electronics

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JANUARY · 1953

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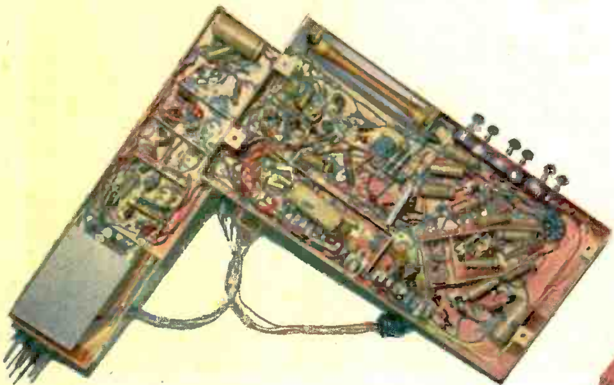
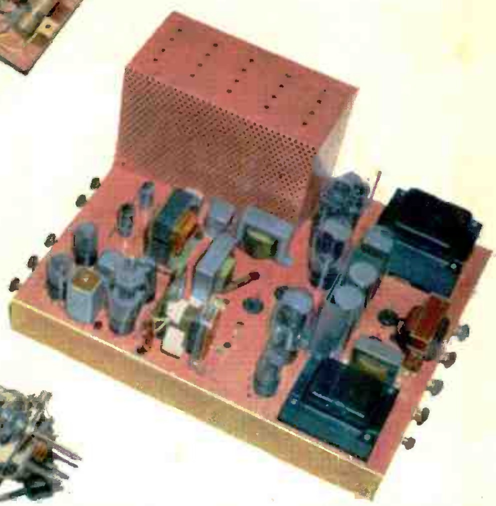
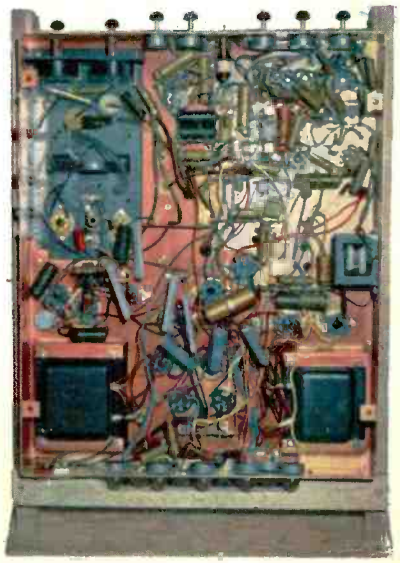






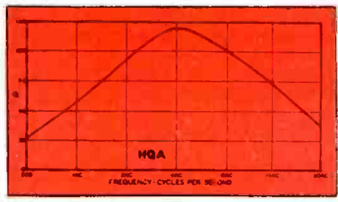
Monochrome effect results when saturation control is turned off. Normal setting of control provides complete color pictures

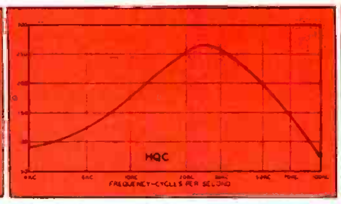
COMPATIBLE COLOR TV RECEIVER

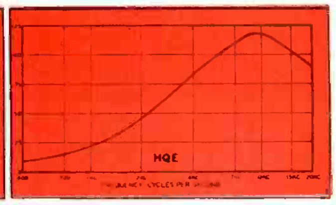
PERMALLOY DUST TOROIDS FOR MAXIMUM STABILITY...

The UTC type HQ permalloy dust toroids are ideal for all audio, carrier and supersonic applications. HQA coils have Q over 100 at 5,000 cycles... HQB coils, Q over 200 at 4,000 cycles... HQC coils, Q over 200 at 30 KC... HQD coils, Q over 200 at 60 KC... HQE (miniature) coils, Q over 120 at 10 KC. The toroid dust core provides very low hum pickup... excellent stability with voltage change... negligible inductance change with temperature, etc. Precision adjusted to 1% tolerance. Hermetically sealed.

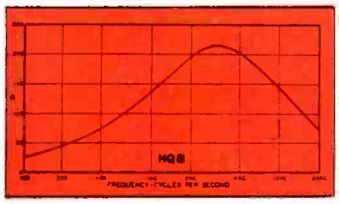
HQA, HQC, HQD CASE
1 13/16" Dia. x 1 3/16" High

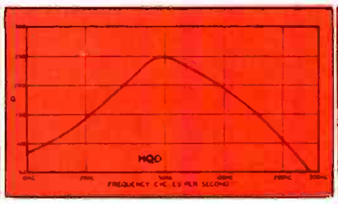


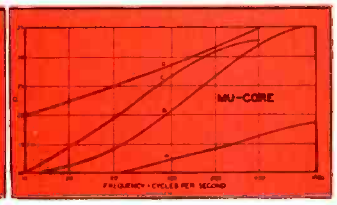




HQB CASE
1 5/8" x 2 5/8" x 2 1/2" High



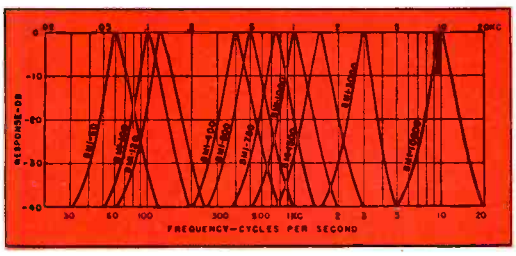


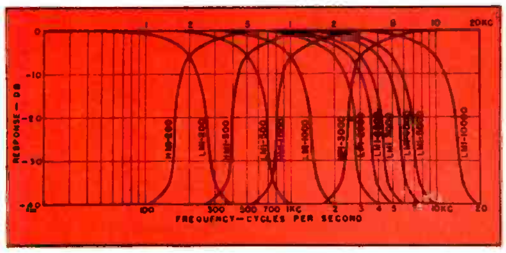


HQE CASE
1/2" x 1 5/16" x 1 3/16" High

Type No.	Inductance Value	Net Price	Type No.	Inductance Value	Net Price	Type No.	Inductance Value	Net Price
HQA-1	5 mhy.	$7.00	HQA-16	7.5 hy.	$15.00	HQC-1	1 mhy.	$13.00
HQA-2	12.5 mhy.	7.00	HQA-17	10. hy.	16.00	HQC-2	2.5 mhy.	13.00
HQA-3	20 mhy.	7.50	HQA-18	15. hy.	17.00	HQC-3	5 mhy.	13.00
HQA-4	30 mhy.	7.50	HQB-1	10 mhy.	16.00	HQC-4	10 mhy.	13.00
HQA-5	50 mhy.	8.00	HQB-2	30 mhy.	16.00	HQC-5	20 mhy.	13.00
HQA-6	80 mhy.	8.00	HQB-3	70 mhy.	16.00	HQD-1	.4 mhy.	15.00
HQA-7	125 mhy.	9.00	HQB-4	120 mhy.	17.00	HQD-2	1 mhy.	15.00
HQA-8	200 mhy.	9.00	HQB-5	.5 hy.	17.00	HQD-3	2.5 mhy.	15.00
HQA-9	300 mhy.	10.00	HQB-6	1. hy.	18.00	HQD-4	5 mhy.	15.00
HQA-10	.5 hy.	10.00	HQB-7	2. hy.	19.00	HQD-5	15 mhy.	15.00
HQA-11	.75 hy.	10.00	HQB-8	3.5 hy.	20.00	HQE-1	5 mhy.	6.00
HQA-12	1.25 hy.	11.00	HQB-9	7.5 hy.	21.00	HQE-2	10 mhy.	6.00
HQA-13	2. hy.	11.00	HQB-10	12. hy.	22.00	HQE-3	50 mhy.	7.00
HQA-14	3. hy.	13.00	HQB-11	18. hy.	23.00	HQE-4	100 mhy.	7.50
HQA-15	5. hy.	14.00	HQB-12	25. hy.	24.00	HQE-5	200 mhy.	8.00

UTC INTERSTAGE AND LINE FILTERS





FILTER CASE M
1 3/16 x 1 11/16,
1 5/8 x 2 1/2 High

These U.T.C. stock units take care of most common filter applications. The interstage filters, BMI (band pass), HMI (high pass), and LMI (low pass), have a nominal impedance at 10,000 ohms. The line filters, BML (band pass), HML (high pass), and LML (low pass), are intended for use in 500/600 ohm circuits. All units are shielded for low pickup (150 mv/gauss) and are hermetically sealed.

STOCK FREQUENCIES
(Number after letters is frequency)
Net Price $25.00

BMI-60	BMI-1500	LMI-200	BML-400
BMI-100	BMI-3000	LMI-500	BML-1000
BMI-120	BMI-10000	LMI-1000	HML-200
BMI-400	HMI-200	LMI-2000	HML-500
BMI-500	HMI-500	LMI-3000	LML-1000
BMI-750	HMI-1000	LMI-5000	LML-2500
BMI-1000	HMI-3000	LMI-10000	LML-4000
			LML-12000

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electronics

JANUARY • 1953

A McGRAW-HILL PUBLICATION

COMPATIBLE COLOR TV RECEIVER—Unretouched reproductions of crt screen of 42-tube color receiver developed by Westinghouse engineers. Chassis of receiver used in field tests of NTSC system contain all circuits for color or monochrome reception (see p 98)........COVER

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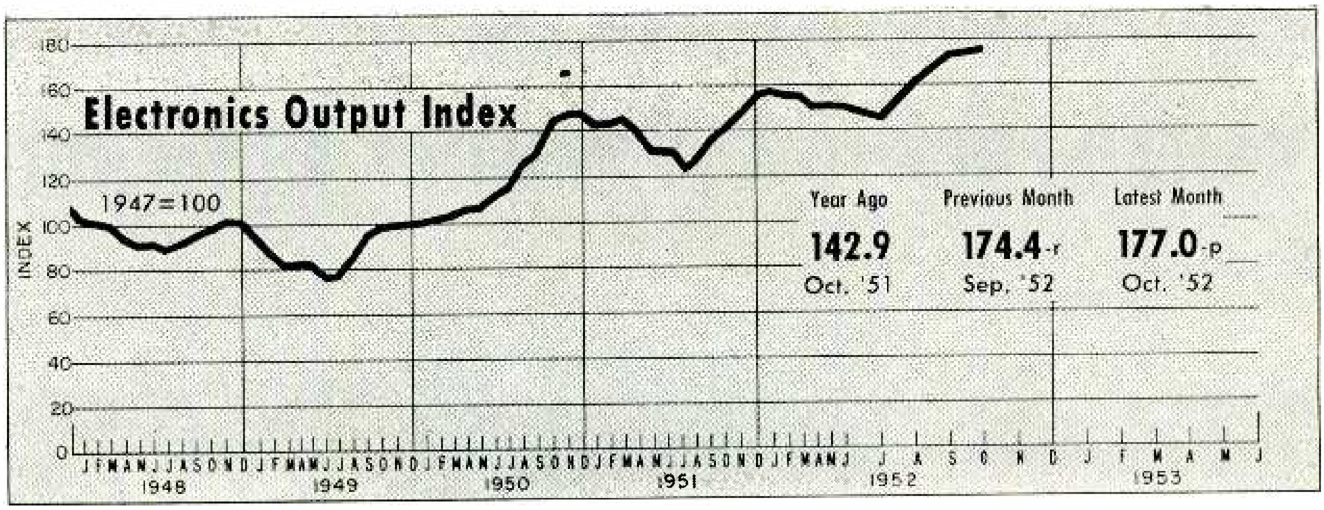


FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RTMA)	Year Ago	Previous Month	Latest Month
	Oct. '51	Sept. '52	Oct. '52
Television sets	411,867	755,665	724,117-p
Home sets	513,609	324,786	314,459-p
Clock Radios	————	183,496	180,841-p
Portable sets	94,053	126,666	113,552-p
Auto sets	267,061	230,706	163,494-p

RECEIVER SALES

(Source: RTMA)	Year Ago	Previous Month	Latest Month
		Sept. '52	Oct. '52
Television sets, units...	————	875,290	847,219
Radio sets (except auto)	————	892,761	580,077

RECEIVING TUBE SALES

(Source: RTMA)	Year Ago	Previous Month	Latest Month
	Oct. '51	Sept. '52	Oct. '52
Receiv. tubes, total units	34,137,519	34,196,286	41,880,318
Receiving tubes, new sets	21,103,669	23,826,408	29,132,068
Rec. tubes, replacement	9,615,159	7,435,333	8,791,404
Receiving tubes, gov't.	1,567,190	2,032,539	3,105,005
Receiving tubes, export.	1,851,501	902,006	851,841
Picture tubes, to mfrs..	455,636	640,793	862,431

BROADCAST STATIONS

(Source: FCC)	Year Ago	Previous Month	Latest Month
	Nov. '51	Oct. '52	Nov. '52
TV Stations on Air....	108	114	116
TV Stns CPs—not on air	0	77	114
TV Stns—Applications..	463	840	836
AM Stations on Air...	2,321	2,368	2,374
AM Stns CPs—not on air	85	138	139
AM Stns—Applications.	302	255	250
FM Stations on Air...	635	624	626
FM Stns CPs—not on air	12	17	14
FM Stns—Applications.	10	8	9

COMMUNICATION AUTHORIZATIONS

(Source: FCC)	Year Ago	Previous Month	Latest Month
	Oct. '51	Sept. '52	Oct. '52
Aeronautical	31,989	34,462	33,630
Marine	33,309	37,437	37,914
Police, fire, etc.......	9,965	11,615	11,772
Industrial	10,930	14,761	15,090
Land Transportation ..	4,542	5,250	5,346
Amateur	97,587	116,629	116,102
Citizens Radio	674	1,767	1,788
Disaster	22	80	80
Experimental	442	282	519
Common carrier	834	1,026	1,032

TV AUDIENCE

(Source: NBC Research Dept.)	Year Ago	Previous Month	Latest Month
	Nov. '51	Oct. '52	Nov. '52
Sets in Use—total.....	14,555,800	19,124,900	19,751,200
Sets in Use—netw'k conn.	13,777,700	19,095,500	19,720,900
Sets in Use—New York.	2,630,000	3,135,000	3,180,000
Sets in Use—Los Angeles	1,045,000	1,255,000	1,270,000
Sets in Use—Chicago..	1,020,000	1,255,000	1,290,000

NETWORK BILLINGS

(Source: Pub. Info. Bureau)	Year Ago	Previous Month	Latest Month
	Oct. '51	Sept. '52	Oct. '52
AM/FM—ABC	$3,158,714	$2,533,785	$2,887,571
AM/FM—CBS	$5,615,723	$4,847,138	$5,817,930
AM/FM—MBS	$1,759,468	$1,607,107	$2,304,804
AM/FM—NBC	$4,414,200	$3,898,867	$4,230,576
TV—ABC	$1,897,427	$1,203,917	$1,453,811
TV—CBS	$4,731,219	$5,835,622	$6,754,231
TV—DuMont	$768,684	$809,475	$995,376
TV—NBC	$7,060,289	$6,581,618	$7,805,668

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	Year Ago	Previous Month	Latest Month
	Sept. '51	Aug. '52	Sept. '52
Prod. workers, electronic	247,300	280,300-r	296,600-p
Av. wkly. earnings, elect.	$62.75	$66.54-r	$67.06-p
Av. wkly. earnings, radio	$59.40	$63.11-r	$63.45-p
Av. weekly hours, elect.	41.2	41.2-r	41.5-p
Av. weekly hours, radio.	40.8	40.9-r	41.2-p

STOCK PRICE AVERAGES

(Source: Standard and Poor's)	Year Ago	Previous Month	Latest Month
	Nov. '51	Oct. '52	Nov. '52
Radio—TV & Electronics	245.7	310.9	321.9
Radio Broadcasters ...	231.3	288.1	300.3

Quarterly Figures

INDUSTRIAL EQUIPMENT ORDERS

(Source: NEMA)	Year Ago	Previous Quarter	Latest Quarter
	3rd '51	2nd '52	3rd '52
Dielectric Heating	$210,000	$510,000	$320,000
Induction Heating	$4,060,000	$2,410,000	$1,760,000
Welding Control	$1,280,000	$1,480,000	$1,810,000
Other Electronic Control	$720,000	$1,020,000	$920,000

INDUSTRIAL TUBE SALES

(Source: NEMA)	Year Ago	Previous Quarter	Latest Quarter
	3rd '51	2nd '52	3rd '52
Vacuum (non-receiving).	$8,420,000	$12,110,000	$10,580,000
Gas or vapor	$2,620,000	$3,150,000	$2,950,000
Phototubes	$270,000	$480,000	$570,000
Magnetrons and velocity modulation tubes ...	$3,740,000	$9,830,000	$8,500,000

p—provisional; r—revised; e—estimated

INDUSTRY REPORT

electronics—JANUARY • 1953

John Q. Meets the Transistor

Raytheon announces mass availability of junction types; RCA shows uses

In this four-transistor audio amplifier pnp and npn types are combined to provide transformerless class-B amplification with direct coupling to loudspeaker voice coil

THE YEAR 1952 ended with a flourish, electronically speaking, as the word transistor became public property.

Raytheon announced availability in large numbers of junction types and RCA demonstrated practical applications. Cornell University introduced a course in transistors for electrical engineering students, and amateur George Rose, K2AH, made three contacts on 2-meter phone using a transistor transmitter (could be call this a transmister?).

It is significant to note that these announcements came in the third year of existence of practical semiconductor amplifying devices.

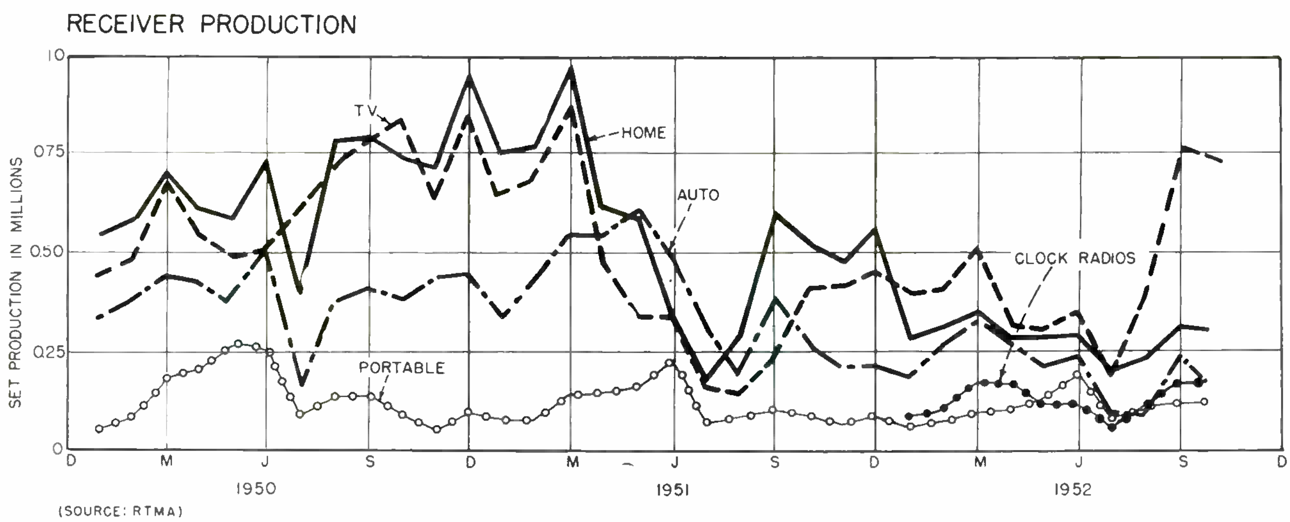
▶ **A First**—From the industry's standpoint, Raytheon's announcement probably created the most stir. Junction transistors, hitherto available only in sample lots from pilot runs, were suddenly available for mass application, and at reasonable cost.

First to take advantage of Raytheon's $750,000 transistor production facilities were hearing aid manufacturers who were willing to accept higher initial cost to offer greater operating economy. Battery costs for subminiature tube hearing aids run between $30 and $50 per year, while the transistor hearing aid might require $5 to $10 worth of 1½-volt cells.

▶ **Circus**—Adaptability of transistors to other practical applications was demonstrated by RCA in a showing of experimental transistorized entertainment and industrial devices. An automobile radio operated directly from the 6-volt car battery, without vibrators or other voltage stepup devices. Power taken from the battery for a half-watt output is less than that required to light two pilot lights for the dial.

A good-quality audio amplifier was shown that used only junction

ELECTRONIGRAPHS—A Year-End Glance at Electronics Industry Figures



More charts following →

Thirty-six transistors perform all the functions in this 5-inch battery-powered tv set, except for c-r tube

transistors and no transformers. Four junction transistors in a circuit using 'complementary symmetry', for which there is no vacuum-tube analogy, automatically transform signal to push-pull and provide class-B amplification and impedance transformation for direct coupling to a 15-ohm voice coil.

A transistor-operated 6-note toy organ was demonstrated that plays through any conventional a-m radio. A single broadcast-band oscillator is quenched at different audio frequencies to obtain the desired notes in the receiver. A single-transistor phono oscillator smaller than a package of cigarettes was also shown that had a self-contained power source capable of powering the oscillator for 3,000 hours.

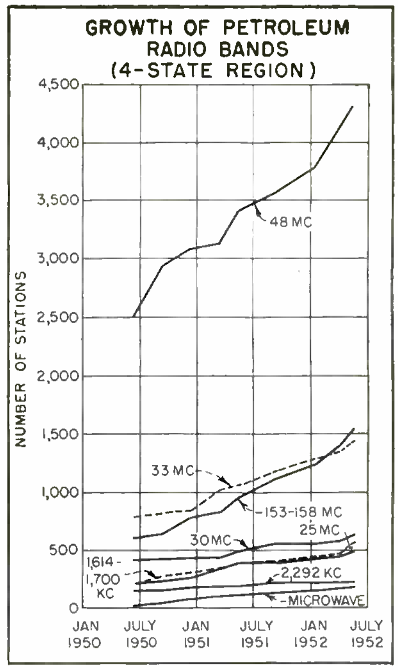
The application that created most public interest was a portable tv receiver in which the only electron tube was a 5-inch picture tube. Thirty-six transistors performed the rest of the functions in the set and self-contained batteries provided the necessary power. This set was, however, demonstrated to show what *could* be done—battery life is prohibitively short.

Petroleum Radio Service Continues Uptrend

GEOPHYSICAL explorers for oil began early to use radio communications techniques. They are inclined to smile and remark wistfully that their use of frequencies antedates both the old Federal Radio Commission and its successor, the Federal Communications Commission.

With the formalizing of the Petroleum Radio Service by FCC in 1949, a growth to 10,000 stations was forecast. There are now 20,000 stations and applications are coming in at the rate of 5,000 a year.

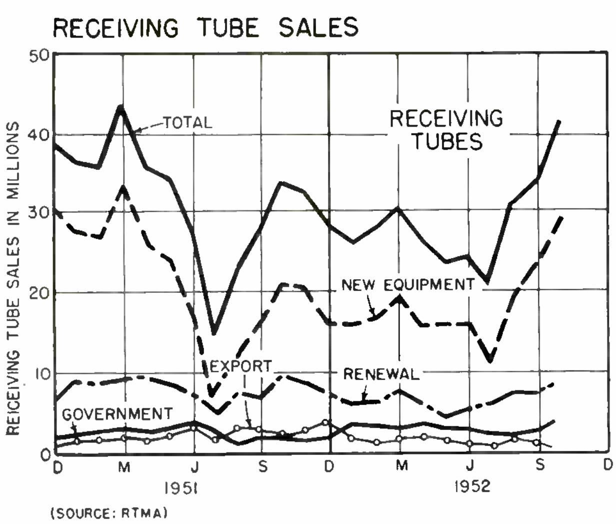
▶ **Figures**—At present, Region 4 of the National Petroleum Radio Frequency Co-ordinating Association, comprising Texas, Louisiana, Arkansas and Mississippi, is the most active.

