OCTOBER · 1952

PRICE 75 CENTS

electronics

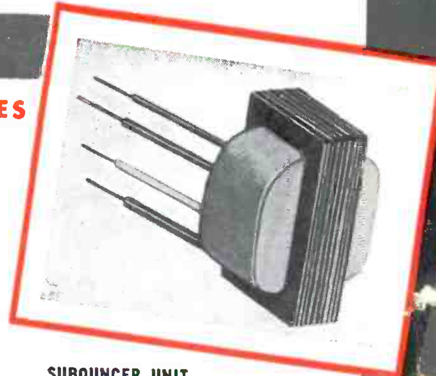
A McGRAW-HILL PUBLICATION

Printed Circuit Techniques

MINIATURE COMPONENTS FROM STOCK...

SUBOUNCER UNITS

FOR HEARING AIDS...VEST POCKET RADIOS...MIDGET DEVICES

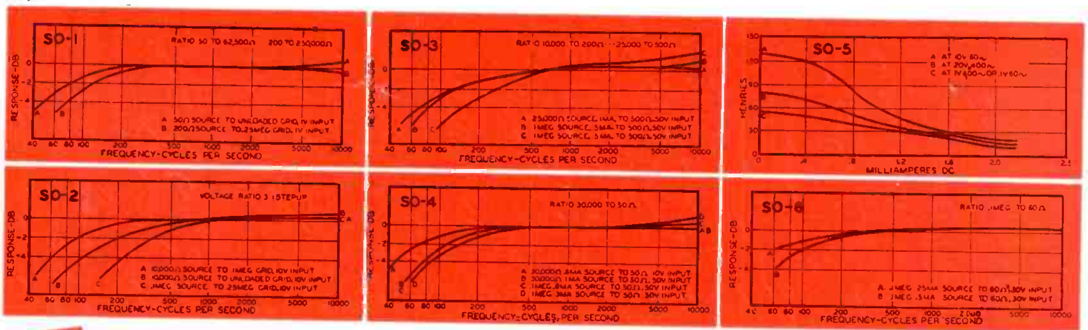


SUBOUNCER UNIT
Dimensions....9/16" x 5/8" x 7/8"
Weight .... .03 lb.

UTC Sub-Ouncer units fulfill an essential requirement for miniaturized components having relatively high efficiency and wide frequency response. Through the use of special nickel iron core materials and winding methods, these miniature units have performance and dependability characteristics far superior to any other comparable items. They are ideal for hearing aids, miniature radios, and other types of miniature electronic equipment. The coils employ automatic layer windings of double Formex wire . . . in a molded Nylon bobbin. All insulation is of cellulose acetate. Four inch color coded flexible leads are employed, securely anchored mechanically. No mounting facilities are provided, since this would preclude maximum flexibility in location. Units are vacuum impregnated and double (water proof) sealed. The curves below indicate the excellent frequency response available. Alternate curves are shown to indicate operating characteristics in various typical applications.

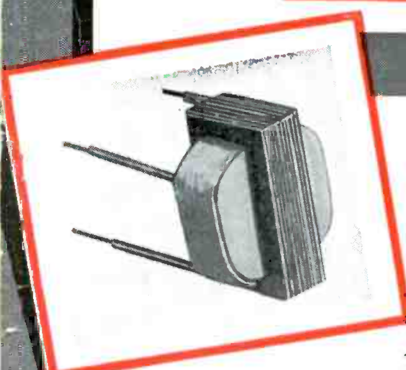
Type	Application	Level	Pri. Imp.	D.C in Pri.	Sec. Imp.	Pri. Res.	Sec. Res.	List Price
*SO-1	Input	+ 4 V U	200 50	0	250,000 62,500	16	2650	$6.50
SO-2	Interstage/3:1	+ 4 V.U	10,000	0	90,000	225	1850	6.50
*SO-3	Plate to Line	+ 20 V U	10,000 25,000	3 mil 1.5 mil.	200 500	1300	30	6.50
SO-4	Output	+ 20 V.U	30,000	1.0 mil	50	1800	4.3	6.50
SO-5	Reactor 50 HY at 1 mil D.C 3000 ohms D.C. Res							5.50
SO-6	Output	+ 20 V U	100,000	.5 mil.	60	3250	3.8	6.50

*Impedance ratio is fixed, 1250:1 for SO-1, 1:50 for SO-3 Any impedance between the values shown may be employed



SUB-SUBOUNCER UNITS

FOR HEARING AIDS AND ULTRA-MINIATURE EQUIPMENT

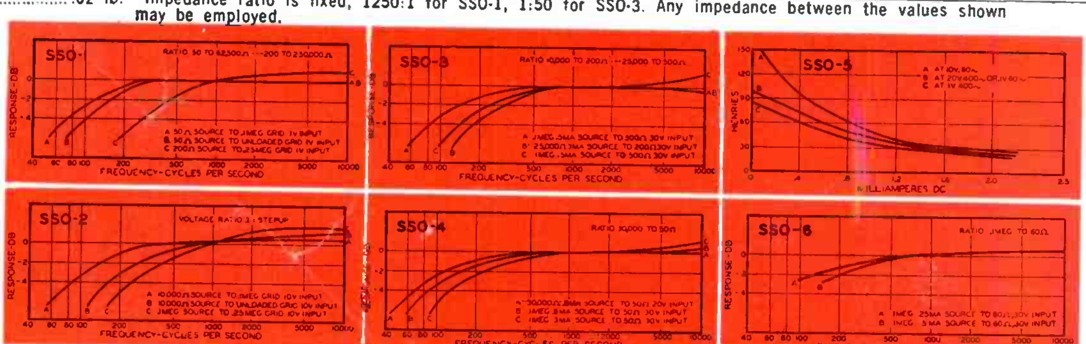


SUB-SUBOUNCER UNIT
Dimensions....7/16" x 3/4" x 5/8"
Weight .... .02 lb.

UTC Sub-SubOuncer units have exceptionally high efficiency and frequency range in their ultra-miniature size. This has been effected through the use of specially selected Hiperm-Alloy core material and special winding methods. The constructional details are identical to those of the Sub-Ouncer units described above. The curves below show actual characteristics under typical conditions of application.

Type	Application	Level	Pri. Imp.	D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. Res.	List Price
*SSO-1	Input	+ 4 V.U.	200 50	0	250,000 62,500	13.5	3700	$6.50
SSO-2	Interstage/3:1	+ 4 V.U.	10,000	0	90,000	750	3250	6.50
*SSO-3	Plate to Line	+ 20 V.U	10,000 25,000	3 mil. 1.5 mil.	200 500	2600	35	6.50
SSO-4	Output	+ 20 V U	30,000	1.0 mil.	50	2875	4.6	6.50
SSO-5	Reactor 50 HY at 1 mil. D.C. 4400 ohms D.C. Res.							5.50
SSO-6	Ouptut	+ 20 V.U.	100,000	.5 mil.	60	4700	3.3	6.50

*Impedance ratio is fixed, 1250:1 for SSO-1, 1:50 for SSO-3. Any impedance between the values shown may be employed.



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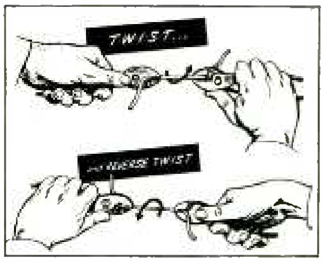

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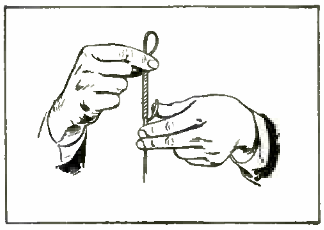

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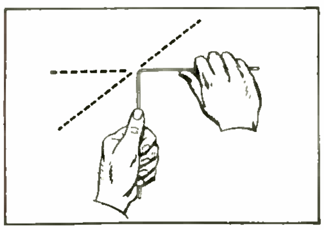

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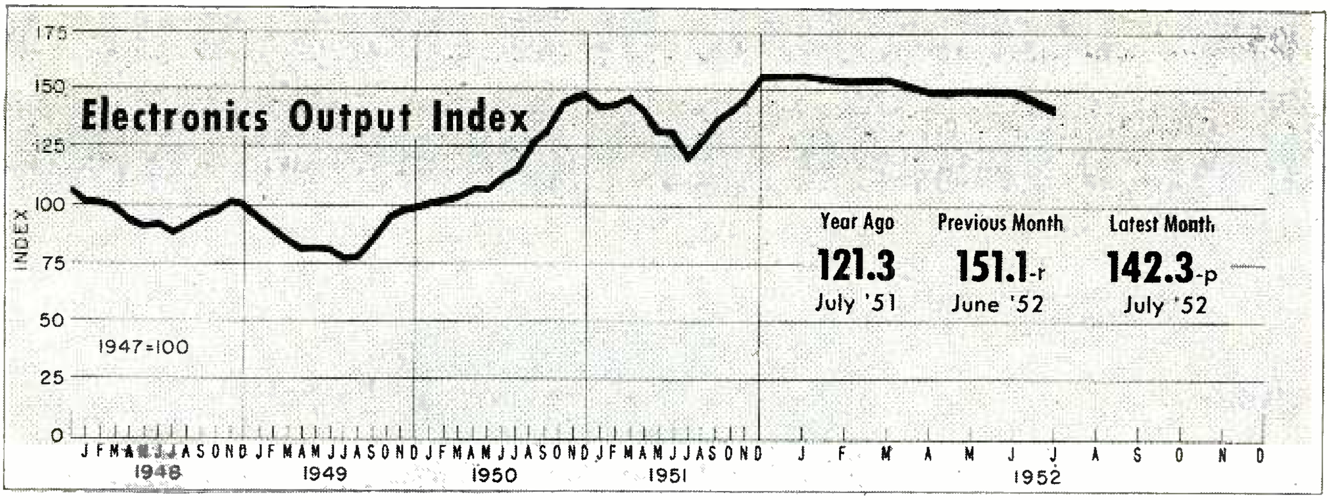


FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RTMA)	Year Ago July '51	Previous Month June '52	Latest Month July '52
Television sets	152,306	361,152	198,921-p
Home Radio sets	184,002	422,158	265,163-p
Portable sets	70,538	205,186	81,353-p
Auto sets	293,955	246,909	95,220-p

RECEIVER SALES

(Source: Licensee figures)	Apr. '51	Mar. '52	Apr. '52
Television sets, units	285,498	370,905	349,015
Electric radio sets, units	485,970	380,846	354,518
Battery sets, units	136,981	68,339	82,873
Auto sets, units	1,057,484	204,990	235,651
Television sets, value	$49,061,450	$62,988,663	$58,872,294
Electric radio sets, value	$11,222,433	$7,963,825	$8,594,861
Battery sets, value	$2,592,267	$1,332,640	$1,495,919
Auto sets, value	$26,076,566	$5,912,217	$6,700,718

RECEIVING TUBE SALES

(Source: RTMA)	July '51	June '52	July '52
Receiv. tubes, total units	13,185,567	24,365,462	20,944,831
Receiving tubes, new sets	7,117,435	15,770,335	11,504,503
Rec. tubes, replacement	4,625,314	5,187,557	6,795,252
Receiving tubes, gov't	220,083	2,477,569	1,956,905
Receiving tubes, export	1,222,735	930,001	688,171
Picture tubes, to mfrs.	89,144	285,975	239,625

BROADCAST STATIONS

(Source: FCC)	Aug. '51	July '52	Aug. '52
TV Stations on Air	107	109	109
TV Stns CPs—not on air	1	21	34
TV Stns—Applications	440	838	855
AM Stations on Air	2,292	2,356	2,356
AM Stns CPs—not on air	105	95	112
AM Stns—Applications	278	300	291
FM Stations on Air	645	627	622
FM Stns CPs—not on air	11	18	21
FM Stns—Applications	8	12	12

NETWORK BILLINGS

(Source: Pub. Info. Bureau)	July '51	June '52	July '52
AM/FM—ABC	$2,267,674	$3,001,314	$2,082,666
AM/FM—CBS	$4,387,193	$4,590,536	$3,238,256
AM/FM—MBS	$1,347,841	$1,632,977	$1,339,276
AM/FM—NBC	$3,728,687	$3,708,014	$2,878,196
TV—ABC	$1,351,168	$1,276,250	$943,387
TV—CBS	$3,434,659	$5,385,820	$4,163,245
TV—DuMont	$645,359	$758,356	$653,415
TV—NBC	$3,477,952	$5,904,546	$4,591,130

TV AUDIENCE

(Source: NBC Research Dept.)	Year Ago Aug. '51	Previous Month July '52	Latest Month Aug. '52
Sets in Use—total	13,271,700	17,983,200	18,354,300
Sets in Use—netw'k conn.	11,205,500	17,955,000	18,325,700
Sets in Use—New York	2,455,000	3,040,000	3,070,000
Sets in Use—Los Angeles	1,003,000	1,215,000	1,230,000
Sets in Use—Chicago	942,000	1,185,000	1,210,000

COMMUNICATION AUTHORIZATIONS

(Source: FCC)	June '51	May '52	June '52
Aeronautical	34,061	32,852	32,603
Marine	29,544	35,476	35,500
Police, fire, etc.	9,129	10,965	11,143
Industrial	9,551	13,056	13,680
Land Transportation	4,253	4,966	5,027
Amateur	90,585	110,931	113,092
Citizens Radio	560	1,175	1,401
Disaster	2	65	71
Experimental	475	357	488
Common carrier	815	970	985

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	June '51	May '52	June '52
Prod. workers, electronic	241,200	267,000-r	266,800-p
Prod. wkrs., radio, etc.	149,000	167,200	166,100-p
Av. wkly. earnings, elect.	$62.05	$64.80-r	$64.48-p
Av. wkly. earnings, radio	$58.42	$60.83-r	$60.77-p
Av. weekly hours, elect.	41.2	40.6	40.3-p
Av. weekly hours, radio	40.4	40.1	39.8-p

STOCK PRICE AVERAGES

(Source: Standard and Poor's)	Aug. '51	July '52	Aug. '52
Radio—TV & Electronics	242.9	295.7	291.1
Radio Broadcasters	230.6	232.4	279.6

INDUSTRIAL EQUIPMENT ORDERS

Quarterly Figures			
(Source: NEMA)	Year Ago 2nd '51	Previous Quarter 1st '52	Latest Quarter 2nd '52
Dielectric Heating	$600,000	$150,000	$510,000
Induction Heating	$3,140,000	$2,400,000	$2,410,000

INDUSTRIAL TUBE SALES

(Source: NEMA)	2nd '51	1st '52	2nd '52
Vacuum (non-receiving)	$7,750,000	$11,320,000	$12,110,000
Gas or vapor	$2,700,000	$3,100,000	$3,150,000
Phototubes	$360,000	$500,000	$480,000
Magnetrons and velocity modulation tubes	$4,130,000	$8,460,000	$9,830,000

p—provisional; r—revised; e—estimated

INDUSTRY REPORT

Army Spurs Transistor Production

Four recent contract awards totaling $5,377,960 are aimed at machinery development

WITH the awarding of four large contracts (Raytheon $1,180,053, General Electric $1,364,674, Sylvania $1,599,200 and RCA $1,234,033), the Signal Corps has started the ball rolling on increased production of point-contact and junction transistors and germanium diodes.

These contracts have not been awarded for large quantities of transistors but rather for setting up operations, developing automatic production machinery and for running off sample lots.

Pilot production runs with the machinery developed will be used to prove out and perfect designs, machines and techniques leading to final approval of the transistors. Standardization for size and test procedures will also result.

▶ **Machinery Requirements**—Automatic machinery is to be designed to perform the following basic operations or functions: purify germanium, grow crystals, cut and prepare pellets, mount and clean pellets, etch pellets, form junctions, form cat whiskers, assemble and test point contacts, package and test electrically.

The machinery is to be capable of producing 5,000 units each of point-contact transistors, junction transistors and diodes per week and will remain Signal Corps property once developed.

▶ **Transistor Types**—Point-contact transistors involved in these contracts are for general purpose and switching applications. Junction transistors are for low-power general-purpose use and for high-power applications (½ watt to 100 watts) at audio frequencies. Junction-type phototransistors are also included. Diodes are to be of the point-contact type and junction type for power rectification at low and high currents.

New ASDE Radar At Idlewild Airport

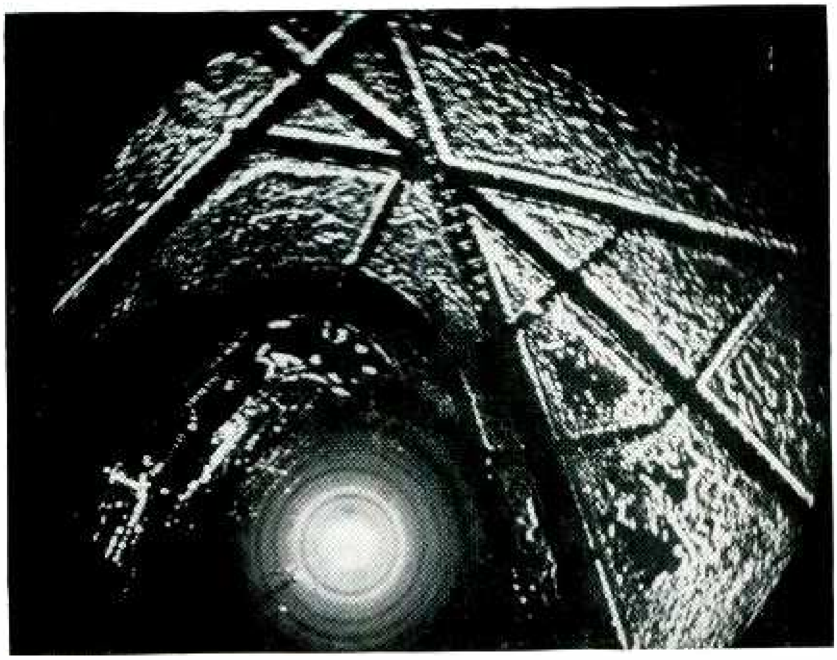
High-resolution set guides ground traffic in instrument weather

ON THE 16th of September a new eleven-story CAA control tower at New York's Idlewild International Airport went into operation, using something new in the way of electronic control equipment.

In the control room a prominent position has been given to the new ASDE (Airport Surface Detection Equipment) radar. This equipment has received the popular name "taxi" radar, since it is used in guiding aircraft after landing and before takeoff during weather when planes cannot be seen visually by the tower operators.

The new high-resolution radar was developed for the USAF Rome Air Development Center and has been installed at Idlewild for CAA evaluation under high-traffic-density conditions. Through its use, experienced operators can follow an aircraft from touchdown and guide it safely by radio to appropriate taxi strips and to unloading platforms.

▶ **Grass**—In dealing with the high-resolution ground surveillance equipment, engineers have found it



Airport surface radar clearly shows outline of planes, buildings, runways and taxi strips. Note multiple image of plane made during landing by time exposure of successive 60 per minute sweeps necessary to use qualifying words in speaking of grass. When referring to radar grass (noise), one uses the two words "radar grass" to avoid confusion with "green grass" (that which grows on the ground) which shows up clearly on the 16-inch radar scope.

An experienced operator can distinguish between 2 and 4-engine airplanes by their returns.

Research on the project was begun at Gilfillan and final development work was carried on at Airborne Instruments Laboratories. It is believed that the new type radar will speed up traffic in large air terminals during instrument weather by providing airport operators with a positive means for controlling ground traffic.

UHF Egg Is Waiting for UHF Chicken

Receiver manufacturers working fast to ready sets for coming markets

"I DO NOT WISH to seem bureaucratic," said Federal Communications Commissioner Rosel H. Hyde recently, "but I feel strongly that every purchaser of a new tv set is entitled to a set providing complete tv service. And a set which is not designed for uhf reception does not offer complete tv service." What his West Coast audience of radio engineers and electronic manufacturers thought in reply is not recorded.

▶ **Three Questions**—Engineers and set manufacturers face three general technical problems—what basic circuits to put in a uhf set; whether to use strip or continuous tuning; how much of the whole uhf-vhf receiving package they should consider.

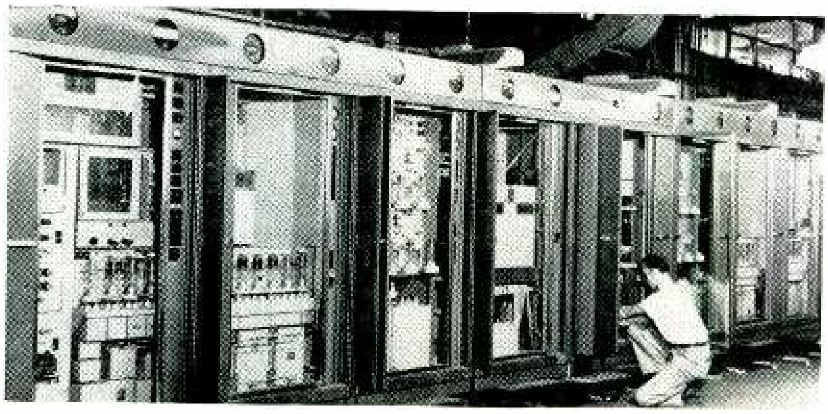
Engineers know how to build uhf receivers or adapters. But to market a receiver that appeals to the general public requires compromise with optimum engineering design. As a result, production men to whom ELECTRONICS has talked think that the initial large production can be expected to comprise converter-type circuits, either built into the console or in separate boxes with a uhf oscillator beating the signal down to vhf around channel 5 or 6. Suitable oscillator tubes seem to be available, but it is a safe bet that germanium or silicon crystal mixers will be used for some time. Many designers think radio-frequency amplifiers either have discouraging noise figures or cost too much. Intermediate frequencies will be 40 mc and noise figures may run between 15 and 22 db. (Good vhf sets may be as low as 10 db.)

Will most people buy sets having switches for quick tuning? Or will they prefer continuous tuners that may be slightly less convenient to use, but insure complete coverage of all uhf television channels? The answer may well reside in the attitude of dealers out of whose time, and perhaps profits, will come the changing of strips. Manufacturers haven't made up their minds just how this problem will finally work out but they tell us that they will not be caught napping.

Some set manufacturers, like the people who make tubes, transmission lines and antennas, feel that their own problems are a big enough worry. They are content to turn out their respective products and let the serviceman put the pieces together. Others take a lively interest in the whole receiving package from the roof down. While they may not manufacture the various critical components they are in active co-operation with those who do.

▶ **Outside the House**—Antennas (p 5, Sept. 1952) seem to present no great problem, although installers may quickly find that no one design is the answer for every location at every frequency. Inexpensive low-loss transmission line to connect antenna and set just ain't! Line available now has losses ranging upwards from 5 db per 100 feet at 1,000 mc when dry. Tested under water the losses rise fantastically. Fortunately, there will be few uhf-tv installations as damp as this. It is known that new lines have been developed and ordered in quantity. Other, better, lines are in development. But the developers won't let their names be mentioned.

New York's Ch. 9 Gets Power Boost



New vhf 20-kw television transmitter on test. Final amplifier for WOR-TV comprises four-units of this lineup

NEW YORK CITY'S lone standout tv station, located across the river in Jersey rather than on the Empire State tower, is due to jump its erp (effective radiated power) from 22,000 to 90,000 watts in late September. At this time, fringe-area regions will start getting better signals and Grade A coverage will increase from a present radius of 30 miles to about 39.5 miles. The Grade B region will expand its present 50-mile radius to approximately 57 miles.

While this leaves some margin

(Continued on page 8)

STILL ANOTHER

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▶ **First of a Line**—WOR-TV's Decision to use Standard Electronics Corp. equipment is a minor triumph for this Claude Neon, Inc. subsidiary. The company inherited the Western Electric line of a-m and f-m transmitters some time ago. The tv transmitter line, however, is pure Standard, whose engineers have been working hard over its development for more than two years.

Nub of the high-power amplifier is the Amperex type AX9904R/5924 forced-air-cooled triode. With a manufacturer's upper limit of 220 mc, this tube should be good even at channel 13 (210-216 mc).

Broadcast Phase of CONELRAD Approved by Co-op Agencies

CD officials urge production of $8 battery-or-line receiver and repair campaign

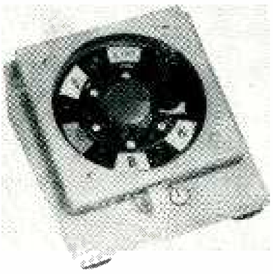
OPERATION CONELRAD (control of electromagnetic radiation) is essentially a broad-gage plan to furnish limited broadcast radio service to the general public while denying navigation information to enemy aircraft (ELECTRONICS, p 94, Aug. 1952).

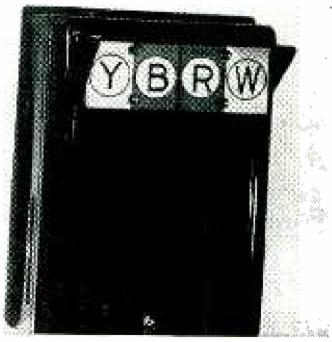
Implementation of the broadcast (a-m, f-m, tv) phase involves more than 1,200 a-m stations grouped in 200 clusters throughout the country. Most of the technical bugs have been ironed out and the plan approved by FCDA, FCC, Air Force, Air Defense Command, Secretary of Defense and National Securities Resources Board.

▶ **Who Pays** – Air Force has agreed to foot the $400,000 bill for control telephone lines that will be installed by the Bell System. Program lines to carry identical material to all stations of a cluster will cost $80,200, to be paid by FCDA. Broadcasters have already sunk a million and a half dollars of their own into emergency-operation equipment. They still have to buy more new crystal-control and power-varying equipment.

▶ **Listener's Job** – During an emergency, all the listener has to do is tune to 640 or 1,240 kc and follow directions.

Federal Civil Defense officials are talking up a program of keeping receivers in good condition, especially battery-operated types that can be carried into shelters. Manufacturers are considering a suggestion that they develop a "cheap, portable a-m set that could sell for seven to eight dollars, operating with power or battery."





Bell System wire alerting network proposed for hospitals, factories and other large centers. Alerts and clear signals are sent from defense control point by special dial impulse to light appropriate indicator. Dial shown is under glass cover locked with key to prevent unauthorized tampering

TV Station CP Holders Look Ahead

Estimates of first year's revenue, construction and operating costs vary widely

INTRIGUING picture of the tv broadcasting business is revealed in an analysis of the first-year cost and profit estimates made by tv station applicants who now hold construction permits.

The first 49 cp grantees expect to spend a total of $15,717,624 on station construction. Thus new cp holders expect to spend an average of $350,000.

This is considerably higher than recent FCC estimates of the average investments of present tv stations in markets of comparable size.

The range in construction cost estimates swings from a low of $138,800 expected by the Appalachian Company of Scranton, Pa. using channel 73, to a high of $972,000 (nearly $300,000 higher than that of any other grantee) for the Vindicator Printing Company in Youngstown, Ohio, also granted channel 73.

▶ **Profit and Loss**—First-year operating cost and revenue estimates of 41 commercial cp holders show that more than half of them expect to go in the red.

Vindicator Printing Company sees the greatest loss. They estimate first-year operating costs at $446,104 and revenue at $315,000 for a first-year loss of over $131,000.

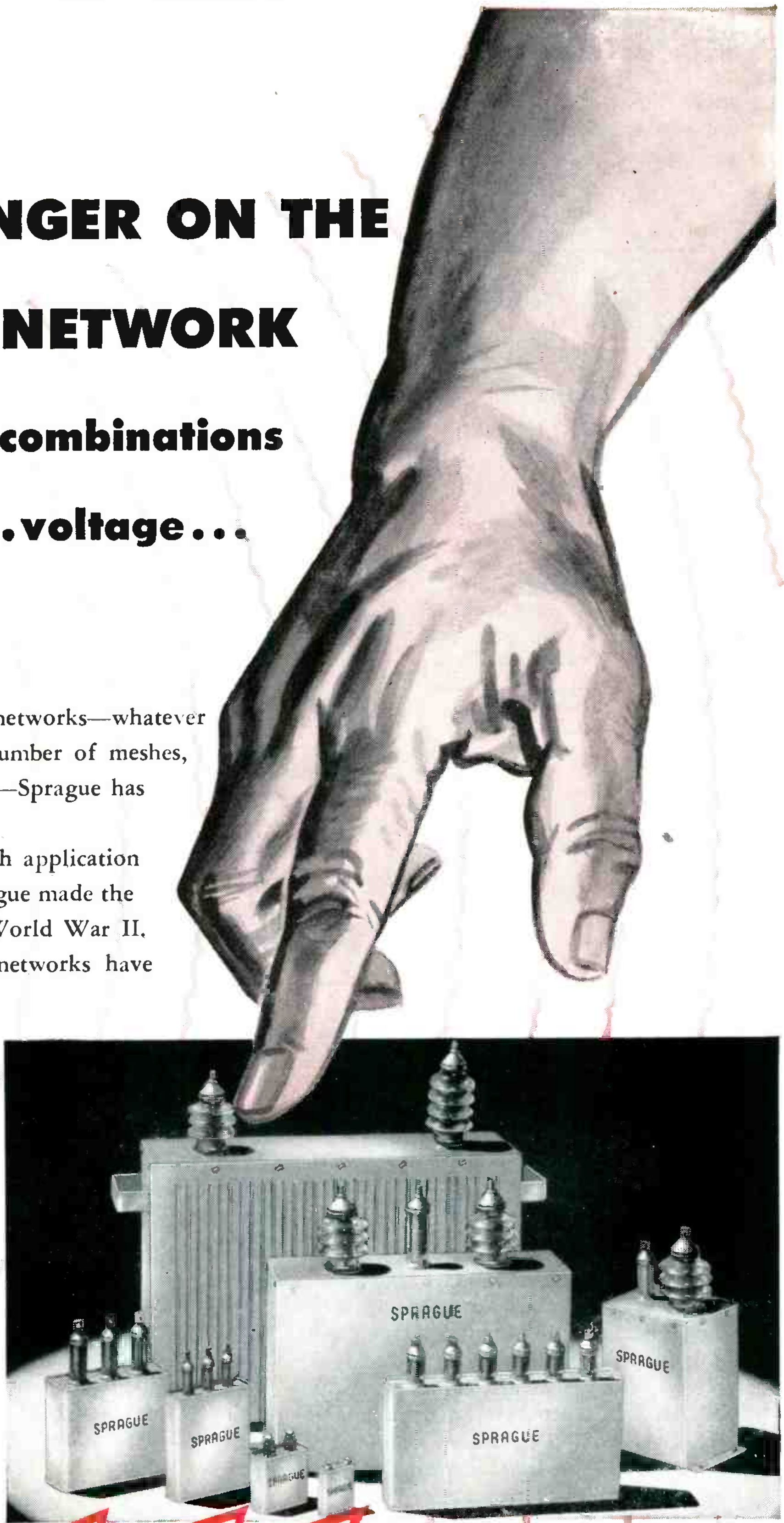
On the other side of the ledger, Empire coil expects its station in Portland, Oregon, due in November, to show a profit. They estimate operating costs at $450,000, but expect revenue to total $525,000 for a net of $75,000.

KFEL-TV, pioneer on-the-air station of the new cp holders, estimates its first year in Denver at $520,000 for operating costs, but revenue is only expected to total $500,000 for a loss of $20,000. However, it is possible that KFEL's early estimates will need revision

(Continued on page 10)

PUT YOUR FINGER ON THE RIGHT PULSE NETWORK

Hundreds of combinations for the right size...voltage... pulse shape



Whatever your needs in pulse-forming networks—whatever your requirements for size, voltage, number of meshes, pulse lengths, or pulse repetition rates—Sprague has the right answer for that need.

Providing the right network for each application has been a Sprague specialty since Sprague made the very first networks for radar during World War II. Literally hundreds of pulse-forming networks have been designed and built by Sprague since then. Among these standard types can usually be found the solution to a specific requirement. If not, you'll find Sprague ready, willing, and able to manufacture networks to your exact order.

For details, write for our special bulletin "Pulse-Forming Networks."

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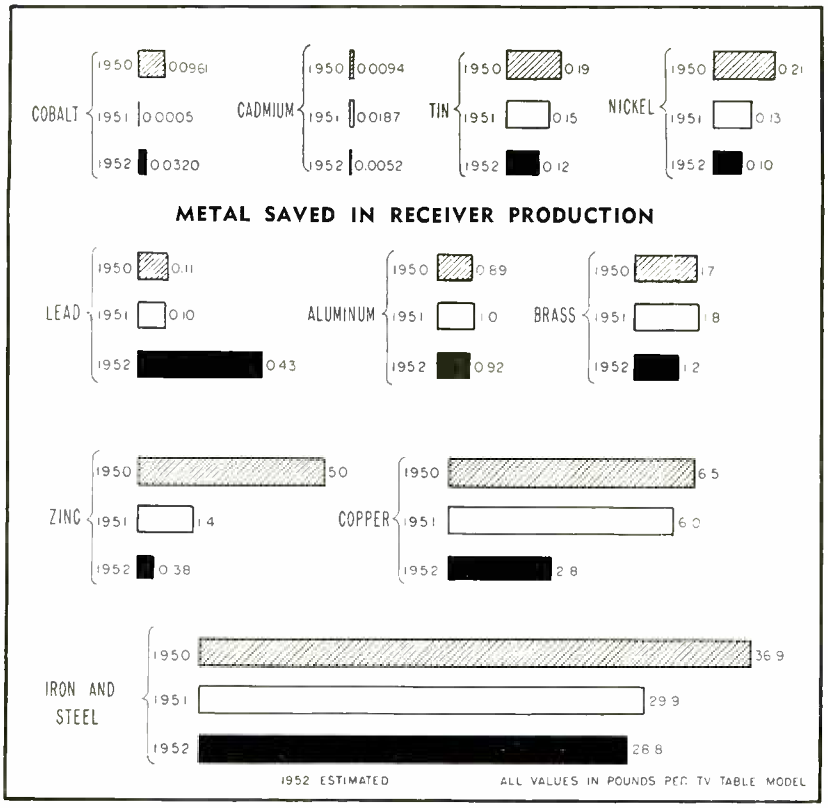
WORLD'S LARGEST CAPACITOR MANUFACTURER

after the tv set sales boom that Denver experienced. Already the tv audience is larger than expected, so that rates can be raised to increase total revenue and reduce loss.



METAL USAGE in table model and console sets declines as . . .

Manufacturers Conserve Materials

Early estimates of savings may have to be revised but gains will still be substantial

IF the 1952 radio and television production estimate made by the RTMA Material Bureau Advisory Council earlier this year holds true, the industry will effect a 50 percent saving in the use of critical metals. (In its final report on materials used by radio and television manufacturers, the council estimates that total radio-tv production for 1952 will be 14,267,000 units compared to 18,012,160 for last year and 22,053,700 units in 1950.)

▶ **Outlook**—With new television markets already becoming a reality, it is probable that early 1952 production estimates, especially for tv sets, will have to be revised upwards and that total critical metal savings will not be quite as substantial as indicated. But manufacturers do not expect that the current sales upswing will drastically affect conservation.

The supply of many critical metals has improved steadily, so that some are no longer listed as critical. Copper and aluminum were recently dropped from the list and are now classified by the DPA as "supplies in approximate balance with demand."

▶ **Total Savings**—The following table gives a comparison of the total amounts of metals used in 1950 and likely to be used in 1952 in radio-tv production if early production estimates hold:

	1950 (tons)	1952 (tons)	% Saved
Aluminum	6,229	3,139	50
Brass	13,361	4,844	64
Cadmium	284	119	59
Cobalt	629	218	66
Copper*	40,487	12,951	69
Lead	1,154	1,790	..
Nickel	1,278	450	65
Iron, Steel	224,115	118,915	47
Tin	1,064	534	50
Zinc**	15,631	5,745	51

* Includes copper used in brass
** Includes zinc used in brass

Savings of over 47 percent are expected for every critical metal this year except lead, which has increased in use since 1950 as a result of greater use in solder.

Microwave Sharpens Europe's Air Defenses

Relay network carries radar intercept data and top-level orders

FREE EUROPE'S air defenses are now being sharpened and toughened by a million-dollar microwave radio-relay network providing highly-mobile multichannel communications, free from jamming and interference, for top-priority operational voice and telegraph circuits.

Ordered by Allied Air Forces, Central Europe, from RCA International, the system will consist of 6 terminals and 17 repeater stations plus complete standby equipment and spares. Two terminals and one repeater were in operation this month during Operation Blue Alliance as 1,500 aircraft of seven NATO countries mock-clashed in Western Europe's skies and flew close cover for British and French armies maneuvering on the Rhine.

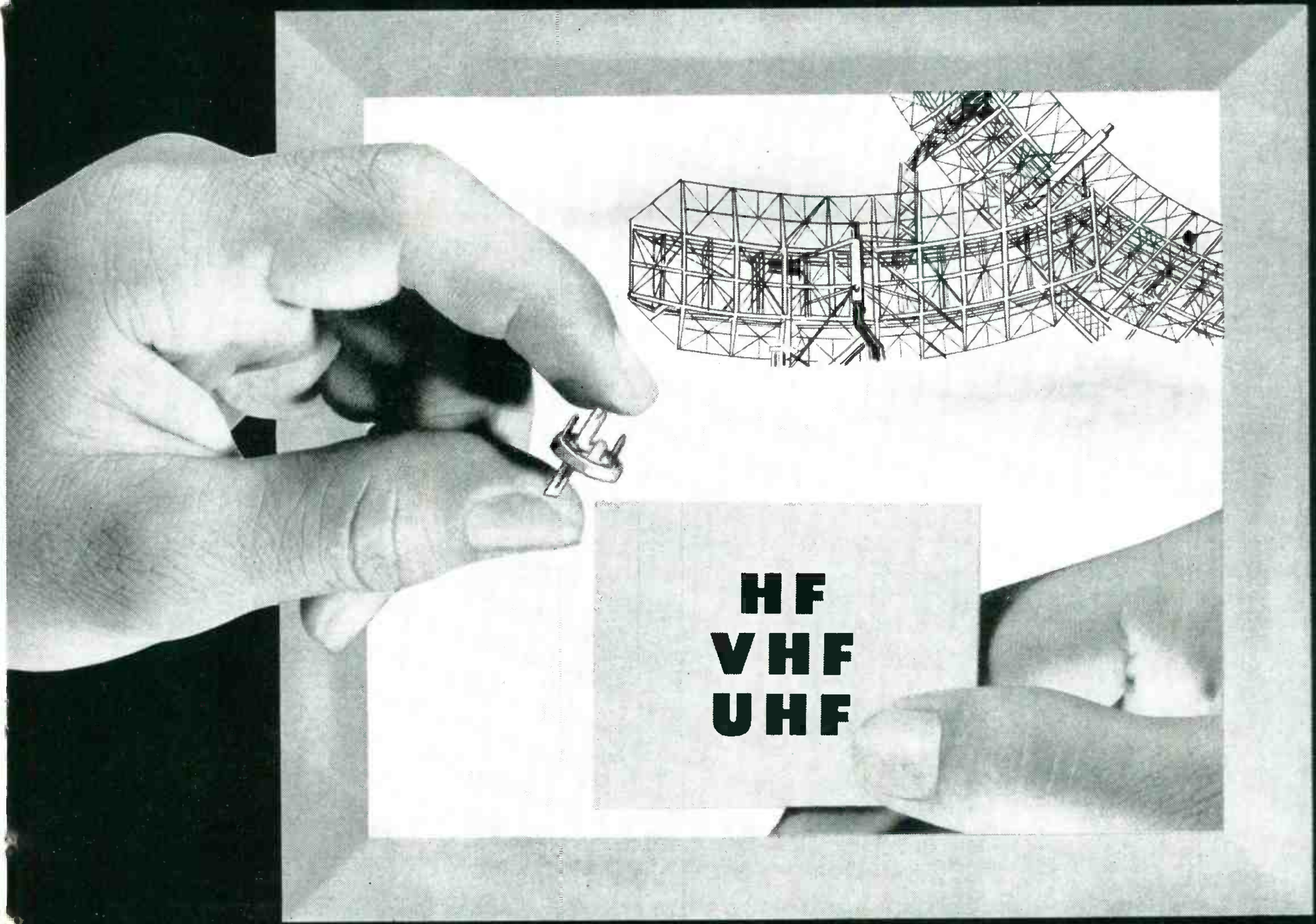
▶ **Mobility**—Initially installed to link major allied air installations with NATO headquarters, the equipment is readily transportable and will be moved around in the AAFCE area as required. The 58-ft, three-section telescoping masts can be collapsed to a mere 23 feet.

Each station is installed in five trucks carrying tower and antenna, cables and accessories, receiving and transmitting equipment, power generating equipment and personnel. The six-foot paraboloidal antennas, used both for transmitting and receiving, are fed with flexible RG-17/U coaxial cable.

▶ **System Layout**—The 15-centimeter carrier is modulated by a Lenkurt

(Continued on page 14)

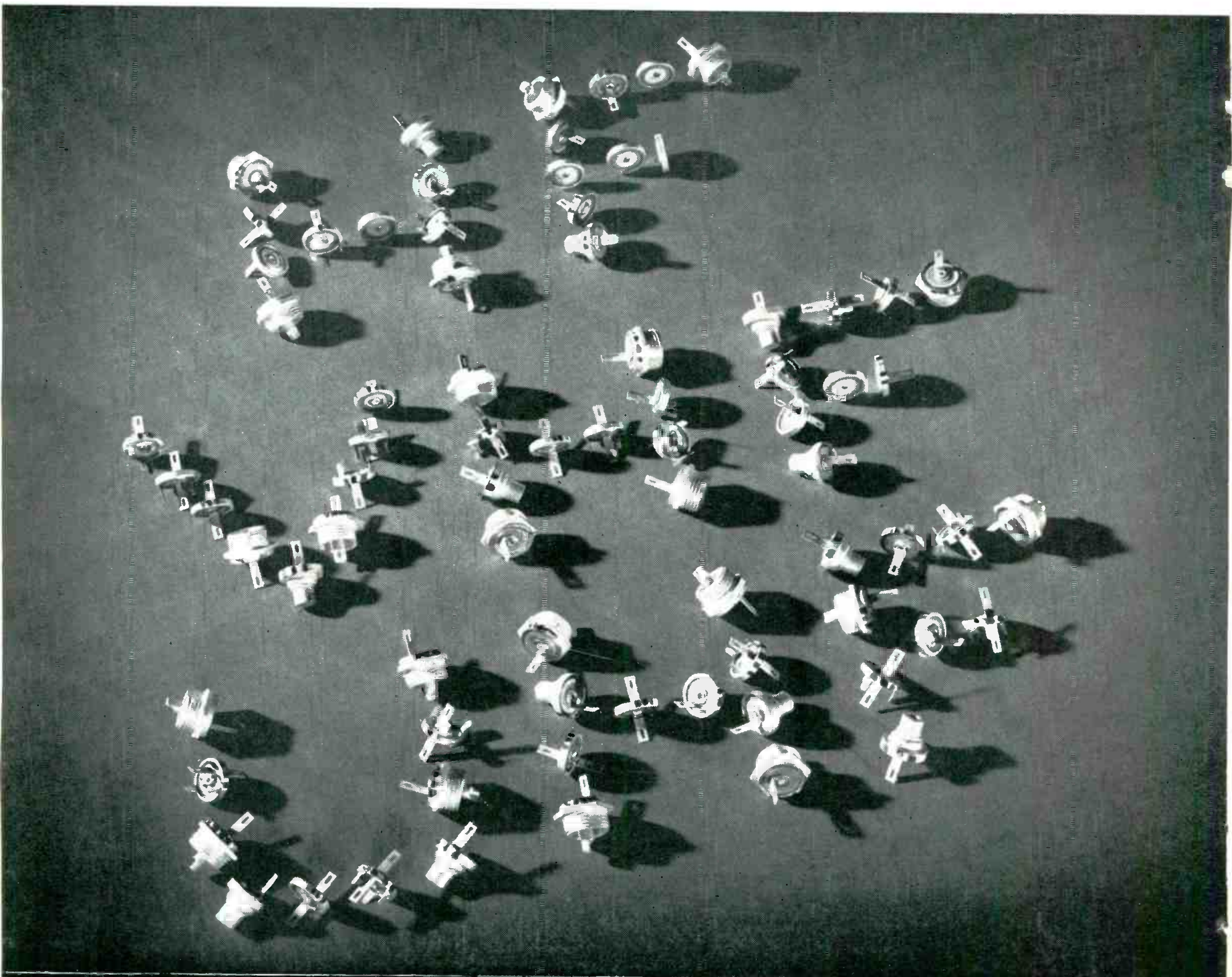
Put this Ceramic Button-type Capacitor in your electronic picture...

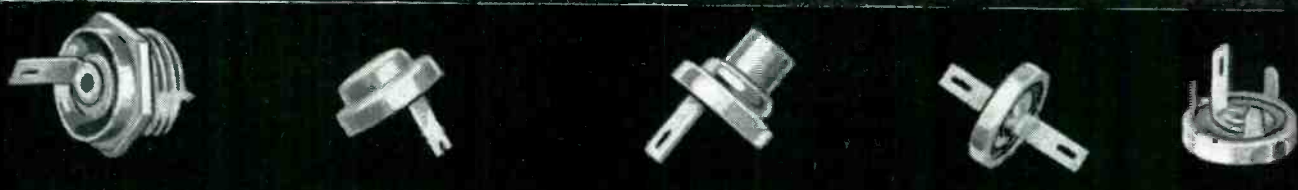


and get 4 big exclusive advantages

for proof... see next two pages

CRL Ceramic Button-type Capacitors you get small size... longer life...





TYPE 902
FEED-THRU — with threaded shell

TYPE 903
STAND-OFF with single soldering lug

TYPE 904
STAND-OFF with tapped base-single lug

TYPE 905 and TYPE 906
FEED-THRU (LEFT) with mounting lugs (RIGHT) plain with two soldering lugs

BUTTON STYLE CERAMIC CAPACITORS are available in five different types, including feed-through with threaded shell, stand-off with soldering lug and ground terminal, and stand-off with tapped ground terminal. Used on HF, VHF, and UHF, they are especially suited for feed-through and by-pass. The shell is effectively at ground potential in all styles. Capacities range from 5 to 1000 mmf. Voltage ratings, 500 vdcw and 1000 vdct. For complete details, write for Bulletin 42-122R.

replace old-fashioned "micas"... lower inductance...lower cost!

YES, only Centralab offers these four big reasons for specifying Ceramic Button-type Capacitors for use in low power, high frequency electronic equipment. Their ceramic construction provides: (1) Small size and light weight, (2) lower cost, (3) lower inductance—a real advantage in high frequency work, (4) longer life — *there's no deterioration with age.*

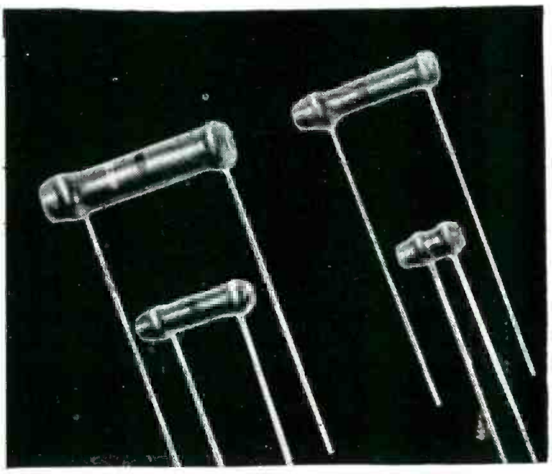
These capacitors are adaptable for transmitter exciter units and communication receivers and for aircraft, marine and government equipment.

Ceramic X, the exclusive CRL dielectric, is used for the ceramic body. It's non-hygroscopic, providing the ultimate in humidity resistance. All units withstand moisture conditions as specified in Jan C-20-A.

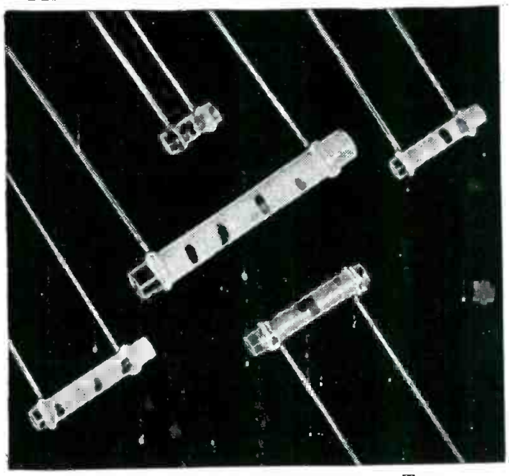
In addition, CRL Button-type Capacitors are solder-bonded to provide maximum sealing between shell and disc. Pressure contacts are eliminated, removing the possibility of intermittance and mechanical flutter.

Compare these dependable Centralab Ceramic Button-type Capacitors with old-fashioned micas. You'll find their exclusive features are your assurance of highest quality performance and true permanence at lower cost.

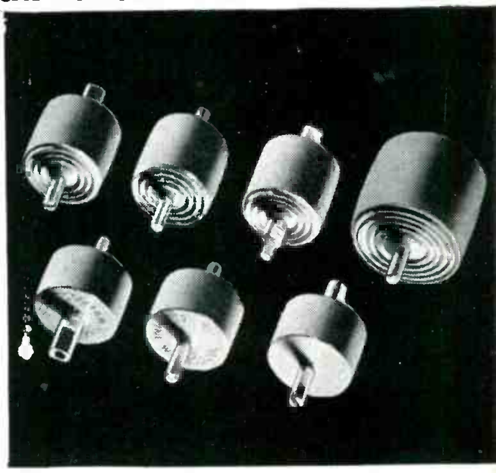
CENTRALAB OFFERS THE WIDEST LINE OF CERAMIC CAPACITORS AVAILABLE



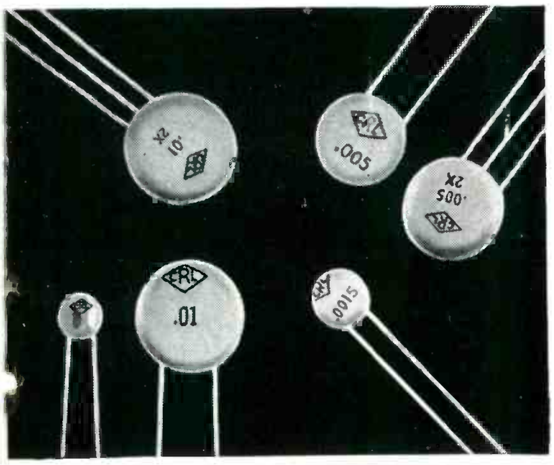
BC HI-KAP TUBULAR CERAMIC CAPACITORS available from 1 mmf to 10,000 mmf. Ideal for use in r.f. by-pass and audio-coupling applications. For details, write for Bulletin 42-3R.



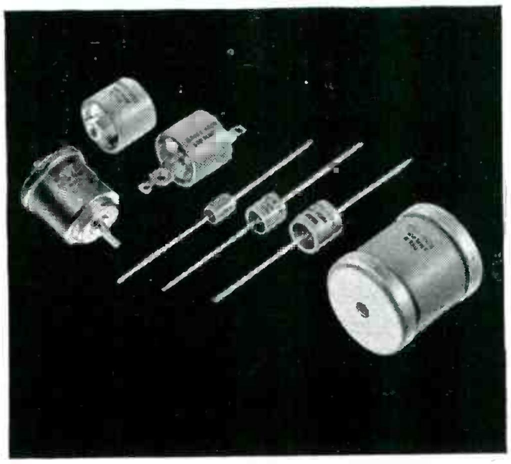
TUBULAR CERAMIC CAPACITORS — Type TCZ show no capacitance change over wide temperature range. Type TCN special ceramic body varies capacitance with temperature. Write for Bulletin 42-18.



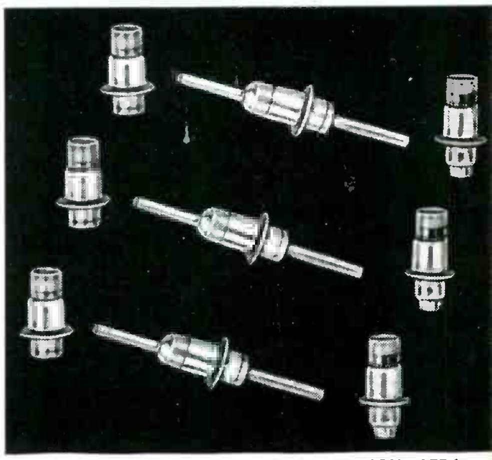
TV HI-VO-KAPS are the standard high-voltage capacitors for the TV industry. Capacitance: 500 mmf, 10 KV, 20 KV and 30 KV D. C. working. Write for 42-10R.



CERAMIC DISC HI-KAP CAPACITORS hold thickness to a minimum. Make possible very high capacity in extremely small size. Used in HF by-pass and coupling. For details, write for Bulletin 42-4R.



HIGH VOLTAGE CERAMIC CAPACITORS. Capacitance: 5 to 500 mmf, 5KV to 40 KV D.C. working. Ideal for portable or mobile equipment and high-voltage, high-frequency gear. Bulletin 42-102R.



EYELET-MOUNTED FEED-THROUGH CERAMIC CAPACITORS—smallest made... widest range obtainable with general temperature-compensating characteristics. 10 to 3000 mmf, 500 vdcw. Bulletin EP-15.

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frequency-division system to obtain 24, 5-kc voice channels in the 10 to 135-kc modulation spectrum. Each voice channel transmits frequencies from 300 to 3,400 cps. Twenty-three channels are used for telephone circuits while the remaining voice channel is subdivided to give 16 channels of on-off keyed tone telegraph.

Encompassing about 660 route miles, the microwave network is laid out in several legs converging on Allied Air Headquarters at Fontainebleau and connecting to their major subordinate commands on the Western European continent.

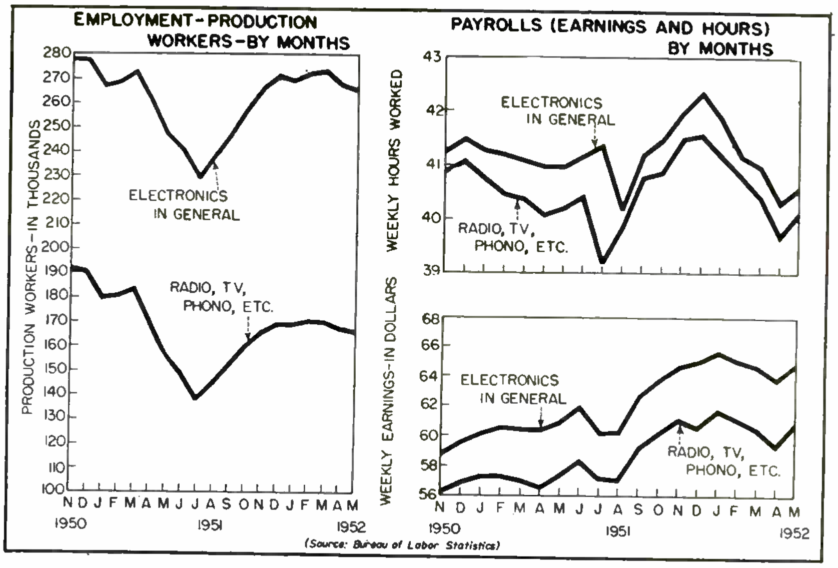
The primary network includes the 6 terminals and 17 repeaters. All 24 voice channels are available at each terminal and five voice channels are brought out for drop and insert at each repeater station. The voice channel carrying the telegraph circuits is available for drop and insert at every repeater. There is also a voice channel available below 10 kc on a party-line basis for order wire service.

A 40-mc carrier shift between transmit and receive frequencies is introduced at each relay station and terminal. Crosstalk, in addition to being reduced by a high front-to-back antenna ratio, is further reduced by changing the plane of antenna polarization 90 degrees at each terminal and relay point. Basic equipment supplied is commercial RCA CW-20 microwave radio relay.

Civil Defense Doubles Communications Budget

FCDA will spend $6 million on communication equipment and $3 million on noise devices during the 1953 fiscal year. The Federal Civil Defense Administration budget, made up of equal contributions by states and the federal government, represents a complete reversal of the 1952 budget which earmarked $3 million for communications and $6 million for warning devices.

Communications equipment to be purchased includes such items as radio receivers, television receivers, loud-speakers, and portable transmitter-receivers.



1952 Employment Peak Falls Short

Electronics industry production employment figures level off below predicted high

FALLING SHORT of the expected high, the 1951-1952 electronics production-worker peak reflects material shortages and slow-downs in military spending. Weekly salaries for production workers in radio and electronics continue their steady increase, despite seasonal dip in average number of hours worked. These trends are revealed in the accompanying plot of "Employment and Payrolls" statistics that appear on the "Figures of the Month" page in each issue of ELECTRONICS (p 4).

▶ **Breakdown**—Figures showing the number of workers engaged in electronics production are obtained from the Bureau of Labor Statistics publication, "Employment and Payrolls". They include personnel involved in such activities as fabricating, processing, inspecting, handling, maintenance and repair of electronic equipment, but exclude those primarily engaged in purchasing, finance, accounting, legal and executive phases of the business.

Earnings and hours statistics are taken from the BLS publication "Hours and Earnings". The salary figures are before deductions and include pay for sick leave, holidays and vacations. Pay for vacations not taken and retroactive pay and bonuses are excluded unless earned and paid regularly each pay period.

Transistors Operate at High Temperatures

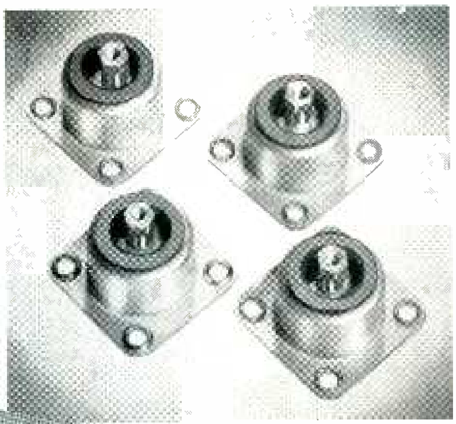
SUCCESSFUL operation of junction transistors at temperatures in the neighborhood of 120 degrees Centigrade has been reported by the General Electric Company in Syracuse, N. Y. This is in contrast to previous reports that operation above 75 degrees Centigrade was inherently unstable.

According to John S. Saby of GE, the alloy-diffusion process used in making the junction transistor results in the collector of the transistor having low resistivity. The low resistivity of the collector keeps the current control factor of the transistor constant within a fraction of one percent up to about 120 degrees Centigrade. Formerly, the current control factor would increase above unity with increasing temperature (above 75 degrees Centigrade) and cause instability.

Failure of transistors under high-

(Continued on page 16)

an ounce (and 1/4) of Protection



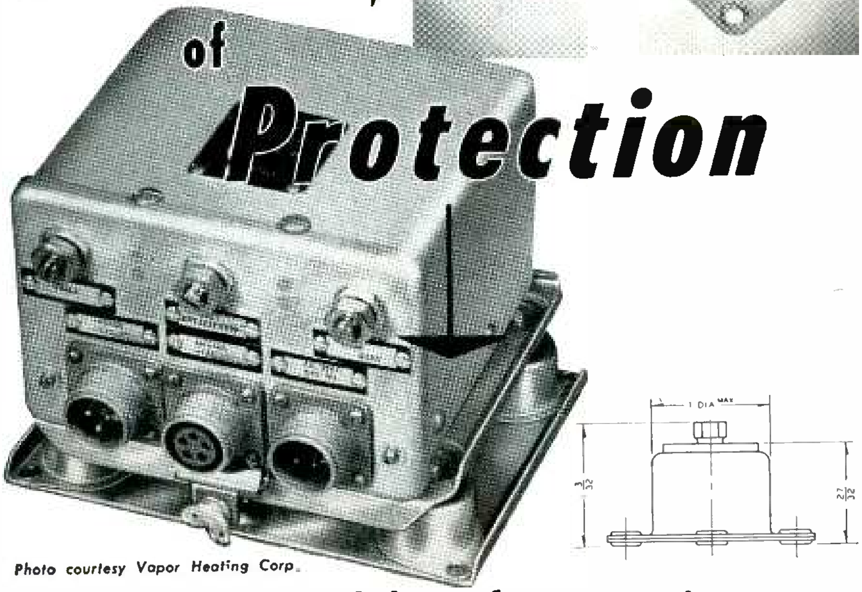
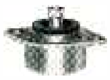


Photo courtesy Vapor Heating Corp.

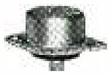
insures the reliability of your equipment.

Miniature air-damped Barrymounts were developed specifically to help you with your miniaturization projects. They give you these advantages:

1. Less space — reduced height cuts cubage of mounted equipment.
2. Less weight — only 5/16 ounce per unit isolator.
3. Wide load range — 0.1 to 3.0 pounds per isolator.
4. Satisfy temperature (−67 to +170F), vibration, and other performance requirements of JAN-C-172A — special models available for extreme high or low temperatures.
5. Ruggedized models — available for equipment that must meet shock-test requirements of AN-E-19, MIL-E-5272, and MIL-T-5422.
6. Four styles — available as unit isolators or assembled with mounting bases built to your needs.



TYPE 6475



TYPE 6695

TYPE 6465

TYPE 6690

For complete information, ask for Barry Catalog 523-A; it's free on request. And for greatest benefits with miniature Barrymounts, let our Field Engineering Service share our experience with you in the early stages of your designs.

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SALES REPRESENTATIVES IN

Atlanta Chicago Cleveland Dallas Dayton Detroit Los Angeles Minneapolis New York Philadelphia Phoenix Rochester St. Louis San Francisco Seattle Toronto Washington temperature conditions has been a major obstacle. With this problem at least experimentally licked and high-frequency operation possible (ELECTRONICS, Aug. 1952, page 10), the chief obstacle remaining seems to be quantity production.

Tell-Tale Cars Speed Subway Travel

Train equipped with "electronic describer" signals destination before entering station

NEW YORK CITY'S subway system, one of the safest railroads in the world, is ever on the alert to increase safety and speed traffic. Latest device undergoing test will undoubtedly be called AETID by some newsman because it is officially described as "automatic electronic train identification device". Originator of the idea, Cameron A. Reed, Engineer of Line Equipment for the Board of Transportation, is emphatic that he does not consider it a safety device. Other engineers think it does contribute to safety.

▶ **How It Works**—A coil tuned to some frequency between 50 and 220 kc and requiring no energy sticks out from the first car of a train. Alongside the track is another coil, tuned to the same frequency and connected into a Wheatstone-bridge circuit. As the train passes, the bridge is unbalanced and a relay rings an alarm or lights a lamp. Other coils have no effect.

▶ **How It is Used**—A train on the Independent line coming into 59th St. station is identified by the towerman from the pattern of colored lights displayed on the front car. He throws switches to send this train onto either the 6th or 8th Ave. tracks. If he makes an error, there is no danger to the passengers but there is considerable inconvenience and the towerman gets the next day off—without pay. The electronic describer will help avoid such infrequent errors.

Boxed Orthicon Is Lightest Camera

Designed for closeups during fight telecasts, this new portable tv camera developed by Robert Sammon of CBS contains only an image orthicon tube and controls. It is connected by cable to sweep and video circuits in a standard studio camera some 15 feet away. Equipped with a bullseye view finder, it weighs 22 pounds

Technical Book Prices Rise

Labor, constituting 80 percent of cost, is chief reason for trend to 2¢-a-page books

PUBLISHERS of engineering books today have a double worry—about costs and prices of the books they do put out, and about the books they can't afford to publish.

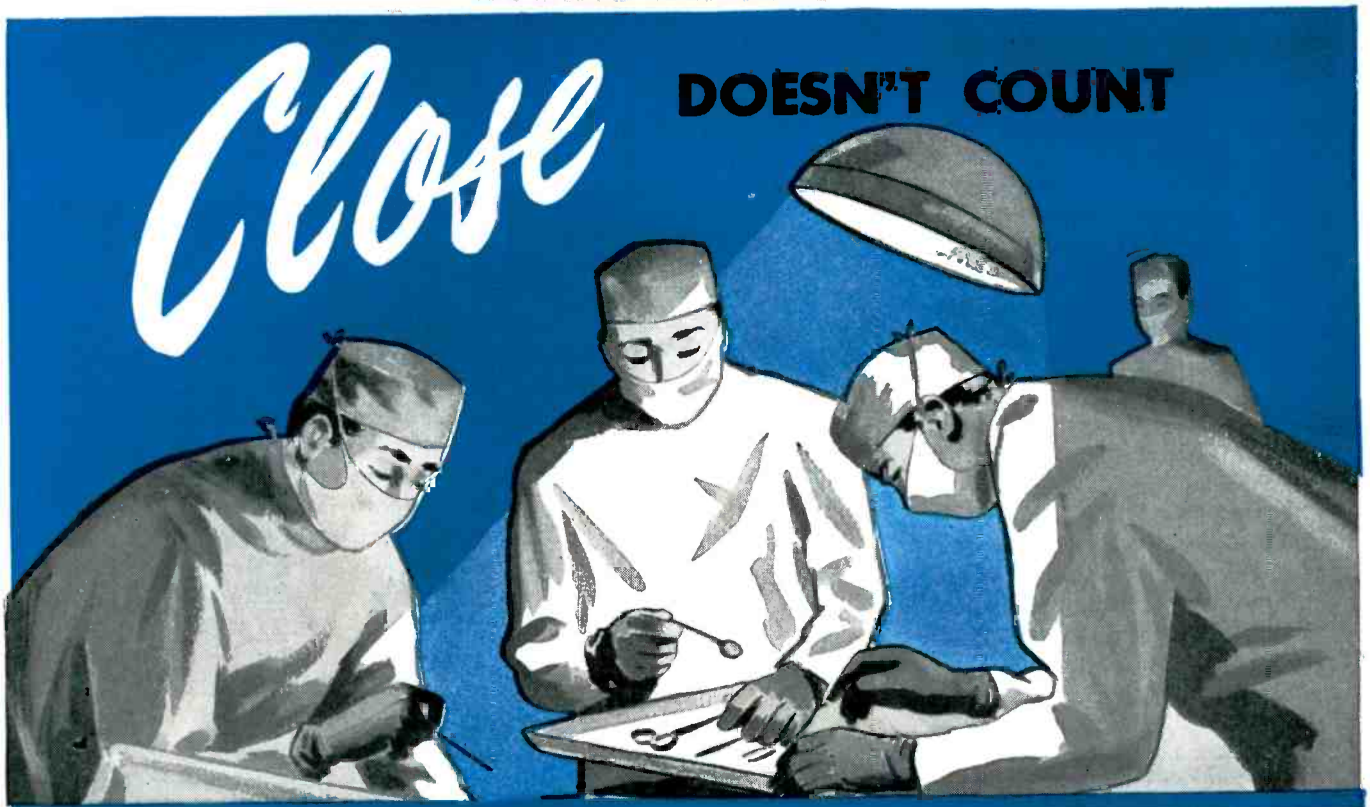
In the early '40's it took only about 5,000 copies to reach a satisfactory profit position (regain production, editorial, promotion and overhead costs) on a new technical book. Today, however, around 8,000 copies must be sold in order to get back the original investment, even with the book priced at the new 2¢-a-page level. This means that many meritorious specialized manuscripts without such high sales prospects will go unpublished, unless some publisher has the nerve to price them at the required break-even figure of 3¢ or even 4¢ a page.

Success of such a gamble hinges on willingness of engineers to pay upwards of $10 even for the books they need badly.

▶ **Cost Breakdown**—The raw materials of books are paper, ink and binding; their cost, added to prorated amortization of plant, equipment, engraving metal and printing metal, amounts to 20 percent of the cost of manufacturing a new scientific book. The balance is labor—for editing, type-setting, making drawings, making engravings, operating the presses, proof-reading, and binding.

The labor portion of this cost has almost doubled in the past ten years, paper has gone up 54 percent, binder's cloth 75 percent, binder's board 58 percent, and even the gold leaf for stamping covers has gone up 56 percent. As a consequence, the book that cost $1 a

(Continued on page 18)

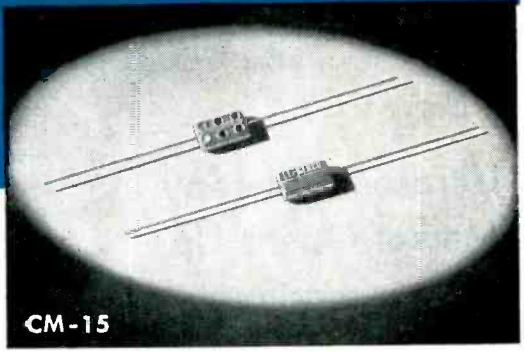


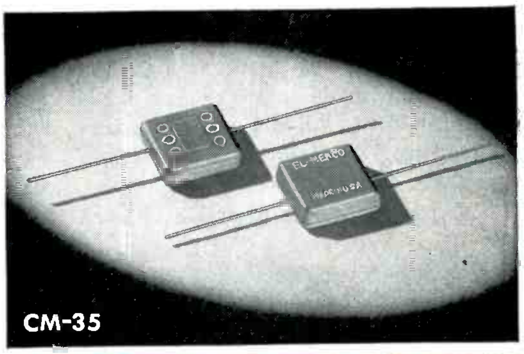
In the hushed white of the operating room, precision and dependability mean life to the quiet patient. **Almost** is the same as failure. In electronics the identical holds true . . . close just isn't good enough.

This is why El-Menco Capacitors are designed for the ultimate in reliability and are built with razor-edge accuracy.

Lessons have been learned from surgery . . . today a doctor always allows a large margin of safety in standard operations. For long life and freedom from failure in your electronic applications every El-Menco Silvered-Mica Capacitor is factory-tested at more than **double** its working voltage.

For peak performance in compact form . . . for higher capacity values, which require extreme temperature and time stabilization . . . there are no substitutes for El-Menco Capacitors. Available for every specified military capacity and voltage.





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CAPACITORS

Radio and Television Manufacturers, Domestic and Foreign, Communicate Direct With Factory—

THE ELECTRO MOTIVE MFG. CO., INC. WILLIMANTIC, CONNECTICUT

copy to produce in 1942 is today costing close to $1.75 a copy.

Author royalties, generally 10 percent of retail selling price, go up whenever a book price is boosted. Promotion, advertising, mailing and other incidental costs likewise go up. Selling prices have not risen at the same rate, because publishers kept hoping that costs would stop rising and because they were afraid of market resistance to higher prices.

Net profit on books has dropped steadily downward in the last four years. Whereas traditionally publishing contracts have been so calculated that overall profit on the average book was divided about equally between author and publisher, today the author is making about twice as much as the publisher. The only shining light in the picture for publishers, albeit very dim, is that federal income taxes go down when income goes down.

Ultrasonic Therapy Market Opens Up

One company already has units in production for treating organic disease

INTEREST in ultrasonic therapy among American medical men has been negligible until recently, although units have been manufactured and used in Europe for ten years.

Experiments of physicians here are now reported to show that ultrasonic energy can be used in alleviating some organic diseases.

Ultrasonic vibrations being applied to the spinal column of a patient

▶**How It Works**—One technique is to apply ultrasonic vibrations to the spinal cord of a patient. The human nervous system is said to conduct high-frequency vibrations to other parts of the body and so stimulate hormone production to combat disease. Some danger lies in the fact that too much energy could injure the nervous system.

An ultrasonic therapy unit is being manufactured by the Birtcher Corporation of Los Angeles, California.

Emerson Electric Explains Contract Loss

ALTHOUGH a $105-million Emerson Electric Mfg. Co. contract for the intricate A-2 remote fire control system for B-47 tail armament was cancelled by the Air Force last year (Oct. 26, 1951), the action only recently received widespread newspaper publicity. Stories were considered so misleading by the St. Louis firm that it sent a special letter of explanation to its stockholders:

▶**History of Contract**—In January 1945 Emerson Electric started research and development on an advanced type of fire control system comprising over 20,000 parts, to be used in the Boeing six-jet B-47 bomber for controlling the tail-turret guns automatically from an up-forward radar-aiming location. The next six years were a story of one difficulty after another, with the Air Force continuing to pour in money because success always seemed just around the corner. Critical stability problems in a highly advanced system design were the chief trouble.

By January 1951, engineering time was running out and the company was given a "must" schedule of deliveries to meet requirements of the B-47 program. The engineering changes still needed were scheduled to be made as production progressed. Systems already delivered were to be modified at the installation point.

▶**Interim System**—The modification program did not work out. On May 7, 1951 production was stopped, and the Air Force ordered Emerson Electric to concentrate on making the system "reliable." Bomber production continued, however, and tail-turret controls were badly needed. In September, the company was requested to provide an interim armament system using certain major components of the original system, with plans for swinging back to the original design as soon as it proved satisfactory.

In October 1951 the Air Materiel Command cancelled the original Emerson A-2 contract; plane manufacturer requirements far exceeded production capacity of Emerson's government-owned armament plant at that time, forcing the decision to use the simpler alternate system.

Engineering work is continuing on the original system, with a recent prototype undergoing extensive tests on a bomber. The basic design is considered fundamentally sound. The troubles encountered with it are considered typical of those encountered when taking the calculated risk of developing extremely complex equipment for military aircraft concurrently with design and production of the aircraft itself.

American Airlines Buys New A-12's for DC-7's

Company reaffirms faith in aviation electronics after mishap with automatic pilot

AVIATION ELECTRONICS took what seemed to be a hard knock last month when American Airlines discontinued use of automatic pilots in certain of their commercial airliners following a malfunction during operation that caused one of these planes to assume an irregular attitude in flight.

That this action was not a

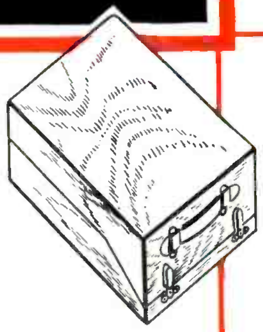
(Continued on page 20)

marion's NEW metertester

MODEL M-2

MEASURES SENSITIVITY AND RESISTANCE

for testing and calibration of D. C. instruments in the laboratory and on production lines



Marion's New Metertester (Model M-2) retains proven Marion features but increases application flexibility. In addition to improved circuitry for sensitivity measurement it also measures internal resistance of sensitive instruments without exceeding full scale rating of the instrument under test.

FEATURES

- Regulated Power Supply
- Stepless Vacuum Tube Voltage Control
- Illuminated 8½" Mirror-Scale Standard Instrument, Hand Calibrated
- Marion Ruggedized Null Indicator movement for bridge balance indication
- Decade of .1% accurate Manganin Wire Wound Resistors
- Direct Reading Bridge Circuit using Helipot
- Complete. No accessories required

SPECIFICATIONS

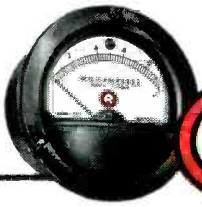
ACCURACY: Overall better than ¼ of 1%
RESISTANCE RANGE: 0-5000 ohms
POWER SOURCE: 115V A C 60 cycles
CASE SIZE: 15⅛" x 10⅛" x 5⅜"
WEIGHT: 15 lbs.

SENSITIVITY RANGES

0-25UA	0-200UA	0-800UA	0-10 MA
0-50UA	0-400UA	0-1 MA	0-100 Volts
0-100UA	0-500UA	0-5 MA	

The New M-2 Model can also be used for additional purposes, such as a precise source of DC current and voltage and as a precision Wheatstone bridge in the 0-5000 ohm range.

For further information write Marion Electrical Instrument Co., 401 Canal Street, Manchester, N. H., U. S. A.



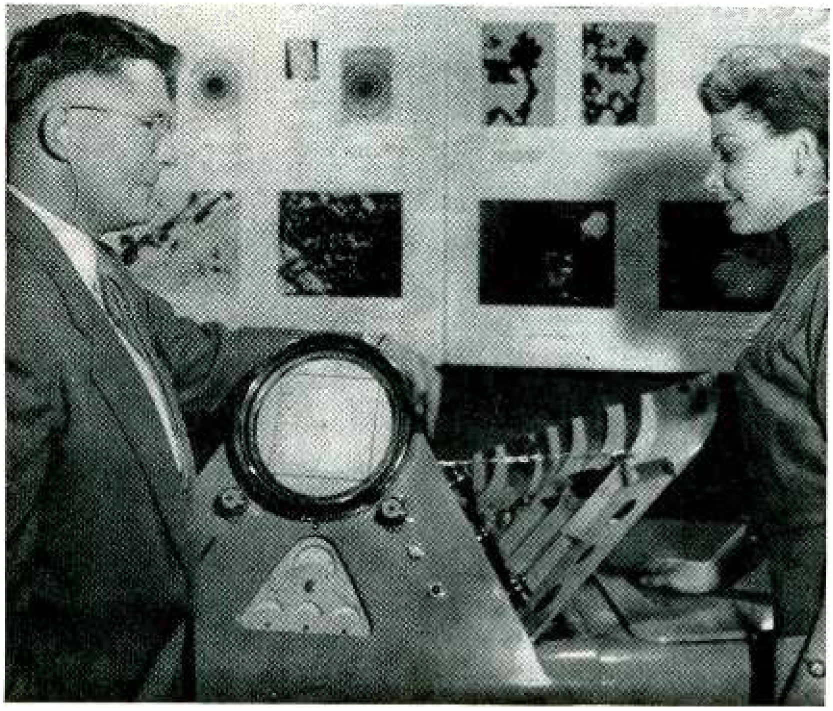
marion meters

Reg. U. S. Pat. Off.

MANUFACTURERS OF RUGGEDIZED, HERMETICALLY SEALED AND STANDARD PANEL INSTRUMENTS blanket rejection by that company of all electronic flight equipment was vividly illustrated when American later announced that a complete complement of new automatic control equipment will be installed in its new fleet of Douglas DC-7 Flagships.

▶ **Improved Model**—The 25 new ships now on order will be equipped with Sperry autopilots complete with automatic approach couplers and a newly-developed automatic cut-off device to prevent such violent maneuvers as might be caused by autopilot misbehavior.

The new automatic cutoff consists of a pair of accelerometers, one in the nose and one in the tail of each ship. These measure vertical acceleration and are thus able to measure angular acceleration about the pitch axis of the aircraft. Improper relationship between autopilot signals and the airplane's angular motion causes the detectors to signal the human pilot to take over manually.



PERT CLEVELAND LASS gets pointers on an electron microscope at the National Instrument Show where . . . . .

Instrument Makers Stabilize Lines

New offerings scarce, manufacturers exploit last year's strides

COMMERCIAL exploitation of instruments designed within the last two years rather than introduction of brand-new models characterized displays of 198 manufacturers exhibiting at the seventh National Instrument Conference and Exhibit held September 8-12 in Cleveland's public auditorium.

The show belonged predominently to smaller manufacturers, some larger instrument makers having decided that progress in the field warrants exhibition only every other year.

▶ **Computers**—Electronically, the most significant development was emergence of the computer from the laboratory into the field of instrumentation. This has been hailed as a long step towards fully-automatic control of industrial operations.

One electronic analog computer on display handles differential equations up to the seventh order and incorporates 12 amplifiers. Another boasts 24 amplifiers and handles twelfth order equations. With an improved cooling system, this machine uses regular-sized tubes.

▶ **New Products**—A novel temperature and strain-gage recorder was introduced that permits a-c amplification of low-level d-c voltages. An electronic chopper inverts the signal at a 50 kc rate.

A unique capacitor-follower recorder minimizes indicator loading. A vane, acting as one plate of a variable capacitor, is mounted on the indicating galvanometer pointer. The other plate is mechanically coupled to a servo motor controlled by an electronic capacitance relay. The servo drives the recording pen.

Other instruments included a surface-roughness gage operating on the principle of a phonograph pick-up and a viscosity meter deriving its information from the damping rate of an ultrasonic pulse.

Industrial control devices were largely of the temperature, pressure, rate-of-flow and liquid level regulating type applicable mainly in chemical plants and other process industries. Midget electronic components for process control have recently met with wide acceptance by larger chemical and petroleum manufacturers.

The navy exhibited a halogen-filled Geiger-Mueller tube using no critical materials and a vector airborne magnetometer using three saturable inductors as sensing elements.

▶ **Foreign Competition**—Rumblings that may portend the return of Western Europe's master instrument makers to the American market were heard at the show. One Dutch firm and three Swiss concerns displayed their wares and an American manufacturer exhibited a line of Danish instruments.

Further evidence of increased productivity in Europe was found in announcement of the first International Instrument Congress and Exposition, scheduled for Philadel-

(Continued on page 22)

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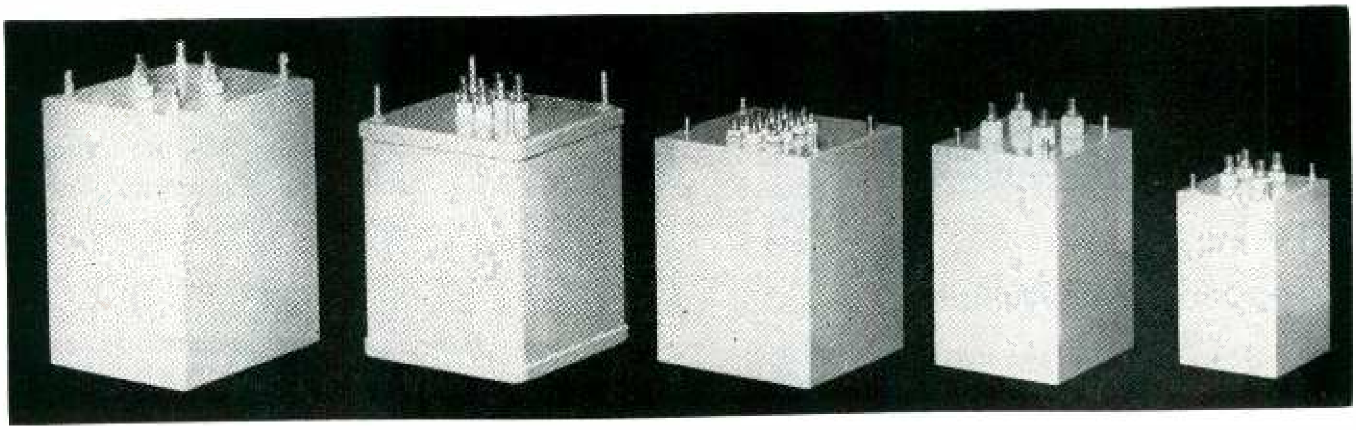

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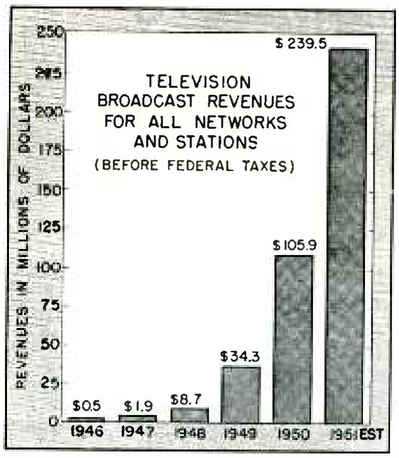
STATIC ELECTROMAGNETIC DEVICES

phia's museum and convention hall, September 13-25, 1954. The next national instrument show will be held in Chicago, Sept. 21-25, 1953.



TV Income Topped $239 Million

TELEVISION network and independent station revenues (time, talent and program sales) for 1951 totalled $239.5 million, more than twice the 1950 figure.

Networks, including owned and operated stations, grossed $132.2 million, with expenses of $119.8. (For the first time, the networks received more from tv than from a-m with its $100.4 million gross and $90 million expenses.) Income from combined a-m and tv networks came to $22.8 million, more than double the 1950 income of $8.7.

Ninety-three independent tv stations reported totals of $107.3 million compared with 1950's $50.4. With station expenses increasing at a slower rate, the 1951 station income was $31.2 million as compared with $0.8 million in 1950.

▶**Individual Income**—Of the 106 stations reporting preliminary figures to the FCC, 93 showed a profit in 1951. Median income was $350,000 as compared with a median for 53 stations in 1950 of $129,000.

Seven of the 13 losing tv stations reported losses of $200,000 or less, while two reported losses in excess of $800,000. Eight of the thirteen losing tv stations were located in the two seven-station markets—New York and Los Angeles.

TV Component Delivery Near Normal

Receiver manufacturers report delivery time at 4 to 6 weeks for most parts

TELEVISION RECEIVER manufacturers are reasonably happy about the component supply. Deliveries of most parts are only 2 to 3 weeks behind normal and are being made in quantities ordered, a survey of leading set producers reveals.

A few set makers are feeling a pinch in the supply of 21-inch picture tubes which now are used in the lion's share of tv set production, but they expect the shortage to be quickly overcome. One manufacturer notes that electrolytic capacitors are taking as long as 8 weeks to deliver and another reports a 16-week lag in chassis delivery.

▶ **Early Pickup**—The earlier-than-usual upswing in tv sales this year caught some component manufacturers with their inventories down. The rise came in July, about a month and a half ahead of the usual time.

Set producers see three main reasons for the early tv sales increase. The defreeze started the ball rolling; early opening of the Denver market helped bring inventories down to the present level of about 240,000 sets. Then the political convention telecasts promoted sales for all tv manufacturers during the traditional summer slump.

The fact that the majority of leading set producers brought out new lines ahead of time to tie in with the political convention promotions also contributed heavily to the tv sales upswing. In July, tv production was 34 percent higher than it was for the same month in 1951. During August, each weeks production topped the preceding week by a good margin.

▶ **Outlook**—Some component manufacturers do not share the present optimistic attitude of tv set manufacturers concerning the supply situation. Selenium rectifier manufacturers, for example, recently advised NPA that fewer of their products may be available for tv sets in 1953 because of military requirements. Loudspeaker manufacturers also expect shortages in production because of lack of steel. They predict that set manufacturers may feel the pinch in the next few months.

Russian Periodicals Available in U.S.

Some technical information on radio and electronics flows freely from east to west

RUSSIAN equivalents to ELECTRONICS and other western technical journals are available in this country in certain libraries. Through these publications, with a little effort in translating, the western engineer can keep fairly well abreast of advances made by his eastern counterpart.

For example, an article in one Russian magazine describes a new ultrasonic microscope with complete details of theory, construction and operation. Another describes Russian progress in transistors and presents experimental results obtained by subjecting various semiconductor materials to a wide variety of operating conditions. The article credits O. V. Losev with having developed a semiconductor device capable of producing oscillations in the early 1920's.

Much information is dispersed in report form. One such report tells of successful use of ultrasonic energy in processing steel. Others describe progress at virtually all levels from pure theoretical dissertations to experiments and projects for hobbyists.

▶ **Sources**—According to Gilbert B. Devey, whose search of the Library of Congress Slavic Room and the MIT Science Library inspired this article, Russian technical language is relatively easy to

(Continued on page 24)

read by the "hunt and peck" method, with a Russian-English dictionary.

Lists of Russian publications are available as follows: "Serial Publications of the Soviet Union", published by the Library of Congress, Washington 25, D. C., "Guides to Russian Scientific Periodical Literature", Brookhaven National Laboratory, Upton, New York (Available through Office of Technical Services, Department of Commerce, Washington 25, D. C.) "Monthly List of Russian Accessions", Library of Congress, Washington 25, D. C.

Automatic ILS System Released

Lear F-5 demonstrates ability to guide planes smoothly to point of touch-down

BY ADDING 79 pounds and $13,750 worth of electronic components, commercial aircraft can now be flown to within five feet of an ILS-equipped runway with only airspeed control by the pilot. This advance in flying was demonstrated to ELECTRONICS by inventor-engineer Bill Lear in New York on June 12 as his company made the hitherto military F-5 autopilot available for civilian use.

The 27-tube (all 12AY7's) autopilot has many features that make it unique. Most noticeable of these is the smooth control afforded by circuits that average error signals and thus avoid violent maneuvers due to momentary signal discontinuities. In fact, if the plane is on the glide slope for one minute or more, it will continue steadily toward the point of touch-down even if the ILS transmitter fails.

Military airplanes of the F86D, F89 and F84G types already incorporate the F-5. This same 8 x 10 x 13-inch package can be used to fly automatically any plane from a B36 intercontinental bomber to a single-engine lightplane such as the Beechcraft Bonanza.

Printed Circuits Cut Home Radio Costs

PRODUCTION of home radios with printed circuits, and using dip soldering, will begin in mid-October at Hallicrafters. Using a recently-developed "power print" process, in which unwanted copper is photographically etched away from a plastic base, over 100 hand operations will be eliminated, according to Bill Halligan, president of the company.

In rough figures, a particular radio that now requires 100 girls to produce 1,000 sets a day will in the future require 20 girls, because the new technique permits use of single-dip soldering. Eventually, the process may reduce the cost of tv and radio sets by as much as 25 percent.

Sightless TV Keeps Up With the Joneses

Sound-channel receiver provides all vhf bands and f-m broadcasting

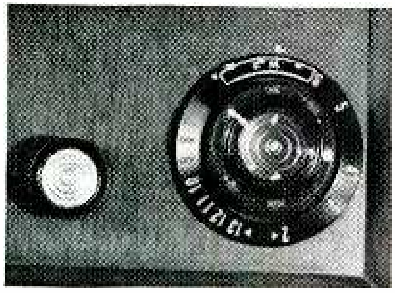
KEEPING up with the Joneses is as important to sightless persons as to the rest of us, and sometimes more so.

Just as children of a televisionless family feel socially outcast, so blind children and adults both feel left out of the main stream of life when they lack knowledge of tv personalities. Workers with the blind say this frame of mind tends to make the sightless person withdraw further from contact with the world.

To supply this lack, Herbert Abrams, president of Pyramid Television Service Co., New York City, put together a simple table radio receiver that tunes in the sound on tv channels 2 through 13 and all f-m channels.

A standard tuning unit is modified so that a detent device emits clicks as the dial is moved from one tv channel to the next.

Engraved numbers also serve to identify channels through the sense of touch. Across the f-m band, where the clicks are missing, raised dots on both the outer dial and the inner vernier show a pattern that can be interpreted by fingertips as broadcast channels. The only other knob operates a combination volume control and on-off switch.



Screenless tv controls in one corner of front panel include on-off volume control (left) and tuning dial (right). As each channel is tuned in, the dial clicks. Raised dots over the f-m range where there are no clicks give Braille-like channel identification

► Soon Available—Although the set is expected to sell for $50 to $65, it is simpler, less bulky and more easily moved about than even the smallest, most inexpensive television receiver. Its simplicity is expected to result in lower maintenance costs and greater reliability.

The New York Guild for the Jewish Blind, a nonsectarian agency for the blind and visually handicapped, will distribute the screenless tv set as soon as demand has been established and a manufacturing program is set up.

Radar Heads U.S. List Of Electronics Orders

REPORTS from RTMA members show $538,794,477 in electronics orders from the U. S. Government in the first six months of the current year.

Radar heads the list at $263,-131,886. Communications equipment ran second at $160,-693,327 and radio navigation aids accounted for $45,423,158. Sonar orders amounted to $10,783,-

(Continued on page 26)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479, laboratory and test equipment $13,459,401, and miscellaneous, $45,-296,101.

Billings to the government by RTMA members for the same period jumped from $76 million in 1951 to $243 million this year.

Experimental UHF TV Goes Commercial

RCA'S PIONEER experimental uhf tv transmitter at Bridgeport, Connecticut may soon become the pioneer commercial uhf tv station in the country.

Operating experimentally since 1949, it was recently sold to Empire Coil for use in Portland, Oregon.

The equipment is being modified to operate on the Portland channel and should be in service by Thanksgiving, possibly by election day.

▶ **20 Left**—Shift of KC2XAK to commercial service brings the number of experimental tv stations in the U. S. down to 20. Following is the current list of experimental stations now in operation or with CP grants.

Stations

Call Letters and Licensee	*Frequency in mc*	*Power a—aural v—visual*
KG2XAZ—Assoc. Broadcasters, main transmitter, Bethlehem, Pa.	511–519	5 kw; 500 w v; 250 w a
booster, Easton, Pa.		50 w v; 25 w a
KQ2XBB—Radio Electronic TV School, Detroit, Mich.	500–520	400 w v; 50 w a
KE2XIA—CBS, New York, N. Y.	470–476	1 kw v; 1 kw a
KQ2XBH—Crosley Broadcasting Corp., Cincinnati, O.	529–535	100 w v; 50 w a
KE2XDN—DuMont Labs, New York, N. Y.	600–620	1 kw v; 1 kw a
KE2XDR—DuMont Labs, New York, N. Y.		1 kw v; 1 kw a
KE2XHZ—Federal Tel. Labs, Nutley, N. J.	700–720; ch 2–13 (incl)	5 kw v; 5.5 kw v; 3 kw a
KE2XHX—General Electric Co., Syracuse, N. Y.	ch 2–13 and 480–890	50 kw v; 25 kw a
KA2XBD—Kansas State, Manhattan, Kan. (L)		400 w v; 200 w a
KM2XBB—Paramount TV, Los Angeles, Calif.		100 w v; 50 w a
KM2XCW—Television Calif., San Francisco, Calif.	580–630	1 kw v
KG2XCV—Philco, Phila., Pa.	6,875–6,900	0.1 w v
KM2XAD—Pacific Video Pioneers, Mt. Wilson, Calif.	520–540; 780–800	200 w v; 100 w a
KS2XBR—Zenith, Chicago, Ill.	512–528	1 kw v; 1 kw a
KS2XBS—Zenith, Chicago, Ill.	ch 2	1 kw v; 500 w a
KG2XDI—Conestoga TV Lancaster, Pa.	590–610	5 kw v; 2.5 kw a
KG2XDU-Sylvania, Emporium, Pa	509–529	300 w v; 100 w a
KG2XEL—Sylvania, Emporium Pa.	878–884	30 w v; 10 w a
KG2XEJ—Sylvania, Emporium, Pa.	1,990–2,008	0.2 w v
KG2XEV—Sylvania, Emporium, Pa.	2,042–2,059	0.2 w v

MEETINGS

OCT. 1-3: Canadian Electrical Manufacturers Association, General Brock Hotel, Niagara Falls, Ont.

OCT. 3-4: American Society for Quality Control, Sheraton Hotel, Worcester, Mass.

OCT. 6-8: NAED, Fall Meeting of the Pacific Zone, Hotel del Coronado, Coronado, Calif.

OCT. 13-17: AIEE Fall General Meeting, New Orleans, La.

OCT. 20-22: Radio Fall Meeting, RTMA Engineering Department, Hotel Syracuse, Syracuse, N. Y.

OCT. 20-24: National Metals Show, Philadelphia Auditorium, Philadelphia, Pa.

OCT. 21-23: Twenty Ninth Annual Session, Communications Section, Association of American Railroads, Edgewater Gulf Hotel, Edgewater Park, Miss.

OCT. 26-29: NAED, Meeting of Board of Governors, Grove Park Inn, Asheville, N. C.

OCT. 28-30: AIEE Middle Eastern District Meeting, Commodore Perry Hotel, Toledo, Ohio.

OCT. 29-Nov. 1: Audio Fair, Hotel New Yorker, New York, N. Y.

NOV. 5-7: Sixteenth Annual Time and Motion Study and Management Clinic, Sheraton Hotel, Chicago, Ill.

NOV. 7: IRE Microwave Professional Group, Symposium On Microwave Circuits, Western Union Telegraph Co. Auditorium, New York, N. Y.

NOV. 10-13: NEMA, Haddon Hall, Atlantic City, N. J.

NOV. 10-30: International Radio and Electronics Exhibition, Bombay, India.

NOV. 17-18: AIEE, Technical Conference on Recording and Controlling Instruments, Benjamin Franklin Hotel, Philadelphia, Pa.

NOV. 19: American Standards Association, 34th Annual Meeting, Waldorf Astoria, N. Y.

NOV. 21-22: Fourth Annual IRE Regional Papers Technical Conference, President Hotel, Kansas City, Mo.

DEC. 10-12: IRE-AIEE Computer Conference, Park Sheraton Hotel, New York, N. Y.

JAN. 14-16, 1953: Joint AIEE-IRE Conference on High Frequency Measurement, Washington, D. C.

FEB.. 4-6: Western Computer Conference, Hotel Statler, Los Angeles, Calif.

FEB. 5-7: IRE Southwestern Conference and Electronics Show, Plaza Hotel, San Antonio, Texas.

MARCH 9-12: NEMA, Edgewater Beach Hotel, Chicago, Ill.

MARCH 23-26: IRE National Convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N. Y.

MAY 11-13: National Conference on Airborne Electronics, Dayton, Ohio.

MAY 24-28: NAED, 45th Annual Convention, Conrad Hilton Hotel, Chicago, Ill.

Business Briefs

▶ **Magnetic Recorder** plugged into toll telephone lines to announce delays when circuits are busy is expected to release operators for active duty during rush times, like Christmas.

▶ **Pinholes** in telephone cables formerly detected by leaking gas and application of soap that blew bubbles will be pinpointed in future by an electronic sniffer. The GE device (ELECTRONICS, p 100 Mar. 48) pulled along a cable filled with Freon 12 (CCl_2F_2); rings a bell at the leak.

▶ **Telecommunications** Planning Committee appointed by Haraden Pratt, advisor to the President, includes representatives of Office of Transportation and Communications Policy (State Department); Communications-Electronic Director of the Joint Chiefs of Staff (Department of Defense); Administrator of the Civil Aeronautics Administration (Department of Commerce), Federal Communications Commission and Central Intelligence Agency. New committee will plan and advise, not operate or procure.

▶ **Reduction** in sales taxes on wireless sets and tubes has been ordered by the Australian government to help the electronics industry. On an average wireless set, drop will amount to an estimated $15.

▶ **Popocatepetl,** the 17-thousand foot volcano in Mexico, is the site on which a tv signal repeater station may be constructed to send Mexico City tv signals to the Gulf seacoast city of Vera Cruz.

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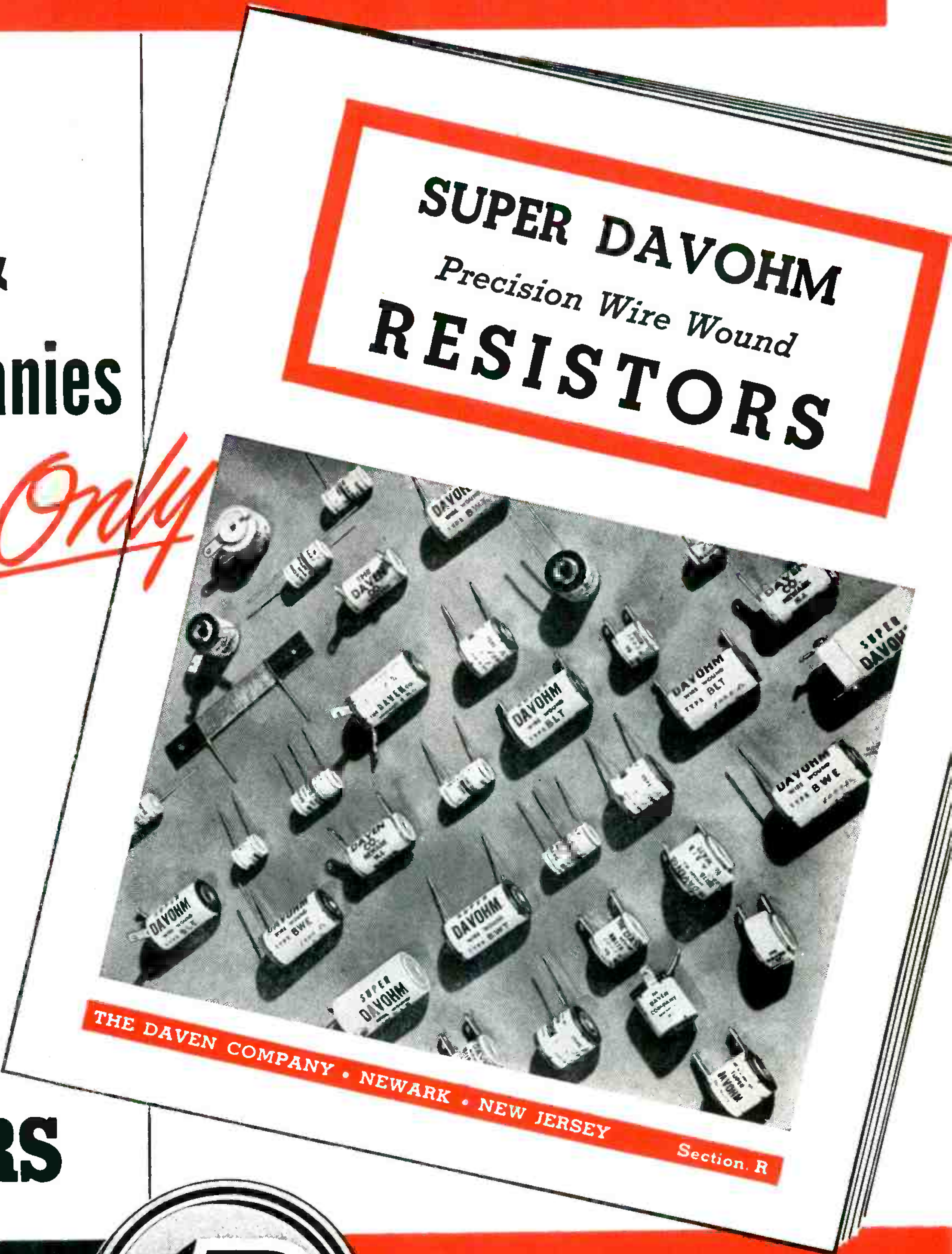

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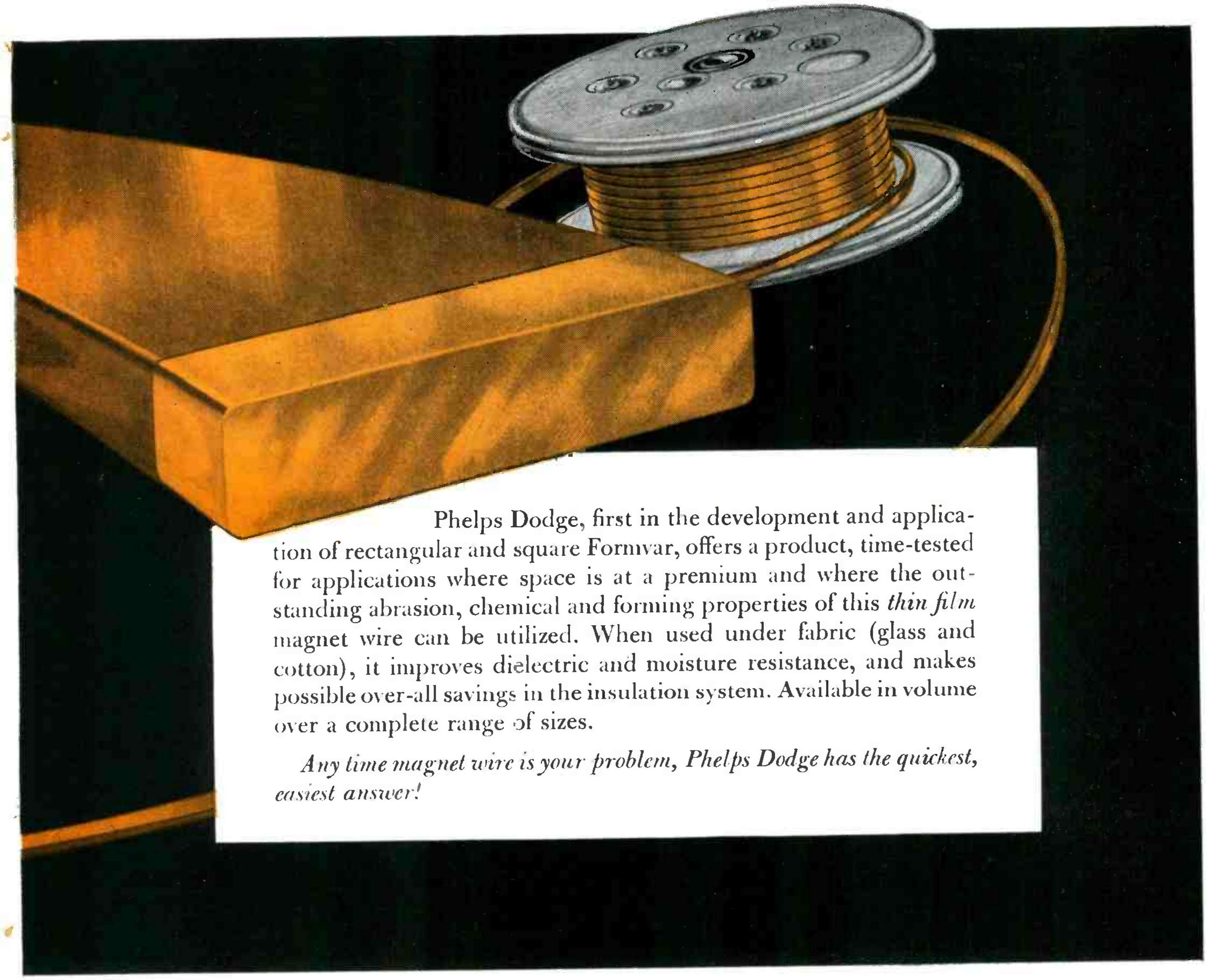

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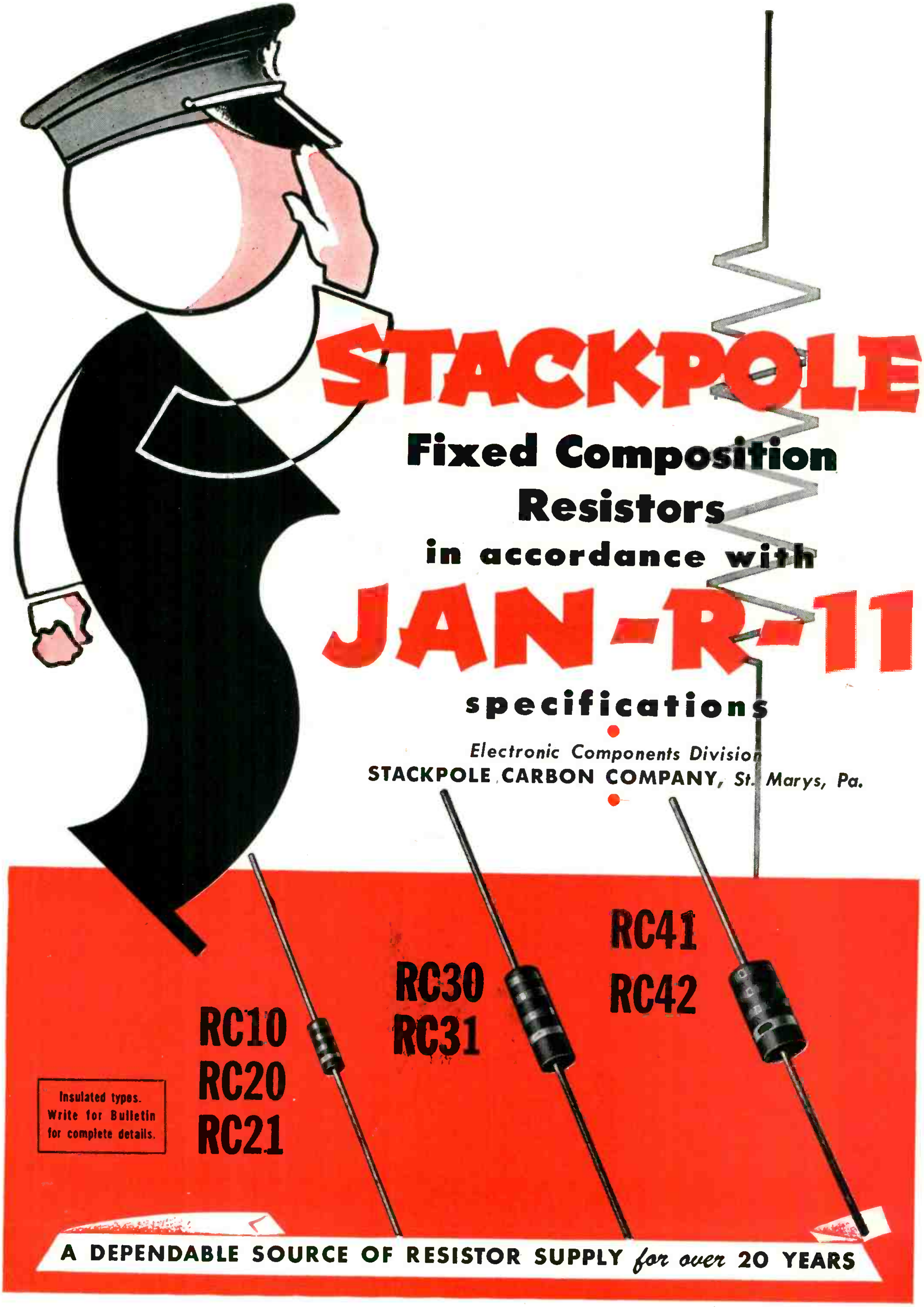
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To the advertiser who contemplates using the magazine as an advertising medium, this symbol has a well-recognized significance. It tells him that the circulation records and practices of the magazine are wide open to the auditors of the Bureau, who check the publisher's claims and make public the precise terms and conditions under which subscriptions are obtained. And it assures him that the magazine stays in business by virtue of a demonstrated demand from its readers as shown by their paid subscriptions or newsstand purchases.

BUT HERE we are concerned only with the significance of ABC to you as a reader. For when the advertisers, the advertising agencies, and the publishers founded the Bureau nearly forty years ago to help establish honest circulation figures, they unwittingly set up a cooperative institution that has become a major safeguard for the interests of the reading public.

That is because membership in ABC constitutes one of the strongest guarantees that any publication can offer of its primary devotion to the interests of its readers. And by making that guarantee possible, ABC becomes a major safeguard of the freedom of the press, an objective of exceptional importance in these days when the public is flooded with propaganda from so many sources.

THE SUREST MEANS by which to preserve a free press is to keep it directly answerable to the reading public it would serve. It follows, then, that the survival of a truly free press must depend on its acceptance by that public; and that means in turn that the people must have in their hands some adequate means for holding the publishers responsible to them.

No one has yet devised any means to that end more simple, more direct or more practical than the paid subscription or newsstand purchase price. The right to purchase or refrain from purchasing a publication gives to the readers and to no one else the power to pass judgment on whether that publication should continue to serve the reading public.

TO SUPERVISE this vital process, to check and certify the integrity of the publication's circulation methods and claims, requires a strict and continuing audit of each publication's success in meeting this test of its public acceptance. To that essential function the ABC has contributed mightily by the conscientious performance of its mission. And that is why we are able to have a press supported, for the most part, by advertising revenues, but not controlled as to its circulation or content by any influence other than its readers.

When an advertiser consults the ABC statement of a publication to ascertain the amount, the quality and the trend of its circulation, he does so in the legitimate pursuit of his own interest. But at the same time, inevitably, he is helping the ABC to keep the press responsible and responsive to the reading public. For, in effect, he is asking the publication to demonstrate through its circulation figures that it owes its standing to a voluntary demand by its readers.

SO THE Audit Bureau of Circulations, by auditing and certifying paid circulations, has come to perform a vital service to the readers of this magazine and of every other member publication. And in performing that service, it helps to maintain in our country a press that is answerable to the reading public and to it alone. So long as the practices and principles for which ABC stands continue to prevail in American publishing, we shall find in it a sure support for a truly free press, responsible only to the public it serves.

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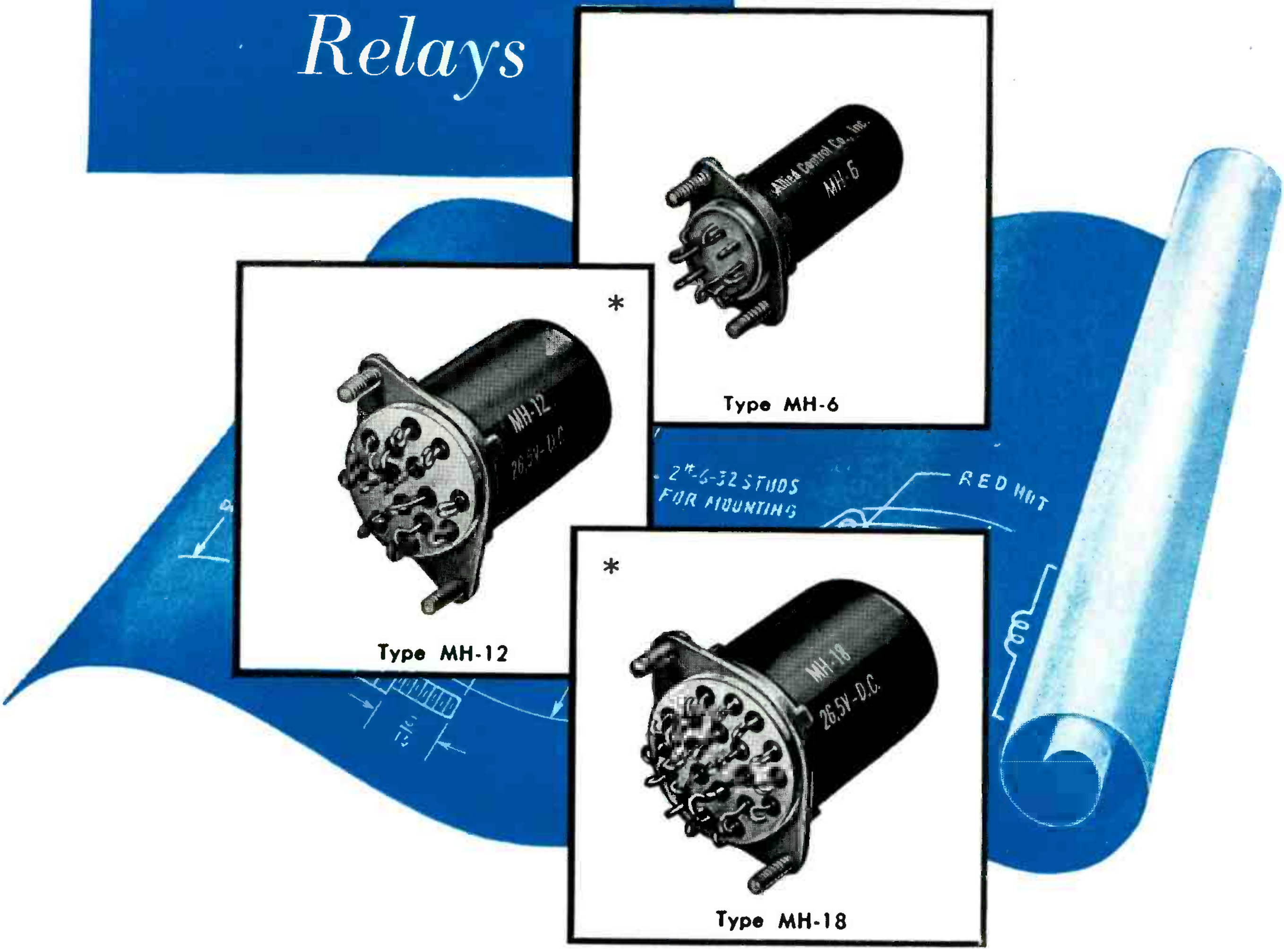
Spec. MIL-R-5757A



Developed specifically to meet the rigid requirements of U.S.A.F. Spec. MIL-R-5757A, the new Allied line of sub-miniature double throw relays includes the MH-18 (6-Pole). the MH-12 (4-pole), and MH-6 (2-pole). • Contacts are rated at 2 amps resistive or 1 amp inductive at 28 volts D.C. • The high performance of these relays has been achieved in an extremely compact, unitized construction and parallels the most recent advances in airborne equipment design.

For detailed specifications and drawings of these new relays, write for Bulletin 1002

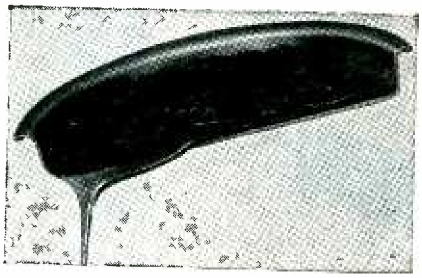
ALLIED CONTROL COMPANY, INC. 2 EAST END AVE., NEW YORK 21, N. Y.

AL 149

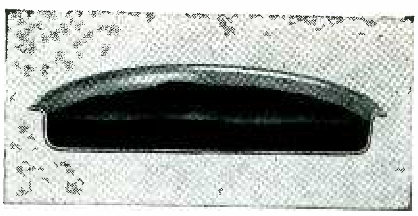
IRVINGTON INSULATING VARNISH DIGEST

Comparative Tests Show Superiority Of Internal Curing

That heat-induced chemical polymerization results in more thorough drying of insulating varnishes and does away with soft, tacky interiors is indicated by studies performed on test lids with various types of varnishes. These studies show that varnishes which dry chiefly by oxidation may remain soft and tacky in the interior, even after prolonged baking, while the internal curing type of varnish, which dries by polymerization, sets throughout after only a few hours of baking.



Varnish on this test lid—one of a type drying by oxidation—baked two weeks at 220° F., remained soft and tacky in the interior



Internal curing varnish on this test lid set completely after only 8 hours baking at 212° F.

Air Drying Varnishes Have Many Applications

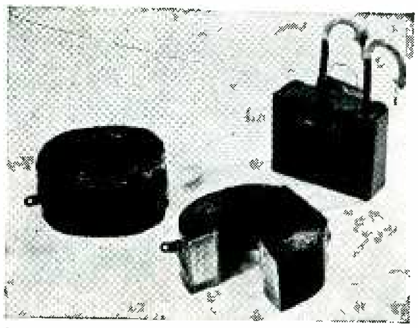
Air drying varnishes produced by Irvington Varnish & Insulator Company find wide use both as a final coat on windings already impregnated with other types of Irvington varnish and as a means of protecting other types of electrical apparatus and improving appearance.

These varnishes are also used as coatings on switch boxes, battery trays, conduit boxes, signal boxes and metallic surfaces in general. Varnishes are supplied in both black and clear types. A list of the major types is available on request.

"Deep-Cure" Insulating Varnishes Give Outstanding Performance

Finished Windings Combine High Dielectric, Mechanical Strength with Exceptional Resistance to Chemicals

Insulating varnishes that cure throughout by heat-induced chemical polymerization offer unusual service advantages, because this method of curing does away with wet, sticky interiors even in very deep windings. The exceptional degree of penetration of these varnishes and their complete solidification on curing combine to assure a thoroughly insulated, firmly bonded winding. These features prevent shorts caused by chafing of insulation resulting from the movement of adjacent turns.



Thorough impregnation and complete curing result from use of internal curing type varnish on these and many other types of windings

In addition, these varnishes offer high dielectric strength, ranging from 1,700 to 2,200 volts per mil, depending on the particular type of varnish used. Specific formulations are adaptable to a wide range of operating conditions, from stationary coils to high-speed rotating equipment.

Chemical Stability

All Irvington internal curing varnishes have good-to-excellent resistance to oil, moisture, acids and heat, and the majority of them have good resistance to alkalies as well. Because of this high degree of chemical stability, they are adaptable to a wide range of service conditions. Typical applications include high-voltage coils; radio and TV transformers; low, medium and high speed armatures; field coils; oil-cooled transformers; relay coils.

Production Procedures

These varnishes are adaptable to a wide variety of application processes. The vacuum and pressure method is commonly used to assure the fullest degree of impregnation of deep windings. The varnishes may also be successfully applied by dipping. Brush application is used between layers as coils are being wound. All of these varnishes are adaptable to a variety of baking schedules. Their internal curing properties permit application of multiple coatings with only short, partial curing bakes between coats.

Internal curing varnishes are available in both black and clear types, and in formulations that provide either considerable flexibility or high rigidity in the finished windings. In addition, Irvington's Research Department is prepared to assist varnish users in evaluating the properties of varnishes for specific requirements of service performance, methods of application and baking schedules.

Finishing Enamels Protect Windings Against Oil, Dust

Insulated windings can be protected from the harmful effects of oil, moisture, chemicals, water and grease by means of a quick-drying coat of a finishing enamel. Formulated specifically for use as a finishing coat, Irvington Enamels are easily applied by brush and dry rapidly to a tough adherent film. Two major types are: No. 32 red, designed to give the fastest drying time consistent with good protection under most service conditions; and No. 30 red, for especially severe service conditions..

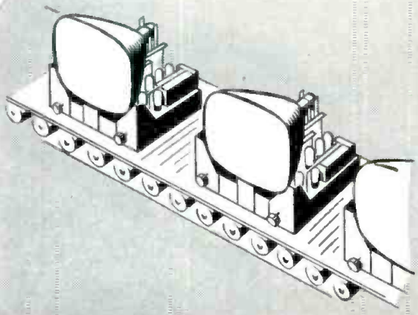
Easy to brush on, Irvington Red Enamels protect windings from corrosive action and also improve dielectric properties

[For further information, write the Sales Manager, Varnish Div., Irvington Varnish & Insulator Co., 11 Argyle Terrace, Irvington, N. J.]

However you compute

IRC BT RESISTORS ARE FIRST

By whatever factor you consider most important, IRC filament type BT resistors lead the industry. The next time you specify insulated composition resistors remember—it pays to do business with the leader. Most people do.



IF QUANTITY PRODUCTION INDICATES LEADERSHIP— ***remember*** more IRC BT resistors are used in radio and TV sets than any other brand. During the last five years IRC supplied 40% of the resistors used in radio and TV set production.

IF QUALITY STANDARDS DENOTE LEADERSHIP— ***remember*** IRC Advanced Type BT resistors meet and beat rigid JAN-R-11 specifications. Nearly all producers of government equipment have tested and approved IRC's advanced BT resistor.

TYPE 252, 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. Attached Switch can be supplied.

	RA20, JAN Shaft Type SD		RA20 High Torque, JAN Shaft Type SD	
Resistance	CTS Part	JAN-R-19 TYPE	CTS Part	JAN-R-19 TYPE
50±10%	B8079	RA20A1SD500AK	X3496	RA20A2SD500AK
100±10%	W6929	RA20A1SD101AK	L9388	RA20A2SD101AK
250±10%	X3497	RA20A1SD251AK	M9879	RA20A2SD251AK
500±10%	W6931	RA20A1SD501AK	X3498	RA20A2SD501AK
1000±10%	W6932	RA20A1SD102AK	X3499	RA20A2SD102AK
1500±10%	W6933	RA20A1SD152AK	M9809	RA20A2SD152AK
2500±10%	W6934	RA20A1SD252AK	L9103	RA20A2SD252AK
5000±10%	W6935	RA20A1SD502AK	L9104	RA20A2SD502AK
10,000±10%	W6936	RA20A1SD103AK	H8979	RA20A2SD103AK

TYPE 25, JAN-R-19, Type RA30 (May also be used as Type RA25)

4 watt, 1 17/32" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19. Attached Switch can be supplied.

	RA30, JAN Shaft Type SD		RA30 High Torque, JAN Shaft Type SD	
Resistance	CTS Part	JAN-R-19 TYPE	CTS Part	JAN-R-19 TYPE
50±10%	X3502	RA30A1SD500AK	W2837	RA30A2SD500AK
100±10%	X3503	RA30A1SD101AK	X3504	RA30A2SD101AK
250±10%	X3505	RA30A1SD251AK	X3506	RA30A2SD251AK
500±10%	X3507	RA30A1SD501AK	M7566	RA30A2SD501AK
1000±10%	X3508	RA30A1SD102AK	S2444	RA30A2SD102AK
1500±10%	X3509	RA30A1SD152AK	X3510	RA30A2SD152AK
2500±10%	X3511	RA30A1SD252AK	S2736	RA30A2SD252AK
5000±10%	Q1409	RA30A1SD502AK	X3512	RA30A2SD502AK
10,000±10%	X3513	RA30A1SD103AK	R1561	RA30A2SD103AK
15,000±10%	X3514	RA30A1SD153AK	L9107	RA30A2SD153AK

Immediate delivery from stock

JAN-R-94 AND JAN-R-19 TYPE MILITARY VARIABLE RESISTORS

167 types

Preference given to orders carrying military contract number and DO rating. Other JAN items or special items with or without associated switches can be fabricated to your specifications. Please give complete details on your requirements including electrical and mechanical specifications.

UNPRECEDENTED PERFORMANCE CHARACTERISTICS

Designed for use in military equipment subject to extreme temperature and humidity ranges including jet and other planes, guided missiles, tanks, ships and submarines, telemetering, microwave, portable or mobile equipment and all other military communications.

For further information, write for Stock Sheet No. 162

NEW 38-PAGE 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. Write today for your copy.

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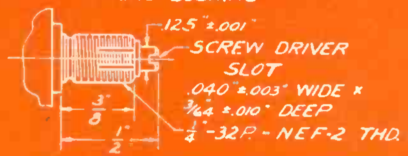
specialists in precision mass production of variable resistors

FOUNDED 1896 • ELKHART, INDIANA

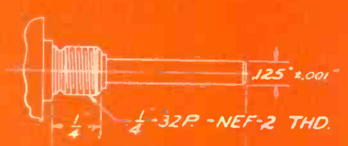
SHAFT TYPES AVAILABLE ON STOCK CONTROLS

CTS SHAFT TYPE LT-2
LOCKING BUSHING



MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT 3/8 HEX × 3/32
LOCK NUT 3/8 HEX × 1/8
LOCK WASHER #1914A

CTS SHAFT TYPE RE



MOUNTING HARDWARE ASSEMBLED
MOUNTING NUT 3/8 HEX × 3/32
LOCK WASHER #1914A

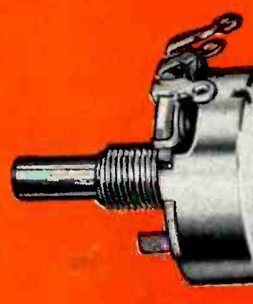
TYPE 65

½ watt 70° C, ¾" diameter miniaturized variable composition resistor.

Resistance	CTS Part CTS Shaft Type RE	CTS Part Locking Bushing CTS Shaft Type LT-2
250±10%	X3516	X3530
500±10%	X3517	X3531
1000±10%	X3518	X3532
2500±10%	X3519	X3533
5000±10%	X3520	X3534
10,000±10%	X3521	X3535
25,000±10%	X3522	X3536
50,000±10%	X3523	X3537
100,000±10%	X3524	X3538
250,000±10%	X3525	X3539
500,000±10%	X3526	X3540
1 Meg±20%	X3527	X3541
2.5 Meg±25%	X3528	X3542

TYPE 95, JAN-R-94, Type RV4

2 watt 70°C, 1⅛" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94. Attached Switch can be supplied.



Resistance	JAN-R-94 TYPE RV4 JAN Shaft Type SD	JAN-R-94 TYPE RV4 JAN Shaft Type RJ	CTS Part Non-JAN Locking Bushing CTS Shaft Type LT-1
100±10%	RV4ATSD101A	RV4ATRJ101A	W3160
250±10%	RV4ATSD251A	RV4ATRJ251A	W3161
500±10%	RV4ATSD501A	RV4ATRJ501A	W3162
1000±10%	RV4ATSD102A	RV4ATRJ102A	W3166
2500±10%	RV4ATSD252A	RV4ATRJ252A	W3163
5000±10%	RV4ATSD502A	RV4ATRJ502A	W3164
10,000±10%	RV4ATSD103A	RV4ATRJ103A	W3167
25,000±10%	RV4ATSD253A	RV4ATRJ253A	W3168
50,000±10%	RV4ATSD503A	RV4ATRJ503A	W3169
100,000±10%	RV4ATSD104A	RV4ATRJ104A	W3170
250,000±10%	RV4ATSD254A	RV4ATRJ254A	W3171
500,000±10%	RV4ATSD504A	RV4ATRJ504A	W3172
1 Meg±20%	RV4ATSD105B	RV4ATRJ105B	W3173
2.5 Meg±20%	RV4ATSD255B	RV4ATRJ255B	W3165
5 Meg±20%	RV4ATSD505B	RV4ATRJ505B	W3159

TYPE 45, JAN-R-94, Type RV2

¼ watt, 15/16" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94. Attached Switch can be supplied.

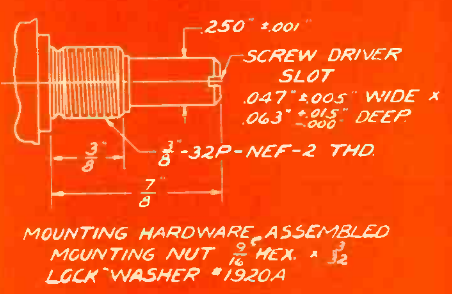
Resistance	RV2, JAN Shaft Type SD CTS Part	JAN-R-94 TYPE	CTS Part Non-JAN Locking Bushing CTS Shaft Type LT-1
100±10%	A5876	RV2ATSD101A	A5922
250±10%	A5877	RV2ATSD251A	A5923
500±10%	A5878	RV2ATSD501A	A5924
1000±10%	A5879	RV2ATSD102A	A5925
2500±10%	A5880	RV2ATSD252A	A5926
5000±10%	A5881	RV2ATSD502A	A5927
10,000±10%	A5882	RV2ATSD103A	A5928
25,000±10%	A5883	RV2ATSD253A	A5929
50,000±10%	A5884	RV2ATSD503A	A5930
100,000±10%	A5885	RV2ATSD104A	A5931
250,000±10%	A5886	RV2ATSD254A	A5932
500,000±10%	A5887	RV2ATSD504A	A5933
1 Meg±20%	A5888	RV2ATSD105B	A5934
2.5 Meg±20%	A5889	RV2ATSD255B	A5935

TYPE 35, JAN-R-94, Type RV3

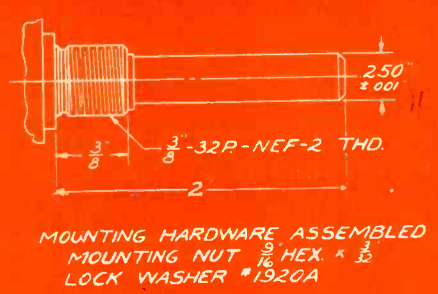
½ watt, 1⅛" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94. Attached Switch can be supplied.

Resistance	RV3, JAN Shaft Type SD CTS Part	JAN-R-94 TYPE	CTS Part Non-JAN Locking Bushing CTS Shaft Type LT-1
100±10%	A5861	RV3ATSD101A	A5907
250±10%	A5862	RV3ATSD251A	A5908
500±10%	A5863	RV3ATSD501A	A5909
1000±10%	A5864	RV3ATSD102A	A5910
2500±10%	A5865	RV3ATSD252A	A5911
5000±10%	A5866	RV3ATSD502A	A5912
10,000±10%	A5867	RV3ATSD103A	A5913
25,000±10%	A5868	RV3ATSD253A	A5914
50,000±10%	A5869	RV3ATSD503A	A5915
100,000±10%	A5870	RV3ATSD104A	A5916
250,000±10%	A5871	RV3ATSD254A	A5917
500,000±10%	A5872	RV3ATSD504A	A5918
1 Meg±20%	A5873	RV3ATSD105B	A5919
2.5 Meg±20%	A5874	RV3ATSD255B	A5920
5 Meg±20%	A5875	RV3ATSD505B	A5921

JAN SHAFT TYPE SD



JAN SHAFT TYPE RJ



CTS SHAFT TYPE L-T-1

LOCKING BUSHING

*Quality Controlled**

TO THE HIGHEST STANDARDS OF THE INDUSTRY

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WIRES and CABLES

***Quality Control works 2 ways at CHESTER**

It's a fact and here's why! First, Chester quality control engineers certify every phase of manufacture from raw material to finished product packed for shipment. No detail is too small or unimportant to merit their full attention. Second, quality in turn governs production — not a single foot of Chester wire or cable is ever "hurried through" to meet a shipping date or heavy schedule. Extra shifts, not faster production is the method used to break bottlenecks at Chester.

This two way quality control is just one of many important reasons why electrical and electronic men, in increasing number, specify Chester wire and cable for an extra measure of reliability. Why not check your requirements with Chester today.

FOR EVERY APPLICATION —

JAN-C-76 • 80°-90°-105°C
Hook-Up Wire • Shielded Wire and Cable Flexible Cords • Coaxial Cable • Television Lead-In Cable • Gas Tube High Tension Cable • Oil Burner Ignition Cable • Blasting Wire • Thermostat Cable • Bell and Office Wire • TW Building and Fixture Wire

CHESTER CABLE CORP.
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"Chesty" says —
Rely on Plasticord and Plasticote - write for the new Catalog today

MANUFACTURERS OF QUALITY WIRE AND CABLE FOR EVERY ELECTRICAL AND ELECTRONIC REQUIREMENT

Speed up analysis with these Brush instruments

Direct-coupled Amplifier
Model BL-932

AMPLIFIES VERY LOW VOLTAGES. The Brush Direct-coupled Amplifier features high sensitivity and low drift. When used in conjunction with the Brush Magnetic Oscillograph, it gives one chart millimeter deflection per millivolt input. Design features reduce effects of power line fluctuation. Zero signal drift not more than one chart millimeter per hour. Frequency response essentially uniform from d-c to 100 cycles.

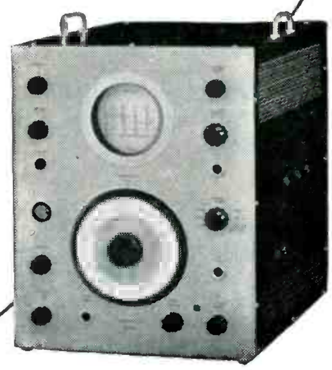
When used with the Brush Magnetic Oscillograph, the Amplifier can be used to record phenomena previously requiring the use of complicated intermediate equipment. Analysis of static or dynamic conditions involving either high or low signal strength is simplified and speeded with this equipment. Below, it is shown recording time constants of a reactor to provide a saturation curve.

PROVIDES IMMEDIATE RECORDING. The Brush Magnetic Oscillograph, used with the proper Brush Amplifier, makes a direct chart recording of physical phenomena which is immediately available. Either direct inking or electric stylus models available. Gear shift provides chart speeds of 5, 25, and 125 mm per second. An auxiliary chart drive is available for speeds of 50, 250, and 1250 mm per hour. Accessory equipment provides event markers where an accurate time base is required, or where it is desirable to correlate events. Photo shows two-channel model for recording of two phenomena simultaneously.

Direct-writing Two-Channel
Magnetic Oscillograph Model BL-202

CHECKS FREQUENCY RESPONSE QUICKLY. The Frequency Response Tracer permits visual examination of frequency response characteristics of radio receivers, amplifiers, transmission lines, filters. Electro-acoustic investigation of loudspeakers, microphones, and telephones can be made. Frequency range is 20 to 20,000 cycles, logarithmic scale. Continuous motor drive scans entire frequency range in 8 seconds.

Write for free copy of Bulletin 618 giving details on these Brush instruments. The Brush Development Company, Dept. K-24, 3405 Perkins Ave., Cleveland 14, Ohio. In Canada: A. C. Wickman Limited, Box 9, Station N, Toronto.



Frequency Response
Tracer Model
BL-4703

PUT IT IN WRITING WITH A BRUSH RECORDING ANALYZER

THE Brush DEVELOPMENT CO.

PIEZOELECTRIC CRYSTALS AND CERAMICS • MAGNETIC RECORDING
ACOUSTIC DEVICES • ULTRASONICS • INDUSTRIAL & RESEARCH INSTRUMENTS

improve your product with –

MYCALEX

THE OUTSTANDING **LOW LOSS** *HIGH FREQUENCY* **INSULATION** FOR OVER A QUARTER OF A CENTURY

MYCALEX is a highly developed glass-bonded mica insulation backed by a quarter-century of continued research and successful performance. Both pioneer and leader in low-loss, high frequency insulation, MYCALEX offers designers and manufacturers an economical means of attaining new efficiencies, improved performance. The unique combination of characteristics that have made MYCALEX the choice of leading electronic manufacturers are typified in the table for MYCALEX grade 410 shown below. Complete data on all grades will be sent promptly on request.

***MYCALEX* is efficient, adaptable, mechanically and electrically superior to more costly insulating materials**

- **PRECISION MOLDS TO EXTREMELY CLOSE TOLERANCE**
- **READILY MACHINEABLE TO CLOSE TOLERANCE**
- **CAN BE TAPPED THREADED, GROUND, SLOTTED**
- **ELECTRODES, METAL INSERTS CAN BE MOLDED-IN**
- **ADAPTABLE TO PRACTICALLY ANY SIZE OR SHAPE**

***MYCALEX* is available in many grades to exactly meet specific requirements**

CHARACTERISTICS OF
MYCALEX GRADE 410

Meets all the requirements for Grade L-4A, and is fully approved as Grade L-4B under Joint Army-Navy Specification JAN-1-10

Power factor, 1 megacycle	0.0015
Dielectric constant, 1 megacycle	9.2
Loss factor, 1 megacycle	0.014
Dielectric strength, volts/mil	400
Volume resistivity, ohm-cm	1×10^{15}
Arc resistance, seconds	250
Impact strength, Izod, ft.-lb/in. of notch	0.7
Maximum safe operating temperature, °C	350
Maximum safe operating temperature, °F	650
Water absorption % in 24 hours	nil
Coefficient of linear expansion, °C	11×10^{-6}
Tensile strength, psi	6000

***MYCALEX* is specified by the leading manufacturers in almost every electronic category**


Mycalex 410
Tuning Coil Form


Mycalex 410
Tuning Switch Plate


Mycalex 410 Terminal Base and Cap Assembly for Fire Detection Equipment


Mycalex 410
Rotary Switch Stator


Mycalex 410
Solenoid Type Coil Form


Mycalex 410
Tuning Stator Plate

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Owners of 'MYCALEX' Patents and Trade-Marks

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SORENSEN *electronically* REGULATES AND CONTROLS

HIGH-VOLTAGE
DC
LOW-CURRENT

SORENSEN'S EXPANDED LINE OF B-SUPPLYS NOW INCLUDES THIS NEW MULTI-RANGE DUAL SUPPLY.

Many users of Sorensen Nobatrons* and AC Regulators are unaware that the standard Sorensen line includes a wide range of "B-Nobatrons" — high voltage, low-current DC sources.

Are you familiar with the number of units in the line? Two of them — models 360BB and 520BB — are low-cost units for those not requiring outputs adjustable down to zero, but which can be paralleled for higher current requirements. The other models are highly flexible, all-purpose laboratory instruments. All of them provide voltage and current well in excess of the specifications given below (these "plus values" are shown graphically in the new Sorensen DC catalog).

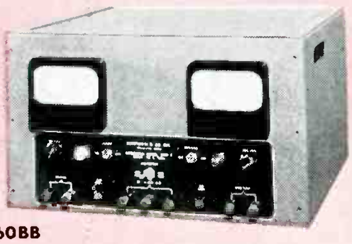
You owe it to yourself to get acquainted with these Sorensen B-NOBATRONS. You'll find they are reasonably priced — surprisingly so — yet in all ways live up to the Sorensen reputation for sound engineering, quality construction, dependable operation. Write for information.

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

MODEL 350-B SPECIFICATIONS

INPUT	105 - 125 VAC, 50 - 60 ~, 1Ø.
OUTPUT	1. 175-350 VDC @ 0-60 Ma simultaneously from two independently adjustable outlets. 2. 175-350 VDC @ 0-120 Ma from one outlet. 3. 0-175 VDC @ 0-60 Ma from one outlet. 4. 6.3 VAC @ 3.5 amps., C.T., unregulated.
OUTPUT REGULATION	±1.0%
RIPPLE	10 mv
SIZE	13" x 7½" x 8"

520BB



560BB

500BB

1000BB

325BB

360BB

MODEL NO.	325BB	360BB	520BB	560BB	500BB	1000BB
Output voltage	0-325	175-360	200-500	0-500	0-500	200-1000
Output current	0-125 Ma	0-120 Ma	0-200 Ma	0-200 Ma	0-300 Ma	0-500 M
Output voltage, bias	0-150			0-150	0-150	
Output current, bias	0-5 Ma			0-5 Ma	0-5 Ma	
Ripple	10 mv	10 mv	10 mv	10 mv	10 mv	20 mv
Low AC voltage (center tapped, unregulated)	6.3 at 10 amp.	6.3 at 10 amp.	6.3 at 10 amp.	6.3 at 10 amp.	6.3 at 10 amp.	

Regulation accuracy: ±0.5% (±1% in 360BB and 520BB)
Input: 105-125 volts AC, 50-60 cycles, single phase.
Models 325BB, 560BB, 500BB and 1000BB are metered.
Units are normally self-contained. All can be provided with a front panel for rack mounting.

SPECIFY **SORENSEN**

For Complete Information Write

SORENSEN & COMPANY, INC.
375 Fairfield Avenue Stamford, 1 Conn.

AMAZING NEW IMPREGNANT

makes good capacitors better by permitting higher operating voltages

E-therm impregnated capacitors are now available in production quantities. E-therm is a unique new impregnating material developed and compounded by Sangamo. E-therm impregnated capacitors far exceed the requirements of JAN Specifications. E-therm possesses exceptionally high thermal stability and superior electrical characteristics. E-therm impregnated capacitors mean—higher operating temperatures—lower power factor—higher resistance—longer life.

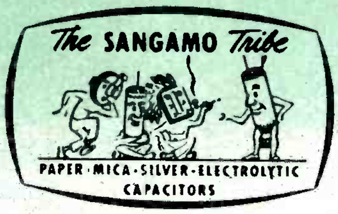
E-therm

DEVELOPED BY SANGAMO

Operating temperature 125°C

E-therm is another example of advanced Sangamo engineering. Continued research and development of new products enables Sangamo to meet the existing and future needs of the electronic industry. *For additional information about E-therm, write for Engineering Bulletin No. 104.*

Those who know ...*choose Sangamo*



SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

SC52-9

FOR
LOW-COST WIDE RANGE FREQUENCY COVERAGE
5 cps to 500 kc

DISTORTION 1%

CALIBRATION ±2%

AMPLITUDE ±1 db

HUM 0.1%

FIXED SYNC. OUTPUT

KROHN-HITE—Model 430-A—Audio Oscillator

only $145.00 For Immediate Delivery

Specifications

FREQUENCY RANGE: 4.5 to 520,000 cps., continuously variable in five decade bands.

FREQUENCY DIAL: Single scale, direct reading, calibrated logarithmically from 45 to 520 on a 6″ scale.

FREQUENCY ACCURACY: Calibration ±2%, drift including initial warm-up is less than 2%, drift with ±10% change in line-voltage is less than ±0.2%.

OUTPUT:

VOLTAGE: 10 volts rms. maximum, adjustable continuously by a logarithmic output level control with a scale calibrated from .01 to 10 volts. Additional fixed output 10 volts rms.

LOAD: Minimum 1000 ohms.

AMPLITUDE: Varies less than ±1 db over the entire frequency range from 4.5 to 520,000 cps. and less than ±0.5 db for ±10% change in line voltage.

DISTORTION: Less than 1% at any output level setting.

HUM: Less than 0.1% at any output level setting.

INPUT POWER: 105–125 volts, 50–60 cps., 45 watts.

TUBE COMPLEMENT: Furnished with instrument: 2-6AC7, 2-6V6-GT, 1-6AX5-GT.

FORM: Aluminum cabinet, overall dimensions 12″ wide, 7″ high, 8″ deep. Weight 15 lbs.

Write for free catalog.

KROHN-HITE INSTRUMENT COMPANY
580 MASSACHUSETTS AVENUE
DEPT. E, CAMBRIDGE 39, MASS., U.S.A.

OTHER INSTRUMENTS

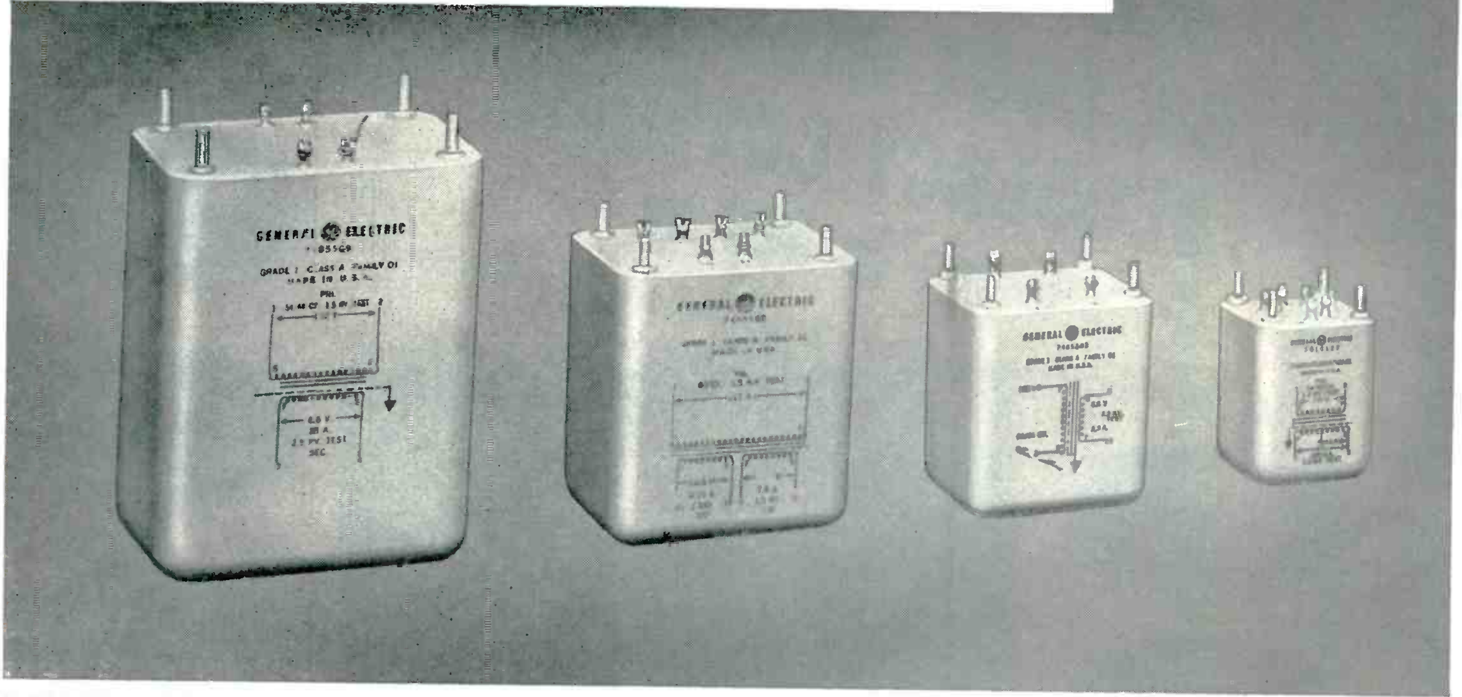
FILTERS

Model	Type	Frequency Range	Noise & Hum	Price
310-A	Band-Pass	20 cps to 200 kc	3 mv	$275.00
330-A	Band-Pass	.02 cps to 2 kc	0.1 mv	$450.00
	Band-Pass	0.2 cps to 20 kc	0.1 mv	$450.00
340-A	Servo	.01 cps to 100 cps	10 mv	$350.00
350-A	Rejection	.02 cps to 2 kc	0.1 mv	$450.00
360-A	Rejection	20 cps to 200 kc	5 mv	$275.00

OSCILLATORS

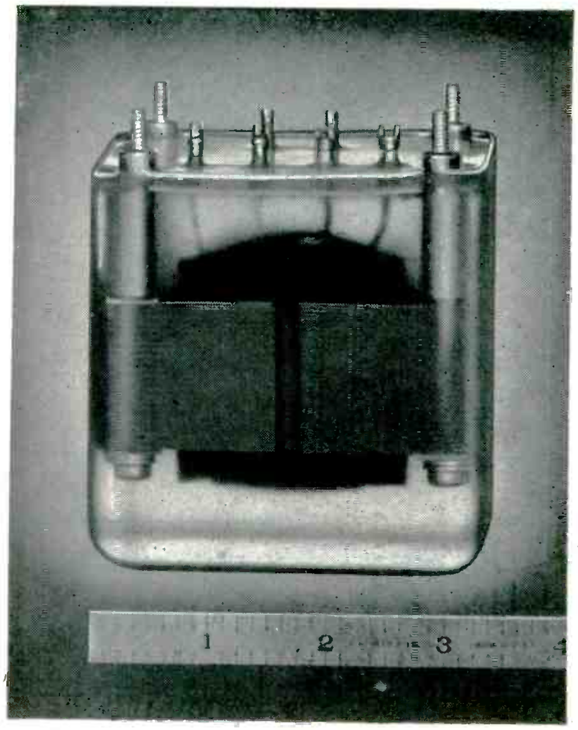
Model	Frequency Range	Distortion	Output	Price
400-A	.009 cps to 1.1 kc	1%	25 mw/10 v	$350.00
410-A	.02 cps to 20 kc	1/4%	10 mw/5 v	$950.00
420-A	.35 cps to 52 kc	1%	25 mw/10 v	$290.00
400-C	.009 cps to 1.1 kc	1%	100 mw/10 v	$375.00
420-C	.35 cps to 52 kc	1%	100 mw/10 v	$325.00
440-A	.01 cps to 100 kc	1/10%	100 mw/10 v	$450.00

CAST-PERMAFIL TRANSFORMERS



NEW LINE of G-E cast-permafil electronic transformers does away with the need for hermetically sealed metal enclosures. Cast construction, lighter weight and smaller size offer the designer greater flexibility in many types of electronic designs.

New G-E designs available



SIMPLER CONSTRUCTION of G-E cast-permafil transformers shows up dramatically in this model cast in clear resin. Note how the resin anchors the terminals, eliminating need for a steel enclosure.

Smaller, Lighter Cast-Permafil Transformers Designed to MIL-T-27 "Specs"—Need No Fungus-Proof Coatings

Interchangeable with existing hermetic designs, General Electric's new line of cast-permafil transformers—solventless resin type—offer many design advantages.

MOISTURE PROOF—"Cast-in" construction seals transformer permanently against moisture as required in MIL-T-27 Grade 1 Performance Specifications. Permafil forms a tough, shatter-resistant, solid casing.

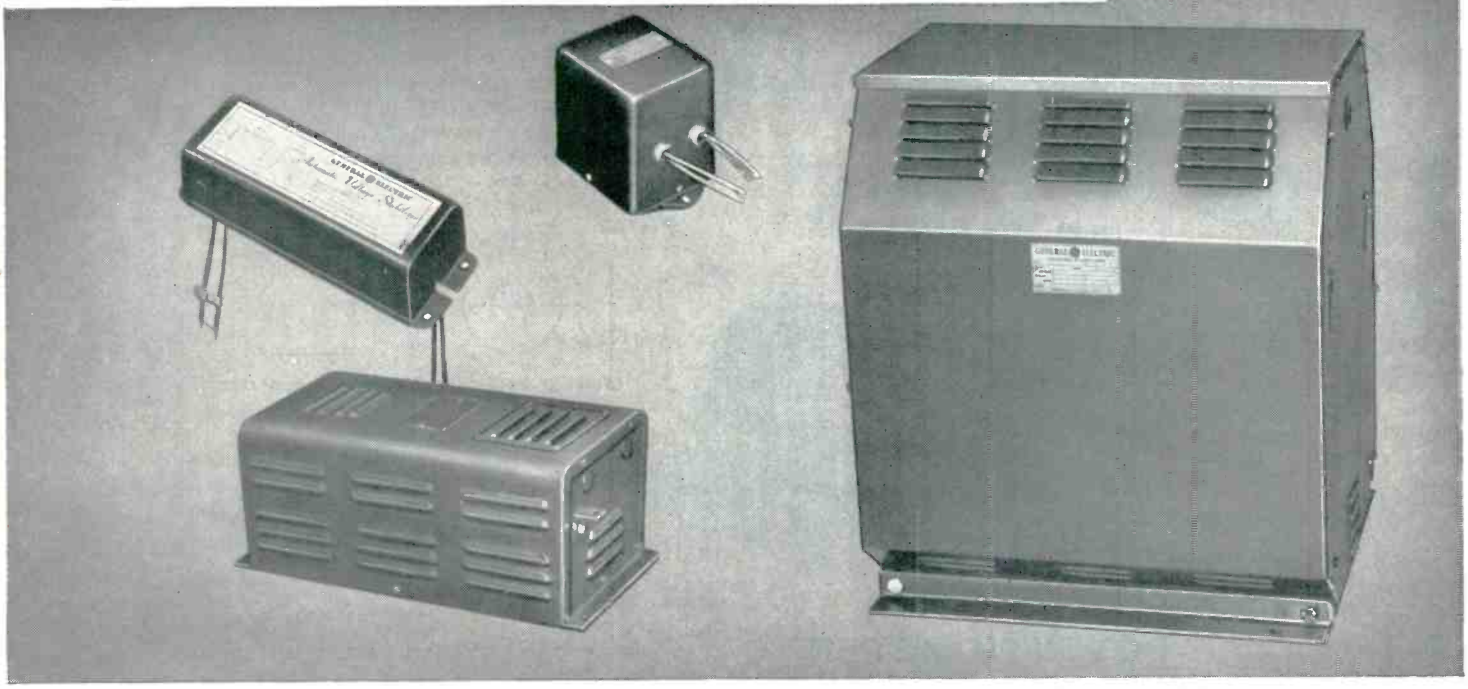
AVERAGE 20% SMALLER because they eliminate metal enclosures, and because their terminals can be anchored directly in permafil mixture, the new G-E cast-permafil transformers are smaller and lighter weight. The complete line—which includes 11 sizes, 9 of them in two heights—averages about 20% smaller than previous models.

MORE FLEXIBLE with fewer machined and punched parts, greater flexibility in design and construction is possible. Terminal arrangements can be varied. Color can be "built in" by adding pigment to the permafil mixture. Permafil makes fungus-proof coatings unnecessary.

ACCELERATED LIFE TESTS indicate that G-E cast-permafil transformers will stand up as long as Class A hermetics at 105 C. And at 130 C. ultimate, they have an expected life of 1000 hours or more.

For complete information on the application, ratings and availability of G-E cast-permafil transformers, write to *Section 411-102, General Electric Company, Schenectady 5, N. Y.*

AUTOMATIC VOLTAGE STABILIZERS



NEW LINE rated from 15 VA to 5000 VA. Stabilizers feature totally enclosed, single-core construction, reduced weight and greater flexibility for designs involving voltage ratios other than 1:1. A wide range of voltage correction is offered.

for electronics use

Lighter G-E Automatic Voltage Stabilizers Feature Inherent Input-Output Isolation—More Voltage Ratios

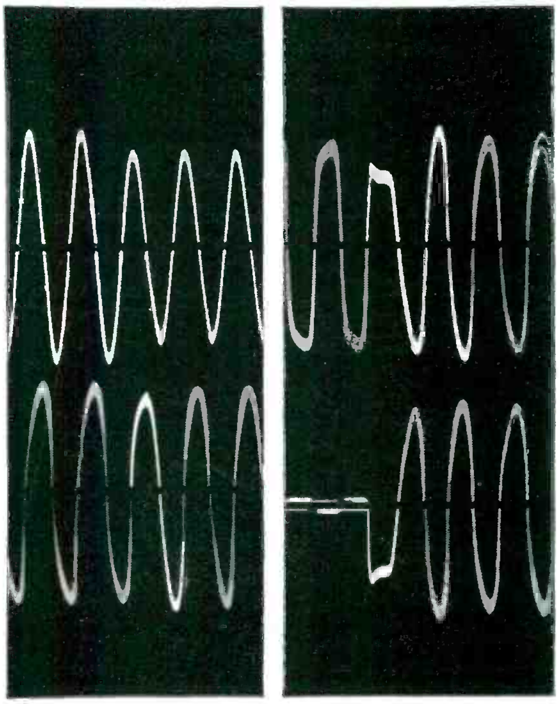
SINGLE-CORE CONSTRUCTION in General Electric's new standard line of 60-cycle automatic voltage stabilizers provides inherent input-output isolation—eliminates the need for an additional isolating transformer. You get substantial weight reduction over previous units in the 1000 to 5000 VA ratings.

TOTALLY ENCLOSED construction of the new design cuts down stray magnetic fields—allowing use near sensitive electronic devices like oscilloscopes.

VOLTAGE RATIO FLEXIBILITY has also been increased in the new line. Standard stabilizers—with ratings from 1000 VA through 5000 VA—are provided with series multiple input and series multiple output.

IN ADDITION, these new units offer a wide-range of voltage correction, plus rapid stabilization, ease of installation and maintenance-free operation.

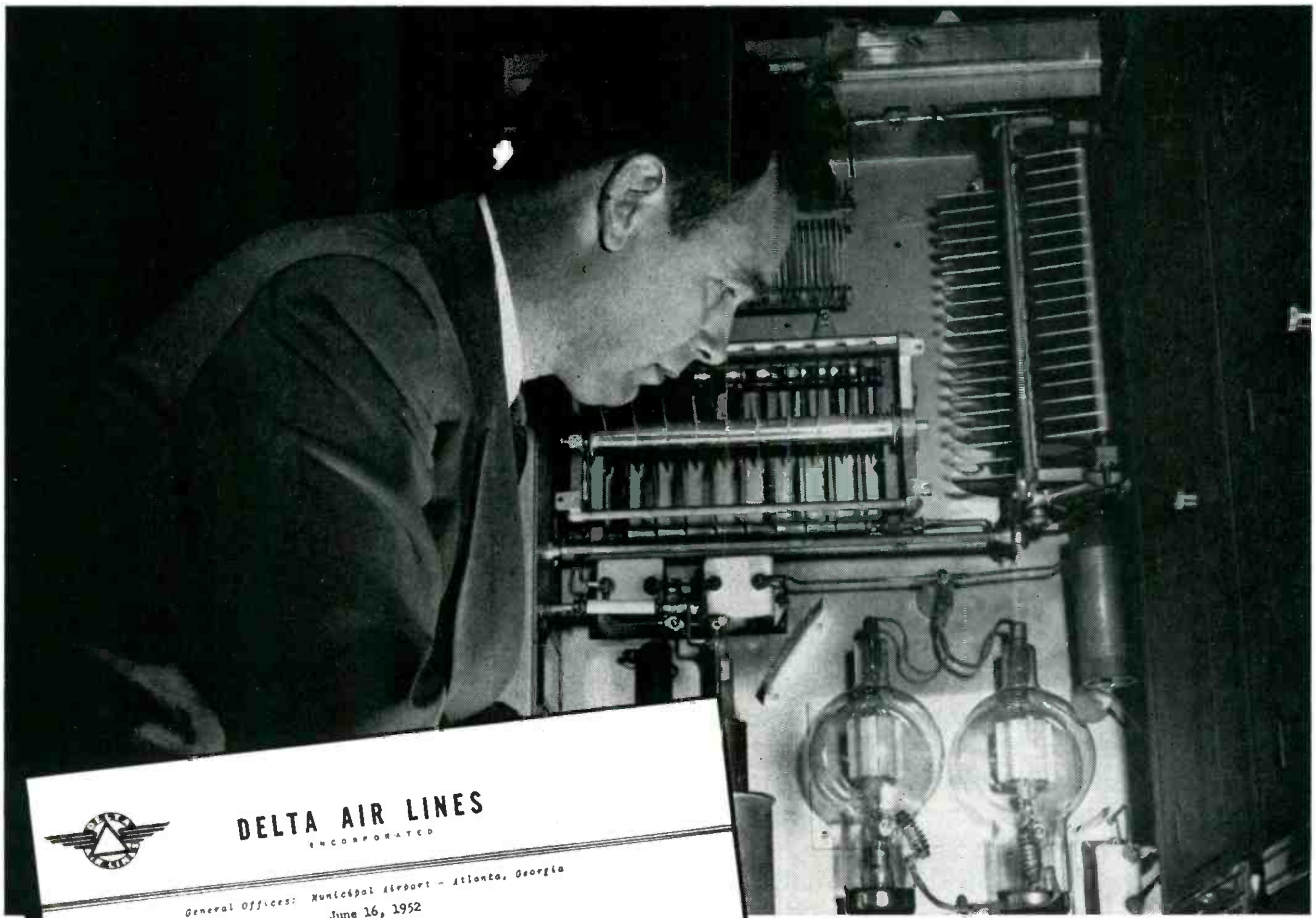
For further information on this new line of standard automatic voltage stabilizers call your local G-E distributor. Or write for bulletin GEA-5754 G-E Automatic Voltage Stabilizers. *Section 411-102, General Electric Co., Schenectady 5, N. Y.*

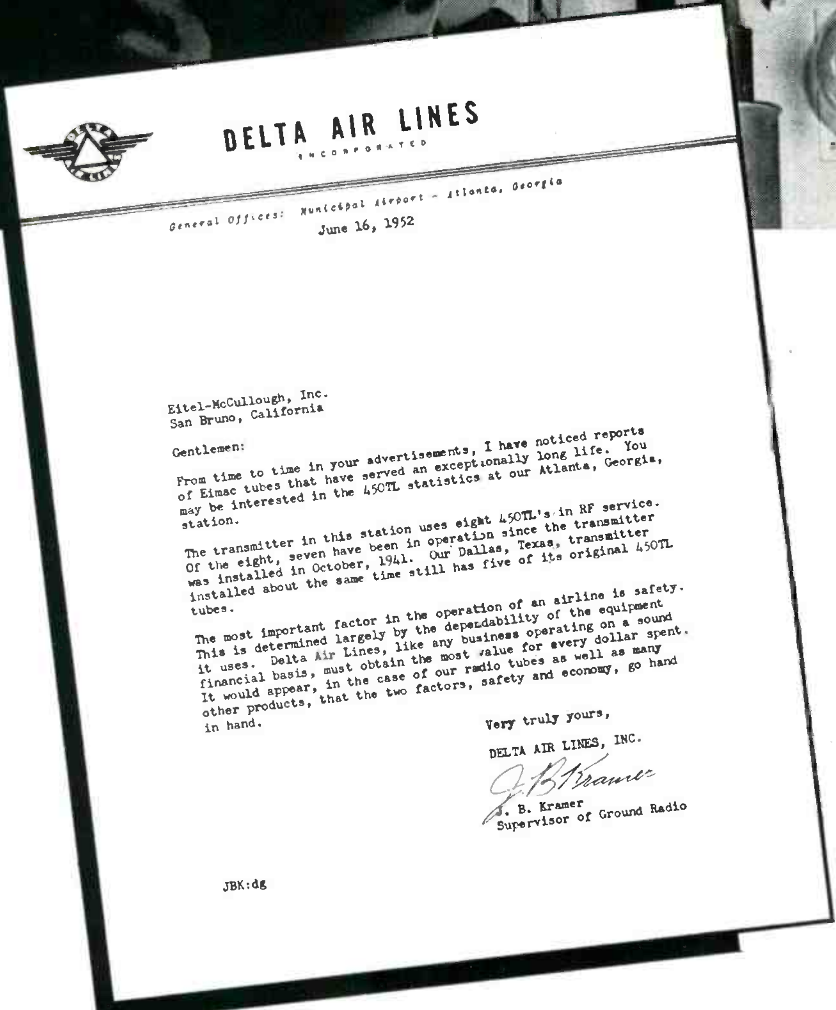


RAPID RESPONSE of G-E Automatic Voltage Stabilizers. *Left:* Stabilization within 1½ cycles as input drops from 130 to 95 volts. *Right:* Stabilization in 2 cycles as load current jumps from 0 to full load.

GENERAL ELECTRIC

INSTALLED IN 1941 AND STILL GOING STRONG...





DELTA AIR LINES
INCORPORATED

General Offices: Municipal Airport – Atlanta, Georgia

June 16, 1952

Eitel-McCullough, Inc.
San Bruno, California

Gentlemen:

From time to time in your advertisements, I have noticed reports of Eimac tubes that have served an exceptionally long life. You may be interested in the 450TL statistics at our Atlanta, Georgia, station.

The transmitter in this station uses eight 450TL's in RF service. Of the eight, seven have been in operation since the transmitter was installed in October, 1941. Our Dallas, Texas, transmitter installed about the same time still has five of its original 450TL tubes.

The most important factor in the operation of an airline is safety. This is determined largely by the dependability of the equipment it uses. Delta Air Lines, like any business operating on a sound financial basis, must obtain the most value for every dollar spent. It would appear, in the case of our radio tubes as well as many other products, that the two factors, safety and economy, go hand in hand.

Very truly yours,

DELTA AIR LINES, INC.

J. B. Kramer

J. B. Kramer
Supervisor of Ground Radio

JBK:dg

...reports
DELTA AIR LINES of EIMAC Tubes

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ERIE

DISC CERAMICONS®

ERIE offers a complete line of Disc Ceramicons in By-Passing, Temperature Compensating, and High Voltage types. A distinguishing feature of Erie Disc Ceramicons is high capacity—up to .02 mfd—in extremely compact size. Also, High Voltage Disc Ceramicons are available in ratings up to 8000 volts D. C. working. Basic diameter sizes are 5/16", 3/8", 19/32", and 3/4" maximum.

They are amazingly easy to install in small spaces . . . they simplify soldering and wiring operations, and speed up the assembly line. Erie Disc Ceramicons consist of round flat dielectrics with fired on silver plates, and leads of tinned copper wire firmly soldered to silver electrodes. The units are given a protective coating of phenolic and vacuum wax impregnation. Dual discs are available in both shielded and non-shielded construction.

Such simplicity of construction results in low series inductance and unusual efficiency in high frequency by-passing.

Write for complete information regarding your specific needs, and samples.

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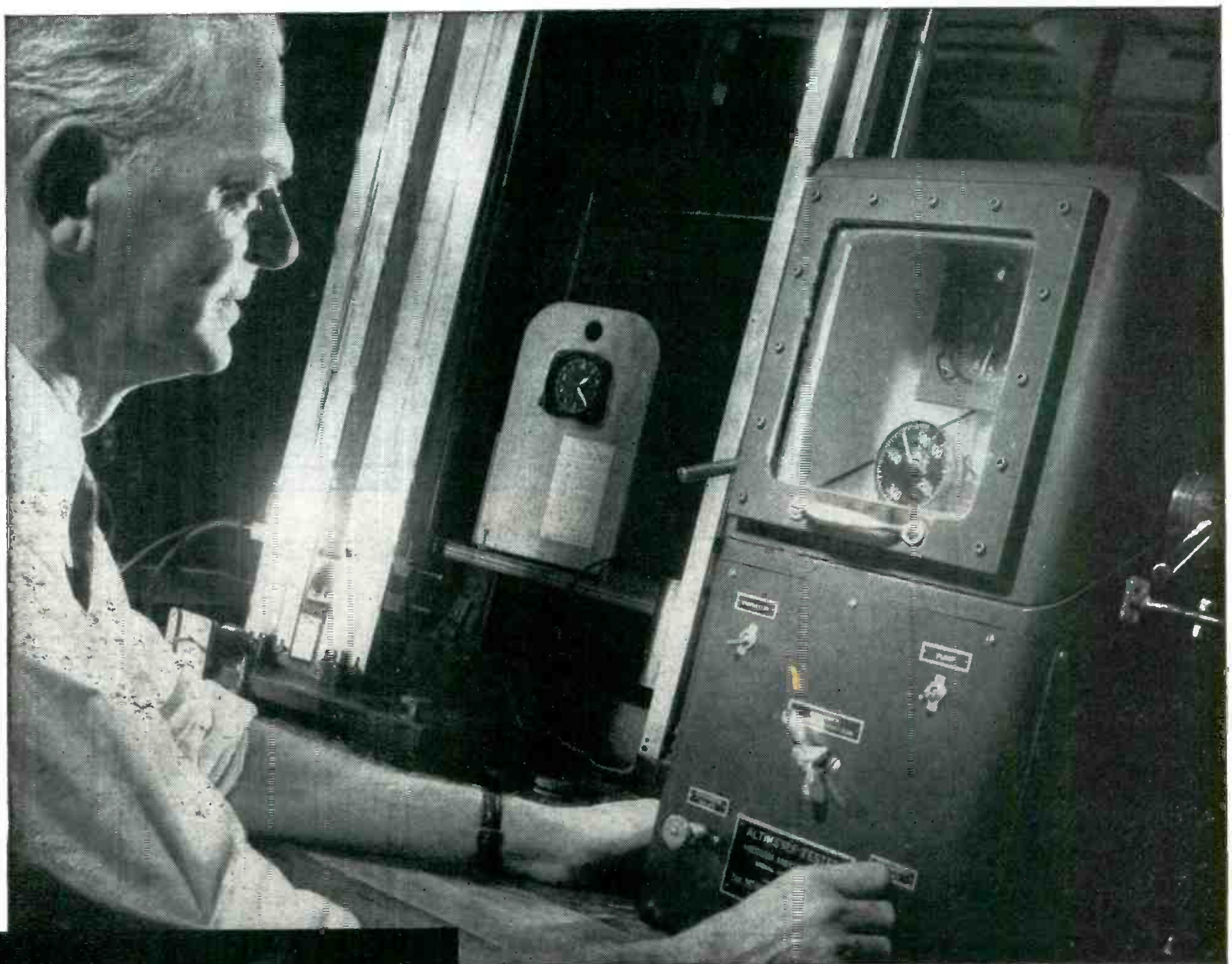

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KOLLSMAN INSTRUMENT CORPORATION

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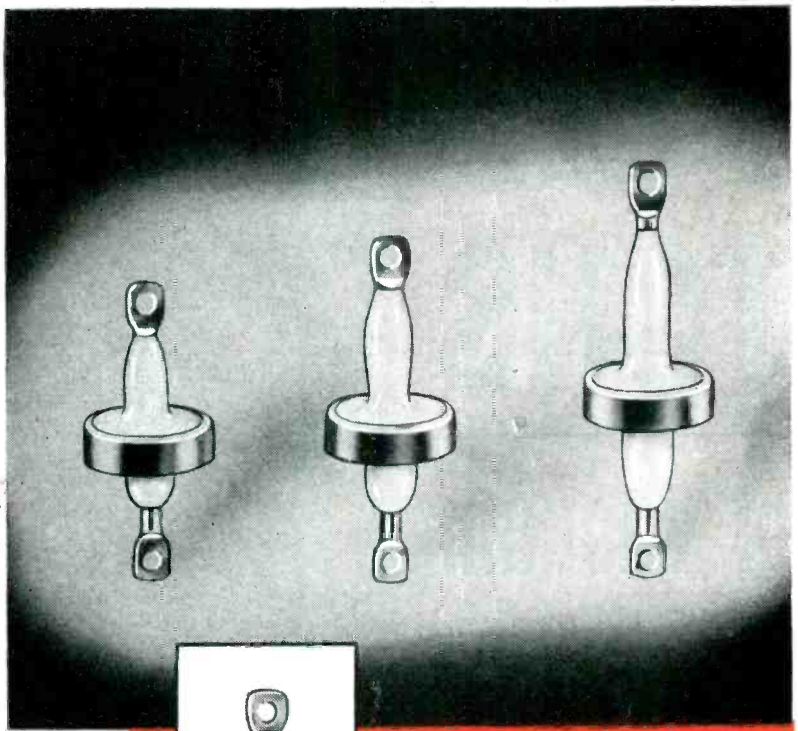
Standard COIL PRODUCTS CO. INC.

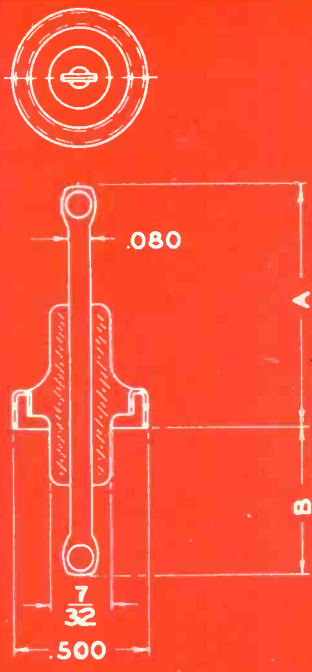
TAKES UP TO 10,000 VOLTS TEST

New

HIGH VOLTAGE TERMINAL

RUGGED
FOOLPROOF





HERMETIC's new high voltage terminal is a glass-metal header that can take up to 10,000 volts and yet occupies only ½" diameter on the mounting surface. It is amazingly rugged and will insure foolproof operation because of the diaphragm construction of the mounting. It is available with solid or tubular center conductors. Applications are many, among which are its use in transformers, choke coils, capacitors and pulsed circuits.

What are your requirements in hermetic sealing? Contact HERMETIC, the one and only dependable source of supply, and be sure that your problems, too, will be solved to your complete satisfaction.

Write for your FREE copy of HERMETIC's informative new 32-page brochure, the most complete presentation ever offered on hermetic seals.

PART NO.	A	B	TEST VOLT *
1533-50	11/16	17/32	5000
1533-75	7/8	23/32	7500
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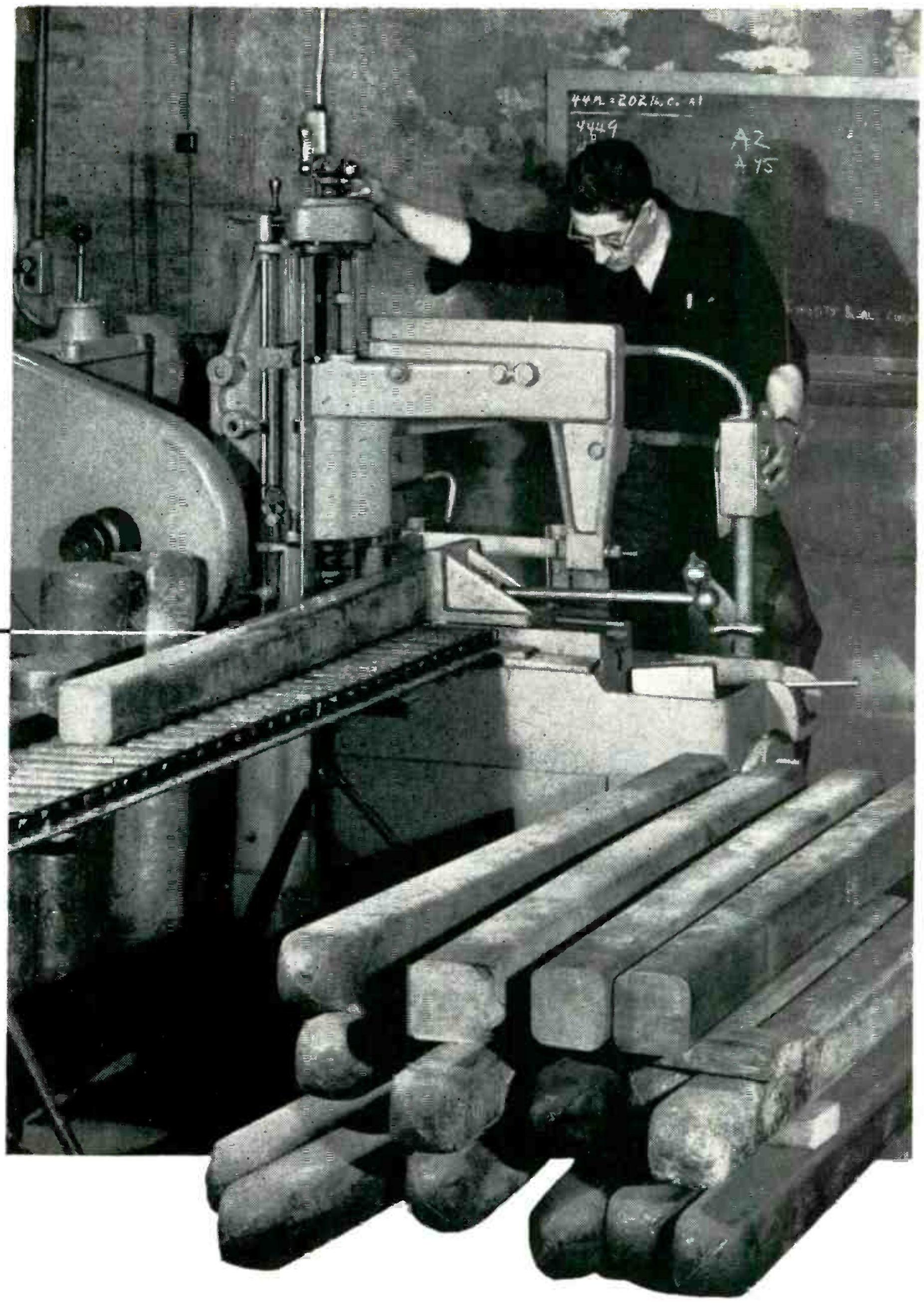
SEALED IN by HERMETIC HEADERS

HERMETIC SEAL PRODUCTS CO. 31 So. Sixth St., Newark 7, N. J.

