK5702	2.90
2D21	1.18	6AS7G	3.48	12BA6	.55	WL652	65.00	CK5703	1.29
2E43	1.49	6AT6	.54	12BA7	.94	WL676	34.59	WL5736	130.00
2J31	27.00	6AU5GT	1.18	12BD6	.59	703A	4.72	5751	1.72
2J32	29.48	6AU6	.56	12BE6	.59	705A	1.88	5763	2.88
2J33	27.00	6AV5GT	.98	12BF6	.85	707A	7.90	5769	298.00
2J34	24.98	6AV6	.49	12BH7	1.29	708A	14.88	5812	2.99
2J37	12.70	6B4G	1.18	12SA7GT	.68	715A	4.98	5814	2.08
2J38	69.98	6B8G	.60	12SC7	.54	715A	4.98	5820	148.50
2J39	6.98	6BA6	.54	12SF5GT	.84	715B	7.94	5840	7.98
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2K25	28.49	6BK7	1.58	FG17	1.32	726A	14.48	1N21B	2.10
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2K28	27.48	6BN7	2.69	25Z6GT	.67	726C	64.88	1N23	1.33
2K33	219.48	6BQ6GT	1.20	26L6GT	.78	801A	.42	1N23A	1.89
2K39	134.99	6BQ7	1.65	25Z5	.51	803	3.48	1N23B	2.00
2K41	126.00	6C4	.52	25Z6GT	24.50	FG-27A	8.24	805	3.22	1N25	4.98
2K42	145.00	6C21	24.50	FG-27A	.54	807	1.54	1N26	8.75
2K45	129.48	6CB6	.59	35Z5GT	4.88	808	2.62	1N27	1.55
2K48	99.48	6CD6G	1.69	35T	.67	809	3.58	1N34	.64
2K50	298.00	6U4	2.70	35L6	.68	810	10.88	1N34A	.88
2X2	.42	6D6	.84	35Y4	.98	811	3.05	1N35	1.65
3B22	2.48	6F4	6.20	45Z3	1.93	812	2.70	1N38A	1.25
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3B26	3.70	6J4	6.66	50C5	.62	815	5.98	1N45	1.45
3B28	7.90	6J5	.54	50L6GT	.58	RK61/XFG1	2.65	829	7.94	1N47	.68
3C22	85.00	6J6	.58	RK61/XFG1	2.65	829	7.94	1N47	4.00
3C23	8.67	6K6GT	.54	FG67	14.68	829B	12.48	1N48	.47
3C24/C1B	3.45	6K7	.58	HY69	4.98	832	7.72	1N51	.45
3C33	9.51	6K8	1.08	71A	.74	832A	9.92	1N53	.78
3C45	9.98	6L6	1.48	78	.75	833A	39.48	1N54	.78
3D6/1299	.69	6L6G	1.08	80	.58	836	5.95	1N54A	1.00
3D21A	8.15	6L6GA	1.08	81	1.34	837	1.42	1N58A	1.15
3D22	13.97	6L6GAY	1.98	83	1.12	849	29.45	1N60	.60
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3E29	14.49	6SC7	.90	84/6Z4	.62	865	1.26	1N64	.69
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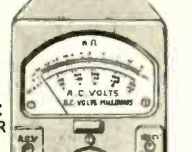

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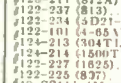

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