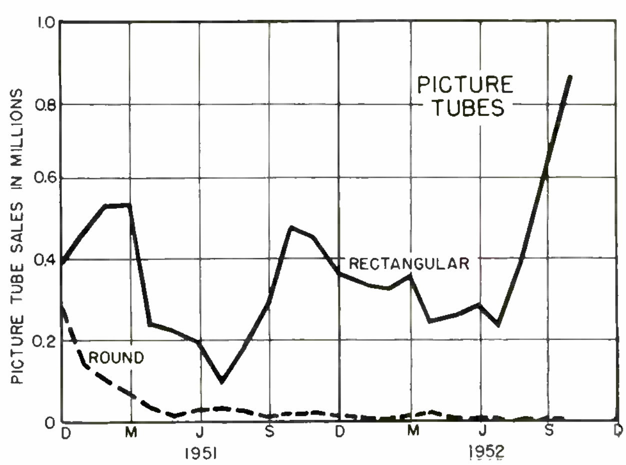


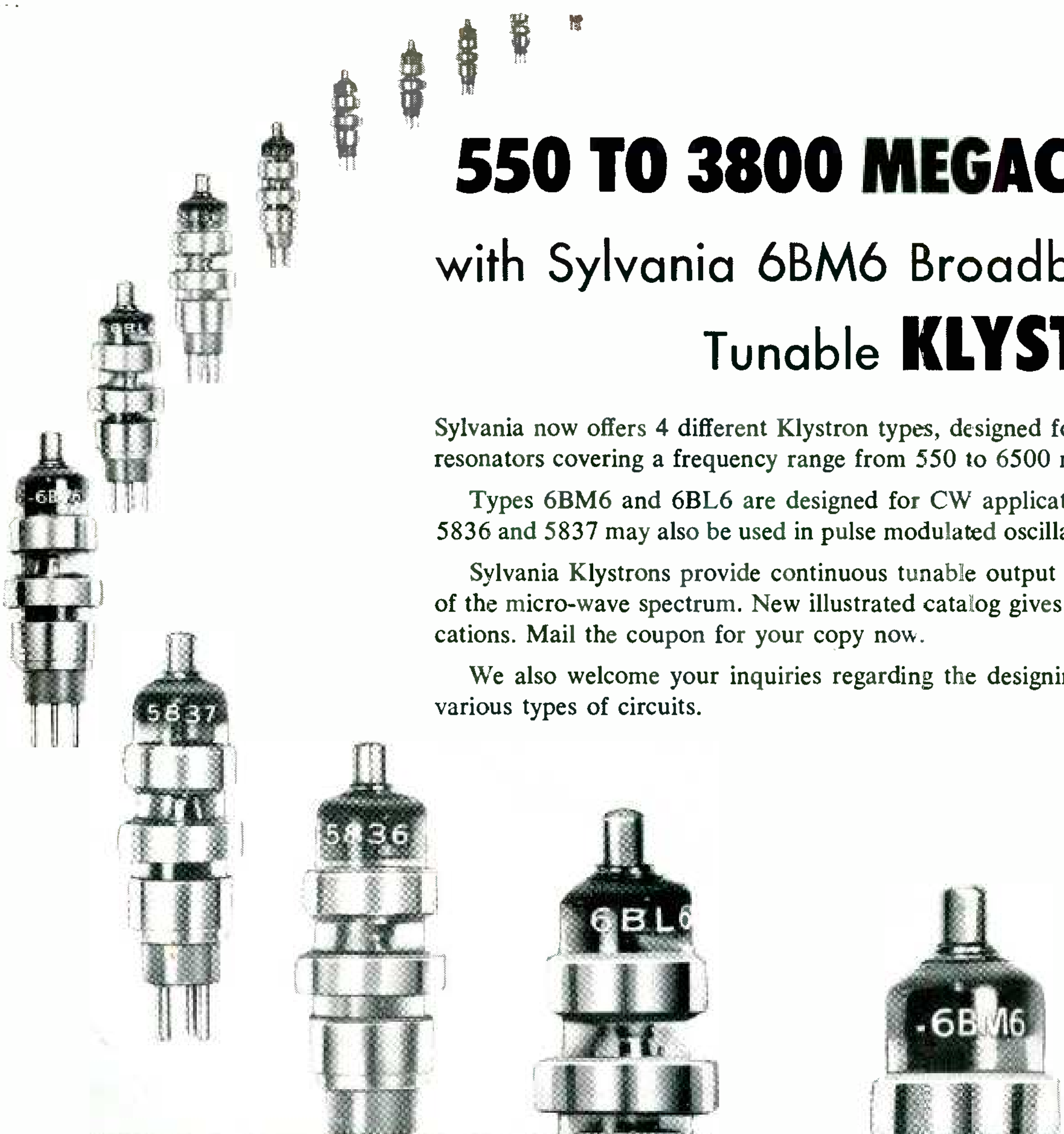
Figures showing the upswing of communications are plotted in the graph. It is apparent that channels alloted to 48 mc are in greatest demand at present, with future expansion here probable. Experiments now in progress show that it is possible to operate equipment satisfactorily in half the bandwidth as-

(Continued on page 8)

ELECTRONIGRAPHS Continued







550 TO 3800 MEGACYCLES

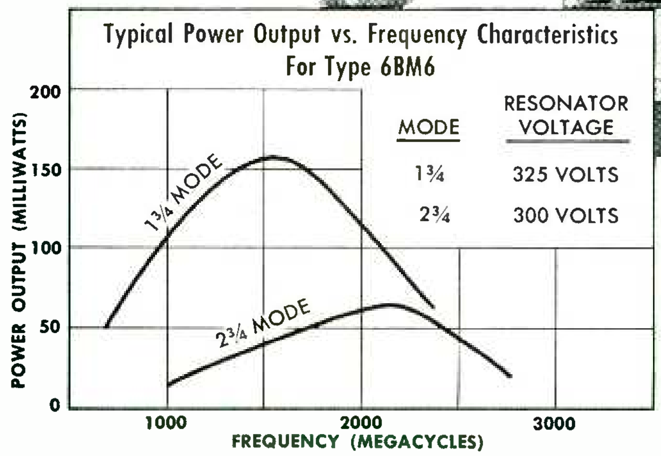
with Sylvania 6BM6 Broadband Tunable KLYSTRONS

Sylvania now offers 4 different Klystron types, designed for external cavity resonators covering a frequency range from 550 to 6500 megacycles.

Types 6BM6 and 6BL6 are designed for CW applications, while types 5836 and 5837 may also be used in pulse modulated oscillation.

Sylvania Klystrons provide continuous tunable output over wide ranges of the micro-wave spectrum. New illustrated catalog gives complete specifications. Mail the coupon for your copy now.

We also welcome your inquiries regarding the designing of cavities for various types of circuits.



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signed each channel by FCC. Although halving the channel width does not automatically produce quite twice the station potential, it does permit continued healthy growth in this mobile two-way radio band.

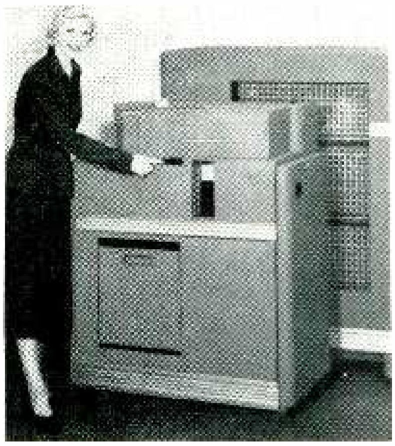
Electronics Gains In Business-Machine Field

More office equipment companies adopt electronics as applications increase

ALL-ELECTRONIC offices may be far in the future but the business-machine industry is getting ready now for this multi-million dollar market of the future.

Although business-machine manufacturers have been moving into the field for some years, the trend last year was accelerated. Most recent entrants are National Cash Register, which recently acquired control of Computer Research Corp., and the Friden Calculating Machine Company, which now controls Computyper Corp. Nearly every major business-machine manufacturer now has an electronic division.

IBM, one of the largest companies in the field, is producing electronic machines for business use in greater volume. In addition to the machine pictured, more than 100 of its electronic card-programmed calculators are now used in business applications.



Electronic calculator made by IBM has 1,400 tubes. Over 1,000 of the machines are now used in business offices in the U. S.

▶ **Business Show**—Growing importance of electronics in the business-machine field was apparent at the recent National Business Show in New York, where a wide variety of electronic items were on display. Among them was an electronic sorter which sorts alphabetically and numerically at a speed of 800 cards a minute by means of a photoelectric cell that reads the punched card values.

Also on display was a device that integrates the operations of an electric typewriter and a calculating machine so that the calculating results are automatically recorded by the typewriter at the rate of ten characters per second.

▶ **Business Trends**—The recent Office Management Conference in New York City also showed the increasing potential of electronics for business. One full day of the two-day meeting was devoted to electronics in office management. Topics discussed ranged from an evaluation of present electronic computers for use in business to an analysis of what the smaller office can do now to be ready for the shift to electronics.

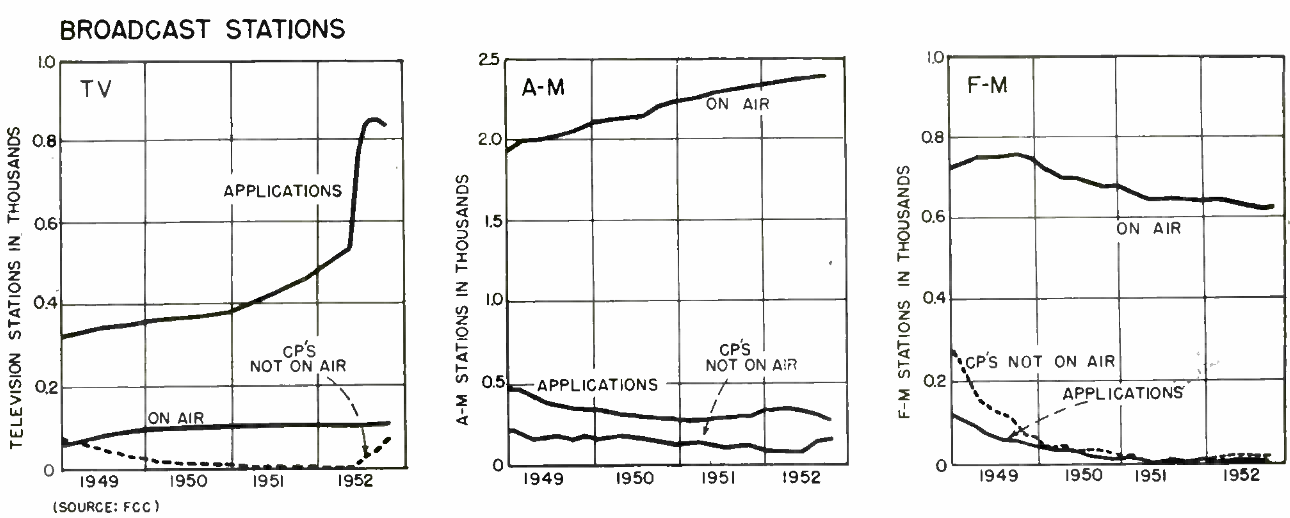
Vehicular Radio Group Ponders Expansion

Channel splitting and systems co-ordination seen as solution to present overcrowding

SOME 250 engineers of the IRE group on vehicular communications met in Washington early in December to discuss, in particu-

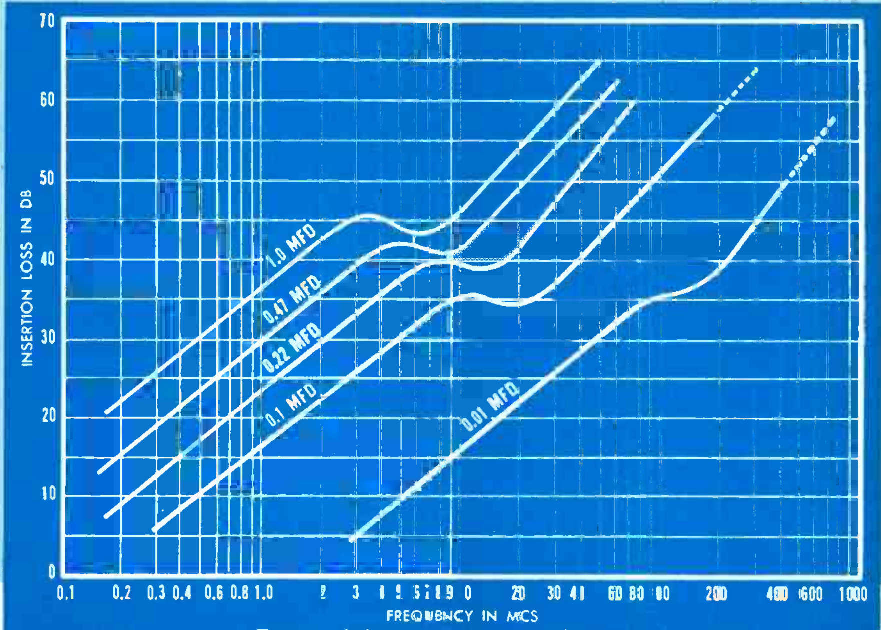
(Continued on page 10)

ELECTRONIGRAPHS Continued



THE MOST EFFECTIVE CAPACITORS FOR R-F NOISE SUPPRESSION...

...are the NEW SPRAGUE THRU-PASS® CAPACITORS



Typical Insertion Loss Curves

THRU-PASS CAPACITORS are a new Sprague development for use in radio interference reduction in communication and radar equipment.

• Thru-Pass Capacitors not only reduce to a negligible value the effect of external connection inductance to a capacitor but they also have a minimum length of internal path for radio interference currents. *Their performance is closer to that of a theoretically ideal capacitor than that of any other paper capacitor!*

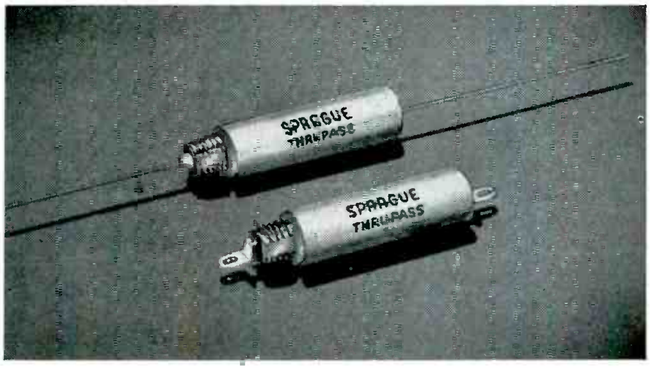
• Electrically, Thru-Pass Capacitors are three-terminal feed-thru devices which are connected in a circuit in a manner similar to a low pass filter; the tab or lead terminals are connected in series with the circuit being filtered while the case is grounded.

• The threaded-neck mounting on Type 102P and 103P Subminiature Thru-Pass Capacitors is designed to give a firm metallic contact with the mounting surface over a closed path encircling the feed-thru conductor and to eliminate unwanted contact resistance so that the theoretical effectiveness of these new units is realized in practice. The milled flats on the threads help ensure vibration-proof mounting since the capacitors cannot rotate if mounted in a flatted opening instead of the usual circular hole.

• Type 102P and 103P Capacitors are all hermetically encased. Glass-to-metal solder-seal terminals are employed in order to assure positive protection against severe atmospheric conditions.

• Both types are impregnated with Vitamin Q, Sprague's exclusive inert synthetic impregnant, in order to provide maximum insulation resistance and minimum capacitance change with temperature. Type 102P units are processed for −55°C to +85°C operation while Type 103P units have their top operating temperature extended to +125°C.

• Engineering Bulletin 215 gives full details and standard ratings. Write on your business letterhead for your copy to Sprague Electric Co., 35 Marshall St., North Adams, Massachusetts.



TYPES 102P AND 103P 5 AMPERE THRU-PASS CAPACITORS SHOWING CHOICE OF LEAD OR TAB TERMINALS

SPRAGUE WORLD'S LARGEST CAPACITOR MANUFACTURER

EXPORT DIVISION: CABLE SPREXDIV, NORTH ADAMS, MASS.

"THRU-PASS" AND VITAMIN "Q" ARE SPRAGUE TRADEMARKS.

Want more information? Use post card on last page.

lar, band crowding. They received a summation of the results of tests culminating in those conducted by the Joint Technical Advisory Committee at Syracuse, N. Y. during late October. From this information JTAC will propose new standards to FCC, by whom it had been asked for recommendations.

It is expected that the JTAC report will be issued during February or March, but that FCC will probably not take immediate action on it. Instead, as each service in the mobile field encounters intolerable interference, it can come to FCC and ask for relief under the new plan. In this way, the burden of choice is put upon the user.

▶ **Big Business**—Keynote speaker at the Washington meeting was W. R. G. Baker of GE, who estimated two-way radio as a $34 million business that will grow to $50 million a year by 1962. Other engineers think the present figure, undoubtedly based on FCC authorization, is a little high and that the true gross is between $25 and $30 million. They point out that applicants usually ask for more than the immediately required number of mobile authorizations and FCC customarily honors this blank check to save future bookkeeping when all equipment finally comes into full-scale operation. But there is no quibbling regarding the health of mobile radio or doubts as to its future.

▶ **Techniques** — Increased engineering knowhow has made it possible to split present FCC-assigned channels in half. While, for various abstruse technical reasons, splitting doesn't double the total number of channels, it helps.

In some very crowded areas, it may be necessary for licensees to get together and establish a common transmitting point (in much the manner that television broadcasters use the Empire State tower) to cut down interchannel interference at the mobile receiver. Fixed receivers to pick up the mobile transmitters will have to be spotted around the working area. Wire lines will bring the strongest mobile signal for each user into his operating room. A further advantage to this scheme will be the fact that each mobile transmitter will need only two or three watts of power.

Communications Center Goes Underground

COMMUNICATIONS center designed to resist atomic attack, located inside Raven Rock Mountain, about 5 miles East of Fort Ritchie, Md., is being completed by the U. S. A half million cubic yards of hardest rock was blasted out for the equivalent of a 3-story communications building. Five microwave stations will tie the "Ritchie Project" into signal facilities of Army, Navy and Air Force already constructed in the Washington, D. C., area.

Theater Television Moves Ahead

Equipment sales were down last year but the outlook for 1953 is bright

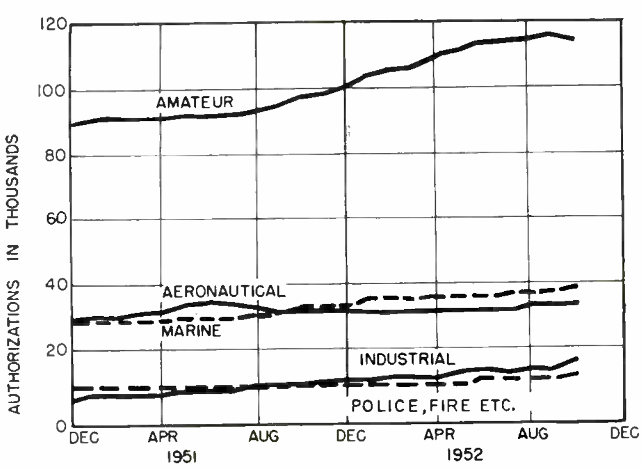
DESPITE a decline in sales last year, theater television equipment represented an important and growing business for electronic manufacturers. About 40 systems were sold last year compared to 1951 sales of near 50 units. In 1950, less than 12 units were installed. Even these small unit sales represented substantial dollar volume for electronic manufacturers. The average price for the equipment is between $15,000 and $20,000.

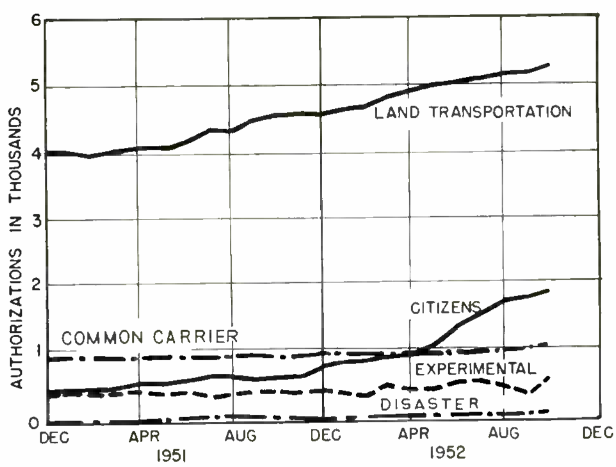
With about 100 systems now installed, the theater tv equipment

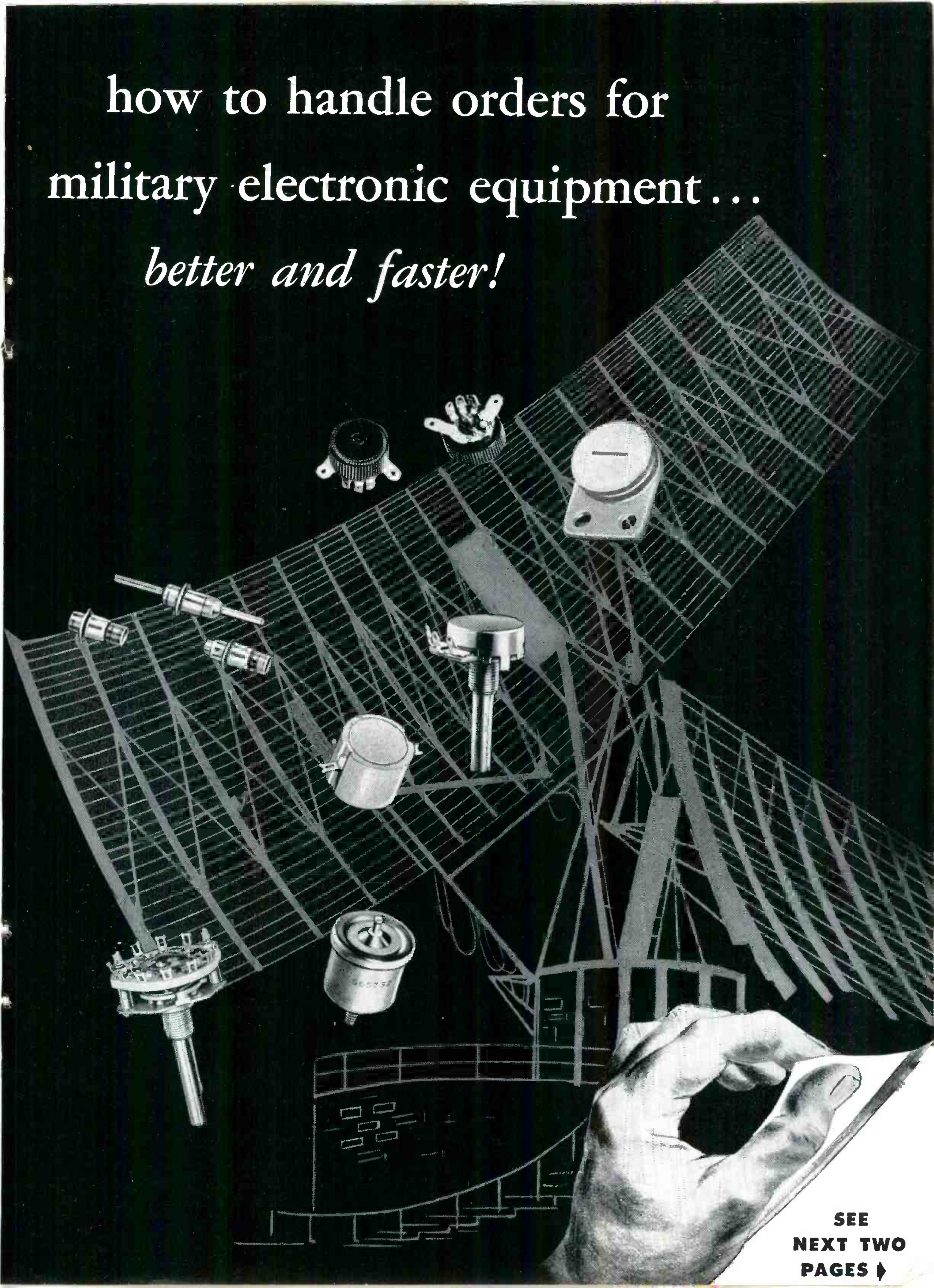
(Continued on page 14)

ELECTRONIGRAPHS Continued

COMMUNICATION AUTHORIZATIONS





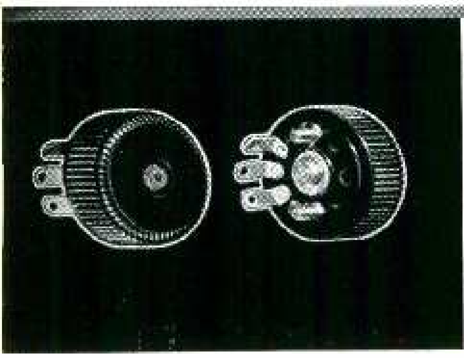

how to handle orders for
military electronic equipment...
better and faster!
SEE
NEXT TWO
PAGES

Choose CENTRALAB...