FIRST & FOREMOST IN MINIATURIZATION

Serving up TONS of Vacuum Melted Metals



Preparing samples of vacuum melted metals for analysis.

PRODUCTION on vacuum melted metals that was formerly measured in pounds can now be measured in tons. Vacuum Metals' new expanded facilities are capable of producing 5 tons per day of Gas Free High Purity metals and alloys.

Vacuum melting techniques provide metals of higher purity . . . and alloys held to closer composition tolerances than ever before achieved commercially.

The unusual physical, chemical and electrical properties of these metals have proved of particular value for applications such as electronic and electrical parts, magnetic materials, bearing materials, diaphragms, instrument components, and Atomic Energy projects.

Metals now being vacuum melted include copper, nickel, iron, and molybdenum. Further information will be furnished gladly on request.

HIGH PURITY METALS
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SPECIAL ALLOYS
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VACUUM METALS CORPORATION
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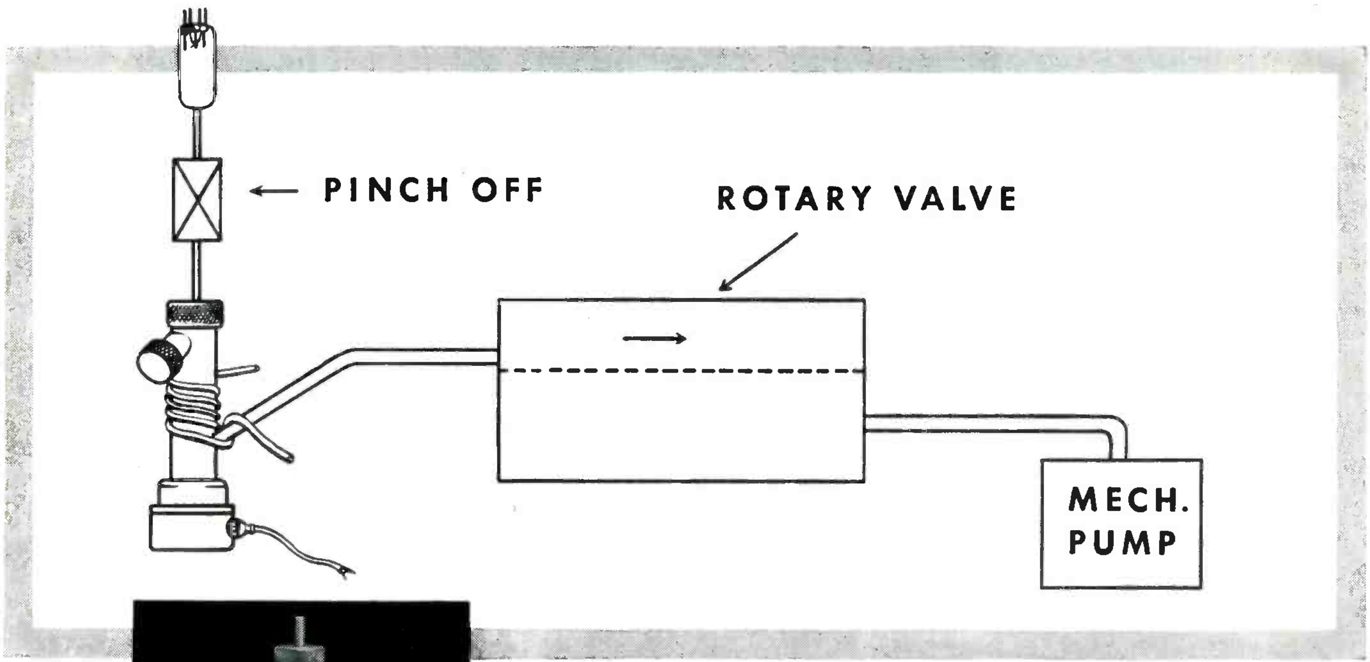
The Modern Way to Build Rotary Exhaust Equipment for Miniature Tubes

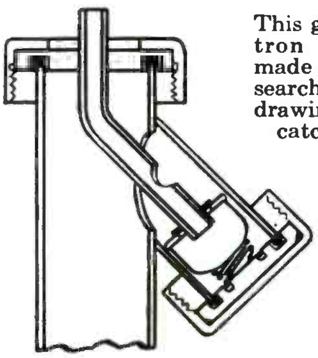


NRC's TYPE B-1 BOOSTER PUMP

- ***Provides Higher Vacuum***
- ***Reduces Exhaust Cycle***
- ***Eliminates Troublesome Oil Vapors***

Our Type B-1 Booster Pump was built to meet ideal production methods as outlined by Hytron production engineers. On the production line it exactly meets their specifications in every detail — step by step. This Booster Pump lowers production costs. Its high speed reduces the exhaust cycle. Write for details.

HYTRON-DESIGNED GLASS TRAP
Ends Important Maintenance Problem



This glass trap, designed by Hytron production engineers, is made and sold by National Research. As you can see by the drawing at the left, the trap catches and holds broken glass particles. It works on the principle of a cyclone separator. The trap can be easily cleaned. Write for full details.

INDUSTRIAL RESEARCH
PROCESS DEVELOPMENT
HIGH VACUUM ENGINEERING
AND EQUIPMENT

METALLURGY
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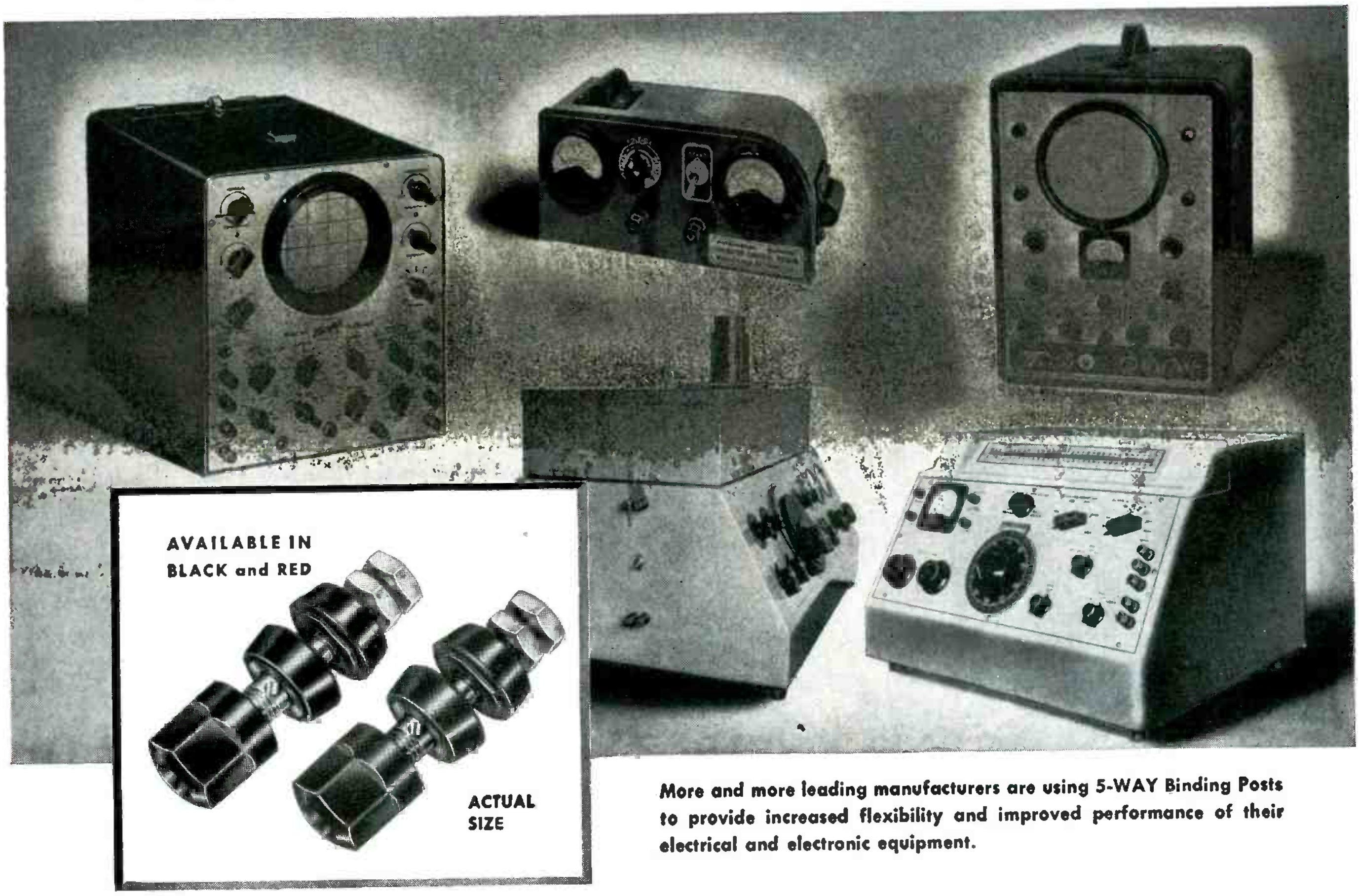
APPLIED PHYSICS

National Research Corporation

"Equipment Division"

Seventy Memorial Drive, Cambridge, Massachusetts

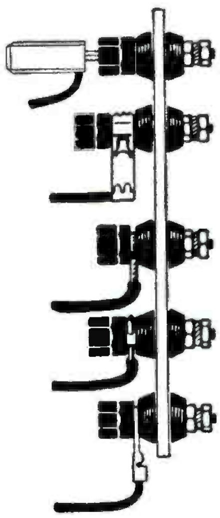
FIRST CHOICE on EQUIPMENT of FINE QUALITY



More and more leading manufacturers are using 5-WAY Binding Posts to provide increased flexibility and improved performance of their electrical and electronic equipment.

SUPERIOR 5-WAY BINDING POSTS

1. **Plug-in for standard 3/4" banana plug**
2. **Clip-lead to shaft**
3. **Wire looped around shaft and clamped**
4. **Wire (up to #12) permanently clamped through center hole**
5. **Clamped spade lug connection**



Better electrically *and* mechanically, the rugged SUPERIOR 5-WAY Binding Post affords quick, safe and positive connections for practically every application. Mounting in any panel from 1/16" to 1/4" is easily accomplished by means of a single keyed or unkeyed hole. It provides complete insulation from the panel. Construction is extra strong. Only the most durable of phenolic plastics is used. The hexagonal shaped head can be tightened with a 1/2" socket wrench without damage. Current capacity is 30 amperes; working voltage is 1000 volts. The color choice of RED or BLACK permits ready circuit or polarity identification.

A FREE SAMPLE IS AVAILABLE IF REQUESTED ON YOUR LETTERHEAD. 210 THURE AVENUE, BRISTOL, CONNECTICUT

THE SUPERIOR ELECTRIC CO.
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for electronic advancement

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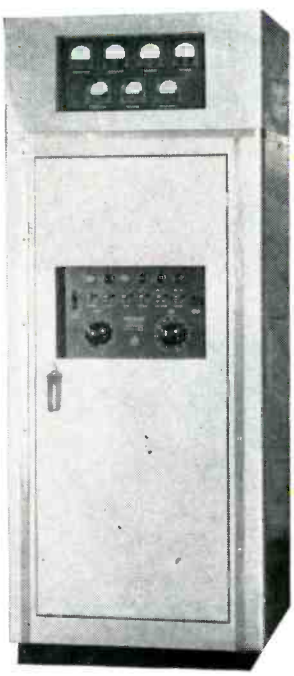
Model CA-71

Lobing Switch
Model CA-31

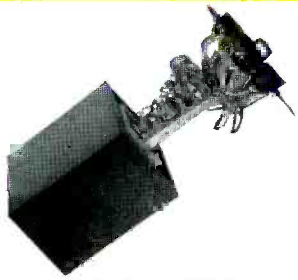
Manual Coaxial Switch
Model CA-36

Motor Actuated Coaxial Switch
Model CA-26

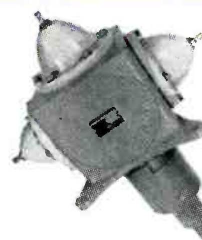
1P-2T Coaxial Switch
Model CA-20



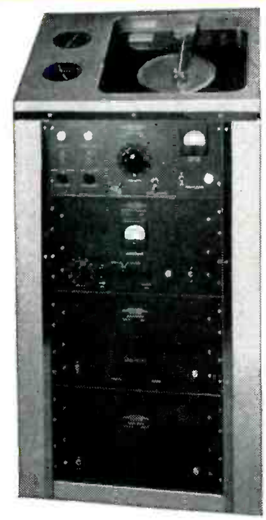
High Voltage Power Supply Unit
Model BP-01



RF & Power Switch
Model CA-60



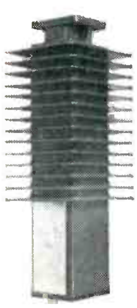
Antenna Switch
Model CA-57



Polar Recorder
Model BU-02

Transfer Switch
Model CA-19

Logarithmic Amplifier
Model BA-01



Dummy Load
Model BL-07

The research facilities of Thompson Products are helping in the development of the electronic industry. In fact, many electronic developments owe part of their creation to Thompson research or Thompson-made equipment.

We are proud of our contributions—and, we think, justfully so. On the other hand—we *should* do a top job! We are equipped to solve tough problems. Thompson has two plants—one in Cleveland, another in Columbus, Ohio—devoted exclusively to research engineering and manufacturing of electronic equipment. And our facilities stand ready, willing and able to help you solve your every problem—whether today's production or tomorrow's design—in coaxial switches, antennae, specialized test equipment or wave guide and coaxial components and accessories.

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radio frequency bypass
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electronic computers
electrometer and oscillator circuits
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Send us your requirements and we will recommend the proper capacitor.

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* *Glassmikes* . . . an exclusive capacitor line originally designed by our engineers

SANTA CLAUS Could Die of Old Age

No one shoots Santa Claus. This remark about a government which spends and spends and spends may well be true. But it is also true that Santa Claus is an old man. At his age overwork might well kill him.

It is with the possibility of working Santa Claus to death that this editorial is concerned. No position is taken as between the contending political parties in the present campaign. Our concern is with the problem of protecting Santa Claus.

It is true that as a nation we now enjoy great prosperity. The prosperity is not nearly so general as the political advertisements of it would suggest. Millions of individuals, notably those living on pensions, annuities and other fixed incomes, have been robbed of half their purchasing power by inflation during recent years, and whole industries know little or nothing of boom times.

However, measured by so basic a gauge as unemployment, we do have great prosperity. Less than two million of our total working force of over 64 million are unemployed, and many of them are unemployed only while moving from one job to another. The real income, i.e., what their dollars will buy, of those with jobs is somewhere near its all-time peak.

Our Prosperity is Precarious

The prosperity we enjoy, however, is precarious. This is primarily because it is dependent upon a rising volume of expenditures by the federal government. At present almost a quarter of our entire national income is ladled out through Washington, and in an ever increasing amount.

If, as matters now stand, federal expenditures were to be suddenly and sharply cut, our government-financed prosperity would be severely upset. But if the federal government were to try to keep right on providing prosperity by steadily increasing its expenditures, the end result would be more certainly disastrous. It would be a crash caused primarily by having continuing inflation of prices destroy the value of the dollar.

Higher government expenditures of worthless dollars then could accomplish nothing. Santa Claus would be dead from overwork.

To Provide Firm Foundations

The general route to be followed in putting firm foundations under our prosperity is quite clear. It involves two steps which must be taken closely together. The first is to stop the continuous increase in federal expenditures. The second step is to substitute expanding private business for government-financed business as the principal foundation of expanding prosperity.

The increase in federal expenditures can be stopped without sacrificing any effective measures now directed toward meeting our top priority requirement—protection from armed Communist aggression. The most competent authorities of both major parties agree it can be done by (1) better planning of and the elimination of outright waste in defense arrangements, and (2) cutting those civilian expenditures which cannot be justified at the same time we are undertaking a great new load of defense expenditure.

It is also possible to substitute expanding private business for government-financed business. The problem is primarily that of relieving private business of the staggering load of federal taxation it now is carrying. Federal taxation now takes 52 per cent of all corporate profits and 82 per cent of all so-called excess profits. If it were not for the forced draft placed under our economy by rapidly mounting defense expenditures, this burden would surely lay a disastrous blight on private business expansion. If expanding private business is to have a chance to play its critical role as a subtitute for government-financed business, its taxes must be cut, and soon.

It Won't be Easy

It would be naive to contend that it will be easy to check the expansion of federal expenditures. They have been running wild too long, and in the process contributing to a feverish, inflationary prosperity. Likewise, there is no reason to believe that the easing of the load of business taxes is going to be easy. The basic blight it puts on business expansion has been too long obscured by having our economy dosed with artificial stimulants, most notably enormous injections of federal expenditures.

The Key Question—How Long?

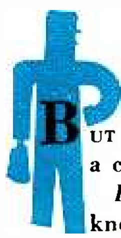
It is obvious that prosperity is going to be a major topic of discussion in the present political campaign. There is nothing the matter with that. Prosperity is a key concern of the voters in choosing a national administration.

To make the discussion of prosperity really useful, however, it is important to ask and get answers to the right questions about it. The key question is not whether or not we have prosperity. That we have it in large measure is generally conceded.

The key question is, "How long can we continue to have prosperity?" The answer—not very long if we continue to rely primarily on new injections of inflationary federal expenditures. Santa Claus, be it remembered, is no youngster. If we continue our present improvident course, he will be worked to death. Those politicians, regardless of party, who see this clear danger and who have plans to escape it are facing up to the crucial question about our prosperity.

McGraw-Hill Publishing Company, Inc.

Our most eloquent salesman can't talk



BUT HE CAN SELL. In fact, every prospect who meets him becomes a customer. Every one.

For "he" is the Karp plant itself. And if you saw him, you'd know why he's a successful salesman.

It begins with our engineering department where your designs are detailed for sheet metal production. It continues through tooling where our vast assortment of available dies often eliminates the need for new tooling . . . where our toolmakers create special tooling when needed.

Then to actual fabrication, where skilled craftsmen process every job, whether large or small, with equal care — and use the finest of metal-working equipment to do it.

You'd see all of these things and much, much more as you travel through our plant ranging three city blocks.

At the risk of becoming dissatisfied with your present sheet metal fabrications, you're invited to tour the Karp plant—any time. Meanwhile, write for a copy of our data book.

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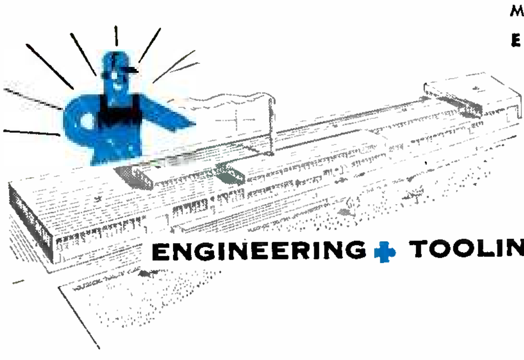
MOST COMPLETE FACILITIES FOR LARGE AND SMALL RUNS OF
ENGINEERED SHEET METAL FABRICATION



ENGINEERING + TOOLING + PRODUCTION + FINISHING = KARP

ROLLING ELECTROLYTIC CAPACITORS with "Scotch" Electrical Tape No. 42 at The Magnavox Company, Fort Wayne, Indiana.

WHAT'S NEW IN TV TAPES?

High-purity, stick-at-a-touch tape cuts condenser break-downs at The Magnavox Co.

At last—a tape that won't corrode electrolytic condensers! It's "Scotch" Electrical Tape No. 42—a tape with extremely low chloride content, and it's now proving its worth at The Magnavox Company, Fort Wayne, Indiana. Condenser breakdowns caused by usual wrapping methods have been sharply reduced.

This "Scotch" Electrical Tape is only one of many "Scotch" Electrical Tapes designed to give you lower costs, faster production and more dependable results.

Over 30 of these stick-at-a-touch tapes are described in a new booklet we'd like you to have as a reference. The booklet is titled "Tapes for Television," and it gives you *facts* like dielectric strength, caliper, type of backing and mechanical strength of tapes that can save you real money.

Write for your copy of this handy booklet today! Use coupon below for immediate attention.

Minnesota Mining & Mfg. Co.
Dept. E102, St. Paul 6, Minnesota

Please send a copy of "Tapes for Television."

Name..

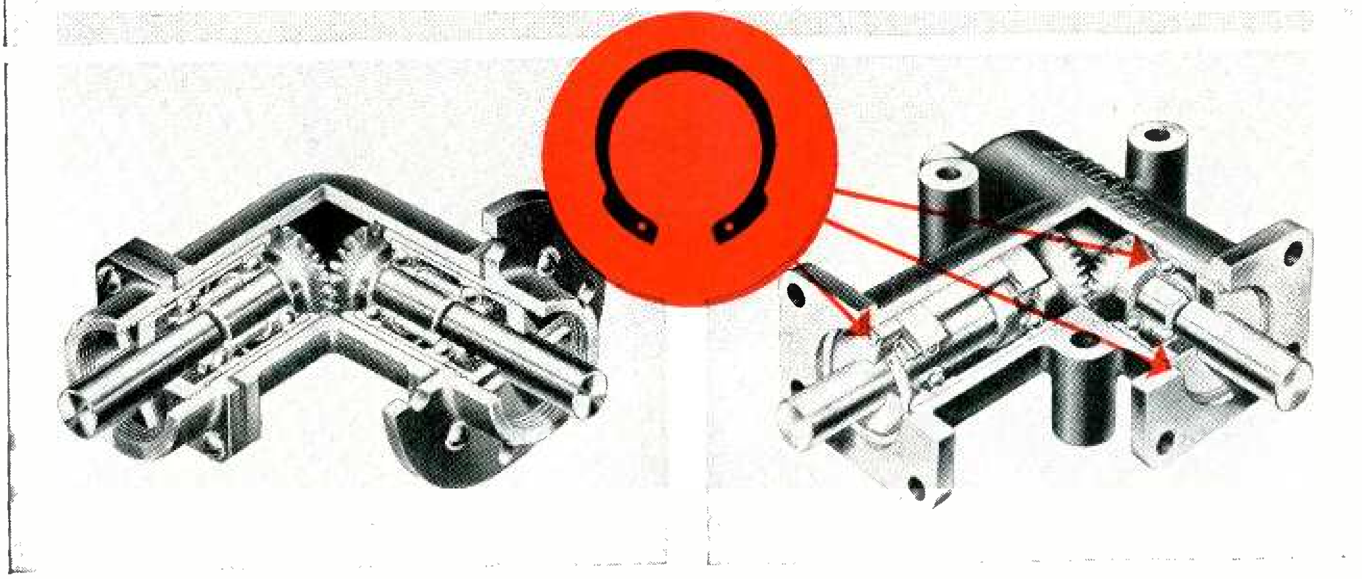
Firm..

Address.....................................

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

The term "SCOTCH" and the plaid design are registered trade marks for the more than 100 pressure-sensitive adhesive tapes made in U.S.A. by Minnesota Mining & Mfg. Co., St. Paul 6, Minn.—also makers of "SCOTCH" Sound Recording Tape, "UNDERSEAL" Rubberized Coating, "SCOTCHLITE" Reflective Sheeting, "SAFETY-WALK" Non-slip Surfacing, "3M" Abrasives, "3M" Adhesives. General Export: Minn. Mining & Mfg. Co., International Division, 270 Park Avenue, New York 17, N. Y. In Canada: Minnesota Mining & Mfg. of Canada, Ltd., London, Canada.

3 Waldes Truarc Rings Replace 19 Parts ...Save $6.75 Per Unit...Cut Weight by Nearly 16%



OLD WAY 2 Threaded nuts locked bearings in place. 8 screws and washers positioned bearing and shaft assemblies. This fastening method required expensive tapping and threading. Assembly was slow and costly.

TRUARC WAY Two Truarc inverted rings (Series 5008) provide uniform shoulder to lock bearings in place, position bearing and shaft assemblies. Additional Truarc Ring (Series 5100) locates ball bearing ...eliminates 1 sleeve type spacer.

Airborne Accessories Corporation, Hillside, New Jersey, uses Waldes Truarc Retaining Rings to take *all* thrust load from right angle bevel gears in their ANGLgear*. Truarc Rings make ANGLgear* more compact—save approximately ¼" at each end of housing. By providing a choice of 3 mounting possibilities — instead of 1 — Truarc Rings make ANGLgear* adaptable to many different assemblies. New design increases load capacity . . . eliminates machining of threads.

Redesign with Truarc Rings and you, too, will cut costs. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better job of holding parts together.

Waldes Truarc Rings are precision-engineered . . . quick and easy to assemble and disassemble. Always circular to give a never-failing grip. They can be used over and over again.

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

*Trade Mark of Airborne Accessories Corp.

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: 2,382,947; 2,382,948; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING.

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

Please send me the new Waldes Truarc Retaining Ring catalog. E-104

(Please print)

Name....................

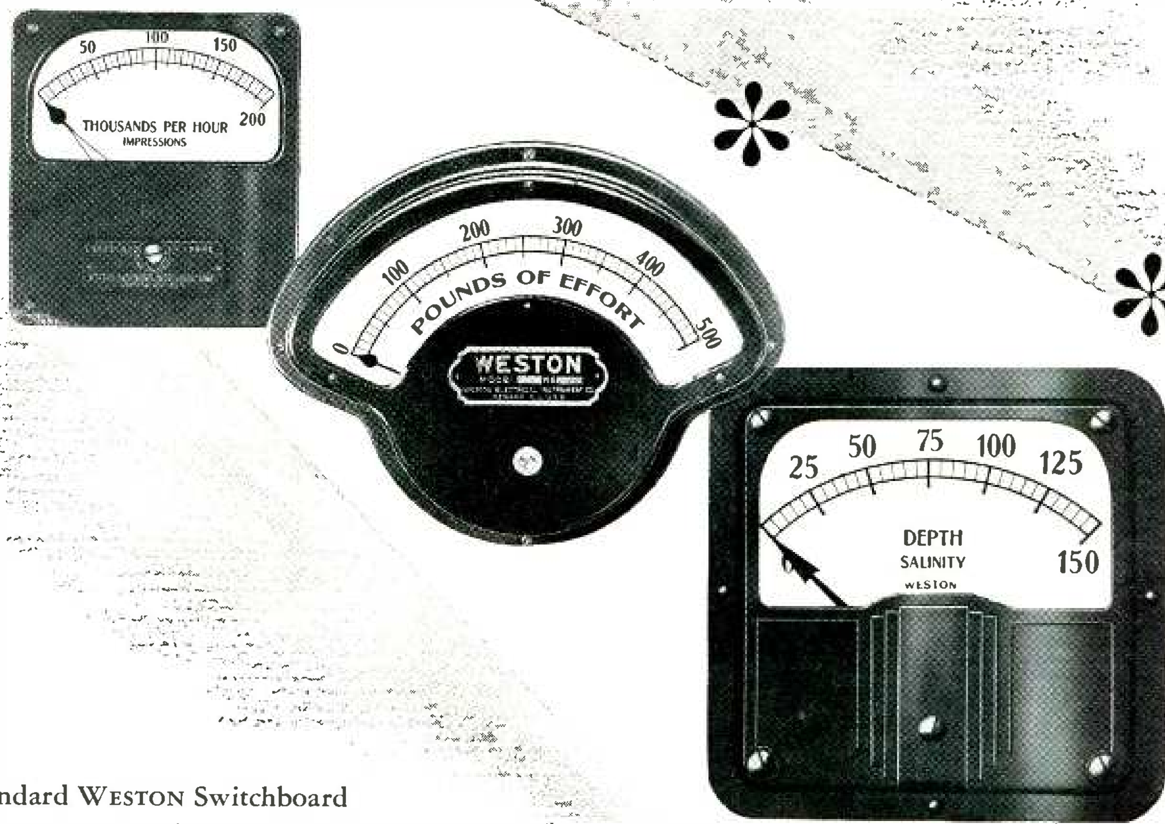
Title....................

Company....................

Business Address....................

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

*NOT Catalogued!

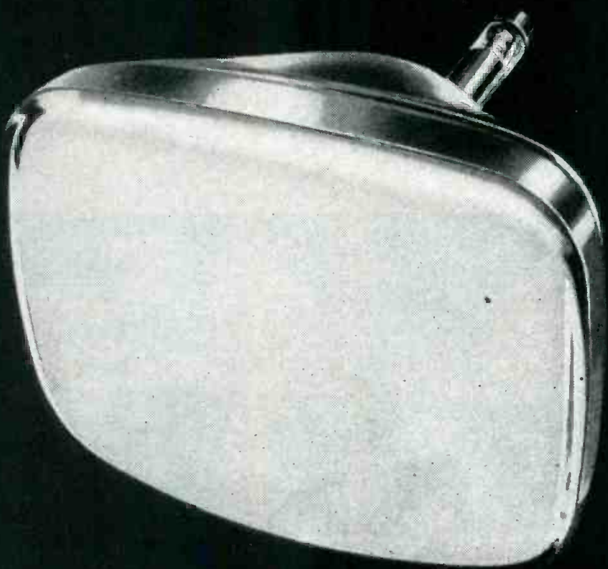


Standard WESTON Switchboard Instruments are all catalogued, of course. But these are *special* switchboard instruments . . . a few of the many hundreds of different types being constantly engineered and produced to meet specific requirements. Requirements such as . . . *special sensitivities —scale markings—pointer styles and response—mirror scales— adjustment to give maximum accuracy at critical points, etc.* Whatever your instrument requirement . . . *standard or special* . . . the answer is available here at *instrument headquarters.* WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and TAG instruments.

WESTON

798

SWITCHBOARD *Instruments*

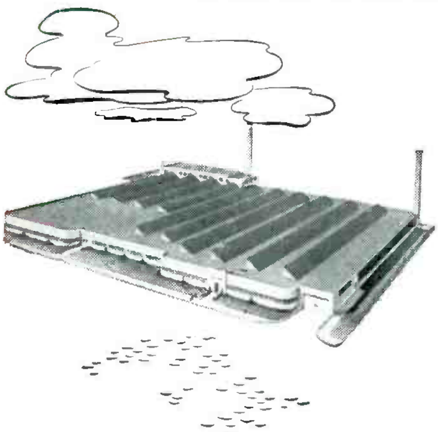


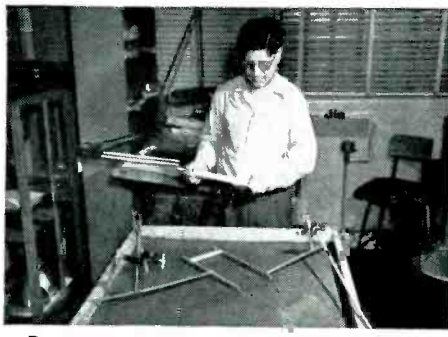
What Rauland means by "Perfection Through Research"

Rauland is one of the few companies devoting so much top engineering talent full time to picture tube improvement and perfection.

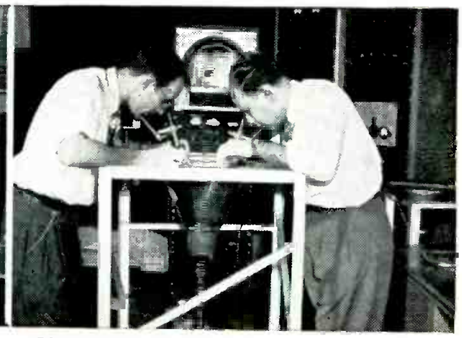
The result has been to give you more picture tube advancements since the war than any other manufacturer . . . first chance at the latest developments for companies using Rauland tubes as original equipment . . . and a real selling edge at the retail level because of the extra satisfaction which Rauland advantages offer.

That's why so many alert manufacturers look to Rauland for the best in picture tubes.

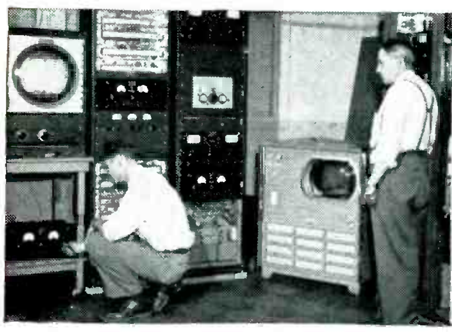




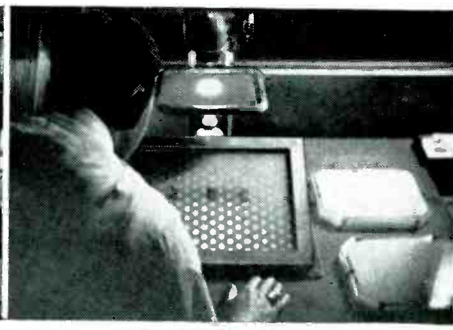
Rubber model for studying electron optical designing—basis for Rauland's exclusive Indicator Ion Trap.



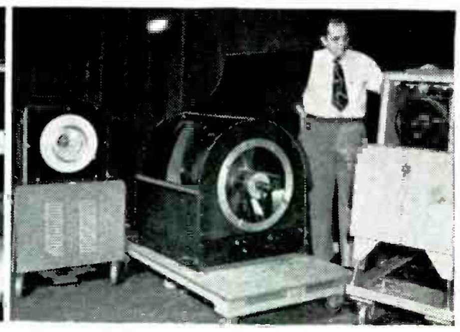
Alignment of the screen and parallax mask of tri-color tube containing approximately a million fluorescent dots.



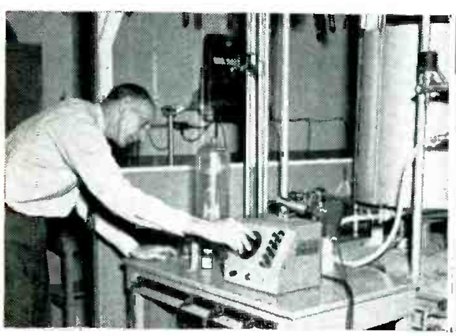
All-electronic tri-color tube in electronic receiver system (left) in comparison with mechanical system (right).



Inspection and checking of perforations .0075" in diameter in masks of tri-color picture tubes.

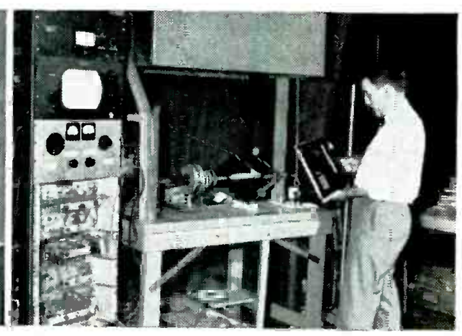


Rauland large-screen projectors using three different optical systems, all of which give theater-size pictures.



Careful study of the formation of thin metallic films in a vacuum . . . basis for the aluminizing of tubes.

Examination with polarimeter permits careful control of strains for superior glass-to-metal sealing.



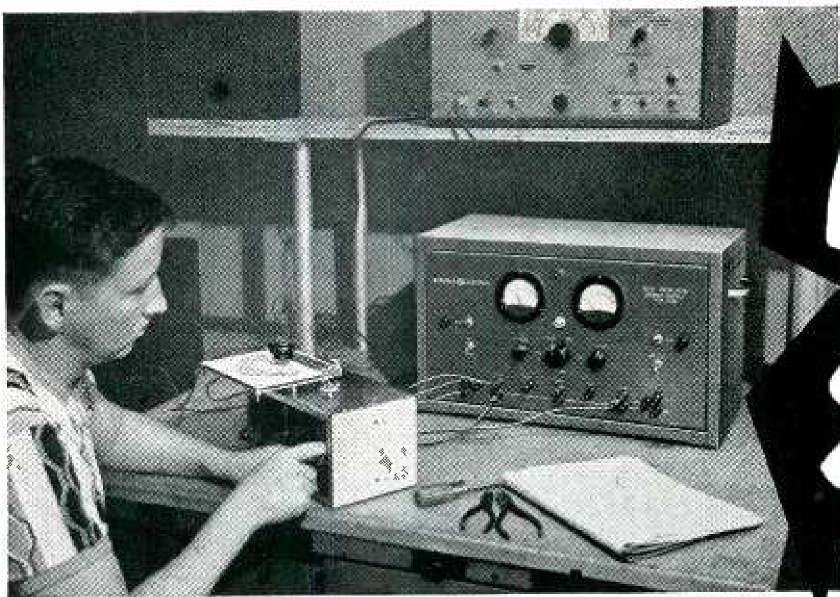
A physicist using a Rauland-developed radiation meter in checking X-ray radiations from cathode ray apparatus.

THE RAULAND CORPORATION

Perfection Through Research

4245 N. KNOX AVENUE • CHICAGO 41, ILLINOIS

Only the G-E Dual Regulated Power Supply ST-9A gives you...

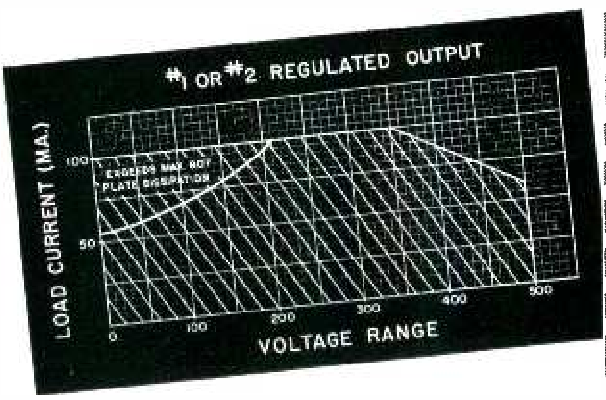


1. ELECTRONIC OVERLOAD PROTECTION

2. BUILT-IN MODULATOR

TYPE ST-9A (500 VOLT)
Electrical Specifications

Power Requirements	105-125 volts (210-250 volts), 50/60 cycle, 320 watts maximum
Output Voltages	
#1 Regulated	Continuously variable, 0-500 volts, maximum current 100 ma
#2 Regulated	Same as #1
Parallel #1 and #2	Continuously variable, 0-500 volts, maximum current 150 ma
Unregulated	Approximately 650 volts no load, maximum current 200 ma
—75 Volts	VR tube regulation, 0-2 ma
—150 Volts	VR tube regulation, 0-4 ma
Filament Supply	6.3 volts a-c at 10 amps
Regulation	Better than ½% + ½ volt within the cross-hatched area of the graph (below)
Ripple and Noise	Less than 3.5 mv (10 mv peak-to-peak) on all regulated outputs
Instruments	Milliameter 0-300 ma d-c; voltmeter 0-500 volts d-c; voltage and current can be metered at #1 and #2 Regulated and Unregulated outputs; total current drawn from all outputs can be metered and it should not exceed 200 ma
Overload Protection	3 amp fuse in the a-c line; ⅜ amp fuse in the d-c line; overload of any degree on the regulated outputs will harm neither the supply itself nor the instruments.
Ambient Temperature	0 to 40°C



For general laboratory purposes, no power supply on the market today can match this new General Electric unit. Routine bench casualties are no problem for the ST-9A: the instruments cannot be harmed by short circuits on the regulated outputs. And—for the first time you can observe hum and noise tolerances by actually duplicating them on the equipment. This saves you time by establishing final power supply design specifications quickly.

- Outputs readily available on insulated binding posts
- Output terminal on rear for rack mounting
- Outputs are individually metered and a fourth position is added for metering total current
- *Even when* the unit is cabinet or rack-mounted, drop front panel permits easy accessibility to components (without removing panel lock)
- Regulation specification holds over the full range of 0-500 volts.

General Electric Company, Section 4102,
Electronics Park, Syracuse, N. Y.

Please send my copy of your new G-E Power Supply Catalog.

NAME ______________________

COMPANY ______________ TITLE ______

ADDRESS ______________________

CITY ______________ STATE ______

GENERAL ELECTRIC

NEW *hp* AUDIO

New! Completely redesigned!
Highest quality throughout
Lighter weight, smaller size
New wider frequency range
Time-tested RC circuits
No zero set. High stability
Constant output, low distortion

New convenience for laboratory, field or production measurements in sub-audio, audio, telephony, carrier current, super-sonic, telemetering and rf applications.

COMPACT, EASY TO USE BASIC INSTRUMENTS FOR LABORATORY OR PRODUCTION TESTS

Hewlett-Packard RC oscillators have long been basic tools for making electrical and electronic measurements of precise accuracy. Now these world-famous test instruments are redesigned to give you the most compact, dependable, accurate and easy-to-use commercial oscillators available.

New *-hp-* 200 series oscillators have highest stability and precisely accurate, easily resettable tuning circuits. Low impedance operating levels together with superior insulation guarantee peak performance throughout years of trouble-free service. New models have wider frequency range. Operation is simplified—just three front panel controls. Size is different, too—the instruments are more compact, lighter in weight and enclosed in an easy-to-handle aluminum case with carrying strap. Minimum bench space is required. (Rack mounting available on request.)

Complete Coverage! HEWLETT-PACKARD

OSCILLATORS

The total coverage of just two of the new *-hp-* oscillators is materially greater than that offered by four previous *-hp-* instruments. For example, new Model 200AB, for general audio tests, offers a wider frequency range of 20 cps to 40 kc and a full watt output. New *-hp-* 200CD, for wide-range measurements at lower power, provides constant voltage output from .5 cps to 600 kc.

In addition to these new instruments, *-hp-* continues to offer Model 200H for carrier current work up to 600 kc, and Model 202D for low frequency and vibration studies down to 2 cps. These instruments retain their time-tested design.

Components, insulation and other electrical and mechanical features are of the highest possible quality. The instruments are carefully adjusted and calibrated to meet exact frequency and performance specifications. An output amplifier provides complete isolation of the load, and changes in the output load cannot change the performance of the oscillator. Frequency stability is better than ±2% including warmup, and hum voltage is less than 0.1% of rated output.

-hp- 202A Low Frequency Function Generator

This instrument is a compact, convenient and versatile source of transient-free test voltages between 1,000 and 0.01 cps. It provides virtually distortion-free signals for vibration studies, servo application, medical and geophysical work and other subsonic and audio problems. The equipment generates 3 wave forms — sine, square and triangular. Output is 30 volts peak-to-peak fot all wave forms. The output system is fully floating with respect to ground and may be used balanced or single-ended. The instrument will deliver 10 volts RMS to a 2,500 ohm load; internal impedance, however, is only 40 ohms. There are no coupling capacitors in the output system, and a high degree of dc balance is achieved by a special circuit. Price, $450.

BRIEF SPECIFICATIONS—200 SERIES OSCILLATORS

-hp- MODEL	FREQUENCY RANGE	BANDS	FREQUENCY RESPONSE	POWER OUTPUT	LOAD IMPEDANCE	DISTORTION	POWER CONSUMPTION	PRINCIPAL APPLICATIONS	PRICE
200AB	20 cps to 40 kc	4 ranges	± 1 db Ref. 1 kc	1 watt or 24.5 v	600 ohms	1%	60 watts	Audio Tests	$120.00
200CD	5 cps to 600 kc	5 ranges	± 1 db Ref. 1 kc	160 mw — 600 ohms or 20 volts open circuit*		1%	75 watts	Audio, Ultrasonic, tests	$150.00
200H	60 cps to 600 kc	4 decades	± 1 db Ref. 1 kc	10 mw or 1 v	100 ohms	1%, 100-100,000 cps 3%, 60-600,000 cps	115 watts	Carrier Current & Telephone Tests	$350.00
202D	2 cps to 70 kc	5 ranges	± 1 db Ref. 1 kc	100 mw or 10 v	1,000 ohms	1%	80 watts	Low Frequency Measurement	$275.00
200I	6 cps to 6 kc	6 ranges	± 1 db Ref. 400 cps	100 mw or 10 v	1,000 ohms	1% 10-6,000 cps	115 watts	Interpolation and Frequency Measurement	$225.00

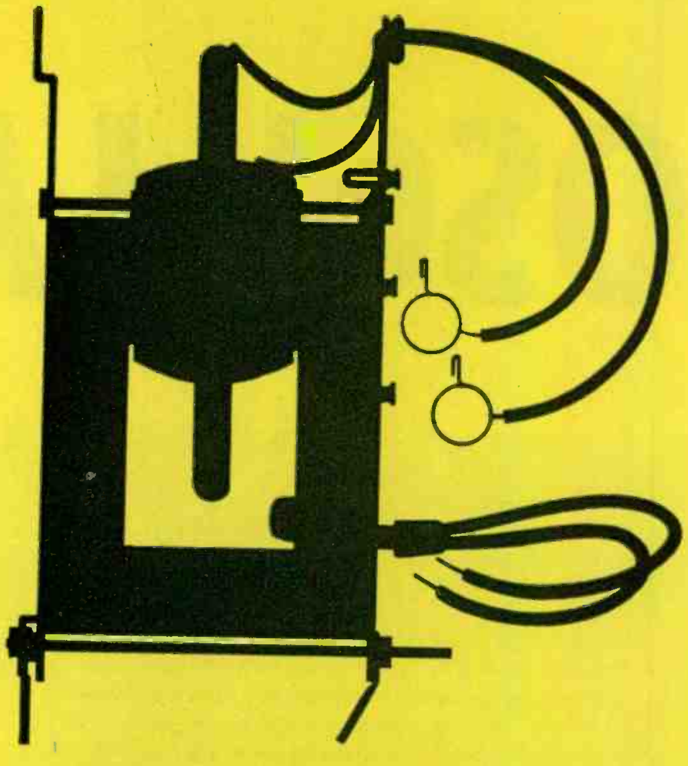
(*Internal impedance 600 ohms.) Data subject to change without notice. Prices f.o.b. factory.

HEWLETT-PACKARD COMPANY
Field Engineers in Principal Cities
2523A PAGE MILL ROAD • PALO ALTO, CALIFORNIA

INSTRUMENTS — Complete Coverage!

edwin i. guthman & co., inc.

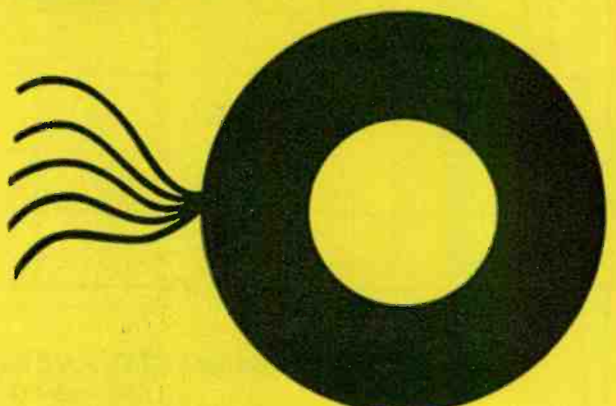
15 s. throop st. chicago 7, CH 3-1600 • also attica, indiana



flyback transformers

For reliability in high voltage specify Guthman Flybacks—they wont break down even under the most severe voltage requirements. Wire used in Guthman Flybacks is fabricated in our own plant and is quality controlled from raw material to finished product guaranteeing a superior uniformity of performance. The excellent linearity and voltage regulation characteristics of Guthman Flybacks aids in preserving picture quality.

Coils used in Guthman Yokes are form wound. Complete isolation between vertical and horizontal coils achieved by a molded nylon piece permits a yoke rating of 5,000 volts pulse maximum. Anti-magnetic core retainer band and brass mounting nut assures no magnetism in Guthman Yokes.



DELAY LINES
SHIELD CANS
ANTENNA COILS
OSCILLATOR COILS
COMPRESSION TYPE MICA TRIMMERS
I.F. TRANSFORMERS
LOOP ANTENNAS
R.F. TUNERS

yokes

BURTON BROWNE ADVERTISING

THIS IS NOT a TAFT-HARTLEY CIRCUIT BREAKER

Unique in the field of circuit protection equipment, **HEINEMANN** Circuit Breakers do not require a "cooling-off period." Immediately after correction of a fault, either short circuit or overload, **HEINEMANN** Circuit Breakers can be turned ON. There is no waiting for a thermal element to cool . . . no wasted production time . . . no reset procedure . . . just restore service by throwing the switch to the ON position.

NO WAITINC TO RESET . . . YET NEVER NUISANCE TRIPPING

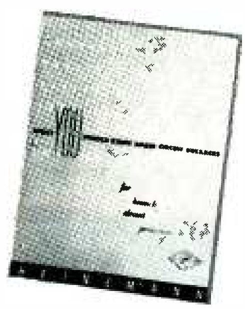
While there is no waiting to reset after tripping, **HEINEMANN** Circuit Breakers do provide time delay before tripping to allow for **temporary, harmless** overloads, thus avoid nuisance tripping. This allows for the initial inrush of starting motors and other equipment.

TIME DELAY FOR OVERLOADS . . . YET INSTANTANEOUS SHORT CIRCUIT PROTECTION

Beyond providing time delay for overloads, the hydraulic-magnetic operating principle of **HEINEMANN** Circuit Breakers differentiates between overloads and short circuits. **HEINEMANN** Circuit Breakers always trip instantly at ten times the rated current . . . providing the fast protection you must have for your wiring and equipment even at the low short circuit values.

KNOW THE FACTS . . .

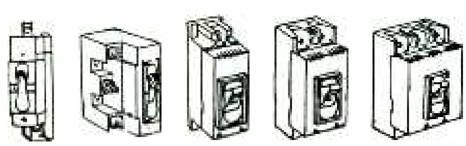
Send for this new informative booklet entitled, "WHAT YOU SHOULD KNOW ABOUT CIRCUIT BREAKERS." Ask for Manual 101 . . . no obligation, of course.



HEINEMANN ELECTRIC COMPANY

97 Plum Street • Trenton 2, N. J.

HEINEMANN Circuit Breakers



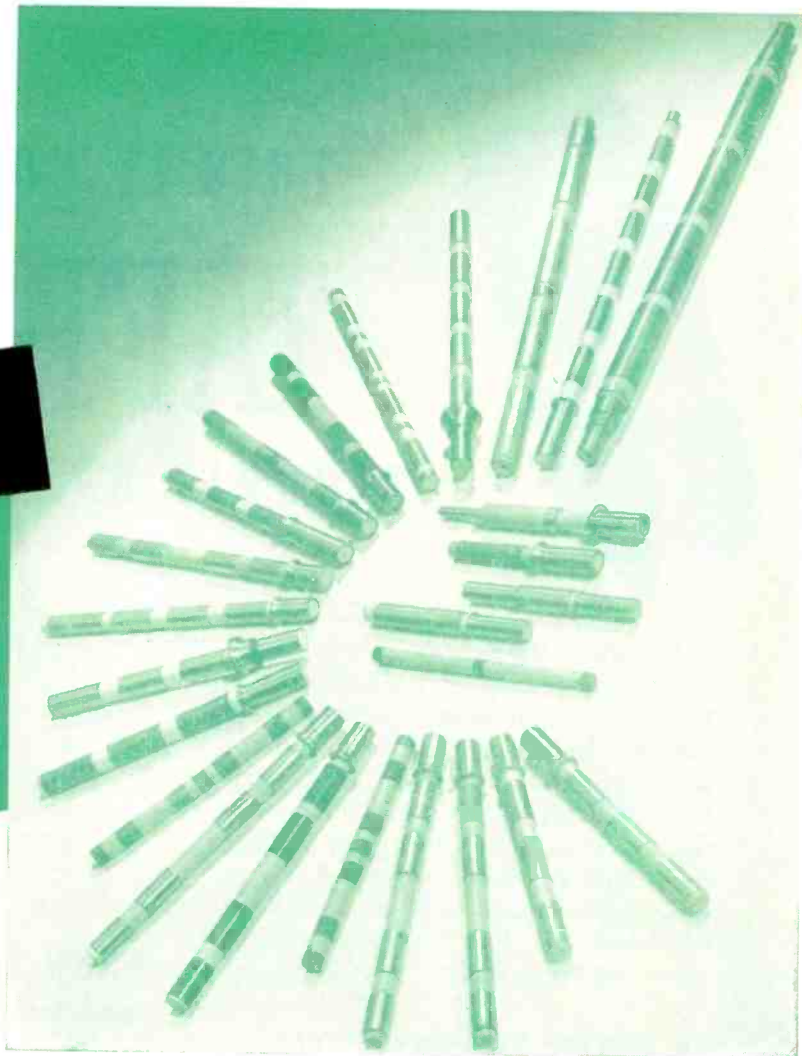
Heinemann Circuit Breakers. One, two and three pole. 10 milliamps to 100 amperes.

Simplify your production procedure with High-precision

Stupakoff

CERAMIC to Metal ASSEMBLIES

for Electrical and Electronic Applications

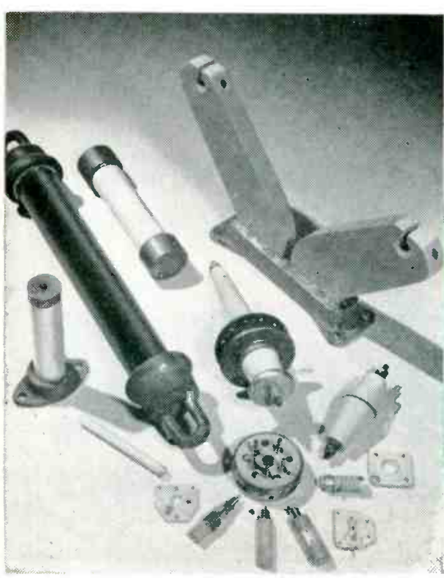


To combine ceramic and metal parts into one permanent unit, Stupakoff draws upon extensive experience with both materials. Methods of assembly employed by Stupakoff include: metallizing, soldering, pressing, spinning and others. Among the metals assembled to ceramics are silver, copper, brass, stainless steel and monel.

The rotor shafts shown above consist of metal bands attached securely to ceramic rods, and exemplify Stupakoff precision manufacture. On a mass production basis, concentricity of components, for example, are held to less than ± 0.001 in. Likewise, the strains and spreaders, stand-offs and trimmers shown below meet the exacting requirements of the service for which they are made.

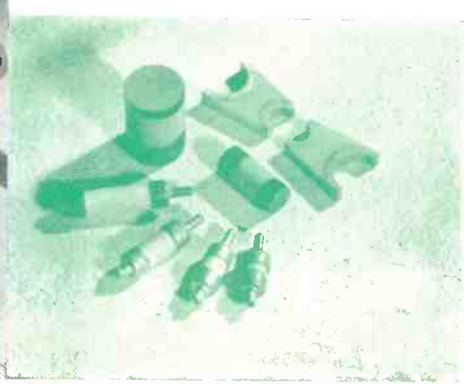
Stupakoff high-precision ceramic assemblies offer many opportunities to reduce costs, increase production and improve electrical and electronic equipment.

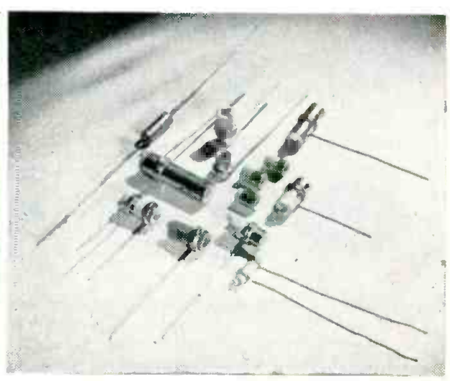
We will be glad to discuss your requirements with you and to submit samples for your inspection.



STUPAKOFF CERAMIC & MANUFACTURING CO.

LATROBE, PENNSYLVANIA





Ready for Your Circuit

Basic Foundation Components, Plug in, Connecting, Fastening Devices for the
ELECTRONIC CONTROL INDUSTRY

Making it possible to build quickly any electronic circuit into practical production design (you supply the circuit — we supply the components).

— by giving you basic components of tremendous flexibility which simplify layout time in production of your equipment.

— by providing you a technique to solve mechanical, space, connecting, interconnecting, fastening, sensing and indicating problems for you.

Giving you equipment that is easy to operate and maintain

— so that — with spares — your equipment never needs to be out of operation more than 30 seconds.

— so that non-technical personnel can set up, operate and maintain your equipment.

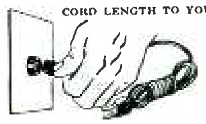
Suggestion to your Lab or Research Dept.

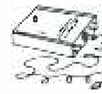
Numerous labs have seen the advantage of using Alden's components to build the particular pet circuits needed for the experimental or test circuits that they use over and over. It may be an assortment of unitized, plug-in power supplies, amplifiers, oscillators, modulators, connecting circuits, etc., to handle most any problem of research and experiment. With these on your shelf ready to plug in, you avoid using experimentally models that are completely unlike anything you'd use finally on equipment. Instead, you're using right from scratch units which illustrate directly what your final systems will be like: meeting production standards, servicing standards, appearance standards.

WORKING WITH "ALDEN'S HANDBOOK", THE DESIGN ENGINEER AUTOMATICALLY CREATES *PRACTICAL PRODUCTION DESIGN*, as follows —

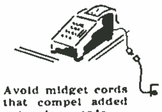
1. **Anything electrical or electronic usually operates with an *outside* source of power and may be connected to outside circuits.** So Alden provides for this with the efficient Detachable Line Cord for bringing in 110V AC power. Available in lengths to your specs for making a neat connection. Sure grip plug is self-piloting for quick mating.

   SEE "ALDEN HANDBOOK" PAGES 4A & B FOR COMPLETE DETAILS





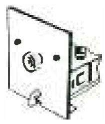
Avoid floorful of over-length cords.



Avoid midget cords that compel added extension cords.

2. **A great deal of equipment will have a front panel with such things as sensing controls, jacks for testing and fuseholders.** For this Alden provides a basic slide-in chassis with a detachable front and back panel so that rheostats, indicator lights, test jacks, interwiring, etc. are all easy-to-work subassembly operations.

   SEE "ALDEN HANDBOOK" PAGES PI-1E thru G FOR COMPLETE DETAILS



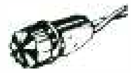
Front panel (various sizes) carries controls, indicators, sensing elements, with their interwiring.

Detachable front panel hinged giving accessibility for ease of assembly and servicing.

3. **Sensing Units — telltales that all is well or not — in simple indicator light — fuse holders that glow when blown — memory or pulse circuits including Static Magnetic Memory that sense — or command — or keep on repeating so that units or elements almost assume brain functions.**

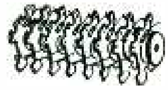
   SEE "ALDEN HANDBOOK" PAGES ES-5A & B; DL-5A & B; TE-3A & B; CG — all pages

Fuses that indicate when blown.



Indicator lamps always easily replaced so always functioning.

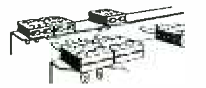
Insulated test point jacks for plate voltages up to 6,000V.



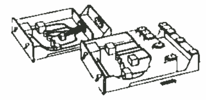
Plug-in Memory or Pulse Circuits.

4. **The telephone, telegraph, electric light companies have always brought the incoming circuits to a bus bar or terminal board so that the *incoming circuits* could *always* be checked at one point — and equipment connected not being condemned because of imperfect outside circuits.** So Alden provides in its Back Connectors and supporting Back Plates the one area in which all incoming circuits can be checked.

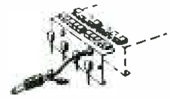
   SEE "ALDEN HANDBOOK" PAGES PI-2A & B; 4D FOR COMPLETE DETAILS



Alden Back Connectors, color coded, with accessible uncongested solder terminals — permit easy servicing and rapid circuit checks at central point.



Back Connectors permit direct efficient wiring — avoid conventional rat's nest wiring.



Back Connectors mount on Back Plate to give one point to check all chassis connections.

5. **The next problem is to house the components and have them do the electrical or electronic work required.** Any such circuitry will have certain main functions and branching from it other functions. Many of these functions can be layered—so circuits go direct from back connector to front panel. Alden provides: simple component mounting panels for putting any circuit in layers. (And incidentally such component panel simplify the thinking, should the circuits give sufficient volume to be printed.) So Alden has the Terminal Panel Boards to make equipment easy to lay out by putting any function in one plane—plus the unit cables of correct lengths with stripped ends ready for interconnecting the Terminal Panels.

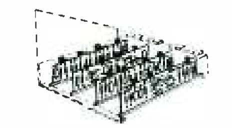
   SEE "ALDEN HANDBOOK" PAGES PI-1B thru D FOR COMPLETE DETAILS

Terminal Panel Board with all components mounted in one plane, and Alden Unit Cable for interconnecting all panel elements with leads.

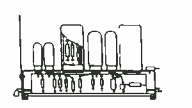
Layering of circuits using Alden Terminal Panels to segregate each main function and associate elements in one plane—for ease of assembly and check.

6. **Not all circuits can be a simple, straight circuit from back connector to front panel because there are auxiliary functions and branches that have to be in the main functions.** The usual chassis carries tubes, transformers and components that rise vertically from the chassis, often leaving vacant spaces. In these spaces can be placed the plug-in units which have these secondary circuits; using the plug-in technique usually removes the congestion of the wiring below the chassis, provides automatically for shielding and heat dispersion and yet gives you largest amount possible circuitry per cubic space, the circuits free from interaction.

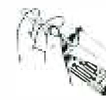
   SEE "ALDEN HANDBOOK" PAGES PI-1A thru H FOR COMPLETE DETAILS



Massing of essential electronic elements yet with efficient heat dispersion and freedom from interaction, in a Basic Chassis.



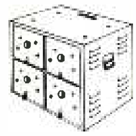
How Alden Terminal Panel groups main functions and how plug-in units have parallel functions for largest amount circuitry per cubic space.



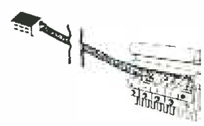
Alden "20" Packages house plug-in Units give independent shielding and heat dispersion.

7. **Again these techniques often lead to putting one function such as a power supply and amplifier on separate chassis and so the back connectors or the chassis itself may need interconnecting unit cables to either chassis or racks.** Alden provides sufficient variety of connectors to choose from—and designed so that any cable, no matter how involved, cannot be wrongly plugged in.

   SEE "ALDEN HANDBOOK" Sec. PC - Sec. MPS FOR COMPLETE DETAILS



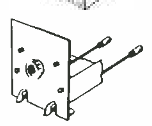
Separate chassis may be stacked in Alden Un-i-rack Cabinet. Cabinet can be interconnected within by Alden unit plug-in cables.



Alden Unit Cable — with variety of plug-in connectors. Carries wiring from chassis to chassis or rack to rack.

8. **To design so that no equipment — whether plug-in unit or slide-in chassis — needs to be out of operation for more than 30 seconds (having adequate spares on hand), Alden provides quick detaching and quick fastening devices for chassis.** The Serve-a-Unit locks that will move chassis against weight or the resistance of gaskets. There is the Target Screw (coin operated), a Tool-less screw—the Captive Screw which becomes part of the equipment.

   SEE "ALDEN HANDBOOK" PAGE PI-11 FOR COMPLETE DETAILS



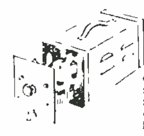
A turn of the Serv-a-Unit Lock handle—located in front panel—draws in unit against pressure—reverse turn ejects.

Alden Target Screw
The Toolless Screw

The Captive Screw, never lost.

9. **Government designers and those in the electronic control industry want elements of equipment so that they can be portably operated or tested, can be carried by one man with spares, parts easily sent by mail or airborne and also prefer that the same design equipment can be used in conventional racks.** Those designing for field operation use, at sea, prefer to have the equipment so it can be unloaded by two people, set up and immediately interconnected. This is provided by the Alden Basic Chassis using Back Connectors, Unit Cables and for the last purpose, the Uni-Rack which can be set on top of one another and immediately interconnected with each other.

   SEE "ALDEN HANDBOOK" PAGE PI-11 FOR COMPLETE DETAILS



Chassis in carrying or serviceman's case or case to house spare.

Same chassis fits in Uni-Rack Cabinet for field or permanent use. In field all elements can be connected as fast as you can unload them.

SEND FOR the Alden Handbook—your key to *practical production design*—with components already tooled—yet can be modified—ready for volume production without delays or procurement headaches.

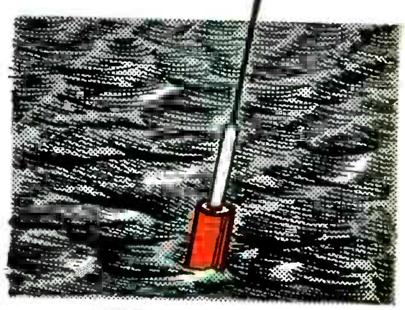
ALDEN PRODUCTS COMPANY 127 North Main Street, Brockton, Massachusetts

BURNELL AUDIO FILTERS clock the speed of the S. S. UNITED STATES

WE ARE PROUD TO ANNOUNCE THAT *ONLY* BURNELL & COMPANY AUDIO FILTERS WERE EMPLOYED IN THE HASTINGS INSTRUMENT COMPANY RAYDIST EQUIPMENT ABOARD THE S. S. UNITED STATES ON ITS RECORD SHATTERING RUN.

"Although the forces of nature combined to make the speed run AND the speed measurement extremely difficult, our raydist equipment using BURNELL filters surmounted all handicaps and exceeded specified accuracy", said Mr. Hastings.

WE ARE HAPPY TO ADD THIS TO OUR EVER INCREASING LIST OF TESTIMONIALS ON THE QUALITY OF BURNELL'S TOROIDS AND AUDIO FILTERS.



Exclusive Manufacturers of Communications Network Components

Burnell & Company
YONKERS 2, NEW YORK
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thinking in circles?

When you're about to order recording discs, do you begin to think in circles? Are you confused by claims of low cost, best lacquer, top quality? Then, consider PRESTO.

As America's pioneer producer of recording equipment and discs, PRESTO has brought its manufacturing process to the point where the PRESTO label is synonymous with perfection. Every step of disc production . . . the selection of the finest aluminum base . . . the exclusive lacquer flowing process, where the disc is untouched by human hands . . . the rigid inspection of each disc and the long curing process have set new standards in the disc industry.

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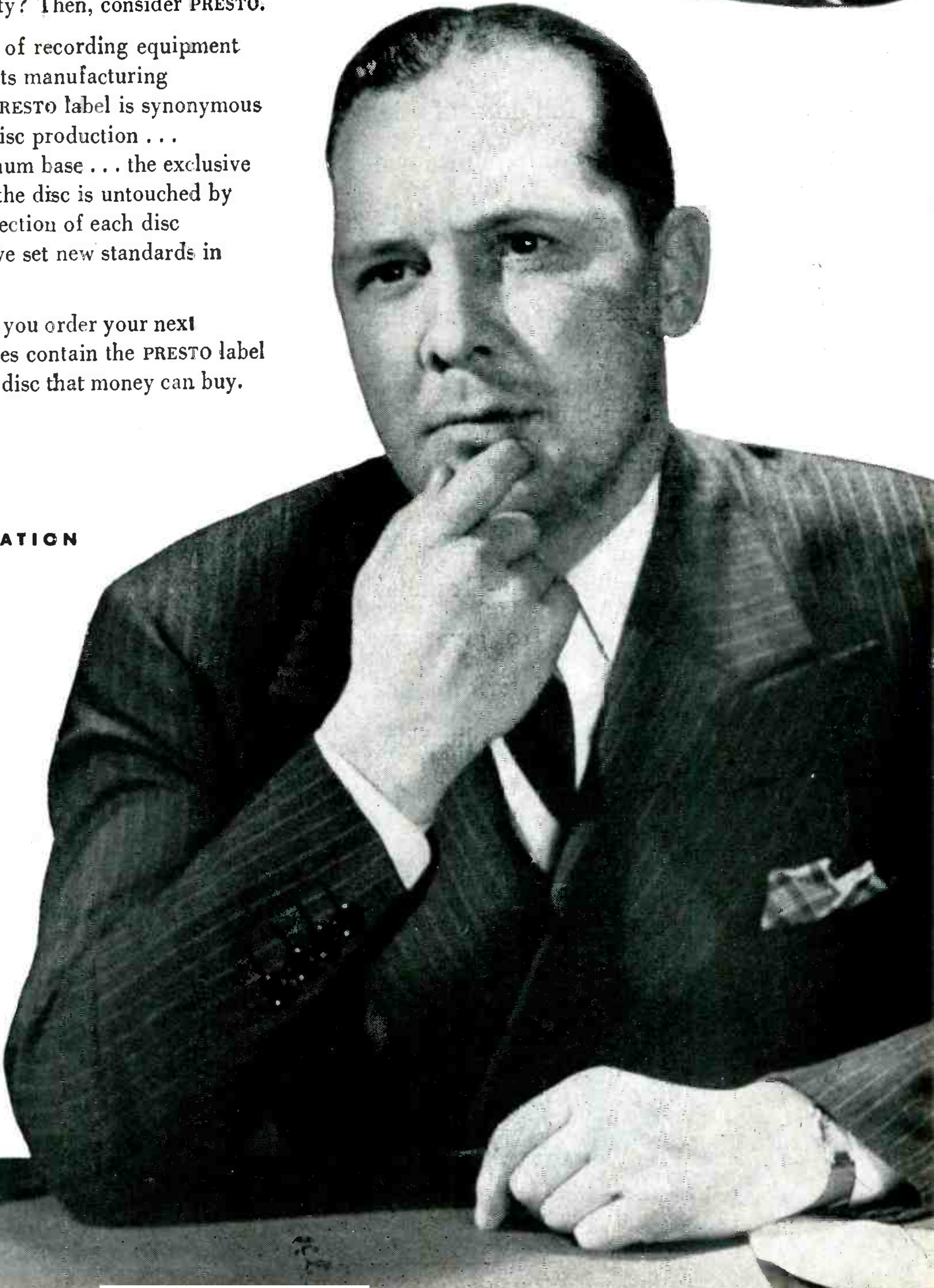

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EXPORT DIVISION:
25 Warren Street,
New York 7, N. Y.

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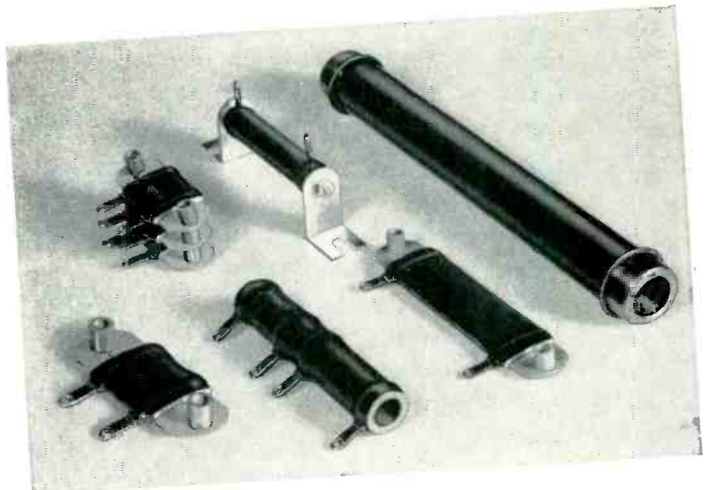
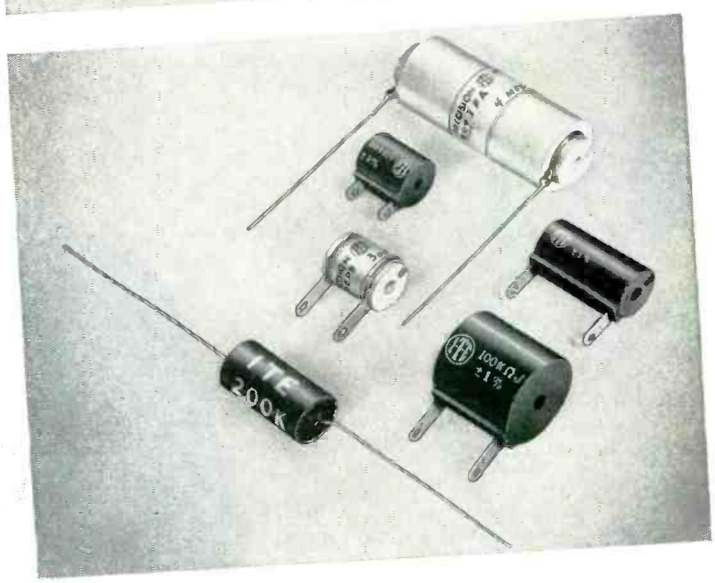
PRECISION-BUILT for

I-T-E

WIRE-WOUND COMPONENTS





Now you can get a full line of high quality wire-wound components—all from one reliable source. Specially designed to meet the exacting and changing requirements of the electronics industry, every I-T-E wire-wound product is precision-built by quality-controlled methods.

Whatever your wire-wound needs, it will pay you to investigate I-T-E quality products. They're made to give you long, accurate, dependable performance—in every critical electronic application.

specify I-T-E **WIRE-WOUND**

I-T-E RESISTOR

1924 HAMILTON STREET • PHILADELPHIA 30, PA.

dependable performance

I-T-E POWER RESISTORS

- **Non-hygroscopic ceramic foundations** are in accordance with JAN specifications.
- **Purest resistance wires** are uniformly wound to prevent shorted turns and excessive hot spots. All connections silver-soldered.
- **Vitreous enamel coating** (organic if required) provides a glazed moisture-repellent surface with fast heat-dissipation qualities.
- **Advanced production methods** assure high stability, long life.

Standard fixed resistors:
5-200 watts

Adjustable resistors:
10-200 watts

Oval resistors:
30-75 watts

Ferrule resistors:
12-200 watts

Special resistors:
built to specifications

Standard tolerance: ±10%. ±5% *and less* made to order.

I-T-E PRECISION RESISTORS

- **High quality wire alloys** are used—free from internal stresses and strains.
- **Automatic precision winding** assures even tension—eliminates hot spots.
- **Hermetic or vacuum-impregnated** sealing protects against destructive effects of salts, moisture, and atmospheric conditions.
- **Accelerated aging process** prior to calibration assures accuracy.
- **Critical quality control** eliminates all resistors which do not come up to high I-T-E standards.

TYPE A:
lightweight, hermetically sealed—for precision operation up to 125 C. Surpass JAN R-93 A, *Characteristic* A, and MIL R-93 A specifications.

TYPE B:
vacuum-impregnated, moisture-resistant. For JAN R-93, *Characteristic* B, specifications.

Ratings from 0.01 ohm—10 megohms, 0.125—5 watts.

Standard tolerance: ±1%. Available in specified tolerances down to ±0.05%.

I-T-E DEFLECTION YOKES

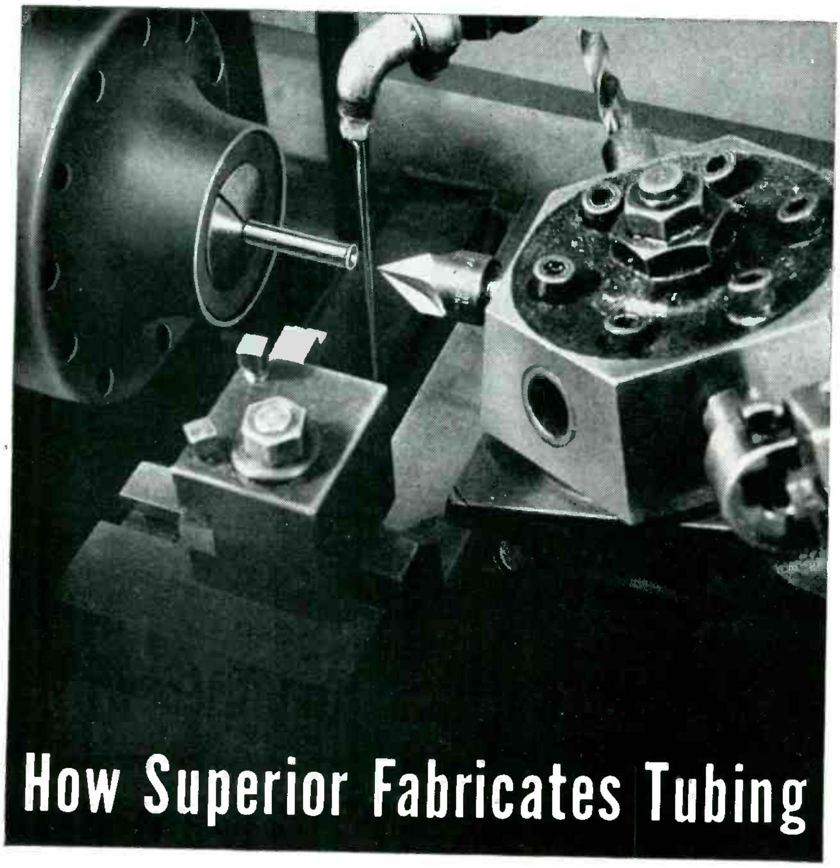
I-T-E offers you high quality deflection yokes—all built with uniform characteristics. Wire size and quality are constantly checked. Coils are impregnated in special moisture-resistant thermoplastic—properly cured to insure a firm coil with minimum losses. Deflection yokes can be obtained complete with wire leads, resistors, and capacitors—to your specifications.

FOR DETAILS—
get in touch with your nearest I-T-E representative. Or, send for your copies of the I-T-E *Power Resistor Catalog* and the new *Precision Resistor Bulletin 100A* today.

RESISTOR PRODUCTS

DIVISION

A DIVISION OF THE I-T-E CIRCUIT BREAKER CO.



to give you the parts you need

Need a tubular part machined, inside or out, at one or both ends?

Like to have it drilled transversely at one or several points?

Want it to meet rigid dimensional and metallurgical specifications?

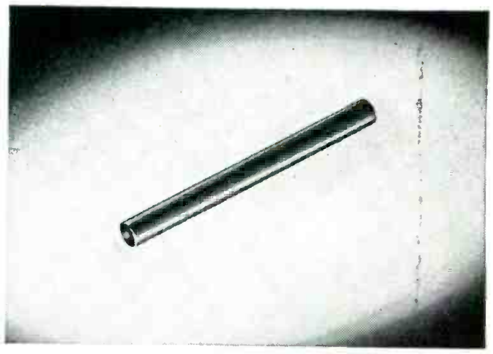
You're reading the right advertisement for all of these are Superior Specialties.

Superior has the experienced men, the specialized, highly developed equipment, the floor space, and the research facilities to produce quantities of drilled and machined tubular parts rapidly and economically.

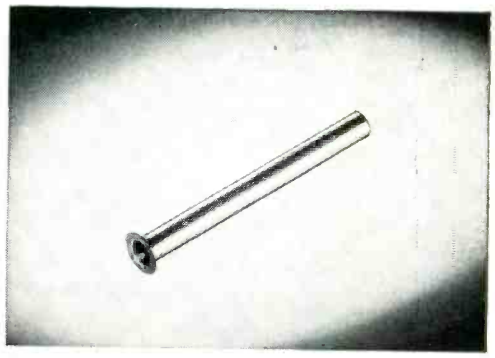
It's a job we like to do and know how to do. But there's more to the story than simple production of fabricated or semi-finished parts, or even top-quality tubing in any analysis and many sizes.

The rest of the story is our willingness, desire and ability to work closely with customers' development engineers and product designers. Frequently we are able to materially assist in design of parts, selection of analysis, and development of processes. Many times we have been able to suggest minor changes in shape or method to effect major economies in assembly time and product cost.

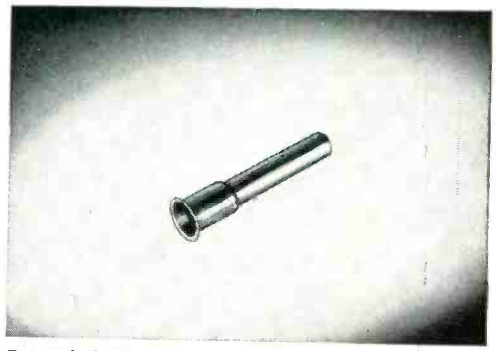
If you are a manufacturer or an experimenter in electronics and have a need for a tubular part of any kind, check with us. We can probably help by giving you quantity production of the parts you need. Write Superior Tube Company, 2500 Germantown Ave., Norristown, Pennsylvania.



Cut and Annealed. Extensive cutting equipment, hand cutting jigs, electronically controlled annealers and other equipment, much of it developed within our own organization results in high speed, precision production of parts.



Flanging. Automatic flaring and flanging machines are combined in Superior's Electronics Division with carefully trained production and inspection personnel who know how to do a job right and take the time to be sure.



Expanded. Here is a part almost ready for delivery. Simple as it looks, it may well have been the subject of a score of operations and at every stage the prime consideration has been the *quality* of the finished part.

This Belongs in Your Reference File

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NICKEL ALLOYS FOR OXIDE-COATED CATHODES: This reprint describes the manufacturing of the cathode sleeve from the refining of the base metal. Includes the action of the small percentage impurities upon the vapor pressure, sublimation rate of the nickel base; also future trends of cathode materials are evaluated.

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All analyses .010" to ⅝" O.D.

Certain analyses (.035" max. wall) Up to 1⅛" O.D.

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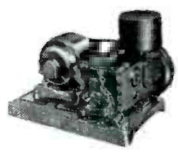
VACUUM FACTS

It's a **FACT** . . .

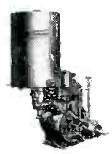
. . . Kinney originated the rotating plunger vacuum pump . . . universally acclaimed for fast pump down and quick recovery.

It's a **FACT** . . .



. . . Kinney pioneered the oil-sealed pumping system.

It's a **FACT** . . .

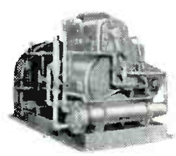


. . . Kinney is the BIG LINE of mechanical vacuum pumps . . . more models, more sizes, more capacities to choose from.

It's a **FACT** . . .

. . . Only Kinney offers in such a wide range both single stage and compound vacuum pumps — for creating and maintaining low absolute pressures alone or with diffusion pumps.

It's a **FACT** . . .



. . . More vacuum processes depend on Kinney Vacuum Pumps than on any other make or type of pump.

Find out for yourself how Kinney Vacuum Pumps can help in your low pressure processes — in laboratory, pilot plant, or production.

Send coupon or write for details.

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Please send new Bulletin V-51B. Our vacuum problem involves:

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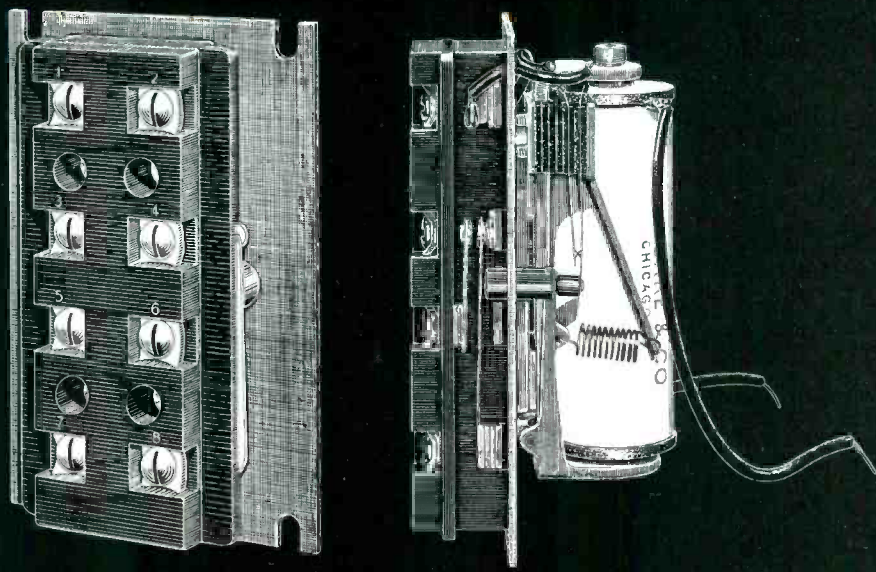
IT PAYS TO

Bring your relay problems to CLARE



Front View

Side View

CLARE Type "CP" POWER RELAY

• Some of the most important relay developments of the past decade have been the result of CLARE cooperation with engineering staffs of acknowledged leaders in the electrical and electronic industries.

Development of the CLARE Type CP Power Relay, for instance, came about from a consultation with a large electrical manufacturer who uses power relays extensively in the manufacture of various electronic control units. This CLARE customer objected to the use of ordinary power relays in plate circuit applications because one watt or more was required to operate them. Also, this necessitated the use of a high-current thyratron tube, or the interposition of another, more sensitive relay. He wanted a power relay sensitive enough to operate in the plate circuit of any triode, including miniatures.

Years of satisfactory service from CLARE telephone-type relays had convinced the customer's engineers that the best way to achieve this would be to adapt these sensitive, dependable, durable relays to suit the special requirements of their use as power relays. Valuable contributions to the design of the CLARE Type CP Power Relay were made by the customer's engineers.

The result of this cooperation between these engineers and the CLARE engineering staff is a relay which simplified control equipment, saves money and space, and will outwear several ordinary power relays.

CLARE engineers, both in the field and in the plant, are anxious and willing to cooperate with you and your engineers to solve perplexing relay problems. Call the nearest CLARE office or write: C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable Address: CLARELAY.

CLARE RELAYS

First in the Industrial Field

VOLTAGE REGULATED POWER SUPPLY

MODEL 700

The Kepco Model 700 features one regulated voltage supply with excellent regulation, low ripple content and low output impedance.

SPECIFICATIONS

OUTPUT VOLTAGE DC: 0-350 volts continuously variable.

OUTPUT CURRENT DC: 0-750 milliamperes continuous duty.

REGULATION: In the range 30-350 volts the output voltage variation is less than ½% for both line fluctuations from 105-125 volts and load variation from minimum to maximum current.

RIPPLE VOLTAGE: Less than 10 millivolts.

FUSE PROTECTION: Input and output fuses on front panel. Time delay relay is included to protect rectifier tubes.

POWER REQUIREMENTS: 105-125 volts, 50-60 cycles.

OUTPUT TERMINATIONS: DC terminals are clearly marked on the front panel. Either positive or negative terminal of the supply may be grounded. DC terminals are isolated from the chassis. A binding post mounted on the front of the panel is available for connecting to the chassis. All terminals are also brought out at the back of the chassis.

METERS:
Ammeter: 0-1 ampere, 4" rectangular.
Voltmeter: 0-500 volts, 4" rectangular.

PHYSICAL SPECIFICATIONS: Cabinet height 22¾", width 21¾", depth 15¼". Rack panel height 21", width 19", color gray, panel engraved.

CONTROLS: Power on-off switch, H.V. on-off switch, H.V. control.

FOR NEW POWER SUPPLY CATALOG — WRITE DEPT. #1

ADDITIONAL MODELS AVAILABLE IN THE 700 SERIES VOLTAGE REGULATED POWER SUPPLIES

Volts	Current	Model
0-350	0-0.75 Amp.	700
0-350	0-1.50 Amp.	710
0-350	0-2.25 Amp.	720
0-350	0-3.00 Amp.	730
0-600	0-0.75 Amp.	750
0-600	0-1.50 Amp.	760
0-600	0-2.25 Amp.	770
0-600	0-3.00 Amp.	780

KEPCO LABORATORIES, Inc.

131-38 SANFORD AVENUE FLUSHING 55, NEW YORK

If it uses gas, it can use SYNTHANE

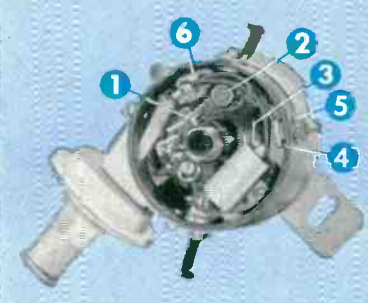
"I like to stand at the corner of Market and Main in my home town," one Synthane representative tells us, "and watch the traffic on a Saturday afternoon."

"There are our customers on parade . . . anything that uses gas—passenger cars, trucks, fire engines, motorcycles . . . Joe Zink's tractor . . . even the gas pumps at Eddie's service station use parts made from Synthane laminated plastics."

The reason is plain. When America turns on the ignition key it expects to go places. Back of this confidence are components.

Reliable components have to be made from dependable materials. Synthane is such a material. So you find it in water pumps because it makes a good seal washer, in differential thrust washers because of its wear resistance, in power steering for its light weight and rigidity, in starting and lighting equipment because it is an excellent electrical insulator and machines like a breeze.

Synthane might be a material you can use. The Synthane Catalog will help you decide. Send for your copy. Synthane Corporation, 6 River Road, Oaks, Penna.



Auto-Lite distributor uses laminated plastics in 6 places. (1) and (2) insulating angle and bushing on breaker arm (3) condenser seal washer, (4), (5), (6) insulating washers.

Synthane-one of industry's unseen essentials

SYNTHANE

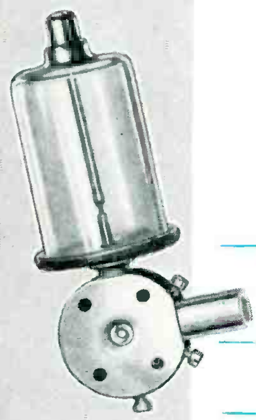
S

LAMINATED PLASTICS

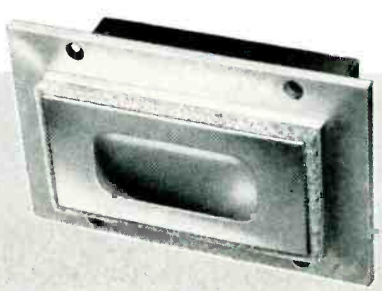
Bomac FOR GAS SWITCHING TUBES

TR, ATR, PRE-TR, HYDROGEN THYRATRONS CRYSTALS AND MICROWAVE COMPONENTS



BAND	FREQ.	DESCRIPTION	TYPE
K BAND	23630-24580	TR, Integral Cavity, Tunable	1B26
	23500-24500	ATR, Fixed-Tuned, Low Q	1B36
	23350-24950	TR, Band Pass	BL-11
X BAND	9300-9450	Cross Guide Duplexer	BL-3
	9050-9600	ATR, Fixed-Tuned, Low Q	1B35
	9050-9600	ATR, Fixed-Tuned, Low Q Fast Recovery Time	6038
	8750-9300	ATR, Fixed-Tuned, Low Q	ATR388
	8600-9650	TR, Glass Envelope, Fixed-Tuned	724B
	8600-9050	ATR, Fixed-Tuned, Low Q	1B37
	8490-9600	TR, Integral Cavity, Tunable	1B24A
	8490-9600	TR, Integral Cavity, Tunable	1B60
	8490-9578	TR, Band Pass	1B63A
	8490-9600	TR, Integral Cavity, Tunable Reservoirless	BL-22
Xb BAND	6200-6700	ATR, Fixed-Tuned, Low Q	1B51
	6000-7100	TR, Integral Cavity, Tunable	1B50
S BAND	3550-3700	ATR, Fixed-Tuned, Low Q	1B52
	3400-3550	ATR, Fixed-Tuned, Low Q	1B53
	3300-3700	Pre-TR	1B54
	3250-3400	ATR, Fixed-Tuned, Low Q	1B57
	3100-3650	TR, Band Pass	1B55
	3000-3100	ATR, Fixed-Tuned, Low Q	5793
	2900-3000	ATR, Fixed-Tuned, Low Q	5792
	2870-3230	TR, Band Pass	5853
	2800-2900	ATR, Fixed-Tuned, Low Q	1B56
	2750-2850	ATR, Fixed-Tuned, Low Q	ATR387
	2700-3400	TR, Glass Envelope, Tunable	1B27
	2700-3300	TR, Glass Envelope, Fixed-Tuned	1B62
	2700-3300	TR, Glass Envelope, Fixed-Tuned	721B
	2700-2800	ATR, Fixed-Tuned, Low Q	1B44
	2650-2950	Pre-TR	1B38
	2600-3000	TR, Band Pass	1B58
	2600-3000	TR, Band Pass Pressurized System	6117
L BAND	1215-1355	TR, Glass Envelope, Tunable	BL-25
	900-1200	TR, Glass Envelope, Fixed-Tuned	1B23
	1075-1095	TR, Fixed-Tuned, Electrodeless Discharge	1B40
Ku BAND	16,200-16,800	ATR, Fixed-Tuned, Low Q	BL-15
	16,200-16,800	TR, Integral Cavity, Tunable	BL-16
SPARK GAP MODULATORS			1B41
			1B45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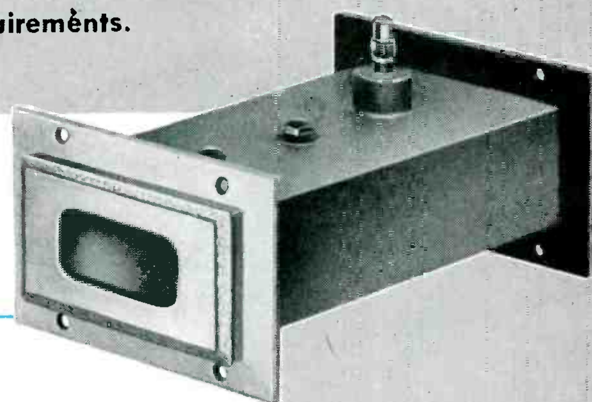
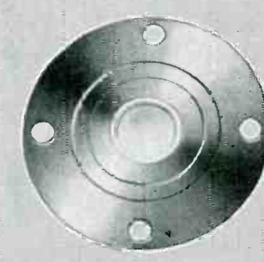


HYDROGEN THYRATRONS

Type	Peak Anode Voltage	Peak Anode Current	Average Anode Current	Peak Trigger Voltage
	kv max.	amps max.	ma max.	volts min
3C45	3.0	35	45	175
4C35	8.0	90	100	175
5C22	16.0	325	200	200



PRESSURIZING WINDOWS

TYPE	FREQUENCY	DESCRIPTION
BL105	9375	Pressurizing Window RG 51/u Guide
BL106	9245	Pressurizing Window RG 52/u Guide
BL107	9310	Rectangular Window RG 51/u Guide
BL114	9310	Pressurizing Window RG 52/u Guide
BL112	9080	Pressurizing Window RG 52/u Guide

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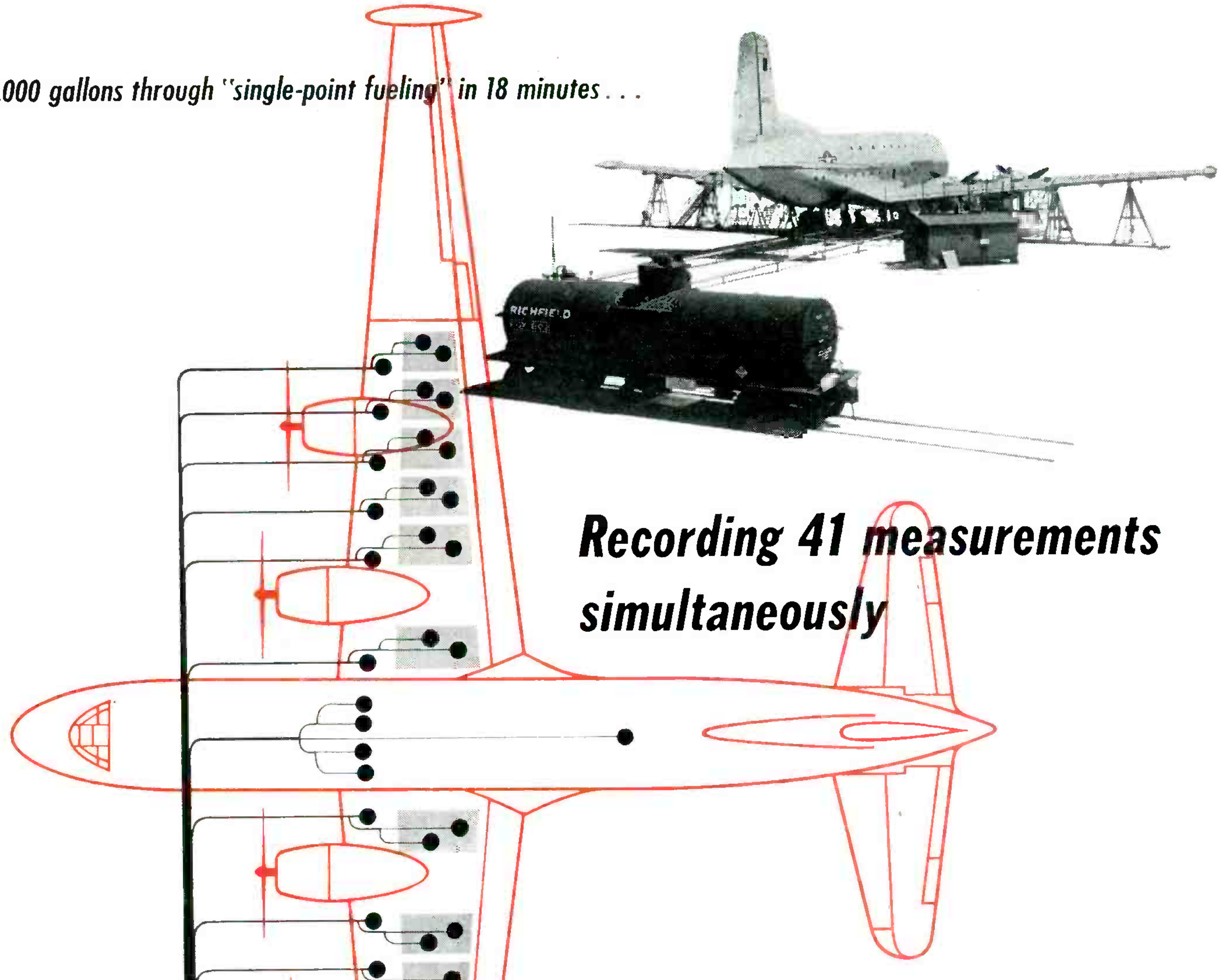
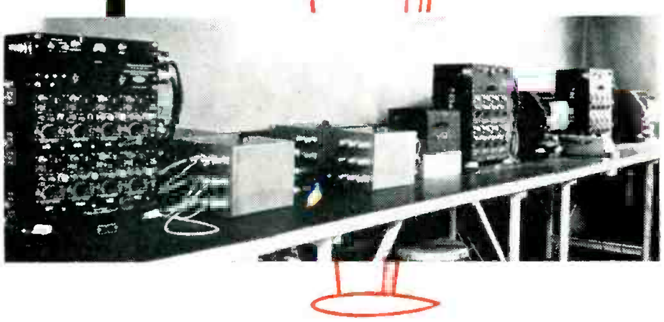


Recording 41 measurements simultaneously



DOUGLAS, Long Beach Division, engineers used CEC Dynamic Recording Equipment to test the new "Single-Point Fueling" system for the C-124 Globemaster. The 12 fuel tanks, 6 in each wing, hold approximately 11,000 gallons—equal to a full tank car. Fueling normally requires 4 to 5 hours. The new system cuts this time to 18 minutes by pumping through a single entry at 600 gpm, filling all 12 tanks at once.

By using three CEC 5-114 Recording Oscillographs and five sets of System "D" amplification (shown at left), Douglas was able to simultaneously record all tank inlet pressures, tank internal pressures, manifold pressures, tank shut-off time, pressure drop through the main inlet nozzle, and the fuel level in each tank. In all, the findings of 29 pressure pickups and 12 capacitance fuel gages were recorded.

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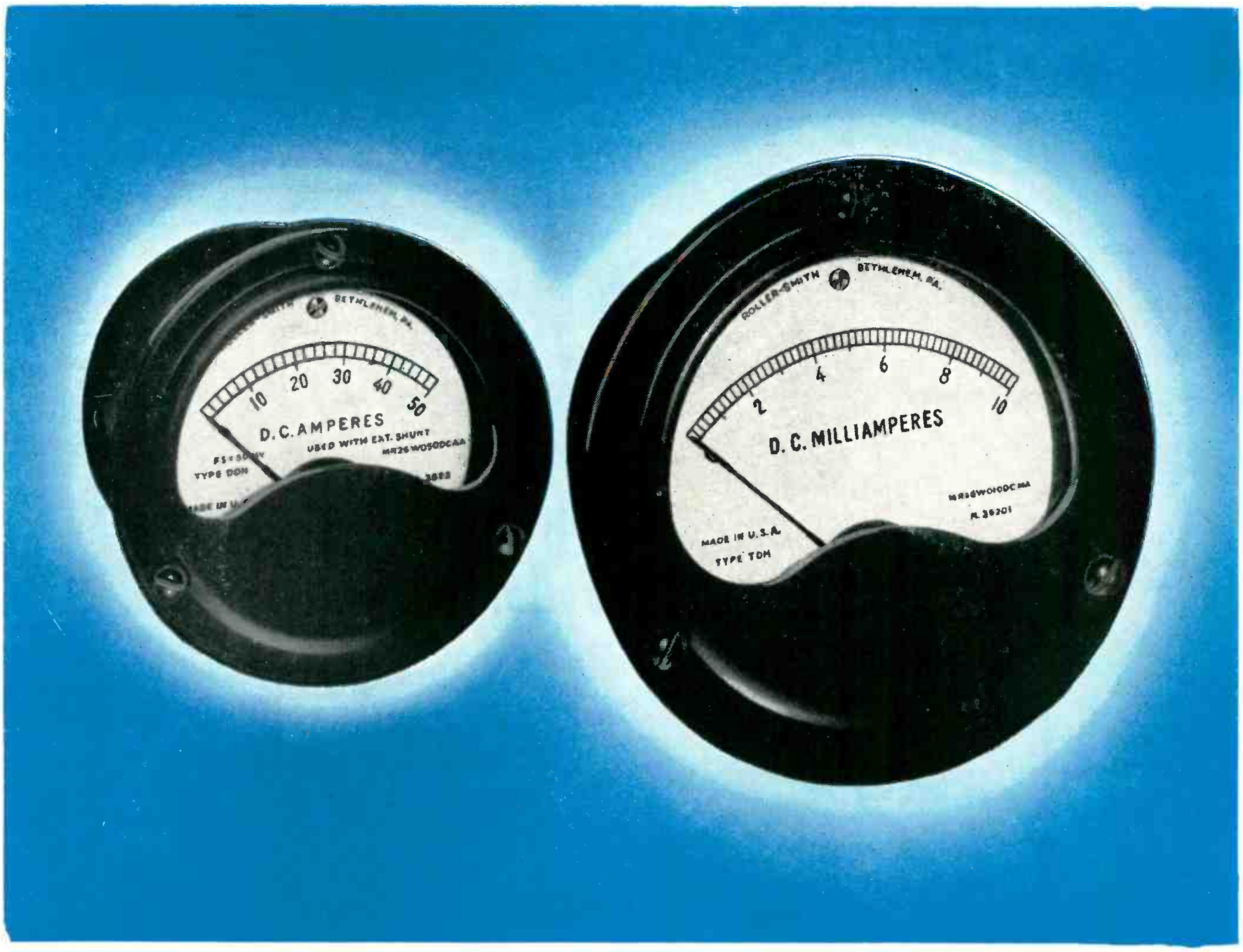
Dynamic Recording Systems

such as the one shown here are designed and manufactured by Consolidated. Variations in the arrangement of the equipment are infinite. Applications are widely varied throughout industry and the sciences. A typical recording system includes pickups, amplifiers or bridge balances, and a recording oscillograph. Write for Bulletin CEC 1500B.



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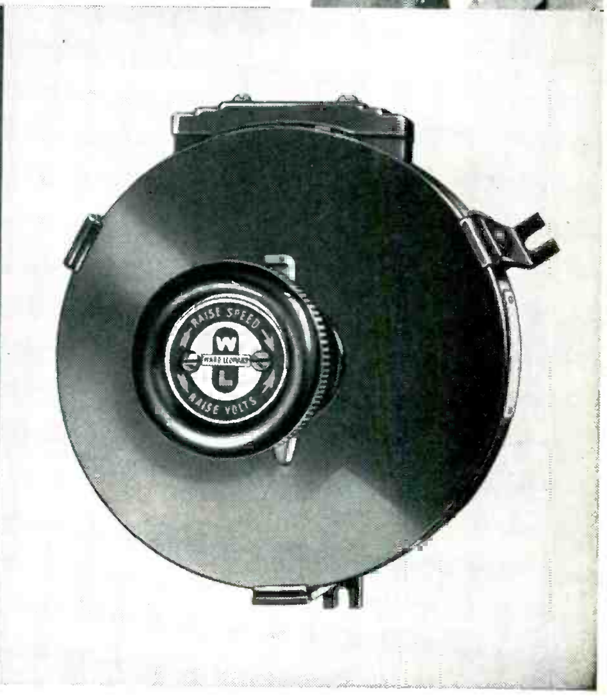
The Electric Candy Floss Machine Co.

"A pink cotton candy machine rheostat must provide exact temperature control"

says John G. Pettyjohn, John G. Pettyjohn Company, Knoxville, Tennessee, representative for Ward Leonard Electric Company.



Spinning sugar into fine, fluffy floss for pink cotton candy requires precise heat control. Unless a high degree of heat is closely controlled, candy becomes too thick or too thin. Since these machines are used at circuses, traveling carnivals, resorts, and similar places, machines must be ruggedly built. They must also be able to compensate for variance in voltage and surrounding temperature, depending upon the location.

The Electric Candy Floss Machine Company, Nashville, Tenn., uses Ward Leonard VITROHM plate rheostats in the heater circuits on the spinner heads of their new super deluxe candy floss machines for two reasons:
(1) VITROHM rheostats are the only rheostats they have found that would stand up and give good service,
(2) they are able to get a much better grade of candy.

Ward Leonard rheostats are available in several multiples of resistance values to meet various operating conditions. Special purpose rheostats requiring non-standard values and tapers can also be supplied.

Our engineering department is always ready to work with you to design the most economical rheostat for your particular application. Write for Rheostat Bulletin 60A.

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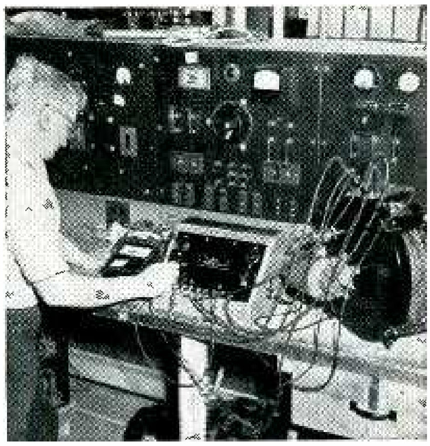
Result-Engineered Controls Since 1892

ERICK SCHNEIDER, a company employee for over 23 years, operates a hydraulic press for securing the bushing assembly to the rheostat base plate.



MOTOR-DRIVEN RHEOSTAT undergoes a thorough electrical test prior to final inspection. Ian Scott, a company employee for 17 years, is the electrical tester.

VITROHM rheostat construction assures smooth, precise control and long life

Five features of VITROHM rheostat construction important to efficient operation are:

(1) Pressed steel plate forms a rigid, durable, but lightweight base.

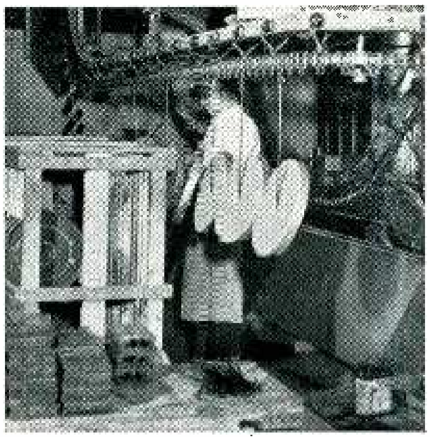
(2) Resistance element of special alloy wire, of low temperature coefficient of resistance assures permanent resistance values.

(3) Stationary contacts are solidly anchored to the resistance element by a patented Ward Leonard process assuring a perfect junction.

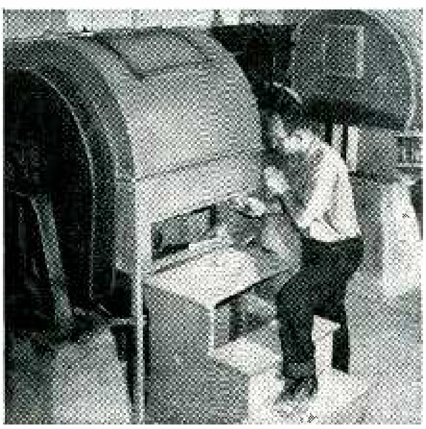
(4) Movable contact is made of solid metal graphite having self-lubricating properties for smooth operation.

(5) VITROHM insulation applied over the resistance wire holds the wire and contacts in place and protects them against corrosion, mechanical damage.

Consult Ward Leonard on the adaptability of standard or modified electric controls to meet your particular needs.



HEAT-RESISTANT FINISH is automatically applied and infrared baked. Arthur Vasold removes finished plates and loads sandblasted plates on continuous conveyor.



REVOLVING BALL MILLS grind the frit to the exact fineness needed to produce the perfect vitreous enamel used in the manufacture of the VITROHM rheostat.

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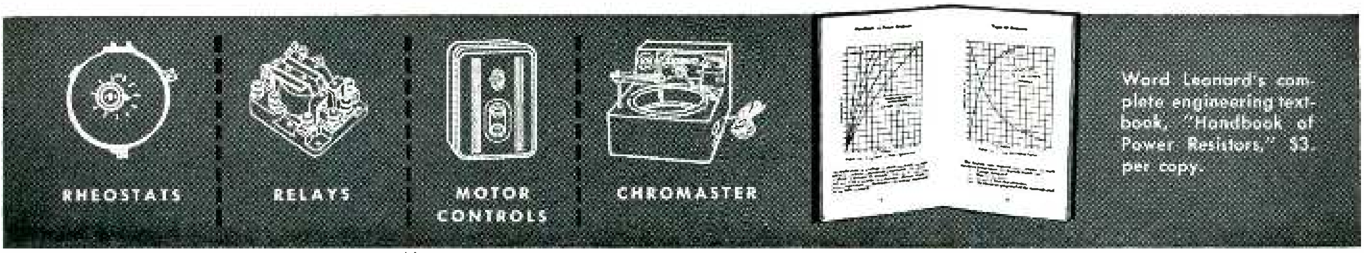

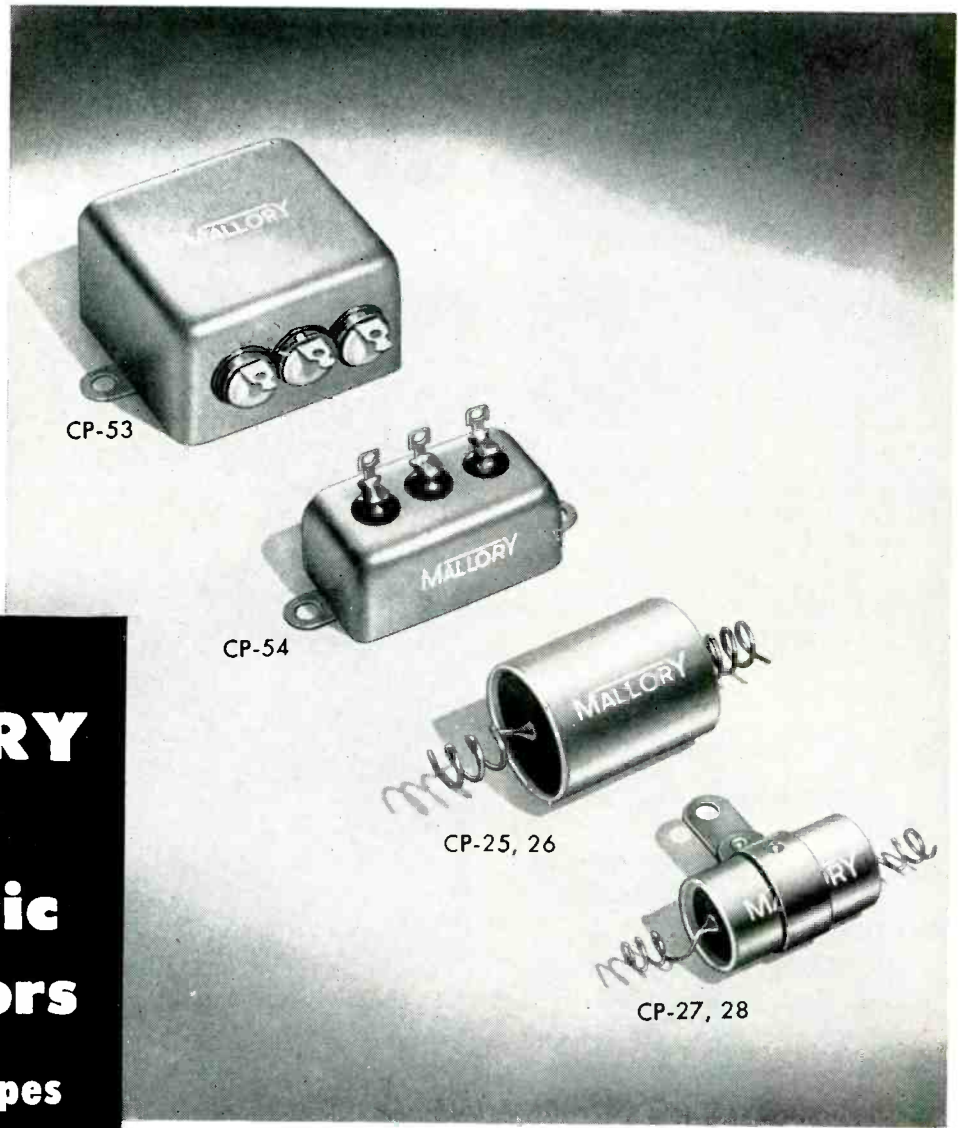

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JAN-C-25 types

For use in military electronic equipment, Mallory manufactures a line of paper dielectric capacitors which will conform to Characteristic E of Specification JAN-C-25. Included in the Mallory line are the following types:

CP-25, CP-26, CP-27, CP-28
CP-29, CP-53, CP-54, CP-55

Into these military-type capacitors go the same engineering know-how and production craftsmanship which have made Mallory capacitors the standard of quality in the industrial and electronic fields. They are now in quantity production and your inquiry will receive prompt attention.

Look to Mallory for all your capacitor needs . . . whether for military or civilian applications.

New Folder Describes JAN-C-62 Capacitor Types

In addition to paper dielectric capacitors Mallory produces a full line of electrolytic capacitors conforming to JAN-C-62. Write for your copy of the new Technical Information Bulletin. It is an ideal reference for everyone who uses or specifies electrolytic capacitors.

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CROSS TALK

▶ **COLOR** . . . Lifting of the freeze gave the television industry a shot in the arm that will keep it very much alive and kicking for many years. And when the rejuvenated body again begins to slow down along will come more adrenalin in the form of color; there may even be a modest injection before the arteries show serious signs of hardening.

It now seems certain that when color comes again it will be compatible. People who have monochrome sets will be able to watch programs transmitted in color without buying accessories. They will, of course, see these programs in monochrome. If they want to see color programs in color they will probably buy a new set. And there is no reason to suppose that this necessity will be widely resented. People always have been willing to spend more money for more service, in this and every other business.

Already several companies operating tv stations are quietly air-testing compatible color on their own hook. There are still some bugs but these appear to be minor. Next step will be coordination of test results and proposal of just about universally approved standards to the FCC.

The second coming of color should please the public, the government and the industry, in timing as well as in result.

▶ **TURNABOUT** . . . Sooner or later, export business will once again become as important to American manufacturers of electronic equipment as it was before the war and subsequent domestic shortages. When this time comes, much of our ability to sell merchandise abroad will depend upon how many dollars foreign customers can scrape up. And this, in turn, will depend largely upon what they can sell us to get the necessary exchange.

Exports are inevitably tied to imports. Countries that facilitate one kind of business are very likely to get the other.

▶ **HANDICAP** . . . Speaking of imports, several firms selling European-made electronic equipment in the U. S. tell us it is not the easiest job in the world to secure Underwriters' approval. Checking, we find that this is true. Foreign equipment is gone over with a particularly critical eye, and this process takes time and costs money.

We can think of several reasons why charity, if any, might begin at home when equipment is examined for possible fire hazards. But there is one aspect of the inspection routine which seems almost too pat. Equipment hooked up with European-made wire is generally disapproved; foreign manufacturers apparently have to buy our insulated wire if their gear is to receive the seal of approval.

It seems very curious indeed that insulated wire made in Europe should seemingly have at least two strikes against it before coming to bat. Surely all of the wire made overseas is not as bad as that.

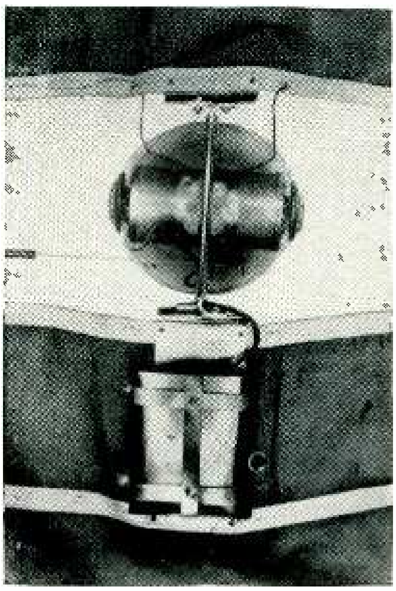
▶ **NAMES** . . . "Reliable" tubes have now become "military" reliable tubes, "commercial" reliable tubes and "electronic industry" reliable tubes. There are also "reliable-rugged" tubes.

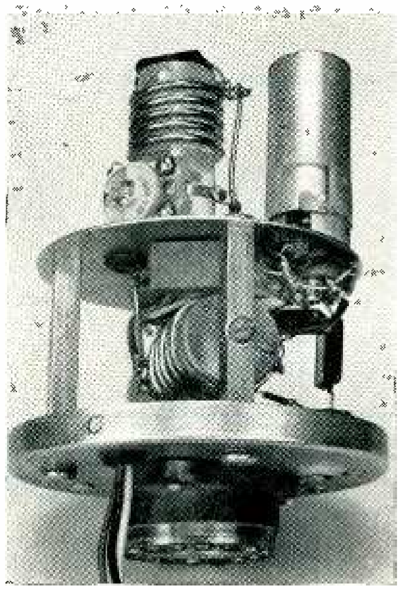
A reliable tube may or may not be ruggedized, depending upon whether it has been engineered to withstand extreme shock or vibration. A ruggedized tube may or may not be reliable other than with respect to its ability to withstand shock or vibration.

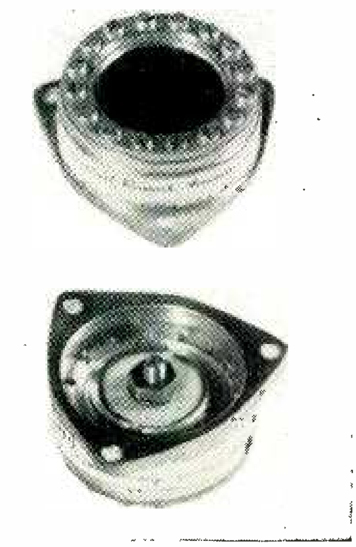
All this trick terminology is very confusing. In the end it is the same old story of picking the right tube for the right job and then using it in the right way.

▶ **UP** . . . Business is good with ELECTRONICS. So we are ploughing more and more material into the book for the reader.

This issue contains 22 (count 'em) feature articles, plus expanded departments. We think it really covers the waterfront in our fast-moving field and hope you do too.







Construction details of transmitters and microphones used in target to detect misses. At left is complete two-microphone transmitter unit mounted in plastic ball set into window of airborne flag target. Battery case is below sphere, and the two antenna wires are woven through the flag. Center—closeup of one transmitter, with microphone mounted under its base. Right—details of rugged capacitor microphone used, having extremely close spacing of diaphragm from case to get high sensitivity

Acoustic Firing Error Indicator

By MARCUS C. ELIASON*

Hughes Aircraft Co.
Culver City, Calif.

and W. G. HORNBOSTEL*

International Research Associates
Santa Monica, Calif.

AIRBORNE TARGETS used to simulate a plane have been chiefly flags, sleeves or gliders towed at the end of several thousand feet of cable by a special towing plane.

The number of actual target hits which can be made in training on such targets is an extremely small fraction of total rounds fired.

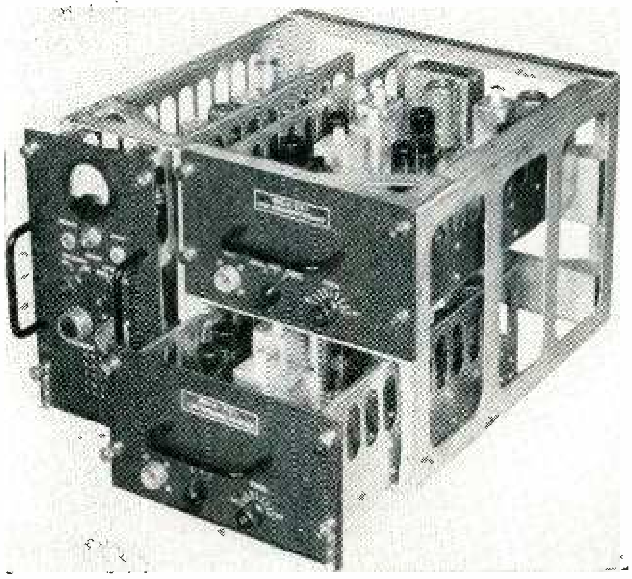
The firing error indicator described gets training value from misses by indicating errors of aim directly to the marksmen both in ground-to-plane and plane-to-plane shooting at airborne targets. It came as the result of certain ideas originating with members of the staff of the California Institute of Technology who had witnessed Army target practice in connection with other war research work, so that their attention was forcibly called to the existence of the problem. The idea was carried through development and production stages at Caltech during World War II under NDRC contract OEM sr 600.

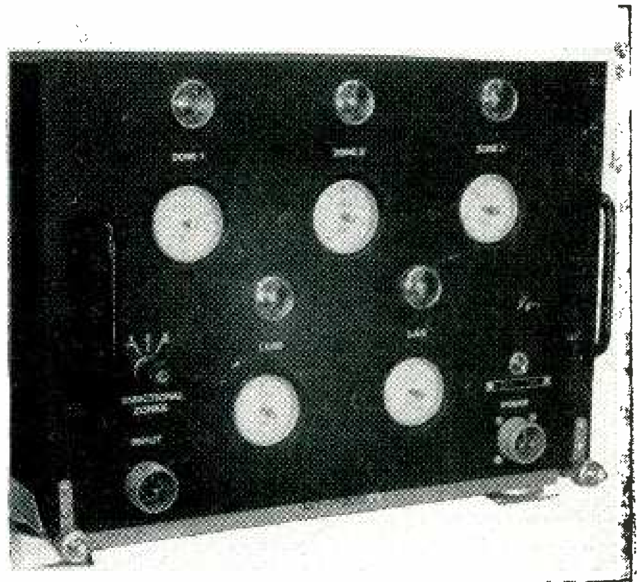
* Formerly with Air Associates Inc., Teterboro, N. J.

As long as their speed relative to the air mass substantially exceeds the speed of sound, projectiles send out from their trajectories acoustic waves known as ballistic shock waves. The intensity of the ballistic shock waves existing at a given point in the air is a characteristically diminishing function of the distance from the trajectory. In the firing error indicator, two microphone-and-transmitter units are mounted in the airborne target and linked by radio with a radio receiving station near the gun. The target-borne units send quantitative signals to that station indicative of the intensity of the shock waves from the bullets as they pass in the vicinity of the target. These signals are interpreted at the receiving station by automatic means as projectile distance and direction from the target for each miss or hit.

Two f-m receivers placed near the gun detect the radio signals and convert the frequency modulation into brief audio voltage pulses proportional to the response of the microphones to the shock wave. These pulses are suitably amplified and pulse-lengthened to give visual indications and permanent records. Since the radio-frequency excursion from the carrier value corresponds to shock wave amplitude, the telemetered measurement is independent of transmission conditions so long as the input signal level is sufficient for limiter saturation.

The two pulse-lengthened audio signals, proportional to the responses of the two microphones, are electrically added to form the sum response, which is taken as a measure of the miss distance. The difference in time between the two microphone signals is taken as an indication of the side of the trans-





Receiving and indicating equipment used either at ground location or in accompanying observation plane. Three-chassis unit contains the two receivers one above the other, with the computer chassis at their left. Indicator is separate unit, shown at right. Computer adds the two audio output signals to get miss distance in three zones on upper three counter dials, and subtracts for direction of miss, shown on lower two counter dials as count of lead and lag shots

Microphones at opposite ends of plastic sphere in towing-sleeve target respond to ballistic shock waves and modulate tiny f-m transmitters. Two receivers near gunner actuate indicators that show miss distance and tell if gunner is leading or lagging

mitter on which the bullet passed.

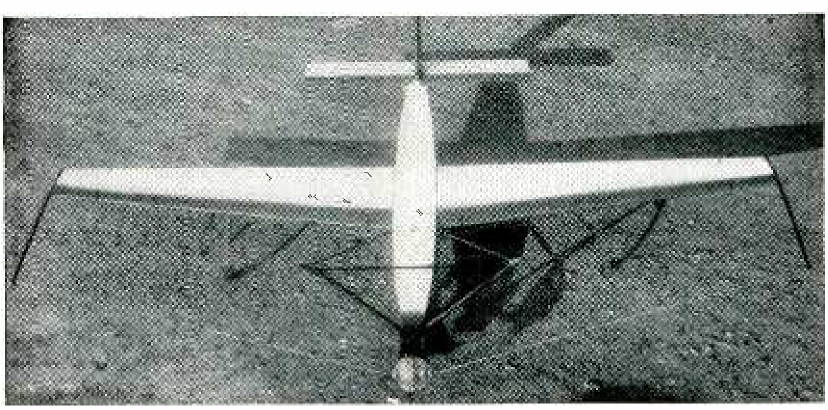
In the receiver unit, circuits provide two directionality-indicating channels corresponding to the two microphones in the transmitter. The coupling is such that a signal appears at the output only in that channel which received the earlier of the two microphone signals, the signal in the other channel being completely blocked.

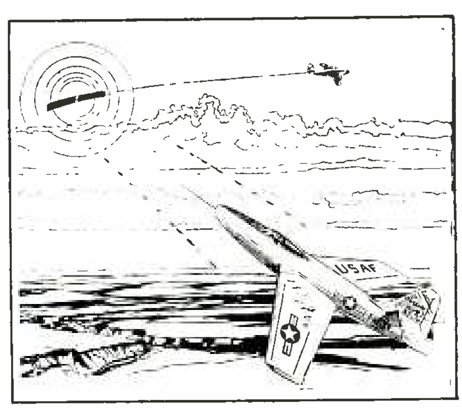
Adjustable thresholds are provided in the receiver in such a manner that the sum signal is, according to its intensity, routed into one or more of three different sum channels. Choice of these thresholds establishes in the target area substantially circular concentric sum response zones.

Each transmitter is a master oscillator-power amplifier using a 3A5 double triode. The microphone is mounted on top of a cylindrical box which shields the oscillator components. Carrier frequencies used are 56.75 mc and 55.5 mc.

Receiving Station

The block diagram of the receiver unit is shown in Fig. 1. The antenna cable feeds a tee connector from which quarter-wave 100-ohm cables lead to the antenna coils of the two receiver channels. Each antenna coil is matched to





Two examples of firing error indicator installations. When used in 16-foot target glider, antenna wires run from plastic sphere back to outriggers on wing tips. Antennas for towing-sleeve installation are woven into cloth. In both uses, the receiving station is located in the tow plane, and error information is relayed on a command set to each fighter pilot in turn as he makes passes at the target

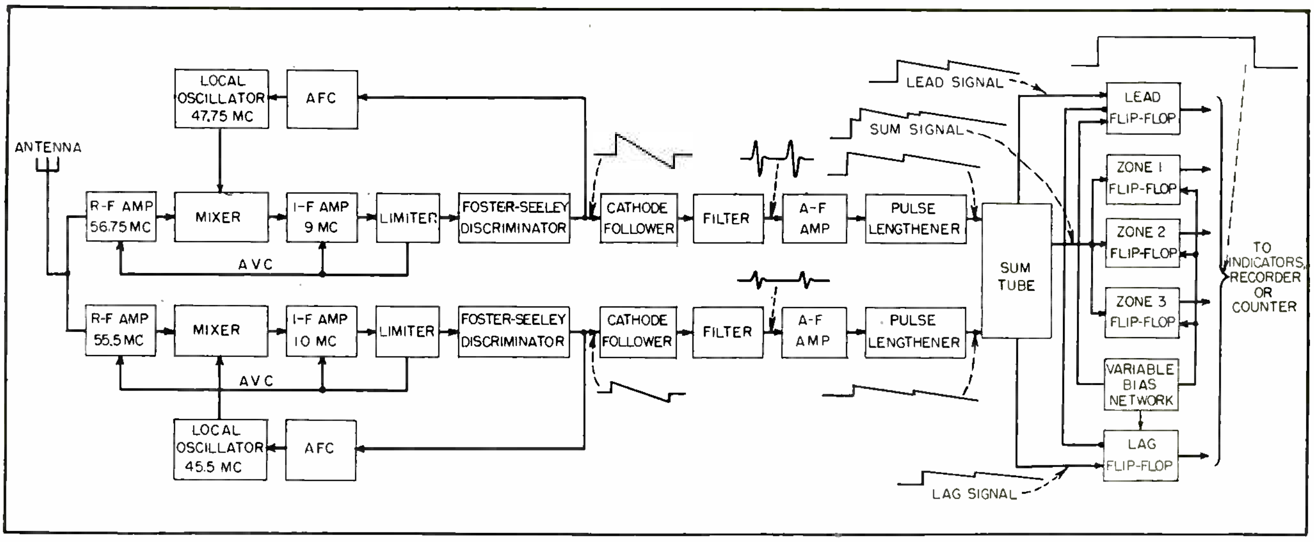


FIG. 1—Block diagram of receiver unit. Two separate f-m receivers feed the sum tube in the computing section in such a way that the five outputs indicate the number of bullets passing through each of three miss zones, the number of leading misses and the number of lagging misses

this same impedance for its own signal frequency. For the signal frequency of the other channel, however, the antenna coil presents a terminal impedance of only about 15 ohms and hence rejects signals of that channel.

Two separate local oscillators and two different i-f values are used to permit individual automatic frequency control of the two channels.

The gain of the i-f amplifier is maintained over a wide range of input amplitude fluctuations by the use of avc fed back from the first limiter and by the operation of the two-stage limiter itself.

The discriminator output voltage is also used to furnish automatic frequency control to the local oscillator. Moderately slow drifts of transmitter frequency are automatically followed so as to maintain the i-f signal in the receiver at the correct value.

After suitable impedance transformation in the cathode follower stages, the a-f signals pass through audio bandpass filter networks which are 3 db down from mid-band value at 4,000 and 10,000 cps respectively. The filters eliminate low-frequency noise and disturbances but retain the two discontinuities of the shock wave[1] in the form of two transient pulses, as indicated on the block diagram. These pulses do not usually coincide in time in the two channels because the two microphones on opposite sides of the spherical case in the transmitter unit seldom receive the shock wave simultaneously. This time displacement, which may be in the order of one millisecond, would prevent addition of the two microphone signals to form the sum response unless pulse lengthening is used.

Computer and Indicators

Figure 2 shows one channel of the audio amplifier and the sum-

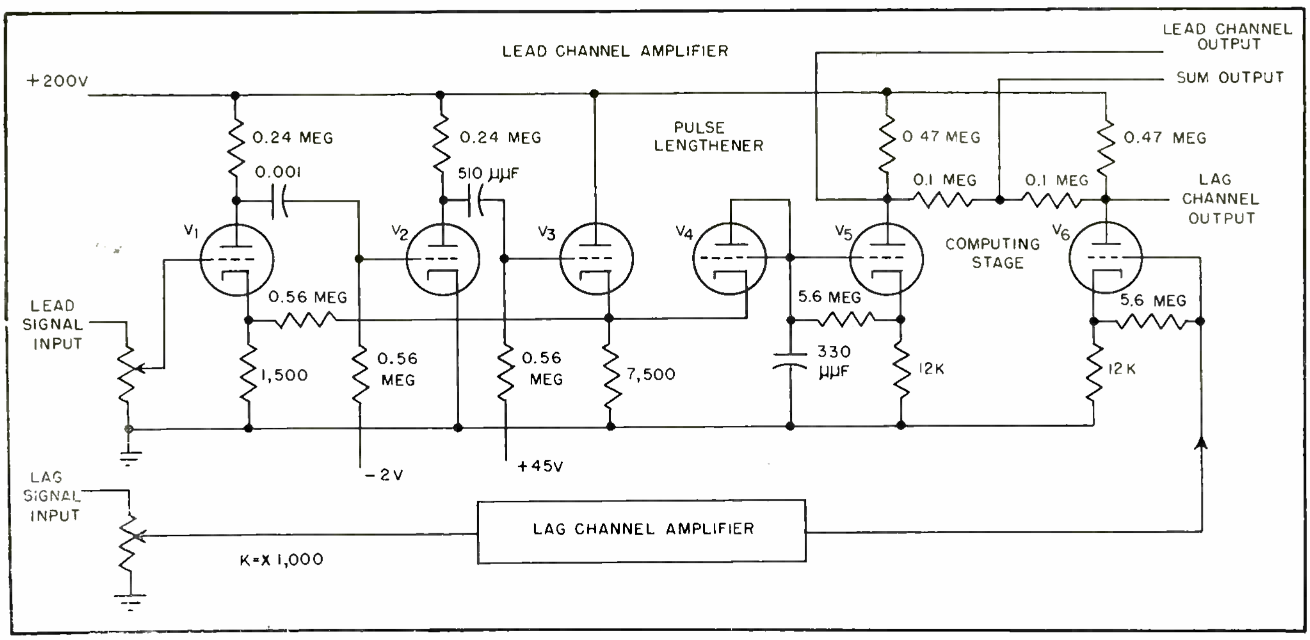


FIG. 2—One channel of audio amplifier in a receiver, and sum-difference computing stage serving both receiver channels

difference computing stage. The audio amplifier uses negative feedback with a certain amount of direct coupling and small time constants to flatten the response, give stable amplification and provide a very low impedance output to drive the pulse-lengthening diode which connects to the sum tube. The lengthened pulse exhibits a delay to half its initial peak value in approximately six milliseconds. Since the tops of lengthened pulses are nearly constant for a few milliseconds, the signals from the two channels may now be combined in a sum tube or computing stage. The sum of the two pulse-lengthened signals is a superimposed exponential pulse, as indicated in Fig. 1.

For purposes of scoring, it is desirable to classify the shock-wave signals as having fallen in three concentric miss distance zones of predetermined radii. This function is performed by the zoning flip-flops.

Whenever the sum signal exceeds a certain amount, one of the zoning flip-flops will trip and furnish, for a standardized length of time, a plate signal which can be used for recording equipment or for use with a mechanical counter. The peak value of input pulse at which flipping occurs is adjustable by means of bias potentiometers; with these, the sizes of the miss-distance zones of a target can be set for a given calibre of ammunition.

Two more flip-flops are so interconnected that one or the other trips according to which microphone channel receives its signal first. The receiver output thus contains five channels, one or more of which are activated as the bullet passes through the three miss distance zones and two directionality zones. These five channels may be connected to indicating devices such as a tape recorder or a counter.

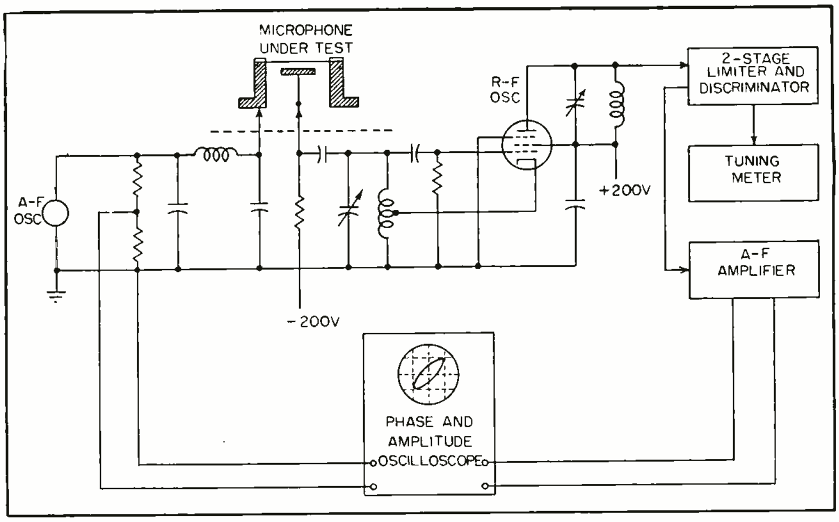


FIG. 3—Simplified diagram of electrostatic microphone tester used in production-testing the special flat-response microphones required

The Microphone

The heart of the system is a specially designed and carefully built capacitor microphone having a response characteristic flat to within plus or minus 1 db from 0 to over 10,000 cps. The construction is such that it will withstand repeated application of 200-G shocks without damage or change of characteristics. Response is linear to within 5 percent up to an applied pressure of 30,000 bars, which is 0.44 lb per square inch. A relief vent in the microphone permits use at any air pressure from sea level up to 10,000 feet of altitude with no serious change in its characteristic.

The microphone diaphragm is made of 0.0016-inch beryllium copper. The diaphragm-supporting casting is a special bronze selected to have essentially the same coefficient of expansion as the diaphragm material, so that the temperature coefficient of the sensitivity of the microphone is negligible.

Microphone Testing

The electrostatic microphone tester circuit shown in Fig. 3 uses the microphone as part of a tuned r-f oscillator circuit. By applying an a-f voltage from a low-impedance source to the microphone and simultaneously applying a d-c polarizing voltage to the insulated electrode button of the microphone, it is possible to make the diaphragm move at the a-f rate by electrostatic attraction. This correspondingly varies the capacitance that the microphone introduces in the r-f oscillator grid circuit.

The a-f oscillator voltage is simultaneously fed to the horizontal plates of an oscilloscope. The r-f oscillator voltage, which becomes frequency-modulated by the a-f voltage, is fed through a two stage-limiter, discriminator and a-f amplifier. The resulting a-f output is fed to the vertical plates of the same oscilloscope. The voltage between the horizontal and vertical plates is compared for phase angle. When the microphone is critically damped, the only way in which the resonance point of the diaphragm can be determined is by using the criterion that when it is at resonance, the diaphragm movement is 90 degrees out of phase with the applied voltage. This makes it possible to duplicate microphones under production conditions. The response of the microphone to the electrostatic deflection is essentially identical to that which will occur if the microphone were acoustically excited.

Since the original development of the acoustic firing error indicator equipment, this device has been produced in large quantity by electronic equipment manufacturers for use by the Armed Services.

The successful development of the equipment described was to a very large extent due to the able direction and efforts of J. W. M. DuMond of California Institute of Technology, who was project coordinator, and W. K. H. Panofsky, now at Stanford University, who was project director.

REFERENCE

(1) J. W. M. DuMond, E. R. Cohen, W. K. H. Panofsky and E. Deeds, A Determination of the Wave Forms and Laws of Propagation and Dissipation of Ballistic Shock Waves, *Jour. Acoustical Soc. America*, p 97, July 1946. This paper was the result of field studies of ballistic shock waves in conjunction with development of firing error indicator equipment.

Using C-R Tubes With

Use of pole-piece extensions built into neck of cathode-ray tube reduces magnetic energy required to achieve focus and minimizes astigmatisms due to nonsymmetrical fields from the external focus unit. Different types of internal pole pieces and their use in e-m and p-m picture tubes are discussed

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IN ATTEMPTS to reduce the consumption of critical materials in television receivers, much attention has been paid to the focus system of the picture tube. The electrostatically focused tubes represent one means of saving copper and Alnico. However, it has become apparent that other material-saving focus systems would be desirable.

Design

Work on this problem has led to the development of the magnetically focused picture tube that uses internal magnetic pole pieces to form the focus lens. The use of these poles has reduced the external focus energy requirements by 36 to 65 percent, depending upon the particular pole-piece design and upon the type external-focus device used. Further, due to control of aberrations in the focus lens, picture quality has been improved beyond that of the conventional magnetic and electrostatic-focus tubes.

It has long been clear that the conventional magnetic focus system is inefficient owing to the fact that much of the magnetic circuit is in air or vacuum unnecessarily since the region in which the electron beam must enter the field is relatively small. By providing a comparatively low reluctance path for the magnetic flux inside the tube, it is possible to produce a sufficiently strong magnetic field near the beam with greatly reduced amounts of magnetomotive force.

The magnetic circuit that has been developed has one unavoidable high-reluctance gap due to the glass neck thickness, and one other gap near the beam where the magnetic lens is formed. In the focus-lens gap, the diameter of the apertures in the pole pieces was made as small as possible to give the greatest reduction in magnetomotive force necessary to focus, but large enough to prevent beam masking. The length of the lens gap was determined by other considerations, which will be discussed below. The aperture diameter and the gap length chosen determine the reluctance of the lens gap. The separation of the poles of the external source of magnetomotive force determines the length of the pole-piece assembly, since these must be coupled to the external poles with minimum air gap to give minimum gap reluctance. For the same reason, the inner diameter of the external poles should be held to a minimum to reduce the reluctance of the gap between them and the inner pole pieces.

A simplified consideration of the effect of the length of the focus lens gap on the required amount of magnetomotive force shows that the change ought to be directly proportional; increasing the gap length increases the magnetomotive force necessary. This would be expected since the effect of increasing any gap would be to increase the reluctance of that gap.

A series of pole pieces was constructed in which the length of the gap was varied in 1/16-inch steps, and all other parameters were held constant. A graph of the focus current required for these various gaps, all at the position of best coupling between outside and inside poles, is shown in Fig. 1.

The results shown confirm the conclusions drawn above. Since reluctances vary as the inverse of the area of the gap, it might be expected that energy requirements would also vary as the inverse of

Early design of internal pole piece for mounting atop anode barrel

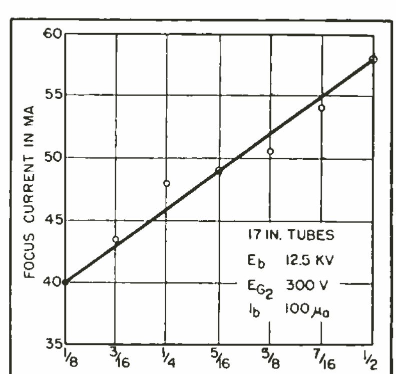
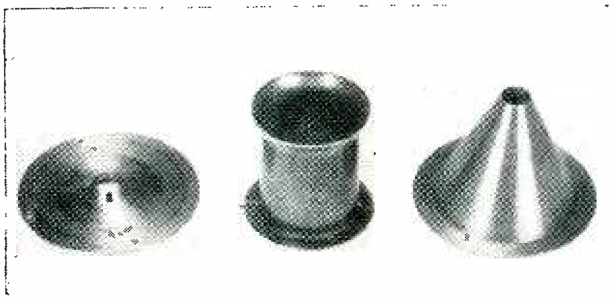
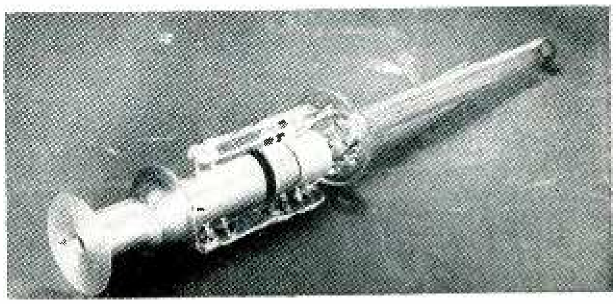


FIG. 1—Focus current for different gap lengths

Internal Pole Pieces



Later internal pole piece uses flat-plate front pole to reduce shielding of focus lens and allow shifting of field for centering



Photograph shows flat-plate pole piece mounted on crt gun before insertion in cathode-ray tube

the gap area. This was found not to be true. The explanation of this lies in the fact that the flux effective in focusing the beam is essentially leakage flux between the two poles. Removing the two poles from this region by increasing the aperture diameter increases the energy required to produce a given lens.

Positioning

Since outside support of the magnetic source might be necessary, it was deemed desirable to locate the lens at the same general region in which the present focus devices are located. This further avoids insulation problems since this is a region essentially free from electric fields.

In previous magnetic-focusing systems that located the focusing device near the deflection system, an interaction between the focusing field and the deflection fields was unavoidable. The fact that the focus field in the pole piece tube is largely confined to the low-reluctance pole-piece region reduces this problem to a minimum. A shortening of the anode barrel further reduces field interaction.

In addition to energy requirements, consideration of the relative centering motion available with different pole pieces is important. Centering of the beam is often obtained by shifting the axis of the magnetic field with an outside slide pole piece. When this sort of device is used with a pole-piece lens, the shielding effect of the pole pieces tends to smooth out the effect of shifting the outside pole to the point where insufficient centering motion is available. The longer gap lengths tend to increase centering motion but increase the energy requirements as noted above. This difficulty is avoided by displacing the outside focus device toward the face of the tube. This produces sufficient flux for centering without greatly increasing the energy requirements. A displacement of about one-eighth inch to the front of the front pole piece was found to give good results.

The shorter gap lengths require extremely careful alignment of the outside pole pieces of the focusing device with the internal pole pieces, and were, therefore, deemed impractical despite the lowered reluctance of the lens gap. Various types of internal pole pieces are shown in the accompanying photographs.

The photograph shows a pole piece designed to be mounted on top of the anode barrel. With this early design it was noted that insufficient centering motion was possible with the slide-pole device used. This is to be expected since the change in field produced by the slide pole is largely smoothed out near the lens, and little stray field exists on the screen side of the gun. An independent centering device is commercially undesirable.

The more recent flat-plate front pole design (see above) reduces the shielding of the focus lens, and allows a shifting of the magnetic field to affect the beam sufficiently to provide adequate centering. This reduced shielding works in conjunction with added stray field in front of the front pole piece.

A gratifying result of this work was the improved picture quality caused by reduced aberrations of a focus lens produced by means of pole pieces as compared to a lens produced by wholly external focus devices. Flux lines are linearly distributed. Nonuniformities of the focus magnet's field have been smoothed out by the pole pieces producing an essentially non-astigmatic field near the beam.

Focus devices for use with the pole-piece tube may be either permanent or electromagnetic in design. Both kinds have been built and give excellent results.

Production tolerances for pole-piece tubes are, in general, wide. The variations in gap length produced by common tolerances used in stamped electron gun parts are almost unnoticeable. Standard tolerances for aperture diameters hold, as is true for aperture concentricity. Alignment of the pole pieces on the axis is important, but is easily attained with proper assembly fixtures.

Attempts to redesign the focus system of magnetically-focused picture tubes have led to a focusing system that requires greatly reduced amounts of magnetomotive force. This result may be translated into greatly reduced consumption of critical materials and picture tubes giving noticeably better performance without increased manufacturing difficulties.

Application

Internal pole-piece material is generally cold-rolled steel between 0.010 and 0.020-inch thickness. Low-carbon irons, however, have the advantage that their permeability is almost independent of the direction of rolling whereas in cold-rolled steel there may be as much as 20 percent difference between the axis of rolling and that at right angles.

Centering of a tube with internal pole pieces requires that displacement of the electron beam be done in front of the pole piece closest to the face of the tube. If the beam is displaced in the area between the pole piece closest to the face of the tube and the base of the tube, cutting of the beam by the various apertures takes place. It has been found that if an internal-pole-piece configuration such as shown in Fig. 2 is used and a slide pole arranged on the external focus unit, centering of the picture follows the conditions plotted in Fig. 3. These curves show the amount of centering as a function of the displacement of the slide pole piece on the focus unit with respect to the front internal pole piece. This data is presented for two second-anode voltages.

It is seen here that the position of the slide pole for maximum centering is not the position for the most efficient coupling. The percentage of flux carried by the slide pole as compared to the fixed pole mounting the slide pole is a factor controlling the amount of centering available. In the designs found practical the largest percentage of the flux is carried by the slide pole. This is the reverse of the general case in the conventional p-m unit.

The amount of centering motion shown is possible only if the front pole piece (the one closest to the face of the tube) is substantially a flat plate. Tubes that use two truncated cones to form the internal pole pieces are generally found to be a little more efficient magnetically but as a rule do not allow adequate centering motion.

The length of the magnets chosen for these focus units seems optimum for the conditions of use, but it is possible that with further tube development, the spacing between the internal pole pieces will not be such that the back poles will be in alignment for maximum coupling. On this account, a sleeve is inserted in the back pole piece of the focus unit to allow a fairly large displacement along the neck of the tube without losing coupling between the back pole pieces. This rearward-pointing sleeve may be so arranged that part is inside the focus unit if tube design tends to place internal pole pieces very close together.

Basic Types

Practical p-m focus units for these tubes have evolved as two basic types, the pilaster-mounted and the neck-supported types shown in the photographs.

The pilaster-mounted type is rigidly supported by the same assembly holding the deflection yoke in conventional practice. The mounting is designed so that the unit has the proper relationship to the internal pole pieces for magnetic coupling and for proper centering conditions.

Focus is controlled by turning the focus control knob, (Fig. 2) which moves the annular ring forward and back to change the shunting effect on the magnets.

Centering is achieved by displacing the slide pole using the slide-pole extension. This unit is used and handled in the same way as is the conventional p-m unit, except that care must be exercised in placement along the neck of the tube.

To facilitate this positioning, which is important in both types of units, the tube manufacturers who will position the internal poles relative to the reference line intend to also provide either a window in the Aquadag or an external mark on the tube as a quick guide for positioning.

The neck-supported type of unit was the original design approach and came about because of the economies involved, both in construction and in mounting ease.

Control of focus with this unit is achieved by moving the entire flux-producing part of the assembly along the neck of the tube. By doing this the air gap between the external and internal pole pieces can be varied and focus controlled. Centering is again controlled by the slide pole. The data shown in Fig. 2 also hold for this design. A sleeve in the back pole piece is used here also to allow displacement between the front pole pieces at all times and still allow focus control by moving the whole assembly.

It has also been found that this sleeve gives a smoother control over focus since only one air gap is changed as the unit is moved.

A unit of the neck-supported type weighs about 6 oz, depending some-

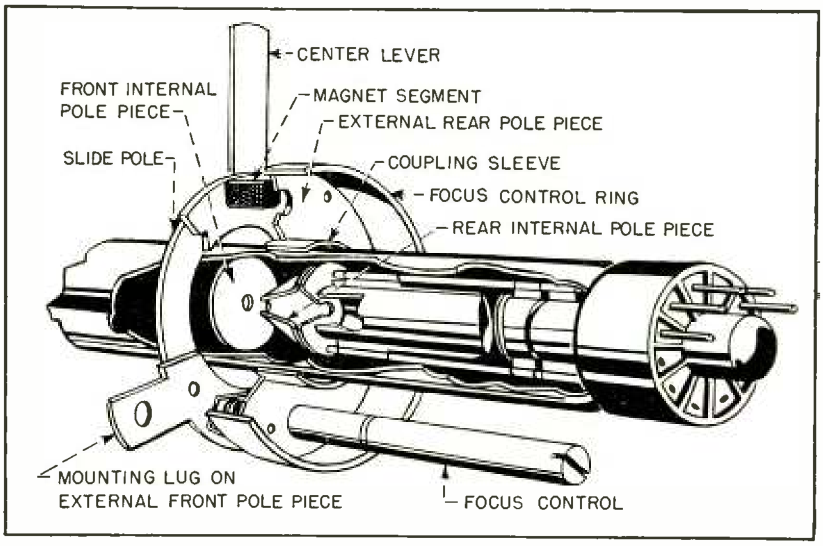


FIG. 2—Drawing shows typical positions of internal pole pieces and focus unit mounted externally on neck of tube

what on the magnet requirements. Initially, it was believed this was too much weight to put on the neck of a tube. However, one receiver manufacturer has investigated this point and is of the opinion this weight is safe.

Mechanical Problems

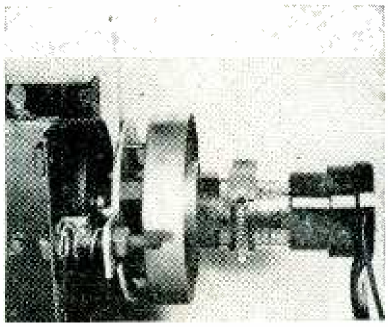
While the design of the pilaster-mounted type of unit was straightforward several problems had to be solved with the neck-supported design.

Even with internal pole pieces it is not desirable to bring the three magnet segments used close to the neck of the tube for reasons of stability. Close spacing aggravates the tendency of the unit to displace sideways during focusing and centering causing the entire picture to wiggle.

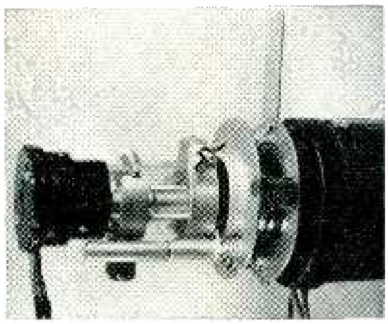
By means of close-fitting guides the neck supported unit shown has a stability during focusing and centering that is entirely satisfactory even with the magnets at some distance from the neck of the tube.

Possibly one large-scale use for this type of unit is in the replacement of electrostatic tubes. Most electrostatic tube sets do not have provisions for mounting a focus unit.

One unusual effect noticed, that is probably of importance only to the engineer working experimentally, results from the residual magnetism of the internal pole pieces. If work is being done with



Pilaster-supported external focus unit for use with tubes containing internal pole pieces



Photograph shows neck-supported focus unit

focus units of reversed magnetization it is suggested the internal pole pieces be demagnetized before each test. The use of low-carbon irons for the internal pole pieces will largely avoid this. However, since the flux in the gap at the center of the tube is of the order of 20 gausses it is seen that even 2-gauss residuals, which have been found, can cause trouble. In addition, if there are areas around the aperture with unequal residual flux, the dot can be distorted. This effect has been seen on some tubes and easily remedied by demagnetizing the internal pole pieces.

The ion-trap setting has proved to be a little more critical than is found for the conventional magnetic focus, but not as critical as in the electrostatic tube. This condition is believed to come about for somewhat the same reasons as in the electrostatically-focused tube. Because the length of the magnetic lens is very short and because the aperture in the internal pole pieces is in the order of 0.150 inch it is evident that the beam-bundle axis should be as coaxial as possible with the magnetic lens so as to minimize astigmatism.

Industry Use

The saving in magnetic material in the p-m case is quite high and in the neighborhood of 65 to 70 percent over that required in the conventional magnetic case. This much saving has not appeared in the e-m case primarily because of the difference in the stray field conditions from the e-m compared to the p-m. Much more of the total energy in a conventional p-m unit is lost to stray fields than in the e-m unit.

Due to the more complete magnetic path of the internal-pole-piece tube much of the field normally stray is utilized. At this stage of the development of the e-m coil about 36-percent saving in ampere turns is achieved. This actually represents a bigger savings in copper because the reduction in copper takes place on the longer outside turns.

It is now believed correct to state that at this time there are three types of c-r tubes available to the industry: the conventional magnetic focus, the electrostatic focus, and internal pole piece magnetic type. The factors dictating the choice of tube are evident as being comparative performance, cost of tube and associated equipment and availability.

It seems that all three types will find a place in the industry but with the possibility that the ipp tube may in time displace the conventional magnetic type.

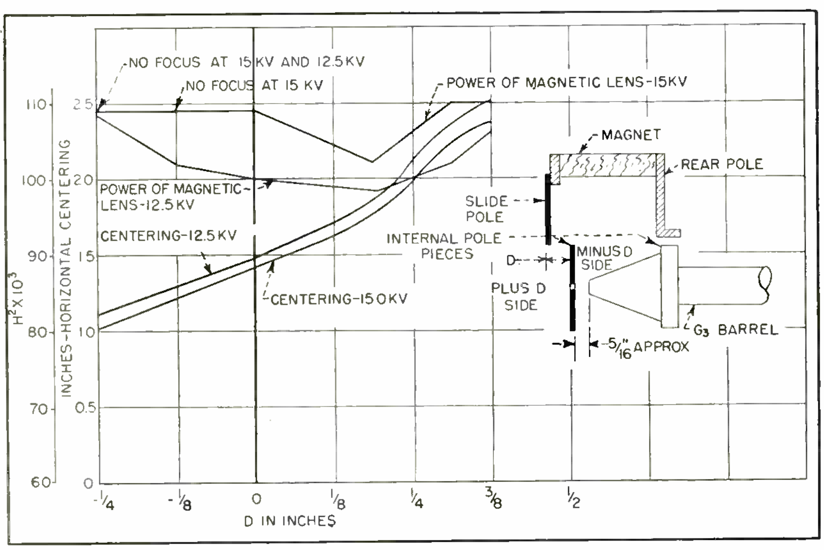
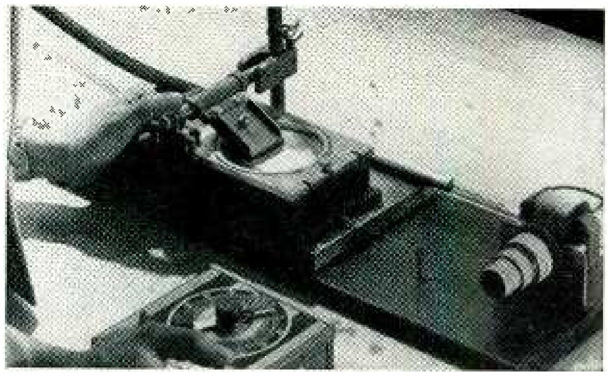
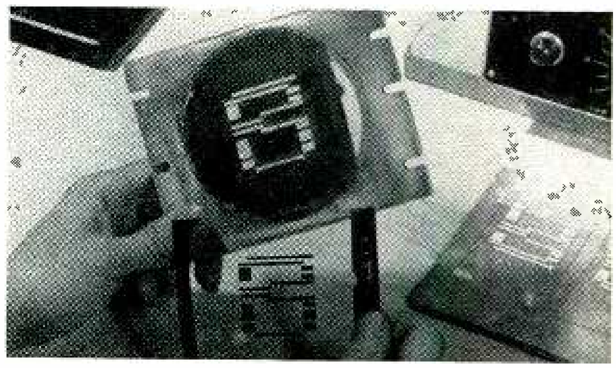


FIG. 3—Effect of alignment of internal and external poles. Minimum current point in front pole is due to rear flange of focus

Applying silver mix to screen for producing terminal areas. Techniques for resistor mixes are identical



Use of small geared-down motor to pull screen under rubber squeegee. Uniform velocity is essential for reproductibility of results



Silk screen for silver mix (left hand) and silver terminal pattern on glass plate (right hand)

Production Control

AN IMPORTANT objective to be attained in the use of a printed circuit is the reduction of production cost. This cost in any mass-production process is closely dependent on the rejection rate. A second factor is the effect of producing several circuit elements on one plate, a procedure which precludes selection and sorting of components. Relatively uncontrolled processes are rendered usable in the production of individual components by sorting 100 percent of the product into salable value groups.

The silk-screened resistor is generally intended as a replacement for fixed composition resistors and its requirements as to value, tolerance, temperature coefficient, drift, noise, life and voltage stability are at least nominally evaluated by JAN-R-11 tests. Although these specifications are not entirely appropriate since the functioning of a printed group is a more valid criterion than a blanket tolerance applied to each resistor value, it will be assumed here that the same limits are required for printed as for individual composition resistors.

Steps in Manufacture

Theoretical and experimental effort has been directed toward isolating major cases of variability in the printing process and toward optimizing the procedures. In outline, the procedure used is:

(1) Firing silver terminal areas on base plate

(2) Printing resistors with silk screen

(3) Low-temperature drying with convection

(4) Baking at intermediate temperature

(5) Curing

(6) Screening with protective coating

(7) Room-temperature drying with convection

(8) Stabilizing in convection oven

A complete cycle of manufacture exclusive of the first step (metallizing) is about 4 hours.

For silk screening of the silver terminal areas, a common commercial ceramic decorating paint was used, with consolidation of the paint by 600 C firing.

The resistor screening mixes were formulations of graphite, carbon-black, resin and a solvent. The

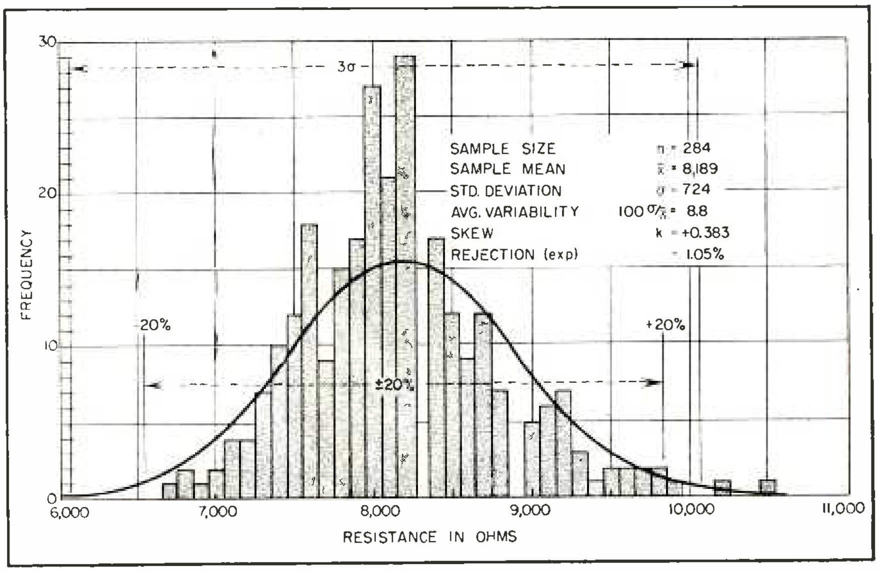


FIG. 1—Distribution of resistance values for batch of uncoated cured resistors

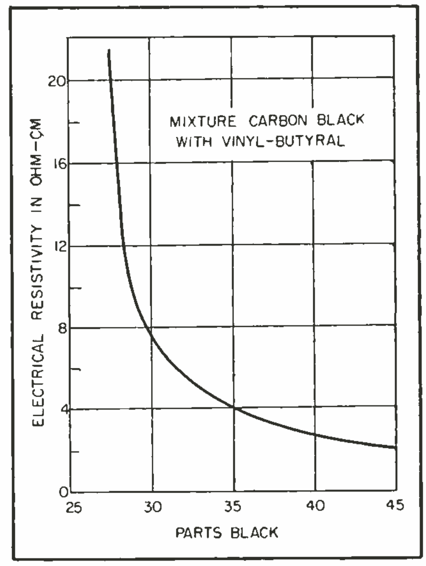


FIG. 2—Effect of carbon concentration

Analysis of factors affecting reproducibility of silk-screened resistors. To minimize final-assembly rejections, five major variables require critical control: carbon concentration, squeegee speed, screening temperature, curing temperature and overcoating

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# of Printed Resistors

binder resin is a modified styrene and the solvent a high-boiling acetate, to minimize evaporation on the screen. White shellac provides a satisfactory seal coat when overprotected with slurry-applied granular phenolic resin. While not followed in these tests, commercial practice requires a third protective layer comprising impregnation with wax.

All of the data given is for resistors screened on glass. Drying and baking were done with conventional laboratory equipment refined slightly to achieve the temperature uniformity required. Screening was done in an environment controlled to prevent temperature variations greater than ±0.5 C on the printing screen.

In Fig. 1 is shown a distribution of values for a lot of uncoated resistors several times minimum sample size, including several runs under normally varying conditions. Control of all variables in the process up to the coating step is evidenced by the small actual rejection, 1 percent at the ±20 percent limits.

Rejection Rates

The detection of fine differences representing the effects of low-order variables requires samples of considerable size. Samples of 48 or more resistors have been found necessary for maintaining a confidence level of 80 percent in most of the tests reported.

The influence of mixture concentration is shown in Fig. 2. Although this curve is for a mixture containing carbon black as the only conductive material, it is representative of the situation most frequently met in graphite, carbon-black, resin and solvent combinations where the carbon black is a small but critical constituent. With low concentrations of carbon black, high variations in resistivity result from small changes in composition.

The application of a protective coating is a critical step because of the large and general unpredictable increases in value produced. After considerable investigation, several types of sealant were found which give only moderate interference. As a typical example, screening a sealing coat of shellac on a sample of resistors containing 3 percent rejects broadened the distribution and shifted the values. As shown in Fig. 3, the shift was about 12

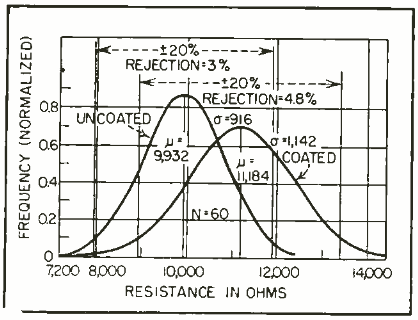

FIG. 3—Effect of overcoating on final resistance value

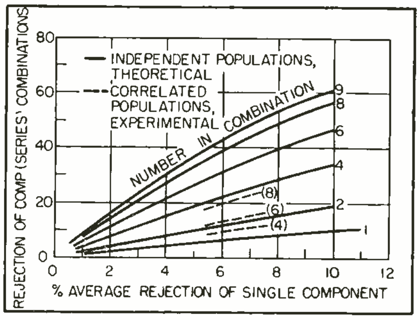

FIG. 4—How rejection rate increases with number of components

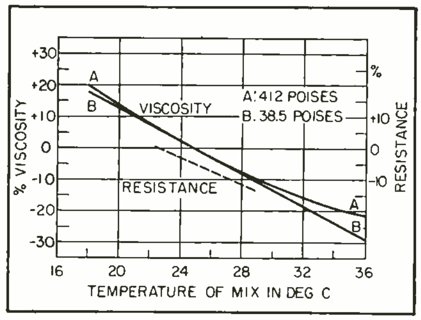

FIG. 5—Effect of temperature on viscosity of resistor mixes

percent and the rejection increased to 4.8 percent for this particular lot.

The rejection of component groups printed together, because of defects in one individual, has a significant bearing on all printed circuit applications. If the simplest series case is analyzed, the theoretical effect of combination, up to 9, is shown by the solid lines of Fig. 4. The rejections shown for combinations are based on the following assumptions: the complete assembly does not function when one member is out of specification, and the components in the group are from independent random populations which were not related during fabrication. This represents the maximum rejection, seldom met in production. Actually, in a process under control, there is considerable probability that an assembly rejected for one bad component will also contain another defective. For two or more resistors silk-screened simultaneously the correlation is sufficiently high so that rejects in aggregate amount to less than 40 percent of the above predicted value. These experimentally derived results are shown as the dotted lines in Fig. 4.

Process Variables

The major influences on the final value of resistors were found in the carbon concentration, screen opening size, curing temperature, overcoating formulation and the screening temperature. This is only a small proportion of the total number of variables.

Some indication of the factors entering into the printing operation can be had by applying the laws of fluid mechanics to the dispensing of wet resistor mix. The volume of a fluid discharged through a square orifice per unit time is described by the relation

$$q = \frac{\pi S^4 C}{7.12\eta}\frac{dp}{dL} \qquad (1)$$

If this is applied as an approximation of the flow of resistor mix through a screen opening, with consideration of the angle and pressure of the squeegee, the total volume discharged is

$$q' = \frac{\pi S^4 C T p}{7.12\eta L}\cos\theta \qquad (2)$$

Relating time to squeegee travel and velocity, combining constants and multiplying for additional orifices results in

$$Q = \frac{C_1 S^5 K A p}{\eta v L}\cos\theta \qquad (3)$$

The resistance of a particular uncoated resistor may be expressed in terms of its dimensions when dry (l, w, t_d) and specific resistance ρ

$$R = \rho\frac{l}{w t_d} \qquad (4)$$

Another consideration is volume change upon drying, in terms of the dimensions of the freshly screened resistor and a wet-to-dry ratio γ,

$$R = \rho\frac{l}{w\gamma t_w} \qquad (5)$$

As an approximation, the wet thickness t_w may be taken as equal to the volume of mix discharged (Q) divided by the cross-section or open area A in screen and pattern. Substituting this for t_w,

$$R = \frac{\rho\eta l L v}{K w \gamma S^5 \cos\theta p} \qquad (6)$$

in which

A = area in sq cm
R = resistance in ohms
μ = viscosity in poises
v = velocity of the squeegee in cm per sec
w = width of resistor in cm
l = length of resistor in cm
c_1 = proportionality constant
γ = ratio of wet to dry film thickness
S = linear parameter of sieve opening in cm
K = numbers of openings per sq cm of screen
L = distance fluid travels through screen in cm
ρ = resistivity in ohm-cm
θ = angle of the squeegee with respect to the work
p = vertical pressure of squeegee on the screen in dynes per sq cm
dp/dL = differential pressure throughout the length of an orifice

Placing coated glass plates in small furnace for curing of silver. Resistor printing with silk screen is next operation

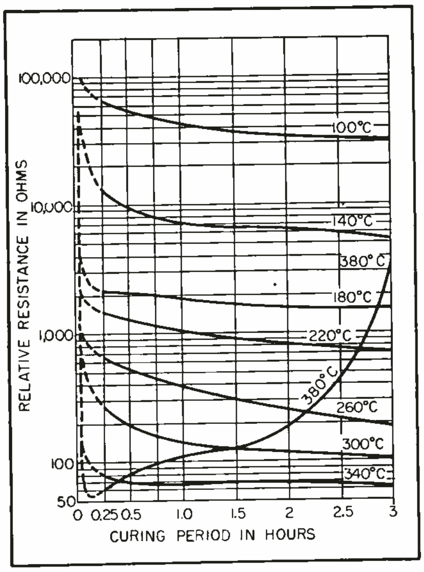

FIG. 6—Curing curves for mixture of lampblack and alkyd resin

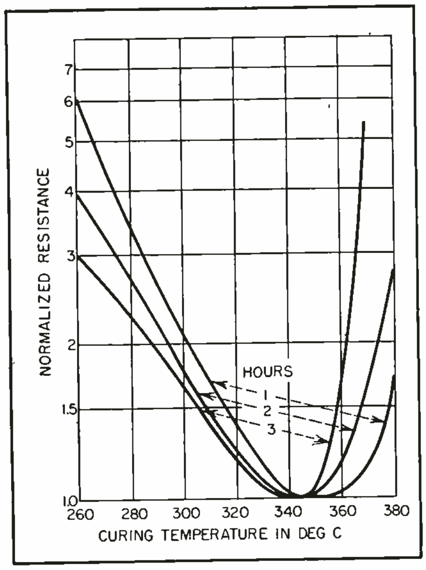

FIG. 7—Determination of optimum curing schedule for uncoated resistors

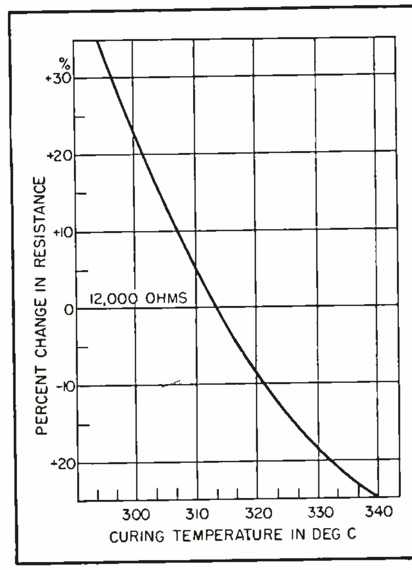

FIG. 8—Effect of curing temperature on uncoated resistors

C = nozzle coefficient
T = time of fluid flow in seconds

The value of a given resistance is thus illustrated to be effected by eleven factors in the screening process plus the superimposed effects of time-temperature in the curing cycle, interference during overcoating and the basic formulation of the mix. Equation 6 indicates that the resistance produced is directly dependent on the resistor length, viscosity of the mix, distance through the orifice and the speed of the squeegee. The resistance is inversely proportional to resistor width, the wet-to-dry ratio, holes per unit area, the pressure drop through the orifice, the squeegee angle and to the fifth power of the hole parameter.

Critical Factors

The influence indicated for the hole size suggests that wear of the screen may be a prime importance. The weight of some of the factors in Eq. 6 has been evaluated experimentally. A velocity increase of 14.4 percent in squeegee motion was found to result in an increase of 21 percent in uncoated resistor value. A decrease of 13.7 percent in viscosity resulted in a 12.6-percent decrease in resistance. The viscosity is markedly reduced by slight increases in the temperature of the mix at the time of screening. These three related variables are shown together on Fig. 5. Significantly, a rise of one degree centrigrade in room (mix) temperature during screening translates into a 2¼-percent decrease in the mean value of resistors produced.

In the overall manufacture, the main curing step prior to coating is critical. Batches subjected to progressively higher baking temperatures decrease in resistance during curing as shown in Fig. 6, successively approaching lower and presumably more stable final values until the decomposition level is reached, when the resistance rapidly rises during baking.

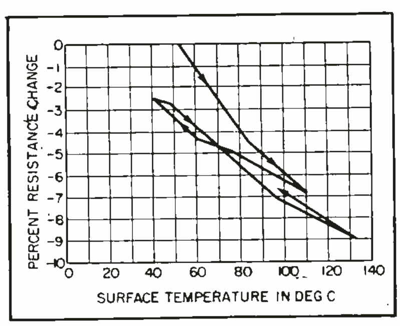

FIG. 9—Drift of protected 10,000-ohm resistor under temperature cycling

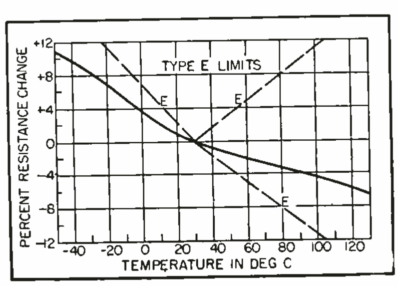

FIG. 10—Temperature coefficient for nominal 10,000-ohm silk-screened resistor

Similar data near the crossover point may be analyzed in a different manner, as in Fig. 7, to find the temperature-time schedule which represents the fastest approach to a low, stable value. With a curing schedule near the indicated optimum, resistors may be lowered 5 percent in value by an increase of only 3⅓ deg C, as shown in Fig. 8.

The use of a curing schedule optimized only with respect to speed and stability may result in higher noise levels; resistors processed by the fastest cure on Fig. 7 show about 3 microvolts per volt.

Screened resistors approximating the other JAN standards may be produced by the procedure outlined: an average voltage coefficient of about 0.04 percent per volt (25 C) has been noted. Drift is of about 3½ percent as shown in Fig. 9. The temperature coefficient, which is well within type E limits, is shown in Fig. 10.

In conclusion, the principle limitations in reproducibility are set by a critical carbon concentration, squeegee speed, a viscosity of screening which is sensitive to temperature, the curing temperature and the overcoating formulation. Theoretical analysis points also to squeegee pressure and to irregularities in screen openings as possible causes of large variations in printing.

CONELRAD

Crystal-controlled broadcast receiver gives alarm when key station to which it is tuned goes off air in response to FCC technique denying navigation aid to enemy aircraft. Malfunction in receiver itself sounds alarm

In complying with the request of the Federal Communications Commission to participate in the air-raid warning project CONELRAD (control of electromagnetic radiation)[1] many broadcast station engineers are confronted with the problem of constructing monitoring equipment that will give an indication of carrier failure of a key station.