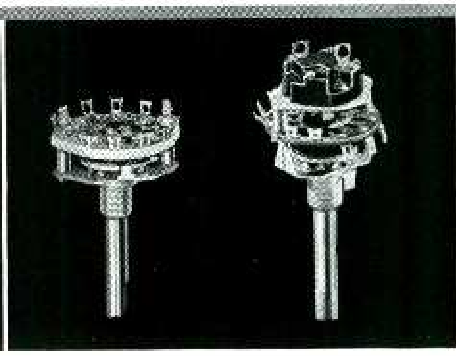
America's widest line of components that meet military specifications

CENTRALAB MODEL 2 VARIABLE RESISTORS

There's no prior contract approval or waivers required if you specify Centralab's Model 2 variable resistors on your next military order. They meet JAN R94, characteristic U requirements. Two types available — RV2A and RV2B — plain or with attached switches. Ratings from 2000 ohms to one megohm. For complete engineering data, check Bulletin No. 42-85 in coupon below.

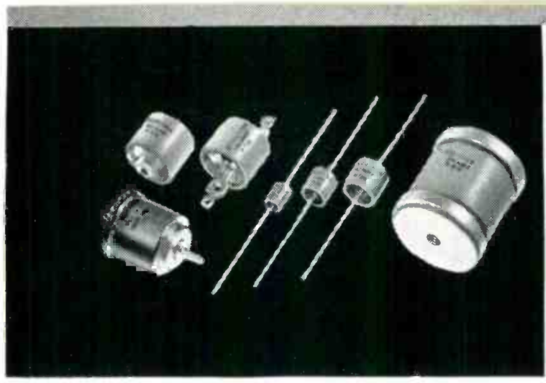


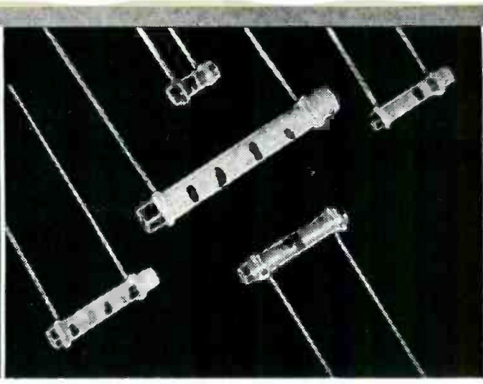
Model 1, miniature variable resistors . . . no bigger than a dime . . . available in Standard or Hi-torque types. Either with or without on-off switch. Also available with slot — front or rear — for screw-driver adjustment. Hi-torque units hold settings under conditions of vibration or shock. For complete data check No. 42-158 in coupon below.

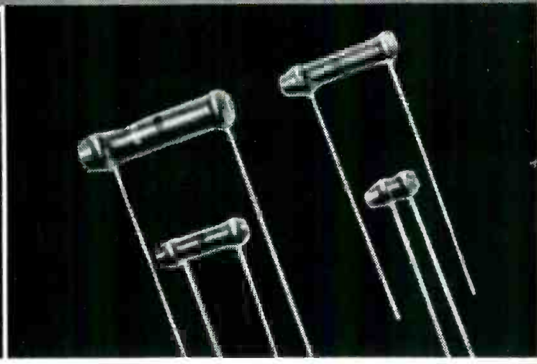


For miniature switches — specify Centralab's Series 20 with Steatite or Phenolic sections. Steatite is Grade L5. Meets JAN I-8 specs. Phenolic sections conform to JAN P-13 . . . Grade LTSE4. Available in 2 to 11 positions with stops, or 12 positions, continuous rotation—single or multiple sections—with or without attached on-off switch. Check No. 42-156.

Centralab's Medium-Duty Power Switches. Use for R. F. or 110-115 V. application . . . 7½ amps. Voltage breakdown to ground — 3000 volts — RMS 60 cycles. Available with Grade L5 (JAN I-8) Steatite sections — shorting or non-shorting contacts. Models in 1, 2 or 3 poles, 18 contacts per section with adjustable stops, can be furnished up to 20 sections per shaft. Contacts and collector rings are coin silver. For complete data, check No. 42-136 in coupon.



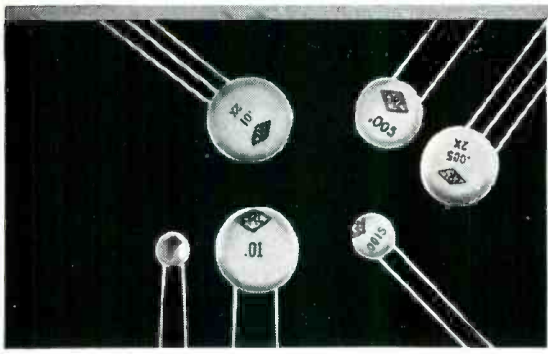


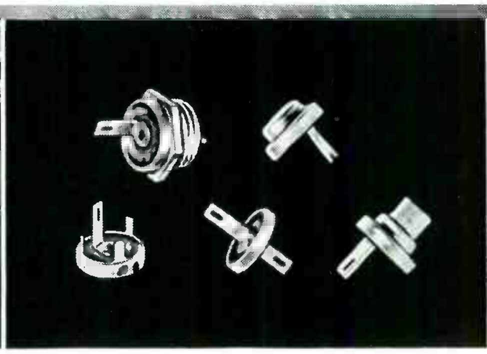


Centralab's Type 850 high voltage ceramic capacitors are especially designed for high voltage, high frequency circuits. Centralab's Type 950 high accuracy ceramic capacitors are especially developed for exacting electronic applications. Check bulletin No.'s 42-102 and 42-123.

TC (Temperature Compensating) Tubulars — No prior contract approval or waiver necessary. Meet JAN-C-20A requirements. Type TCZ shows no capacitance change over wide range of temperature. Type TCN has special ceramic body to vary capacitance according to temperature. Bulletin No. 42-18.

BC (Bypass Coupling) Tubulars — Recommended for bypass coupling. Well suited to general circuit use. Centralab's own Ceramic X body provides imperviousness to moisture and low power factor. Easily withstands temperatures normally encountered in most electronic equipment. Bulletin No. 42-3.

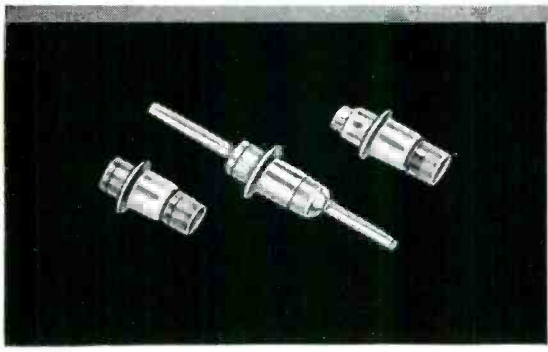


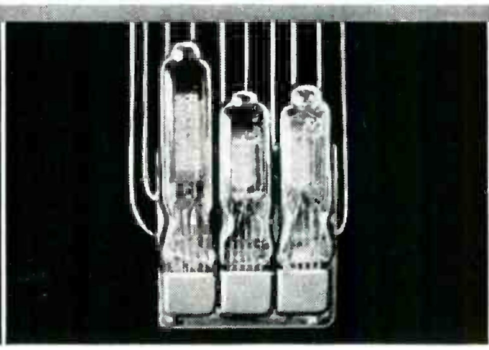


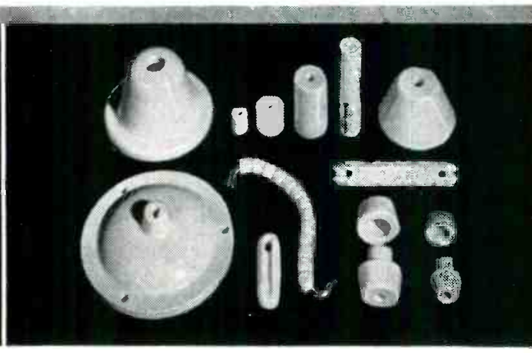
Ceramic Disc Hi-Kap Capacitors hold thickness to a minimum . . . have very high capacity in extremely small size. Use in h.f. circuits for bypass and coupling. Ceramic body assures low inductance. Other characteristics—humidity resistance, power factor, etc. — similar to BC Tubulars, Bulletin No. 42-4R.

Something new in miniature ceramic capacitors! These "button types" are available in 5 different styles. Used for bypassing in low-power, high-frequency applications where small size, low inductance and light weight are essential. Check Bulletin No. 42-122 in coupon for more information.

Centralab Ceramic Trimmers meet applicable portions of JAN-C-81. Very small size. Screw driver adjustment over full capacity range (180° rotation). Maintain stability in any position and under vibration. Spring pressure contact for rotor and stator. Bulletin No. 42-101.







Centralab's New Eyelet-Mounted Feed-Through Ceramic Capacitors are smallest available. They meet applicable portions of JAN-C-20A specifications. Capacities range from 10 to 3000 mmf...the widest range on the market. Voltage rating. 500 V.D.C.W. Check No. EP-15 in coupon.

New Sub-miniature Model III Ampec — a full three-stage speech amplifier of remarkably small dimensions — approximately $1\frac{1}{32}$" x $\frac{15}{16}$" x $\frac{11}{32}$" (barely larger than a postage stamp!). Excellent for microphone preamplifiers and similar applications. Check No. 42-130 on coupon for complete information.

Centralab standard and custom-molded Steatite ceramics plain or metallized . . . fully comply with JAN I-8. Steatite is Grade L5 for military use. Characteristics — high dielectric strength, low loss at high frequencies, high mechanical strength. For data on standard parts or custom molding, check No. 720.

Centralab

CRL®

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Please send me Technical Bulletins as marked

☐ 42-85 ☐ 42-158 ☐ 42-156 ☐ 42-136 ☐ 42-102 ☐ 42-123 ☐ 42-18

☐ 42-3 ☐ 42-4R ☐ 42-122 ☐ 42-101 ☐ EP-15 ☐ 42-130 ☐ 720

Name..

Title..

Company..

Address..

City...State..............................

market has only been scratched. There are more than 18,000 theaters in the U. S. Some theater tv proponents estimate that 10,000 theaters will be equipped within the next 5 years, representing an equipment sales volume of nearly $200 million. This year sales of at least 100 units are expected.

▶ **Equipment**—Instantaneous and delayed film are the two types of equipment that make up the 100 systems now in use. Largest sales volume has been done with instantaneous systems. Only eight film systems have been installed. General Precision Laboratories, a leading manufacturer of film equipment, has discontinued production for theater tv use. The company is now concentrating on instantaneous equipment exclusively. They found that film systems were too costly for the average theater owner ($30,000.) and were too bulky for easy installation.

A new type of instantaneous theater tv equipment called Eidophor, introduced by Twentieth Century Fox in recent months, may be the successor to film systems. It will be competitive in price with present instantaneous units and is adapted for CBS color television. Although no sales have been made as yet, it is reported that production of 500 units is planned for this year.

▶ **Manufacturers** — Three companies are producing and installing theater tv equipment at the present time: RCA, General Precision Laboratories and Trad Television Corp. RCA has sold about 75 percent of all units installed to date. General Precision and Trad follow in that order. General Electric will become the fourth company in the field when it begins production of Eidophor equipment for Twentieth Century Fox. Other electronic manufacturers are working on theater tv systems but have not yet announced definite production plans.

▶ **Future**—Theater tv manufacturers agree that the outcome of current FCC hearings on exclusive channels for theater tv will have a profound effect on overall development of the field. But they do not see any great immediate effect on equipment sales. They are more concerned with theater tv programs, which have been few and far between. Such programming has made many theater owners reluctant to buy equipment.

Manufacturers are optimistic about future program schedules for theater tv. At least 12 programs have already been scheduled for 1953.

Communications Firms Expand Facilities

Companies sold more stocks and bonds in 1952 to buy new plants and equipment

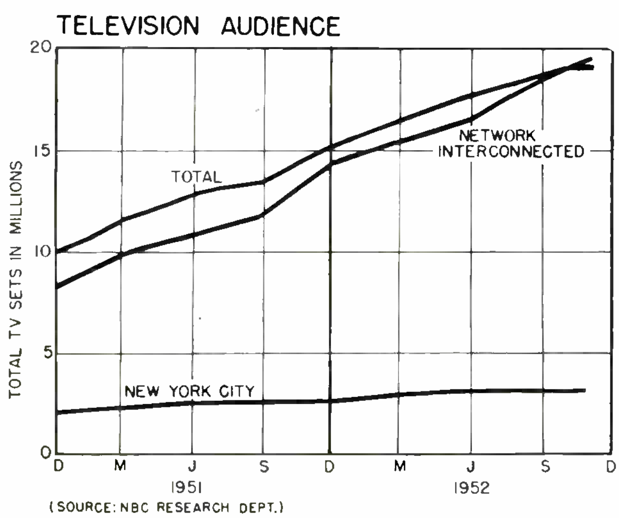
EXPANSION that took place in 1952 and is continuing this year in the communications industry is indicated by new corporate securities that were offered for cash sale in the first 9 months of last year. Estimated gross proceeds from such offerings made by the end of September (latest reported month) were expected to total over $651 million, topping full year proceeds in 1951.

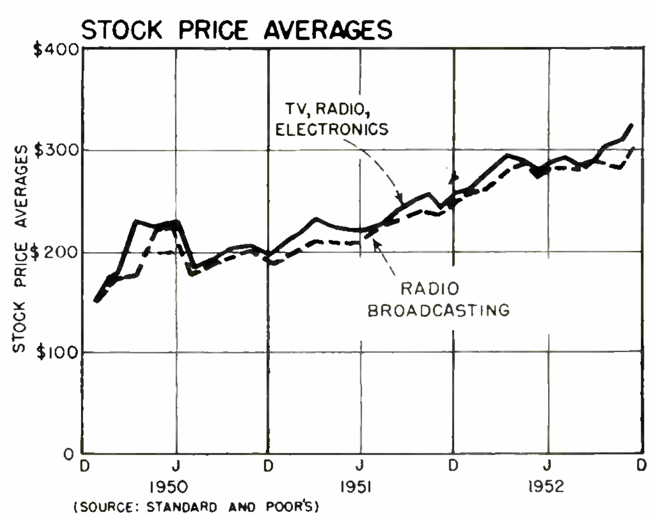
As shown in the chart, last year's volume of security offerings by the communications industry reached the highest point since 1948. It reflected the continuing need for external financing by communications companies to carry out substantial capital expansion programs.

▶ **Expansion**—Proposed uses of estimated net proceeds from the offerings in 1952 was almost entirely for plant and equipment. Out of the total estimated net proceeds of $645 million, communications companies planned to use more than

(Continued on page 16)

ELECTRONIGRAPHS Continued





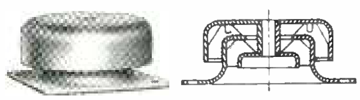
SHOCK AND VIBRATION NEWS

Builder Claims Smooth Performance and Quiet Operation thru the use of Barrymounts in Dehydrator

The 2-way protection given by Barry-mounts is applied in AUTO-DRYAIRE® dehydrators as a design feature of these automatic pressurizing units for high-frequency transmission lines.

In this service, Type C-2000 Barry-mounts prevent transmission of air-compressor vibration to the supporting surface. They also cushion the mounted apparatus to protect active parts, piping, and controls within the dehydrator from external shock and vibration.

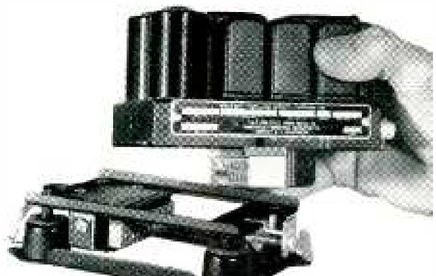
The maker of AUTO-DRYAIRE®, Communication Products Company, Inc. of Marlboro, N. J., states: "We have used Barry Isolators for several years. The excellent service they have rendered in our equipment is the primary reason for their continued use."



Type 2000 Barrymount

Barry "cup" mounts are satisfying a wide variety of needs in industrial, mobile, and marine service. Ask our Field Engineering Department for help with YOUR vibration problems. FREE CATALOG 504-B tells about these and other vibration isolators.

Miniaturized Vibration Isolators Help Cut Space and Weight in Fuel-Gauge Power Unit



70% size reduction and 50% weight reduction — with no loss of performance — is the effective miniaturization obtained in the new Minneapolis-Honeywell aircraft-fuel-gauge power unit. Miniature, air-damped Barry-mounts, Type 6465, helped M-H engineers in this achievement.

These vibration isolators, in which size and weight have been cut while operating characteristics have been maintained, will help you redesign for miniaturization.

Check these useful features of miniaturized Barrymounts.

Light weight — only 5/16 ounce each.

Small size — 1" diameter 11/32" loaded height.

Resonant frequency — 9 cps

Transmissibility at resonance — 3

Wide load range — 0.1-3 pounds

4 different styles available — for plate or stand-off mounting.

Write for data sheets 605 and 606 giving details of dimensions and load ratings.

FREE CATALOGS

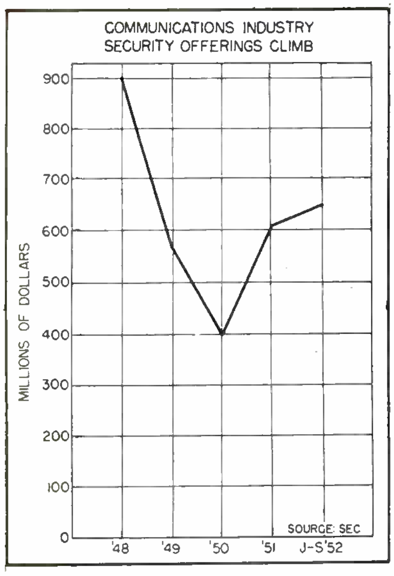
- 523-A — Air-damped Barrymounts for aircraft service; also mounting bases and instrument mountings.
- 509-A — ALL-METL Barrymounts and mounting bases for unusual airborne applications.
- 504-B — Shock mounts and vibration isolators for marine, mobile, and industrial uses.
- 607 — How to cut maintenance costs by using Barrymounts with punch presses.

THE BARRY CORP.

707 PLEASANT ST., WATERTOWN 72, MASSACHUSETTS

SALES REPRESENTATIVES IN

Atlanta Chicago Cleveland Dallas Dayton Detroit Los Angeles Minneapolis New York Philadelphia Phoenix Rochester St. Louis San Francisco Seattle Toronto Washington



$638 million in this manner. A total of $3.8 million was to be used for working capital. The remainder, which amounted to less than $5 million, was to be set aside for retirement of debts, preferred stocks and other purposes.

▶ **Securities**—Bonds were the predominant type of security offered for cash sale during the first 9 months of 1952 by communications companies. About $607 million out of total security offerings of $651 million were of this type. The remaining volume of $42 million was split equally between preferred and common stock sales.

Bond offerings have been predominant in the communications industry since World War II. In fact, most corporate offerings by all industry groups are made in bonds. Two reasons for this are: taxes are less on bonds; less money needs to be paid out on them before investment of the offering's proceeds begin to pay off. It is expected that future security offerings by the communications industry will be largely in bonds for these reasons.

Television Sales Boom in Canada

Cumulative sales total $80 million as broadcasting begins above the border

SCHEDULED television broadcasting in both Toronto and Montreal has given new impetus to retail sales of tv receivers in Canada and their manufacture is now well established in the dominion.

Cumulative retail sales total $80 million, representing 172,000 sets; 92,800 sets were sold during the first ten months of 1952.

▶ **Set Makers**—Twenty-two Canadian set manufacturers are active in the field, many of them subsidiaries of U. S. concerns. Several European firms, mostly British, are also represented.

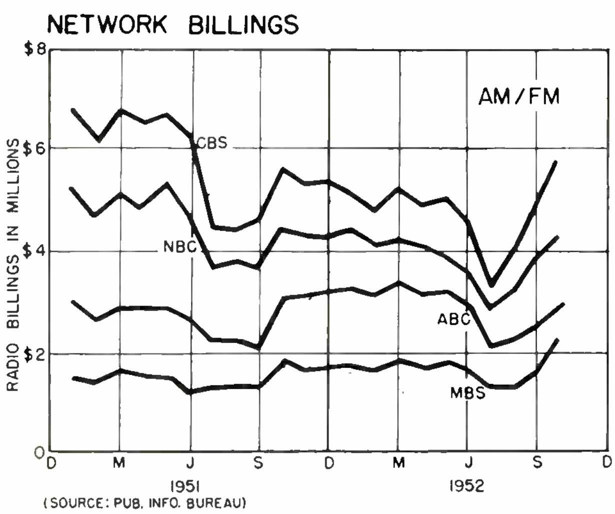
Importation of sets from the states, formerly a big factor in Canadian televiewing, is expected to decline proportionately as protective tariffs encourage Canadian set manufacturers. Set production is restricted somewhat by a shortage of cathode-ray tubes.