The simplest solution to the problem is to utilize the failure of the avc voltage of an existing receiver to trigger some warning device. This approach has several disadvantages. Most broadcast receivers are not designed for rack mounting, and therefore present a mounting problem if a neat and compact installation is to be maintained. Such receivers are often not constructed according to broadcast equipment standards, and they may leave something to be desired in the way of dependability when operated continuously.

Single-Frequency Receiver

It is possible to purchase a communications receiver that overcomes all these objections. However, this solution raises the objection of high cost plus the rather ridiculous situation of having provided equipment capable of tuning a large portion of the spectrum to monitor one frequency. The problem is simplified by starting from scratch and building a receiver solely for an alerting device.

Since the receiver is to monitor only one frequency, crystal control can be used and all front-panel tuning controls dispensed with. In addition, this design goes a long way toward achieving dependability by virtually eliminating oscillator drift problems. With such stability in the local oscillator, and since high-fidelity audio is not required, use of a rather low intermediate frequency is justified. This low i-f will permit great gain and selectivity in a minimum number of stages.

Low intermediate frequencies are usually accompanied by image interference, but for single-frequency reception it is easy to select the intermediate frequency and local oscillator frequency so that no strong images will be present. Design is further simplified in that the range of signal intensities encountered will be much less than that an ordi-

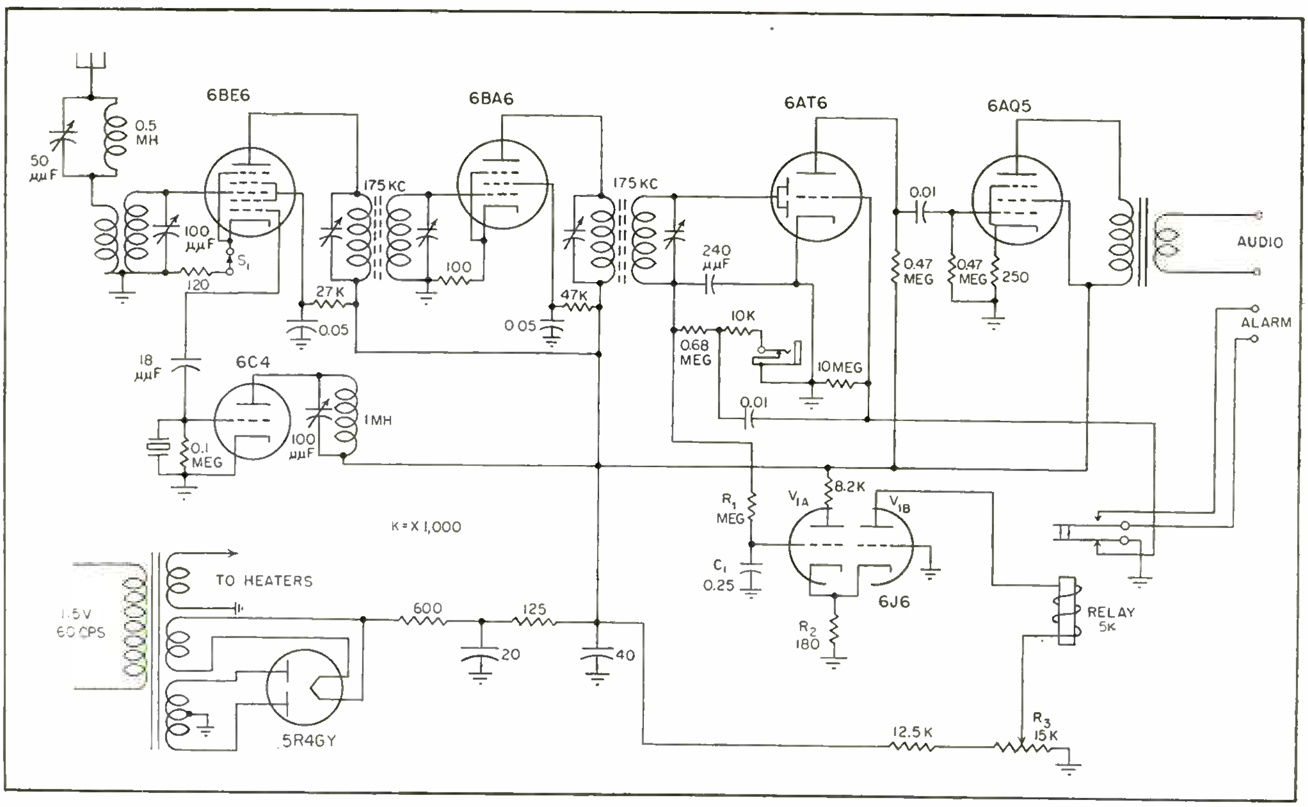

FIG. 1—Circuit diagram of the fixed-tune alert receiver

Alert Receiver

By MARTIN M. MITCHUM
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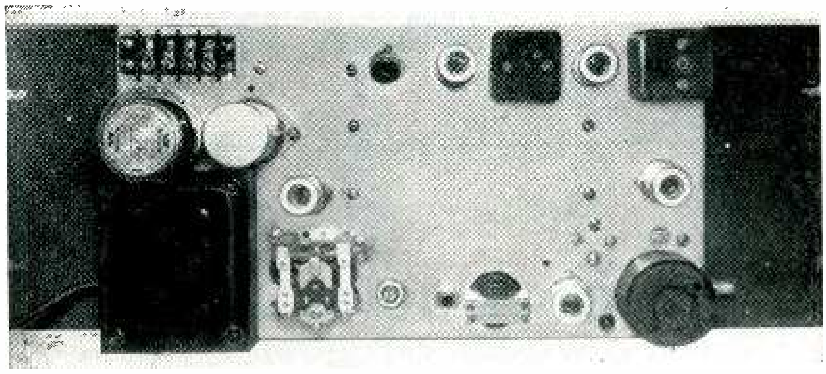

Rack mounted receiver requires no front-panel controls

nary receiver is designed to accommodate.

The system to be described was constructed for use at radio station KTTR in Rolla, Missouri to provide day and night monitoring of KMOX in St. Louis, Missouri, which operates on 1,120 kc with 50-kw. During the day, a signal of the order of 0.5 millivolt per meter can be expected from KMOX. At night the signal will vary considerably above and below this value.

Image Signals

With this much signal, it was decided that a converter and one stage of intermediate-frequency amplification would be sufficient. Since image interference was no problem, it was decided to dispense with any stages of radio-frequency amplification preceeding the converter.

An intermediate frequency of 175 kc was decided upon and the local oscillator operates at a frequency 175 kc lower than the carrier frequency of KMOX or 945 kc. There is virtually no signal present in this area on the image frequency of 770 kc.

Reference to Fig. 1 will disclose few departures, other than those already mentioned, from normal receiver design. It was decided, in the interest of simplicity, to use no avc in this receiver. Since the signal strength is not great enough to overdrive the i-f stage, and since carrier fading is taken care of in the alerting device, avc would serve no useful purpose here.

A meter jack is placed in series with the second-detector load resistor to permit the use of a microammeter as an indicating device when it is desired to make tuning adjustments or to observe carrier fading.

The simplest and therefore most obvious method of obtaining an alert alarm would be to use the voltage produced by carrier rectification to bias a tube to cutoff. The condition could be indicated by inserting a relay in the plate circuit of the tube. A moment's reflection, however, shows that with this system many receiver failures (for example, heater failure of the control tube) could occur that would make the system inoperative and yet would give no indication that things were not as they should be.

Receiver Failure

It is desirable, therefore, to design an alerting device that will indicate receiver failure as well as carrier failure of the key station. The rectified carrier voltage is therefore used to bias a triode but the relay is inserted in the plate circuit of a second triode and the two triodes share a common cathode resistor.

Under normal operation, V_{1A} is biased by the rectified carrier voltage and R_3 is adjusted so that V_{1B} is conducting enough to hold the relay closed. If a carrier failure occurs, V_{1A} will conduct, producing an increased voltage across R_2. This increased voltage biases V_{1B} enough to cause the relay to drop out. Any receiver failure that causes V_{1B} to stop conducting (such as a failure of the rectifier tube) will give an alert.

An added set of contacts on the relay provides for closing a circuit to ring a bell in case the failure is of such a nature as to provide no audio voltage to operate the speaker. The components R_1 and C_1 have a time constant that prevents relay operation until two seconds after a carrier failure. This is to prevent operation of the alerting system by momentary fading of the night-time signal of KMOX. The relay is so adjusted that it does not reclose when the carrier of the key station is restored. Resetting is done manually. Snap-action switch S_1 provides simulated carrier failure for testing.

When the receiver was installed at the KTTR transmitter, some cross modulation was encountered. This was eliminated by inserting a wave trap tuned to the KTTR frequency in the antenna lead to the receiver.

Installation

The receiver was constructed for rack mounting and occupies 7 in. of panel space. The chassis mounts vertically and all wiring is exposed by removing the front panel but without removing the receiver from the rack cabinet.

No particular claim is made for the virtues of the components used in this receiver. Some of them were selected because they were on hand or readily available. In the case of tubes, selection was made, in part, on the basis of tubes already stocked by the station for replacement in other equipment.

REFERENCE

(1) A. A. McKenzie, War-Emergency Operation of Broadcast Stations, ELECTRONICS, p 94, Aug. 1951.

A Phase Indicator

High-speed device is useful in development of circuits for color tv and as an aid in aligning and producing color receivers. Other applications are p-m and f-m monitoring, direction finding and delay network problems

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IN THE NTSC system of band-shared color television, the chromaticity information is transmitted by a subcarrier of 3.89 mc, whose amplitude and phase are used to transmit saturation and hue of the colors, respectively.[1, 2]

The need for an all-electronic high-speed phase indicator, capable of displaying on the screen of an oscilloscope, the instantaneous phase and amplitude of the color subcarrier became apparent. Such an instrument is described here.

Theory of Operation

The instrument requires two signal inputs: a constant carrier e_g at $\omega/2\pi = 3.89$ mc for phase reference and a test carrier at the same frequency but with unknown phase. As Fig. 1 shows, the reference carrier is applied to a balanced modulator, where it is split into two sidebands and suppressed. Since the local oscillator has a frequency $\Omega/2\pi = 1$ mc, the two sidebands are placed at nominally, 3 mc and 5 mc. The two carriers at 1 and 4 mc are suppressed in the special modulator, Fig. 2.

If both sidebands have equal amplitudes, the modulator output reads

$$e_1 = e_0 \tfrac{1}{2} [\cos (\omega + \Omega) t + \cos (\omega - \Omega) t] = e_0 \cos \omega t \cos \Omega t \quad (1)$$

This sideband doublet is employed to decode both the test signal

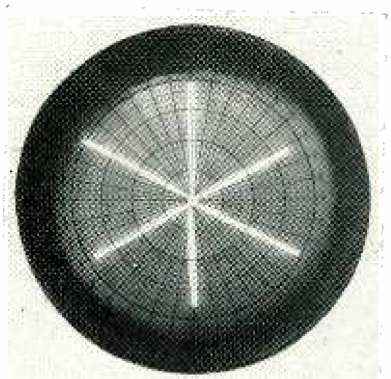
$$e_2 = A \cos (\omega t + \varphi) \quad (2)$$

and its quadrature component

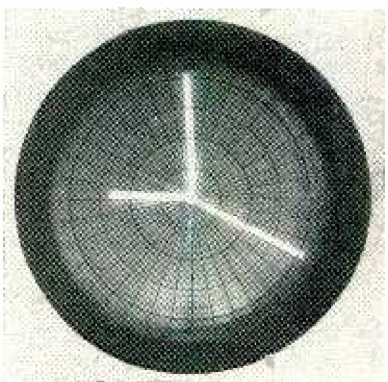
$$e_3 = A \sin (\omega t + \varphi) \quad (3)$$

To obtain the quadrature signal e_3 from the test signal, the latter is fed through a quarter-wave delay line or through a 90-deg phase shifter.

Both the test signal e_2 and the quadrature signal e_3 are then fed into separate synchronous detectors where they mix with the decoding wave e_1. Only demodulation products at the frequency $\Omega/2\pi = 1$



Hexagon display resulting from tying the instrument sequentially to six equidistant points along a delay line one wavelength long at 3.89 mc. Line was made up of lumped constants and contact to the instrument was made through an electronic sequencer



Odd-field display used to monitor an NTSC color test picture consisting of three horizontal bars per field, each in a saturated primary color. Short blue signal vector may be distinguished from a parallel but longer vector representing the cpa axis

for Color Television

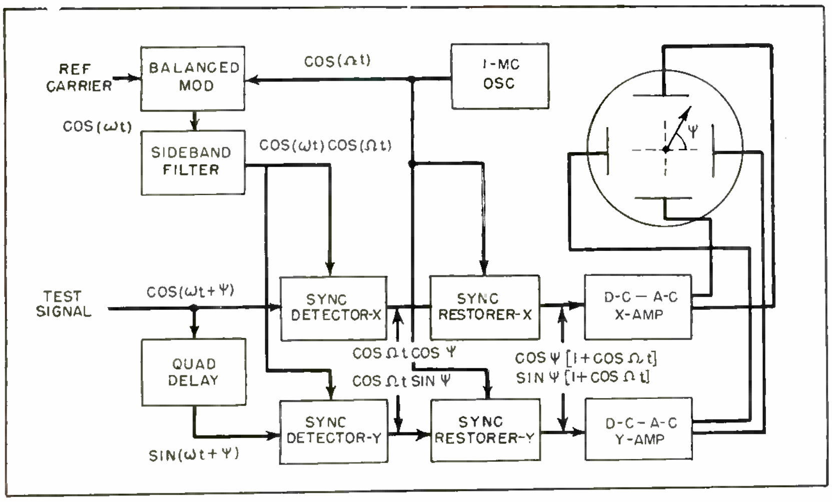


FIG. 1—Block diagram of the instrument called the Vectorscope

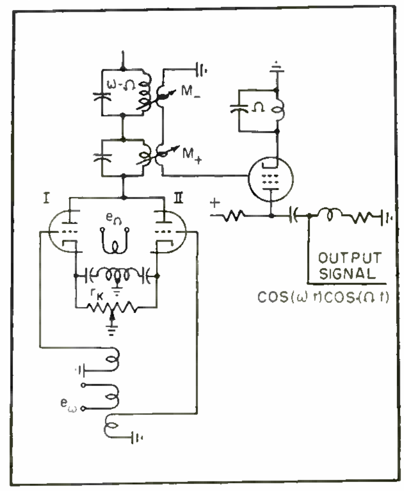


FIG. 2—Carrier-split circuit

mc are allowed to pass through the output filters of these detectors.

To find these components, expand Eq. 2

$$e_2 = A\ (\cos \omega t \cos \varphi - \sin \omega t \sin \varphi) \quad (4)$$

Since synchronous detection by e_1 yields no output from the sine term of Eq. 4, the detector output is

$$e_4 = \tfrac{1}{2}\, e_0\, A \cos \varphi \cos \Omega t \quad (5)$$

Similarly, the result of synchronous detection of e_3 by e_1 becomes

$$e_5 = \tfrac{1}{2}\, e_0\, A \sin \varphi \cos \Omega t \quad (7)$$

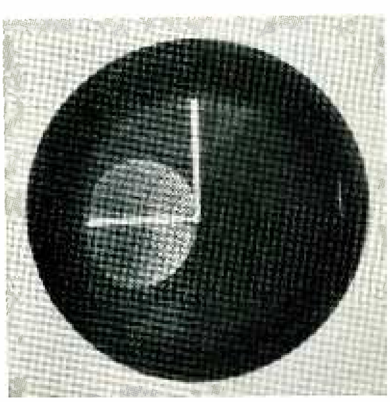
If the phase signals e_4 and e_5 were used directly for deflection in the x and y direction, respectively, the result would be a phasor with the correct amplitude and inclination, swept through the center of the screen by a one-mc sine wave. This type of display is unable to differentiate between phasors 180-deg apart.

To avoid this ambiguity, a radial offset is desirable, which makes each phasor start from the center on outward. Mathematically speaking, this requires the addition to the phase signals e_4 and e_5 of shift voltages of the form

$$e_6 = \tfrac{1}{2}\, A\, e_0 \cos \varphi \quad (7)$$

$$e_7 = \tfrac{1}{2}\, A\, e_0 \sin \varphi \quad (8)$$

respectively. In operation, these terms can assume either polarity.



Attempts to lock a quartz crystal in with a variable frequency. Two vectors at 0 and 90 deg show resulting quadrature relationship between input and output. Vector pattern is response of the quartz. Luminescent area displays the expected circle diagram

Appearance of side-locking, the locking of a resonator on sidebands of a carrier which arrives in bursts. This vector display of first-order side-locking shows a luminous circle swept by a radius vector rotating at a speed of 15.750 revolutions per second

Synchronous Restorers

Generation of the shift-signals e_6, e_7 from the phase signal input e_4, e_5 is done in two synchronous d-c restorers. At the restorer output, shift and phase signals are combined

$$e_y = \tfrac{1}{2}\, e_0\, A \sin \varphi\, [1 + \cos (\Omega t)] \quad (9)$$

$$e_x = \tfrac{1}{2}\, e_0\, A \cos \varphi\, [1 + \cos (\Omega t)] \quad (10)$$

These composite voltages require only some suitable amplification, see Fig. 5, before being applied to the deflecting plates of the instrument. The resulting vector display con-

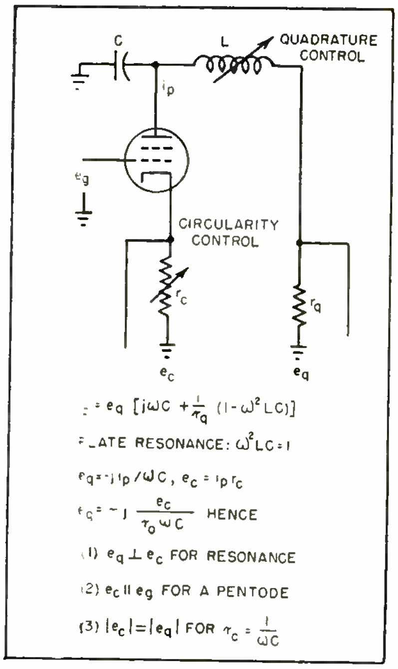


FIG. 3—Pentode delay circuit

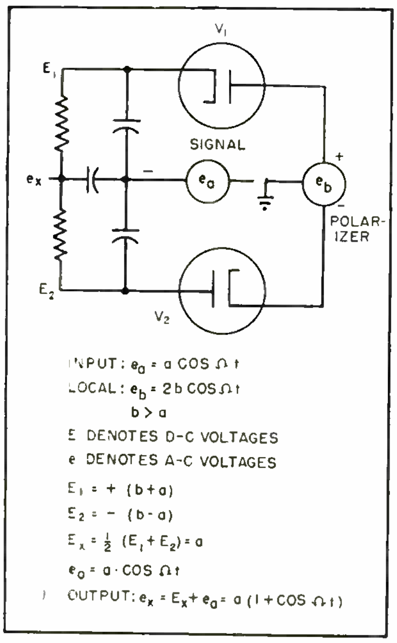


FIG. 4—Synchronous d-c restoration

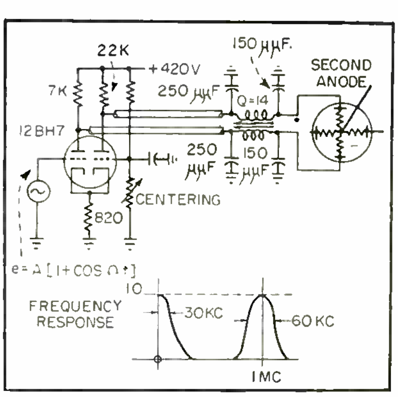


FIG. 5—Deflection amplifier for instrument display

veys not only the angular or phase information, but amplitude information as well, as long as the reference level e_0 is kept constant. The instrument is thus capable of a complete vector presentation of the test carrier in polar coordinates.

Unconventional Circuitry

Figure 2 presents the carrier split circuit used to replace the 4-mc reference by two sidebands at 3 and 4 mc. This unit employs a double triode modulator with double balance; both the signal carrier ω as well as a modulating carrier Ω are applied in push-pull fashion. The plate output is single ended with both plates in parallel.

If the triodes are balanced at the cathode bias resistor r_k as shown, both carrier frequencies ω and Ω cancel in the plate circuit, whereas the two sideband energies at $(\omega \pm \Omega)$ add.

The sideband frequencies are selected by two circuits tuned to 3 and 5 mc, respectively. By adding controlled amounts of pickup from each in a common tertiary, the sideband amplitudes are equalized and the desired decoding signal e_1 results. The output amplifier is flat beyond 5 mc and has a tuned cathode trap to remove any remnants of the 1-mc carrier.

The signal delay circuit used to obtain e_3 from e_2 is shown in Fig. 3. The circuit permits separate adjustment of amplitude ratio and phase angle between two output voltages e_g and e_c. This is shown by the set of equations indicated on Fig. 3 that quadrature between e_g and e_0 is obtained for any value of r_g by tuning the plate inductance for resonance. Circularity or equal output in both phases results if the cathode resistor r_c equals the reactance of the plate capacitor C. The values of plate inductance and plate load resistance r_g are again immaterial in this respect.

The transfer constant of this circuit is somewhat less than unity. The use of a pentode, rather than a triode, insures phase coincidence between grid voltage and cathode output regardless of the plate load impedance.

Figure 4 demonstrates the principle of synchronous d-c restoration which is used in the instrument to add a radial shift to an on-center display of phasors. The technical problem consists in converting a waveform $A \cos \Omega t$ into the composite wave $A\ (1 + \cos \Omega\, t)$, where A can assume both positive and negative values in rapid succession. To make the restorer polarity conscious, a synchronous polarizing wave is used whose amplitude exceeds the signal.

Two diodes serve as envelope detectors for sum and difference of signal and polarizer. The difference of the two d-c outputs is then the desired shift voltage.

Figure 5 shows the deflection output amplifier used in the instrument. Since the signal consists of a constant frequency component and a d-c shift, the frequency response of the unit is designed for two separate lobes. One is around 1 mc and the other around the d-c axis. The bandwidth of each lobe is chosen such that the resulting speed of a-c and d-c response is of the same order, 5 μsec. This prevents the vectors from overshooting the center for rapidly varying color signals.

Color Applications

The photographs illustrate some of the results obtained when the device was put to use in connection with color equipment. The instrument was first lined up by tying it sequentially to six equidistant points along a delay line one wavelength long at 3.89 mc. The line was made up of lumped constants and contact to the instrument was made through an electronic sequencer, with each contact lasting 1/360 sec.

The use of a phase indicator of this type is not limited to color television. Other applications include p-m and f-m monitoring, direction finding and problems involving delay networks. This includes the study of phase and delay distortion in the general four-terminal network.

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(2) Specifications for Color Television Field Tests, ELECTRONICS, p 126, Jan. 1952.

Power Control With Magnetic Amplifiers

Recent developments in high-power industrial magnetic amplifiers, which have been overshadowed in the past few years by more glamorous advances in miniaturization, are described. New materials and circuits improve power control characteristics

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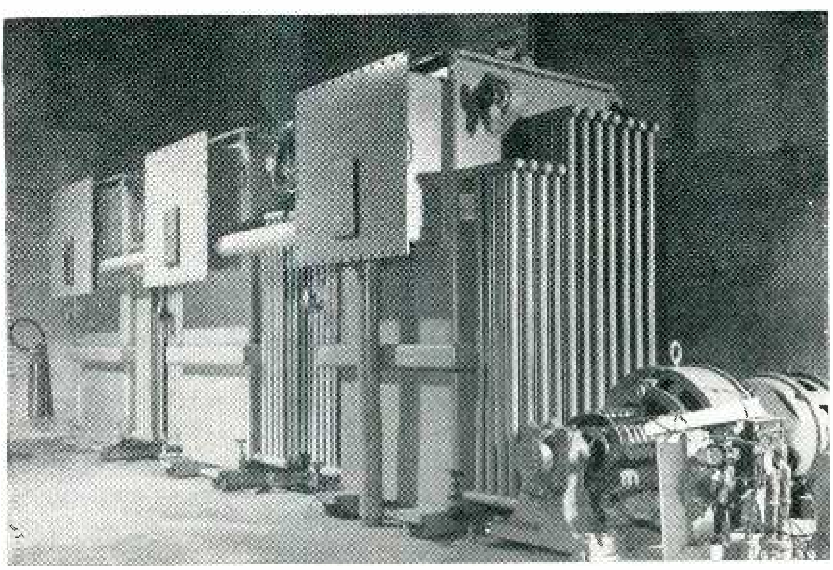
THREE outstanding advances have changed the magnetic amplifier from the crude and sluggish amplifier of 20 years ago to the amazingly fast, flexible, and powerful control component of today. These are: the self-saturating circuits, which raised the ratio of power gain to response time by about 100; the development of square-loop magnetic materials such as Hipernik V and others which gave combined high gain with high output, and improved control; and improvements in dry-type rectifiers which further improved the gain, stability, and reliability.

This article is based on a paper presented at the American Power Conference, sponsored by Illinois Institute of Technology.

Operation of the self-saturated magnetic amplifier may be explained by the idealized half-wave circuit of Fig. 1A in which a large inductance blocks a-c from the control winding. During the reverse (opposite to rectifier) half cycle of voltage the flux density B has assumed a value corresponding to the control current, I_{co} as shown in Fig. 1B. When the forward half cycle of voltage occurs, the core generates a back voltage preventing the flow of load current until the core saturates. This is repeated each cycle.

The average voltage reduction on the load, occasioned by this delay in firing (Fig. 1C) on each forward half cycle, is directly proportional to the flux reduction, $\Delta\phi$, below saturation produced by the control current I_{co}. The control characteristic of Fig. 1D results. Practical full wave circuits operate in essentially the same manner but do not require the inductor in the control circuit.



Magnetic amplifiers for controlling 1,800-kw 60-cps power supply for r-f heater on tin reflow line. Motor-generator set supplies d-c control power

The basic magnetic amplifier circuits now in use for power control represent many combinations and modifications of the circuit shown in Fig. 1. The self-saturated types have replaced the simple saturable reactor type for most applications. Most popular are the parallel-connected or doubler circuit, with a-c output; the center-tapped transformer, full-wave connection for d-c output; and the bridge connection for d-c output. The doubler output can of course be rectified for d-c output. Usually the choice of d-c or a-c output and the voltage rating will determine which circuit should be used.

The rectifiers may be divided into self-saturating, those directly in series with saturable reactor windings, and simple rectifying units. The latter act as in any rectifiers but the former have the added requirement of low and stable back current to produce high amplifier gain and low drift. In low-voltage applications, where a single disk in series is adequate, the bridge connection results in smaller size and weight, whereas if several disks are required in series, the doubler (requiring fewer self-saturating rectifiers) is advantageous. Such and other practical considerations dictate the basic circuit to be employed.

The center-tapped transformer connection and the bridge connection correspond to the connections of dry-type rectifiers except for the insertion of the saturable reactors to control the firing, giving the equivalent of a thyratron grid delay. This equivalence gives rise to

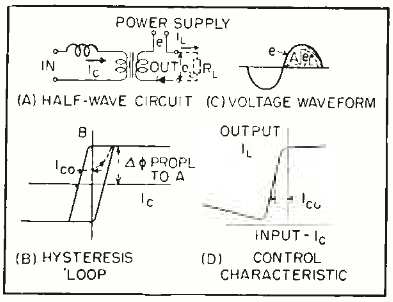


FIG. 1—Idealized magnetic amplifier circuit and characteristics

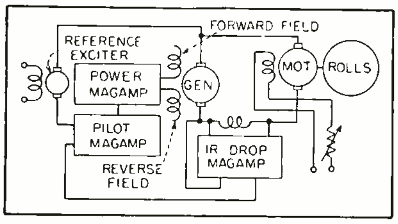
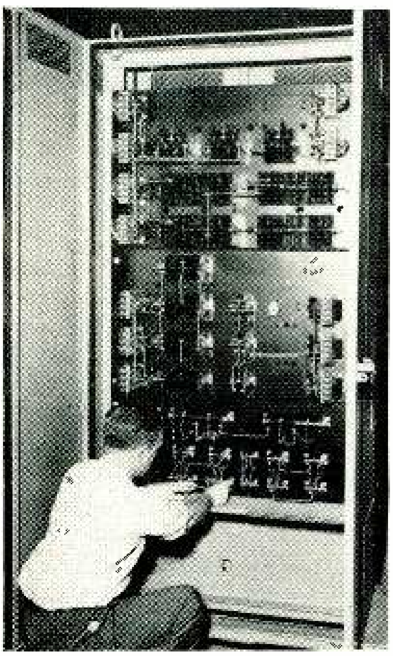


FIG. 2—Schematic of magnetic amplifier for one stand of tandem steel mill regulator



Cubicle housing 400-cps pilot, power and IR-drop magnetic amplifiers for tandem steel mill regulator (Fig. 2)

the symbolic representation used in the remainder of this article, in which the rectifiers alone are shown with the control and bias windings indicated schematically.

A few typical power applications illustrate the potentialities of this new tool.

Steel Mill Regulator

The four or five stands of a tandem cold rolling mill are regulated to follow in speed a master d-c reference bus which brings the mill from a low threading speed up to running speeds of over a mile a minute in a matter of six seconds, closely controlling the tension all the while. The stop is also six seconds (four in emergencies) and uniform tension between stands must be maintained down to standstill.

A high grade regulator is required which can maintain proper interstand relations throughout this difficult cycle in spite of minor load fluctuations and irregularities. High regulator speed prevents differing acceleration lags and prevents loops accumulating due to minor fluctuations of material or voltage. Reliability is a prime requisite because a shutdown means serious loss of production.

Figure 2 shows the circuit of a magnetic amplifier regulator for one stand of such a mill. The equipment replaces an earlier system with about 5 to 1 improvement in response time, greatly simplified damping requirements, simpler adjustments and consequent improved reliability. The inherent delay in a magnetic amplifier tends to be about the same number of cycles, irrespective of frequency so that the 420-cycle magnetic amplifier is inherently seven times faster than a corresponding 60-cycle unit.

Other Mill Applications

Magnetic amplifier applications have also been made to the main drives of many other types of mill, tin plating lines, and printing presses, as well as to many auxiliaries.

The reel drive is worthy of special notice since so much processed material must be reeled and re-reeled as it passes through various processes from the raw material to the finished product. The usual requirement is a constant tension drive permitting a reduction in rotational speed as the material builds up on the reel. This is secured by current regulation, the magnetic amplifier comparing the reel motor current with a reference and controlling the motor field current accordingly. Highly successful applications have been made and it is interesting to note that the control panel, including the magnetic amplifiers, for one of these is no larger than the control panel previously used for the rotating regulators being displaced.

Magnetic amplifiers are now controlling the firing circuits of ignitron rectifiers, providing a smooth reliable control and replacing the thyratrons previously used for this purpose.

Regulated d-c power supplies are now available, entirely without vacuum tubes. These are being applied in government applications at present but will also provide an almost maintenance-free unit for industry.

Magnetic amplifiers have been used for years in certain variable speed controls to cranes and hoists. Now the new high performance units are bringing in a whole field of applications of variable speed drives, both d-c and a-c, for all kinds of industrial operations, elevators, wind tunnels, and the like.

Tin Reflow Line

High performance control is nowhere better exemplified than in the tin reflow line where high-frequency heat raises the temperature of electrolytically-plated tin to the flow point so precisely that with the plated strip moving nearly half a mile a minute, the flow line remains stationary in position. A phototube signals the position of the flow line to an amplifier. Power is amplified through an exciter and three 600-kw power magnetic amplifiers to the plates of the tubes that generate the high frequency for heating. This set-up is shown in Fig. 3.

The smooth control obtained with static high power equipment is advantageous in this case. Of interest is the use of electronic, rotating, and magnetic amplifiers, in this single control. However, the present

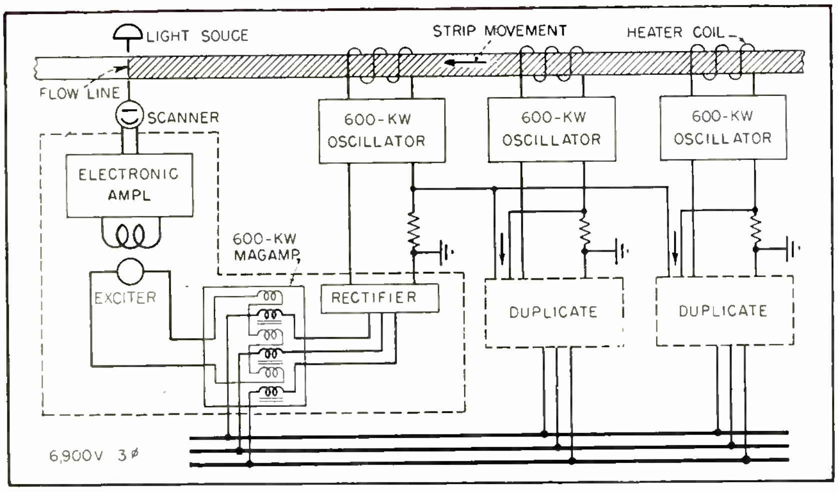


FIG. 3—Tin reflow line requires a series of 600-kw magnetic amplifiers for accurate heating control

trend is to extend the use of the magnetic amplifier.

Magnetic amplifiers are finding use in generator excitation systems from the smallest aircraft generators to the largest central station unit. The advantages offered are numerous.

Exciter Circuit

A magnetic amplifier excitation unit and regulator for machines of several hundred kilowatts is shown in Fig. 4. In this case about half of the excitation at full load is supplied directly by series compensation, resulting in extremely rapid response to sudden load changes. The balance of the excitation required for no load and to compensate for drift, aging, temperature changes and forcing is supplied through the exciter under control of the static regulating circuit.

The latter unit in effect compares the generator voltage, compensated for reactive drop, with a fixed reference and provides a corrective signal to the magnetic amplifier in event of any voltage deviation from setting. Essentially the same magnetic amplifier that serves as the exciter for this size generator would be the pilot magnetic amplifier supplying a main exciter for the largest turbine-generator units.

In addition to voltage, all manner of other quantities are being regulated. These include speed, frequency, position, temperature, charging rate, light intensity, and the like, it merely being required to reduce the regulated quantity to an electrical signal for application to the amplifier.

Military Applications

Greatest current interest in power magnetic amplifiers is in the military field, where because of their smaller size, greater efficiency, rugged construction and prospective freedom from maintenance, they are replacing electron tubes in many applications. A number of autopilots and gun mounts and stabilizers are already converted, a single autopilot using over 30 separate magnetic amplifiers. The tremendous development in the military field is making technical improvements in power magnetic amplifiers available at a rapid rate for industrial applications.

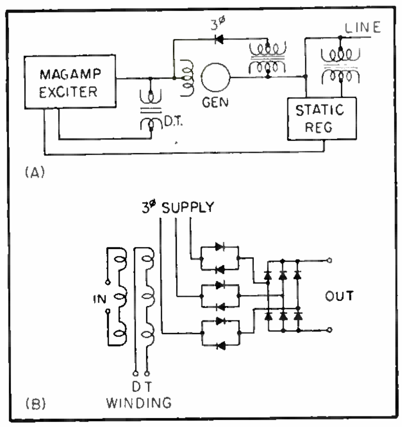


FIG. 4—Magnetic amplifier and regulator for machines of several hundred kilowatts

D-C Transductor

The d-c current transformer like perpetual motion was long ago crossed off the slate as impossible. However, the series-connected magnetic amplifier has an equal-ampere-turn law and provides isolation of instrumentation from d-c power circuits and so serves the role so well that it is by courtesy sometimes called a d-c current transformer. For larger direct currents of 2,000 to 75,000 amperes, the d-c is passed through the openings of the saturable reactor cores and acts as the control current. The a-c secondary current is proportional to it. For smaller currents, shunts are more economical and auxiliary current-transductors are used for the isolation function.

Similarly shunt-connected magnetic amplifiers are used to isolate the power d-c bus from potential coils of switchboard instruments. Other instrumentation uses of magnetic amplifiers are to thermocouple and photocell amplifiers, strain gages and as a d-c amplifier.

Performance

The figure of merit of small 10 to 50-watt magnetic amplifiers is of the order of 1,000 per cycle, this figure increasing with physical size. This means that a power gain of 10,000 per stage is feasible with 10-cycle time constant or 3,000 with 3-cycle time constant, and so forth. Special circuits have been developed to carry this relation down to one cycle or less.

The control characteristic of the magnetic amplifier approaches a straight line relationship between control current and output or load current.

For many industrial controls the advantage of using available 60-cycle power sources precludes 400 or 800-cycle sources for the improved speed and lower weight. Static frequency multipliers are available and afford an answer to this problem for the lower power stages.

A frequency tripler, three phase from single phase, is composed of a star-delta transformer bank operated in saturation with the triple frequency load taken from one corner of the delta.

The applications which have been cited are typical of literally hundreds of applications being made in all branches of power control.

High-Speed Counter Uses Ternary Notation

Counter based on powers of three attains high counting speeds using fewer tubes than conventional counters. Circuit described operates reliably up to 175,000 counts per second using only nine stages. Application of circuit in fast nuclear scalers is predicted

MOST ELECTRONIC COUNTERS are binary in nature. Regardless of the number system used, they are made up of binary cells. In such counters, those using binary notation are most economical, not only in cost, but also in space and power requirements for a given memory capacity.

The usual four-tube decade when employed in a scale of one thousand would have a scale of over four thousand if the same twelve stages were used in binary notation. In commercial applications, such as nuclear scalers, even with binary notation there is a severe limitation in the memory capacity of a reasonably sized unit.

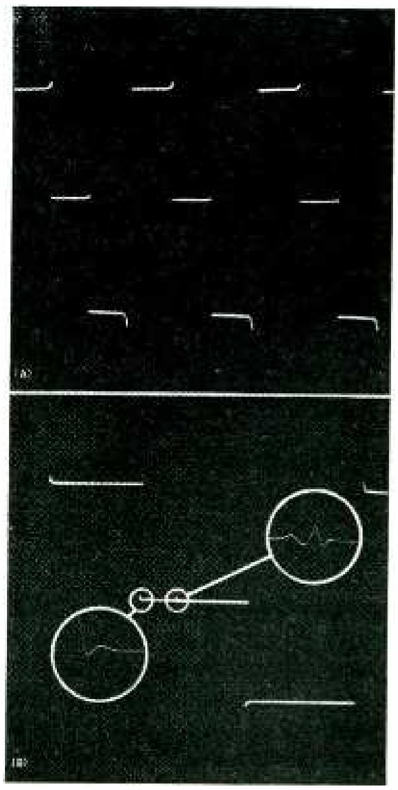
To take full advantage of a high-speed counter when storing large counts, it is necessary to use more binary stages than are commonly employed in nuclear scalers. Since the usual mechanical number register has a maximum speed of about twenty counts per second, to utilize the full speed of a 200-kc counter, at least fourteen binary stages must be used ahead of the number register. This is more than twice the number of stages found in commercial units. Improvement would be achieved through use of a memory element comparable in size and cost to the binary element but having greater memory capacity. The advantage of reliably increased memory capacity in large computers needs no explanation.

This paper describes a simple ternary memory and a fast counter using this memory in ternary notation. Any number of stages may be used, giving a number capacity of 3^n for n stages. In this counter, eight stages provide a scale of 6,561 as contrasted with 256 for an eight-stage binary counter.

Much of the work described in this article was carried on at Illinois Institute of Technology.

Ternary Memory

The flip-flop circuit, which provides conventional binary memory, may be considered as a closed-loop positive-feedback circuit comprising two amplifier stages. When the loop gain is greater than one, the circuit is unstable, and any minute change in plate current of either tube will reinforce itself and keep building up until loop gain is reduced to one, either by an approach to saturation in one tube or an approach to cutoff in the other.



Ternary counter waveforms illustrate the three discrete operating states comprising a counting cycle. Stage 2 plate voltage (B) shows division by three of input prf. Stage 1 plate voltage is shown in (A)

The circuit will then be in a stable condition until a change in voltage in any part of the loop drives it back to the region of higher gain. The change will then continue until limited by saturation or cutoff of the opposite tube, affording a second condition of stable operation.

To obtain more than two stable states, there must be an intermediate region wherein loop gain is reduced below unity. This may be accomplished by insertion of additional nonlinear elements into the loop. A convenient way of inserting the required nonlinearity is the use of diode coupling between cathodes. The component requirement is about the same as that of a Higinbotham-type binary stage[1].

Theory

The ternary memory is illustrated in Fig. 1. With the diodes removed, each half of the circuit resembles a phase-splitting circuit wherein plate and cathode resistances are about equal. The gain of each half is approximately one at both plate and cathode. Plate currents of both halves will be equal, since the circuit is symmetrical. Total loop gain will be the product of the gains of each half (slightly less than one).

If the cathodes are tied together,

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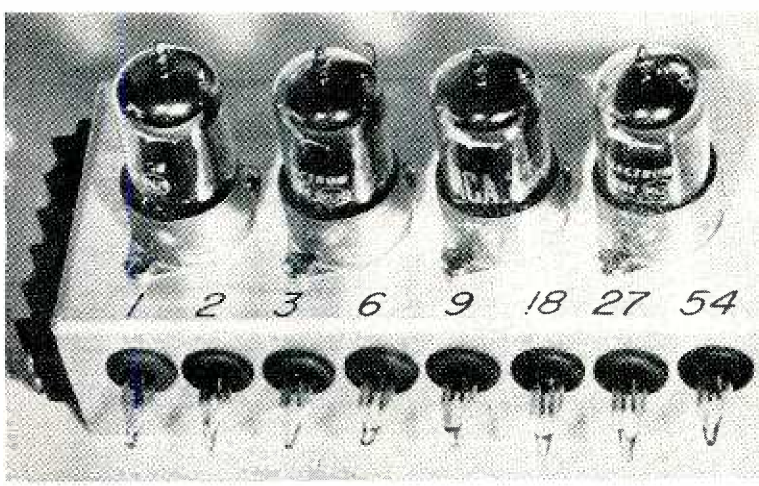
in addition to the signal at the grid of either tube, we may consider that another signal is injected at its cathode by the cathode of the other tube. The loop gain will now be greater than one and the circuit operates as a flip-flop. Another way to visualize the effect of tying cathodes together is to consider that as long as the circuit is symmetrical, increase in plate current of one tube will be cancelled by decrease in plate current of the other tube and the cathodes will remain at a fixed potential, thereby eliminating the degenerative effect of the cathode resistor.

With diodes connected as shown in Fig. 1, as long as both plate currents are the same, the cathodes will be at the same potential and both diodes will be nonconducting since the diode anodes are at a negative potential with respect to their cathodes. A stable intermediate condition is thus provided as though the diodes were not in the circuit.

Memory Operation

If a pulse is applied at any electrode, the pulse being of sufficient amplitude to cause an amplifier cathode to move to a voltage below that of the tap on the opposite cathode resistor, or to raise a cathode resistor tap above the potential of the opposite cathode, a diode will begin to conduct. Once a diode begins conducting, the effect is the same as that of tying the cathodes together through a small resistor. Loop gain will be increased to a value considerably greater than one, and flip-flop action will take place. Any tendency of a diode to conduct will result in a signal injected at a cathode, the signal being of the right polarity to make the diode conduct still further. Thus, using nonlinear coupling in a closed-loop positive-feedback system, it is possible to obtain three regions in the conduction characteristic wherein loop gain is less than unity, and consequently to achieve three stable conditions. The three states are well defined and widely separated. Plate potentials in a typical circuit are 135, 190 and 255 volts.

Counting, or plus-one operation necessitates driving the memory successively through its three states by a repeated pulse at the same point of the circuit. If the counter



Four-stage ternary counter, with two-light-per-stage indication, having a scale of 81. Lighted neon bulbs indicate 3" and 2 × 3"

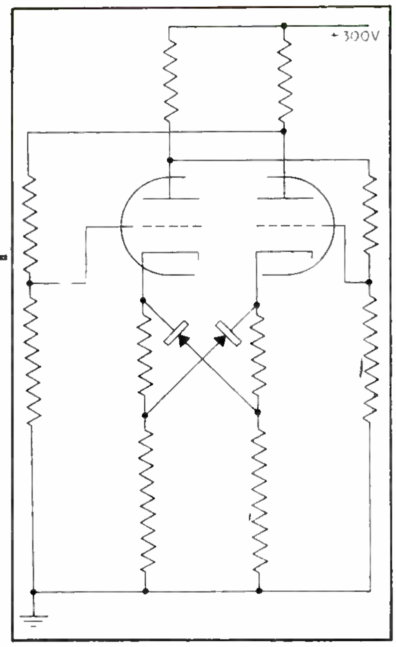


FIG. 1—Basic ternary memory has three stable operating states

is to be used in ternary notation, the operation must be cyclical. Instead of stopping at the last stable position, the circuit must revert to its initial condition on the next impulse and repeat its cycle.

Counting Operation

Derivation of the cyclical counting operation from the ternary memory requires the use of the same plate-to-grid capacitors found in binary memories. Injection of the input pulse at a cathode is used here, but plate and grid injection have been found successful as well. An advantage of additional stability is obtained by cathode injection because of relative freedom from kickback from the driven stage since the injection point is not subject to full transition voltage.

Counting Circuit

Two stages, providing a scale of nine, and the means for interstage coupling are shown in Fig. 2. Additional stages of the same type may be added as desired. The explanation of the first stage applies also to subsequent stages.

Referring to the first stage, the three stable states are designated as follows: 0,V_{1B} cut off, 1,V_{1B} and V_{1A} both in medium conduction, and, 2,V_{1B} fully conducting. The sequence of states is 0-1-2-0. In state

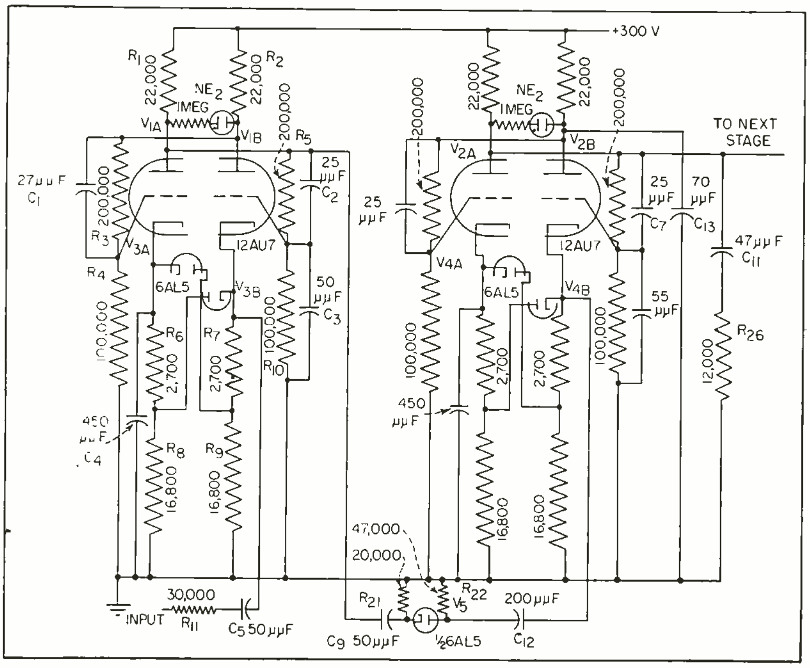


FIG. 2—Successive negative pulses to V_{1B} cathode drive the counter through its three states. With V_{1B} cut off, first pulse drives both tubes into conduction. Second pulse cuts off V_{1A}. Third pulse returns circuit to initial condition

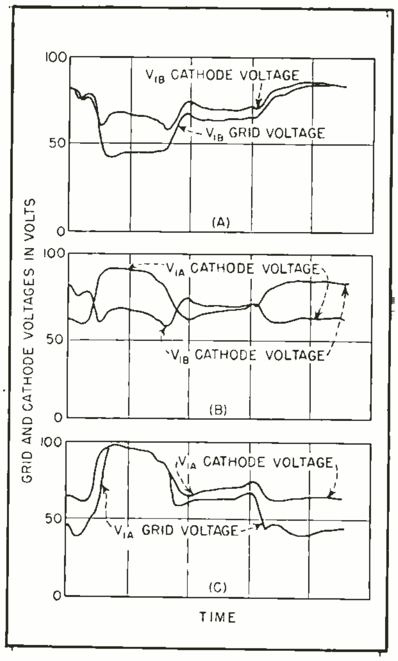


FIG. 3—Simultaneous grid and cathode voltage waveforms from both stages show step-by-step counter operation

0, V_{1B} is cut off and V_{1A} is fully conducting. A negative-going pulse of one microsecond duration is injected at the V_{1B} cathode. The momentary lowering of cathode potential drives V_{1B} out of cutoff and multivibrator action ensues, carrying the stage toward state 2. When both triodes are in the region of medium conduction, the cathodes are at the same potential and diodes V_{3A} and V_{3B} are nonconducting because of negative plate-to-cathode voltage. The input pulse has by this time disappeared. Multivibrator action ceases because cathode degeneration is permitted in the region of medium conduction and overall loop gain is reduced below unity. Thus the stage never reaches state 2 on the first pulse, but remains stably in the medium-conducting state.

Second Pulse

The next input pulse increases the conduction of V_{1B} to a point where loop action drives the cathode of V_{3A} negative with respect to its plate. Cathode degeneration is no longer permitted and multivibrator action takes place until state 2 is reached. Cutoff of V_{1A} reduces the loop gain and the circuit remains stably in state 2. V_{1B} is now fully conducting.

The next input pulse drives V_{1B} into positive-grid-voltage region wherein C_2 takes on an additional function. Because of diode action between grid and cathode of V_{1B} during the pulse, current flows through R_1 to increase the charge of C_2. When the input pulse has ended, V_{1B} grid is sufficiently negative with respect to its former potential for V_{1B} to start into cutoff. The new potential across C_2 is maintained for a long enough time for the stage to pass completely through stage 1 and directly to the stable 0 condition. Diode action between grid and cathode of V_{1B} acts as a pulse stretcher, permitting fast charge and slow discharge of C_2. Thus the secondary effect of the input pulse, which is to lower the grid potential of V_{1B}, is prolonged until some time after the pulse itself has ended. By virtue of this secondary effect V_{1B} begins to cut off.

Memory Reset

Multivibrator action takes the stage to state 1, but this time, instead of stopping in state 1, the stage passes through the middle state directly into the initial 0 condition since C_2 still retains some charge from the prolonged secondary effect. Since V_{1B} has previously been cut off and its grid is considerably lower in potential than its

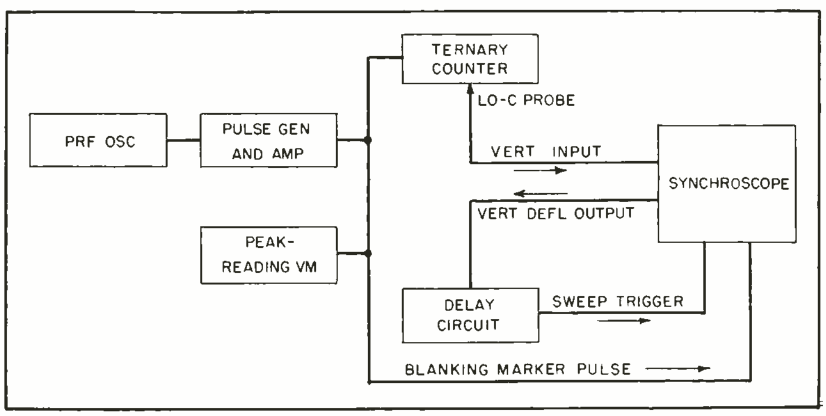


FIG. 4—Ternary counter and test equipment setup used to study circuit operations. Waveforms shown in Fig. 3 were traced from synchroscope

cathode, the secondary effect can not occur in the transition from state 0 to state 1.

Typical waveforms of the ternary counter are shown in the photograph. They were taken at the first and second stage plates. For a detailed study of the various events occurring simultaneously in different parts of the circuit during each transition, it was found convenient to make tracings directly from the oscilloscope. Intensity modulation was used to secure a fixed time reference so that waveforms taken from separate points could be shown accurately on the same time axis. Use of a variable sweep delay permits display of the three transitions in the first stage on a time base of one microsecond per centimeter. Figure 3 shows the essential voltage relationships in the grid and cathode circuits with blanking markers derived at the start of each input pulse. The test setup, which is useful in any general study of counters and similar circuits, is shown in the block diagram, Fig. 4.

Circuit Details

In Fig. 2, capacitor C_3, not only complements the secondary effect in the 2-0 transition by a fast discharge-slow charge action similar to that of C_2, but also serves to reduce overshoot from the 0-1 transition. This overshoot would result in V_{1B} grid being driven farther negative than its normal state 1 potential and would tend to produce an undesired 0-2 transition. Capacitor C_4 acts to reduce rise time of V_{1A} plate voltage. Relatively fast rise of V_{1A} plate voltage in the 2-0 transition is necessary to obtain a sufficiently sharp output pulse to drive the succeeding stage.

Resistor R_2 prevents overshoot in the input pulse, which would otherwise result from the C_5-R_7-R_9 combination when the input pulse is rectangular. With R_{11} in the input circuit, the input pulse shape is not critical. In the second and subsequent stages C_{13} is added; C_{13} permits use of the comparatively slow rising pulse derived from the previous stage by slowing up the 0-1 transition to assure the passing of the input pulse by the time transition is well under way. In the first stage, faster counting speed requires a shorter input pulse and C_{13} is not necessary.

To derive the pulse for triggering the second stage, the step waveform of the 0-2 transition in the first stage is differentiated by the R_{21}-C_9 combination. Diode V_6 eliminates positive pulses from 0-1 and 1-2 transitions. Resistor R_{22} establishes the diode plate reference point and C_{12} serves as a blocking capacitor. At the second stage output R_{26} and C_{11} are used as an output load to represent the succeeding stage.

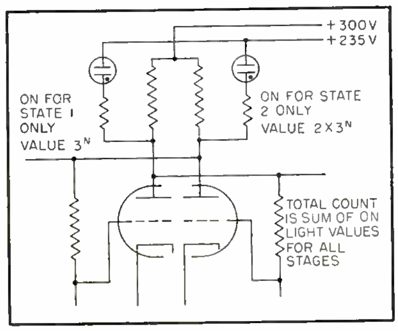


FIG. 5—Two-light-per-stage ternary indicating system

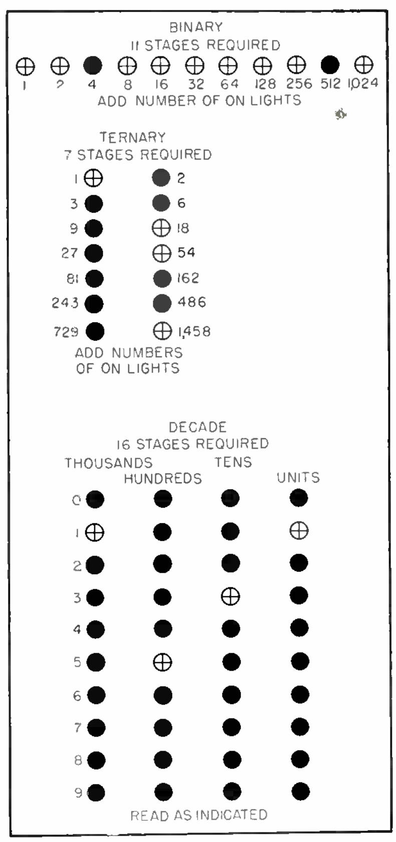


FIG. 6—Number 1,531 displayed in binary, ternary, and decade indications. Economy in number of stages characterizes ternary system

Diodes in this circuit are hard tube types, but germanium rectifiers will work equally well.

Indicating System

The indicating system shown in Fig. 2 requires only one neon light per stage. The left electrode glows in state 0, the lamp is dark in state 1, and the right-hand electrode glows to indicate state 2. In applications where ease of reading is more important than compactness, a two-light-per-stage system as shown in Fig. 5 may be used. In either case, there is no marginal operation and no resistor network is needed to obtain the read-out in ordinary ternary notation. As an example of the ternary read-out with two lights per stage compared with the conventional binary and decade indication the arbitrary number 1,531 is displayed in Fig. 6 in three different systems. The relative number of stages required is indicated for each system.

Components

The counter operates reliably at speeds up to 175,000 pulses per second. Input pulse height can vary from 85 to over 150 volts with perfect counting action throughout the range. The component tolerances are about the same as for a conventional binary counter. Symmetrically located component pairs are required to be matched within five percent with the exception of the plate load resistors, which can be within twenty percent. If the required matching of pairs is effected, the pairs may be within ten percent of the nominal value. Exceptions may be made for R_{21}, R_{22}, R_{11}, C_5, C_9, C_4, C_{10} and C_{12}, which need only be held to within twenty percent of nominal value.

The counter is not critical of supply voltage variation and will operate satisfactorily with B voltages from 250 to 325. At the nominal operating voltage of 300 volts, the current drain is about eight milliamperes per stage, which is about the same as that of the conventional Higinbotham-type binary stage of equal speed.

REFERENCE

1. W. Higinbotham, J. Gallagher, M. Sands, The Model 200 Pulse Counter, *Rev Sci Instr.* **18**, 10, Oct. 1947.

Field Plotting in

By E. SIEMINSKI

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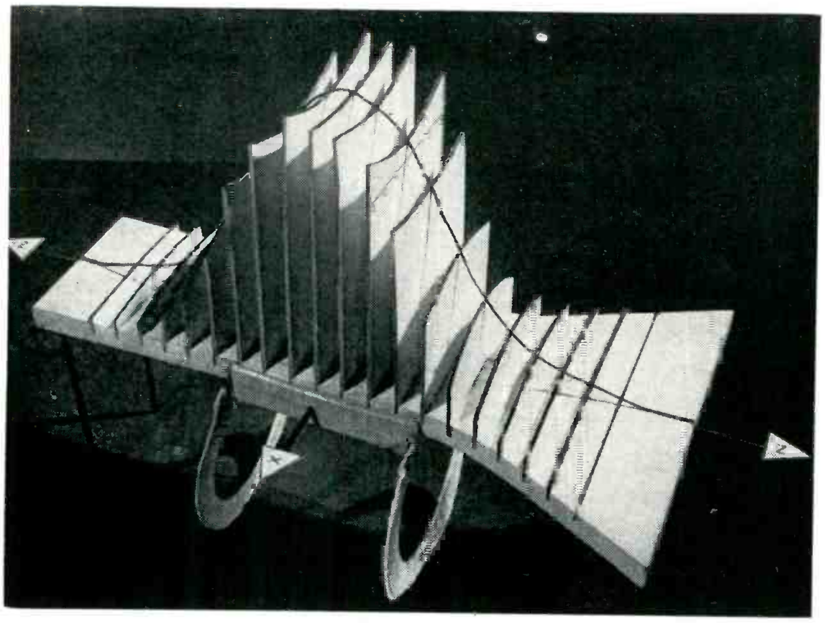
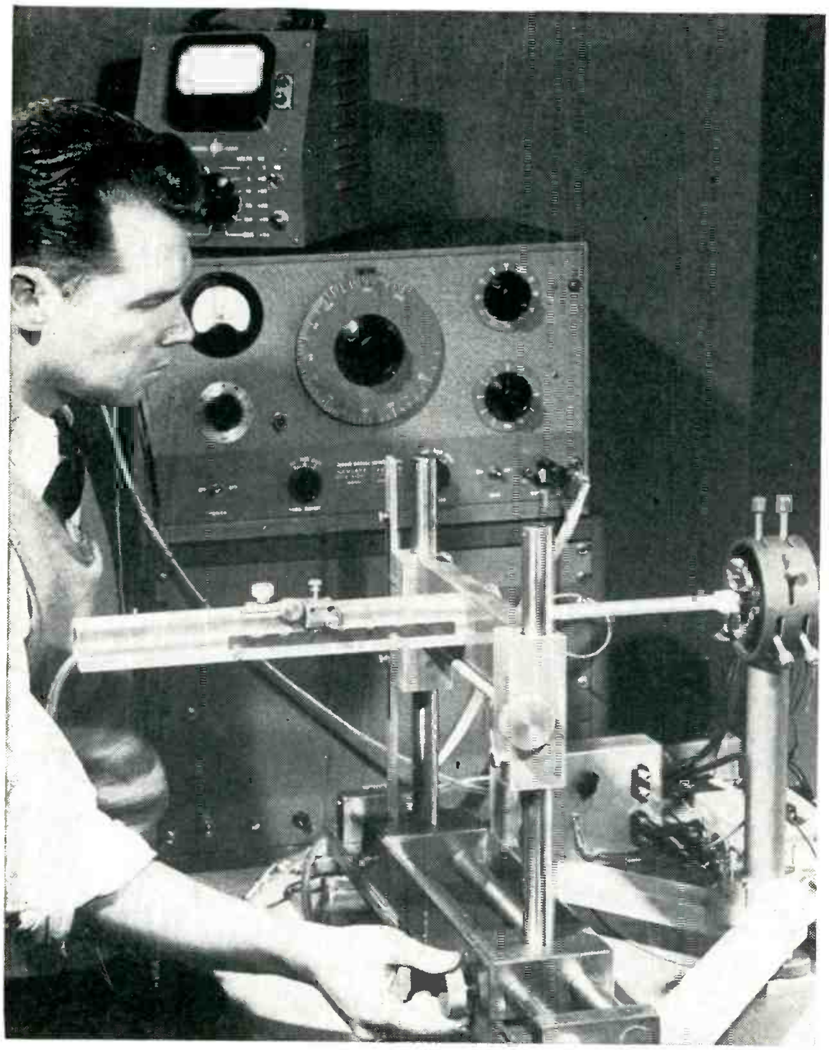


Space-model plot of the H_y component through the xz plane



Field-plotting equipment. Probe coil may be rotated fully about the longitudinal axis of the probe rod

SCANNING PROBLEMS in television picture tubes challenge the ingenuity of the television engineer. This is largely because of the difficulty of analyzing the magnetic deflection yoke, the heart of the scanning system in common use. Significantly, the conventional deflection yoke was developed almost entirely by empirical techniques.[1,2,3,4]

Competition has fostered a demand for better picture quality and picture tubes with larger faces and shorter neck and cone lengths, all of which magnify the difficulties of yoke design. The advent of tricolor picture tubes with most exacting deflection requirements has necessitated a renewed search for better design techniques. In the course of this search, deflection field configurations were studied and the utility of the field plot established in both the empirical and analytical[5,6] approaches to the deflection problem.

The Field

An electron beam has an appreciable thickness and in the process of being focused on the phosphor screen, takes on a long, thin conical shape. The greater the deviation from the ideal (infinitely-thin) cylindrically shaped beam and the greater the angle of deflection, the more serious are the defocusing and raster distortion effects[7]. In the three-gun tricolor tube, the cluster of three beams behaves like an extra-thick composite beam having an extra-large convergence angle and aberration effects are severe. The elimination of deflection aberrations is usually the major problem in the design of deflection yokes.

In the following discussion, the horizontal and vertical magnetic

Deflection Yoke Design

Simple method of analysis permits accurate measurement of differences in performance caused by design changes. Specific deflection responses may be attributed to specific design changes. Need for manipulating cathode-ray tubes is minimized

fields of the television yoke will be identified by the symbols: H = magnitude of the field set up by current in horizontal deflection windings and V = magnitude of the field set up by current in vertical deflection windings.

Since both fields follow the same laws of physics, only one field H is to be studied and the conclusions reached applied, in principle, to the other field.

A magnetic field is a vector quantity which can be visualized as the resultant of component vectors directed along the three axes of a system of Cartesian coordinates, Fig. 1. The three components of the H field will be designated H_x, H_y, and H_z. Since the H_y component is the one which produces horizontal deflection (x direction), it will receive the most attention.

Figure 1 depicts also the manner in which the H_y component varies in a typical television yoke. The H_y component is explored along x, y and z axes. Cross-sectional sketches of side and end views of the windings serve to locate the plotted points in space with reference to the physical windings. The points A, B, C, D and E are common on all three sets of curves.

As a further aid in visualizing field configurations it is sometimes helpful to build a space model such as that shown in the photograph. This is a plot of the H_y component throughout the xz plane. The base of the model represents the xz plane which bisects the horizontal windings and the height of the curves above the base represents the relative magnitude of field component in the xz plane. Mathematically, the surface formed by the curves expresses H_y as a function of x and z, or H_y (x, z).

The sets of line plots employed here are those most useful in practice namely: The H_y (x) function expressed in a family of curves taken along lines paralleling the x axis and the H_a function defined as the single curve $H_y(z)$ taken along the z axis proper. In the photo-

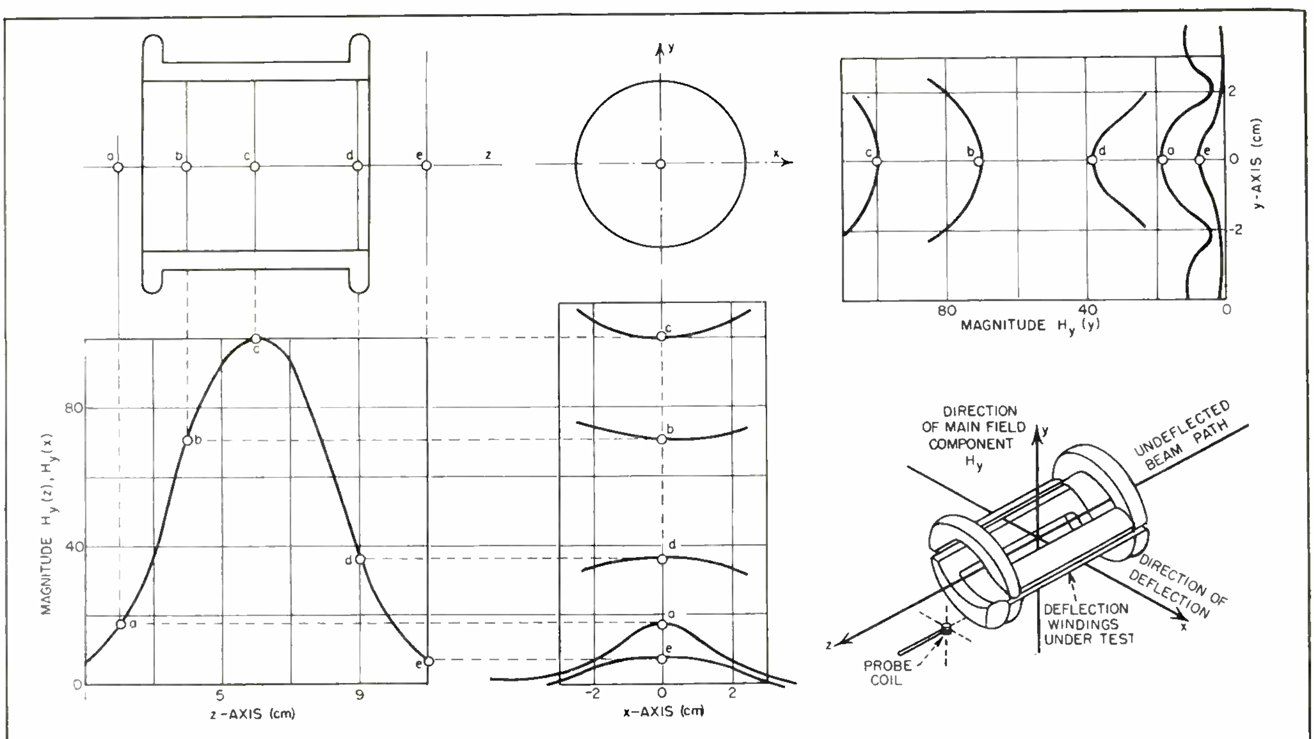


FIG. 1—The H_y field plot of a commercial yoke and a mechanical sketch showing the coordinate axes

graph, this curve is the dark line joining the midpoints of the successive $H_y(x)$ curves.

A complete picture of the field would require a discouragingly large number of plots in families of curves $H_y(x)$, $H_y(y)$, $H_y(z)$, repeating all for $H_x(x,y,z)$ and $H_z(x,y,z)$. In practice a modest number of plots suffices. A specific problem often involves restricted areas of interest, so that only those areas need be explored. Advantage may be taken of the similarities exhibited by field characteristics in different regions plotted, reducing the number of curves necessary to supply desired information. For the H field, the H_y component is the dominant one. In the region of the main field, the H_x and H_z components are insignificantly small and need not be explored extensively.

Empirical-Design Plots

The ultimate criterion of a deflection yoke design is its performance on a picture tube, but the use of field plots provides unique advantages in analyzing and evaluating the numerous expedients used in reaching the design. It is a simple method of analysis that minimizes the need for manipulating cathode-ray tubes, always troublesome in experimental work. Whereas observations on picture tubes are subject to considerable error, the field-plotting technique permits accurate measurement of differences in performance caused by various design alterations. It becomes practicable to attribute specific deflection responses to specific design changes.

The degree of deflection produced by a winding geometry is proportional to the field intensity set up by the winding with a given current flow. To a first approximation, the integrated area under the H_y plot is a measure of the total deflection produced in a picture tube. When comparing plots, one must keep in mind the values of current required to produce the fields, as well as the relative inductances of the windings used in the comparison.[1]

Field plots reveal the amount of useful magnetic component present as compared to the remaining, usually troublesome, components. The field produced outside possible beam

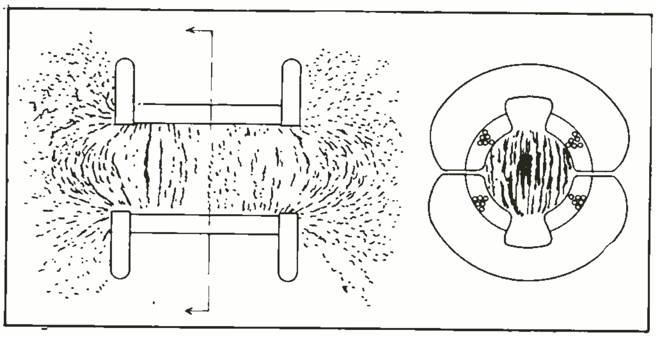


FIG. 2—Iron-filing plot of a uniformly-distributed winding and resulting barrel-shaped field

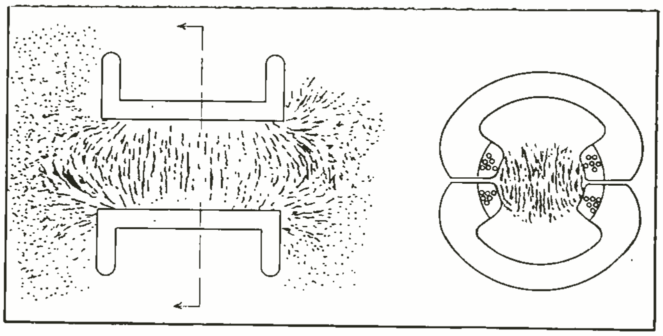


FIG. 3—Iron-filing plot of a concentrated winding and pincushion field

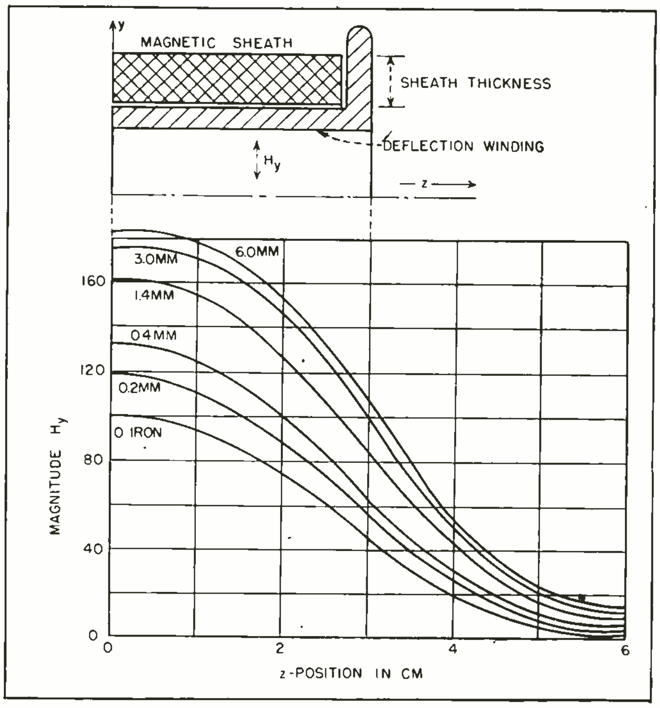


FIG. 4—Deflection field as a function of magnetic-sheath thickness

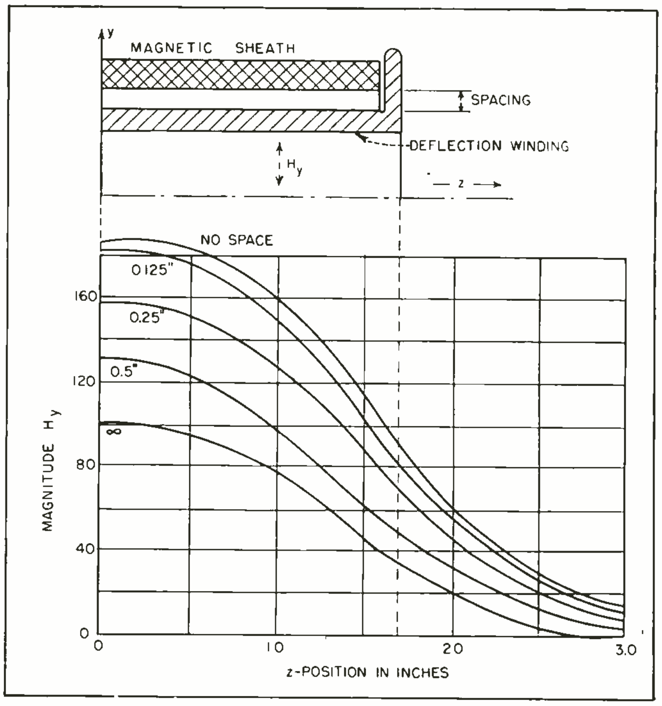


FIG. 5—Deflection field as a function of magnetic-sheath spacing

paths is wasteful of power since it has no effect on deflection. The involved fringe field may be studied effectively also by exploring all components.

With large deflection angles, avoidance of neck shadow may require a concentration of the field in the flared region of the tube neck. By contrast, in conventional yokes (Fig. 1), the build-up of area under the H_v curve indicates that the bulk of deflection occurs well before the beam enters the flared neck of the picture tube, which is the screen end of the deflection winding. With the help of field plots, a more efficient concentration of field can be obtained.

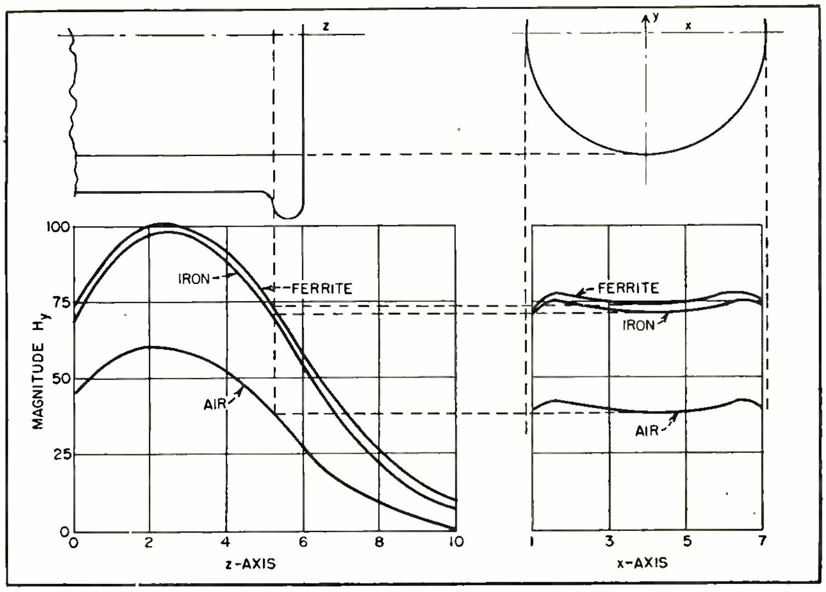


FIG. 6—Suitability of different sheath materials may readily be evaluated

Pattern Distortion

Shaping the deflection field has a profound effect upon raster distortion.[8] Even if the ideal uniform field could be obtained ($H_y = 0$), the flat or near-flat geometry of the conventional tube face would cause a pincushion-shaped distortion to appear on the tube screen. The perfect raster would be formed on a spherical screen surface. To eliminate the raster distortion, an equal and opposite distortion may be introduced by curving the deflection field appropriately. It may be shown[8] that a barrel-shaped distortion in the raster is produced by a pincushion-shaped field. Conversely, a pincushion distortion is introduced by a barrel-shaped field.

Figures 2 and 3 illustrate these two field configurations obtained experimentally. In these illustrations, iron-filing pictures were made in d-c excited windings. Unlike the other field plots appearing graphically in this discussion, Fig. 2 and 3 each show combinations of two field components (H_z and H_y in the lengthwise view and H_x and H_y in the end-on view). These are isometric plots of the field, loci of points of the same intensity, in the cross-sectional planes indicated.

Winding Geometry

Winding geometry may be studied effectively with field plots. Whereas uniform distribution of conductors on the circumference of the tube neck tends toward generation of the barrel-shaped field of Fig. 2, a relatively concentrated winding generates the pincushion-shaped field of Fig. 3. Present-day commercial yoke windings often utilize a type of conductor distribution wherein the number of conductors in a small arc on the circumference varies as the cosine of the angular location of the arc with reference to the direction of deflection. In each cosine-type winding, the main curves expressing H_y (x) will tend to be straight lines.

The curvature in plots of H_y (x) is related to the curvature illustrated by the iron-filing pictures. The H_y (x) plot of the barrel-shaped field would show the field intensity dropping off toward the ends of the plot. The H_y (x) plot of the pincushion-shaped field would show the field intensity increasing at the ends of the plot. Both curvatures can be seen in the plot of Fig. 1.

Shaping of the field is effective in minimizing spot distortion. For better focusing over the face of the usual picture tube, a deflection yoke should have a field characteristic H_y least intense at the center of the yoke and increasing slightly in intensity with distance along the x axis, the direction of deflection. This is a pincushion-shaped field. In practice, a form of conductor arrangement approaching the cosine-squared distribution has proven advantageous. The role of field plotting in such a result is obvious.

Field plots are useful in studying the effects of ferromagnetic materials in deflection windings. Figure 4 was plotted with constant current in the winding, varying the thickness of the ring or sheath of magnetic material. The curves show that with increasing thickness of sheath, the field intensity increases until a ring depth is reached above which there is a negligible increase in intensity. It is interesting to note that the relative shape of the curves remains practically the same in all cases, only the magnitude changing. The corresponding curves of H_y (x) and H_y (y), although not illustrated, follow the same rule.

Air Space

Figure 5 reveals a further result of investigating magnetic sheaths. The air space within the yoke, through which the beam travels, is the dominant factor in fixing the reluctance of the magnetic flux path. A ferromagnetic sheath provides a low-reluctance return path for the flux. Spacing the sheath from the windings lengthens the air gap in the magnetic path and thereby affects the field intensity.

In Fig. 6, field plots are used to compare the effectiveness of different magnetic materials having the same physical dimensions. There is little difference in the two results. Evidently the reluctance of the return path of the field flux is reduced to a negligible value in either case;

a choice between the two materials must depend upon considerations other than their relative permeabilities.

Fringe-Field Effects

The fringe field in deflection yokes has always been a source of uncertainty. From an inspection of the preceding field plots it should be evident that there is no sharp line of demarcation between main field and fringe fields. Figure 7 shows one way in which field plots may be used to study fringe fields. The same deflection yoke is used in each case.

In one of the trials the winding end is flared to fit the flared neck of the television picture tube. In another trial, the winding end is spaced off the tube neck but is not flared as in the first trial. The curves show the corresponding effects on the field. More detailed conclusions may be reached only after exploration of the other components involved in the three alternatives and an evaluation of their influence upon deflection and spot focus.

The classical treatment of deflection appears to have originated in German laboratories[6] and has been expanded upon in this country. All such approaches pre-suppose a knowledge of field distributions. Conceivably, these may be calculated but even in the simplest cases, the calculation proves so laborious that an experimental determination of the field becomes a necessity.

Utility of the field plot may be shown by a theoretical analysis involving beam deflection.[5] In such an analysis, two-dimensional fields (components in x and y directions only) are used and the work is restricted to field types which have mirror symmetry about the xz and yz planes. The vertically deflecting and horizontally deflecting fields exist simultaneously in the same region.

It is interesting to note that any magnetic-field nonuniformity which a field plot discloses is evidence that the flux lines of the field are curved in that region. Any curvature in the plot of a field component discloses the existence of another field component.

Studies involving the mathematics of deflection may well lead to yoke designs having a minimum of deflection distortions.

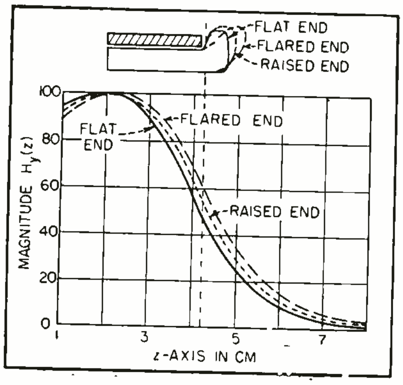


FIG. 7—Field plots show effect of forming the winding end

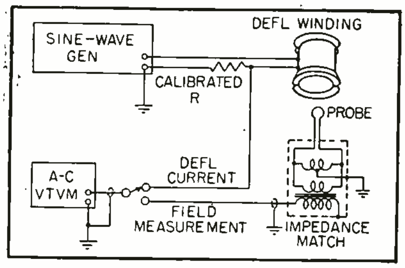


FIG. 8—Block-schematic diagram of the test equipment

Equipment

Figure 8 outlines the equipment used for measuring the deflection field. Sine-wave currents are used in the yoke windings and a calibrated series resistor provides a means for measuring the current flow.

Stable, sensitive and precise equipment is readily available for generating and measuring sine waves, a waveform which is easily controlled and offers a minimum of difficulty in calibrations and computations.

To approximate dynamic operating conditions, a frequency of 15 or 16 kc is used in the horizontal windings and approximately 1 kc in the vertical windings. The latter frequency is low enough to avoid deleterious effects of frequency, yet high enough to permit field exploration with the low-impedance probe coil used.

The probe coil consists of approximately 200 turns of No. 42 wire, wound on a nylon form having winding space of 0.040 in. inside diameter, 0.120 in. outside diameter and 0.040 in. wide. The terminal wires connect to a miniature type step-up transformer feeding a sensitive vacuum-tube voltmeter which serves to indicate field strength.

A second photograph shows the field-plotting equipment, essentially a mechanism for locating the exploring coil accurately in all parts of the magnetic field of a deflection winding along each of three mutually perpendicular coordinate axes. The probe coil may be rotated fully about the longitudinal axis of the probe rod.

In the field area, construction is nonmetallic to avoid distortion of the field under test. The probe rod is of plastic material. Electrostatic pickup is minimized by using a carefully balanced bifilar winding centertapped to ground at the probe terminals. The transformer and this balancing winding, for reasons of magnetic shielding, are housed in a thick-walled iron shell located at the base of the probe rod. This shell functions as a plunger which rides in a bored casing of squared cross-section and acts as a support and guide for moving the probe along the z axis in the direction of the probe rod. Precautions must be taken to avoid operating the equipment in the presence of interfering fields. The 60-cycle pickup which is encountered in the vicinity of voltage-regulating line transformers is particularly objectionable.

Credit is due Fred Clair, John Kackauskas, William Hoenig and Daryl Shipley for contributions in this work.

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Digital to Analog Converter

By M. MILLER, B. L. WADDELL and J. PATMORE
Electronic Associates
Long Branch, New Jersey

Information stored in digital systems, such as business machine cards and magnetic tapes, is changed to analog form for application to industrial processes requiring d-c control voltages, or to analog-type plotting boards for rapid interpretation

INFORMATION STORAGE, whether it be data concerning the performance of a guided missile or the rise and fall of bobby pin sales, whether in analog form such as a curve plotted by two variables or in digital form such as columns of figures, pulses on magnetic tape, or holes punched in cards or tape, can be represented through the medium of numbers.

The information stored in several thousand numbers expressing, for example, the performance of a turbo jet engine under test, becomes extremely hard to evaluate. The digital information might be reduced to analog form by some plotting method for rapid interpretation, but this operation usually is accomplished manually at the cost of speed and accuracy.

The digital-to-analog converter is intended to automatize plotting of digital information without materially sacrificing the speed or affecting the accuracy of the digital system. The converter can be used in applications other than digital plotting, such as, furnishing input data to analog computers, or as an electronic control for industrial processes. However, development of the converter was initiated primarily so that digital information from IBM cards could be plotted.

The function of the converter is that of transforming digital data into d-c voltages for plotting and recording, and the equipment can be attended readily by non-engineering operating personnel.

The basic elements of the converter, as shown by the block diagram of Fig. 1, are a basic timer, two temporary storage units, two d-c converters and a control panel.

Operation

In operation, two four-digit numbers and their signs recorded on an IBM card are read by a type 513, 517, or 523 IBM card machine. This information is stored in the temporary storage units until the card-reading cycle is completed and the two numbers assembled. While the numbers are being assembled, the two d-c converter units switch in precision resistors in a voltage-divider arrangement. The resultant voltages are summed in the d-c amplifiers and the output, which is proportional to the digital input, is applied to the plotting board servo system to position a pen and plot a point.

Each card has eighty columns across its width, each column numbered from zero through nine from top to bottom. Two other positions arranged above the zero at the top of the card will be considered as the eleventh and twelfth numbers. During the card-reading cycle, the IBM machine emits a series of pulses which indicate the particular line the machine is reading.

The eleventh position is used to indicate the sign of the number, a hole punch in this position indicating that the whole number is negative, and no punch a positive number. In recording the number on the card, the sign may be indicated in any column of the four-digit number. Regardless in which column the sign appears, the converter will detect it and cause the

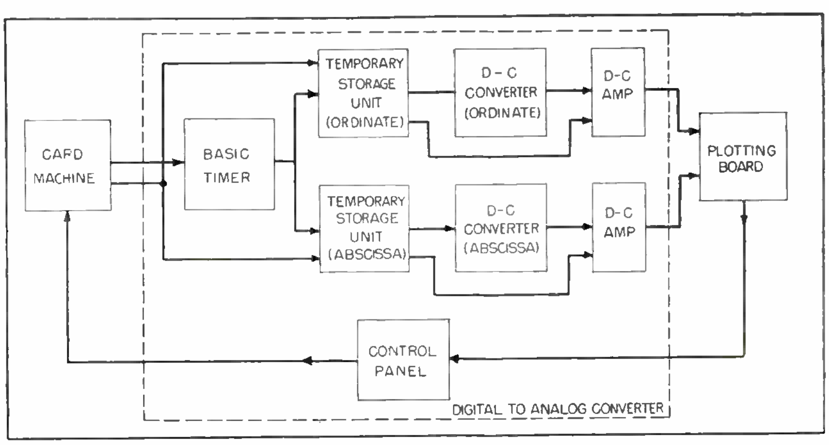


FIG. 1—Block diagram shows principle of digital to analog converter

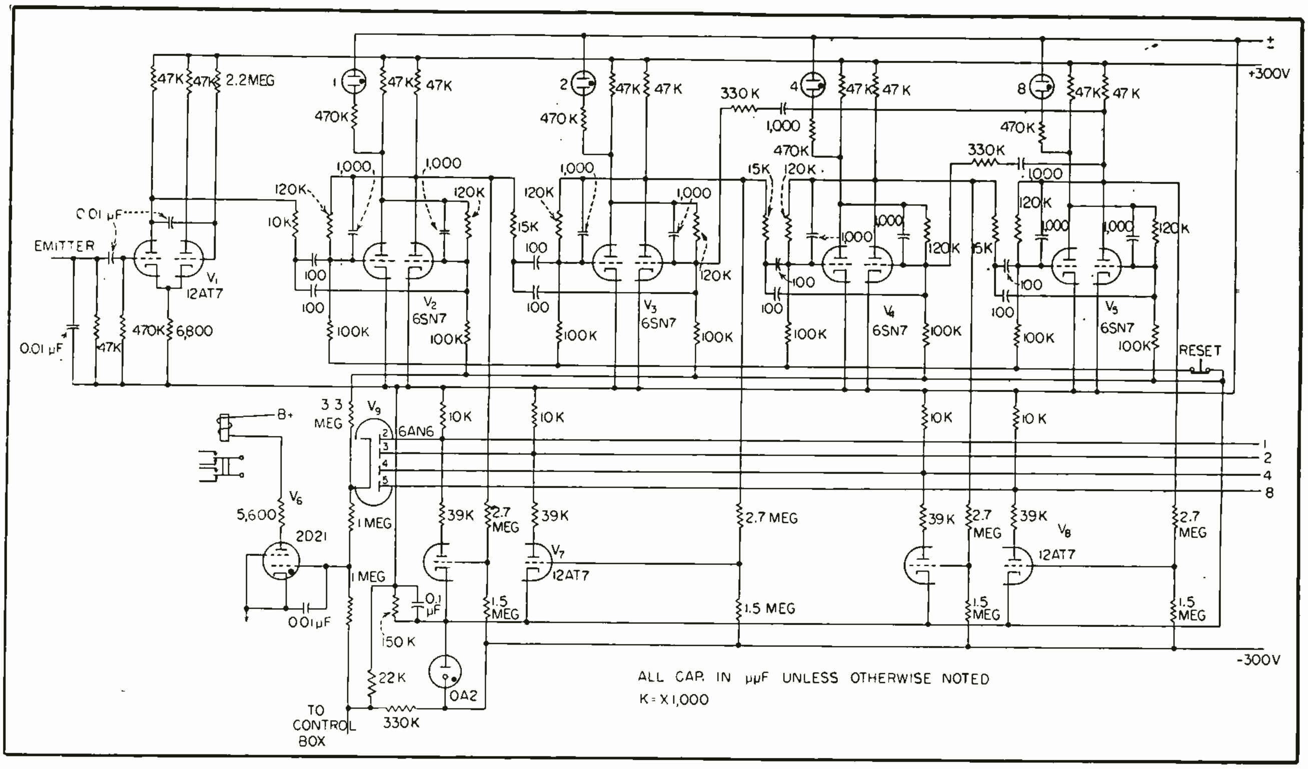


FIG. 2—Converter basic timer consists of a pulse shaper and four multivibrators and isolation amplifiers

resultant d-c voltage output to be either positive or negative.

Basic Timer

The converter basic timer (Fig. 2) consists of a pulse shaper, four Eccles-Jordan multivibrators, and four associated isolating amplifiers used to furnish control voltages to the temporary storage units. The 12AT7 pulse shaper V_1 insures that the emiter pulses are clear and well defined, for dependable and accurate operation. The timer counts from nine through zero in a coded binary form, that is, with the first emitter pulse the Eccles-Jordan circuit registers nine, indicated by the numbers one and eight. This corresponds to the nine-line being read on the IBM card.

The second pulse for the eight-line is indicated by the number eight. The third pulse is indicated by the numbers one, two, and four, representing the seven-line, and so on through zero. The eleventh pulse, indicating sign, is not handled in the basic timer but is applied to the appropriate temporary storage unit which selects a positive or negative voltage.

A self-checking circuit is included which compares the count of the timer against the zero emitter pulse. If the basic timer is not on zero, a thyratron is fired which pulls in an error relay causing a buzzer to operate, simultaneously, the operation of the IBM machine and the converter are stopped so that the d-c output voltage for that pulse will not be plotted. Indicator lights on the front panel show which multivibrator failed, and also show the number of pulses missed during that cycle. A reset button is provided, which when operated, will reset the basic timer to zero.

Temporary Storage Units

Two temporary storage units hold the ordinate and abscissa numbers while they are being assembled and converted to d-c voltages. Each storage unit (Fig. 3) has a pulse-shaping section, an isolating amplifier, and a matrix or number assembly (storing thyratron) section.

The pulse-shaping section uses five 12AT7 dual triodes. Four of the triode sections receive pulses produced by the IBM machine brushes when a punched hole is encountered on the card in any of the four number columns. Two tubes are used as isolating amplifiers to provide half-control voltages to the matrix. The fifth pulse shaper fed by the eleven-line emitter pulse is arranged to furnish half-control voltage to a sign-changing thyratron. The other half-control voltage is obtained when a punched hole appears on the eleventh line in any column of the IBM card. When this occurs, the appropriate IBM column brush, pulse shaper, and isolating amplifier feed a voltage to one plate of a 6AN6 diode and from there to the control grid of the sign-changing thyratron. The thyratron in turn will fire and operate a relay which selects either positive or negative voltage in the d-c converter.

D-C Converter

The two d-c converters accomplish the actual changing of digital information to d-c voltages. When a thyratron is fired in the matrix a relay is operated, connecting a precision resistor in a voltage-divider circuit. When the whole number is assembled by this resistor selection process, the resultant voltages are summed in a contact-stabilized d-c amplifier and applied to the plotter. The sign of the voltage is determined by the presence or absence of a hole on the eleventh line of the card.

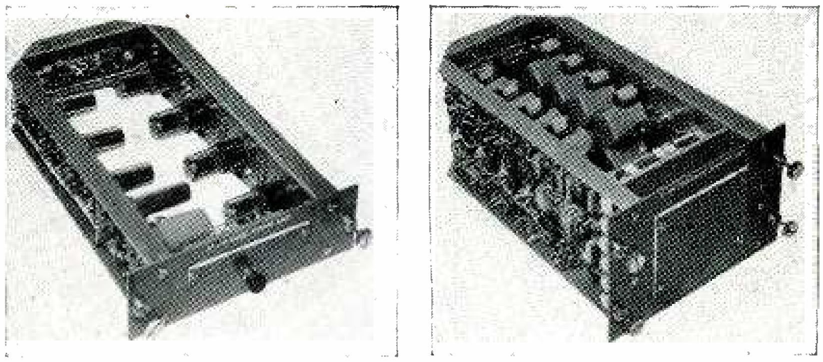
The converter unit has been provided with a control circuit to provide operate pulses to the auxiliary devices and control starting and stopping of the converter. The check circuits operate through the control circuits and provide stops to suspend operation if an error occurs. The control circuits allow different auxiliary devices to be connected without rewiring.

The control panel contains a power on-off switch, automatic-manual feed, a manual pushbutton, and a storage clear. The control circuit also provides parallax and scale factor controls previous to the d-c amplifiers to allow the summing inputs to be modified according to the requirements of the digital input.

Sequence of Operation

Let us assume that one of the two numbers punched in an IBM card is —1952. As the card-reading operation proceeds, a pulse is received from the IBM emitter which indicates that the nine-line is being read. This pulse, which is fed to the basic timer, causes the first and fourth Eccles-Jordan multivibrators to go on, representing the numbers one and eight, or the coded binary equivalent of the number nine.

When the two stages of the basic timer go on they cause a voltage, amounting to half control voltage, to be applied to thyratron rows one and eight in the matrix. At the same time that the nine-line pulse is produced, a brush riding the second column of the card makes contact through the punched hole representing the nine of the whole number 1952.



Basic timer (left) and temporary storage unit (right) form basis of converter

This contact produces a pulse which is fed to the temporary storage unit (Fig. 3) where one-half of the control voltage required to fire the thyratron is formed. This voltage is then applied to all of the thyratrons in the second or hundreds column. Since thyratron rows one and eight have received half their required control voltage from the basic timer, this additional voltage is then sufficient to fire thyratrons one and eight in the second column only. These thyratrons, in turn, cause relays to switch appropriate resistors into the voltage divider of the d-c converter.

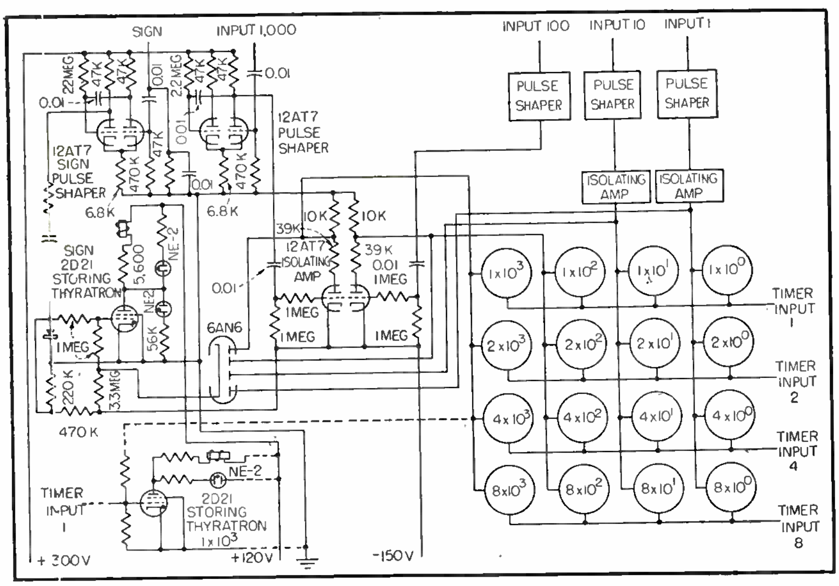


FIG. 3—Two storage units hold ordinate and abscissa numbers while they are being assembled and converted to d-c voltages

At this point we have achieved temporary storage of the number nine and partial conversion of the whole number into d-c voltage. As the card-reading cycle continues, the remaining lines of the IBM card are read in the same manner as described above until the whole number and its sign are stored and converted. The total d-c voltage produced is fed to the plotter. For this application, the plotter has been arranged to plot a point only after its servo system and associated pen have come to a complete null, thereby realizing the maximum possible accuracy.

Applications

The digital to analog converter has many applications. The d-c outputs can be used to control manufacturing processes. This application allows uniformity of information from day-to-day or hour-to-hour control. The digits or control number used at time t_1 will have the same d-c value at time t_2. The change in controlled process can be easily effected by giving the device new numbers to operate on in the form of new IBM cards, new list for keyboard operation, or a new magnetic tape.

The data reduction flexibility of the device can be seen from the fact that d-c or analog comparator techniques can be applied between the d-c amplifier and the plotting board; that is, multiplication by a constant, or subtraction or integration previous to the plot. Thus, the engineer can try many different parameter combinations on his test data and receive a plot of the results of his changes almost simultaneously.

Skewed

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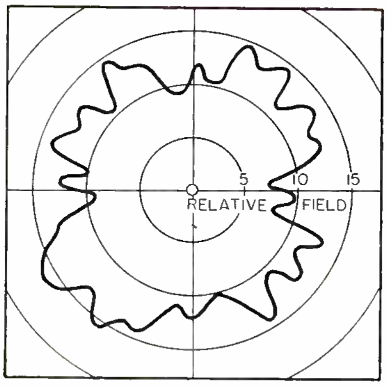


FIG. 1—Measured pattern in relative field strength of four-element skewed group mounted on circle of 4.2 wavelengths diameter

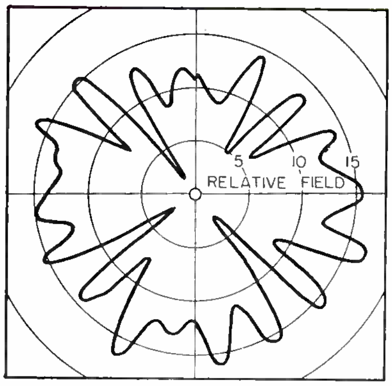


FIG. 2—Measured pattern in relative field strength of antenna group with four-element conventional orientation that causes dips

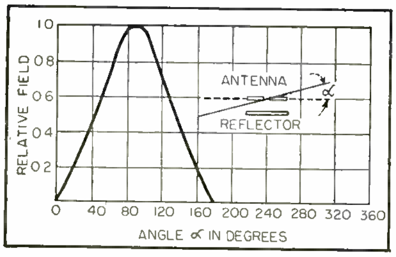


FIG. 3—Simplified calculated curve of antenna field vs angle for individual radiator. Backward radiation is not considered

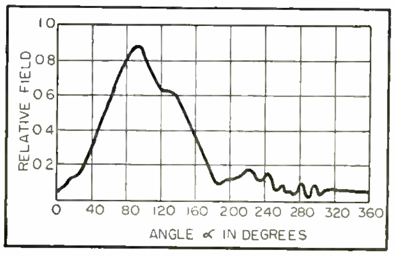


FIG. 4—Actual measured pattern of individual radiator. Undesired backward radiation deepens nulls of final array pattern

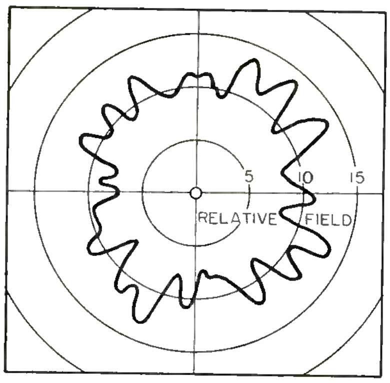


FIG. 5—Measured pattern from vertically-polarized elements. This polarization is not used for television

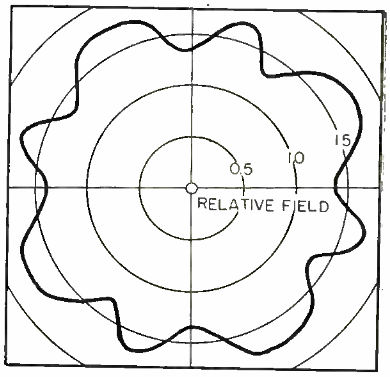


FIG. 6—Midchannel calculated pattern of the skew antenna showing the relatively uniform coverage

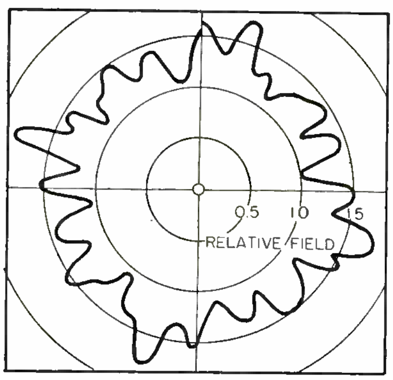


FIG. 7—Midchannel measured pattern showing effect of Fig. 4

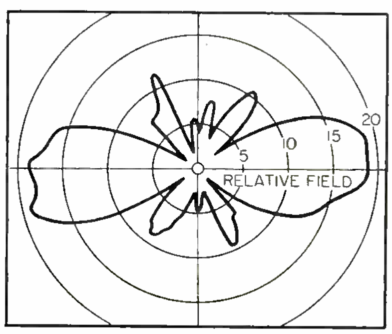


FIG. 8—Average vertical pattern of the standby array scale model

TELEVISION broadcasting stations find it highly practical from a commercial viewpoint, to have available a completely separate standby transmitting antenna system. At the Empire State Building in New York City, one of the five prominent antenna positions is occupied by WJZ-TV. The conical portion of the building directly beneath the five- antenna tower is allotted to them for a standby radiator.

Skew Method

The normal method of installing radiators employs four directive antennas beamed away from the center, each covering one-fourth of the azimuthal range. It is customary in this case, to use the supporting tower surface as a reflector and produce a directive beam with a simple half-wave radiator.

A new arrangement, in which the simulated tower faces have been extended in one direction to produce reflectors at 90 degrees with respect to radial directions, is shown in the photograph. Now the half-wave radiators, turned 90 degrees from their former positions, produce beams that are skewed 90 degrees.

Halfway between the beams, in both cases, is a crossover angle, at which the radiation is equal from two adjacent radiators. The phasing can be chosen to give the desired relative signal at this angle but at other angles near it the resultant signal depends on the several chosen fixed conditions.

When there is no skew, the rate

Antenna at WJZ-TV

Standby radiator comprises four corner-reflector units mounted on the conical tower below regular tv antennas. Elements skewed 90 degrees smooth radiation contours that would otherwise suffer dips from interference patterns resulting from mounting elements tangent to frustum of the cone

of change of the phase between the individual radiated signals varies rapidly as the angle changes and the pattern develops relatively deep null values. When there is 90-degree skew, this rate of change of phase is much slower so that the pattern nulls are less prominent.

Initial work made use of an experimental setup of four antennas mounted on a circle of 4.2 wavelengths diameter. In the particular case the antennas were skewed at 90 degrees. Because of the horizontal polarization it was important to drop the individual cables considerably below the level of the antennas for the interconnections. Each antenna was a corner-reflector type, giving good control of both planes of polarization.

The experimental curve obtained with this arrangement is given in Fig. 1. Figure 2 gives the result when the skew is reduced to zero. The improvement by the use of a skew angle is quite apparent. Calculations have been made for comparison with the experimental data. Figures 3 and 4 show the calculated and measured curves for the individual radiators. Figure 3 is based on the forward radiation obtained from a commercial corner-reflector antenna. The backward radiation was eliminated to reduce computation and the sources were assumed to be points, in order further to simplify the work.

Although the principal concern in this study was horizontal polarization because of its application to tv, it should be noted that there is nothing about the skew technique that is restricted by polarization. To demonstrate the point the experimental curve of Fig. 5 is shown for which the corner-reflector radiators were vertically polarized.

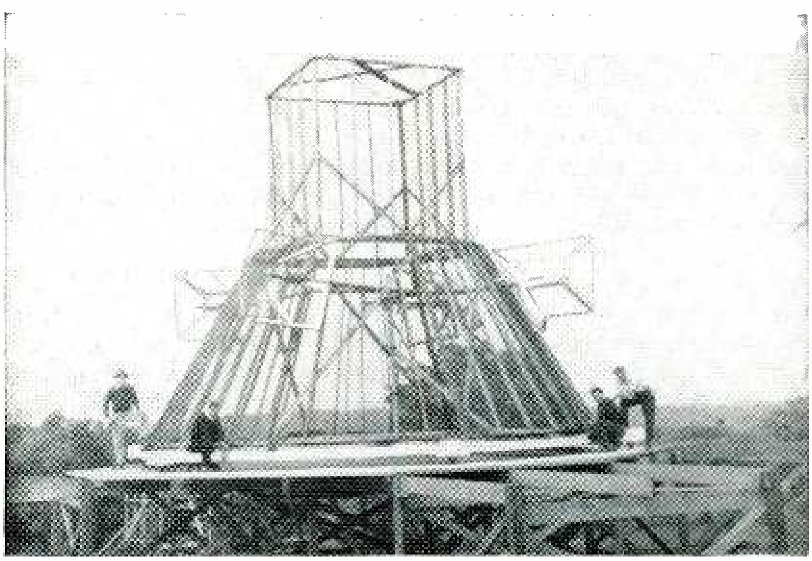
Empire State Mockup

The WJZ-TV antenna was given a full-scale test at our laboratory site in Orland Park. The conical portion of the building and a short lower section of the antenna tower were reproduced in wire mesh. The entire arrangement was rotated for horizontal patterns. Earlier tests on a model basis were used to obtain the vertical patterns so that the antenna gain could be calculated.

Figures 6 and 7 show respectively the calculated and measured patterns at midchannel. Better agreement between them is prevented by the limitations of the individual pattern, shown by Fig. 4. The presence of undesired backward radiation introduces interference and results in doubling the number of radiation lobes and deepening the nulls.

Figure 8 is the average vertical pattern obtained from the scale model. It can be shown that the gain of the antenna system as compared with a half-wave dipole antenna is unity.

We are indebted to V. J. Andrew for the origin of the skew principle and to R. E. Green and A. Wojnowski for assistance in calculating numerous patterns and for the experimental work.



Full-scale mockup of the Empire State tower section showing three of the corner-reflector radiators mounted at 90 degrees

Closed Loop Controls Human Centrifuge

Electronically-controlled 4,000-hp motor accelerates massive human centrifuge from rest to 173 mph in 7 seconds. Gimbal-control motors produce any desired stress concentration. Centrifuge is designed to test airborne electronic gear and pilots' G-suits

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Naval Air Development Center
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ACCELERATION FORCES up to 40 g are developed by the human centrifuge at NADC, Johnsville, Pa. The centrifuge simulates stresses encountered in high-speed flight and will be used to conduct research into biological effect of forces developed in aircraft, in testing airborne electronic equipment and in developing protective clothing for pilots.

As shown in the photograph, the 180-ton centrifuge consists of a 50-foot tubular-steel arm attached to the shaft of a 4,000-hp motor. At the end of the arm is an oblate spheroidal gondola. The gondola is mounted in gimbal supports and positioned by an electrohydraulic system. This permits the axis of the gondola to be positioned continuously through the resultant of the radial, tangential, and vertical components of acceleration when the centrifuge is in motion.

The centrifuge may be accelerated from a dead stop to approximately 173 mph in less than seven seconds and decelerated at the same rate. Both the main accelerating motor and the two gimbal control motors are electronically controlled using closed-loop systems.

Instrumentation

Close study of the subject in the gondola is accomplished by television, motion-picture cameras, high-speed x-ray equipment and special physiological sensing and measuring equipment. Gimbal motor control information, television signals and output from physiological sensing devices are linked to control stations through rhodium-plated slip rings on the main rotor shaft. The entire centrifuge room is shielded with $\frac{1}{16}$-inch copper against electrical and magnetic interference.

Braking is accomplished using a photoelectric relay. When the centrifuge in decelerating reaches a rate of three rpm, a light source on the end of the arm activates a phototube relay that reduces the speed to 0.5 rpm.

As the light source passes a second phototube, a second relay is activated that in turn sets the brakes and the centrifuge comes to a dead stop opposite the retractable platform in the chamber wall.

Acceleration Motor

The acceleration motor control circuit is shown in Fig. 1. The 4,200-hp synchronous motor is started as an induction motor. When its speed reaches a predetermined value, the motor is automatically thrown across the 4,160-volt a-c line.

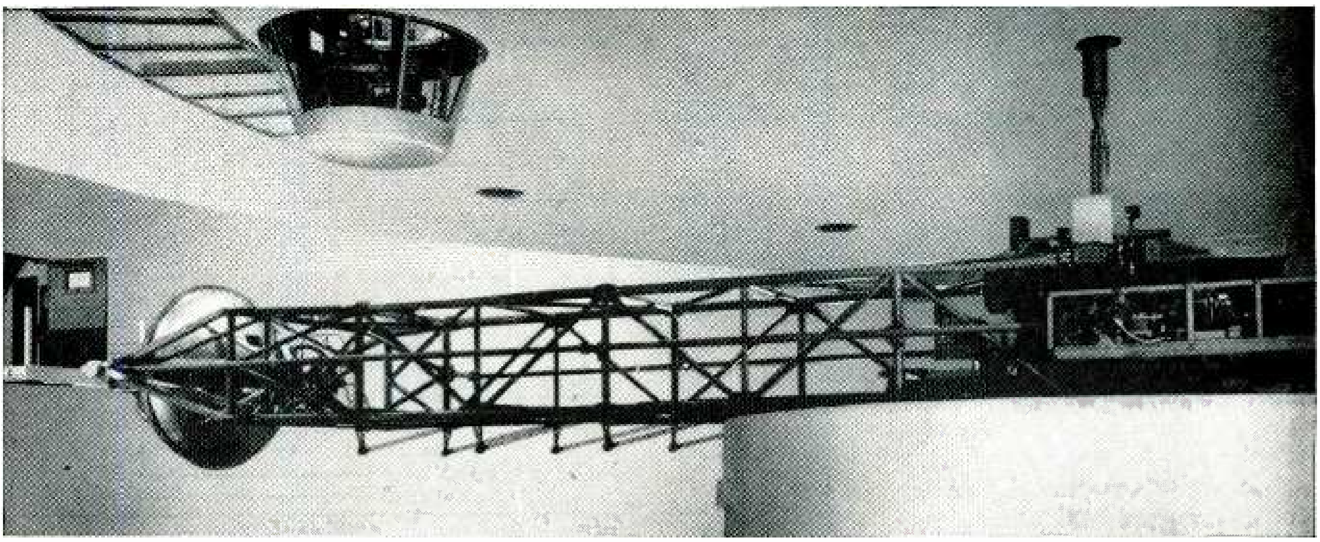
The field of the 4,200-hp motor is supplied by a voltage-regulator-controlled exciter mounted on the motor shaft. Also, on this shaft are two 1,500-kw d-c generators. These generators are connected in parallel and supply power to drive the 4,000-hp accelerator motor. Two speed ranges, 0 to 29.8 rpm and 0 to 48.5 rpm are made available by splitting the generator fields for either parallel or series connection.

The fields of the d-c generators are supplied by two electronically controlled 32.5-kw amplidyne generators. The amplidynes are driven by a 100-hp synchronous motor. Their output is a function of the difference between the actual speed of the accelerator motor and the speed called for by the operator or automatic program cam. This difference voltage is introduced to the amplidyne fields through the electronic amplifier.

Amplifier Control Panel

The operator in the overhead control-blister selects the desired type of operation, either by hand throttle, or by means of automatic program cam, or by the subject in the gondola.

The amplifier control panel, shown in Fig. 2, contains the outputs from three potentiometer controls. From the position of the potentiometer in use, a reference voltage is obtained that is balanced against the tachometer output voltage. Part of the difference voltage



Subject rides gondola at end of 50-foot boom. Operator controls test from overhead control blister. Gimbal-mounted gondola is brought to positive stop opposite retractable access port by phototube-controlled braking system

is applied to the grid of the control amplifier. Calling for increased speed raises the output voltage from the amplifier and will keep it raised until the tachometer generator output and the voltage being called for are equalized.

Limit-Balance Panel

The output from the amplifier-control panel is trimmed in the limit-balance control panel. Here also are introduced, two voltages, proportional to the portions of the accelerator motor field supplied by generators *A* and *B*, respectively. When the load is equally divided between the two generators, the voltages cancel. However, should one generator supply more current than the other, current will pass through the control coil of a kenotron (a high vacuum diode whose plate current is controlled by a magnetic field). The unbalanced load drives the tube beyond cutoff raising the signal level of the generator not bearing its share of the load and lowering the signal of the other until balance is restored.

Current-Limit Panel

In the current-limit control panel, a voltage is introduced proportional to each generator's armature current. Two magnetically-controlled kenotrons are used for each generator, one for forward current and one for reverse current. As limiting current is reached, the appropriate kenotron is cut off. In this manner, the increased signal potential is dissipated in fixed resistors thus limiting the current.

Part of the output voltage from the generators is used as a bias source providing negative, adjustable feedback to aid in system stabilization.

Rectifier Panel

The control signal is applied to the rectifier panel that consists of two banks of four push-pull 807's each. The first bank has the amplidyne buck field in its plate circuit; while the second bank has the boost field in its plate circuit. Both banks have a common cathode potentiometer set for maximum amplidyne field current. Current through the buck and boost fields is held equal at zero signal input. Calling for increased speed lowers the input signal to the first group of 807's, decreasing current in the buck field. Because of the common cathode resistor, current flow is increased in the boost field. The main generator field is strengthened resulting in higher generator output and increased motor torque

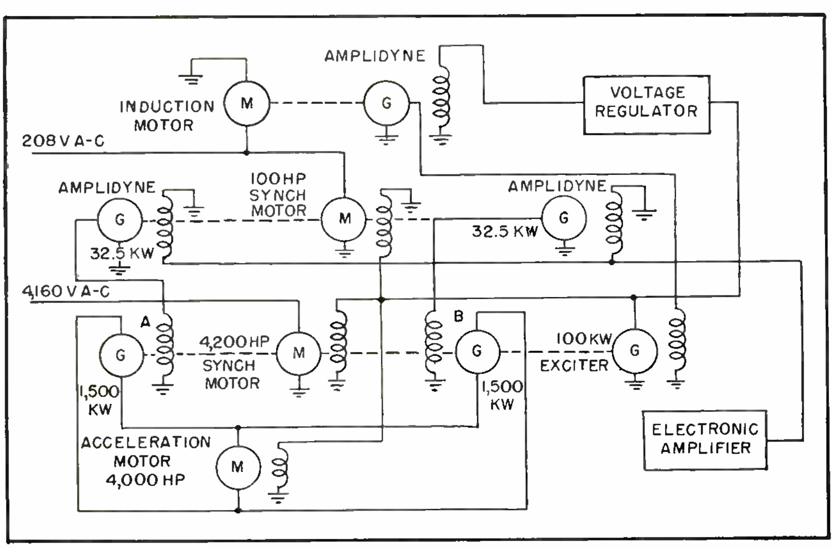


FIG. 1—Accelerator-motor control system. Electronic amplifier controls amplidynes supplying fields to dual d-c generators driving motor

to accelerate the centrifuge.

The gimbal control motors, 75 hp for the outer gimbal, 40 hp for the inner gimbal, drive the gimbal rings through shafts running the length of the arm.

Gimbal Control

The gimbal control system, shown in Fig. 3, is designed to control accurately the movement of a gimbal ring using two parallel closed loops. One is responsive to input angular position and the other to input angular velocity. The angular-position loop uses a pair of selsyns to generate an angular-position error signal.

The angular velocity-loop employs a tachometer generator and linear potentiometer to obtain a differentiated voltage proportional to the rate of change or angular velocity of the input.

The selsyn error signal is fed to a phase-sensitive detector. The d-c voltage appearing across the output varies in magnitude with the magnitude of the error signal.

The error signal is also applied to a second amplifier and detector combination. When the d-c voltage output of this detector exceeds a predetermined value (error signal for approximately 4 degrees), an emergency circuit is actuated that stops the centrifuge since the gimbal rings are not following the operator's commands within specified limits. This arrangement also prevents starting if control and gimbal positions are not synchronized with those being called for by the operator or program cam.

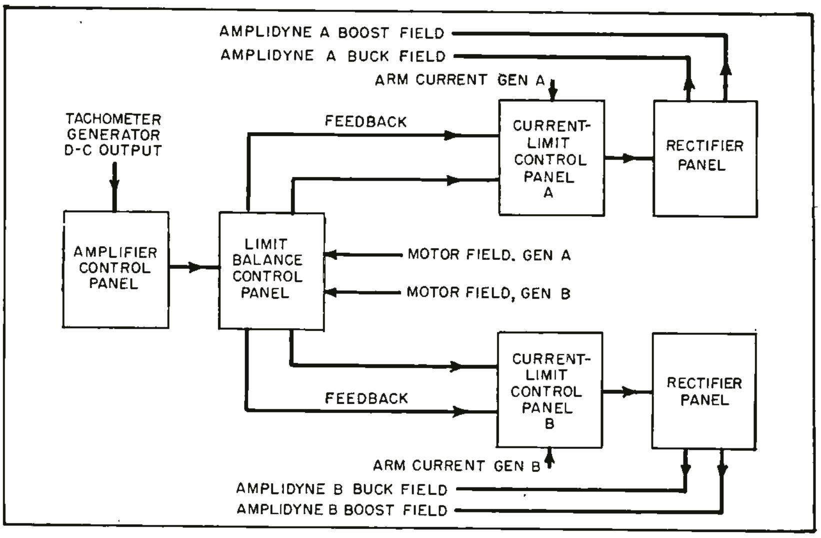


FIG. 2—Closed-loop motor control system uses difference voltage between tachometer d-c output and voltage picked off control potentiometer

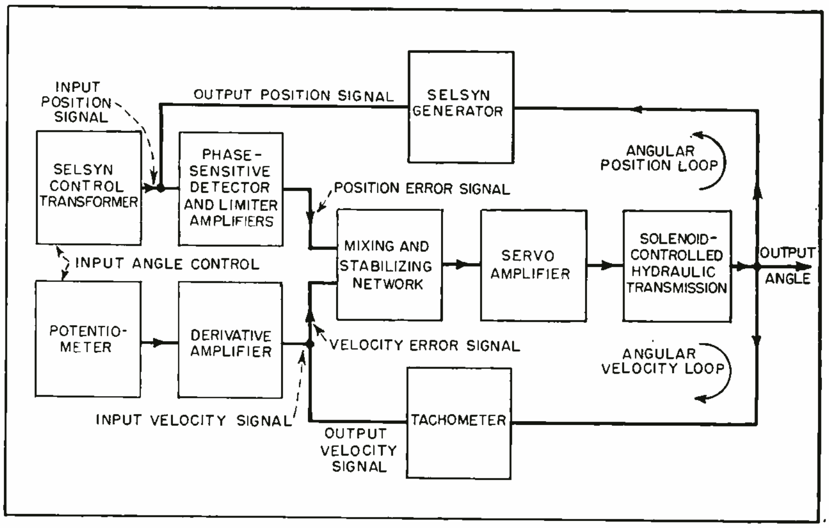


FIG. 3—Gimbal-control system employs parallel closed loops responsive to both angular position and velocity

In the derivative amplifier, variation of the linear potentiometer changes bias of the input tube. From an R-C network in the plate circuit of the input tube, a voltage is obtained proportional to the time derivative of angular movement of the potentiometer. This voltage is fed to a push-pull d-c amplifier and cathode follower. The output of this circuit varies in proportion to the desired angular velocity set up on the linear control potentiometer.

Mixing and Stabilizing

Output from the phase-sensitive detector, derivative amplifier, and tachometer generator are algebraically summed and inserted into the mixing and stabilizing panel. The resultant is fed to a push-pull d-c amplifier that excites the gimbal solenoid coils in accordance with angular and velocity error signals. The solenoid controls the hydraulic amplifier and transmission.

Rotation of the outer gimbal ring through 90 deg. results in approximately 5 deg. rotation of the inner gimbal ring with the inner gimbal ring not powered. A selsyn differential driven by the outer gimbal shaft is connected in the selsyn circuit and compensates for differential gearing.

With this control system, the inner gimbal ring may be rotated and the gondola tumbled at a rate variable from 0 to 30 rpm in either direction.

The outer gimbal ring permits tilting the gondola through a 90 deg. about a horizontal axis at right angles to the longitudinal axis of the centrifuge arm. This 90-deg. movement may be accomplished in approximately one second.

The cooperation of the General Electric Company and the McKiernan-Terry Corporation in the preparation of this article is sincerely appreciated by the author.

How To Design VR Tube Circuits

By RAYMOND C. MILES

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Direct approach for determining optimum design on the basis of a stated set of requirements saves time and paper work. Family of curves for various tube types is the key to a quick solution of VR tube circuit-design problems

VOLTAGE-REGULATOR tubes of the gaseous glow-discharge type find many applications in d-c voltage supplies required to deliver fixed output voltages with moderately good regulation.

For the circuit designer, the problem frequently becomes one of design by successive approximations. A more satisfactory design procedure would be to employ a direct approach to the synthesis of an optimum design on the basis of a stated set of requirements. Such a procedure may be based on the accompanying charts, which have been developed as described below.

Table I lists the most significant electrical characteristics of six popular types of gaseous voltage-regulator tubes. These characteristics include the nominal d-c voltage at which the tube operates, E_T, the supply voltage which must be available to the tube in its unfired condition to insure that firing will occur, E_F, and the maximum and minimum values of current drawn by the tube itself to insure satisfactory operation of the tube, I_{Tmax} and I_{Tmin}, respectively.

Figure 1 shows a simplified schematic of a typical power supply employing a VR tube. Battery E_s represents the open-circuit voltage of the supply to the VR tube, essentially the no-load output voltage of the transformer-rectifier-filter combination used in most applications. Resistor R_s is equivalent to the internal resistance of the supply to the VR tube. It includes the effective resistance of the transformer-rectifier combination and the d-c resistance of any filter chokes in addition to the lumped series resistance deliberately inserted in the VR tube supply.

Although the total series resistance R_s is ordinarily not constant as a function of current because of the nonlinear characteristics of the rectifier-filter, it may be considered so for most practical purposes. This is so because the nonlinear components of the resistance are ordinarily a small portion of the total. The voltage developed across the load in Fig. 1 is equal to E_T for the VR tube employed when the tube has fired and is operating normally.

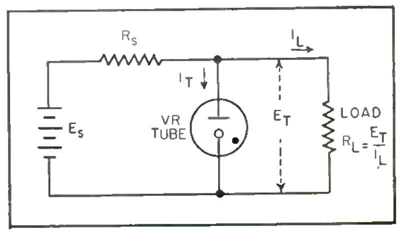

FIG. 1—Simplified schematic diagram of a typical power supply using a V-R tube

The current drawn by the VR tube itself is represented as I_T, and that drawn by the load at voltage E_T as I_L. The analysis which follows assumes a load of linear characteristics, so that load resistance

$$R_L = \frac{E_T}{I_L}$$

In order for the VR tube to operate within its rated limitations, three relations must be satisfied by the circuit values shown in Fig. 1.

First, the voltage applied to the VR tube in its unfired condition must equal or exceed the minimum supply voltage E_F for the particular tube type. Since the tube itself

Table I—Electrical Characteristics of VR Tubes

Tube Type	OA2	OA3 VR75	OB2	OB3	OC3 VR105	OD3 VR150
D-C Operating Volts .... E_T	150	75	108	90	105	150
Min D-C Supply Volts .... E_F	185	105	133	130	133	185
Max Tube Current (amps) .... I_{Tmax}	0.030	0.040	0.030	0.030	0.040	0.040
Min Tube Current (amps) .... I_{Tmin}	0.005	0.005	0.005	0.005	0.005	0.005

represents essentially an infinite resistance before it fires, the minimum supply voltage requirement may be expressed as

$$E_s \frac{R_L}{R_L + R_s} \geqq E_F$$

Load resistance may be expressed in terms of the load voltage E_T and maximum load current I_{Lmax} which exist when the VR tube is fired. The expression may then be solved for required supply voltage E_s, for example, yielding

$$E_s \geqq E_F + \frac{E_F}{E_T} R_s I_{Lmax} \qquad (1)$$

Once the tube has fired, the minimum VR tube current must equal or exceed I_{Tmin} for the tube type employed. The tube will draw its lowest value of current when the load current is maximum. At maximum load current, the circuit relations for Fig. 1 are

$$E_s = E_T + R_s (I_T + I_{Lmax})$$

Since the VR tube current must equal or exceed the minimum value I_{Tmin}, the required supply voltage is then limited by the equation

$$E_s \geqq E_T + R_s (I_{Tmin} + I_{Lmax}) \qquad (2)$$

Equations 1 and 2 both relate to the maximum load current and both must be satisfied in order for the VR tube to operate within the proper limits.

The third condition of VR tube operation which must be satisfied is that the tube current must not exceed I_{Tmax}. For this condition, it is possible to write another expression similar to Eq. 2 but for minimum load current and maximum tube current. This expression is

$$E_s \leqq E_T + R_s (I_{Tmax} + I_{Lmin}) \qquad (3)$$

Once a VR tube type has been selected, the circuit values chosen must be such as to satisfy Eq. 1, 2 and 3 simultaneously.

The charts of Fig. 2 through 4 present Eq. 1, 2 and 3 in a form which is convenient for the design of VR tube circuits. Once a tube type has been selected, known or assumed values of any two of the quantities supply voltage, supply series resistance, and load current permit determination of the third quantity.

Each of the figures shows supply voltage as the ordinate, supply series resistance as the abscissa and load current as a parameter. The maximum load current which may be drawn without exceeding the VR tube ratings is indicated by a family of solid lines, while minimum load current is presented by dashed lines. The charts may be entered at the ordinate, abscissa or parameter and followed to a point which represents a suitable combination of all three variables (four considering both maximum and minimum load currents).

Use of the charts in designing VR-tube regulated supplies is best illustrated by the following examples:

Example 1. Using an OA2 with a supply voltage of 300 volts and a supply series resistance of 5,000 ohms, what is the maximum load current which may be drawn?

Solution: Find the point on the OA2 chart, Fig. 2, corresponding to 300 volts and 5,000 ohms and interpolate between the solid lines. The maximum load current is found to be approximately 19 ma.

Example 2. In example 1, what is the minimum permissible load current?

Solution: The zero-ma minimum load-current line passes through the point representing 300 volts and 5,000 ohms. Hence the load current may be allowed to fall to zero.

Example 3. What is the lowest value of supply voltage which may be used with an OA3 voltage regulator to supply an output of 75 volts at any load current between 5 and 20 ma? What value of series resistance is required?

Solution: Using the chart for the OA3, Fig. 3, the minimum permissible value of supply voltage will be found at the point where the line representing a maximum load current of 20 ma intersects the line representing a minimum load of 5 ma. This point is found to be at 152 volts and the required series resistance is 1,700 ohms.

Example 4. In example 3, what

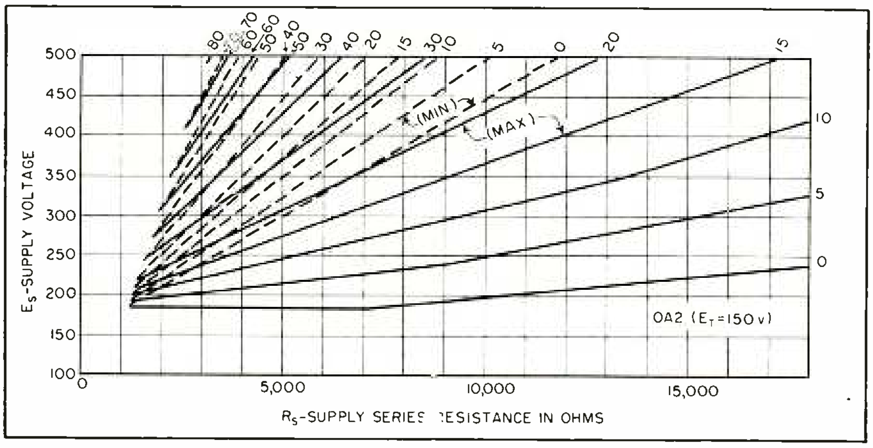

FIG. 2—Family of curves for the OA2

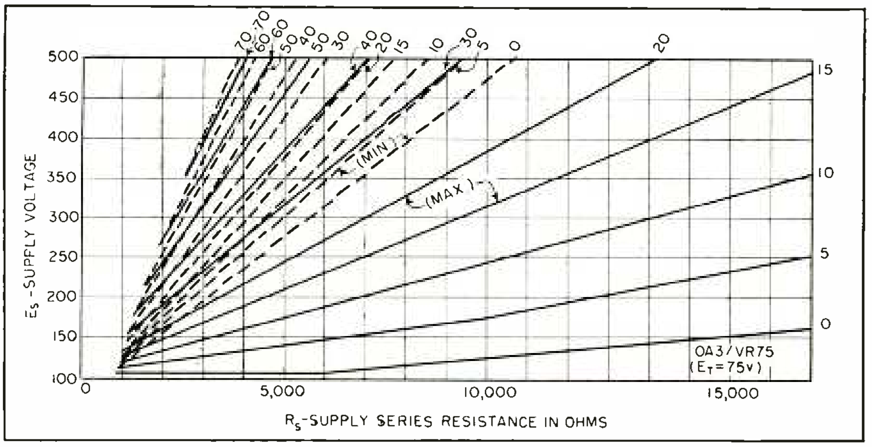

FIG. 3—Family of curves for the OA3

is the lowest nominal value of supply voltage which may be used if this voltage is subject to a ± 5-percent variation? What is the new value of required series resistance?

Solution: This problem may be solved readily by a trial and error method as follows. The variation in supply voltage necessitates a nominal supply voltage higher than that found in example 3. From example 3, one may first assume a minimum supply voltage of 152 volts together with a series resistance of 1,700 ohms. The corresponding nominal supply voltage is 152/0.95 = 160 volts. At minimum supply voltage, concern is with maximum load current. From example 3, the maximum load current is known to be 20 ma for 152 volts and 1,700 ohms. The value of maximum supply voltage is 160 × 1.05 = 168 volts. From Fig. 3, however, it will be seen that this voltage and a series resistance of 1,700 ohms correspond to a minimum load current of 15 ma instead of the desired 5 ma. Consequently, these values may not be used.

As a second assumption, one may choose a higher value of supply series resistance, 3,000 ohms. With this value, a maximum load current of 20 ma can be delivered with a minimum supply voltage of 188 volts. The corresponding nominal supply voltage is 188/0.95 = 198 volts and the maximum supply voltage is then 198 × 1.05 = 208 volts. With 208 volts and 3,000 ohms, minimum load current is slightly less than 5 ma. Thus a nominal supply voltage of 198 volts and a series resistance of 3,000 ohms will be adequate.

Example 5. In examples 3 and 4, what supply voltage and series resistance will be required if the supply-voltage variation is ± 10 percent from nominal?

Solution: By the same method used in example 4, the required nominal supply voltage is found to be 268 volts (241 volts minimum to 295 volts maximum). The required series resistance is 4,900 ohms. Examples 3, 4 and 5 illustrate the severe penalty in terms of supply-voltage requirements and power loss imposed by a varying supply voltage.

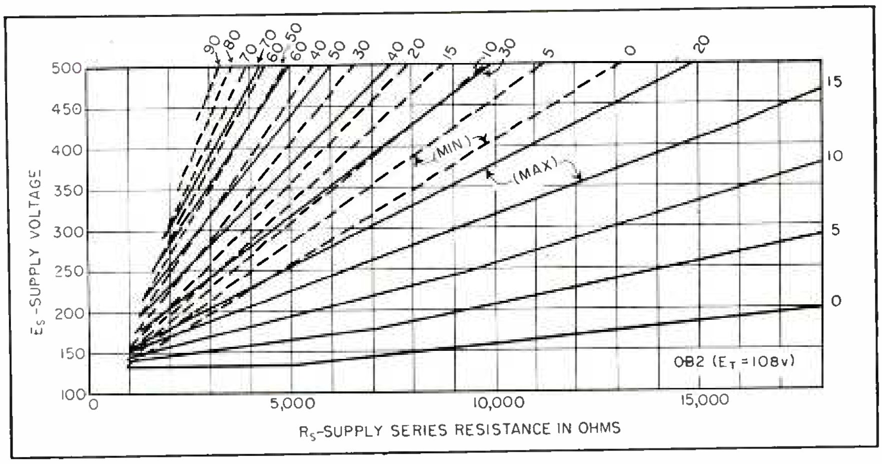

FIG. 4—Family of curves for the OB2

Example 6. Using an OB2 tube in a circuit with a fixed supply voltage of 350 volts, what range of adjustment must be provided in the series resistance in order that any load current from 0 to 50 ma may be supplied?

Solution: The maximum series resistance required is determined by the zero-ma minimum load current and is found from Fig. 4 to be 8,100 ohms. The minimum series resistance is determined by the 50-ma maximum load current and is 3,550 ohms.

Example 7. What nominal supply voltage and series resistance should be used to deliver 108 volts at a constant load current of 20 ma from a supply using an OB2 if supply voltage is subject to a ± 5-percent variation and if a ± 10-percent tolerance resistor is to be used as the series resistance?

Solution: This problem is solved by a process of trial and error. First assume a minimum supply voltage of 157 volts and a minimum series resistance of 1,000 ohms (values at the intersection of the two 20-ma load-current lines on the OB2 chart, Fig. 4). Maximum supply voltage is then $\frac{157 \times 1.05}{0.95}$ = 173.5 volts and maximum series resistance is $\frac{1{,}000 \times 1.1}{0.9}$ = 1,220 ohms.

At 157 volts and 1,220 ohms, maximum load current is only 15 ma. Also, at 173.5 volts and 1,220 ohms the required load current is not available. As a second set of assumptions, choose a minimum supply voltage of 220 volts and a minimum series resistance of 2,900 ohms. Corresponding maximum values are 244 volts and 3,540 ohms. Examination of Fig. 4 discloses that, with any combination of these values of maximum and minimum voltages and resistances, minimum load current is less than or equal to 20 ma and maximum load current is greater than or equal to 20 ma. Therefore, the corresponding nominal values of voltage and resistance, 232 volts and 3,220 ohms, will be satisfactory.

Example 8. Two type OA2 tubes in series are to be used to supply 300 volts regulated at 10 to 15 ma load current. What supply voltage and series resistance should be used?

Solution: Using the OA2 chart, Fig. 2, find the supply voltage and resistance required to deliver the specified load current at 150 volts from a single tube. These values are 213 volts and 1,600 ohms as determined from the intersection of the 15-ma maximum and 10-ma minimum load current lines. These values may be doubled to find the required values for 300 volts from two tubes. Required voltage and resistance are then 426 volts and 3,200 ohms, respectively.

Similar sets of curves may be drawn for other VR tube types and the curves of Fig. 2, 3 and 4 may be extended to include higher supply voltages.

Bandwidth of Quarter-Wave Sections

Charts show relative bandwidth obtained for specified impedance ratio and reflection coefficient when a load is matched to a transmission line by a single or double quarter-wave matching section. Band for the double section is half again as wide as that for a single section

By E. G. FUBINI and F. H. ROCKETT, Jr.

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A WIDELY used method for matching the impedance of a load to a transmission line is to interpose a short line between the two. The characteristic impedance of this matching section is made the geometric mean of the impedance of the load and the transmission line; its length is made a quarter wave at the frequency for which the impedances are to be matched.

In general, however, the load is required to be matched over a band of frequencies. If the load need not be perfectly matched, the bandwidth over which the load is matched within a specified reflection coefficient can then be computed from transmission-line equations. It is more useful, however, to normalize the equations and to plot their solutions as design curves[1]. This has been done in the charts whose uses are described.

The first chart is for a single quarter-wave section; the second chart is for a double quarter-wave section. The double section matches the impedances—for a specified maximum reflection coefficient—over a wider band than the single section. By comparing the bandwidths on the two charts for a specified problem, it can be determined quickly whether a single or a double matching section is required.

Consider first the commonest type of matching section—a line that is a quarter-wavelength long at the matching frequency f_1. For maximum bandwidth (and perfect matching at f_1), the load must be a pure resistance at f_1.

If the load is a pure resistance R, constant with frequency, the reflection coefficient $|K|$ can be calculated and plotted as a function of the relative frequency f/f_1 for various values of relative load R/R_0 where R_0 is the characteristic (resistive) impedance of the transmission line. This was done in Fig. 1, giving the frequency characteristic for a series of values of R/R_0. Because the chart is symmetical about $f/f_1 = 1$, it has been folded back on itself about this axis. Then, if $|K|$ is required to be less than a certain value, the maximum and minimum values of f/f_1 are given at that ordinate. The following is a ty-

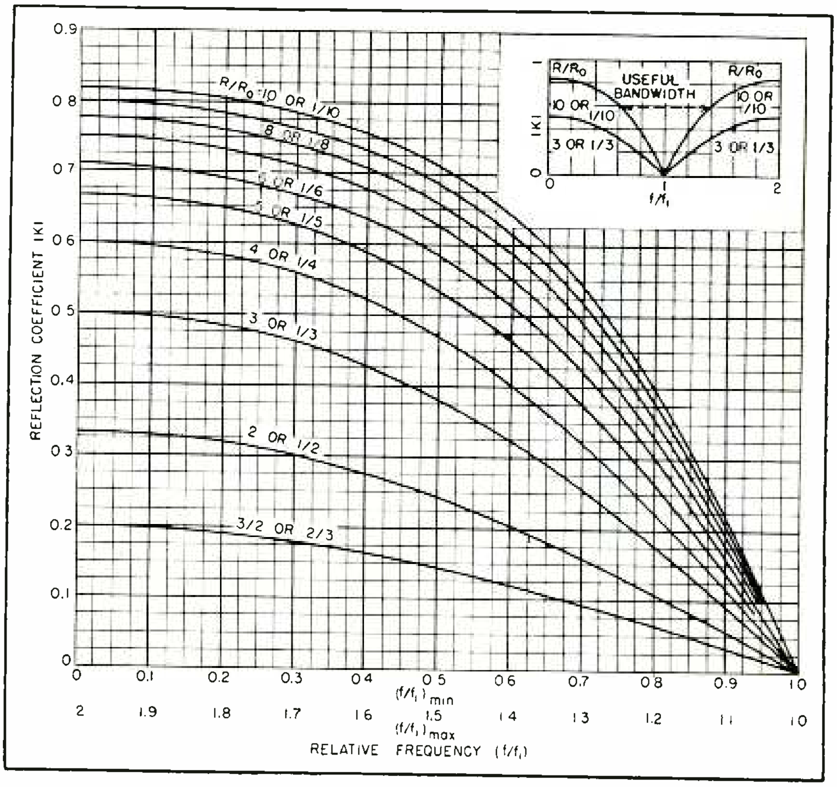


FIG. 1—Frequency characteristic of a quarter-wave matching section

pical example: Given a resistance of 140 ohms to be matched to a 70-ohm line, $R/R_0 = 2$, and the frequency characteristic is given by this curve in Fig. 1. If $|K|$ is required to be less than 0.2, the limiting values of f/f_1 are about 0.61 and 1.39; the frequency band is 1.39/0.61 or 2.28 to 1.

Folding the chart about $f/f_1 = 1$ results in the relative frequencies being spaced as in an arithmetic series. Because the edge and center frequencies used in specifying bandwidth are usually in geometric ratio, $f/f_1 = 1$ is not the center frequency as usually given. Rather, in the foregoing example, the relative center frequency (the geometric mean between the edge frequencies) is $f/f_1 = 0.92$.

Double Quarter-Wave Section

The simplest multiple-matching section is a pair of lines of equal length, each a quarter-wavelength long at the matching frequency f_1. At this frequency the load must be a pure resistance R for perfect matching. For this case and by proper choice of the impedances of the matching sections, a purely resistive load can be transformed at f_1 to an impedance that not only has the correct resistance (with zero reactance) but also has a zero derivative of resistance (and of reactance). Thus the whole frequency characteristic can be improved, giving a considerably wider frequency band than that obtained by the single, conventional quarter-wave section.

For the case of a constant resistive load, Fig. 2 gives the relative bandwidth. The reflection coefficient $|K|$ was calculated and plotted as a function of relative frequency f/f_1 for various values of the relative load R/R_0. The curves of this chart are very similar to those of Fig. 1, except that the frequency band for a specified $|K|$ is wider.

For example, using the values of the previous problem (140-ohm load matched to a 70-ohm line with $|K|$ less than 0.2), from the curve in Fig. 2 for $R/R_0 = 2$, the limiting values of f/f_1 are found to be about 0.45 and 1.55; the frequency band is 3.44 to 1. Thus, the band for the double section is half again as wide as that for a single section.

It will be noted, of course, that the curves for single and double-matching sections come to the same values of $|K|$ at $f/f_1 = 0, 2, 4$ and so on.

Impedance Computations

In using the information obtained from the two charts, one computes the required characteristic impedance for the matching sections. For a single matching section of impedance Z, the impedance is given by $Z = (RR_0)^{1/2}$. For a double-matching section where the section nearer the load has an impedance Z_1 and the section nearer the line has an impedance Z_2, the impedances of the sections are given by

$$Z_1 = \sqrt{R(R_0R)^{1/2}}$$

$$Z_2 = \sqrt{R_0(R_0R)^{1/2}}$$

The charts are plotted in terms of reflection coefficient $|K|$. Impedance ratios are often measured in terms of standing-wave ratios S. The relation between the two is

$$|K| = (S-1)/(S+1)$$

Figures 1 and 2 are plots of $|K|$ as functions of transformation ratio $A^2 = R/R_0$ and the relative angular frequency $\Theta = 0.5\pi f/f_1$. The equation for Fig. 1 is

$$|K|^2 = \frac{|A^2-1|^2}{(A^2-1)^2 + 4A^2\sec^2\Theta}$$

The equation for Fig. 2 is

$$|K|^2 = \frac{|A^2-1|^2}{(A^2-1)^2 + 4A^2\sec^4\Theta}$$

If the load impedance is a resistance that varies with frequency, the charts are no longer valid.

The charts given here can be used in several ways other than that illustrated in the examples. If the maximum tolerable reflection coefficient and impedance ratio are specified, the charts show whether a single or a double matching section can produce a match, and, if so, what bandwidths can be obtained.

If the relative bandwidth and either the reflection coefficient or the relative impedance are specified, the unspecified quantity can be determined. Thus, these charts provide useful design data for many common transmission-line problems.

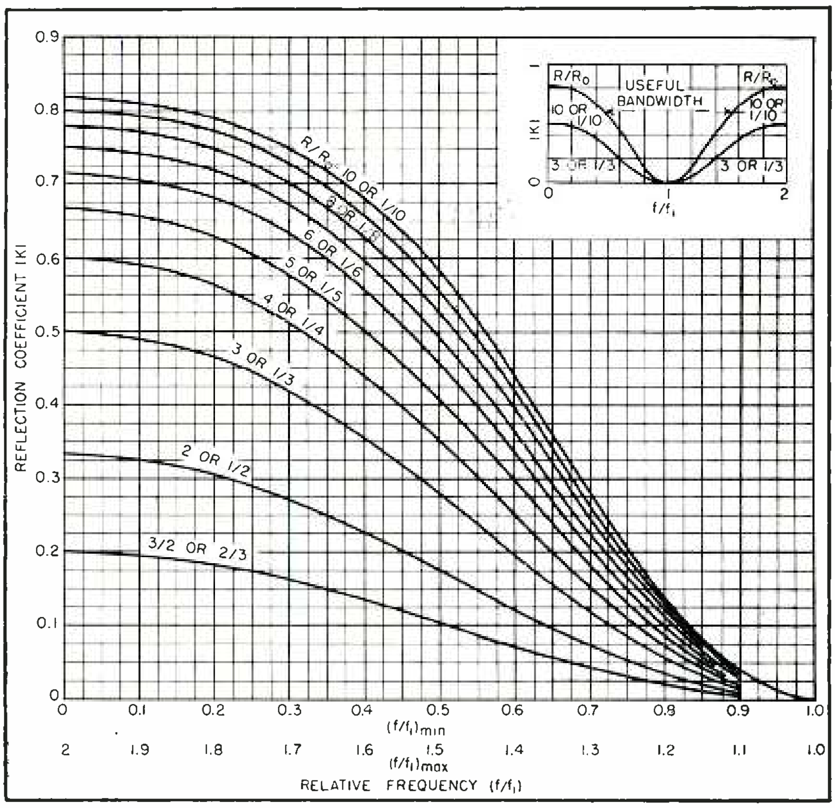
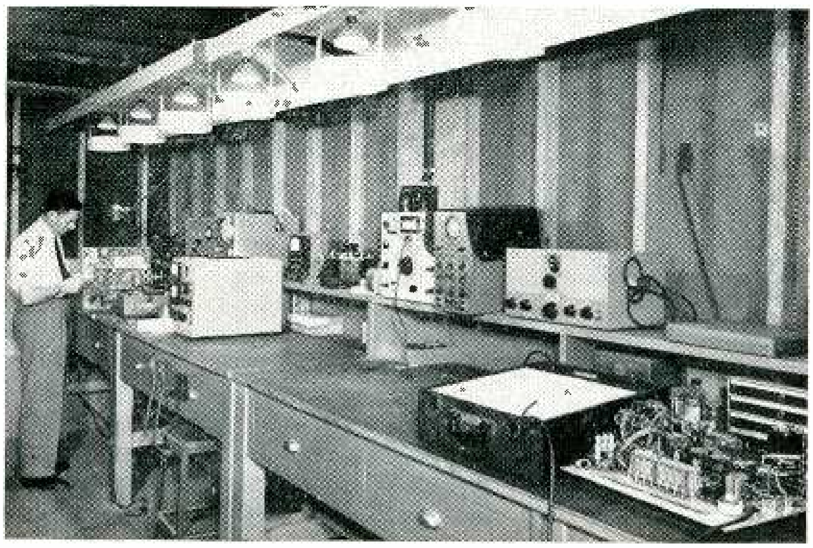


FIG. 2—Frequency characteristic of a double quarter-wave section

REFERENCE

(1) E. G. Fubini, P. J. Sutro and R. F. Lewis, Frequency Characteristics of Wide-Band Matching Sections, Report 41123, Radio Research Laboratory, Harvard University, April 19, 1943.


"A shielded or screened inner room is desirable for noise-free receiver alignment and transmitter testing"

Servicing Mobile Radio Equipment

New business opportunity combining some attributes of the engineering consultant with those of the radio serviceman exists in the rapidly growing two-way radio field. At the present rate of expansion, more qualified technicians and inexpensive test equipment will be needed to keep communications systems running at top efficiency

By MAURICE E. KENNEDY

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SKILLED radio technicians throughout the United States and Canada are finding new opportunities to expand existing servicing business by adding facilities for mobile communications equipment.

Up to May 1949, two-way mobile radio communications facilities for police and other emergency services, developed over the past 20 years, were generally serviced in shops maintained by municipalities or companies operating large fleets of mobile units.

In the past three years, since the Federal Communications Commission has released its stabilized mobile communications plan, thousands of new radio systems have been established by progressive taxi operators, oil companies, lumbering interests, trucking and transportation concerns, ambulance services, common carriers with their fleets of private subscribers, small municipalities, industrial services and numerous others.

This rapidly expanding use of electronic equipment is beginning to present many maintenance problems for owners and operators. In many cases, the equipment was originally installed by the manufacturer's sales engineering organization. Because the federal law requires that a licensed technician be responsible for the equipment, some inexperienced person in the company with a license or a local radio repairman, has often been assigned the task of keeping the system operating.

In many instances a local broadcast station technician with limited test equipment is attempting to assist several small radio communication systems in his area.

For economic reasons the small operator of a dozen taxis, or three ambulances, a utility with 15 mobile units, or a small community with a dozen police cars and two fire engines, must seek outside technical assistance from a skilled technician holding at least a second-class radiotelephone license.

A number of qualified technical men have seen the opportunity of establishing a profitable business in this growing field. A review of their operations will indicate that most of them start out with their own back-yard service shop or small radio repair shop. In many cases these men are licensed amateur radio operators with transmitter experience or a good technical knowledge of f-m radio equipment and circuits.

They put themselves through a training program on the various types of communications equipment which they will have to maintain. These servicemen have found the equipment manufacturers interested in helping them do a good job. Most manufacturers will gladly furnish service manuals, circuits and a wealth of technical data to qualified servicemen. A number of the larger equipment manufacturers will send a representative to inspect the shop, make recommendations for proper test procedures on their equipment, suggestions for test equipment needed, or even establish the shop as an authorized service station for specific sets.

Opportunity Knocks

A manufacturer writes, "There are excellent servicing opportunities in the mobile communications field for qualified technicians. It is a growing field with little competition offered to the man who has above-average technical know-how. Because of the inherent complexity of communications equipment, the qualifications are in excess of those required for routine service of home sets."

Such a serviceman is ultimately responsible to the Federal Communications Commission both for the accuracy of required tests and for subsequent operational performance. Moreover, the usefulness of mobile equipment may often depend in large part upon the availability of qualified service personnel.

The design of simple, inexpensive electronic test equipment, some of it to solve problems unique to this field, offers still another opportunity

The service technician desiring to enter this equipment maintenance field must possess a second-class radiotelephone license, or better yet, a first-class license.

Test Equipment

Most of the test equipment found in a modern radio shop can also be used for servicing mobile f-m radio equipment. This would include a modern tube tester, oscilloscope, vacuum-tube voltmeter, a good all-purpose volt-ohm-milliammeter, and possibly a sweep generator.

Special test equipment that is not usually found in radio and television service shops but should be included in the f-m communication equipment service shop would include:

Some form of grid-dip meter for circuit alignment, and r-f output wattmeter (also used as a dummy antenna load), a precision all-band oscillator with controlled output (crystals with reference points on all intermediate frequencies), and a number of small test items that the technician can build.

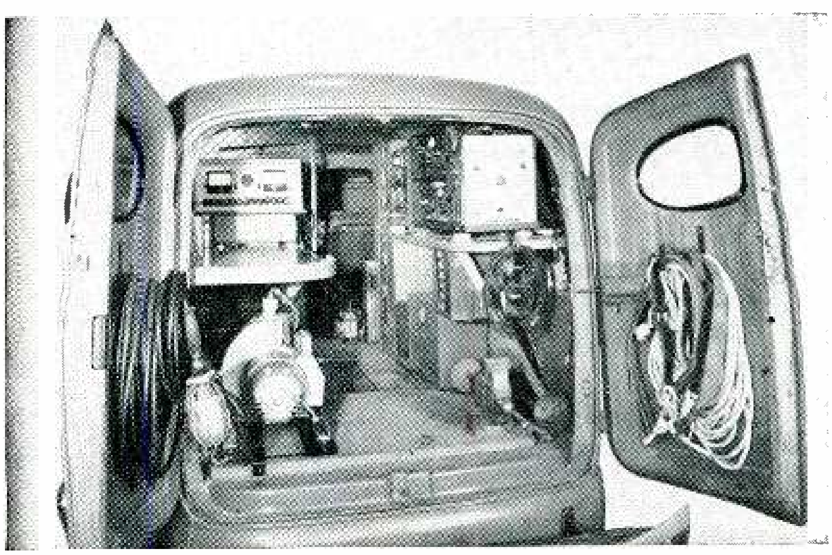
These items should include a single-tube Pierce oscillator with plate current and output indicators for testing quartz crystals, a small amplifier with impedance multi-matching input transformer for testing microphones, and a field-strength meter to cover all of the communication frequencies.

The FCC requires that operators of mobile and base stations in the communication services must have each licensed transmitter checked for frequency deviation, modulation, and power input at least every six months. This service should also be offered by the progressive communications service shop.

Many service technicians have purchased secondary frequency standards (such as BC-221 and LM) from war surplus sources, altered the equipment to cover the frequency ranges of interest to their clients and built or purchased interpolation oscillators for expanded applications. The surplus type TS-323 covers the 20 to 200-mc range. Commercial frequency standards are also available.

Radio station WWV is the primary source of calibration check and its service is available to anyone merely by tuning in the standard frequency transmissions on 2.5, 5, 10, 15, 20, 25, 30 and 35 mc. By utilizing the heterodyne principle and beating the WWV signal against a local secondary standard, continuous accurate calibration can be maintained. Local broadcast stations (required to maintain frequency within ±20 cycles) and their harmonics offer additional check points.

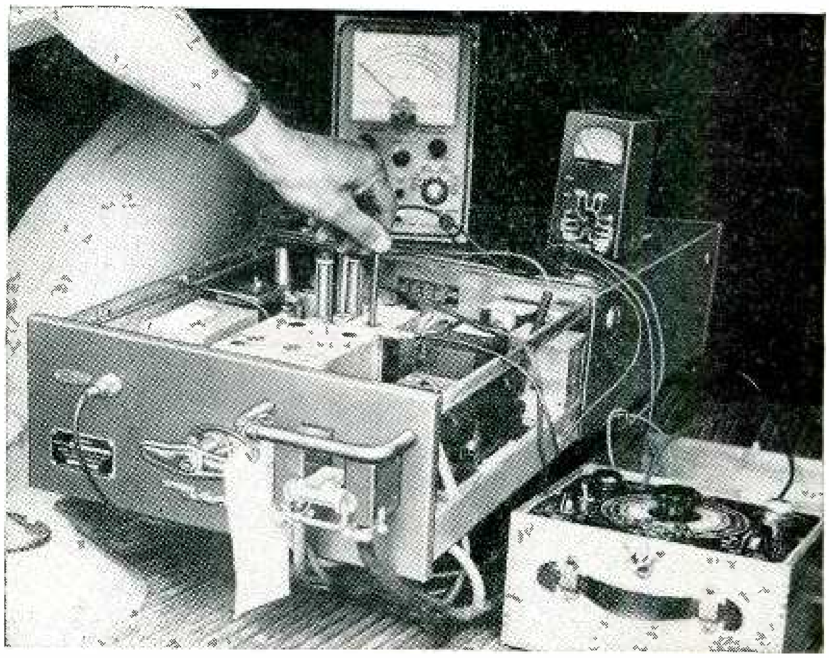
The modulation meter for a-m systems may be an oscilloscope or



"Many of the servicemen in the Southern California area maintain a portable service shop in a panel delivery truck . . ."

inexpensive modulation indicator meter. For frequency modulation checks the deviation instrument is not so simple. It is possible to build and calibrate an instrument using accurate crystal-controlled receivers with the addition of calibrated deviation indicators in the discriminator circuits. This equipment would have to be checked for frequency and placed exactly on the transmitter frequency before each measurement.

Commercial modulation measuring equipment is available and would probably be less expensive than a composite modulation-deviation indicating instrument. Some of the mobile equipment manufacturers make an all-purpose test kit for their equipment which is very satisfactory for tuning purposes.



"Most manufacturers will furnish service manuals, circuits and a wealth of technical data to qualified servicemen"

Charges

Simple mobile equipment installations can be done in a day's time by one man with some additional assistance on larger installations. Trucks, fire engines, and special vehicles usually take more time, owing to the need for waterproof housing boxes and other special construction. No standard exists for installation or service charges, but new mobile installations usually run about $25.00 and up.

Main-station installations, antenna erections and control-desk wiring should generally be done on a labor plus materials basis.

Some fleet operators are paying from $3 to $10 per month per mobile unit for maintenance labor plus parts. This charge includes routine repairs and service checks, six months complete frequency, modulation and power-input measurements, and technical supervision of the system. Main station equipment maintenance contracts run slightly higher.

Most small operations prefer to pay a straight labor-plus-parts cost when the equipment fails, or at the six-months service period.

Preventive maintenance is hard to sell the small operator. The large operator has found that it reduces the possibility of equipment failure with resulting increased in-service time.

The well-organized service shop should include some provision for working on cars within a building, preferably over a pit, hoist, jacks, or ramp. The necessity for working under the cars to install cables makes some form of car-elevating device desirable.

The service bench should have a 7.1-volt 60-ampere direct current source available from busbars extending to all service positions. Storage batteries with a floating charger will supply this current, but a high-current transformer, dry-disk rectifier and large filter make for a cleaner operation. A high-current ammeter and an accurate 0-to-8 volt d-c voltmeter are useful features in this bus supply system.

Screen Room

A shielded or screened inner room is desirable for noise-free receiver alignment and transmitter testing.

Soldering irons of the instant-heat type or with very small tips are necessary to work within the limited clearances of most modern mobile equipment.

Other tools required should include rubber and forceps-type tube-pullers, soldering-aid tools, tube-pin straighteners, long-nose pliers, diagonals with sharp oblique points, miscellaneous pliers, wrenches, socket sets and screwdrivers. A good stock of spare parts including tubes, vibrators, all values of resistors and capacitors, filters, generator brushes and wire should be maintained.

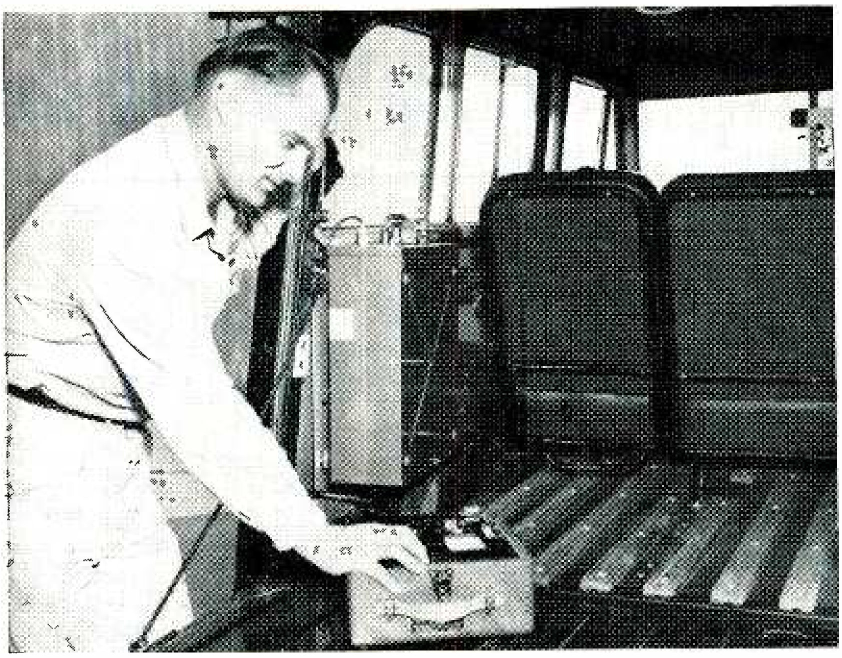
Portable Shop

Many of the servicemen in the Southern California area maintain a portable service shop in a panel delivery truck or station wagon. This practice permits them to make the rounds of their many customers, working a day or two at each location.

One of the most useful service procedures in the larger systems is the maintenance of one or more spare units for instant exchange in the field or when the car driver comes to the main shop with a defective unit. This provision permits repair work on the service bench under ideal conditions and it does not hold up a busy customer while the serviceman looks for a defective component.

Automobile Electrical System

Prior to tuning up a new installation in a radio car the battery voltage should be checked. Most radio equipment manufacturers recommend a battery voltage of not over 7.2 volts and not under 6.3 volts measured at the battery terminals. There is a voltage drop in the long battery cables to the larger



"Preventive maintenance . . . reduces equipment failure with resulting increased in-service time"

mobile equipment particularly during the time the transmitter is in operation. Special high-current generators or alternators with dry-disk rectifiers are recommended for cars with mobile radio equipment of the 30 and 60-watt sizes.

Care in adjusting the car's voltage regulator will usually permit continued use of the standard (35 amp) car generator for mobile units up to and including 30 watts if the battery is not required to furnish power for too many other loads such as red lights, sirens, heaters, fan and full lights for considerable night driving.

Standard automobile voltage regulators are seldom set for optimum adjustment at the factory and considerable trouble from too-low or too-high battery voltage is common. This fact necessitates drilling off enclosure rivets, and with accurate d-c meters, adjusting the charging rate to maintain a 7.2-volt value under normal driving conditions.

The battery's specific gravity should be approximately 1.280 when a regulator is adjusted. Drivers should be cautioned to inspect battery water level at least once a week. Battery voltage should be checked as part of the routine equipment service.

Ignition noise reduction should be accomplished on all initial installations. Resistor-type spark plugs may be necessary. Capacitors, suppressors, and full instructions are usually furnished with the installation kit that comes with a new mobile unit.

Ignition noise in some cars presents problems that can best be solved by reading all the known data on the subject and then overcoming individual cases by trial and error. Experience will be the best guide on noise elimination as each car is different with respect to ignition-noise problems.

Legal Tips

One of the most important good-will building services that a mobile service station can render its customers is to help educate the owners and operators of the radio equipment.

Field engineers of the FCC indicate that a large number of law violations by mobile fleet operators result from not understanding the simple rules and regulations about keeping an operating log, posting licenses, announcement of call letters, and dozens of other simple requirements that most engineers and all licensed operators must know.

The best sources of legal information are the following government bulletins:

Part 6—Rules Governing Public Radio Communication Services, 10¢.

Part 10—Rules Governing Public Safety Radio Services, 10¢.

Part 11—Rules Governing Industrial Radio Services, 10¢.

Part 13—Rules Governing Commercial Radio Operators, 5¢.

Part 16—Rules Governing Land Transportation Radio Services, 10¢.

These publications may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

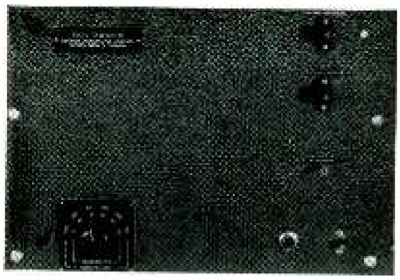
By studying the legal requirements and passing the information along, the serviceman helps the customers operate within the law. Six-month service checks should also include a check of operating practices to be sure the customer is operating in such a manner that embarrassing violation citations will not be received each time his system is inspected by a field representative of the Federal Communications Commission.

A good shop file system is indispensable. Accurate technical logs are required on each piece of equipment serviced. Copies of this information should also be on file at the customer's headquarters for reference at inspection time. Service file records should also show expiration dates of customers' construction permits and station licenses. At least two months notice should be given them prior to expiration or better yet, they should be assisted with their license problems.

Identification tags issued by the Federal Communications Commission must be attached to each mobile transmitter.

By offering this type of courtesy to customers, assuming a few routine responsibilities for them, and doing a good workmanlike technical maintenance job, it will soon be found either that the shop will have to turn new business away or expand to accommodate a rapidly growing, profitable organization.

Some of the photos used in this article were furnished through the courtesy of the Southern Counties Gas Co. of California and the Los Angeles County Flood Control District.



Front panel has six-position frequency-duration switch

High-Power

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In the study of vacuum-tube cathodes[1], a pulse generator supplying square-top high-voltage and high-current output pulses was desired.

Previous experiments with vacuum-tube cathodes had shown correlation between the emission of a cathode when operating with direct current and with short duration pulses.

Pulse Technique

If pulses of relatively long duration were used, it was hoped that the correlation between direct current and pulsed emission data might be improved to a point that would permit the pulse technique to be used. This would allow the measurement of temperature-limited emission without excessive heating of tube parts.

For this work a pulse generator was required capable of supplying pulses with a maximum amplitude of 1,200 volts at two amperes of current drain with approximately a one-percent duty cycle. Both pulse amplitude and repetition rate were required to be adjustable. A survey of existing commercially available pulse generators revealed none capable of supplying pulses with the required peak power and voltage amplitude. To satisfy these requirements, the pulse-generating circuit shown in Fig. 1 was developed. Although specifically designed for a study of vacuum-tube cathodes, this instrument may find other applications where nearly square-top, high-voltage and high-current pulses are desired.

It was essential for this application that overshoot of pulse amplitude, at the beginning and end of the pulse, be minimized. The need for multiple power supplies and transformers with high-voltage insulation was to be eliminated if possible.

The use of standard components or easily constructed special components was a primary aim in the instrument design.

Circuit Description

The complete circuit diagram of the instrument is given in Fig. 1. An unbalanced multivibrator, V_1, is controlled to give repetition rates of 10, 20, 30, 40, 50 and 60 pulses per second, with a constant one-percent duty cycle. The six-position selector switch S_1 provides the selection of pulse repetition rate and at the same time adjusts the pulse duration so that the one-percent

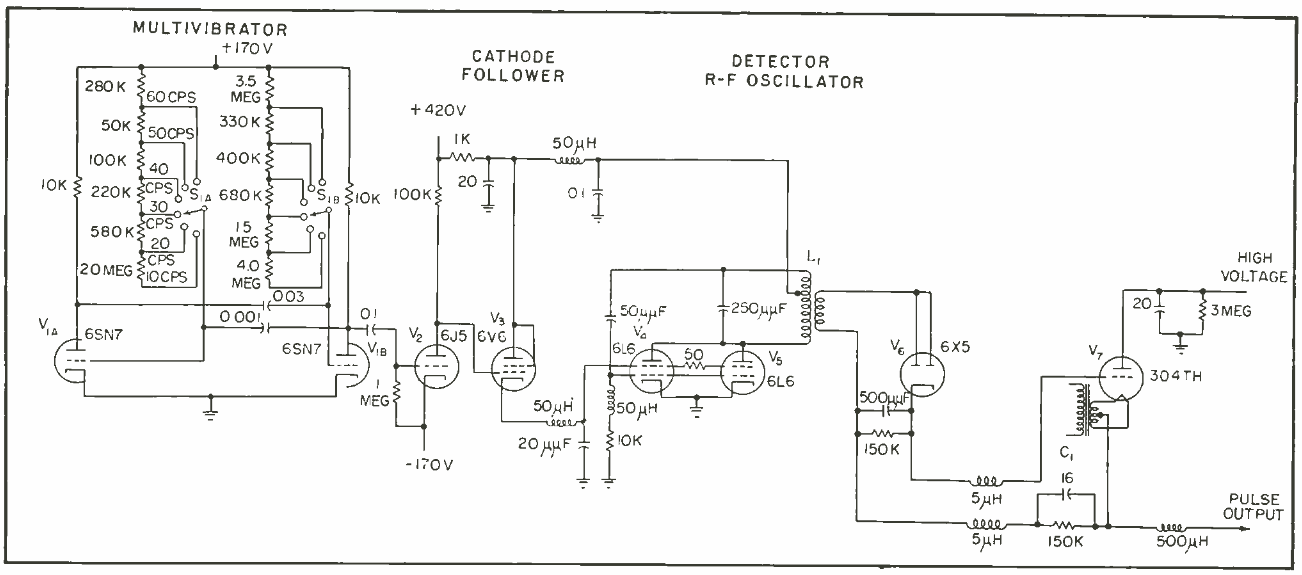

FIG. 1—Schematic diagram of the pulse generator

Square-Pulse Generator

Repetition frequency is variable in steps from 10 to 60 pulses per second with fixed duty cycle of one percent. Output is square-top pulses at several amperes with adjustable amplitude up to 1,200 volts

duty cycle is maintained. The multivibrator output pulses are amplified by a single triode stage V_2 and coupled by the cathode follower V_3 to the r-f oscillator V_4 and V_5 which is then keyed-on for the duration of the pulse.

The cathode follower controls the screen voltage of the class-C 4.2-mc oscillator, holding it biased at cutoff until a positive pulse is received. The oscillator output is a 4.2-mc carrier with 100 percent 10 to 60-cycle modulation. This triggered oscillator and rectifier combination is substituted for a pulse transformer with high-voltage insulation, which otherwise would be required for such applications.

Diode Detector

The signal is applied to a diode detector from the secondary winding of the oscillator coil L_1. This secondary is used in place of a transformer and high-voltage insulation between the two windings of L_1 provides the necessary isolation from the high d-c output voltages.

The modulated signal is passed through a diode detector V_6 resulting in a square-top pulse of the same repetition rate and duty cycle as that of the multivibrator. This pulse is then used to trigger the 304TH power triode V_7 supplying the desired output pulse.

Grid current in V_7 provides bias fairly independent of plate-supply voltage, thus the tube is self-biased to cutoff with the −130 v charge on C_1. The plate voltage of the 304TH is supplied from an adjustable external source not exceeding 2,000 volts, control of which determines the output pulse amplitude. Both the r-f oscillator and detector are enclosed in a shielded box to keep the radiated energy to a minimum.

All circuit components are commercially available with the exception of the oscillator coil L_1 the construction details of which are given in Fig. 2.

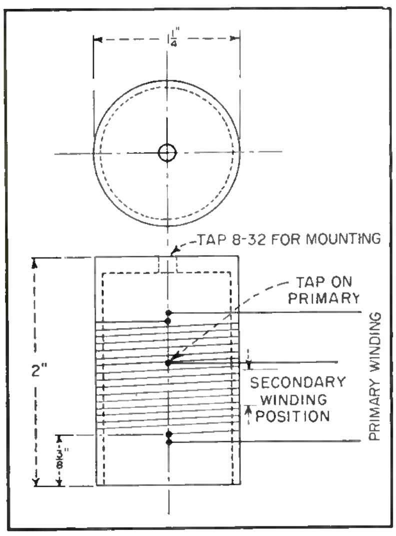

FIG. 2—Construction details of the oscillator coil

Performance

The instrument produces square-wave pulses at a repetition rate of 10, 20, 30, 40, 50 and 60 pulses per second with a duty cycle of one percent, equivalent to pulse durations from 165 to 1,000 microseconds.

The pulse amplitude is determined by the plate voltage of the 304TH triode V_7. In the service for which the instrument was designed, pulses at voltages up to 1,200 volts with 2-ampere current drain were obtained.

With the use of other external power supplies, to supply the high plate voltage of the 304TH, pulses at higher voltages and considerable higher currents may be obtained.

The output pulse has an amplitude which was found to fall off linearly at the rate of 0.01 percent per microsecond of pulse duration. The drop, for example, is two percent for 200-microsecond pulses. This die-away is due primarily to the decrease in the plate supply voltage for the 304TH, resulting from discharge of the final capacitor in the supply. The circuit is capable of supplying pulses having sufficiently flat tops to meet the requirements of many applications calling for square-top, high-voltage and high-current pulses.

Coil Construction

A drawing showing the construction details of the coil form for oscillator coil L_1 is given in Fig. 2. The primary consists of 16 turns of No. 20 copper wire with Formex insulation, with a tap six turns from one end, wound 12 turns per inch. The secondary is composed of 10 turns of No. 20 copper wire closewound over the primary as shown. Insulation between primary and secondary must be capable of withstanding 2,000 volts.

The author is indebted to M. L. Greenough for many helpful discussions and suggestions.

REFERENCE

(1) Ralph Forman and G. F. Rouse, Oxide Cathode Base Metal Studies, *NBS Journal Research*, 46, p 30, Jan. 1951.

Frame Synchronization

Analysis shows present FCC monochrome sync waveform contains adequate timing information for reliable frame synchronization on simple triggered basis for use with NTSC color-television system. Simple circuit is developed and discussed

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PROPOSED NTSC Standards for compatible color television are based on the principle of adding color to a monochrome picture by means of a color subcarrier. The standards include the technique of color phase alternation wherein the phase sequence of colors in the color subcarrier is reversed on alternate fields. The red color difference signal leads the blue color difference signal by 90 deg during one field and lags by 90 deg in the succeeding field in each frame, and results in improved color fidelity.

An arrangement for automatically synchronizing the direction of reversal at the receiver and at the transmitter is essential. This necessity has created the problem of determining whether or not adequate timing information exists in the present monochrome FCC synchronizing waveform to provide reliable frame synchronization for color television.

Apparently there is enough timing information in the present signal for this purpose.

Frame synchronization, as described in this paper, depends on a beatnote process and requires the combination of two pieces of timing or synchronizing information, one at field rate and one at line rate.

Timing information at any single frequency may exist within a composite sync waveform in three basic forms; it may exist as a single component at the fundamental sync frequency, it may be carried by harmonics of the fundamental frequency, or it may exist in the beatnote between two signal components which are not harmonics of the fundamental sync frequency. The problem of using all of the timing information at any frequency involves using all of the frequency components which may help carry the desired timing information and decoding it so that it is converted to the desired frequency in the most efficient manner with regard to signal-to-noise ratio.

Figure 1 shows ideally how the line and field timing information can be combined for frame synchronization. The line rate information derived from the composite sync signal is used in the form of very narrow pulses which are shown at the correct normal phase during each field retrace period. The field rate information derived from the composite sync signal is used in the form of a single broad pulse during each field retrace period, having, ideally, a duration of just a little less than one line. In field 1 the field pulse normally occurs halfway between two line pulses. In field 2 the field pulse is coincident with one line pulse and provides a means for positive means of identification of this field.

In actual practice the waveforms used may differ from these ideal waveforms. More important, the presence of random noise causes fluctuations in the relative timing between the line and field rate pulses. It is possible to obtain substantially perfect performance down to some level of signal-to-noise ratio at which the random fluctuations become large enough so that occasional observable errors in identification of the fields occur. In order to evaluate the level at which this begins to take place in (color phase alternation) frame synchronization, for bandwidth-limited white thermal noise, it is necessary to understand the physical nature of sync timing information.