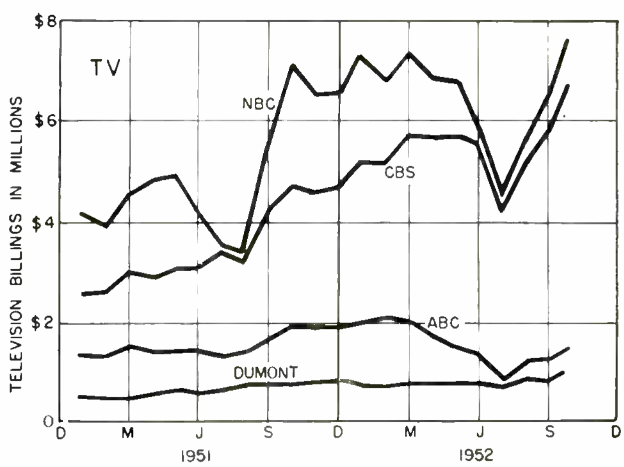
▶ **Market**—The tv receiver market is expected to expand even further as more Canadian stations go on the air. Thus far, 40 percent of set sales have been in the Toronto-Hamilton area and 28 percent in the Montreal area. Remaining sales have been largely in the Windsor area and on the Niagara peninsular, where reception is from U. S. stations.

Canadian Broadcasting Corporation plans include stations in Ottawa, Halifax, Winnipeg and Vancouver. However, the CBC has recently announced that privately-owned stations will be permitted in cities where no CBC outlet is contemplated. A good deal of

(Continued on page 18)

ELECTRONIGRAPHS Continued





Precision Decade Resistors

FOR USE AT D C
AUDIO and RADIO
FREQUENCIES

★ *Either three, four or five decades are available in welded aluminum cabinets*

★ *High basic accuracy — ±0.05% for all decades except ±0.5% for the 0.1-ohm decade, and ±0.15% for the 1-ohm decade*

★ *Excellent stability of calibration — mica cards and special phenolic forms are shaped and heat treated to minimize aging effects — temperature coefficient of resistance is less than 0.002% per degree C. at room temperature; slightly higher for the 0.1-ohm decade*

★ *Low residual impedance — less than 0.003 ohm per decade at dc; 0.04 ohm at 1 Mc. Zero inductance per decade is 0.10 microhenry. Effective shunt capacitance varies from 10 to 45 micromicrofarads depending on combinations of decades in use*

★ *Excellent frequency characteristic permits use up to several hundred kilocycles*

★ *Excellent mechanical and electrical shielding provided by welded aluminum cases*

★ *TYPE 1432 DECADE RESISTORS in ten sizes with resistance ranges from 0 to 111 ohms in 0.1-ohm steps, to 1,111,100 ohms in steps of 10 ohms. PRICES: $56 to $133*

For use as variable laboratory resistance standards, in arms of a-c and d-c bridges, as dummy loads and almost anywhere electrical measurements are made, a variety of G-R precision decade resistors are available.

These boxes have very high accuracy, low residual impedance, excellent stability and good frequency characteristics from zero to several hundred kilocycles.

The individual decades of the Type 1432 boxes are ideal for assembly into production test instruments, laboratory apparatus and custom-built equipment. These Type 510-D Resistance Units are available in ranges from 1 ohm to 1,000,000 ohms, maximum, at prices from $7.50 to $40.00, each.

Type 670-F Compensated Decade Resistor . . . $74.00

This unit is used when even the very low inductance of the Type 1432 Decade Resistors is too large. This decade resistor is valuable wherever non-reactive increments in resistance are required, as tuned-circuit substitution measurements and variable resistance elements in antenna measuring circuits.

★ *Inductance remains constant within 0.1 microhenry at any resistance setting*

★ *Resistance increments are correct within ±0.1% for 10-ohm steps; ±0.25% for 1-ohm steps, and ±1% for 0.1-ohm steps*

★ *Temperature coefficient is less than .002% per degree C. at room temperatures*

★ *Resistance range is 0 to 111 ohms in steps of 0.1 ohm*

GENERAL RADIO Company
275 Massachusetts Avenue, Cambridge 39, Massachusetts
90 West St., NEW YORK 6 · 920 S. Michigan Ave., CHICAGO 5 · 1000 N. Seward St., LOS ANGELES 38

pressure is being exerted on the CBC to allow operation of privately-owned stations in competition with CBC outlets.

Canadian tv station building may affect favorably sales of receivers in American towns near the border not now adequately served by U. S. stations.

▶ **Problems** — Cathode-ray tubes and tuners are not yet made in appreciable quantities in Canada. Tariff on these components adds materially to Canadian tv set prices. Assembly costs, too, are higher and smaller production runs have also served to increase unit costs.

In Toronto costly modifications are necessary to make tv receivers run satisfactorily on 25-cycle current.

In Montreal, a bilingual population demands programs in both French and English, with accompanying time-sharing difficulties.

Rediffusion, a wired television system operating in Montreal, is also a factor in development of broadcast television.

More New Television Stations On Air

Honolulu, Austin, Colorado Springs, El Paso, Roanoke, and Spokane debut

LAST two months of 1952 saw a flurry of new vhf tv stations go on the air, expanding the market for television receivers. Activity was also evident in the uhf tv field.

Following the debut of KDUB-TV in Lubbock, Texas (ELECTRONICS, p. 10, Dec.) KONA, channel 11 in Honolulu, took to the air. The transmitter went by air to the island. It began operating on November 17. Then Austin's KTBC-TV, channel 7, went on the air Thanksgiving Day, followed on December 1 by another new tv station in Honolulu, KGMB-TV channel 9. Less than one week later KKTV, channel 11, in Colorado Springs, made its air debut. The station made record time in getting on the air despite the fact that it had to build a second transmitter building after its cp was issued, to comply with FCC requirements.

On December 4, KROD-TV in El Paso began tests. WSLS-TV in Roanoke and Spokane's KHQ-TV began regular programming on December 11 and 15 respectively.

▶ **Market Status** — Speed with which new tv cp grantees went on the air did not catch television receiver manufacturers napping. Set sales estimates for the six new markets seem to indicate that they were far ahead of the game. In Austin, for example, it is estimated that between 12,000 and 15,000 sets were in the area on December 1, just 4 days after the station went on the air. NBC estimated that on November 1, there were just 4,000 receivers in Austin.

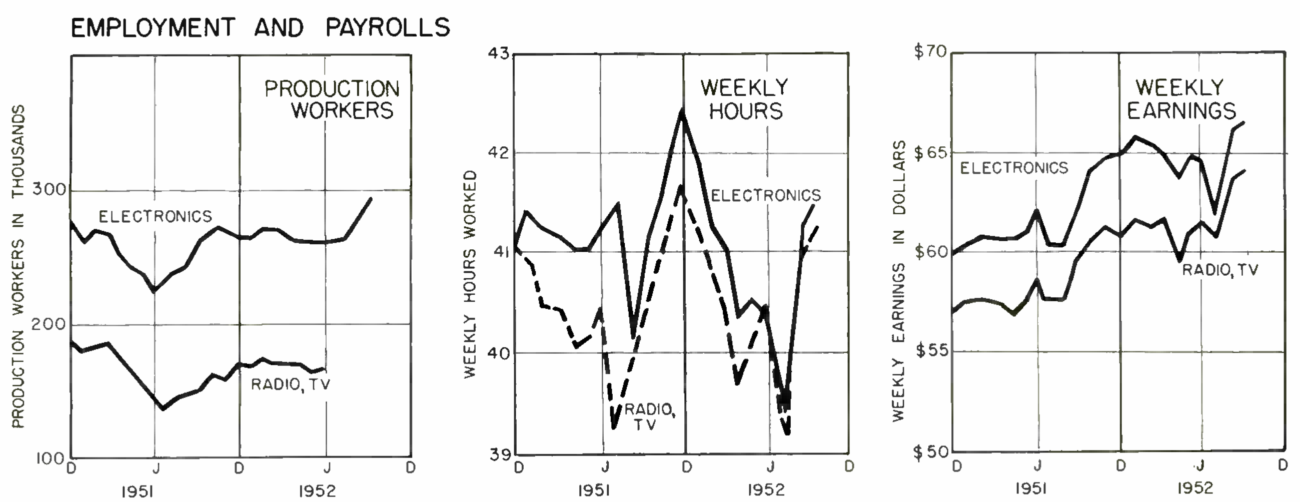
Reliable set estimates for Honolulu have been difficult to get even for tv station representatives but educated guesses set the figure between 3,000 and 5,000 as of December 1. It is reported that both stations are completely covering the city so that sets in use are expected to increase rapidly.

Set estimates for El Paso; Roanoke and Spokane were 8,000; 26,000 and 6,000 respectively when the stations began operations in December.

Set makers were also ready for KKTV's debut in Colorado Springs. There were from 1,500 to 2,000 sets in the area long before a cp was granted to the station. Manufacturers had begun selling sets there when Denver stations went on the air. As of December 8, it was estimated that 10,000 sets were in

(Continued on page 20)

ELECTRONIGRAPHS Continued



(SOURCE: BUR LABOR STATISTICS)

marion

INDUCTION SOLDERING UNIT
MODEL PM1
for soldering small metal parts and assemblies

SPEEDS UP PRODUCTION
REDUCES COSTS
IMPROVES QUALITY

The Marion Model PM1 Induction Heating Units, pictured above, are in service at the Clyde, New York, plant of the General Electric Company.

Germanium diodes, diffused junction rectifiers and transistors are manufactured at the Clyde plant and the Model PM1 Induction Heater plays an important role in a sub-assembly operation on the whisker diode line. A very small pellet of germanium metal is soldered to the end of a nickel pin and the Induction Heater is used to elevate the temperature to the desired value.

This Marion low cost, low powered, portable Induction Soldering Unit (Model PM1) simplifies, improves and speeds up the production of magnet assemblies, relay armatures, connectors, capacitors, transformer cans, germanium diode assemblies and other parts and assemblies in the manufacture of electrical and electronic components. In addition, the Marion PM1 Induction Soldering Unit has many applications in other fields such as jewelry, watches, toys, automotive parts, household fixtures, etc. Wherever the application of intense heat to small units is required chances are that it can be done better, faster and easier with this Marion Unit.

The unit was originally designed and has been used successfully for many years by Marion in the true glass-to-metal sealing of Ruggedized and other hermetically sealed instruments.

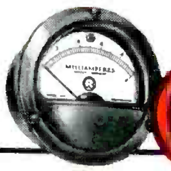
SPECIFICATIONS

Power Supply: 115 volts, 60 cycles
Size: 15¾" x 21½" x 15"
Mounting: Standard relay rack cabinet
Weight: 150 pounds

Power: 775 watts at full power output, 100 watts standby.

The entire unit is rigidly assembled and mounted to prevent arc-over and failure of components. It easily meets latest F.C.C. requirements on radiation.

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



marion meters

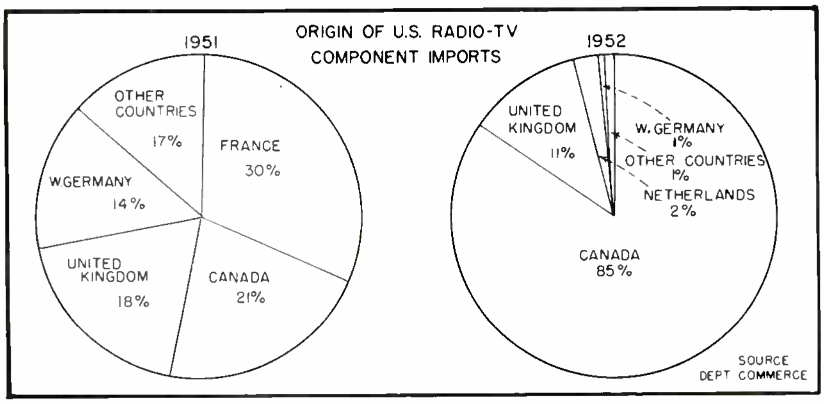
Reg. U.S. Pat. Off.

MANUFACTURERS OF RUGGEDIZED, HERMETICALLY SEALED AND STANDARD PANEL INSTRUMENTS

KKTV's area, which includes Pueblo as well as Colorado Springs.

▶ **UHF Status**—The uhf tv station picture brightened in December when GE made its first shipment of a uhf transmitter, a 100 watt unit, to WKAB-TV in Mobile. Delivery of the antenna, however, was not expected until January.

WHUM, the uhf station in Reading, was also awaiting delivery of equipment. It reported that one of the chief reason's for delay in uhf operations was a shortage of waveguides. Vendors were reported to be unable to supply the much needed equipment in the volume and at the time needed.



CANADA gained but Western Europe lost as . . .

Component Imports Rose In 1952

Totals for first 8 months topped 1951 figures as Canada increased U. S. trade

RADIO-TV apparatus and parts imports to the U. S. reached a total of $4,161,366 by the end of August last year (latest reported month) compared to $4,066,891 for the same period in 1951. As shown in the charts, only Canadian imports increased substantially during the period. Other countries lost.

Volume of U. S. imports of radio-tv apparatus and parts by country of origin during the first 8 months of 1952 were: Canada, $3,371,125; United Kingdom, $463,333; Netherlands, $88,476; West Germany, $25,263. In 1951, for the same period, the totals of leading countries were: France, $1,256,903; Canada, $847,436; United Kingdom, $753,515; West Germany, $566,103.

▶ **Gain**—Canada increased her volume of radio-tv apparatus and parts exports to the U. S. by almost 400 percent over 1951 totals. Her volume was larger than all other countries combined. It represented 85 percent of total radio-tv imports for the period.

Most of the expanded volume of radio-tv imports from Canada is attributed to the increasing number of U. S. electronic equipment manufacturers who have opened branch plants in the Dominion. The general overall expansion of the country as well as the rising amount of U. S. investment capital that is going to Canada have also contributed to the rise.

▶ **Outlook**—With the upswing in business experienced by all segments of the industry in the last quarter of 1952, it is expected that final radio-tv apparatus and parts import totals will show a substantial increase over 1951's volume. However, it is considered unlikely that the totals for countries of Western Europe will change appreciably.

Financial Roundup

REFLECTIONS of the slump in radio and tv sales that took place in early 1952 are apparent in the latest income statements released by companies in the field. Continued expansion of the industry is evident, however, in the stock offerings and filings that were made.

▶ **Profits**—For most of the following companies, net profits for the first 9 months of 1952 were lower when compared to those of the same period in 1951:

Company	1952	1951
Admiral	$3,741,107	$5,400,156
American Cable & Radio	445,055	1,024,506
American Phenolic	922,803*	631,356*
AT & T	264,846,327	243,308,956
CBS	3,807,101	3,532,666
General Cable	3,618,489	3,679,997
Hallicrafters	378,460**	678,946**
Hoffman	994,282	−126,957
Motorola	4,079,262	5,327,442
Philco	6,073,000	7,963,000
Standard Coil	1,963,945	1,164,957
Stewart Warner	2,828,306	3,056,754
Stromberg Carlson	779,614	158,921
Tung-Sol Electric	1,288,324	1,524,628
Webster-Chicago	−607,118	368,739
Westinghouse	48,741,000	42,757,000
Zenith	2,576,212	2,689,630

* Adjusted to reflect retroactive aspects of 1951 Revenue Act.

** Fiscal year ending August 31, 1952.

▶ **Stocks Offered**—Standard Tungsten offered publicly 284,499 shares of common stock (par 10 cents) at $1 per share "as a speculation". Net proceeds will be used to acquire additional properties, to buy equipment and for working capital.

Telecomputing Corporation offered 1,000 shares of capital stock (par $1) at $29 per share (dealers discount of $1.50 per share). The issue was quickly sold. Net proceeds went to W. W. Beman, selling stockholder.

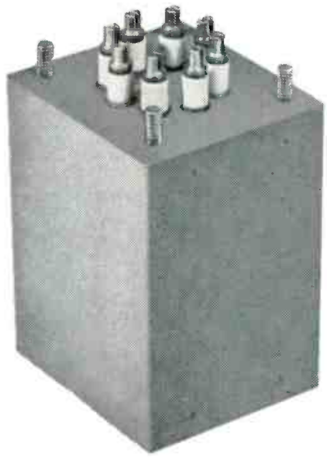
Standard Coil Products registered with SEC for an offering of $5 million of 5 percent convertable subordinated debentures due Dec. 1, 1967 and 250,000 shares of common stock. Proceeds will be added to working capital and used to repay present short term bank loans of $3 million and to provide additional working and expansion capital.

Electronic Devices publicly offered "as a speculation" an issue

(Continued on page 22)

AN IDEAL COMBINATION

ATLAS ENGINEERING TRANSFORMERS



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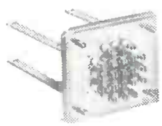
Heldor

CANS & TERMINALS



Built to Meet MIL-T-27 SPECIFICATIONS

Atlas Engineering Company, Inc. of Boston selected Heldor Transformer Cans and Terminals as ideal components for their products . . . Heldor Transformer components give them *better quality* and *consistent uniform production.*

Whether your production is military or civilian, it will pay you to investigate the time-saving, money-saving and inventory-reducing features of HELDOR's complete package . . . transformer cans with compression-type hermetic-seal bushings pre-assembled in cans.

Mail specifications of your present can and terminal assemblies for a convincing, money-saving quotation.

FREE! New Can Catalog! Write today for your copy!

Heldor

HELDOR MANUFACTURING CORPORATION

HELDOR BUSHING & TERMINAL CO., INC.

225 Belleville Ave. Bloomfield, N. J.

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of 3 million shares of common stock (par 1 cent) at 5 cents a share. Proceeds will be used to expand operations and for working capital.

▶ **Stocks Filed**—Electronics and Nucleonics (no relation to us) filed with SEC for 1.2 million shares of common stock (par 1 cent) to be offered at 25 cents per share. Net proceeds to be used to expand current operations and for working capital.

Sightmaster filed with SEC for 5,000 shares of common stock (par 5 cents) to be offered at the market (about 44 cents per share). No general public offering is contemplated. Proceeds are to go to M. L. Kaplan, president, who is the selling stockholder.

Trad Television filed with SEC for 130,000 shares of common stock (par 1 cent) to be offered at the market (approximately 27 cents per share). Proceeds go to Victor Trad, president who is the selling stockholder.

General Electronics Distributors filed with SEC for 1,000 shares of non-voting common stock offered at $37 per share. Proceeds to be used for business operations.


GERMAN V-2 (left) carried its 2,000-lb warhead 250 miles at 3,600 mph; multistage rocket gains range when 'Wac Corporal' in V-2's nose is fired at top of trajectory (right); intercontinental missiles seem closer today because . . .

Tiny Gyro May Guide Missiles

Available components can furnish essentials of guidance

PILOTLESS supersonic parent missiles, able to make round-trip flights and launch air-to-ground atomic missiles at important targets en route, are seen by Arma Corporation engineers as entirely possible.

Using miniaturized gyroscopes, computers and servomechanisms, the 'inertial' guidance system would be wholly self contained, dependent upon the earth's course through space and impervious to enemy deception or jamming.

▶ **Pilotless Flight**—Aside from missile applications, programmed flight based upon inertial navigation is forseen as a means for safe supersonic flight where the human pilot's reaction time is now the limiting factor.

The complete system would weigh about 200 lbs and require no more space than a human pilot. In addition, pilot equipment such as G-suits, parachutes and oxygen would be unnecessary.

▶ **Inertial Navigation**—The missile's flight plan referred to a free gyroscope could be stored in computers.

With error sensing by accelerometers, the system could be made continuously self-correcting through closed-loop servo systems.

FCC Tosses Ball to JTAC On Interference

Government group outlines five-point program aimed towards spectrum conservation

ANY GI knows the dangers of volunteering. Willing volunteers, the members of the Joint Technical Advisory Committee recruited from Radio and Television Manufacturers Association and the Institute of Radio Engineers, have just learned some of the hard facts of life from the Federal Communications Commission.

▶ **How It Started**—JTAC's comprehensive report on spectrum utilization, based on present uses and future needs, was recently published by McGraw-Hill in book form under the title "Radio Spectrum Conservation" ($5). In it, the Committee points out some present inefficient practices and suggests general principles for future betterment.

At the same time, RTMA (which constitutes half of the JTAC combination) has been carrying on a gentle epistolary feud with FCC, which thinks all television set manufacturers should reduce set radiation interference and start using the new standard 41.25-mc intermediate frequency before more stations and receivers go into circulation.

▶ **What FCC Wants**—Now that the JTAC report has outlined broad solutions, including reduction of all interfering signals from transmitters and receivers, FCC is asking that specific suggestions with teeth in them be formulated. It asks that special attention be given to these subjects:

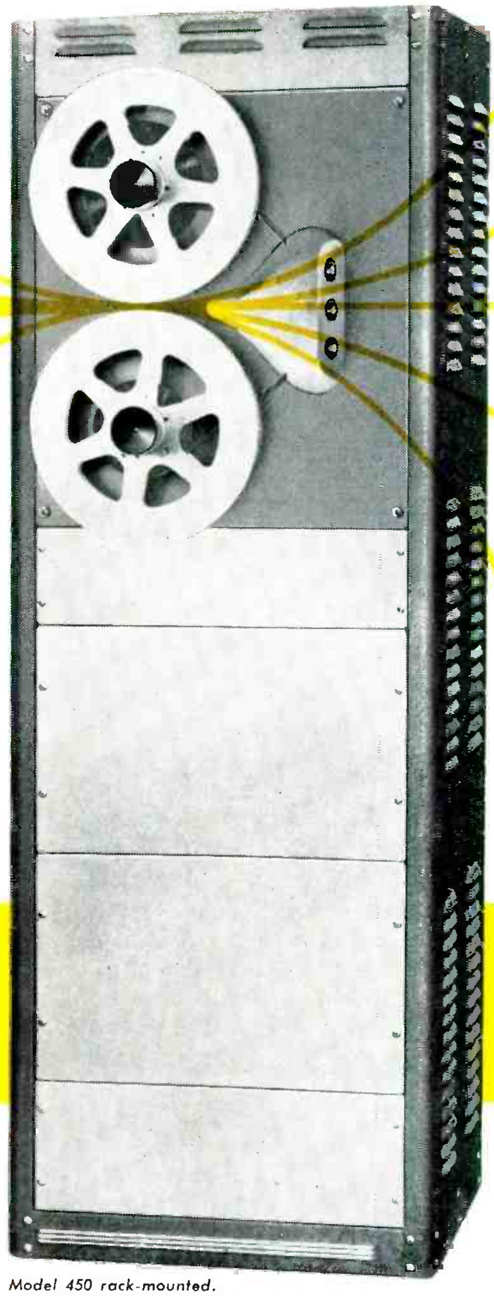
(1) Limits be put on useless but interfering radiations that fall outside the assigned frequency bands. (This is to safeguard broadcasting, aircraft communications and navigational aides.)

(2) Review technical problems of reducing radiation from various non-communications devices (like

(Continued on page 24)

INTRODUCING THE

AMPEX 450



Model 450 rack-mounted.
Also available in portable or console mount.

- ***Up to eight hours of uninterrupted performance — day after day, year after year***
- ***Requires no attention during operation***
- ***Lowest cost per hour***

The new AMPEX 450 gives you hours of high-quality background music delivered at *lowest cost per hour* of any musical reproduction system. With the AMPEX there are no interruptions, no records to change and no attendants since it *needs no attention* during operation. It plays at the touch of a button and keeps on playing for as long as eight hours without repetition. Because tape doesn't lose quality with repeated playings, music is always scratch-free and pleasant, with less background noise and distortion.

The Model 450 is engineered to rigid AMPEX standards and is capable of delivering thousands of hours of service with no breakdowns and minimum maintenance.

For further information, write to Dept. E

IF YOU PLAN FOR TOMORROW, BUY AN AMPEX TODAY

FEATURES

- 50 to 7500-cycle frequency response at 3¾ inch tape speed
- Standard NARTB reels up to 14 inches
- Pushbutton controls
- Automatic reverse control available as an accessory permits full eight hour program without interruption.

AMPEX

MAGNETIC RECORDERS

AMPEX ELECTRIC CORPORATION
934 CHARTER STREET • REDWOOD CITY, CALIF.

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diathermy, welding apparatus and high-frequency heaters) to determine the feasibility of attaining the limits outlined above.

(3) Review the instrumentation problem necessary to put over a national program of spurious radiation control.

(4) Study the procedure and organizational effort in this field to find whether additional effort is needed to co-ordinate interference-reduction efforts.

(5) Determine whether action is needed to co-ordinate "external performance" of receiver with engineering of service and station allocations.

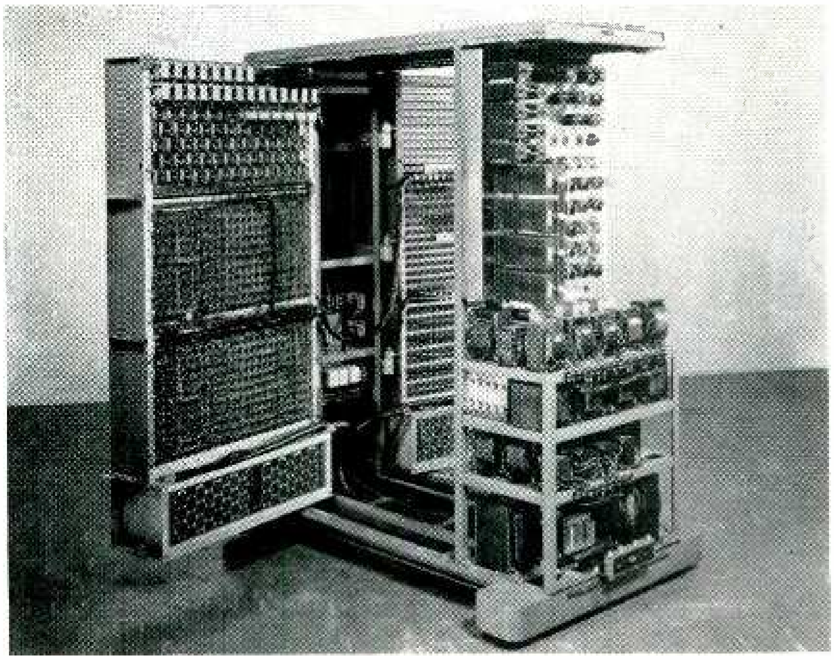
▶ **TV Proposal**—FCC has already proposed a change in its tv broadcast rules. Inviting industry comment before Jan. 12, 1953, it suggests that all emissions removed in frequency in excess of 3 mc above or below the respective channel edge shall be attenuated no less than 60 db below the visual transmitter power. In the event of interference caused to any service, greater attenuation will be required. Manufacturers have already indicated that such suppression at the transmitter output terminals can readily be obtained by harmonic filters.

Parts Industry Set To Appeal Putnam Action

MANUFACTURERS of radio-tv parts and tubes prepared through RTMA to make a joint industry protest to OPS under appeal procedures when Roger L. Putnam, Administrator of the Economic Stabilization Agency, did not lift present price lids on radio-tv parts and tubes (ELECTRONICS, p. 8, Dec. '52).

RTMA will base the new protest on the points that the OPS action is not supported by facts, is contrary to the intent of Congress and the law, and that it is arbitrary and capricious. The Association plans to carry the fight to the courts if the joint appeal fails.

Tubes Speed Magazine Mailing



Highlight of the second annual joint AIEE-IRE-ACM Computer Conference held in New York, Dec. 10-12 was Eastman Kodak's multiple-stylus electronic printer, the electronic portion of which is shown above. Printing capacity is 400 characters per second. Machine is designed for printing magazine and mailing envelope labels, utility bills and insurance premium notices. Address labels can be turned out at six hundred per minute

'Booster' TV Stations Aborning

TOO YOUNG to denote a trend, booster and satellite tv stations now operating nevertheless hold promise for areas too far from ordinary stations to get decent reception and too sparsely populated to support local stations.

The FCC has never authorized such stations commercially, but two of them are operating experimentally. Applications for two more are pending. When results of the experiments are reported, the Commission will consider whether commercial operation should be permitted.

A booster station rebroadcasts the originating station's signal on the same frequency. A satellite rebroadcasts on a different frequency.

▶ **Operating Now**—One satellite is in Emporium, Pa., owned by Sylvania Electric, which operates a tube plant there. It is KG2XDU, radiating 300 watts on uhf channel 22 (518-524 mc). The company also has a construction permit for KG2XEL, to operate on channel 82 (878-884 mc), with 50 watts. Propagation, interference and coverage of the two will be compared. Signals of commercial station WJAC-TV, Johnstown, Pa., are rebroadcast.

A 5-watt installation at Lawrenceburg, Tenn., is operated by WSM-TV, Nashville, as a booster. Like WSM-TV, it employs channel 4, but it radiates vertically polarized signals while WSM-TV transmits conventional horizontally polarized signals. The idea is to determine whether this technique will minimize cochannel interference which would otherwise occur.

▶ **Future Business**—A pending satellite application was filed by Howard-Yale Inc., of Palm

(Continued on page 26)

Springs, Cal., which seeks to rebroadcast the signals of Los Angeles stations, scramble them, and institute a pay-as-you-look system in Palm Springs.

Also pending is the booster application of WSAZ-TV, Huntington, W. Va., which proposes a one-watt station at Williamson, W. Va., to pick up and rebroadcast the mother station's signals for the benefit of Williamson residents. Engineers calculate that one watt, into a directional antenna, can serve 7,000-10,000 people in a 5.57-square mile area.

KGMB-TV in Honolulu plans to put a satellite tv station in operation this year.

The FCC has been in no hurry to authorize boosters and satellites commercially, feeling that regular stations should be given time to develop first. However, if it can be proved that boosters and satellites don't create interference to existing or prospective regular stations, their chances of getting approval will be considerably enhanced. And if proponents of such baby stations can satisfy the Commission that they will bring tv to people who would otherwise get little or none for years, if ever, they're likely to get favorable action.

MEETINGS

JAN. 6: N. Y. AIEE, Lecture on "Storage Devices In High Speed Digital Computers," Engineering Societies Bldg., New York, N. Y.

JAN. 6-8: 1953 Surplus Show, Hotel Statler, New York, N. Y.

JAN. 8-9: AIEE, IRE, Symposium on Industrial Applications of Automatic Computing Equipment, Midwest Research Institute, Kansas City, Mo.

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

JAN. 16: Mica Symposium, American Ceramic Society, Oscar's Restaurant, New York, N. Y.

JAN. 19-23: AIEE Winter Meeting, Hotel Statler, New York, N. Y.

JAN. 26-27: Seventh Regional IRE Conference, University of New Mexico, Albuquerque, N. M.

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.

FEB. 5-7: Audio Fair, Alexandria Hotel, Los Angeles, Calif.

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

MARCH 23-25: Sixth Annual Conference for Protective Relay Engineers, A & M College of Texas, College Station, Texas.

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

MARCH 23-27: Western Metal Exposition, Pan-Pacific Auditorium and Western Metal Congress, Statler Hotel, Los Angeles, Calif.

APRIL 18: Seventh Annual Spring Technical Conference, Cincinnati IRE, Cincinnati, Ohio.

APRIL 27-MAY 8: British Industries Fair, Birmingham & London, England.

APRIL 28-MAY 1: Seventh Annual NARTB Broadcast Engineering Conference, Burdette Hall, Philharmonic Auditorium, Los Angeles, Calif.

APRIL 29-MAY 1: 1953 Electronic Components Symposium, Shakespeare Club, Pasadena, Calif.

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

MAY 18-21: 1953 Electronic Parts Show, Conrad Hilton Hotel, Chicago, Ill.

MAY 18-23: Third International Congress On Electroheat, Paris, France.

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

MAY 24-28: Scientific Apparatus Makers Association Annual Meeting, The Greenbrier, White Sulphur Springs, W. Va.

JUNE 15-19: Exposition of Basic Materials for Industry, Grand Central Palace, New York, N. Y.

JUNE 16-24: International Electro-acoustics Congress, The Netherlands.

JUNE 20-OCT. 11: German Communication and Transport Exhibition, Munich, Germany.

AUG. 19-21: Western Electronic Show & Convention, Municipal Auditorium, San Francisco, Calif.

AUG. 29-SEPT. 6: West German Radio and Television Exhibition, Duesseldorf, Germany.

Transistors In Use

Long-distance dialing service in Englewood, N. J., is a Bell Telephone proving ground for transistor oscillator equipment. The oscillators are used to generate electrical signals by called numbers sent from one central office to another. Each oscillator unit uses six transistors

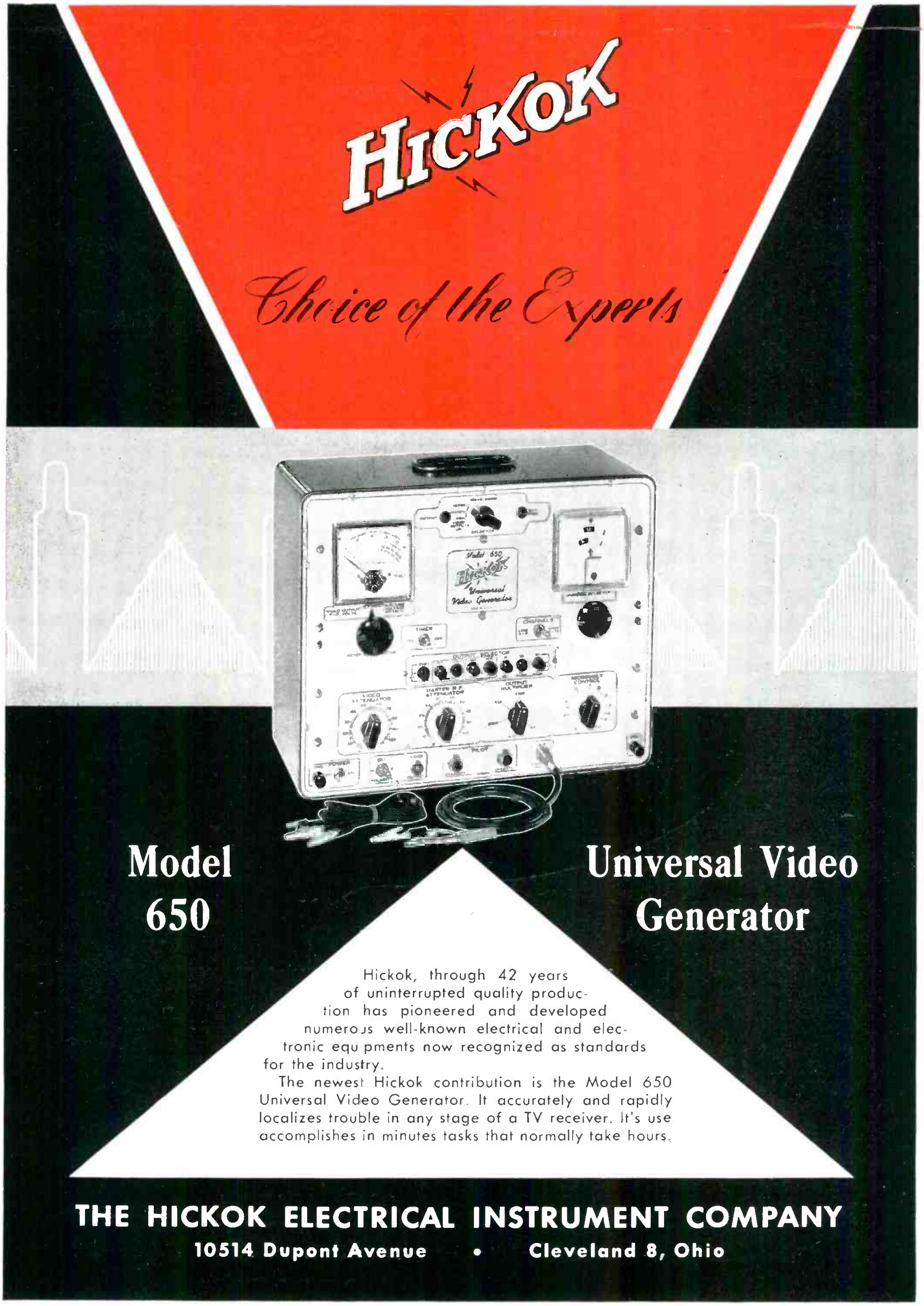
Business Briefs

▶ **MIT's** computer-controlled milling machine (ELECTRONICS cover, Nov. 1952) is now being used to turn out special parts for jet aircraft. One particular part once took 30 hours to produce by conventional methods. With the computer, the job takes 4 minutes.

▶ **Cow Service** in the Lehigh Valley is now being facilitated by two-way radio. Artificial inseminators are speedily dispatched to the receptive animal that can ordinarily be bred only during a 17-hour period every 21 days.

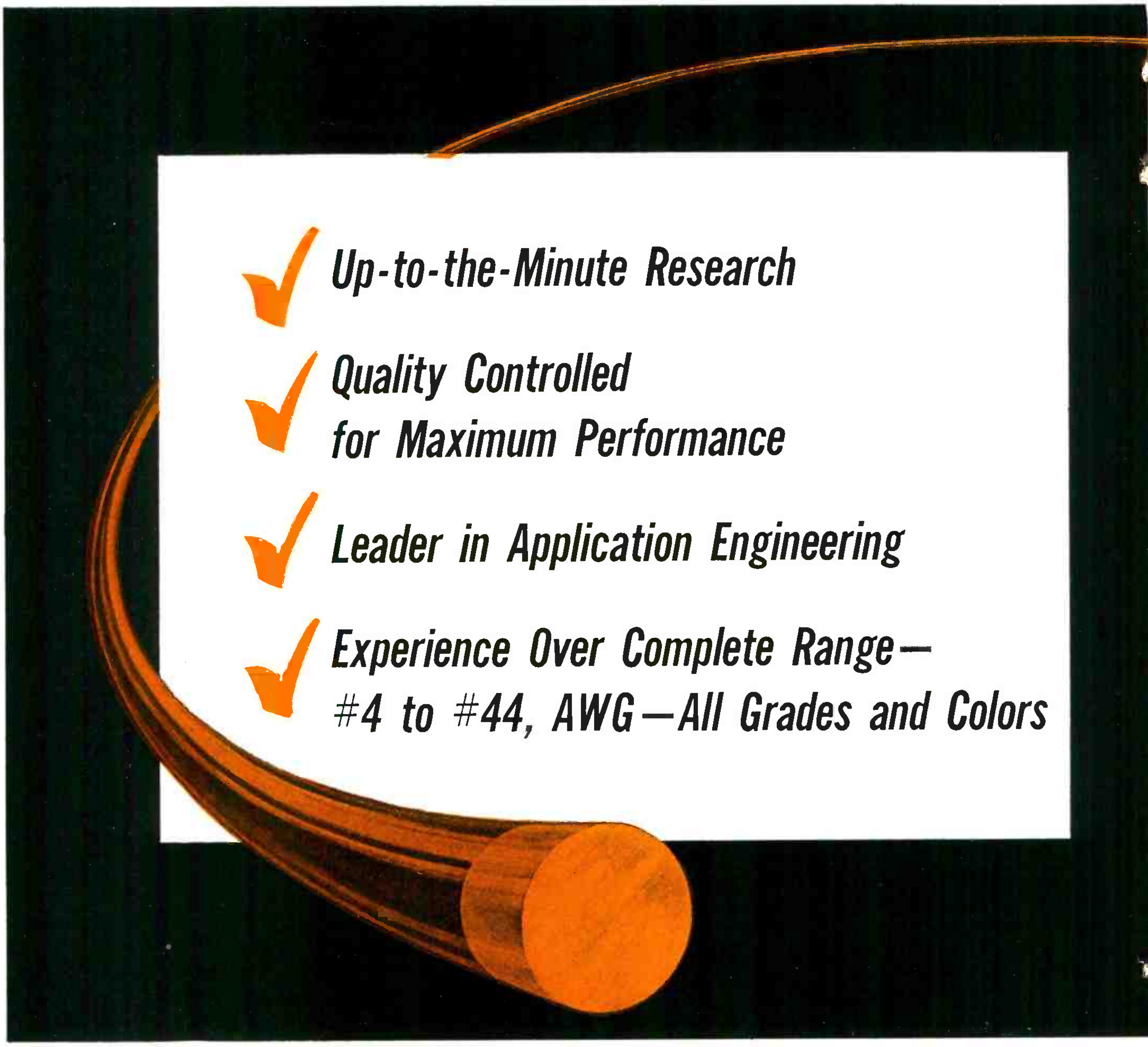
▶ **Siam** is expected to have its first television station on the air this month. A second station expects to begin operations in the early summer of 1953. All equipment for both installations, from transmitters to 16-inch receivers, is being supplied by Marconi.

▶ **Suppressing** devices to prevent tv interference will be compulsory in England on new cars, motorcycles and motorboats sold after July 1, 1953. All such interference radiations between 40 and 70 mc must not exceed 50 microvolts beyond 35 feet. Fines will be imposed if suppressors are not used.


HICKOK
Choice of the Experts
Model 650
Universal Video Generator
Hickok, through 42 years of uninterrupted quality production has pioneered and developed numerous well-known electrical and electronic equipments now recognized as standards for the industry.
The newest Hickok contribution is the Model 650 Universal Video Generator. It accurately and rapidly localizes trouble in any stage of a TV receiver. It's use accomplishes in minutes tasks that normally take hours.
THE HICKOK ELECTRICAL INSTRUMENT COMPANY
10514 Dupont Avenue • Cleveland 8, Ohio

Why **PHELPS DODGE ROUND**

THE YARDSTICK FOR



"It takes the best

PHELPS DODGE COPPER PRODUCTS

CORPORATION

FORMVAR has become
FILM WIRE QUALITY!

PHELPS DODGE, recognizing the advantages of round Formvar magnet wire, became the leader in replacing enamel, fabric and paper-covered wires. Today, round Formvar is used extensively in motors, transformers and coils, with resultant overall cost reductions and quality improvements in the insulation system.

Where greater spacing or additional safety factors are indicated, fabrics such as cotton or paper can be added. For higher temperature operation Phelps Dodge Formvar, with a wrap of fiberglass, has been widely used.

For some applications a thin sheath of Nylon has been applied over the Formvar and identified as Phelps Dodge Nyform magnet wire.

★ ★ ★

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

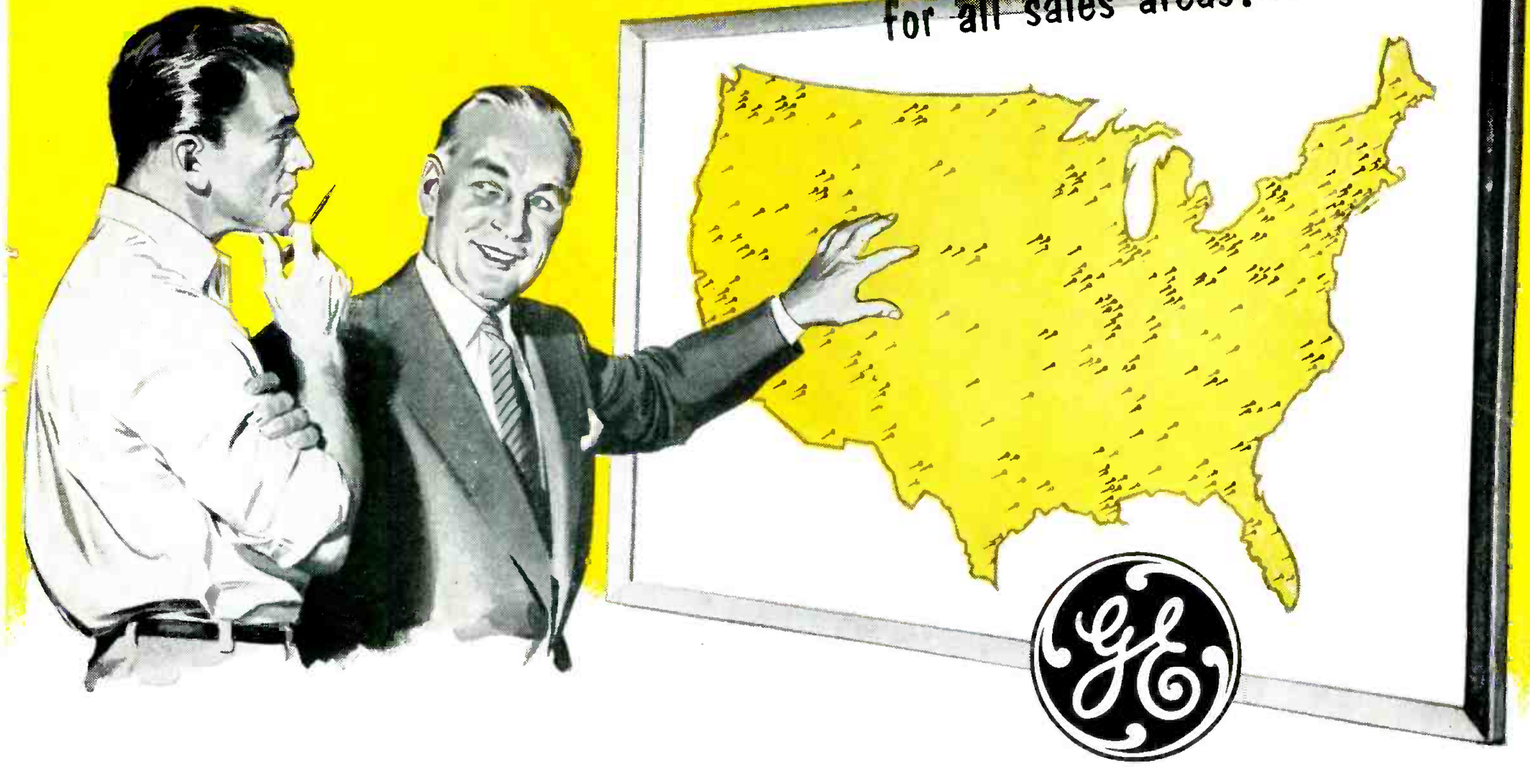
"to make the best!"

PHELPS DODGE COPPER PRODUCTS CORPORATION

INCA MANUFACTURING DIVISION

FORT WAYNE, INDIANA

"We need an 82-channel tuner
—only one line of receivers
for all sales areas!"



TRIM TV COSTS WITH G-E VHF-UHF TUNER TUBES!

6AJ4
Grounded-grid r-f triode (2 stages)

6AM4
Grounded-grid mixer triode

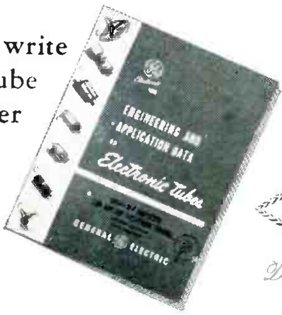
6AF4
Local-oscillator triode

AVOID DOUBLE INVESTMENT IN WAREHOUSE STOCKS . . . cut production expense . . . with the aid of G.E.'s tuner-tube trio! Now you can have one-dial tuning through all TV channels—economically.

45-TO-870-MC RANGE! No need to switch tubes between high and low bands! General Electric tuner tubes are usable at *all* TV frequencies. Layout of your combined head end can be simple, saving tubes, components, and circuitry.

HERE ARE PERFORMANCE PLUSSES YOU OBTAIN: (1) low noise level, with less snow, (2) less radiation interference, (3) high r-f gain. They add up to a far better head-end circuit, as well as one that provides single-dial tuning at low cost.