Basic Timing

For any sync signal $S(t)$ such as that shown in Fig. 2, there is an upper limit to the sync accuracy, which can be computed for any specified signal-to-noise ratio. Since the signal is repetitive, it can be expressed in terms of a Fourier series. The signal is characterized by its peak-to-peak amplitude S_o, by phase coefficient ϕ_k and by the relative amplitude coefficients Z_k. The relative phases of the frequency components do not affect the sync accuracy which can be obtained, provided these phases are

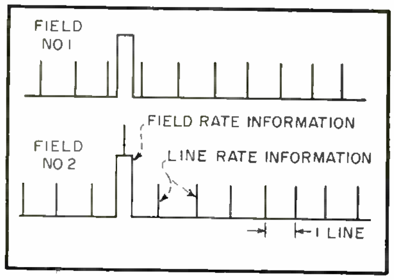


FIG. 1—Idealized drawing shows how line and field timing information can be combined for frame synchronization

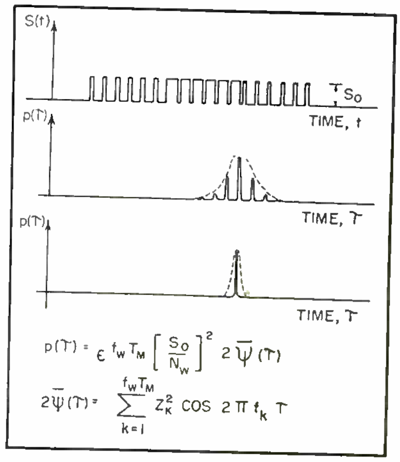


FIG. 2—Typical sync signal analysis used to study basic timing information

for Color Television

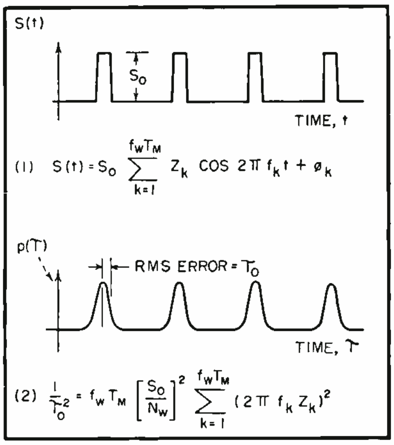


FIG. 3—Field timing signal which is applicable for frame synchronization

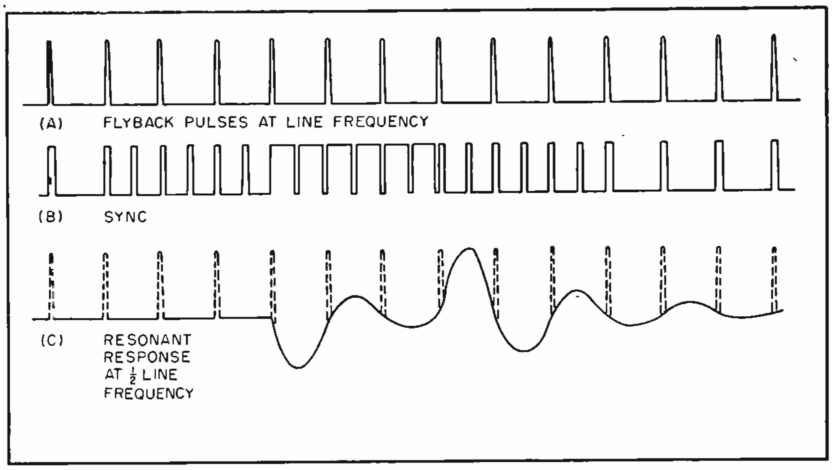


FIG. 4—Waveforms showing one mode of time-selection relating to field I, as explained in text

known in advance.

The measuring device may be considered to examine a section of the signal, T_M in duration, for each composite measurement of the sync signal. Each such measurement defines the phase during a cycle. If the video signal bandwidth is f_W there are $f_w T_M$ possible harmonic components associated with each time measurement of the signal. If the noise is uniform throughout the band f_W it may be represented by its rms value N_w.

The timing accuracy obtainable for a given signal-to-noise ratio may be expressed in terms of a relative probability density function $p(\tau)$ such as appears in Fig. 2. The curve $p(\tau)$ permits the determination of the probability that the sync timing answer which results from a single complete measurement of the sync signal will occur within a specified time interval. This probability is proportional to the area under the curve $p(\tau)$ within the specified interval.

The curve $p(\tau)$ defines the probability laws for the noise in the output of the synchronizing system. The probability curve which describes the timing accuracy is repetitive at the fundamental frequency of sync because the sync signal is repetitive. In other words, the output noise from the sync measuring device has the same character from cycle to cycle.

For many energy distributions, $p(\tau)$ has very nearly the shape of a normal or gaussian probability curve, and in such cases it may be completely specified by the rms time error of measurements τ_o for any specified signal-to-noise ratio. When the normal law applies, as it may for line or for subcarrier phase synchronization, the formula shown in Fig. 2 may be used to compute the rms time error. The formula shows that the mean squared error is inversely proportional to the product of several quantities. These are the number of independent Fourier component phase measurements applicable to each time measurement $f_w T_M$, the power ratio of signal-to-noise during a sync pulse $(S_o/N_W)^2$, and a function which depends on the distribution of signal energy throughout the frequency spectrum. This formula is based on taking the best possible weighted average of the timing measurements on all of the frequency components of the signal. This formula applies accurately when there is enough timing information in the low frequency components to identify cycles of the highs. For example, it is found that line-frequency flyback pulses in a receiver having an efficient afc system with a reasonable time constant of integration may be considered essentially noise free for purposes of frame sync performance, at all noise levels for which the video content of the picture is likely to be visually acceptable.

Timing Threshold

The field timing signal which is applicable for frame synchronization is indicated as $S(t)$ in Fig. 3 for one field sync interval of a frame. When the signal-to-noise ratio is very poor, the relative probability density function for time measurements, $p(\tau)$, has the serrated shape shown by the upper curve of Fig. 3. This occurs because there is not enough low-frequency timing information, indicated by the dotted curve, to identify completely one of the multiple peaks. At some higher signal-to-noise ratio, as indicated in the lower curves for $p(\tau)$, the main lobe is effectively the only one that exists and the formula presented earlier for the rms error may apply.

Whenever the probability density curve is multipeaked, the rms error based on the characteristics of the main lobe is not adequate to describe the threshold accuracy and it is desirable to know the shape of the probability density curve. The equation for $p(\tau)$ which is shown in Fig. 3 has been used to estimate the threshold of substantially perfect performance for frame sync. It includes as exponential parameters the number of independent phases or harmonic components $f_W T_M$, the power ratio of signal-to-noise during a pulse peak, and a function which is represented by a series including all of the Fourier components of the signal, weighted according to the squares of the relative amplitudes.

The function $\overline{\psi(\tau)}$, is a form of normalized auto-correlation function. In many cases its value for a specific value of τ may be computed by convolution methods. The threshold level has been computed from this formula for the case where the first pair of side lobes of the multipeaked probability density curve is 10 napiers or 87 db smaller than the main lobe. It corresponds to slightly more than one erroneously phased field in a 15-minute program. For this case the rms noise is approximately five times the peak-to-peak amplitude of the sync pulses.

This value obtained for the complete composite field sync signal including the notches and equalizing pulses is only two db better than would be obtained for a single broad pulse three lines in duration, using the same formula. This occurs as a result of the nonuniform energy distribution of the signal, which causes the high-frequency components introduced by the equalizing pulses and notches to be chiefly effective to quantize $p(\tau)$ as shown, but not to narrow its envelope substantially.

This suggests that if a beatnote type of frame sync system is built in which horizontal flyback timing information is compared with the basic field synchronizing information of the broad pulse group, and the information added by the equalizing pulses and notches is ignored, that it should be possible to obtain substantially perfect performance up to the point where the rms noise is about four times as large as the peak-to-peak amplitude of sync pulses.

Waveforms, Field 1

One method which has been used to accomplish nearly this level of performance is as follows. The field selection is made by comparing the phase of vertical field synchronizing information with the phase of horizontal flyback information. The composite sync waveform is used to shock-excite a damped tuned circuit resonant at one-half line-frequency. The resulting waveform exists predominantly in response to the field synchronizing broad pulses. When keyed during horizontal flyback intervals, this oscillation permits selection of the desired field as on alternate fields the line rate keying pulses occur alternately (1) at the intervals of zero amplitude or (2) the intervals of peak amplitude of the damped oscillation at one-half line-frequency.

Figure 4 presents some waveforms illustrative of this mode of time selection relating to field 1. Curve A represents flyback pulses at line frequency. Curve B represents the sync signal near the field sync interval. Curve C represents the resonant response at one-half line frequency, the peaks of which may be seen to be interleaved in time between the line flyback pulses.

Waveforms, Field 2

Figure 5 represents relevant waveforms occurring in field 2. Curve A represents flyback pulses at line frequency and curve B represents the sync signal near the field sync region. Curve C represents the resonant response at one-half line frequency. In this case the flyback pulses are coincident with the peaks of the ringing waveform. A peak detector will nominally select the pulse at t_4. If the sensitivity threshold is adjusted as indicated, any one of the pulses at t_2, t_4 and t_6 may be used to identify the start of the selected field in the frame. The unit which derives an output pulse from the combined timing information, so that the desired field in each frame may be identified, is called a field recognizer.

Although the line rate pulses are present at all times the resonant ringing of the one-half line-frequency resonator normally occurs only at the field sync intervals. This self-keying action is adequate for reliable field recognition in the presence of weak signals with substantial thermal noise interference. In the presence of strong impulse noise interference it is desirable to provide additional noise immunity. This immunity may be obtained by time-gating so that the field recognizer is operative only during a short interval in each field in the vicinity of the vertical sync interval.

Curve D represents a pulse indicative of the occurrence of vertical retrace relative to the synchronizing waveform of curve B. Such a pulse normally appears in television receivers across the spike resistor of the interstage network between the vertical scanning oscillator and the vertical output amplifier. The indicated variation in front edge or

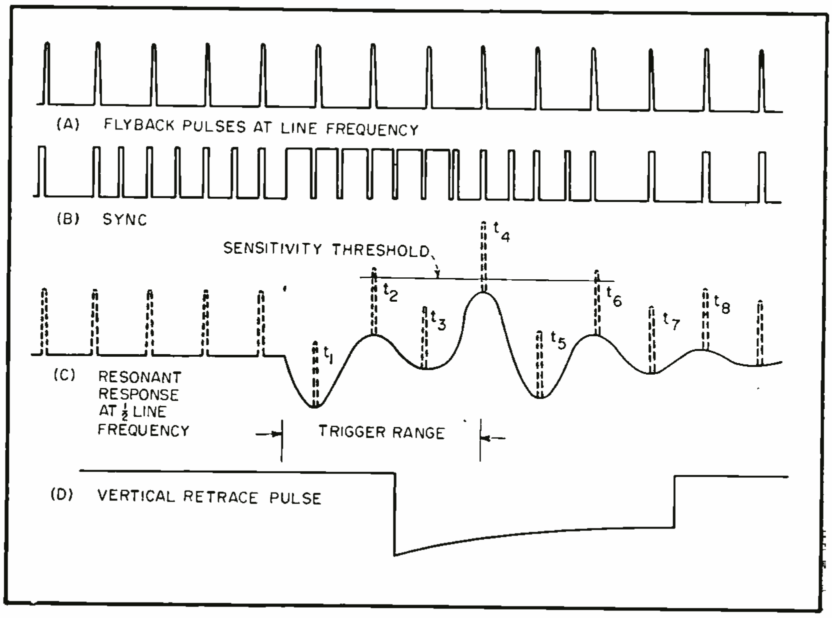


FIG. 5—Field 2 waveforms show coincidence of flyback pulses and peaks of ringing waveform

trigger range is believed representative. The retrace pulse provides a convenient source of a narrow time gate for impulse noise immunity. A pulse duration of the order of five lines is reasonable. This means that the system can be made to ignore noise impulses 98 percent of the time.

Circuitry

The connections of a typical cpa frame synchronizing system in a color television receiver are shown in the block diagram of Fig. 6. The frame sync system receives as input signals composite stripped sync from the sync separator of the receiver, horizontal flyback pulses from the horizontal scanning system and vertical retrace pulses from the vertical scanning system. It provides a square-wave control voltage as an output to the color decoder of the receiver.

A detailed block diagram showing the units in the frame sync circuit is shown in Fig. 7. The cpa frame sync system includes a field recognizer unit and a square-wave generator or flip-flop. The field recognizer unit is shown within a dashed line box. It includes a sync amplifier and limiter and associated circuitry, a shock-excited resonant circuit tuned to one-half line frequency, an amplitude limiter for the 60-pps field keying pulses which gate on the recognizer and the recognizer phase detector which is a biased peak detector.

Output of the recognizer phase detector is normally a train of pulses at a 30-cycle rate occurring, for example, at the normal trigger time t_4. Occasionally, ringing of the one-half line-frequency resonator by impulse noise will cause an output pulse from the recognizer phase detector on the undesired field. Less often a desired sync pulse may be missing. The 30-cps output pulses from the recognizer are fed to the flip-flop for providing triggering in one direction. A 60-cps train of pulses derived from the leading edge of the vertical keying pulse by differentiation is fed to the flip-flop for triggering in the other direction.

The circuit arrangement is such that after the flip-flop has been triggered it cannot be triggered again during the keying interval. In this mode of operation, called latch-on, once the flip-flop has begun operating in the proper phase sequence, occasional noise output pulses from the recognizer on undesired fields are not able to interfere with the proper functioning and the phase sequence of the flip-flop or of the cpa switching system. This reduces the time interval in each frame during which the noise impulses can cause interference from two to one percent. Since noise causes extra output pulses from the recognizer more often than it causes the desired pulse to be missing, the reduction in the number of of erroneous phases due to severe impulse noise is greater than two or one.

A schematic diagram for the frame sync circuit is shown in Fig. 8. An input signal of about 15 volts of positive composite sync is supplied as indicated to the sync amplifier through a wave-shaping network which is designed to emphasize the trailing edge of the vertical broad pulse group. For best performance, it is desirable that the sync be double limited prior to this point. The resonant waveform is developed across the tuned transformer. Horizontal flyback pulses derived from the horizontal scanning system are added in series with it, by virture of L_3. The resultant waveform as it appears on alternate fields at the grid of the recognizer phase detector is sketched in the figure. The 60-cycle vertical retrace pulses are applied through the pulse limiter tube, and a biasing network, to the cathode of the recognizer phase detector, to render it sensitive during the pulses. The plate current of the phase detector is a series of pulses at a 30-cycle rate and is fed to a suitable point in one voltage divider of the flip-flop. The 60-cycle pulses derived from the leading edges of these field retrace pulses are fed capacitively to the other voltage divider of the flip-flop which then generates a synchronized 30-cycle square wave as indicated in the figure.

Waveforms relating to the mode

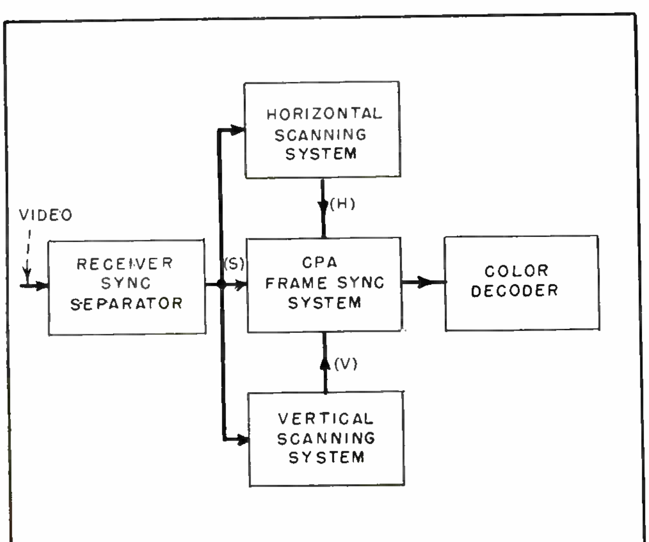


FIG. 6—Block diagram shows connections of frame sync system in tv receiver

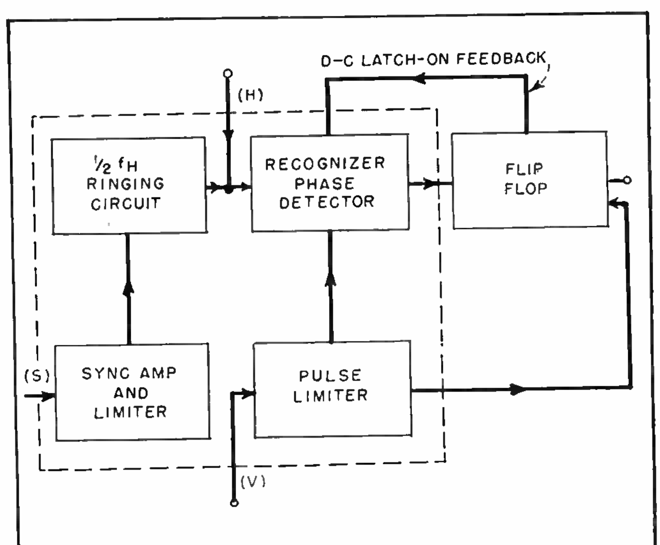


FIG. 7—Frame sync circuit consists of field recognizer (inside dashed line) and flip-flop circuit

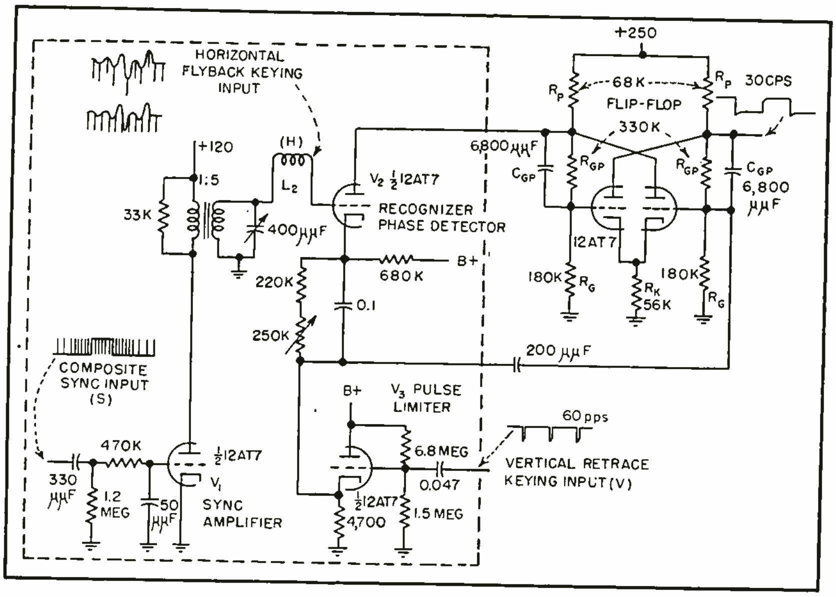


FIG. 8—Schematic for frame synchronization system

of triggering are shown in Fig. 9. Figure 9A represents (to an exaggerated time scale) the negative keying pulses at field rate, as they appear at the cathode of the recognizer phase detector V_2 Figure 9B represents the differentiated pulses derived therefrom for triggering the flip-flop in one direction. Figure 9C represents the output current pulses of the recognizer phase detector V_2. Pulses P_1 and P_2 represent normal output pulses in the desired fields. Pulse N_1 represents a spurious pulse due to noise in an undesired field. Figure 9D represents the desensitized period for the system following field trigger pulse F_1, whereby N_1 is ignored. Figure 9E shows the grid waveform of the flip-flop showing the existence of a finite recovery time after triggering, thereby causing the desensitized periods.

Experimental tests were run to investigate the performance of the field recognizer for normal signals, and under the adverse conditions of weak, noisy signals and impulse interference.

An important factor relating to impulse noise immunity of the frame sync system is the ability of the receiver to maintain horizontal and vertical synchronization in the presence of impulse interference, as well as the ability of the receiver to maintain a good signal-to-noise ratio at the output of the sync channel in the presence of noise.

The circuit was tested in several different receivers, having different sync systems. All of these receivers provided double-limited full amplitude sync at the output of the sync channel for all signal levels of interest.

For thermal noise, the threshold level with this circuit appears to be within a few db of the theoretical optimum value for a triggered system. In most cases when misfirings occurred, the cpa phase was in error for one sixtieth of a second. This disturbance has low visibility due to its short duration, and it was masked by the high amplitudes of the low-frequency components of thermal noise in the video signal at the levels for which occasional misfirings would occur. Visibility of the short time (1/60 second) misphasing of cpa sync was higher in some present models of color receivers than it will be in true constant luminance receivers.

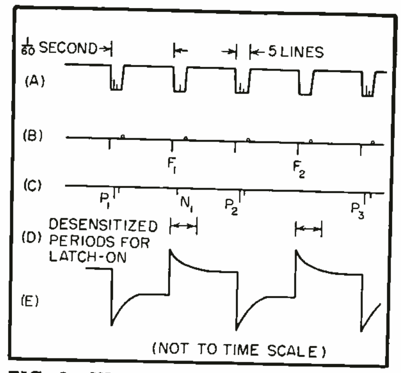


FIG. 9—Waveforms relative to mode of triggering flip-flop

One difficult problem in the evaluation of thermal noise performance is the determination of the noise level at which the picture becomes visually unacceptable. This level may vary by a considerable amount, depending on a number of factors. Tests thus far, as viewed by one group of observers, have indicated that the video signal may become visually unacceptable due to noise in the picture before occasional misphasing of the cpa frame sync occurs.

In the presence of high-amplitude impulse noise the frame sync appeared to hold together to within a few db of the level at which vertical sync failed, in all receivers. The differential performance of field versus frame sync did not appear to vary significantly between receivers.

The tests indicated that the time-gate for impulse noise immunity provides the difference between satisfactory and unsatisfactory performance with impulse interference.

Field tests now in progress should provide more data on how well triggered frame sync meets the requirements. While it is recognized that the effective signal-to-noise ratio can be further improved by integration, using an afc system, data obtained thus far does not indicate this as being necessary.

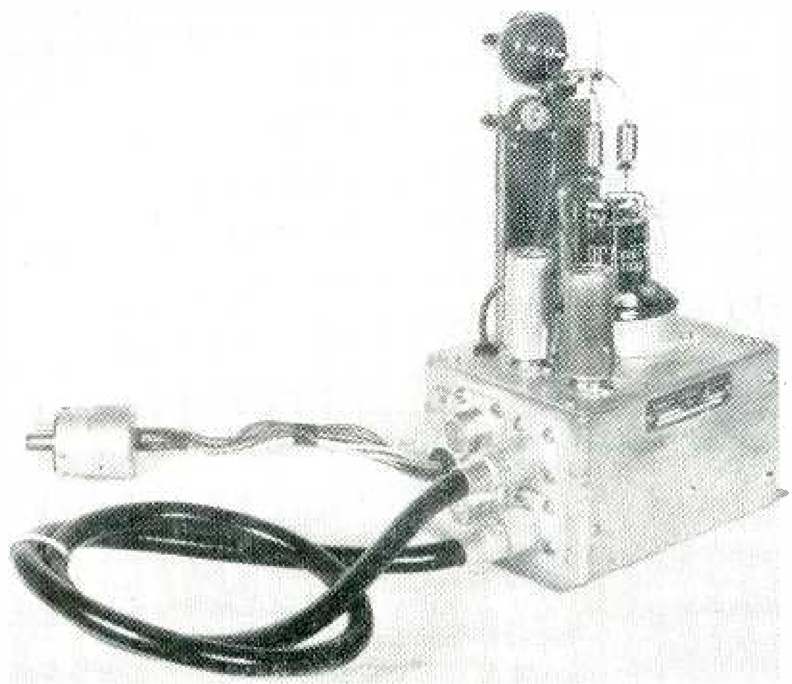
Preliminary field tests for adjacent and cochannel interference using color receivers designed for the NTSC signal shows that pictures usually become intolerable in video content before cpa sync fails.

The circuit presented above is economical and thus far has given satisfactory performance.

Conclusion

It has been shown that the present monochrome FCC synchronizing waveform appears to contain adequate timing information for reliable frame synchronization on a simple triggered basis, and that simple circuits can be built which achieve close to the theoretical optimum performance.

The author is indebted to J. R. White, R. J. Keogh, C. E. Page and C. J. Hirsch for encouragement in the preparation of this paper.



Chassis of cathode-ray-tube beam intensifier showing delay cable used to control duration of beam-on time

Cathode-Ray-Tube Beam Intensifier

Three-tube circuit provides positive spot intensification for millimicrosecond oscillography of random transients. Composite photographs of high-voltage pulses may be made using intensifier to select various portions of pulse

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SPECIAL TECHNIQUES are employed in the design of intensifiers for use with multiband post-acceleration cathode-ray tubes. These tubes are noted for their extremely high writing speed and spot brilliancy. The duration of the signal presented to them is small, so that advantage can be taken of their fast writing rate. Intensification of the beam becomes harder to accomplish as the period of observation grows smaller. To offset this, a cathode-ray-tube intensifier has been developed to provide positive intensification for time durations in the millimicrosecond range. This intensifier originally was designed to intensify the beam from nonrecurrent transients. The prime requisite is that the transient signal be delayed as little as possible while the tube beam is being turned on.

There are various methods of intensifying the beam of a cathode-ray tube. Multivibrators often are used to gate long-time-base oscilloscopes. As observation time is shortened, the multivibrator cannot be depended upon to produce the desired rise-time gating pulse; consequently, some systems use thyratrons. Thyratrons have fast ignition time; however, with low triggering voltages, ignition time may be well over one microsecond. This time is too long for observation of fast rise-time pulses. Further, ignition time of a thyratron varies with trigger-signal waveform and amplitude. The intensifier described uses a hard tube as the gating tube and thyratrons to shut off the beam.

This system is novel in that the

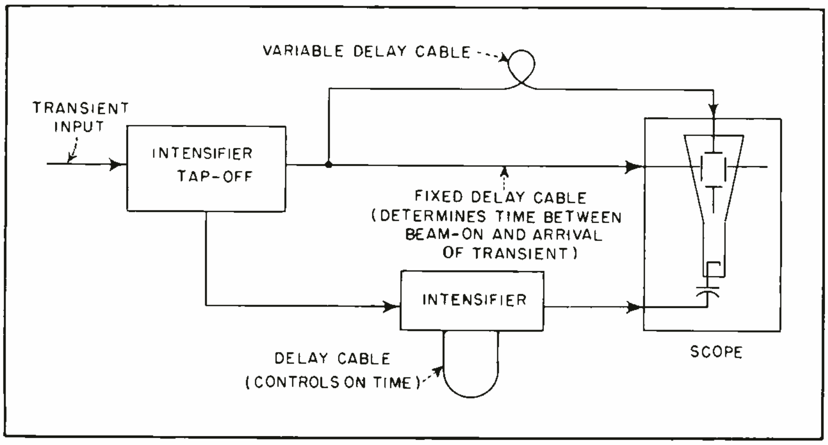

FIG. 1—Block diagram shows how intensifier is connected with oscilloscope

gating signal is the trigger signal amplified and clipped. The hard tube assumes two functions: it amplifies a portion of the leading edge of the trigger signal and clips the remainder to provide a constant level of intensification. Clipping occurs in the grid circuit as the grid goes positive. The output is a negative signal and must be capacitively-coupled to the cathode of the cathode-ray tube.

Since multiband high-voltage cathode-ray tubes have deflection factors in the range of 100 to 250 volts per inch, the signal applied to the plates can be applied directly to the intensifier through a tap-off. This results in extremely accurate time coordination between gating pulse and observed signal.

With negative or zero trigger signals the intensifier is turned off. It is on only for positive signals that carry the hard tube to zero grid bias. This is not a disadvantage since the purpose of this type of intensifier is to examine a small portion of a pulse, such as the leading or trailing edge. Various portions of the pulse may be displayed by changing the length of delay cable between the intensifier tap-off and the cathode-ray tube. A series of pictures of the pulse taken with decreasing length of delay line will effectively expand the sweep length many times when the pictures are joined to make one composite photograph.

Linear Sweep

The generation of a linear sweep for a short duration presents a difficult problem. A convenient method of generating a linear sweep, when observing such phenomena as rise times of phototubes and pulse generators, is to bias the cathode-ray-tube horizontal plates so that the linear portion of the fast rise from the signal appears across the center of the tube. The vertical signal may then be delayed in successive steps by inserting lengths of delay line to complete the composite photograph. Figure 1 is a block diagram of the setup.

The intensifier delays are adjusted so that intensification is obtained only in the linear portion of the horizontal trace. When this method is used, there will be no time jitter between the signal and the sweep. An advantage in the case of periodic signals is that a sweep generator is not required for the oscilloscope. Periodic signals are handled in the intensifier by removing the thyratrons. Biasing the grid of the hard tube controls the duration of intensification, and the delay line from tap-off to intensifier controls the phase.

The circuit of the intensifier is given in Fig. 2. A 3E29 or 829-B is used as the hard tube. The ability of these tubes to deliver a large current at zero grid voltage helps to charge the cathode-ray-tube cathode capacitance quickly, resulting in a faster rise time. The series grid resistor allows clipping to occur after the trigger signal has reached zero grid bias and, consequently, has been amplified in the plate circuit.

Two 2D21 thyratrons turn off the intensifier. One is across the screen grid of the 3E29 and the

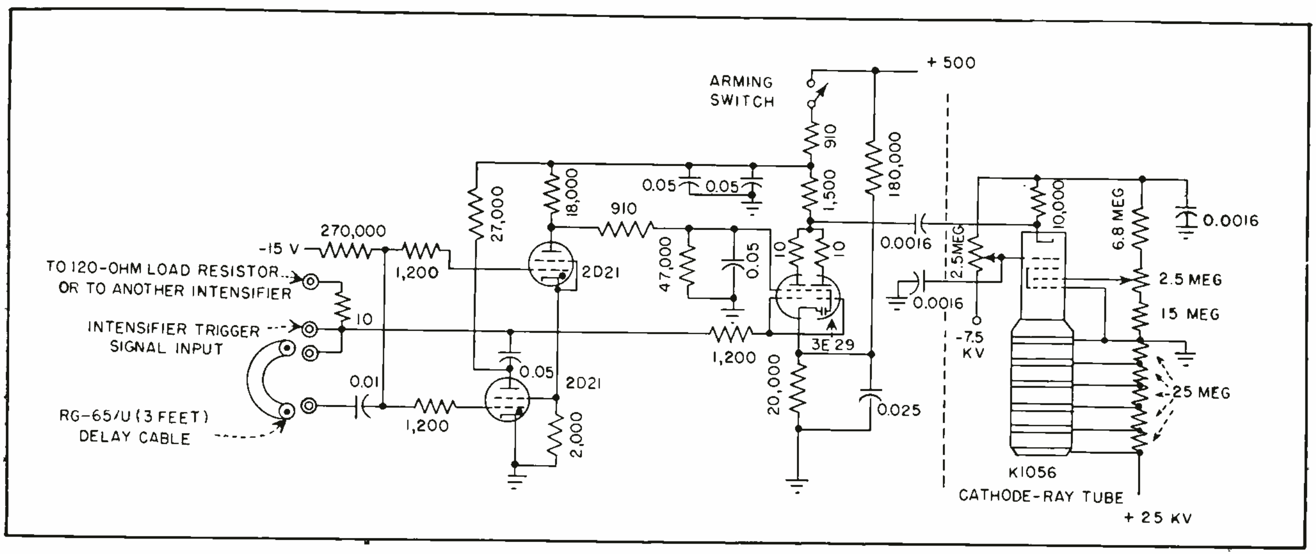

FIG. 2—Complete circuit of intensifier attached to multiband postacceleration cathode-ray tube

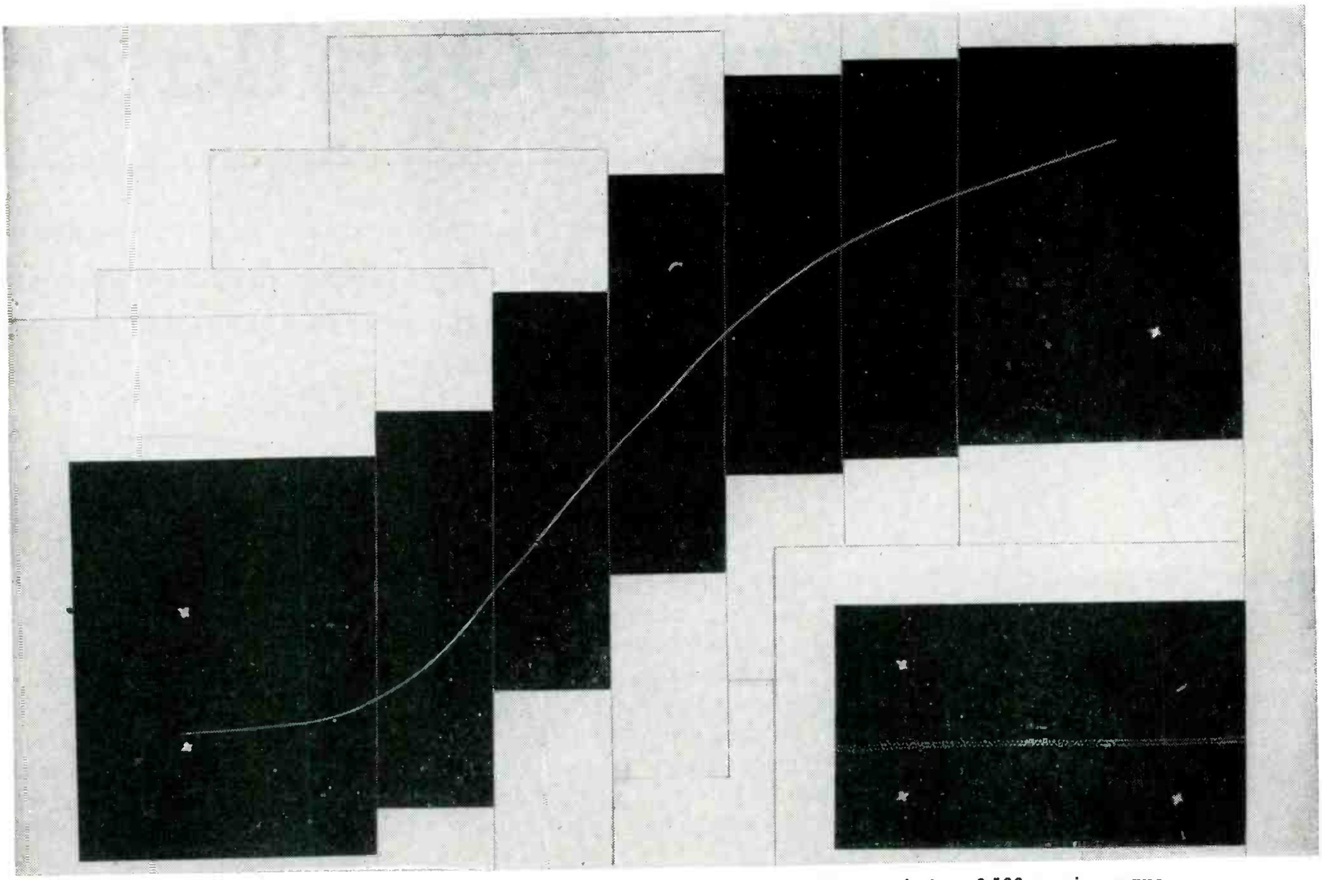

FIG. 3—Composite photograph of pulse rise made with intensifier. Time scale is a 6,500-mc sine wave

other is across the control grid.

For the particular application for which the intensifier was designed, it was necessary to lock out all signals after the main signal. The thyratrons are triggered from the main trigger signal but delayed for the presentation time by means of a small section of high-delay RG-65/U cable. This cable has a characteristic impedance of 950 ohms and a velocity of propagation of approximately 20 feet per microsecond. The screen-grid thyratron provides positive lockout, but its action is not fast enough. The screen-grid capacitor is slow in discharging; therefore, a thyratron has been added on the control grid to provide immediate cutoff. However, this thyratron will not lock out for all time owing to the possibility that a negative trigger signal could extinguish the tube by carrying its plate below ground potential. Another positive signal would then intensify the hard tube before the trigger signal reached the thyratron grid through the high-delay cable, thus causing a spurious intensification. This cannot occur since the screen-grid thyratron has cut off the hard tube.

The intensifier has been used to intensify a DuMont type-K1056 multiband, high-writing-speed cathode-ray tube. The time of signal observation can be changed by connecting different lengths of RG-65/U delay cable on the side of the intensifier. A 2-ft length gives approximately 100 millimicroseconds of presentation.

Transient Photography

Figure 3 shows a composite photograph taken of the leading edge of the output from a pulse generator. The linear-rise portion of the pulse comprises the horizontal sweep as explained above. The pulse was connected to the vertical plates through a delay cable. A delay of four millimicroseconds was added in this variable delay cable after each picture was taken, until the entire leading edge had been photographed. Fiducial markers from small masked lights near the cathode-ray-tube screen aided in positioning the individual photographs.

A timing trace for obtaining a time base was made by photographing a 6,500-mc magnetron output on the vertical plate against this same horizontal sweep. A distance equivalent to four millimicroseconds, the time delay between successive photographs, was laid off in the center of the negative. This distance was transferred to the pulse photographs, and the right edge of each was clipped at the end of the 4-millimicrosecond period. The traces were then joined and photographed, as shown in Fig. 3. The resulting trace covers a total time of 30 millimicroseconds.

By using the method just described, the resolution will effectively be increased when large signals are to be observed. Another advantage is that the recording is obtained with a minimum of required equipment; for example, it is not necessary to employ a pulse attenuator or to provide a horizontal sweep source.

The author wishes to acknowledge the helpful suggestions rendered by H. J. Peake and N. W. Matthews in the design and development of this intensifier.

Stable-Output Oscillator

Oscillator amplitude is reduced only 3 percent for 30-percent decrease in either heater or plate-to-cathode potential. Output stabilizing circuit can be applied to existing equipment when provided with 2-ma source of regulated d-c reference potential

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MODERN INSTRUMENTATION has increased the demand for stable radio-frequency potentials. For widest application, generators supplying such voltage should satisfy certain requirements. First, r-f output amplitude should be maintained within reasonable limits over an anticipated range of long and short-term variations. Second, means for varying the magnitude of the regulated potential should be included, and third, circuits should remain simple and noncritical from the standpoints of maintenance, adjustment, and economics.

Regulated amplitude oscillators satisfying one or more of the above requirements, either in full or in part, have been constructed.[1,2,3] The main advantage of the unit to be described here is its ability to operate with any positive d-c reference potential available, whether within or external to the equipment of which it is a part. To the author's knowledge, the particular circuitry shown has not been previously used in this manner. From the standpoints of economics, simplicity, and ease of adaptability to existing equipment, the above feature should prove valuable for laboratory use.

The input stage of the d-c amplifier, upon which control depends, and the voltage divider that supplies the reference potential comprise V_3, R_4, R_5 and R_6 in the circuit diagram. It is this circuit feature that makes the unit so readily adaptable in practice. The fact that the plate resistor of the input stage of the d-c amplifier V_3 is 15 megohms limits the maximum cathode current variation to less than 20 microamperes, when using a supply potential of 300 volts or less. With the voltage-divider resistors R_5 and R_6 chosen to allow a current flow of two milliamperes from the d-c reference source, the maximum change in reference voltage due to cathode current flow is less than 1 percent.

The output of oscillator V_1 is rectified by a CK-707 germanium diode, and the positive d-c potential thus obtained is applied to the grid of V_3. The d-c amplifier output stage V_2 is a cathode follower that supplies the plate and screen power to the oscillator. An increase in potential at the grid of V_3 causes a decrease in potential at the cathode of V_2, thereby reducing the amplitude of the r-f output of V_1. The stabilizer thus attempts to keep the r-f output amplitude constant.

Circuit Analysis

Voltage-divider network R_5 and R_6 allows adjustment of output amplitude. For many purposes a particular output voltage is desired. In these cases R_6 can be fixed and minor adjustments for a constant-output voltage made by detuning the oscillator tank capacitor, C_1. It might be preferable to obtain the reference potential from a gaseous regulator tube or a stabilized low-voltage supply using a mercury cell battery as reference.[4] For this reason, the values of R_5 and R_6 are not specified.

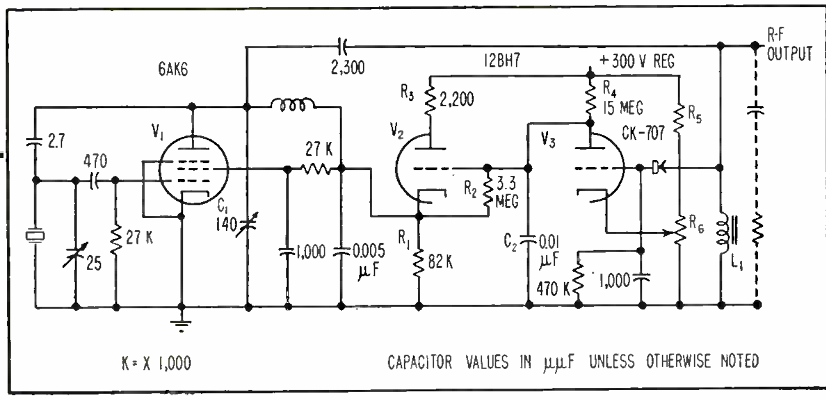
The rectifier circuit is a series, peak-reading arrangement. A 2-mh iron-core choke L_1 provides a low-resistance d-c return necessary for capacitively coupled peak-reading rectifiers. The choke in question must have sufficient reactance at the lowest oscillator frequency to minimize oscillator loading, and hence must not become series resonant at the highest oscillator frequency. In the circuit shown, rectification efficiency was found to be constant within 2 percent in the range from 1.8 to 19.5 megacycles.

In the V_3-to-V_2 coupling network, C_2 (a plate bypass capacitor) prevents the unit from oscillating as a low-frequency phase-shift oscillator. The plate of V_3 is directly coupled to the grid of V_2. Resistor R_2, connected from the grid to cathode, provides the grid return for V_2. The impedance looking into the grid of V_2 is

$$Z = R_2\left(1 + \frac{\mu R_1'}{r_p + R_1'}\right) + \frac{r_p R_1'}{r_p + R_1'}$$

For this equation, only the low-frequency case has been considered; R_1' is the parallel impedance of R_1 (the cathode-follower cathode resistor) and the plate and screen-loading of V_1; μ is the amplification factor of V_2. When R_2 is large compared to the parallel combination of R_1' and r_p, the second term on the right may be neglected.

Under the operating conditions for the circuit shown, the plate resistance of V_2 is approximately 4,000 ohms and the minimum value of R_1' is about 4,000 ohms. The μ of V_2 is about 20. Under these conditions, the load presented to the plate of V_3 by the input of V_2 will be approximately 36 megohms. It



Circuit diagram of the stabilized oscillator. Control section can be used with existing oscillator circuits to insure constant-amplitude output

should be noted that with this circuit arrangement, some of the current drawn by V_3 will come from the cathode of V_2. This restricts the value of R_2 to a magnitude large enough to prevent the maximum current through V_3 from exceeding 20 microamperes. A higher value of cathode current will adversely affect the stability of the reference potential at the cathode of V_3. The cathode resistor R_1 is chosen small enough to keep the cathode-heater potential within rated value if oscillator current discontinues for any reason, but large enough to prevent excess current drain with high output voltages.

Under normal conditions the largest current drawn by this resistor will be less than 2.5 milliamperes. Keeping down the current drawn by the cathode resistor allows the d-c amplifier portion to operate with essentially full gain when the cathode emission falls off (as approximated in tests by reduced heater temperature). Stability with respect to heater potentional changes is thereby improved. The plate resistor R_3 of V_2, is inserted for decoupling and overload protection.

The plate and screen of the oscillator are fed from the cathode of V_2. A d-c blocking capacitor is often connected in series with the tank capacitor of series-fed circuits to prevent temporary shorts in the tank capacitor, during adjustment or operation, from blowing the plate supply fuse. The connection shown eliminates the need for such a capacitor and,in addition, provides a single oscillator d-c power lead.

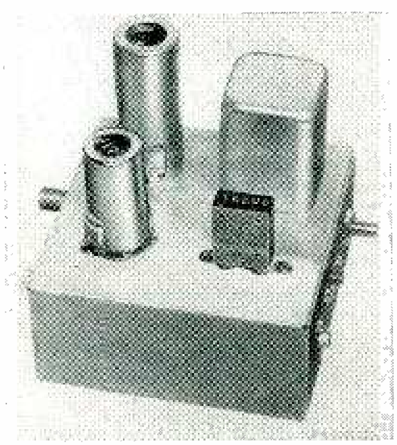
Amplitude-stabilized devices used in a laboratory should be stable with respect both to short and long-time intervals. The prime factors usually affecting amplitude in the short term (fifteen minutes or so) are changes in load and changes in line voltage. Factors affecting long-term stability are usually associated with tube transconductance changes. Stability with respect to short-time changes was approximated by changing heater potential on V_1, V_2, and V_3, and oscillator load. A change of 2½ percent in output amplitude resulted from a 30-percent decrease in heater potential.

Stability

A maximum change of 3 percent in output amplitude resulted from either doubling or halving the oscillator load. Stability with respect to long-time changes may be approximated by changing plate potential on all tubes (keeping the reference potential constant by use of a second stabilized supply) and filament potential.

The tube mutual conductance is a function of plate-cathode potential. The effects of decreased emission from an aging cathode can be approximated by reduced heater potential. Here a 30-percent decrease in heater potential and plate-to-cathode potential (each taken separately) resulted in an output amplitude reduction of 3 percent. Since the accuracy of the average laboratory r-f voltmeter is 3 percent, this stability may be considered good.

The stabilized oscillator described may be used as a separate source of r-f potential, or the d-c amplifier stabilizer may be adapted to existing generators. In cases requiring much greater d-c power for the oscillator, a separate power stage and pentode input tube may be used, or the oscillator plate may be supplied separately and the screen alone fed from the regulator. The unit is simple and easy to install. It shows good long and short term stability, and provides a ready means of amplitude adjustment.



Laboratory model of the stabilized-output oscillator

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Unitized Pulse Circuits

Rack-mounted pulse-control circuits perform basic gating, mixing and delay functions to save time and money in design of pulse equipment. Any type of pulse equipment can be set up quickly by interconnecting basic units with coaxial cable

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PULSE CIRCUIT DESIGN is accomplished with a minimum of time, effort and material by use of basic pulse circuit units to generate, control and distribute 0.1-μsec pulses.

Building block units, like the coincidence detector shown in the photograph, perform elementary pulse manipulations such as gating, mixing and delay. These units are mounted in standard 19-inch racks and may be interconnected by coax to set up any desired type of pulse equipment.

The large photograph shows an experimental digital computer using about 500 pulse-control units. This computer has been in operation for over a year.

Basic pulse-control units are listed in the table. Figure 1 is a functional block diagram illustrating how several basic units may be interconnected. The system shown is a four-way pulse distributor wherein pulses applied to the input appear successively at outputs one, two, three and four. Two flip-flop circuits and six coincidence detectors are employed.

Voltage Waveforms

All operations are performed almost entirely by two kinds of voltage waveforms, a half-sine wave having a 0.1-μsec duration, and a two-valued voltage waveform that can be switched in 0.2 μsec, and which can remain at either value for an indefinite period the higher value being ground potential and the lower value between −14 and −30 volts.

Pulse durations other than 0.1 μsec are used mainly in terminal circuits linking a system of pulse-control units with other equipment types.

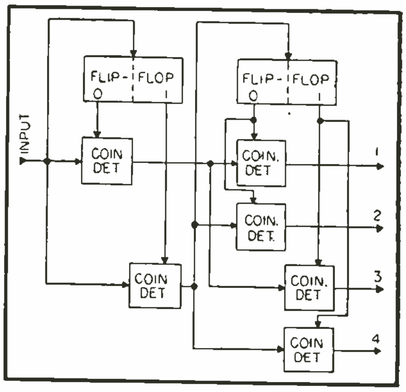


FIG. 1—Four-way pulse distributor requires two flip-flop circuits and six coincidence detectors

Each unit is designed so that pulse distortion is corrected before the pulse is delivered to the output jack. This correction permits cascading units without pulse deterioration.

Output Characteristics

The pulse-control units deliver 0.1-μsec half-sine pulses into RG-62/U, 93-ohm, terminated coaxial cable. The zero-signal output and baseline voltage level is ground potential.

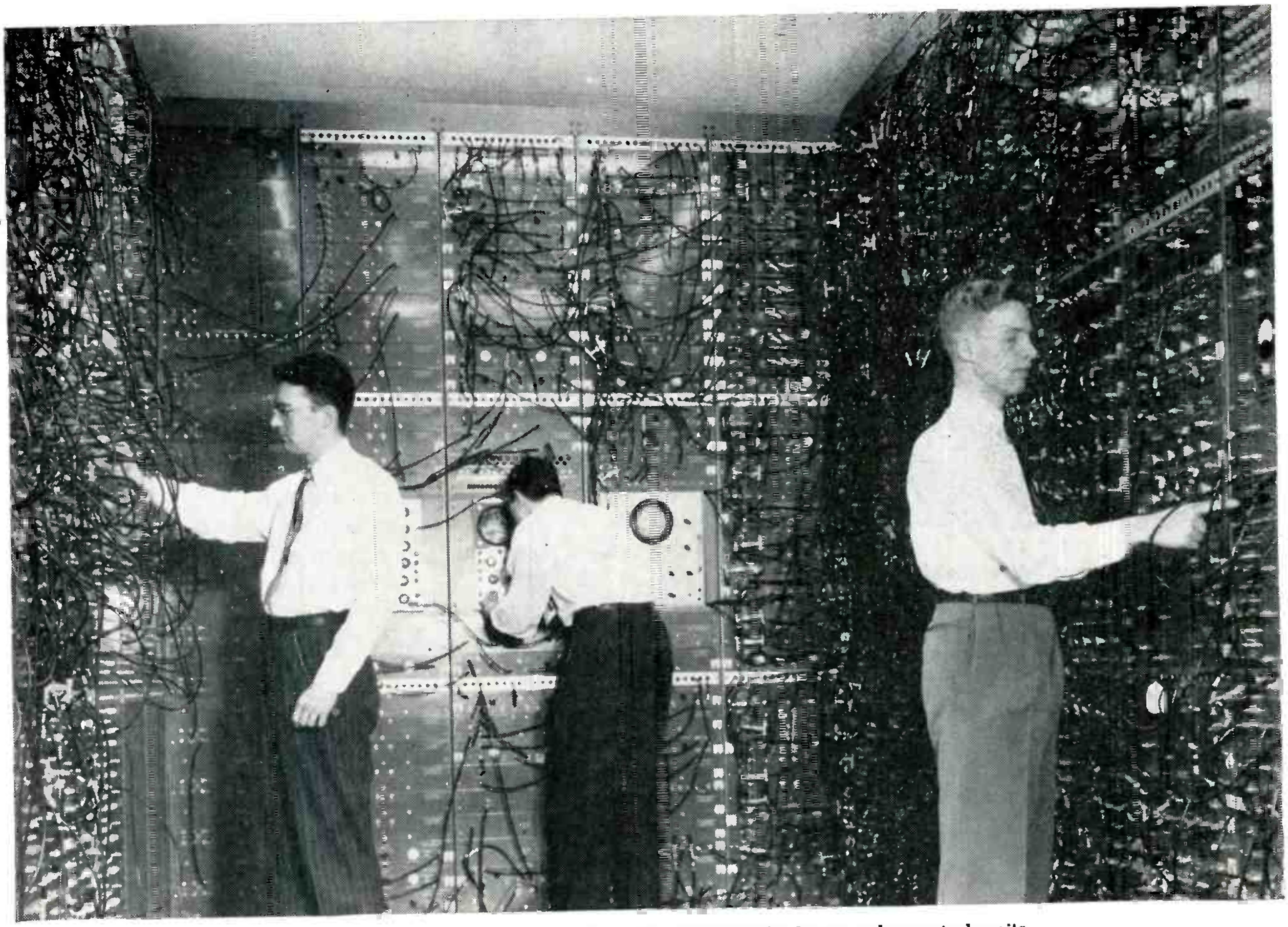
The output transformer is connected to the line through two parallel crystal diodes and a three-position switch. The diodes connect the outputs of several parallel units without impedance mismatch and disconnect the low impedance of the terminated output cable during the time the transformer output tends to go negative. This cuts off negative overshoot and ringing following the output pulse.

The switch permits reversal of output pulse polarity. In neutral position, the transformer is discon-

Building Block Units for Pulse Circuit Research

Unit	Function
Pulse Generator 1001B	Generates 0.1-μsec pulses over continuous frequency range 15 to 650,000 cps
Pulse Generator 1002A	Generates 0.1-μsec pulses over continuous frequency range 0.2 to 4.5 mc
Pulse Generator 1003A	Generates single pulse by push-button control
Flip-Flop 1101B	Bistable E-J circuit can be switched by 0.1-μsec pulses. Two outputs are d-c levels for gating pulses
Coincidence Detector 1201A	Senses coincidence between 0.1-μsec pulse and flip-flop output
Coincidence Detector 1202A	Senses coincidence between outputs of up to five flip-flop circuits
Pulse Delay 1301B	Delays 0.1-μsec pulses from one to 70,000 μsec
Pulse Delay 1302A	Delays 0.1-μsec pulses from 0.1 to 1.9 μsec in 0.05-μsec steps
Channel Selector 1401A	Feeds input 0.1-μsec pulses to four output jacks
Mixer 1601	Mixes up to five inputs for a common output

Speed Computer Design



This experimental digital computer incorporates nearly 500 basic pulse-control units

nected from the output jack.

The output circuits can be paralleled only when the desired pulses have the same polarity.

The amplitude of the output pulse can be varied between 10 and 32 volts by a potentiometer. Output impedance level is not affected by amplitude. The output pulse is slightly distorted at maximum amplitude setting but the distortion will not affect operation of succeeding units.

Input Characteristics

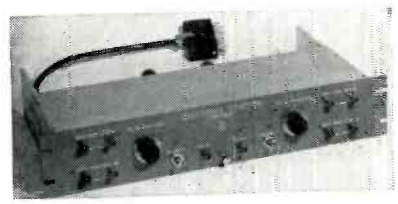
The input circuits utilize positive 0.1-μsec pulses or d-c voltage level. Minimum amplitude required to trigger the units varies from 9 to 15 volts. The units are designed for uniform operation over a wide range of input pulse amplitude.

Since the input impedance of most units is high compared to the characteristic impedance of the terminated cable, it is possible to feed several units with one cable.

When using the pulse-control units with other equipment, it may be necessary to convert the 0.1-μsec pulses into pulses having different shapes and impedance levels. It may also be necessary to convert pulses from an external source into 0.1-μsec pulses.

For these applications, special adapter units must be made to obtain signals with the proper amplitude, shape, impedance and voltage level.

The pulses can be lengthened with single-shot multivibrators, blocking oscillators, smearing circuits, and so on. Pulses from external equipment can be shortened with peaking circuits operated by current pulses easily obtained from single-shot multivibrators, flip-flops, Schmitt circuits, or gas tubes. Gas-tube peaking circuits are simplest, but are limited to lower frequencies.



Coincidence detector is typical of rack-mounted pulse circuit building blocks

Acknowledgment

The author wishes to acknowledge the efforts of Jay W. Forrester, head of Project Whirlwind, MIT, who first proposed the idea of constructing unitized components and whose encouragement led to the development and construction of the original equipment.

Phototube timer is located unattended on ski slope. Servomechanism operates meter farther down slope, where skier may stop and read her speed

Linear Scale

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SKIERS can determine their speeds using a phototube-operated timer that displays speed directly in miles per hour on a linear-scale meter. The timer may be located unattended on the slope with the servocontrolled meter installed at the foot of the hill.

The timer may also be used to clock vehicle and animal speed trials. With some circuit modification, it can measure other events per unit time or events per unit event. Such applications could include measuring cycles per second, watch ticks per hour, revolutions per minute or miles per gallon. If desired, the timer can be modified to display elapsed time as well as speed.

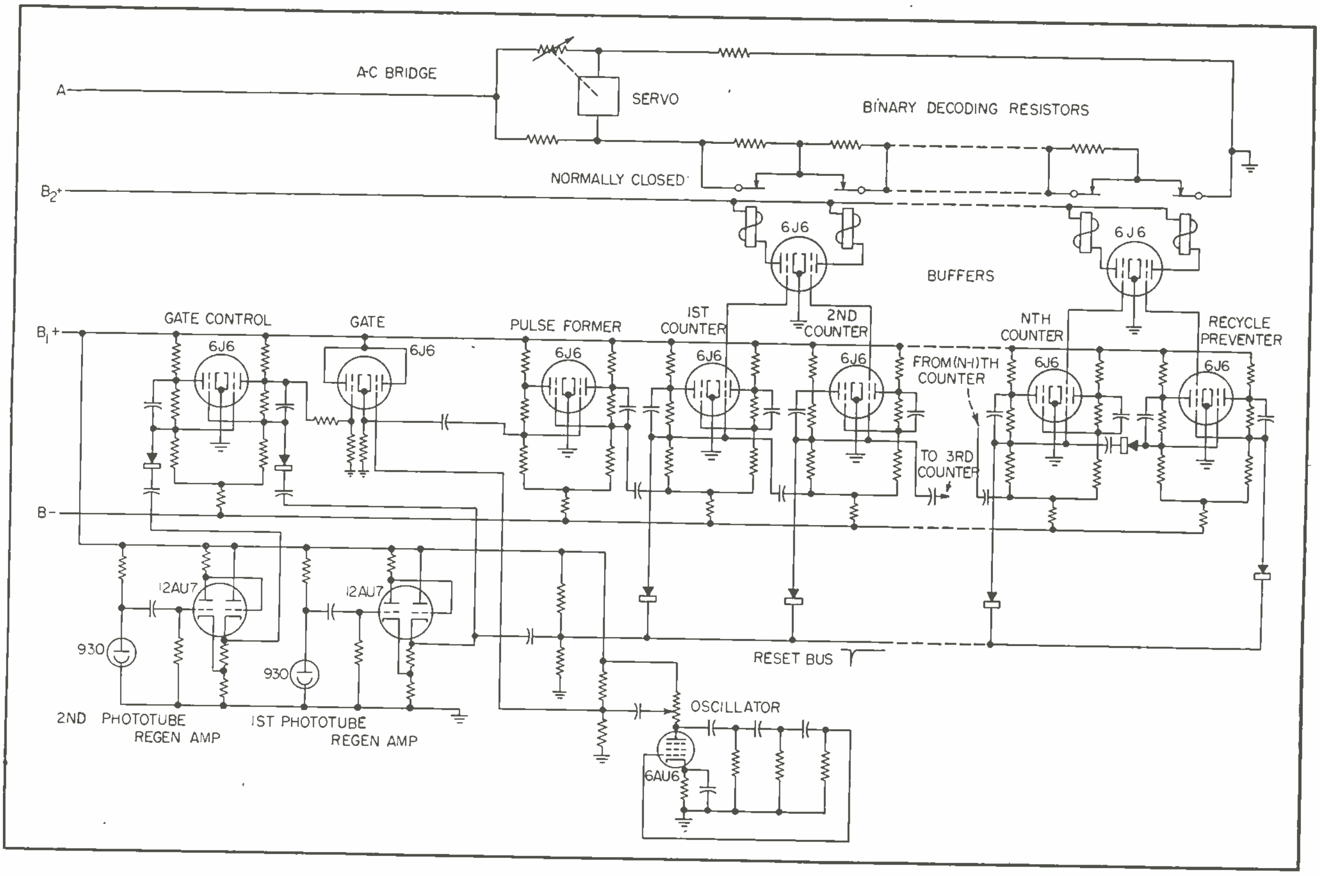


FIG. 1—Phototubes gate pulse input to binary counter. Binary decoding resistors, switched by counter-output relays, form one arm of Wheatstone bridge

Velocity Meter

Versatile timer clocks speed trials, or it can also measure auto miles per gallon. Phototube pair gates constant-rate pulse train fed to binary counter. Counter output selects resistors proportional to elapsed time. Current through resistor chain then varies directly with speed

The device consists of two phototubes separated by a short distance and used to gate a standard oscillator on and off as the skier passes. A binary counter registers the number of cycles passed from the standard oscillator as a measure of elapsed time. Relays operate to connect in series a resistor chain proportional to time and a bridge-balancing servomechanism converts this information into speed.

Circuit Details

Figure 1 is the circuit of the linear, direct-reading velocity meter. The signal from the first phototube is amplified by a regenerative amplifier that accepts the slowly-varying waveform and supplies a pulse to activate the trigger pair that opens the cathode-follower gate. The gate-tube grid receiving the oscillator signal is then at the higher potential and the cathode voltage follows it.

This signal is converted into pulses by a modified trigger pair and the pulses fed to the binary counter until a signal from the second phototube gates off the oscillator signal. The counter stages (bistable multivibrators) activate, with the help of buffer tubes, relays that connect resistors in series. Each successive resistor is twice the previous one. The total resistance is proportional to the number of cycles and thus, to the elapsed time.

If a fixed voltage is applied to this resistance, the current will be inversely proportional to time and an ammeter will give a linear indication of speed. In Fig. 1, the binary resistors constitute one arm of a Wheatstone bridge whose opposite arm is a potentiometer driven to balance the bridge. The setting of the potentiometer is inversely proportional to time and its attached dial can be calibrated in speed.

If a skier feels he has made good time at the measuring point, he can stop farther down the slope and activate the bridge servomechanism to display his speed.

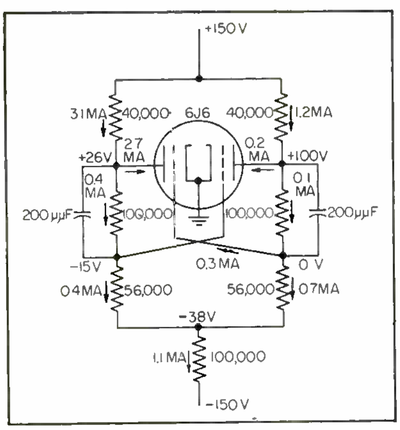


FIG. 2—Binary counter cell capable of counting about 75,000 pulses per second

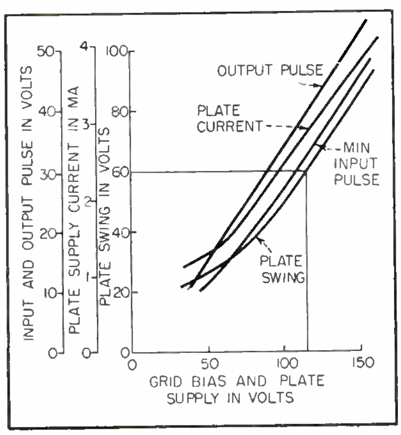
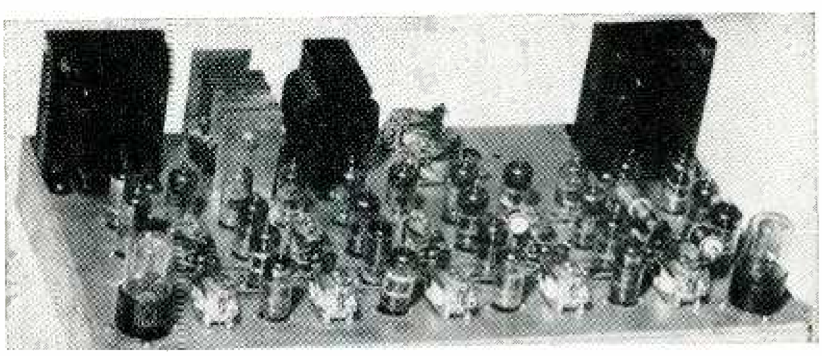


FIG. 3—Characteristics of binary counter cell shown in Fig. 3



Electronic timer using binary counters. Input phototubes are at extreme ends of chassis

Counter Reset

The trigger pairs act as a short memory, storing information about each skier's speed until the next one comes along. When the next skier passes the first phototube, the binary counters are instantly reset and immediately start counting.

Reset action is not impaired if, due to a fall, a skier crosses only the first phototube. Since only a limited range of speed is of interest the last trigger pair is diode coupled so it will not switch back. After a maximum count, it opens the resistor string and the reading, if displayed, will correspond to zero velocity.

The cathode-follower gate is especially poor for gating fast, negative-going signals; thus the sinusoidal wave is gated and then shaped into pulses. The reset bus must be biased a few volts positive or the counters will interact and normal counting will be impossible. Circuit constants in Fig. 1 depend upon the order of magnitude of the speeds. A medium-speed trigger pair is shown in Fig. 2. Its characteristics are given in Fig. 3.

These circuits are stable and do not require regulated power supplies. As line voltage increases, output pulse height increases at the same rate that sensitivity of the next stage decreases, and they readily cascade. A convenient operating point is with plate supply and grid bias both approximately equal to 125 v as delivered by half-wave, selenium-rectifier circuits. A switch- operated, monostable multivibrator is used to activate the indicator circuits.

Accuracy

Since the accuracy of indication varies with magnitude, the designer is primarily concerned with maximum error. A maximum error of one percent requires a count of at least 100 cycles during the shortest interval of interest. If a speed range of ten-to-one is to be covered, ten counters are required.

Binary resistors should be accurate to about one percent, though each successive resistor smaller than the seventh need be only half as accurate as the previous one.

If the phototube separation is known, the oscillator frequency (which must be accurate to one percent) is also specified. In practice, however, the oscillator can be adjusted to make all readings perfect once a single known velocity is properly indicated. Although the effective position of a phototube depends upon the gain of the associated amplifier and the speed of passing, both tubes are similarly affected and their separation remains accurately fixed. Parallax introduces little error since the cosine of an angle varies slowly near zero degrees.

Uncertainty in the count can be reduced by using a pulsed oscillator, which can start instantly because its inductive energy is continuously stored, rather than using a gated continuous oscillator.

Light Sources

The device can usually be used with ambient illumination, changes in which have no effect because of the capacitor-coupled input. The heat dissipated by the tubes keeps the windows clear.

In some circumstances, separate light sources are desirable. They can be aimed from inside the phototube housing and the light returned from suitably placed auto-collimators. One can avoid possible blocking by using a U-shaped beam of ultraviolet light falling on a single phototube.

The servomechanism display device is usually preferred to the simpler ammeter. The bridge circuit provides readings independent of line voltage, permits partial cancellation of temperature effects on precision resistors and minimizes possible damage due to accident off-scale operation.

Bridge-Balancing Servo

The servo indicator provides a large, rugged, weatherproof, 360-degree scale and a permanence of display between indications; an expanded scale or suppressed zero may be incorporated.

A simple, bridge-balancing servomechanism is shown in Fig. 4. It employs a differential amplifier to analyze the bridge signal and activate the relays. If there is bridge unbalance, only one relay will be activated. Fitted with trailing-tube rectifiers to stop chattering, the relays operate the motor, which turns to restore bridge balance. If both relays are either activated or not activated, no power is applied to the motor. At such a balance point, no power is drawn and the load is shorted. This not only supplies

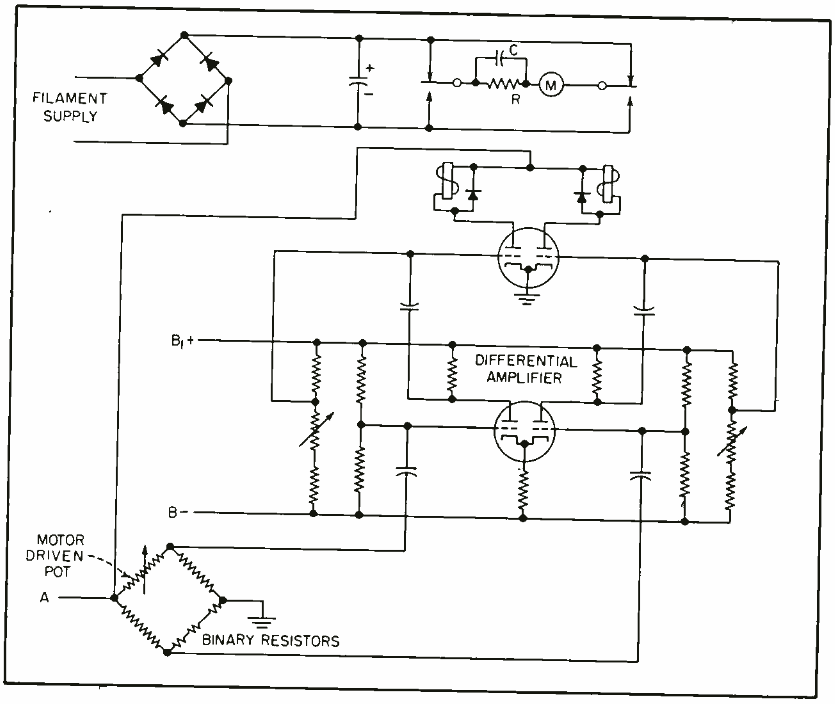


FIG. 4—Bridge-balancing servomechanism employs differential amplifier to control potentiometer motor drive

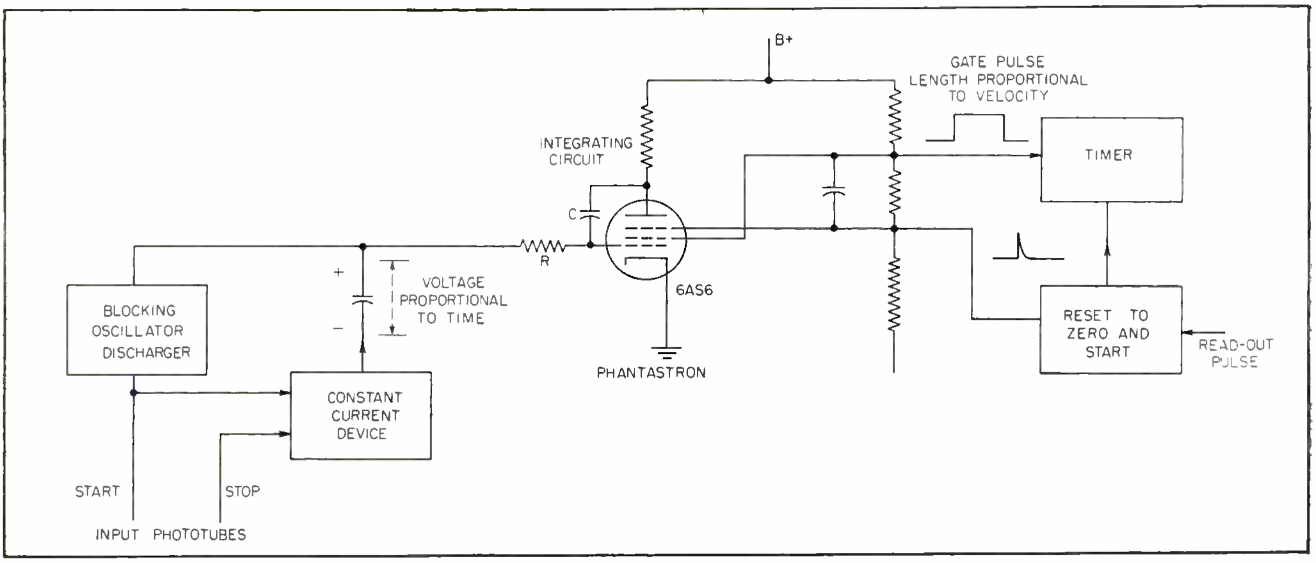


FIG. 5—Integrating a fixed voltage proportional to elapsed time until a preset voltage is reached requires a time interval proportional to velocity. Length of timer grating pulse from phantastron measures integration time

dynamic breaking at the null, but also permits insertion of a lead network. This network applies, through the capacitor, a larger-than-normal voltage change of suitable polarity during any transition between the three states of motion and thus provides extra fast response. This is true whether the discharged capacitor allows a larger-than-normal current surge to start the motor, or the charged capacitor discharges in the reverse direction to stop the motor. If R and C are matched to the motor one can apparently cancel armature mass and tolerate a smaller dead zone.

In the bridge circuit, one need only interchange two adjacent arms to display elapsed time rather than speed. With meter indication one would have to pass a constant current through the resistor chain and place a voltmeter across it.

If an event consumes appreciable time, a motor-driven potentiometer will furnish a resistance increasing linearly with time. The input devices can activate a small magnetic clutch to provide instant starting.

Capacitor-Charge Timer

Instead of counting cycles arriving at a uniform rate, it is possible to charge a capacitor from a constant-current source. This then provides a linearly-increasing voltage and a final voltage proportional to time. Constant current can be supplied by pentodes, beam power tubes, saturated diodes, phototubes with constant illumination and cascode amplifiers or other feedback systems.

The voltage proportional to time, can be converted into a corresponding resistance by passing constant current through a variable resistor and adjusting it until its voltage drop equals the input voltage. A servomechanism can then be used in a bridge-balancing circuit.

Voltage proportional to time can also be impressed across a potentiometer having a constant-voltage source in series with its arm. If the arm is driven by a servomechanism until the voltage tapped off the potentiometer balances the voltage in its arm, the resistance from arm to ground will be proportional to speed.

Other Circuits

Another circuit is indicated in Fig. 5. Here the voltage proportional to time is integrated with respect to time until a preset value is reached. Integration time is inversely proportional to elapsed time. An indication proportional to this new time gives speed. The indicator can be a second capacitor charging at a constant rate during integration and observed with a voltmeter or a standard scaler counting cycles from an oscillator.

These methods can incorporate instantaneous reset at the start of each new count if a discharging high current is delivered to the capacitor. Discharging current of the order of an ampere can be delivered by a blocking oscillator.

A constant voltage gated into one of the more precise integrating circuits will also provide a voltage increasing linearly with time. A binary-counter system can likewise be used wherein each successive stage switches a resistor half as large as the one previous; the output voltage will stair-step linearly with time.

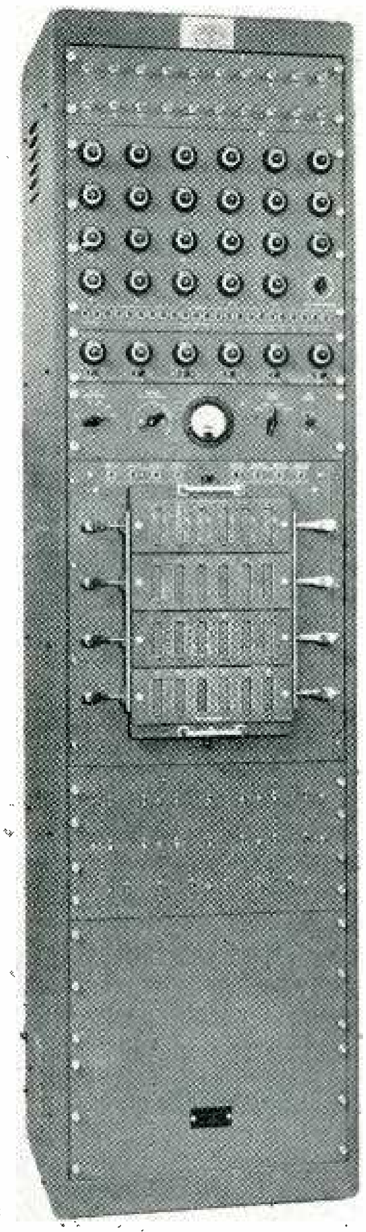
A capacitor can be charged linearly and the voltage passed through any device with a logarithmic response. The derivative of this signal is proportional to $1/t$ and drops sharply to zero at the end of the interval. The magnitude of this drop is proportional to the reciprocal of the total time involved.

A final scheme starts with a fully-charged capacitor, and to discharge it during the interval with some device having a voltage-current characteristic of i proportional to V^2. One can obtain such a response from a biased-diode, arbitrary-function generator. The final voltage on the capacitor is a linear measure of speed.

Isolation Circuits

Cathode followers fail to provide adequate isolation for computer circuits. Output circuits described have high input, low output impedance with nearly unity gain. Differential amplifiers and high-gain feedback amplifiers are used

By RAWLEY D. McCOY and FRANK R. BRADLEY*
Reeves Instrument Corporation *New York 7, New York*



Electronic analog computers, such as REAC, require isolation circuits better than the usual cathode follower. Special isolation circuits designed for this computer are described in detail.

ELECTRONIC ANALOG computers place stringent requirements on their isolation or buffer circuits. Ideally such circuits should have infinite-impedance input, zero-impedance output circuit and exactly unity gain.

The cathode-follower circuit, the elements of which are shown in Fig. 1A, is not adequate for most computer applications. The two basic isolation circuits to be described were developed in conjunction with the REAC (Reeves Electronic Analog Computer).

Voltage gain of a cathode follower is

$$\frac{\mu}{(\mu + 1) + \frac{r_p}{R_K}}$$

By making μ large, the overall gain can be made close to unity and, the output impedance reduced. Figure 1B illustrates a method for accomplishing this. The output voltage is produced by the cathode follower, but the difference between output and input voltage is measured by a differential amplifier and amplified in two stages before being applied to the cathode follower. The effective μ of the cathode follower is then $G_1G_2\mu$ and the overall gain close to unity.

D-C Application

Figure 2A shows a d-c isolation amplifier. One grid of the 5691 is returned to the cathode of the 6SN7 as is the cathode of the 6SJ7. The 5691 is connected as a differential amplifier so that its output voltage is the amplified difference of its inputs.

If both input grids swing positive at the same time, the net grid-to-cathode voltage change of the first grid remains unchanged because the cathode follows the second grid. Plate voltage is therefore unchanged. If the second grid swings negative while the first grid goes positive, the net grid-to-cathode voltage change of the first grid is the sum of the two inputs, hence the plate voltage change is proportional to the sum of the input voltages.

The differential amplifier has an appreciable gain because of its 350,000-ohm plate resistance. Its output is amplified in the 6SN7 and the total output applied between grid-and-cathode of the 6SN7 in a bootstrap arrangement.

Bootstrap Circuit

Plate voltage for the bootstrap stages is supplied by two 5651 voltage-regulator tubes, which are referred to the output voltage. No matter what the voltage swings are required of the circuit, the bootstrap-amplifier tubes operate at the same place on their characteristic curves. This makes the amplifier virtually independent of the characteristics of input tubes.

A bias potentiometer is included in the cathode of the 6SJ7 to set the stage operating point and antising networks are included in the coupling between the first and second stage and from grid to plate in the second stage. These shape the open-loop amplifier response curve to attenuate amplifier gain

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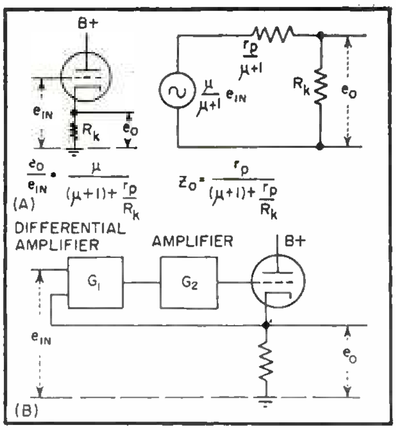


FIG. 1—Cathode follower (A) has nearly unity gain when used with a differential amplifier (B)

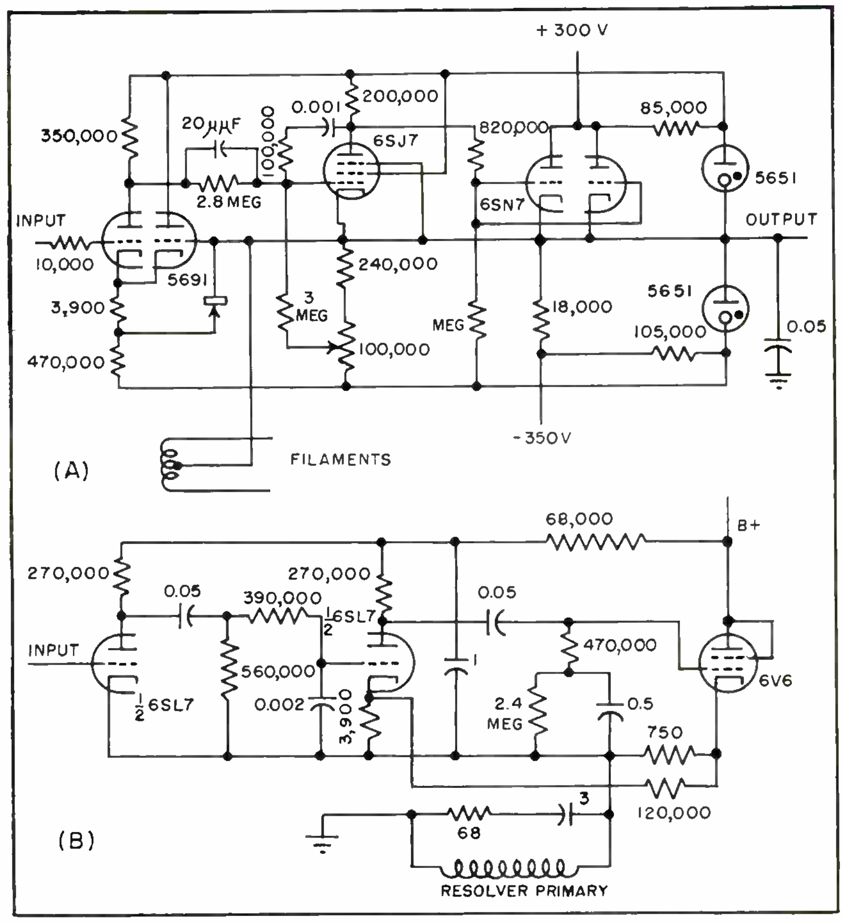


FIG. 2—Isolation amplifier using cathode follower and differential amplifier is suitable for either d-c (A) or a-c (B) application

below unity before the phase shift approaches 180 degrees. A crystal diode is used in the second grid input circuit of the 5691 to eliminate the possibility of the circuit settling in a stable but nonoperable condition. If, on starting, the grid should go positive with respect to the plate, the stage would remain in that condition. The crystal prevents this by limiting the grid-to-cathode voltage.

A-C Application

An a-c version of this circuit, used at 60 cps as a resolver buffer amplifier is shown in Fig. 2B. This circuit, developed by P. A. Seay, was the predecessor of the d-c circuit. The circuit is a-c coupled and interstage antising networks used. Since it is necessary to shape frequency response at both the high and low ends, the networks are more complex. The input amplifier cathode is returned to the output rather than to a differential amplifier since the succeeding a-c coupling eliminates d-c level adjustment problems, which dictated the differential amplifier used in Fig. 2A.

The cathode load is a 750-ohm resistor in series with a parallel R-C network across the resolver primary. The network consists of a three-microfarad capacitor and a 68-ohm resistor and provides power factor correction for the inductive resolver load.

Operating point of the second amplifier stage is set by the voltage divider consisting of the 120,000 and 3,900-ohm resistors from the 6V6 cathode to the output.

The decoupling network consisting of a 68,000-ohm resistor and one-microfarad capacitor between the 6V6 and 6SL7 plate supplys replaces the two VR tubes used in the d-c version of this circuit. The capacitor refers the 6SL7 plate supply to the a-c output voltage so that the 6SL7 operates in the same portion of its characteristic curve and the circuit is relatively stable despite tube variation.

The isolation circuit shown in Fig. 3A uses high-gain feedback amplifiers. The voltage at the potentiometer arm drives a low or varying-impedance load. Without isolation, load variations would affect the voltage at the potentiometer arm.

High-Gain Amplifiers

High-gain phase-inverting amplifiers, when connected in feedback circuits as shown, develop an output voltage that cancels the input voltage. Thus the voltage at the output of the first amplifier is $-e$ and the voltage division between e and $-e$ across R_1 and R_2 gives a null at the grid. Similarly, the voltage at the output of the second amplifier is $2e$. The junction of R_1 and R_2 is a virtual ground and the output voltage, $2e$, divides across R_1 and R_3 to give

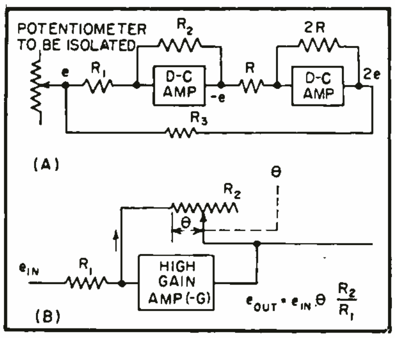


FIG. 3—Alternative isolation circuits use either one (B) or two (A) high-gain feedback amplifiers

e at the potentiometer arm. Current drawn from the potentiometer can be reduced essentially to zero by precise adjustment of R_3 so that current through R_1 is supplied by the second amplifier.

With this circuit, high input and low output impedances may be achieved. It is necessary for stability that the impedance looking into the potentiometer be a reasonable value, depending upon the phase and gain margin of the amplifiers. Resistor R is normally one megohm and the potentiometer 30,000 ohms.

Actual Circuit

A circuit, suitable for potentiometer unloading at 400 cycles is shown in Fig. 4. It consists of a three-stage amplifier, V_{1A}, V_{1B}, V_2, and a single-stage amplifier V_3 both of specified gain.

Resistors R_1 and R_{12} provide negative feedback around the three-stage amplifier and R_{13}, R_{14} and R_{15} provide feedback around the single-stage amplifier.

Since the sources of amplifier phase shift are the reactive components, it would be desirable to use d-c coupling to eliminate entirely the causes of low-frequency oscillation. This cannot be done because of the problem of drift. The first and second stages are, however, d-c coupled, the resultant drift being eliminated by the capacitance coupling.

A high-frequency bypass network, R_5 and C_2 is, coupled from the plate of V_{1B} to ground. This attenuates the amplifier output on high-frequency side of the passband.

The coupling network between the second and third stage consists of C_3, C_4 and R_6. Primary coupling in the passband is accomplished by C_4. At lower frequencies the impedance of C_4 becomes large and coupling is accomplished by C_3 and R_6. In this fashion, gain in the passband is maintained while the effective time constant of the coupling network is very large, due to the large value of R_6.

Passband Boost

A choke is used to increase the dynamic range of the stage, permitting the output voltage to swing above $B+$ by self-induced voltage. Capacitor C_6 and the choke's distributed capacitance resonate the choke in the passband resulting in steep attenuation of gain on either side. This is permissible since phase shift around the passband is small and the steep slope will not result in oscillation.

It is desirable to attenuate the gain as much as possible where the phase shift is small so that the frequency range over which the phase shift must accurately be controlled is a minimum. Resistor R_9 reduces the Q of the plate load to give the amplifier sufficient bandwidth. The single-stage amplifier is a cathode-biased pentode. For perfect isolation, the amplitude and phase of positive-feedback current must be the same as that of the input signal. The positive feedback amplifier input is tapped from voltage divider R_{13}, R_{14} and R_{15}, the stage gain being determined by the setting of R_{15}. Capacitor C_9 across feedback resistor R_{11} permits adjustment of phase of positive feedback. Thus the amplitude and phase of the positive-feedback current may be adjusted for ideal operating conditions. Capacitor C_9 is particularly important when long runs of shielded wire introduce capacitance to ground.

Zero Source Impedance

The last scheme is superior to the others in many applications. Figure 3B indicates a method of isolation using a single high-gain feedback amplifier. The circuit is demonstrated for potentiometer isolation but it is applicable to other problems as well.

The high-gain phase inverting amplifier in a feedback arrangement maintains its input grid at a virtual ground and there is little or no grid-current flow. Thus the current indicated is independent of the potentiometer position and the voltage at the arm is independent of the load. The source impedance to the load is then the impedance looking into the feedback amplifier, normally a small fraction of an ohm.

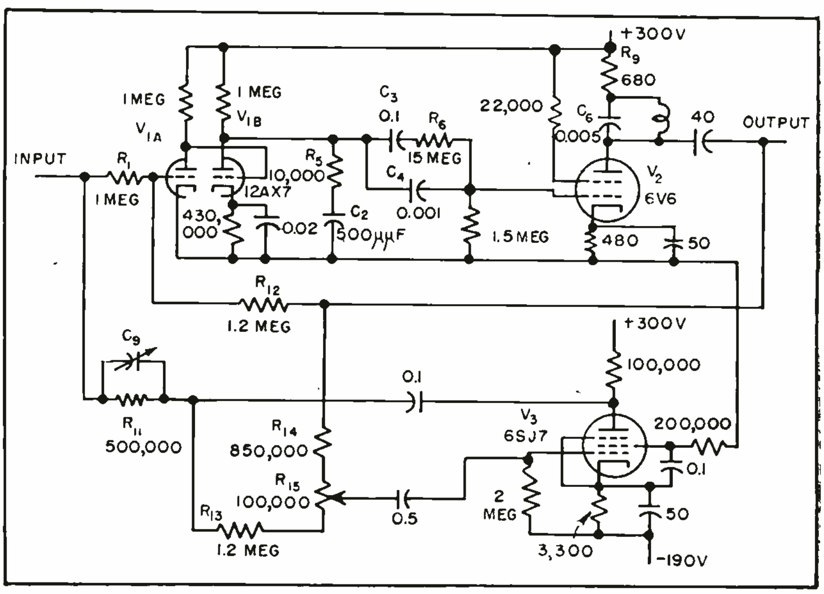


FIG. 4—Isolation is accomplished using two high-gain feedback amplifiers. One amplifier consists of three stages, other is a single stage

R-F Coupling Nomograph

Gives coefficient of inductive coupling of an r-f transformer directly from Q-meter measurements. Procedure permits correcting for effects of distributed capacitance

By RAYMOND E. LAFFERTY
Engineering Development Group
National Broadcasting Co.

When measuring the coefficient of inductive coupling of an r-f transformer with a Q-meter, one winding of the transformer is connected to the inductor terminals of the Q-meter and the capacitance of the Q-meter circuit is tuned to resonance with the second winding open to give C_1, and shorted to give C_2. Then

$$k = \sqrt{1 - (C_1/C_2)} \qquad (1)$$

Equation 1 also neglects the effect of distributed capacitance in either or both windings, and is valid only if the Q's of both windings are greater than 10. Where primary distributed capacitance C_p and secondary distributed capacitance C_s are both present to a significant degree,

$$k = \sqrt{1 - U} \qquad (2)$$

where $U = \dfrac{1}{(1-\gamma^2)\left(\dfrac{C_2 + C_p}{C_1 + C_p}\right) + \gamma^2}$

$\gamma^2 = (f/f_o)^2$
f = Q meter frequency
f_o = self-resonant frequency of secondary, or $1/2\pi\sqrt{L_sC_s}$

Where C_p is significant and C_s is negligible ($\gamma^2 \cong 0$);

$$k = \sqrt{1 - V} \qquad (3)$$

where $V = (C_1 + C_p)/(C_2 + C_p)$

Where C_s is significant and C_p is negligible ($C_p < 5$ percent of C_1);

$$k = \sqrt{1 - W} \qquad (4)$$

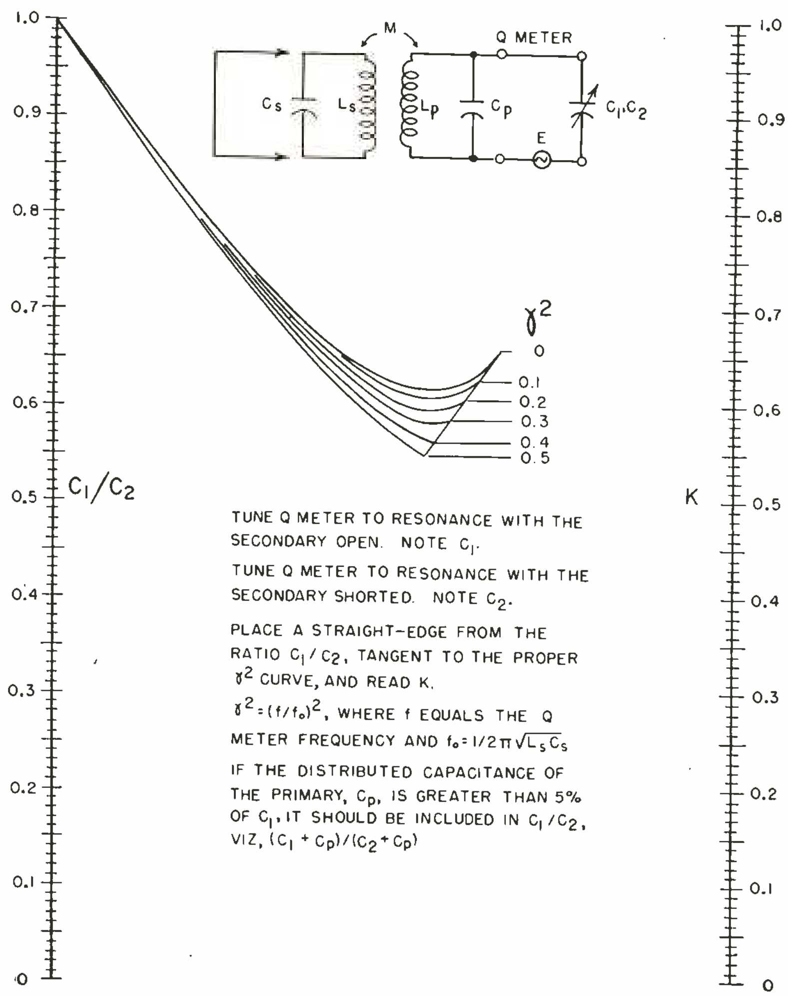
where $W = \dfrac{1}{\left(1 - \gamma^2\right)\dfrac{C_2}{C_1} + \gamma^2}$

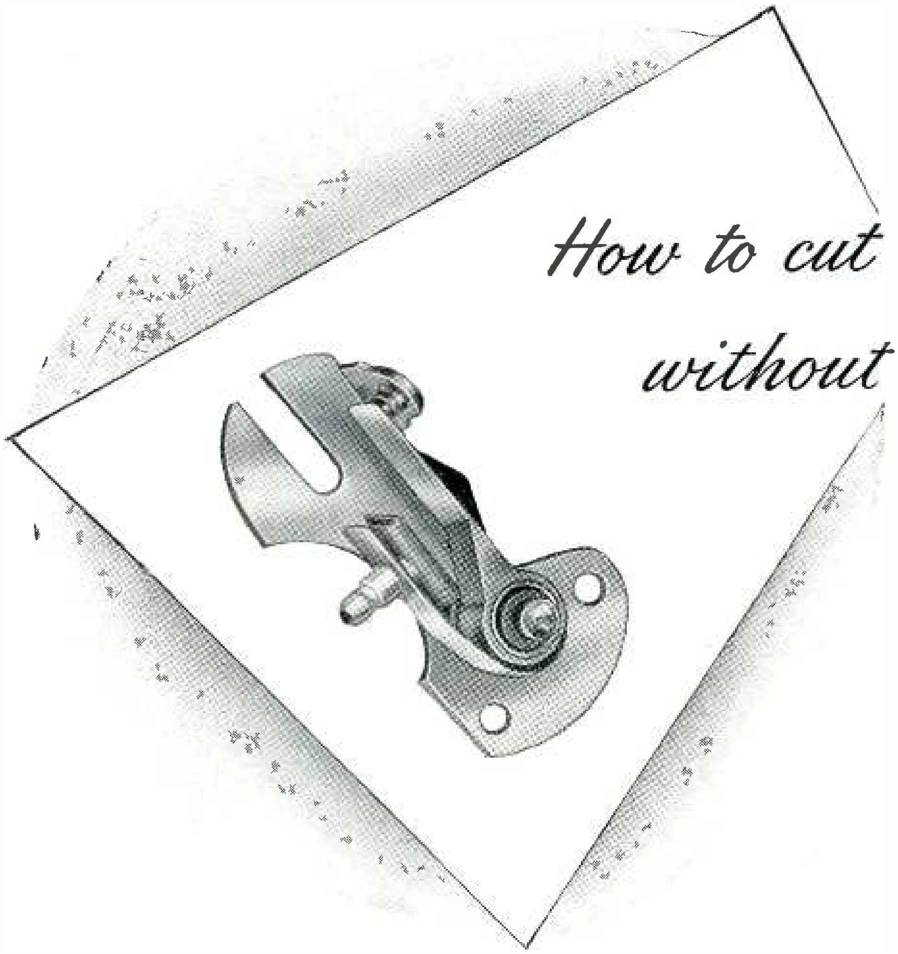
The nomograph is used by extending a straight-edge from C_1/C_2, tangent to the correct γ^2 curve, and reading its intersection with the scale for k. If C_s is small enough to be neglected, γ^2 is approximately zero and the zero curve should be used.

If both windings of the transformer have appreciable capacitance, C_s and f_o should be measured before the coils are inductively coupled.

Example 1. The Q-meter tunes to 460 kc with 210 μμf of capacitance when one winding of an r-f transformer is connected to the inductor terminals and the other winding is left open. When the second winding is shorted the Q-meter capacitor must be increased to 375 μμf to maintain resonance at 460 kc. The self-resonant frequency of the secondary is found to be 840 kc, and C_p can be considered negligible. From this, $C_1/C_2 = 0.56$ and $\gamma^2 = 0.3$. Using the nomograph, k is 0.6.

Example 2. $C_1 = 95$ μμf, $C_2 = 116$ μμf, $C_p = 15$ μμf and C_s is negligible (hence $\gamma^2 \cong 0$). From these data, $(C_1 + C_p)/(C_2 + C_p) = 0.84$ and the nomograph shows k to be 0.4.





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ELECTRONS AT WORK

Including INDUSTRIAL CONTROL

Edited by RONALD K. JURGEN

OTHER DEPARTMENTS

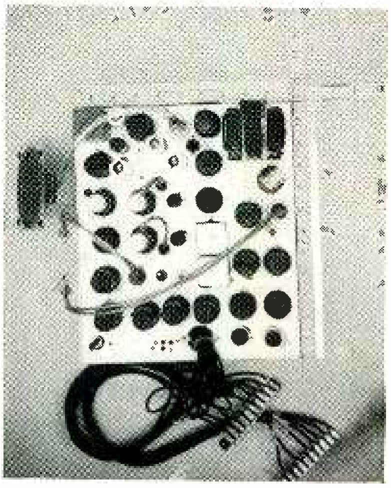
featured in this issue:

Automatic Communications System

By J. D. Lane
General Engineering Development Co.
Boston, Mass.

AUTOMATIC MESSAGE and/or signal collection and repeating for communication networks is accomplished by a device known as the Robo-Communicator, which may be used as a terminal equipment for automatic answering of calls. The equipment will also record two-way communication network conversation and office conference and it will record and reproduce spoken messages and other types of signals.

When answering a call, the communicator responds to call signals so as to impress a station identification announcement on the coupled communication system for a timed interval. This broadcast may include a voice message to instruct the calling station that it is connected to a signal recording device at the called station that will make an electrical transcription of message transmission.



Amplifier chassis for the communicator

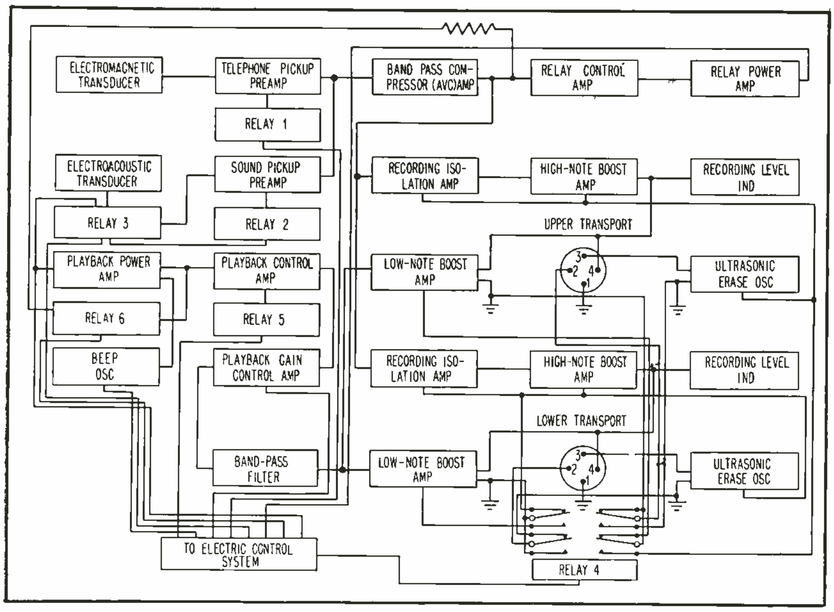


FIG. 1—Block diagram of the amplifier for the Robo-Communicator

A further announcement may state that the message to be stored will be received by the called party at his earliest convenience. The machine then shifts automatically into condition for recording reception of the calling station's message. At the completion of the call, the machine disconnects itself from the communication network and waits to receive further calls.

The amplifier is shown in block-diagram form in Fig 1. Various circuit combinations to be mentioned are controlled by selective switching apparatus located remote from the amplifier tubes.

When using the machine with an external communication system, it is desirable to broadcast beep signals from the beep oscillator, Fig. 1, so that a caller will receive signals to distinguish recording pe-

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The G Meter, 192-A, employs a crystal controlled oscillator to supply a constant amplitude voltage to a high quality reference tuned circuit. A calibrated precision loss circuit and a differential VTVM are internally connected across the resonant circuit. External means are provided for connecting test samples across the same resonant circuit. By substituting internally connected values of calibrated loss and capacitance for the test sample, to secure a reference voltage, the conductance and capacitance of the sample may be determined. The differential VTVM provides very great sensitivity to changes from the reference voltage allowing very accurate settings of the conductance and capacitance dials.

SPECIFICATIONS

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riods from dead-system condition whenever the machine is used to record messages from a remote station. The electromagnetic transducer together with the following block components constitute a receiver-amplifier system for signals to be recorded from an external communication system.

The receiver-amplifier system includes the band-pass compressor (avc) amplifier, the recording isolation amplifier and the high-note boost amplifier which supplies recording signal power to the voice coil on one of the wire transports. Calling signals are tapped from the output of the avc circuit and coupled to the line by the relay control amplifier and the relay power amplifier.

Relay 1 is energized to close a

Model of the equipment for use as terminal equipment

cathode circuit to ground when the telephone pickup preamplifier is used to complete coupling to an external communication system via the electromagnetic transducer. When acoustic signals are picked up from the vicinity of the machine's microphone, relays 2 and 3 are energized to put the sound pickup components in operation to feed signals to the receiver-amplifier.

When it is desired to broadcast signals stored on the lower transport, relay 4 is energized, its contacts are pulled down and the low-note boost amplifier is energized. The amplifier couples the voice coil on the wire transport to the band-pass filter, playback gain-control amplifier, the playback control amplifier and the playback power amplifier unit.

Relay 4 controls the coupling of electronic components to both transports so that when one transport is coupled for playback operation, the other will be coupled for recording and vice versa. Feedback isolation of circuits to be coupled to the two transports is provided by using relay 4 to control the action of coupled amplifier units as well as the erase oscillators. Isolation amplifier circuits effectively isolate the two transducers so that one transport may be coupled to record from any communication network that is directly energized by playback from the second transport.

When it is desired to copy a recording from the lower transport and record the lower transport signals on the upper transport, as for editing and dubbing-in operations, the playback circuits mentioned previously are energized. Relay 5 is energized also to complete connection from the playback circuit to the recording circuit.

Gated Lamp Decade Counters

By Robert L. Rod

Assistant Director of Research
Bogue Electric Manufacturing Company
Paterson, New Jersey

Among many electronic counter circuits devised during the past few years, the scale-of-ten decade counter is perhaps the most widely used. The particular feedback circuit devised by Grosdoff[1] utilizing neon lamp decimal read-out is finding many applications in frequency measuring and similar systems which are used to count events per unit time.

Generally, decimal indicating decades are used to count an unknown number of pulses occurring during a definite interval of time. Some time after this summation process has been completed, the decade counters are either electrically or manually reset to zero prior to the onset of another cycle of counting operation.

Whereas, the individual neon

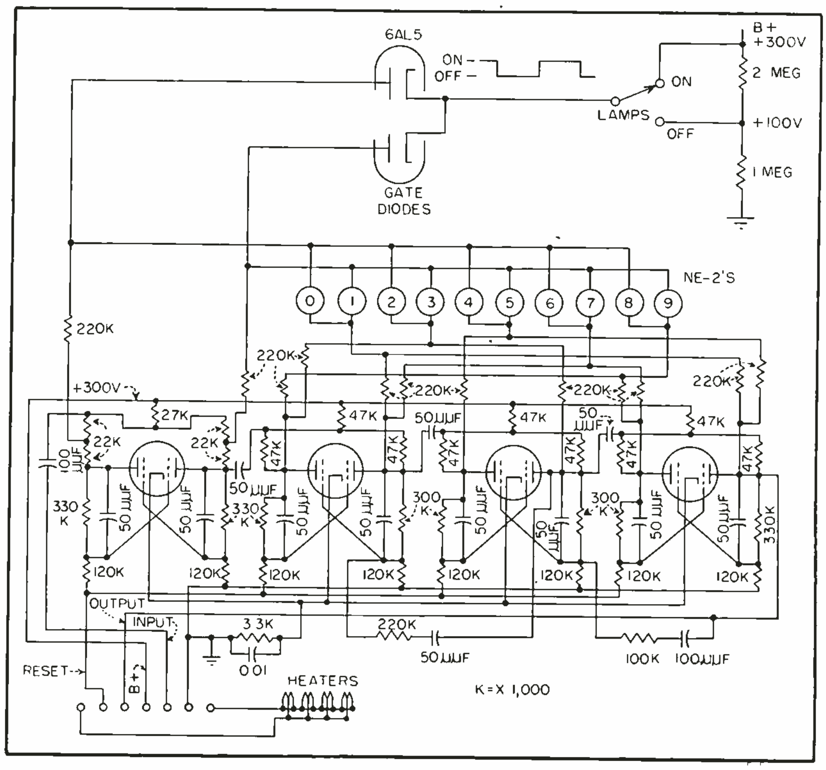

FIG. 1—Gated lamp decade modifications. Counter tubes are 12AU7's

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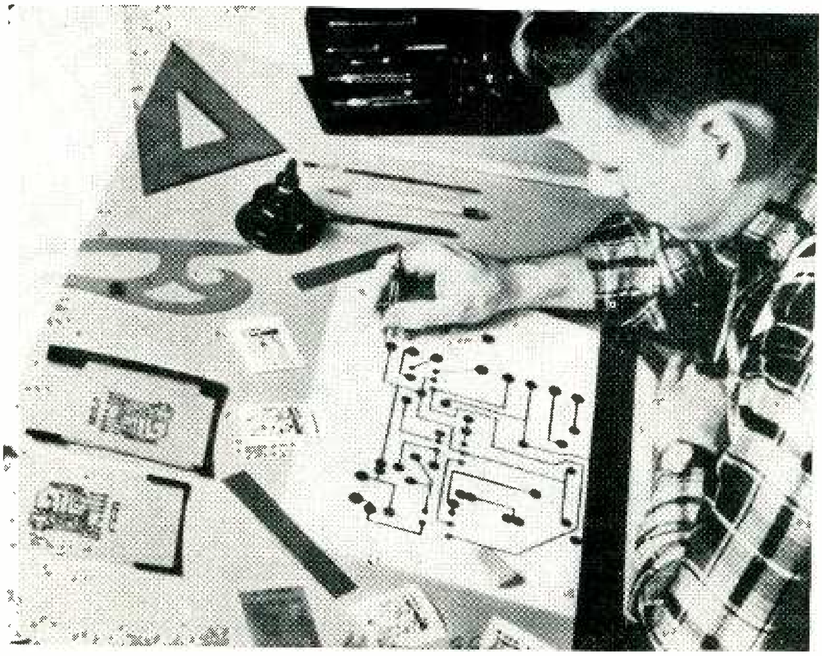


SHOWN in the cover photographs and the accompanying photograph are steps in the Auto-Sembly System of circuit fabrication. The elements of this Signal Corps process are the insulating base chassis bearing the circuitry with conventional components in their proper position on the blank side and all component leads passing through perforations to the circuit side of the chassis. Application of a suitable soldering flux, solder dipping and removal of excess component leads completes the assembly.

Patterns of subminiature circuits requiring great accuracy are drawn three or four times original size and reduced to actual size photographically. Advantage of the enlarged drawing may be taken to include lettering, terminal designations or other circuit details before reduction to the required size. Precision of conductor size and spacing is a further advantage.

lamp indicators in a particular decade are continually advancing during the summation cycle, only one particular lamp remains lit after the count is terminated until the circuit is reset. In applications where the "on" or counting time is appreciably more than the subsequent "hold" time prior to reset, the observer is annoyed by a flickering effect during counting that can very well obscure the final reading. In the extreme case where the decade is reset to zero shortly after the termination of counting, the final reading is not clearly distinguishable.

Means for gating off the lamps and eliminating the flickering during the counting interval without affecting the dividing action of the individual scale-of-two stages are useful during high-duty-cycle operations. The arrangement shown in Fig. 1 above the neon diodes is an auxiliary gating system designed to satisfy this requirement.

In this type of decade, representative of many commercially available units, the neon lamps are energized by a sufficiently great peak-to-peak voltage developed from a combination of a positive-going square wave derived from the head odd-even binary and a composite negative-going waveform obtained from combinations of the outputs of the three succeeding stages. By individually clipping the positive output pulses of both sides of the first stage by means of the auxiliary gating diodes, the neon lamps fail to light on the remaining negative-going voltage pulses derived from the subsequent binaries because of insufficient impressd voltage.

Biasing the gate diode cathodes at the supply voltage will effectively open-circuit the diodes and permit normal operation of the lamps. Lowering the voltage to 100 volts or so will cause the diodes to slice the odd-even square waves sufficiently low in amplitude to keep the lamps out.

This gating technique may be useful in the simplest case with manual selection of the gating voltage applied to the diode cathodes. In those applications using pulsed timing oscillators whose shaped pulses are counted by decade counters, the oscillator gating waveform itself can be directly applied to the gate diode cathodes to gate the lamps on and off.

Germanium or selenium diodes can be used for this application providing that their reverse resistance is sufficiently high. However, the use of vacuum diodes results in far more stable and reliable operation of the system. Either a subminiature dual diode integral to the decade itself or an external tube such as a 6AL5 can be used as desired. In any event, with the diodes integral to the decade itself only one additional terminal is required for this modification.

REFERENCE

(1) I. E. Grosdoff, Electronic Counters, *RCA Review*, 7, p 438, Sep. 1946.

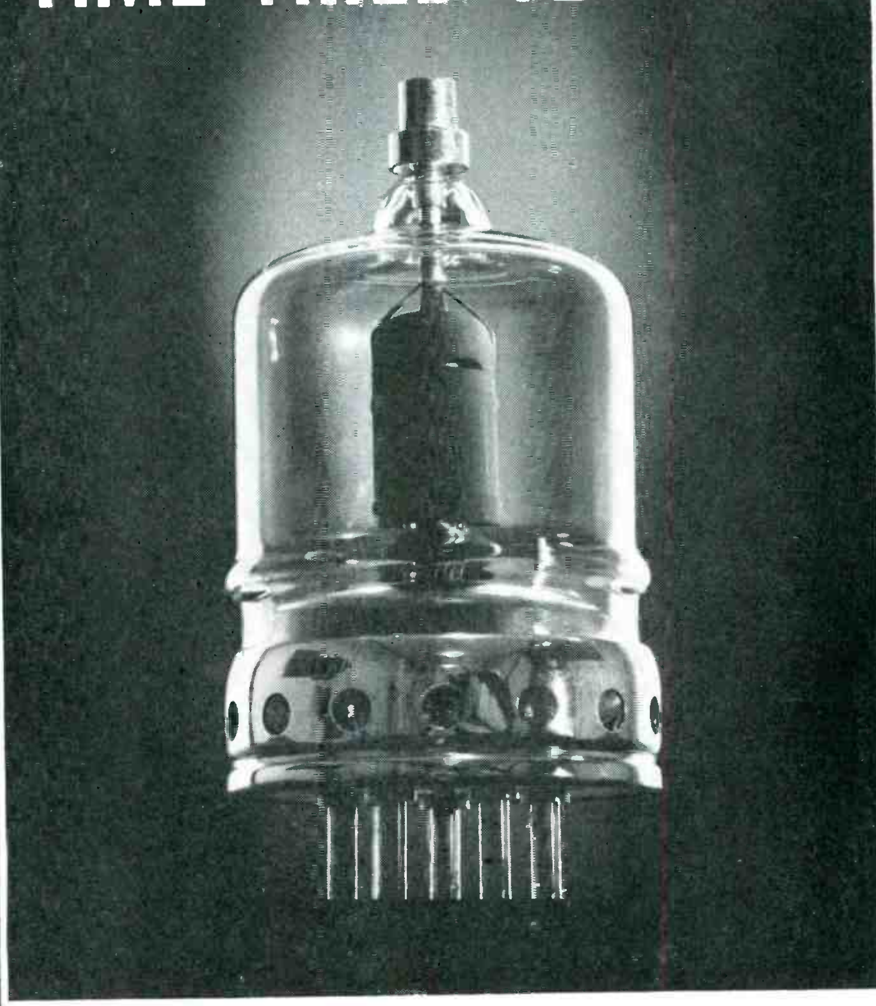
Compound Sweep Circuit

By JOHN H. PORTER

Office of Naval Inspector of Ordnance
Navy Ordnance Division
Rochester, New York

FREQUENTLY it is desirable to examine in its entirety a fairly long transient whose initial rate of change is considerably different than the rate during the rest of the interval. The circuit shown in Fig. 1 was developed to provide a sweep voltage to photograph a transient lasting for 100 seconds and which arrives at 75 percent of its maximum value in approximately 0.1 second and which decays to about 85 percent of its maximum

TIME-TRIED TETRODE



LOS GATOS 4D21/4-125A

MODERN in every respect—with exclusive Sintercote black-body high-dissipation anode and emission-free grids—the Los Gatos 4D21/4-125A provides a new source of supply for a widely-applied tetrode type. Check Los Gatos for your requirements in other types with emphasis on long service life.

LEWIS AND KAUFMAN, INC.

LOS GATOS 1 CALIFORNIA

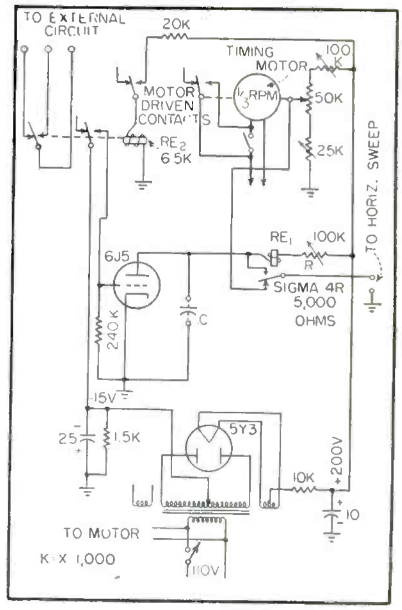


FIG. 1—Schematic diagram of the sweep circuit

value during its duration.

The time span is broken into two intervals and individual sweep voltages are provided for each interval. The initial sweep is short, lasting from 0.02 to 1 second depending on the C and R used, while the second sweep lasts up to 3 minutes.

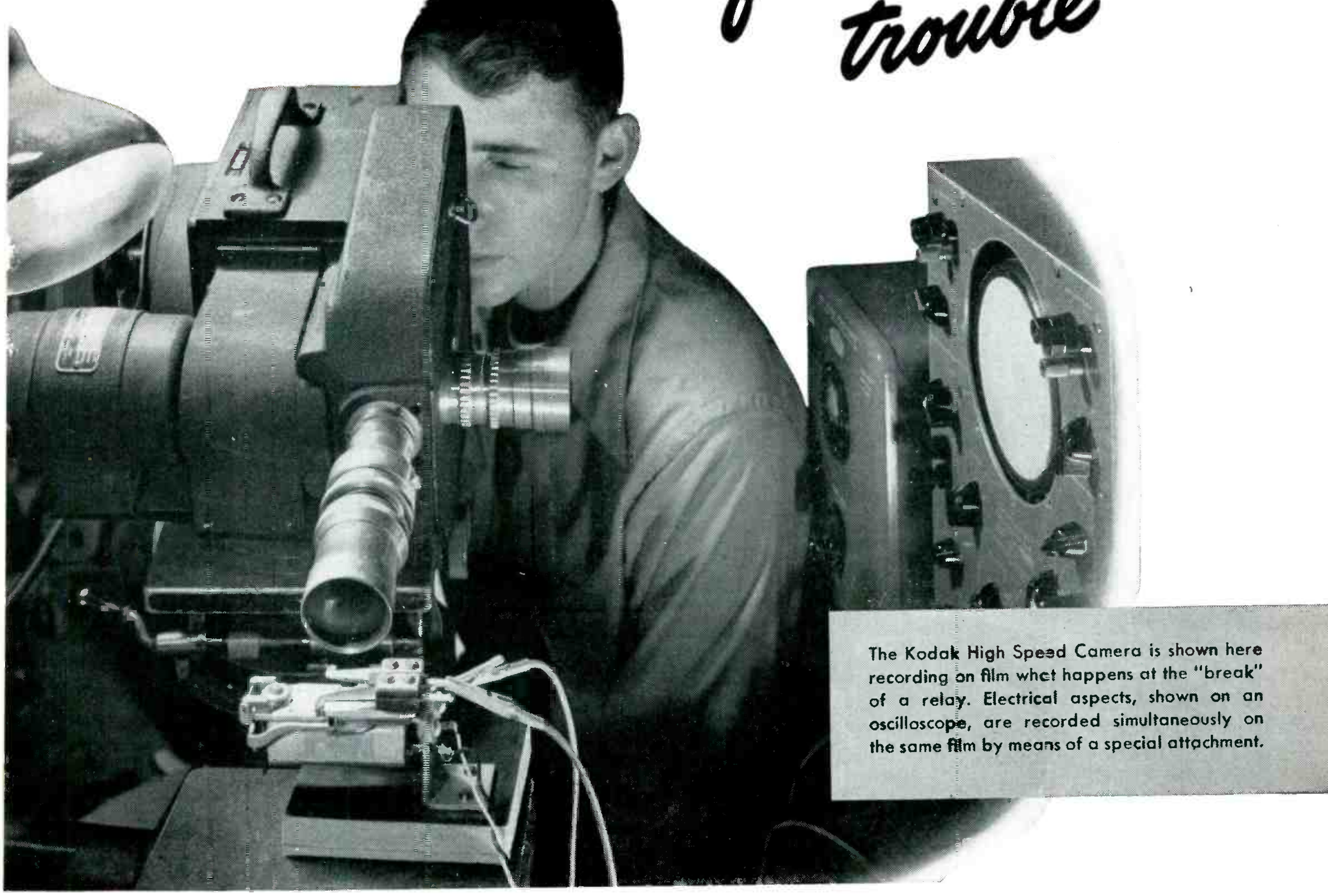
Initially, the tube is without bias and draws sufficient current to hold R_{y1} closed and keep the output connected to the tube plate. To initiate the sweeps, the timing motor is started and upon reaching synchronous speed, puts cutoff bias on the tube via R_{y2} and with the same relay energizes an external circuit as desired.

As the energy contained in the coil of R_{y1} is dissipated in the capacitor C through the timing resistance R, the voltage across C rises and eventually R_{y1} drops out. It is this rise of voltage, limited to but a volt or two, that provides the fast sweep.

When R_{y1} opens, the output is connected to a potentiometer across the power supply and driven by the timing motor. The control used is an Ohmite AB with the stop removed to allow 360 deg rotation. The voltage gradient across the motor-driven potentiometer is adjusted to be the same as the change in voltage across C after R_{y1} opens.

This circuit has been used with a Land-Polaroid camera for single-

This eye spots *fast-moving trouble*



The Kodak High Speed Camera is shown here recording on film what happens at the "break" of a relay. Electrical aspects, shown on an oscilloscope, are recorded simultaneously on the same film by means of a special attachment.

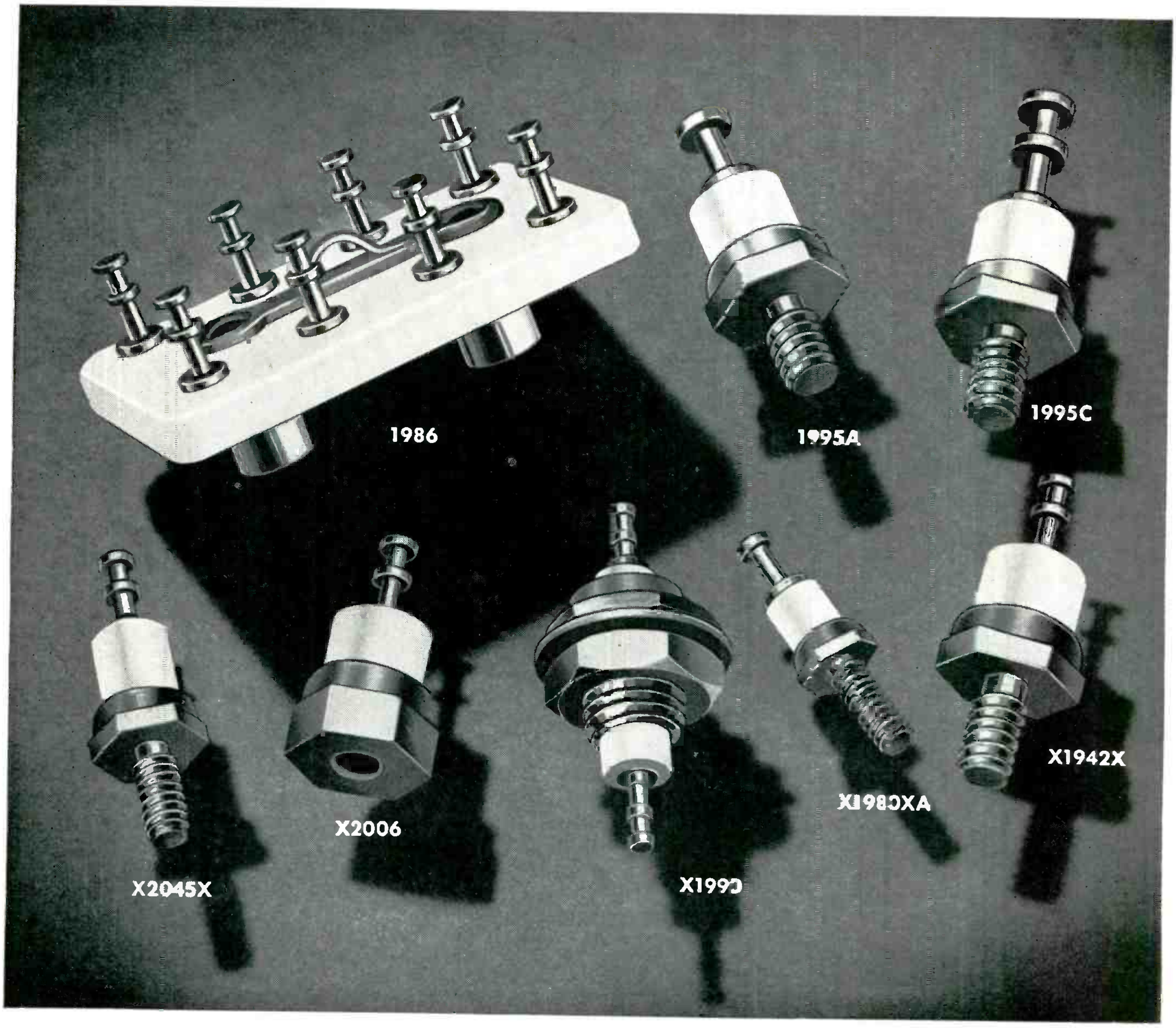
When trouble is hidden in a blur of speed too fast to see, the cause is hard to find. Here's the way to get the answer in a hurry without costly, tedious cut-and-try experimentation or theoretical analysis.

With the Kodak High Speed Camera, you can take up to 3200 clear pictures a second on 16mm film. When projected at normal speed, the film shows action slowed as much as 200 times—makes visual analysis quick and easy. And the films are available for study over and over.

This high speed "eye" is daily solving complex problems of design, production, and product performance—problems where usual methods of analysis would be slow and costly. One manufacturer projects high speed movies within two hours after they are taken—the solution to a problem is on the drawing board the same morning it is discovered. We'd be glad to send you, with our compliments, a folder showing how this company uses the Kodak High Speed Camera so effectively. Eastman Kodak Company, Industrial Photographic Division, Rochester 4, N. Y.

the Kodak *HIGH SPEED* Camera

Kodak
TRADE-MARK



Units shown magnified approximately 2½ times

Make *sure* of meeting government "specs" . . . see C.T.C. for ceramic insulated components

You have to be 100% on-the-beam if your equipment is to withstand the conditions it must undergo in military service.

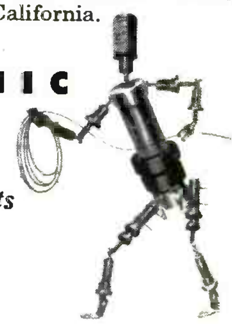
That's why manufacturers using electrical and electronic components turn to C.T.C. for their ceramic insulated units. Our long experience and constant dealing with government requirements have gained us a wide acceptance as an outstanding supplier to those working on U. S. contracts . . . especially for the armed forces.

Whatever your needs in ceramic insulated terminals, feed-throughs or terminal boards you can depend on C.T.C. We meet the most exacting government standards for materials, tolerances, finishes, moisture prevention and anti-fungus treatment. Finishes on metal surfaces for instance, can be hot tinned, electro-tinned, cadmium plated, silver plated or gold plated to your requirements. All ceramic units in our standard line are grade L-5, silicone impregnated.

C.T.C. offers a consulting service at no extra charge to help solve your special problems. For all specifications and prices, write to Cambridge Thermionic Corporation, 437 Concord Avenue, Cambridge 38, Mass. West Coast Manufacturers contact: E. V. Roberts, 5068 West Washington Boulevard, Los Angeles 16 and 988 Market Street, San Francisco, California.

CAMBRIDGE THERMIONIC CORPORATION

custom or standard . . . the guaranteed components



For our complete listing of C.T.C. electronic and electrical components, see Electronics Buyers Guide.

electrical insulation headquarters

mitchell-rand features electrical insulating tapes

BI-SEAL

self-bonding Polyethylene, for resistance to corrosion and chemicals.

BI-PRENE

self-affixing Neoprene, for resistance to oils and chemicals.

BI-SEAL INSULATION CHARACTERISTICS

Electrical Properties

Dielectric strength		1000 volts/mil avg.
Power factor	60 cycles	0.0006
	1000 cycles	0.0006
	10^6 cycles	0.0004
Dielectric constant	60 cycles	2.32
	1000 cycles	2.34
	10^6 cycles	2.13

Physical and Chemical Properties

Resistance to:

Ozone	Excellent
Oxygen	Excellent
Acids	Excellent
Alkalies	Excellent
Moisture vapor transmission	Negligible
Castor Oil	Good
Commercial Hydraulic Fluids	Excellent
Aging qualities	Excellent
Operating temperature	197°F to −67°F
Application temperatures	150°F to −67°F

SELF-BONDING

MOISTURE RESISTANT

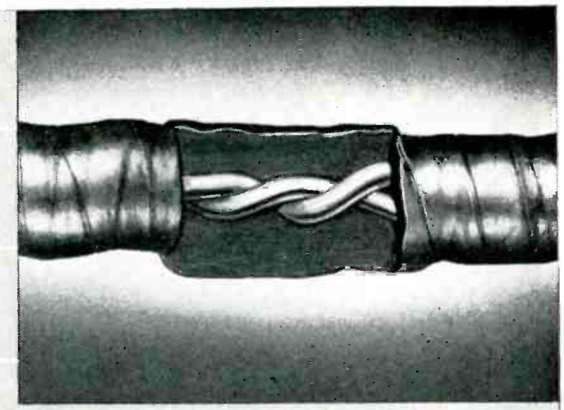
UNAFFECTED BY LOW TEMPERATURES

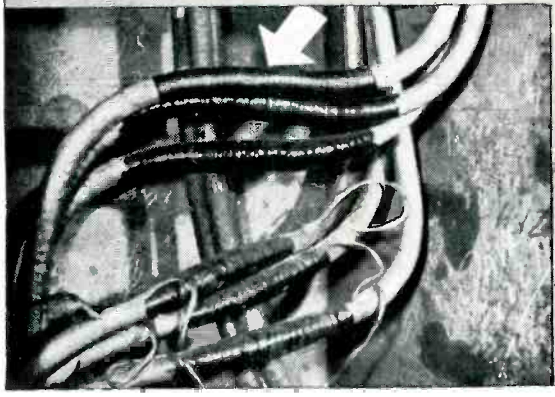
HI-DIELECTRIC STRENGTH

SUPERIOR AGING

EXCELLENT CONFORMABILITY

CORROSION-CHEMICAL OIL RESISTANT





BI-PRENE INSULATION CHARACTERISTICS

Physical Tests on Press Cured Slabs 10°/310°F

Tensile	1980 p.s.i.
Elongation	400%
200% Modulus	1030 p.s.i.
Ozone	6 hours to cut

Physical Properties on Aging

80°C Oxygen Bomb for 14 days
67.4% of original elongation
62.6% of original Tensile

Air Bomb at 260F for 30 Days at 80 p.s.i.
160% of original elongation
66% of original Tensile

Oil Resistance

A.S.T.M. Reference fluid number one—11.7% maximum swell in 24 hrs. A.S.T.M. Reference fluid number two—69.7% maximum swell in 24 hrs. 18 hr. exposure in oil at 121°C —Tensile decreased 4.5%. Elongation increased 70%.

Here are two multi-purpose electrical insulating tapes for wire or cable splicing . . . the self-bonding BI-SEAL and the self-affixing (air-curing) BI-PRENE . . . to meet the strictest requirements for unusual as well as ordinary cable splice applications for the smallest wire or the largest cable . . . wherever tape can be used for splicing.

The outstanding characteristics and excellent electrical insulation properties, plus the feature that once applied BI-SEAL and BI-PRENE tapes fuse into a solid mass, impossible to unwrap or delaminate, enables these products to offer complete and lasting protection against moisture, acids, alkalies, oils, chemicals, sunlight, corrosion, fungus, ozone, etc.

MITCHELL-RAND · SINCE 1889 · Electrical Insulation Headquarters

Write for samples and detailed data

MITCHELL-RAND INSULATION COMPANY, INC.

51 MURRAY STREET — COrtlandt 7-9264 — NEW YORK 7, N. Y.

A PARTIAL LIST OF M-R PRODUCTS: FIBERGLAS VARNISHED TUBING, TAPE AND CLOTH • INSULATING PAPERS AND TWINES • CABLE FILLING AND POTHEAD COMPOUNDS • FRICTION TAPE AND SPLICE • TRANSFORMER COMPOUNDS • FIBERGLAS SATURATED SLEEVING • ASBESTOS SLEEVING AND TAPE • VARNISHED CAMBRIC CLOTH AND TAPE • MICA PLATE, TAPE, PAPER, CLOTH, TUBING • FIBERGLAS BRAIDED SLEEVING • COTTON TAPES, WEBBINGS AND SLEEVINGS • IMPREGNATED VARNISH TUBING • INSULATING VARNISHES OF ALL TYPES • EXTRUDED PLASTIC TUBING shot photography of a transient initiated by R_{y2}. The relay selected for R_{y1} is a Sigma 4R with coil resistance of 5,000 ohms. The drop-out current for the particular relay used is approximately 1.5 ma and is obviously independent of the initial rate of sweep. Since it is desirable to reduce the beam intensity for the long sweep, a relay with additional contacts might be chosen for R_{y1}, to control the crt bias.

Color TV Projection System for Theaters

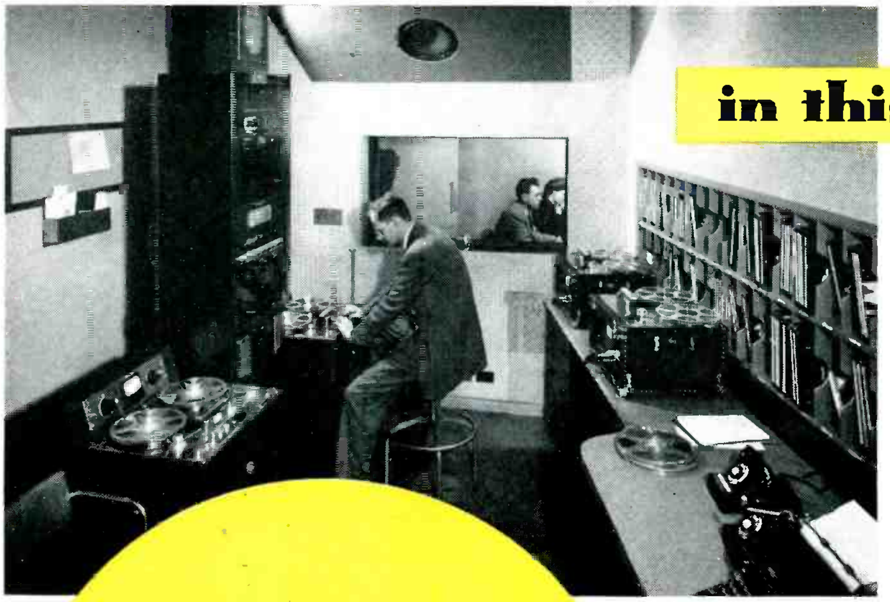
LARGE-SCREEN color television in the Eidophor system works from a signal of 150 fields a second and 75 frames per second, 25 for each of the three colors red, green and blue. This gives 25 complete colored pictures or frames per second since a frame of each color is required to give one complete frame in color.

Actually, there is first a red picture, then a green one and then a blue but they seemingly overlap, because of the properties of the human eye, and give the impression of a colored picture. Sound movies use 24 frames per second.

Interlaced scanning is used in the Eidophor system. The entire picture is scanned over half of its lines and then over the intervening lines, first the odd-numbered lines and then the even ones. The entire field (half the lines) is scanned 150 times per second. Since two fields are equal to one frame, this gives 75 frames, in the three different colors, each second.

The system uses overlapping lines. The scanning beam is wider than necessary to cover the picture. A mirror system comprises a film of specially developed oily liquid on a continuously moving spherical mirror. The picture is formed on the surface of the oil film as a result of surface deformation caused by the discharge of the electron beam on the surface of the oil. The liquid consists principally of a special petroleum oil containing a salt as the electrically conductive material. A stationary knife blade maintains the oil film at the right thickness.

Since the liquid changes rapidly in viscosity and flow characteristics



in this room...

there's no room for doubt

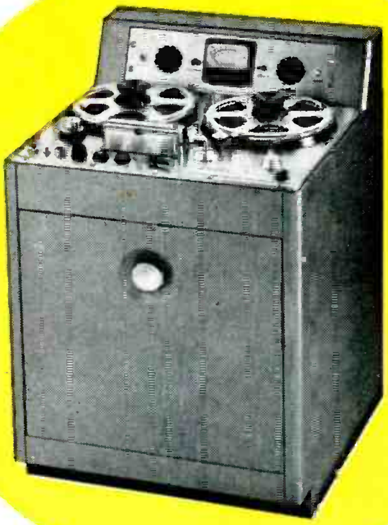
There can be no room for doubt in the continuity and fidelity of your broadcast. Precisely the reason you demand — and get — the best in transmitting and studio equipment.

Nor should you compromise with quality in the tape recorder you select.

In AMPEX Recorders you will find the same matchless reliability and performance you expect of your transmission equipment... and for the same reason — they are engineered to the highest *professional* standards.

AMPEX
brings you these cost-saving operating advantages:

- **UNINTERRUPTED SERVICE**
  Under the demand of heavy-duty programming, AMPEX Recorders deliver thousands of hours of unbroken service. Recently a set of AMPEX heads was returned from Honolulu for routine replacement after 11,000 hours continuous use, 17 hours a day. The heads were still within AMPEX specifications for new heads and had several thousand more hours of use remaining.
- **MINIMUM "DOWN TIME"**
  AMPEX Recorders are designed for thousands of hours of continuous operation with minimum "down time," resulting in low maintenance costs and protection from sudden broadcast failures.
- **ACCURATE TIMING**
  AMPEX split-second timing accuracy protects your programs and commercials from embarrassing time overlaps.
- **HIGHEST FIDELITY**
  Even when programs are repeatedly transcribed from one tape to another, there is no noticeable build-up of noise level, "wow" or distortion.
- **LONG LIFE**
  AMPEX Recorders are designed and built for years of service dependability. Its recordings match established NARTB standards. When you have an AMPEX, you have a machine built for years-ahead performance.



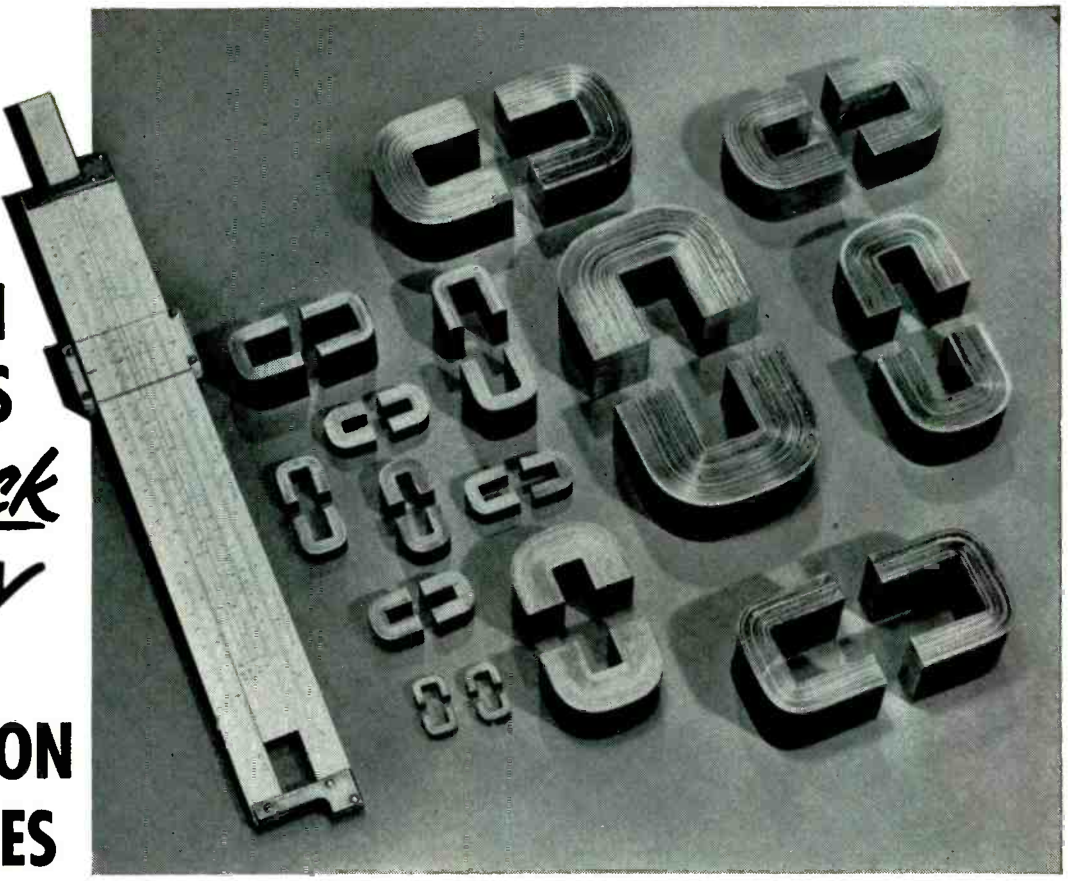
IF YOU PLAN FOR TOMORROW, BUY AN AMPEX TODAY

AMPEX

MAGNETIC RECORDERS

AMPEX ELECTRIC CORP.
934 CHARTER STREET • REDWOOD CITY, CALIF.

SILECTRON "C" CORES *for quick delivery* IN PRODUCTION QUANTITIES



. . . wound from strip as thin as 0.00025"

Quality-Tested and Proved

- ★ Arnold "C" Cores are made to highly exacting standards of quality and uniformity. Physical dimensions are held to close tolerances, and each core is tested as follows:
- ★ 29-gauge Silectron cut cores are tested for watt loss and excitation volt-amperes at 60 cycles, at a peak flux density of 15 kg.
- ★ 4-mil cores are tested for watt loss and excitation volt-amperes at 400 cycles, at a peak flux density of 15 kg.
- ★ 2-mil cores are tested for pulse permeability at 2 microseconds, 400 pulses per second, at a peak flux density of 10 kg.
- ★ 1-mil cores are tested for pulse permeability at 0.25 microseconds, 1000 pulses per second, at a peak flux density of 2500 gauss.
- ★ ½ and ¼-mil core tests by special arrangement with the customer.

Now available—"C" Cores made from Silectron (oriented silicon steel) thin-gauge strip to the highest standards of quality.

Arnold is now producing these cores in a full range of sizes wound from ¼, ½, 1, 2 and 4-mil strip, also 29-gauge strip, with the entire output scheduled for end use by the U. S. Government. The oriented silicon steel strip from which they are wound is made to a tolerance of plus nothing and minus mill tolerance, to assure designers and users of the lowest core losses and the highest quality in the respective gauges. Butt joints are accurately made to a high standard of precision, and careful processing of these joints eliminates short-circuiting of the laminations.

Cores with "RIBBED CONSTRUCTION"* can be supplied where desirable.

Ultra thin-gauge oriented silicon steel strip for Arnold "C" Cores is rolled in our own plant on our new micro-gauge 20-high Sendzimir cold-rolling mill. For the cores in current production, standard tests are conducted as noted in the box at left—and special electrical tests may be made to meet specific operating conditions.

● **We invite your inquiries.**

*Manufactured under license arrangements with Westinghouse Electric Corp.

W&D 4211

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois

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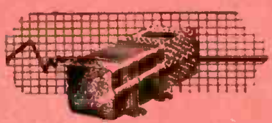
5 Voltage Regulator Types

MEETS MOST
MILITARY and INDUSTRIAL
REQUIREMENTS



SOLA DISCIPLINES VOLTAGE

SOLA adjustable, harmonic filtered type CVL:

Regulation ±1%
Harmonic Distortion less than 3%
Output adjustable from 0-130 volts

SOLA standard type CV:

Regulation ±1%

SOLA television receiver type CVA:

Regulation ±3%
Plug-in accessory unit

SOLA plate and filament type CVE:

Regulation ±3%

SOLA harmonic filtered type CVH:

Regulation ±1%
Harmonic Distortion less than 3%

CHARACTERISTICS OF SOLA CONSTANT VOLTAGE TRANSFORMERS

- Static-magnetic regulation
- Ultra-fast response (1.5 cycles)
- No moving or renewable parts
- No manual adjustments
- Complete automatic, continuous regulation
- Self-protecting against short circuits
- Automatic current limiting action
- Choice of transformation ratios

We invite you to write regarding your voltage regulating problems, or for inclusion of your name on our technical mailing list.

SOLA *Constant Voltage* **TRANSFORMERS**

Made under one or more of the following patents: 2,143,745; 2,212,198; 2,346,621; 2,552,111; 2,489,245 and patents pending.

Transformers for: Constant Voltage • Fluorescent Lighting • Cold Cathode Lighting • Airport Lighting • Series Lighting • Luminous Tube Signs Oil Burner Ignition • X-Ray • Power • Controls • Signal Systems • etc. • SOLA ELECTRIC CO., 4633 W. 16th Street, Chicago 50, Illinois

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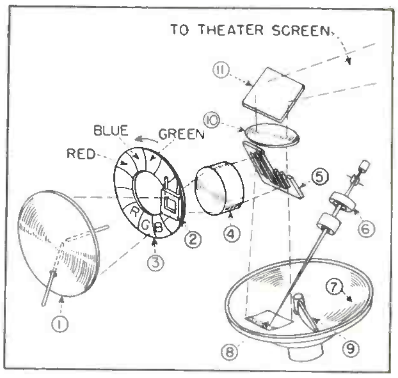


FIG. 1—Mechanical drawing of the projection system. Arc light source (1), aperture plate (2), color wheel (3), condenser lens (4), mirror bar system (5), electron gun and deflection system (6), spherical mirror with thin layer of liquid (7), electron bombarded liquid area that modulates light beam (8), knife edge determining thickness of liquid layer (9), projection lens (10) and directing mirror (11)

with temperature, changes in temperature cause a difference in the rate of the disappearance of the picture or any given portion of it. The correct temperature is maintained by a cooling machine which circulates water on the under side of the mirror. The water temperature is adjusted automatically by a thermostat.

The entire mirror system is maintained continuously under high vacuum. The mirror is driven by a motor outside the vacuum system operating through a specially packed shaft. A large vacuum line leads from the mirror system to a high vacuum pump. The pressure in the mirror system is kept at 10^{-5} millimeters of mercury.

Arc Light

The system utilizes a special arc light which gives a completely symmetrical arc. Air is blown continuously around the positive carbon to stabilize the arc. Magnetic stabilization is also provided. These two types of stabilization give a constant arc of constant brightness. It is essential with color to have a uniform arc light. The lighting density required by the Eidophor system is much higher than with the ordinary movie projection systems. About twice as much current is fed to the arc.

The positive carbon is fed by a photoelectrically-controlled device which keeps the crater exactly in

the focus of the mirror behind the arc, the best position for the most light. The negative carbon is fed in the conventional manner using the negative characteristic of the arc to control its feeding. As is conventional, the positive carbon is consumed about twice as fast as the negative.

Light from the arc is directed through a gate, see Fig. 1, then through a rotating color wheel, into a condenser in the wall of the vacuum system in which the mirror is located. After the light goes through this condenser, it strikes a mirror bar system made of a group of spaced reflective bars with the space between the bars approximately equal to the width of the bars.

Half of the light from the arc goes straight through the openings between the bars and strikes a water-cooled black surface in the vacuum housing and is lost. The other half of the light from the arc is reflected down by the bars onto the mirror with the film on it, striking the film over the area where the image is found on the oil film. If there is no picture on the film and consequently no deformation of the surface of the liquid, the mirror reflects the light back to the bars and then back to the arc lamp. If there is a picture on the film because of an incoming television signal, the light hits the picture and is reflected back between the bars, through a normal objective lens with its axis vertical, to a mirror inclined at 45 deg and then to the screen on which the picture is projected.

The picture is formed on the surface of the film by an electron beam generated by an electron gun of conventional type activated by the incoming television signal and located in the vacuum system.

Small Wire Capacitors

THE WIRE CAPACITOR developed by N. V. Philips, Eindhoven, Netherlands, has a capacitance of about 100 $\mu\mu$f and, in its most common form, consists of a small metal tube less than 1 mm in diameter and about 5-cm long. The tube contains a metal core about ½-mm thick while

From the world's largest manufacturer of precision potentiometers . . . Helipot

come to Helipot *for the largest selection of* multi-turn *precision potentiometers*

advanced engineering! volume production!

HELIPOT is the organization that originated the helical potentiometer—the device that brought to electronic engineering new horizons of precise control by its greater resolution, higher linearity, mechanical precision, and broad range of resistance values. HELIPOT'S policy of constantly working to anticipate the needs of the industry has led to steady advancement in the basic multi-turn principle—and today, HELIPOTS are available in the industry's widest selection of ranges and designs to meet varying requirements.

HELIPOT offers you . . .

- **Advanced Engineering.** Through its years of leadership HELIPOT has built an organization unequalled in the industry—with trained engineers, specially-designed equipment, overall facilities to solve *tough* potentiometer problems!
- **Volume Production of Special Designs.** HELIPOT not only welcomes tough potentiometer problems, but also has expanded facilities to mass-produce special designs to rigid specifications—at economical cost!
- **Versatile Basic Designs.** Most of the basic units shown below can be readily adapted to special requirements—ganged assemblies, servo mountings, single or double shaft extensions, taps spot-welded to a *single* turn of winding at virtually any desired point, and many other individualized features to meet *your particular needs!*

See the next pages for complete electrical and mechanical data on the following Multi-Turn Helipots . . .

MODEL A:

A 10-turn unit, approximately 1¾" diameter with 12 to 14 times the resolution of single-turn units of same diameter. Very versatile—low in price—wide range of applications.*

MODEL C:

Similar to Model A, but 3 turns of resistance winding instead of 10.*

MODELS B, D, & E:

Larger-diameter (3 5/16") designs. B has 15 turns—D, 25 turns—E, 40 turns, for applications requiring extreme ranges of adjustment and highest possible resolution.*

ultra-precision

MODELS AN, BS, BSP, & CN:

Similar to Models A, B & C in size and performance but feature precision ball-bearings and extra-close tolerances throughout. Have approximately twice the linearity accuracy of equivalent standard Helipots—are ideal servo units.*

miniature

MODELS AJ, AJS, AJSP:

Tiny multi-turn Helipots the diameter of a penny, weight 1 oz. All have 18.5" slide wire for high resolution (1/6550—50 K unit). AJ has threaded bushings, sleeve bearings . . . AJS, servo mountings, sleeve bearings . . . AJSP, servo mountings, ball bearings. Many other features.*

THE Helipot CORPORATION
SOUTH PASADENA, CALIFORNIA

* See next two pages for complete mechanical and electrical details

(Turn page for list of representatives)

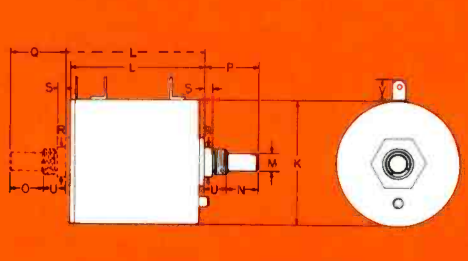
ELECTRICAL CHARACTERISTICS

MODEL	A	AJ
HELICAL TURNS	10	10
RESISTANCE RANGE (OHMS)	10 TO 300,000	100 TO 50,000
RESISTANCE TOLERANCE (ST'D)	±5%	±5%
LINEARITY TOLERANCE (ST'D)	±0.5%	±0.5%
BEST LINEARITY TOLERANCE	±.05% (above 2KΩ)	±.1% (above 5KΩ)
ELECTRICAL ROTATION	3600° $^{+4°}_{-0°}$	3600° $^{+12°}_{-0°}$
MECHANICAL ROTATION	3600° $^{+4°}_{-0°}$	3600° $^{+12°}_{-0°}$
POWER RATING (WATTS) (40° Ambient)	5	2
COIL LENGTH (INCHES)	46.5	18.5
NET WEIGHT (OUNCES)	4	1

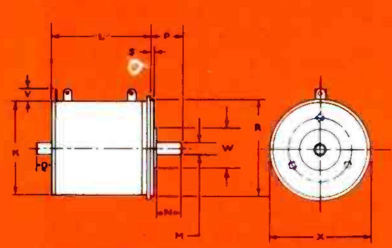
Technical Data for Helipot Potentiometers

PHYSICAL DIMENSIONS (In Inches)

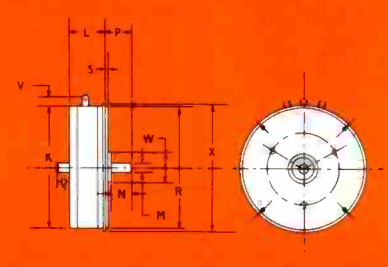
		A	AJ
K	BODY DIAMETER	1.812	.750
L	Body Length (To Front Mtg. Surface)	2	1.375
M	Shaft Diameter	.2500 $^{+.0000}_{-.0005}$	.1250 $^{+.0000}_{-.0005}$
N	Shaft Extension (Beyond Bushing) Front	.5	.375
O	Shaft Extension (Beyond Bushing) Rear	.5	.375
P	Shaft Extension (Beyond Mtg. Surf.) Front	.812	.687
Q	Shaft Extension (Beyond Mtg. Surf.) Rear	.812	.375
R	Mounting Shoulder Diameter	.4062 $^{+.0000}_{-.0010}$	.281 $^{+.000}_{-.002}$
S	Mounting Shoulder Length	.125	.062
U	Bushing Extension (Beyond Mtg. Surface)	.312	.312
V	Height of Terminals (Above Body)	.312	.203
W	Mounting Shoulder Diameter	—	—
X	Lid Outer Diameter	—	—
	THREADS	3/8-32	1/4-32
	Number of Sections (Max.)	3	1
	Add to "L" Dimension for each additional Section	—	0
	Type Bearing	Sleeve	Sleeve
	Starting Torque (Oz. In.)	2	.75



A-AJ-B-BP-C-D-E-L



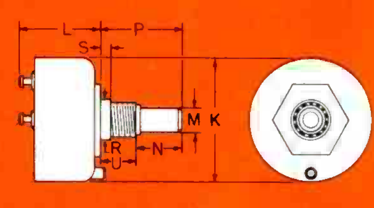
AJS-AN-BS-BSP-CN



J-LS-LSP-T

NOTES:

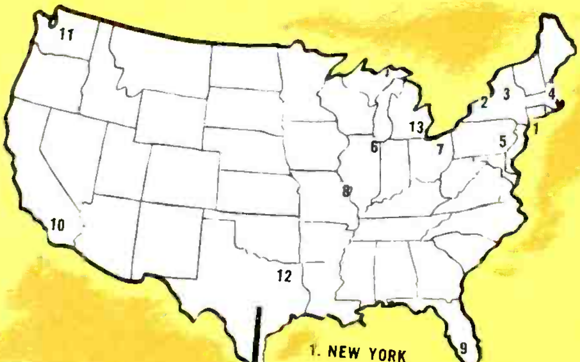
1. All locating lugs extend 1/16" beyond mounting surface.
2. Locating lugs on Models A, C and G are placed on a radius 9/16" from shaft centerline.
3. Locating holes on Models B, D, E and L are placed on a radius 17/32" from shaft centerline.
4. Three threaded 8-32 NC-2 x 5/32" deep equally spaced holes are provided on a 1.250 B.C. on Model AN, CN and J.
5. Terminals are marked as follows: C.C.W.—#1 . . . C.W.—#2 . . . Slider—S.
6. Tolerances on all decimal dimensions are ±.015".
7. Tolerances on all fractional dimensions are ±1/64".



G

	AJS AJSP	AN	B BP	BS BSP	C	CN	D	E	G	J	L	LS	LSP	T
	10	10	15	15	3	3	25	40	1	1	1	1	1	1
	100 TO 50,000	100 TO 250,000	50 TO 500,000	50 TO 500,000	5 TO 50,000	30 TO 75,000	100 TO 750,000	200 TO 1,000,000	5 TO 20,000	50 TO 50,000	10 TO 100,000	10 TO 100,000	10 TO 100,000	1000 TO 100,000
	±5%	±5%	±5%	±5%	±5%	±5%	±5%	±5%	±5%	±5%	±5%	±5%	±5%	±5%
	±0.5%	—	±0.5%	—	±0.5%	—	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%
	±.1% (above 5KΩ)	±.025% (above 5KΩ)	±.025% (above 10KΩ)	±.025% (above 10KΩ)	±.1% (above 5KΩ)	±.05% (above 30KΩ)	±.025% (above 1KΩ)	±.02% (above 1KΩ)	±.25% (above 5KΩ)	±.15% (above 10KΩ)	±.1% (above 5KΩ)	±.1% (above 5KΩ)	±.1% (above 5KΩ)	±.25% (above 5KΩ)
	3600° +12° −0°	3600° +1° −0°	5400° +4° −0°	5400° +4° −0°	1080° +4° −0°	1080° +1° −0°	9000° +4° −0°	14,400° +4° −0°	356° ±2°	357° ±1°	358° ±1°	358° ±1°	358° ±1°	355° +0° −5°
	3600° +12° −0°	3600° +1° −0°	5400° +4° −0°	5400° +4° −0°	1080° +4° −0°	1080° +1° −0°	9000° +4° −0°	14,400° +1° −0°	360°	360°	360°	360°	360°	360°
	2	5	10	10	3	3	15	20	2	5	5	5	5	2
	18.5	46. 5	140	135	14	14	234	374	3.1	5.0	8.5	8.5	8.5	2
	1	4	13	13	2	2.5	17	21	2	4	8	8	8	.56

	.750	1.820	3.312	3.328	1.812	1.820	3.312	3.312	1.312	2	3.000	3.000	3.000	.875
	1.516	1.969	2.828	2.938	1.141	1.094	4.140	6.015	.891	1.032	.9375	.875	.875	.781
	.1247 +.0000 −.0003	.2500 +.0000 −.0005	.2500 +.0000 −.0005	.2500 +.0000 −.0005	.2500 +.0000 −.0005	.2500 +.0000 −.0005	.2500 +.0000 −.0005	.2500 +.0000 −.0005	.2500 +.0000 −.0005	.2500 +.0000 −.0005	.2497 +.0000 −.0003	.2497 +.0000 −.0003	.2497 +.0000 −.0003	.0780 +.0000 −.0003
	.313	.5	1	.875	.5	.5	1	1	.5	.5	1	.5	.5	.25
	.375	—	.5	—	.5	—	.5	5	None	.5	.5	.5	.5	.25
	.375	.625	1.5	1	.812	.625	1.5	1.5	.875	.625	1.5	.625	.625	.312
	.375	—	1	—	.812	—	1	1	None	.5	.5	.5	.5	.25
	.625 +.000 −.001	1.875 +.000 −.001	.5437 +.0000 −.0010	.750 +.000 −.001	.4062 +.0000 −.0010	1.875 +.000 −.001	.5937 +.0000 −.0010	.5937 +.0000 −.0010	.4062 +.0000 −.0010	1.875 +.000 −.001	.5937 +.0000 −.0010	3.000 +.000 −.001	3.000 +.000 −.001	.7500 +.0000 −.0003
	.062	.062	.125	.125	.125	.062	.125	.125	.125	.062	.125	.062	.062	.062
	0	0	.5	0	.312	0	.5	.5	.375	0	.5	0	0	0
	.203	.281	.265	.281	.312	.281	.265	.265	0	.250	.203	.203	.203	.156
	—	.750 +.000 −.001	—	—	—	.750 +.000 −.001	—	—	—	.750 +.000 −.001	—	.750 +.000 −.001	.750 +.000 −.001	—
	.750	2	—	3.5	—	2	—	—	—	2	—	3.125	3.125	.875
	Flange	Flange	½-32	Flange	⅜-32	Flange	½-32	½-32	⅜-32	Flange	½-32	Flange	Flange	Flange
	1	2	3	3	3	2	1	1	1	8	8	8	8	4
	0	1⅝	—	2½	—	1	0	0	0	11/16	½	½	½	½
	AJS—Sleeve AJSP—Ball	Ball Bearings	B—Sleeve BP—Ball	BS—Sleeve BSP—Ball	Sleeve	Ball Bearings	Sleeve	Sleeve	Sleeve	Ball Bearings	Sleeve	Sleeve	Ball Bearings	Ball Bearings
	.75	1.0	B—2.75 BP—.75	BS—2.75 BSP—.75	1.75	1.0	3.5	4.5	.75	1.0	1.75	1.75	1.50	.005 Min. .015 Std.



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The same engineering know-how and precision manufacturing facilities that have made HELIPOT the world's largest manufacturer of multi-turn potentiometers, have also established its leadership in the design and production of high precision *single*-turn potentiometers. These single-turn units are built with the same infinite care . . . on the same types of specially-designed equipment . . . by the same highly trained personnel that have made Helipot multi-turn potentiometers the world's standard. *Result*—a wide selection of single-turn potentiometers, available in volume, built to the highest-possible standards—*at mass-production economies!*

Most of the units shown at right are readily adaptable to special requirements—servo mountings, ball or sleeve bearings, ganged assemblies, single or double shaft extensions, taps spot-welded to a *single* turn of winding at virtually any desired point, and many other optional features to meet the needs of *your* applications.

So, no matter what your requirement in precision potentiometers, bring it to Helipot!

ADVANCED ENGINEERING! VOLUME PRODUCTION!

MODEL L SERIES (3" DIA.):

A high-precision single-turn unit with continuous mechanical rotation and minimum electrical dead space. Model L has bushing mounting, sleeve bearings . . . LS, servo mounting, sleeve bearings . . . LSP servo mounting, ball bearings. All are gangable to 8 sections, sections phaseable after assembly to within ±1°. Many other features.*

MODEL J (2" DIA.):

The first production designed potentiometer with ball bearings as a standard feature—also versatile three-way servo mounting. Individual sections can be easily ganged and independently phased by the user after installation without external brackets or clamps. Many other unique features.*

MODEL G (1 5/16" DIA.):

A compact, single-turn precision potentiometer—low in price, extra rugged. Developed initially for remote positioning and indicating in aircraft applicatons—now also used for general instrumentation and servo mechanisms. Continuous 360° rotation. In certain resistance values is excellent for high temperature applications—at ambient temperatures as high as 165°C. under certain conditions.*

miniature

MODEL T "TINYTORQUE" (7/8" DIA.):

A miniature ultra-low-torque unit for guided missiles and aviation electronics. Features shielded ball bearings, highest possible precision and quality, long life, rugged dependability. Length only 25/32"—weight only 0.56 oz.—starting torque only 0.005 oz. in., when specified—negligible running torque. Sliders phaseable to within 3°. On vibration tests units have successfully withstood frequencies 0 to 2000 c.p.s. in 3 planes, accelerations up to 20 G's for periods to 1 hr.*

**See preceding pages for complete electrical and mechanical data.*

Duodials *for every application*

Duodial turns-indicating knob-dials are ideal for Helipots and other multi-turn applications. Available in a wide range of sizes and turns ratios . . .

MODEL RA:

The beautiful new 10 turn *Precision Duodial* (1-13/16" dia.) with a "feel" and appearance that add distinction to the finest instrument panels. Features excellent readability, positive locking lever, easy assembly. Available in 10:1 ratio only.

MODEL R:

Standard 2" Duodial in 10:1, 15:1, 25:1, 40:1 turns ratios for various Helipot ranges. Locking device, if desired.

MODEL W:

Large 4¾" Duodial for primary control applications. Easy to adjust and read. Finger hole for rapid rotation. Available in turns ratios of 10:1, 15:1, 25:1, 40:1.

THE LABORATORY HELIPOT (MODEL T-10A):

A 10 turn Helipot, "RA" Duodial and 3-way binding posts combined in a handsome walnut-cased unit ideal for laboratory and instruction purposes. Simplifies making and changing experimental circuits. More compact and 5 times faster to set than decade boxes. Linearity 0.1%, Power Rating 5 watts, Standard Resistance Ranges 100 to 100,000 ohms—others on order.

See preceding page for nearest representative

THE **Helipot** CORPORATION

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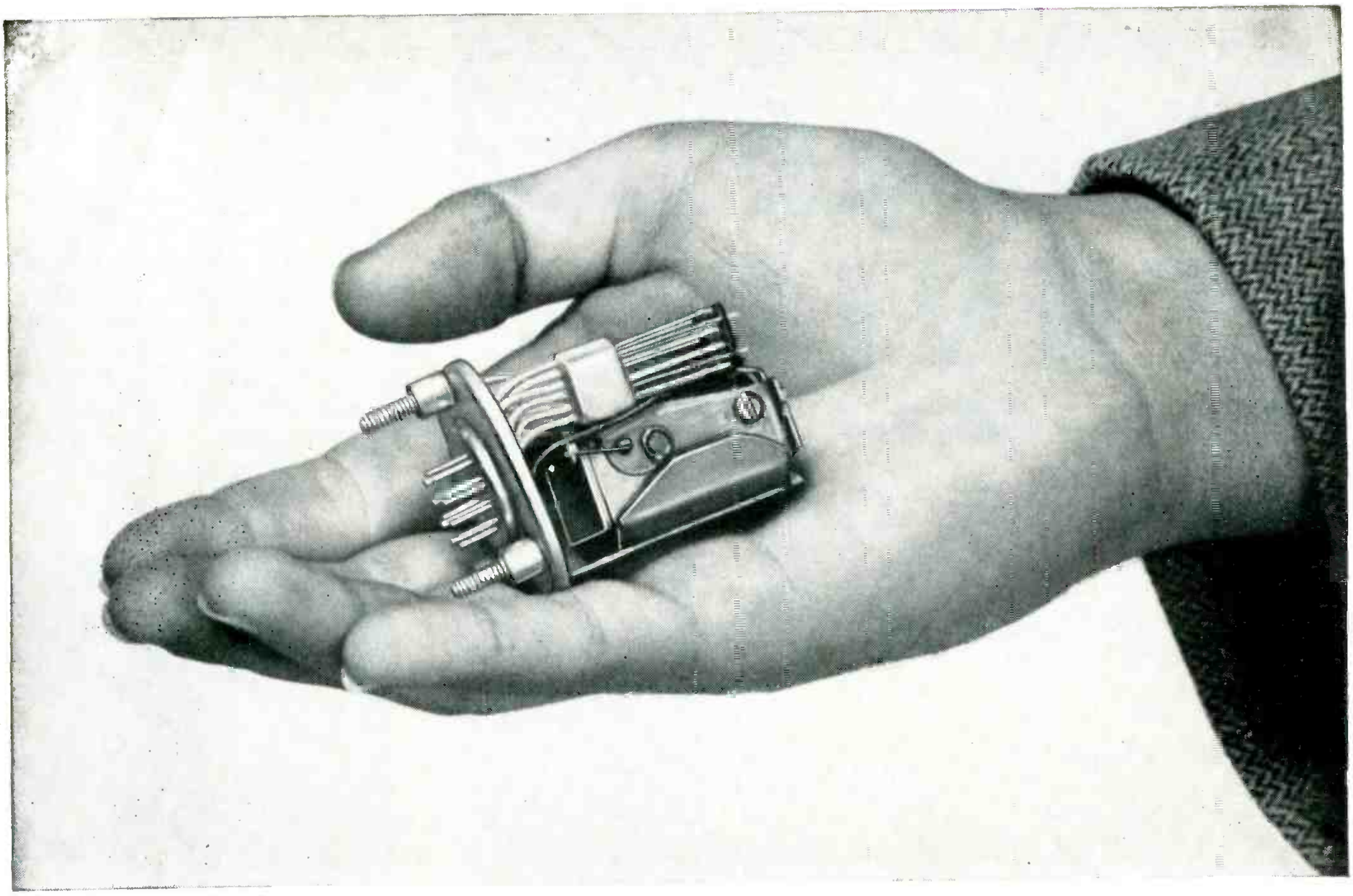


New G-E Relay Doubles Tip Pressure

Hermetically-sealed unit has larger magnet, no extra weight

Double the average tip pressure, 40-55 grams, is delivered by the larger magnet structure of the new G-E relay without exceeding Air Force-Navy specifications for size and weight.

The new relay, the first specifically designed for hermetic sealing, will withstand 50g operational shocks and instantaneous voltage surges up to 1500 volts rms *without failure*.

LONGER RELAY LIFE

The large magnet, polyester stack insulation, and silver-tipped contacts assure reliable, long-lived operation in aircraft, shipboard, portable land-based equipment and other systems which must meet Air Force-Navy specifications.

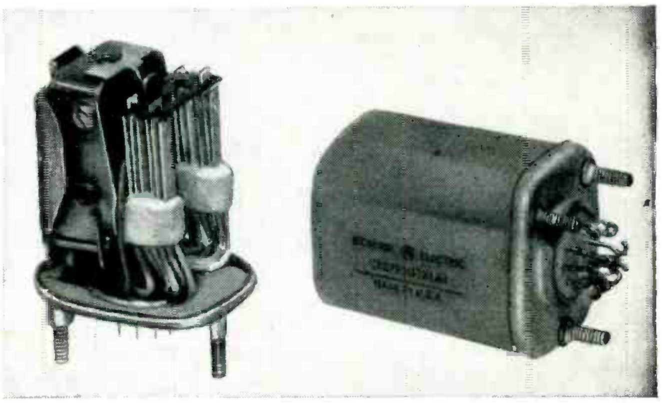
In every way, this new G-E relay is in a world of its own—sealed in a standard size enclosure against dirt, salt spray, high humidity, and widely varying air pressures.

RELIABLE SHIPMENT

This new device is now in full production and shipment can be made to meet your schedules.

Ask your nearest G-E office for more information, and send the attached coupon today. *General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC



THE LARGER MAGNET is made possible by an exclusive G-E design which utilizes the relay housing for structural support, thus eliminating much of the weight of internal bracing.

General Electric Company
Section B730-41
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Gentlemen:

I would like __ copies of Bulletin GEA-5729 on hermetically-sealed relays for:

_____ reference only   _____ an immediate project

Name .... Title ....

Company ....

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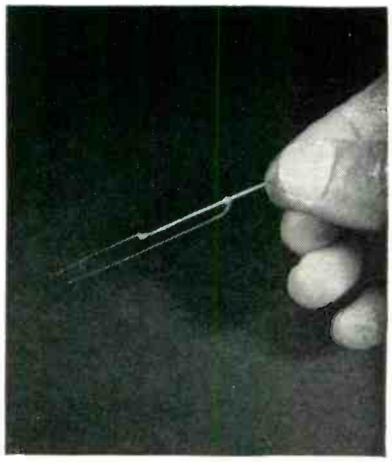
City .... State ....

the space between the core and the jacket is filled with a compressed insulating material with high dielectric constant. Total volume of the wire capacitor is about 30 cubic mm.

The narrow space between the core and the jacket is filled with the insulating material in such a way as to make it highly uniform throughout. The basic material for the production of drawn capacitors is a copper tube 20-cm long, with outer diameter of 20 mm and a wall thickness of 2 mm.



Photograph illustrating the small size of the wire capacitor

A wire core about 8 mm thick is inserted in the tube and centered with the aid of two rings acting as jigs. The annular space is filled with insulating material in powder form which is stamped in. The whole piece is then hammered and drawn out to a wire of about 40 meters and of a diameter slightly less than 1 mm.

The drawn wire is divided into pieces of the desired length and at one end of each piece, the jacket and insulation are removed to leave the core bare. Connecting wires are soldered onto the bare end of the core and onto the jacket.

Manufacturing Details

When dividing the 40-meter wire there must not be any short-circuiting between the inner and outer conductors. Since the jacket always bends somewhat outward when being broken, there is not much danger of a short circuit developing. The insulating material is packed so firmly between the core and the

DESIGNER'S

CAPACITORS

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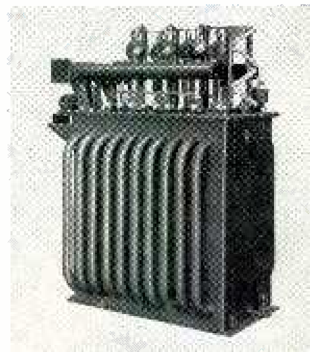

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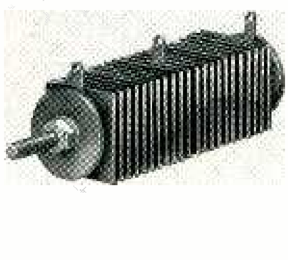
VOLTAGE REGULATORS



RECTIFIERS

CONTROL

AMPLISTATS

Ready to serve expanding tv industry— G-E components for transmitter builders

Recent lifting of the freeze on new television stations has created many design and production problems for transmitter manufacturers. General Electric is ready to help designers solve one of these problems by providing a dependable supply of reliable, long-life electrical components.

To avoid costly delays, G.E. will plan output of its ample manufacturing facilities to match your production schedules. And recent design improvements and important new products resulting from continuing G-E research and development activities will add to the performance of your equipment.

If you are engaged in supplying the huge demand for new tv station equipment, you'll find it worthwhile time-wise, cost-wise, and quality-wise to investigate the full line of applicable General Electric products. Your G-E Apparatus Sales Engineer has the story. Get in touch with him today, or write, giving full details and quantities involved, to General Electric Co., Sect. 667-22, Schenectady 5, N. Y.

GENERAL ELECTRIC

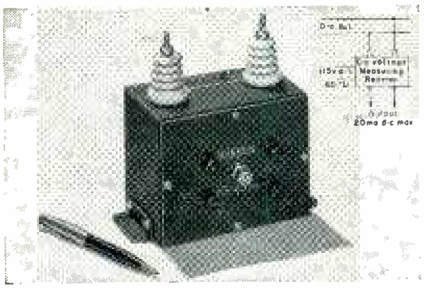
DIGEST

TIMELY HIGHLIGHTS ON G-E COMPONENTS

New drawn-oval capacitors are 10 to 20% lower priced

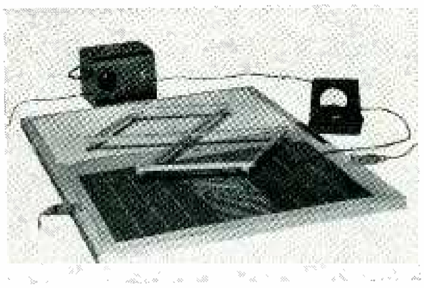
Here's a new line of General Electric capacitors for electronic applications, housed in drawn-oval containers, that features size reductions up to 30 per cent and cost reduction up to 20 percent! These fixed paper-dielectric capacitors also weigh less and are mechanically stronger than conventional types because of the drawn-steel container's single seam, hermetically sealed by double rolling. What's more, shipments are shorter. Designed to replace case styles CP70 and CP53, the new units are available in ratings from 2.0 muf to 10.0 muf, 600 to 1500 volts d-c and 330 to 660 volts a-c. See Bulletin GEA-5777.

New G-E reactor makes d-c voltage measurement safer



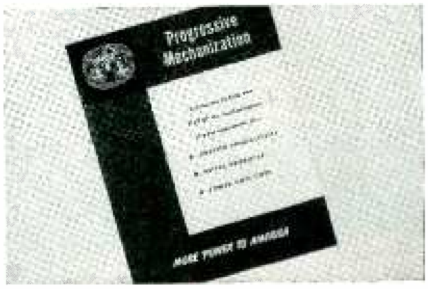
G.E.'s new d-c voltage measuring reactor minimizes hazard to personnel and equipment by isolating the instrument circuit from the d-c power source when making d-c voltage measurements. Since special safety precautions are not necessary, instrumentation costs are reduced. Available in six models for measurements up to 1200 volts. For complete application information, check Bulletin GEC-898.

New analog field plotter simplifies field studies



Electronics equipment engineers will find the General Electric analog field plotter a valuable aid in design work. Comprising plotting board and associated electric equipment, it speeds solution to problems such as electrode shapes in electronic tube design, field patterns in wave guides and electron lenses. Accompanying 50-page manual explains operation. See Bulletin GEC-851.

New G-E program boosts electronics in industry



"Progressive Mechanization," a new G-E More Power to America program, has just been launched. Consisting of a color movie and an authoritative manual, its aim is to help step up industry's mechanization. One expected result is an expansion of the market for electronic controls. For details on this program which may mean added business for you, check Bulletin GEA-5789.

EQUIPMENT FOR ELECTRONICS MANUFACTURERS

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Please send me the following bulletins:

Indicate: √ for reference only
X for planning an immediate project

☐ GEA-5777 Drawn-Oval Capacitors
☐ GEA-5789 Progressive Mechanization
☐ GEC-851 Analog Field Plotter
☐ GEC-898 DC Voltage-Measuring Reactor

Name..

Company..

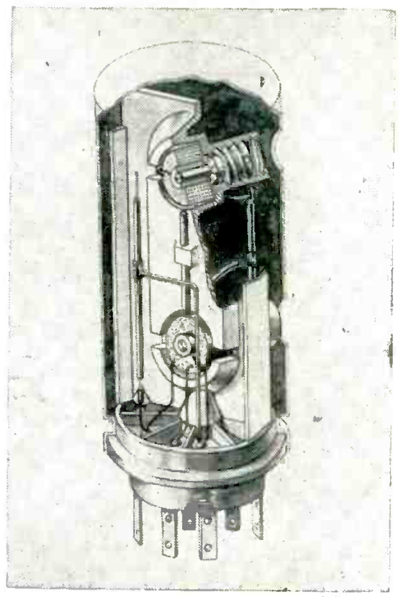
City.......................... State..........................

jacket that there is no possibility of any of it falling out of the capacitor along the plane of rupture.

To bring about electrical contact with the inner conductor, the jacket and the insulation have to be removed over part of the length of the capacitor. This affords an opportunity to give the capacitor exactly the desired value by removing just as much of the jacket as necessary to reach the particular value of capacitance.

In practice, the jacket is removed by electrolytic etching with the jacket serving as anode. One hundred of the capacitors at a time are immersed in the etching bath to a depth corresponding to the length of jacket to be removed. A voltage is then applied between all the jackets and an electrode placed in the bath.