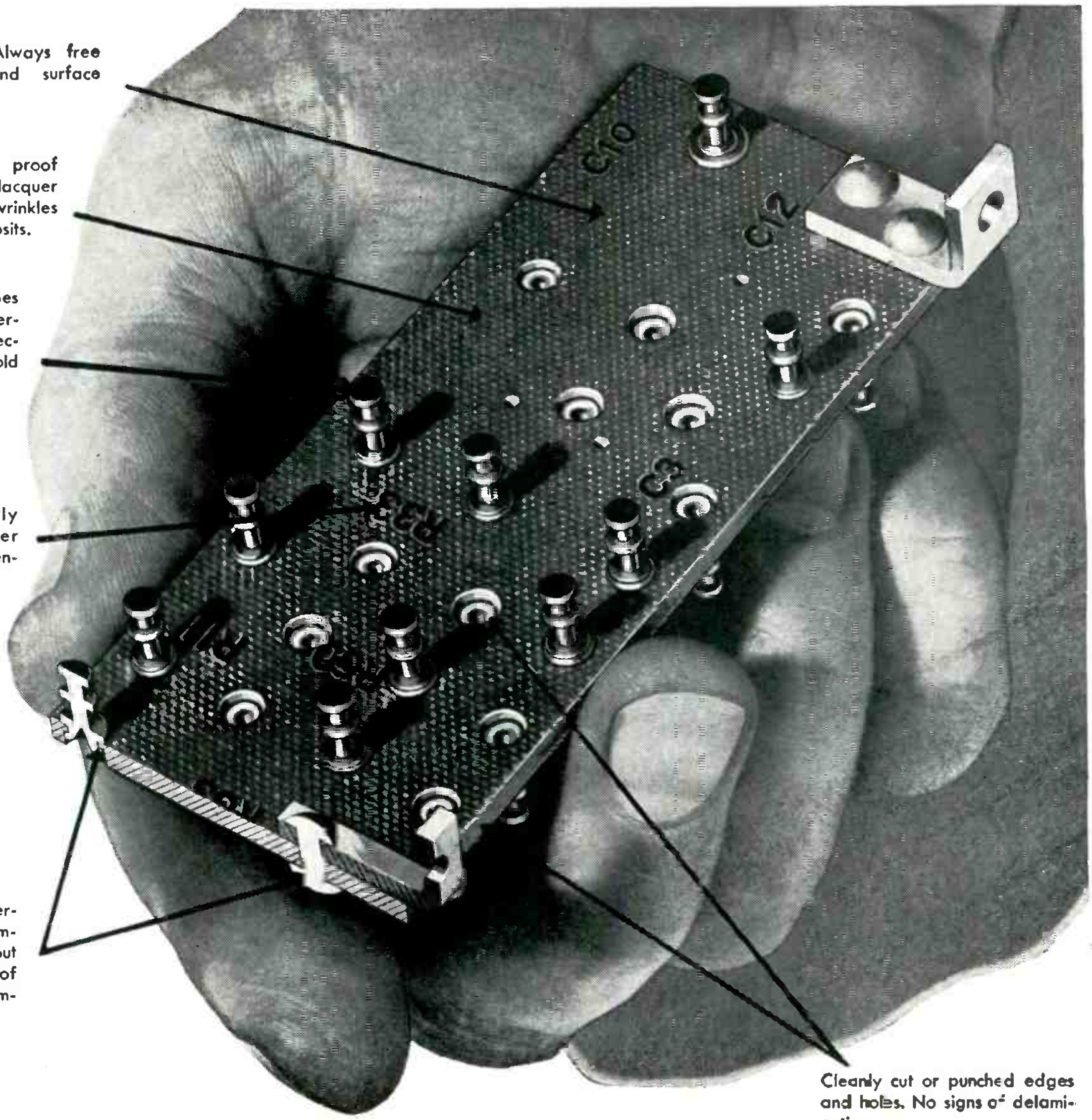
GET FURTHER FACTS—TODAY! Phone, wire, or write for Booklet ETD-591, giving complete tuner-tube information! Or, if you wish, a G-E tube engineer will be glad to call. Address *Tube Department, General Electric Company, Schenectady 5, N.Y.*



1878 75 1953
YEARS OF ELECTRICAL PROGRESS
Diamond Anniversary

GENERAL ELECTRIC

162-1A1



Little details on terminal boards ...*make the big difference in quality*

C.T.C. is constantly supplying special terminal boards to the top names in electronics. These boards are built to strict government specifications, are fabricated of certified materials to fit the job. Among the specifications involved are: MIL-P-3115A, MIL-P-15037, MIL-P-15035, MIL-P-15047, MIL-P-997A.

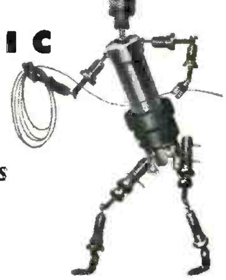
Our Custom Engineering Service is well-equipped to fill these specifications for you. We are thoroughly familiar with the JAN and MIL-approved materials and finishes in accepted usage by government agencies and the armed forces. This, combined with assembly know-how developed over many years of supplying electronic components and equipment to the government, enables us to meet your needs for quality above and beyond the basic government standards.

Boards can be made of cloth, paper, nylon or glass laminates (phenolic, melamine or silicone resin), and can be lacquered or varnished to specifications: JAN-C-173, MIL-V-173 and JAN-T-152. Lettering and numbering is done by rubber stamping, silk screening, hot stamping, engraving. Inks used in rubber stamping contain anti-fungus and fluorescent additives.

For complete information write: Cambridge Thermionic Corporation, 437 Concord Avenue, Cambridge 38, Mass. West Coast manufacturers, contact: E. V. Roberts, 5014 Venice Blvd., Los Angeles, or 988 Market St., San Francisco, Cal.

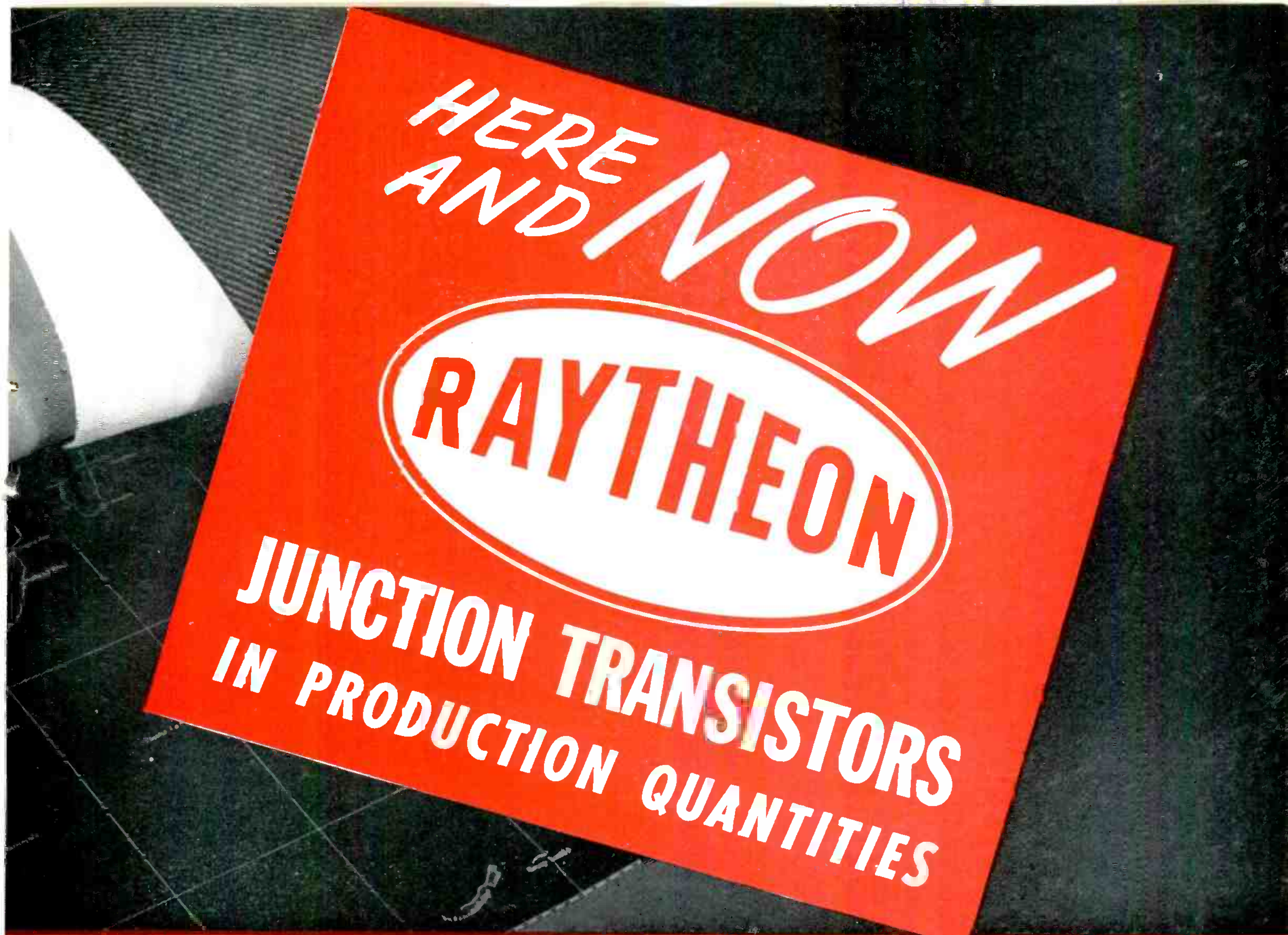
CAMBRIDGE THERMIONIC CORPORATION

custom or standard... the guaranteed components



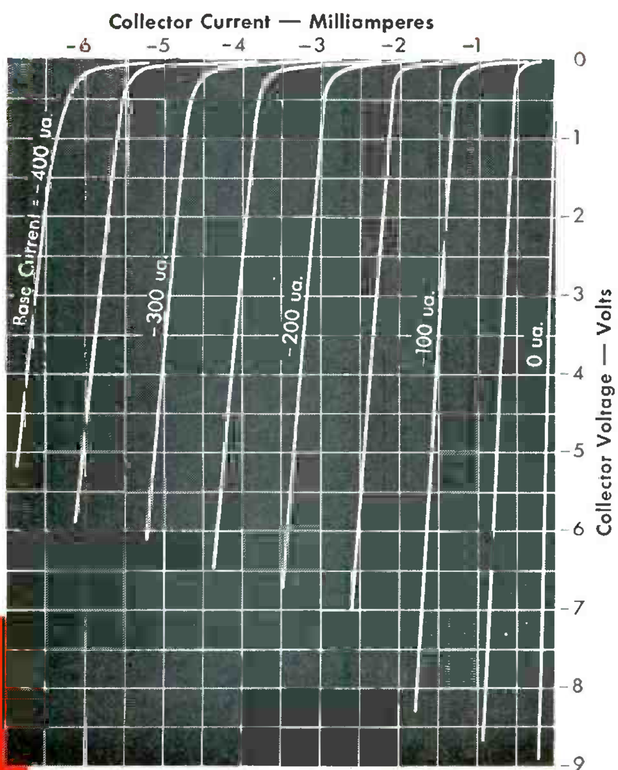
See our listing in Electronics Buyers' Guide

Want more information? Use post card on last page.

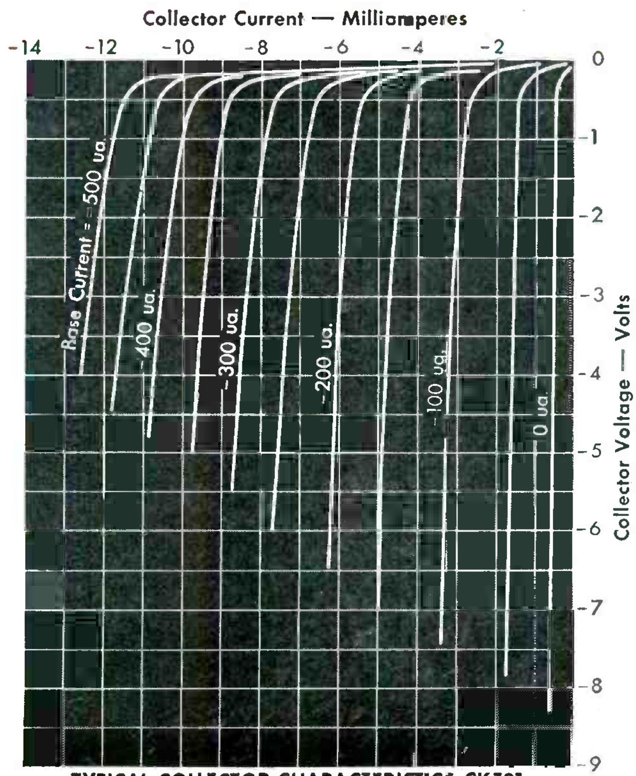


CK722 IMMEDIATELY available in PRODUCTION quantities

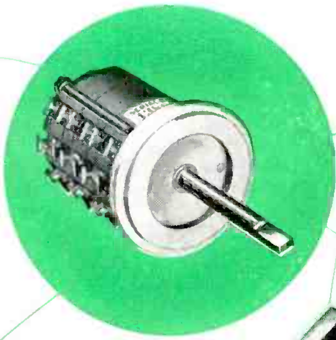
CK721 available in limited quantities until April, 1953



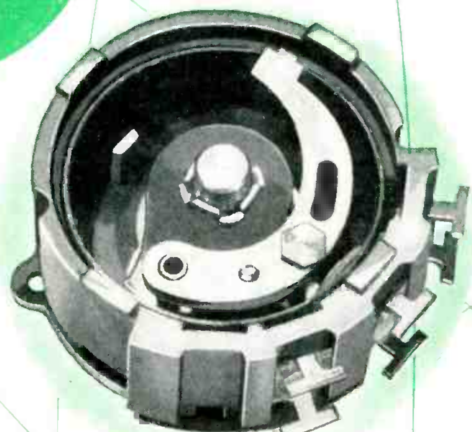
TYPICAL COLLECTOR CHARACTERISTICS CK722



TYPICAL COLLECTOR CHARACTERISTICS CK721



YOU NAME IT



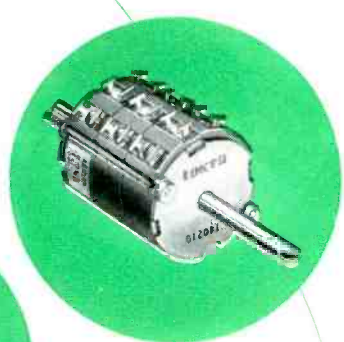
WE'LL MAKE IT

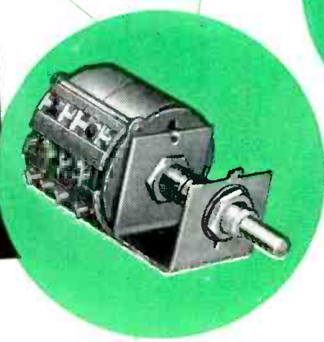
economically

at

CRITICAL CONTROLS

HEADQUARTERS





Ingenuity saves you money when Clarostat engineers collaborate. Mainly because certain basic designs, parts and production procedures are applied to both *standard* and *special* control requirements.

Take the Series 42a high-precision wire-wound controls, for example. The basic unit is a marvel of *quality* production. Exceeds JAN-R-19 specs where applicable.

Used alone or in multi-tandem assemblies, it meets tolerances even to 0.5%.

But Clarostat doesn't stop with the standard unit. Series 42a is made in many variations — all kinds of shafts; high-torque; continuous rotation; many different mountings; etc.

Typical of Clarostat engineering ingenuity—channeled to your exceptional control needs—and at real savings!

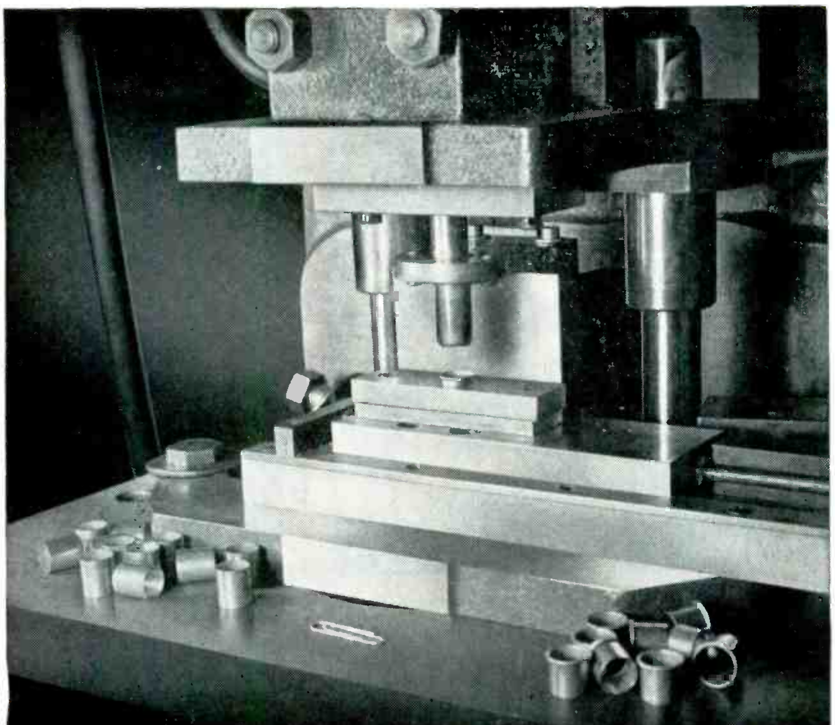
STAND PAT WITH

Don't hesitate to submit that "difficult" control problem to Clarostat engineers. They thrive on making the "impossible", possible. Engineering data on request.

CLAROSTAT Controls & Resistors

CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE

In Canada: Canadian Marconi Co., Ltd., Toronto, Ontario



Rolled and Bent Tubular Parts

—a Superior Specialty

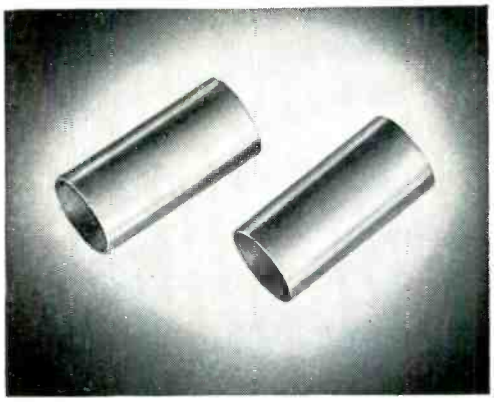
Men, experience, and machines-that-do-everything-but-talk, are generally the answer to a problem of obtaining parts of complex shape and precise dimension.

Here at Superior, customers for parts of this kind get a particularly good answer. We have the experienced men with a solid background of tubular parts production who are willing and able to take the time and care required for top-quality products. And we have the machines.

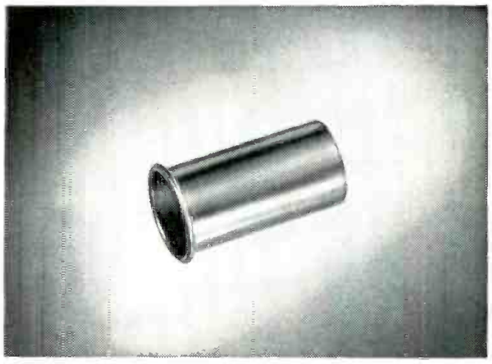
The delivery end of one of them is shown above. The part coming out came into our plant as a 2" tube, went through several redraw and annealing operations, was finally cut to exact length, tumbled to remove cutting burrs, then rolled by a controlled process to the precise dimensions established by customer specifications.

There's nothing spectacular in the story . . . it's just the outline of one of the many jobs that we know how to do well. Behind the story, however, is a thought for you.

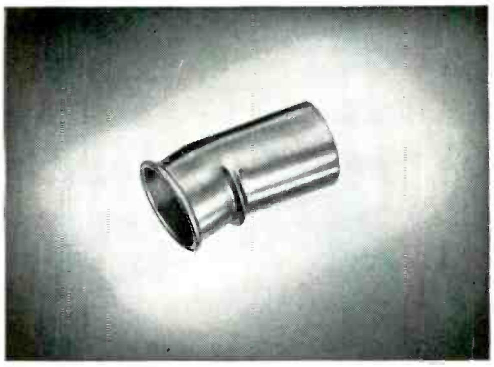
Our production story is backed by our ability, facility and desire to help you. If you are an experimenter in electronics or a manufacturer of electronic equipment and you need a tubular part to do a tough job well, better check with us. We'll be glad to assist with research, development, and design aid toward the solution of your problems. Tell us about them by writing Superior Tube Company, 2500 Germantown Ave., Norristown, Pennsylvania.



Cutting and Tumbling. Cutting machines and jigs of many types and sizes are combined with extensive tumbling equipment to permit fast, accurate production of quantities of parts at Superior.



Fabrication. Parts can be readily rolled at either or both ends, flared, flanged, expanded, or beaded (embossed) as required. The anode above is one of many such parts we produce at high speed and low cost.



The Finished Part. Final stage in the fabrication of the part, shown above at three stages of production, is a bend nicely controlled for both precise angle and freedom from other, unwanted distortion.

This Belongs in Your Reference File
. . . Send for It Today.

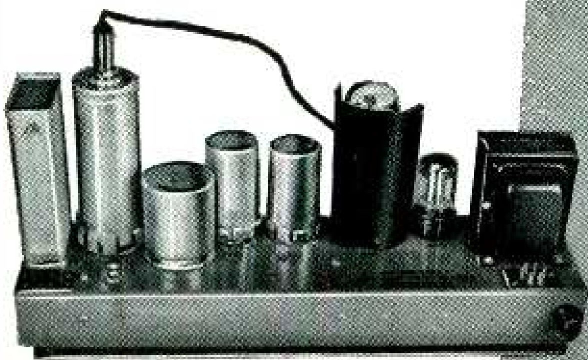
NICKEL ALLOYS FOR OXIDE-COATED CATHODES: This reprint describes the manufacturing of the cathode sleeve—from the refining of the base metal; includes the action of the small percentage impurities upon the vapor pressure and sublimation rate of the nickel base. Future trends of cathode materials are also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

Superior
THE BI[illegible]E IN SMALL TUBING

All analyses .010" to ⅝" O.D.
Certain analyses (.035" max. wall) Up to 1⅝" O.D.

***SUPERIOR TUBE COMPANY** • Electronic products for export through Driver-Harris Company, Harrison, New Jersey • Harrison 6-4800*

Want more information? Use post card on last page.



A lot of Engineering for an Amplifier, but...

Good engineering shows in this Amplifier's wide range of sensitivities, and of impedances, thorough filtering and plug-in connection to the rest of the Speedomax instrument.

it helps Speedomax to fit your ideas!

Good engineering shows in this Converter's phenomenally low noise level and in its long-lived performance.

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.

• Your needs and ideas put this electronic "tool" to work on an amazing variety of jobs. Controlling furnaces and peering into atoms; counting bottles and spying on the weather; taking the "shine" out of rayon or putting it on hardware, to name six out of thousands of uses. For, in general, if you can feed Speedomax a tiny electrical signal, representing the condition you wish to measure, the instrument will not only put "calipers" on it, but will amplify it enormously to direct anything that can be directed through electrical or pneumatic means.

The Speedomax way of handling this job provides particularly accurate results and an especially good fit in meeting your individual ideas. For instance, there's the matter of receiving the signal in a way suited to its size—or, more usually, to its smallness.

We have no less than twenty-three carefully-engineered Speedomax Amplifiers covering a wide range of sensitivity and impedance levels. One Amplifier in the series enables the Speedomax to respond to a signal of only 10^{-16} watt—one ten-billionth of a microwatt. No other recorder amplifier comes within 3 magnitudes of this figure. Such sensitivity means corresponding accuracy in detecting the tiny unbalance—called "error" by circuit engineers—which actuates the rebalance system.

In terms of power, all 23 Amplifiers deliver the same—5 or 6 watts. This is from 2 to 4 times the output of other recorder amplifiers; permits a more powerful balancing motor. And the Amplifier-Motor team provides an especially high torque gradient just where it's needed—centering around the balance point—for prompt, positive balancing and easy, effortless operation of a "heavy" load of control or signal devices in the motor shaft.

The Speedomax story for industry is told in Catalog ND46(1); for Research, in Tech. Pub. ND46(1). We will send either on request; address our nearest office or 4979 Stenton Ave., Phila. 44, Pa.

CAREER OPPORTUNITIES AT L&N

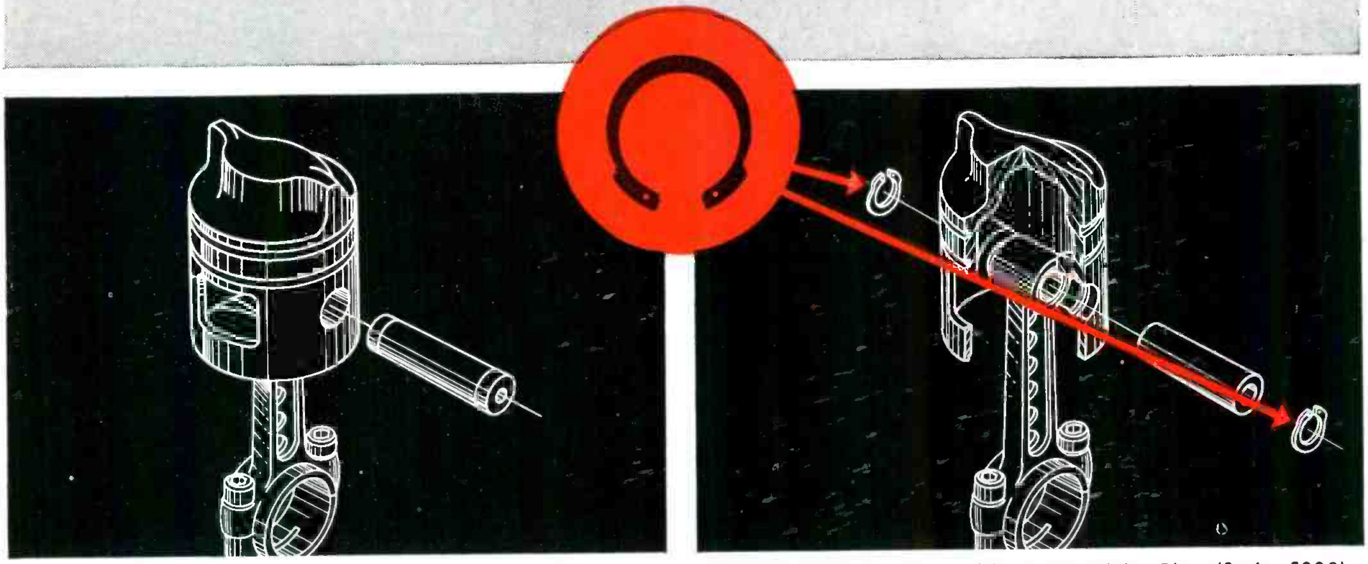
Expansion program of this long-established firm has many features to attract outstanding recent graduates in engineering and science. Opportunities are in sales field engineering, product and application engineering, research, advertising, market development. Widely-respected policies assure recognition of progress and achievement. Address Personnel Manager for preliminary interview at nearest of 17 L&N offices.

LEEDS NORTHRUP

instruments automatic controls • furnaces

Jrl. Ad. ND46(7)

2 Waldes Truarc Rings Replace 2 End Plugs ...Eliminate 3 Operations...Save $.066 Per Unit



OLD WAY Two inserted-plug type wrist pin locks hold wrist pin in place. 3 operations involved: costly machining, pressing in place, post-assembly machining. Costly maintenance problem—resulting from end plugs hammering loose.

TRUARC WAY Two Truarc Inverted Retaining Rings (Series 5008) hold wrist pin in place. Truarc Rings snap into grooves easily cut in piston, provide positive lock . . . practically eliminate maintenance costs. Quick assembly, disassembly.

Titan Chain Saws, Inc., Seattle, Washington, uses 2 Waldes Truarc Rings to replace old-style inserted-plug type wrist pin locks in their Titan chain saws. Use of Waldes Truarc Retaining Rings eliminates 2 press fit end plugs. Machining of plugs, pressing in place, finish machining—no longer required. Truarc way holds rejections to a minimum. Unit efficiency is greatly increased.

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

USE OF 2 WALDES TRUARC RINGS PERMITTED THESE SAVINGS PER UNIT:

OLD WAY	
Cost of 2 end plugs / Cost of pressing in and machining	$ .169
TRUARC WAY	
Cost of grooving piston / Cost of 2 Truarc Rings	.103
Saving per Unit	**$ .066**

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

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.

(Please print)

Name..........

Title..........

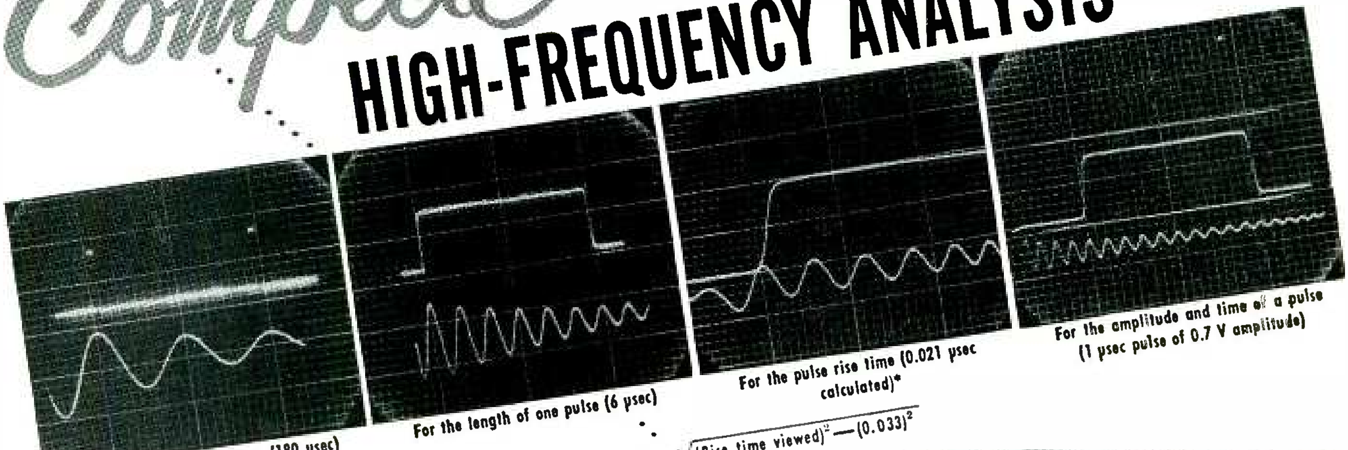
Company..........

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

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

Want more information? Use post card on last page.

Complete HIGH-FREQUENCY ANALYSIS



For the time between pulses (180 μsec)

For the length of one pulse (6 μsec)

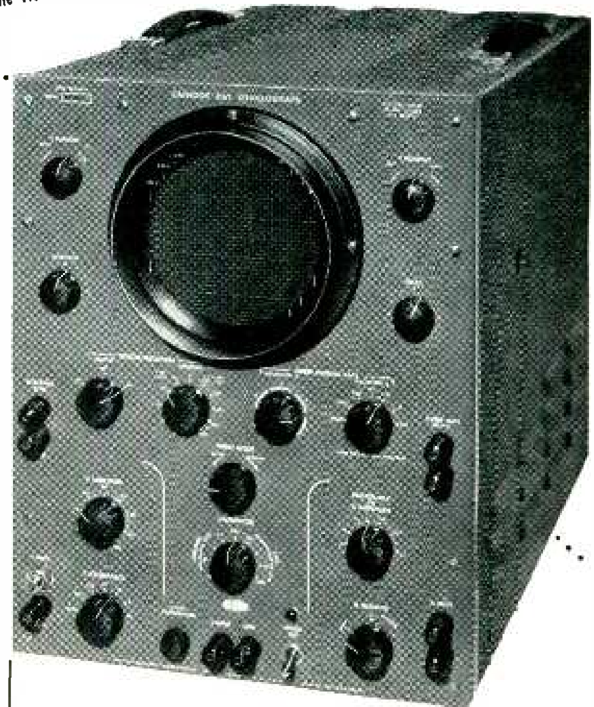
For the pulse rise time (0.021 μsec calculated)*

For the amplitude and time of a pulse (1 μsec pulse of 0.7 V amplitude)

*Rise time $= \sqrt{(\text{Rise time viewed})^2 - (0.033)^2}$

with a DU MONT HIGH-VOLTAGE TYPE 303-AH

The new Du Mont Type 303-AH *is the high-voltage, high-frequency instrument for you — why?*



The 10,000 volts applied to the cathode-ray tube provides a bright, highly resolved presentation for viewing or recording short duration transients or high-frequency signals even at low repetition rates.

The metallization of the cathode-ray tube greatly increases brightness over normal screen brightness and prevents buildup of spurious screen charges, thus allowing faithful reproduction of short-duration transients having low repetition rates.

The BNC-type coaxial input permits convenient connection of pulse-type signals usually carried on coaxial lines.

The wideband vertical amplifier (3 db down) 10 MC has a pulse response of 0.033 μsec for faithful reproduction of short rise-times without overshoot.

The fast linear sweeps, 6"/μsec (0.065 μsec/cm) at 10 KV, take fullest advantage of the wideband amplifier for expanding and measuring short rise-times.

The 0.25 μsec signal delay line introduces no signal distortion and allows sufficient time for the sweep to start before the signal appears.

The provision for both amplitude and time calibration of 0.1, 1, 10 and 100 volts peak to peak and 0.1, 1, 10 and 100 μsec intervals insures accuracy and convenience of measurement.

The variable-intensity illuminated scale facilitates visual or photographic measurements.

Type 316-A probe available for low capacity input. Price $27.00.

- METALLIZED CATHODE-RAY TUBE
- SELF-CONTAINED
- HIGH VOLTAGE
- LIGHT WEIGHT
- FAST SWEEPS
- LOW COST

PRICE **$990**

WRITE FOR FULL DETAILS AND SPECIFICATIONS

DU MONT

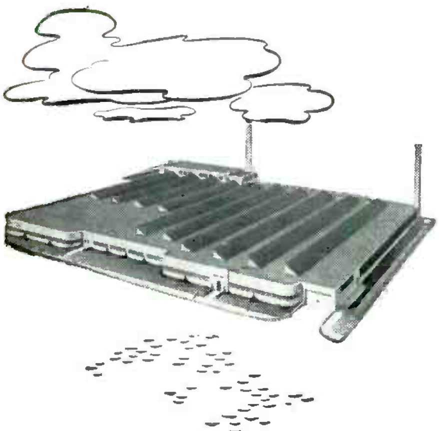
ALLEN B. DU MONT LABORATORIES, INC. • INSTRUMENT DIVISION • 1500 MAIN AVE., CLIFTON, N.J.

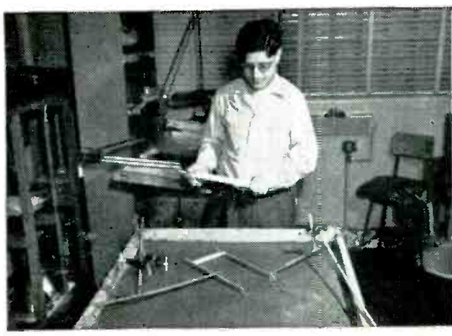
What Rauland means by "Perfection Through Research"

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

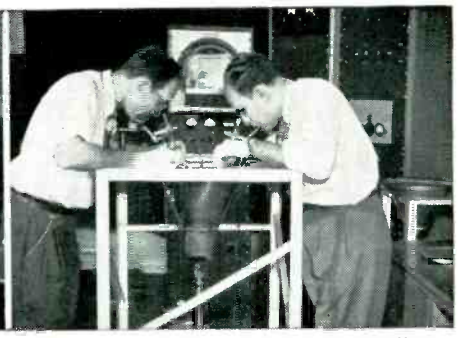
The result has been to give you more picture tube advancements since the war than any other manufacturer . . . first chance at the latest developments for companies using Rauland tubes as original equipment . . . and a real selling edge at the retail level because of the extra satisfaction which Rauland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

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

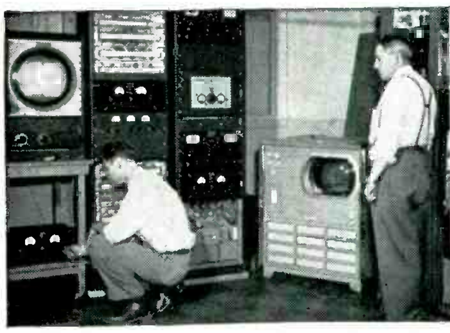




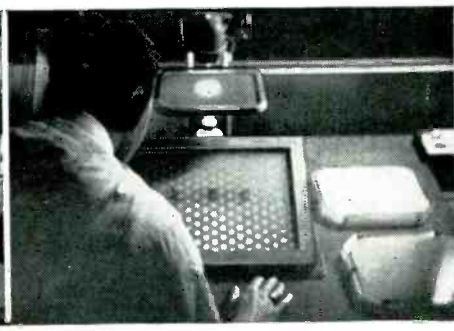
Rubber model for studying electron optical designing—basis for Rauland's exclusive Indicator Ion Trap.



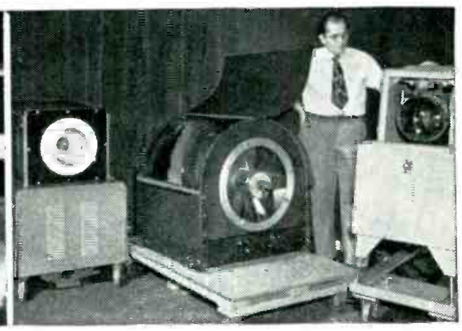
Alignment of the screen and parallax mask of tri-color tube containing approximately a million fluorescent dots.



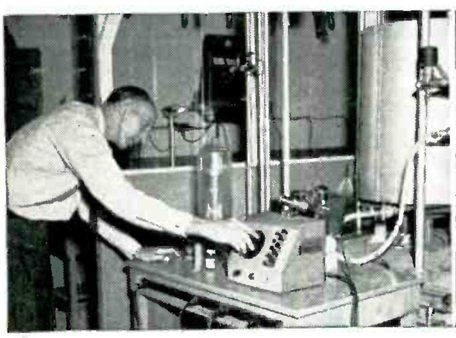
All-electronic tri-color tube in electronic receiver system (left) in comparison with mechanical system (right).



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

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.

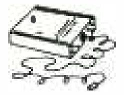
Suggestion to your Lab or Research Dept.

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

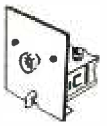


Avoid floorful of over-length cords.

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

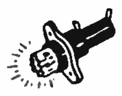


Front panel (various sizes) carries controls, indicators, sensing elements, with their interwiring.

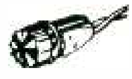
Detachable front panel hinged giving accessibility for ease of assembly and servicing.

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.**

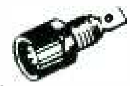
   SEE "ALDEN HANDBOOK" PAGES ES-5A & B; DL-5A & B; TE-3A & B; CG — all pages



Fuses that indicate when blown.



Indicator lamps always easily replaced so always functioning.

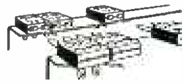


Insulated test point jacks for plate voltages up to 6,000V.

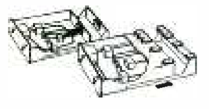
Plug-in Memory or Pulse Circuits.

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.

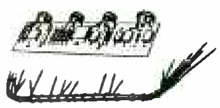


Back Connectors permit direct efficient wiring — avoid conventional rat's nest wiring.

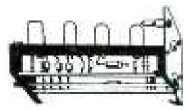
Back Connectors mount on Back Plate to give one point to check all chassis connections.

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



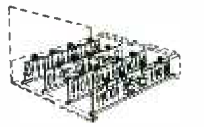
Terminal Panel Board with all components mounted in one plane, and Alden Unit Cable for interconnecting all panel elements with leads.



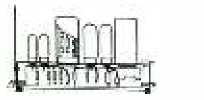
Layering of circuits using Alden Terminal Panels to segregate each main function and associate elements in one plane—for ease of assembly and check.

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.

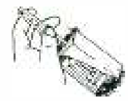
   SEE "ALDEN HANDBOOK" PAGES PI-1A thru H FOR COMPLETE DETAILS



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



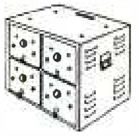
How Alden Terminal Panel groups main functions and how plug-in units have parallel functions for largest amount circuitry per cubic space.



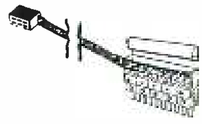
Alden "20" Packages house plug-in Units give independent shielding and heat dispersion.

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



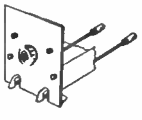
Separate chassis may be stacked in Alden Un-i-rack Cabinet. Cabinet can be interconnected within by Alden unit plug-in cables.



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

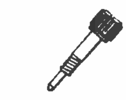
8. **To design so that no equipment — whether plug-in unit or slide-in chassis — needs to be out of operation for more than 30 seconds (having adequate spares on hand), Alden provides quick detaching and quick fastening devices for chassis.** The Serve-a-Unit locks that will move chassis against weight 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.

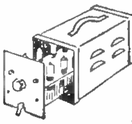
Alden Target Screw
The Toolless Screw



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



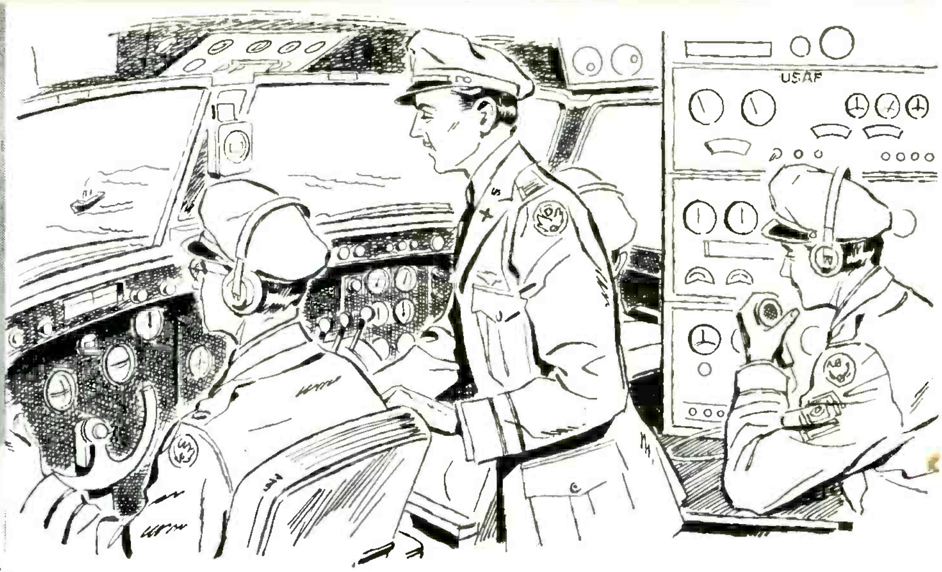
Chassis in carrying or serviceman's case or case to house spare.

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.

NA-ALD

ALDEN PRODUCTS COMPANY 127 North Main Street, Brockton, Massachusetts



Courtesy Lear, Inc.

in instruments where reliability is imperative

SILASTIC* works

where other materials fail

To assure maximum service life and accuracy, engineers at Lear, Incorporated, planned to protect their new vertical gyro-mechanism from corrosion by housing it in a completely inert and dehydrated atmosphere.

Sealing the housing, however, proved to be more easily said than done. Despite the most elaborate precautions, solder and flux fumes often penetrated the joint and contaminated the delicate mechanism. Once sealed, it was impossible to reopen the case without loss of the expensive cover and harness.

To both of these problems a simple and ingenious solution was found. A thin O-ring of Silastic molded to fit snugly under the cover flange is used to exclude the corrosive fumes generated in soldering a metal strip over the entire joint. The Dow Corning silicone rubber O-ring is not damaged by soldering temperatures. And, the gyro-mechanism is just as accessible for repairs as the contents of a hermetically sealed can of coffee.

Lear also uses a large ring washer of Silastic at each end of the housing to serve as resilient, shock-absorbing cushions for the apparatus at stratospheric temperatures.

And that's just one of hundreds of examples of how Silastic is used to improve the performance of products ranging from cable to traction motors, from domestic steam irons to aircraft.

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

For more information about the properties or fabricators of Silastic, mail this coupon today or phone our nearest branch office.

Dow Corning Corporation, Dept. BE-1, Midland, Mich.