The current passing through the bath is continuously controlled. By the time the metal of the jacket has dissolved, the current has dropped practically to zero. The inner conductor of the capacitor cannot act as an electrode because it is insulated from the outer conductor. The insulating material is so firmly compressed during the drawing process that after the outer jacket has been etched off, it does not of itself break away from the inner conductor but has to be removed separately. After the etching proc-



Wire capacitor as used in an i-f transformer. The capacitor may be seen on the left and right sides

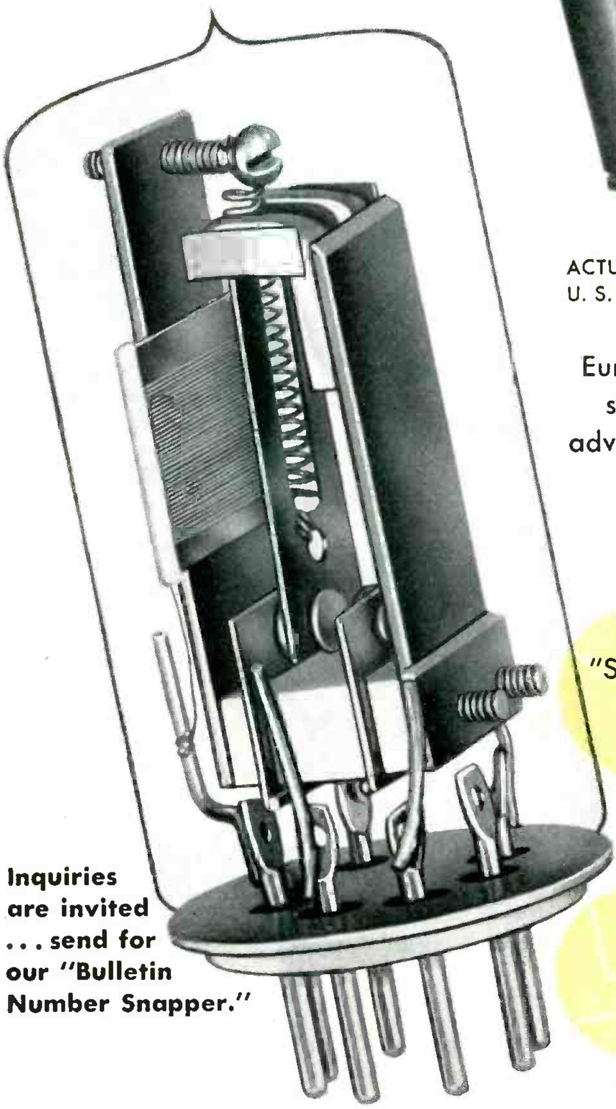
TYPE "SNAPPER"

THERMAL TIME DELAY RELAY

FEATURES . . .

Snap action. Small size. Light weight. Low operating temperature. Operates in any position. High contact rating. Gas filled. Consistent timing. Mechanical structure insures durability and long life.

ACTUAL SIZE
U. S. PATENTS APPLIED FOR



Inquiries are invited . . . send for our "Bulletin Number Snapper."

Eureka's "SNAPPER" incorporates the most radical forward step in the history of THERMAL TIME DELAY RELAYS with the advent of "POSITIVE SNAP ACTION". . . With this action the ELIMINATION OF CHATTERING is accomplished . . . The various uses for a THERMAL TIME DELAY RELAY have been increased manifold with the incorporation of a "SINGLE POLE DOUBLE THROW" feature. Due to its versatility, the "SNAPPER" relay can be manufactured to suit required needs.

VOLTAGE: 6.3, 26.5 and 115 volts (A.C. or D.C.) or as required. AMBIENT TEMPERATURE RANGE: − 60°C. to + 80°C. ENVELOPE: Miniature, or octal metal; glass upon request. All have identical operating characteristics.
TIME DELAY PERIODS: Preset from 2½ seconds and up.
VACUUM: Evacuated, inert gas filled producing an arc quenching atmosphere.
HEIGHT: 1¾" max. seated.

EUREKA TELEVISION AND TUBE CORPORATION

Manufacturers of Cathode-Ray Tubes and Electronic Products

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INTERNATIONAL RECTIFIER CORPORATION

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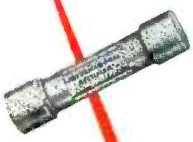
CALIFORNIA

HERMETICALLY SEALED

Diameter . . . . 3/16" to 1-1/4"
Length . . . . 9/16" to 10"
Current: half-wave . . 1.5 ma to 60 ma
Voltage: DC output . . . . . . 20 volts to 4,000 volts



PHENOLIC CARTRIDGE

Diameter . . . . 1/8" to 1"
Length . . . . 1/2" to 12"
Current: half-wave . . 1.5 ma to 60 ma
Voltage: DC output . . . . 20 volts to 10,000 volts

SELENIUM DIODES

Diameter . . . . 0.100" to 0.300"
Length . . . . 0.210" to 0.250"
Output Voltage . . . . 20V to 80V
Output Current . . . 200 ua to 1.5 ma
Temperature Range –50°C to 100°C

Selenium Rectifiers

A recent month's production included Rectifiers to supply 40 microamperes, 1,000 volts, and Rectifiers with a capacity of 140,000 amperes, 14 volts.

POWER STACK
30 Kw DC Power
Considered to be the largest single selenium rectifier stack produced.

Owned and managed by Engineers who are specialists in the design and manufacture of Selenium Rectifiers. Submit your problems for analysis and we will be glad to offer our recommendations.

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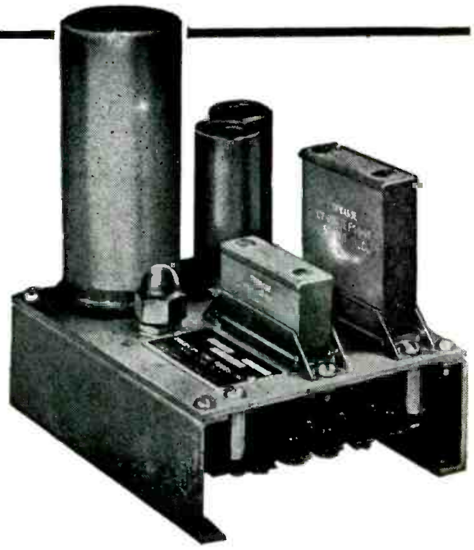
–OR ANY OTHER



precision

FREQUENCY

CALIBRATED AGAINST A STANDARD ACCURATE TO 1 PART IN 10-MILLION

The basic unit of this frequency standard is an electronically driven fork,—temperature compensated and hermetically sealed against changes of humidity and barometric pressure. Through its use, any frequency or multi-frequencies between 40 and 20,000, fractional or otherwise, are obtainable.

FROM 40 TO 20,000 CYCLES

CONSERVATIVE ACCURACY UNDER USUAL CONDITIONS
1 PART IN 100,000—(.001%)

Have you a need for any specific number of cycles in precision frequencies?

Can a source of such frequency solve your design problem or increase its factor of safety?

Have you a system that requires great accuracy, stability and dependability?

The frequencies shown at the top of the page are but a few among hundreds furnished for precision application in industries, laboratories and Government departments.

OUR ENGINEERS ARE AVAILABLE TO COOPERATE ON ANY PROBLEM

American Time Products, Inc.

580 Fifth Avenue ***New York 19, N. Y.***

MANUFACTURING UNDER PATENTS OF WESTERN ELECTRIC CO.

ess, the capacitors are washed in water to remove any traces of the etching medium.

An entirely different method of removing the jacket is to shave it off with a lathe. For this purpose, a special lathe has been designed which is characterized by the fact that the cutter rotates while the capacitor is clamped close up against the cutter. The capacitor is centered in the lathe by means of a diamond cutting die, while a diamond cutter shaves off the jacket over the length necessary.

The capacitance is measured while the jacket is being shaved off and as soon as it reaches a value within the required tolerances, the rotating cutter is stopped automatically. By this shaving process, it is possible to reach a tolerance of 0.2 percent in capacitance. By the etching method the degree of accuracy is not as high.

Applications

The wire capacitor has been developed for use in i-f transformers consisting of two mutually magnetically coupled L-C circuits. The two coils are wound directly on a core of Ferroxcube, a ceramic material with high permeability. In these transformers, the small wire capacitors have replaced the large mica capacitors.

Simple high-frequency tuning circuits also are applicable for wire capacitors. These consist of a small coil with a movable Ferroxcube core and a wire capacitor. By screwing the core in or out of the coil, it is possible to vary the resonant frequency of the circuit. This device replaces the conventional tuning circuits built up from one or more coils and one or more variable capacitors.

Graphical Aids to Broadcasting

By A. E. Richmond

Consulting Engineer
Portland, Oregon

ALTHOUGH MUCH graphical and tabular data have been published relative to the design of electronic equipment, the use of graphical information in the operation of equipment is not too common. Graphical operating devices have several advantages over the more

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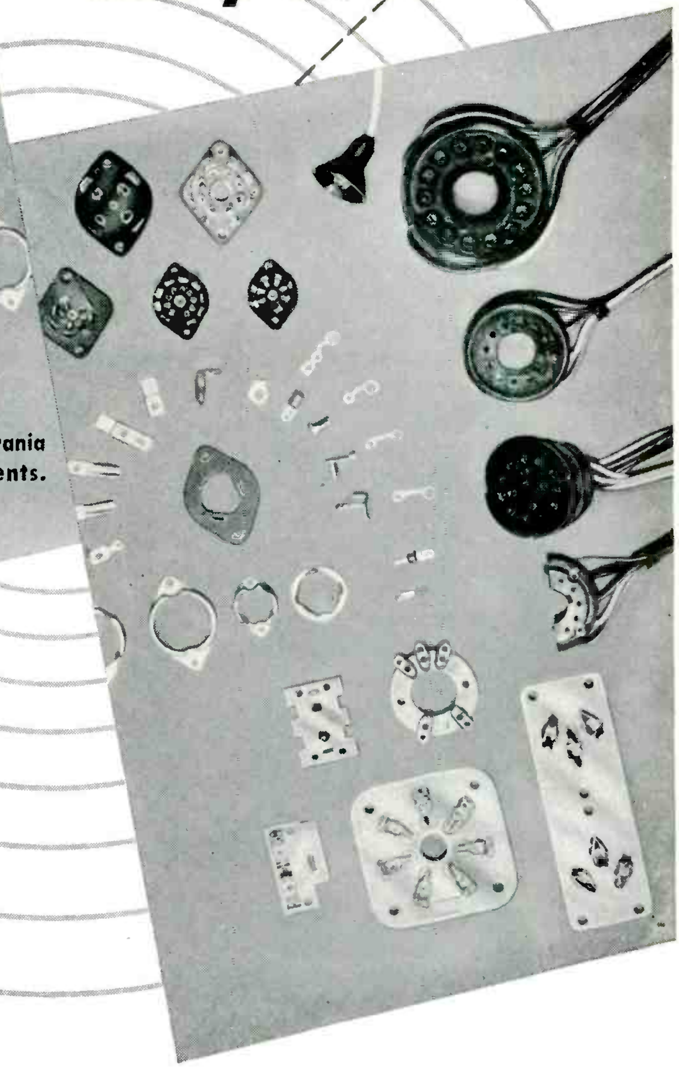

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Table 1—Operating Currents for Array of Fig. 1

Tower Number	Normal Current (amp)	Normal Ratio to Tower 1 Current
1	2.1	1
2	1.5	0.714
3	2.8	1.333

customary slide-rule or pencil-and-paper methods. In particular, the graphs are made especially for the job and can be made more accurate and convenient than other rapid methods.

As examples, this article presents two easily prepared aids to the broadcast-transmitter operator. The graphs are to be prepared individually for the particular values anticipated in each case.

Figure 1 shows a method of determining almost instantly whether or not the ratios of currents within a directional array are within their required five-percent tolerance. This sort of graph is especially useful where several towers are used, although to avoid confusion not more than about two other currents should be compared with the reference current on any one sheet. Figure 1 applies to an array having the normal operating currents given in Table I.

It is a simple matter to determine

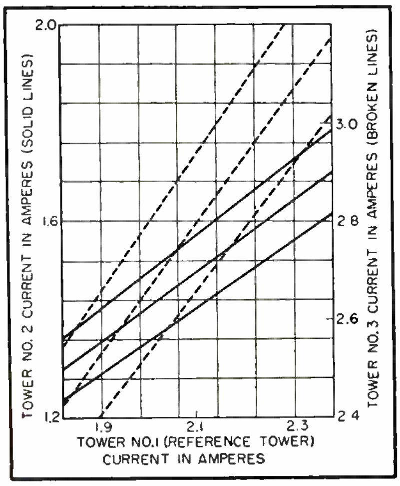

FIG. 1—Sample graph for checking ratios of currents in different towers of broadcast directional antenna

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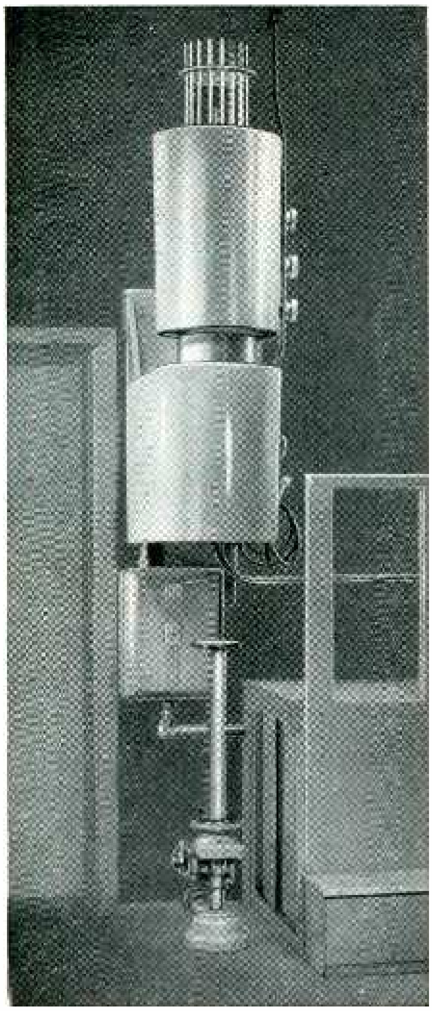
BETTER CONTROL OF COPPER OR ALLOY BRAZING WITH LITTON HYDROGEN FURNACE

Litton Model 4400 Vertical Hydrogen Furnace is designed for easily observed, accurately controlled production-line brazing of assemblies up to 6½″ in diameter and 12″ in length. Brazing is performed in a hydrogen atmosphere and work can be inserted into the open bottom either mechanically or hydraulically. Operating temperature range permits copper brazing as well as all types of gold-copper and silver alloy brazing.



Model 4400 Furnace is divided into two chambers. The upper or brazing chamber is equipped with radiant heating for maximum flexibility. The lower or cooling chamber permits rapid cooling to the freezing point of the metal or alloy. The heating chamber has an inconel inner wall surrounded by 3″ of thermal insulation. Two replaceable pyrex windows permit a clear view of the work during the heating cycle. Tungsten heating rods are spring-loaded to preserve tautness, and may be easily replaced. The cooling chamber is a double-walled cylinder of stainless steel within which water is circulated.

In operation, work is raised into the upper chamber, heated at the desired rate or rates, and immediately lowered into the cooling chamber. Since power is applied only during the heating cycle (normally less than one-third of loading, heating and cooling time), power consumption is minimized.

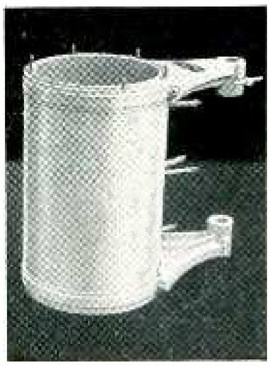
SPECIFICATIONS—MODEL 4400 VERTICAL HYDROGEN FURNACE

Work diameter, max.	6½″
Work length, max.	12″
Temperature, max.	1250°C
Voltage to maintain 1250°C	Approx. 22v
Kva to maintain 1250°C	Approx. 23 kva
Overall height	75″
Overall diameter, heater	17″
Overall diameter, cooler	12″

Heater elements: 15 Tungsten rods, .050″ dia. x 40″ long, connected in parallel.

Time to raise furnace and work to 1000°C: Approx. 17 minutes.

GLASS BAKING OVENS



Litton Glass Baking Ovens are circular and easily mount in any exhaust position. Heating is by Calrod units and ovens are designed for continuous operation at 500° C. Oven models 2, 3 and 4 can be operated in either series or parallel. Ovens range from 5″ to 12¾″ in diameter, and 12″ to 18″ in length. Complete details and prices for all models will be supplied on request.

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Base	11½″ x 16½″
Column height	56¾″
Heater stand, height	23½″
Heater stand arm (extended length)	10⅝″
Heater stand, vertical travel	12″
Work stand extensions	2″, 4″, 6″, 8″ and 12″
Jar diameter	12″
Height	24″
Travel of jar	28½″

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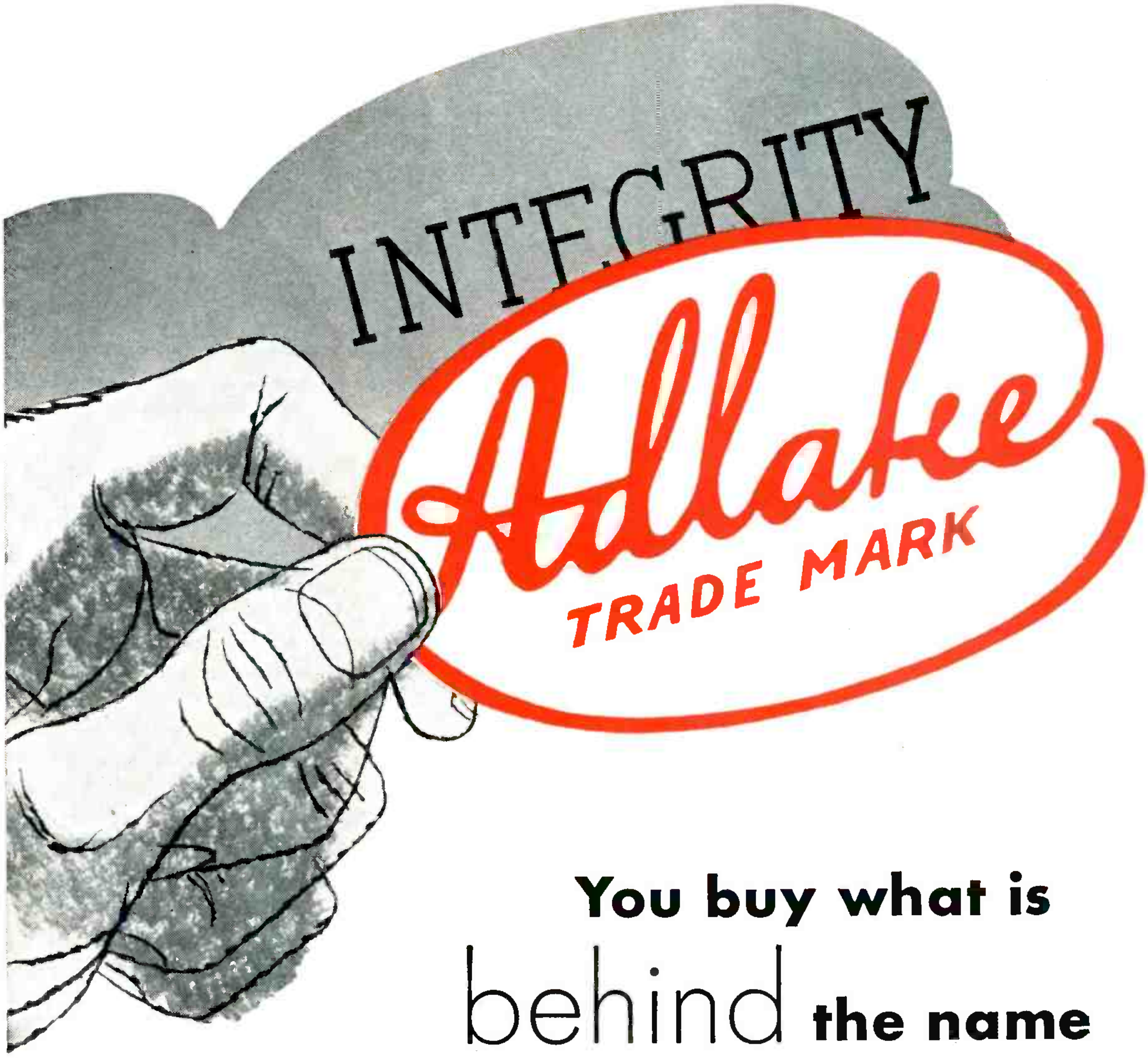

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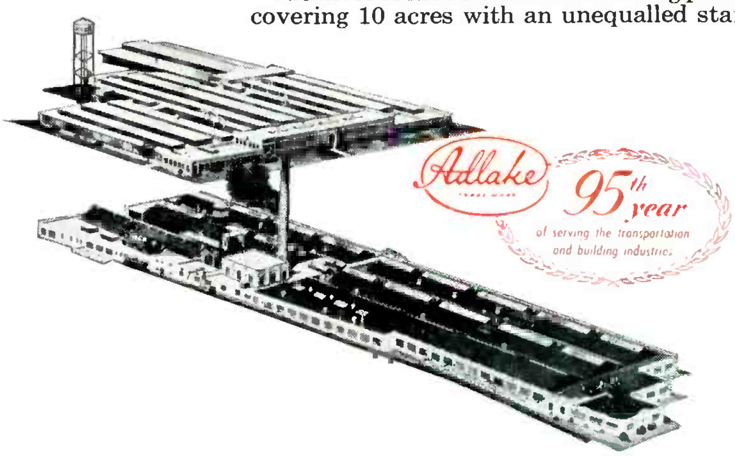

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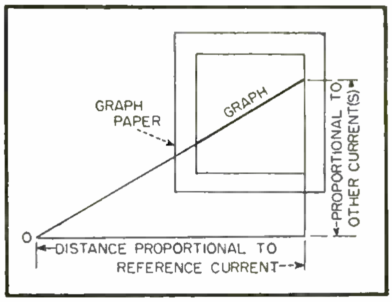

FIG. 2—Method of preparing graphs of type shown in Fig.1

whether or not the currents have ratios within their tolerances if the reference current remains constant. With a graph of this kind, however, the operator is prepared to meet quickly the more probable situation wherein the reference current changes simultaneously with the other currents.

Figure 1 depends for its design upon the proportional relationships between the sides of similar triangles. Each graph is a segment of the hypotenuse of a right triangle, the base and altitude of which are proportional, respec-

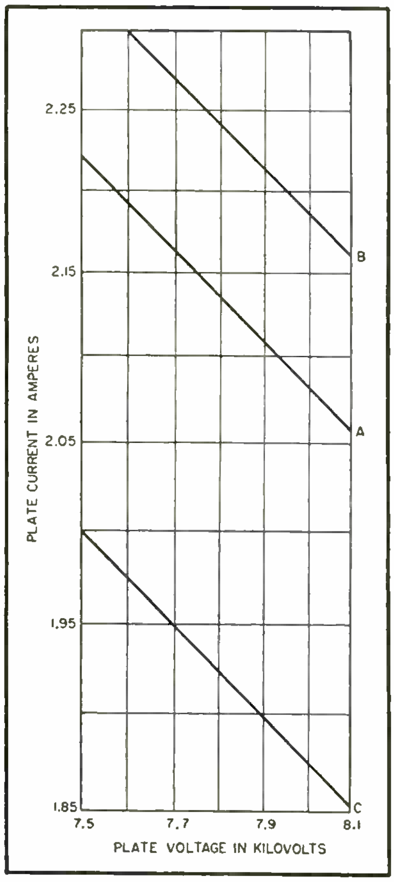

FIG. 3—Rapid determination of input power to transmitter final amplifier

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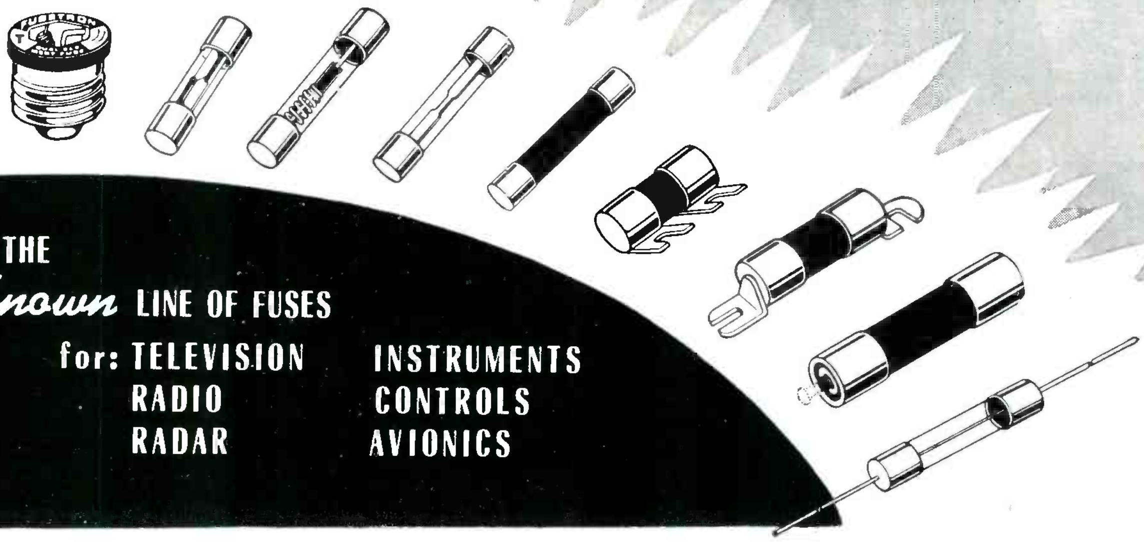

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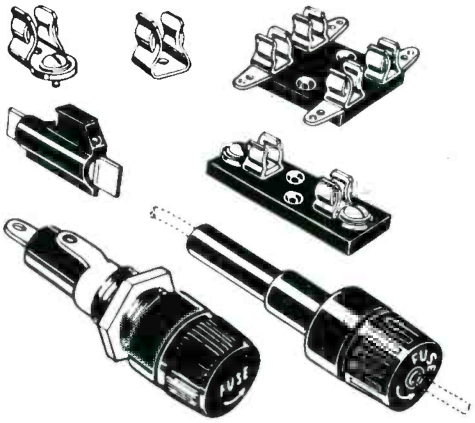

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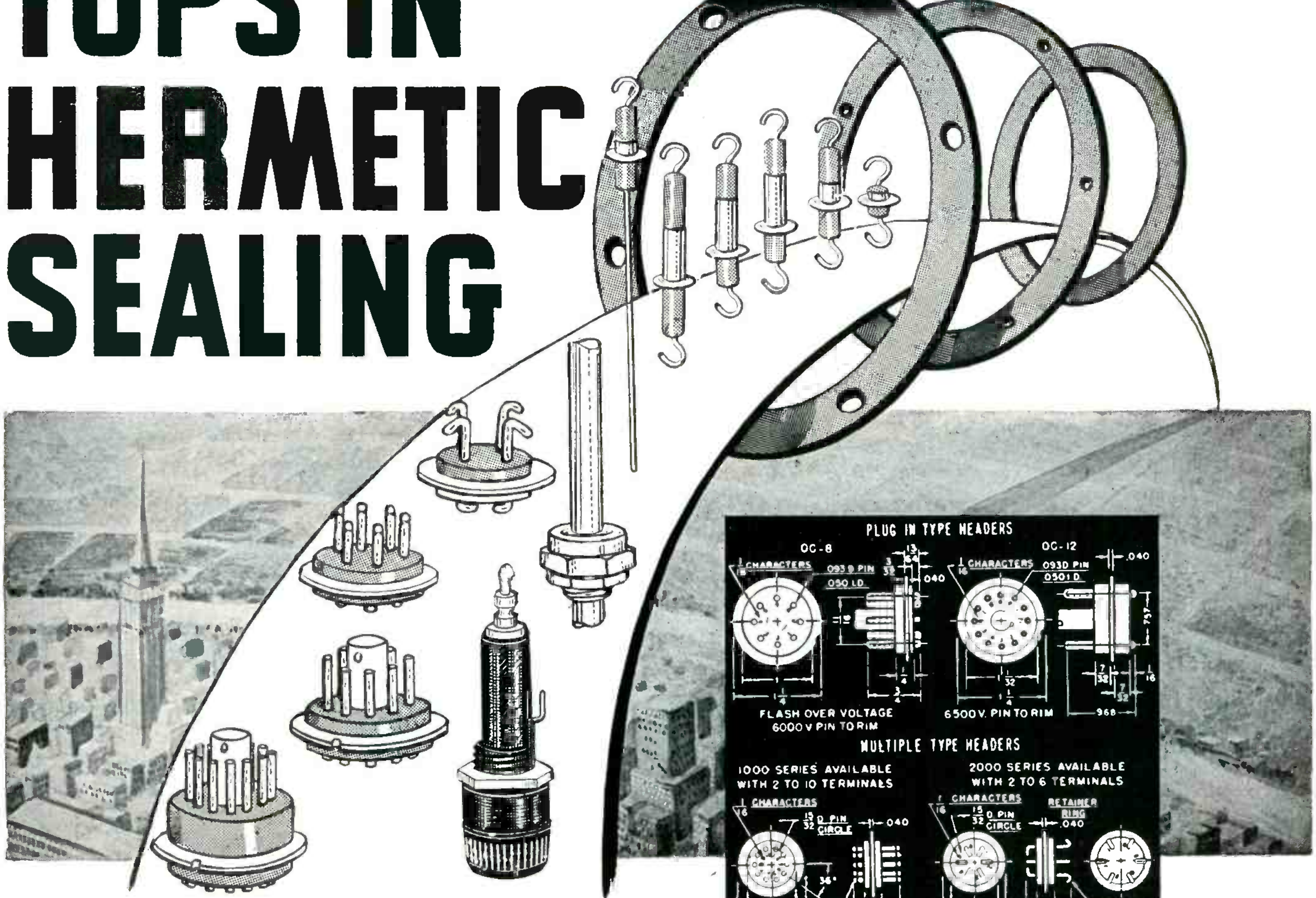

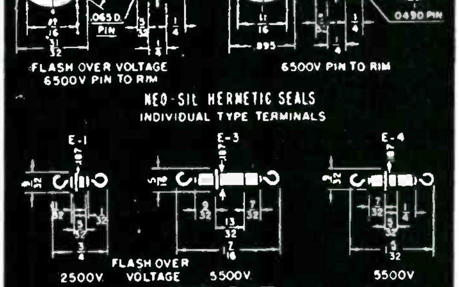

TEST DATA

The result of the Electrical Testing Laboratories Inc., Report #330655, dated March 18, 1949, on this material shows the following:

Volume Resistivity at 800 Volts d-c

Room Temperature 25°C	R.H. 30 percent
Megohm-inches	*ohm-centimeters*
1.4×10^6	3.5×10^{12}

Dielectric Constant and Dissipation Factor

Dielectric Constant	*Dissipation Factor*	*Loss Factor*
	@ 60 cycles per second	
9.22	.058	5.32
	@ 1 megacycle per second	
6.17	.0455	.28
	@ 50 megacycles per second	
5.35	0.20	1.1

Dielectric Strength at 60 cycles
Volts per mil — 370

Durometer Average — 80 ± 5

Temperature — Rated as a Class A material conservatively + 175° to —70° centigrade.

The Flashover Voltages indicated were taken at a temperature of 68° Fahrenheit, and 47% Relative Humidity.

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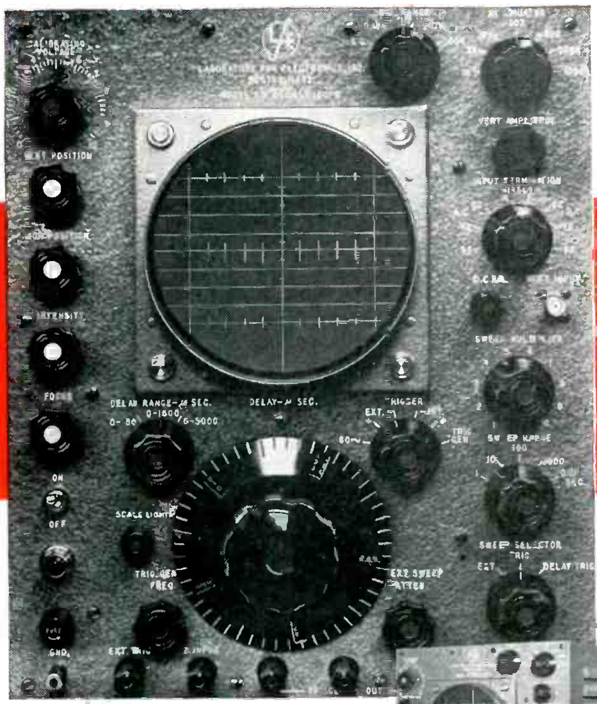

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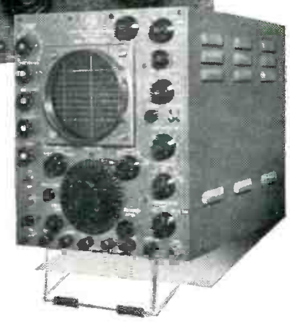

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Frequency Response — DC to 10Mc

Transient Response — Rise Time — 0.035 microseconds

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tively, to the reference current and to the current being compared with it.

Figure 2 shows one way of preparing such graphs. The intermediate graph of each set indicates currents of precisely the proper ratio and the ±5 percent tolerances are indicated on the upper and lower graphs of the set.

Figure 3 is helpful in checking the operating power of transmitters, such as f-m or tv transmitters, using the indirect method of power measurement. The example shown would be suitable for use with a 10-kw f-m transmitter using an arbitrary efficiency figure of 60 percent. The normal plate voltage is about 7.8 kilovolts for the particular example chosen, and the current about 2.12 amperes. Current and voltage products falling upon graph *A* provide the specified power input, while those between the limits of graphs *B* and *C* are within the f-m transmitter temporary tolerances of 5-percent above and 10-percent below rated power.

The voltage and current scales of Fig. 3 are not linear but have intervals proportional to the logarithms of the quantites represented. In graphs for actual use, additional divisions of the scales will be convenient in both types shown.

Impulse Modulator

By HILARY MOSS
Chief Engineer
Electronic Tube Corp.
Philadelphia, Penn.

GENERATING amplitude-modulated waves which are substantially free from distortion at high modulation depths is far from easy. The classical plate-modulated class-C circuit is quite good but involves critical adjustments. This article describes a simple feedback method which gives excellent results and requires little adjustment.

Development of the method may be seen from Fig. 1. This shows the essentials of a perfect modulator. The switch *S* operates at the carrier frequency to which the secondary of T_1 is tuned. Assume that transformer T_2 has a perfect core material, then the whole network is linear and it follows that the am-

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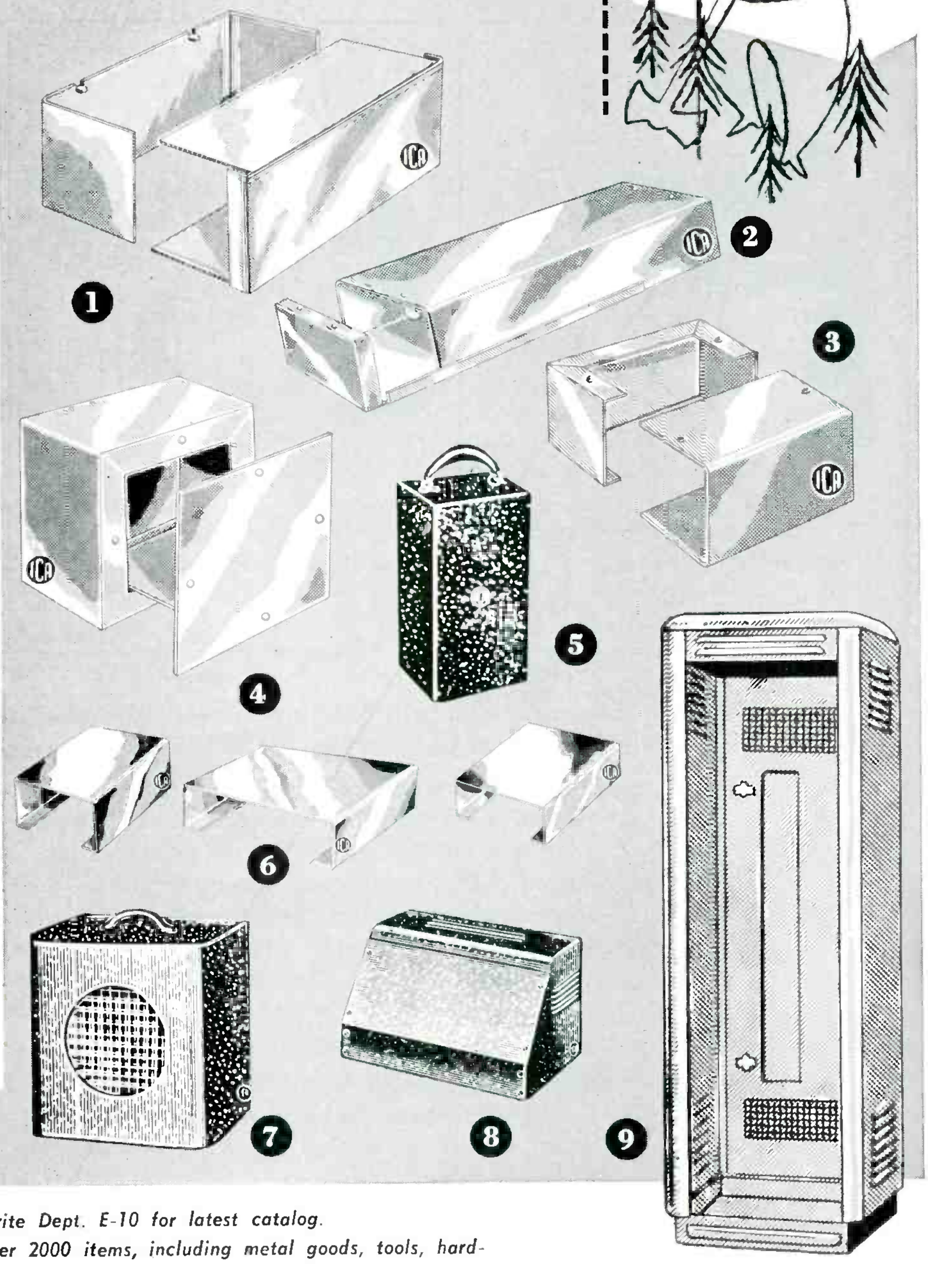

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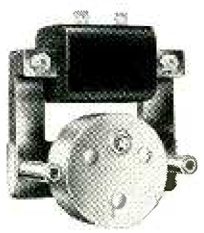

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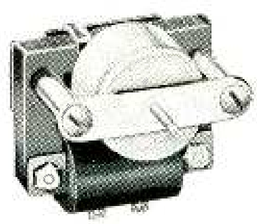

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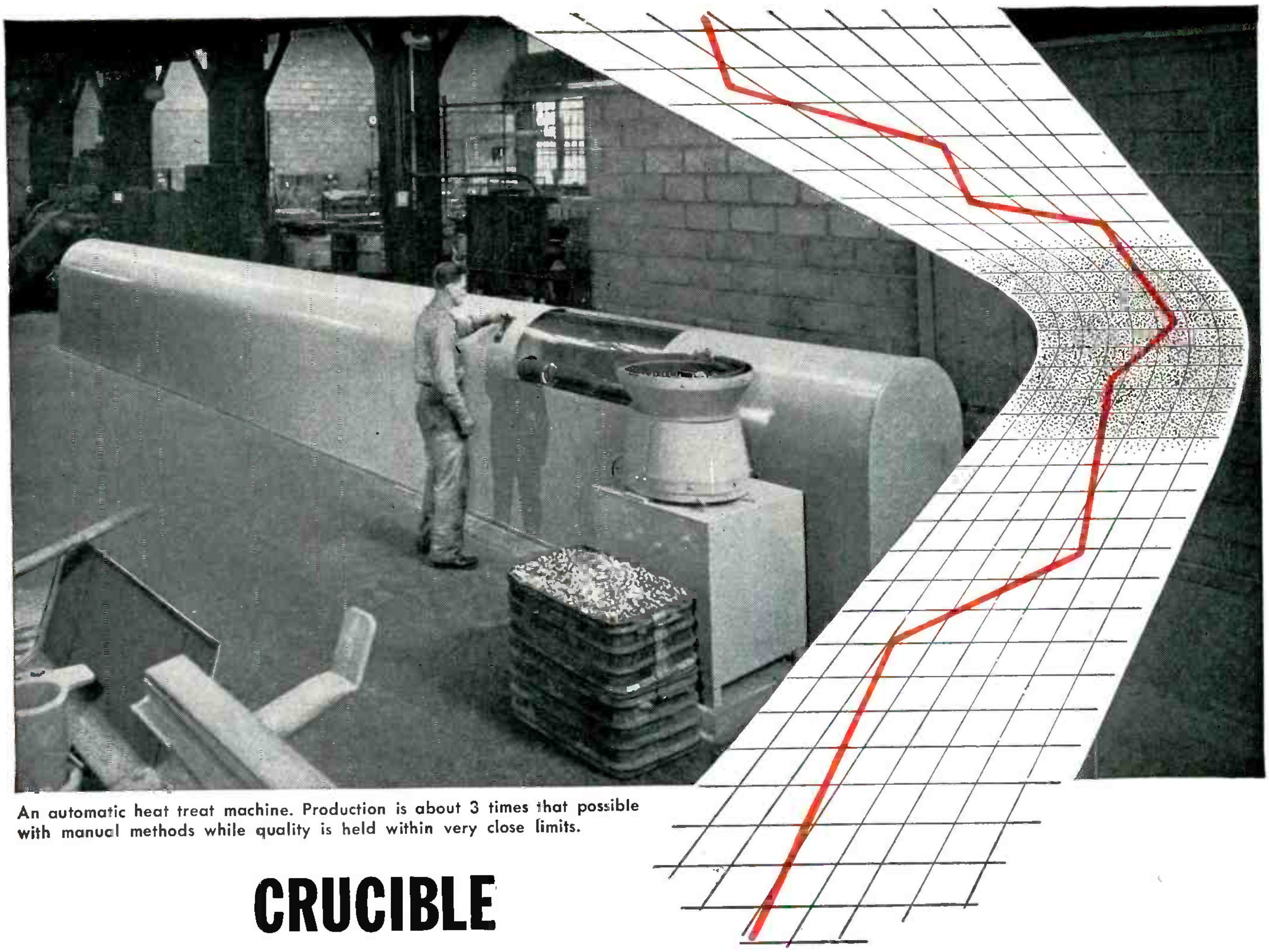

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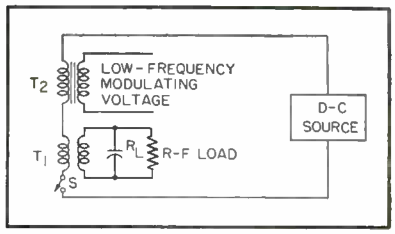

FIG. 1—Essential circuitry for a perfect modulator

plitude of the r-f voltage across the load R_L is an exact reproduction of the modulating voltage waveform. The mark/space ratio of the switch S is immaterial, provided it is constant.

It would seem profitable to try to simulate the network of Fig. 1 in the search for a perfect linear modulator. The problems of doing this are wholly associated with the switch S. The only form of switch having suitable frequency characteristics must be a thermionic tube. Since this is inherently a nonlinear device, the simplicity and perfection of Fig. 1 can not be entirely achieved.

Figure 2 shows a practical network to simulate that of Fig. 1. Tube V_1 is the off-on keyed tube replacing S. Its resistance when conducting is made low by connection of a low-valued resistor R_1 between the anode and control grid. Nonlinearities in the tube's conductance-voltage curve become relatively unimportant in comparison with the cathode resistor R_c. The capacitor C_1 which shunts R_c acts as a bypass only for the carrier frequency.

The turns ratio on T_1 is kept high so that the variation in back voltage across its primary is small and does not appreciably vary the resistance of V_1 during the conducting portion of its cycle. These details of operation will be quantitatively discussed elsewhere.

Tube V_2 is the keying tube which

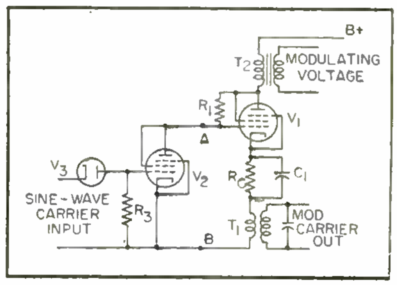

FIG. 2—Practical network simulating circuit of Fig. 1

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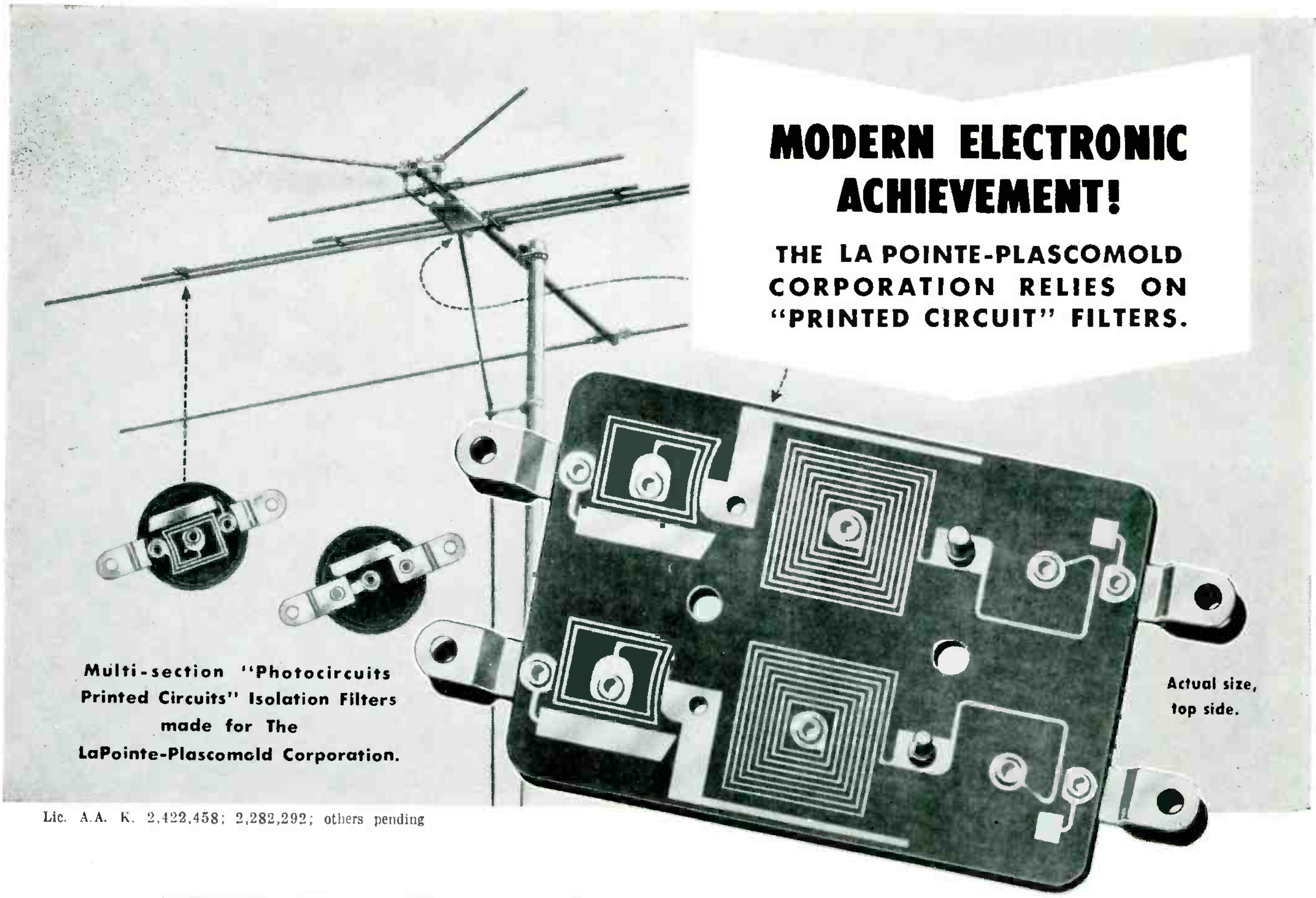

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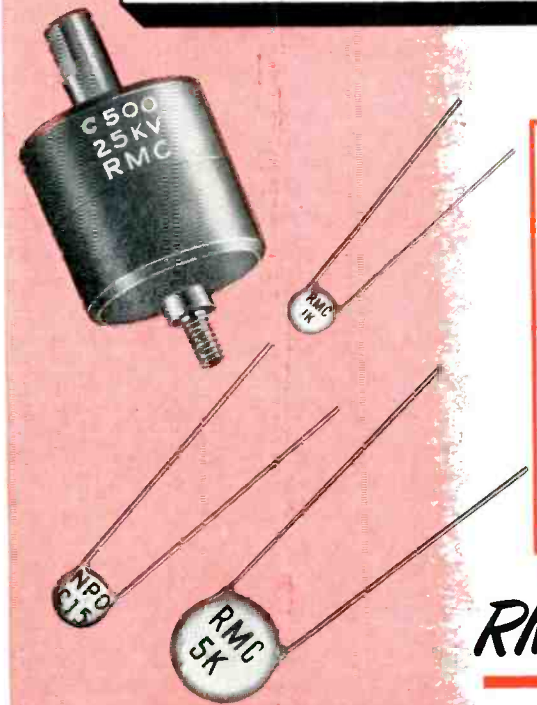

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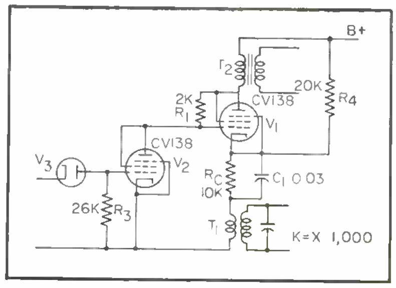

FIG. 3—Final circuit of the impulse modulator

is periodically made conducting by driving it from a large amplitude carrier source via diode V_3 and load R_3. This operation cyclically cuts off V_1 by joining A and B through an equivalent low resistor. The bias developed across C_1 cuts off V_1.

The network of Fig. 2 has one obvious weakness. At those portions of the modulation cycle when the anode potential on V_1 is low, V_2 operates over very nonlinear portions of its characteristic and one should expect nonlinearity in the output modulated wave. The circuit however, is quite good for modulation depths up to about 80 percent.

In the circuit of Fig. 3, a resistor R_4 has been added between the cathode of V_1 and the high-voltage supply. Thus, V_1 becomes cut off and the modulation reaches 100 percent before the potential of V_2 reaches zero. By making R_4 sufficiently small, the keying tube V_2 is made to operate almost linearly.

Synchronous Demodulator for Color TV

By Robert B. McGregor

Senior Design Engineer
Arvin Industries, Inc.
Chicago, Ill.

Much similarity exists between a black-and-white tv receiver and the NTSC color receiver. The front end, the i-f amplifier and the sweeps are the same. However, the video which is extracted by the second detector contains a subcarrier of 3.89 mc which carries the color information. Besides the standard video amplifiers, which may be called the monochrome channel, there is a channel which extracts the color information and then uses video amplification to put the color into the picture. This is called the chro-

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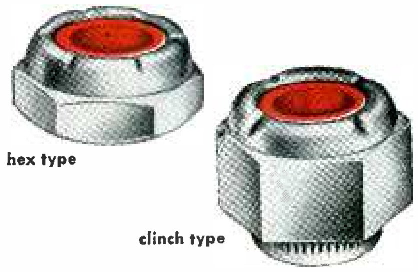

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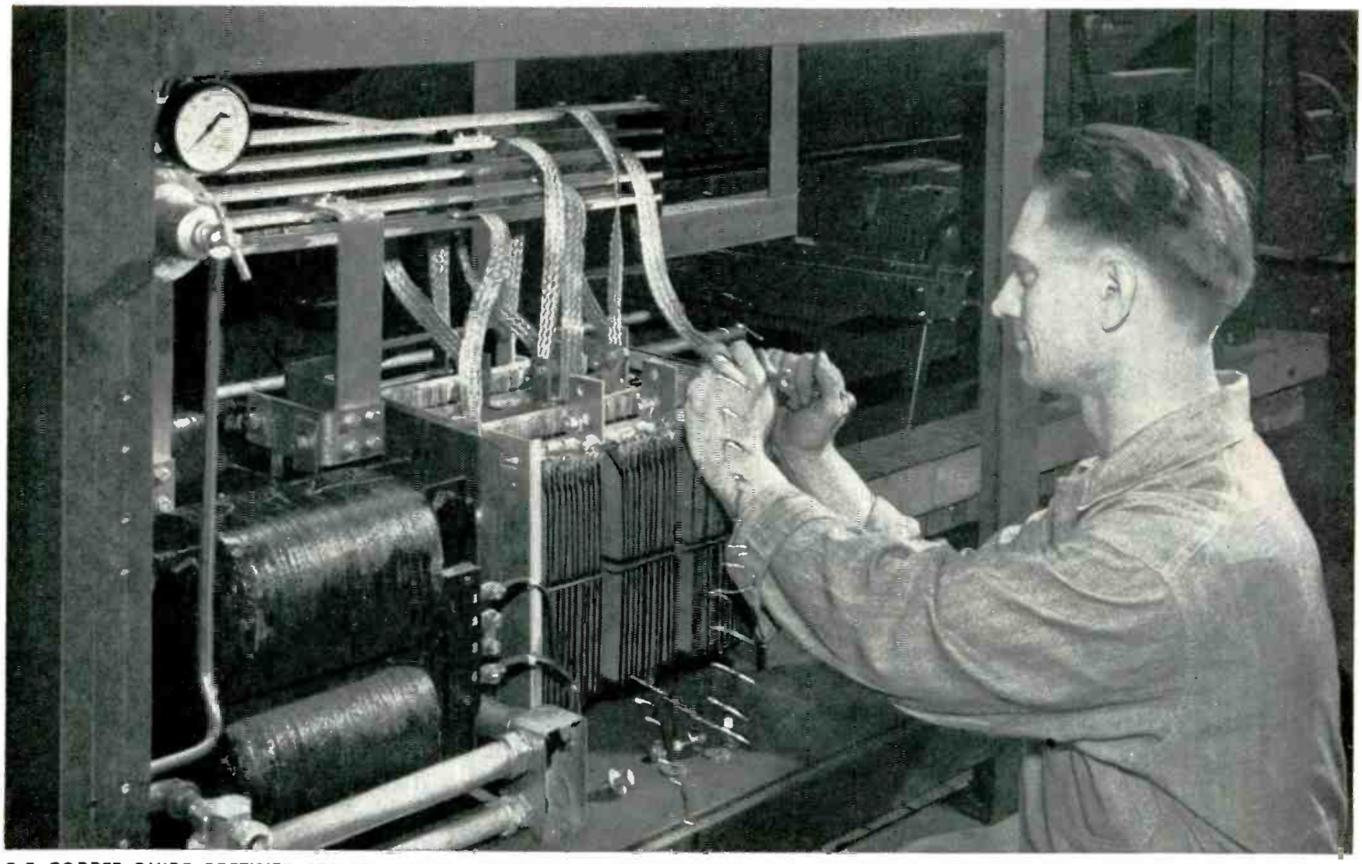
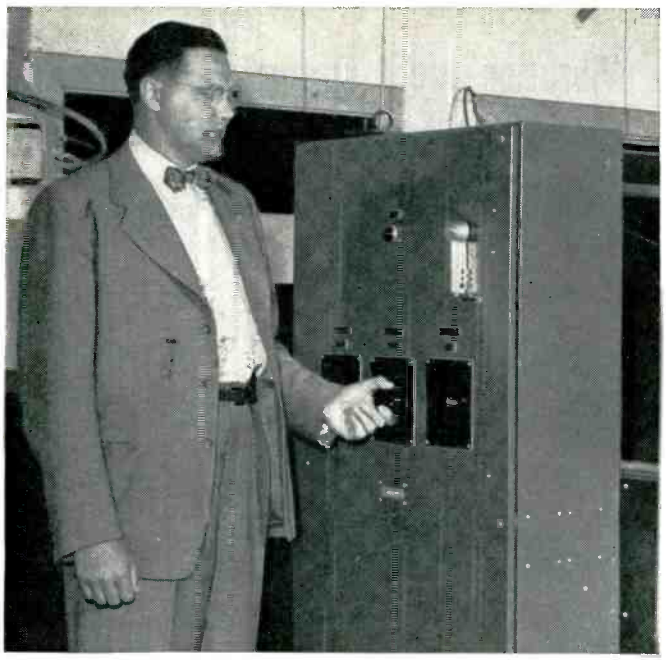


G-E COPPER-OXIDE RECTIFIER STACKS, BEING INSTALLED BY MAGNAFLUX' H. E. SCHREIBER, PROVIDE HIGH CONVERSION EFFICIENCY.

Magnaflux Corp. Relies on G-E Rectifiers



STABLE ELECTRICAL CHARACTERISTICS of General Electric copper-oxide rectifier stacks help maintain customer good will, says W. D. Reid, Magnaflux second vice-president and plant manager.

COPPER-OXIDE STACKS MEET SEVERE SERVICE REQUIRED BY MAGNAFLUX TESTING EQUIPMENT

As pioneer developer and world leader in the manufacture of non-destructive testing equipment, the Magnaflux Corporation insists on dependable rectifiers.

These rectifiers supply the d-c current that sets up the magnetic field for detecting sub-surface defects. G-E copper-oxide rectifier stacks were selected because tests proved that they can take heavy current overloads for short periods without over-heating or deteriorating.

Mr. W. D. Reid, second vice-president and plant manager at Magnaflux, enthusiastically reports, "In our application, rectifiers are subjected to extremely severe service because of the high currents drawn from them for the magnetization of parts to be inspected. They must have the highest conversion efficiency to assure maximum voltage output with lowest losses in operation. G-E copper-oxide rectifiers meet all these requirements."

"We have several thousand copper-oxide rectifiers in service. Failures have been almost unknown."

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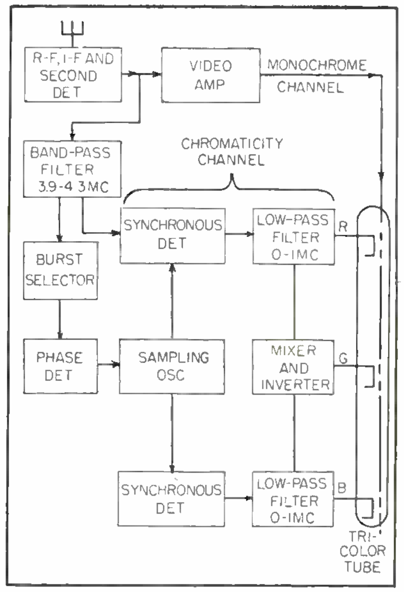


FIG. 1—Block diagram of color-tv receiver

maticity channel,[1] see Fig. 1.

To recover the color information from the subcarrier, it becomes necessary to employ a process of synchronous demodulation or detection. The subcarrier contains two different sets of data provided by modulating the carrier both in amplitude and phase. The amplitude determines the color saturation and the phase modulation conveys the hue.

A more informative representation is to consider the subcarrier as composed of two sine waves in quadrature, each amplitude modulated. The problem is to recover the modulation information from each sine wave separately without crosstalk from the other.

Consider the circuit in Fig. 2, with the two sine-wave voltages applied to the control grid G_1 in quadrature as shown. The wave to be detected or demodulated is *ACE*. The sine wave which must contribute nothing is *BDF*. When switch S_1 is closed to the negative position, negative voltage on the screen grid G_2 of the tube, there can be no plate current. When the switch is thrown to the alternate position so that there is normal screen grid voltage, the tube functions in a normal manner.

Consider that there is negative voltage on the screen grid of the tube at all times except for an instant at time *B*. For each cycle of wave *ACE*, the tube functions in a

normal manner at point *B* which corresponds to the time of maximum amplitude of this sine wave. If the amplitude of this sine wave varies, as with amplitude modulation, the pulses of plate current will vary in a like manner as shown. If the low-frequency component of these pulses is extracted as with a low-pass filter, the envelope of the wave will be reproduced as shown by the dotted line.

When examining the effect of sine wave *BDF* on this synchronous detector, remember that the plate current in the tube flows only at point *B* of each cycle, but sine wave *BDF* is zero at point *B*. Even though the amplitude of this wave increases or decreases, it will always be zero at the time of the sampling pulse. Therefore, the information contained in the modulation of wave *ACE* is recovered without crosstalk from the other sine wave *BDF*.

If the modulated subcarrier is fed to another synchronous detector which is pulsed on at time *C*, the information contained in wave *BDF* will be recovered. This type of synchronous detection was one of the first types used. Later methods of recovering the information use a synchronous sine wave in precisely the same manner as the synchronous pulse sampling.

Figure 3 shows a synchronous detector with desirable characteristics. The input signal is applied to the control grid G_1 while the sampling oscillator is applied to the suppressor grid G_3. Since the plate current of the tube is cut off when the suppressor is more negative

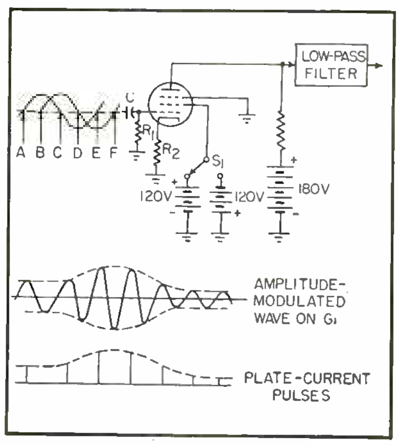
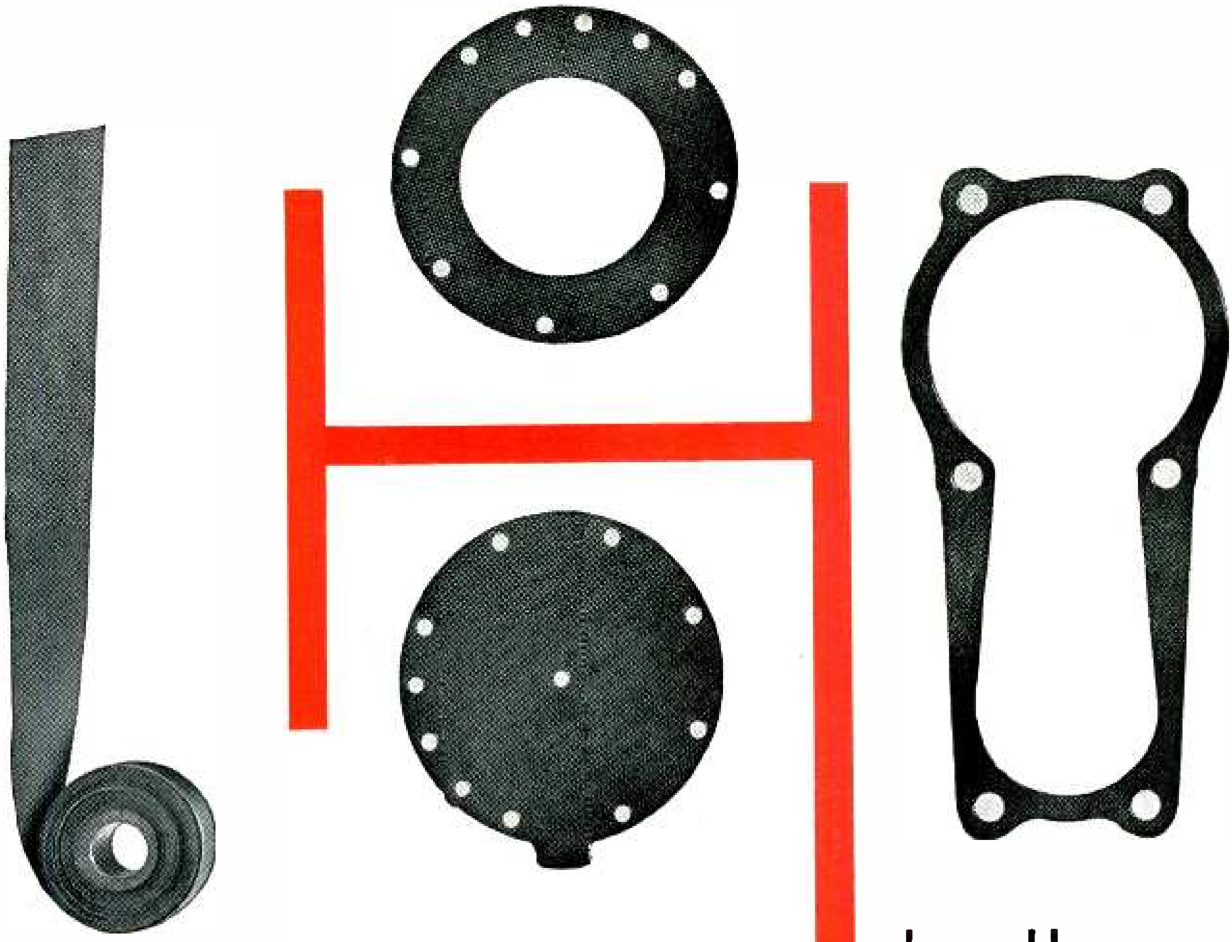


FIG. 2—Synchronous detector used in early work



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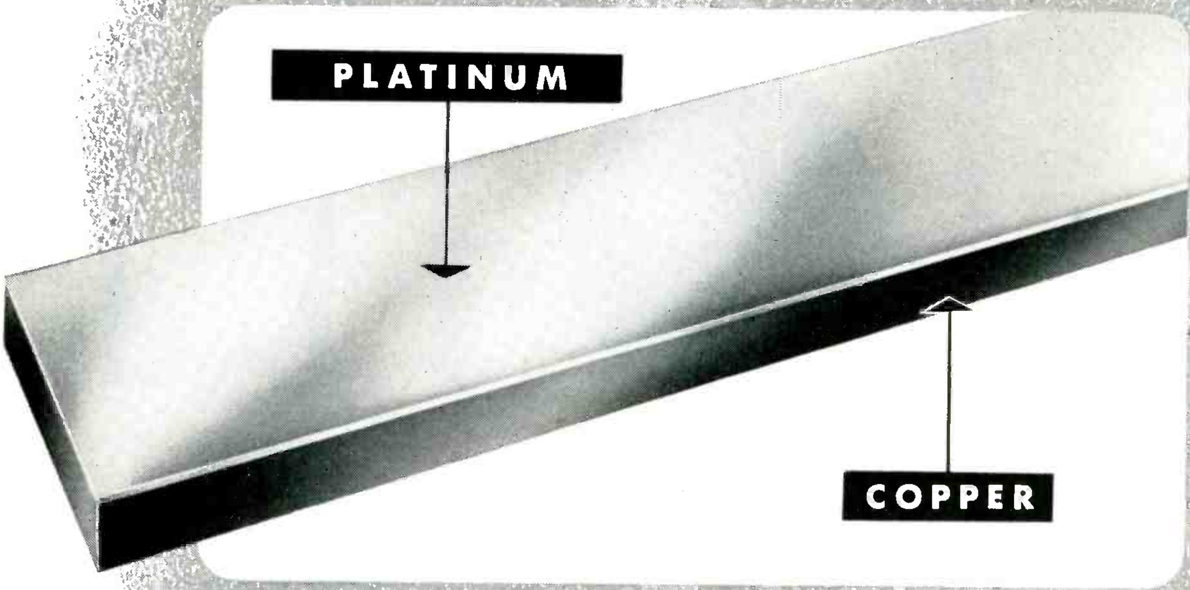

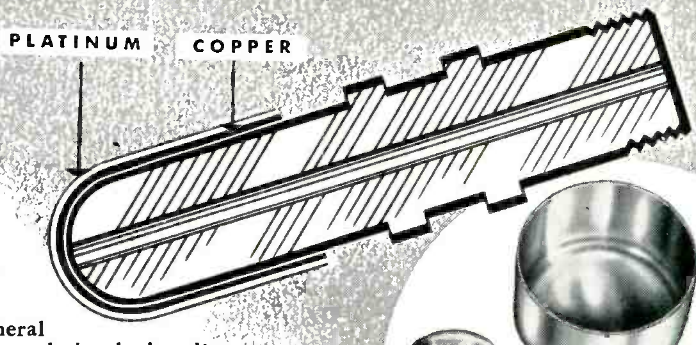

A well-known manufacturer was faced with the problem of how to cut the cost of a platinum electrode. Pure platinum was ideal but was expensive and the supply short.

The problem was presented to General Plate whose engineers quickly found a solution by bonding a thin layer of platinum to a thicker, less costly layer of copper.

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One of these two MICRO switch assemblies turns off the current when the cabinet is opened. If current is then turned on manually for checking equipment, the other switch flashes a warning light on the front of cabinet. Reclosing the door automatically resets switches.

Tom G. Banks, Jr., Gates engineer, pulls out drawer of Navy 400-watt transmitter cabinet to show location of two MICRO door interlock switches which protect operating personnel from high voltages.

Radio transmission in the Navy recognizes no climate. Equipment must be ready to "send" instantly after a splash through the surf to a humid, south sea "desert island" or a trek over the ice to an Aleutian hut.

These high voltage transmitters must be safe, too. There must be no danger to personnel from the 2500 volts if the door is opened accidentally.

These were just a few of the exacting requirements which faced engineers of the Gates Radio Company when they designed their AN/URN-5 Radio Beam Transmitter for the U. S. Navy. For a door interlock switch that would always work, under all conditions, they turned to MICRO. This switch, they told us—

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These requirements were met in every particular by the MICRO double door interlock switch; now three of these units guard each door of this Navy transmitter.

This recognition on the part of Gates engineers of MICRO precision and dependability as components of equipment which must not fail is typical of confidence industrial designers everywhere place in MICRO engineering. MICRO has, or can develop, a switch to meet YOUR most exacting problem. Field engineers are located near you to cooperate in the solution of YOUR switch problem. We invite you to call the nearest MICRO branch.

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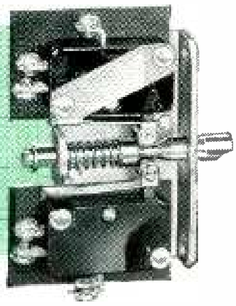

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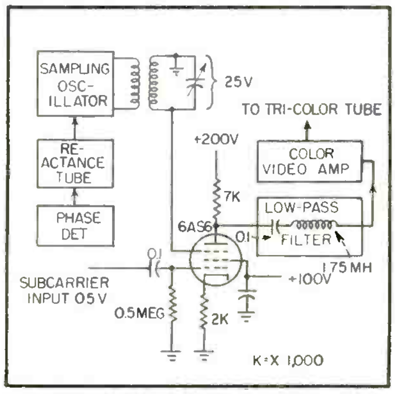

FIG. 3—Synchronous demodulator with desirable characteristics

than −10 v, every negative peak is limited.

If the input signal to G_1 is in phase with the sampling oscillator voltage on G_3, G_1 will go positive when G_3 goes positive. The transconductance of the tube increases greatly and there is heavy plate current on the positive peaks. These plate-current pulses will follow the modulation which is impressed on the wave on G_1. The response of the tube is linear to the G_1 voltage.

The detector will again ignore the quadrature component of the frequency on G_1 although this component will again produce phase shift of the plate-current pulses. This component can be recovered by applying the same signal to another synchronous detector on whose suppressor there is a frequency which is in phase with the desired signal on G_1.

If the frequency on the suppressor is not the same as the frequency of the modulated wave on the control grid, there will be a beat frequency and the usual superheterodyne mixer circuit emerges. The difference frequency will be modulated in accordance with the combined amplitudes on G_1. There will be other products of the mixing process just as in any mixer.

The difference frequency may readily pass through the low-pass filter. This suggests a method of adjusting the frequency of the sampling oscillator in a synchronous demodulator circuit. With an oscilloscope on the output of the low-pass filter and a pure unmodulated sine wave on G_1 and G_3, the frequency of one is varied. The scope will show the beat frequency. As the frequency on G_1 approaches G_3,

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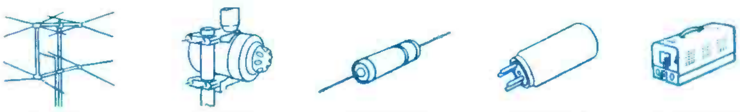

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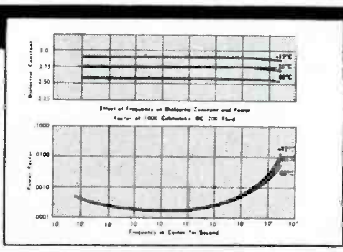

As indicated by these curves, neither frequency nor temperature changes have any pronounced effect on the power factors or dielectric constants of Dow Corning 200 Fluids. Power factor and dielectric constant of 1000 cs. fluid at −17°, 23°, and 83° C. are plotted against frequencies ranging from 10 to 10^{10} cycles per second.

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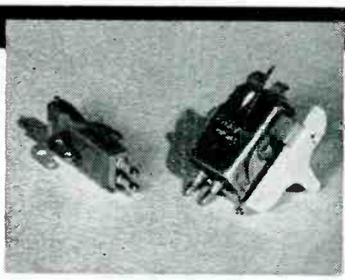

Dow Corning 4 packed in phonograph pick-up head cartridges increased crystal service life 20 times. The silicone compound prevents Rochelle Crystals from deteriorating due to absorbed moisture. It also acts as a viscous damping medium, thereby reducing excess vibration and enabling the head to handle a much higher frequency.

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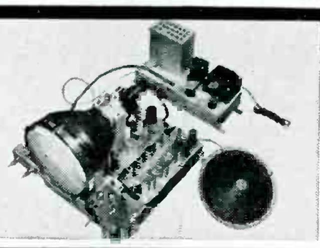
DOW CORNING 996 VARNISH dries tack-free in not more than 3 hours at 150°C. Dielectric strength measured with 2 inch electrodes on 2 mil films baked for 16 hours at 150°C. is 1000-2000 volts/mil, dry, and 500-1500 volts/mil, wet. Heat flexibility is more than 100 hours at 250°C. Cured films have good resistance to dilute acids, concentrated hydrochloric acid, and dilute or concentrated alkalies.



Flashover in high voltage television power supply coils can set ordinary organic varnish aflame. To eliminate this fire hazard, coils are impregnated with Dow Corning 996. Highly resistant to arcing, 996 provides positive protection against carbon tracking for the life of the entire set.

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Silastic combines the remarkable heat stability and moisture resistance of resinous silicones with the physical properties of rubber, including resilience, shock and abrasion resistance, and resistance to both mechanical and electrical fatigue. Its dielectric properties show little change over a wide range of frequencies, even after aging at high temperatures. The surface resistivity of Silastic is high, and its thermal conductivity is about twice as great as that of either organic rubber or resinous insulating materials.

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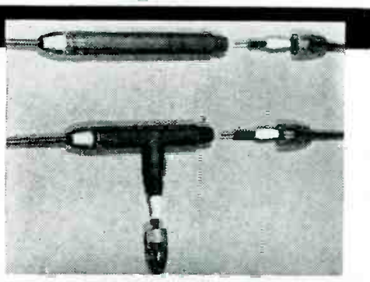

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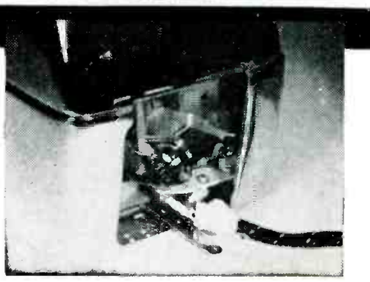
DOW CORNING THERMOSETTING RESINS are used to bond inorganic fabrics and finely divided particles such as powdered metals or mica. Typical ⅛" silicone-glass laminates have a flexural strength of 22,000 to 45,000 psi; water absorption after 24 hours of 0.25 %; dielectric strength with continuous filament cloth of 250 volts/mil or more; power factor of 0.002 at 1 mc; loss factor of 0.007 at 1 mc; wet insulation resistance of more than 10^{12} ohms; arc resistance of 300 seconds and a heat distortion value above 250°C.



For maximum dependability and long service life, silicone-glass terminal blocks and contactor bases are being used in late model automatic toasters. Tests prove that Dow Corning silicone resin bonded glass laminates are more rigid, more heat-stable, more resistant to moisture and easier to fabricate and assemble than conventional materials.

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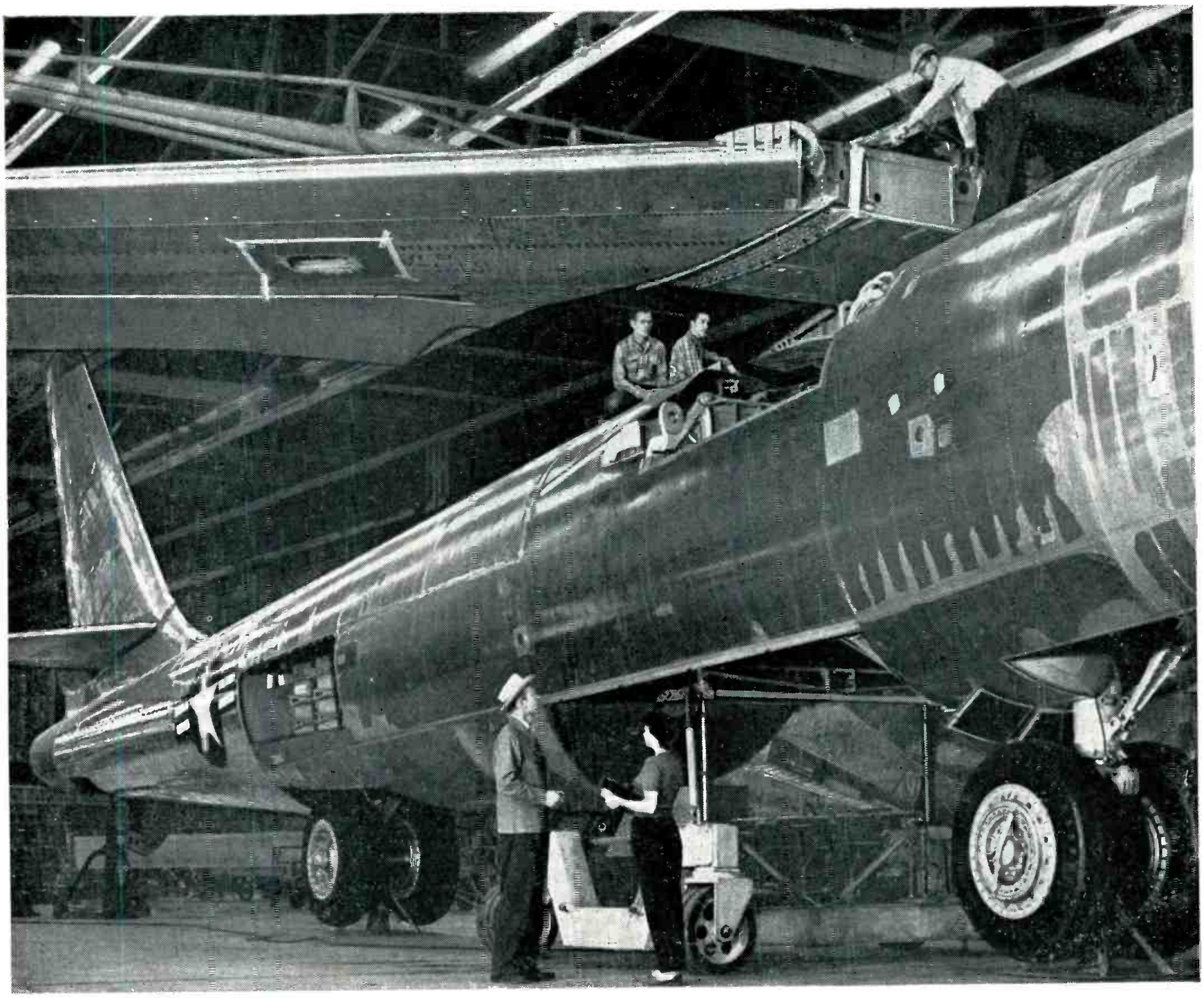

the number of cycles on the scope will become fewer and fewer until the two frequencies are the same. If the sampling oscillator has the proper lock-in circuit, the frequencies will then lock in synchronism. The scope display is then a straight line. Assuming G_1 and G_3 are in phase, if modulation is applied to the wave on G_1, the modulating wave will appear on the scope.

This type of synchronous detector functions similiarly to the mathematical process of trigonometric multiplication. After the electrons in the detector tube leave the cathode and receive modulation at G_1, they pass to the neighborhood controlled by G_3 and are again acted upon. Another viewpoint is to consider that the instantaneous voltage on G_1 determines the amount of current and the instantaneous voltage on G_3 determines the proportion of that current that goes to the plate of the tube. The first function G_1 is multiplied by the second G_3.

REFERENCES

(1) D. G. Fink, Plans For Compatible Color Television, ELECTRONICS, 24, p 90, Aug. 1951.
(2) C. J. Hirsch, W. F. Bailey and B. D. Laughlin, Principles of NTSC Compatible Color Television, ELECTRONICS, p 88, Feb. 1952.

Counter Test Circuits

BY RICHARD WEISSMAN
Senior Engineer
Cook Research Laboratories
Skokie, Illinois

TO STUDY the behavior of a ternary counter, it was found helpful to use certain auxiliary equipment. A monopulse generator proves convenient in locating faults in any complex counting operation. To obtain a single keyed pulse directly from a switch closure is extremely difficult when an identical waveform, free from raggedness and spurious transients, is desired.

Another small unit which has proved invaluable in the study of waveform transitions is the variable delayed trigger circuit for initiating the oscilloscope sweep. When it is desired to view a small detail of a recurrent waveform on a greatly expanded time scale, it is usually impossible to select the particular detail for display from the entire pattern with the regular oscilloscope controls without at least

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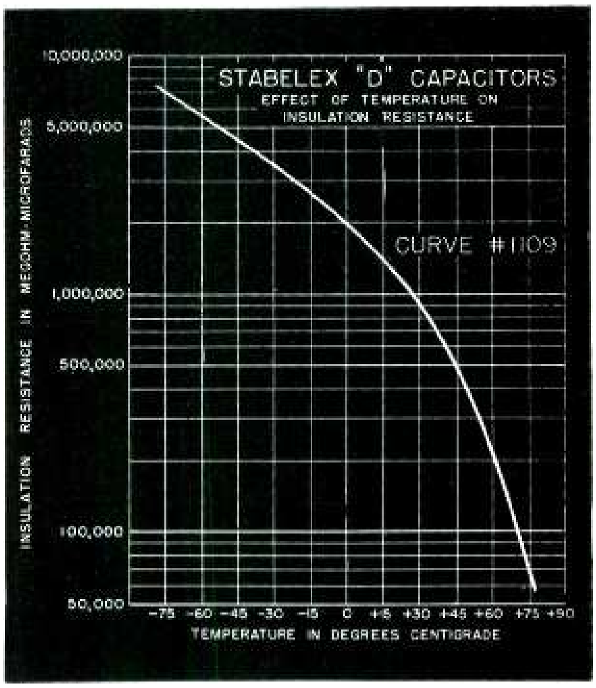
YOUR FREE INDUSTRIAL CONDENSER CORPORATION Stabelex "D" Capacitor Catalog may prove to be the most important new single piece of literature for you this year!



The unusually high insulation resistance at 20° C. in turn insures unusually high resistance at temperatures up to 75° C. The insulation resistance of these capacitors at 75° C. is approximately ten times that of commercial oil capacitors at 20° C. This is well illustrated in Curve #1109.

Performance curves illustrating various characteristics of the Stabelex "D" Capacitor will appear in this magazine each month.

OUTSTANDING FEATURES

INSULATION RESISTANCE AT 20° C. AFTER THREE MINUTES CHARGE—900,000 megohm microfarads

INSULATION RESISTANCE AT 75° C.—78,000 megohm microfarads

INSULATION RESISTANCE AT −75° C.—In excess of 5 million megohm microfarads

CHANGE IN CAPACITANCE FROM 25° C. TO −80° C; +0.76%

SELF TIME CONSTANT OF 10 MFD CAPACITOR—4800 hours

Q AT 50 KILOCYCLES—10,000

POWER FACTOR AT 1 KC—0.00025

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After a long period of research, Industrial Condenser Corporation now offers to industry for the first time the first of their family of Stabelex capacitors, stabelex "D", which has been produced for special applications for some time.

Complete information performance curves, characteristics, and suggested applications of the various types now available will be found in this catalog.

INDUSTRIAL CONDENSER CORPORATION

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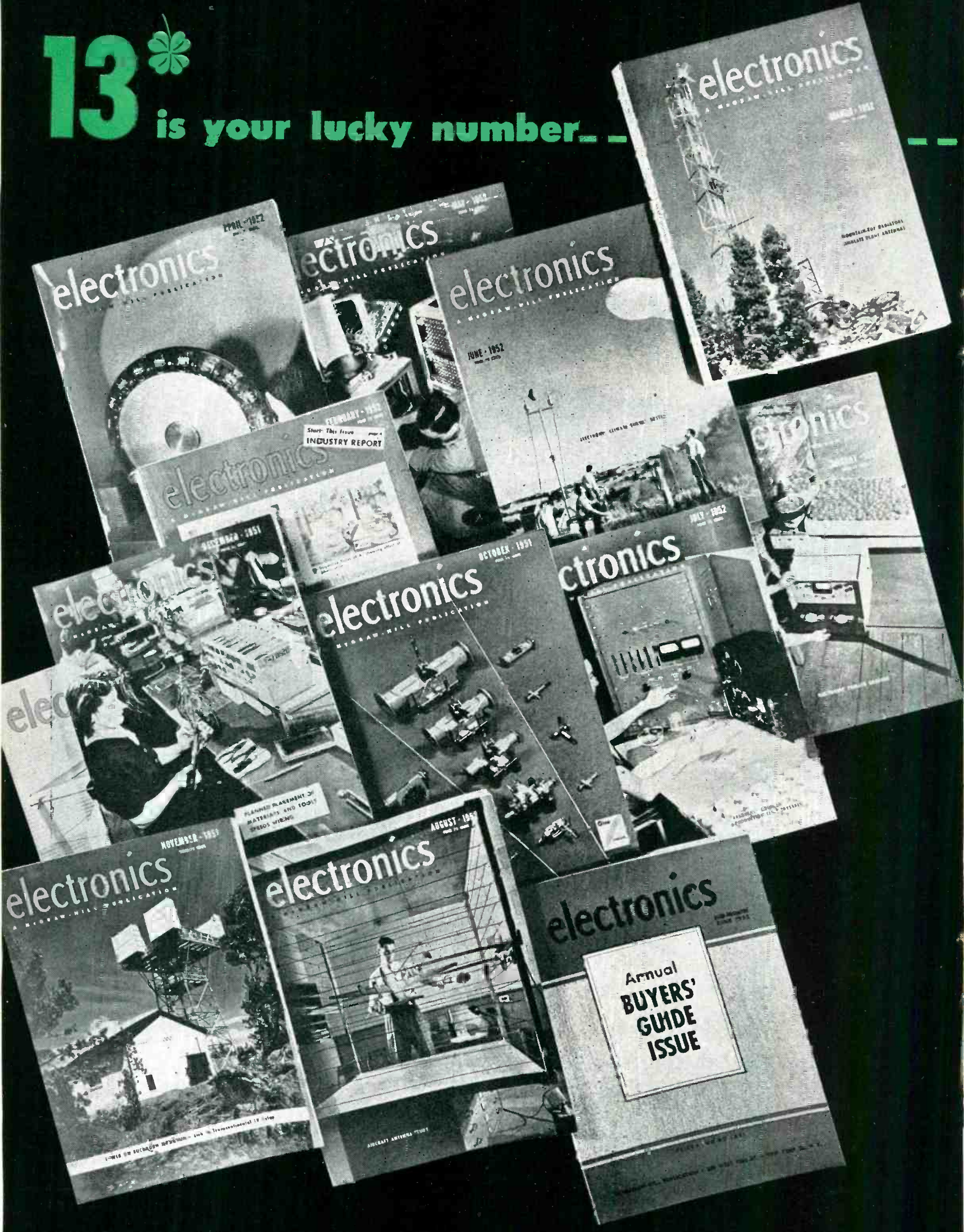


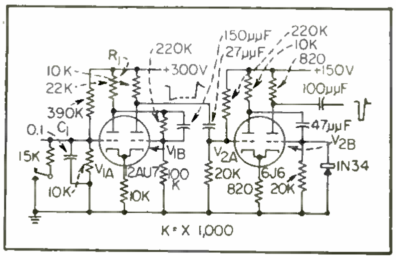


FIG. 1—Schematic diagram of the monopulse generator

destroying the sweep-speed calibration.

By initiating the sweep from an external variably delayed trigger it is easy to magnify any desired part of a waveform, such as a fast transition in a slowly recurring pattern, using any sweep speed up to the maximum capabilities of the scope without changing the calibration or linearity of the sweep.

Figure 1 shows the circuit for the monopulse generator. Triode V_{1A} is normally conducting but when the key is depressed, the grid voltage drops exponentially until the multivibrator action flips the V_{1B} plate into conduction. The differentiated negative step triggers V_2 which is a monostable trigger circuit delivering a single one-microsecond negative pulse each time it is triggered.

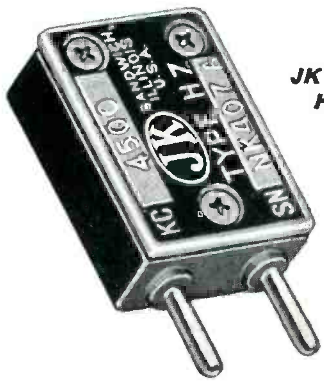
Resistor R_1 prevents free running in the V_1 multivibrator so that the key must be released before the circuit can flip back to normal. Relaxation time, controlled by C_1, is sufficient to prevent double pulsing from switching transients.

The variable sweep delay is shown in Fig. 2. A cathode-coupled monostable multivibrator is triggered by the signal at some fixed time in each cycle. When the circuit flips back to the stable condition, a positive output pulse is derived by the C_1R_1 differentiating circuit. The crystal diode prevents the initial negative multivibrator pulse from appearing at the output. The time required for the right-hand grid to relax and flip the circuit back is determined by the setting of the switch and the fine-delay potentiometer.

The sweep, triggered by the multivibrator output pulse is delayed until the occurrence of the desired portion of the signal. The multivibrator may be triggered conveniently from one of the vertical de-

JK PRODUCTS

keeping communications ON THE BEAM



JK STABILIZED H-7 CRYSTAL

CRYSTALS FOR THE CRITICAL

The H-7 crystal is in common use with two-way police radio systems. Frequency range: 3 to 20 mc. Water and dust-proof, it is pressure mounted, has stainless steel electrodes. Just one of many JK crystals made to serve EVERY crystal need!

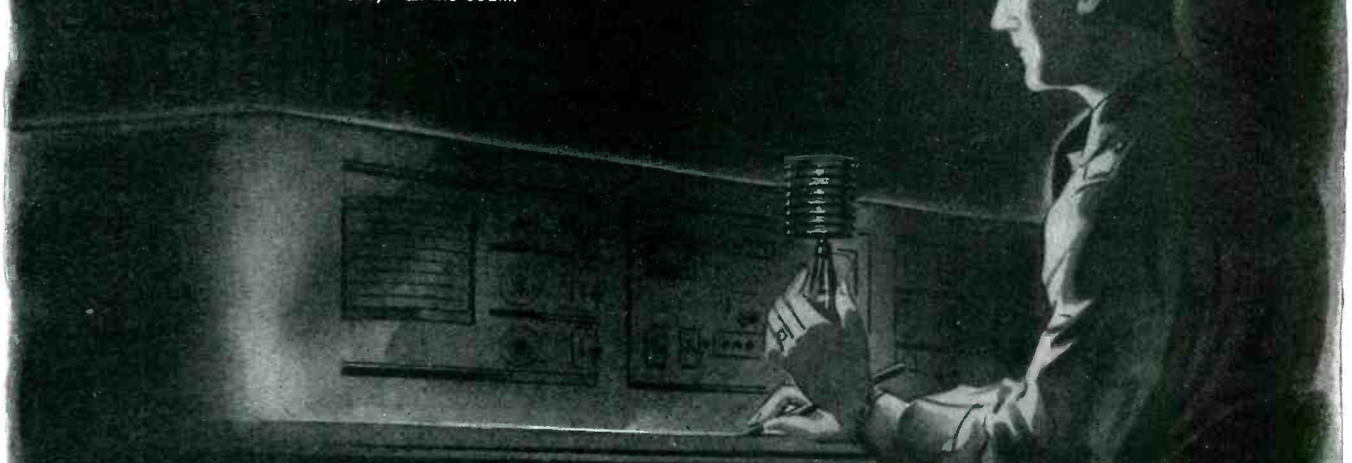
FREQUENCY & MODULATION MONITOR

the JK FD-12

Monitors any four frequencies anywhere between 25 mc and 175 mc checking both frequency deviation and amount of modulation. Keeps the "beam" on allocation; guarantees more solid coverage, too!

Time-Saver to Prowl Cars, Life-Savers to Thousands!

In a split second your police station and the farthest cruising prowl car can respond as one man! Such "safety at your doorstep" is possible only through compactly efficient two-way radio. JK crystals and monitors are in constant use to keep police radio frequencies reliably "on the beam."

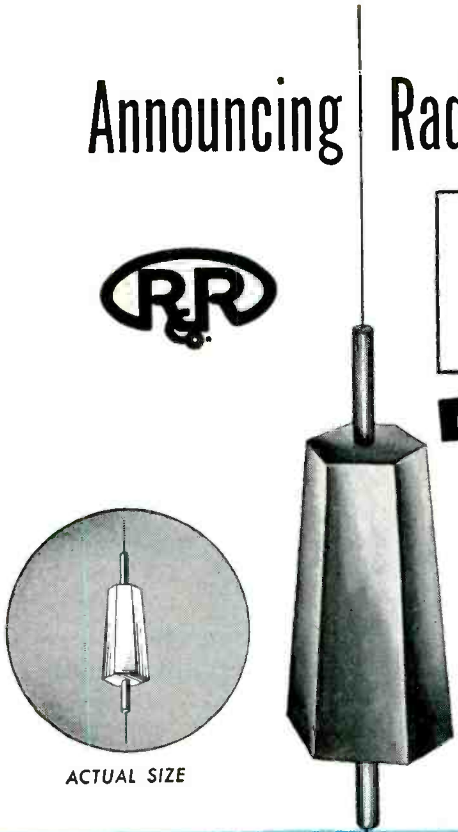


THE JAMES KNIGHTS COMPANY
SANDWICH 3, ILLINOIS

Announcing Radio Receptor's new range of

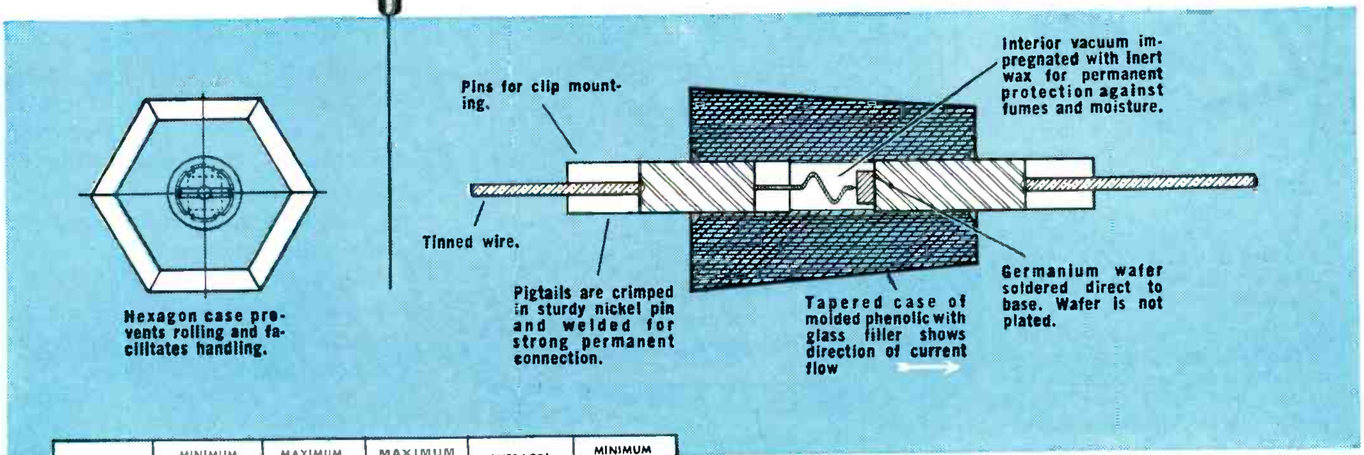
Germanium Diodes

FEATURING POLARITY AT A GLANCE!



Keynoting sound design features and simplicity in construction, the new Radio Receptor Germanium Diodes will give a maximum of trouble-free operation even under the most adverse conditions.

Normally in diodes such as these, one side of the germanium wafer is plated so that it may be soldered to the base . . . but Radio Receptor's improved production methods make it possible to *omit* plating, thus eliminating possible flaking and improving quality.



CODE NO.	MINIMUM CURRENT AT 1 VOLT FORWARD MA	MAXIMUM CURRENT AT 10 VOLTS REVERSE MA	MAXIMUM CURRENT AT 50 VOLTS REVERSE MA	AVERAGE‡ RECTIFIED CURRENT MA	MINIMUM INVERSE PEAK VOLTS
IN48	4.0	—	0.833	50	85
IN51	2.5	—	1.667	25	50
IN52	4.0	—	0.150	50	85
IN63	4.0	—	0.050	50	125
IN64	Minimum of 0.100 MA in 44 MC Test Circuit				20
IN65	2.5	—	0.200	50	85
*IN69	5.0	0.050	0.850	40	75
*IN70	3.0	0.025	0.300	30	125
IN75	2.0	—	0.050	50	125
*1N81	3.0	0.010	—	30	50

*JAN type

‡Average half wave rectified current at 60 CPS and 25° C. Consult us for ratings at other conditions.

The distinctive tapered shape of the glass-filled phenolic cartridge body indicates the direction of current flow, while the hexagon form assures ease of handling — Prevents rolling, especially when the leads are cut off to permit mounting the diode in clips.

Submit your germanium diode application problems to us . . . . We'll be glad to make recommendations without obligation!

Germanium Transistors are coming!

. . . WATCH FOR OUR ANNOUNCEMENT SOON

SELETRON & GERMANIUM DIVISION

RADIO RECEPTOR COMPANY, INC.

Since 1922 in Radio and Electronics

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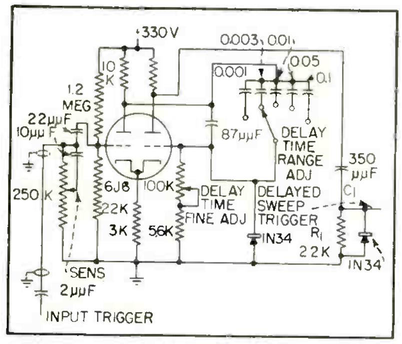

FIG. 2—Variable sweep delay circuit

flection plates of the oscilloscope through a 2-μμf capacitor to avoid loading either the scope or the circuit under test.

Remote-Controlled Broadcast Transmitter

By V. E. Hughes
Marconi's Wireless Telegraph Company Chelmsford, England

UNATTENDED remotely-controlled radio transmitters offer numerous advantages, outstanding among which are the major points of releasing personnel for important work other than at the station site and the feasibility of installing transmitters in remote places, to cover a limited area.

One pair of lines is all that is necessary to remotely control the station. Programs are sent over a pair of high-quality lines.

Compactness of the equipment is an additional advantage and the self-contained monitoring circuits automatically close down a faulty section of the installation while good sections carry on the program.

Installations of ½ to 2 kw can be made up of the units which comprise the robot transmitters shown in the photograph. Units are of 500 to 660 watts output, each unit being a complete transmitter. The units are operated singly, at reduced power, or in parallel. Each has monitor circuits which check phase difference between r-f drive input and r-f output, amplitude of the r-f drive and output, as well as the a-f input and output.

Each transmitter is enclosed in an aluminum alloy cabinet, and access is required only at the front, thus allowing the units to be placed close to a wall.

Heavy components are mounted

Phaostron presents a new concept in meters

LABORATORY TYPE INSTRUMENTS
RUGGEDIZED for FIELD SERVICE

at a realistically low price

ILLUSTRATION APPROXIMATELY ¾ SIZE

AVAILABLE IN FOUR MODELS

1000 OHMS PER VOLT DC VOLTMETER WITH 5 RANGES

0-2.5, 0-10, 0-50, 0-250, 0-1000

20,000 OHMS PER VOLT DC VOLTMETER WITH 5 RANGES

0-2.5, 0-10, 0-50, 0-250, 0-1000

AC VOLTMETER WITH 5 RANGES

0-10, 0-50, 0-150, 0-500, 0-2500

DC MICRO-MILLIAMETER WITH 5 RANGES

0-250μa, 0-1 MIL, 0-10, 0-100, 0-500

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WALTER BERGGREN & ASSOCIATES, Chicago, Ill.
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ENVIRONMENT FREE ELECTRICAL EQUIPMENT by *Phaostron*

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For *Critical* Applications

Triplett 630-A Has No Counterpart

Accuracy
to 1½%

Readability
with a Mirror-Scale

Adaptability
with ½% resistors

Try it at your distributor's

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TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON— OHIO

TWA specifies EAD

Centrifugal Blowers for their new Super Constellations

J 55-C CENTRIFUGAL BLOWER

Overall Dimensions
(3-11/16"x2-29/32"x2-15/16")

SPECIFICATIONS:

- 115 Volts
- 400 Cycles
- 7000 RPM
- Single Phase
- 1 Amperes
- 1.12 lbs. wgt.
- 13 CFM 0" Static Pressure

Meets all military specifications for corrosion resistance, fungus-proof, humidity, shock and vibration.

APPLICATIONS

- VENTILATING EQUIPMENT
- RADAR EQUIPMENT
- AMPLIFIER UNITS
- TRANSMITTERS
- OSCILLATORS

This new 60 ton giant is scheduled for TWA coast-to-coast service this fall. It is 113½ feet long . . . has a wingspread of 123 feet . . . and can carry 64 passengers at more than 300 miles per hour. It's the world's largest commercial airliner . . . utilizing the finest safety and comfort features conceivable.

Right in the heart of this giant's main electrical system TWA specified EAD's J 55-C Centrifugal Blowers, to cool the vital voltage regulators. These amazing midgets weighing only approximately 18 ounces met every rigid specification. Another outstanding example of EAD's ability to produce the finest in rotating electrical equipment.

"Choose EAD for reliability"

Solving Special Problems is Routine at E A D

If your problem involves rotating electrical equipment, bring it to EAD. Our completely staffed organization will modify one of our standard units or design and produce a special unit to meet your most exacting requirements.

EAD

Eastern Air Devices INC.

585 DEAN STREET
BROOKLYN 17, NEW YORK

in the base of the cabinets and, to facilitate removal and replacement, the location of heavy components is by spigots.

Individual chassis do not exceed 50 lbs in weight.

The drives supplied with these transmitters fulfill the requirements of the Copenhagen Plan and have a day-to-day stability of one in one million.

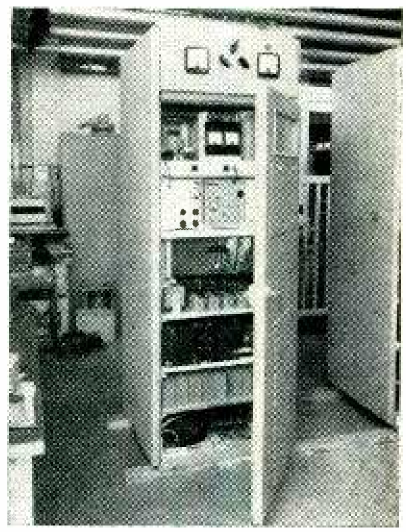
Two drives are supplied. These are mounted in a separate cabinet, which is smaller than the transmitter cabinet. This cabinet houses also the transmitter control circuits.

Should high precisions drives be required for common wave or synchronous working, these can also be supplied and used without alterations to the transmitter. Such drives have a day-to-day stability of one in 100,000,000.

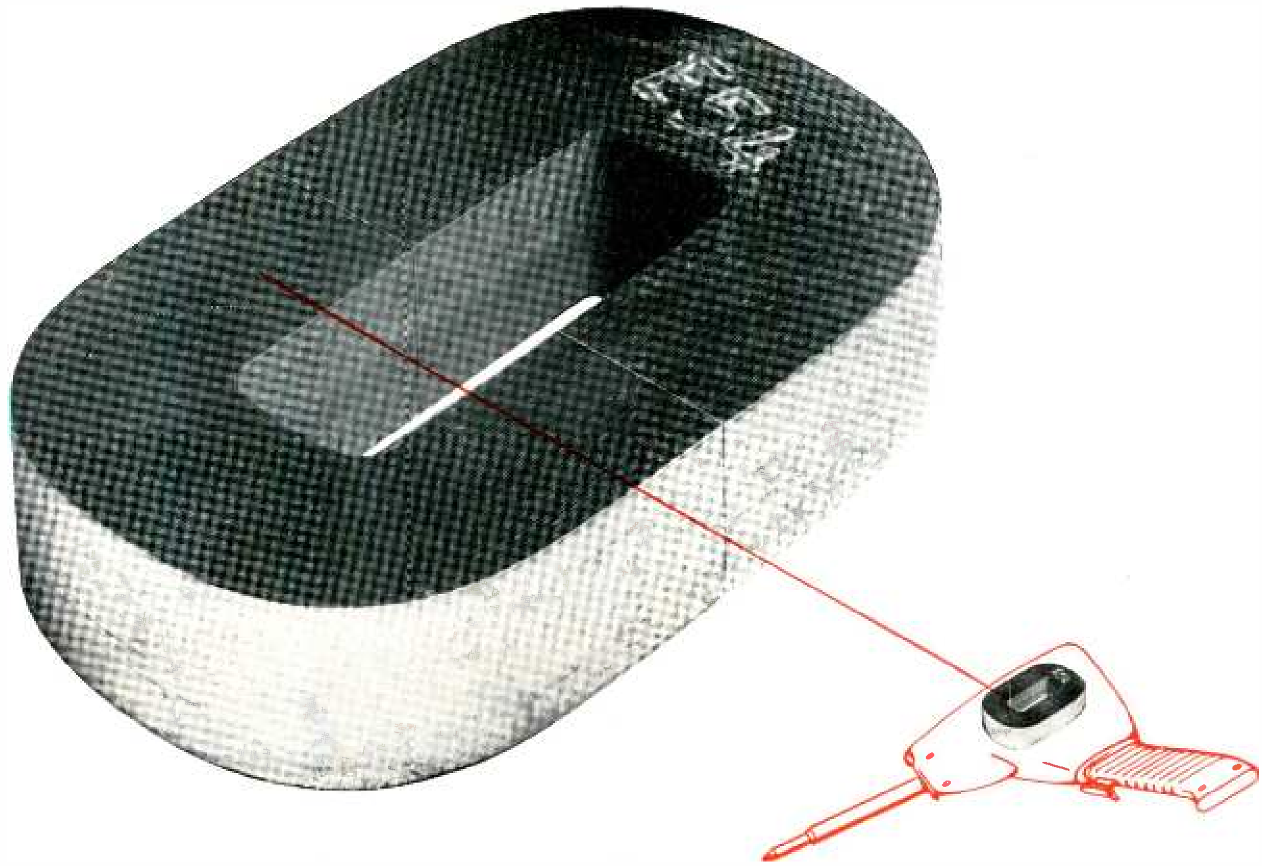
The r-f amplifier consists of two beam tetrodes in parallel and the anode circuit of this stage is tuned by an L-C circuit. The output is then R-C coupled to the grids of the modulated amplifiers.

The anode circuit of the penultimate stage of the transmitters is used for effecting phase adjustment. In this stage the anode voltage is provided by a 500-v auxiliary rectifier.

The modulated amplifier, consisting of two transmitting triodes



One of the 660-watt unattended transmitters. Top shelf, modulator and modulated amplifier; second shelf (left to right) submodulator, monitor unit, r-f amplifier; third shelf (top) contactor panel, (bottom) bias rectifier chassis. The lower three shelves contain the high-voltage rectifiers and auxiliary rectifiers



HIPERSIL CORES

help revolutionize this soldering gun!

In designing their new Versa-Tool soldering gun, Phillips Manufacturing Company wanted a power unit that would provide instantaneous heat for off-on operation, yet operate on household voltage. A transformer was needed to build adequate amperage. But it had to be small, to fit into the handle . . . lightweight, for balance . . . reasonable in cost, to insure competitive pricing of the assembled unit.

Westinghouse Type RC Hipersil Cores provided the complete answer.

Because Hipersil Cores have greater flux-carrying capacity, Phillips engineers were able to cut size and weight of the transformer, effecting considerable savings in coil as well as core costs. But, better still, because the two-piece cores simplified assembly, manufacturing costs were slashed.

Hipersil Cores can cut cost, size and weight in all types of electrical and electronic transformers. Available in a wide range of sizes and shapes for low or high-frequency applications. Greater flux-carrying capacity, compact construction, plus the savings they effect in your manufacturing costs make them the best transformer cores on the market today. For more technical information on applying Hipersil Cores to your product, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70628

YOU CAN BE SURE...IF IT'S

Westinghouse

HIPERSIL CORES

The Collins Navigation Computer *automatically* . . .

- Displays course and distance from aircraft to destination which may be an off set point where . . . *no radio facilities exist!*
- Gives continuous right-left steering information with regard to the desired course.
- Supplies continuous readings of distance to touchdown during an ILS approach.
- Greatly simplifies all in-flight navigation computations.

Soon to be available is the Collins Navigation Computer, a punched card operated electronic device which automatically furnishes all essential in-flight navigation computations. This development presents, for the first time, a foolproof automatic navigation aid to give the pilot a continuous position fix measured in miles from his destination along his chosen course.

VOR, ILS, DME, or ADF information is fed to the Navigation Computer on a pre-computed punch card provided with the equipment. Simple interpretation of the readings from only two instruments gives the pilot his position at all times.

Whether the flight plan calls for Chicago to Des Moines, or Dallas to Schenectady, the navigation for the complete flight can be pre-calculated. Armed with the appropriate punched card to activate the Navigation Computer, the pilot is confident of knowing his exact position at any point along the entire route . . . and of flying an accurate course to his final destination.

We have prepared a descriptive booklet on the Collins Navigation Computer and will be glad to mail you a copy on request. Also available are 16-mm demonstration films of the Collins Flight System.

For Electronic Advancement in Aviation, It's . . . COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 W. 42nd St., NEW YORK 36 | 1930 Hi-Line Drive, DALLAS | 2700 W. Olive Ave., BURBANK

operated at an anode voltage of 1,600 v, is modulated by two tubes of the same type operated as Class-B modulators.

A-F Stages

The line input is transformer-coupled to the low-frequency amplifier which is a preamplifier employing high slope pentodes in push-pull. Output from the preamplifier feeds two tetrodes which act as a push-pull amplifier driving the cathode followers. The a-f amplifiers and cathode-follower stages are all fed from the auxiliary rectifier.

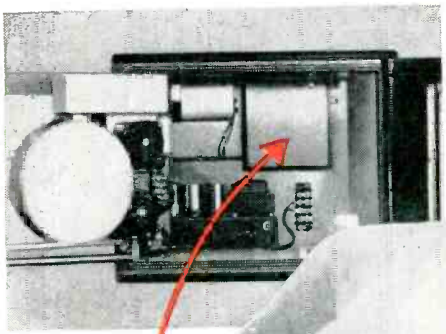
When two or three transmitters are used to give higher power, three transmitters for 2 kw, they are mounted side by side. The output feeders of each transmitter unit are paralleled and connected to a transducer, the elements of which are switched by contactors. This allows the correct matching of one, two or all transmitters. The transducer consists of an inductance, capacitors and contactors, all of which are liberally rated and carefully designed thus eliminating the need for an automatically switched spare unit.

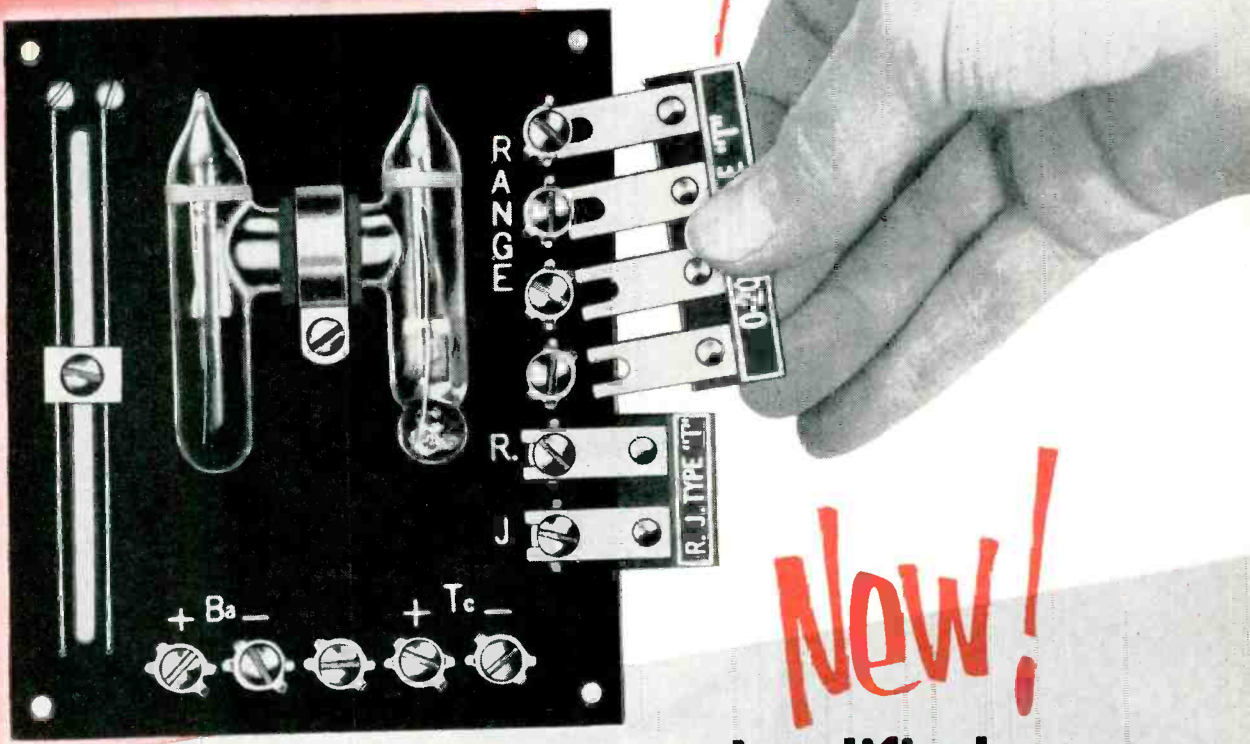
A change-over contactor is provided in the output feeder of each transmitter and is arranged to switch the transmitter output to either the transducer or a test load. Separate test loads are provided for each transmitter and this arrangement enables the transmitters to be tested independently. Facilities for automatic checking are also included.

As stated previously, each transmitter is provided with two monitoring circuits, one for the r-f chain and one for the modulator. The r-f amplitude and phase monitoring is achieved by comparing vectors derived by direct capacitive coupling from the antenna output and the r-f drive input to the transmitter. These vectors, when all is well, are applied in antiphase to the monitor and adjusted to give equal amplitude.

The resultant voltage is rectified and applied to the grid of a tube, in the anode circuit of which is a relay. The tube under normal conditions carries current and holds the relay energized. A fault con-

You change ranges this simple way





New!

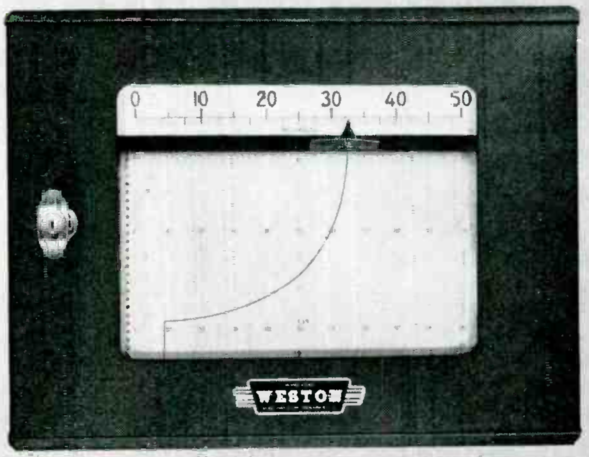
simplified...

Recording Potentiometer by WESTON

The question probably occurs to you, as it has to many other instrument users who have examined the new WESTON Recording Potentiometer, "Why haven't such improvements been offered before?"

Take range changing, just as an example. *You* make the change, simply by inserting the desired range standard, as illustrated above. Not even a soldered connection to break. No change in the universal slide-wire necessary. And reference junction compensation is changed in like manner, when changing type of sensing element.

And there are many more features, electrical and mechanical, that remove the complexities from instrument operations and maintenance. They're all found in this new WESTON Recorder. Ask us to send you all the facts . . . WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey . . . *manufacturers of Weston and Tag Instruments.*



WESTON TAG **WESTON** *Instruments* . . . INDICATE — RECORD — CONTROL

versatile

Multi-channel -- telegraph Al or telephone A3.

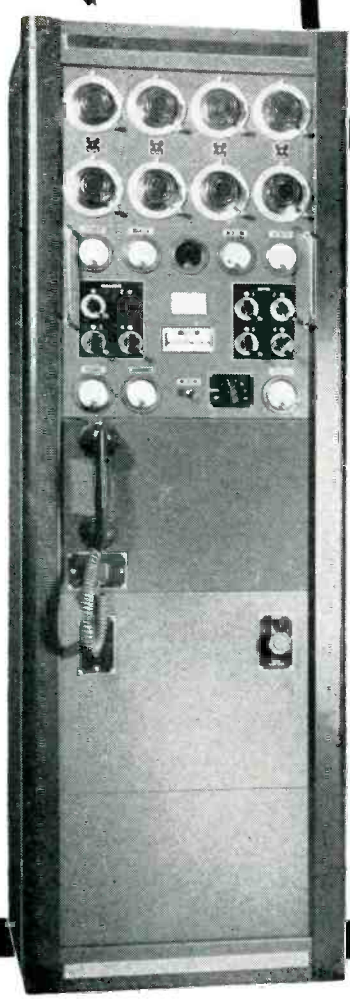
FROM GROUND TO AIR OR POINT TO POINT

STABLE

High stability (.003%) under normal operating conditions.

RUGGED

Components conservatively rated. Completely tropicalized.



Model 446 transmitter operates on 4 crystal-controlled frequencies (plus 2 closely spaced frequencies) in the band 2.5-13.5 Mcs (1.6-2.5 Mcs available). Operates on one frequency at a time; channeling time 2 seconds. Carrier power 350 watts, A1 or A3 AM. Stability .003% using CR-7 (or HC-6U) crystals. Operates in ambient 0° to + 45° C using mercury rectifiers;-35° to + 45° C using gas filled rectifiers. Power supply, 200-250 volts, 50/60 cycles, single phase. Conservatively rated, sturdily constructed. Complete technical data on request.

Here's the ideal general-purpose high-frequency transmitter! Model 446... 4-channel, 6-frequency, medium power, high stability. Suitable for point-to-point or ground-to-air communication. Can be remotely located from operating position. Co-axial fitting to accept frequency shift signals.

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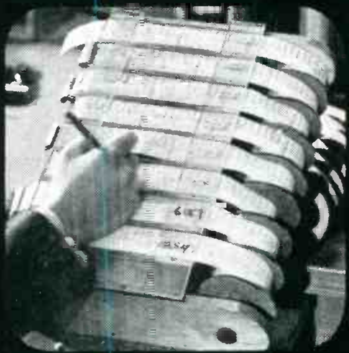
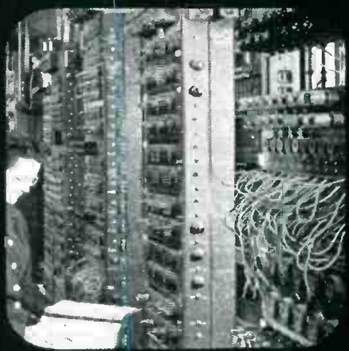
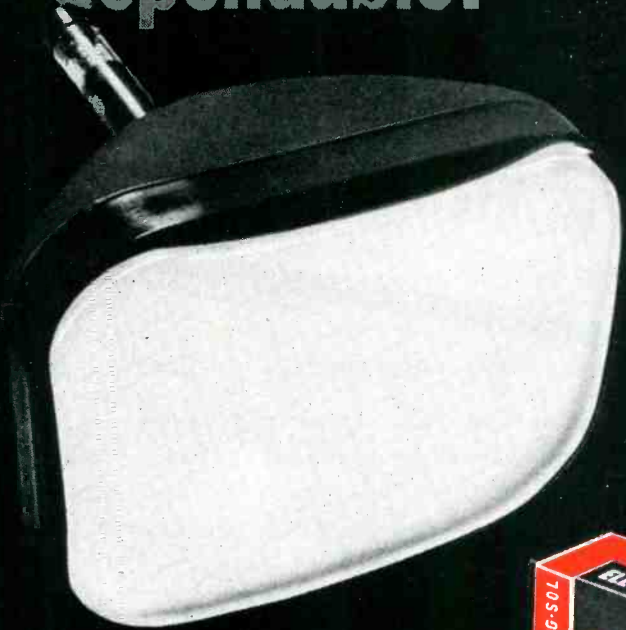


Statistical control assures uniformity of quality and performance.



Life tests prove Tung-Sol Tubes can take it.

Complete control of materials and manufacturing procedures makes Tung-Sol Tubes dependable!



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TUNG-SOL ELECTRIC INC., Newark 4, N. J.

Sales Offices: Atlanta, Chicago, Culver City, Dallas, Denver, Detroit, Newark

TUNG-SOL MAKES All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes.

dition backs the tube off and de-energizes the relay. A stage of amplification follows the drive to provide isolation and sufficient amplitude for the monitor.

To overcome the effect of modulation on the vector from the antenna output terminal, a rectified signal proportional to the incoming audio frequency is used as a variable bias on the relay tube.

The a-f monitor compares the input audio signal with the output, taken from the modulation transformer. The two signals are made equal under normal conditions and the difference is made to operate a relay when a fault condition occurs. The transmitters will then be checked by their monitors. The defective transmitter will be switched off but the good transmitters are returned to the output bus bar.

The time taken for the transmitters to switch to test load, check, and switch back to the output feeder is of the order of 5 to 10 seconds. A reasonable time delay on the operation of the monitors is in any case essential in order to avoid the transmitters switching out due to momentary over-modulation peaks.

These monitors obviate the need for overload protection on individual tubes because a fault on any tube in the transmitter will operate either of the monitors.

Low-Copper Sweep Yoke

By C. E. Torsch

Receiver Department
General Electric Company
Syracuse, New York

UNORTHODOX COIL utilization provides improved sensitivity, balance and focus uniformity. An improved high-frequency coil design minimizes a common defect in yoke performance—sweep velocity modulation.

Novel manufacturing methods were developed to yield precise coil, insulator and coil form shapes to gain performance through compactness.

Conventional yoke connections use the slightly shorter pair of yoke coils for vertical sweep. The longer coils are used for horizontal sweep, favoring the more difficult task with the more sensitive, long coils. Shape interlock of the coil ends

Miniature MULTIPLE HERMETIC Terminal Panels

The Fusite line of glass-to-steel hermetic terminals has kept pace with the trend toward miniature sizes. As interest in these small sizes continues to increase, we present herewith a complete line of both regular and plug-in types now available from Fusite. These terminals are available in several flange variations in addition to those shown. Write to Dept. (B) for engineering drawings and complete dimensions.

4-900 SERIES

1000 V (RMS)

Available in 2 to 9 turret head straight wire or looped electrodes.

4-909 THSW-2E illustrated

4-1100 SERIES

1000 V (RMS)

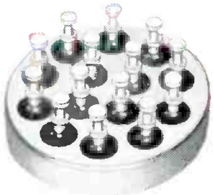
Available in 2 to 11 turret head straight wire electrodes.

4-1109 THSW-2F illustrated

4-1400 SERIES

1000 V (RMS)

Available in 2 to 14 turret head straight wire electrodes. Also available with longer center electrodes as -1.



4-1414 THSW-2-2F illustrated

4.5-1400 SERIES

1250 V (RMS)

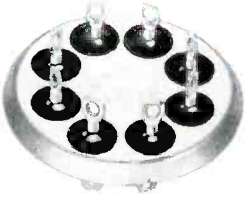
Available in 2 to 14 turret head straight wire electrodes. Also available with short center electrodes as —2.

4.5-1414 THSW-1-2H illustrated

5-900 SERIES

1500 V (RMS)

Available in 2 to 9 flattened and pierced or looped electrodes.



5-908 FP-1B illustrated

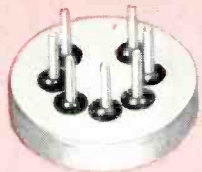
FUSITE TERMINALS PROTECT PRODUCT PERFORMANCE — ELECTRICALLY — GLASS TO METAL — HERMETICALLY SEAL

FOR PLUG-IN APPLICATIONS

4-907 PISW

1000 V (RMS)

For top side plug-in to standard 7 pin miniature socket.

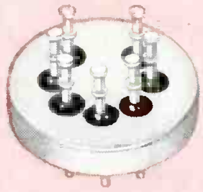


2E Flange illustrated

4-907 THPI

1000 V (RMS)

For bottom side plug-in to standard 7 pin miniature socket.



2E Flange illustrated

4-1109 PISW

1000 V (RMS)

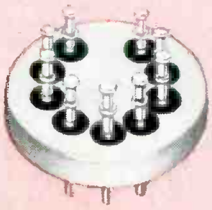
For top side plug-in to standard 9 pin miniature socket.

2F Flange illustrated

4-1109 THPI

1000 V (RMS)

For bottom side plug-in to standard 9 pin miniature socket.

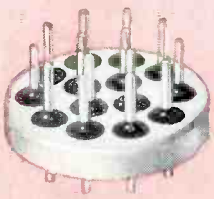


2F Flange illustrated

4-1414 PISW

1000 V (RMS)

For top side plug-in to standard 14 pin miniature socket.



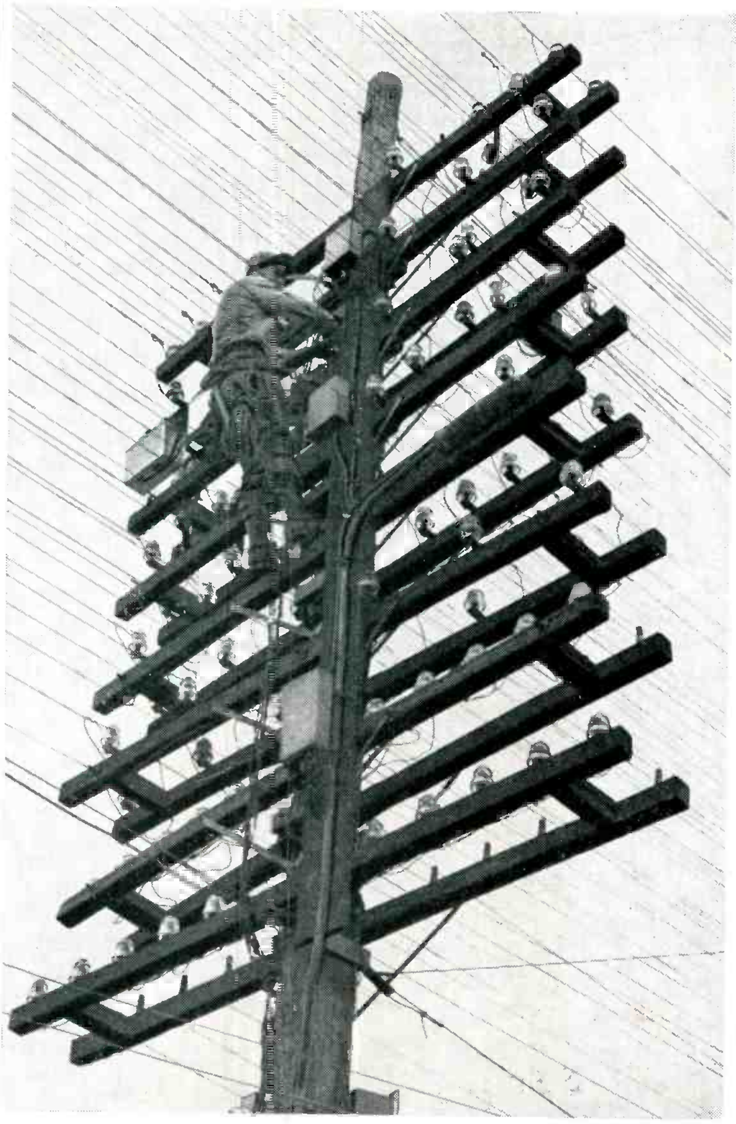
2F Flange illustrated

THE FUSITE CORPORATION

6028 FERNVIEW AVENUE - CINCINNATI 13, OHIO

Same wires—many more voices

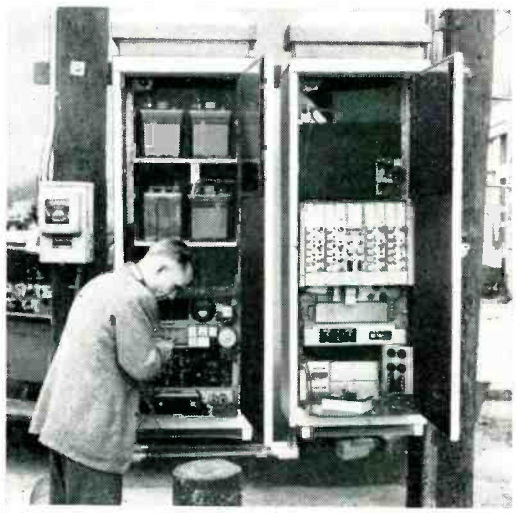
Connecting new multi-voice system to open-wire lines, near Albany, Georgia. With new system, 150,000 miles of short open-wire telephone lines can be made to carry up to 16 simultaneous messages economically.



Much of your Long Distance telephone system works through cable but open-wire lines are still the most economical in many places. Thousands of these circuits are so short that little would be saved by using elaborate carrier telephone systems which are better suited for long-haul routes. But a new carrier system . . . the Type O designed especially for short hauls . . . is changing the picture. It is economical on lines as short as 15 miles. With Type O thousands of lines will carry as many as 16 conversations apiece.

Type O is a happy combination of many elements, some new, some used in new ways. As a result, terminal equipment takes up one-eighth as much space as before. Little service work is required on location; entire apparatus units can be removed and replaced as easily as vacuum tubes.

Moreover, the new carrier system saves copper by multiplying the usefulness of existing lines. For telephone users it means more service . . . while the cost stays low.



Repeater equipment is mounted at base of pole in cabinet at right, in easy-to-service position. Left-hand cabinet houses emergency power supply. System employs twin-channel technique, transmitting two channels on a single carrier by using upper and lower sidebands. A single oscillator serves two channels.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields

AMERICAN TELEPHONE & TELEGRAPH CO. BELL SYSTEM AND ASSOCIATED COMPANIES

Stokes is FIRST in vacuum

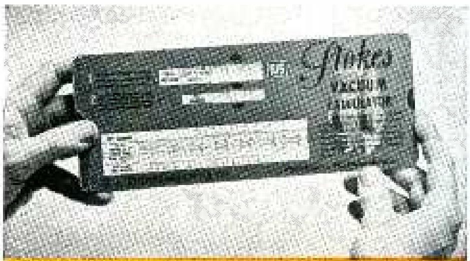
For many manufacturers in the high vacuum field the gap between the laboratory and the successful process has been a costly step . . . wasteful of time and money.

To vacuum engineering problems Stokes brings a wealth of experience in the design and manufacture, the installation and operation, of practical high vacuum equipment.

Stokes is the only manufacturer to design and make every element of its high vacuum equipment. Integrated design, centralized manufacturing responsibility and unparalleled experience are the unique extra value in Stokes High Vacuum equipment.

Stokes Vacuum Engineering steers a practical course through such design considerations as fluid flow, the effect of temperature and vacuum on structural elements, the selection of condensing surfaces, the introduction of mechanical motions to the vacuum chamber, and the operation of electrical equipment under high vacuum. The skilled application of these and other design factors is necessary for the successful use of high vacuum in metal coating and emission equipment, and in the production of zirconium, hafnium, titanium, magnesium and many other products.

Send for new Vacuum Calculator for rapid slide-rule calculations. Includes standard ABCD log scale. Also send for catalog 700, "Stokes Microvac Pumps for High Vacuum" with copious reference material.



Stokes vacuum equipment includes Microvac pumps, diffusion pumps, booster pumps, vacuum gages, vacuum furnaces and equipment for vacuum drying, vacuum freeze-drying, vacuum impregnation, vacuum evaporation and vacuum distillation.

STOKES

F. J. STOKES MACHINE COMPANY, 5547 TABOR ROAD, PHILADELPHIA 20, PA.

considerably lengthened the short coils relative to popular 70-deg yoke designs. The long nylon coil form developed for a 52-deg yoke was adequate for 70-deg coils with nested ends allowing the effective deflection center to move forward on the picture tube neck.

Benefits of reduction in core-enclosed air-path reluctance (relative to conventional yokes) were not appreciated until excessive horizontal sweep sensitivity, relative to the byproduct of anode supply voltage with a single diode rectifier was noted. Reconnection of the yoke coils to reduce horizontal sweep sensitivity by using the shorter coils for horizontal produced three benefits: favorable energy storage to balance high voltage derivation with sweep for single diode rectifier systems, increased vertical sweep sensitivity and substantial improvement in focus uniformity due to field astigmatism compensation by 90-deg rotation of the yoke assembly.

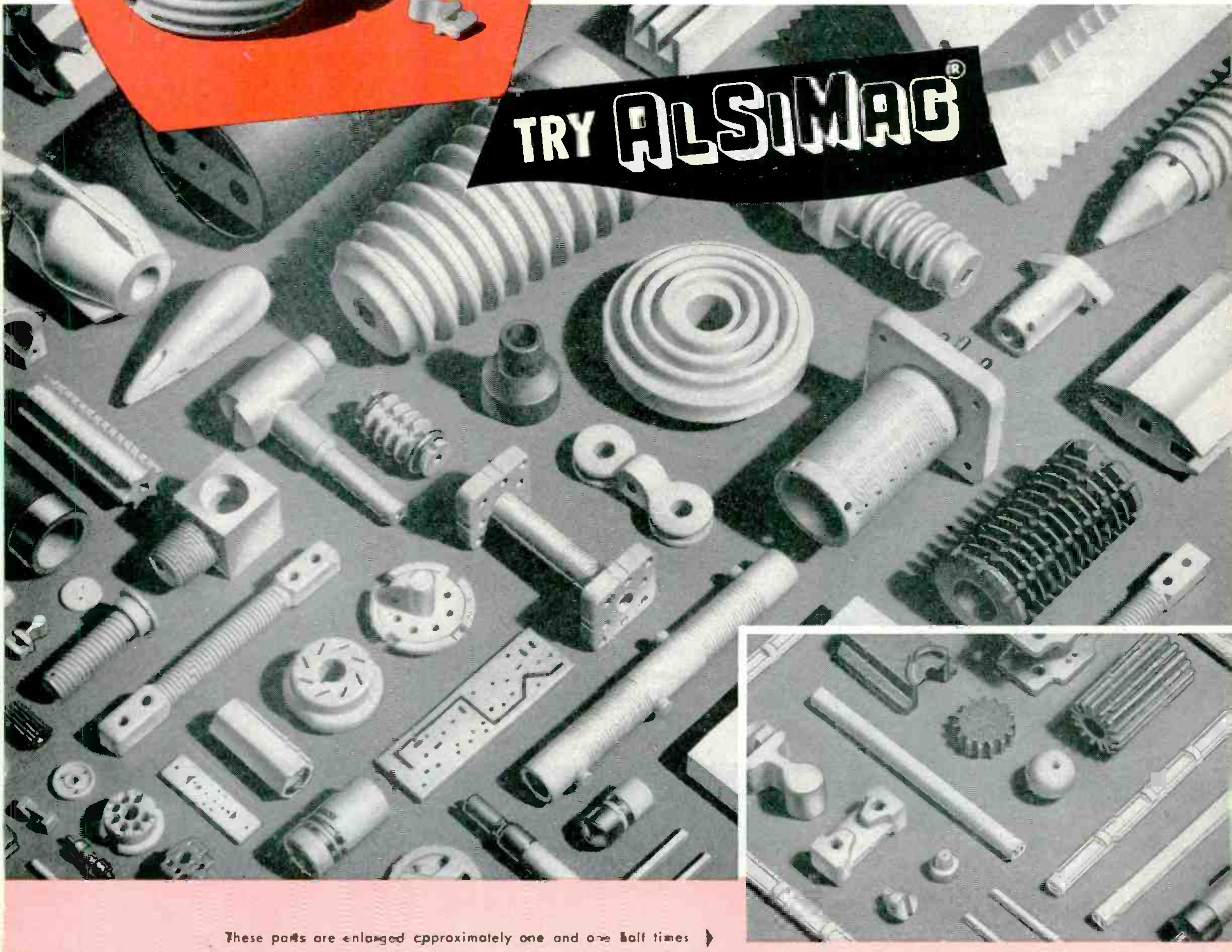
Yoke Field Analysis

Yoke field analysis with a small probe-coil disclosed that the edge fields of conventionally wound coils were not fully in phase with the field at that instant at the yoke axis, following the retrace transient. This led to modulation of beam sweep and to objectional vertical bands of brightness modulation in most commercial television equipment.

Since this discovery, a fundamental cure has been evolved and successfully manufactured. The transient response of both units of each high-frequency coil pair has been equalized to minimize circulating harmonic currents superimposed on the desired sawtooth wave. This eliminates field-intensity modulation at the coil edges and avoids velocity modulation of the cathode-ray sweep.

Elimination of the usual balancing capacitor is now practical by winding such self-balanced coils to high impedance, of relatively fine wire (No. 35 or 36) and connecting such coils in parallel. Less than half of the copper usually needed for 70-deg yokes is shown to produce even improved performance and fully comparable focus in the reproduced picture.

HAVE YOU AN *"impossible" requirement* FOR TECHNICAL CERAMICS?



These parts are enlarged approximately one and one half times ▶

Many people are kind enough to say we're the first to try for any "impossible" technical ceramic. It's probably true that we've made more different sizes, types and shapes than anybody.

Through cooperation, and a little give and take on both sides, we've been able to make a lot of "impossible" ceramics. If you have an "impossible" requirement, let us know. We might be able to work it out with you. Anyway, we'd be caught trying.

We don't make a thing but technical ceramics. We've been doing it for over fifty years. It might pay you to give us first crack at anything in technical ceramics.

P. S. A couple of new plants in production now! On most things we can give you pretty fast deliveries.

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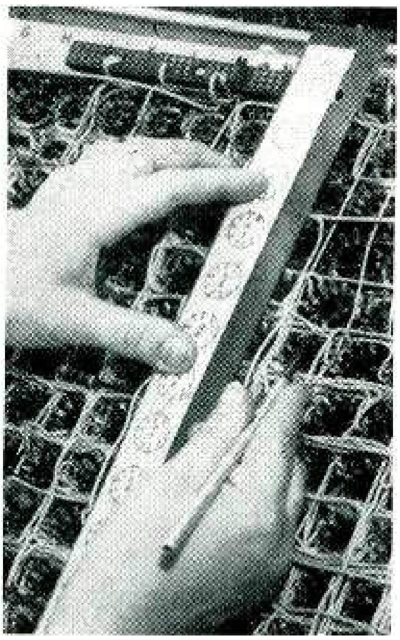
LOS ANGELES, 5603 North Huntington Drive, Capitol 1-9114 • CHICAGO, 228 North LaSalle St., Central 6-1721 • ST. LOUIS, 1123 Washington Ave., Garfield 4959

Production Techniques

Edited by JOHN MARKUS

OTHER DEPARTMENTS featured in this issue:

Connection-Checking Card



Use of checking card and probe for inspection of socket wiring

TO SPEED the checking of socket connections on an electronic calculator having over 200 tubes, a separate checking card is used for each vertical row of eleven sockets. Each card is made of heavy fiber on which is cemented a paper strip with checking data. The wires that should go to each terminal are drawn in their correct colors on the card, so that the operator can compare colors for an entire socket almost at a glance.

The checking card is held in position with the left hand, and a probing tool in the right hand is used for wiggling suspicious joints or dressing wires. The probing tool also has psychological value in improving the accuracy of inspection.

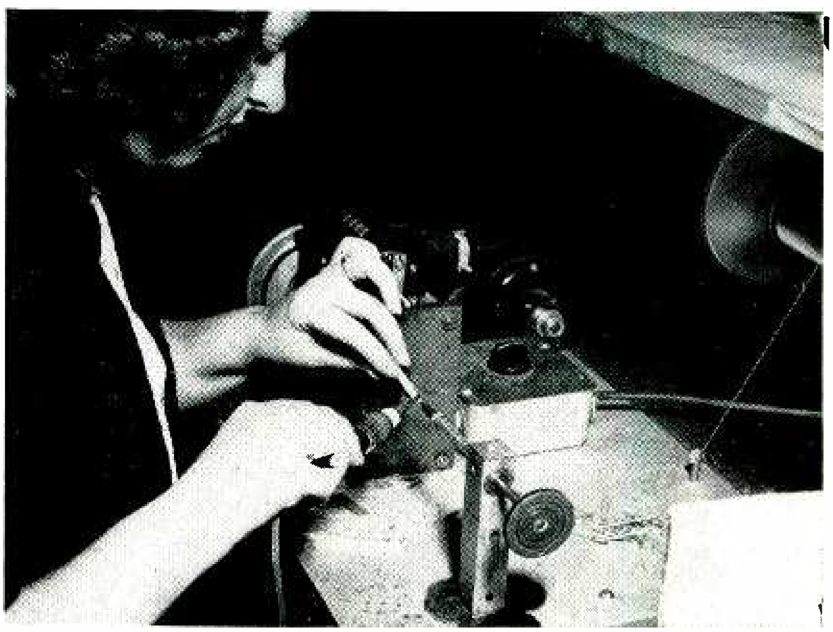
Checking cards are identified by letters corresponding to those imprinted on the chassis of the calculator. The technique has greatly improved the efficiency of a tedious inspection operation in the Poughkeepsie, N. Y. plant of International Business Machines Corp.

Coil-Winding Setup

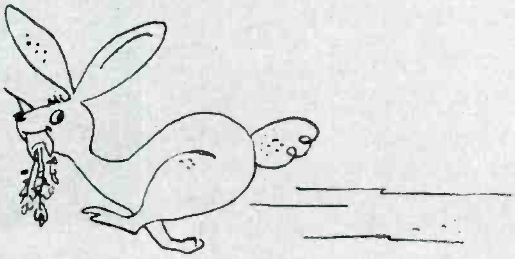
THE low-cost improvised winder for r-f grid coils, shown here, was developed by production engineers of DuMont's East Paterson, N. J. plant. A belt-and-pulley drive is used in combination with rheostat control of a fractional-horsepower electric motor to provide the desired headstock speed for the winding lathe. The spring-loaded tailstock slides and turns freely in a ball-bearing mount. Starting and stopping is by means of a foot-pedal switch. A counter on top of the headstock indicates total turns at a glance, and is crank-reset to zero after completion of each coil.

Ends of coils are fastened securely in place by applying beeswax with a pencil-type soldering iron.

Except for the reel of wire, the



Improvised setup for winding r-f grid coils, showing how wax is melted over end of coil with small soldering iron to anchor the lead



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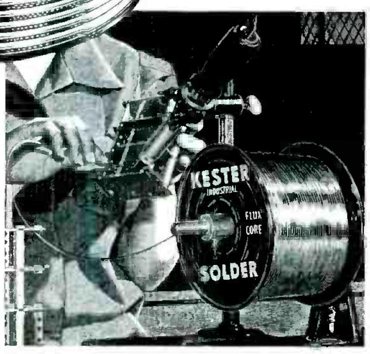

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entire assembly is mounted on a heavy steel plate, to maintain alignment of parts while retaining portability. A small aluminum dial-cord pulley mounted on a metal stud guides the wire from the reel to the coil.

Continuity Tests

A POWER supply chassis with indicator lamps is used to check the continuity of all four coils in a television receiver deflection yoke in one simple operation in the Television Receiver Division of Allen B. DuMont Labs., Inc., East Paterson, N. J. A different chassis-mounted test set is provided for each type of yoke.

Units ready for test are slid down a metal trough that rests on top of the bench. Units which pass the test are given another push down the trough to the next position.

Plugging deflection yoke unit into test set socket, cable for which runs under metal pass-along trough on bench

Testing merely involves plugging the deflection yoke cable into a socket that comes out of the test set and making one alligator-clip connection to the metal yoke frame.

Pliofilm Bags Protect Finished Subassemblies

IN THE military electronic production department of IBM's Poughkeepsie, N. Y. plant, completed subassemblies for electronic equipment are placed in pliofilm bags to keep out dirt and prevent scratching of finished surfaces. A large assortment of bag sizes is maintained in stock for this purpose.

Larger covers made to particular shapes are used to protect finished commercial products during actual shipping. These are so designed that they can be used by the customer later as a dust cover.

Low Stools on Casters For On-Floor Assembly Work

INEXPENSIVE shop-made stools eliminate the need for kneeling or crouching on the floor during final assembly and testing of the large racks of electronic equipment used in the type 604 IBM electronic calculator.

One type of stool is essentially a wood box with four casters on the bottom and a leatherette cushion on top. A small drawer fitted into the box provides convenient storage for pliers, screwdrivers and other needed hand tools.

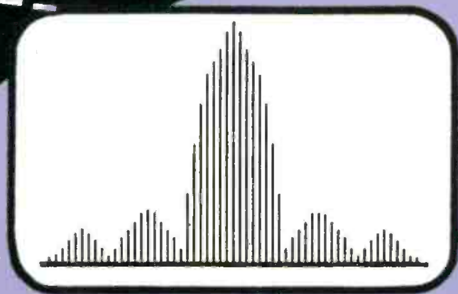
Another type has a back rest, supported by bent pipe attached to the base of the stool. The back rest may be removed when not wanted. Projecting parts of the pipe are taped to prevent them from scratching the finished cabinet of the

Rolling stools developed for work on rack-mounted equipment

The FIRST and still the only all-band direct reading SPECTRUM ANALYZER

10 MCS TO 21,000 MCS

Polarad's Model LSA Spectrum Analyzer is the result of years of research and development. It provides a simple and direct means of rapid and accurate measurement and spectral display of an r.f. signal.



Outstanding Features:

- Continuous tuning.
- One tuning control.
- 5 KC bandwidth on final i. f.
- 250 KC to 25 MCS display at all frequencies.
- Tuning dial frequency accuracy 1%.
- No Klystron modes to set.
- Broadband attenuators supplied with equipment from 1 to 12 KMC.
- Frequency marker for measuring frequency differences 0-25 MCS.
- Only four tuning units required to cover entire range.
- Microwave components used latest design non-contacting shorts for long mechanical life.
- Maximum frequency coverage per dollar invested.
- 5 inch CRT display.

Where Used:

Polarad's Model LSA Spectrum Analyzer is a laboratory instrument used to provide a visual indication of the frequency of distribution of energy in an r.f. signal in the range 10 to 21,000 MCS.

Other uses are:

1. Observe and measure sidebands associated with amplitude and frequency modulated signals.
2. Determine the presence and accurately measure the frequency of radio and/or radar signals.
3. Check the spectrum of magnetron oscillators.
4. Measures noise spectra.
5. Check and observe tracking of r.f. components of a radar system.
6. Check two r.f. signals differing by a small frequency separation.

Write for Complete Details

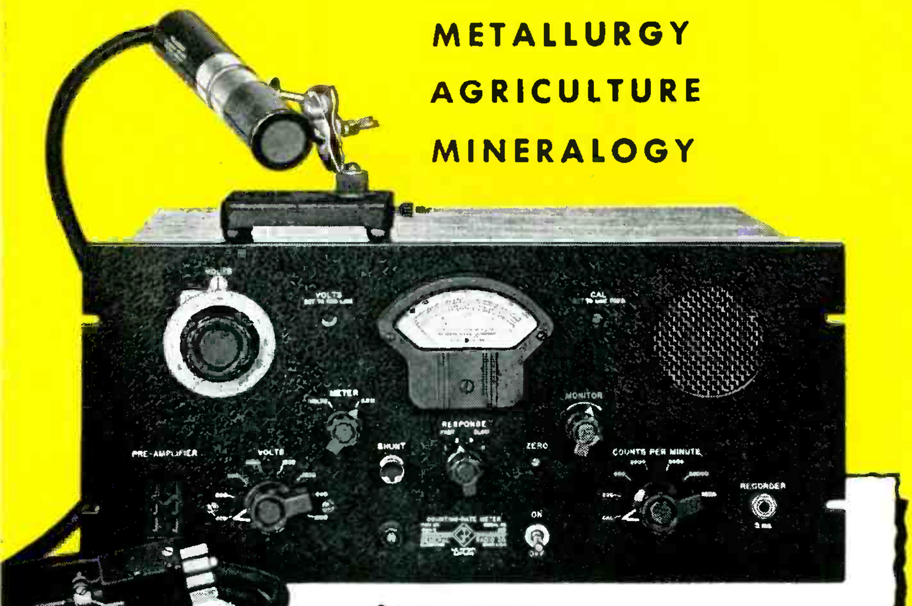
The instrument consists of the following units:

Model LTU — 1 R.F. Tuning Unit — 10 to 1000 MCS.
Model LTU — 2 R.F. Tuning Unit — 940 to 4500 MCS.
Model LTU — 3 R.F. Tuning Unit — 4460 to 16,520 MCS.
Model LTU — 4 R.F. Tuning Unit — 15,000 to 21,000 MCS.
Model LDU — 1 Spectrum Display Unit.
Model LPU — 1 Power Unit.
Model LKU — 1 Klystron Power Unit.

Polarad Electronics Corporation

100 METROPOLITAN AVE.
BROOKLYN 11, N. Y.

Manufacturers of broadband microwave laboratory instruments.



equipment. All other parts that might bump a cabinet are wood or leatherette, and hence are not likely to scratch. These stools were developed at International Business Machines Corp.

Candle Flame Singes Whiskers on Wire

WHEN hard, tough fibres of woven insulation on wires are not completely cut by automatic stripping machines, workers at the Poughkeepsie electronic plant of International Business Machines Corp. use

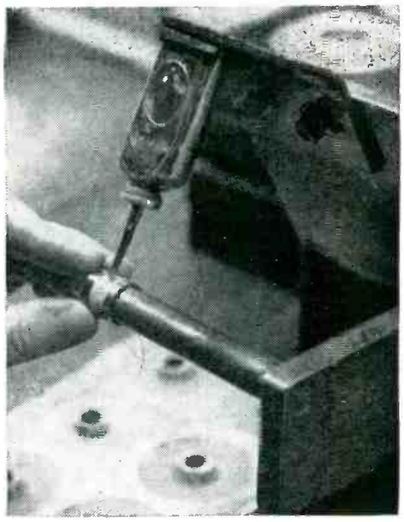
Flame of candle burns off dangling strands of insulation

an ordinary candle to burn off the whiskers of cotton that remain. This prevents the insulating strands from impairing continuity of soldered joints. Burning proved much faster than the former practice of cutting with scissors.

Oil Can Applies Cement to Voice Coil

A SMALL oil can mounted upside down on a cement-applying fixture is used in Crosley's Cincinnati plant to apply a band of loudspeaker cement around a voice coil during the operation of assembling the voice coil and spider.

The voice coil is pushed on an arbor to a turned stop, then rotated under the spout of the oil can. Dur-



Method of mounting small oil can to apply cement in uniform-width band as voice coil is rotated on arbor of fixture

ing normal steady production the cement flows freely without being started. When starting up after lunch, a few squeezes on the side of the can clear the clogged spout.

Overhead Coat Hangers

DEAD space near the ceiling in production areas is used for hanging coats in the Cincinnati plant of the Crosley Division, Avco Mfg. Corp. This unique practice eliminates the

Crosley employee demonstrates how a coat is brought down from the ceiling

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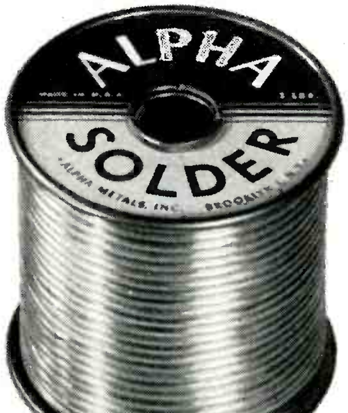
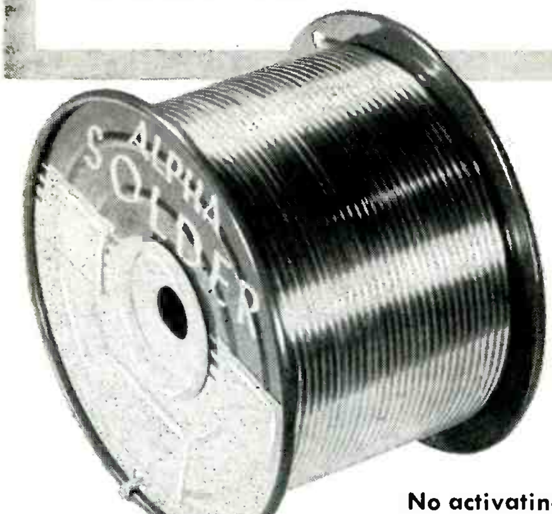
FOREMOST IN QUALITY

ALPHA SOLDER

for everything electronic

CEN-TRI-CORE *ENERGIZED* ROSIN-FILLED SOLDER





Guaranteed non-corrosive for radio, television, electronic and other electrical applications. No other solder works faster or easier . . . It provides greater fluxing uniformity and stronger smoother joints.

No activating chlorides or other chemical agents tending to produce acid conditions, toxic or sticky vapors, or latent corrosion.

Ideal where plated and/or oxidized parts must be soldered. Designed for use where faster fluxing is desirable.

CEN-TRI-CORE's exclusive design guarantees rosin throughout the complete length of the wire. Eliminates rejects commonly encountered in the use of ordinary rosin core solders. CEN-TRI-CORE is faster fluxing: thinner walls between solder and rosin assure faster penetration of heat to the flux — requires less heat and guarantees maximum fluxing action of the rosin.

CEN-TRI-CORE
PLASTIC
ROSIN-FILLED
SOLDER

For those applications where a conventional rosin flux is required. For telephone and other critical soldering operations.

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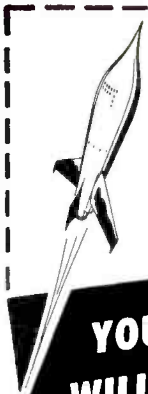

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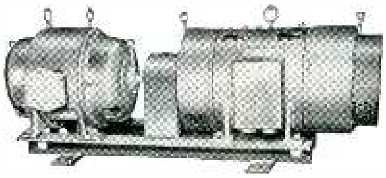

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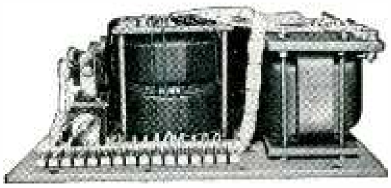

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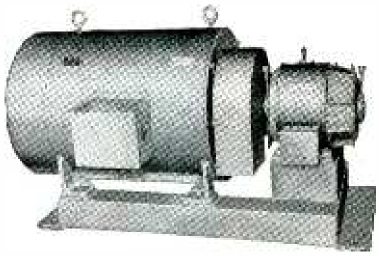
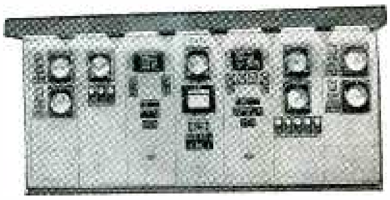


PANELS FOR AUTOMATIC PROCESS CONTROL



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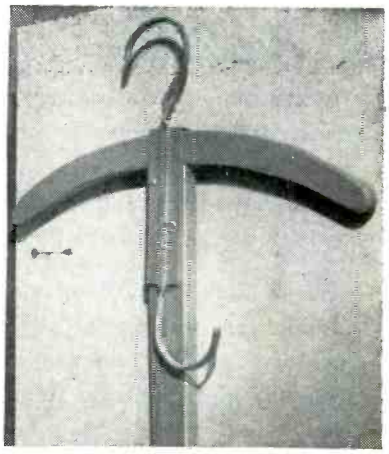


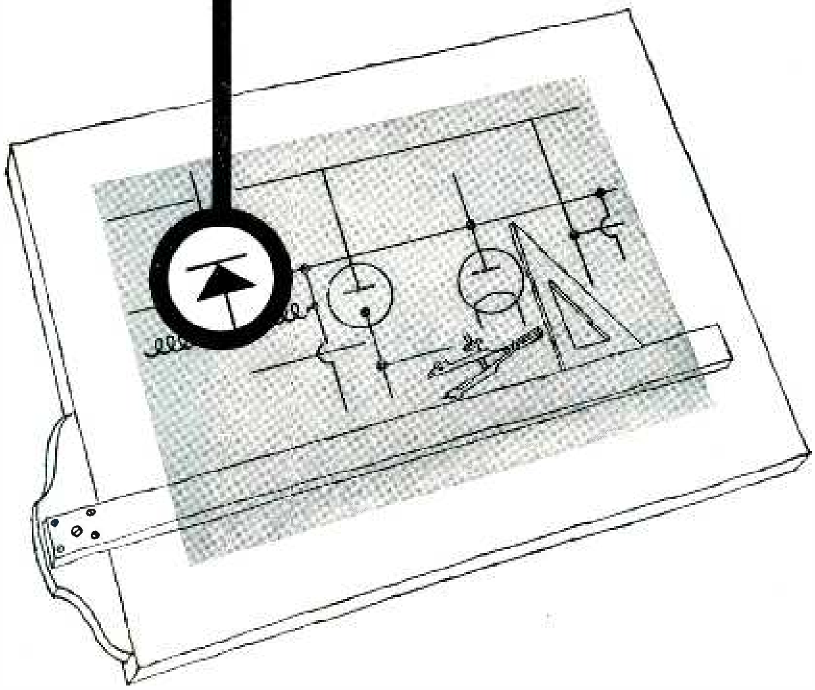
Closeup of overhead coat hanger, showing construction details. The double-hook piece is spot-welded to the U-shaped sheet metal brace

need for space-consuming locker rooms and in no way hinders use of floor space under the coats.

Overhead storage is made possible by a Crosley-designed long-handled hanger that hooks over a two-inch pipe suspended from the ceiling. The handle and the conventional curved crosspiece are of wood, fastened together by stove bolts and a U-shaped piece of sheet metal. The hook, made from $\frac{1}{8}$ by $\frac{3}{8}$-inch soft iron, is spot-welded to the sheet metal. An additional hook

New chair for assembly-line workers, showing compartment for storage of personal property

Bradley will do the engineering for you on rectifier specifications



We have selfish reasons for making this offer. Experience has shown that we save time in our own engineering, give the customers a better rectifier and more often than not deliver the production item at a lower cost than expected. We know that customers so served come back again and again.

Why not make sure that your rectifier specifications are the stiffest you can set for the intended application and for the price per unit you wish to pay. You can be sure by letting Bradley handle your rectifier requirements — the tough ones especially — from the very start. Simply tell us what your application needs are and we will draw up the specifications.

You will not only save valuable engineering time, but you will get the right rectifier more promptly and in all probability at less cost. In addition, our exclusive vacuum manufacturing process assures production rectifiers that are true to rating, built precisely to specifications.

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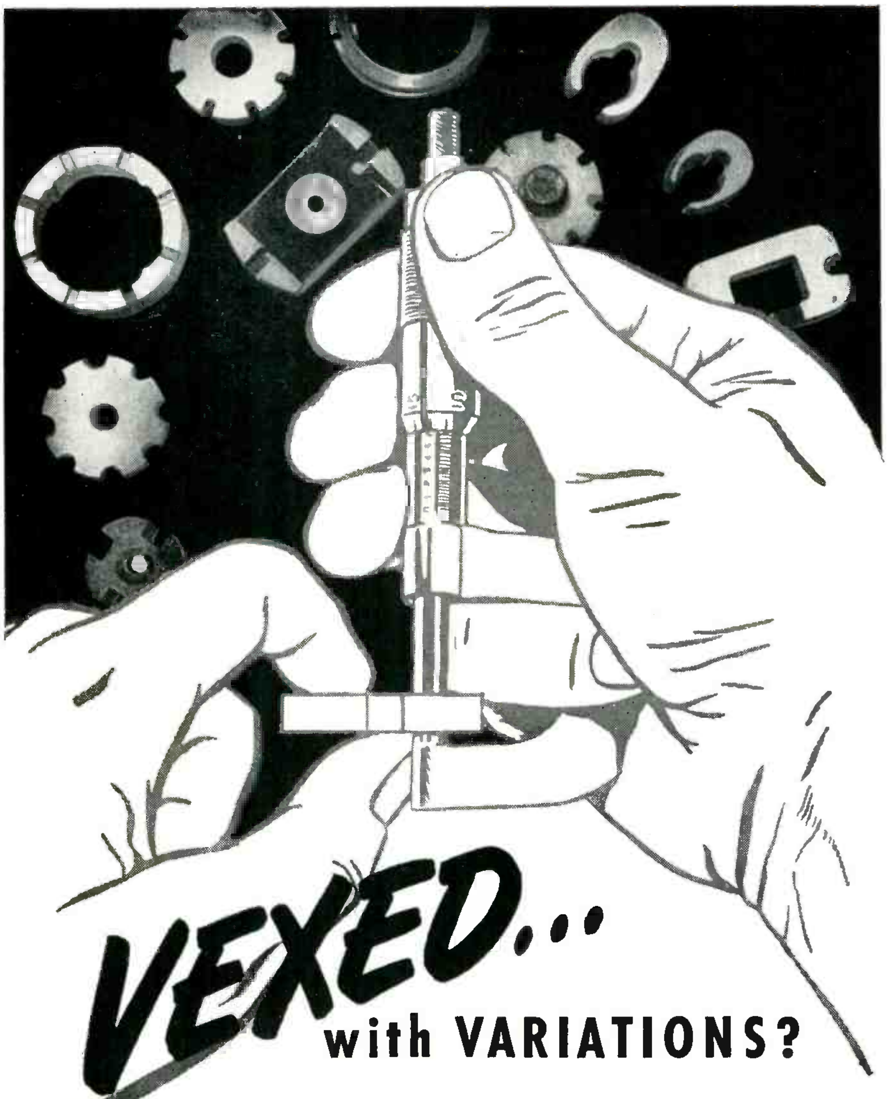

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Single pole

60 cycles
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#230A 10-500 cycles
#246C 60 cycles

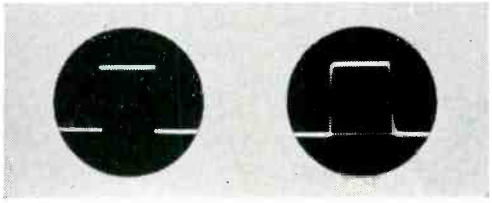
STEVENS ARNOLD INCORPORATED

22 ELKINS STREET
SOUTH BOSTON 27, MASS.

SA-5

RCA WO-88 A...

A new 5-inch scope with "picture-perfect" square-wave response



Unretouched photographs of 60-cycle and 50 Kc square waves reproduced on screen of WO-88A. Note fast retrace.

FEATURES—

- Direct-coupled, push-pull, two-stage vertical amplifier; push-pull horizontal amplifier.
- Frequency-compensated and voltage-calibrated attenuators.
- Front-panel source of 1-volt peak-to-peak calibrating voltage.
- Graph screen scaled directly in peak-to-peak voltage.
- Metal shield enclosing CRT gun to minimize hum-pickup from stray fields.
- Extra fast sweep-oscillator retrace.
- Built-in 60-cycle sweep with phasing control.

SPECIFICATIONS—

- Deflection Sensitivity: (vertical amplifier) 25 rms millivolts or better per inch.
- Vertical Amplifier Frequency Response: Flat from dc to 100 Kc; within −3 db at 500 Kc; within −10 db at 1 Mc.
- Input Resistance and Capacitance: 10 megohms and 9.5 uuf with WG-216B Low-Capacitance Probe.
- Sweep-Circuit Frequency (four ranges): 15 cps to 30 Kc.
- Square-Wave Response: Negligible tilt and overshoot.
- Power Supply: 105/125 volts, 50/60 cycles.
- Size 13½" high, 9" wide, 16½" deep. Weight only 25 lbs (approx.).

New WG-216B Low-Capacitance Probe gives the WO-88A an over-all input resistance of 10 megohms shunted by less than 10 uuf.

The WO-88A combines the features required for TV receiver servicing, and the high stability and ruggedness essential for continuous production-line duty.

The outstanding feature of the WO-88A is its remarkably true square-wave response, obtained by adequate band-width, negligible phase shift, and a complete absence of peaking circuits. Vertical and horizontal sync pulses, as well as other complex wave forms, are reproduced with fidelity characteristic of expensive laboratory instruments. Furthermore, uniform frequency response is maintained over the entire range of the attenuators.

The two-stage dc vertical amplifier has more than enough gain for all usual applications. Moreover, all of the gain is useable because the input circuits are shielded against extraneous noise and hum right out to the probe tips. Push-pull circuitry in both stages of the vertical amplifier minimizes "line bounce"; and direct coupling provides instantaneous "recovery" time.

For operating convenience, the controls for push-pull balance, astigmatism adjustment, and interstage dc coupling are accessible from outside the cabinet.

Voltage measurements and waveshape observations can be made simultaneously with the WO-88A. A front-panel terminal provides a 1-volt peak-to-peak reference voltage; the green graph screen is scaled in peak-to-peak voltage divisions, which are multiplied by the settings of the step attenuator to determine the voltage.

The WO-88A incorporates other quality 'scope features such as "plus" and "minus" sync, 60-cycle sweep and phasing, and a shield around the CRT gun.

For complete details on the WO-88A, see your RCA Test Equipment Distributor, or write RCA, Commercial Engineering, Section JX-42, Harrison, New Jersey. TMK. ®

RADIO CORPORATION of AMERICA
TEST EQUIPMENT — **HARRISON, N. J.**

is formed at the lower end, on which umbrellas and other personal belongings can be hung.

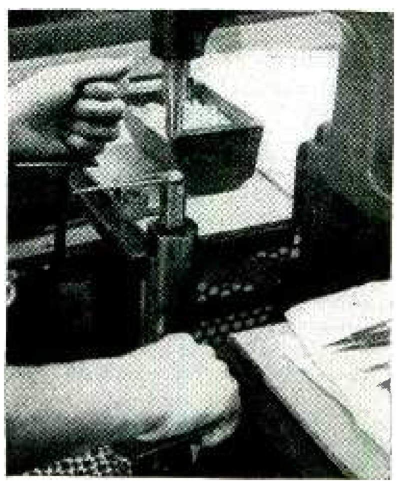
With this arrangement, each assembly-line workers' coat is only a few steps back of her bench. This reduces considerably the time otherwise spent in going to locker rooms to get things from coat pockets. Overhead storage also reduces the possibility of theft, as pockets are well out of reach and a person lifting down somebody else's coat to get into the pockets would be in plain sight of assembly-line workers.

The rods are painted grey, with a few inches of the lower end a bright red. The red serves to warn the cleaning crew against bumping their heads on empty hangers at night.

A new Crosley-designed chair for assembly-line positions contributes further to the needs of workers by providing a compartment underneath for storage of purse, lunch, working shoes and other small personal belongings. Again theft is minimized, and bench appearance is greatly improved by keeping personal belongings out of sight.

Magnet Holds Pointer on Riveting Machine

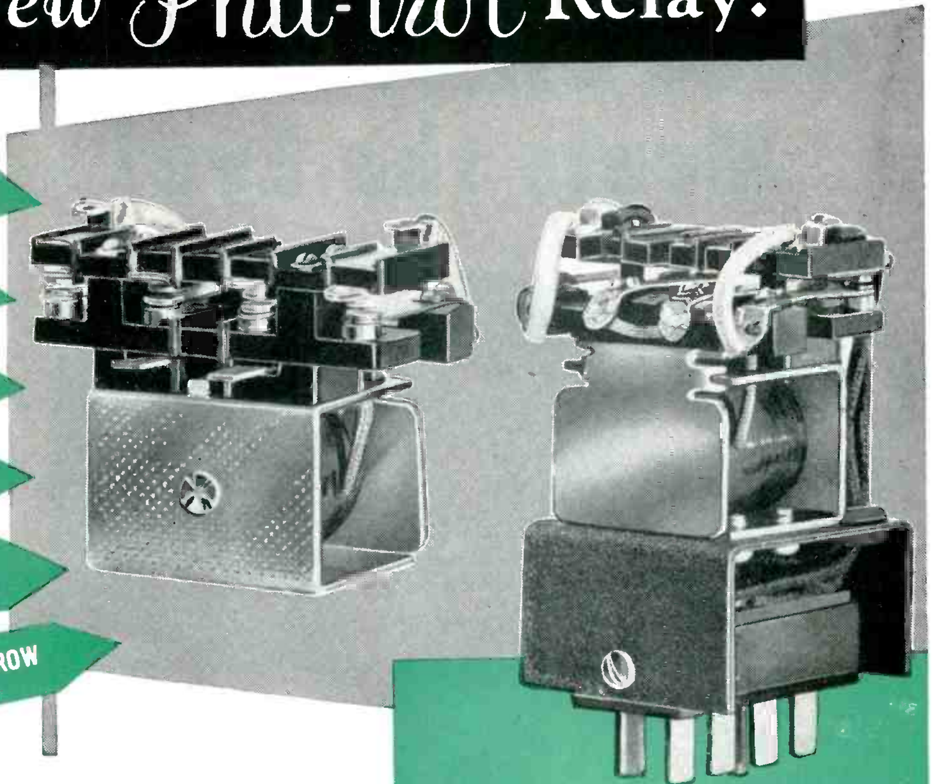
IN THE operation of flaring a bushing after insertion in a radio dial pointer, many rejects formerly occurred because the operator could

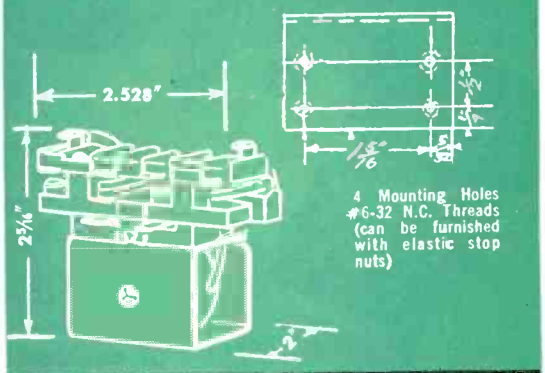


Alnico permanent magnet holds dial pointer in correct position on mandrel of riveting machine, leaving both hands of operator free to actuate the two safety controls that start the machine

Another New Phil-trol Relay!

- WITHSTANDS VIBRATION AND SHOCK
- LONG OPERATING LIFE
- COMPACT, LIGHTWEIGHT, RUGGED
- 10 TO 20 AMPERE CAPACITY
- RESPONDS TO ½ CYCLE
- 1 TO 5 POLE, DOUBLE THROW



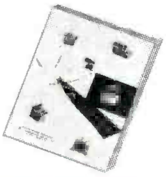


Sets a New High in Performance, Efficiency and Economy!

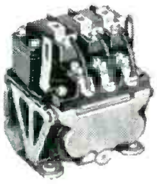
The new Phil-trol Type 33 Relay is another triumph of Phillips designing and engineering. It is an important addition to the complete line of Phil-trol Relays that enables you to select the type practically tailor-made for your particular needs.

The Type 33 Phil-trol Relay is of single coil design and box shape construction. Armature and frame construction of a type that affords fast action in both operation and release. Contacts are quickly and easily pressure adjusted by means of screws. The Type 33 is available for either a.c. or d.c. operation (33 AC or 33 QA). The constant of operate and release times has qualified this relay for many applications such as are found in timing circuits.

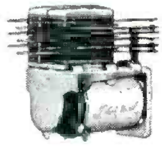
Write for detailed Data Sheet and copy of latest Phil-trol Relay Catalog



OTHER PHIL-TROL RELAYS:



Power Relay
Type 27QA



Miniature Telephone
Type 4QA

Telephone
Type 2QA

Hermetically Sealed
Type 20366-1

Hermetically Sealed
Type 40015

Phil-trol PRODUCTS

PHILLIPS CONTROL CORPORATION
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OFFICES IN PRINCIPAL CITIES

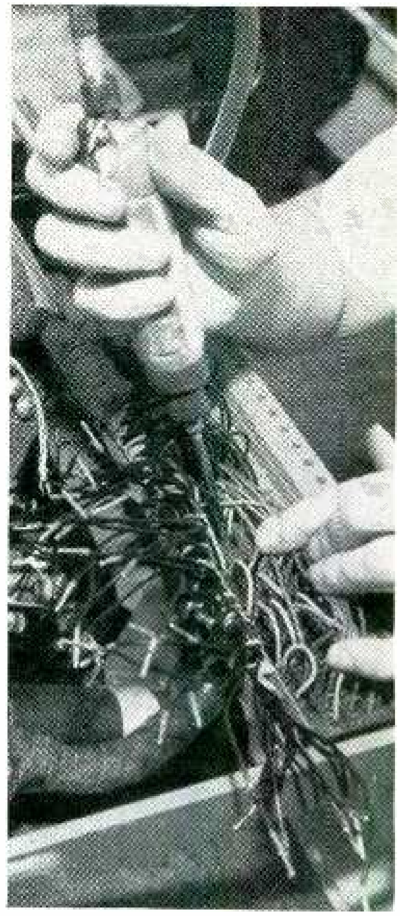
not hold the pointer precisely at right angles to the bushing and at the same time safely actuate the two starting controls for the press.

The problem was solved in the Cincinnati plant of Crosley Division by mounting a small permanent magnet on the mandrel of the machine, and taping onto this a V-shaped piece of iron which positioned the pointer at exactly the correct angle. The magnetic attraction is sufficient to hold the plated iron pointer rigid despite the jar as the press first hits the bushing.

Wire-Plugging Tools

WIRES with AMP insulation-piercing plugs are pushed into mating pin jacks with two types of tools during assembly of electronic business machines in the Poughkeepsie, N. Y. plant of International Business Machines Corp., to give secure joints without use of solder.

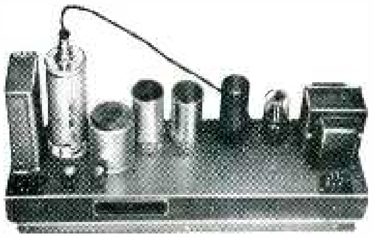
At working positions where a large number of such connections are made, a pneumatic plugging tool



Using air-operated tool to push plug-tipped wires into tiny jacks

A lot of engineering for a Component!

Converter's job in Speedomax instruments is to receive the (often very small) direct current signal which is related to the temperature, stress pH or other condition being measured, and produce an alternating voltage. This output is amplified, and then directs the balancing system to measure, record, and if desired control.



Good engineering shows in this Amplifier's thorough filtering, high impedance, and plug-in connection to the rest of the Speedomax.

Good engineering shows in this Slidewire's non-inductive winding and in absence of any flexible leads which might form inductive loops.

Good engineering shows in this balancing motor's small size, and in its torque ample to operate accessory control and signalling fitments.

and every Speedomax user benefits by it!

● The operating precision of the thousands of Speedomax Recorders and Controllers which serve industry and science begins with the engineering of components like this Converter. Our specifications apply at all stages—all the way back to the plants which make metals, insulation materials, etc., for us. These specs represent also the best thinking of our suppliers' engineers. The resulting materials are thus quality-controlled for us—and us alone.

From these materials our engineers tell our factory how to make converter parts to truly tight specifications. Some parts require principally flatness, or elasticity, or dimensional stability. Reeds need correct natural frequency. Many parts of course combine various needs; each gets its requirements.

Life tests show Fidelity and Stamina. Ingenious and often original design creates from these parts a converter with noise level equivalent to only 0.2 microvolt in an emf potentiometer circuit. And this fidelity promotes accurate measurement and control.

Running on life tests since 1948, present-model converters are today still well inside performance tolerances. Such a run equals 21.9 years of 8-hours-a-day, 200-days-a-year-service—or 1.9 years more than the present age of the first Speedomax.

This kind of engineered performance is also built into the amplifier, slidewire, motor and scores of other exclusively Speedomax parts. It's at your service whether you want to control a laboratory furnace, plot an X-Y function, or record the facts about atoms or molecules. Call on L&N application engineers in selecting the range (from among thousands) and measuring circuit (from among over 2300) to meet your needs. Write our nearest office, or 4979 Stenton Avenue, Philadelphia 44, Pa.

CAREER OPPORTUNITIES AT L&N

Expansion program of this long-established firm has many features to attract outstanding recent graduates in engineering and science. Opportunities are in sales, field engineering, product and application engineering, research, advertising, market development. Widely-respected policies assure recognition of progress and achievement. Address Personnel Manager for preliminary interview at nearest of 17 L&N offices.

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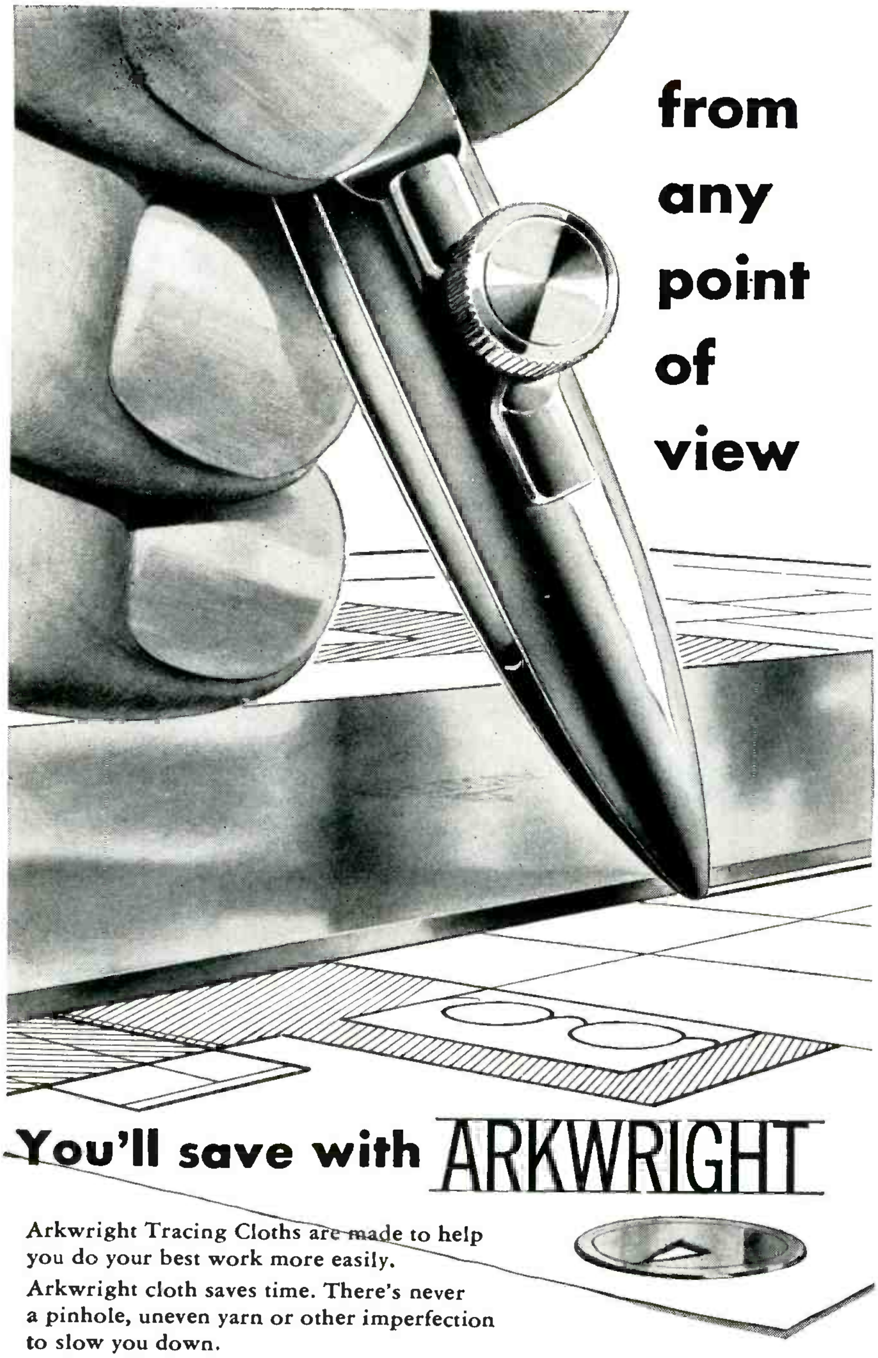

from any point of view

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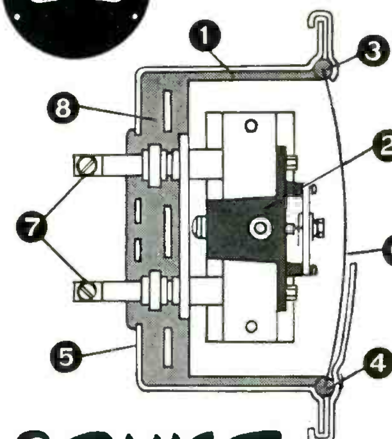
...TO MEET SIG. C. SPEC. MIL-M-10304



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EXTRA "RUGGEDIZED" FEATURES

1. Meter movement shock-mounted and housed in rubber-lined case.
2. Meter movement supported by die-cast frame for greater strength and increased accuracy.
3. Observation window rubber grommeted and sealed to rubber lining of case—providing hermetical seal of high dielectric materials.
4. Non-rigid mounting of observation window with rubber grommet increases resistance to shock.
5. Each meter designed and built by SUN to highest quality and precision standards.

EXTRA INSTALLATION ADVANTAGES

6. Slight convexity of observation window reduces chance of accidental breakage during installation or shipment.
7. Terminals side-tapped and provided with tined binding screws to facilitate wiring with or without wire lugs or by pressure, soldering or both.
8. Breakage or damage in wiring is reduced through non-rigid mounting of terminals and use of flexible interior conductors.

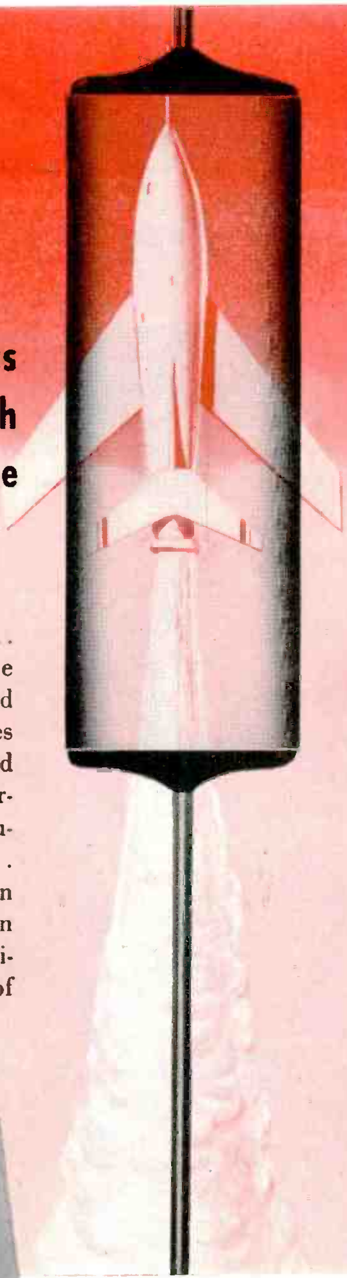
Building rugged electric meters is not new to SUN . . . For over 20 years, the automotive industry has depended on SUN as one of the largest "D'Arsonval-type" meter manufacturers—to produce rugged, tough meters that will stand up under the abuse and rough handling of portable field instruments used in automotive repair work. SUN "Ruggedized" Meters not only meet Specification MIL-M-10304 (Sig. C)—but also embody many *plus* features that make installation easier, faster and help prevent assembly or shipping damage. Complete data bulletin on SUN "Ruggedized" Meters available on request.

SUN "Ruggedized" Meters are available as D-C Volt Meters, Ammeters, Milli-ammeters and Micro-ammeters and also may be ordered as rectifier type A-C instruments. 6060-0

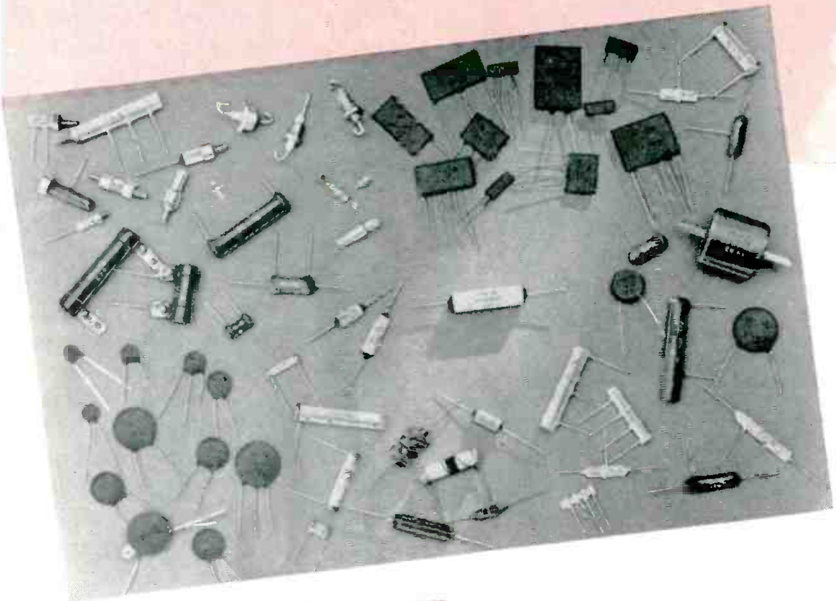
SUN ELECTRIC CORPORATION
6383 Avondale Avenue, Chicago 31, Illinois

Hi-Q SERVES NATIONAL DEFENSE

Wherever Electronics Play Tag with a Plane



Guided missiles that can chase an enemy plane for miles . . . and eventually catch and destroy it . . . are just one of the many "fantastic weapons" which electronics have contributed to the defense of our nation. And here, as in all other phases of this great new science, you'll find **Hi-Q** components valued for their dependable performance, long life and rigid adherence to specifications. Whether it be disk capacitors . . . tubulars, plates or plate assemblies . . . high voltage slug types . . . trimmers, wire wound resistors or choke coils . . . you can count on the **Hi-Q** trade mark as a guarantee of quality in ceramic units. And you can likewise count on **Hi-Q** engineers for skilled cooperation in the design and production of new components to meet specialized or unusual needs.



Hi-Q TUBULAR CAPACITORS

. . . may be had with axial leads and a specially developed endseal as shown above, or with conventional leads. **Hi-Q** tubulars are available in a complete range of by-pass, coupling and temperature compensating types as well as in an HVT line developed specifically for use on the relatively high pulse voltages encountered in the horizontal sweep and deflection sections of television circuits. Whatever your needs for tubular capacitors or other ceramic components, you are invited to consult **Hi-Q**.

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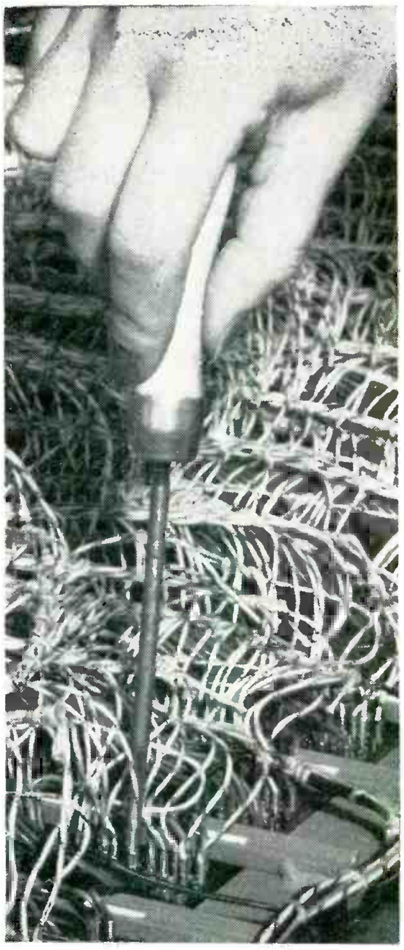


Hand tool for plugging wires into jacks

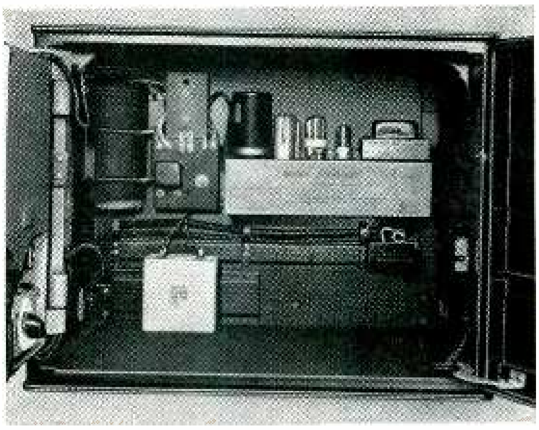
is used. The tool in this is a rod having a hole drilled in its end to the diameter and depth of the thick part of the plug. A milled slot runs lengthwise into this hole. In use, the tool fits over the plug, with the wire coming out of the slot. After inserting a plug-tipped wire in its correct jack loosely by hand, the operator holds the tube over the jack and operates the thumb valve. The resulting vibratory action forces the plug into the jack smoothly in a few seconds.

At working positions requiring only occasional plugging in of wires, a hand plugging tool having a plain screwdriver-type handle is used. Here the operator must have sufficient strength to push in the plug, since force is required. The plugs are made by Aircraft Marine Products Co., Harrisburg, Pa.

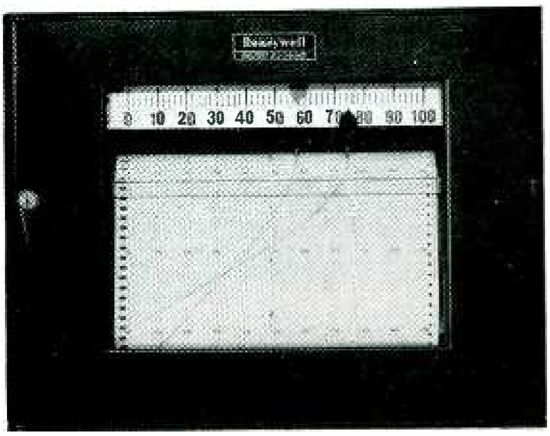
Solder Holder

SIMPLE metal holders attached to the undersides of benches keep rosin-core solder within reach of assembly-line operators at all times

Important to
Engineering, Research & Testing



Internal view showing amplifier and damping circuit components.



• NEW HIGH SPEED *ElectroniK* RECORDER

For accurate records of rapidly changing variables

• Now you can accurately record, on a wide chart and on a *null-balance instrument*, full scale signals which vary as rapidly as 20 cycles per minute. Signals with a peak to peak amplitude of 10% of scale can be reproduced at variations up to 3 cycles per second.

The instrument develops a pen speed that traverses its eleven inch graduated chart in *one second!* It has chart speeds up to 4 inches per second—20 feet per minute. It incorporates an adjustable damping circuit . . . has a motor driven reroll mechanism to maintain constant tension on the chart . . . and is adaptable to the measurement of practically any d-c signal.

• THE *ElectroniK* DUPLEX RECORDER

Simultaneously records two independent variables ON ONE CHART

• On a single chart, the *ElectroniK* Duplex Recorder provides a clear, easily read record of the measurement of practically any combination of two independent variables. A "natural" for such applications as atomic energy, stress analysis and acoustics . . . this instrument is particularly useful in before and after comparisons made by recording a measurable characteristic of a substance as it enters and emerges from a processing stage or reaction.

Auxiliary switches can be supplied on one pen for control or signalling . . . a solenoid-actuated third pen can be provided to register in time conformance with one of the standard pens.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4428 Wayne Avenue, Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

First in Controls

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• *Important Reference Data*

WRITE FOR A COPY OF DATA SHEET NO. 10.0-7 ON THE HIGH SPEED RECORDER . . . DATA SHEET NO. 10.0-6 ON THE DUPLEX RECORDER.

Century MODEL 1809
BRIDGE CONTROL UNIT
FOR VIBRATION AND STRESS ANALYSIS

Designed as a companion unit to Century's famous Model 409 Oscillograph, the Model 1809 Bridge Control Unit is the latest addition to Century's line of industry-standard vibration and stress analyzing equipment. Packaged in a small, compact space, the unit contains all of the facilities necessary for use with 12 channels of resistance strain gages or bridge-type transducers. Where used with the Model 409 Oscillograph, it is necessary only to connect strain gages and power source to have a complete stress-strain measuring and recording system, small and rugged enough to be placed in an aircraft wing tip or guided missile warhead.

FEATURES:

Size: 4½" x 7" x 11".

Weight: 10½ pounds.

Aluminum case.

Up to 12 channels.

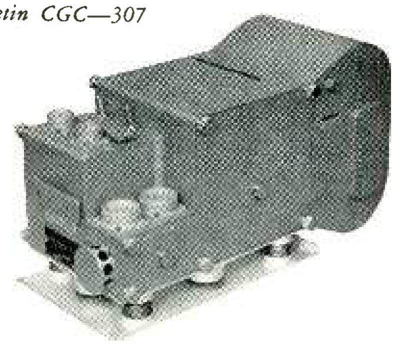
For any resistance strain gage or bridge-type transducer.

May be used with direct indicating instrument.

Power: Control unit, 22-28 Volt D.C.
Strain gage, 6-28 Volt D.C.

Write for Bulletin CGC—307

MODEL 409 OSCILLOGRAPH



The Century Model 409 Oscillograph has been designed for recording data where space and weight requirements are limited. The Oscillograph has been tested to record faithfully while subjected to accelerations up to 20 G's.

FEATURES:

Size: 5" x $6\frac{15}{16}$" x $11\frac{15}{16}$".

Weight: 13 pounds.

Cast aluminum case.

Paper speeds variable ½" to 6" and 2" to 24" per second.

Detachable daylight loading magazine with a capacity of 3⅝" x 100' paper.

2 to 14 individual channels.

Trace identification.

Trace viewing.

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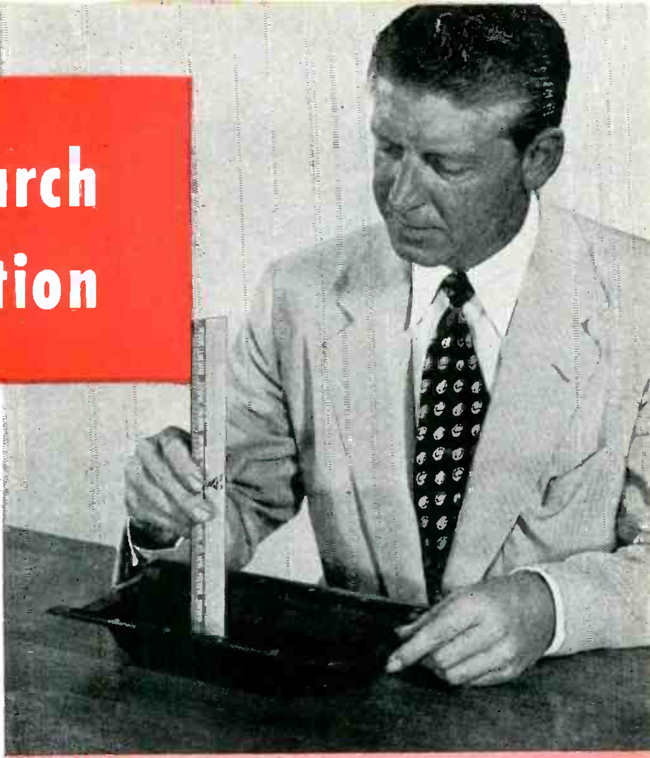
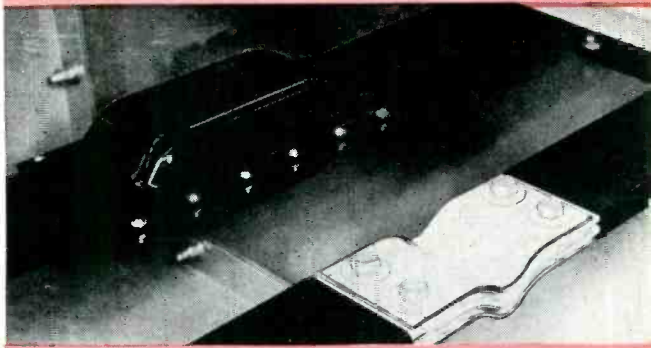


Phenolite postformed expansion joint cover.

The problem:

to insulate a 5 kilovolt, 1500 ampere bus bar installation

Recently I-T-E Circuit Breaker Company of Philadelphia had the problem of *completely* insulating 5 kilovolt, 1500 ampere 3 phase bus bar units for an Atomic Energy Commission installation. It was simple enough to insulate the bus bars with oval Phenolite tubing. But, to completely insulate the bus supports and expansion joints was a real problem. I-T-E's engineers showed us what they wanted . . . postformed Phenolite insulating covers . . . drawn deeper than anything we had ever attempted. Our engineers tackled the problem.

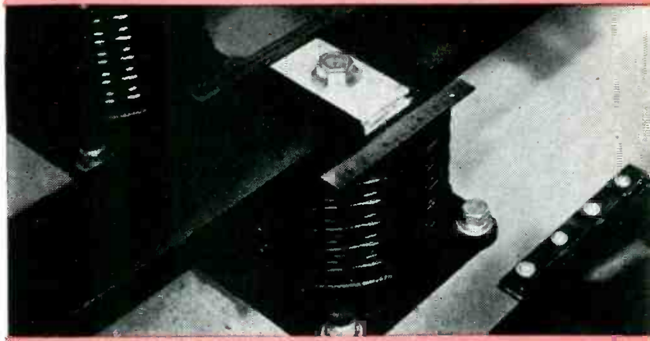


Expansion joint with and without Phenolite insulating covers.

The solution:

Phenolite Grade X-114A postforming material and National's technical "know how" in the design of forming dies

Perhaps *your* problem doesn't involve the insulation of 5 KV, 1500 ampere bus bars. But maybe you have an insulating problem where National can give you some real help in solving how to do your certain job economically. Write us, our engineering service is immediately available.

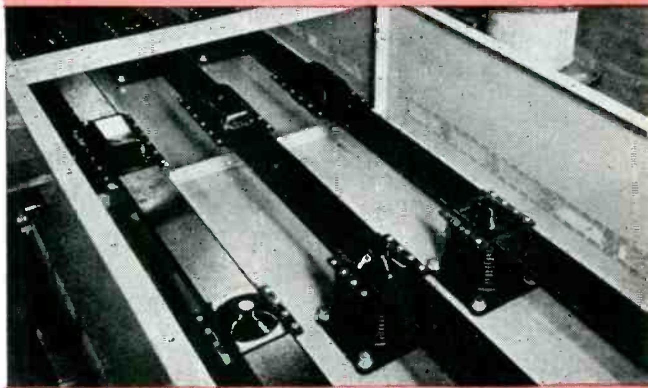


Bus support with and without Phenolite insulating covers.

National Laminated Plastics
nationally known—nationally accepted

PHENOLITE Laminated PLASTIC

The perfect insulation material for high and low voltage applications, Phenolite possesses an unusual combination of properties. It has great mechanical strength and high resistance to moisture; ready machinability; is about one-half the weight of aluminum. Standard colors are natural, black, chocolate; mirror, semi-gloss and dull finishes. Sheets, Rods, Tubes, Special Shapes.



Completed installation, showing Phenolite insulation for bus bars, supports and expansion joints.

National Vulcanized Fibre Company

Wilmington Delaware

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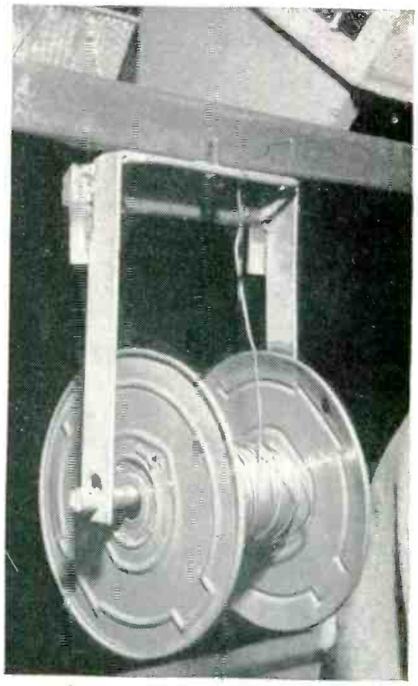
Since 1873



Metal holder for solder reel

in Emerson's Jersey City television plant. The metal shaft for the reel of solder has a deep turned groove in one end to prevent it from sliding out of the U-shaped frame. To change reels, the grooved end of the shaft is lifted slightly, so it can be slid out of the hole in the frame.

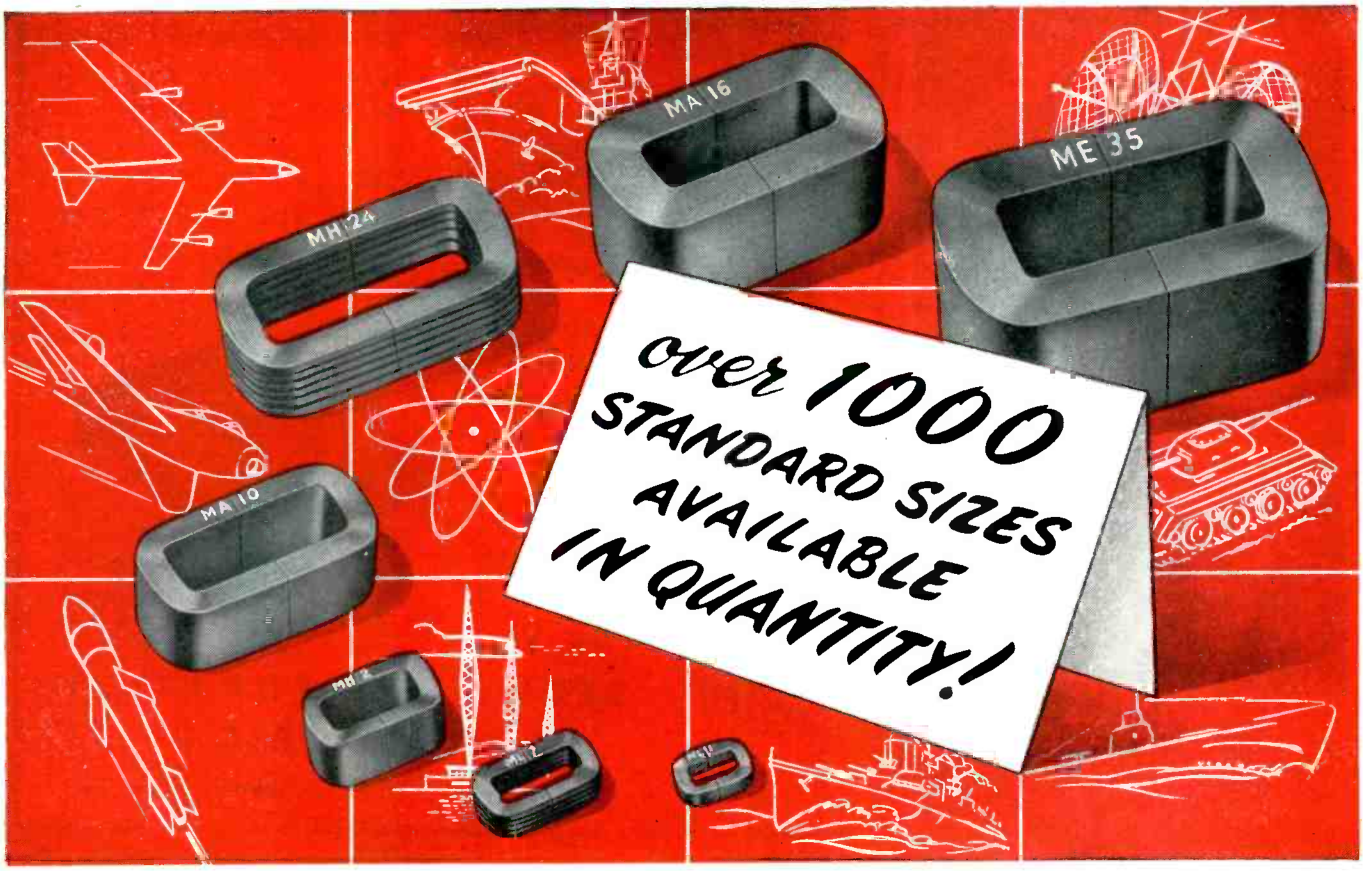
The end of the solder is brought up through a hole in the top of the holder. This prevents the end from dropping to the floor out of reach.

Dual Air Guns Speed Subassembly Work

ASSEMBLY of two television controls on a small subpanel is speeded in Crosley's Cincinnati plant by mounting two air-operated socket

Dual air gun setup for driving nuts on vertical linearity control and height control for tv set

MOLONEY *HiperCore* ELECTRONIC CORES



Over 200 manufacturers of electronic products for ultimate use by the U. S. Government are now using Moloney HiperCore Cores for Electronic Transformers.

More than 1000 standard sizes are available in quantity to such manufacturers in thicknesses from 1 mil to 12 mil and in widths from ¼″. HiperCore Electronic Cores are of wound core construction using oriented-grain, cold-rolled silicon steel which results in greater flux carrying capacity and lower losses than other type cores of comparable sizes. These smaller, lighter cores perform better and permit increased production by savings in assembly time.

Rigid control of core production permits these cores to test well within industry tolerances. Table at right shows typical test requirements. Special tests for specific operating conditions are made when desired.

Write today for further information.

ME-52-27

STANDARD TESTS

All 12 mil cores are tested for core loss (true watts) and exciting volt-amperes (apparent watts) at 60 cycles. 4 mil cores are tested at 400 cycles. Following table gives maximum test values. Average values are approximately 20% less than maximum.

	12 Mil—60 Cycle @ 15000 gauss	4 Mil—400 Cycle @ 10000 gauss
Core Loss (TW)	0.95 x lbs.	4.4 x lbs.
Exciting Volt-Amps (AW)	1.75 x lbs. + 6.25A*	5.0 x lbs. + 16.6A*
* A = Gross Area of core face in Sq. In.		

All 2 mil cores are tested for pulse permeability by using a 2 microsecond pulse width at 400 P. P. S. and maximum flux density of 10000 gauss. The minimum permeability will be 500.

All 1 mil cores are tested for pulse permeability by using a 0.25 microsecond pulse width at 4000 P. P. S. and maximum flux density of 3000 gauss. The minimum permeability will be 175.

MOLONEY ELECTRIC COMPANY

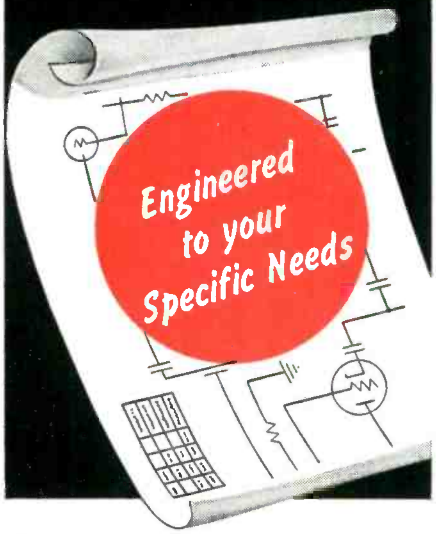
Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers Step Voltage Regulators • Unit Substations

MOLONEY ELECTRIC = BETTER PERFORMANCE GREATER RELIABILITY LESS MAINTENANCE

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

WIRE *and* CABLE

for every application



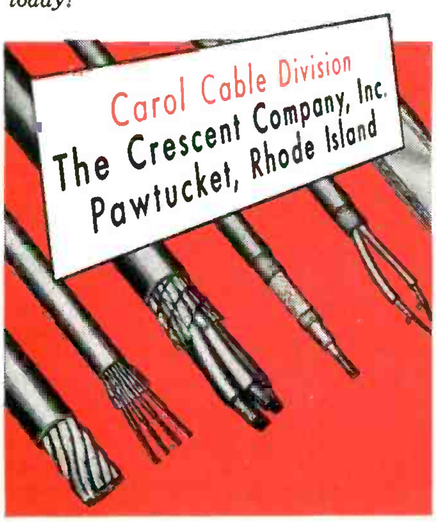
The sensitive and dependable performance so important in electronic equipment demands wire and cable that conform to rigid specifications.

You can depend on Carol wires, cables, and wiring assemblies made to *your* specifications to *surpass* every test requirement!

Carol engineering and manufacturing facilities are complete—for we draw copper, copperweld, and aluminum; formulate our insulating materials from natural rubber or synthetic rubber or plastics. Carol is a complete wire mill with all the necessary adjuncts to be completely independent and without intermediate profits.

Constant Laboratory control over raw materials, work in process, and finished product assures dependable performance.

Check the advantages of Carol quality and service in solving your wiring problems. Write us about those problems *today!*

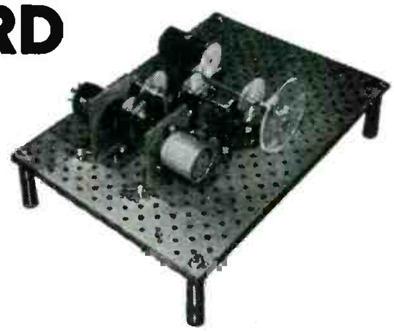


SERVOSCOPE®

Test analyzer for use in development and PRODUCTION of SERVOMECHANISMS and PROCESS CONTROLS. Measures FREQUENCY RESPONSE, PHASE SHIFT 0.1 to 20 CYCLES SINE WAVE, SQUARE WAVE, MODULATED CARRIER, 50 to 800 CYCLES.

SERVOBOARD

A FLEXIBLE SET of PRECISION mechanical parts for quickly coupling motors, synchros, potentiometers to form assemblies of Servo systems, regulators, computors.



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DEPT. E-10 NEW HYDE PARK, N.Y.

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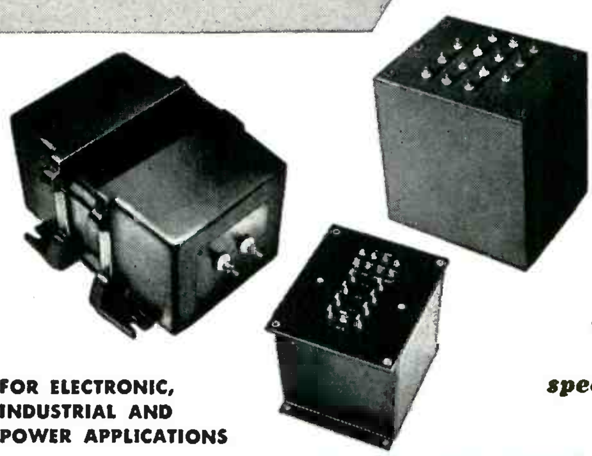
•

Top Engineering and Workmanship

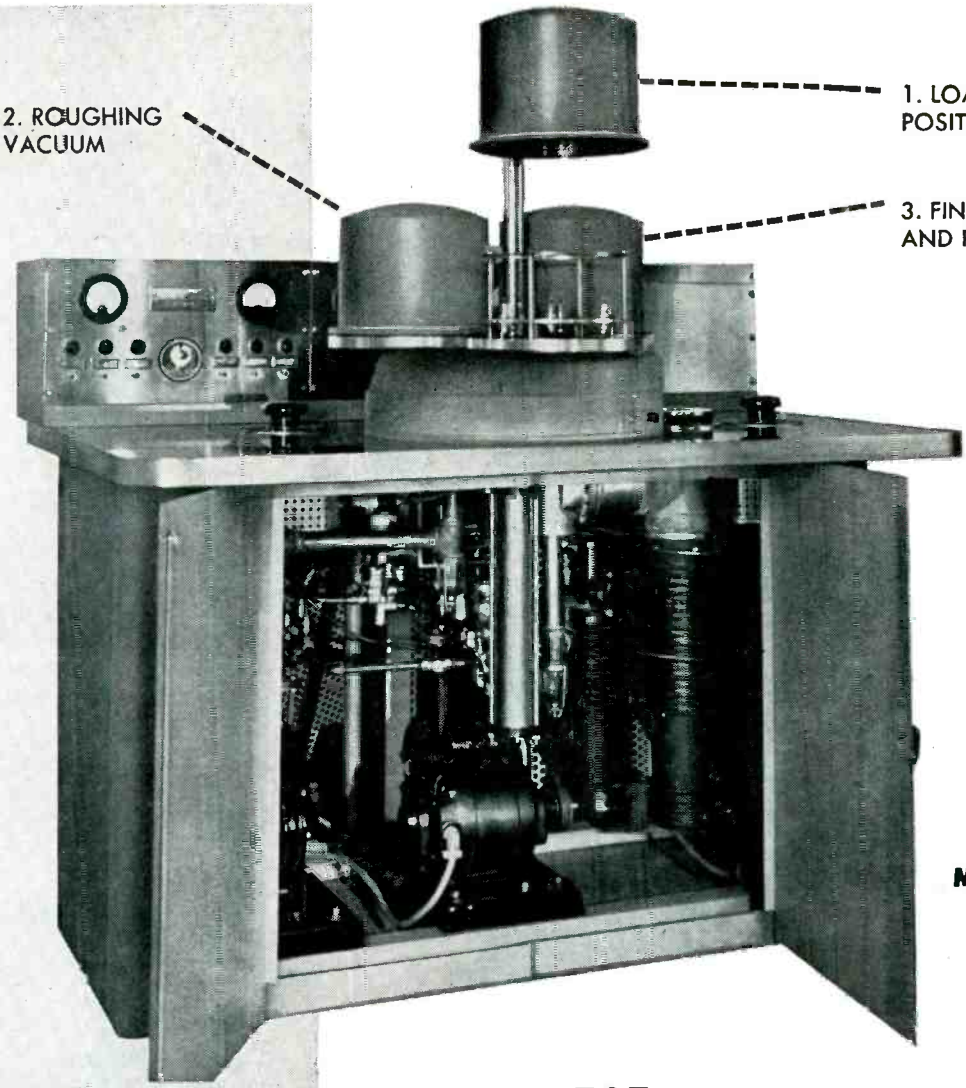


We have been solving the transformer engineering problems of government and industry since 1938!

Write or phone us regarding your special requirements.

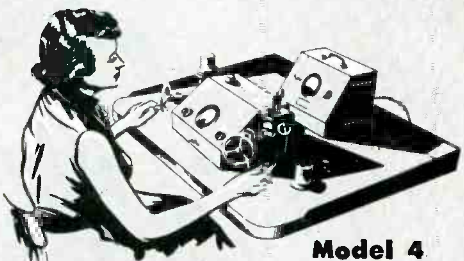
FOR ELECTRONIC, INDUSTRIAL AND POWER APPLICATIONS

ELECTRONIC TRANSFORMER COMPANY, INC.
209 West 25th Street • WAtkins 4-0880 • New York 1, N. Y.



Model 3

here's how to calibrate crystals accurately, quickly . . .



Model 4

Manifold type final frequency calibration unit, type FFO. This unit is engineered to calibrate one crystal every 15 seconds with vacuum of less than ½ micron. Designed for bench mounting in multiple units, this model is available for immediate delivery designed for either manual or electric valve operation. Although possible to base plate with this machine, it was primarily designed for final frequency calibration only. This equipment does not include frequency measuring instruments.

Production quantities of quartz crystal oscillator plates can be brought to precise frequencies efficiently and accurately with the equipment shown above. This unit, Model 3, deposits thin, uniform films of metal (gold, silver, aluminum, etc.) on crystal blanks, glass, metal or ceramics . . . in both base plating and final frequency operations for crystal manufacture.

An important feature of Model 3 is the triple turret design. This turret, indexing to 3 positions, permits the simultaneous operations of 1. loading-unloading, 2. initial evacuation 3. final evacuation and plating. Completion of exhaust cycle in less than 2 minutes is accomplished by use of two mechanical pumps and two oil diffusion pumps. These exclusive features are but a few reasons **why nine out of ten crystal manufacturers today use CONSTANTIN equipment.**

For complete information and specifications, write now to Constantin — pioneers in vacuum coating equipment.

MANUFACTURING ENGINEERS

L. L. Constantin & Co.

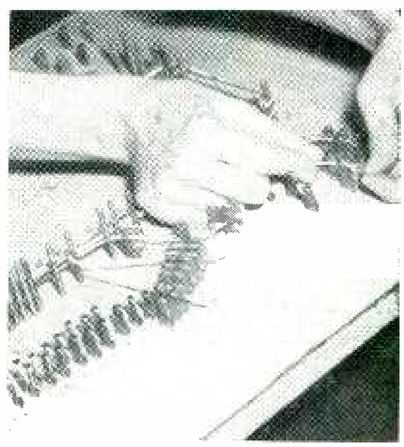
ROUTE 6 AT FRANKLIN AVE. • P. O. BOX 283, LODI, NEW JERSEY

LEADING PRODUCERS OF EVERY TYPE HERMETIC SEAL INCLUDING CRYSTAL HOLDERS wrenches side by side rigidly on the bench. The operator merely places the controls in their panel holes, places Pal nuts in the wrenches, then pushes the shafts of the controls into the hollow shafts of the wrenches, to spin both nuts tight simultaneously. The wrenches are of the clutch type, hence they start as soon as the threaded bushings of the controls are pushed against the nuts.

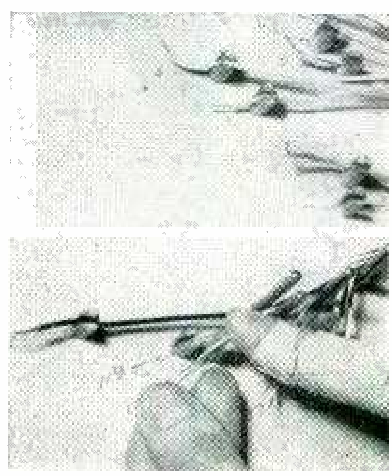
Cabling-Board Pegs

METAL rods are used in place of nails for positioning wires on cabling boards, to improve accuracy and quality in the military radio section of Federal Telephone and Radio Corporation's Clifton, N. J. plant.

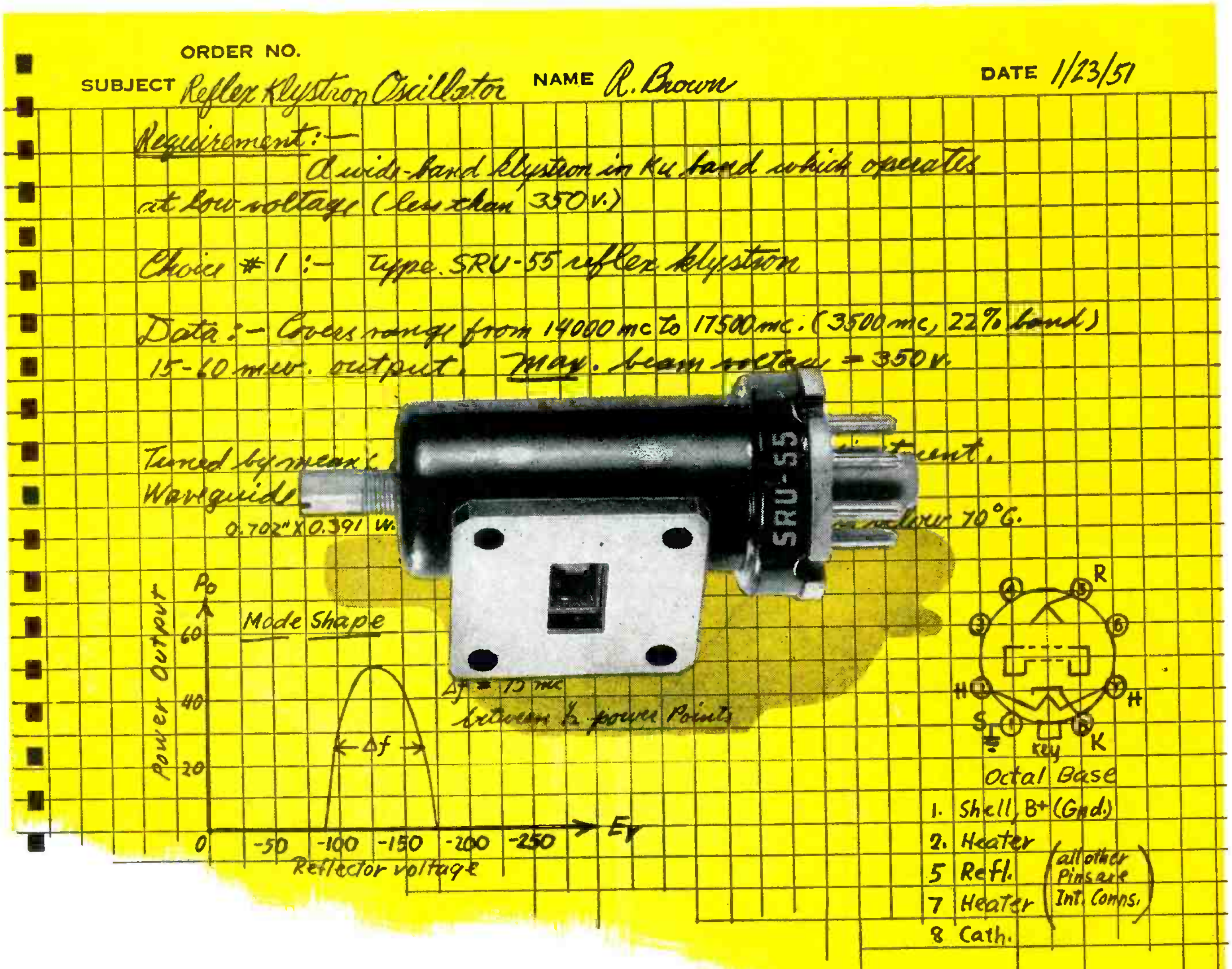
Three different techniques are used for anchoring the ends of wires. The most used and most



Use of metal wire-positioning rods and steel clips on cabling board



Pushing wire into slot of wood dowel rod



. . . WIDE TUNING RANGE with LOW-VOLTAGE KLYSTRON

14,000 to 17,500 MC at 300 VOLTS

Type SRU-55 is a low-voltage, reflex klystron oscillator with radio frequency output of 15 to 60 milliwatts, operating over the frequency range of 14,000 to 17,500 mc. This Sperry tube can be used as a local oscillator for microwave receivers or as a bench oscillator in the measurements laboratory.

Operating at a frequency of 16,000 mc with a beam voltage of 300 volts, this tube provides 25 milliwatts of output power. Under these conditions the modulation sensitivity is approximately 1.3 megacycles per volt. The electronic tuning range measured between 3 db points is 75 megacycles per second.

Physical characteristics of Sperry Type SRU-55 are: weight, 3¼ oz. —height, 3 1/16″—mounting, standard octal 8-pin socket (in any position). The r-f connection is a standard UG-419/U fitting for 0.702″ x 0.391″ waveguide. Its cathode is of the oxide coated, unipotential type. For ambient temperatures below 70°C, only free convection cooling is required. The tuning adjustment on this tube is driven by a ¼″ shaft containing a screwdriver slot.

For additional information on Type SRU-55 and other Sperry Klystrons, write our Special Electronics Department.

MODEL SRU-55

GENERAL CHARACTERISTICS	
Freq. Range (mech. tuning)	*14,000-17,500 mc.*
Heater Voltage (ac or dc)	*6.3 v.*
Heater Current	*0.6 amp.*
MAXIMUM RATINGS	
Beam Voltage	*350 v.*
Beam Current	*35 ma.*
Reflector Voltage	*0 to —350 v.*
Heater-Cathode Voltage (peak)	*45 v.*

SPERRY GYROSCOPE COMPANY

DIVISION OF THE SPERRY CORPORATION

GREAT NECK, NEW YORK · CLEVELAND · NEW ORLEANS · BROOKLYN · LOS ANGELES · SAN FRANCISCO · SEATTLE
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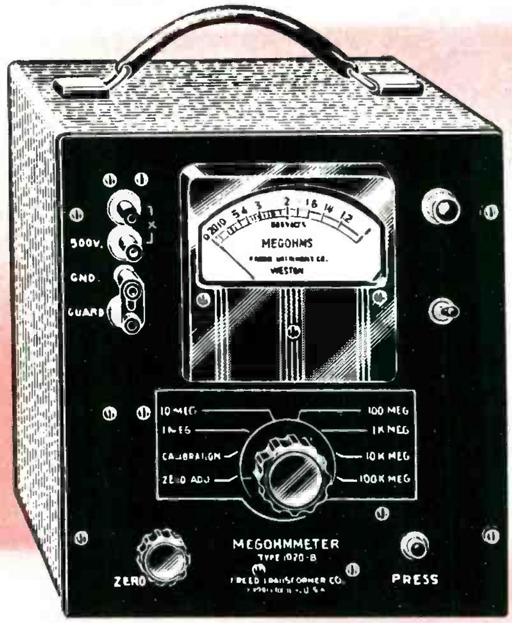
FREED *Instruments & Transformers*

Famous for

QUALITY • DEPENDABILITY • ACCURACY

FREED 1020-B MEGOHMMETER



A precision electronic megohmmeter which for years has given satisfactory service in hundreds of laboratories and on production lines.

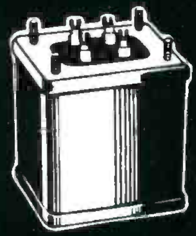
- **EASY TO READ**
  Direct reading on a 4" scale.
  Protected against overload.

- **RAPID & SAFE TO USE**
  Test voltage removed from terminals and capacitive components discharged to ground in all positions of multiplier switch.

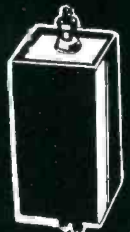
- **ACCURATE**
  Within 3% up to 100,000 megohms, 5% from 100,000 to 2,000,000 megohms.

SPECIFICATIONS

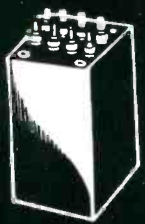
Range: 1 megohm to 2,000,000 megohms in six overlapping ranges selected by a multiplier switch.
Voltages on Unknown: The voltage applied to the unknown terminals is 500 volts d-c and is independent (less than 1%) of the value of the unknown.
Stability: Line voltage variations from 105-125 volts will cause less than 2% variation in the meter reading.
Power Supply: 105-125 volts A.C. 50-60 cycles 30 watts.
Dimensions: 9½ x 10½ x 8 inches.
Net Weight: 18 pounds.



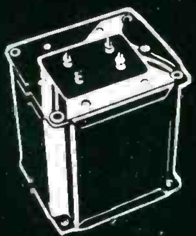
High Fidelity Transformers



Slug Tuned Components

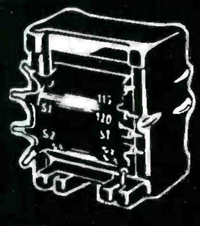


Hermetically Sealed Components to meet MIL-T-27 Specs

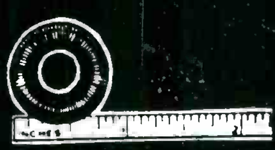


Commercial Components

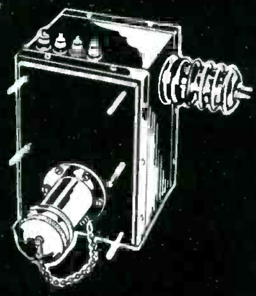
Sub-miniature hermetically sealed Toroidal Inductors



Freedseal Treatment ANE-19 Specs



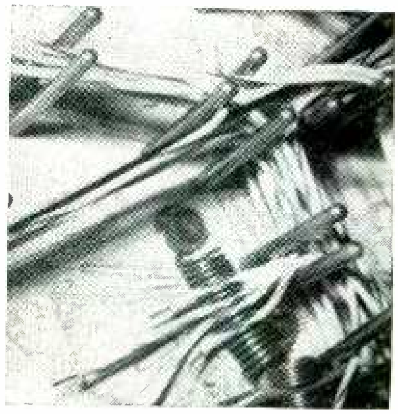
Miniature Inductors



Pulse Modulators

FREED TRANSFORMER CO., INC.

1722B WEIRFIELD ST. (RIDGEWOOD) BROOKLYN 27, N. Y.



Use of springs to anchor ends of wires

satisfactory is a spring steel clip that is pushed into holes drilled in the board to make a force fit. Each clip holds a single wire in practice, even though it could grip two or more. Individual clips permit checking for completeness of the harness at a glance by noting whether all clips are filled.

During a shortage of the steel clips, substitutes made from hardwood dowel rods were used instead. The rods were driven into slightly undersize holes in the board after slotting one end of each rod. Slot width was slightly less than insulation thickness, to give a gripping action.

Where a large number of wires terminated in a small area on the board, a coil spring was fastened to the board with two wood screws and wires were pushed between adjacent turns of the spring. Here one turn of spring was used for each wire, hence the entire spring had to be filled to complete the harness.

When a particular cabling board is no longer needed, pegs and clips are pulled out for reuse on new boards.

Drafting Board is Low-Cost Wiring Bench

ADJUSTABLE-HEIGHT, adjustable-angle drafting boards costing approximately fifteen dollars each provide an ideal working position for wiring and assembly of magnetic drum storage unit panels used in IBM electronic data processing machines. A simple angle-iron framework added to the rear of the bench near the floor provides sup-

These "Firsts" Helped Westinghouse Customers

1920 Westinghouse Makes First Dry Battery WD-11 Tube

1921 Westinghouse Testing New Indirectly-Heated Tube

1926 WESTINGHOUSE INVENTS NEW KU-610 THYRATRON

1928 Announce New Photo-Tube and Long-Life Cathode Ray Tube

1929 Westinghouse Patents KOVAR for Metal-to-Glass Tube Sealing

1931 Westinghouse Unveils First High Power UHF Tube

1932 Westinghouse Tells of New Ignitron Tube

1941 WL-530 in Radar at Pearl Harbor

USERS OF WESTINGHOUSE TUBES GET FIRST BENEFITS FROM MANY NEW TUBE DEVELOPMENTS

These are only a few of the "firsts" that Westinghouse created in the electronic tube industry. In each case, designers using Westinghouse Tubes gained advantages by having first chance to use these innovations.

Today, Westinghouse still pioneers in electronic tubes and tube making. For instance, Westinghouse 40 KV and 20 KV rectifying tubes are under 9 ounces, only 2¾" high. Designers seeking the ultimate in space and weight savings will find them in these new WL-6102 and WL-6103 tubes.

Radical new developments in other power tubes and receiving and television picture tubes are now being engineered at the *NEW* Westinghouse Electronic Tube Division at Elmira and Bath, New York.

NEW SERVICE, NEW DISTRIBUTION

Westinghouse plans for Electronic Tube Division expansion are in operation. New service facilities, new warehousing policies, and new distributors are opening rapidly.

New merchandising methods will aid distributors in serving industrial users—many of these business-building programs are totally new in the tube industry. Here, as elsewhere, Westinghouse plans to provide industry leadership in service.

It pays in profits to deal with Westinghouse and with Westinghouse distributors. For full information on how Westinghouse can help you with problems of design, service, or supply, call your nearest Westinghouse representative, or write to Department A-110.

RELIATRON™ TUBES

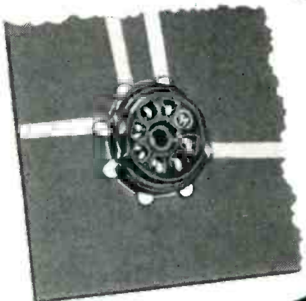
YOU CAN BE SURE...IF IT'S Westinghouse

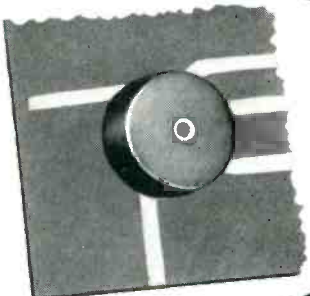
ET-95003

ELECTRONIC TUBE DIVISION

Westinghouse Electric Corporation
Box 284, Elmira, N. Y.

Tube Sockets for PRINTED CIRCUITS





ready for mass production

METHODE, now ready with volume production capacity on seven pin miniature tube sockets for printed circuit application . . . offers units with simple, time-proven design features providing reinforced mechanical spring contact with printed conductors, easily supplemented by solder dip operations. Insulators and retainer caps are heat resistant black phenolic and hardware is cadmium plated copper base alloy.

Recommended Usage: 1) sockets are snapped into keyed holes of 43/64" diameter; 2) insulating panel is solder dipped on under side to fuse socket terminals to printed conductors; 3) supplementary connections for top panel connections, if necessary, are spot soldered; 4) retainer cap is eyeletted or screwed to socket, locking assembly to board and assuring pressure contact.

We invite your inquiries

METHODE Manufacturing Corp.
2021 West Churchill Street
Chicago 47, Illinois

Geared to produce Plastic and Metal Electronic Components

smaller than a suitcase

. . . and almost as portable!

AMERICAN ELECTRIC

400 Cycle MOTOR ALTERNATOR

WEIGHT: Approx 125 lbs.
SIZE: 22" x 12" x 12"

Designed for production and laboratory high frequency power supply requirements. STRONG—SIMPLE—INDESTRUCTIBLE CONSTRUCTION—No delicate moving parts, brushes or springs to wear out or maintain.

Replaces single large, hard-to-get H-F power supply serving multiple purposes . . . *A bank of these compact, flexible units costs far less, provides individual portable power sources for each project, avoids downtime hazards of single unit!*

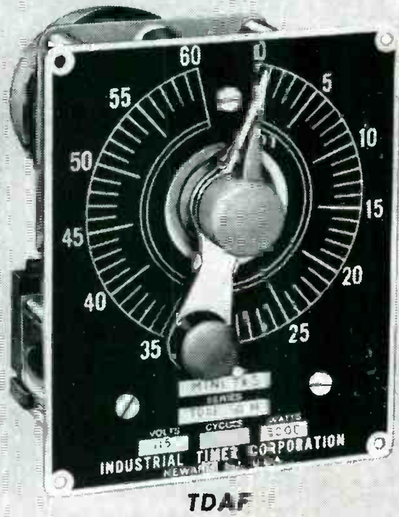
Meets power supply requirements for AN-E-19 equipment.

OUTPUT: Up to 1000 Watts single phase 115V or up to 1800 Watts three phase 115/200V. Input: 60 cycle AC.
Total harmonic content under 5%; ± 1% voltage regulation.

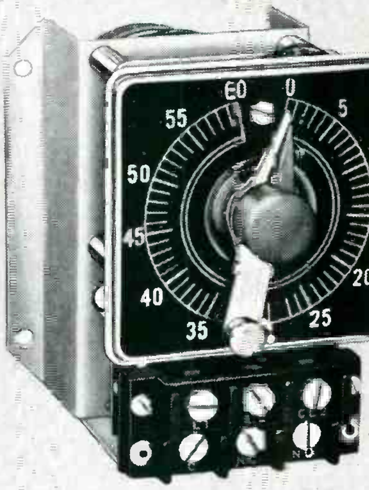
WRITE FOR DETAILS!

Larger capacities available.

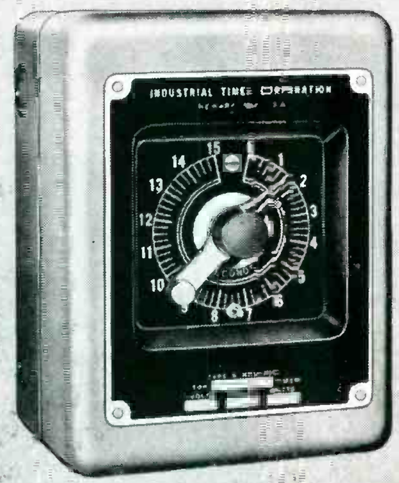
AMERICAN ELECTRIC MOTORS
TRADE MARK
4811 Telegraph Rd.
Los Angeles 22,
California



TDAF



TDAB



TDAB (in case)

TWO IMPROVED TYPES of Synchronous Motor Driven TIME DELAY TIMERS for Industrial Applications

Time Delay Timers are designed for application on circuit controls where a time delay is required between the closing of one circuit and the predetermined closing or opening of another.

Series TDAF and Series TDAB Time Delay Timers are built to stand abuse, and afford the dependable, consistent operation which modern industrial applications demand.

These timers are designed to handle time cycles up to 3 hours. They employ an external, magnetically-operated clutch that not only assures exceptional accuracy but permits *instantaneous*, automatic reset. Thus these timers are ideal for use where rapid recycling is necessary.

OUTSTANDING FEATURES

Automatic, Instant Reset—As soon as the clutch is disengaged, an internal spring brings the actuating arm back to its reset position in a fraction of a second.

Time Setting Adjustment—Adjustment is accomplished by simply moving the black-button pointer to the time cycle required. Quick, easy, accurate.

Dial—Dials of both series have large, easily read numerals.

SERIES TDAF TIMERS

for panel mounting. Terminal strip for electrical connections located at back. 115 volt and 220 volt, A.C.—25, 50, and 60 cycles. (For time ranges, see chart.)

SERIES TDAB TIMERS

for surface mounting. Terminal strip for electrical connections located at front, below dial. If required, can be supplied in steel housing, as illustrated—eight knockouts for easy hook-up. 115 volt and 220 volt, A.C.—25, 50 and 60 cycles. (For time ranges, see chart.)

TIME RANGES—Series TDAF and Series TDAB Timers

DIAL CALIBRATION	MAXIMUM TIME CYCLE
1/10 Second	5 Seconds
1/4 Second	15 Seconds
1/2 Second	30 Seconds
1 Second	60 Seconds
2 Seconds	3 Minutes
5 Seconds	5 Minutes
15 Seconds	15 Minutes
30 Seconds	30 Minutes
60 Seconds	60 Minutes
2 Minutes	3 Hours

For complete technical data request bulletin 39

MANUFACTURERS OF THESE AND OTHER TIMERS AND CONTROLS FOR INDUSTRY—Cam Timers • Manual Set Timers • Tandem Automatic Recycling Timers • Instantaneous Reset Timers • Running Time Meters

Timers that Control the Pulse Beat of Industry

INDUSTRIAL TIMER CORPORATION
115 EDISON PLACE, NEWARK 5, N. J.

Use of inexpensive drafting table for assembly work

port for the reels of wire used in the operation.

To hold the work in position on a slanting board, four studs are set into the board and the panel is fastened to them with thumb screws. These boards proved much cheaper and yet more satisfactory than conventional benches in the Poughkeepsie, N. Y. plant of International Business Machines Corp.

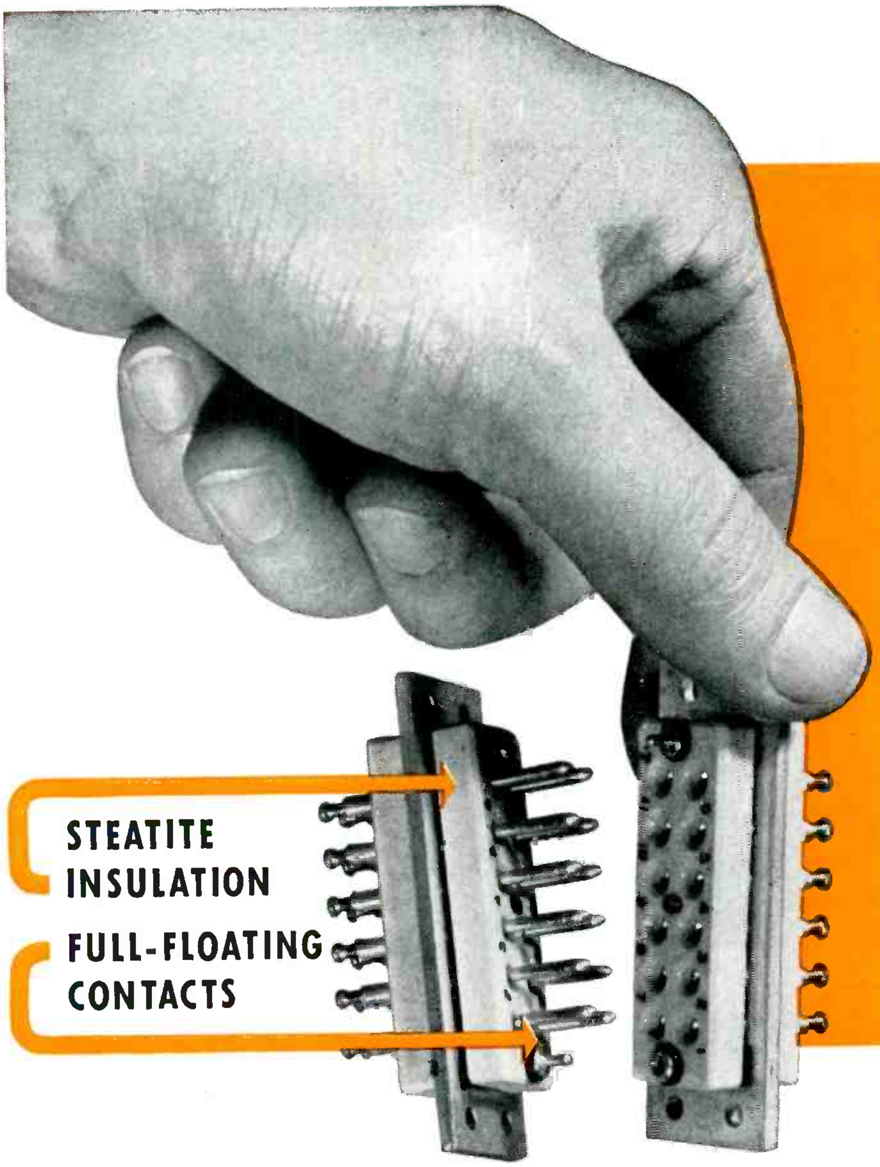
Capacitor Breakdown Tester

By Curtiss R. Schafer

The Liquidometer Corp.
Long Island City, N. Y.

In the capacitor breakdown test unit shown, a d-c voltage, usually equal to twice the rated voltage of the capacitor, is applied for one minute. The on time is controlled

Capacitor tester; hinged box for ten capacitor units, in foreground, is connected to cut off high voltage automatically when cover is raised, to protect operator



Lapp PLUG-AND-RECEPTACLE for Sectionalizing Circuits

SIMULTANEOUS contact of any number of leads can be made or broken by use of Lapp Plug-and-Receptacle units, for panel-rack assembly or other sectionalized circuits. Insulation is Steatite, the low-loss ceramic which is non-carbonizing, even when humidity, moisture or contamination sets up a leakage path. The unit shown above provides twelve contacts, rated for operation at 2.5Kv peak terminal-to-terminal, 1.5Kv peak terminal-to-ground, 25 amps at 60 cps. All contacts are silver-plated; terminals are tinned for soldering. Polarizing guide pins assure positive alignment. Write for specifications of this and other available units, or engineering recommendations for special units for your product.
Lapp Insulator Company, Inc., LeRoy, New York

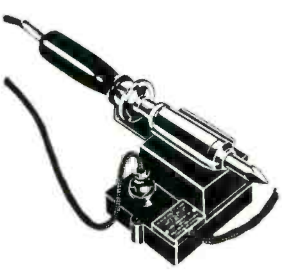
Lapp

American Beauty

Electric Soldering Irons are Service Proven...

Since 1894

These features make American Beauty the Standard-of-Perfection on the world's production lines . . . where dependability, long life and efficiency are demanded.



TEMPERATURE REGULATING STAND

Thermostatically controlled to maintain heat of Iron at any desired temperature while at rest.

- **Nickel-coated, corrosion-resistant tips, easily and quickly replaced**
- **Super-flexible cord, American Beauty made, resists wear due to flexing**
- **Heating element of chrome-nickel ribbon resistance wire**
- **Insulated with pure mica**
- **Built-in adapter for ground wire**

WRITE FOR FREE LITERATURE

A-102

AMERICAN ELECTRICAL HEATER COMPANY
DETROIT 2, MICHIGAN

DOUBLE BARREL

Advertising

Advertising men agree—to do a complete advertising job you need the double effect of both Display Advertising and Direct Mail.

Display Advertising keeps your name before the public and builds prestige.

Direct Mail supplements your Display Advertising. It pin-points your message right to the executive you want to reach—the person who buys or influences the purchases.

More and more companies are constantly increasing their use of Direct Mail because it does a job that no other form of advertising will do.

McGraw-Hill has a special Direct Mail Service that permits the use of McGraw-Hill lists for mailings. Our names give complete coverage in all the industries served by McGraw-Hill publications—gives your message the undivided personal attention of the top-notch executives in the industrial firms. They put you in direct touch with the men who make policy decisions..

In view of present day difficulties in maintaining your own mailing lists, our efficient personalized service is particularly important in securing the comprehensive market coverage you need and want.

Ask for more detailed information today. You'll be surprised at the low over-all cost and the tested effectiveness of these hand-picked selections.

Dept. A

McGRAW-HILL PUBLISHING CO., INC.
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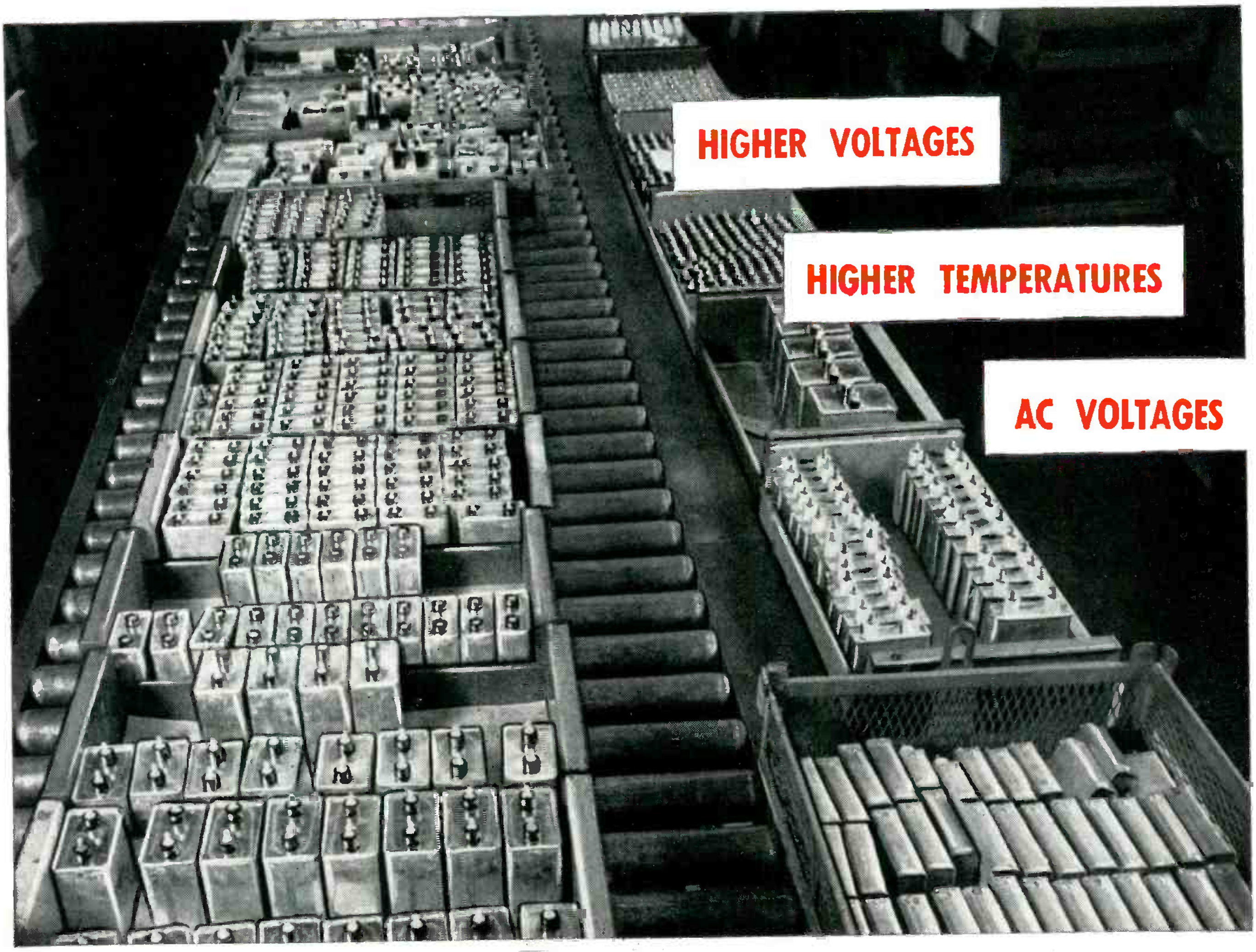


General Electric can show you how to make wider use of JAN-C-25 capacitors

From years of experience in manufacturing paper-dielectric capacitors, General Electric can show you how to make wider use of your JAN capacitors.

These capacitors are used in thousands of applications —primarily d-c at rated voltages and temperatures. However, most JAN units can be operated at other voltages and under widely varying conditions.

For example, actual life tests have shown that a General Electric 1 muf. CP 70 unit rated for a minimum life of 10,000 hours at 1000 v. d-c and 40 C or 700 v. d-c and 85 C, can also be used at:

Higher voltages—1380 v. d-c at 85 C for 500 hours.
1300 v. d-c at 85 C for 1000 hours.

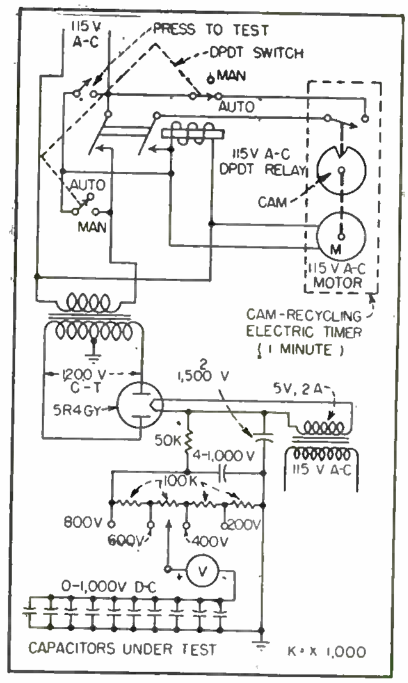
Higher temperatures—105 at 525 v. d-c for 500 hours.

AC voltages—440 volts, 60 or 400 cycles
with normal JAN-C-25 derating.

General Electric has similar data for most of its JAN units, showing how each may be operated under a variety of conditions. For information on how these standard G-E capacitors may be applied in your circuits, consult your Apparatus Sales Office, or write to Specialty Capacitor Sales, General Electric Company, Hudson Falls, N. Y.

GENERAL ELECTRIC

407-307



Circuit gives choice of automatic 1-minute high-voltage test or manually timed application of high voltage to capacitors

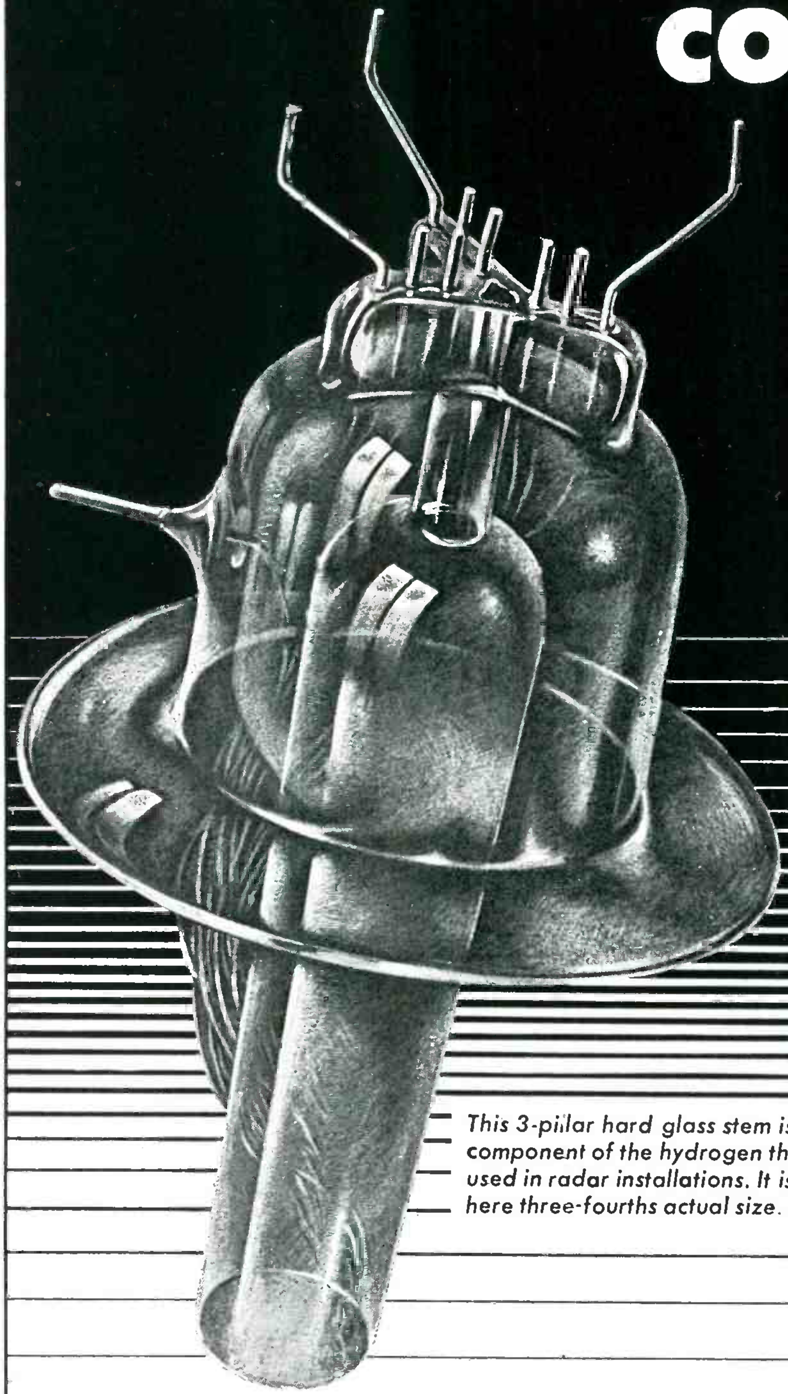
by a built-in timer of the synchronous motor type.

Ten capacitors are tested at a time. The capacitor tray has a hinged cover; when this cover is raised, the high voltage is automatically cut off, to preclude the possibility of shock to the operator. A shorted capacitor causes the meter to indicate the total applied voltage; a capacitor with excessive leakage causes a partial deflection of the pointer. A good capacitor causes only a momentary deflection, depending upon the capacitance value, after which the pointer returns to zero. A meter having a resistance of 5,000 ohms per volt is used. The applied voltage is selected by a switch. If the timer is not wanted, it is switched out and application of the test voltage is controlled by a press-to-test pushbutton switch.

If a shorted or leaky capacitor is indicated in the group under test, the operator must open the tray and remove capacitors one at a time until the faulty unit is eliminated.

In addition to the breakdown test, each capacitor is checked for actual capacitance value and dissipation factor on a General Radio 740-B bridge. A small percentage from each shipment is checked by the

when *production* COUNTS!

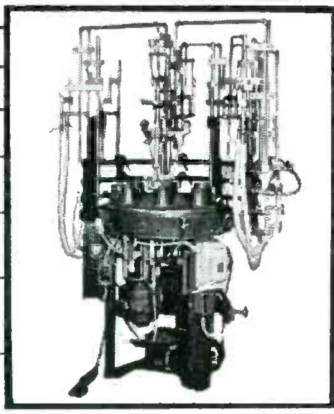


MACHINE-PRODUCED 3-PILLAR HARD GLASS STEMS . . . ANOTHER KAHLE SOLUTION TO DIFFICULT PROBLEMS OF ELECTRONIC TUBE PRODUCTION.

Hand-blown hard glass stems proved too costly for a recent Kahle client. The problem was to find a machine capable of *mass-producing* uniform 3-pillar hard glass stems. Kahle's solution was to design and build the special purpose machine, Model 1958, shown below. This unique, hydrogen-fired machine permits semi-skilled operators to produce the hard glass stems in quantity . . . maintaining rigid quality control.

This is but one of hundreds of problems solved by Kahle. In every case, Kahle's experience and ability have resulted in the design, development and production of a machine engineered to produce results as specified. Working closely with your organization, Kahle's experienced staff of electronic and equipment engineers will, at your request, recommend a solution to your own specialized production problems. Learn how Kahle's more than 40 years of practical experience can benefit you . . . write Kahle now.

This 3-pillar hard glass stem is a vital component of the hydrogen thyratron used in radar installations. It is shown here three-fourths actual size.



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14kc to 250kc
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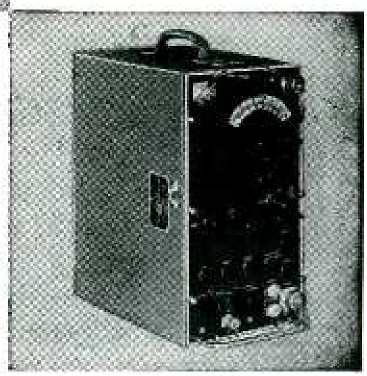
Very low frequencies.



HF **NM - 20A**

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Commercial Equivalent of AN/PRM-1. Self-contained batteries. A.C. supply optional. Includes standard broadcast band, radio range, WWV, and communications frequencies.

NMA - 5A VHF

15mc to 400mc
Commercial Equivalent of TS-587/U.
Frequency range includes FM and TV Bands.

UHF **NM - 50A**

375mc to 1000mc
Commercial Equivalent of AN/URM-17.
Frequency range includes Citizens Band and UHF color TV Band.

These instruments comply with test equipment requirements of such radio interference specifications as JAN-I-225a, ASA C63.2, 16E4(SHIPS), AN-I-24a, AN-I-42, AN-I-27a MIL-I-6722 and others.

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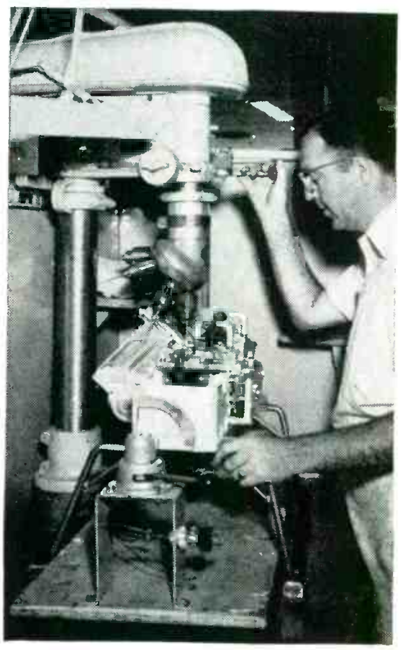
engineering department for hermetic sealing, and for variations in capacitance and dissipation factor over the temperature range from −65 C to +125 C.

These test units have been designed, for the most part, to check components for a production line producing between 200 and 5,000 electronic fuel gage amplifier or indicator units per month. These quantities would not be considered high in the radio or television receiver industry, but they are relatively high for the production of precision aircraft fuel gauges at this time.

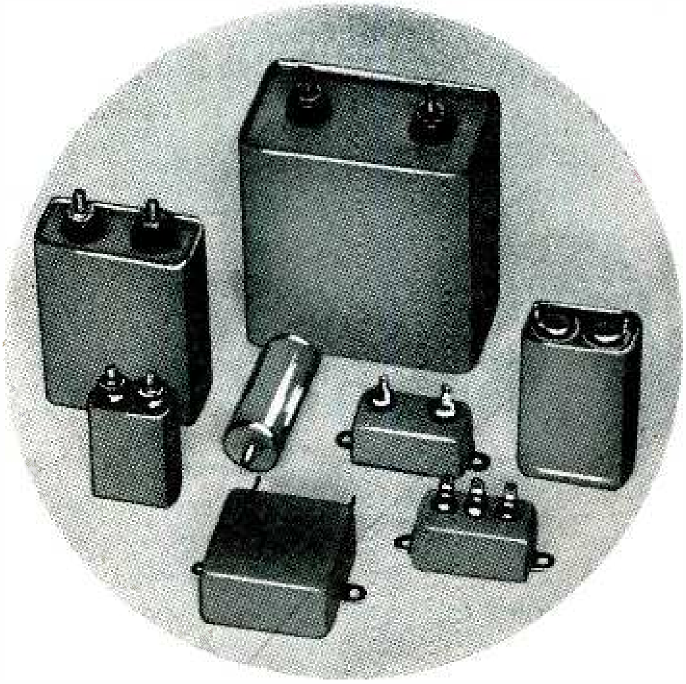
The author acknowledges the skillful work of Arthur Hull in the mechanical layout of these units and their actual construction and wiring.

Chassis-Tilting Cradle

A SINGLE cradle serves for assembly, machining and testing operations on the base unit for an electronically controlled IBM key punch. A Powrarm Junior holding fixture is mounted on a sheet metal pedestal at one end of the plywood pallet, and a plain pivot support for the chassis is bolted to the other end. For drilling operations, a guide fixture is clamped over the chassis and a welded steel frame work is slipped under it to take



Use of multiple-spindle drill press on chassis while mounted in special cradle



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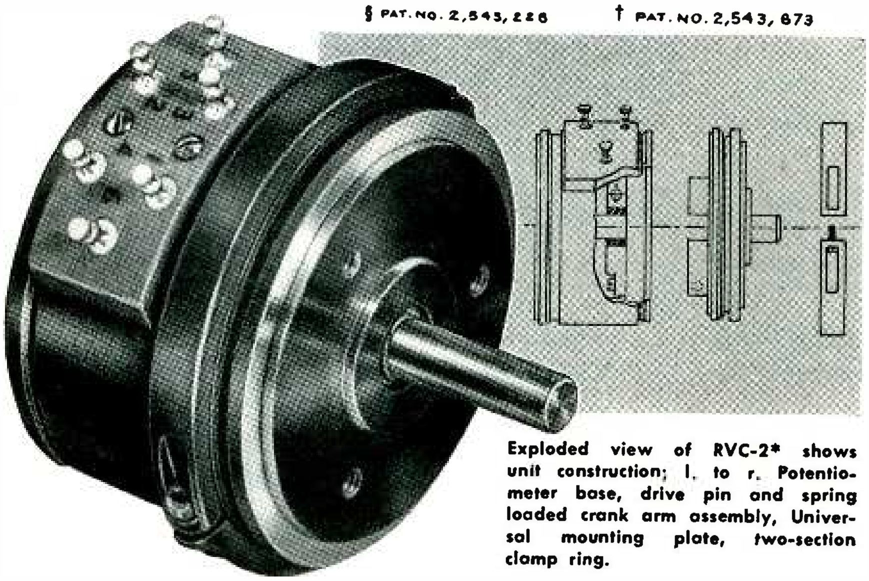

Exploded view of RVC-2* shows unit construction; l. to r. Potentiometer base, drive pin and spring loaded crank arm assembly, Universal mounting plate, two-section clamp ring.

DESIGN FEATURES:

Dual Paliney spring contacts to winding, precious metal take-off contacts; Bases—precision machined aluminum, black Alumilite finish; Oilite bushings, stainless steel shaft.

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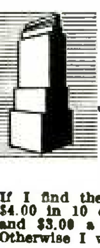

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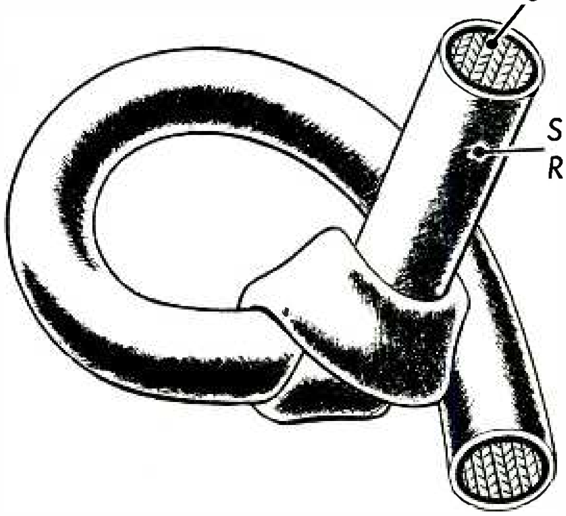

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drilling pressure off the cradle.

For testing, power is applied to a plug mounted on the pedestal. Leads from the plug are connected to the a-c input terminals on the chassis throughout the sequence of test operations in the Poughkeepsie, N. Y. plant of International Business Machines Corp.

TV Alignment Island

IN THE test and alignment section of Emerson's Jersey City television plant, good sets go to the right and bad ones to the left past openings or islands in a wide metal-covered bench. At each island are test facilities, large mirrors and small stocks of spare parts. Access is

Two-man island for testing and aligning television sets. Section of bench in foreground is hinged to provide access

provided by a hinged section of the metal covered bench, the bottom of which often serves for pin-up pictures. A wood fence around the island provides a resting place for the caster-mounted pallets, so that the chassis does not move around during alignment adjustments.

Soldering Plastic Wires to Connectors

TO PREVENT runback of plastic insulation when soldering wires to the terminals of large cable connectors, the terminals are each filled with solder first. Next, the correct stripped wire for a particular terminal is held over the end of the terminal and a soldering iron is applied to the side of the terminal. When the solder inside melts, the stripped end of the wire is quickly inserted without over-heating adja-

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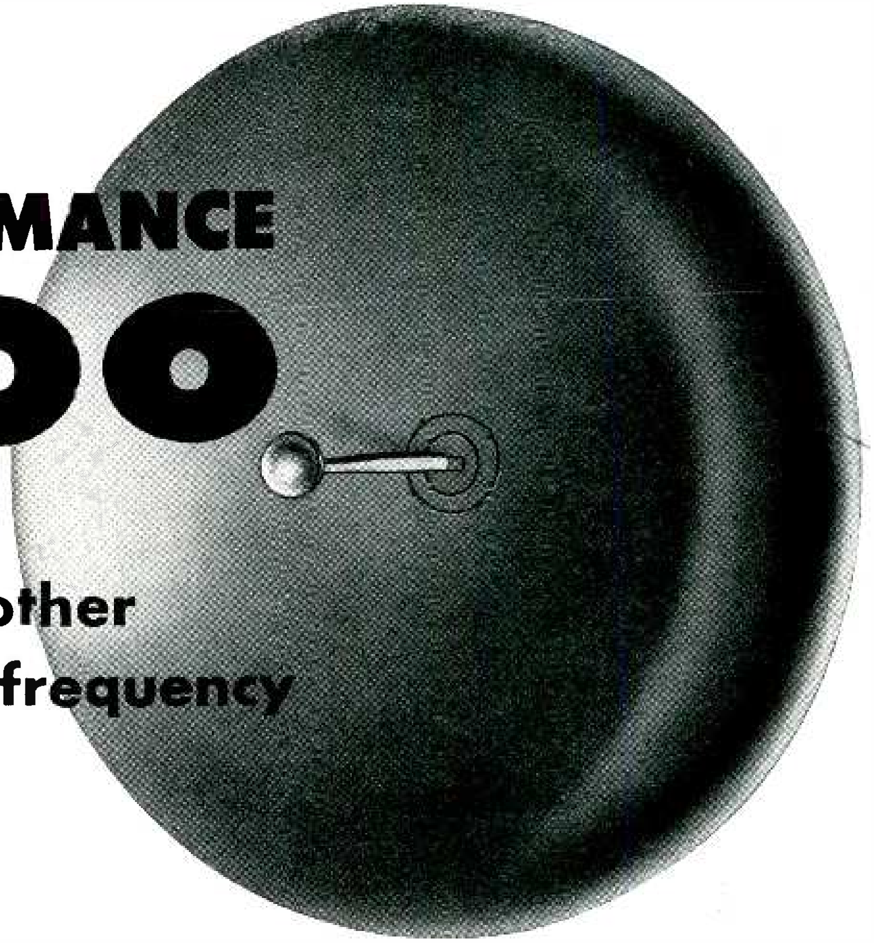
7000 MCS
and every other microwave frequency



The WORKSHOP was the first manufacturer to bring out a complete line of parabolic antennas. Today these antennas are recognized as the *top performers* for all microwave frequencies. This is the result of years of specialization on all types of high-frequency antennas in laboratories with the finest research and test equipment. Normally, we can meet your requirements with our standard equipment but for special applications, reflectors can be supplied in a wide range of sizes and focal lengths.

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	Model 6075			Model 6725			Model 7275		
Frequency Range	5925 to 6175 Mcs.			6525 to 6875 Mcs.			7125 to 7425 Mcs.		
Reflector Size	48″	72″	96″	48″	72″	96″	48″	72″	96″
Gain (db, approx., over isotropic radiator)	34.4	37.5	40.4	35.0	38.5	40.8	36.0	39.4	42.0
Half Power Angles (H plane)	2.86°	1.92°	1.32°	2.50°	1.74°	1.32°	2.42°	1.61°	1.21°
(E plane)	3.24°	2.04°	1.47°	2.79°	1.94°	1.47°	2.70°	1.81°	1.36°

Input Impedance	52 ohms nominal
VSWR	1.3 to 1 or better
Power Rating	1 kw. continuous
Polarization	Either vertical or horizontal available at time of installation.
Side Lobes	25 db down or better
Input Connection	UG-343/U choke flange fitting for RG-50/U (¾″ x 1½″) pressurized waveguide. Standard fitting. Special feeds and fittings on special orders only.
Dish and Feed Heaters	Available for all models. The dish heater capacities range from 400 to 4000 watts. The feed heater draws 20 watts.

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MODEL NO.	FREQUENCY (MCS.)	GAIN* (DB.)	HALF POWER ANGLE E Plane*	HALF POWER ANGLE H Plane*
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2000	1700-2300	27.0-34.5	10.28°-3.65°	9.2° -3.25°

*Gain and Half Power Angles are dependent on size and frequency of parabolas, — 4, 6, 8 or 10 foot diameter.

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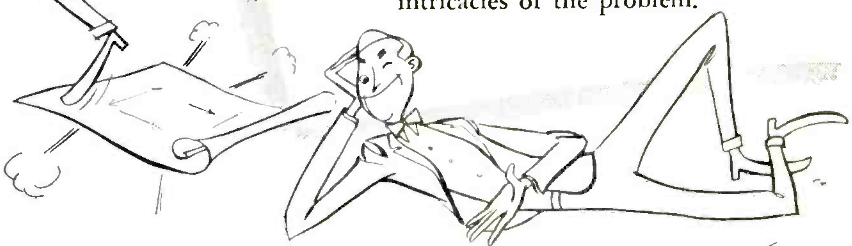

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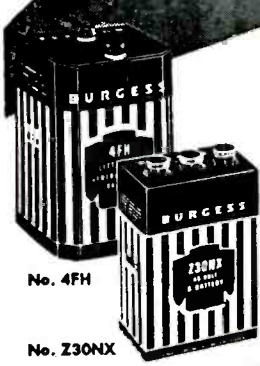

No. 4FH

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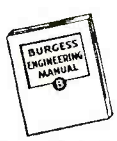

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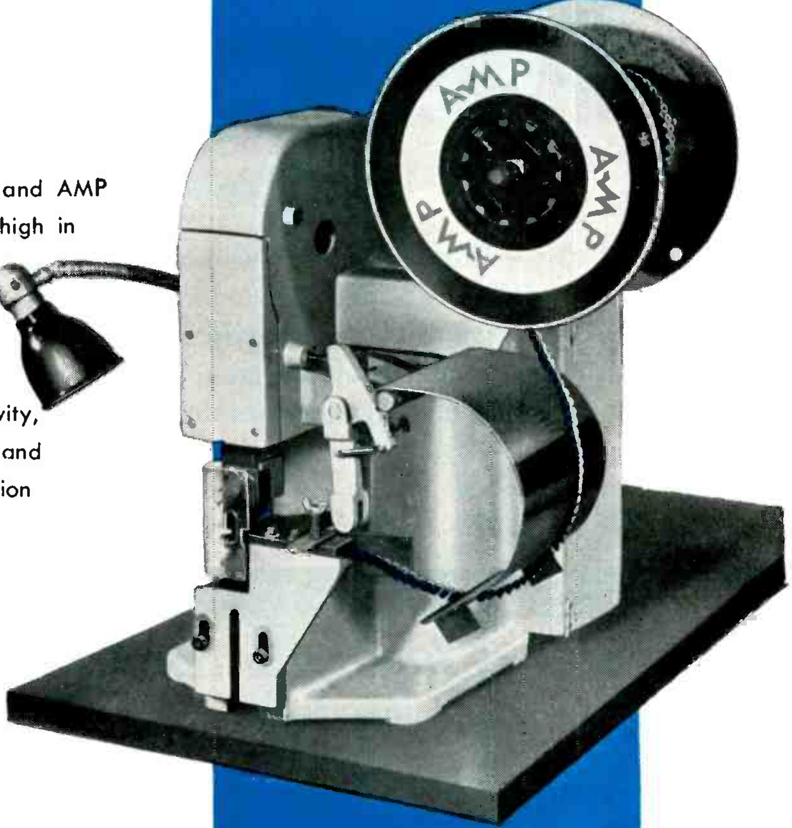

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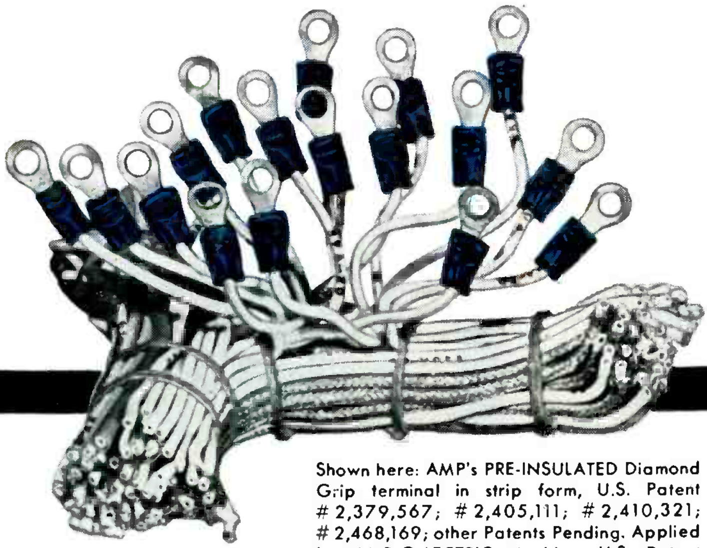

Shown here: AMP's PRE-INSULATED Diamond Grip terminal in strip form, U.S. Patent # 2,379,567; # 2,405,111; # 2,410,321; # 2,468,169; other Patents Pending. Applied by AMP-O-LECTRIC Machine, U.S. Patent # 2,396,913; other Patents Pending.

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Method of soldering wire to cable connector without softening plastic insulation. Wood block serves as fixture for holding connector outside of transmitter housing during assembly

cent plastic insulation. This technique is used in the military radio section of Federal Telephone and Radio Corporation's Clifton, N. J. plant.

Clips Hold Leads

DURING wiring of a 275-socket electronic calculator panel, alligator clips are used freely to hold longer leads in position temporarily. After shorter wires have been put in, the long leads become automatically locked in position and the clips can be removed. This technique has proved highly satisfactory in IBM's Poughkeepsie, N. Y. plant.

Alligator clips hold long leads in position temporarily until enough additional wires have been added to give effect of weaving that locks all wires in position

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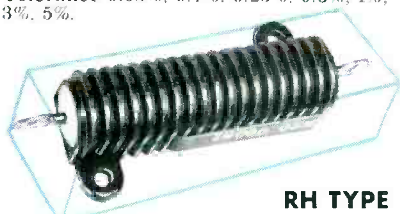
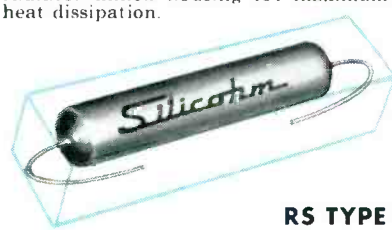


RH TYPE

Available in 25, 50 and 250 watt sizes. Silicone sealed in die-cast, black anodized radiator finned housing for maximum heat dissipation.



RS TYPE

Available in 2 watt, 5 watt, and 10 watt sizes. Silicone sealed offering maximum resistance to abrasion, high thermal conductivity and high di-electric strength.

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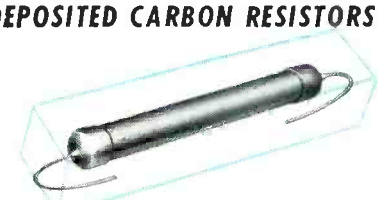

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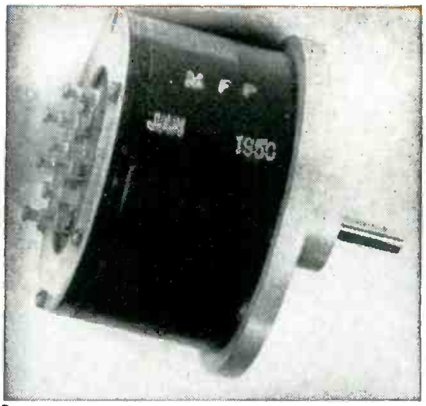
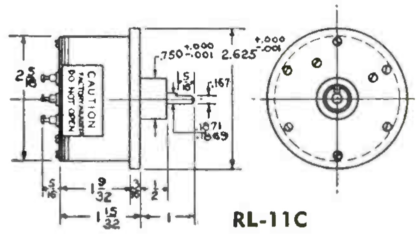


PRECISION POTENTIOMETERS

SINUSOIDAL TYPE



CONDENSED SPECIFICATIONS	RL 11-C	RL 14-MS
Total resistance	16,000 ± 10%	35,400 ± 1%
Percent resistance within brush circle	Approx. 85%	99 ± ¼%
Angle of rotation	360°	360°
Weight	4.75 oz.	1.8 lbs.
Torque (Approximate)	¾ oz. in.	2 oz. in.
Wire	80 Ni 20 Cr	80 Ni 20 Cr
Resolution	.4°	.2°
Angular accuracy	±.6°	±.5°
Amplitude accuracy	±.8%	±.6%
Maximum volts across winding	150	350
Maximum speed	60 rpm	60 rpm
Expected Life	350,000 cycles	200,000 cycles

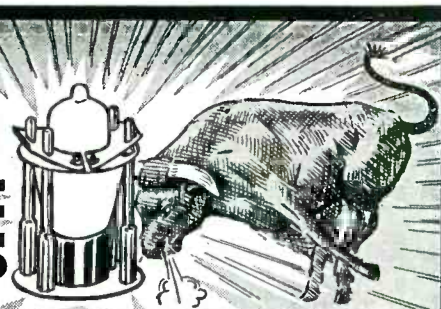
Illustration shows RL-11C unit, RL-14MS unit is approximately twice as large. Minor variations of these standard designs, available on special order, permit operation at high rotational speeds with some loss of accuracy but, with a substantial increase in expected life. Sine and cosine voltages are produced simultaneously. Resistances other than those shown above are available within certain limits.

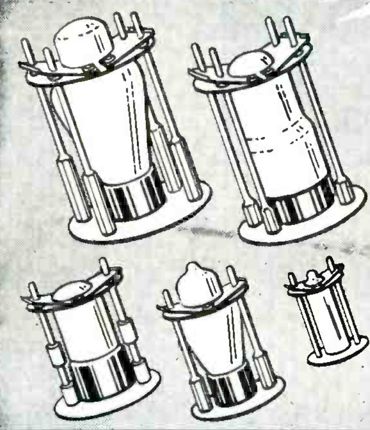
FOR COMPLETE DETAILS SEND FOR BULLETIN F-68-A

THE GAMEWELL COMPANY

NEWTON UPPER FALLS 64, MASSACHUSETTS

SHOCKPROOF VACUUM TUBE RETAINERS





These retainers are used to secure Vacuum Tubes and to resist side motion of Vacuum Tubes used in radio equipment which is subject to shock and vibrations. These retainers meet the requirement of all JAN specifications. The insulated portion is made of a melamine base Fibre Glass Phenol which provides 300 volts insulation to ground and withstands a temperature of 350 F. The insulated plate can readily be fastened or released by hand.

Available for envelope types T7, T8, MT8, T9, T12, ST12, T12ZDI, ST14, S14, ST16, T5½, T6½, MT-IC, ST19, T14, ST128CT-9.

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NEW PRODUCTS

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Testing Devices For Laboratory and Industry Are Described . . . Variety of New Components Included . . . Thirty-Six Recent Manufacturers' Catalogs Reviewed (p 374)

OTHER DEPARTMENTS featured in this issue:

Intermodulation Meter

D&R, Ltd., 402 E. Gutierrez St., Santa Barbara, Calif. Model IM-3B intermodulation meter features compactness, simplified operation, high stability and reduced weight. The instrument is provided with high impedance input terminals for bridging at any point within an amplifier. In this manner the contribution of any stage to the total intermodulation factor may be readily determined. A vtvm is provided, having a flat frequency response throughout the range of the instrument, and a sensitivity of 10 mv full scale. The lowest full-scale intermodulation reading is 1.0 percent, and the inherent intermodulation of the instrument is less than 0.1 percent.

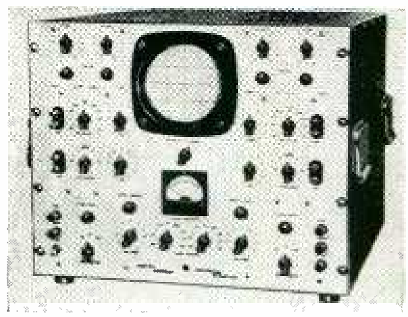
Pressure Transmitter

Wright Engineering Co., 180 E. California St., Pasadena 1, Calif. A new pressure transmitter, the Digitran, is available for ranges from 0 to 3 psi absolute to 5,000 psi absolute. It was designed to satisfy the requirements for digital computers, automatic process control and digital recording systems. By using the magnetic field vibrating wire principle, the instrument generates a frequency output variable with pressure, or other physical variables. The use of the stable frequency output can be counted for a specified period of time and a digital number is provided in the electronic counter equal to the pressure experienced. This new technique realizes increased accuracy, resolution, readability and recording without the need for additional conversion equipment to digital numbers.

TV Booster

Turner Co., Cedar Rapids, Iowa, is producing a new model of its television booster. The model TV-2 employs the cascode circuit, which is noted for its low noise factor, in combination with the Inductuner. The unit tunes continuously over tv channels 2 to 13 with single-knob tuning. A three-way control switch turns on set only, set and booster, or turns off both set and booster simultaneously. The unit is supplied complete with twin-lead lines for quick connection to the receiver.

A simple terminal strip accommodates either 75-ohm coaxial or 300-ohm twin-lead transmission lines.



Dual-Channel Oscilloscope

Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa., announces model H-21A general- purpose twin-channel oscilloscope that displays two independent signals on the face of a single 5-in. crt. Each of the two channels has individual controls for intensity, focus and positioning of the X and Y axes. Both input signals can be observed either on a common or on separate time bases. Sweep circuits with a range from 2 to 50,000 cps can be triggered externally with a delay of less than 1 sec. Either internal or external sync may be selected. A built-in, direct-reading calibrator supplies a 60-cycle square wave to either vertical amplifier. A panel voltmeter indicates continuous calibration voltage from 0 to 1.5 v peak-to-peak. Range is governed by a built-in attenuator per-

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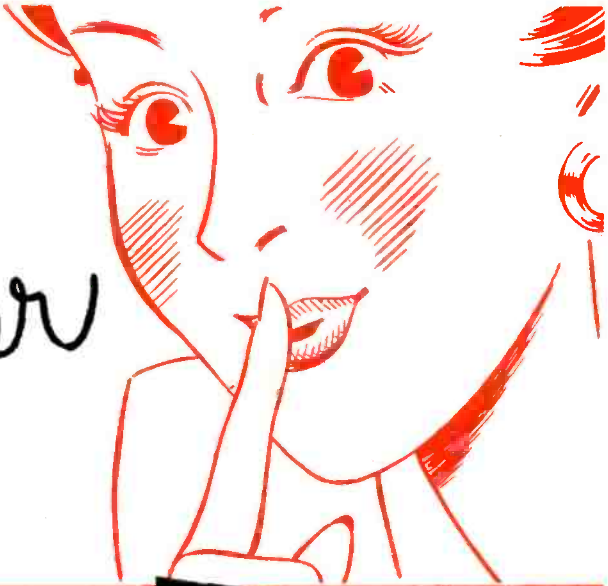

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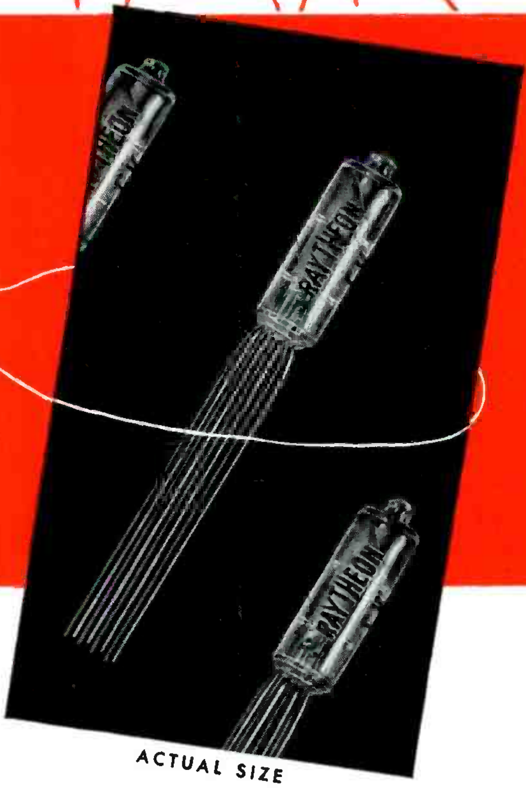

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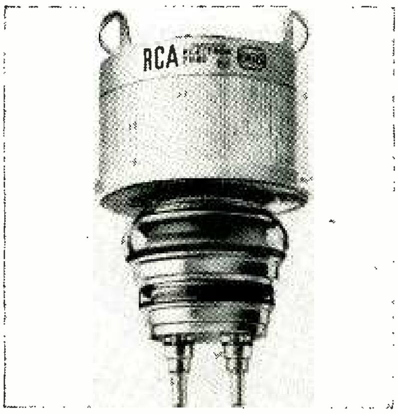
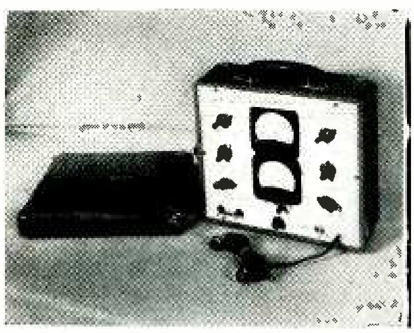


Power Tetrode

Radio Corp. of America, Harrison, N. J. The forced-air-cooled power tetrode type 6166 is designed for vhf service in tv and c-w applications. It has a maximum plate dissipation of 10 kw, is rated for operation up to 220 mc, and utilizes an economical thoriated-tungsten filament. The tube can deliver a synchronizing-level power output of 12 kw in broad-band tv service at 216 mc; and a power output of 9 kw in class C f-m telephony service in circuits operating at 216 mc. The coaxial electrode structure of the 6166 is designed especially for use with high-power circuits of the coaxial-cylinder type. The design provides low-inductance, large-area, r-f electrode terminals for insertion into the cylinders, and facilitates multiple use of the 6166 in cavity circuits.

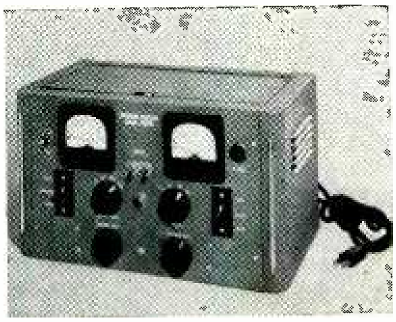


Germanium Diode Checker

General Electric Co., Syracuse, N. Y., has announced a germanium diode checker for use in laboratories, quality control groups, service shops and wherever a need exists for checking static characteristics of diodes. Among the device's other uses are general resistance checking, an accurately metered power supply, and forming electrolytic capacitors and checking d-c leakage current. The type ST-12-A has test clips for diodes having leads, and for those with pins on each end. Diode resistance is checked by placing a variable accurately-metered d-c voltage across the diode. A three-inch voltmeter and three-inch current meter permit voltage and current to be metered simultaneously. A chart of manufacturer's limits for about 40 of the most commonly used diodes is secured in the cover of the new unit.

Radiation Detector

Jordan Electronic Mfg. Co., Inc., 9042 Culver Blvd., Culver City, Calif. The Radector, a radiological monitoring field unit for civil defense, military or industrial use, utilizes the Neher-White ionization chamber. The unit is designed to measure from 0.02 roentgens per hr to 500 roentgens per hr on a large, easy-to-read, logarithmic scale. Powered by only $4\frac{1}{2}$ v, without the need of amplification, it has eliminated such troublesome components as vibrators, rectifiers, voltage regulators, capacitors, high megohm resistors and transformers. It measures 5 in. × 3 in. × 3 in. and weighs only 2 lb. It has a performance record of 168 hours of continuous use with no drop in meter reading. Demonstrable accuracy is within less than ±10 percent of radiation intensity shown anywhere on the scale.



Diode Tester

Computer Research Corp., 3348 W. El Segundo Blvd., Hawthorne, Calif., has developed an instrument for testing the dynamic as well as static characteristics of crystal diodes. Where large numbers of diodes are used in plug-in form, the diode tester can also be used for periodic circuit checks to detect potential diode failures before they occur. The unit occupies a space less than $\frac{1}{2}$ cu ft, and will accommodate diodes with forward currents of 0 to 100 ma and back currents of 0 to 1,000 μa. Forward voltage is measured to an accuracy of 2 percent and back current to 3 percent. The tester is adaptable to high speed, volume testing and operates on 115 v, 60-cycle current, using 100 watts or less.

Pulse Transformer

Engineering Research Associates, Inc., 1902 W. Minnehahah Ave., St. Paul W4, Minn., has developed a new multipurpose miniature pulse transformer designed especially for use in low-power applications. Type 130A1 transformer has several features: Its three isolated windings provide versatility of application: compact transformer design permits mounting on a tube strip or chassis in approximately the same space required for a standard miniature tube; short

New! hp

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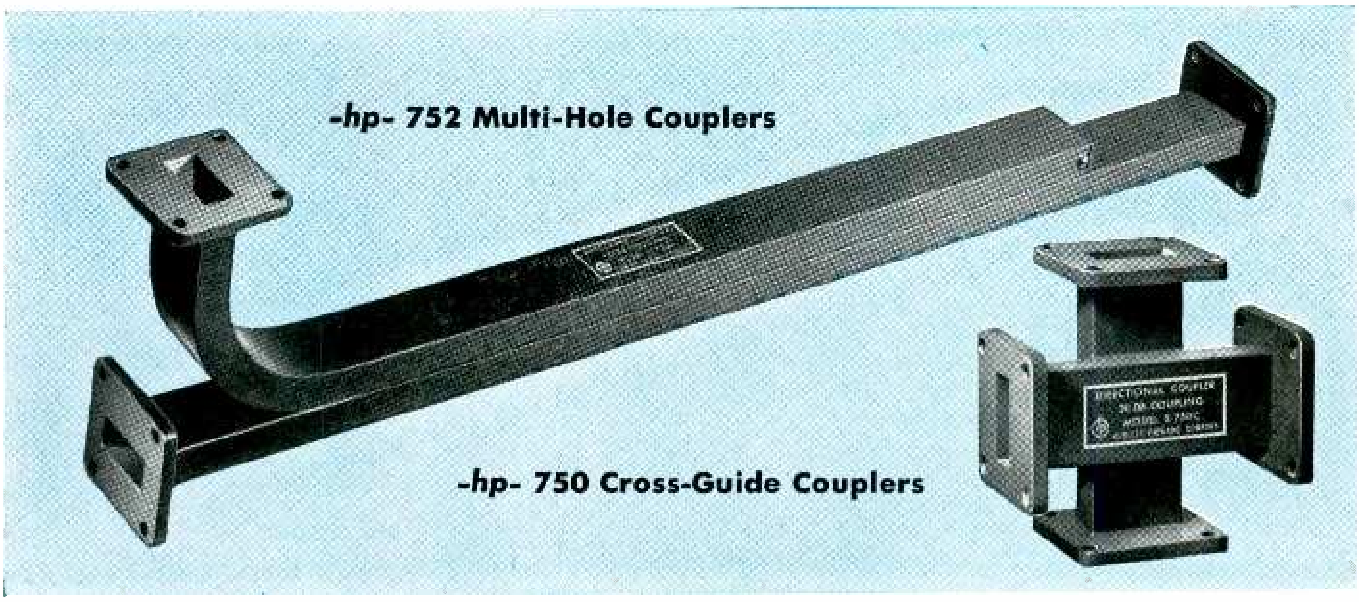

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-hp- 752 Multi-Hole Couplers

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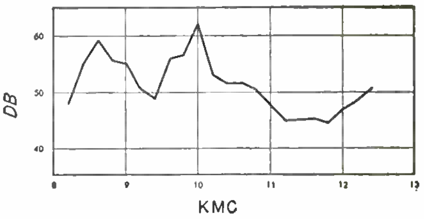
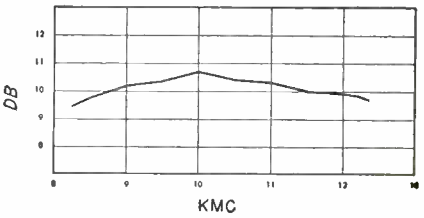


Typical over-all directivity, *-hp-* 752, 10 db model



Typical coupling, *-hp-* 752, 10 db model

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rise time and small droop minimize critical associated circuit design problems. Typical applications include triggering and counting circuits, blocking oscillators, d-c isolation, inversion, pulse-shaping and pulse-transmission circuits.

UHF Tuner

General Instrument Corp., 829 Newark Ave., Elizabeth 3, N. J. A new and unique approach to uhf tuners is characterized in the model 60 (illustrated) that features very low noise factor, better sensitivity, no sliding contacts, straight-line-frequency dial calibration and full uhf channel coverage. It can be fitted and mounted in any position around a vhf tuner. A typical application is shown above, where the model 60 is used in conjunction with model 48, 13 position vhf turret tuner, 3-shaft design, with built-in reduction drive for fine tuning.

Selenium Rectifier Tester

Galvanic Products Corp., 110 E. Hawthorne Ave., Valley Stream, N. Y. Model 100A Seletester, for

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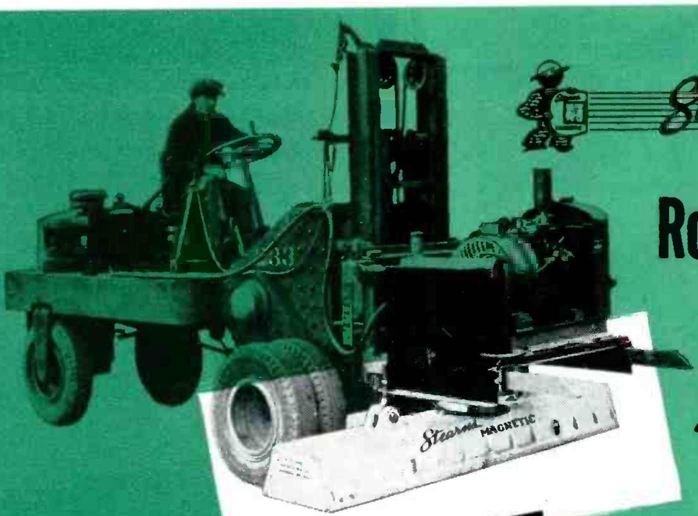

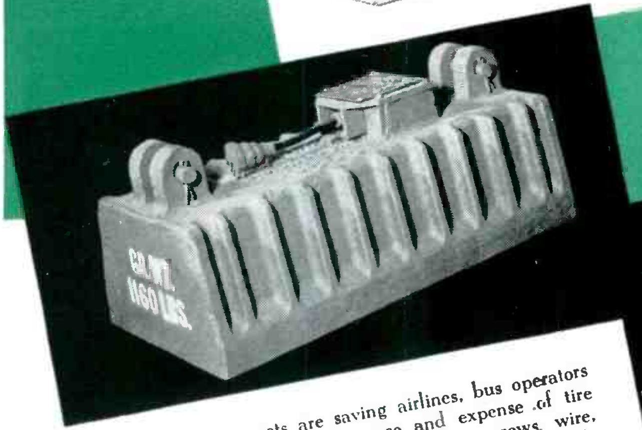

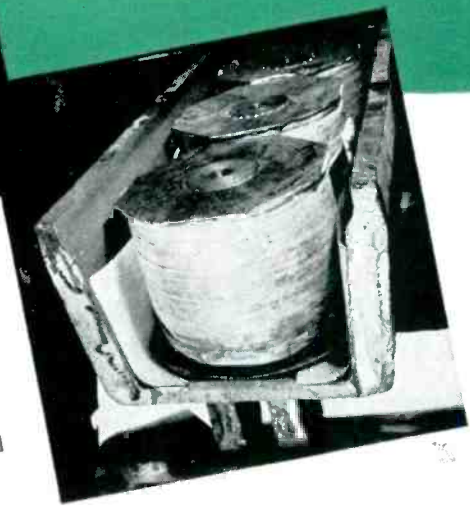

Stearns road magnets are saving airlines, bus operators and motorists from inconvenience and expense of tire repairs by removing tons of nails, spikes, screws, wire, and other scrap metal from runways and highways. In many cases, the metal recovered more than pays for the operation of the magnets. Coils of these highly specialized, heavy-duty magnets are built to last. They are insulated and protected with Natvar Silicone Coated Fiberglas because of its excellent electrical and mechanical characteristics, particularly its ability to withstand heat and moisture.

Stearns Magnetic, Inc., Milwaukee, manufactures magnetic clutches, brakes, separators, pulleys, drums, and other magnetic devices and equipment for industrial uses, where reliability of performance is essential.

This calls for a highly specialized engineering knowledge of magnetism, its practical application to specific problems, and a thorough familiarity with the characteristics of materials under actual operating conditions. Natvar Silicone Coated Fiberglas was selected for their road magnet because of its proven resistance to heat and moisture.

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testing selenium rectifiers as used in radio and tv receivers, provides means for testing for (1) forward resistance, (2) reverse leakage currents, (3) "opens" and (4) "shorts". It provides positive, fast and accurate tests for all stacks rated at 10 to 1,000 ma. The Seletester will also test any new miniature selenium rectifiers which may be introduced, without any adaptors or other equipment. Input is 117 v, 60 cycle a-c.

Inspection Instruments

ENGINEERING DEVELOPMENTS, INC., 32 West Pelham St., Newport, R. I., has introduced its latest types of Magnivision inspection devices and assembly aids. The units are essential for accurate viewing of fine detail for all classes of inspection and assembly of machined parts, wire, tubing, radio parts, crystals, electric relays, meter assembly and many other uses around the shop. Magnivision gives strain free vision, stereoscopic vision, shadowless vision and cool intense light with no discomfort due to heat ordinarily present from filament lamps.

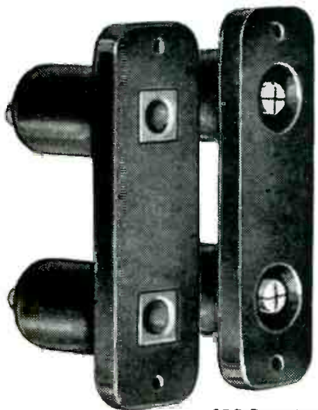
Maintenance Instrument

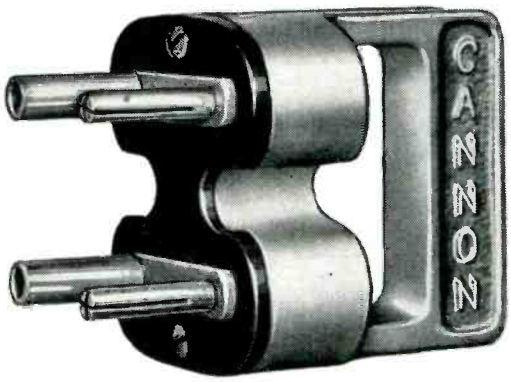
ANCO INSTRUMENT DIVISION, 4254 West Arthington St., Chicago 24, Ill., has announced the Elec-Detec, a portable electronic maintenance instrument for locating trouble in machinery and other moving mechanisms. This electronic stethoscope helps maintenance men locate friction noises in engines, gears, shafts, transmissions, traps, valves and

CANNON PLUGS *for laboratory and switchboard*


CSR Tandem Receptacle
CSP Plug

Here are a few examples of Cannon's Experimental Laboratory and Switchboard Connectors. They are used extensively throughout industry, public utilities, sound studios, broadcasting stations, college and university physics and chemistry laboratories, in AC network analyzers and electronic analog computers. They may be applied wherever quick disconnect switching and patch cord plugs are required. High grade materials are used throughout. Molded phenolic of high dielectric strength is used for insulation. Both pin and socket contacts are machined from solid brass. Some are silver plated. All are rated at 75 amps. Pin contacts are split for low loss seating in tapered bore sockets. Single contact fittings are supplied in either red or black phenolic to designate direct or alternating current circuits respectively. Two-contact and larger plugs have sand-blasted cast aluminum shells and handles with clear lacquer finish. Various combinations of pin and socket contacts are used as a polarizing guide. For further information write for Bulletin LS5-1951.


SDR Receptacle
SDP Receptacle

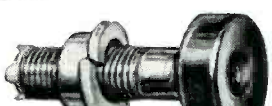


SWPR-4 Switching Plug having both pin and socket contacts


SR Receptacle


SCR Plug


SCP Plug


SRB Receptacle

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THE *Better* PLASTIC U. H. F. INSULATION

BECAUSE OF:—

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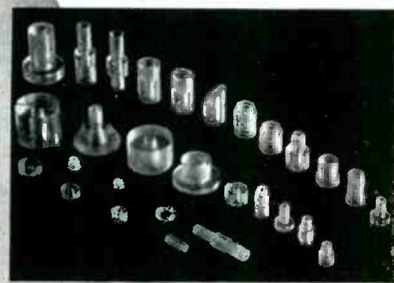
- high heat resistance
- dimensional stability and extremely low initial cost



Rexolite 1422 has been specifically designed and developed to meet the growing need for a lightweight — low cost U. H. F. insulating material.

Rexolite 1422 is available for immediate delivery as centerless ground rod in any diameter up to 1". Also cast in larger diameter rods and sheets.

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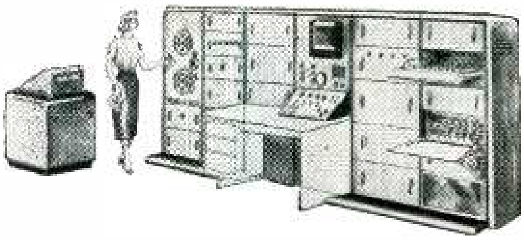
ASCOP

PRECISION ENGINEERING IN ELECTRONICS

Telemetering and Data Handling Equipment

Special Components

GROUND STATION EQUIPMENT



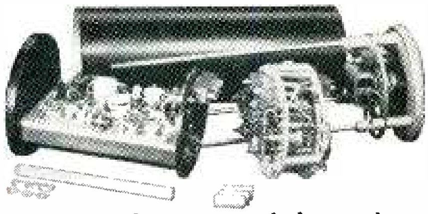
Installations for reception and all forms of handling and reduction of data from pulse width and FM/FM radio telemetering systems • Custom-engineered and custom-built to hold equipment to a minimum consistent with accuracy, operation ease, reliability • Functional mounting of components assures servicing ease — and flexibility for ready unit expansion with any of the following:

- *Specialized receiving equipment*
- *Magnetic tape field storage and playback*
- *Regenerative integrator for PM signals*
- *Channel selector for PW systems with automatic zero and channel sensitivity adjustments, and automatic missing pulse insertion.*
- *Oscillographic film reader, with line center finder*
- *Tabulated numerical output*
- *Punched card output*
- *Graphical output*

DATA HANDLING EQUIPMENT

Automatic or semi-automatic devices for marked reduction of time, expense, man-power usually required to place volumes of recorded data in final usable form • Input data — film records, varying DC voltages, magnetic tape recordings, etc.— processed point by point, at high rates, with automatic correction for zero drift, scale factor, and measuring system non-linearities • Outputs available as continuous plots on film or paper, with scale and time coordinates, as DC voltages, as pulse coded signals for remote transmission, or as electrical indications for existing tabulating and card punching devices • All systems custom-designed for accuracy and economy; custom-assembled from special purpose components devised in continuous engineering of data handling systems.

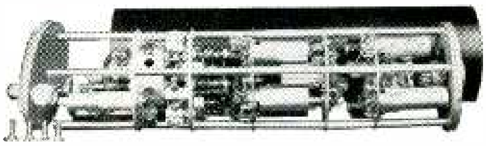
PULSE WIDTH RADIO TELEMETERING



PW/PM Small, rugged units particularly suited to vehicular use where many different variables must be continuously transmitted.

- 30 data channels
- 215-235 mc Carrier-crystal controlled
- Based on RDB telemetering standards
- 4 watt RF power output
- 30 cps sampling rate
- 1% system accuracy
- ½% linearity
- 0-5 volt DC inputs
- 60 g sustained acceleration
- −40° to +60°C
- Vibration —⅛ in. at 60 cps
- Single or two package form
- 3¼ in. diam.; 17 in. length; 7 lbs. weight
- Primary power 28 volts, 3.5 amps

Note: *Also available without dynamotor. Transmitters available separately. Integral subcommutator if more channels are desired*



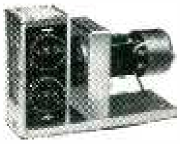
PW/FM For higher power output, with space no factor. Stable, highly reliable over long distances. Components readily accessible for replacement to extend unit life.

- Based on RDB telemetering standards
- 215-235 mc Carrier
- Max. drift — .04%
- 10 watt RF power output
- 30 data channels
- 30 cps sampling rate
- 1% system accuracy
- ½% linearity
- 0-5 volt DC inputs
- 60 g sustained acceleration
- Vibration: ⅛ in. at 60 cps
- 10 kc oscillator supply for AC pickups included
- 4¼ in. diam.; 30 in. combined length; 17 lbs. combined weight
- Primary power 28 volts at 5.7 amps.

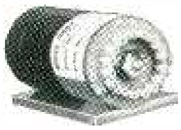
Note: *Model PAD-1 Power Amplifier-Dynamotor unit may be added to increase transmitter power to 40-50 watts. Transmitter of Transmitter-Dynamotor packages available separately.*

HIGH-SPEED ROTARY SAMPLING SWITCHES

ASCOP designs and manufactures switches to your most difficult and exacting requirements. Here are a few typical examples



TYPE T Built to withstand vibration, shock, temperature and altitude extremes. Switching designed for airborne radio telemetering systems. DC motors for 27, 12, and 6 volts. Up to 4 poles, each with 30 contacts. Sampling speeds from 0.1 to 20 rps.



TYPE U Custom-designed for limited space applications. Complete with DC drive motor, yet only 1 in. in diameter. A single pole samples 32 fixed contacts at the rate of 100 rps.

TYPE L For high performance with space secondary. Single pole samples 120 fixed contacts at rates up to 30 rps. Connection to external drive through ¼ in. steel shaft running in sealed ball bearings. Special contact material for long service-free life.

TYPE V For precision in sampling speed plus long life. Synchronous drive motor permits selection of single pole sampling of 60 fixed contacts at many rates from 1 rps. to 1 rev. per day. Adaptable, through variety of mountings and terminals, for use as a component of industrial instrumentation systems.

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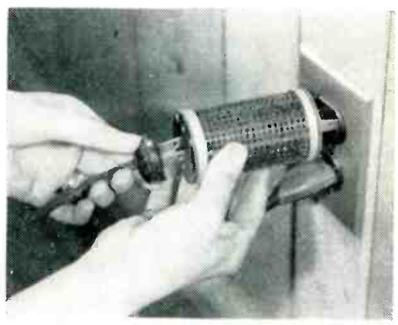
pipe lines. The instrument uses a metal probe which serves as a microphone to locate the exact source of tell-tale noise. Noise impulses are transmitted through an amplifier to headphones.

Mobile Transmitter

E. F. JOHNSON CO., Waseca, Minn. Designed primarily for under-dash mounting in autos, the Viking mobile transmitter is capable of 60 w input, 100-percent a-m modulated, on the 75, 20 and 10 meter amateur bands. The unit is completely bandswitched and has provisions for one additional band. Additional features include: receiver muting, front panel audio gain control, gang tuning and provision for push-to-talk operation.

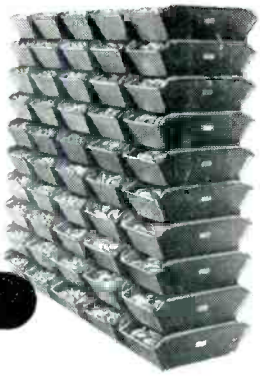


TV Ballast

CLAROSTAT MFG. CO., INC., Dover, N. H. The tv ballast is designed primarily to be plugged in between tv set and electric receptacle, for use in areas where line voltage tends to increase up to 140 v. The unit operates on the ballast principle, whereby, as voltage increases, the resistance increases, giving an increased drop across the resistance, thus allowing a lower poten-

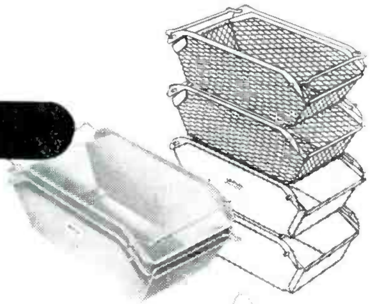
STANDARD BOXES *for* SPECIAL JOBS!

No matter what business you are in—or what problems you have in handling small parts, there is a standard NesTier custom-made to fit your requirements. A production line product, the NesTier effects savings in initial cost as well as on the job—from stock room to loading dock.



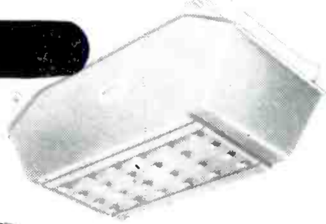
STOCK ROOM OR STORAGE

Nowhere else will you find a box that will serve alone as a permanent stock room fixture. No racks are necessary as tiered units lock themselves together to form rigid stacks. Parts in all units are visible and accessible.



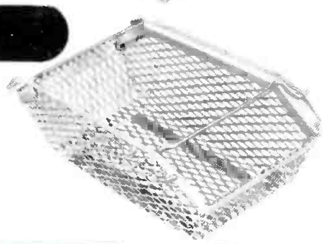
PRODUCTION

NesTiers were designed primarily for production line work. Empty, they nest to save space. Filled and tiered, they lock together with contents of all units visible and accessible. Filled or empty, they are easily transported by truck, roller or overhead conveyor—even by hand.



DRAINAGE

Here is the standard one-piece sheet steel NesTier with a lanced bottom that permits rapid drainage of contents without allowing even the smallest parts to slip through. No need to transfer parts requiring drainage when this box is used.



DEGREASING

The necessity to change boxes for any cleaning, dipping or degreasing operation has been eliminated with this NesTier expanded metal basket. Formed in the distinctive NesTier shape, this unit is as rugged as the solid sheet steel box and retains all of the outstanding NesTier features.

PROTECTION

NesTier fibre inserts actually perform two functions. Parts are protected against damage from metal box and a variety of parts may be placed in one box without becoming mixed. Furnished with or without dividers.

SHIPPING

The NesTier one-piece "snap on" lid keeps parts from jouncing out while being transported through the plant or from plant to plant. Filled units with lids attached can be tiered, allowing parts to be stored or transported and yet keep clean.

NesTiers are formed of one-piece sheet steel, with or without lanced bottom; zinc plated expanded metal, galvanized, stainless steel or aluminum. All units and accessories interchangeable. Two standard sizes.

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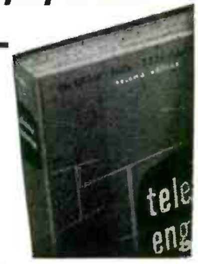
Understand TV Technology *fundamentals* • *circuits* • *equipment*



Here is the volume that gives you working knowledge of the complete television system—prepares you fully for technical work in designing television systems—operating television equipment—or understanding the details of receiving equipment. Much has been done in advancing television technology in the past few years—much more is to come. This book gives you the essential grounding and the knowledge of today's practice that will equip you to take advantage of the opportunities ahead in this great field.

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Editor, *Electronics;* Vice Chairman, National Television System Committee

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This outstanding book meets the need for grounding in the engineering and technical fundamentals of television. The whole television process, from studio to receiver, is covered. Aspects peculiar to television technology, such as scanning and wave-form analysis, illumination and colorimetry, camera tubes and picture tubes, are treated in detail, starting from first principles. The principles of operation of television systems, in black-and-white and color, are covered, and the book describes in detail the design, operation, and use of television equipment.

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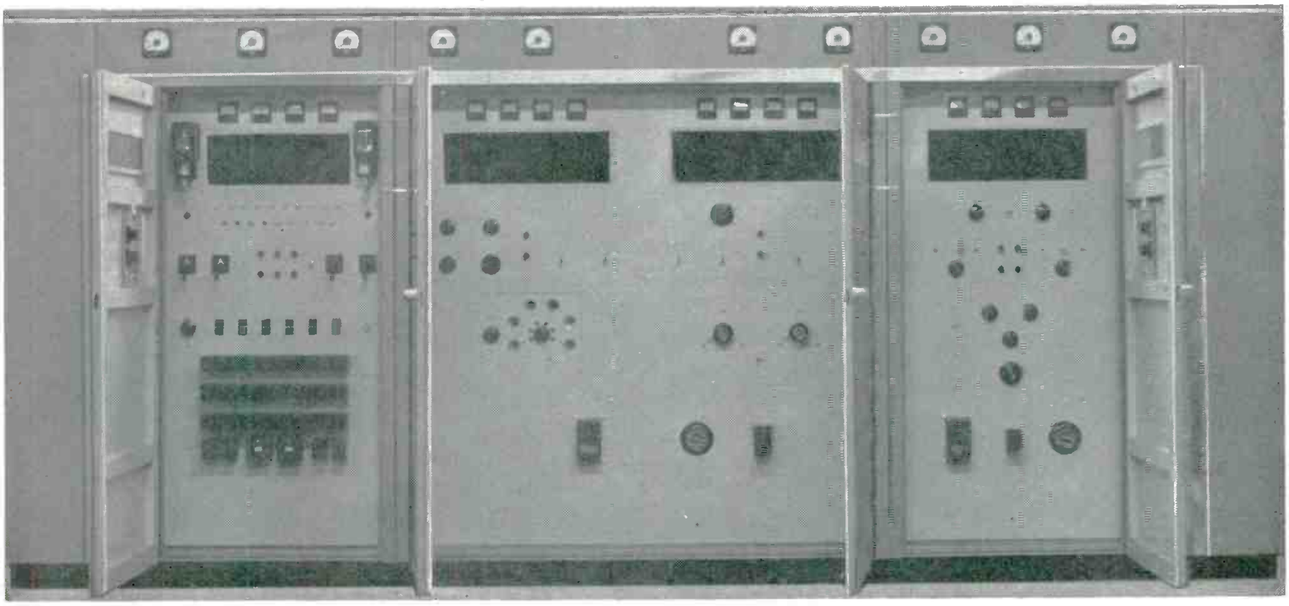

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25 / 40 KW Short Wave Broadcast and Communication Transmitter

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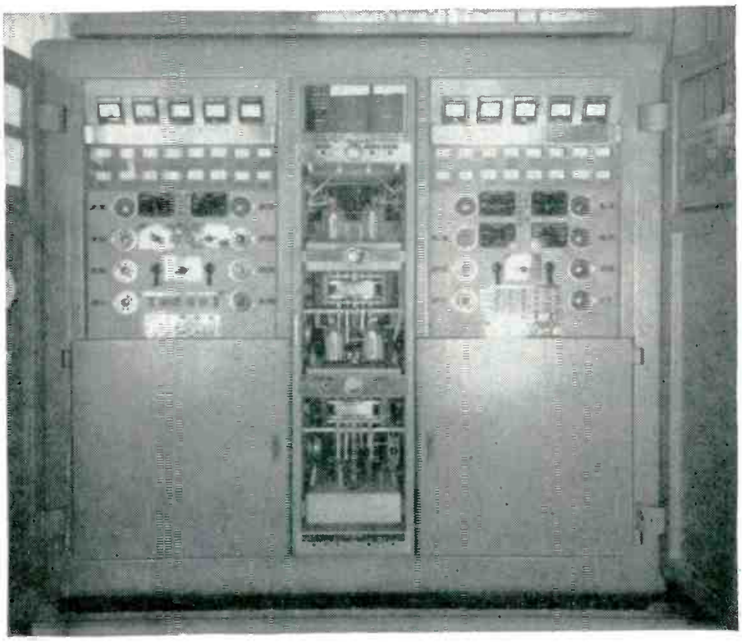
Inquiries invited . . .

Our engineering department is prepared to submit proposals upon receipt of inquiry.



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tial to be applied to the tv set. At 110 v and under, the voltage drop is negligible; but with increases up to 140 v, the voltage applied to the tv set will not normally increase much above 115 v, depending on the load applied. They are available in type TVA, 200 to 300 w; and type TVB, 300 to 375 w.

Monitor Kinescope

RADIO CORP. OF AMERICA, Harrison, N. J. The 10SP4 directly-viewed, 10-in. c-r tube was designed for monitor service in connection with theater-tv systems, industrial tv equipment and studio broadcast equipment. Utilizing electrostatic focusing the 10SP4 features an electron gun designed with an acceleration type of electron lens to provide high resolution and good uniformity of focus over the entire picture area. Focus can be maintained automatically with variation in line voltage and with adjustment of picture brightness.

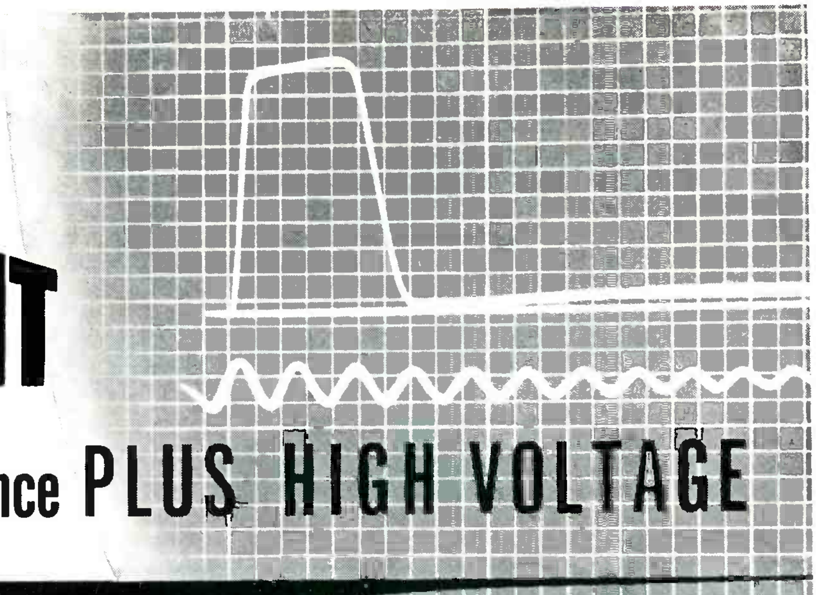
Auto Speakers

QUAM-NICHOLS CO., Chicago, Ill., has announced two new rear seat auto speakers. Model AS-1 kit includes a 6½-in. p-m. Adjust-A-Cone

Another new instrument by

DU MONT

Type 303-A Performance PLUS HIGH VOLTAGE



- Up to 10,000 volts accelerating potential.
- Pulse response, 0.033 μsec.
- 10-megacycle bandwidth.
- Maximum linear sweep speed, 10" per μsec.
- Time calibration.
- Amplitude calibration.
- Vertical sensitivity, 0.1 p-p v in.

the new Du Mont type 303-AH

Now, in addition to all the features that won for the Type 303-A such wide acceptance as *the* wide-band, quantitative oscillograph in the medium-price range, *high accelerating potential* has been added. Thus the range of this versatile laboratory instrument is now extended to include the analysis of high-speed single transients, pulses of low-duty cycle, or other phenomena where high spot intensity is required. The high accelerating potential of the Type 303-AH not only makes possible the observation of extremely rapid phenomena by providing higher light output, but also produces finer spot size and hence increased resolution for more precise observation and measurement.

Intensifier potentials of 3000, 7000 or 10,000 volts may be selected in the Type 303-AH, enabling the operator to make the most satisfactory compromise between pattern brilliance and deflection sensitivity for a given signal.

In the new Type 303-AH, Du Mont presents the first high-gain, wide-band, high-voltage oscillograph in a single, small cabinet at a low cost.

INSTRUMENT DIVISION, ALLEN B. DU MONT LABORATORIES, INC.
1500 Main Avenue • Clifton, N. J.

SPECIFICATIONS . . .

- Type 5XP- cathode-ray tube; accelerating potentials, 3000, 7000, or 10,000 volts.
- Y-Sensitivity: 0.1 p-p v/in. (0.04 p-p v/cm.) at 3000 volts' acceleration. Sensitivity lower at higher accelerating potentials.
- Y-Frequency Response: Down less than 30% at 10 cps and 10MC at any setting of attenuator or gain control.
- Pulse Response: 0.033 μsec.
- X-Frequency Response: d-c to 700 KC (30% down).
- Sweep Speed: 0.1 sec. to 2 μsec; expansion on all ranges to six times full screen; max. linear sweep speed better than 10"/μsec (25.4 cm./μsec.) at 3000 volts' acceleration.
- Amplitude Calibration: 0.1, 1.0, 10, 100 volts, better than ±5% accuracy.
- Time Calibration: 0.1, 1.0, 10, 100 μsec.; better than ±3% accuracy.
- Illuminated scale with front-panel dimmer control.
- Du Mont Type 2592-B52 shielded coaxial adapter with 52 ohm termination, included.

PRICE $990.00

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Dr. Rodriguez Jimenez, Venezueian Consul-General in London, at the signing of a contract in the London consulate on 9th July, 1952, to provide British equipment for a television service at Caracas.

Equipment for the Caracas Television Station, sponsored by "Televisa," includes

- 5 kW vision transmitter
- 3kW sound transmitter
- Associated aerial system
- Complete studio installation
- Complete mobile O/B television unit, with two camera channels and micro-wave links

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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.

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Sample Precision Potentiometers now available in 4 to 6 weeks

Better delivery than ever before of Fairchild Precision Potentiometers is the result of recently improved facilities and additions to personnel. Now you can expect delivery of sample standard units with windings to meet your requirements in 4 to 6 weeks after your final approved specifications are received. The same reasonable prices prevail, too.

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HOW PRECISION IS DESIGNED AND BUILT INTO FAIRCHILD POTENTIOMETERS

1. Shaft is centerless-ground from stainless steel to a tolerance of +0.0000, −0.0002 in. which, together with precision-bored bearings, results in radial shaft play of less than 0.0009 in.

2. Mounting plate has all critical surfaces accurately machined at one setting to insure shaft-to-mounting squareness of 0.001 in./in. and concentricity of shaft to pilot bushing within 0.001 in. FIR.

3. Housing is precision-machined from aluminum bar stock. Close tolerance of this construction permits ganging up to 20 units on a single shaft with no eccentricity of the center cups, even though only two bearings are used.

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PRECISION POTENTIOMETERS

speaker with capacity to handle the full ouput of any single-ended auto set. It has a 1.47-oz Alnico V magnet. Model AS-2 kit includes a heavy-duty 6 × 9-in. p-m Adjust-A-Cone speaker with capacity to handle the most powerful auto set made. It has a 2.15-oz Alnico V magnet. Both types feature rugged 3-position switch for dash mounting and ample cable, flocked grill screen, baffle plate, miscellaneous hardware and installation instructions.

Running Time Meter

MARION ELECTRICAL INSTRUMENT Co., 401 Canal St., Manchester, N. H., has introduced a new hermetically sealed running time meter for registering the operating time of machine tools, electronic, electrical or general industrial equipment. It is designed to perform perfectly in a wide range of temperatures and in hazardous atmospheres. The unit is powered by a self-starting synchronous motor, available for 110 to 125, 220 to 250 v, 50 or 60 cycles a-c.

Crosshatch Generator

SIMPSON ELECTRIC Co., 5200 W. Kinzie St., Chicago 44, Ill. With the model 485 cross hatch pattern

VARIAN associates

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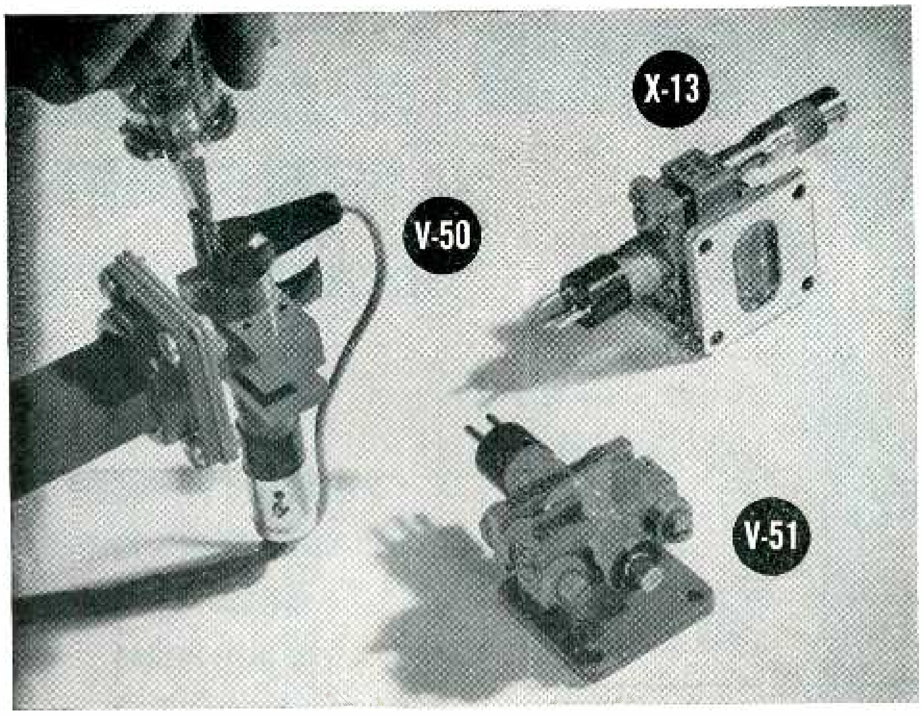

8.5 to 10.0 kmc

Meet MIL-T-5422 and AN-E-19 specifications

Development based on the widely-used Varian X-13 klystron has produced two new Varian tubes with unusual possibilities for X-band applications involving extreme shock and vibration.

V-50 RUGGED, TUNABLE RADAR LOCAL OSCILLATOR. Here is a tube capable of withstanding severe vibration and shocks well beyond 30 times gravity It is tunable with extreme smoothness over the band from 8.5 to 10.0 kmc, and can be used with conventional afc circuits. Power output is 25 milliwatts, minimum, with a resonator voltage of 300 volts. The output connector mates with UG39/U flange (1 x ½″ waveguide).

V-51 RUGGED RADAR L. O. OR LOW-POWER TRANSMITTER. Lock-nut tuning enables the Varian V-51 klystron to withstand even rougher treatment than the V-50. Frequency range, application, and construction are otherwise similar. Tuning is easily done in the field with a standard open-end wrench. This tube is capable of 75 milliwatts, minimum, at 350 volts on the resonator. The output connection also mates with a UG39/U flange.

X-13 GENERAL-PURPOSE X-BAND SIGNAL SOURCE. A versatile, stable, reliable, laboratory-type signal source, the familiar Varian X-13 klystron tunes readily with a built-in micrometer device over a wide frequency range of 8.2 to 12.4 kmc. The X-13 is not intended for rugged service. It delivers well over 100 milliwatts at a resonator voltage of 500 volts. Output connection is a UG39/U flange.

Send for your copies of data sheets giving full information about this group of X-band Varian klystrons. There is a Varian Associates field representative nearby to assist on any application problems you may have.

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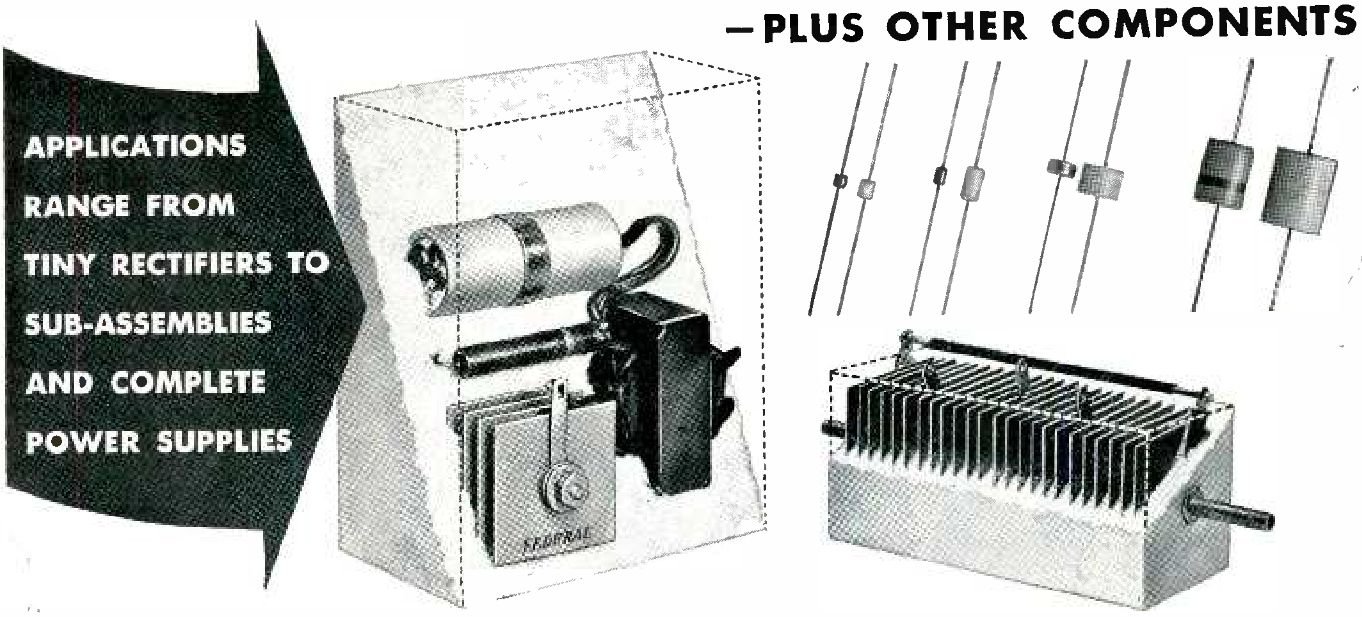
Federal announces the first successful ENCAPSULATION of SELENIUM RECTIFIER STACKS

—PLUS OTHER COMPONENTS



ENCAPSULATION OFFERS THESE MAJOR ADVANTAGES:

- Expands the application range of rectifiers
- Replaces oil-filled and special applications
- Ideal for sub-assemblies of various components
- Assists heat dissipation at high altitudes
- Better protection from fungus, corrosion, etc.
- Adaptable to complicated printed circuits
- Increases the over-all efficiency of equipments
- Provides ruggedness of a single, solid block

A unique development in component-sealing —opening to industry a new concept in MILITARY EQUIPMENT DESIGN

FEDERAL—America's *pioneer* in selenium rectifiers—now enables manufacturers for the first time to obtain these versatile AC-to-DC power conversion units in encapsulated form . . . to use them where special conditions formerly made their application impossible!

Encapsulation gives *new flexibility* to military equipment designers . . . offers a new means of greater protection against vibration, mechanical abuse, moisture, fungus, salt air corrosion and other hazards . . . plus faster heat dissipation in rarified atmosphere.

Sub-assemblies comprising transformers, capacitors, resistors and other components —*inter-connected with selenium rectifiers*—may now be assembled in equipments as single expendable blocks. Broad opportunities are offered to printed circuits involving numerous components. Encapsulated rectifiers also provide an improved replacement for oil-filled and other special applications.

For full information on Federal encapsulation of selenium rectifiers, power supplies and complete sub-assemblies of various components, write to Selenium-Intelin Division, Dept. F-213.

America's oldest and largest manufacturer of selenium rectifiers

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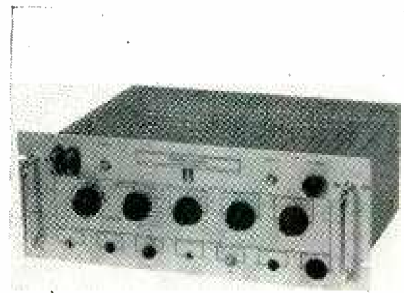
Federal Telephone and Radio Corporation

SELENIUM-INTELIN DIVISION 100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

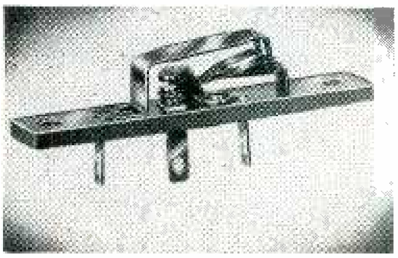
generator, horizontal and vertical linearity, hold, height, width and drive adjustments may be made easily and quickly when transmitter test patterns are not available. It provides a synchronized signal, modulated on the carrier frequencies of channels 2 through 6, which can be tuned and sent through the receiver under test. When the receiver has been properly adjusted, the signal will show equally spaced lines in vertical, horizontal or cross-hatch patterns on the picture tube. All patterns are locked in place with synchronizing pulses, exactly the same as the sync pulses in transmitted waveforms, making it unnecessary to double check against actual transmitted test pattern. The output cable includes a variable termination network which is quickly adapted to provide 75 or 300-ohm terminations.



Universal Amplifier

THE BRUSH DEVELOPMENT CO., 3405 Perkins Ave., Cleveland 14, Ohio. Model BL-360 universal amplifier for rack mounting was designed for use with magnetic direct-writing oscillographs in studies of static or dynamic strains up to 100 cps when measured by the use of resistance-sensitive strain gages. The instrument was designed for use with the SR-4 120-ohm strain gage but may be used with any gage type with ohmic resistance of 50 to 1,000 ohms. Measurable range of the unit is 10 to 40,000 μ in. per in. with one active gage. Sensitivity is increased 4 times by use of 4 active gages. The control panel contains a 10-step attenuator, terminals for connection of strain gages, calibration resistor holder, resistance and capacitance bridge balance controls,

gain controls and pen centering control. The amplifier contains a 2,000-cycle bridge energizing oscillator, high-gain a-c amplifier, phase-sensitive discriminator and d-c output amplifier.



Snap-Acting Switch

THE W. L. MAXSON CORP., 460 W. 34th St., New York 1, N. Y. Wherever electrically operated apparatus has limited space for switch installation, the new Unimax type E switch offers an answer to the control problem. Requiring only $1\frac{1}{4} \times \frac{7}{16} \times \frac{3}{8}$ in., exclusive of terminals and terminal strip, the miniature switch will handle a resistive load of 10 amperes at 125 v a-c and 5 amperes at 250 v a-c. Its contacts have positive wiping action that makes the switch adaptable to use with tungsten-filament lamp loads.

Static Detector

KEITHLEY INSTRUMENTS, 3868 Carnegie Ave., Cleveland 15, Ohio, has announced the model 2005 static detector, a device that clips onto a v-t electrometer providing a convenient combination for detecting and locating static charges. The new electrometer accessory consists primarily of two concentric tubes and an aluminum rod. When clipped over the high terminal electrode of

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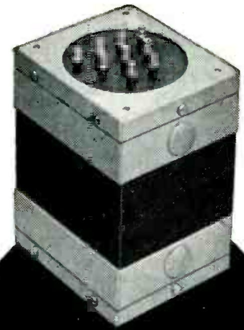

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3-320

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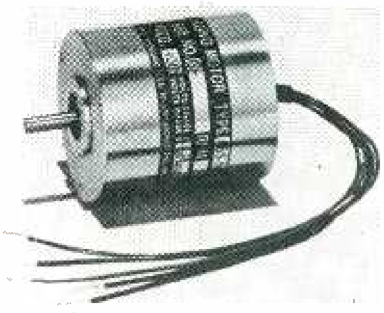
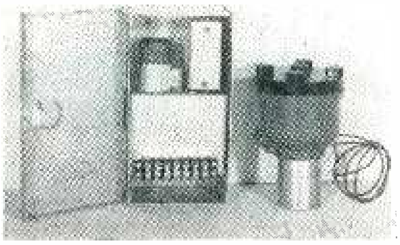
the electrometer, the tubes provide shielding which gives charges along the cylinder axis the most effect. Results are qualitative and observed by noting the deflection of the meter pointer. Many uses are cited for the instrument, such as locating charged bobbins in textile mills, detecting charges on moving paper in printing plants, and for sensing dangerous charges in explosives plants.



Precision Servo Motors

G-M LABORATORIES INC., 4300 N. Knox Ave., Chicago 41, Ill., has introduced a small precision servo motor measuring 1.7 in. in diameter and $1\frac{3}{4}$ in. long, for frequencies varying from 60 to 400 cycles, and in 2, 4 or 8-pole construction. Stall torque is approximately 2 in. oz. The extreme precision required in these motors involves tolerances as small as ±0.0001. The motors can be supplied to meet rigid military specifications with regard to humidity, temperature, range, vibration and altitude.



Liquid Level Control and Indicator

INDUSTRIAL ELECTRONICS CO., INC., Hanover, Mass. The Acrafloat is a ruggedly built, industrial type in-

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For more than 18 years, Eclipse-Pioneer has been a leader in the development and production of high precision synchros for use in automatic control circuits of aircraft, marine and other industrial applications. Today, thanks to this long experience and specialization, Eclipse-Pioneer has available a complete line of standard (1.431″ dia. X 1.631″ lg.) and Pygmy (0.937″ dia. X 1.278″ lg.) Autosyn synchros of unmatched precision. Furthermore, current production quantities and techniques have reduced cost to a new low. For either present or future requirements, it will pay you to investigate Eclipse-Pioneer high precision at the new low cost.

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	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes
Transmitters	AY201-1	26V, 400~, 1 ph.	225	1.25	25+j115	11.8	9.5	3.5	15
	AY201-4	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	20
Receivers	AY201-2	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	45
Control Trans-formers	AY201-3	From Trans. Autosyn	Dependent Upon Circuit Design				42.0	10.8	15
	AY201-5	From Trans. Autosyn	Dependent Upon Circuit Design				250.0	63.0	15
Resolvers	AY221-3	26V, 400~, 1 ph.	60	0.35	108+j425	11.8	53.0	12.5	20
	AY241-5	1V, 30~, 1 ph.	3.7	—	240+j130	0.34	239.0	180.0	40
Differentials	AY231-3	From Trans. Autosyn	Dependent Upon Circuit Design				14.0	10.8	20

**Also includes High Frequency Resolvers designed for use up to 100KC (AY251-24)

AY-500 (PYGMY) SERIES

	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes
Transmitters	AY503-4	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	25.0	10.5	24
Receivers	AY503-2	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	23.0	10.5	90
Control Trans-formers	AY503-3	From Trans. Autosyn	Dependent Upon Circuit Design				170.0	45.0	24
	AY503-5	From Trans. Autosyn	Dependent Upon Circuit Design				550.0	188.0	30
Resolvers	AY523-3	26V, 400~, 1 ph.	45	0.5	290+j490	11.8	210.0	42.0	30
	AY543-5	26V, 400~, 1 ph.	9	0.1	900+j2200	11.8	560.0	165.0	30
Differentials	AY533-3	From Trans. Autosyn	Dependent Upon Circuit Design				45.0	93.0	30

For detailed information, write to Dept. C.

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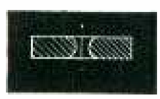

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Output voltage (p. to p.)	= DC input voltage
Output frequency	20 cps ± 1.5 cps
Contact rating	30 VA. .25 amps. max.
Contact dwell	74% min.
Operating Temp.	—40°C to 85°C
Overall size (approx.)	3-11/32 L x 2-1/32 W x 2-7/8 H
Mounts	4 No. 4-40 x 1/4 studs
Mtg. Dimensions	1-23/32 x 2-29/32
Dielectric strength	200 V. DC each terminal to case

For more information write Dept. 26-J

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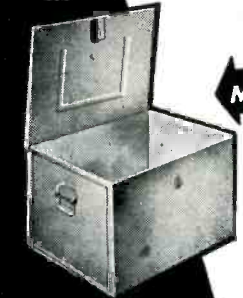

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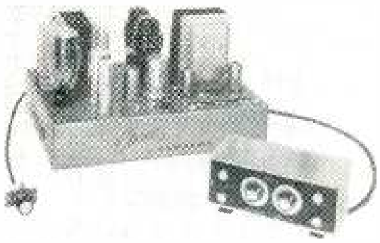
strument designed for controlling and indicating liquid levels, especially in those applications beyond the scope of the conventional liquid level controls. The unit has no electrodes, thereby eliminating danger of shock or explosion. It operates equally as well on nonconductive liquids as it does on conductive liquids. Parts exposed to the liquid are normally made of stainless steel and can be made of other corrosion resisting materials such as glass or ceramic. If the proper size wire is provided between the float and the control to avoid voltage drop, the control can be located at a considerable distance from the float.



Home Music Amplifier

NEWCOMB AUDIO PRODUCTS CO., 6824 Lexington Ave., Hollywood 38, Calif., has introduced the Classic 25 amplifier with complete remote control unit. Frequency response extends from below 10 to over 100,000 cycles. A newly developed Audi-balance permits one to achieve perfect balance of output tubes in seconds. Six inputs are provided for radio, tv, tape recorder, crystal and 2 magnetic pickups. A crossover selector simplifies attainment of correct playback response, includes foreign and domestic frequencies and the new AES standard.

Resonant Amplifier

KALBFELL LABORATORIES, INC., P.O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif., has available a new type of resonant amplifier giving high-Q performance at very low frequencies, as well as at audio frequencies. The compact plug-in unit measures 2 × 2 × $4\frac{3}{4}$ in. The well known method of incorporating a twin-T filter in the feedback loop of an amplifier is employed, but

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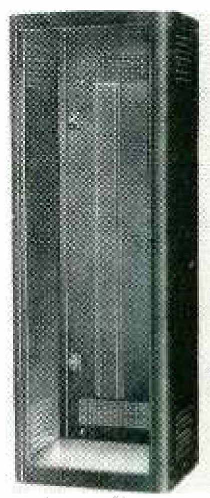
some novel direct-coupled features give stable values of Q up to 100 plus feedback stabilization of gain even at the peak of the frequency response curve. Ask for peaked amplifier bulletin 504.

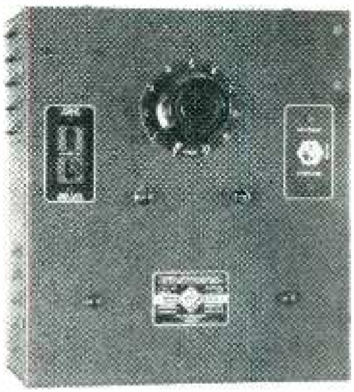
Mercury Switches

MICRO SWITCH, Freeport, Ill., has announced newly designed Honeywell mercury switches embedded in plastic potting compounds for added protection. The first of these new switch assemblies is the 1MP1 switch whose overall size is 2½ in. long, 3¼ in. wide and 1⅛ in. high. This unit provides less than 1 deg differential angle, with an electrical rating of 2 amperes 115 volts a-c, or 1 ampere 115 volts d-c. Contact arrangement is single-pole, normally open.



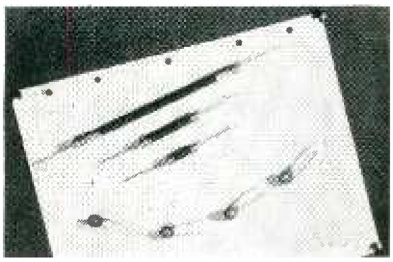
Relay Racks

PREMIER METAL PRODUCTS CO., 3160 Webster Ave., Bronx 7, N. Y., announces the manufacture of a line of enclosed relay racks rigidly constructed of 16 gage cold rolled sheet steel. The panel mounting angles of 12 gage steel are tapped for 10/32 machine screws on Western Electric spacings. Panels fit into a recess so that edges are not exposed. Rear doors are hung on sturdy loose-jointed hinges and closed by a flush snap catch. A complete catalog of precision-built metal housings is available on request.



Motor Speed Control

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. Designed for light production work where a ¾ h-p motor is used, the type 1702-A Variac speed control uses no electronic tubes and so takes no warm-up time. Instant starting and reversing are provided together with strong dynamic braking. It saves production time. Typical applications are on lathes, for instance, where several operations are done on the same piece at different optimum speeds; or for operations such as blind tapping where gradual starting and stopping is desired.



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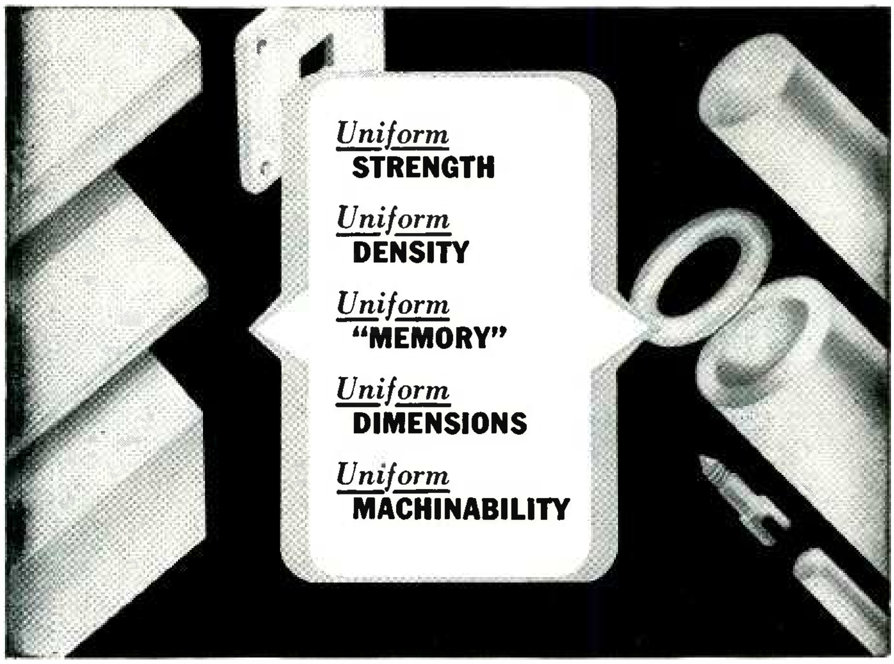

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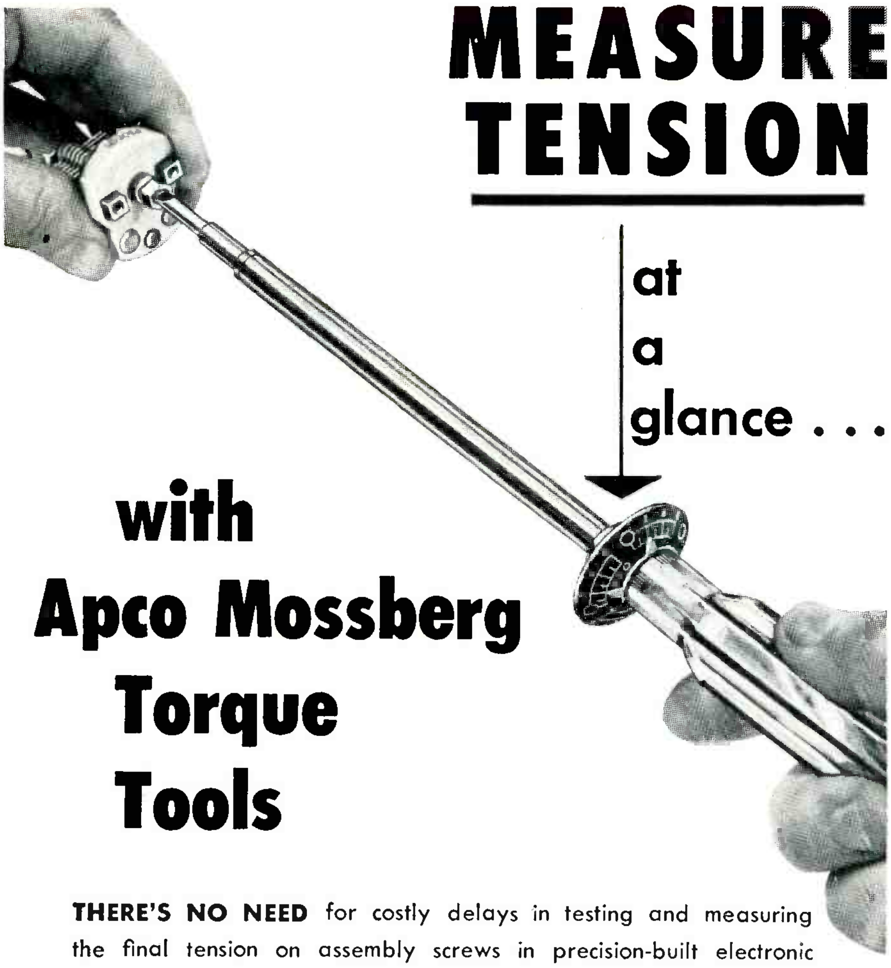

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YOU'LL FIND that Apco Torque Screw Drivers are available in a complete range of sizes — from the 0 to 6 inch ounce size for light bench work to the 0 to 24 inch ounce models with large positive and positive-negative dials for every job in the shop. Get the complete details on these and other Apco Mossberg Torque Tools for Industry from your distributor or write direct. Apco Mossberg Co., 189 Lamb Street, Attleboro, Mass., U. S. A.

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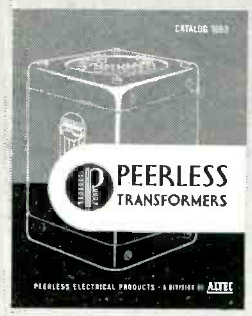

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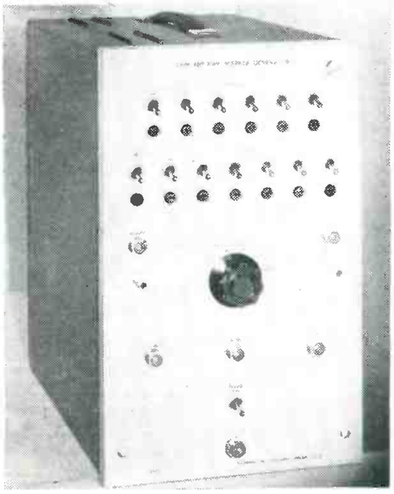
of miniature resistors. The resistors, whose electrical resistance decreases with increases in applied voltage, are designed for use as a stabilizing influence on circuits supplied by rectifiers, for control of voltage-selective circuits and for protection against voltage surges. They are composed of a silicon carbide ceramic resistance material called Thyrite, whose nonlinear resistance characteristic is stable and substantially independent of polarity and frequency. The line now includes small ½ in. diameter units, with or without wire leads, having a maximum continuous rating in free air of 0.1 watt. Small ¼ in., rod-type units, rated from 0.25 to 1.0 w, are available from 1 in. up to 6 in. in length. For one watt ratings, rod-type resistors capable of continuous operation at 10 kv are available.



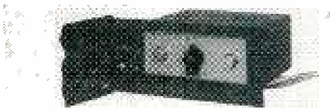
Time Mark Generator

TEKTRONIX, INC., Sunset Highway and Barnes Road, Portland 7, Oregon. Type 180 time mark generator has time markers of 1, 5, 10, 50, 100 and 500 μsec; 1, 5, 10, 50, 100 and 500 milliseconds; and 1 second, all available separately and simultaneously through pin jacks or mixed in any combination through uhf connector. It also features: sine wave outputs of 5, 10 and 50 mc; trigger impulses of 1, 10 and 100 cycles, and 1, 10 and 100 kc through uhf connector; all outputs controlled by a 1-mc crystal accurate within 0.02 percent. The unit was developed for the purpose of

oscilloscope time base calibration and is useful for calibrating counters and computers.

Aircraft Test Instrument

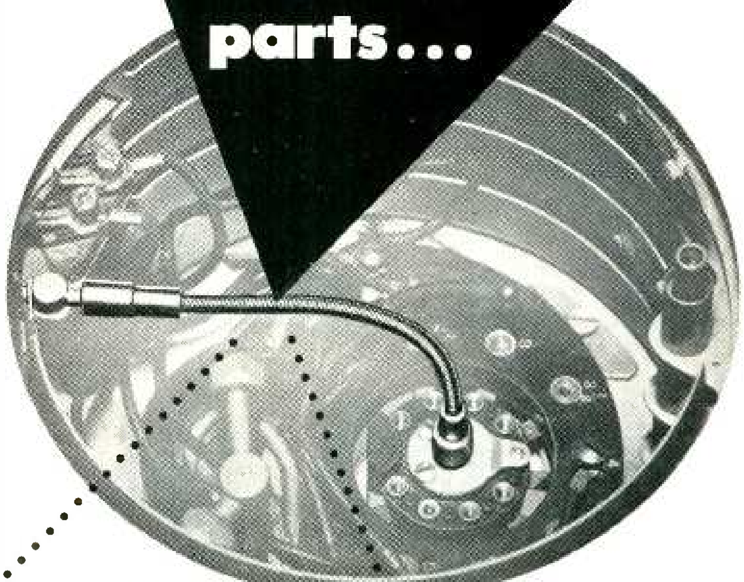
MIDWESTERN GEOPHYSICAL LABORATORY, Tulsa, Oklahoma. Model 310 dynamic meter is a miniature oscillograph used to present flight test data for either visual or photographic observation. The galvanometers used in the meter produce appreciable deflections from conventional strain-gage signals without amplification. The light intensity of the edge-lighted Lucite screen may be varied (external potentiometer) to produce optimum contrast between signal spots and screen graduations. Specifications include: weight—2.3 lb; optical arm distance—4.8 in.; and power required—24 v at 1.5 amperes.



Demodulators

AUTOMATIC TEMPERATURE CONTROL CO., INC., 5200 Pulaski Ave., Philadelphia 44, Pa. Three new demodulators have been designed for rectifying an a-c signal, generated by an Atcotran transmitter for

Easy way to control inaccessible parts...



S.S.WHITE FLEXIBLE SHAFTS

Providing a means of controlling inaccessible parts *could be* a tough problem — especially if the parts had to be mounted some distance away from the point of control. We say *could be,* because S.S.White remote control flexible shafts are a simple, time-saving way to do the job.

These shafts have been built just for this purpose. They have all the flexibility needed to run them around turns or to install them over or under obstacles. What's more, S.S.White flexible shafts have the necessary physical properties to provide a quality of control that satisfies practically every requirement. It's simply a matter of proper selection and application.

Use them to —

Meet exacting space and dimensional requirements

Eliminate alignment problems

Bring control around turns

Gain extra design freedom

Control variable elements

Simplify servicing

Reduce costs

SEND FOR THE FLEXIBLE SHAFT HANDBOOK

256 pages of factual data and information on how to select and apply flexible shafts. Sent free — if you request it on your business letterhead.

THE S.S.White INDUSTRIAL DIVISION
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NEW YORK 16, N. Y.

Western District Office • Times Building, Long Beach, California

Accurate • Portable • AVAILABLE

the Type H-12 UHF SIGNAL GENERATOR

900-2100 Megacycles

This compact, self-contained unit, weighing only 43 lbs., provides an accurate source of CW or pulse amplitude-modulated RF. A well-established design, the Type 12 has been in production since 1948. The power level is 0 to —120 dbm, continuously adjustable by a directly calibrated control accurate to ± 2 dbm. The frequency range is controlled by a single dial directly calibrated to ± 1%. Pulse modulation is provided by a self-contained pulse generator with controls for width, delay, and rate; or by synchronization with an external sine wave or pulse generator; or by direct amplification of externally supplied pulses.

Gold Plating of the oscillator cavity and tuning plunger assures smooth action and reliable performance over long periods. Generous use of silicone-treated ceramic insulation, including resistor and capacitor terminal boards, and the use of sealed capacitors, transformers, and chokes, insures operation under conditions of high humidity for long periods.

Built to Navy specifications for research and production testing, the unit is equal to military TS-419/U. It is in production and available for delivery.

Price: $1,950 net, f.o.b. Boonton, N. J.

Type H-14 Signal Generator

(108 to 132 megacycles) for testing OMNI receivers on bench or ramp. Checks on: 24 OMNI courses, left-center-right on 90/150 cps localizer, left-center-right on phase localizer, Omni course sensitivity, operation of TO-FROM meter, operation of flag alarms.

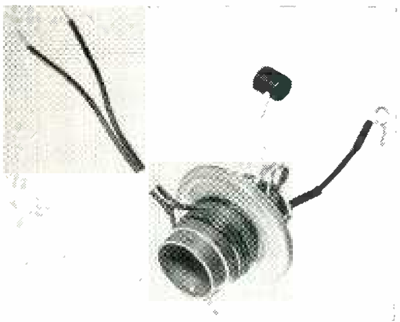
Price: $942.00 net, f.o.b. Boonton, N. J.

WRITE TODAY for descriptive literature on A.R.C. Signal Generators or airborne LF and VHF communication and navigation equipments, CAA Type Certificated for transport or private use. Dept. 5

ARC — **Dependable Electronic Equipment Since 1928**

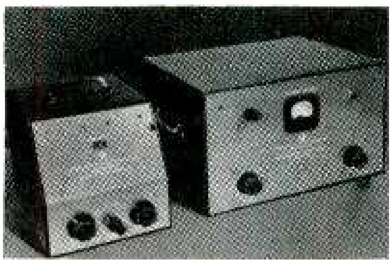
Aircraft Radio Corporation
Boonton, New Jersey

pressure, flow, thickness, weight and displacement, into a d-c signal that may be fed into a d'Arsonval type d-c meter or potentiometer type instrument of the indicating or recording variety. Operation features include a single electronic tube rectifying circuit designed for continuous trouble-free service. One type 6101C will operate into any existing potentiometer type recording instrument and incorporates a chopper circuit for changing the a-c input signal to the d-c output signal.



Autotransformer

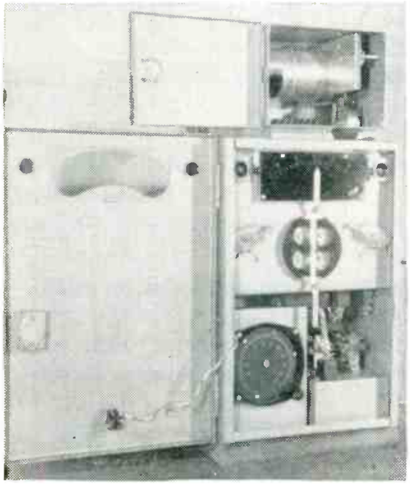
RAM ELECTRONICS SALES CO., Irvington-on-Hudson, N. Y. Latest horizontal output transformer just off the company's production line is the model X068 air-core autotransformer. Featuring high efficiency and excellent voltage regulation, as well as improved anticorona construction, it delivers 11 to 13 kv output for 14 to 20-in. tv picture tubes. Since the unit is designed for direct drive circuits, the model Y70F30/3 direct-drive deflection yoke is recommended as its associated component.



Magnetometer

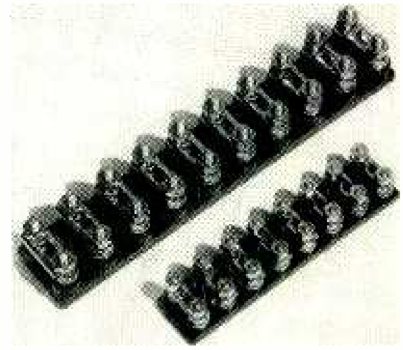
LABORATORY FOR ELECTRONICS, INC., 75 Pitts St., Boston 14, Mass. Model 101 magnetometer accurately measures magnetic field strength by

using the principle of nuclear resonance. An oscillatory magnetic field is provided by means of a coil surrounding a sample which permits measurement of proton resonance and the nuclear resonance of lithium. The coil is part of an oscillator which is so designed that its level of oscillation drops with an increase in circuit losses, such as may be introduced by nuclear resonance in the sample material. Means have been provided to make this resonance easily viewed on an oscilloscope. Range of field strength measurements is from 300 gauss to 25,000 gauss, covered by proton and lithium resonances. This range is covered by a frequency spectrum of 1.18 to 34 mc. Means are provided for varying the width of modulation sweep from 1.6 to 16 gauss.



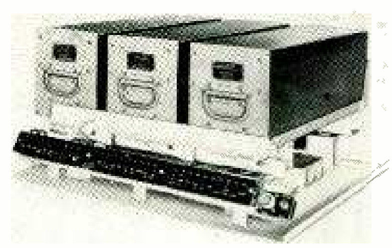
Remote Indicating Contact Gage & Alarm

INDUSTRIAL ELECTRONICS CO., INC., Hanover, Mass., now has a device for measuring thickness on the fly and indicating at a convenient remote location. Any material which can tolerate a moderate pressure, such as rubber or asphalt tile, metals of all kinds, sheet asbestos and rubber impregnated cloth can be measured. The device consists of two sections: (1) a housing containing a precision ground roller mounted with and coupled to a selsyn motor; (2) a main cabinet containing a scale graduated in thousandths of an inch, as well as an electronic relay connected to a selsyn motor in such a way that a pilot light is lit when the material being measured exceeds the preselected tolerance.



Terminal Strips

THE BRACH MFG. CORP., 200 Central Ave., Newark, N. J., has developed the type 2500 universal terminal strips (shown above, rear). Each is made of 10 units molded in one piece. It is so constructed that circuits can be opened and closed for testing by means of a sliding link without disturbing any connected wire. The strips are made of Bakelite with heavy screws molded rigidly into place to prevent their turning. Type 1500 terminal strip, also illustrated, is smaller and more compact, and uses silicon bronze screws with heavy specially designed nuts for strength.



Railroad & Mobile Equipment

BENDIX RADIO DIV. OF BENDIX AVIATION CORP., Baltimore 4, Md., has announced production of a line of railroad and mobile equipment designed for operation in the 152 to 174-mc band. The new vhf equipment can be packaged either in a three unit housing or a single compact case. The equipment is provided with a choice of transmitter

power—2½, 12, 25 or 35 watts. In addition, fixed stations can transmit up to 60 watts. The transmitter consists of basic exciter chassis with interchangeable power amplifier decks which, when operated with appropriate power supply, can be replaced at any time to increase power as desired. Dual channel operation can be provided by insertion of sealed plug-in relay and crystal. Frequency stability is 0.0006 percent with crystal type oven and 0.0025 percent without oven.

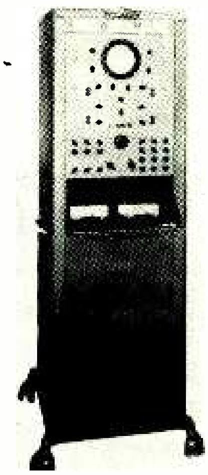
Low-Voltage High-Current D-C Sources

Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn., has available an addition to its line of Nobatrons. Designated as models E-6-5A, E-6-15A, E-6-40A and E-6-100A Nobatrons, the instruments convert nominal 115 v ac line to 6 v d-c adjustable ±10 percent, at currents of 5, 15, 40 and 100 amperes respectively, and with a regulation accuracy of ±0.2 percent. The important new feature is a front panel switch that instantly changes output from 6 v d-c to 7 v d-c, adjustable ±10 percent.

Servo Amplifier

Automatic Temperature Control Co., Inc., 5200 Pulaski Ave., Phil-

adelphia 44, Pa., has introduced a high-gain, class A amplifier that is designed for driving servo-mechanisms from very small a-c input potentials such as those generated by differential transformers, a-c potentiometer circuits and resistive and inductive bridge circuits. The amplifier consists of a low-impedance transformer input to a dual triode, two-stage voltage amplifier tube which drives a pentode power amplifier tube having one motor winding in its anode circuit. The d-c voltage for the amplifier is obtained from a transformer and a full-wave rectifier tube. A potentiometer in the grid of the pentode provides control of the amplifier gain. Power input to the unit is isolated from ground allowing the input circuit to be adequately grounded and decrease the possibility of stray pickup.



Memoscope

MILLIVAC INSTRUMENT CORP., 444 Second St., Schenectady 6, N. Y. Type MS-10A Memoscope records magnetically wave shapes and signal traces for instantaneous reproduction on the screen of its c-r tube. A new frequency converter makes it possible to record magnetically frequencies as high as 10 mc without harmonic distortion. The instrument can be used as a production testing tool where instantaneous comparison of wave shapes is needed, also as an auxiliary device in development and research where wave shapes change too frequently for photographic reproduction and

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for aluminium and aluminium alloys

The Siemens Supersonic Soldering Device solders quickly, neatly and easily aluminium parts of all kinds such as aluminium sheet, casings, wires and small fittings. The supersonic vibrations destroy the aluminium oxide coating on the surface of the part to be soldered so that the bare aluminium is brought into direct contact with the molten tin. The soldered joint should be given a coat of lacquer to protect it from the effect of moisture.

Frequency approx. 20 kilocycles

Electrical requirements: 110/127/220 volts a.c.

Power consumption: 45 va

E/45/15

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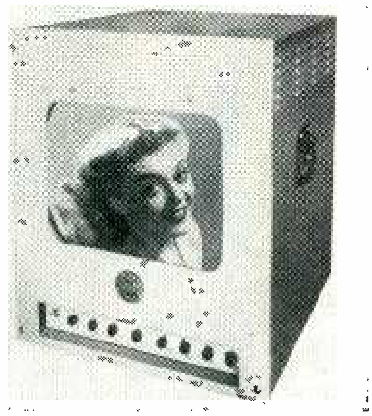
where instantaneous comparison of two traces is essential.



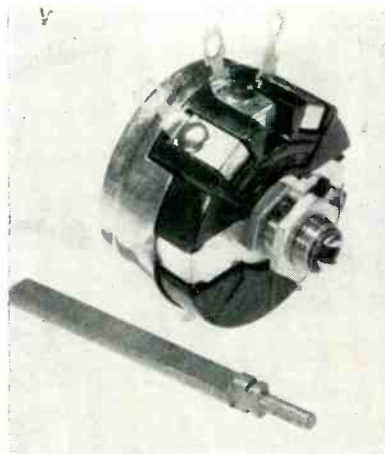
Utility Picture Monitor

FEDERAL TELECOMMUNICATION LABORATORIES, INC., Nutley, N. J., has announced a new low-cost utility picture monitor for tv station applications. The FTL-P-91B monitor is available either rack or cabinet mounted. A high-quality, high-resolution 9 × 12-in. presentation is made on a 16GP4 kinescope. Duplicate coax input connectors with a switch to select composite video, or separate video and composite sync, are provided at the rear of the chassis. A self-contained, fused power supply is included.

Power Amplifier and Speaker

TAPEMASTER, INC., 13 West Hubbard St., Chicago 10, Ill. Model SA-13 portable power amplifier and speaker combines in one unit a new $7\frac{1}{2}$-in. accordion-type floating cone speaker, new advanced amplifier design, and a more effective principle of baffling. Amplifier response is within 1 db from 30 to 15,000 cps. Total distortion at 5-w output

is less than 1.0 percent. Peak output is 8 watts. Power characteristics at 5-w are within 3 db from 30 to 15,000 cps. Other features are: regulation, within 1 db; damping factor of 10; and internal impedance at 8-ohm output, less than 1 ohm.



Wire-Wound Controls

CLAROSTAT MFG. CO., INC., Dover, N. H., announces availability of wire-wound controls with field-attached shafts. The new controls may be used with any one of the company's 11 different Pick-A-Shafts. They come in three series: the A43 is rated at 2 watts; the A58 is rated at 3 watts; and the A10 is rated at 4 watts. A wide range of resistance values is available in each series.

Function Generator

COMPUTER CORP. OF AMERICA, 149 Church St., New York 7, N. Y. Computations involving backlash, dead-zone and limit-stops now may

CUSTOM *Molded* POWDERS

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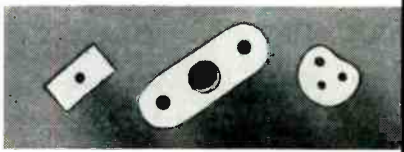
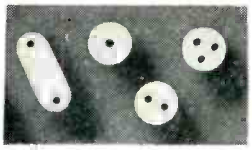
Close tolerance maintained . . . the highest precision to satisfy your specifications.



NAME YOUR REQUIREMENTS

We'll be glad to meet your specifications. Our laboratories welcome working with you on new powders and designs for pressing. Let us quote on your requirements.



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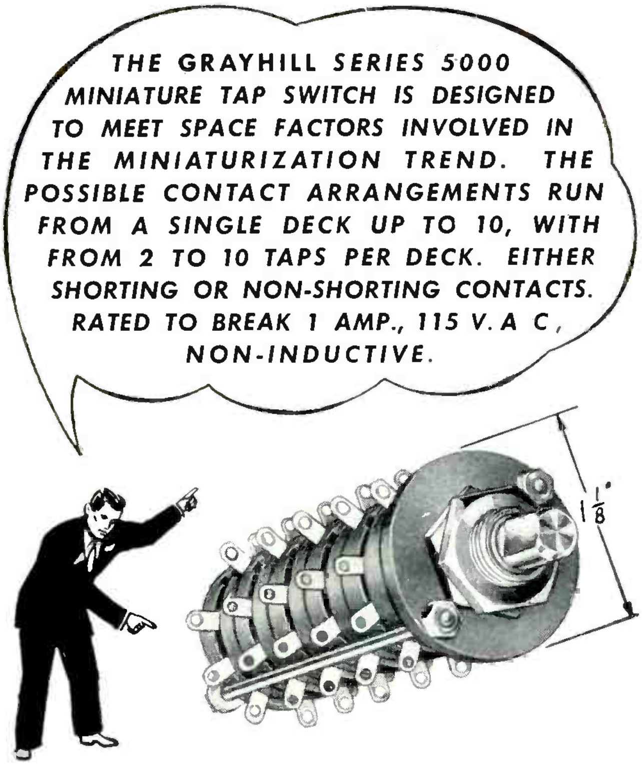

Grayhill

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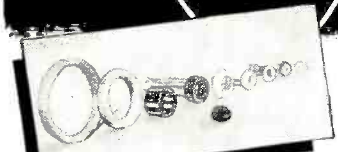
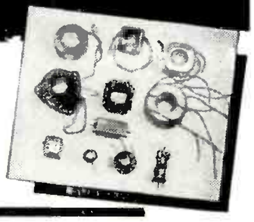
Boost Your Quality Standards with DX ELECTRONIC COMPONENTS



TOROID COILS

SPECIAL ASSEMBLIES



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If you require exacting quality and dependable performance, let DX engineers figure with you on your next production run. Users of DX components enjoy exceptional freedom from field failures. This advantage can be yours at no extra cost. Write today.

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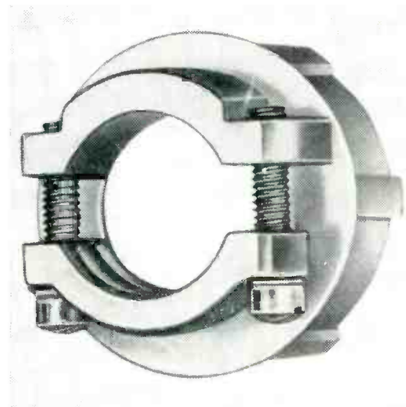
be easily and accurately accomplished on any real-time analog computer such as IDA, REAC or GEDA. Generation of these three nonlinear functions is made possible by a new, compact unit, designated model NLU-2. It has two completely independent channels, each of which may be set for any of the three modes of operation. All-electronic in design, the unit may be used at higher frequencies than a servo- operated function generator. The NLU-2 has a self-contained power supply operating from a 115-v, 60-cycle line and drawing ½ ampere.



Cable Clamps

TLG ELECTRIC CORP., 31 W. 27th St., New York 1, N. Y., are producing AN3057 cable clamps in 7 popular sizes. These clamps are time-proved standards for communication application in the electronics, aviation, marine, railroad and transportation industries. Precision-manufactured and guaranteed to meet every requirement of rigid Army-Navy specifications, these clamps support cable or wire at the plug or receptacle with excellent security, and prevent twisting or pulling at vulnerable soldered connections. The sizes of type AN3057 now in production are: 3, 4, 6, 8, 10, 12 and 16. Further information is available on request.

Phono Accessories

GENERAL ELECTRIC CO., Syracuse, N. Y., has added a new variable reluctance cartridge and a new wide-

IT'S NEW!

10-POUND PORTABLE BATTERY-OPERATED TAPE RECORDER

THE MAGNEMITE*

NEW **DRY BATTERIES**

Inexpensive flashlight-type cells that last 100 operating hours.

NEW **SPRING MOTOR**

Governor-controlled constant speed motor runs 15 minutes per winding.

NEW **PLAYBACK &. MONITORING**

Feeds directly into headphones or external amplifier and speaker.

NEW **SENSITIVITY**

Crystal-clear recordings up to 100 feet from the microphone.

4 models available
Priced from **$225**
Size: 11½ x 8½ x 5½

Field recording is now as easy as studio recording, with the Magnemite* Portable series. There's a midget battery-powered spring-motor Magnemite* model for every recording need — speech, music and sound effects. Write today for descriptive literature and direct factory prices.

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METERING PUMP for HOT WAXES and CEMENTS

- Filling
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Transformers	Sockets
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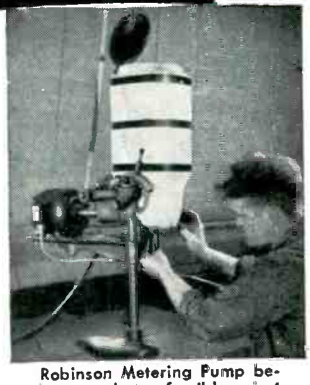

Robinson Metering Pump being used to forcibly eject metered amounts of cement into wire brush handle. Reservoir temperature 350° F.

Not a gravity dispenser — Forcibly ejects hot waxes and cements.
Thermostatically controlled heat — Variable with a maximum reservoir temperature of 450° F.
Motor driven, clutch actuated — 2/3 second per ejection.
Variable discharge — Ejections changed in 2 seconds, *without tools.*
Reduces unit costs—No skilled operator required. Saves material — reduces rejects.
Easily installed — Adaptable to any production set-up.

For complete information on this modern production tool and its possible application to your requirements, write for Bulletin No. 1A-R.

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SHIELDED TYPE PLUGS & SOCKETS

P-101-¼

S-101

LOW LOSS PLUGS AND SOCKETS FOR HIGH FREQUENCY CONNECTIONS. SUPPLIED IN 1 AND 2 CONTACT TYPES:

101 Series can be furnished with ¼", .290", 5/16", ⅜" or ½" ferrule for cable entrance. Knurled nut securely fastens unit together. Plugs have ceramic insulation and sockets have bakelite. Quality construction. Fine finish. Assembly meets Navy specifications.

For full details and engineering data ask for Jones Catalog No. CS-18.

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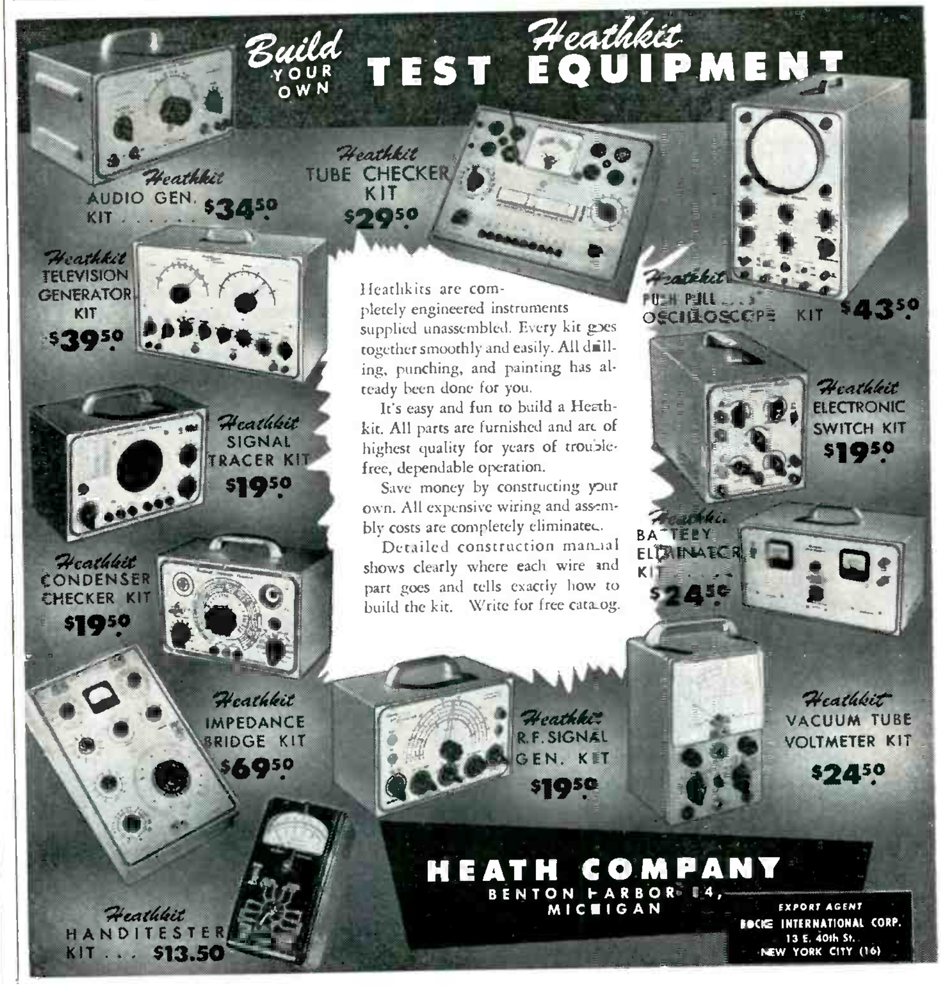
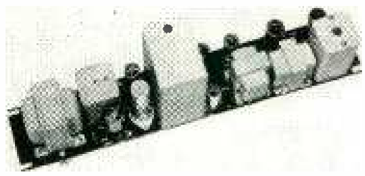
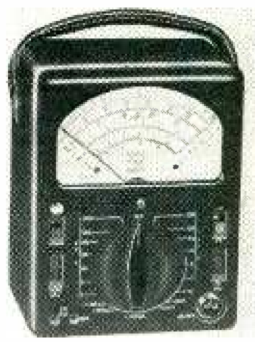


range stylus to its line of phono accessories. The new wide cartridge, model RPX-052 is equipped with a dual wide-range sapphire and diamond Baton stylus. It is designed to perform with uniform velocity response up to 15,000 kc. Minimum record wear is assured by designing the stylus in such a way that only six to eight grams of pressure results for all types of records.



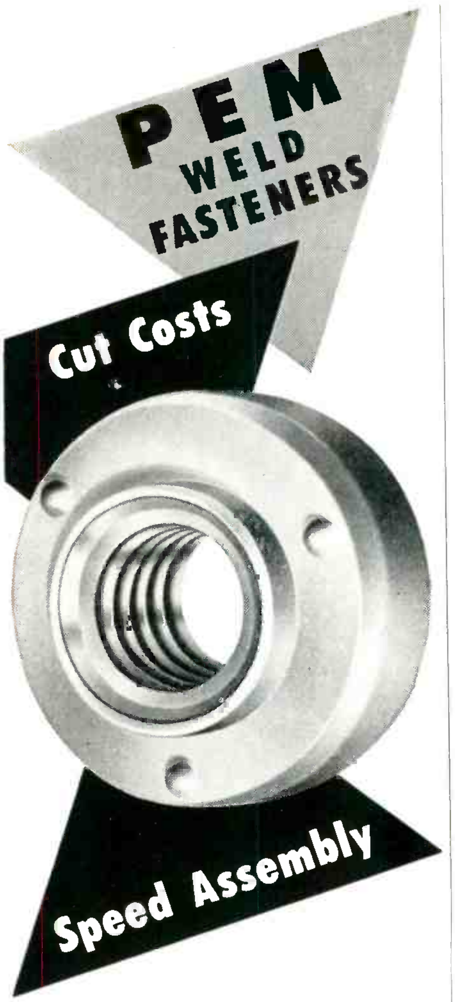
Duplex Signaling Unit

HAMMARLUND MFG. CO., INC., 460 W. 34th St., New York 1, N. Y., has introduced a new duplex signaling unit consisting of a tone transmitter and frequency selective receiver designed to operate over wire lines, telephone or power line carrier, and radio or microwave communications circuits. The units may be used to transmit and receive signaling, dialing, telemetering, teleprinting, supervisory controls or other information. Transmitters and receivers are available on the same or different frequencies between 2,000 and 6,025 cps. Up to 33 channels can be used over a single circuit.



VTVM

TRIPLETT ELECTRICAL INSTRUMENT CO., Bluffton, Ohio. Peak-to-peak a-c voltage and r-f measurements by the model 650 vtvm are made



NO BURN OUTS in thin sheets. Engineered projections prevent.

NO RETAPPING. Shank protects threads from weld spatter.

NO PILOTS or costly special electrodes.

NO INDEXING. Round, compact shape eliminates orientation. Permits use on narrower flanges. Self Locating.

YES. PEM WELD FASTENERS will do a better fastening job at lower cost, wherever load carrying threads are required in thin metals that may be welded. Write for literature and samples for trial. Penn Engineering & Manufacturing Corp., Doylestown, Pa.

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ACCURATELY MEASURES

Rate of Acceleration or Motion

UP TO 20,000 PER SECOND *WITHOUT* CONTACT

Model 3010 U. S. Pat. 2396703

other uses

Measure acceleration and velocity. Trigger or synchronize cathode ray oscillograph sweep circuits, angular position indicator (shaft or fly-wheel), reference marker (degrees, position or dead center). Indicate RPM, operations, cycles or motion at rates in excess of 20,000 per second when used with electronic counters.

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ELECTRONIC EQUIPMENT

Small low cost electromagnetic pick-up amplifies electrical impulses for counting recurring operations, revolutions, sequences, cycles or motions. It produces a voltage output proportional to the object's rate of speed. And may be actuated by the displacement or vibration of any magnetic material in the field of the pick-up. Such as a slot or keyway in the rim of a wheel or shaft, the teeth in a gear or any magnetic part on a moving body. *Consult Our Engineers on Your Particular Problem.*

Write for Bulletin MP 552 Today!

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TIME DELAY RELAY

Small ~ Compact ~ Few moving parts ~ Easily mounted
Operates in any position
Time delay range, 1 second to 5 or more minutes

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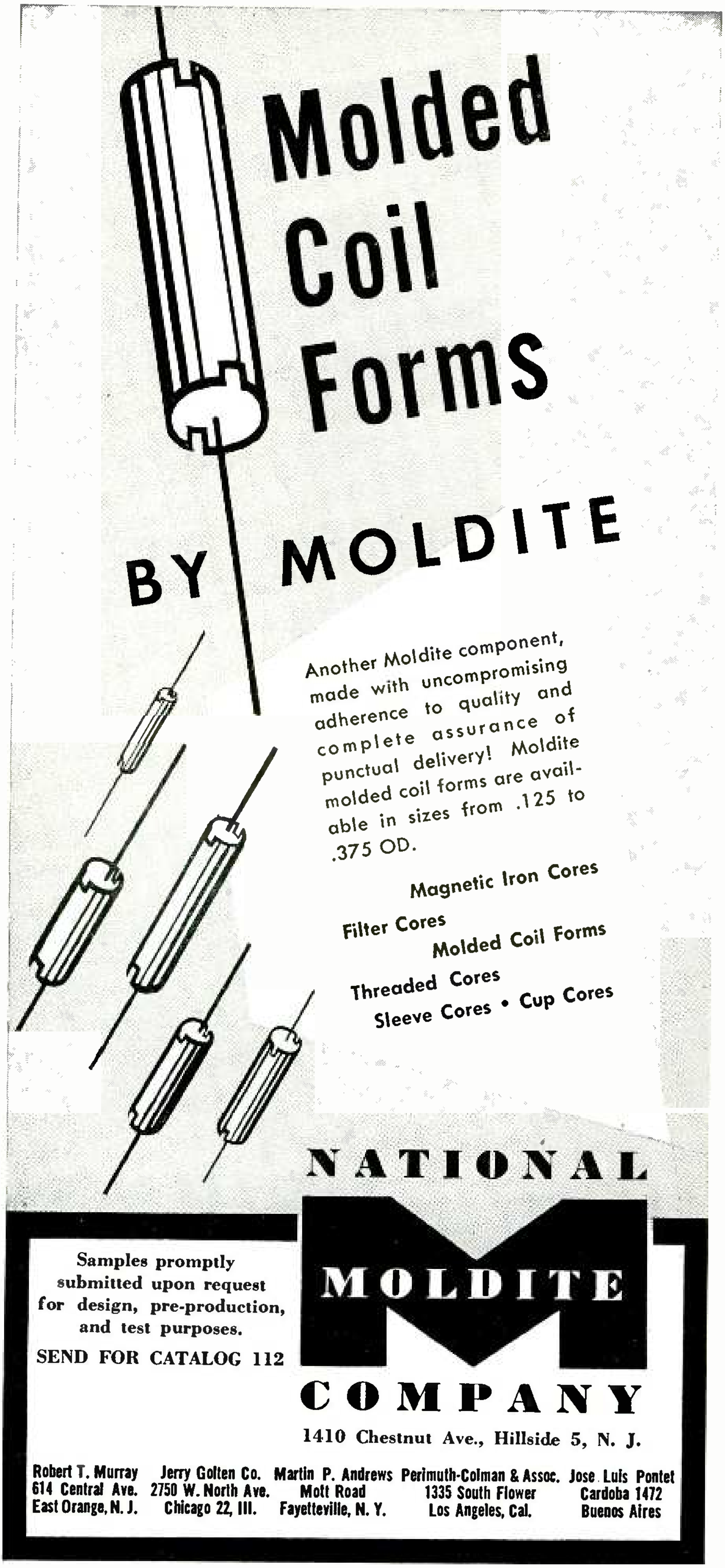
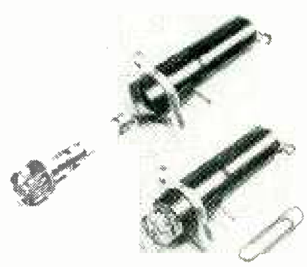
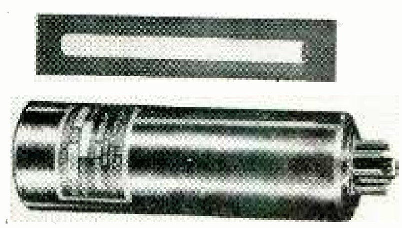


with one probe. Complete frequency coverage is from 20 cps to over 110 mc. One main selector switch controls all ranges. An especially designed, insulated, shielded r-f probe with short leads provides for h-f measurements and the tester has zero center mark for f-m discriminator alignment plus any other galvanometer measurements. A high input impedance of 11 megohms on d-c allows for accurate measurements without loading the circuit under test.



Indicating Fuseholder

ALDEN PRODUCTS CO., 117 N. Main St., Brockton 64, Mass., has announced a new neon indicating fuseholder, the Fuselite 44-5FH, that takes a standard 3AG or 3AB fuse. A unique feature is the integrally molded neon bulb in a crystal clear plastic lens that lights up instantly when the fuse blows. Because of its standard design and compact construction, the 440-5FH has practically universal application in 110 v circuits. With slight modifications it can be used for 220 v.



Frequency Standard

AMERICAN TIME PRODUCTS, INC., 580 Fifth Ave., New York 36, N. Y. Type 2003 frequency standard, a hermetically-sealed, plug-in unit, contains a miniature, high-Q tuning

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Transcription Player

AUDIO-MASTER CORP., 341 Madison Ave., New York 17, N. Y., has developed a more elaborate version of its transcription player combined with p-a system. Model AM53-PA has a 12-in. detachable loudspeaker with 10-ft extension cord and plays all sizes and types of records and transcriptions from 7 to 17½ in. It has a 5-tube high-gain amplifier, twist crystal cartridge fitted with 2 permanent needles, a 3-speed motor for 33⅓, 45 and 78 rpm, variable volume and tone control, and special mixer that permits simultaneous use of record and microphone.

Literature

Electronic Components. Sylvania Electric Products Inc., Second Ave., Warren, Pa., has issued an 8-page folder illustrating and describing a line of electronic components. Items covered include radio and c-r tube sockets, terminal

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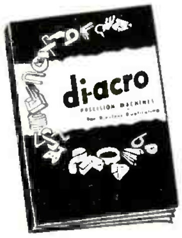

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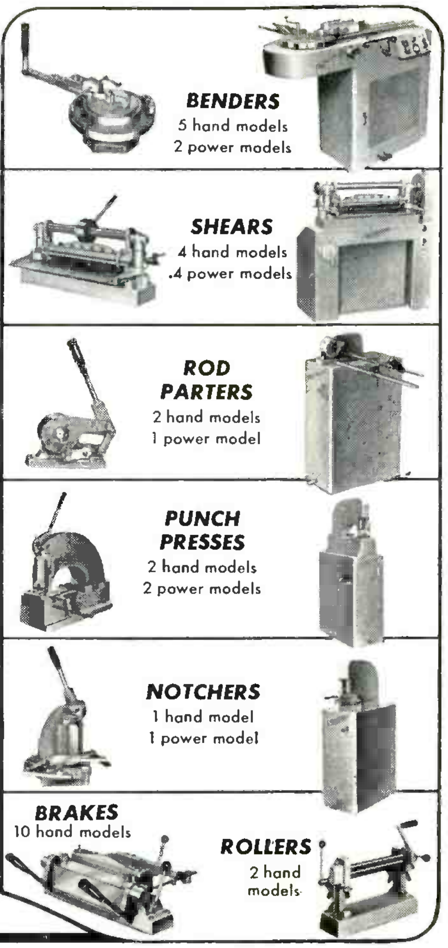

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boards, terminal strips, plugs and connectors and loop antennas.

Ultrasonic Soldering Equipment. Mullard Ltd., Century House, Shaftesbury Ave., London, WC2, England. An 8-page publication describes the principles and methods of use of the company's ultrasonic soldering equipment, which consists of a soldering iron and tinning bath. Applications suggested for the equipment include the tinning of electronic chassis assemblies, the soldering of connections to aluminum foil capacitors, and the joining of aluminum lugs to stranded aluminum cables.

Self-Locking Fastener. Elastic Stop Nut Corp., 2330 Vauxhall Road, Union, N. J. Interesting case histories and latest engineering data for the Rollpin self-locking fastener are important features of catalog No. 800. Photographs illustrate the versatility of the device as a practical substitute for rivets, cotter pins, set screws, stop pins, hinge pins, positioning dowels, lock pins and shaft keys.

Precision Indicating Potentiometers. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa. Specification sheet 177 describes and illustrates both the new console type operator's desk and the Brown ElectroniK precision indicator. It describes the precision indicator for both single and multipoint indication of variables as well as the extended range indicator and shows how this indicator, when combined with the operators desk and banks of switches, permits the operator to review and log many variable readings while sitting at the desk.

Potentiometers and Resistors. Cornell Electronics Corp., 40-33 Main Ave., Douglaston, N. Y. A recent 4-page folder gives a technical description and illustration of the F-101 series potentiometers designed for military airborne instrumentation and similar applications. Also included is information on the company's standard

and noninductive fixed wire-wound resistors.

Rotary Accelerator. Statham Development Corp., 12411 West Olympic Blvd., Los Angeles 64, Calif., has available a 4-page brochure on its rotary accelerator, an instrument that provides a controlled variable centrifugal acceleration for calibrating or testing instruments, electronic subassemblies, small mechanisms and other similar equipment. Acceleration range of the unit described is from 0.1 g to 100 g.

Carbon Film Resistors. Chase Resistor Co., 9 River St., Morristown, N. J., has issued a 4-page folder dealing with a line of 1-percent precision microcrystalline carbon film resistors. Dimensions of the various types, construction information and characteristics are given. Temperature coefficient curves are shown. A price list is included.

Oscillator. Southwestern Industrial Electronics Co., 2831 Post Oak Road, Houston 19, Texas. A 4-page folder describes the model L oscillator that has been designed as a source of power covering the frequency range of 0.01 to 100 cps. An illustration, technical specifications, a page of information on output circuits and prices are given. Also included is a circuit diagram showing a simplified version of the two-amplifier-bridge-stabilized oscillator which is used in the model L oscillator.

Electronic Flow Meter. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa. Instrumentation Data Sheet 10.3-5 describes the Potter-Brown Flowmeter for measurement of fluids over an extremely wide range of temperatures and pressures with an accuracy of 0.5 percent. The system described is easily installed, has linear characteristics and can be used to measure, record and control flow at one or more points.

Hermetic Seal Bushings. Heldor Terminal and Bushing Co., Inc., 225 Belleville Ave., Bloomfield,

N. J. A new, comprehensive catalog gives full technical descriptions and dimensional diagrams of a complete line of hermetic seal bushings. The 40-page presentation features in addition to bushings and terminal assemblies, technical data on studs, washers, steatite, convoluted steatite and glands. Special sections are devoted to the company's MIL-T-27 cans and covers, and attention is focused on a new cover assembly service.

Precision Test Equipment. Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y. Eighty-eight pages of loose-leaf perforated bulletins are presented in the latest edition of the test equipment catalog. Subjects covered include attenuators and terminations, impedance measurement and transformation, transmission line components, frequency measuring devices, detection and power measurement, signal sources and receivers and vhf-uhf test equipment.

Tube Booklet. Mullard Ltd., Century House, Shaftesbury Ave., WC2, London, England, recently issued a revised and enlarged edition of a booklet entitled "Valves and Tubes for Industry and Communications. Purpose of the booklet is to provide electronic equipment designers with a convenient guide to the wide range of tubes recommended for communication and industrial applications. Besides abridged data on all available types, the publication includes general operational recommendations and a guide to American (RTMA) types replaceable by Mullard types.

Production Facilities. Sylvania Electric Products Inc., Second Ave., Warren, Pa., has announced a new bulletin describing production facilities available at its Parts Division. The 20-page 2-color publication describes the company's manufacturing and engineering services in the following industries: plastics, formed metal parts, wire, welds, mica and electronic components. The 8 × 10 bulletin contains more than 60

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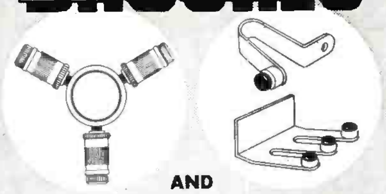

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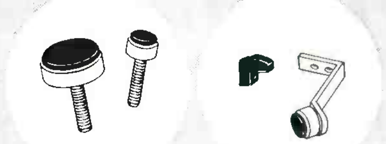

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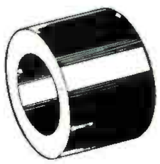

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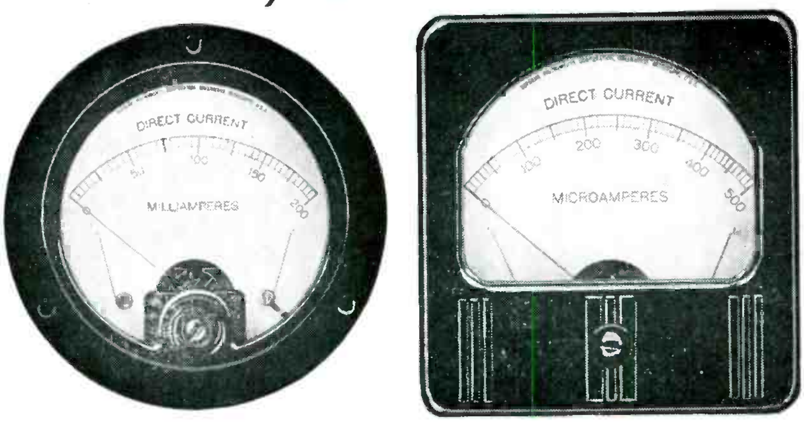

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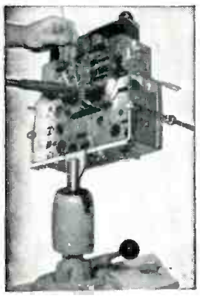

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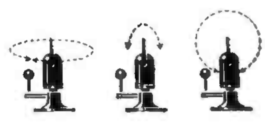

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illustrations describing plants and services in 10 locations.

Broadband Ferrite-Core Transformers. Sierra Electronic Corp., 810 Brittan Ave., San Carlos, Calif. Several examples of new transformer-engineering techniques are presented in a new folder, Form SA14. Transformers utilize ferrite cores to achieve extremely high permeabilities and efficiences at the higher radio frequencies as well as new insulation techniques which minimize leakage inductance and distributed capacitance. Examples of four typical units are shown by illustration, circuit application and response curves. Also included in the folder is an application chart revealing the areas of frequency and power-handling capacity most advantageously served by transformers of this design. Data are also included on a plug-in adjustable inductor for aircraft radio use at 200 to 400 kc.

Antenna Catalog. The LaPointe Plascomold Corp., Windsor Locks, Conn., has released the 1952 Vee-D-X catalog containing the complete line of antennas and accessories. Containing 24 pages and printed in two colors, the catalog features not only standard Vee-D-X products, but also includes such new developments as the Q-Tee, the Long John, 3 new models of the RW series lightning arresters, the new Mighty Match, and many others.

Atomic-Hydrogen Arc Welding. General Electric Co., Schenectady 5, N. Y., has available a new two-color, two-page bulletin on single-phase, 60-cycle atomic hydrogen arc welding equipment. In addition to explaining the process of atomic-hydrogen welding, bulletin GEC-598A describes the recently redesigned power generating equipment and lists its specifications, applications and advantages. It also covers the features of the companys atomic-hydrogen torch.

High-Vacuum Rectifier. Lewis & Kaufman, Inc., 50 El Rancho Ave., Los Gatos, Calif. A two-page loose-leaf-perforated data sheet de-

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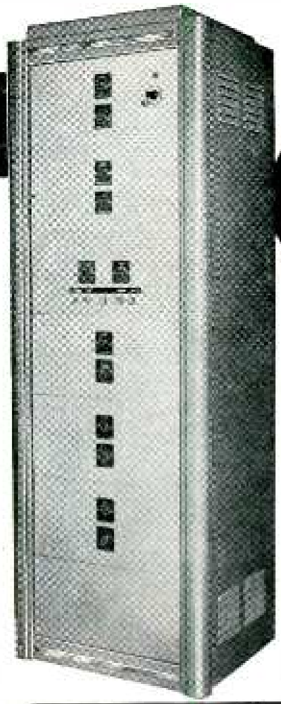

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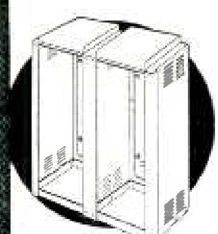

"MULTIRACKS" These Racks may be assembled in multiple units as shown above.. SHELVES available. Also ROLLER TRUCKS available for single racks or "Multiracks".

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scribes the type 8020 high-vacuum rectifier. It gives operating characteristics for both rectifier and surge-limiting diode operation. The tube is illustrated and outline dimensions are given.

Patch Cords and Jack Panels. Trimm, Inc., 400 Lake St., Libertyville, Ill., has published bulletins R-15a and R-23 describing complete lines of patch cords and jack panels used in broadcast stations and recording studios. Included in the bulletins are descriptions of sub-parts of jack panels frequently useful to laboratories in construction of specialized test equipment.

Vibration Meter. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif., has issued a 4-page bulletin describing the 1-110B vibration meter, an extremely simple and compact instrument that gives direct readings of both linear and torsional velocity and displacement, allowing rapid, easy calculation of the vibrational characteristics of machines and structures. The instrument described incorporates a four-stage, single-channel amplifier, highly stabilized by negative feedback to insure extreme reliability over long periods of time.

Industrial X-Ray Folder. Westinghouse Electric Corp., 401 Liberty Ave., Pittsburgh 30, Pa. In a 4-page folder entitled "Seven Industrial Eyes", seven types of x-ray equipment for industrial application are pictured and described. The units described are: a single-column tubestand unit; an industrial jib crane unit; an ultra-high-speed radiograph unit; a mobile unit; equipment for mass inspection of parts; a wall-mounted industrial x-ray unit; and a thickness gage.

Recording Potentiometer. Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. A recent pamphet introduces the single point recorder of the null-balancing (potentiometer) type, which employs a line-driven synchronous converter and amplithe annual

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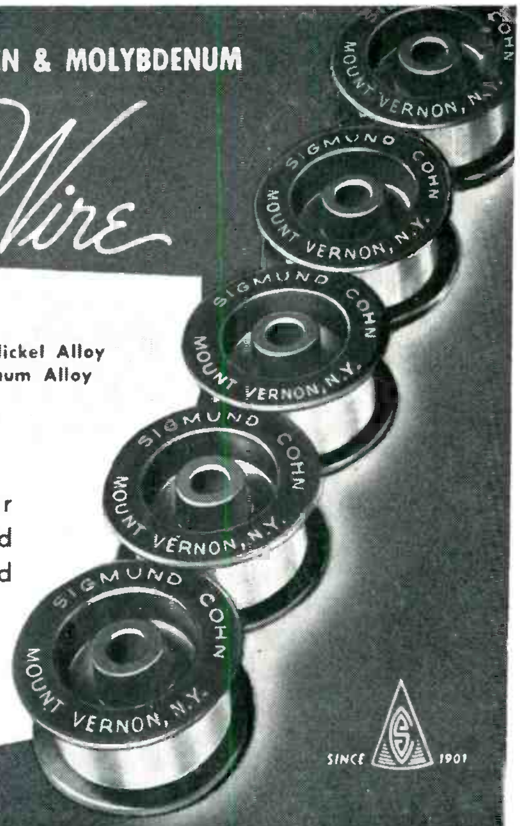

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fier to control a two-phase motor and rebalance the measuring circuit. The instrument illustrated and described in the brochure can be used to measure and record temperature, d-c current, d-c voltage, resistance, a-c voltage, a-c current, speed, speed ratio, power, frequency, hydrogen ion (pH), light intensity or any other quantity that can be converted into electrical values.

H-V Ceramic Capacitors. Sprague Electric Co., 35 Marshall St., North Adams, Mass. Bulletin No. 606 gives complete details on type 700C high-voltage ceramic capacitors that are molded in moisture-resistant, nonflammable thermosetting plastic, rated at 20,000 v d-c and designed for 85C operation. The capacitors described find broad use as h-v supply filters in tv receivers and c-r instruments and have a standard rated capacitance of 500 $\mu\mu$f.

Industrial Fasteners. Southco Division, South Chester Corp., Lester, Pa., has available a handbook of fastening specialties containing 22 pages of information on industrial fasteners for metal-to-metal and metal-to-wood applications. Blind rivets and a variety of door latching and fastening devices are illustrated in this two-color, spiral-bound book which also includes several pages of frequently used engineering data. Installation procedure, sample applications and complete dimensional information are given for all fasteners.

Flexible Waveguides. Technicraft Laboratories, Inc., Thomaston, Conn. A recent 6-page folder gives an illustrated description of the type V (vertebra), type S (seamless-corrugated) and type L (interlocked) flexible waveguides. Charts are included showing standard lengths available, nominal attenuation in db, angular bend and axial twist. Information on combination assemblies is also given.

Decadal Frequency Generator. Arthur Schomandl, Troger Strasse 32, Munich 8, Germany, has published a 4-page bulletin illustrat-

ing and describing the type ND5 decadal frequency generator for generation of any desired frequency with crystal accuracy within a range from 1 kc to 30 mc. Output frequency of the instrument described is controlled in a fixed-phase relationship by an input frequency of 100 kc, for which either an available 100 kc standard frequency or the output frequency of any 100 kc crystal-oscillator may be employed.

Tape Recorder. Magnecord, Inc., 360 N. Michigan Ave., Chicago 1, Ill. A recent issue of the company's house organ describes and illustrates the Magnecordette, a tape recorder for use with radio or amplifier systems. The mechanical part of the unit described has separate erase and record-reproduce heads and includes 7½ and 15 in. per second tape speed capstans for either speed with a frequency response of 15,000 cycles ±2 db.

Heavy-Duty Connectors. Cannon Electric Co., 3209 Humbodt St., Los Angeles 31, Calif. An 8-page bulletin covers a rugged heavy-duty connector series having resilient material insulators and grommets made to Army Ordnance specifications. The series described, available in AN shell styles with various accessories, is moisture proof and pressurized.

Solderless Terminals. Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa., has available a booklet dealing with quality control of the entire solderless wire termination process. Of special interest to engineers, designers and manufacturers in the electrical and allied fields, it provides technical information concerning 3-way control of the process from the raw metal, through manufacture, to the finished installation.

Transformers. Milwaukee Transformer Co., 5231 North Hopkins St., Milwaukee 9, Wis., has issued a booklet on its transformers, reactors, filter networks and similar components that are custom-engineered for commercial, industrial, laboratory and government applications. It gives a well illustrated

description of the company's facilities and production techniques. Ordering information is included.

Subminiature Capacitors. Astron Corp., 255 Grant Ave., E. Newark, N. J., has announced new catalog sheets, complete with engineering performance and test specifications, on its new type AQ subminiature paper capacitors. As a result of the newly developed X-250 high temperature impregnant, the capacitors described will operate at temperatures up to 125 C without derating.

Hermetically Sealed Components. T. C. Wheaton Co., Millville, N. J., announces catalog W52. In addition to the specifications covering the regular line of hermetic lead-thru terminals and suggestions on how to use them, the company's new glass trimmer capacitors are introduced. An insert covering the specifications on the new WR-8 relay is also included with the catalog.

Transformers and Related Components. Standard Transformers Corp., 3580 Elston Ave., Chicago 18, Ill. A completely revised 24-page catalog and replacement guide contains over 500 separate listings of transformers and related components. A numerical index and price list; classified index, and separate sections for high fidelity, input and interstage, output, driver modulation, power, filter chokes, filament, plate, isolation and autoformers and a separate tv component section are contained in the book. Seventy classifications are indexed in the catalog. Also included are an output transformer chart, matched power supply chart and data on the Stancor-Williamson amplifier.

Ground Plane Antennas. Ward Products Corp., 1523 E. 45th St., Cleveland 3, Ohio, has available a descriptive sheet dealing with three new ground plane antennas. It covers the SPPA-94 that is designed for the amateur two-meter band, 144 to 152 mc; the SPPC-94 that covers many of the aircraft frequencies, operating between

108 and 120 mc; and the SPPD-94 that covers 120 to 132 mc.

Ridged Waveguide. Polytechnic Research & Development Co., Inc. Volume 1, No. 2 of the PRD Reports covers a transmission system that operates over a wider frequency range than conventional rectangular waveguide. It gives a fully illustrated technical description of the ridged waveguide, a rectangular waveguide with a rectangular metal ridge protruding from the center of one broad face. Compared with a rectangular guide of the same fundamental mode cutoff frequency, the ridged waveguide described has five times the attenuation for a bandwidth of four and nine times for a bandwidth of five.

Carrier Amplifier. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif. Bulletin 1522A describes the type 1-118 carrier amplifier which is designed primarily for the smaller engineering and development laboratory not having a full-time staff devoted exclusively to testing. The instrument discussed is of special interest to engineers engaged in development of high-speed industrial equipment as it greatly simplifies analysis and evaluation of all the h-f and transient physical factors affecting product performance.

Silicone Rubber. General Electric Co., Pittsfield, Mass. Designers, purchasing agents and engineers will be interested in a recently published booklet entitled "Imagineering With Silicone Rubber." The 24-page bulletin CDS-3 includes comprehensive information on properties, applications, classes and design specifications of the company's silicone rubber.

The applications illustrated show how the unique properties of this silicone rubber are helping to make for better products, improve production processes and develop entirely new products. The silicone rubber parts described feature resistance to temperature extremes, release from sticking, inertness and unusual surface properties.

PLANTS AND PEOPLE

Edited by WILLIAM P. O'BRIEN

OTHER DEPARTMENTS featured in this issue:

Marchant Gets New Division

MARCHANT CALCULATORS, INC., has acquired a controlling interest in Physical Research Laboratories, Inc. of Pasadena, Calif., developers and makers of electronic computers and components. The laboratories will be re-named Marchant Research, Inc., and will be moved to company headquarters at Oakland.

Research activities of the new division will be directed toward developing simplified electronic computers with broad applications in science and business. Electronic components—such as magnetic recording heads for electronic computers, pulse transformer and delay lines for radar and loran equipment—developed by Marchant Research, will be manufactured and sold by Marchant Calculators.

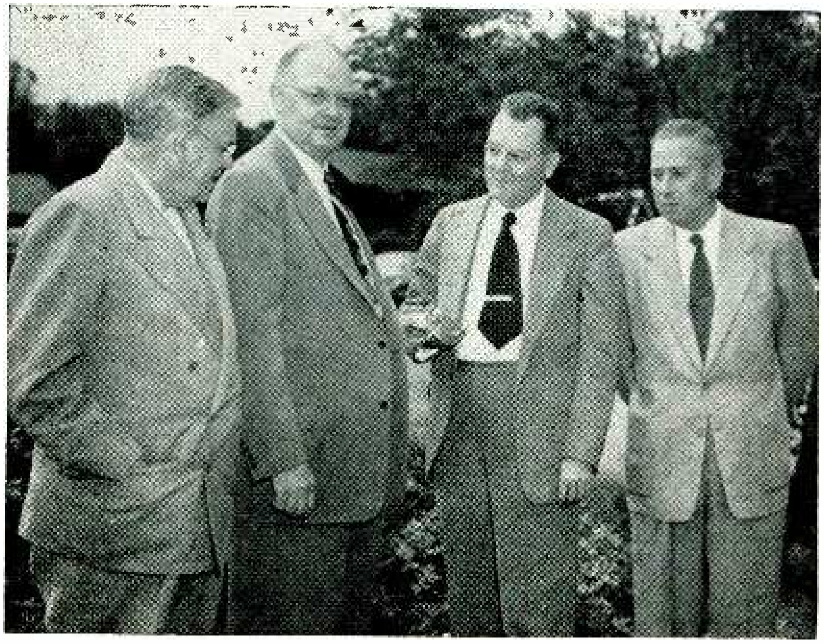
Edgar B. Jessup, president of the parent company, will be chairman of the board of directors of Marchant Research, Inc., and George Greene, who was founder and president of Physical Research Labs, will be president and director. Donald White, co-founder of Physical Research Labs, will be chief engineer and a director.

Battelle Expands

GROUND was recently broken in Columbus, Ohio, for a new million-dollar special-purpose laboratory building for Battelle Institute. Construction was authorized by the NPA because of the important defense research being conducted at Battelle.

Some 300 industrial firms, in addition to the Air Force, Army, Navy and Atomic Energy Commission, are sponsoring important research studies at Battelle. Director Clyde Williams estimates that in the space provided by the new building, Battelle will be in a position to conduct an additional $2,000,000 worth of research for defense agencies and defense industry.

SERVICE AWARD PRESENTATION



Albert C. Gable, second from left, manager of engineering for General Electric's Industrial and Transmitting Tube operations, receives the first Service Award of the Joint Electron Tube Engineering Council at the council's last meeting in Big Moose Lake, N. Y. Presentation of the award plaque was made by Virgil M. Graham, council chairman. At left is Frank J. Martin, council secretary, and at right is Henry J. Hoffman, NEMA director of JETEC. Mr. Gable recently resigned from the council after two years' service, during which he served as chairman of the council's critical materials committee

Beckman Buys Berkeley

BERKELEY SCIENTIFIC CORP., Richmond, Calif., manufacturer of electronic equipment, has been purchased by Beckman Instruments, Inc., of South Pasadena, Calif. The Berkeley Corp. has been dissolved and its operations will continue as a division of the parent company.

W. K. Rosenberry, founder and president of Berkeley Scientific, becomes vice-president of Beckman Instruments in charge of operations at the Richmond plant.

The Beckman organization now has 18 plants or plant sites in the country, and employs 1,400 people. Biggest source of sales is a precision potentiometer made by subsidiary Helipot Corp. The company also makes pH meters, spectrophotometers, computers, radioactivity meters and other devices.

Engineering Changes at Bendix

EDWARD K. FOSTER, vice-president and general manager of the Bendix Radio Division of Bendix Aviation Corp., has announced the appointment of Arthur C. Omberg as director of engineering and research for the division. Adam E. Abel has been named as his assistant. Om-

TO-DAY'S GREATEST SUCCESS . . .

THE AUTO-CHANGER OF TO-MORROW

The "Monarch" auto changer

A masterpiece in design and technical excellence—a three-speed automatic record changer designed to play 12", 10" and the increasingly popular 7" records *intermixed in any order.* The "Monarch" combines ease and simplicity of operation with the high standard of reproduction and performance demanded by the most discriminating listener.

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- * New reversible dual stylus crystal pick-up has extended frequency range to 10,000 c.p.s. Self compensated for the L.P. lower frequencies with the Turnover frequency at the correct point.
- * Remarkably compact design makes it an ideal unit for the radiogram/TV combination console.
- * Simplicity of design guarantees long life and trouble-free operation.
- * Beautiful styling and finish that will harmonize with any cabinet design.
- * Operates on 100/125–200/250 volts, 50 cycles A.C. Models also available for 60 cycles A.C.

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. . . a beautifully styled three-speed gramophone. Complete with ingenious automatic stop and light-weight high-fidelity turnover type crystal pick-up fitted with two permanent sapphire styli.

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BSR

Birmingham Sound Reproducers Ltd., Old Hill, Staffs. England. Grams: 'Electronic Old Hill, Cradley Heath.'

berg succeeds W. L. Webb who was recently promoted to the central engineering staff of the Bendix Aviation Corp. in Detroit.

Mr. Omberg, who has been associated with Bendix since 1944, has been assistant director of engineering and research for the past two years.

Adam E. Abel, who becomes assistant director of engineering and research, has been chief radar engineer for the radio division, responsible for the design of both the military and civilian radar which is now being produced by Bendix in large quantity.

New West Coast Manufacturer

LLOYD M. JONES, with KFI A-M—F-M—TV for over 19 years and with KTTV for 1½ years as operations engineer, has left KTTV to embark upon his own manufacturing business. The business will be known as Lloyd's Enterprises, Box 313, Altadena, Calif.

During the war he was with the Radiation Lab at MIT as a staff member. Projects included APG-1, APG-5, APG-8 and APG-15.

The new organization will make new types of test equipment for TV and electronic research.

Co-Design President Named

DONALD E. WILLIAMSON has been named president of the Co-Design Corp., located at 751 Main St., Winchester, Mass. He is former associate director of research of Baird Associates, Inc. The new corporation will engage in engineering and manufacture of special instruments and devices.

Sylvania Promotes Moncton

THE APPOINTMENT of Howard S. Moncton as administrative engineer of the Radio and Television Division of Sylvania Electric Products Inc. was recently announced. He joined Sylvania in 1939 and has been assistant to the manager of the Physics Laboratories since 1943.


H. S. Moncton

Mr. Moncton assumes his new duties at headquarters of the Radio and Television Division in Buffalo, N. Y. He will be responsible for the coordination of the administrative functions of the division's engineering department.

Audio & Video Names New Board Member

SIDNEY K. WOLF has been appointed to the board of directors of the Audio & Video Products Corp., 730 Fifth Ave., New York City. He was at one time deputy director of the radio and Radar Division of the War Production Board and director of the Communication Division of the Munitions Board.

Kahle Announces Engineering Rep

THE KAHLE ENGINEERING CO. of North Bergen, N. J., has announced the appointment of James B. Lindsay as a special engineering representative for the company.


J. B. Lindsay

Mr. Lindsay, former vice-president of Thomas Electronics, has devoted the past 25 years to the electronics industry. His association with RCA for more than 12 years resulted in many important contributions to the design and development of tube equipment and techniques.

Instrument Labs Acquires Stewart Bros.

STEWART BROTHERS, INC. of Chicago, Ill., manufacturers of telephone and telegraph test equipment for the independent telephone systems in this country and abroad, has been acquired by Instrument Laboratories, also of Chicago, and will be operated as Stewart Brothers, Division of Instrument Laboratories. The acquisition will result in a program of modernization and improvement to make the line of even greater use and value to the telephone industry.

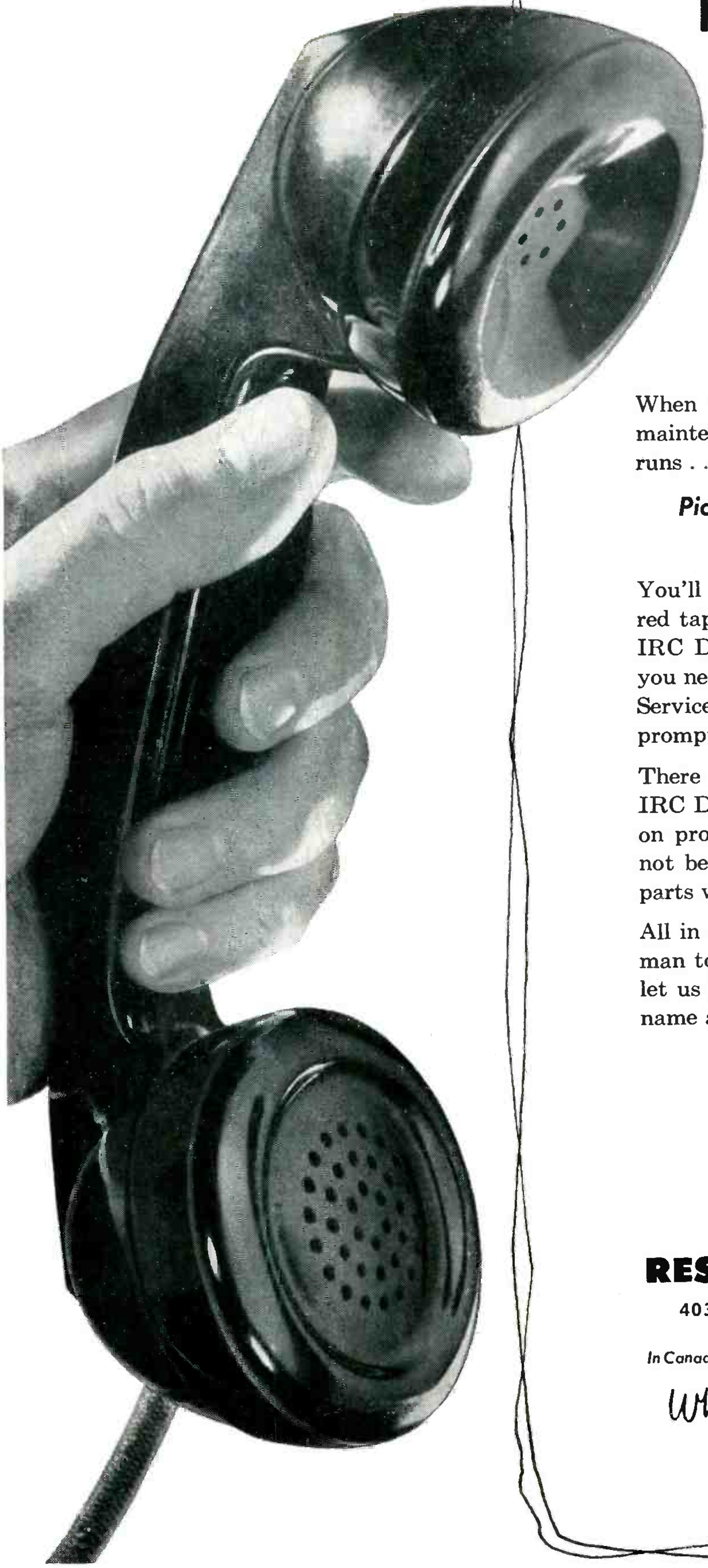
Westinghouse Establishes Fellowship Fund

A FELLOWSHIP fund to help promising young engineers and scientists of the Westinghouse Electric Corp. continue their studies at a graduate level has been established in honor of the late Leon R. Ludwig, inventor (he collaborated in the development of the ignitron rectifier) and company engineering executive. The fund will be administered initially by five company officers.

To be eligible for a fellowship, a candidate must have shown marked ability in engineering or scientific fields and must be a Westinghouse employe of at least two years' service.

Goss Joins RCL

C. GILBERT GOSS, development engineer in electronic circuitry at Oak Ridge National Laboratory for the past four and one-half years, has joined Radiation Counter Laboratories, Inc., as director of electronic research. He has had wide experi-



ence with linear amplifiers, scalers, differential discriminators, special voltage supplies and other electronic equipment used in nuclear detection work.

Prior to becoming a member of the staff at ORNL, he was an instructor in electrical engineering at Louisiana Polytechnic Institute.

AIEE Appoints New Committee Chairman

L. F. HICKERNELL, chief engineer of the Anaconda Wire & Cable Co., Hastings-on-Hudson, N. Y., has been named chairman of the newly formed Committee on Technical Operations of the AIEE. The new

L. F. Hickernell

committee will be coordinating agency for the AIEE's five technical divisions, which represent 38 technical committees, and will supervise all technical affairs of the Institute.

Philips Plans Java Plant

CONSTRUCTION of an electronic and communications equipment manufacturing plant at Bandoeng, Java, is being planned by the Indonesian Philips Co. In additional to locally recruited manpower, at least 2,000 workers will be brought from Sourabaya, Java.

New Audio & Video V-P

KENNETH B. BOOTHE has been elected a vice-president and director of the instrumentation division of Audio & Video Products Corp., New York, N. Y. This advances him from the position of manager of

the instrumentation division.

Before joining Audio & Video in 1949, Mr. Boothe was chief engineer and technical supervisor for the United Nations Sound and Recording Department. He organized and directed the engineering for the Paris General Assembly and supervised the simultaneous interpretation and recording installations for the U. N. in Geneva and Havana.

New Chief Engineer

CONDENSER PRODUCTS Co. of Chicago, manufacturer of Glassmikes, capacitors, high-voltage power supplies, pulse-forming networks and plasticon capacitors, has announced the promotion of Tom Murphy to chief engineer.

Mr. Murphy, with the firm for four years, will head the engineering department, which is presently composed of eleven engineers.

T. Murphy

Sylvania Occupies New Site

THE ELECTRONICS DIVISION of Sylvania Electric Products Inc. recently moved its headquarters from Boston to 100 Sylvan Road, Woburn, Mass. Products manufactured in Woburn will be used in such fields as radar, navigation, communication and flight, and will include electron tubes, microwave tubes, semiconductor devices (including transistors) and special-purpose tubes.

Opening of the multi-million dollar Woburn plant brings to six the *from*

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number of communities in Massachusetts in which Sylvania has manufacturing operations. The Electronics Division last spring opened a new plant in Newton for the production of magnetrons for radar, and the company will retain the Boston plant for production of electronic equipment, such as radar systems and electronic computers.

Hoffman Plants Enlarged

ADDITIONS to the company's Los Angeles plants have been made by Hoffman Radio Corp., making a total factory area of nearly a half million sq ft. The new buildings, with an aggregate of 122,000 sq ft of space, are located at 3764 South Broadway Place and 2034 East 48th St.

Construction has just begun on an annex to the main plant in Los Angeles (3761 So. Hill St.). Cost will be $550,000.

The two buildings already occupied plus the new one will increase the production area by 31 percent.

D&R Staff Addition

LEO JOHNSON, formerly with the Naval Research Laboratory and General Electric Co., has joined the staff of the Magnetics Division of D&R Ltd., Santa Barbara, Calif.

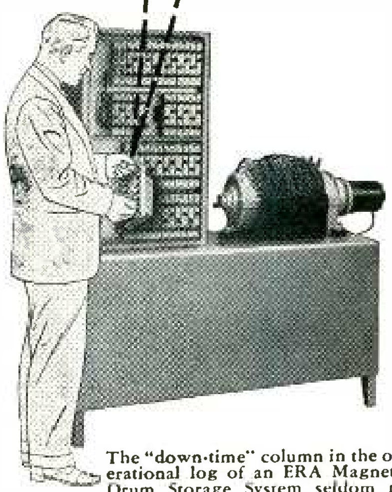
At both GE and NRL his work was in connection with servo projects, computers and the development of high-performance magnetic amplifiers. He will continue his research work on magnetic amplifiers in his present position with D&R.

AiResearch Expands

THE ENGINEERING department of AiResearch Mfg. Co. has been moved to enlarged quarters in a new building at 9225 Aviation Blvd., Los Angeles, Calif. The new engineering building is a single-story structure embracing 37,500 sq ft of floor space.

In addition to engineering personnel, the new quarters are providing space for the handbook department, preliminary design and engineering records.

ERA MAGNETIC DRUM STORAGE SYSTEMS



The "down-time" column in the operational log of an ERA Magnetic Drum Storage System seldom receives an entry. Every component of these systems has been designed or specially selected to assure day-in day-out operational reliability.

Simple test routines have been developed to detect marginal electronic components *before* they fail. The pluggable chassis construction utilized in the electronic sections of ERA Magnetic Drum Storage Systems permit the easy replacement of any unit incorporating a faulty component. Result—the system continues to operate while the pulled chassis is serviced. This practical design philosophy is one of the important reasons behind the ERA Magnetic Drum Storage System reputation for reliability.

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This model is fitted with compound dovetail slides and with an all angle table top capable of being inclined 3½ degrees on two planes, which adapts itself to laboratory, production or research work or where a particular technique requires orientation of the X axis in two directions from horizontal. The Z axis may be rotated throughout 360 degrees with orientation within one minute precision.

Lead screw operated micrometer dials permit accuracy of sawing to one thousandths of an inch. Heavy rigid construction has been designed into these heads to insure maximum stability during the sawing operations.

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- **Mechanical Engineers—3 to 10 years' experience in Manufacturing, Tooling and Design for Manufacturing for work on Defence Projects and Home Appliances.**
- **Electrical Engineers—Experienced on small Transformers for Research and Development Department.**

These are permanent positions, combining security with excellent opportunities to get ahead in a Company and a Country with an unequalled future! Salary fully commensurate with qualifications. Location, Hamilton. Special assistance given in securing living accommodation. Please give full details as to qualifications in first letter. Replies strictly confidential. Address replies to:

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CANADIAN WESTINGHOUSE CO. Limited,

HAMILTON, ONTARIO, CANADA.

NEW BOOKS

Principles of Radio

BY KEITH HENNEY AND GLEN A. RICHARDSON. *John Wiley & Sons, Inc., New York, 6th ed.*, 1952, 655 *pages*, $5.50.

THE Sixth Edition of "Principles of Radio" keeps this text in the lead in the field of basic radio knowledge. In the same manner that a certain gift is required to teach the fundamentals of a subject to beginners, it is also difficult to write a text for that purpose, particularly so if the material is to be rigorous.

To make certain that the reader has the proper background to understand and follow the radio material, the first nine chapters cover the electrical knowledge essential to radio, and in a manner that invites the student to keep on going and see what is coming up next. A variety of problems are included so that the material will not be the "descriptive" type only.

Then proceeding through several chapters on the vacuum tube and its basic operation, the particular applications of radio are treated to give a well rounded study so that the reader will cover a-m receivers, a-m transmitters, antennas, frequency modulation, ultrahigh frequency phenomena, television and radar. Or if the reader is interested in audio systems there is a chapter on that subject.

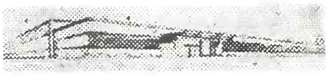
A book of this type without a mention of electronic instruments would be incomplete. A very interesting chapter is included on that subject. Also the non-sinusoidal wave and its circuits has been treated. Even the recent developments in color television are described.

The price of the book, based on the number of pages and their contents, is very moderate at present day book prices.—HOLLIS BAIRD, *Northeastern University, Boston, Mass.*

Electronic Measurements

By F. E. TERMAN & J. M. PETTIT. *McGraw-Hill Book Co., Inc., New York*, 1952, *2nd Edition*, 890 *pages*, $10.00.

THE AUTHORS claim that they have extensively revised the senior



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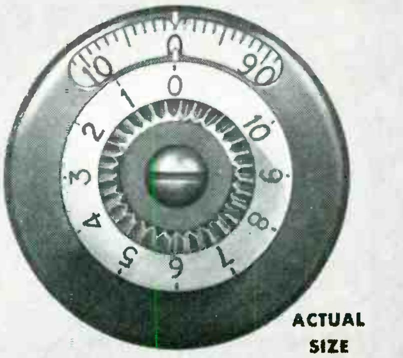
Microdial is composed of two concentrically mounted dials . . . one for counting increments of each turn and the other for counting turns. The incremental dial has 100 equal divisions and is attached rigidly to the shaft so there is no backlash. Thus the contact position is indicated to an indexed accuracy of 1 part in 1000. Rotation is continuous in either direction. There are no stops on the Microdial assembly.

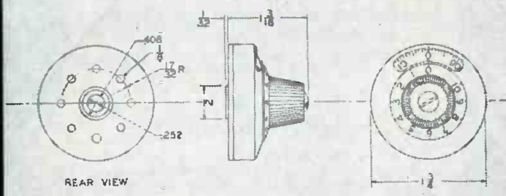
COMPACT . . . Microdial has same O.D. as Micropot . . . requires no more panel space.

CLEAR READING . . . Forced fast-reading tests showed only 1/20th as many errors with Microdial open window as with next most legible dial. Turn counter distinguishes between 0 and 10 turn readings, and accelerates to avoid confusion on readings near integral turns. Precise readings are made from larger dial with maximum separation of graduations and wide angle visibility.

CONVENIENT . . . delivered completely assembled with dials synchronized. Easily mounted in a few seconds. All dials may be locked.



ACTUAL SIZE



Microdial . . . turn-counting dial, primarily designed for use on Micropot ten turn linear potentiometers . . . use it on any multiturn device having ten turns or less.

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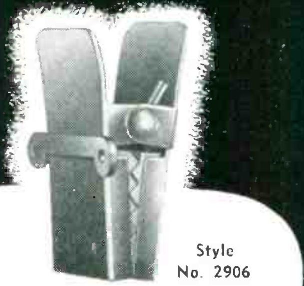

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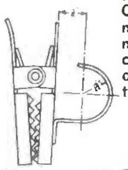
Sturdily constructed for maximum life. Finished in semi-gloss black enamel. Ribbed, firm-gripping clamping pads made of hard neoprene. Mounting plate enables clip to be attached to hard surface, such as a switch case. Hard drawn steel spring wire insures optimum spring action.



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DATA SHEETS ON REQUEST.

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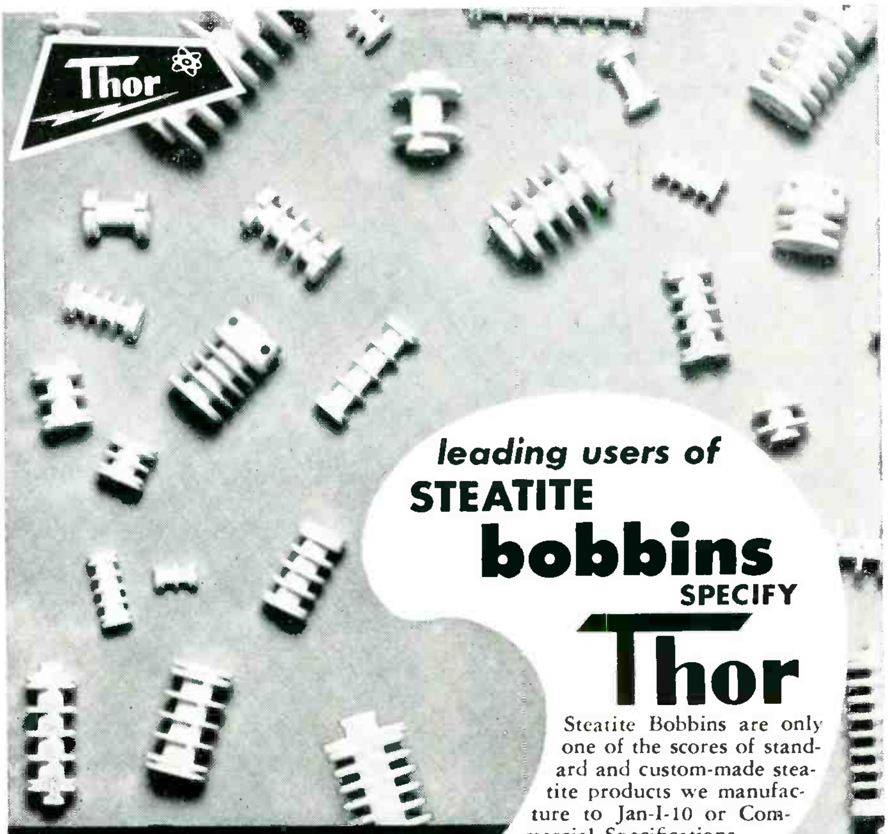

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author's book, "Measurements in Radio Engineering." This is an understatement. The book is essentially a new one—not just a "second edition,"—and the authors' claim that the "change in title is indicative of the increased scope of the new book" is modest, indeed. It is a pleasure to read a book which has obviously been so carefully planned and executed. The intent, as defined in the preface, is carefully followed throughout, and the typography and illustrations are excellent.

The book "has as its aim the providing of a comprehensive engineering discussion of the measuring problems commonly encountered by radio or electronic engineers." The fundamental measurements of voltage, current, and power are first covered, followed by chapters on measurements of circuit constants in both lumped and distributed constant systems. Frequency, waveform, phase and time-interval measurements are discussed. A short chapter on tube characteristics is followed by chapters on amplifier, receiver, antenna and radio wave measurements. Descriptions of various types of laboratory oscillators, reactance and resistance standards, and attenuators and signal generators are given. A chapter on generators of special waveforms contains a wealth of information not readily available in such practical form elsewhere. This latter chapter is unusual to find in this type of book, but it has obviously been included because of its importance as an aid to laboratory measurement techniques.

The specialist in any single field will undoubtedly find his own particular interest too sketchily covered in this text—this is as it should be, for the aim of the text is to present to the student the "experimental aspects of radio in the same comprehensive way that the general principles are ordinarily studied." On the other hand, it will be a very finicky specialist who will not admit that the footnote references will lead the reader, if he so desires, to the latest and best literature in practically every field covered. The references are amazingly complete and up-to-date; a quick glance gives the impression

that over 50 percent are dated subsequent to 1945 and many are dated 1951. The authors are to be commended for the help they have given to the man they term "the practicing engineer." This man will find "Electronic Measurements" in the same category as Terman's "Radio Engineer's Handbook."

It is unfortunate that the criticisms which must be mentioned cannot be printed as footnotes or in very small print, so that their relative importance could be made clear. In lieu of this, they will be short. The section on measurement of feedback amplifier characteristics is very condensed considering the extensive use of such amplifiers and the importance of accurate knowledge of their characteristics. No mention is made of measurements of servo systems, in which a large measure of control of the overall characteristics of the electro-mechanical system rests in the electronic portion of the circuit. The section on noise figure, both in the amplifier and receiver chapters, is rather loosely written and contains several technical errors and misconceptions. (Here the authors may criticize the reviewer for being the "finicky specialist" mentioned above. The accusation is admitted, but the criticism stands.)

On the whole, this book is one which will find its way into the libraries of most engineers in the electronics field. It is an excellent book in an area which has been devoid of one for many years.—MATTHEW T. LEBENBAUM, *Assistant Supervising Engineer, Radar Section, Airborne Instruments Laboratory, Mineola, New York.*

Radio and Television Receiver Troubleshooting and Repair

BY A. A. GHIRARDI AND J. R. JOHNSON. *Rinehart Brooks, Inc., New York,* 1952, 822 *pages,* $6.75.

ASSUMING a basic knowledge of how television and radio receiver circuits work, this vocational text gives major emphasis to techniques for finding and fixing trouble. The first chapter is both orientation and review, stressing the importance of individual components in circuits

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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.

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and discussing briefly the commonest troubles associated with each type of component. The next nine chapters cover the different types of troubleshooting techniques used by practical servicemen on the various types of receivers. Three chapters cover alignment of a-m, f-m and tv receivers respectively; one tells how to take performance data; six chapters cover in detail the repair and replacement of defective components; the last two chapters deal with record players and recorders.

Chapter summaries and review questions greatly improve the effectiveness of the book both for classroom use and home study. Answers to odd-numbered questions are given at the end of the book, presumably to enable home-study readers to grade their own work.

This book merits the same high praise as its predecessor, "Modern Radio Servicing", and can be recommended to anyone desiring to learn how to fix receivers of all types. Though not specifically covering electronic control circuits, it can also serve for training service technicians in that field because many of the circuits and components are the same in the two fields.—J.M.

Handbook of Engineering Fundamentals

OVID W. ESHBACH, *editor. John Wiley & Sons Inc., New York, Second edition*, 1952, 1,000 *pages plus*, $10.00.

FIRST edition of the popular handbook, published in 1936, had for its purpose the embodiment in a single volume of those fundamental laws and theories of science which are basic to engineering practice. Although much of the present volume is identical with material in the first edition, all of the older material has been reviewed, much has been revised, and much new matter appears. Here and there are changes in emphasis as necessitated by newer knowledge and the greater use of MKS units. While the volume has grown, it is not unwieldy or overly expensive.

There are 14 sections divided roughly into tables, mathematics, units and standards, mechanics, aerodynamics, thermodynamics,

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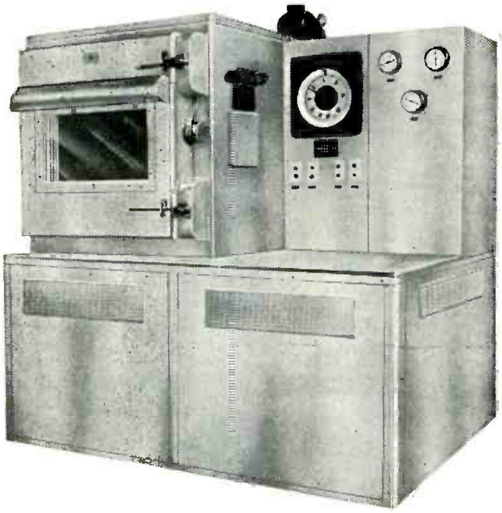

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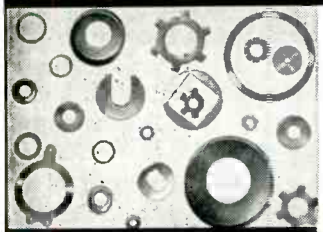

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Electronic Analog Computers

BY G. A. KORN AND T. M. KORN. *McGraw-Hill Book Co.*, 1952, 378 *pages*, $7.

THIS text, the first of its kind, should be especially welcome to the newcomer in this field. It represents an integration of the current techniques of application, operation, and design of analog computers, which has heretofore been available only in widely scattered form in periodicals and reports of limited circulation. The authors have succeeded in keeping the treatment mathematically simple so that the qualified electronic engineer should have little difficulty in grasping the essential principles involved while at the same time getting an introduction to the more difficult analytical aspects of the field. Not the least important group who will be benefited by this text, particularly in these days of critical personnel shortages in the computer and associated fields, are the service personnel who form such an essential part of a computer facility. The service personnel, be they maintenance personnel or machine operators, can profitably, with a limited technical training, study this text to increase their effectiveness by a better overall understanding of computer techniques.

In the introductory chapter, the functional characteristics of basic computer components are described. Chapters 2 and 3 deal with the detailed steps in the application or setup of these components into a machine configuration to solve problems. Step-by-step procedures are described and the details are carried out of some specific typical problems. In Chapters 4, 5, and 6 a detailed study of the theory and design of computing elements is

presented: circuit configurations of feedback amplifiers which add, integrate, and differentiate, and error analyses of such configurations; multiplying and dividing devices employing voltage sensitive elements, and the recently developed step type multipliers; a variety of functional generators which can generate functions of a single variable.

The final two chapters are devoted to such items as power supplies, recorders for plotting results, control circuits, operating procedures, and some of the overall requirements involved in the design and layout of a complete computer installation. The overall design features of several modern analog computer installations are described.

The book should prove popular as an introductory treatment. As a textbook, it has unfortunately the shortcoming that no problems have been included.—DR. W. H. BOGHOSIAN, *Associate Professor, University of Pennsylvania, Philadelphia 4, Pennsylvania.*

Automatic and Manual Control

By A. TUSTIN. *U. S. edition published by Academic Press Inc., New York, 584 pages,* $10.00.

THIS volume is, in effect, the proceedings of a Conference on Automatic Control. The conference, under the auspices of the Department of Scientific and Industrial Research with the support of the Institution of Electrical Engineers and the Institution of Mechanical Engineers, took place at the College of Aeronautics, Cranfield, England, July 1951.

Usefulness

Author and subject indices, in addition to a table of contents, facilitate locating information in the volume. This is especially important because of the breadth of subjects. Each of the three dozen papers deals at the specialist level with a particular aspect of control; for the most part, the authors have assumed that readers are conversant with the current state of the art. In bringing together these related but varied papers that might otherwise appear in several

different journals, the conference committees have provided a volume of widening influence and at the same time relieved society journals of the great pressure from papers awaiting publication. Other conference committees might well study the economics of a book such as this. It takes longer to produce such a book but the result is more legible, although with pages as wide as those of this book, a two-column makeup might have been preferable. Distributing the book through commercial channels brings the conference before as wide an audience as possible.

Organization

The papers are grouped under sections dealing with educational problems, general theory, process control, nonlinear problems, systems working on intermittent data and step-by-step servos, the human operator, descriptions of particular devices and a symposium on analog computers.

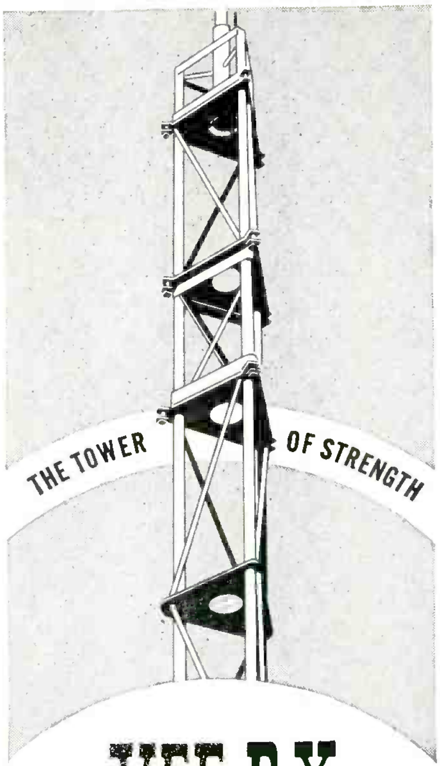
The content of the volume is too specialized and varied to discuss adequately in a short review. Engineers dealing with automatic and assisted control will find it an authoritative reference on advanced aspects of servo design.

Examples

The two papers on the human operator illustrate the nature of the conference and of this volume. One paper presents the results of psychological tests comparing free-moving and fixed control levers in manual tracking.

Beyond the specific subject of this paper is the problem of how to evaluate operator error; if the operator is treated as a filter (predictor), by what measure of error shall his performance be judged? This problem is considered in the second paper in which the human transfer function in servo systems is developed for several environmental conditions. The theoretical development, which is based on servo and modern information concepts, provides statistical design criteria such as stability boundaries. The results point the way for obtaining further and much needed experimental data such as that presented in the first paper.

It is in this manner that papers



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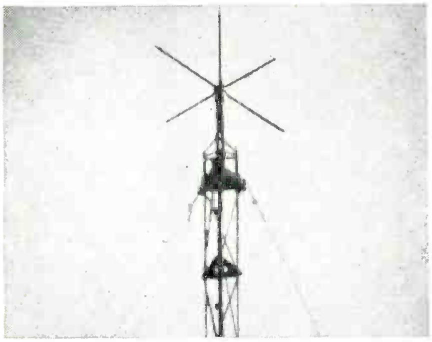

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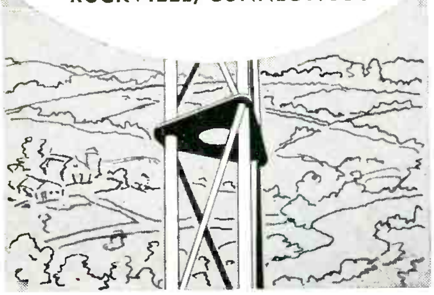

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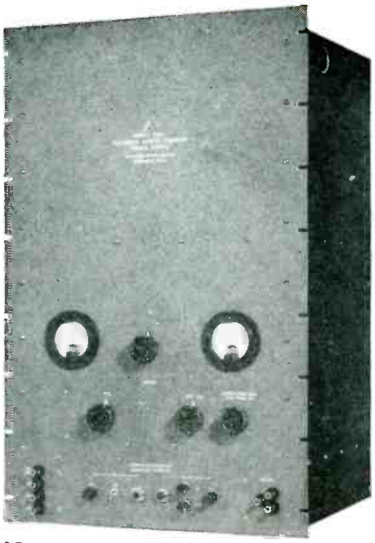

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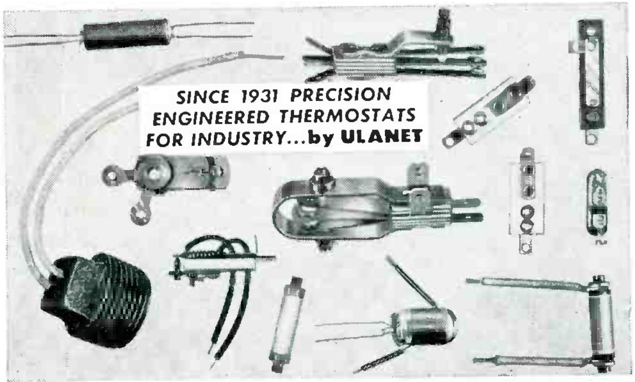

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throughout the book present complementary viewpoints and collateral information.—F. H. ROCKETT, *Airborne Instruments Laboratory, Mineola, N. Y.*

THUMBNAIL REVIEWS

RADIOLOGICAL MONITORING METHODS AND INSTRUMENTS. Handbook 51, National Bureau of Standards, 1952, 33 pages, 15¢. Indicates types of measurements and instruments necessary to determine adequacy of radiation shielding. Valuable to anyone dealing with x-rays, beta and gamma radiation and neutrons.

WORLD LIST OF SCIENTIFIC PUBLICATIONS, 1900-1950. Edited by William Allan Smith, Francis Lawrence Kent and George Burden Stratton. Butterworth's Scientific Publications, London, and Academic Press Inc., New York, N. Y., 1952, $37.00. A revised and reset third edition listing more than 50,000 volumes. A standard reference work for libraries, editors and research people.

TV TROUBLESHOOTING AND REPAIR GUIDE BOOK. By Robert G. Middleton. John F. Rider, Publisher, Inc., New York, N. Y., 1952, 204 8½ x 11 pages, $3.90. An obviously valuable book for radio service technicians faced with keeping modern complex tv receivers in operation.

ANALYSIS OF ALTERNATING CURRENT CIRCUITS. By W. R. LePage, Syracuse University. McGraw-Hill Book Co., 1952, 444 pages, $6.50. An introductory course devoted to the steady-state in lumped linear networks. Presupposes a knowledge of the elements of a-c and d-c circuits.

EXTENSION AND DISSEMINATION OF ELECTRICAL AND MAGNETIC UNITS BY THE NATIONAL BUREAU OF STANDARDS. By Francis B. Silsbee, NBS. Circular 531, 33 pages, 25¢, 1952. Historical report of the work of NBS in the field of electrical measurements during its first 50 years. Describes processes whereby from the ohm and volt the other units (farad, henry, ampere, watt, joule, gauss and oersted) are derived.

ELECTRONIC RAYS AND SIGHT EQUIPMENT IN TECHNIQUE AND MEDICINE, Vol. 11, by Paul E. Klein, Weidmannsche Verlags buchhandlung, Berlin, Germany, 1952, 356 pages, DM 35.00. Applications of the cathode-ray oscilloscope to numerous fields of science, medicine and engineering. In German. Also by the same author and publisher, Electronic Ray Oscillographs, 212 pages, DM 9.50; and Time and Period Measuring by Cathode-Ray Oscillographs, 60 pages, DM 3.90.

CHARTING STATISTICS. By Mary Eleanor Spear. McGraw-Hill Book Co., 1952, 253 pages, $4.50. Methods of designing and the proper use of basic charts for portrayal of economic and statistical data. Useful to those who lecture or write on economic matters, as well as the drafting room or artist who makes the illustrations for such lectures or articles.

MEASUREMENT OF THICKNESS OF CAPACITOR PAPER. By Wilmer Souder and S. B. Newman, Circular 532, National Bureau of Standards, 1952, 10 pages, 15¢. Discusses methods used at the Bureau, gives statistical analysis of measurements made there, and offers suggestion to laboratory workers dealing with the problem of maintaining capacitor uniformity.

MOLECULAR MICROWAVE SPECTRA TABLES. By Paul Kisliuk and Charles H. Townes. Circular 518, National Bureau of Standards, 1952, 127 pages, 65¢. Gives frequencies, assignment of quantum numbers and intensities of about 1,800 microwave absorption lines of frequency higher than 1,000 mc. Also includes considerable other pertinent molecular data.

NOISE: Causes, Effects, Measurement, Costs, Control. University of Michigan School of Public Health and Institute of Industrial Health, Ann Arbor, 192 pages, $5.00. A valuable series of papers on the problem of noise and its effects on people.

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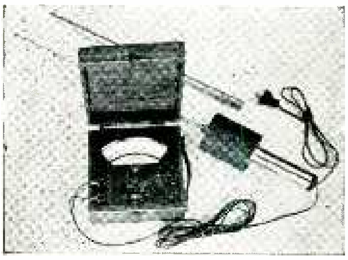

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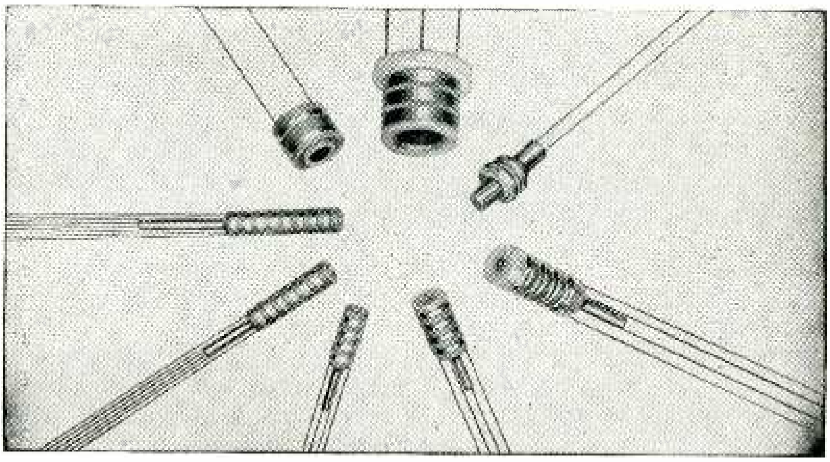

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BACKTALK

Insanitary

DEAR SIRS:

THE DESIGNERS of the amplifier described in the March 1952 issue of ELECTRONICS (40-DB Feedback Amplifier, p 130) make no mention of the fundamental disadvantage of the type of feedback used, a disadvantage which to my mind makes it unfit for use in a high-quality amplifier with a large amount of negative feedback.

The primary of a push-pull output transformer is, in effect, a center-tapped autotransformer with its center tap grounded (for a-c). Consequently, no matter how much out-of-balance there may be in the output valves, approximately equal voltage swings will appear at the two anodes. Therefore the voltages fed back to the cathodes of the driver valves will also be equal, $\pm x$ percent, where x depends mainly on the tolerances in the six resistances in the feedback chains. Now if there is 40 db of feedback the input voltage to the driver valves should be 1 percent greater than the voltage fed back to the cathodes.

If the net input voltages to the driver valves are to be equal to $\pm$ 10 percent the voltages from the phase splitter and the voltages fed to the cathodes from the feedback chains should be matched to about 0.1 percent (i.e. 10 percent of 1 percent). This involves selecting resistors to better than 0.05 percent, which is an absurd requirement for an audio amplifier.

In practice it appears that the designers have not attempted such careful matching but have tried to ensure reasonable balance in the output stage by the very dubious method of unbypassed common screen and cathode resistors, dubious because common screen droppers and bias resistors tend to increase any inherent d-c unbalance, while the omission of cathode and screen bypass capacitors from the output valves reduces the maximum undistorted output even for a per-

fectly balanced pair.

Please forgive me for troubling you with purely destructive criticism. I sincerely believe, however, that it is wrong that any of your readers, some of whom may have little experience of audio-frequency techniques, should be encouraged to copy an "insanitary" design when much better designs exist.

E. F. GOOD
Malvern, Worcs., England

Grads and Post-grads

DEAR SIRS:

I SHOULD like to register a protest against an impression given in an item appearing on page 8 of the June 1952 issue of ELECTRONICS. This item concerned the shortage of electrical engineering graduates.

First, may I compliment you on gathering the data and presenting it in attractive graphical form. My only point of protest lies in your analysis of the percentage of graduates available to industry. You show a "loss" of 19 percent of the graduates, including 8 percent going into graduate study. The implication seems to be that men disappearing into this status of graduate students do not ever appear again! The fact of the matter is, of course, that in addition to those men graduating this year at the Bachelor's level, there are a substantial number of M.S. and Ph.D. men who undoubtedly compensate in numbers for the 8 percent entering graduate study this year.

To ignore the men emerging from the colleges with advanced degrees is to commit an error not only in numbers, but more importantly in quality. As you well know, there is a very heavy demand from industry at present for men with advanced degrees, and it would be folly indeed if someone should magically change the situation so that the 8 percent of the graduates which you show as "lost" would go with the 81 percent into industry immediately upon graduation.

While the situation at Stanford is perhaps not typical, it might interest you to see how far in error you would be as to our production

of engineers for industry if you counted only men with Bachelor degrees. We had 25 such graduates in Electrical Engineering in the 1952 class. For this same year we had 41 graduating with the M.S. degree, 14 with the Engineer's Degree and 19 with the Ph.D. degree, all in Electrical Engineering.

I will not labor you further with this issue, as I am sure you are well aware of the importance to industry of men going on for graduate work. Unfortunately, it seems not to be well known among engineering seniors with whom I have talked at other universities, and even with faculty members. Accordingly, may I urge you in future editorial presentations to lean more in the direction of encouraging graduate work for our best graduates in order that they may make a maximum contribution in later years.

JOSEPH M. PETTIT
Stanford University
Stanford, California

(Editor's Note: Actually, our figures for total electrical engineering graduates included those entering industry at a graduate level. We agree completely with Prof. Pettit's views on the importance of advanced work. Any impression given otherwise is unintentional.)

Three A's

DEAR SIRS:

I READ Doctor Kantor's article in the June 1952 issue of ELECTRONICS, and have been following the back talk in "*Backtalk*" ever since. My reactions have been somewhat of a mixture of approval, amazement and amusement.

I have felt approval because I like to see informative articles such as Dr. Kantor's appear in magazines like ELECTRONICS. As you have seen, interest is always stirred up and productive developments are always forthcoming.

I have felt amazement because I have been active and reasonably productive in the field of electronic instrumentation for application to biological problems for over a decade, and realize the extent which this art has reached. Visit any laboratory or facility devoted to biological research and look about. I venture to predict that you will be unable to find any laboratory in

this country which is not simply filled with a variety of electronic instruments without which the techniques being employed would be impossible.

I find it hard to realize that people in both the biologic and electronic fields can have remained unaware of the impact of electronics upon biologic research. Are they also unaware that every research activity with which I am personally familiar, and that includes a large number, has a full-time electronic engineer as an important and indispensable member of its staff? I suspect that one reason might be that most of our instruments are "one-shot" affairs and with a few exceptions, such as the electroencephalograph and electrocardiograph, have not had much in the way of commercial applications after they have helped supply the answers to the problems for which they were designed and fabricated.

I am also amazed at the general lack of knowledge concerning the existence of the American Instrument Society, and the fine annual meetings held since 1948 on "Electronics in Medicine and Biology" which a joint AIEE-IRE committee has sponsored in New York. The attendance has always numbered several hundred about equally divided between medical and electronics personnel. Maybe next year we should have a subcommittee for missionary work!

I am amused because I have a visit almost everyday from some eager electronics engineer who wants to know what sort of instrument he could make which would be useful to a biologist. I rattle off a number of requirements and he is pleased. He then asks questions concerning the probable market for such things, and I must tell him it is not large. I am forced by honesty to disabuse him of the likelihood of his devising an Idiopathometer[1], and thus having a market for his device comparable to that of the tv industry. When confronted with this unhappy news the eager engineer invariably loses much of his enthusiasm for shoving back the frontiers of biologic knowledge.

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biology. Let those who doubt that this is so base their conclusion, not on an inspection of their family physician's suite of offices, but rather on a visit to a research organization such as the Lovelace Foundation.

As a clincher, my subscriptions to professional journals have always included ELECTRONICS as well as those devoted to biology and medicine, and it is regarded to be as indispensable as any of the latter. By actual count, fifty percent of the volumes in my working library are reference texts on electronics and electromagnetic physics. I am not regarded as particularly unique—crazy perhaps—but all agree that I have plenty of company!

F. G. HIRSCH, M. D.
The Lovelace Foundation
Albuquerque, New Mexico

[1] Idiopathic—self-caused disease, or disease of unknown cause. We in the business refer to the ultimate apparatus which will diagnose all and treat all as an idiopathometer.

Noise

DEAR SIRS:

A METHOD of measuring uhf-tv receiver noise figures is described in the March issue of ELECTRONICS (p 128). I have been using a simpler procedure of measuring uhf converter noise figures based on a method developed by Goldman in his book, "Frequency Analysis, Modulation and Noise" in the paragraph on noise figures with networks in cascade. He develops the formula

$$F_a = \frac{F_b\,(Y-1) + 1}{G_a}$$

where $Y = N_{ab}/N_b$ and all values are in terms of power.

A suitable tv receiver of known noise figure is set up with the antenna properly terminated. The detector is linearized in the usual manner and the noise output voltage recorded. The uhf converter is then connected to the receiver (keeping the detector linearized) and the noise output again recorded. Knowing the gain of the converter, its noise figure is easily calculated. It is assumed that the converter output impedance and the receiver input impedance are substantially resistive and equal.

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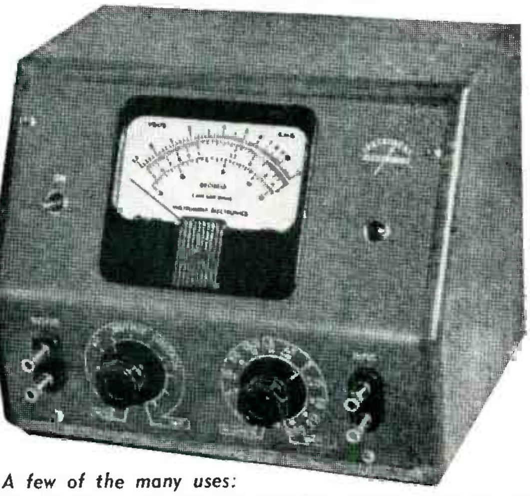

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"SEE YOU AT THE POLLS!"

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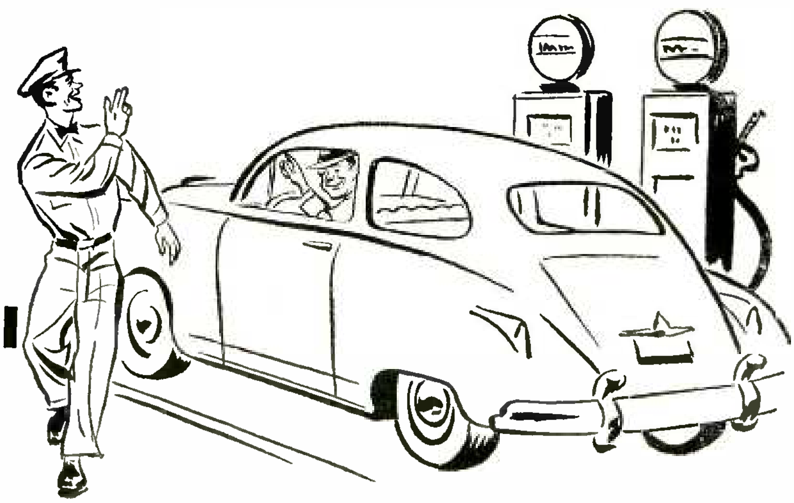

Nobody knows for sure how it started—this line about "See you at the Polls!" we're hearing all over these days.

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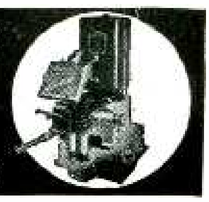

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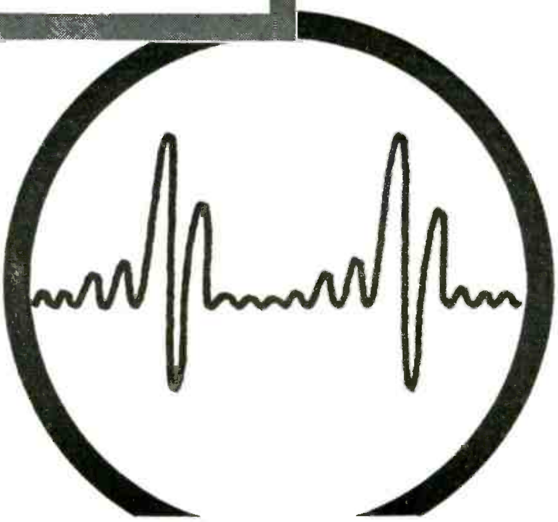

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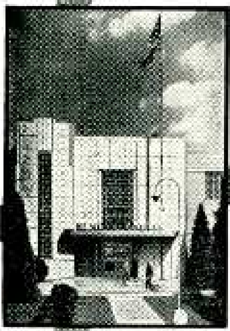

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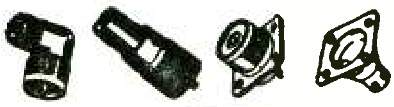

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RG-8/U	100.00	RG-19/U	1250.00	RG-35/U	900.00	RG-59/U	60.00
RG-9/U	250.00	RG-20/U	1450.00	RG-54A/U	97.00	RG-62/U	75.00
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500 ma. DC 2½" R.—General Electric 2.95
2 amp. RF 2½" Sq.—Simpson 3.15
5 amp. AC 4½" R.—JBT 4.11
30 V DC 2½" R.—General Electric 3.95
3 amp. RF 3½" R.—Weston 6.00

CRYSTAL DIODES

1N21	$1.19	1N27	$1.79	1N41	$11.25
1N21A	1.69	1N31	8.10	1N42	18.75
1N21B	3.50	1N34	.66	1N43	1.55
1N22	1.09	1N34A	.95	1N45	.94
1N23	1.95	1N38	1.70	1N52	1.05
1N23A	3.25	1N39	6.25	1N55	3.15
1N23B	4.25	1N40	10.60	1N60	.55

TYPE "J" POTENTIOMETERS

Resis.	Shaft	Resis.	Shaft	Resis.	Shaft
60	SS	5K	1/4"	50K	3/8"
60	9/16"	5K	3/8"	50K	1/2"
100	SS	5K	1/2"	100K	SS
200	SS	10K	SS	150K	1/2"
250	1/8"	10K	3/8"	200K	3/8
500	SS	10K	1/2"	250K	SS
500	5/16"	15K	SS	250K	3/4"
500	1/2"	15K	1/2"	250K	3/8"
500	5/8"	20K	SS	500K	SS
650	1/2"	25K	SS	500K	1/4"
1K	SS	25K	1/4"	500K	7/16"
2K	3/8"	30K	1 1/8"	1Meg	SS
2500	SS	40K	SS	2.5 Meg	SS
4K	SS	50K	SS	5 Meg	SS
5K	SS	50K	1/4"		

$1.25 each

DUAL "JJ" POTS.—$2.95 ea.

50 SS	330 SS	2500 SS	2.5 meg SS
100 SS	500 SS	10K SS	5 meg SS
250 SS	1K SS	1 meg SS	1K/25K ⅜"

TRIPLE "JJJ" POTS.—$3.95 EA.

100K/100K/100K ⅜"   20K/150K/15K ⅜"

SOUND POWERED TELEPHONES

U. S. NAVY TYPE M HEAD AND CHEST SETS
U.S.I. A-260   W.E. D-173013
A.E. GL832BAO
ANY TYPE—$14.88 EACH
TS-10 Type Handsets $9.25

GENERATORS AND INVERTERS

Eclipse-Pioneer type 716-3A (Navy Model NEA-3A) Output-AC 115V 10.4A 800 to 1400cy. 1φ: DC 30 Volts 60 Amps. Brand new $38.50
Eclipse-Pioneer type 1235-1A. Output-30 Volts DC 15 Amps. Brand New-Original Packing $15.50
PE-218 Inverters-28 VDC to 115 VAC 400 cy 1500 VA. (New) $49.50
Pioneer Type 800-1B Inverter-28VDC to 120V 800 cy 7 amp AC (used) $22.65
G. E. Inverter-28 VDC to 120 VAC 800 cy 750 VA 1φ $39.50
ATR Inverter 6VDC to 110 VAC 60 cy 75W $22.95
PU-7/AP Inverter-28 VDC to 115 VAC 400 cy 2500 VA (used) $75.00
Eclipse-Pioneer type 12121-1A Inverter—Voltage and frequency regulated—24VDC 18 Amp Input—AC output 115V 3φ 400 cy 250VA 0.7 PF — (New) $225.00

TEST EQUIPMENT

- Gen. Radio 475B Frequency Monitor *$200.00
- Gen. Radio 681A Freq. Deviation Meter *$87.50
- I-72K Signal Generator $48.50
- C-D Quietone Filter Type IF-16 110/220V AC/DC 20 Amps. *$9.00
- TS-143/CPN Oscilloscope *$95.00
- Dumont 175A Oscilloscope *$225.00
- Gen. Radio 757-P1 Power Supply *$27.00
- A.W. Barber Labs. VM-25 VTVM *$86.00
- TS-10A/APN Delay Line Test Set $45.00
- TS-19/APQ-5 Calibrator $75.00
- CWI-60AAG Range Calibrator for ASB, ASE, ASV and ASVC Radars $39.95
- CRV-14AAS Phantom Antenna for Transmitters up to 400 MC $11.75
- 3 CM Pickup Horn Antenna AT-48/UP $9.95
- I-138A Signal Generator—10 cm *$185.00
- BC-221 Frequency meter *$125.00
- CW—60ABM Frequency Meter—10 CM $97.50
- Weston Model 1 D.C. Milliameter 150/1500 MA with leather case $75.00

All Items New Except Where noted * (Exc. Used Condition.)

MISCELLANEOUS EQUIPMENT

I-82F Selsyn Indicator $6.95
SCR-515 compl. w/dynamotor, control box 69.50
Amperex 1B98 Gamma Counter 9.87
Powerstat 1226—115/230V Input—0-270V out. @ 9 amp. 37.00
EIMAC 35T Ionization Gauge 5.95
R-7/APS-2 Receiver 49.50
FL-8 1020 cycle filter 2.95
RM-29 remote control unit 8.95
RM-14 remote control unit 8.95
RTA-1B 12/24 V dynamotor 40.00
BC-1206-CM2 Receiver 12.95
ASB-4 Radar equip. Complete 69.75
RCA AVR-15 Beacon Recvr 18.50
Navy DP-14 Direction Finder complete 385.00
CU-24/ART-13 Antenna Loading Cond 4.95
T-85/APT-5 300-1600 MC Transmitter 175.00
Sola #30807 Constant Volt. Transf. 250 VA .. 49 00
PP-104/APT-5 Rectifier Unit for above 42.50
BC-1016 Tape Recorder 350.00
AN/APA-30 .... 375.00
BC-910A Oscilloscope 147.50
BC-1068 Receiver 57.50
ATJ and ATK TV Block Equip .... Quote
BC-348 Receiver .... Quote
RTA-1B Transceiver .... Quote
T-47/ART-13 Transmitter .... Quote
Sperti 1S21 vacuum relay switch (P/O AN/ART-13) 9.50

PULSE TRANSFORMERS

UTAH 9262 9278 9280   UTAH 9318 9340 9350

G.E. K54J318	Westinghouse 187AW2F
G.E. 68G-627	Westinghouse 232-AW2
G.E. 68G828	Westinghouse 232-BW-2
G.E. 68G929G1	AN/APN-4 Block Osc.
G.E. 80G13	Philco 352-7149
G.E. K-2468B	Philco 352-7150
G.E. K-2469A	Philco 352-7071
G.E. K-2744B	Philco 352-7178
AN/APN-9 (901756-501)	Raytheon UX-7350
AN/APN-9 (901756-502)	Raytheon UX-10066
AN/APN-9 (352-7250)	W.E. D-161310
AN/APN-9 (352-7251)	W.E. D-163247
Westinghouse 132-AW	W.E. D-163325
Westinghouse 139DW2F	W.E. D-164661
Westinghouse 166AW2F	W.E. KS-9563
Westinghouse 176AW2F	

AN/APA-23 RECORDER

Sweeps any receiver through its tuning range and permanently records frequency and time of received signals on paper chart. Power input—(motor) 27V DC 1.5A, and (recorder) 80/115V AC 60-2600 cy 135W.

Originally designed to record pulse or sinewave modulated signals received by AN-APR-1, AN/APR-2, AN/APR-4, AN/APR-5, BC-348, S-27, SX-28. BRAND NEW $147.50

SPRAGUE PULSE NETWORKS

7.5 E3-1-200-67P, 7.5 KV, "E" Circuit 1 Microsec. 200 PPS 67 ohms imped, 3 sections $4.30
7.5 E3-3-200-67P, 7.5 KV, "E" Circuit 3 Microsec. 200 PPS. 67 ohms imped. 3 sections $6.75
7.5 E4-16-60-67P, 7.5 KV. "E" Circuit 4 sections. 16 microsec, 60 PPS, 67 ohms imped $8.25
15 E4-.91-400-50P. 15 KV, "E" Circuit .91 microsec. 400 PPS. 50 ohms imped. 4 sections $16.50
15-A-1-400-50P, 15 KV, "A" Circuit, 1 microsec. 400 PPS, 50 ohms imped $37.50

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST.   PHILA. 6, PA.

Telephones - MARKET 7-6771-2-3

"CABLE ADDRESS - LECTRONIC PHILADELPHIA"

GUARANTEED BRAND NEW

TUBE SPECIALS

STANDARD BRANDS ONLY

Receiving Tubes

OOA $1.50
O1A .67
OZ4 .74
OZ4A .90
1A3 .71
1A5GT .72
1A6 .72
1A7GT .91
1AB5 .89
1B3GT .99
1B4P 1.17
1C5GT .85
1C6 .69
1C7G .69
1D5GP .69
1D7G .69
1D8GT .71
1E5GP .71
1F4 .69
1F5G .69
1F6 .71
1G4GT .69
1G5G .69
1G6GT .69
1H4G .89
1H5GT .74
1H6G .99
1H6GT 1.01
1J5G .74
1J6G .95
1L4 .69
1LA4 .87
1LA6 1.10
1LB4 1.01
1LC5 .81
1LC6 .93
1LD5 .93
1LE3 .93
1LH4 .82
1LN5 .91
1N5GT .85
1N6G .97
1P5GT .69
1Q5GT .99
1R4 .69
1R5 .89
1S4 .71
1S5 .81
1T4 .81
1T5GT .71
1U4 .86
1U5 .81
1V .69
1X2 1.09
2A3 1.28
2A5 .79
2A7 .89
2B7 .79
2E5 .94
2X2 .89
2X2A 1.85
3A4 .65
3A5 1.89
3A8GT 2.25
3B7 .57
3C6 1.15
3D6 .57
3LF4 .91
3Q4 .77
3Q5GT .83
3S4 .77
3V4 .87
5AZ4 .69
5R4GY 1.59
5T4 1.91
5U4G .69
5V4G 1.07
5W4 .82
5X4G .87
5Y3GT .59
5Y4G .71
5Z3 .87
5Z4 1.11
6A4 1.35
6A6 1.17
6A7 1.05
6A8 1.08
6AB4 .99
6AB7 1.05
6AC5GT 1.19
6AC7 1.11
6AC7W 3.25
6AD6G .98
6AD7G 1.31
6AE6G .89
6AF6G .89
6AG5 .87
6AG7 1.59
6AH6 1.39
6AJ5 2.50
6AK5 1.35
WE-6AK5 2.85
6AK5W 3.05
6AK6 .99
6AL5 .69
6AL5W 2.90
6AQ5 .89
6AQ6 .79
6AR5 .79
6AS5 .99
6AS6 3.30
6AS7G 4.53
6AT6 .63
6AU5GT 1.21
6AU6 .69
6AV6 .63
6B4G 1.60
6B5 1.20
6B7 .97
6B8 .99
6B8G .85
6BA6 .72
6BA7 1.20
6BC5 .88
6BC7 1.10
6BD5GT 1.60
6BD6 .99
6BE6 .72
6BF5 1.10
6BF6 .83
6BG6G 1.92
6BH6 .99
6BJ6 .99
6BK7 1.60
6BL7GT 1.45
6BN6 1.59
6BQ6GT 1.26
6C4 .65
6C5 .75
6CB6 .89
6C6 .88
6C8G .96
6CD6G 2.40
6D6 .88
6D8G .83
6E5 1.10
6F5GT .83
6F6 .99
6F6G .99
6F7 .85
6F8G .91
6G6G 1.06
6H6 .83
6H6GT .83
6J5 .75
6J5G .64
6J5GT .64
6J6 1.09
6J7 .99
6J7GT .79
6J8G 1.28
6K5GT .99
6K6GT .69
6K7 .83
6K7G .88
6K8 1.22
6K8GT .96
6L5G 1.06
6L6 1.87
6L6G 1.79
6L6GA 1.59
6L7 1.08
6L7G .95
6N7 1.19
6N7GT 1.10
6P5GT .96
6Q7 .99
6Q7G .89
6R7 .99
6S4 .72
6S7 1.06
6S7G .99
6SA7 .84
6SA7GT .74
6SB7Y 1.05
6SC7 1.20
6SC7GT 1.05
6SD7GT .94
6SF5 .83
6SF5GT .80
6SF7 .69
6SG7 .91
6SH7 .89
6SH7GT .89
6SJ7 .89
6SJ7GT .89
6SK7 .89
6SK7GT .89
6SL7GT .96
6SN7GT .89
6SN7WGT 2.30
6SQ7 .75
6SQ7GT .75
6SR7 .81
6SS7 .99
6ST7 1.25
6T7G 1.09
6T8 1.11
6U5 1.19
6U7G .88
6V6 1.60
6V6G .89
6V6GT .79
6W4GT .72
6W6GT .99
6X4 .59
6X5GT .59
6Y6G .99
6ZY5G .89
7A4 .79
7A5 .88
7A6 .83
7A7 .83
7A8 .83
7AD7 1.44
7AH7 1.08
7B4 .83
7B5 .83
7B6 .83
7B7 .83
7B8 .89
7C4 .69
7C5 .83
7C7 .83
7E5 1.20
7E6 .58
7E7 .83
7F7 .99
7F8 1.59
7G7 1.32
7H7 .83
7J7 1.32
7K7 1.32
7L7 .97
7N7 .97
7Q7 .83
7R7 .94
7S7 1.11
7V7 1.11
7W7 1.11
7Y4 .73
7Z4 .89
10 .45
12A .65
12A6 .71
12A6GT .69
12A7 1.16
12A8GT .77
12AH7GT 1.32
12AL5 .89
12AT6 .59
12AT7 1.15
12AU6 .79
12AU7 .95
12AV6 .63
12AW6 1.20
12AX7 1.08
12BA6 .72
12BA7 .95
12BD6 .99
12BE6 .70
12C8 .77
12F5GT .79
12H6 .69
12J5GT .69
12K8 .83
12Q7GT .67
12SA7 .89
12SA7GT .89
12SF5 .79
12SF5GT .79
12SF7 .79
12SG7 .99
12SH7 .73
12SJ7 .79
12SJ7GT .89
12SK7 .81
12SL7GT 1.03
12SN7GT .99
12SQ7GT .79
12SR7 .89
12SR7GT .89
12X3 1.19
12Z3 .89
14A4 .97
14A7 .97
14B6 .93
14B8 1.09
14C5 1.29
14C7 1.15
14E6 1.09
14E7 1.29
14F7 .93
14H7 .93
14J7 .93
14N7 .93
14R7 .93
14W7 .93
14X7 .93
19 .89
19T8 1.16
22 1.16
24A .79
25A6 1.16
25L6GT .89
25Z5 .99
26 .79
27 .69
28D7 1.75
30 .72
30 Spec. .48
31 .62
32 .99
32L7GT .87
33 .99
34 .99
35 51 .79
35A5 .89
35B5 .87
35L6GT .81
35W4 .55
35Y4 .81
35Z4GT .69
35Z5GT .59
36 .69
37 .69
38 .69
39/44 .59
41 .71
42 .89
43 .89
45 .89
45Z5GT .79
46 .81
47 .99
48 1.60
49 1.19
50 1.41
50A5 .91
50B5 .88
50C5 .88
50L6GT .79
50Y6GT .92
53 .95
55 .99
BK55B .40
L55B .32
56 .69
57 .89
58 .89
59 1.24
70L7GT .91
71A .79
75 .89
76 .69
77 .69
78 .79
79 .89
80 .65
81 1.41
82 1.19
83 1.11
83V 1.45
84/6Z4 .79
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Cathode Ray Tubes

2AP1 $9.75
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9GP7 12.85
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12GP7 16.50
12HP7 16.50
902P1 9.95
905 4.45

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1P23 $4.10
1P24 1.27
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927 1.85
931A 6.95
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3C45 17.50
4C35 28.75
EL-C5B 9.95
5C22 53.45
C6A 6.75
C6J 9.95
FG-17/5557 5.25
FG-33 17.50
FG-41 122.50
FG-67 14.80
FG-81A 4.95
91 7.85
FG-95/5560 25.00
FG-104/5561 24.60
FG-105 19.50
FG-166 95.00
FG-172 39.50
FG-178 14.50
RX-233A 4.95
FG-235A/5552 94.50
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394A 4.77
GL-415/5550 39.50
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WL-672 22.00
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WL-681/5550 39.50
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885 1.90
1665 1.80
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2050 1.80
2051 1.15
5545 32.50

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OC3 1.20
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1B23 9.95
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1B24(Sylv) 18.95
1B24A 39.50
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1B27 19.50
1B29 2.90
1B32 3.95
1B35 12.50
1B36 12.50
1B38 32.50
1B40 4.95
1B41 47.50
1B42 9.80
1B54 32.50
1H20 .88
1S21 9.50
1Z2 3.75
2B22 2.20
2C21 .75
2C22 .75
2C26 .49
2C26A .49
2C34 .49
2C39 22.00
2C40 16.25
2C42 26.50
2C43 21.50
2C44 1.50
2C46 29.50
2C51 5.75
2C53 12.00
2E22 1.85
2E24 4.10
2J21A 9.95
2J22 9.95
2J26 26.50
2J27 24.50
2J31 39.50
2J32 42.50
2J33 39.50
2J34 39.50
2J36 85.00
2J37 13.70
2J38 17.50
2J39 49.50
2J40 39.50
2J41 175.00
2J48 49.50
2J49 65.00
2J50 39.50
2JB51 2.50
2J54 47.50
2J55 87.50
2J56 150.00
2J61 45.20
2K23 37.50
2K25 33.50
2K26 107.15
2K28 34.50
2K29 26.00
2K33 295.00
2K45 145.00
2K54 135.00
2K55 135.00
2X2A 1.85
3B22/EL-1C 2.95
3B23 4.75
3B24 5.25
3B24W 7.95
3B25 4.50
3B26 3.75
3B27 3.95
3B28 7.75
3C24 1.85
3C27 6.95
3C37 32.50
3D21 1.98
3D21A 4.75
3E29 14.50
3J31 95.00
4-125A 29.50
4A1 1.18
4B22/EL-5B 8.95
4B24 5.75
4B25/EL-6CF 8.95
4E27 17.25
4J36 150.00
4J38 120.00
4J50 375.00
4J52 400.00
5D21 26.50
5J23 52.50
5J29 18.50
6-8B .85
6AN5 5.95
6AR6 3.35
6C21 29.50
6C24 52.50
6J4 7.95
7-7-11 1.19
10T1 .88
10Y .45
13-4 .80
15E 2.35
15R .95
REL-21 2.25
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RK-25 3.82
FG-32/5558 6.75
RK-34 .49
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REL-36 .78
RK-47 4.92
EF-50 .79
VT-52 .65
53A 5.60
RK-59 2.44
RK-60 1.95
VT-62(Br) 1.15
RK-63 22.50
VT-67 .48
RK-69 2.25
72 1.32
73 1.32
RK-75 3.50
VR-75/OA3 1.51
75T 5.80
VR-78 .64
VR-90/OB3 1.29
VT-98 (Br) 65.00
C100E 2.30
100R 2.90
100TH 10.25
WE-101D 1.65
WE-101F 3.62
WE-102F 2.85
VR-105/OC3 1.20
WE-113A 1.32
HY-114 .75
WE-117A .95
F-123A 8.95
WE-124A 3.80
F-127A 22.50
VT-127A 3.60
AB-150 12.50
VR-150/OD3 1.15
FG-190 12.15
HF-200 16.50
203A 7.40
203B 6.33
204A 49.50
CE-206 3.15
211 .95
WE-211D 12.50
WE-211E 12.50
212E 42.50
WE-215A .24
217C 8.95
221A 1.95
227A/5C27 4.60
WE-231D 2.25
232CH 240.00
WE-244A 5.20
WE-245A 2.35
WE-249B 3.50
WE-249C 3.50
250TH 22.50
250TL 22.50
WE-252A 5.65
WE-254A 5.90
WE-257A 3.77
WE-274A 5.50
274B 2.85
WE-275A 6.95
WE-283A 4.25
WE-285A 5.57
WE-286A 7.90
WE-294A 5.75
304TH 9.75
304TL 9.75
307A 5.50
WE-309A 6.45
WE-310A 7.50
WE-313C 4.15
316A .89
327A 4.25
WE-331A 9.75
WE-343A 185.00
WE-346A 2.75
WE-350A 6.95
350B 4.95
WE-356B 5.45
361A 4.75
368A 6.95
371A .95
371B .95
388A 2.95
WE-399A 4.79
417A 16.95
434A 17.50
446 1.95
446A 1.95
446B 2.25
450TH 42.50
450TL 42.50
451 1.39
471A/1B21A 2.75
SS-501 12.50
503AX 1.65
506AX 1.47
507AX 1.47
527 12.25
530 17.20
531 8.25
532A 3.95
WL-533 65.00
559 2.20
561 3.50
HY615 .49
WL670A 8.70
700A 24.50
700B 24.50
700C 24.50
700D 24.50
701A 6.95
702A 2.95
702B 4.25
703A 6.95
704A .95
705A 2.75
706AY 45.00
706BY 45.00
706CY 45.00
706FY 45.00
706GY 45.00
707A 9.95
707B 22.50
708A 4.85
709A 4.87
710A 1.70
713A 1.45
714AY 10.75
715A 6.75
715B 12.75
715C 26.50
717A 1.47
718AY 45.00
718BY 45.00
720CY 75.00
720DY 75.00
721A 4.90
723A 9.95
723A/B 18.50
724A 3.22
724B 3.22
725A 8.95
726A 14.50
726B 45.00
726C 65.00
730A 25.00
731A 2.45
WL-787 9.80
788Y 1.40
800 1.88
801A .48
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804 8.95
805 4.50
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809 2.40
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813 9.50
814 3.95
815 2.75
816 1.45
826 1.45
828 13.48
829 9.95
829A 14.50
829B 14.50
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832 7.95
832A 9.95
833A 45.00
836 3.50
837 1.85
838 3.25
841 .49
843 .59
845 5.75
845W 6.75
849 29.50
851 67.00
852 22.60
860 4.95
861 24.50
864 .39
865 1.28
866A 1.48
869B 45.00
872A 3.95
874 1.45
876 1.60
878 1.85
886 3.50
954 .39
955 .70
956 .49
957 .49
958A .69
959 1.50
991 .45
1003 .90
CK-1005 .79
E-1148 .35
1201 1.20
1203 .69
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1294 .69
1299 .69
1602 2.25
1613 1.20
1614 2.00
1616 1.07
1619 .39
1620 6.25
1622 2.30
1624 1.95
1625 .45
1626 .39
1629 .39
1630 .95
1631 1.38
1632 .75
1636 3.10
1638 .70
1641 1.95
1642 .75
1644 1.17
1655 1.90
1960 .70
5611 135.00
5651 3.05
5654 5.85
UX-6653 .65
7193 .75
8005 5.95
8011 .87
8012 2.60
8013 2.75
8013A 4.90
8016 1.05
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8025 6.95
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9004 .55
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5DG
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6DG
6G
7DG
7G
A
B
M
N
X
2J1F1
2J1G1
2J1H1
2J1M1
2J5A2
2J5D1
2J5HA1
2JD5E1
C-44968-6
C-56701
C-56776-1
C-69405-2
C-69406
C-69406-1
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PE 218 Leland Electric
Output: 115 VAC; Single Phase; PF 90; 380/500 cycle 1500 VA. **Input:** 25-28 VDC; 92 amps; 8000 RPM; Exc. Volts 27.5. **BRAND NEW** ....$39.95 ea.

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12116-2-A PIONEER
Output: 115 VAC; 400 cyc; single phase; 45 amp. **Input:** 24 VDC 5 amp...$90.00 ea.

10285 LELAND ELECTRIC
Output: 115 Volts AC, 750 V.A., 3 phase, 400 cycle, .90 PF, and 26 volts, 50 amps, single phase, 400 cycle, .40 PF. **Input:** 27.5 VDC, 60 amps, cont. duty, 6000 RPM, Voltage and Frequency regulated..$195.00

94-32270-A LELAND ELECTRIC
OUTPUT: 115 Volts, 190 V.A., Single Phase; 400 cyc.; .90 PF, and 26 Volts, 60 V.A., 400 cyc., .40 PF. **INPUT:** 27.5 Volts DC, 18 amps; Cont. Duty, Voltage and frequency regulated $95.00

5 RPM GEAR HEAD MOTOR

Mfg. RAE., Type 7519, 115 Volts AD, DC. Fractional HP, Overall dimension: 5½" ....$12.95 ea. Lots of 10......$11.95 ea.

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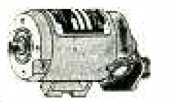
AMMETER: DC; 2" 100-100, complete with external shunt ....$5.95 ea.
AC Volt, Westinghouse, Type NA-35—3-inch round. F.S.-10 MA..........$6.95 ea.

MICROPOSITIONER
Barber Colman AYLZ 2133-1 Polarized D.C. Relay: Double Coil Differential sensitive; Alnico P.M. Polarized field. 24V contacts; .5 amps; 28 V. Used for remote positioning, synchronizing, control, etc........$12.50 ea.



BLACK & DECKER MOTOR AN 94-32159-A; Volts 24; 1 amp; series wound; 12,000 RPM; 1/75 H.P.; Cont. duty; overall size 5-⅝" x 3" dia..$9.95 ea.

6 RPM GEAR BOX MOTOR

110 Volt, 60 cyc., Single Phase; Ratio—544:1; Mfg. by Merkle-Korff Gear Co., Overall dimensions approx. 3½" x 3½" ....$9.95 ea. Lots of 10...........$9.50 ea.

Merkle-Korff 20 RPM motors, 60 cycle, 110 V. AC. ....Like New, $6.95 ea.

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Victor Adding Machine Motors geared down to 56 RPM. Have built-in over running clutch; 60 cycle, 110 V. AC, Universal type. Net cost new $35.00...Like New, $12.95 ea.

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208 Volts, 400 Cycle, 3 Phase Mod. 2CM97B1 55.5 Amps., PF .75, Speed 8000 KW 15, Cont. Duty, Limited Quantity...$320.00

SERVO MOTOR 10047-2-A; 2 Phase; 400 Cycle; with 40-1 Reduction Gear $10.00 ea.

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TYPE 12604-3-A: Contain CK5 Motor coupled to output shaft through 125:1 gear reduction train. Output shaft coupled to autosyn. follow-up (AY43). Ratio of output shaft to follow-up Autosyn is 15:1 $70.00 ea.
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TYPE 12602-1-A: Same as 12606-1-A except it has base mounting type cover for motor and gear train...........$70.00 ea.

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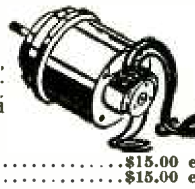
AIRESEARCH: 115V; 40 CPS; Single phase; 6500 RPM; 1.4 amp; Torque 4.6 in. oz.; HP .03 ....$10.00 ea.
EASTERN AIR DEVICES TYPE JM6B: 200 VAC; 1 amp; 3 phase; 400 cycles; 6000 RPM ....$12.50 ea.
EASTERN AIR DEVICES, TYPE J31B: 115 V, 400-1200 Cycle, Single Phase $12.50 ea.
AIRESEARCH: AC Induction, 200 V; 3 Phase, 400 Cycle, 2 H.P.; 11,000 RPM; 8 amps ....$79.50 ea.
AIRESEARCH: AC Induction, 200 V; 3 Phase, 400 Cycle, .12 H.P., 6500 RPM; 1.5 amps $25.00
Electric Motor: PNT—1400—A1—1A Serial No. 207, 208 V., 400 cycles, 3 phase, Kearfott Co., Inc. ....$17.50 ea.

SYNCHRONOUS SELSYNS



110 volt, 60 cycle, brass cased, approx. 4" dia. x 6" long. Mfg. by Diehl and Bendix.
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5CT Control Transformer; 90-50 Volt; 60 Cyc. ....$50.00 ea.
5F Motor (115/90 volt—60 cyc.)..$60.00 ea.
5G Generator (115/90 volt—60 cyc.) $50.00 ea.
5SDG Differential Generator (90/90 volts —400 cyc.) ....$30.00 ea.
TRANSMITTER, BENDIX C-78248; 115 Volt, 60 Cycle..........................$25.00 ea.
REPEATER, BENDIX C-78410: 115 Volt, 60 Cycle ....$37.50 ea.
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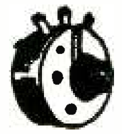
(Approx. size overall) . . . 3⅜" x 1⅛" diameter) **Delco-Type** 5069230: 27.5 volts. DC. 145RPM $19.95 ea.

POWER RHEOSTATS



Standard Brands: 5 Ohms; 100 Watt; 4.48 amps 100 Ohms: 100 Watt; 1.0 amp.

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G.E. Model 5LY77AB1. Input 115 volts D.C.; 1½ H.P. motor; 13 amp; 3600 RPM; shunt contact regulated. Output: 115 Volts A.C. 60 cycles; KVA .06; shunt self excited. $129.00 ea.
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AY27D $25.50
AY6—26 Volt—400 cyc...........$4.95 ea.
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AY14D $14.00
AY34 ....$20.00
AY20—26 Volt—400-cyc. ....$12.50 ea.

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1N21B	4.25
1N22	1.75
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1N23	2.00
1N23A	3.75
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2K29	37.50
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4C27	25.00
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4E27	17.50
4J25	199.00
4J26	199.00
4J27	199.00
4J31	199.00
4J32	199.00
4J33	199.00
4J37	199.00
4J38	89.00
4J39	199.00

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C5B	3.95
5BP1	6.95
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5CP1	6.95
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5JP1	27.50
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5JP4	27.50
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45 Special	.35
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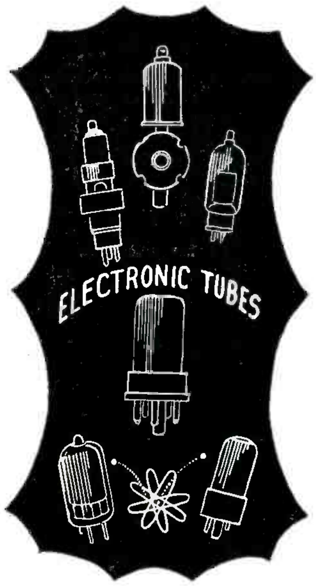
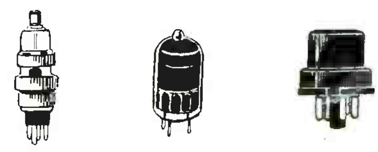
RK72	1.95
RK73	1.95
100TH	9.95
FG105	19.00
203A	8.95
211	.95
217C	18.00
242C	10.00
244A	12.95
249C	4.95
250TL	19.95
274A	3.00
274B	3.00
304TH	15.00
304TL	14.50
307A	4.95





TYPE	PRICE
310A	7.95
311A	7.95
312A	3.95
323A	25.00
327A	3.95
328A	9.95
350A	7.95
350B	5.95
357A	20.00
368AS	6.95
371B	2.95
385A	4.95
388A	2.95
394A	7.95
MX408U	.75
417A	27.95
431A	29.95
446A	1.95
446B	5.40
450TH	45.00
450TL	45.00
464A	9.95
471A	2.75
527	15.00
WL530	3.50
WL531	22.50
WL533	17.50
700A/D	25.00
701A	7.50
703A	6.95
705A	3.95
707A	17.95
707B	27.00
714AY	17.95
715A	7.95
715B	18.00
715C	25.00
717A	1.95
718AY/EY	48.50
719A	29.50
721A	3.95
722A	3.95
723A/B	17.95

TYPE	PRICE
724A	4.95
724B	6.95
725A	9.95
726A	18.00
726B	56.00
726C	69.00
728AY	27.00
801A	1.00
802	4.25
803	7.95
804	13.50
805	5.95
806	25.00
807	1.69
808	3.50
810	11.00
811A	3.15
813	9.95
814	3.95
815	3.50
816	1.45
829	12.95
829A	13.95
829B	15.95
830B	3.50
832	7.95
832A	9.95
833A	49.95
834	7.95
836	4.95
837	2.95
838	6.95
845	5.59
849	52.50
851	80.50
860	4.95
861	39.50
866A	1.79
869B	57.50
869BX	35.00
872A	3.95
878	1.95
884	1.95

TYPE	PRICE
885	1.75
889R	199.50
914	75.00
931A	6.95
954	.35
955	.55
956	.69
957	.29
958A	.69
991	.65
E1148	.35
1280	1.95
1611	1.95
1613	1.38
1616	2.95
1619	.89
1632	2.75
1624	2.00
1625	.45
1851	1.85
2050	1.85
2051	1.80
8012	4.25
8013	2.95
8013A	5.95
8019	1.75
8020	3.50
8025	6.95
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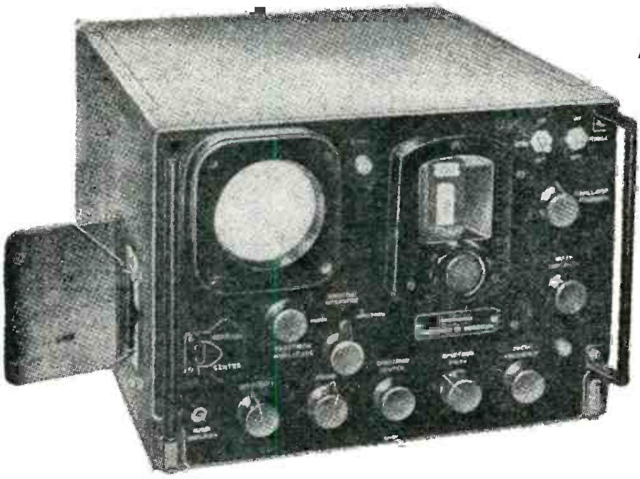

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TS15/AP Flux Meter
TS16/AP Altimeter Test Set
TS33/AP X Band Power and Frequency Meter
TS34/AP Western El. Synchroscope
TS34A/AP Western El. Synchroscope
TS35/AP X Band Signal Generator
TS36/AP X Band Power Meter
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TS100 Scope
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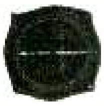
Radio Compass Indicator



I-82F. Compass Indicator. 0-360°-5 in. dial, 26 v. 400 cy. 8-12 v. 60 cy. Ideal position indicator. Stock #SA-284.

Price $6.50 each

JA1 MOTOR (D-C)

Electric Specialty. ¼ hp. 24 v. D-C. (Wing flap motor.) Stock #SA-325. **Price $19.50 ea.**

OSTER PM MOTOR

Alinco Field

27.5 v. d-c. Can also be used as rate generator. #SA-281. **$8.75 each**

DIEHL PM MOTOR

Type FD6-31-1. 27.5 V. D.C. 10,000 rpm. Dual Shaft. Shaft ext. ⅝" ea. end. Diam. 0.120, Motor 1" Sq. x 2" Lg. Stock #SA-355. **Price $13.25 each.**

800 CYCLE INVERTERS

ECLIPSE Type 800—Model 1, Style D. 24-28 v. DC input @ 62 Amps. 8000 rpm. Output 115 volts 800 cycles single phase, 7.0 Amps. Stock #SA-502. **Price $69.50 each.**

G. E. Type 5AS1211J2. Navy Type CRV-21AAR. 27 v. DC input @ 62 Amps. Output 120 volts 800 cycles single phase at 750 VA. VOLTAGE and FREQUENCY REGULATED. Stock #SA-192. **Price $59.50 each.**

60 CYCLE AMPLIDYNES

G.E. Types 5AM45DB15 and 5AM73AB95. Type 45DB15 input 115 v. 60 cy. at 5 amps. Output 250 volts DC at 0.6 amps. Stock #SA-147.

Type 73AB95 input 115 volts 60 cy. at 9 amps. Output 250 volts DC at 1.5 amps. Stock #SA-257.

PRICES ON REQUEST

DELCO CONSTANT SPEED MOTOR A-7155

1/30 hp. 27.5v d-c 3600 rpm. Cont. duty, 2½" diam. x 5½" lg. ⅞" shaft extension. 5/32" diam. 4 hole base mounting. Stock #SA-34. **Price $19.50 each.**

BLOWER ASSEMBLY

Delco 27 v. DC motor, 5400 rpm. 3" Sirroco impeller. Shunt motor, 4 in./oz. torque. Base Mtg. Stock #SA-352. **Price $9.75 each.**

27.5 VOLT DC MOTOR

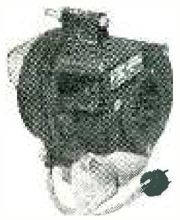
John Oster Type E-7-5 4 lead shunt. 1/20th hp. Internal fan cooled 4¾" lg. 3¼" diam. ⅞" shaft extension. 5/16" diam. 3650 rpm. **Stock #SA-31. Price $19.50 each.**

HOLTZER CABOT MG SETS

Type MG-221. Input 32 volts DC at 8.5 amps. 3430 rpm. Output 110 volts at 1.0 amps. 400 cy. Single phase. 100 watts. **Stock #SA-506. Price $99.50 ea.**

Type MG-218. Input 115 volts DC at 2.3 Amps. Output 110 volts 400 cy. Single phase. 100 watts. **Stock #SA-507. Price $119.50 ea.**

BLOWER ASSEMBLY



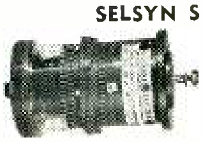
WESTINGHOUSE FL BLOWER

115 v. 400 cy. 17 c.f.m. Includes capacitor. Stock #SA-144. Price **$14.50 ea.**

Pioneer Servo Motor

Type 10047-2A, 2 ϕ 400 cycle low inertia. 26 v fixed phase. 45 v. max. variable phase. Stock #SA-90. **Price $12.50 each.**

SELSYN SPECIALS

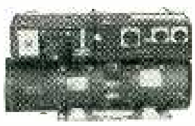


General Electric 2J1F1 & 2J1F3

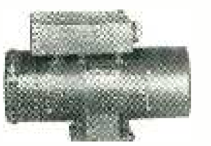
115 v. 400 cycle Selsyn Generator. Large quantity.

Prices on request

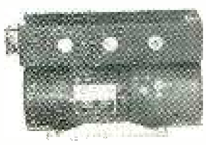
INVERTERS



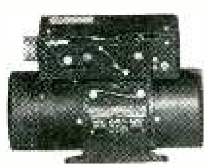
WinchargerPU-7/AP Input 28 VDC at 160 amps. Output 115 v. 400 cy. 1 ϕ at 2500 VA. Voltage and frequency, regulated. Cont. duty. Stock #SA-164. **Price $119.50 each.**



G.E. 5AS131NJ3 (PE-118) Input 26 VDC at 100 amps. Output 115 v. 400 cy. 1 ϕ at 1500 VA. PF 0.8 W.E. Spec. KS-5601L1 Stock #SA-286. **Price $39.50 each.**



PE-218EInverters Russell Electric and Leland. Input 28 VDC at 92 amp. Output 115 v. 400 cycles at 1500 VA. PF 0.9. Stock #SA-112A. **Price $69.50 each.**



Pioneer 12130-4-B Input 28 VDC at 14 amps. Output 120 v. 400 cy. single phase at 1.15 amps. (140 VA.) Voltage and frequency regulated. Made 1949. Stock #SA-304. **Price $99.50 each.**

AUTOSYN POWER SUPPLY (CONVERTER)

PIONEER Dwg. 12108-2B. Designed to supply 26 v. 400 cycle excitation to from 20-50 Pioneer Autosyn units. Input voltage 24 v. DC at 3.0 Amps. 4000 rpm. Stock #SA-504. **Price $59.50 each.**

DIEHL DC MOTOR

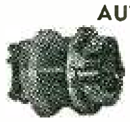
Type FDE-83-2. 24v @ 9.5 Amps. 1/6 hp. 6350 rpm. Cont. duty. Motor 4¼" diam. x 5" Lg. with 1" shaft ext. x ⅜" dia. front mtg. flange 4¼" Sq. Stock #SA-354. **Price $19.50 ea.**

DC MOTOR

John Oster Type A-161-A-2B. 28 v. DC Shunt wound. 8000 rpm. 0.09 oz./in. torque. Large Qty. **Prices on request.**

AUTOSYN MOTOR

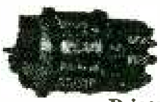
Bendix-Marine 851



32 v. 60 cycle excitation. Use as either generator or repeater. Stock #SA-158.

Price $24.50 each.

KOLLSMAN TELETORQUE



Kollsman Type 403 self synchronous units. (Synchro) 115 volt 60 cycle excitation. Use as either generator or repeater. Stock #SA-79.

Prices on request.

115 VOLT D-C MOTOR

G.E. Type SD. 1/20 hp. 4 lead shunt. Reversible. Double shaft extensions. Speed 1725 rpm. **Large Quantity.**

Special $19.50 each.

LEAR POSITIONING MOTOR

Model 156A. 115 watt 24 v. DC motor. 10,000 rpm. Int. duty. Reversible. Dual rt. angle output shaft. Release clutch. 7:1 reduction to output. 250:1 reduction to limit switches. Stock #SA-343.

Prices on request

MAGNETIC AMPLIFIER

Pioneer Type 12077

115 v. 400 cy. One Tube Servo Amplifier using saturable reactor type outlet transformer. Limited Quantity

SYNCHROS AND SELSYNS

Navy Types

A; M; 1SF; 5G; 5F; 5SDG; 6SG; 5SF; 5HSF 6DG; 7G; etc.

Army Types

II; IV; V; VII; IX; XXI; XV; etc.

G.E. Types

2J6F2; 2JD5J2; 2J5A2; 2J5HA1; 2J1H1; 2J1F1; 2J1G1; 2J1F3; 2JD5HB1; 2J5LA1; 2JD5C2, etc.

SERIES MOTOR

John Oster Type A-21D-7A

24 v. DC. 0.005 hp. .6 Amps. 11,000 rpm. Cont. duty. 1-½" diam. x 2-½" lg. Front flange mtg. Shaft 3/16 dia. x ⅝" ext. Stock #SA-353. **Price $8.75 each.**

Servo-Tek products co.
4 Godwin Ave. Paterson, N. J.

WRITE FOR LISTING
Prices F.O.B. Paterson
Phone ARmory 4-3366
Teletype PAT. 199

SPECIALISTS IN FRACTIONAL HORSE POWER MOTOR SPEED CONTROL

MOTOR GENERATORS

2.5 KVA Diehl Elec. Co. 120DC to 120AC, 60 cy., 1 Ph., Complete with Magnetic Controller, 2 Field Rheos and full set spare parts including spare armatures for generator and motor. New..$295.00
2 KVA O'Keefe and Merritt. 115DC to 120AC, 50 cy., 1 Ph. Export Crated. New..........$195.00
MOTOR GENERATOR, TYPE CGU-2
Unit of U. S. Navy TCK-7 Transmitter
Motor: 2 H.P., 230 V.D.C., 10 amps.
Generator: 1800V. D.C., 0.4 A, 500V. D.C., 0.35A. 115 V. D.C., 1.5A, 12 V. D.C., 2A. 3480 R.P.M. Self excited. Brand new including spare armature $365.00

INVERTERS

Onan M-G.-215H. Navy type PU/13. Input 115/230, 60 cy., 1 Ph. Output: 115, 480 cy., 1 Ph., 1.2Kw and 26V DC at 4 amps. New............$295.00
Leland Elec. Co. PE206A. Input: 28DC at 38 Amps. Output: 80V, 800 cy. 1 Ph., 485VA. New..$22.50
G.E. J8169172. Input: 28DC. Output: 115, 400 cy., 1 Ph. 1.5KVA. New......................$32.50
G.E. 5AS1315511A. Model 218J. Input: 28DC. Output: 115, 400 cy., 1 Ph., 1.5KVA. Regulated. New $89.50
Holtzer-Cabot M.G. 164. Input: 440, 3 Ph., 60 cy., Output: 70V, 146 cy. 3 Ph., 0.140KVA. New $67.50
Eicor. 32DC to 110AC, 60 cy., 1 Ph. at 2.4 Amps. New $39.50

DYNAMOTORS

Navy type CAJO-211444. Input: 105 to 130DC. Output: either 26DC at 20 amps. or 13DC at 40 amps. Radio filtered and complete with line switch. New $89.50
Type PE94CM. For SCR-522. Brand new in overseas cases $19.50

AMPLIDYNES

G.E. 5AM21JJ7. Input: 27VDC. Output: 60VDC. 150 Watts, 4600 RPM. Type MG-27-B. New $34.50
Edison 5AM31NJ18A. Input: 27VDC, 44 Amps. 8300RPM. Output: 60VDC at 8.8 Amps., 530 Watts. New $22.50

SMALL D.C. MOTORS

G.E. 5BA50LJ2A. Armature 27VDC at 8.3 Amps. Field 60VDC at 2.3A. RPM 4000, H.P. 0.5. New $27.50
Oster E-7-5, 27.5DC. 1/20HP, 3600RPM. Shunt Wound. New $9.50
Dumore Co. type ELBG. 24VDC. 40-1 gear ratio. For type B-4 Intervalometer. New..........$8.50

BLOWERS

Westinghouse. Type FL. 115V. 400 cy., 6,700 RPM. Airflow 17C.F.M. New $9.50
E.A.D. Type J50-CW—60 cycle—NEW......$15.50

SYNCHROS

Ford Inst. Co. Synchro Differential Generator. Mod. 3 Type 5SDG. 90/90V. 400 cy., Ord. Dr. 173020. New $22.50
Armor. Synchro Differential Generator. Type 6DG. New $60.00
Hobart Mfg. Co. Synchro Differential Synchro Type XIX 115V. 60 cy. New......................$9.50

PARABOLOIDS

Spun Magnesium dishes 17½" dia. 4" deep. Mounting brackets for elevation and azimuth control on rear. 1¼ x 1⅝" opening in center for dipole. Brand **new. per pair** $12.50

SOUND POWERED CHEST SETS

U. S. Instrument Co. No. A-260 Combination headset and chest microphone. Brand new, including 20 ft. of rubber covered cable.........$17.50 each
W.E. Laboratory Headsets—Type 316 B, 600 ohms at 1000 C.P.S.
Brand new—Price per set....................$6.50

RELAYS

Struthers-Dunn 1BXX129, 110 A.C.........$2.60
Advance type 455C, SPDT, 115 A.C.........$1.95
Leach type 1154A, SPDT, 115 A.C.........$2.35
Leach type 1054, BSN 20-28V D.C.........$2.35
Clare Plug-in base No. 30FMX 115 A.C.....$3.50
G.E. Plug-in base Sensitive K27J853.........$4.50
Western Electric D-163781 Plug-in.........$10.00
Guardian Time Delay type B-9-SPDT.......$2.95
Haydon Time Delay 17717 110V/60.........$4.75

MODEL AN/APA-10 PANORAMIC ADAPTER

Provides 4 Types of Presentation:
(1) Panoramic (2) Aural
(3) Oscillographic (4) Oscilloscopic

Designed for use with receiving equipment AN/ARR-7, AN/ARR-5, AN/APR-4, SCR-587 or any receiver with I.F. of 455 kc. 5.2mc or 30mc. With 21 tubes including 3" scope tube. Converted for operation on 115 V. 60 cycle source.
Price **$245.00**
Gov't Cost $1800.00.
AN/APA-10 80 Page Tech Manual..........$2.75

TEST EQUIPMENT

TS-127/U Lavoie Freq. Meter—375 to 725 MC.
TS-47APR Test Osc. 40-500MC.
TS-487/U Peak to Peak VTVM.
AN/APR-1 Receiving sets.
R111A/APR-5A Receiver—1000 to 6000 MC.
AN/APR-4 Tuning Units TN-17 (76-300 MC).
AN/APR-4 Tuning Units TN-18 (300-1000 MC).
AN/APR-4 Tuning Units TN-19 (950-2200 MC).
TU-58 Range "A" Tuning Units (110-370 MC).
AN/APA-10 Panoramic Adapters 115V/60 cycles.

Repair Parts for BC-348 (H, K, L, R only)

Also BC 224 Models F. K., Coils for ant., r.f., det., osc., I.F., c.w. osc., xtal filters, 4 gang cond., front panels, dial assemblies, vol. conts., etc. Write for complete list and free diagram.

HIGH QUALITY CRYSTAL UNITS

Western Electric—type CR-1A/AR in holders. ½" pin spacing. Ideal for net frequency operation. Available in quantities, 5910-6350-6370-6470-6510-6610-6670-6690-6940-7270-7350-7380-7390-7480-7580-9720. All fundamentals in KC. Good multipliers to higher frequencies ....$1.25 each

RADAR

Antenna-Trans-Rec. Unit ASG-1.
Radar Set SQ complete with spares.
Modulator type SO-11.
Pulse Timers CUZ-50AGD (SD-5 Radar).
Radar Crystal Units 98.35kc, Raytheon.
IN21B Sylvania Diodes.
Repeater Adapters CRM-50 AFO.
SO Series Accessory Control Panels.
SO Series Transmitter-Receiver unit.
CARD 23AEK Bearing Control Units for SO Series.
Auxiliary Rectifier.

RADAR ANTENNAS

Type SO-1 (10CM) assembly with reflector, waveguide nozzle, drive motor, etc. New $279.50
Type SO-3 (3 CM.) Surface Search type with reflector, drive motor, etc., but less plumbing. New in original cases $189.50
Type SO-13 (10CM.) Complete assembly with 24" dish, dipole, drive motor, gearing, etc. New $149.50
Also in stock — spare reflectors, nozzles, probes, right angle bends for SO-1 antennas.

RECTIFIERS

G.E. No. 6 RC89F16 for 54 cells 10 amps.
Mallory APS-20—In: 115/230/60/3. Out: 12/42V-65-130A.
Turret Trainer Supply. In: 220/60/3. Out: 28V-130A.
Complete specs. on request.

TERMS: Rated Concerns Net 30, FOB Bronxville, New York. All Merchandise Guaranteed. Prices Subject to Change

400 CYCLE TRANSFORMERS

AUTO. 400 cy. G.E. Cat. No. 80G184. KVA .9458-.520P Volts 460/345/200/115. New $6.95
FILAMENT—400/2600 CPS. Input—0/75/80/85/105/115/125V. Output—5V3A/5V3A/5V6A/6.3V 0.5A. No. 7249010—New $3.95
PLATE WECO KS 9560 800 cy. Pri: 115V. Sec: 1350-0-1350 at .057A (2700 V. Total). Elecstat shlded. Wt. 2.3 lbs. New..................$2.95
Plate. Thordarson #T46889. 1650 VA. Pri: 105-120V. 500 cy. 1 PH. Sec: 5600V. Center tapped. 1.5KV. insulation. Brand new $49.50
PLATE & FIL. WECO KS9555, 400 cy. Pri: 115V. Sec. #1: 930-0-930. Sec. #2: Three 6.3V windings $4.95
FILAMENT. 400/2400 cps. WECO KS9553. Pri: 115V. Sec: 8.2V1.25A/6.35V1.5A Elecstat shlded. Wt. 0.5 lbs. New..........................$2.95
PLATE & FIL. 400/2600 cy Pri: 0/80/115V. Sec: #1=1200VDC at 1.5MA. Sec. #2=400 VDC at 130MA. Fil. Secs: 6.4V4.3A/6.35VO.8A (ins. 1500V)/5V2A/5V2A $4.95
RETARD. 400 cy. WECO KS9598. 4 Henry 100MA $2.75

HIGH POT TRANSFORMERS

High Voltage Trans. Westinghouse Pri: 115. 60 cy. Sec: 15,000 C.T., 60 MA. Good for Hi-Pot test set up. C. T. ungrounded................$39.50

PULSE TRANSFORMERS

PULSE WECO KS-9563 Supplies voltage peaks of 3500 from 807 tube. Tested at 2000 Pulses/sec and 5000 peak. Wdg. 1-2=18 ohms. Wdg. 1.3=72 ohms. L of Wdg. 1.3=082H at 100 cps......$7.50
PULSE. WECO KS-161310. 50 KC to 4MC, 1¾" Dia. x 1⅞" high, 120 to 2350 ohms. New....$6.75
High Reactance Trans. G.E. type Y-3502A.—60 cy., Voltage 11200-135. Inductance H.V. Winding 135 Henries. Output: Peak Voltage 22.8KV. Cat. 8318065G1. New $89.50

RAYTHEON VOLTAGE REGULATORS

Adj. input taps 95-130V., 60 cy. 1 Ph. Output: 115V. 60 Watts, ½ of 1% Reg. Wt. 20 lbs. 6½" H x 8¼" L x 4⅝" W. Overload protected. Sturdily constructed. Tropicalized. Special $16.75

AMPLIFIERS

GE Servo type 2CV1C1 400 cycle
Constant Output Line RC-730C
Synchro Amplifiers for Radar
Intercommunication type BC-605

ANTENNAS

MR-162 Coast Guard 23½ ft. whips
AS-33 APT-2, AT-38A/APT, AS-62/APS-13
AS-125/APR for APR-5A
TDY RADAR JAMMER HORNS
PARABOLOIDS, MAGNESIUM DISHES 17½" dia.
SCR-623-A (part of RC-153-B Antenna)
CU 64/APT Antenna matching unit 50 ohm unbal. to 100 bal.

POTENTIOMETERS

W.E. KS-15138 Linear Sawtooth
W.E. KS-8732 for SCR547 Radar
W.E. KS-8801 Motor Driven

LINEAR SAWTOOTH POTENTIOMETER
W.E. KS-15138

Has continuous resistance winding to which 24 volts D.C. is fed to two fixed taps 180° apart. Two rotating brushes 180° apart take off linear sawtooth wave voltage at output. **Brand New...$5.50**

MISCELLANEOUS

Cathode Ray Shields for 3" tube............$3.75
Variac type Motor Controls 600 watt........$13.50
10 CM Waveguide 90° elbow................$20.00
Adel Clamps assorted types—write for samples
Shock Mounts Lord #20......................$.40
Shock Mounts U. S. Rubber #5150C..........$.30
Commando Pole Jacks (Cook Elec. Co.)......$1.00
Switchboard Lamp Receptacles & Jewels.....$.40
SCR522 Transmitter Receivers. Brand New
Fire Detector Wilcolator
No. A-4242. Ord. No. B 257736..............$1.00
Dial Drive Assembly for Bendix, MN-28-Y..$4.50
Instruction Manual for SCR-193A, B, C, D, E $1.50
Solenoid Cannon 24 V.D.C.—New...........$2.60
Attenuators Tech-Lab 500/500 type 700.......$4.75
Volume control Dual for BC-433G...........$2.85
Switch 600V., 60A. Bendix CB19078.........$9.50
Switch Arkless 9 sec. Rotary...............$4.50
Switch Arkless 16 sec. Rotary..............$7.50
Switch Panels SA-2/FRC $12.50
Switch Micro R-RL2T ....$.65
Switch Navy Rotary #647491.................$17.50
Contactor CRP-23AGO for SG-1 radar......$24.75
Band-Switch assembly for AR-88 receiver...$9.50
RT7-AN/APN-1 Receivers
BC-423B Modulators
BC-1366M Jack Boxes—Large quantity
Sweep Generator Capacitors 5/10 mfd.......$2.50

HI-VOLT CAPACITORS

.25 Mfd., 20KV..........$26.50
.25 Mfd., 15KV..........$22.50
1 Mfd., 15KV..........$44.50
1 Mfd., 7.5KV..........$12.50
2 Mfd., 6.0KVA..........$14.50
50 KV Capacitors also available various sizes. Write for list.

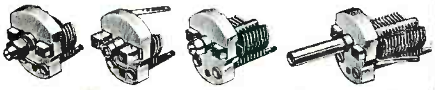
ELECTRONICRAFT
INC.
27 MILBURN ST. BRONXVILLE 8, N. Y.
PHONE: BRONXVILLE 2-0044

INDICATORS

ID-24/ARN-9 ....$12.50
ID-14/APN-1 ....$7.95
ID-60/APA-10 Panoramic Adapter converted for 60 cycle operation—complete with tubes and 80 page Tech. Manual
$245.00

COMMUNICATIONS EQUIPMENT CO.

AIR TRIMMERS



Capacity Min. $\mu\mu f$	Max. $\mu\mu f$	Fig.	Shaft Length	Post Length
2	12	D	5/16"	3/32"
2	27	A	1/2"	3/32"
3	10	D	5/16"	3/32"
2	18	D	5/16"	1/4"
4	25	A	17/32"	3/32"
5	50	A	1/2"	3/32"
5	55	A	1/2"	3/32"
7	28	C	5/16"	3/32"
7	85	D	5/16"	3/32"
8	45	A	17/32"	3/32"

PRICE, EACH . . . . 47¢

Fig. A: Round Shaft, Screwdriver Adj. W/Locknut. Fig. C: Rd. Shaft, Screwdriver Adj. Fig. D: Hexnut screwdriver Adj.

AUDIO TRANSFORMERS

AT201 50L6 output (4000 ohms) to V.C. (3 ohms) .... $.40
AT SUb Subouncer, Multimatch, 200 ohms to 15 K ohm C.T. and 100 K ohm Grids .... $.69
AT731 H.F. Plate (1500 ohm C.T.) to V.C. (16/4 ohms) 20-15KC $3.29
AT501 HI-Fi Special; PRI: 3000 ohms P-P/Sec: 4/16/12/50/200 ohms 60-10,000 CY.—1 db 50W $3.49
AT152 Hi-Fi Driver Pri: 10,000 ohms Sec: 40,000 ohms PP Grids 50-15 KC/1 db $1.49
AT062 Output to H.S. or line PRI: 14,200 ohms SEC: 8000/600 ohms $1.10
AT449 HI-Fi Driver (5000 ohms), to P.P. output grids (4,000 ohms) 100-10,000 CY. 10W 6V6 to PP 805's $2.39
AT666 Intercon Input: Spkr (-4-8 ohms) to grid (250-000 ohms) .... $.69
AT415 Plate (18,000 ohms C.T.) to line (125 ohms) 175 w.—500-600 CY $1.95
AT858 Plate (10,000 ohms C.T.) to line (125 ohms) 125130 ohms) HI-FI—50W $6.95
AT070 Mike-or-Line (250 ohms) to grid (250,000 ohms C.T.) $1.20
AT765 Mike-or-Line (600 ohms to grid (50,000 ohms C.T.) .. $.69
AT-694 HI-FI Output: 3 Watts. 8500 Ohms P-P to V.C. (15 Ohms) 15-15KC PM 1 db $1.49
AT4-AI: Mike (35 ohms Carbon) to Line 600 ohm/200 ohm $1.19
AT649: Line (500 ohms) to Grid (75K ohms) .... $.89
AT448: Line (600 ohms) to V.C. (6 ohms) 17 d.b. Level ... $1.19
AT631: Mike-or-Line (200 ohms) to Single or P-P Grids (50K Ohms) .... $.59
AT718 Line (300 ohms) to Line 600/30 Ohm) Response 50-20KC P.M. 1 db .... $.49

RU/GF GEAR

RU/GF XMTR COIL SETS

2000-2500 KC
3000-3675 KC
3675-4525 KC
6000-7350 KC
7350-9050 KC

PRICE: $1.79 each

ACCESSORIES

REMOTE TUNING BOX TYPE. CW-23012 .... $1.75
XMTR. CONTROL BOX, CW-23097 .... 1.69
RCVR, SWITCH BOX, CW-23096A 1.75
28V DYNAMOTOR & FILTER BOX FOR RU 8.95

COMPLETE RU/GF SET, WITH ALL PLUGS, MOUNTINGS, XMTR., RCVR., TUNING UNITS, DYNAMOTOR; INSTRUCTION BOOK—READY TO GO—ALL BRAND SPANKING NEW $97.5

RU/GF COIL SETS SINGLE BAND RCVR UNITS

BAND	FREQUENCY
L	400- 600 KC
C	545- 850 KC
D	850- 1330 KC
E	1330- 2040 KC
F	2040- 3000 KC
G	3000- 4525 KC
H	4000- 6000 KC
M	5200- 7700 KC
N	6000- 9050 KC
K	9050- 13.375 KC

PRICE: $1.50 EACH

RCVR. DUAL BAND COILS

400-600 KC 6000-9050 KC
540-830 KC 5200-7700 KC
195-290 KC 290- 435 KC
540-830 KC 540- 830 KC

PRICE $2.25 EACH

Schematic of RU/GF Set .. 35c

UNIVERSAL SUPPLY KIT

Delivers 230V @ 40MA DC. From 110/220VAC, 60 CY. Kit consists of 1 Transformer, 1—5 HY @ 40MA Choke, 2—8MFD @ 450V Filter Cond, 1—6X5 Tube. A Great Buy at Only **$3.95**

MFRS! MFRS! MFRS! NEW, FINISHED JAN MATERIAL FOR YOUR WAR CONTRACTS
Write! Phone! Wire!

ID-24 ARN-9 Dual 0-200 Micro-amp. Movement in 3" Case. ILS Equipment $6.95

932 PHOTO TUBE

Gas Phototube having SI Response, particularly sensitive to Red and Near Infrared Radiation. Can be used with incandescent light source. Send for data. Price .... **75¢**

INTERPHONE AMPLIFIER

Easily converted to an ideal inter-Communications set for office, home, or factory. Original. New w/conversion. Diagram **$4.75**

This Month's Special

SUPERSONIC CRYSTALS, Rochelle salt ..... $.50 ea.
MOTOR, 24 vdc. 3 HP 3800 rpm. New $75.00
TV LEAD-IN WIRE, 300 ohms, HI-Q, Lo-Loss .... $17.50/M FT Roll
BC 306 ANTENNA TUNING UNIT. NEW .. 6.95
R9/APN-4, New, With Tubes 75.00
ID6/APN-4, New, With Tubes and Crystal .. 75.00
A-62 Phantom Antenna 8.50
2 Meter Choke, 1000 MA, 20-144 .... 8/ 1.00
Supersonic Crystal Head, M-1, 22-27KC HI-2 .... 27.45
Underwater Microphone, Model JR, Z=50ω .. 24.50
Dynamic Mike & Headset Combo, B-19. New. 3.75
HS-30 Inserts, M-300 .... per M 3,50
AN/ARC-4 VHF Trans-Rcvr 75.00
PE 36 Test Set. New 37.50
SCR 274 Test Set, I-104 .... 12.25
ART-13 Driver Trans. 6V6 to P-P 811's 1.29
DM 34 Dynamotor, 14V In. 220V, 80 MA out
Sens. Relay: 3.5MA, 13K ohms, 2PST, 2A .. 1.29
Klixon Breaker; Thermal, 35A .... .69
T-30 Carbon Mikes. New .... .89
Tel. Tape. 3/8"x8½" Rolls .... 23¢ ea. 5/ 1.00
Tel. Tape. 4" Rolls .... 12¢ ea. 10/ 1.00
BC366 Interphone Jack Box .... .79 ea.
AN/109-A Antenna .... 1.98 ea.
C-30/ARC-5 Control Box .... 2.35 ea.
EE-89A Telephone Repeater .... 12.50 ea.
EE-65A Telephone Test Set .... 50.00 ea.
ID24/ARN-9 Cross Point Indicator .... 6.95 ea.
TU-8 Tuning Unit 6.2-7.7mc .... 4.95 ea.
BC-496-A Dual Rcvr. Con't box, 3-6 & 6-9. 1mc .... 1.75 ea.
AN/104-A Antenna, 150mc .... 1.49 ea.
BC704 Indicator, 5" CR Tube, New .... 22.50 ea.
BC929 Indicator, 3BPI. all tubes, New .... 29.50 ea.
Noise Filters, 100 AMP. G.E .... 1.39 ea.
MC211 Right Angle Drives .... .19 ea.
IF Transformers, 112 KC Double Slug Tune. .69 ea.
IF Transformers, 1600 KC Double Slug ..... .79 ea.
MD/7 Modulator for ARC/5, All tubes ...... 7.95 ea.
ARC-5 Xmtr. Tuning Cond. #5032 .... 1.49 ea.
ARC-5 Xmtr. M.O. Trimmer #4990 .... 1.29 ea.
Buffer or Osc. Coil, 160 meters, 50W End-Link, 5 pr. STD. Socket, OEL-160 .... .79 ea.
MP 22 MAST BASE $4.95
OSCILLOGRAPH RECORDING, PHOTO PAPER, 35 MM, 250 FT. Roll $1.00

UNIVERSAL POWER XFMR

Pri: Vibrator Input @ 6/12/24/110 VDC. AC Input: 110/220-V @ 60 CY. Sec: 230-0-230 V—40 MA 6.3V—1.8A **$1.49**

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps input

CTJ5-2-600VCT/.2A, 5V/6A $5.95
CT-15A 550VCT .085A 6.3V/.6A, 6.3V/1.8A 2.85
CT-164 4200V.002A/12KV Test, 5VCT/3A/12KV Test. 6.3V/0.6A/5400V Test 12.95
CT-341 1050V/10 MA.—625V @ 5 MA. 26V @ 4.5A 2x2.5V/3A, 6.3V @ 3A 16.95

CR-825	360VCT	.340A	6.3VCT/3.6, 6.3VCT/3A	3.95
CT-626	1500V	.160A	2.5/12, 30/.100	9.95
CT-071	110V	.200A	33/.200, 5V/10, 2.5/10	4.95
CT-367	580VCT	.050A	5VCT/3A	2.25
CT-99A	2x110VCT	.010A	6.3/1A, 2.5VCT/7A	3.25
CT-403	350VCT	.026A	5V/3A	2.75
CT-931	585VCT	.086A	5V/3A, 6.3V/6A	4.25
CT-610	1250	.002A	2.5V/2.1A, 2.5V/1.75A	4.95
CT-866	330V	.065A	6.3V/1,2, 6.3V/600 MA	1.75
CT-456	390VCT	30MA	6.3V/1,3A, 5V/3A	3.45
CT-160	800VCT	100MA	6.3V/1,2A, 5V/3A	4.95
CT-931	585VCT	86MA	5V/3A, 6.3V/6A	4.95
CT-442	525VCT	75MA	5V/2A, 10VCT/2A, 50V/200MA	3.85

CT-720 550-0-550V/250MA, 6.3V/1.8A 8.95
CT-43A 600-0-600V/.08A, 2.5VCT/6A, 6.3VCT/1A 6.49
CT7-501 650VCT/200MA, 6.3V/5A 6.49
CT-444 230-0-230V/.085A, 5V/3A, 6V/2.5A 3.49

Filament Transformers—115V/50-60 cps input

Item	Rating	Each
FT-674	8.1V/1.5A	$1.10
FT-157	4V/16A, 2.5V/1.75A	2.95
FT-101	6V/.25A	.79
FT-924	5.25V/21A, 2x7.75V/6.5A	14.95
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	8.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT-55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V 3A	8.95
FT-986	16V @ 4.5A or 12V @ 4.5A	3.75
FT-38A	6.3/2.5A, 2x2.5V/7A	4.19
FT-A27	2.5V/2.5A, 7V/7A, TAP 2.5V/2.5A, 16KV TEST	18.95
FT-608	6.3V/3A/750V Test	1.79
FT-873	4.5V/.5A, 7V/7A	2.19
FT-899	2x5V @ 5A, 29KV Test	24.50

POWER RESISTORS

120W—WW—5% Tol.
1⅛" Ferrule, 9½" Long

Res.-Ohms	Price	Res.-Ohms	Price
2.5*	55c	198*	35c
25*	35c	225	30c
30	45c	250	45c
32.5	35c	300*	35c
40	30c	450	65c
50*	45c	500*	40c
70*	45c	630*	55c
100	70c	4.500	50c
125	35c	8,000	90c
125*	45c	160,000	65c

* Tapped to give 10 equal sections with 9 tabs.

ELECTROLYTIC CAPACITORS

TWIST PRONG

Cap. Mfd	WVDC	Price
8	450	$0.16
30	300	.18
40	450	.33
50	400	.36
60	300	.21
80	150	.29
8¢8	450	.24
30-20	25	.16
20-20	150	.23
80-80	300	.21
90-10	350	.21
80-10	450	.49
150-50-25	150	.49
80-10-10-10	300	.21
40-40-20-20	150	.28
30-15-15-15	300	.28
80-10-10-10	350	.32
40/10	450/350	.55
40/20	150/25	.21
40/50	400/300	.28
80/50	450/50	.65
250/1000	10/6	.30
8-8-10	450/25	.26
10-10/10	150/25	.23
10-10/20	450/25	.26
10-15/20	350/25	.18
15-15/10	450/350	.23
80-40/150	400/50	.45
120-60/20	150/25	.45
30-30-15/30	300/50	.39
40-40-20/20	350/15	.28
60-40-20/50	300/25	.28
60-40-20/200	150/10	.39
80-40-30/20	150/25	.36
80-40-30/100	150/25	.36
8/8/8	475/100/100	.23
10/50/100	350/100/50	.23
10/50/100	450/100/50	.27
20/20/10/20	350/300/300/25	.35

UPRIGHT OIL CAP.

MFD	Each
220VAC/600VDC	
6.2	$1.29
15	3.49
330VAC/1000VDC	
15	3.79
1000VDC	
.5	.69
.5-.5	1.19
1	1.49
4-1.5	2.19
1.5	1.39
1500 WVDC	
1	1.59
1.5	1.59
2	1.79
2000 WVDC	
1	1.79
2500 WVDC	
.5	2.98
4000 WVDC	
.15	6.95
4800 WVDC	
.1-.1	4.79
6000 WVDC	
.1	3.69
.15-.15	3.89
1.5	10.98
7000 WVDC	
.1-.1	3.79
1	9.95
8000 WVDC	
.075-.075	3.79
10K VDC	
.1	8.95
15K VDC	
.0016	7.95
16K VDC	
.015	9.50
20K VDC	
.25	17.50
25K VDC	
1	35.00
.5	65.00

1 PER CENT PRECISION RESISTORS

ALL VALUES IN OHMS

5	82	150	800	7,500	20.000
5.05	120	250	920	10,000	30,000
10.1	125	430	1100	12,000	35,000
18	128	468	4300	17,000	84,000

30c EACH .... 10 FOR $2.50
100K 120K 150K 220K
40c EACH .... 10 FOR $3.50
1 MEGOHM .... EACH 75c

DYNAMOTORS

Type	Input Volts	Input Amps	Output Volts	Output Amps	Radio Set
PE86	28	1.25	250	.060	RC 36
DM416	14	6.2	330	.170	RU 19
DM33A	28	7	540	.250	BC 456
PE101C	13/26	12.6	400	.135	SCR 515
		6.3	800	.020	
BD AR 93	28	3.25	375	.150	
23350	27	1.75	285	.075	APN-1
ZA0515	12/24	4/2	500	.050	
B-19 pack	12	9.4	275	.110	MARK 11
			500	.050	
D-104	12		225	.100	
			440	.200	
DA-3A	28	10	300	.060	SCR 522
			150	.010	
			14.5	.5	
5053	28	1.4	250	.060	APN-1
PE73CM	28	19	1000	.350	BC 375
PE94	28	10	300	.200	SCR 522
			150	.101	
			14.5	.5	

INVERTERS

PE-218-H: Input: 25 28 vdc, 92 amp. Output: 115 v. 350-500 cy 1500 volt-amperes. New
PE-206: Input: 28 vdc. 38 amps. Output: 80 v 800-cy. 500 volt-amps. Dim: 13"x5½"x10½". New $22.50
LELAND #10536: IN: 28 VDC, 12A. OUT: 115V. 115VA, 400 CY 3 PHASE. EXC. COND. **$70.00**

MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D. RATED CONCERNS SEND P.O. ALL MDSE. SUBJECT TO PRIOR SALE, AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE. PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK & RAILEX.

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WE ALSO HAVE PRODUCTION QUANTITIES IN STOCK OF

APC AIR TRIMMERS
BINDING POSTS
CABLE
CAPACITORS
CERAMICONS
CERAMICS
ADEL & TINNERMAN CLAMPS
CHOKES
COILS
CONTROLS
FILTERS
FUSES
KOVAR GLASS SEALS
RUBBER GROMMETS
HARDWARE
IRON CORE SLUGS
KNOBS
SINE-COSINE POTENTIOMETERS
PULSE TRANSFORMERS
RELAYS
RESISTORS
SERVO TRANSFORMERS
SHOCKMOUNTS
SOCKETS
SPAGHETTI
MICRO SWITCHES
TOGGLE SWITCHES
TRANSFORMERS
TUBES
AND OTHER RADIO & ELECTRONIC PARTS

SENSITIVE SWITCHES

MICROSWITCHES

Type	Contacts	Actuator	Ea
WZRS9	Clsd	Plunger	.69
M2	Actuator		.49
WZ7RTC	Clsd	Pin	.69
WZRQ41	Clsd	Plunger	.89
WZ7RQ1T	Clsd	Plunger	.97
WZ3RTC	Clsd	Pin	.79
WZ3RD1	Clsd	Button	.69
WZ7RST1	Clsd	Plunger	.79
WP37	Clsd	Plunger	.79
YZRQ41	Open	Plunger	.89
YZR31	Open	Pin	.69
APR201	SPDT	P unger	.89
B15 (Magnet)	Open	Plunger	1.94
BZRW842	SPDT	Leaf	1.79
BZRS	SPDT	Pin	.79

MU SWITCHES

Type	Contacts	Actuator	Ea
DGBP-32	Open	Plunger	1.19
CUM24211	2 ckt	Pin	.79
MGS	2 ckt	Plunger	.89
2A2R	SPDT	Pin	.79

CUTLER HAMMER

A2.......... Normally Closed Plunger .79 ea

CR1070 G.E. SWITCHETTES

No.	Contacts	Ea	No.	Contacts	Ea
C103E3	Open	.69	C130B3	Open	.69
C122A3	Closed	.69	C130D3	Closed	.59
C103F3	2 ckt	.69	C103R3	SPDT	.69

Enclosed Type CR1070D107B3......... Open 1.19

ACRO SWITCHES

Type	Contacts	Actuator	Ea
TD48LSPLL	SPDT	Leaf	1.39
HRC71A2T	Closed	Pin	.69
S1276	Open	Pins (Set of 3)	per set 1.50
XC72L	Closed	Leaf	.69
RD1A	SPDT	Pin	.79

MINIATURE ACRO SWITCHES

Type	Contacts	Actuator	Ea
2MC31A	Closed	Pin	.59
2MD31A	SPDT	Pin	.79
2MD21A	SPDT	Pin	.69

TOGGLE & PUSH SWITCHES

Contacts	Mfgr. & No.	Description	Amps	Each
SPST	Carling	Small Toggle	3A 110V	.15
SPST	C-H	Toggle	6A, 110V	.29
SPST	A, H&H	Toggle	3A, 250V	.29
SPST	C-H B5A	Aircraft	35A, 24V	.29
SPDT	C-H B9A	Aircraft	35A, 24V	29
SPDT	A, H&H	Toggle	3A, 125V	.29
1 B*	A, H&H	Momentary	5A, 125V	.23
1 B*	T&M Co.	Push	3A, 125V	.29
1 A*	Square D	Push	15A, 24V	.49
SPST	Circle F	Molded Toggle	6A, 125V	.25
DPDT	A, H&H	Molded Toggle	6A, 115V	.69
2Bs	C-H	C6B Aircraft	20A, 125V	.89
3DPT	C-H	8744K7	10A, 250V	1.95
3PST	C-H	8740-K4	10A, 250V	1.29

*1A = SPST n.o. 1B = SPST n.c.

20% off in lots of 100 or more

OIL FILLED CAPACITORS

Many other sizes available at comparative prices. Send us your requirements

BATHTUBS

Mfd.	WVDC	Term	Ea	Mfd.	WVDC	Term	Ea
3x0.1	200	Side	.35	0.5	400	Side	.45
2x0.1	600	Top	.35	2x0.64	600	Side	.45
2x0.1	600	(2)Bot.	.35	1.0	400	Side	.55
2x0.1	600	Bot.	35	2x1.0	600	(2)Side	.65
3x0.1	600	Bot.	.40	2.0	600	Bot.	.65
0.2	440AC	Side	.40	4.0	50	(1)Side	.65
0.25	600	Top	40	100	25	(2)Side	.65
0.5	600	Bot.	.45	50	25	(1)Side	.30
0 5	600	Top	.42				

CHANNEL

Mfd.	WVDC	Term	Ea	Mfd.	WVDC	Term	Ea
0.015	600	Top	.28	2x0.5	200	(2)Bot.	.35
0.05	1000	Bot.	.35	2x0.5	400	Bot.	.45
2x0.1	600	Bot.	.35	0.5	400	Bot.	.40
3x0.1	400	Bot.	.40	0.5	600	Bot.	.48
3x0.1	600	Bot.	.45	1.0	400	Bot	.48
0.25	1000	Bot.	.40	1.0	400	Top	.48
2x0.25	600	(2)Bot.	.48	1	500	Top	.48

RECTANGULAR

Mfd.	WVDC	Ea	Mfd.	WVDC	Ea
2x0.1	7000	1.69	1.0	2000	1.85
3x0.2	4000	1.95	1.5	330AC	.89
0.2	5000	2.25	2	600	.95
0.25	4000	1.95	5	25	.49
2x0.5	1500	1.49	7	600	1.45
0.75	1000	.69	3x8	5	1.95
1.0	400	.30	17.5	330AC	3.25
1.0	600	.65	Filterette	50V3A	.59
1.0	1500	1.49			

ROUND CANS (Single Terminal)

Mfd.	WVDC	Ea	Mfd.	WVDC	Ea
0.1	3000	2.25	2.0	600	.95
0.25	2500	1.75			

SHOCKMOUNTS

Large Quantities of Lord, Barry, U. S. Rubber and Other Makes of Shockmounts in Stock. Most Sizes Available. Prices Below Manufacturer's Cost. Send Us Your Requirements.

APC TRIMMERS

We Have Production Quantities of 13, 15, 25, 35, 50, 75, 100 and 140 Mmf Air Trimmers Available at Low Prices.

Mu-Metal Laminations

Es, Fs, Is, Ls. Ten Sizes. Quantities Available.

Sample Kit, 6 lbs, Sufficient Quantity of Each Size for One Unit—Post-Paid in U. S. A. $19.75

TERMS:—All Prices F.O.B. Our Plant. Rated Firms Net 10 Days: All Others Remittance with Order. Orders Under $10 Remittance With Order. Plus Approximate Shipping Charges (overage will be returned.)

115V AC RELAYS

SIGMA 41FZS7; SPDT, 10,000 ohms #R909...$2.95
WARD LEONARD 104-662; DPDT, #998.....$3.50
PRICE ELECTRIC Type 1620; DPST N.O. 10 Amp. Contacts $2.95
RBM #42600; DPST N.O. 10 amp. Contacts...$3.25

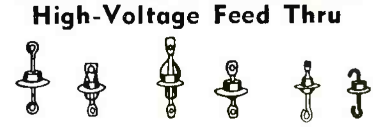
H-F TIE POST

Low-Loss Melamine Insulation, pictured actual size (4-40 Thread) ...$7.50/C $67.50/M

SEALED RELAYS

Clare 5001; 24vdc; DPDT; 300 ohm; Octal Plug Base; #R678....$5.95
Struthers-Dunn 181CXC100; 12 vdc; 3As, 3Bs; #R679..........$5.95
Sigma 73351; 16vdc; SPDT; 2000 ohm; 8 ma; #R682..........$6.95
Allied SKHX, 24VDC; 3A, 3B; 425 ohm; #R913 ....$5.95
SIGMA Type 4AH; 2000 ohm; SPDT, 4 ma. pull in, 2.5 ma. hold, 5 prong plug-in..........$3.95
SIGMA 71257; 6 voc. SPDT, 500 ohms........$4.95
SIGMA 949; 115V AC, SPST N.C..........$4.95

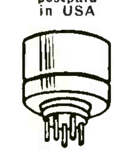
Kovar Glass to Metal Seals High-Voltage Feed Thru



Many types and sizes. Send us your blueprint or sample for our quote. Our prices are a fraction of original factory costs.

SAMPLE KIT 96 Seals (8 ea. 12 types) 5.00 postpaid in USA
LAB KIT 300 Seals (20 types) 15.00 postpaid in USA

D.C. SENSITIVE RELAYS



SIGMA Type 4AH; 2000 ohms; SPDT 4 ma. pull in. 2.5 ma. hold, 5 prong plug-in..........$3.95
Sigma 41FS7; 2 ma; SPDT; 10,000 ohm; @ #R914 ....$2.95
Allied FID; 8 ma; 1A; 3000 ohm; &R916..... 1.50
RBM 23024; 6 ma.; 4PST n.o. (4As); 6500 ohm; #R802 .... 2.95
RBM 23025 6 ma., SPDT, 8000 ohm, #R428.... 1.50
W.E. (Whelock) KS9665 9 ma., 1A, 1B, 1C, 2000 ohm, #R426.......... 4.95
Kurman Midget 12 ma., **SPDT**, 1500 ohm. #R427 .... .98
Clare Type J (K102) 6 ma., SPDT, 3500 ohm, #R30 .... 3.50
Cooke Type C 4 ma., 1A, 6500 ohm, #R596.... 3.50
B11613 (K101) 2 ma., SPDT, 6500 ohm, #R588. 4.95
Clare A8053 8 ma., 3A, 6500 ohm, #R08......3.95
RBM 452-1041: 4 ma., 12,000 ohm; DPDT; Telephone Type; #R685.......... 4.95
POTTER-BROMFIELD Type LC; 5000 ohms, 5 ma. SPST N.O. #R230.......... 1.50
POTTER-BROMFIELD Type LC; 2500 ohms, 9 ma. SPDT #684.......... 1.50

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Universal general corp.

CONDENSERS

MICRO & TOG. SWS. – RELAYS – "J" POTS

OIL CONDENSER SPECIALS

8 mfd.—1000 V.....$3.20
CP70E1EG805K—New Stock. Lots of 10 5% disc., 25 or more 10%.

.1 mfd.—7500 V.....$1.75
Standard Brand #25F475, plus bracket Carton of 10 10% disc. Quantity disc.

7 mfd.—600 V......$1.15
Brand new—Dims. 4⅝" x 3¾" x ¾" Bracket.....$.15

.2 mfd.—1000 V......$.21
Standard 2 side term. bathtub cond. Same dims. as .25 mfd-600 V type. Exceptional value. Qua. disc.

10 mfd.—600 V......$.98
Three term. bal. mtg. channel type. Dims. 3¾" x 3½" x 2". Two 5 mfd. sections rated 400 V at 72 deg. "C". 1800 V test. Meets commercial specs. for 600 V. operation up to 40 degs. "C". Ideal for filter or power factor application. Repeat sales prove this rugged high quality condenser to be of outstanding value. Carton of 24, weight 42 lbs. Large qua. available.....**$.89**

2 mfd.—1000 V......$.85
4" x 1¼" x 1" Standard Brand

1 mfd.—600 V.......$.59
Top term. bathtub cond. Type DYR 10% disc. Lots of 100

7 mfd.—800 V......$1.90
Windings insulated for 1000 V operation. Individually box. Case of 20 10% disc. 2 x 1 mfd—230 VAC (600 DC) 2 ST Bathtub cond. Individually boxed (Qua. disc.)

POWER SUPPLY
#CJP-20ABX for ASB 7/7A/7B equip. 800 cy. 115V. inp. 2.5/56.5/880/2000V. out. Contains 6AC7, 5T4 & 2X2, plus oil conds; chokes, resistors, connectors & switches. Brand new and individually boxed. Measures 7"H x 5¾"W x 13"-L. Cover not shown.........$6.75
Lots of 10, 10% disc.; 25, 15%; 50 & over, 25%.

JAN APPROVED

10mfd—1000V 4.55 8mfd—600V 2.25
8mfd—1500V 4.25 6mfd—600V 1.55
8mfd—1000V 3.25 4mfd—600V 1.75

Mfd	Volts	Price	Mfd	Volts	Price
.005-			2	1500V	1.65
.005-.01	10KV	3.75	2	2000V	2.80
.01	10KV	4.25	2	2500V	3.39
.012	25KV	19.50	2	3000V	4.69
.02	20KV	15.90	2	4000V	5.69
.03	16KV	Quote	2	5000V	10.95
.075-			2	12 500V	Quote
.075	7.5KV	3.95	2-2	600V	1.25
.08	12.5KV	15.95	3	600V	.59
.1	1500V	.59	3	4000V	7.95
.1	2000V	.49	3	13.5KV	Quote
.1	2500V	1.20	3-3	150V	.35
.1	3000V	1.75	3-3-3	400V	.75
.1	7500V	1.75	3.75	1000V	1.59
.1	7500V	4.25	4	400V	.85
.1-.1	7500V	6.25	4	600V	1.25
.1	10KV	8.95	4	1000V	1.95
.1	15KV	15.95	4	1500V	2.79
.15-.16	8000V	1.95	4	2000V	4.25
.2	10KV	10.95	4	3000V	7.95
.25	2000V	1.25	4-4-4	600V	2.40
.25	3000V	2.15	5	330VAC	1.75
.25	6000V	1.75	5	600	1.35
.25	18KV	15.95	5	600V	2.49
.25	20KV	19.95	5	1500V	2.89
.4	10KV	12.95	5-1	400V	.89
.5	1500V	1.02	6	600V	1.45
.5	2000V	1.39	6	330VAC	2.49
.5	3000V	2.69	6	1000V	2.49
.5	25KV	Quote	6	1500V	3.25
.5-.1	2000V	.89	6	2000V	3.95
.5-.5	600V	.69	7	600V	1.45
1	400V	.45	7	800V	1.90
1	500V	.59	7	1000V	2.49
1	1000V	.69	8	500V	1.35
1	1500V	1.35	8	600V	1.75-2.15
1	2000V	1.95	8	660VAC	4.25
1	2500V	2.25	8	1000V	3.20
1	3000V	3.50	8	1500V	4.25
1	6KV	7.50	8	2000V	4.95
1	5000V	4.99	8-8	600V	1.75
1	10KV	Quote	10	600V	2.50
1	15KV	Quote	10	1000V	4.55
1	16KV	Quote	10	6000V	Quote
1	25KV	Quote	12	600V	2.40
1-1	7500V	Quote	12	1000V	4.95
2	600V	.59-.79	14	1000V	5.25
2 TLAD	600V	.80	15	1000V	5.25
2	1000V	.85	17	25V	.69
2 TLA	1000V	1.29	24	1500V	8.50

COAX. CONNECTORS

83-1R...... $.45 83-1SPN.. $.39
83-1AP.... .25 PL-177... .50

CHOKES

5 Hen 2 amps	14 Hen .13 amps
2.6 Hen .80 amps	15 Hen .50 amps
7 Hen .57 amps	Thord'n T60650
8 Hen .52 amps	Thord'n T19C45
12 Hen .10 amps	Specially Priced

WANTED
Condensers of all types in any quantity. Also other standard components. Top prices.

TRANS. MICA CONDS.

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.0001	3000	$0.80	.01	600	.40
.00015	5000	1.75	.01	1200	.55
.0002	15KV	Quote	.01	15KV	Quote
.00025	1200	.35	.0125	6000	5.50
.0005	5000	2.25	.02	600	.27
.00025	5000	1.95	.02	2000	1.15
.0004	2500	.23	.03	600	.49
.001	2500	.48			
.001	8000	3.65			
.002	6000	3.50			
.0024	5000	1.95			
.003	6000	5.95			
.005	1200	.43			

Other types available.

MICA CONDENSERS

5, 6, 8, 10, 15, 25, 30, 34, 39, 50, 70, 75, 100, 140, 150, 185, 200, 230, 240, 250, 300, 350, 390, 400, 470, 500, 510, 600, 650, 700, 750, 1000, 1200, 1250, 1400, 1500, 2000, 2200, 2400, 3000, 3300, 3700, 3900, 4000, 4700, 5000, 5100, 6000, 6200, 6500, 7900, 7950, 7960, 8000, & 9100 mmfd.

PRICE SCHEDULE

5 to 750 mmfd.........5¢
2000 to 5100 mmfd.........11¢
1000 to 1500 mmfd.........7¢
6000 to 8000 mmfd.........12¢

Special Mica Kit—100 @ $3.50

SILVER MICA CONDENSERS

7, 24, 25, 33, 50, 60, 75, 95, 100, 120, 150, 170, 200, 270, 300, 330, 390, 400, 450, 500, 750, 800, 1000, 1400, 1450, 1700, & 2500 mmfd.

7 to 95 mmfd.........8¢
1000 to 1700 mmfd.........14¢
100 to 800 mmfd.........9¢
2500 mmfd.........16¢

Special S.Mica Kit—100 @ $6.50

CERAMICON CONDS.

10, 56 & 100 mmfd @.........05
1000 to 5000 mmfd @.........06
.01 400 V

MOLDED PAPER CONDS.

.01 400 V Type CN35 15¢ ea. $10.50 per "C"
.01, .05, .06 400V. 4¢ ea. $ 3.50 per "C"
.004, .01, .03 600V. 5¢ ea. $ 4.50 per "C"
.1 1000V. 8¢ ea. $ 7.50 per "C"
.01 1000V. 15¢ ea. $13.50 per "C"

AIRCRAFT TOG. SWS.

Aircraft type—20A @ 24VDC-10A @ 125VAC-C-H

CH#	Govt. Spec.	Circuit
8201K4	B-5A	SPST On-Off
8211K5	B-6B	SPST Off-Mom. On
8208K4	B-7A	SPST On-Off-Mom. On
8210K5	B-1B	SPST On-On
8200K8	AN3022-1B	SPDT On-Off-On

Plush Mounted-Luminous Tip—Bat. Handle—Price—$.22 ea; $20/100; $170/1000.
To get 1000 qua. disc. you may combine types.

OTHER AIRCRAFT TYPES

Chn	Circuit	Cur. @ 125VAC	Price
8871K-1	SPST	15A Push but.—Type A2—On-Mom. Off	$.59 P.T.
8905K-514	SP-4Pos.	35A @ 24VDC On-Off-Mom. On-Mom. On	.79 L.T.
8905K-526	SPST	5A B-5A-1¼" Bat.	.32 L.T.
8905K-722	3PST	10A Off-Mom. On	.79 L.T.
8911K-524	DPST	15A Push But.-Off-Mom. On	.59 P.T.
8202K-7	SPST	10A 2 Gang B-5A	.32 L.T.

10% Dis. in quas. of 100 or more per Type.

TOGGLE SWITCHES

CH#	Circuit	Price	AH & H	Circuit	Price
8800K4	SPDT	$.60	6A, 125V	DPST	$.42
8824K4	DPDT	.75	6A, 125V	DPDT	.50

RELAYS & CONTACTORS

Type	Volt	Ohms	Current	Action	Price
1027	12 Leach	67	8	DPDT	1.25
1077-BFW	24 Leach	160	¼ Cont.	DPDT	1.50
1220-DE	24 Leach	95	20	SPST-Double Break	1.25
1222-BF	24 Leach	160	10	SPST-Double Break	1.25
1227-B2A	24 Leach	140	25	SPST	1.25
1254M	24 Leach	160	10	2-SPST N.O.	1.25
7055	12 Leach	100	50	SPST N.O.	3.50
2791-B100-C3	24 GE	150		DPDT	.95
2791-B100-G3	24GE			3PST N.O.	.95
9350-B7A	24 Sq. D	132	250	SPST N.O.	4.75
6041-H81A	24 CH	.65	100	SPST N.O.	2.95
6046-H1A-C1	24 CH	70	50	DPDT	9.95
6046-H1B-C1	24 CH	70	50	DPDT	9.95
6046-H2B-C2	24 CH	49	100	DPDT	11.95
B-9 Time Delay Guard.		500		SPDT	.95
106-612	115 WL		6	DPST	1.50
9340-975 Latching Relay	24 Sq. D	500		4 Pole	8.95

MICRO SWITCHES

Number	Actuator	Circuit	Term.	Price
WZR-31	Pin	SPST-N.C.	Screw	.49
WZR-31-M	MC2711 Plunger	SPST-N.C.	Screw	.69
M-WZ-RS13	Plunger	SPST-N.C.	Screw	.79
WZR-31	HO3-RE11	SPST-N.C.	Screw	1.95
WZ-2YST	Plunger	SPST-N.O.	Screw	.89
WZRQ-41	Plunger	SPST-N.C.	Screw	.89
YZR-31	T-Actuator-LH	SPST-N.O.	Screw	.79
YZ7RDTC	Plunger	SPST N.O.	Screw	.69
YZ3RDT	Plunger	SPST N.O.	Screw	.69
YZ-2YST	Plunger	SPST N.O.	Screw	.95
YP3	Bu on	SPST N.O.	Solder	.49
BZRL2	Roller	SPDT	Solder	.95
BZ3RW2T	Roller	SPDT	Screw	1.05
MU-SW(15A 125V)	Lever	DPST N.O.	Solder	1.05

TYPE "AB" POTS

OHMS	Shaft	OHMS	Shaft
50	1/8 S	20000	1 1/4 & /8 LS
60	1/8 LS	25000	3/8 & 1/ S
150	1/4 S	3000	1/8 S
300	3/8 S	40000	1/8 LS
500	3/8 & 1/8 S	50000	1/4 & 1/8 S
1000	1/8 S	50000	1/8 LS
1500	1/4 S	100000	1/2"
2000	1/8 LS & 3/8 S	150000	2 1/8
2500	1/8 S	200000	1/8 LS
3000	1/8 LS	250000	1/8 LS, 9/16 & 1/8 S
6000	1/4	300000	1/8 S (2 terms.)
5000	1/8 LS & 3/8	5 Meg.	1/8 LS
10000	3/8 & 1 1/7	1 Meg.	1/8 S & 1/8 LS
10000	5/16		
15000	1/8 S		

DUAL "AB" POTS

OHMS	SHAFT	OHMS	SHAFT
1500	5/16"	20K	7/16"
1-5 meg	1/2"	1 meg	1/2"
		2 meg	1/8 S

BATHTUB CONDS.

Mfd	Volts	Price	Mfd	Volts	Price
.01-.01	600	$.25	.25-.25	600	.49
.02-.02	600	.25	.25	1000	.48
.04-.04	600	.25	.3	400	.15
.05	600	.20	.5	400	.37
.05-.05	600	.25	.5	600	.47
.08-.08	600	.25	.5	1000	.52
.1	600	.39	2x.5	600	.59
.1	1000	.42	1	200	.25
.1	1200	.45	1	300	.30
.1-.1	400	.29	1	400	.45
.1-.1	600	.39	1	600	.59
.1-.1	1000	.51	1-1	600	.75
3x.1	600	.40	2	400	.60
.2	1000	.21	2	600	.91
.25	800	.19	4	100	.40
.25	400	.30			
.25	600	.41			

Sp. Bathtub Ki 15 @..........1.00

CHANNEL CONDS.

Mfd	Volts	Price	Mfd	Volts	Price
2x.05	600	.30	.5	400	.21
.1	500	.28	.5	500	.43
.1	600	.32	.5-.1	600	.39
.1	2500	1.20	.5-.5	400	.39
2x.1	400	.34	.5	600	.49
2x.1	600	.40	1	400	.50
3x.1	400	.40	1	500	.58
3x.1	1000	.52	1	600	.63
2x.25	600	.43			
2x.25	600	.48			
.4	600	.30			

—SUPER SPECIALS—

Trans. Jefferson #240-151, 230 to 115V .5KVA Waterproof.......... $10.00
S. Mica Cond. 400 mmfd. Per "C" 7.00.. Per "M".......... 55.00
Mica Cond. 150 mmfd. Per "C" 4.00., Per "M".......... 35.00
Res. 10W 100 ohm WL.......... .15
Res. 20W 5000 ohm WL.......... .22
25 mfd-75V Electro'c.......... .15
500 mfd-6V Electro'c.......... .29
Car filter cond. .01 mfd-200V.......... .07
Socket 7 pin (228569-4).......... .03

Write: **ART HANKINS, Owner**

MONMOUTH RADIO LABORATORIES

BOX 159 Long Branch 6-5192 OAKHURST, N. J.

Quality • Reliability • Service *PAYS OFF*

WE ARE MOVING TO LARGER QUARTERS
OUR NEW FACILITIES WILL ENABLE US TO DO EVEN BETTER

BATHTUB COND. YAB/T CHANNELS WAB/T

MFD	400V	600V	1000V	400V	600V	1000V
.05	$.30	$.35	$.40	$.35	$.40	$.50
.10	.35	.40	.45	.40	.45	.50
.25	.40	.45	.50	.50	.60	.65
.50	.45	.50	.60	.60	.65	.70
1.0	.50	.65	.75	.75	.85	—
2.0	.90	1.25	—	—	—	—
2 x .05	.35	.40	.45	.40	.45	.60
2 x .10	.40	.45	.50	.45	.50	.65
2 x .25	.45	.55	.65	.50	.65	.75
2 x .50	.55	.65	.85	.60	.75	—
2 x 1.0	.85	.95	—	—	—	—
3 x .05	.40	.45	.50	.45	.50	.65
3 x .10	.40	.45	.65	.45	.50	—
3 x .25	.50	.65	—	.60	.75	—
3 x .50	.60	.65	—	—	—	—

Specify Terminal Layout When Ordering
Other Values-Voltages Available

JAN-C-25 Types Available in Quantity
SPECIAL CRYSTALS TO YOUR SPECS.
10 DAY DELIVERY—INVESTIGATE
40 CYCLE TRANSFORMERS

352-7061	352-7096	352-7194
352-7066	352-7098	352-7198
352-7068	352-7099	352-7222
352-7070	352-7102	352-7245
352-7086	352-7106	352-7295
352-7091	352-7167	352-1402

YOUR INQUIRIES INVITED

G.E. THYRITE, K8396832-1, 5-40 ma/21-33 volts.......... $.65
A.E. TYPE #13 STEPPER RELAY, 8-12VDC 3 deck 25 position, 360 degree rotation.......... 8.95
SCR-274N OUTPUT TRANSFORMER, ES-690127.......... 1.65
F-12 MUMETAL LAMINATIONS & #4750 grade, 29 ga.......... QUOTE
10 mfd/600 VDC RECT. OIL UPRIGHT, solder lug term.......... 2.65
HV BARRIER TERMINAL STRIP, 6 term. W/all hwe.......... .25
RELAY COIL ASSY, 600 ohm 10-50 VDC, W/arm, no cont.......... .39
PANEL METERS TO YOUR SPECIFICATIONS—SPECIAL SERVICE

All Our Material is New—Clean—Ready for Your Use, Factory Type Packaging
FOR FAST INTELLIGENT FRIENDLY SERVICE "CALL ON ESSCO"

ELECTRONIC SPECIALTY SUPPLY CO.

58 WALKER STREET BArclay 7-2684 NYC 13, N. Y.

FOR SALE

PLATE TRANSFORMERS

Several hundred new 10 K.W. Amertran oil cooled plate transformers 115 v. 60 cy., 1 phase primary, 17,600 volts, .5 amp secondary. Can be furnished center tapped or two wire 8800 volts, 1.0 amps. Priced $75.00 each f.o.b. Los Angeles. Special Quantity discounts available.

Special Note: These transformers can be seriesed for 220 v. S.P. 2 or 3 wire @ 20 KW with 8800-0-8800 v. sec. or 220 3 ph. @ 60 KW with same sec. voltage output as polarity is additive.

SCR 545-A Radar

New RA-38 15 KV Power Supplies and components

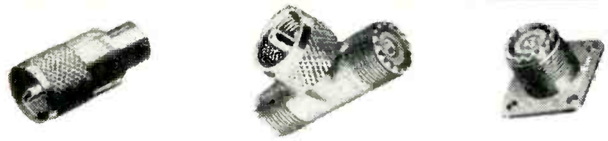
Including 5 v. 10 a. 35 KV test filament transformers. $15.00 ea. and 100 amp, 115 v. transtats $140.00 ea.

EPCO

1527 E. 7th St., Los Angeles, 21, Calif.

YOUR MOST COMPLETE SOURCE OF UHF • UG • AN CONNECTORS

NO.	JAN NO.	DESCRIPTION	1-99	100 TO 999	1000 AND OVER
83-1R	SO 239	RECEPTACLE	$ .50	$ .45	$ .40
83-1SP	PL 259	PLUG	.55	.55	.50
83-168	UG 176/U	ADAPTER	.15	.12	.11
83-185	UG 175/U	ADAPTER	.15	.12	.11
83-1SPN	PL 259A	PLUG	.65	.60	.55
83-776	UG 203/U	PLUG	.65	.60	.55
83-1RTY	....	RECEPTACLE	.75	.65	.65
83-1H	UG 106/U	HOOD	.15	.14	.13
83-1HP	....	HOOD	.27	.24	.22
83-765	UG 177/U	HOOD	.24	.24	.24
83-1AC	.. ..	CAP & CHAIN	.55	.50	.45
83-1BC	....	CAP & CHAIN	.35	.31	.30
83-1T	M 358	T CONNECTOR	1.50	1.40	1.40
83-1AP	M 359	ADAPTER	.35	.30	.28
83-1AP	M 359A	ADAPTER	.80	.75	.70
83-1J	PL 258	JUNCTION	.75	.70	.65
83-1F	PL 274	FEED THRU	1.25	1.20	1.10
83-22SP	UG 102/U	TWIN PLUG	.90	.80	.75
83-22R	UG 103/U	RECEPTACLE	.90	.80	.75
83-22AP	UG 104/U	ADAPTER	1.40	1.25	1.10
83-22J	UG 105/U	JUNCTION	1.50	1.40	1.40
83-22T	UG 196/U	T CONNECTOR	1.65	1.50	1.50
83-22F	PL 275	FEED THRU	2.00	1.80	1.75
83-2SP	PL 295	PLUG	2.25	2.15	2.00
83-2R	SO 265	RECEPTACLE	1.65	1.55	1.50



From stock

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
UG 9/U	$ 1.95	UG 57/U	$ 2.30	CW 155/U	$ .63	UG 254 A/U	$ 3.50	UG 496/U	$ 3.50
UG 10/U	2.75	UG 57 B/U	1.85	UG 155/U	9.50	UG 255/U	2.85	UG 499/U	1.50
UG 11/U	2.25	UG 58/U	.80	UG 156/U	8.50	UG 256/U	15.50	UG 503/U	50.00
UG 12/U	1.55	UG 58 A/U	1.25	UG 157/U	8.50	UG 257/U	15.50	MX 504	.45
UG 13/U	2.25	UG 59/U	2.45	UG 158/U	47.50	UG 259/U	6.50	UG 505/U	50.00
UG 14/U	1.80	UG 59 A/U	2.15	CW 159/U	1.95	UG 260/U	1.20	UG 506/U	50.00
UG 15/U	1.25	UG 59B/U	2.75	UG 159 A/U	2.20	UG 260 A/U	1.40	UG 507/U	50.00
UG 16/U	2.75	UG 60/U	2.40	UG 160 A/U	2.20	UG 261/U	1.20	UG 526/U	3.75
UG 17/U	2.75	UG 60 A/U	2.25	UG 160 B/U	2.50	UG 262/U	1.20	UG 530/U	4.50
UG 18/U	1.75	UG 61/U	2.55	UG 166/U	47.50	UG 266/U	4.50	UG 531/U	5.15
UG 18 A/U	1.75	UG 61 A/U	2.40	UG 167/U	5.75	UG 269/U	3.75	UG 532-U	6.95
UG 18 B/U	1.75	UG 83/U	1.95	UG 167 A/U	5.75	UG 270/U	10.00	UG 533/U	10.00
UG 19/U	2.25	UG 85/U	2.00	UG 173/U	.38	UG 271/U	10.00	UG 535/U	4.95
UG 19 A/U	2.25	UG 86/U	2.80	UG 174/U	20.00	UG 272/U	25.00	UG 536/U	2.45
UG 19 B/U	1.95	UG 87/U	1.60	UG 180 A/U	10.00	UG 273/U	2.55	UG 541/U	3.95
UG 20/U	1.95	UG 88/U	1.10	UG 181 A/U	10.00	UG 274/U	3.95	MX 554/U	2.25
UG 20 A/U	1.90	UG 88 B/U	1.95	UG 182 A/U	10.00	UG 275/U	7.50	UG 557/U	5.50
UG 20 B/U	1.90	UG 89/U	1.35	UG 185/U	1.35	UG 276/U	7.50	MX 564/U	.55
UG 21/U	1.25	UG 90/U	1.60	UG 188/U	1.30	UG 279/U	3.95	UG 564/U	3.95
UG 21 A/U	1.95	UG 91/U	1.95	MX 195/U	1.00	UG 286/U	4.95	UG 565/U	3.95
UG 21 B/U	1.45	UG 91 A/U	1.70	UG 197/U	4.95	UG 287/U	7.75	UG 566/U	7.95
UG 21 C/U	1.75	UG 92/U	1.80	UG 201/U	2.75	UG 290/U	1.20	UG 567/U	6.95
UG 21 D/U	1.95	UG 92 A/U	2.25	UG 202/U	3.95	UG 291/U	1.25	UG 568/U	4.95
UG 22/U	1.65	UG 93/U	1.95	UG 204 A/U	3.50	UG 294/U	2.20	UG 569/U	2.95
UG 22 A/U	1.60	UG 93 A/U	2.25	UG 206/U	2.00	UG 299/U	7.75	UG 570/U	2.95
UG 22 B/U	1.50	UG 94/U	2.25	UG 207/U	25.00	UG 306/U	2.95	UG 571/U	6.95
UG 22 C/U	1.95	UG 94 A/U	1.60	UG 208/U	22.50	UG 309/U	3.75	UG 572/U	5.95
UG 23/U	1.65	UG 95/U	1.95	UG 212 A/U	3.50	UG 332/U	3.50	UG 573/U	7.25
UG 23 A/U	1.95	UG 95 A/U	2.00	UG 213 A/U	4.10	UG 333/U	5.50	UG 602/U	3.00
UG 23 B/U	1.75	UG 96/U	2.10	UG 215/U	5.50	UG 334/U	6.50	UG 603/U	3.00
UG 23 C/U	1.95	UG 96 A/U	1.95	UG 216/U	14.00	UG 335/U	3.75	UG 625/U	1.70
UG 27 A/U	3.75	UG 97/U	4.25	UG 217/U	7.50	UG 347/U	2.50	UG 627/U	7.25
UG 27 B/U	3.75	UG 97 A/U	3.95	UG 218/U	10.00	UG 348/U	1.50	UG 628/U	7.25
UG 27C/U	4.50	UG 98/U	2.50	UG 219/U	7.50	UG 349/U	3.50	UG 634/U	4.95
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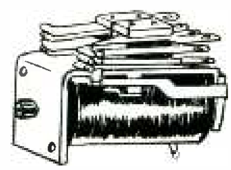

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0B3/VR90	$1.20	5JP2	$19.50	464A	$ 9.50
0C3/VR105	1.20	5T4	1.50	531	14.50
0D3/VR150	.85	6AC7	.95	532A/1B32	3.95
1A3	.85	6AG7	1.20	705A	3.75
1A5GT	.78	6AJ5	2.25	706AB	22.50
1B22	3.75	6AJ6	2.10	706AY-GY	32.50
1B24	14.95	6B6G	.75	707A	14.50
1B27	17.50	6C6	.79	721A	2.45
1B32/532A	3.95	6C8G	.79	723AB	22.50
1N21	1.25	6H6	.69	724A	2.95
1N22	1.25	6K7	.75	724B	5.95
1N23	1.50	6SA7	.74	726A	14.95
1N27	2.95	6SC7	.97	750TL	79.50
1P23/CE-1	3.50	6SH7GT	.79	801	.85
1R4/1294	.85	6SH7	.79	803	5.95
1T4	.59	7C4/1203A	.75	804	10.50
2A3	.95	7E5/1201	.95	805	4.95
2AP1	8.95	7E6	.55	807	1.79
2B22	4.25	10Y	1.50	810	10.95
2C33/RX233A	3.45	12A6	.85	811	2.85
2C40	17.50	12C8	.89	813	8.95
2E22	3.49	12H6	.69	814	3.35
2J21	9.95	12J5GT	.57	815	3.40
2J21A	12.95	12SF7	.75	816	1.45
2J22	14.95	12SJ7GT	.65	826	1.39
2J27	22.50	14H7	.97	830B	2.95
2J34	38.45	14J7	1.10	832	7.95
2J50	69.50	15R	1.00	832A	9.50
2J55	95.00	23D4	.65	836	4.50
2X2	.89	30	.48	838	3.50
2X2A	2.15	45	.35	838W	6.50
3A4	.85	53A	3.95	845	3.95
3B7/1291	.62	71A	.69	845W	6.95
3B24	5.50	76	.58	866A	1.25
3C23	10.50	77	.65	872A	3.65
3C24/24G	1.95	78	.80	884	1.79
3DP1	3.95	100TH	10.50	902P1	7.50
3D6/1299	.62	112A	.49	957	.45
3EP1	4.95	211	1.25	958	.60
3FP7	4.50	227A	4.50	959	1.50
3GP1	4.75	274B	2.95	991/NE16	.25
3JP12	14.50	304TH	13.95	1616	2.95
4B22/EL5B	9.75	304TL	19.50	1619	.89
4B25/EL6CF	8.95	350A	6.95	1624	1.95
4J36	175.00	359A	2.50	1625	2.00
4J37	175.00	371B	2.95	1629	2.00
5BP1	5.95	388A	2.95	1655/65C7	.97
5D21	23.95	394A	4.25	1846	115.00
5FP7	2.50	450TH	44.50	2051	.95
5JP1	23.50	450TL	44.50	8005	5.85

8020	$ 2.50
9001	1.75
9002	1.50
9003	1.75
9004	1.75
9006	.75
CE22/918	1.50
CK501LX	1.50
CK1089	1.50
EL5B/4B22	9.75
ELC5B	9.75
ELC6A	7.50
EL6CF	8.95
EL302.5/3B21	4.50

RADIO SHACK

CORPORATION

167 Washington St., Boston 8, Mass.

FG27A	$ 8.95
FG-90	6.50
GL-316A	3.40
GL-434A	22.50
GL446A	2.50
GL605	49.95
ML-531	14.50
QK-59	85.00
QK-60	85.00
QK-61	85.00
QK-72	85.00
RK-25	3.69
RK-65	26.50
RK-72/CRP72	1.95
RX21	3.85
RX233A/2C33	3.45
VR-90	1.20
VR-105	1.20
VR-150	.85
VT-127A	2.95
WL-417A	22.50
WL-653B	75.00
ZP-653	65.00

BRAND NEW! EXCLUSIVE 3600V @ 520 Ma. PLATE TRANSFORMER

REG. $125 **$49.50**

Thordarson plate transformer in gray steel potted case. Supplies 3600V @ 520 ma. with three 866A rectifiers. Pri. 208/230V Delta conn. to 1890V, ½ phase. Sec. 3280V AC. Input: VA 2270. 19½ x 15 x 8". Wt. 150 lbs. Order No. T-254

BRAND NEW! 8 WATT PRECISION RHEOSTAT

REG. $5.00 ONLY **$1.50**

10 for $12.50 100 for $100

Save $3.50! New, boxed model 260. 20K ohms. Linearity accuracy 1%; tot. resistance accuracy 5%. Max. current 20 ma, 8W rating. Angle of rot. 294° Inside contact arm, 4 separate wiping fingers. 3 x 1½", ¾ x ⅜" shaft. Can be ganged. Order No. R-5262

QUARTZ CRYSTALS

NEW LISTING

Made from the finest Brazilian Quartz. Will provide a high degree of activity and frequency stability. All tested and marked by the manufacturer to a very close tolerance. In the frequencies outlined below the crystals itemized under the heading "From & To" are mostly in progressive frequencies between the limits shown (as for example: "From 3300 to 3377," are as follows: 3300KC, 3301KC, 3302KC—, 3377KC.) are of limited quantities in each frequency. Those listed singly are in quantities of 50 or more.

FT243

Prong centers ½", Prong dia. 3/32"

Price $1.15 ea. (25 for $25.00)

FROM	TO	FROM	TO	FROM	TO
1915	1995	6225		8000	
2030	2065	6250		8025	
2125	2155	6275		8050	
2300			6292	8100	8175
2320	2390	6300	6375	9206	8275
2420	2490	6400	6498	8300	8375
2604		6500		8385	
2605		6506.6	6675	8400	8475
3652	3689	6700	6775	8500	8575
3729	3799	6800	6875	8600	8650
3805	3823	6815		8786.25	
	4100	6830		8808.75	
4104	4150	6900	6975	8876.25	
4244	4290	6978.75		8921.25	
4305	4397	7228	7281	9135.0	
4400	4480	7325	7375	9342	9399
4600	4690	7458.75		9405	9499
4800	4898	7440	7475	9500	
4913	4941	7500	7597	9516	9589
5100	5195	7606	7673.3	9608	9638
5300		7625		10075	
5320	5397.5	7650		12608	12698
5500		7675		12700	12783
5630		7700		12800	12890
5633.3		7725		12902	12998
5655.5		7728.8		13004	13009
5677.7		7750		13010	13099
5700		7751.25		13100	13196
5706.6	5775	7773.75		13213	13299
5722.2		7775	7790	13302	13361
5744.4		7800		13400	13496
5800	5892	7825		13500	13554
5900	5975	7850		13837	13897
5955		7875		13903	13996
6000	6075	7900		14038	14092
6000.6		7925		14110	14198
6150		7950			
6175		7925			
6100	6173.3	7906	7968		

CR 1A/AR or FT241

Prong spacing ½", Prong dia ⅛"

Price 79¢ ea. 12 for $9.00

FROM (Frequencies in KC)	TO
2853	
3988	
4188	
4285	
4300	4374
4788	
5020	5090
5100	
5120	5180
5200	5295
5250	
5300	5396
5410	
5470	
5500	
5468	
5470	5780
5810	
5891	
5910	
5923	5960
6011	6080
6130	6195
6203	6275
6270	
6300	6375
6370	
6400	6499
6490	
6500	6590
6600	6685
6744	
6815	6877
6905	6980
7270	
7330	
7460	
7500	
7540	
7541.6	
7560	
7600	

FROM (Frequencies in KC)	TO
7620	
7625	
7650	
7738	
7740	
7750	
7760	
7770	
7775	
7778	
7780	
7790	
7800	
7810	
7825	
7830	
7850	
7851	7880
7900	
7910	
7925	
7930	
7940	
7950	
7970	
7975	
7990	
8002	
	8010
8007	
8012	
	8092
8205	8298
8308	
8300	8370
8407	
8412	
8405	8490
8506	8561
8645	
8630	8650
8985	
11677	

XL5 Dual

3 prongs ½" X 1 19/32" prong dia.

Price $1.95 ea.

2520 & 2698
2731 & 2891
2436 & 2276
3128 & 3153
2605 & 3153

XL5 Single

3 prongs ½" X 1 19/32" prong dia.

Price $1.35 ea.

FROM	TO
2200	2210
2300	2384
2410	2450
2561	
2600	2698
2704	2787
2802	2891
2916	
3117	3171
3154	
3325	3371
3435	
3857	

FT241A

SPECIAL TYPE WE.

Prong spacing 1" CTS.

Prong Size 3/32" dia.

These are in successive steps of .1 MC variation from 20.0 MC to 27.9 MC.

Suitable for low frequency purposes (1/54 of Stated Values)

Price $1.15 ea.

UNASSEMBLED CRYSTALS

consists of quartz crystal plates made for FT243 holders. Furnished complete with holders, electrodes, springs and all hardware.

Price .29 ea.

Crystal plates available in the following frequencies:—

7533	7750	7873	8475
7541		7950	8750
7550	7775	8275	
7640	7800	8325	
7650	7825	8450	
7700	7850		

EDLIE ELECTRONICS, Inc.

154 Greenwich Street,
New York, N. Y.
Telephone DIgby 9-3143

TUBES

We guarantee all tubes. We endeavor to give you low, low prices, consistent with quality merchandise and service. Stock Up Now.

OA2	$ .98	6AG7	1.45	373-A(WE)	5.00
OB2	1.10	6AJ5	1.90	374-A(WE)	4.00
OZ4	.59	6AK5	.75	387-A(WE)	2.50
1AE4	1.10	6AK6	.90	400-A(WE)	2.50
1B22	2.00	6AN5	1.75	401-A(WE)	3.50
1B23	8.00	6B8	.65	403-B(WE)	7.50
1L4	.69	6C4	.45	407-A(WE)	5.00
1L21	4.00	6F6-M	.88	408-A(WE)	2.75
1N21-B	3.45	6F8-G	.88	GL-559	1.00
1N23-A	2.45	6G6-G	.95	KU-676	25.00
1N23-B	3.70	6J5	.49	700-D	55.00
1N31	5.50	6J6	.59	715-C	20.00
1N34	.64	6J7	.75	717-A	.98
1N34-A	.85	6K7	.70	803	3.59
1N44/400-B	1.21	6L5-G	.49	805	2.50
1N45-400-C	1.39	6L6-G	1.19	807	1.59
1N54	.89	6L7	.98	811-A	3.50
2C39	29.95	6S7	.98	837	1.45
2C43(G.E.)	15.95	6SD7	.79	838	2.25
2C52	5.50	6SG7	.88	860	3.95
2D21	1.35	6SK7-GT	.60	861	22.50
2E24	2.75	6SL7-GT	.60	866-A	1.55
2E30	2.15	6SN7-GT	.65	872-A(G.E.)	3.50
2J30	65.00	6V6-M	1.10	CK-1005	.48
2J34	27.50	6Y6-G	.95	1616	.74
2J49	34.50	7C30	85.00	1619	.30
2K45	85.00	7H7	.80	1622(6L6M)	1.95
3B28	7.50	12A6	.65	1625	.40
3B29	12.00	12C8	.79	1629	.30
3BP1	5.75	12AH7-GT	1.10	1631	1.50
3BP11	10.00	12AU7	.69	1632	.70
3C27	7.50	12SF5	.70	2050	1.45
3C33	9.95	12SG7	.87	2051	1.19
3E29	10.95	12SH7	.65	5516	5.95
3Q5	.99	12SJ7	.65	5508-A	3.95
4C35	26.50	12SR7	.70	5654	2.00
4X150A	37.50	FG-105	19.50	5814	4.50
5BP1	3.50	211	.70	5910	.75
5BP4	4.00	274-A(WE)	3.50	8020	.98
5CP1	3.00	274-B(WE)	2.25	9001	1.35
5FP7	1.95	276-F and G	15.00	9003	1.10
5R4GY	1.40	304-TH	7.00	9004	.39
5U4-G	.59	304-TL	8.00	9006	.39
5X4-G	.85	310-A(WE)	5.95	C6L/5528	15.00
5Y3-GT	.45	311-A(WE)	6.50	F-123-A	6.95
5Z3	.85	350-B(WE)	4.95	RK-72	.75
6AB7	.95	359-A(WE)	4.00	RK-73	.75
6AC7	.98	371-B	.85		

WRITE ON TYPES NOT LISTED

Top Dollar Paid for SURPLUS TUBES & EQUIPMENT — Send List With Details

SELENIUM RECTIFIERS

Full-Wave Bridge Types

Current (Continuous)	18/14 Volts	36/28 Volts	54/42 Volts	130/100 Volts
1 Amp.	$1.25	$2.20	$3.60	$7.50
2 Amps.	2.20	3.60	6.50	10.50
2½ Amps.	.....	.....	.....	13.00
4 Amps.	3.75	6.75	8.75	.....
5 Amps.	4.95	7.95	12.95	27.00
6 Amps.	5.50	9.00	14.00	33.00
10 Amps.	6.75	12.00	20.00	40.00
12 Amps.	8.50	16.00	25.50	50.00
20 Amps.	13.25	24.00	36.00	90.00
24 Amps.	16.00	31.00	39.50	98.00
30 Amps.	18.50	36.00	.....	.....
36 Amps.	25.50	45.00	.....	.....

• **New, Selenium Rectifier Transformers**

PRI: 115 V., 60 cycles in. SEC: 9, 12, 18, 24, and 36 volts
- 4 Amps......$ 8.75
- 12 Amps...... 16.75
- 24 Amps...... 35.75

Made to our specs. for continuous, heavy-duty use

- 115V. PRI—36V. 50 amp second XFMR..$39.95
- 115V. PRI—5V. @ 190 Amp. SEC........$59.95
- 115/230 V. 60 cy. PRI. SEC.: 1.5, 30.5, 33.5, and 36.5V @ 4 AMPS. Herm. Sealed....@ $6.50

- New Selenium Rectifier Chokes
  - 4 Amps.—.07 hy.—.6 ohm $7.95
  - 12 Amps.—.01 hy.—.1 ohm $14.95
  - 24 Amps.—.004 hy.—.025 ohm..............$29.95

We manufacture standard as well as special types of selenium rectifiers, rect. supplies and XFMRS. Low prices . . . Write. You will like our quick service. low prices, and good workmanship.

32 KV. VACUUM CAPACITORS. EIMAC BOXED 6MMF.......$8.50 — 12 MMF.......$10.95 50 MMF.......$13.50

- Bliley-Type SMC100— Crystal Standards. New—100 KC. and 1,000 KC Bar..........$8.50

- ART-1—DeLuxe 75 Meter AM Mobile XMTR—New—Complete ....Only $19.95
- AR-11—Comolete Station for 20, 40, 80. Superhet Rcvr—50 Watts CW w/built in AC Pwr Supply. New—in compact suitcase (orig. cost over $500) Special ....Only $99.50
- Weston Meters. 0-100 micro amps. 2¼" Diam. (Blank Scale) New Boxed. VERY Special..$5.95

Terms: FOB-NYC—25% Deposit with order—or send full remittance to save COD charges—Rated Firms (D.&B.) Net 10 days — All merchandise guaranteed.

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Arrow SALES INC.

ATR-13 TRANSCEIVER

Dynamotor powered, either 14 or 28 V. Shock mounted, remotely controlled transceiver. Tunable receiver, range 108-160 M.C., 4-channel crystal controlled VHF transmitter, built-in provisions for omni. Weight, complete with plugs, less cable, 19 lbs. Less crystal, new **$245.00**

PORTABLE RADAR

Model SQ. 12 cm. Used on small ships. Has PPI indicator. Maximum range 20 miles. 1 Kw. output. Operates from 110 VAC, 60 cps. Price On Request.

NEW HEADSETS & HANDSETS

HS-23	HS-38	TS-10-G	TS-13-C	AS-83
HS-33	HS-18	T-26	RS-38	

RADAR

APS-4	Complete Radar	RC-184IFF
APS-6 Complete	Mark 16	RC-214
APT-1	MD4/APS2	RC-224
APT-2	MD5/APS3	RC-266
APT-3	MD22/UPN2	RT34/APS13
APT-4	MD38/APQ13	T-85/APT-5

TEST EQUIPMENT Complete Line!

DuMont 224-A Oscilloscope		TS-118/AP
1-77 Hickok Tube Checker		TS126
1-208 FM Signal Generator		TS127/U
RPC Model 644 Multimeter		TS131
Ferris Microvolter Mod. 18-C		TS159
Hewlett Packard 200-C		TS170/ARN
I-198	TS19/APQ	TS-173/UR
BC-638	TS-23/APN	TS175/UP
BC-1255	TS24A/ARR-2	TS182/UP
IE-36	TS27/TSM	TS184A/AP
I-95	TS-33	TS204/AP
I-96	TS34/AP	TS251
I-122	TS-35/AP	TS311A/UP
I-130A	TS36/AP	TS323/UP
I-139	TS-45A/APM-3	1-146
I-145	TS61/AP	TS-268/U
I-212	TS62/AP	Boonton Mod. 78B Sig. Gen.
I-222	TS89	
TS-3A/AP	TS92	Boonton Type 102F Sig. Gen.
TS10A/APN	TS100/AP	
TS12/AP	TS-102	
TS16/APN	TS111/CP	

TS-159/TPX

COMBINATION SIGNAL GENERATOR AND FREQUENCY METER. Freq. range: 150-200 MC., crystal calibrated. Has separate 30 MC signal output, crystal cal; 3-stage, AF amplifier. Power measurements by built-in VTVM circuit. 0-1 MA. meter as 2-range voltmeter. Built-in 400 cps. voltage regulated power supply. New.......$69.95

POWER SUPPLY

110 V. 60 cps., 4 tubes voltage regulated. Power output 200 VDC @ 50 MA. and 6.3 VAC @ 7 amps. Used to supply necessary power for radar transmitter G-23200. New.................$39.95

RADAR TRANSMITTER

Model G-23200. 15 tubes. Has 4 independent oscillators, each adjustable in frequency between 509-521MC. by means of knobs on front panel. Has 4 independent variable pulse shaping modulators, complete with tubes. Requires above separate POWER SUPPLY. New $89.95

AN/ART-13 PARTS

Part #	Item
564916	Barometric Switch
565027	4-Pile Ceramic, Variable Cap.
K7890443	6-Pile Ceramic, Variable Cap.
564605	4 Centralab-Type 843-003 Cap Assembly

RA-38 RECTIFIER

High voltage power supply. Used with ground radar set. New. Price on request.

FLUX METER

For measuring flux density between magnet poles. Has two meters in series with a potentiometer and battery for power supply. Range: 500-4000 Gauss in 3 scales. Requires 1 battery which mounts in case. NEW $37.50

RECEIVERS—TRANSMITTERS

APR-4	MP-10G	RTA/1B
APR-5	PE-125AX	SCR-522
ARC-1	R-9/APN-4	TA2J-24
ARC-3	340-580 MC. New complete	733-D
R-4/ARR-2		
ID-6/APN-4	R89	

RA-52 RECTIFIER

Transtat controlled to produce high voltage DC from 110 VAC 60 cycle source. Up to 11,500 VDC @ 50 W. Metered high voltage (0-15 KV) and current (0-20 MA). NEW...............$74.50

MISCELLANEOUS

MINE DETECTOR: SCR-625 for prospecting, mining, etc. NEW..............................$59.50
LP-21 LOOPS: Mod. LM, AM, A. Excel. cond.

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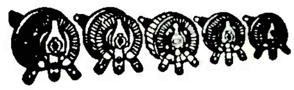
(See Arrow Sales Inc. ad Page 471)

POWER RHEOSTATS



r	W	Ea.	r	W	Ea.	r	W	Ea.
.5	25	1.98	75	25	1.98	500	300	9.49
.5	50	2.81	75	75	3.90	585	150	6.59
.5	150	5.93	80	50	2.53	750	25	2.23
1	50	2.81	80	500	12.46	750	150	5.46
2	50	2.81	100	25	1.98	1000	25	2.53
2	100	4.68	100	50	2.53	1000	50	2.66
2	300	8.42	100	100	4.39	1200	225	7.20
3	100	4.67	125	25	2.23	1200	300	8.40
3	225	6.58	150	50	2.53	1250	50	2.66
4	225	6.60	175	25	2.23	1250	150	6.10
5	25	1.97	185	25	2.23	1500	25	2.53
5	50	2.53	200	25	2.23	1500	50	2.66
5	100	4.68	200	100	4.40	1600	50	2.66
6	25	2.23	200	150	5.04	1800	150	6.19
6	50	2.53	225	50	2.53	2000	25	2.53
6	75	3.90	250	25	2.23	2000	50	2.66
7	25	1.98	250	50	2.53	2250	150	6.24
7.5	75	3.95	300	50	2.53	2500	50	2.66
8	50	2.53	300	75	3.90	2500	100	4.68
10	25	2.23	300	100	4.40	2500	150	6.24
10	50	2.53	300	150	5.04	3000	25	2.66
10	100	4.37	350	25	2.25	3000	100	4.95
12	25	2.23	350	100	4.40	5000	25	2.66
12	50	2.53	370	25	2.23	5000	50	2.90
15	25	1.98	378	150	6.59	7500	50	2.90
15	75	3.90	400	25	2.23	7500	100	5.32
15	100	4.38	400	75	3.90	10000	50	2.99
20	50	2.53	500	25	2.23	10000	100	5.32
22	50	2.53	500	50	2.53	10000	100	5.51
25	25	2.23	500	75	3.95	15000	25	3.25
50	25	1.98	500	100	4.50	20000	150	8.75
50	50	2.53	500	150	5.15			

Specify Type Shaft Required "S" or "Knob"
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G-1 Type		G-2 Type		G-3 Type		G-4 Type	
.0001	6kv	.0001	10kv	.0001	20kv	.00025	30kv
.00015	5kv	.00015	10kv	.00015	20kv	.0006	35kv
.0002	6kv	.0002	10kv	.0004	20kv	.0025	25kv
.0008	6kv	.00025	12kv	.00045	15kv	.003	20kv
.01	4kv	.0003	10kv	.00047	20kv	.0039	20kv
.032	2kv	.000375	10kv	.0005	20kv	.0075	15kv
.04	1kv	.0004	5kv	.00095	5kv	.01	12kv
.051	1.5kv	.0005	10kv	.001	20kv	.03	8kv
.08	1.5kv	.00057	10kv	.0011	20kv	.056	5kv
.09	1.5kv	.00065	10kv	.00124	15kv		
		.001	10kv	.01	5kv		
				.015	3kv		
				.25	1.6kv		

C-D Type #56

.000155	30kv	.001	30kv
.0004	30kv	.03356	2.5kv
.000533	30kv	.007/15kv-70A/300kc	

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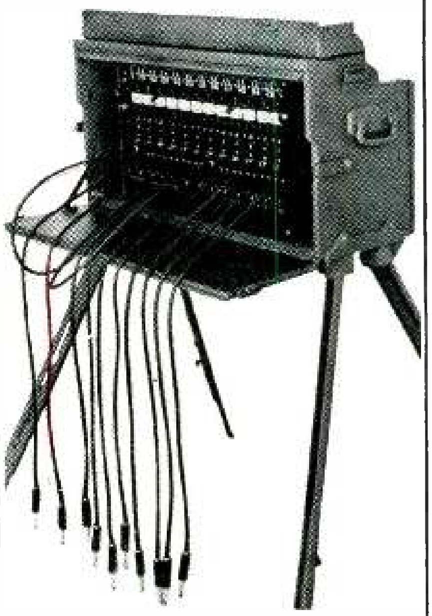

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PL-112 Plug for LP-21 Loop.................. $1.25
PL-P-103 Plug for BC-348.................. 1.50
MC-211 Rightangle Adapter for Comm. Sets... .50
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C-87/ART-13—f/ART-13 Trans	$ 6.95	$4.95
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BC-434 for ADF..................	5.95	3.95
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MC-476 Maple Ball for above—f/Fairlead.... 1.00
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1N21A	1.50	2C46	27.50	3B26	1.95	6SU7GTY	2.25	121A	2.95	721A	2.25	957	.45	1625	.45	9001	.99
1N21B	3.25	2C51	6.75	3C22	120.00	9GP7	12.50	F127A	17.00	723AB	17.50	958A	.59	1641	1.95	9002	.89
1N23A	2.25	2J31	22.00	3C31/C1B	2.50	10Y-G.E.	.49	211 G.E.	1.25	726A	8.25	1005	.59	1644	.85	9003	1.25
1N23B	3.50	2J32	27.50	3C45	15.00	15E	2.35	507AX	1.45	814	2.50	1006	2.95	2050/1665	1.40	9004	.65
1N26	7.75	2J48	37.50	3E31	12.50	T21	1.50	532A	3.75	815	1.50	1007	.85	2051	1.00	9006	.49
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1B29	2.75	2X2	.49	6AK5	.85	VR105	1.25	706CY	45.00	931A	3.95	1613	1.15	5702	5.50		
				6AL5	.39	VU111	1.20	715A	5.95	954	.39	1616	.65	7193	.45		

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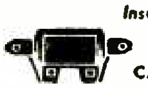

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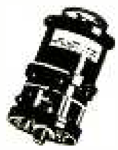

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BC-1016	I-155	TS-12	TS-226
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6AQ5	.41	35C5	.41
6AT6	.32	35L6GT	.45
6AU6	.37	35W4	.26
6AV6	.37	35Z5GT	.31
6AX4GT	.54	50B5	.41
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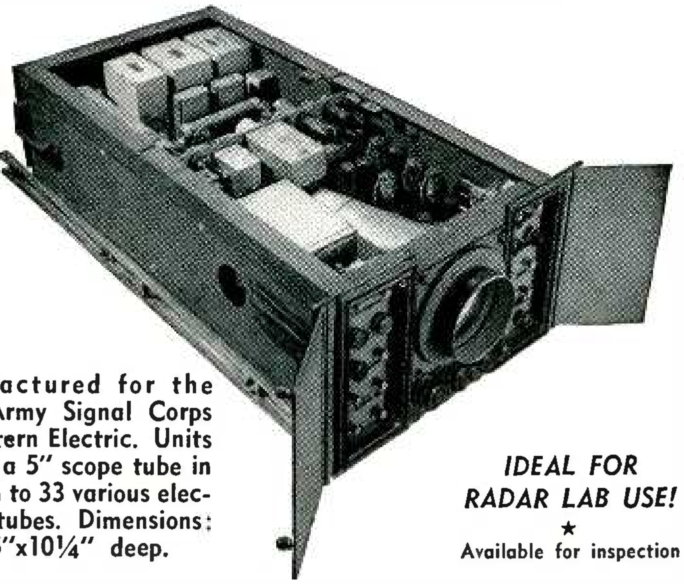

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A hand wound electric TIMING SWITCH Pointer moves back to ZERO and shuts off RADIO—TV—Electric Mixer—Photographic Devices—Time Delay etc. Furnished with Calibration Chart and Pointer Knob. Biggest bargain we ever had. $1.25

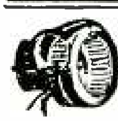
HAYDON SYNCHRONOUS TIMING MOTOR

110 v. 60 cycle 30RPM..... $2.60
110 v. 60 cycle 1/10 RPM.. $2.35
110 v. 60 cycle 1RPM...... $2.85

ISOLATION TRANSFORMER

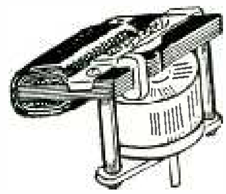
Step-Up or Step-Down
4½ lbs. . . $2.85

230 volts to 115 volts
115 volts to 230 volts
115 volts to 57 volts



REDMOND Powerful 5" Blower or Ventilator 115 volts AC 60 cycles 18 watts. For Kitchen — Laboratory. Heat or Cold or Chemicals....$7.50

Genuine TELECHRON Motors



2 RPM $2.90
3 RPM 3.90
3.6 RPM ... 3.15
1 RPM 3.95
60 RPM ... 4.30
One of each $15.00

Westinghouse ELAPSED TIME METERS $15.50

General Electric Round Case Smaller Numerals $14.50

ALL BRAND NEW

1800 RPM SYNCHRONOUS Motor; 115 volts AC, 18 watts 1¼ lbs.; 2"x3"x2".... $4.50

ALL PRICES F.O.B. N. Y.

EST. 1923 **BLAN** *EST. 1923*

64 Dey St. New York 7, N. Y.

TIME DELAY

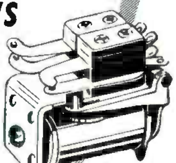
RELAY 115v 60cy adjustable 6 sec. to 2 minutes Cramer TD2-120S. Also TD60S 6 to 60 sec..$12.95
RELAY 3PDT 24vdc 250 ohm Clare Type K...$1.95
RELAY 4 PDT 12 vdc 70 ohm Mini tel type..$1.75
SELSYN—1F Special 115/90 v 400 cy......$11.95
FIL XFRMR 6.3 @ 1.3A (other sizes avail.)...$.99
CHOKE 4H 70ma..69c; 2H 70ma 110 ohm...$.49
BLOWER MOTOR 400-1800cy 115v EAD J31C.$9.95
BIRTCHER CLAMPS 926A, 926B, 926C.......$.25
3-15MMF variable No. HF...49c; MC-100S....$.99
ISOLATION XFORMER 35 watts prim 115v sec. 115 or 135v & 6.3 tap 2¼x2½x3".........$2.45
SUBMINIATURE tube socket 5 pin, 100 for..$10.00
POWER XFRMR 760VCT @ 170ma5 @ 3.6.3 @ 4.$4.25
SILV TRMR TS2A, 1.5-7, 7-45 @ 35c; MICA 3-30.$.04
AN3106-10S-2S, PL-68, PL-259A, 83-1H, S8, JK33A
CONDENSERS: BATHTUB, MICA, AIR, OIL, HV, CER.
POTS, RELAYS, MIKES, 3AG&MDL fuses, **SWITCHES**
SPARES for: **BC-1296A, MK11** Radar, **AN/TPN-2**
2% .002 Silver Mica CM30; many other items.

EMPIRE ELECTRONICS COMPANY

409 Avenue L Brooklyn 30, N. Y.
CLoverdale 2-2411 BRyant-9-1220

CHECK YOUR RELAY NEEDS

RELAYS . . . WORLD'S LARGEST STOCK!

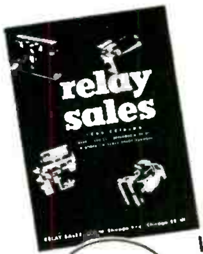


Your requirements of large or small quantities of relays can be quickly supplied from our huge stock.

Wide variety of types, all made by leading manufacturers. Each relay is brand new, inspected and fully guaranteed by Relay Sales.

✓STANDARD TELEPHONE RELAYS ✓SHORT TELEPHONE RELAYS ✓DUAL TELEPHONE RELAYS ✓SLOW ACTING RELAYS ✓SEALED RELAYS ✓ROTARY RELAYS ✓MIDGET RELAYS ✓KEYING RELAYS ✓DIFFERENTIAL RELAYS ✓PLATE CURRENT RELAYS ✓ANTENNA SWITCHING RELAYS ✓"BK" SERIES ✓STEPPERS & RATCHET RELAYS ✓LATCHING & INTERLOCKING RELAYS ✓MECHANICAL ACTION RELAYS ✓VOLTAGE REGULATORS ✓OVERLOAD & CIRCUIT BREAKERS ✓REVERSE CURRENT RELAYS ✓AIRCRAFT CONTACTORS ✓MOTOR & CONTROL DEVICES ✓TIMERS ✓SOLENOIDS

✓RELAY ASSEMBLIES



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WRITE FOR YOUR COPY TODAY

Relay Sales

833 W. CHICAGO AVE.
DEPT. 4, CHICAGO 22, ILL.

Headquarters for Microwave Test Equipment

THE WIDEST ASSORTMENT, THE STRONGEST DEPTH AND THE MOST IMMEDIATE AVAILABILITY OF ANY SOURCE ON TEST EQUIPMENT.

We are currently producing and delivering the TS-117, TS-125, TS-108, TS-102A, TS-89, TS-268, TAA-16EA and the TSX-4SE. A more complete list follows:

TS-1ARR	TS-61/AP	TS-173/UR	TS-303A/G	I-145	BC-1066/A
TS-3A/AP	TS-62/AP	TS-174/U	TS-311/FSM-1	I-147	BC-1201/A
TS-8A/U	TS-63/AP	TS-175/U	TS-323	I-153A	BC-1203
TS-10A/APN-1	TS-76/APM-3	TS-184/AP	TS-324/U	I-167A	BC-1236/A
TS-11/AP	TS-87/AP	TS-189/U	TS-328	I-177	BC-1255/A
*TS-12	TS-89/AP	TS-192/CPM-4	TS-338	I-178	BC-1287/A
*TS-13	TS-96/TPS-1	TS-194/CPM-4	TS-359A/U	I-196A	BC-1277
TS-14	TS-93/AP	TS-197/CPM-4	TS-363/U	I-198A	BE-67
TS-15B/AP	TS-100/AP	TS-198/CPM-4	TS-375	I-208/A	LAD
TS-16/APN	TS-101/AP	TS-203/AP	TS-377/U	I-212	LAF
TS-18	TS-102/AP	TS-204/AP	TS-389/U	I-222/A	LAE-2
TS-19	TS-108/AP	TS-205/AP	TS-421/U	I-223A	LM-(*)
TS-23/AP	TS-110/AP	TS-210/MPM	TS-437	I-225	LU-2
TS-24/APM-3	TS-111/CP	TS-218/UP	I-56	I-233	LU-3
TS-26/TSM	*TS-117/GP	TS-220/TSM	I-61B	IE-21/A	LZ
TS-27/TSM	TS-118/AP	TS-226A	I-83A	IE-36	ME-11
TS-32A/TRC-1	*TS-125/AP	TS-230/B	I-95/A	IF-12/C	OAA-2
TS-33/AP	TS-127/U	TS-233/TPN-2	I-98/A	IS-185	OAW
TS-34AP	TS-131/AP	TS-239A	I-106/A	IS-189	P4E
TS-34A/AP	TS-142/APG	TS-251	I-114	AN-PNS-1	SG/8U
TS-35/AP	TS-143/CPM-1	TS-263	I-115	BC-221(*)	TAA-16EA
TS-36/AP	TS-144/TRC-6	TS-268	I-122	BC-376	TSS-4SE
TS-46/AP	TS-146	TS-270A/UP	I-122-B	BC-438	TSX-3SE
TS-47/APR	*TS-147/UP	TS-281/TRC-7	I-126	BC-439	TSX-4SE
TS-18	*TS-148/UP	TS-285/GP	I-130A	BC-838	TTS-4BR
TS-51/APG-4	TS-153	TS-294/U	I-134B	BC-906/D	TTX-10RH
TS-55/AP	*TS-155	TS-297/U	I-137A	BC-949/A	TUN-9HU
TS-60/U	TS-170/APN-5	TS-301/U	I-139A	BC-1060/A	UPM-13

*Of new manufacture.

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Weston Laboratories

Weston 93, Mass.

IMMEDIATE DELIVERY

PL-112	U-16-U
PL-118	UG-34/U
PL-147-A	UG-88/U
PL-151-A	UG-260/U
PL-259-A	UG-306/U

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2 MFD. 5000 VDC with brackets $11.95

6 MFD. 600 VDC CP 70 BIFF 605K with Brackets, $2.75 each; by 100 lot each...$1.37

1 MFD. 2500 VDC Type TJ $2.75
4 MFD. 1500.....$2.98
10 MFD. 2500 V..$7.98
1 MFD. 6000 VDC Inerteen Type FP..$12.75

BATHTUB CONDENSERS CP53BIFF504K .5MFD—600V. ....$.64

Round 1 MFD. 1000 VDC screw Type 1 Lug 2¾" High ....50¢ ea.
.05 MFD-600 V..........................35¢ ea.

RHEOSTAT

TYPE J150 ohm 50 Watt #5381.......$1.89 each

TYPE K 100 Watt 25 Ohm.................$2.96

TYPE H 25 Watt 15 Ohm..................$1.67

PACKET SWITCHES made by A&H&H Type 80989 25 amp. size 2PDT and 3DP.....$7.95 ea.

SELECTOR SWITCHES CENTRALAB Non shorting Type 1401 1 Pole 2-6 position....49¢ ea.

EQUIPMENT

1—SCR 522 (BC 624A-BC 625A) New in original crate with following accessories:
Antenna AN 188, 3 control boxes BC 1312-13-14, 1 cord 809-A, 1 cord Cd 133 RG 8U, coax.cable w/ all plugs...............................$125.00
2—(same as above without accessories—slightly scratched cabinet, $65.00 each.
2—New (in original boxes) type CH 172-B Power Supply for above equipment, contains 500 ft. cable, 7 conductors and 1 rectifier RA 62 B $100.00 each.
1—Oscilloscope TS—198/CPM—4 for observation of elec'l. wave shapes and radar A—scope.$125.00

TUBES

721A	$3.00	9001	$1.35
815	2.80	9002	1.35
829B	14.50	9003	1.50
830B	3.00	9006	0.40
832	6.95	ELIC	2.75
832A	9.00	6L6G	1.35
1B24SYL	13.95	2J49	105.00
3B24	5,50	2J50	65.00
4J37	125.00	2J38	15.00

Weston WATTMETER Model 641 0-4 KW 250 V. 20 amp. $32.75

Voltmeter Westinghouse Type NX35 0-500 V DC 3½" rd. FS-IMA.....................$12.35

0-150V AC Type NA-35 FS-IMA $7.85

0,-150VAC Burlington 2" $4.75

Meter 0-15 MA-DC Westinghouse RX-37 4" square $11.85

COUNTER Veeder Root Ratchet 5 Number Type 1144 ....$1.19

UG CONNECTORS

UG 352U ....$6.00 EACH

UG 9/U ....95 EACH

UG 483 .... 2.60 EACH

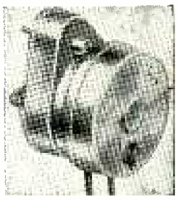
MX 564-U, Chassis type........... 5.75 EACH

83-22 R ....75 EACH

Selenium Rectifier, C. E. 45 V input, 24 V output. D. C. 4 amps..............................$12.95

Selenium Rectifier, Rectox 62 V input, 24 V output, D. C. 4.88 amps......................$12.85

HAYDON SYNCHRONOUS MOTOR



110 V.A.C.
½ R.P.M.
3.6 Watts
$2.75 each

Haydon, 2.2 watt 1-120 RPM...............$2.75
complete with coin arrangement for 25¢ pc. $2.95
minimum order 5 pcs. on synchronous motor.

Haydon, 3-6 watt, 1.5 RPM #5901-4, adjustable reset timer $7.50

MICA TRANSMITTING CAPACITORS Type G3 .0001 Mfd 25KV..........................$35.00 ea.
Type G2-50, .0001 mfd, .0002 mfd, .0005 mfd. 10KV $10.00

Type H, .01 mfd, 2500 V test, #CM50A103M $66.00/hundred
Type 1445.01, 1200 V test, #CM45B103K $30.00/hundred

ATTENUATOR DAVEN TYPE T-994-2 7500/3900-2DBStep $4.25
Type TA-1000-2 7500/3900 Ohm........$5.25 ea.

RELAYS

SIGMA 12 Volts DC S.P.D.T. size 2¼" x 1⅝" $.77 each

G E TYPE CR2791—B109P36 S.P.D.T. 10,000 Ohm Coil $1.05

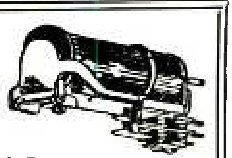
G E TYPE CR2791—B109U39 150 Ohm Coil.$1.15

ALL the material in STOCK

LEONARD GREENE

381 Tremont St.—HA 6-4794 **BOSTON, MASS.**

TELEPHONE RELAYS



Large Stock of
CLARE, TYPES C, D & E
COOKE, AUTOMATIC—ELECTRIC
ALL TYPES of COILS and PILE-UPS

Send Us Your Specs. for Our Quote

Clare Type G Half Size Sensitive Telephone Relays

	Coil	Contacts	Will Close At	Price
1)	6500 ohms	2A	5 MA	$2.50 ea.
2)	5800 ohms	3A	5 MA	2.50 ea.
3)	5800 ohms	2B-1C	5 MA	2.50 ea.
4)	4850 ohms	1C	4 MA	2.50 ea.
5)	3600 ohms	1C	6 MA	2.00 ea.
6)	4850 ohms	1A	5 MA	2.00 ea.
7)	3300 ohms	(None)	ACTUATOR	1.50 ea.

All above Relays may be used for continuous duty operation on 110V, D.C.

Other Type G Telephone Relays

1)	1300 ohms	1A-1C	24 or 48V.	2.50 ea.
2)	700 ohms	2A-1C	24V.	2.50 ea.

CONTACT SYMBOLS
A-Norm. Open B-Norm. Closed C-S.P.D.T.

G. E. Relays #CR 2791-B109P36 Coil—10,000 ohms Contacts 1A, 1B Operates on 8 MA...Price $1.65

Signal Wheelock Relays #KS9665 Coil—2,000 ohms Contacts-1A, 1B, 1C Operates at 9 MA Price—$2.75 ea.

Leach Relays Type 1025-SN-BF. Coil—24V. 425 ohms. Contacts—D.P.S.T. Norm. closed. Rated at 10 Amps ....Price—$1.50 ea.

Five Prong CR-2791 G.E. Plug In Relays.
1) C-103C25 2200 ohms SPDT 4.5 MA..$4.00 ea.
2) C-104B28 700 ohms SPDT 6 MA....$3,00 ea.

Slow Release (For SCR-522-A) Telephone Relays Part No. A18258..........Price—$2.00 ea.

Patch Cords—2½ Ft. long with a Phone Plug (Like PL-55) on each end..........Price—95¢

Chase Electronic Supply Co.
222 Fulton St.
New York 7, N. Y.
Digby 4-3088
HOllis 4-5033

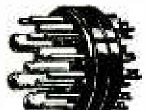
"AN" CONNECTORS

AN-3100 AN-3101 AN-3102 AN-3106 AN-3108

SOCKET INSERT (Female)

Any of the shells pictured here may be used with any of the inserts listed. For example: If a right angle cable connector is desired with a 20-29 pin insert

Shell	Size	Socket Insert
3108	20	29P



PIN INSERT (Male)

8S-1	16S-1	18-9	20-4	20-32	22-23	24-15	28-13	32-19	40-5
10S-2	16S-3	18-10	20-5	20-854	22-24	24-16	28-14	32-20	40-6
10SL-2	16S-4	18-11	20-6	22-1	22-25	24-17	28-15	32-101	40-7
10S-656	16S-5	18-12	20-7	22-2	22-26	24-18	28-16	32-102	40-9
10SL-3	16S-6	18-13	20-8	22-3	22-27	24-19	28-17	36-1	40-10
10SL-4	16S-8	18-14	20-9	22-4	22-28	24-20	28-18	36-2	40-11
12S-1	16S-14	18-15	20-11	22-5	22-29	24-21	28-19	36-3	40-13
12S-2	16S-15	18-16	20-12	22-6	22-30	24-24	28-20	36-4	40-743
12S-3	16S-16	18-17	20-13	22-7	22-32	24-25	28-21	36-5	44-1
12S-4	16S-17	18-18	20-14	22-8	22-34	24-26	28-22	36-6	44-2
12S-5	16-2	18-20	20-15	22-9	22-35	24-28	32-1	36-8	44-3
14S-1	16-7	18-22	20-16	22-10	22-37	24-768	32-2	36-9	44-4
14S-2	16-9	18-23	20-17	22-11	24-1	24-835	32-3	36-10	44-5
14S-4	16-10	18-24	20-18	22-12	24-2	28-1	32-4	36-13	44-6
14S-5	16-11	18-25	20-19	22-13	24-3	28-2	32-5	36-14	48-1
14S-6	16-12	18-26	20-20	22-14	24-4	28-3	32-6	36-15	48-2
14S-7	16-13	18-27	20-21	22-15	24-5	28-4	32-7	36-16	48-3
14S-9	18-1	18-28	20-22	22-16	24-6	28-5	32-8	36-17	48-4
14S-10	18-3	18-29	20-23	22-17	24-7	28-6	32-9	36-18	48-5
14S-11	18-4	18-30	20-24	22-18	24-9	28-7	32-10	36-21	
14S-12	18-5	18-31	20-26	22-19	24-10	28-9	32-12	40-1	
14S-13	18-6	20-1	20-27	22-20	24-11	28-10	32-13	40-2	
14S-14	18-7	20-2	20-28	22-21	24-12	28-11	32-16	40-3	
14-3	18-8	20-3	20-29	22-22	24-14	28-12	32-18	40-4	

Available for immediate delivery from stock.
Write, wire, phone your requirements. Complete stock of UG Connectors. Send for our bulletins and listings of all components.

ACORN ELECTRONICS CORP.

76-E Vesey St. *WOrth 4-3270* New York 7, N. Y.

AUCTION SALE

Radio Receiving Tubes

A. J. WILNER AUCTIONEER, WILL SELL ON WEDNESDAY, NOVEMBER 12, 1952 at 11 A.M. on PREMISES 472 BROAD ST., NEWARK, N. J., 2nd FLOOR. ENTIRE STOCK OF RADIO RECEIVING TUBES, SPECIAL PURPOSE TUBES, EQUIPMENT, OFFICE FURNITURE, ETC. REMOVED FOR CONVENIENCE OF SALE FROM STANDARD ARCTURUS CORPORATION

Approximately 500,000 Tubes
Most Tubes are Cartoned—75% are JANS
All Brands—RCA, GE,
Sylvania, Arcturus, Tungsol, Hytron, Etc.

Type	Quantity	Type	Quantity
OA2	1878	6SK7GT	2943
OB2	2753	6M8GT	427
OZ4	1101	6SQ7GT	61
OZ4G	7754	6U4GT	1875
O1A	360	6U7G	1252
1A5GT	1000	6V6GT	1000
1A6	338	6W4GT	2486
1B5	213	6W7G	187
1C6	381	6X4	2982
1D5GP	524	6X5G	324
1C7G	384	7C4	10727
1E7G	327	7E5	3716
1E7GT	148	12A5	190
1F4	517	12A6	27000
1F5G	251	12BA7	6216
1G4GT	244	12AV6	209
1G6GT	900	12C8	7989
1H5GT	1000	12F5GT	1052
1H4G	1812	12H6	3789
1H6G	209	12J5GT	4272
1H6GT	190	12K8	9238
1G6G	1300	12Q7GT	1039
1J6GT	301	12SR7	386
1L4	12608	12Z3	332
1L5G	351	14A4	291
1LA4	124	18	339
1LC5	249	19	759
1N5GT	1000	19BG6G	4672
1U4	791	22	373
2E5	560	27	190
3B7	221	30 Spec.	65
3D6	1900	31	227
3Q4	4333	32	741
6A6	775	33	998
6AJ6	2730	34	483
6AL5	415	35	1391
6AS5	234	36	1083
6B5	282	37	958
6B8G	1422	38	3866
6B8	4178	39/44	50,000
6BQ6GT	913	46	347
6CB6	2698	49	151
6G8G	241	50	188
6J7G	305	50C5	480
6J8G	181	55	180
6L5G	284	56	316
6P5GT	947	57	67
6R7	200	58	445
6R7G	221	70L7GT	1345
6R7GT	394	71A	649
6S4	256	77	3889
6S7	337	79	113
6SD7GT	7958	81	359
6SN7GT	1000	82	288

Tens of Thousands Other Tubes Not Listed

50,000 Special Purpose Tubes Including:

100-T-H	705A	866A	395A	394A
869B	814	872A	359A	25Z6WGT
2J32	211	FG17	2050W	OD3W
5CP1	3C29	3B25	6AL5W	OR3W
5BP1	719A	3B28	6H6WGT	
2AP1	2050	2D21	5R4WGY	
3GP1	2051	122	BS101	
3C31	884	1Y2	2D21W	
C1B	885	5594	4B32	

200,000 Assorted Cartons and fillers.
Up-To-Date Customer Mailing List with Plates and Machine.

Equipment Used by Standard Arcturus Corporation Tube Testers, Branding Equipment, etc.

INSPECTION—10 A.M. to 4 P.M.—Tuesday, November 11, 1952

WANTED

WANTED

Western Electric gray-finished EQUIPMENT CABINETS

For 19" panels. Heights of 2' 6", 3' 6", 7' 0" and 7' 6".

W-4852, Electronics
330 W. 42 St., New York 36, N. Y.

WANTED TO BUY

Test Equipment

GR 650A Impedance Bridge
GR 667 Inductance Bridge
Boonton Q. Meter
Boonton QX Checker
1000 cycle inductance limit bridge

Give Full Details, including Price, Condition, Age.

Box 445, WESTBURY, L. I.

We Pay Highest $$$$ Prices for
RADIO & AIRCRAFT ELECTRONICS EQUIPMENT

You'll be pleasantly and profitably surprised at the prices we pay for needed parts and equipment. Simply send us a description of what you have—tell us your top dollar asking price—and we'll shoot back a prompt reply! Convert that equipment to ready cash now! Write:

ALVARADIO SUPPLY CO.—Division E
4665 Melrose Av. Los Angeles 29, Cal. OLympia 2155

GLASS TUBING

PYREX - NONEX - URANIUM
BULBS & CYLINDERS

WRITE FOR FREE MONTHLY LIST

HOUDE SUPPLY COMPANY
PHONE KEYPORT 7-1286
M. R. # 1 Box 86X Keyport, N. J.

WANTED

- AN/TRC-1 Equipments.
- T14 Transmitters.
- R19 Receivers.
- TS32 Test Oscillators.

Any condition or quantity

W-3858, Electronics
330 W. 42nd St. New York 36, N. Y.

WE BUY

All kinds of surplus electronic equipment and components.

ELECTRONICRAFT, Inc.
27 Milburn St. Bronxville 8, N.Y.
BRonxville 2-0044

WANTED

BD110 Telephone Switchboards, BD100 Telegraph Switchboards, BD90 Power Boards, EE101 V-F Ringers, BE72 Cabinets, FM19 Frames, RA43, REC30, KS5988, RA87, RA37, RA91 Rectifiers, BD101 Test Boards, SB6 Switchboards. Type CF1A, CF3A, CF2B Carrier Equipments. Any condition and quantity.

W-4212, Electronics
330 W. 42 St., New York 36, N. Y.

IF there is anything you want
that other readers can supply—
OR . . . something you don't want—
that other readers can use—
Advertise it in the SEARCHLIGHT SECTION

WANTED

Federal type
101B Voice-frequency Ringers
Signal Corps type TA-3/FT.

W-4814, Electronics
330 W. 42 St., New York 36, N. Y.

ELECTRONIC EQUIPMENT WANTED!

Sell to Arrow SALES INC.

We want to buy all types of new and used surplus electronics equipment. Use coupon to tell us what you have. We are the largest purchasers of such equipment. WRITE TODAY!

Use following numbers to indicate conditions: N-1, brand new; N-2, used, like new; N-3, used.

ITEM	CONDITION	PRICE WANTED

To: ARROW SALES, INC., 7460 Varna Ave., N. Hollywood, Calif.

Name . . . .

Address . . . .

SEE ARROW SALES, INC. AD ON PAGE 462

ELECTRONIC TUBES

Electro is rapidly becoming the prime source for manufacturers, jobbers and exporters. Your requirements of large or small quantities of tube, all types, can be quickly supplied from our huge stock. Each and every tube is brand new, inspected and fully guaranteed by Electro. We carry Standard Brands Only. Critical tubes are almost always on hand at the right price. Write, Phone or Wire your needs at once.

Receiving

0Y4	.45
0Z4	.59
01A	.65
1A3	.70
1A5GT	.58
1A7GT	.85
1B1	.45
1B3GT	.82
1B4P	.79
1C6	.69
1D5GP	.69
1E5G	.71
1G4GT	.69
1G6GT	.69
1H5GT	.69
1H6G	.75
1J6GT	.75
1L4	.83
1LA6	.95
1LB4	.98
1LC6	.91
1LH4	.87
1LN5	.75
1N5GT	.75
1N6G	.75
1P5GT	.69
1Q5	.68
1R4	.69
1R5	.65
1S4	.69
1S5	.64
1T4	.65
1T5GT	.68
1U4	.67
1U5	.65
1V	.65
1X2A	.90
1Z2	.75
2A3	1.10
2X2	.59
2X2A	1.55
3A4	.65
3A5	.85
3D6	.45
3Q4	.63
3Q5GT	.79
3S4	.70
5T4	1.35
5U4G	.65
5U4GW	2.35
5V4G	.89
5W4	.79
5Y3GT	.49
5Y4G	.65
5Z3	.75
5Z4	.85
6A3	.95
6A6	.82
6A7	.87
6A8	.85
6A8GT	.95
6AB4	.65
6AB5	.85
6AB7	.98
6AC5	1.05
6AC7	.93
6AD7	1.29
6AE5	.89
6AF4	1.45
6AF6	.85
6AG5	.80
6AG7	1.25
6AH6	1.29
6AJ5	1.95
6AK5	1.30
6AK6	1.09
6AL5	.59
6AL7GT	1.15
6AQ5	.57
6AQ6	.85
6AQ7GT	1.02
6AR6	3.35
6AS5	.75
6AS6	3.30
6AS7	4.50
6AT6	.60
6AU5GT	1.19
6AU6	.63
6AV5	.95
6AV5GT	.95
6AV6	.55
6AX5GT	
6BA6	.63
6BA7	1.25
6BC5	.73
6BE6	.63
6BF5	1.10
6BF6	.72
6BG6G	1.59
6BH6	.90
6BJ6	.85
6BK7	.95
6BL7GT	1.25
6BQ6GT	1.20
6B4G	1.25
6B7	.95
6B8	.75
6B8G	.75
6C4	.55
6C5	.60
6C5GT	.60
6C6	.59
6C8	.85
6CB6	.72
6CD6G	1.85
6D6	.72
6E5	.79
6F5	.62
6F5GT	.62
6F6	.85
6F6GT	.80
6F7	.85
6F8G	.87
6G6G	.95
6H6	.65
6H6GT	.65
6J5	.65
6J5GT	.55
6J6	.90
6J7	.89
6J7GT	.60
6J8G	1.30
6K5GT	1.00
6K6GT	.65
6K7	.79
6K7GT	.79
6K8	.85
6K8GT	.85
6L5G	.75
6L6	2.25
6L6G	1.45
6L6GA	1.45
6L7	.85
6L7G	.85
6N5	
6N7	.95
6N7GT	.85
6Q7	.79
6Q7GT	.85
6R7G	.85
6S4	.62
6S7	.85
6SA7	.65
6SA7GT	.65
6SB7Y	.90
6SC7	.85
6SC7GT	.85
6SD7GT	.85
6SF5	.75
6SF7	.75
6SG7	.75
6SH7	.75
6SH7GT	.75
6SJ7	.65
6SJ7GT	.70
6SJ7Y	.80
6SK7	.70
6SK7GT	.72
6SL7GT	.75
6SN7GT	.75
6SN7GTA	.80
6SN7GTW	2.25
6SQ7	.60
6SQ7GT	.62
6SR7	.65
6SR7GT	.67
6SS7	.80
6ST7	.98
6SU7GTY	2.70
6SV7	1.05
6T8	1.00
6U4	.75
6U5	.87
6U6GT	.85
6V6	1.30
6V6GT	.67
6W4GT	.65
6W6GT	.75
6X4	.60
6X5	.60
6X5GT	.60
6Y6G	.95
6Z4	.60
6Z5G	.60
7A4	.75
7A5	.75
7A6	.75
7A8	.75
7AF7	1.05
7B4	.75
7B7	.75
7C4	.75
7C5	.75
7C6	.80
7C7	.75
7E7	.75
7EZ5	.75
7F7	.75
7F8	1.65
7H7	.75
7L7	.85
7N7	.85
7S4	.95
7V7	.89
7W7	.95
12A6	.65
12A6GT	.65
12A7	.90
12AL5	.85
12AT6	.55
12AT7	.95
12AU6	.70
12AU7	.85
12AV6	.60
12AW6	1.20
12AX7	.90
12BA6	.69
12BE6	.69
12BH7	.90
12BN6	1.05
12C8	.69
12H6	.69
12J5	.50
12J5GT	.50
12K7GT	.75
12K8	.72
12K8Y	.90
12SA7	.78
12SA7GT	.79
12SC7	.89
12SF5	.75
12SF7	.81
12SG7	.85
12SH7	.68
12SJ7	.65
12SK7	.75
12SK7GT	.75
12SL7	.75
12SL7GT	.92
12SN7GT	.77
12SQ7	.70
12SQ7GT	.72
12Z3	.75
14F7	.85
14H7	.85
14J7	.85
19BG6G	1.83
19T8	1.05
24A	.85
25AV5GT	1.05
25BQ6GT	1.45
25C6G	1.47
25L6GT	.67
25W4GT	.68
25Z5	.65
25Z6GT	.65
27	.30
28D7	2.35
30	.30
31	.50
32	.47
35A5	.68
35B5	.67
35C5	.67
35L6GT	.67
35W4	.49
35Z3	.69
35Z4	.60
35Z5	.50
36	.64
37	.59
39/44	.25
40	.69
41	.69
42	.65
43	.65
45	.75
50B5	.75
50C5	.75
50L6GT	.65
50Z7G	.75
53	.68
54	1.35
56	.55
70L7	1.35
71A	.55
75	.82
76	.55
77	.55
78	.75
79	.75
80	.60
81	.75
83	1.10
84	.75
85	.69
89	.25
101A	.50
102A	.50
117Z3	.65
300B	3.75

Transmitting

OA2	1.10
OA3	1.10
OA4G	1.10
OB2	1.30
OB3	1.15
OC3	1.05
OD3	.95
OZ3	.95
KC1	350.00
VG1A	8.75
1B21A	2.75
1B22	2.10
1B23	8.45
1B24	9.95
1B26	2.95
1B27	18.75
1B29	2.45
1B32	1.95
1B35A	17.50
1B36	16.75
1B37	19.95
1B38	39.95
1B41	45.00
1B42	10.00
1B44	37.50
1B50	27.50
1B51	12.50
1B54	27.50
1B56	37.50
1B63A	85.00
C1J	9.00
1D21	3.25
1L21	15.00
1L22	30.00
1L23	30.00
1L24	48.00
1L25	16.00
1L31	16.00
1L32	15.00
1L33	34.50
1L36	15.00
1L38	25.00
1N21	1.25
1N21A	1.95
1N21B	3.65
1N21C	17.50
1N23	1.00
1N23A	2.50
1N23B	3.50
1N25	4.50
1N26	6.95
1N34	.65
1N34A	.95
1N36	.55
1N43	1.65
1N47	8.50
1N58A	1.00
1P21	53.95
1P29	2.75
1P37	2.70
1P39	1.60
1P40	1.75
1Q26	100.00
2AP1	6.50
2AP1A	10.50
2B22	2.75
2C21	.69
2C22	.39
2C26	.59
2C26A	.59
2C33	3.65
2C36	27.50
2C39	24.50
2C39A	33.75
2C40	15.95
2C42	20.00
2C43	18.50
2C44	1.45
2C50	3.95
2C51	7.50
2C52	6.25
2D21	1.75
2E22	1.95
2E24	4.50
2E26	3.75
2E30	2.00
2E31	2.35
2E32	1.60
2E36	4.25
2E41	3.35
2E42	2.75
2G21	2.45
2G22	2.45
2H21	125.00
2J21A	7.50
2J22	10.50
2J26	17.50
2J27	17.50
2J30	69.50
2J31	27.50
2J32	27.50
2J34	27.50
2J37A	32.50
2K25	27.50
2RA3	1.95
2X2A	1.95
3AP1A	14.00
3BP1	5.25
3BP4	8.25
3B24	5.25
3B24W	7.50
3B26	3.75
3B27	3.95
3B29	14.95
3CP1	4.75
3C23	9.95
3C24	1.95
3C31	3.45
3C33	14.00
3C45	17.50
3D23	2.35
3E29	14.95
3FP7	2.95
3FP7A	12.95
3JP1	17.50
3KP1	15.00
3MP1	15.00
3UP1	27.00
KC4	69.95
KC4-3	59.95
4B24	6.50
4B26	7.75
4C35	33.50
4E27	17.50
4J31	135.00
4J32	145.00
4J33	145.00
4J52	195.00
C5B	3.95
5BP1	4.95
5BP4	4.95
5CP1	3.95
5CP7	12.50
5C22	50.00
5D21	17.50
5FP7	1.95
5FP7A	12.50
5FP14	16.50
5LP1	22.50
5R4GY	1.75
5UP11	16.50
6BL6	95.00
6BM6	110.00
C6J	7.95
6J4	6.95
6K4	2.50
7BP7	10.50
10Y	.49
12DP7	17.50
12GP7	17.50
12HP7	17.50
CA13	.60
15E	1.75
15R	.79
FG17	5.25
RK20A	9.95
24G	1.85
FG27A	15.00
RK28A	14.75
FG32	15.00
FG33	23.00
RK34	.85
35TIG	4.25
35TG	4.25
35T	7.50
RK39	14.50
RK48A	9.50
EF50	1.30
53A	5.95
FG57	14.95
QK59	65.00
QK62	65.00
FG67	22.50
CEQ72	.75
CRP72	.75
RKR72	.85
RKR73	.65
RK75	4.25
FG81A	9.25
FG95	27.50
FG97	25.00
FG98A	27.00
ML100	69.95
100TH	10.95
100TS	1.95
FG104	24.95
FG105	24.95
114B	.85
RX120A	9.25
F124A	24.95
FG172	29.95
GL203A	9.50
203D	3.25
204A	59.50
211	1.25
CE213	2.50
217C	9.95
GL218	225.00
RX233A	3.95
FG235A	79.50
249B	6.50
250TH	21.50
250TL	18.95
FG258A	235.00
264C	3.25
27[illegible]A	99.50
FG271	57.50
FG280	59.50
FP285	22.50
GL393A	13.25
304TH	13.95
304TL	13.95
307A	4.95
308A	55.00
CE309	5.25
310A	7.50
313C	4.15
316A	.75
327A	4.75
331A	3.50
S340	2.65
349A	1.35
350A	7.95
368AS	6.95
371B	1.25
393A	8.95
394A	4.95
417A	17.50
GL441	4.50
446A	4.95
446B	17.50
450TH	55.00
464A	8.95
471A	2.75
GL473	165.00
GL502A	1.80
WL530	17.25
WL532A	2.50
WL549	34.50
WL559	1.25
GL575A	18.50
GL592A	33.00
HY615	.29
GL627	22.00
WL651	65.00
F660	37.50
WL672	27.50
GL673	21.95
705A	2.35
706DY	59.50
708A	4.65
709A	3.75
713A	1.75
714AY	12.50
715	5.00
715A	6.25
715B	8.50
715C	22.50
717A	1.35
718BY	59.50
719A	24.50
721A	2.25
723A/B	18.95
724A	2.25
724B	3.15
725A	7.50
726A	14.50
726B	39.50
726C	52.50
SN729	3.45
730A	28.95
801A	.75
802	4.25
803	4.95
803A	11.50
805	3.95
807	1.69
807W	3.75
808	2.25
809	1.95
810	15.00
811	2.85
811A	4.50
812	2.75
812A	4.50
813	13.50
814	3.25
815	2.95
816	2.00
826	1.75
828	8.75
829	7.50
829A	9.95
829B	13.95
830B	2.95
832	6.95
832A	9.95
833A	50.00
835	19.00
836	4.45
837	1.65
838	2.65
841	.55
842	3.75
843	.75
845	13.50
849	39.95
851	59.95
852	27.50
857B	225.00
860	3.25
861	37.95
864	.39
866A	1.42
868	2.25
869B	145.00
872A	4.25
874	1.35
884	1.75
885	2.00
886	1.70
889A	225.00
891	250.00
892	250.00
905	3.95
926	2.35
927	1.45
929	1.50
930	1.50
931A	5.25
932	4.25
935	7.45
954	.49
955	.49
956	.49
957	.50
959	3.95
991	.39
CK1005	.95
CK1006	3.45
CK1089	1.25
CK1090	.75
R1111	3.50
R1131C	7.50
E1148	.35
1201	1.20
1203A	.79
1206	.85
1612	2.25
1613	1.60
1614	2.00
1616	1.25
1619	1.25
1620	6.25
1621	2.00
1622	2.15
1623	4.00
1624	4.00
1625	.49
1626	.49
1629	.49
1630	.95
1632	.85
1633	.85
1634	.85
1641	2.65
1642	.85
1851	1.65
2050	1.85
2051	1.15
4120	3.25
R4330	12.00
R4410	15.00
5516	5.00
5518	450.00
5528	12.75
5544	27.00
5545	34.00
5550	54.00
5551	75.00
5552	125.00
5553	250.00
5554	225.00
5555	325.00
5556	13.50
5557	7.25
5558	15.00
5559	17.50
5560	27.00
5561	39.00
5581	2.10
5588	125.00
5593	105.00
5610	.85
5620	13.20
5621	13.50
5622	13.25
5623	13.50
5624	13.50
5625	250.00
5626	22.00
5627	27.00
5628	27.00
5629	21.00
5632	12.75
5654	4.00
5662	1.35
5663	2.00
5670	7.00
5674	105.00
5680	250.00
5686	5.25
5691	7.45
5692	7.45
5693	5.95
5718	8.00
5720	23.00
5725	5.00
5726	2.25
5727	4.00
5728	27.00
5739	49.95
5740	89.50
5742	14.50
5743	14.35
5749	2.95
5750	3.10
5751	3.75
5763	1.65
5779	90.00
5797	12.75
5798	16.50
5803	5.75
5814	3.95
5824	3.35
5830	210.00
5840	12.00
5844	2.25
5855	89.95
5896	7.50
5902	10.75
5931	4.95
5963	1.25
5965	2.25
5973	375.00
5978	350.00
6005	5.25
6011	12.75
6044	42.00
6046	1.50
6072	5.00
6089	1.75
6135	3.00
6136	3.25
6137	3.75
6201	5.25
6653	.75
8000	14.95
8005	7.45
8008	7.60
8013	3.35
8013A	6.70
8020	2.35
8025	5.45
8025A	10.00
9001	1.65
9002	1.15
9003	1.65
9004	.95
9005	1.95
9006	.65

Prices subject to change without notice. TERMS: Rated firms net 10 days, Non-rated 25% with order balance COD. Prices FOB Boston.

ELECTRO Sales Company Inc. (ESCO)

110 PEARL ST. BOSTON 10, MASS. Phone: LIBERTY 2-7890

INDEX SEARCHLIGHT

October, 1952

This index is published as a convenience to the readers. Care is taken to make it accurate but ELECTRONICS assumes no responsibility for errors or omissions.

TO THE ADVERTISERS

October, 1952

SEARCHLIGHT SECTION
(Classified Advertising)
H. E. Hilty, Mgr.

ELECTRO—FOR ELECTRONIC SURPLUS

OIL FILLED CONDENSERS

MFD.	VOLT.	TYPE	PRICE
.01	1000 DC	24F174	.49
.01	4000 AC	26F789	2.95
.02	1000 DC	27F285	1.25
.02	400 DC	23F274	.39
.02	10 KVDC	24714	9.50
.045	16 KVDC	D-4495	9.95
.05	600 DC	S. T.	.29
.05	1000 DC	23F328	.49
.05-.05	600 DC	S. T.	.49
.05-.05	600 DC	22F797	.69
.06	25 KVDC	26F585	17.50
.1	400 DC	481379	.45
.1	500 DC	K7876543	.49
.1	600 DC	22F415	.59
.1	1000 DC	27F287	.65
.1	1500 DC	P70B1EH104K	.69
.1	3500 DC	K5204513	2.95
.1	7500 DC	25F405	3.95
.1	10 KVDC	23F430	9.95
.1	12 KVDC	26F68	9.95
.1-.1	230 AC	Z11860	.49
.1-.1	600 DC	22F805	.85
.1-.1	600 DC	27F291	.85
.1-.1-.1	400 DC	NCP9183	.79
.1-.1-.1	400 DC	CA-255	.79
.1-.1-.1	600 DC	6111G	.85
.1-.1-.1	600 DC	37J425	.85
.15	440 AC	5213288	.70
.15	4000 DC	400015	2.95
.15-.15	6000 DC	26F435	5.25
.15	8000 DC	Ldg. Mfgr.	6.95
.19	2500 DC	28F201	2.35
.2	440 AC	Ldg. Mfg.	.69
.2	1000 DC	23F316	.72
.2	10 KVDC	26F433	10.95
.2-.2-.2	4000 DC	10345	4.95
.25	250 AC	26F822	.69
.25	330 AC	9CE1A147	.72
.25	400 DC	DA4025	.49
.25	460 AC	26F876	.79
.25	600 DC	22F611	.69
.25	1000 DC	62B1FG254K	.89
.25	1000 DC	27F255	.85
.25	1000 DC	26F467	.85
.25	1000 AC	481129	1.45
.25	2000 DC	TJU200025	1.45
.25	3000 DC	5511P	3.45
.25	3500 DC	25F637	4.95
.25	4000 DC	26F767	5.95
.25	6000 DC	25F659	7.95
.25-.25	400 DC	22F640	.79
.25-.25	600 DC	6022G	.79
.25-.25	600 DC	51B4FF254L	.99
.25-.25	600 DC	K7102019P1	.79
.3	2000 DC	25F932	1.45
.3-.3	1000 AC	21F560	1.95
.31	2000 AC	21F480	2.50
.36-.36	800 AC	25F888	1.65
.366-.127-.055	330 AC	25F683	.95
.375	250 AC	26F937	.79
.38-.38	800 AC	21F707	1.65
.4	500 AC	21F720	.79
.4-.4	800 AC	21F588	1.70
.4	1400 AC	25F934	1.70
.42	800 AC	21F331	.85
.44-.44	880 AC	21F484	1.70
.45	120 DC	Ldg. Mfg.	.65
.45-.45	800 AC	21F569	1.95
.46	1750 AC	21F573	1.95
.5	200 DC	Ldg. Mfg.	.62
.5	330 AC	25F572	.79
.5	400 DC	C59589	.69
.5	400 DC	Ldg. Mfg.	.69
.5	600 DC	22F612	.79
.5	600 DC	Ldg. Mfg.	.79
.5	600 DC	Ldg. Mfg.	.79

MFD.	VOLT.	TYPE	PRICE
.5	600 DC	65B144504K	.95
.5	1000 DC	23F331	.89
.5	1000 DC	10050G	.89
.5	1500 DC	481294	.95
.5	1500 DC	21F628	.95
.5	2000 DC	26F698	1.95
.5	3000 DC	30003	3.95
.5	4000 DC	28F128	6.95
.5	5000 DC	50005	7.95
.5-.1	400 DC	481769	.70
.5-.5	300 DC	23F280	.82
.5-.5	400 DC	Top Term.	.79
.5-.5	600 DC	23F498	.92
.5-.5	600 DC	23F487	.92
.5-.5	3000 DC	25F526	4.95
.5-.5-.5	600 DC	22F437	1.25
.58	1000 AC	21F476	1.65
.6	200 AC	28F120	.95
.6-.6-.6	100 AC	22F7142	1.25
.635	1300 AC	21F386	1.65
.656	900 AC	25F891	1.65
.666	800 AC	21F333	1.35
.67	120 AC	26F663	.95
.7	1300 AC	21F485	1.50
.7-.7	800 AC	21F381	1.95
.7-.7	800 AC	21F718	1.95
.75	330 AC	9CE1A148	.95
.75	400 DC	28F168	.89
.8	120 AC	21F603	.89
.86	660 AC	21F336	.95
1.0	100 DC	54B1EB105K	1.25
1.0	500 DC	23F303	.95
1.0	500 DC	9CD6A4	.95
1.0	440 AC	9CE1A320	1.05
1.0	600 DC	62B1BF105K	1.15
1.0	600 DC	Bathtub	.89
1.0	600 DC	Ldg. Mfg.	1.95
1.0	1000 DC	Ldg. Mfg.	1.15
1.0	1150 AC	21F641	1.75
1.0	1500 DC	15010	1.85
1.0	2000 DC	23F70	2.95
1.0	4000 DC	40010	8.95
1.0-1.0	600 DC	Bathtub	1.25
1.0-1.0	600 DC	23F569	1.65
1-1-3-5	150 DC	Ldg. Mfg.	.95
1.05	800 AC	21F592	1.25
1.1	200 AC	25F450	1.25
1.1	440 AC	26F853	1.30
1.1	720 AC	21F477	1.65
1.25	125 AC	26F594	1.45
1.25	125 AC	28F192	1.45
1.25	660 AC	21F713	1.65
1.26	440 AC	21F338	1.45
1.26-.25	1000 AC	21F850	.95
1.26-3.0	1000 AC	21F714	.95
1.35	125 AC	28F238	1.49
1.45	750 AC	Ldg. Mfg.	1.55
1.45-2.8	850 AC	Ldg. Mfg.	1.55
1.5	330 AC	25F483	1.55
1.5	660 AC	21F651	1.75
1.58-0.3	800 AC	21F671	.95
1.66	850 AC	21F697	1.75
1.75	150 AC	28F159	1.55
1.75	330 AC	21F174	1.75
1.75	660 AC	21F631	1.95
2.0	120 AC	1A931	1.45
2.0	220 AC	21F169	1.65
2.0	330 AC	Ldg. Mfg.	1.70
2.0	400 DC	Bathtub	1.45
2.0	600 DC	Ldg. Mfg.	1.70
2.0	600 DC	22F999	1.70
2.0	250 AC	25F150	1.68
2.0	660 AC	25F993	1.85
2.0	800 AC	21F835	1.90
2.0	1000 DC	Ldg. Mfg.	2.95
2.0	1500 DC	Ldg. Mfg.	3.95
2.0	2000 DC	20020	5.50
2.0	2500 DC	Ldg. Mfg.	6.45

MFD.	VOLT.	TYPE	PRICE
2.0	3000 DC	Ldg. Mfg.	7.95
2.0	4000 DC	22F985	14.95
2.0	5000 DC	23F50	15.95
2.0	6000 DC	60020	27.50
2.0-.5-.3	200 DC	355	.95
2.2	750 AC	21F563	1.75
2.25	330 AC	21F479	1.85
2.25	600 DC	Ldg. Mfg.	1.85
2.25	1600 AC	21F667	4.50
2.5	330 AC	Ldg. Mfg.	2.35
2.6	440 AC	21F744	2.35
2.6-0.4	440 AC	21F676	1.75
2.7	230 AC	Ldg. Mfg.	2.45
2.75	330 AC	25F983	2.50
2.75	385 AC	49F16	2.60
3.0	330 AC	Ldg. Mfg.	2.75
3.0	600 DC	F6030	2.25
3.0	1000 DC	Ldg. Mfg.	2.75
3.0-.05	600 DC	22F632	1.65
3.25	330 AC	25F378	3.15
3.26	230 AC	21F696	2.75
3.5	330 AC	21F587	3.45
3.5	660 AC	25F971	3.95
3.7	230 AC	49F9	3.45
3.7	230 AC	21F705	3.45
3.75	330 AC	Ldg. Mfg.	3.50
3.75	1000 DC	6037	3.75
3.9	230 DC	Ldg. Mfg.	3.50
4.0	100 DC	23F548	1.95
4.0	330 AC	Ldg. Mfg.	3.65
4.0	400 DC	Oil Filled	2.50
4.0	500 DC	Oil Filled	2.65
4.0	600 DC	26F106	2.75
4.0	600 DC	70B1FF405V	3.45
4.0	600 DC	481249	2.75
4.0	660 AC	21F665	3.95
4.0	1000 DC	Oil Filled	3.75
4.0	2000 DC	22F195	15.95
4.0	4000 DC	70E1EM405K	27.50
4.0-4.0	1000 DC	4223	4.50
4.5	230 AC	21F703	3.95
4.5	330 AC	21F691	4.25
4.65	230 AC	21F365	3.95
5.0	220 AC	21F134	4.35
5.0	330 AC	9CE1A306	4.35
5.5	230 AC	21F702	4.40
5.75	330 AC	26F100	4.50
5.0	440 AC	21F420	4.75
6.0	330 AC	3060	4.85
6.0	600 DC	5060	4.85
6.5	330 AC	Ldg. Mfg.	4.95
7.0	230 AC	21F300	4.95
7.5	330 AC	9CE1A309	4.95
8.0	660 AC	6080	5.25
8.0	1000 DC	Oil Filled	4.95
9.5	330 AC	26F273	4.95
10.0	50 AC	26F412	2.75
10.0	330 AC	Oil Filled	5.95
10.0	440 AC	25F501	5.95
10.0	600 DC	Ldg. Mfg.	5.95
10.0	1000 DC	10100G	7.95
10.0	1500 DC	23F152	8.95
10.0	1500 DC	70B1FH106K	8.95
12.0	750 AC	25F268	8.95
12.0	1000 AC	25F234	8.95
14.5	275 AC	25F500	7.50
15.0	330 AC	Ldg. Mfg.	9.50
20.0	220 AC	21F299	9.50
25.0	25 DC	Bathtub	.95
25.0	50 DC	Bathtub	1.45
30.0	90 AC	Ldg. Mfg.	2.65
30.0	400 DC	26F702	9.95
42.0	600 DC	25F673	17.50
46.2	330 AC	26F413	24.50
50.0	330 AC	KS8545	27.50
50-50-50	90 AC	MK4 MOD2	29.95

HIGH VOLTAGE CAPACITORS

#18F269 rated dual 60 Mfd @ 3000 VDC. $65.00
#PFD-40244G Paper rated 7.0 Mfd @ 4000 VDC $42.50
14 F Rated 4.0 Mfd at 5000 VDC $42.50
14 F2 Rated 7.0 Mfd at 5000 VDC $52.50
#19F210 rated 0.1 Mfd @ 6000 VDC, max amps 204 .... $37.50
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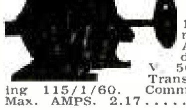
#14F338 rated 4.5 Mfd @ 7500 VDC $79.50
#2C21B1 Paper rated Dual 0.5 Mfd @ 9000 VDC $32.50
Inerteen type FL, rated 1.0 Mfd @ 10,000 VDC $37.50
#26F68 rated 0.1 Mfd @ 12,000 VDC $9.95
#A7548, oil filled, rated Dual 0.25 Mfd @ 6000 VDC $14.50
#TK120065-1 Paper rated 0.65 Mfd @ 12,500 VDC $19.95
#15020 rated 0.25 Mfd @ 15,000 VDC $19.50
20020 rated 0.25 Mfd @ 20,000 VDC $27.50
#TK20002-2 Paper rated 0.25 Mfd @ 20,000 VDC $27.50
#TK20005 Paper rated 0.5 Mfd @ 20,000 VDC $45.00
#14F22 rated 1.0 Mfd @ 20000 VDC $72.50
#20020 rated 2.0 Mfd @ 20000 VDC $129.50
#14F103 rated 0.5 Mfd @ 25,000 VDC $57.50
#TK25050 Paper rated 0.5 Mfd @ 25,000 VDC $57.50
Inerteen type FP rated 0.5 Mfd @ 25,000 VDC $57.50
#14F88 rated 0.75 Mfd @ 25,000 VDC $72.50
#14F59 rated 1.0 Mfd @ 25,000 VDC $82.50
#A6734 rated 1.0 Mfd @ 25,000 VDC $82.50
#14F112 rated 0.001 Mfd @ 50,000 VDC. $42.00
#14F98 rated 0.025/0.025 Mfd @ 50,000 VDC $59.50
#14F127 rated 0.025 Mfd @ 50,000 VDC. $45.00
#14F97 rated 0.25 Mfd @ 50,000 VDC $79.50

Amertran "TRANSTATS" Voltage Regulator



11.5 KVA 50/60 cy. Commutator range 0-115V. Max. Amps. 100. Reconnection diagram available for 220 V. 50 A operation $225.00
Transtat **25 KVA.** Fixed winding 115/1/60. Commutator range 103-126 V. Max. AMPS. 2.17 .... $9.45

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Type 1126-3Y, Pri.: 230V, 3 ph, 60 cy. Output: 0-270 Volts 7 KVA. May be separated and used as three 0-115V, 1 ph, 60 cy. 2.0 KVA units. Brand New $100.00

GP-7 Radio Xmtr. Complete w/6 Tuning Units & all accessories. Freq. Range: 350-9050 Kcs. Tube Complement: (1) 803, (1) 801, (1) 843, (1) 5Z3, (2) 1616 and a full set of spares. 100W output. Brand New export boxed. Gross Wt. 450 Lbs. $149.50

MINE DETECTOR SCR 625

Detects metallic objects (ferrous or non-ferrous) to a depth of approx. 6 ft. Find outboard motors on the bottom of lakes, locate underground piping, treasure, metallic fragments in lumber, etc. New, complete with inst. book. **$65.00.** Used but like new. $45.00

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PE218 Inverters, Input 28VDC 100A; Output 115V 400cy 1500VA $39.95
PE109 Inverters, Input 13.5VDC 29A; Output 115V 400cy 1.53A 8000 RPM $59.95
G.E. Amplidyne 5 AM 31NJ9A $29.95
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Pioneer 10047-2A Servo Motor, 2ph, 400cy, w/ 40:1 reduction gear $14.95
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All 115 V 60 Cyc Input TV & CR Pwr Xfmr up to 20" Tubes. Hi VOLTS to 20KV (w/quadrupler ckt.) ALL Tubes, PL & FIL wndgs & 300 VDC/275Ma Full-Wave, 6.4V/10.3A, 5.4V/8A, 2.5V/3A Hypersil Core, Oil Impreg. $6.49; 2 for $12.49
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1320V & 375VCT/110MA, 5V/3A, 2.5V/3.25A; 6.3V/2.75A HSLD HVINS....$8.98
1000VCT/200MA, 18V/.55A, 6.3V/5A, 5V/6A....$6.98, Two for....$12.98
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840VCT/110MA, & 530VCT/21MA, 2X5V/3A, 6.3VCT/1A, 6.3VCT/.3A....$4.98
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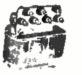
400 CYC XFMRS



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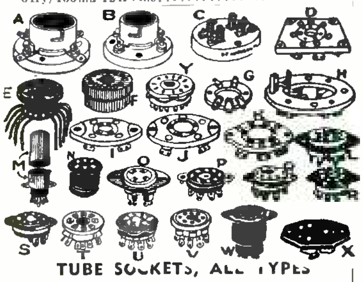
8 HY 225ma Thordason.... 3.50
Dual 2Hy/300ma USN $1.25; 2 for.... 1.98
3Hy/400ma 12KVins.... 3.49



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A. RCA 5-pin GIANT, 803, etc....$1.49
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C. 304TL Socket.... 1.15
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E. Small Shell DUODECAL, 2BP1.... .75
F. Med Shell DIHEPTAL Cinch.... .89
G. 5-pin ACORN 1-9/16" dia HAML'D... .39
H. Johnson 122-234, w/tube Lock 5D21... .98
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J. 5-prong STEATITE Johnson, 807.... .30
K. 7-pr. STEAT Johnson, 1625.... .36
L. 7-pin NATIONAL CIR7L Steatite.... .30
M. MINI 7-pin Mica 'B-HF & Shield.... .30
M. MINI 7-pin Mica 'B Top Mtg & ½ Shld B .23
M. MINI 7-pin Bot Mtg Blkt Sim 147-500 .13
M. MIN 9-pin & Base Shld @ $.32; Ten for 3.00
M. NOVAL Shld, 1½".... .12
N. AMPH fem 78F Pin 4, 5, 6, 8.... .17
O. 4-pin AMPH 49RSS4 & mtg ceramic .27
P. OCTAL 8-pin & plate Bklte.... .10
Q. OCTAL 8-pin & plate Steatite.... .25
Q. OCTAL 8-pin & plate Mica 'B.... .11
R. LOKTAL 8-pin & lock Mica 'B HF.... .10
S. KLYSTRON socket Cinch.... .35
T. LOKTAL Amph 49SSL Steatite.... .30
U. OCTAL Amph 78S8 mica Bklte.... .09
U. 11-pin 78S11/931 Amph.... .16
V. OCTAL Amph 49SS8 steatite.... .20
W. HiV Safety 4-pin Amph 77A4.... .39
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"TAB"
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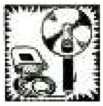
NEW THRIFT-LITE LIFETIME PHOTO-FLASH



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23ST	GE FT 210	200	9.98
53GT	GE FT 403	500	13.50
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23MT	FT 214	250	9.98
22ST	FT 110	200	9.98
353GTQ	FT 503	5000	49.98
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DX	SPRG FA100	150	9.00
U5W	GE FT 105	100	5.98

PHOTO FLASH PWR SUPP KIT

1800VDC/35MA, Using Doubler Crkt. Transformer, Rectifier, Socket, Condensers, Resistors Diagram. W/Flash Tube V4X4/X400. Rated 200-300 Watt Sec. 115V/60Cy Oper.....$29.98

PHOTOFLASH CAPACITORS

2x.36MFD Total .72MFD Per Unit. 30 Units 21.6MFD 1800VDC/38.8 W. Sec...$5.95
30 Units 21.6MFD/3000VDC 64.8 W. Sec... 7.95
Save on Replacements, Write for Details
15MFD/330VAC/1500VDC Intermittent....$3.98
25MFD/330VAC/1500VDC Intermittent.... 6.49
16MFD/600VAC/2800VDC Intermittent.... 6.95
16MFD/660VAC/3000VDC Intermittent.... 7.95
32MFD/1.2KVDC/23W. Sec.... 7.49
27MFD/460VAC/2KVDC:Int. 54W. Sec.... 8.95
4.5MFD/660VAC/3KVDC Int. 20W. Sec... 4.25
26MFD/330VAC/1.5KVDC Int. 29W. Sec.. 6.98
2X.44MFD, Total .88MFD Per Unit, 25 Units Equals **22MFD/660VAC/3KVDC** Intermittent, 99W. Sec.... 8.95

SOUND-POWERED PHONES

US Navy Mike, as illustrated. Push to Talk.....$1.25
A RCA Head & Chest Set, Sound Pwr. No Batteries Needed. Ideal for TV Antenna Installation. New Ea...$15.98
P-20 Rcvrs w/Band & Cord, 24000 Ohm....$4.98
HS-18, 2 Rcvrs/Cord w/PL54 less/HD Band .98

OIL CAPACITORS

Mfd.	Each
50 wvdc	
4	.49
150wvdc	
1-1-3-5	.98
250wvdc	
2x.25	.35
300wvdc	
1 2	.39
400wvdc	
.1	.49
.5	.59
1	.69
4	1.69
6	2.29
8	2.49
10	2.89
2x.1	.75
2x.5	.94
3x.1	.91
3x.25	.99
600wvdc	
.1	.52
.2	.69
.25	.61
.5	.65
1	.75
2	.92
3	1.08
5	1.98
6	2.69
7	2.89
10	3.29
2x.1	.79
2x.25	.85
2x.5	.98
2x1	1.19
2x2	1.39
2x8	3.49
3x.05	.89
3x 22	.98
3x 25	1.09
700wvdc	
4	1.98
800wvdc	
1	.69

Mfd.	Each
1000wvdc	
.45	.79
1	1.09
2	1.69
5	2.98
15	4.98
1400wvdc	
.25	1.29
.5	1.39
1500wvdc	
.5	1.49
.75	1.69
1	1.79
6	3.98
2000wvdc	
.1	1.49
2x.1	1.75
1	1.89
2	2.98
3	3.69
8	9.49
2500wvdc	
.25	2.29
3000wvdc	
.1	2.49
.5	2.98
2	4.49
4	7.98
4000wvdc	
2	8.98
5000wvdc	
.2	4.49
2	10.98
4	19.98
7000wvdc	
.002	1.69
.0075	1.98
.1	4.98
7500wvdc	
.03	2.98
.05	3.49
10000wvdc	
.03	3.49
12000wvdc	
.02	4.98

Mfd.	Each
12500wvdc	
2	95.00
15000wvdc	
.0016	9.98
25000wvdc	
.00025	7.49
1	95.00
AC RATED	
220vac/600dc	
2	.69
4	.89
5	1.29
225vac/630dc	
3.3	.79
230vac/630dc	
5	1.29
330vac/1000dc	
1.25	.79
1.5	.89
1.75	.98
2	.33
2.5	1.09
2.8	1.15
3	1.19
4	1.29
5	1.49
15	3.98
25	6.49
405vac/1200dc	
.15	1.29
600vac/1800dc	
16	6.98
660vac/2000dc	
5	4.49
6	4.98
10	6.98
16	7.98

2 MFD/330VAC/1000VDC "CD" Rd Can....3 for $1; 12 for $3.50
9MFD/220VAC/600VDC $1....12 for $10
QUANTITY USERS, WRITE FOR SPECIAL PRICES

PARTS CABINET

50 Draw Hvy Steel 34½"H/18"W/9"L/65 lbs Draws 3"W/2⅛"H/8"L....$40.00
100 Draws as above 135 lbs....$65.00
27 Draw Hvy Steel 37"H/30¾"W/14¼"L/120 lbs. Draws 3"H/9"W/12"L....$39.95
Write for Quantity Price "EXTEND DO"

FUSES & HOLDERS

3AG: 1/8, 1/4, 1/2 Amp. 5c; 100 for **3.98**
3AG: 1, 1 1/2, 2, 3, 4, 15, 20 Amp. Each **3c**; 20 for **50c**; 100 for **2.49**
3AG: Slo-Blo; 10, 20 Amp. 12 for **1.00**
4AB: BUSS 10 Amp. 7c;..100 for **5.98**
4AG: 1/4, 1/2 Amp. 7c;....100 for **5.98**
4AG: 3, 5, 10, 15 Amp. Ea. 5c;....100 for **3.98**
4AG: Slo-Blo: 3, 10, 15, 20 Amp. Ea. 9c: 100/7.98
5AB: BUSS, Littelfuse, 5 Amp. Ea. 4c; 100/3.00
5AG: 35, 80 Amp. Ea. 5c;....100 for **3.98**
7AG: 0.2 Amp. Littelfuse, Ea. 9c;...100 for **7.98**
8AG: 1/32, 2/10, 1/2 Amp. Ea. 8c;...100 for **6.98**
HOLDER 1075 Littelfuse 20c;....10 for **1.75**

KITS AND COMPONENTS

SPRGE CRP3 Vert Integrator Netwk 3 Res-3CNDSR only **3 LEADS 29c.5 for $1.00**
DISC CERAMIC 2x.004mfd/600V...**6 for 1.00**
VARIAC 200CU 5A Reconditioned....**17.95**
VARIAC 200CU Brushes..$.49 @...5 for 2.00
50 PWR Magnifier & Condsr Lenses $1.25....**4 for 5.00**

MICROWAVE

Klystron Mtg Assy (723 AB) & Coupling to 2 Type "N" Co-Ax Fittings..$9.98....Two for $18.00
1 Microsecond Delay Line, Millen....$2.95
Microwave Lighthouse Assy—P/O RT39 Apg & 15, osc and Tr Cavities, Type N Coupling. Uses 2C43, 2C40, 1B27. Tunes 24-2700 MC Less Tubes $22.00; Two/$40.
3cm T-Sect. Waveguide & Atten. Output. Thermal Comp & Pwr Meas Thermistors Xtal Diode Detector Mtg. & C'ling...$18.95
Less Xtal Mtg. & Thermistor....$13.95
3MC X-Band Wave Meter 9285-9465MC $29.95

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7.5 KV Pulse, Pri 4KV, 50-1000 ohm imped. Permalloy Core, WEco....$14.98
Pulse Blocking Osc. 3 wndgs. Video Interstate, 1:1 ratio, 32 mh wndgs, H'Sld, HiVins, GE..$1.98
Pulse Blocking Osc. 3 wndgs, 1:1:1 ratio, 1 mh wndgs GE H'Sld, HiVins....$2.98
Pulse Blocking Osc. Video Interstage, 3 windgs, 1:1:1 ratio, 4.3 mh windgs, GE, H'Sld, HiVins, 1, Micro Second rise time....$2.98
PULSE SHAPING Xfmr Raytheon UX12819, 1 MU Sec. 2000 CY....$6.95
UTAH 9340 P/O CP-5A/APS15....$9.00
Write for Details on Pulse Units

MICA CAPACITORS

Brand NEW Made to Rigid Gov't Specs.

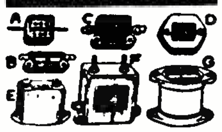

Fig. B. .001 mf. 10c; .006 mf. 23c; .01 mfd. 35c.
Fig. C. Solder Lug Terminals & Mtg Holes

Mfd.	Each
600 WV	
.0001	$0.29
.001	.42
.002	.45
.004	.53
.005	.55
.006	.59
.008	.63
.01	.66

Mfd.	Each
600 WV	
.02	$0.76
.03	1.19
1200 WV	
.002	.66
.004	.68
.005	.71
.01	.78
2500 WV	
.00047	.59

Fig. D. Screw Term & Mtg.

Mfd.	Each
600 WV	
.0001	$0.29
.00055	.37
.00085	.42
.0012	.44
.003	.49
.005	.54
.015	.71
.02	.78
.03	1.19
.033	1.29
.039	1.98
.04	2.09
.05	2.39
1200 WV	
.001	.61
.002	.66
.0051	.71
.0068	.75

Mfd.	Each
1200 WV	
.01	$0.78
.013	.89
.03	1.89
.033	2.39
2500 WV	
.0004	.59
.002	1.09
.0022	1.09
.0024	1.13
.0035	1.19
.0036	1.19
.0043	1.29
.005	1.45
.006	1.55
.01	1.89
.015	2.19
3000 WV	
.005	1.65

Fig. E. Upright Xmtg Micas

Mfd.	Each
250 VDC	
.05	$0.47
.2	2.59
1500 VDC	
.04	.89
.05	1.08
2000 VDC	
.003	1.08
.005	1.19
.006	1.25
.01	1.39
.015	1.68
.02	1.98
.03	2.35
2500 VDC	
.0025	1.08
.006	1.65
3000 VDC	
.00005	.78

Mfd.	Each
.0001	$1.08
.0003	1.15
.0007	1.19
.0055	1.39
3000 VDC	
.0055	1.35
.008	1.79
3500 VDC	
.000033	.78
5000 VDC	
.000082	1.65
.0001	1.79
.00015	2.29
.00018	2.39
.0003	2.75
.00043	2.85
.0006	3.59
.001	3.89
.01	4.79

HIGH CURRENT MICA CNDRS CYLINDRICAL SIMILAR TYPE "G"

MFD	KV	AMPS	MC	EACH
.01	10	30	3	49.50
.0025	20	22	3	45.00
0025	12	20	3	28.95
.001	30	30	3	110.00
.0012	20	16	3	35.00
.002	20	22	3	40.00
.005	10	30	1	32.50
.004	12	20	3	34.00

SELSYNS

2J1H1 GE Selsyns, 2 for $6.98
2J1F3 GE Brand New 115V/400 cy.... 9.75
C78248 Sync. Trans. 115/60 cy 39.95; 2 for 75.00
C78249 Sync. Diff. 115V/60 cy 12.95....2 for 25.00
Sync. Trans. C-69405-2 Type I-I....2 for 90.00
Sync Repeater 115/60 cy Type 11-4 New $52.00....2 for 99.00
Bendix Auto Syn AY1 & AY5....2 for 4.95
Bendix AY20 New Orig. Pckg....$12.98

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Inpt 28VDC/1.4A out 250V/60ma.... 3.69
DM412&24V out **225V/100ma, 440V/200ma 11.98**
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PE97 Plate Supp., Less Tubes.... 9.98
INPT 6VDC/27.5A Oupt 590VDC/150MA Carter Mag Motor....29.95
INPT 6VDC, Output 200V/100ma, or 12/24V Output 500V/50ma Permanent Magnt.... 6.95

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EE65 Telephone Test Set Good Cond....$24.98
I-198 Sig Gen Good Cond.. Less Tubes. Range 7-15 Mc.... 14.95
BC906 Freq. Mtr., Less Tubes.... 29.95
BC221 Sig Gen. Exc. Cond.... 125.00
I-222A Sig Gen. 115V/60cy.... 129.50
I-222A Sig Gen. As Is.... 79.50
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GE Sig. Generator, 9 to 11 cm Direct Reading. Pulse/CW Mod.... Write
*Write for additional information

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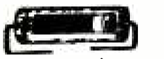

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0.116	271	1225	3333	16500	110000
0.42	275	1250	3384	16900	115000
0.425	280	1260	3500	17000	116667
0.607	286	1300	3509	17500	120000
0.7	289	1350	3600	17977	130000
1.03	299	1355	3700	18000	135000
1.3	300	1400	3730	18300	140000
1.75	310	1488	3760	18380	141000
2.5	311.5	1495	3900	18500	145000
3	320	1500	4000	18800	147000
3.83	325	1510	4030	19000	150000
4	330	1518	4200	19500	155000
4.35	340	1600	4220	20000	160000
5	350	1640	4290	20441	165000
5.025	360	1646	4300	20500	166750
6.25	366.6	1650	4314	21000	167000
6.5	370	1670	4440	21500	169200
7	375	1680	4444	22000	175000
7.8	380	1710	4500	22500	180000
7.9	389	1712	4700	22390	180600
8	390	1740	4720	23000	185000
10.38	400	1770	4750	23150	186600
11.25	410	1800	4850	23325	190000
12	414.3	1818	4895	23400	198000
13.52	418.8	1830	4900	23500	200000
14.2	425	1850	5000	24000	201000
14.25	426.9	1865	5100	24600	205000
14.5	427	1892	5210	25000	210000
15	430	1894	5235	25200	215000
16	440	1895	5270	25400	220000
17	450	1896	5300	25833	225000
19	452	1897	5500	26000	229000
19.2	460	1898	5600	26500	230000
20	470	1899	5730	26600	235500
22	475	1900	5770	27000	238000
23	478	1901	5910	27500	240000
24	480	1902	6000	28000	245000
25	487	1903	6100	28430	250000
26	500	1904	6125	28500	265000
28	510	1905	6140	29000	268000
30	520	1906	6200	29500	270000
31.5	525	1907	6300	29990	275000
37	540	1908	6495	30000	294000
48	550	1909	6500	31000	300000
49	560	1910	6800	31500	307500
50	575	1911	6840	32000	311000
51.78	580	1912	6990	33000	314000
55	588	1913	7000	35000	316000
56.7	600	1914	7320	36000	325000
60	612	1915	7500	37000	330000
63	620	1916	7700	38140	333500
68	625	1917	7717	38500	350000
74	633	1918	7900	39000	353500
75	640	1919	7930	39500	375000
80	641	1922	7950	40000	380000
81.4	645	1924	8000	41400	390000
88	649	1926	8094	42000	400000
89.8	650	1960	8200	43000	402000
95	657	1980	8250	45000	420000
100	665	2000	8500	47000	422000
101	670	2045	8700	47500	425000
103.2	673	2080	8770	48000	430000
105	675	2095	9000	48660	450000
105.7	680	2141	9100	49000	458000
107	681	2142	9445	50000	470000
110	684	2145	9500	51000	472000
120	689	2150	9710	52000	478000
121.2	697	2160	9800	55000	500000
125	699	2180	9900	56000	510000
130	700	2187	9902	57065	520000
135	711	2195	10000	58333	521000
147.5	733	2200	10430	60000	525000
150	740	2250	10500	61430	543000
160	750	2300	10600	62000	550000
165	800	2400	10900	64000	560000
170	806	2450	10936	65000	570000
175	820	2463	11000	66600	575000
179	850	2485	11400	66650	600000
180	854	2490	11500	67500	620000
182	899	2500	11690	68000	650000
182.4	900	2525	12000	70000	654000
200	910	2600	12500	72000	660000
209.4	917	2625	12800	73500	680000
210	946	2635	13000	75000	690000
216	978	2700	13100	80000	700000
220	1000	2750	13500	82000	750000
220.4	1030	2850	13550	84000	761300
225	1056	2860	13600	85000	800000
230	1059	2870	14000	85750	813000
235	1067	2900	14250	88000	820000
240	1100	3000	14400	90000	850000
245	1110	3100	14500	91000	860000
245.4	1150	3163	14550	93000	900000
250	1155	3259	14600	93300	910000
260	1162	3290	15000	95000	930000
270	1200	3300	16000	100000	950000

Any Size Above, Each 35c; Ten for $3.29

MEGOHMS

1.	1.579	2.7	4	6.7	10
1.1	1.65	2.75	4.23	7	11.55
1.2	1.75	2.8	4.25	7.5	12
1.25	1.8	2.855	4.5	7.62	12.83
1.3	1.9	3	5	7.74	13
1.35	2	3.3	5.1	8	13.85
1.39	2.11	3.5	5.5	8.02	30
1.4	2.2	3.673	6	8.5	51
1.5	2.25	3.75	6.5	9.05	
1.57	2.5	3.9	6.6	9.5	

Any Size Above, Each 70c; Ten for $6.49

Vacuum Precision HiVolt Resistors

Megohms — .12/.25/.6/.75/.83/.99/1/1.5/2/3/3.75 ½% Accy....Ea. $1;....Ten for $7.50

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10 Amp/130vacdc Csd USN 0.1 to 1000 Mc's....$1.29
30 Amp/250vacdc Csd USN 0.1 to 1000 Mc's....$3.98
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XFMR Hmt-sld UTC/SuperElect 3 wdg. 600 ohm CT & 400 tapped 250 & 150 ohm can be used Mike to Grid, Line to Grid & Line to Line. Csd & Hmt Sld **SPECIAL 49c**;....**Ten for $4.49**

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1800VDC/35M A, Using Doubler Crkt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram 115V/60cy Oper..............................$6.98

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UHF ANTENNA 12"/30CM AT5/ARR1 Usable Citzn & Ham Band Ins. Coax Term Silv Pl Cont Gask & H'ware Mobile Mtg....39c; 4 for $1.00
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DUAL CKT. 105°F & 32°F. Extremely sensitive & accurate for most exacting requirements—Research, Fire Prev., Freeze, Pt Control, or Max-Min Temp Control. Brand New. Individ. Boxed w-data & ckt.
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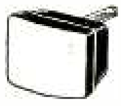

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6V/40AH Willard.......................... 6.98
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Spec Grav Ind & Merc. Thermom........ .98
2V/20AH, w/Vib & Acid.................. 3.59
We Ship R'Exp Only

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926B-5 926B-16, 926B, 929-1, 930-19
926B-19, 926A-10.................5 for $1.00

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BROKEN KEYS—ELECTRICALLY PERFECT

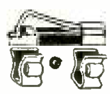
1B3GT, 6H6, 6K6GT, 6SN7GT
12SN7GT .... **Each 50c; 5 for $2.00**
6BG6G, 6BQ6GT, 12SG7, 19BG6, 6L6G, 6L6GA ....**Each 79c; 3 for $2.00**

CONNECTOR AND CABLES

831R/SO239 Receptacle $0.50........10 for $3.90
831SPN/PL259A Plug $0.65.........10 for 5.50
831SP/PL259 Plug $0.50...........10 for 4.75
83-IJ/PL258 Junction.......................... .95
CORD CD307A **W/JK26 & PL55 5 ft** long.. 1.09
CORD same as above **8 ft $1.29; 12 ft** long. 1.49
CORD RG8U COAXIAL CABLE per **ft**..... .12
CORD RG11U 5 foot lengths per **ft**......... .08
CORD CD277 6/CNDTR, P/O BC312.......1.89
RG59U Cable per **ft $0.08;**..........100 **ft** $6.98
300 Ohm Copper Twinex per **ft** 2c; **1M ft** $12.98

CIRCUIT BREAKER FUSES

PUSH TO RESET

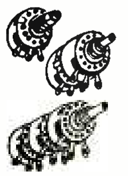


Amps 3-5-7-10-15-20 Ea. 20c
4 for $1.; 25 for $5.; 100 for $18.
Circuit Breaker Fuse W/2 Mounting Clips 39c; 3 for....$1.00; 20 for....$5.98; 100 for....$25. Fuse is 3AG Size. Operates up to 24 Volts

RHEOSTATS

2 ohm 50W Model J.........................$2.59
6 ohm 25W Model LH...................... 1.98
15 ohm 75W Model G....................... 3.74
60 ohm 50W w/knob......................... 2.69
00 ohm 50W Model K........................ 2.25
0 ohm 25W..................ea. 1.39; 4 for 5.00
300 ohm 200W Model P..................... 5.49
350, 500, 5000 ohm Slotted shaft, 25 watt...........................79c; 3 for 2.00
1000 ohm 25W Model J..................... 2.19
Write for Special Prices on 5 Pcs & Up

POTENTIOMETERS—Type J



5 ohm Type J ¾" shaft...93c
200 ohm Type J ⅛" Slotted shaft 93c; 12 for $10.
1000 ohm Type J ¼" shaft.......93c; 12 for $10.
3500 ohm Type J ¾" shaft.......93c; 12 for $10.
7K ohm Type J ⅛" Slotted shaft 93c; 12 for $10.
25K ohm Type J ⅛" Slotted shaft 93c; 12 for $10.
50K ohm Type J ⅜" shaft.......93c; 12 for $10.
100K ohm Type J ⅜" shaft.......93c; 12 for $10.
1 meg Type J ⅛" Slotted shaft 93c; 12 for $10.
1 meg Type JJJ (Triple) 1⅜" shaft............. 3.6

866A KIT AND XFORMER

2 Tubes, Sckts, xfmr 115v 60cyc Inpt, outpt 2.5vct, 10A/Hvinsul..........................$6.98

DIODE PROBE TUBE

Unexcelled for **No-Loss VHF** testing. Ultra sensitive subminiature-envelope. **New,** w/data VR92..............................25c; 5 for $1.

Selenium Power Supply

0 to 12VDC/2 Amp. Variable DC supply, uncased and completely built—inpt. 115v/60 cy. Usable LAB supply, filament D.C. plating, battery charging, model railroad, includes voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives.......$10.95
2 for $20.00

SELENIUM RECTIFIERS

We specialize in Rectifiers and Power supplies to your specifications. Immediate delivery.

Current (cont.)	18/14 Volts	26/18 Volts	36/28 Volts	54/40 Volts	130/100 Volts
2AMP	2.20		3.60	6.50	10.50
4AMP	3.75		6.75	8.75	
5AMP	4.95		7.95	12.95	27.00
10AMP	6.75	9.98	12.00	20.00	40.00
12AMP	8.50		16.00	25.50	50.00
20AMP	13.25	16.20	24.00	36.00	90.00
24AMP	16.00		31.00	39.50	98.00
30AMP	18.50	24.30	36.00		
36AMP	25.50		45.00		

C. T. Rect 100 amp 10-0-10V..............$35.00
Full Wave Selen Rect & Trans: in Kit Form. All 115V/60cy inputs
up to 14VDC at 12 amps.................. 23.98
up to 28VDC at 12 amps.................. 31.98
up to 28VDC at 48 amps..................149.50
up to *20VDC at 6 amps.................. 12.98
* This 6 amp supply has no ageing taps.

RECTIFIER XFMRS

18.8—19.2—20.4—21.4 Volts/12 Amp....$14.98
31—32—34—36 Volts/12 Amp 2 Kvlns... 16.98
18—12—9—CT—9—12—18V/4 Amp..... 8.75
18—12—9—CT—9—12—18V/12 Amp.... 16.75
36VCT—24V—18V/24 Amp............. 35.75

TOGGLE SWITCHES

SPST GE BKLT CSD 3A/250V.25c; 5 for $1.
SPDT AHH BKLT CSD 3A/250V 35c; 4 for $1.
SPDT BKLT CSD Momentary..49c; 5 for $2.
DPST BKLT CSD 15A/125V...89c; 3 for $2.50
DPST CH CSD 8A/125V.......65c; 5 for $2.95
DPST BKLT CSD 20A/250V...1.25; 3 for $3.25
DPDT AHH Laminated........69c; 3 for $1.90

TUBES

"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

OA2	.99
OA3/VR75	1.23
OA4G	1.45
OB2	1.37
OB3/VR90	1.09
OC3/VR105	1.19
OD3/VR150	.98
OY4	2.53
OZ4	.60
C1A/ELC1A	9.75
O1A	.69
VS-1	12.49
1A3	1.10
1A4P	.79
1A5GT	.79
1A6	1.49
1A7GT	1.32
1AD4	2.95
1AE4	1.80
ELC1B/3C31	3.45
1B3/8016	.81
1B4P	.89
1B5/25S	.99
1B7GT	.99
1B21/471A	2.85
1B22	2.20
1B23	9.90
1B24	17.49
1B26	2.45
1B27	14.98
1B32/532A	3.90
1B35	10.98
1B37	16.98
1B38	29.95
1B40	4.95
1B41	49.95
1B42	18.00
1B46	1.98
1B53	49.95
1B56	38.50
1B58	350.00
1B60	69.75
1B63	50.00
1B63A	75.00
EL1C	2.70
1C5GT	.89
1C6	.79
1C7G	.89
1D5GP	.99
1D7G	.89
1D8GT	.89
1D21/631P1	3.89
1E5	.99
1E7G	.99
1F4	.69
1F5G	.79
1F6	.89
1F7G	.89
1G4GT	.89
1G5G	.89
1G6GT	.79
1H4G	.89
1H5GT	.89
1H6GT	.79
1J5G	1.20
1J6GT	.79
1L4	.69
1L6	.98
1LA4	1.19
1LA6	.99
1LB4	1.29
1LC5	.79
1LC6	1.39
1LD5	.99
1LE3	.99
1LH4	.89
1LN5	.79
1N5GT	.99
1P5GT	.79
1P42	5.60
1Q5GT	.89
1Q26	69.00
1R4/1294	1.29
1R5	.79
1S4	1.19
1S5	.79
1S21	7.90
1T4	.79
1T5GT	.99
1U4/5910	.73
1U5	.79
1V	.79
1V2	.70
1X2	.95
1Y2	6.98
1Z2	3.98
2A3	1.78
2A4G	1.19
2A5	.69
2A6	.69
2A7	.69
2AC15	4.98
2AS15	4.98
2B7	.89
2B22	3.90
2C21/1642	.67
2C22/7193	.33
2C26	.19
2C26A	.47
2C33/RX233A	3.49
2C34/RK34	.69
2C39	33.98
2C40	9.98
2C40 JAN	19.90
2C43	26.75
2C43/464A	9.49
2C44	1.20
2C50	3.69
2C51	6.45
2C52	5.98
2D21	1.49
2E5	1.19
2E22	1.95
2E24	4.69
2E25/HY65	5.15

2E26	3.19
2E30	2.19
2E31	1.49
2E36	2.19
2E41	2.39
2E43	1.39
2G21	2.39
2J21	8.75
2J21A	8.90
2J22	7.69
2J30	87.25
2J31	27.25
2J31A	79.95
2J32	27.45
2J33	27.25
2J34	27.25
2J36	120.00
2J37	12.70
2J38	11.75
2J39	44.00
2J42	250.00
2J48	24.25
2J49	34.00
2J50	21.25
2J52	249.50
2J55	85.00
2J56	149.00
2J61	49.95
2J62	49.45
2K22	49.95
2K23	49.95
2K25	39.95
2K25/723AB	39.00
2K28	32.00
2K29	23.95
2K33	300.00
2K35	398.00
2K39	100.00
2K41	145.00
2K42	145.00
2K43	135.00
2K46	360.00
2K47	460.00
2K48	118.00
2V3G	1.29
2W3GT	.98
2X2	.55
2X2A	1.89
3A4	.99
3A5	1.69
3A8GT	1.59
3B4	2.69
3B7/1291	.69
3B22	2.70
3B23/RK22	4.95
3B24	5.40
3B25	4.50
3B26	3.70
3B28	7.90
3C6/XXB	1.49
3C22	95.00
3C23	12.45
3C31/C1B	3.45
3C33	14.98
3C34/HK24	5.49
3C45	17.98
3D6/1299	.69
3D21A	4.98
3D22	13.95
3D23	4.90
3E29	14.95
3K22	275.00
3K23	405.00
3K30	300.00
3LF4	1.29
3Q4	.79
3Q5GT	1.29
3S4	.85
3V4	.79
4-125A	29.95
4-250A	40.95
4-1000A	108.50
4B23	16.98
4B27	4.98
4C25/HK54	5.98
4C33	59.00
4C35	27.25
4C36	15.98
4E27/257	14.50
4J22	148.50
4J31	95.00
4J34	194.00
4J42/700	27.00
4J47	260.00
4J47CY	198.00
4J52	350.00
4T4/2	5.95
4X-150A	45.00
4X-500F	85.00
5AX4GT	.54
5AZ4	1.35
C5B/5C30	3.95
EL5BHD	16.98
5C21/C6J	6.95
5C22	49.95
5C30/C5B	3.95
5D21	27.45
5D23/RK65	36.50
5J29	12.40
5R4GY	1.80
5R4WGY	1.75
5T4	2.49
5U4G	.55
5V4G	1.10
5W4	.89
5X4G	.79
5Y3GT	.43
5Y4G	.79
5Z3	.99
5Z4	1.49
C6A	6.75
6A3	1.59
6A4	1.89
6A5G	2.39
6A6	.89

6A7	1.32
6A8GT	1.09
6AB1	.79
6AB5/6N5	1.33
6AB7/1853	1.39
6AC5GT	1.09
6AC6G	1.49
6AC7	.99
6AD6G	.98
6AD7G	1.49
6AF6G	1.33
6AG5	.79
6AG7	1.99
6AH5G	1.49
6AH6	1.89
6AJ5	1.40
6AK5	.74
6AK5W	2.98
6AK6	1.05
6AL5	.54
6AL7GT	1.29
6AN5	2.90
6AQ5	.55
6AQ5W	3.98
6AQ6	.81
6AQ7GT	1.29
6AR5	.79
6AR6	2.98
6AS5	.79
6AS6	2.65
6AS6W	3.20
6AS7G	4.35
6AT6	.63
6AU5GT	1.49
6AU6	.59
6AV5GT	1.29
6AV6	.59
6AW6	1.89
6AX4/6U4	.79
6AX5GT	.79
6B4G	1.23
6B5	1.19
6B6G	.89
6B7	1.19
6B8G	1.09
6BA6	.63
6BA7	1.27
6BC5	.63
6BC7	1.23
6BD5GT	1.65
6BD6	.83
6BE6	.59
6BF5	.98
6BF6	1.49
6BF7	2.55
6BG6G	1.39
6BG7	1.98
6BH6	.63
6BJ6	.69
6BK7	2.15
6BL7GT	1.45
6BN6	1.49
6BN7	1.69
6BQ6GT	1.20
6BQ7	2.15
6BY5G	1.45
EL6C/6C	16.98
6C4	.60
6C5GT	.79
6C6	.79
6C7	1.26
6C8G	.89
6C21	29.45
6CB6	.69
6CD6G	1.69
6D4	2.70
6D6	.89
6D7G	.89
6D8G	.89
6E5	1.24
6E6	2.65
6E7	1.39
6F4	6.35
6F5	.95
6F6	.99
6F6GT	.79
6F7	1.39
6F7G	1.29
6G6G	1.39
6H6	.89
C6J/5C21	6.95
6J4	7.65
6J5GT	.59
6J6	.57
6J7	1.09
6J8G	1.19
6K4	5.15
6K4A	6.45
6K5GT	1.09
6K6GT	.79
6K7	.85
6K8	1.40
6L5G	.79
6L6	2.09
6L6G	1.69
6L6GA	1.69
6L6GAY	2.29
6L7	1.19
6N4	1.39
6N6G	1.69
6N7GT	1.29
6P5GT	.89
6Q7	.89
6R7	.99
6R8	1.39
6S4	.98
6S7G	.89
6S8GT	.99
6SA7GT	.89
6SA7GTY	3.37
6SB7Y	1.19
6SC7	1.39
6SD7GT	.99

6SF5	.89	12AX7	.79	33	.59	117N7GT	1.79	CK533AX	1.39
6SF7	.89	12AY7	2.95	34	.69	117P7GT	1.39	CK534AX	.8
6SG7	1.39	12AZ7	1.49	33/51	.89	117Z3	.59	CK536AX	.89
6SH7	.99	12BA6	.79	35A5	.79	117Z4GT	1.39	CK537AX	4.98
6SJ7	.89	12BA7	.79	35B5	.79	117Z6GT	1.19	CK538DX	.89
6SK7GT	.89	12BD6	1.23	35C5	.69	117Z7GT	1.49	CK539DX	1.98
6SL7GT	.89	12BE6	.63	35L6GT	.79	F123A	7.90	CK541DX	1.98
6SN7GT	.79	12BF6	.85	35T	6.95	T125	12.49	CK542DX	.98
6SN7WGT	2.25	12BH7	1.29	35TG	5.45	F127A	19.98	CK543DX	.98
6SQ7GT	.79	12BY7	1.35	35W4	.59	VT127A	3.90	CK544DX	.98
6SR7	.69	12BZ7	1.25	35Y4	.69	CV148	4.98	CK546DX	1.98
6SS7	1.12	12C8	1.39	35Z3	.79	150T	14.50	CK547DX	1.98
6ST7	1.33	12F5GT	.79	35Z4GT	.69	FG166	49.00	550P1	19.95
6SU7GTY	3.37	12H6	.89	35Z5GT	.59	FG172	31.50	CK571AX/5886	4.98
6SZ7	1.05	12J5GT	.69	REL36/6J4	.49	182B	1.20		
6T7G	.89	12J7GT	.99	36	.65	FG190	12.80	CK573AX/6029	4.45
6T8	1.09	12K7GT	.89	37	.69	T200	22.98		
6U5/6G5	.99	12K8	.99	38	.59	201A/CX301A	.98	575A/975	13.75
6U6GT	1.09	12Q7GT	.79	RK39	2.89	203A	5.98	WL579	10.49
6U7G	.69	12S8GT	.98	39/44	.59	205B/VT2	1.69	WL579B	12.98
6V3	1.89	12SA7GT	.89	CRC40	.59	CE206	3.15	HY615	.25
6V6	2.25	12SC7	1.39	T40	4.29	211/VT4C	.45	616	37.00
6V6GT	.57	12SF5GT	.79	TZ40	3.98	CE215	8.98	KU627	18.00
6V8	1.99	12SF7GT	.59	40	1.09	RX215	9.95	WL652	65.00
6W4GT	.57	12SG7	1.05	HY40Z	3.75	WE215A	.18	WL673	117.00
6W6GT	.89	12SH7	1.10	41	.79	217C	8.75	WL670A	11.98
6W7G	1.33	12SJ7GT	.79	42	.69	227A	4.98	WL676	39.95
6X4	.69	12SK7	.89	43	.85	231	1.20	WL686	35.00
6X5GT	.75	12SL7GT	.79	45	.69	242C	3.95	701A	5.89
6Y6G	1.27	12SN7GT	.89	45S/VT52	.65	244A	4.15	702A	3.29
6Y7G	.89	12SQ7GT	.79	45Z3	.69	247A	9.95	702B	5.98
6Z7G	.89	12SR7	.98	45Z5GT	.89	250R	9.90	703A	5.98
6ZY5G	.89	12X3	.90	46	.89	250TH	22.25	704A	.98
7A4/XXL	.89	12Z3	.89	47	.99	250TL	18.50	705A/8021	1.98
7A5	.99	14A4	1.09	48	1.99	HK254	14.49	707A	7.90
7A6	.79	14A7/12B7	.99	RK48A	6.85	262B	3.98	707B	17.49

Use Your Priority for SPEEDY DELIVERY—Extend Your DO & Contract Nos.

7A7	.99	14AF7/XXD	1.19	RK49	7.50	274B	3.45	710A/8011	.95
7A8	.89	14B6	.99	49	.83	276A	9.89	713A	.98
7AD7	1.49	14B8	.89	50	1.19	T300	26.98	NL714	5.95
7AF7	.89	14C5	1.09	50A5	1.19	304TH	8.90	714AY	5.90
7AG7	1.99	14C7	1.09	50B5	.79	304TL	8.90	715A	6.45
7AH7	1.19	14E6	.99	50C5	.69	307A/RK75	4.85	715B	8.90
7B4	.79	14E7	1.09	50C6	1.49	310A	6.25	715C	29.85
7B5	.79	14F7	1.09	50L6GT	.69	311CH	10.95	717A	1.49
7B6	.79	14F8	1.29	50X6	.89	311CT	10.50	718BY	48.45
7B7	.89	14H7	.99	50Y6GT	.79	311T	10.50	718CY	48.45
7B8	.89	14J7	1.19	50Z7G	.98	313C	2.98	719A	49.95
7C4/1203A	.79	14N7	1.49	52	.99	316A	1.49	721A	2.49
7C5	.98	14Q7	1.09	53	.69	323A	24.25	722A/287	2.45
7C6	.99	14R7	1.19	T55	8.79	327A	4.95	723A	11.95
7C7	.69	14S7	1.09	55	1.06	S340	2.98	723A/B	25.00
7C23	72.00	14W7	1.09	56	.85	350A	6.50	724A	3.95
7C29	69.95	14X7	1.23	57	.79	350B	5.90	724B	3.45
7E5/1201	1.25	15E	1.98	58	.79	353A	4.65	725A	8.90
7E6	.89	15R	.89	RK59	1.45	HK354	24.98	726A	8.45
7E7	.89	FG17	3.95	59	1.78	355A	14.15	726B	59.95
7F7	1.25	18	.98	RK60/1641	1.95	368AS	7.75	726C	69.95
7F8	2.19	19	.69	RK61	3.05	371B	.90	800	1.85
7G7/1232	1.29	19BG6G	1.79	T60	10.49	380A	.79	801A	.45
7H7	.89	19T8	1.09	HY69	4.98	388A	1.49	802	3.98
7J7	1.09	19V8	1.62	70A7	1.59	393A	8.90	803	3.89
7K7	1.29	120/1623	3.79	70L7GT	1.59	394A	4.90	804	11.50
7L7	1.19	TUF20	5.19	71A	.79	FP400	15.98	805	3.90
7N7	1.19	TZ20	3.79	CRP72	1.20	WE417/5842	18.50	807	1.65
7Q7	.79	20	1.17	CRP73	1.49	417A	8.95	808	2.98
7R7	.99	RK20A	8.95	73	1.67	GL434A	24.98	809	2.43

Top Dollar Paid for Your Surplus Tubes—Send List and Prices

7S7	1.09	RX21	3.75	HY75	4.59	446A	1.05	810	9.95
7T7	1.03	22	.99	75	.99	446B	3.89	811	2.90
7V7	1.39	24	.85	76	.79	450TH	44.00	811A	3.79
7W7	1.19	24A	1.10	77	.69	450TL	52.00	812	2.70
7X7/XXFM	1.19	24G/3C24	1.90	78	1.05	460/HF200	15.95	813	12.49
7Y4	.69	25A6	1.09	79	.89	WL468	13.95	814	3.45
7Z4	.69	25A7	2.98	80	.69	GL471A	2.69	815	2.98
8DC-15	4.98	25AC5GT	1.59	81	1.69	CK501X	1.26	816/866Jr.	1.07
10Y	.43	25AV5GT	1.29	FG81A	3.90	CK501AX	1.26	826	.95
CV11	5.25	25BQ6GT	1.19	82	1.19	GL502A	1.79	828	11.29
12A	.89	25C6	1.18	82V	1.39	CK502AX	1.79	SD828	.98
12A5	1.39	25L6GT	.69	83	1.45	CK503AX	1.79	829	11.49
12A6	.89	25W4GT	.89	83V	1.79	CK505AX	1.79	829B	12.45
12A7	1.29	25Y5	.79	84/6Z4	.99	CK506AX	1.79	830B	3.49
12A8GT	.79	25Z5	.79	85	.79	RK507	9.98	832	7.65
12AC7	1.45	25Z6GT	.99	89	.75	CK509AX	1.26	832A	9.65
12AH7GT	1.45	26	.79	VR92	.25	CK512AX	3.15	833A	39.45
12AK5	1.98	27	.69	FG95/5560	24.85	CK522AX	2.49	834	5.95
12AK5W	2.98	FG27A	8.70	FG98	19.95	CK525AX	3.15	836	4.75
12AL5	.83	HV27	10.95	100TH	8.89	CK526AX	3.95	837	1.45
12AT6	.53	RK28A	4.89	102D	2.98	CK527AX	3.49	838	3.98
12AT7	.72	28D7	1.39	102G	2.98	CK528AX	2.39	843	.39
12AU6	.72	30	.70	FG104	37.98	CK529AX	2.98	845	5.95
12AU7	.57	31	.59	FG105	18.98	GL530	22.00	849	29.45
12AV6	.53	HY31Z	2.75	VU111	1.45	CK531DX	1.98	852	19.98
12AV7	.98	32	.49	HY114B	.75	531	6.98	860	4.90
12AW6	1.79	FG32/5558	13.85	HY115/145	.79	CK532DX	1.98	861	23.95
12AX4GT	1.20	32L7GT	1.49	117L/M7GT	1.59	WL532	3.98		

864	.39
865	1.29
866A	1.50
868/CE1C	3.49
869	36.95
872A	3.29
874	1.39
878	1.95
884/6Q5G	1.80
885	1.45
893A	250.00
922	1.85
923	1.00
927/CE25	1.49
930	1.25
931A	6.90
954	.25
955	.39
956	.36
957	.45
958A	.67
967/FG17	3.95
SD969	.98
973	16.95
991	.45
FM1000	1.50
CK1005	.85
CK1006	3.49
CK1007	.89
CK1027	3.35
CK1028	9.98
CK1089	2.98
CK1090	2.98
R1100	5.00
R1130	12.00
E1148	1.35
HY1231Z	5.39
1612	1.90
1613	.89
1616	.74
1619	.25
1620	4.70
1622	2.69
1624	1.90
1625	.39
1626	.39
1629	.29
1630	.97
1631	.74
1632	.77
1633	.73
1634	.73
1635	1.89
1636	3.19
1644	.95
2000T	149.50
2050	1.47
2051	1.19
5516	5.98
5517	3.39
5594	6.65
5608A	5.95
5637	7.15
5638	12.70
5651	3.05
5654	2.95
5656	6.90
5663	1.85
5670	5.98
CK5672	2.29
CK5676	2.29
CK5678	2.45
5684	14.98
5686	3.90
5687	5.75
5692	7.69
5693	7.69
5694	3.65
CK5697	5.98
CK5702	7.45
CK5703	.98
CK5704	4.39
5718	10.15
5719	12.75
5726	4.39
GL5727	4.49
5744/CK619CX	6.49
5749	3.39
5751	5.45
5763	1.70
CK5783	6.69
CK5784	7.40
5812	2.99
5814	5.49
CK5829	4.49
5840	12.75
CK5851	4.98
CK5875	1.98
5881	2.89
X6030	4.49
8002R	99.50
8005	7.25
8008	6.49
8012	2.89
8013	2.75
8013A	6.45
8014A	28.95
8020	1.25

8025A	4.75
9001	1.55
9002	.95
9003	1.50
9004	.42
9006	.39

C'Ray Tubes

2AP1	9.70
3AP1	9.75
3AP1A	14.25
3BP1	5.75
3BP1A	14.98
3CP1	1.90
3DP1	4.75
3EP1/1806P1	4.85
3FP7	1.65
3FP7A	14.98
3GP1	4.20
3HP7	3.40
3HP14	14.98
3JP7	12.50
3JP12	19.95
3JP14	16.95
4AP10	4.40
5AP1	3.45
5BP1	4.25
5BP4	4.25
5CP1	4.50
5CP7	11.75
5FP7	1.75
5HP1	5.70
5HP4	5.70
5JP2	19.25
5JP4	26.75
5LP1	12.25
5LP7	29.95
5MP1	10.50
7BP1	8.65
7BP7	6.75
7EP4	17.98
7JP4	18.39
9GP7	12.75
9LP7	4.85
12DP7	16.89
12DP7A	49.50
12GP1	49.98
12GP7	14.75
12HP7	14.75
12JP4	27.00
12LP4	21.25
912	89.98
913	11.98

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195528	1.95
217283/5B21	6.75
189049/4B26	6.95
20X672/4B36	2.95
289881	2.50
45X674/5B24	12.95
859483	2.95
195698	2.45
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16X897/4B27	5.95

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1N21A	1.65
1N21B	3.45
1N21C	31.50
1N22	1.25
1N23	1.35
1N23A	2.35
1N23B	3.49
1N25	4.98
1N26	8.75
1N27	1.55
1N29	3.50
1N32	23.75
1N34	.64
1N34A	.98
1N35	1.65
1N38	1.43
1N39	4.15
1N40	7.95
1N41	9.98
1N42	17.50
1N43	1.69
1N44	1.21
1N45	1.39
1N46	.69
1N47	5.49
1N48	.59
1N51	.45
1N52	1.85
1N54	.89
1N55	2.35
1N56	.89
1N57	.89
1N58	1.19
1N60	.60
1N61	2.10
1N63/K63	2.49
1N64	.69
1N67	1.95
1N69	1.98

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AMPEREX

AIR-COOLED TUBE

AX9904-R/5924

"...Offers a maximum in kilowatts per dollar..." HARRY R. SMITH, Manager, Television Engineering, Standard Electronics Corporation

STANDARD ELECTRONICS CORPORATION
(A SUBSIDIARY OF CLAUDE NEON, INC.)

TELEVISION AND BROADCAST TRANSMITTERS AND AUXILIARY EQUIPMENT
AMERTRAN ELECTRONIC TRANSFORMERS AND TRANSTATS

TELEPHONE — BIGELOW 3-5540
BIGELOW 3-4444

285 EMMET STREET
NEWARK 5, N. J.

April 23, 1952

Mr. Sam Norris, Pres.
Amperex Electronics Corp.
25 Washington St.
Brooklyn 1, New York

Dear Mr. Norris:

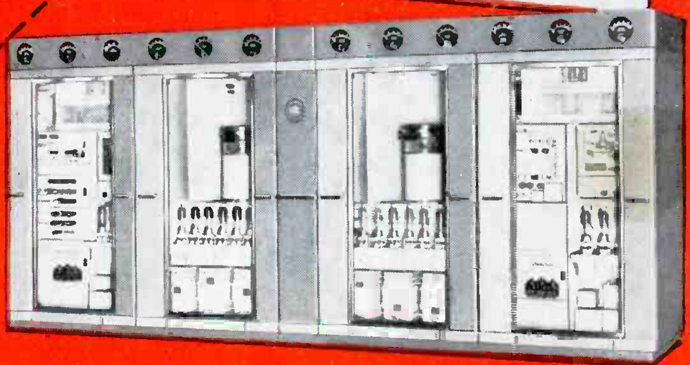
As you know we have been working with the Amperex Type AX9904-R vacuum tube in the development of the various Standard Electronics television broadcast transmitters. The tube is being used in the currently manufactured Model TH653 and TL 653 Transmitters in both the aural and visual sections.

I believe you will be interested in knowing that we are very well satisfied with the performance of this tube as a broad band linear amplifier on all V.H.F. television channels. The low interelectrode capacitance and low internal impedance of the AX9904-R permit power output levels of 5KW and more, with band widths in excess of 5 megacycles. These conditions are readily obtainable from a single tube operating well within its published tube characteristics. The moderate cost of the tube leads us to believe that it offers a maximum in "kilowatts per dollar".

Yours very truly,
Harry R. Smith
Harry R. Smith
Mgr. Television Engineering

HRS:hg

STANDARD ELECTRONICS CORPORATION uses this tube in Models TH653 High Band and TL653 Low Band Transmitters and also in their new 20 Kilowatt Transmitter, built on the exclusive S-E ADD-A-UNIT PRINCIPLE, and with special S-E features that insure dependable operation, maximum convenience, and minimum maintenance.



FEATURES INCLUDE . . . 14 MC band width at 220 MC . . . outputs of 5.7 KW . . . thoriated tungsten filament . . . non-emitting grid . . . disc type grid seal for mimimum inductance . . . minimum capacitance . . . and PROVEN *long life.*

Write for complete data sheets.

This tube is also available in a Water-Cooled Version, Type AX9904-5923.

Re-tube with AMPEREX

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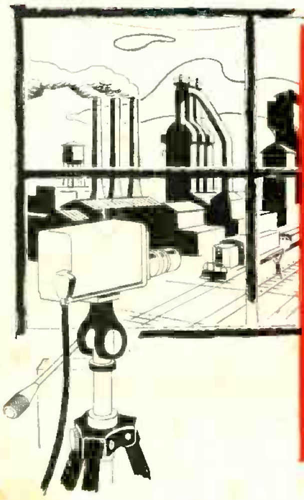
VIDICON



TECHNICAL FEATURES

- ✓ Only 6¼″ long and 1″ in diameter
- ✓ Provides 400-line resolution
- ✓ Spectral response approaching that of the eye
- ✓ Sensitivity permits televising with 100-200 foot-candles of illumination
- ✓ Designed for use with commercially available camera lenses
- ✓ Operates with low dc voltages

ACTUAL SIZE →

NEW, small-size camera tube for low-cost industrial television

Now, the RCA-developed 6198 Vidicon extends the advantages of television coverage to countless industrial users . . . opens the door to simplified television camera designs.

The small size and simplicity of operation of this television camera tube facilitates the design of compact and low-cost television camera equipment — including equipment for closed-circuit, portable, and remote-control applications.

Produced in the same plant by the same skilled hands that make the RCA Image Orthicon camera tube, the RCA-6198 offers the detail of 400-line picture quality at low unit cost. It employs magnetic focus and deflection, and operates with relatively low dc voltages.

Utilizing a photoconductive layer as its light-sensitive element, the RCA-6198 has a sensitivity which permits televising scenes with 100 to 200 foot-candles of incident illumination. The photoconductive layer has a spectral response characteristic approaching that of the eye. The dimensions of the useful area of this layer are such that stock camera lenses can be employed. The size and location of the layer permit a wide choice of commercially available lenses.

The following components, designed for use with the RCA-6198 Vidicon, are also available:

RCA-216D1 Deflecting Yoke
RCA-217D1 Focusing Coil
RCA-218D1 Alignment Coil
RCA-233T1 Horizontal Deflection Transformer
RCA-234T1 Vertical Deflection Transformer

For complete data on the RCA-6198 Vidicon and associated components, write RCA, Commercial Engineering, Section JR42, Harrison, N. J., or contact your nearest RCA Field Office.

FIELD OFFICES: **(East)** Humboldt 5-3900, 415 S. 5th St., Harrison, N. J. **(Midwest)** Whitehall 4-2900, 589 E. Illinois St., Chicago, Ill. **(West)** Madison 9-3671, 420 S. San Pedro St., Los Angeles, California.

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ELECTRON TUBES **HARRISON, N. J.**