Please send me:

- ☐ Silastic Facts 10a with new data on properties and applications of all Silastic stocks and pastes.
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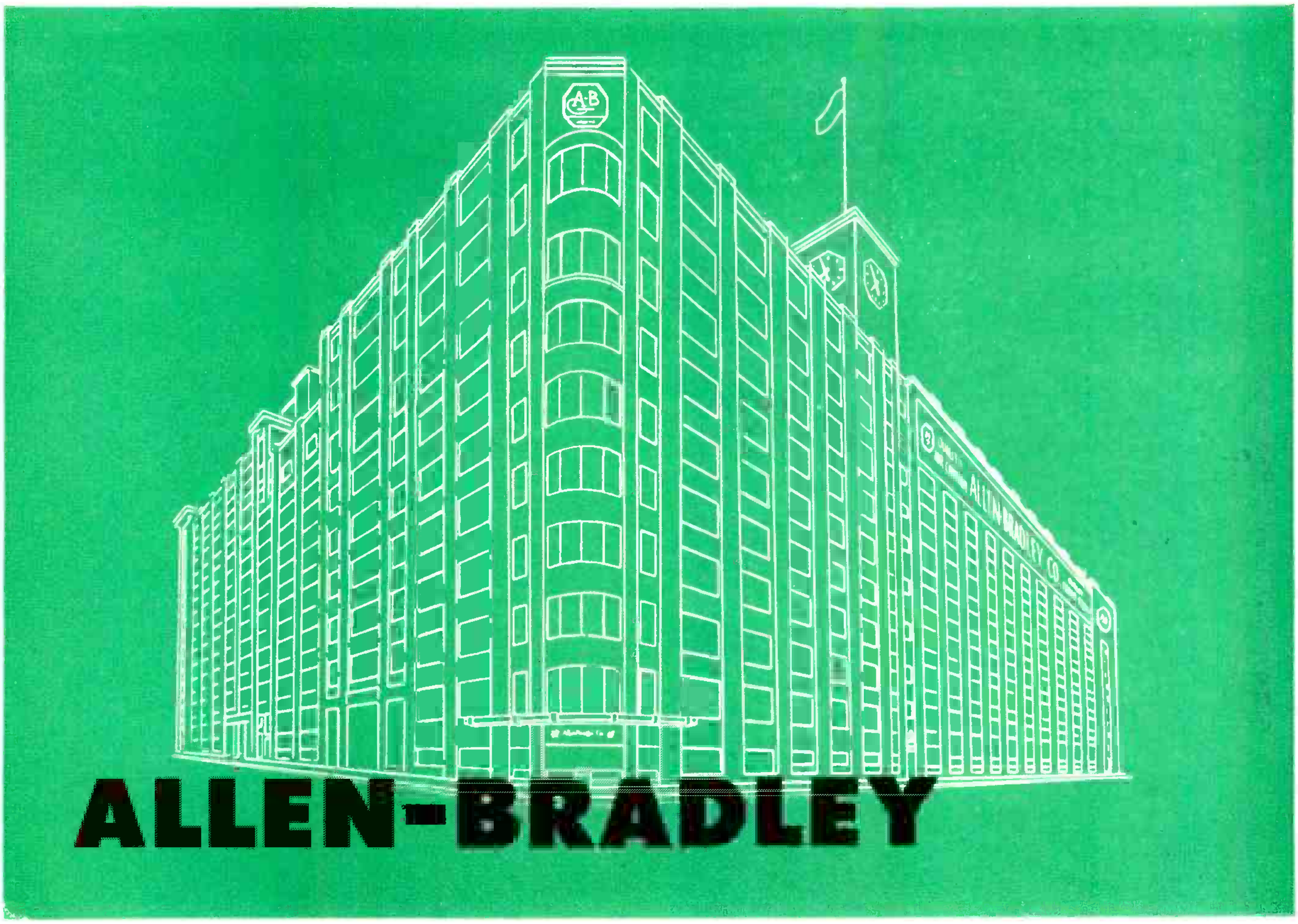


. . . A NEW AND DEPENDABLE SOURCE OF HIGH QUALITY CERAMIC CAPACITORS

Allen-Bradley ceramic discs of high K dielectric material are molded by precision methods. After discs are sintered, silver paste is applied to each side and heat treated. After leads are soldered to silver surfaces, the capacitor is insulated and wax impregnated.

If you use ceramic capacitors, you will be interested in Allen-Bradley as a source, because we make the entire capacitor, from the dielectric disc to the finished and tested unit. Send for samples for your qualification tests. Available from 0.001 to 0.01 microfarads.

Allen-Bradley makes its own Ceramic Discs

To assure dependable production and consistent capacitor quality, Allen-Bradley molds and sinters its own ceramic discs. All manufacturing processes are Allen-Bradley controlled.

Allen-Bradley ceramic capacitors are approved by the engineering departments of leading electronic, electrical, and telephone laboratories. Allen-Bradley . . . long famed for high quality electronic components . . . is at your service as a major supplier of ceramic capacitors of superlative quality.

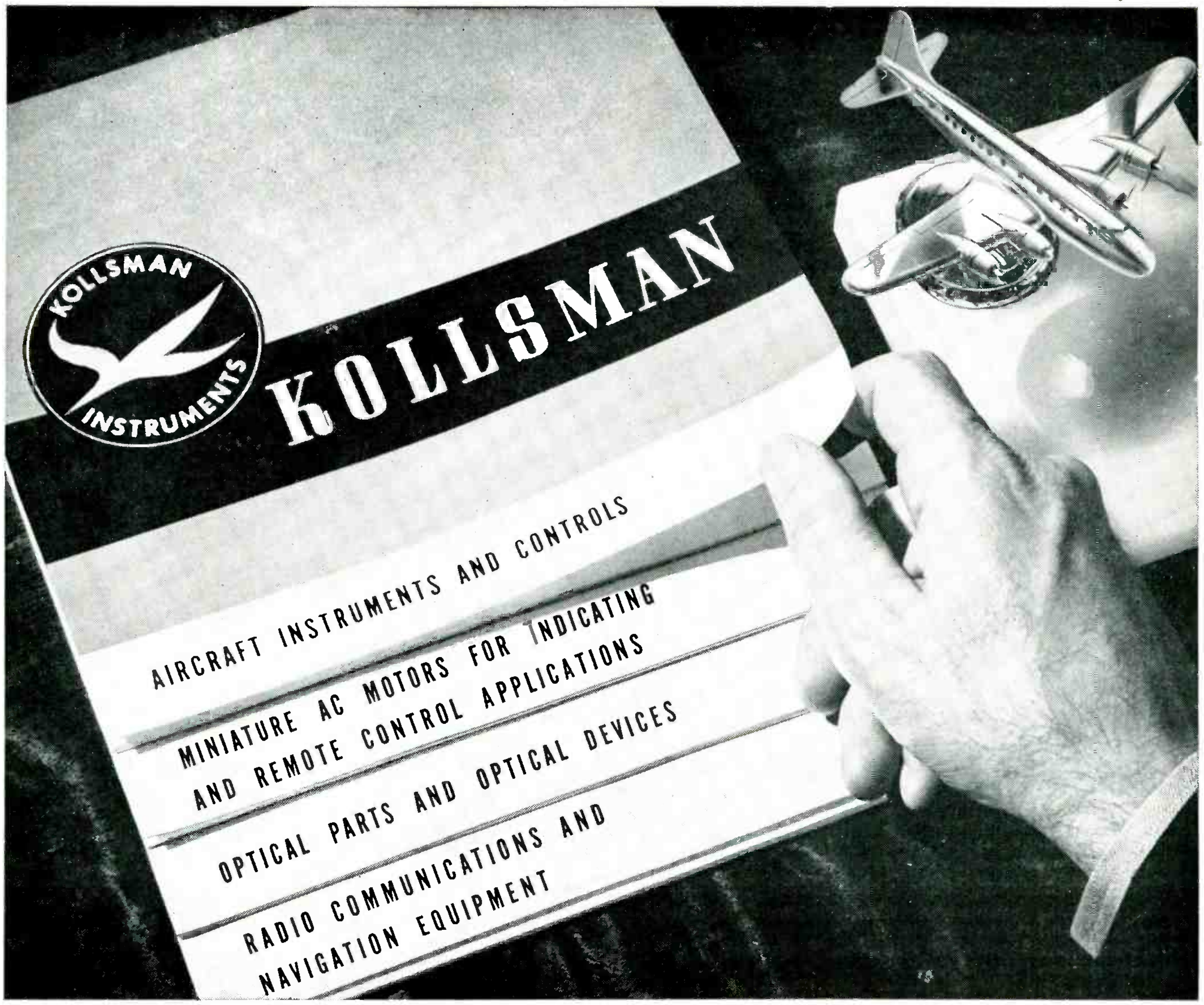
Allen-Bradley Co., 110 W. Greenfield Ave., Milwaukee 4, Wis.

ALLEN-BRADLEY

RADIO & TELEVISION COMPONENTS

QUALITY

Want more information? Use post card on last page.



Which part interests YOU?...

Perhaps that's one question that rightfully belongs with your *future* planning.

For, like ourselves, your manufacturing divisions may be toiling night and day in the interests of America's safety.

But to research scientists—seeking the solution to some intricate problem of instrumentation and control—Kollsman offers an experienced hand. A reputation based on inventive ingenuity, precision craftsmanship and world-over acceptance of its products.

In manufacture or research, there is no finer name than Kollsman—designers, developers and makers of:

Aircraft Instruments and Controls
Miniature AC Motors for Indicating and Remote Control Applications • • • Optical Parts and Optical Devices
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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.

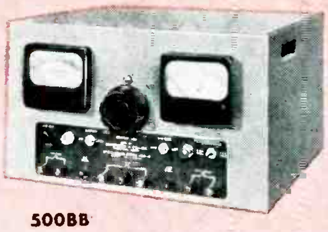
*Reg. U.S. Pat. Off. by Sorensen & Co., Inc.

MODEL 350-B SPECIFICATIONS

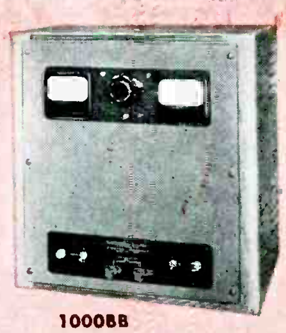
INPUT	105 - 125 VAC, 50 - 60 ~, 1Ø.
OUTPUT	1. 175-350 VDC @ 0-60 Ma simultaneously from two independently adjustable outlets. 2. 175-350 VDC @ 0-120 Ma from one outlet. 3. 0-175 VDC @ 0-60 Ma from one outlet. 4. 6.3 VAC @ 3.5 amps., C.T., unregulated.
OUTPUT REGULATION	±1.0%
RIPPLE	10 mv
SIZE	13" x 7½"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

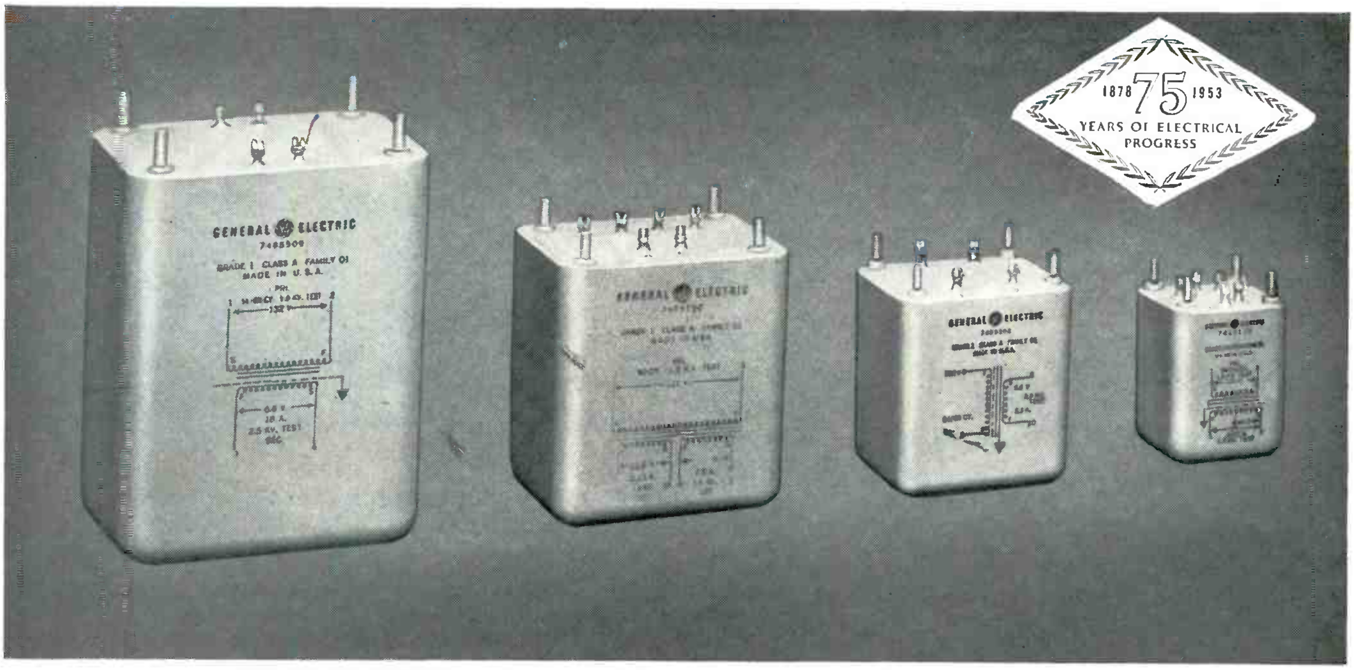
Regulation accuracy: ±0.5% (±1% in 360BB and 520BB)
Input: 105-125 volts AC, 50-60 cycles, single phase.
Models 325BB, 560BB, 500BB and 1000BB are metered.
Units are normally self-contained. All can be provided with a front panel for rack mounting.

SPECIFY **SORENSEN**

For Complete Information Write

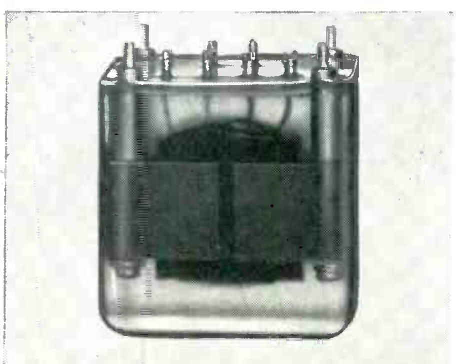
SORENSEN & COMPANY, INC.
375 Fairfield Avenue Stamford, 1 Conn.

DESIGNER'S



"SEALED-IN" DESIGN eliminates need for metal enclosures and fungus-proof coating.

New G-E cast-permafil transformers are 20% smaller, "sealed for life"


TRANSPARENT MODEL shows simple construction of new transformer. Terminals are anchored directly in mixture to cut size and weight.

Meet MIL-T-27 (Grade 1) performance requirements

Greater flexibility in many electronic designs is made possible by General Electric's new line of cast-permafil transformers, thanks to their light weight and small size.

These solventless-resin-type transformers are completely moisture-proof. They have fewer machined and punched parts. Tough, solid, shatter-resistant cast permafil ends the necessity for fungus-proof protective coatings.

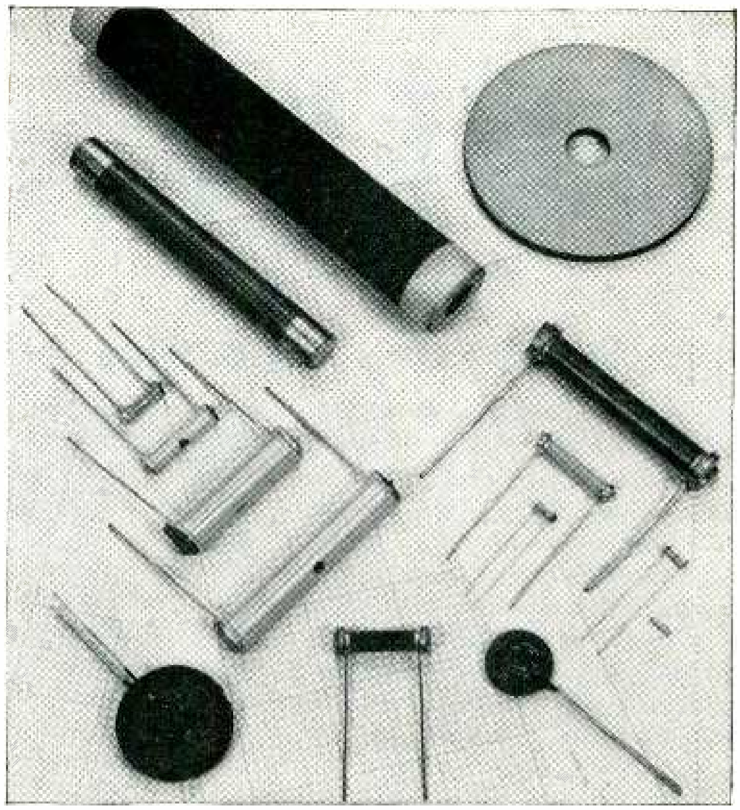
At 130C ultimate, these transformers have an expected life of 1000 hours or more. The complete line of 11 sizes, available in various terminal arrangements, averages about 20 per cent smaller than previous metal-encased transformer models.

For further information, write to Section 667-23, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC

Want more information? Use post card on last page.

Wanted! Tough circuit problems for GLOBAR Ceramic Resistors



To help you solve those tough problems, five types of GLOBAR Brand Ceramic Resistors, with distinctly different characteristics, are available in a wide range of shapes and sizes. Whenever you have difficult temperature or voltage compensation problems in your electrical or electronic circuits, you can count on GLOBAR Ceramic Resistors to help you out. In ordinary circuits, too—wherever maximum resistor life and dependability are required—try GLOBAR Ceramic Resistors.

GLOBAR Ceramic Resistors are engineered to meet your *exact* requirements. They are electrically fired in one piece, and will withstand the severest service. They are always uniform, because they are strictly controlled from design and manufacture to final inspection.

GLOBAR Brand Ceramic Resistors

TYPE	TEMPERATURE COEFFICIENT	VOLTAGE COEFFICIENT	DISSIPATION CAPABILITY
"A"	LOW	LOW	NORMAL
"CX"	LOW (POSITIVE)	PRACTICALLY ZERO	EXCEPTIONAL
"B"	MODERATE (NEGATIVE)	MODERATE	NORMAL
"F"	HIGH (NEGATIVE)	PRACTICALLY ZERO	ABOVE NORMAL
"BNR"	MODERATE (NEGATIVE)	EXTREMELY HIGH	NORMAL

For useful engineering data on GLOBAR Ceramic Resistors, write for your copy of Bulletin R to Dept. E 87-124.

If you have a resistor problem, let our engineers help you—without obligation, of course. Just send complete circuit information.

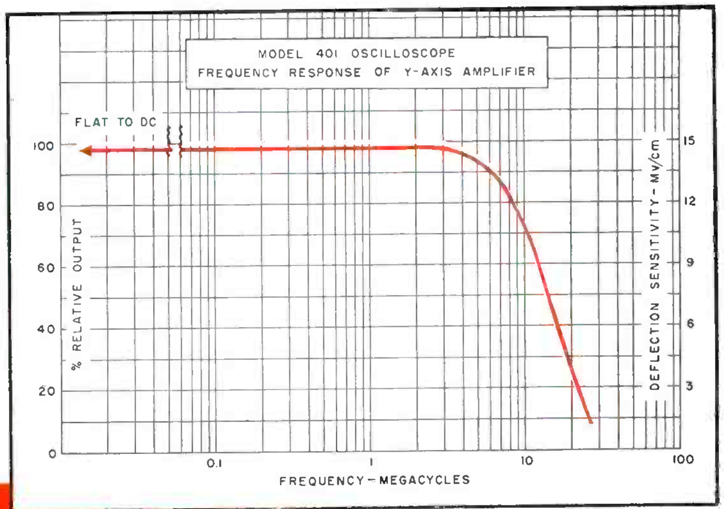
GLOBAR
TRADE MARK
Ceramic Resistors
by CARBORUNDUM

"Carborundum" and "Globar" are registered trademarks which indicate manufacture by The Carborundum Company, Niagara Falls, New York

87-124

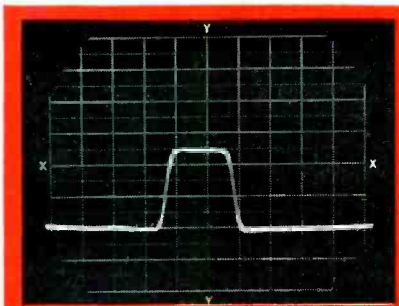
ONLY THE LFE 401 OSCILLOSCOPE

Offers all these Important Features

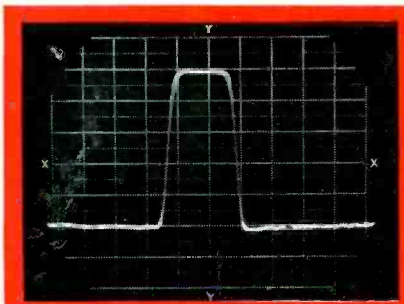


HIGH SENSITIVITY AND WIDE FREQUENCY RESPONSE OF Y-AXIS AMPLIFIER

The vertical amplifier of the 401 has been designed to provide uniform response and high sensitivity *from D-C.* The accompanying amplifier response curve shows the output down 3 db. at 10 Mc. and 12 db. at 20 Mc. Alignment of the amplifier is for best transient response, resulting in no overshoot for pulses of short duration and fast rise time. Coupled with this wide band characteristic is a high deflection sensitivity of 15 Mv./cm. peak to peak at *both D-C* and A-C.



37.5 Mv., 0.2 μ sec width, 1 μ sec sweep full scale



75 Mv., 0.2 μ sec width, 1 μ sec sweep full scale

LINEARITY OF VERTICAL DEFLECTION The vertical amplifier provides up to 2.5 inches positive or negative uni-polar deflection without serious compression; at 3 inches, the compression is approximately 15%. The accompanying photographs illustrate transient response and linearity of deflection.

SWEEP DELAY The accurately calibrated delay of the 401 provides means for measuring pulse widths, time intervals between pulses, accurately calibrating sweeps and other useful applications wherein accurate time measurements are required.

The absolute value of delay is accurate to within 1% of the full scale calibration. The incremental accuracy is good to within 0.1% of full scale calibration.

SPECIFICATIONS

Y-Axis

Deflection Sens.—15 Mv./cm, peak-to-peak.

Frequency Response—DC to 10 Mc

Signal Delay—0.25 μ sec

Input line terminations—52, 72 or 93 ohms, or no termination

Input Imp.—Direct—1 megohm, 30 μμf
Probe—10 megohms, 10 μμf

X-Axis

Sweep Range—0.01 sec/cm to 0.1 μ sec/cm

Delay Sweep Range—5-5000 μ sec in three adjustable ranges.

Triggers—Internal or External, + and −, trigger generator, or 60 cycles, undelayed or delayed triggers may be used.

Built-in trigger generator with repetition rate from 500-5000 cps.

General

Low Capacity probe

Functionally colored control knobs

Folding stand for better viewing

Adjustable scale lighting

Facilities for mounting cameras

Price: $895.00

Additional Features:

TRIGGER GENERATOR with variable repetition rate from 500 to 5000 cps.

POSITIVE & NEGATIVE UNDELAYED TRIGGERS and a **POSITIVE DELAYED TRIGGER** are externally available.

An **INPUT TERMINATION SWITCH** for terminating transmission lines at the oscilloscope.

A **FOLDING STAND** for convenient viewing.

FUNCTIONALLY COLORED KNOBS for easier location of controls.

Designed and built *for* electronic engineers, the 401, with its high gain and wide band characteristics, satisfies the ever-increasing requirements of the rapidly growing electronics industry for the ideal medium priced oscilloscope.

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VOLTAGE REGULATED POWER SUPPLIES

For Industrial and Research Use

MODEL 815

DC POWER SUPPLY SPECIFICATIONS

REGULATION: ½% for both line (105-125 volts) and load variations.
REGULATION BIAS SUPPLIES: 10 millivolts for line 105-125 volts.
RIPPLE: 5 millivolts RMS ½% for load at 150 volts.

VOLTS	CURRENT	MODEL
100-325 0-150 Bias 6.3 AC.CT.*	0-150 Ma. 0-5 Ma. 10 Amp.	131
100-400 6.3 AC.CT.	0-150 Ma. 10 Amp.	141
200-500 6.3 AC.CT.	0-200 Ma. 6 Amp.	245
0-300 0-150 Bias 6.3 AC.CT.	0-150 Ma. 0-5 Ma. 5 Amp.	315
0-500 6.3 AC.CT.	0-300 Ma. 10 Amp.	500R
#1 200-500 #2 200-500 #3 6.3 AC.CT. #4 6.3 AC.CT.	0-200 Ma. 0-200 Ma. 6 Amp. 6 Amp.	510
0-500 0-150 Bias 6.3 AC.CT.	0-300 Ma. 0-5 Ma. 10 Amp.	615
0-350	0-750 Ma.	700
0-350	0-1.50 Amp.	710
0-350	0-2.25 Amp.	720
0-350	0-3.00 Amp.	730
0-600	0-750 Ma.	750
0-600	0-1.50 Amp.	760

VOLTS	CURRENT	MODEL
0-600	0-2.25 Amp.	770
0-600	0-3.00 Amp.	780
#1 0-600 #2 0-600 #3 6.3 AC.CT. #4 6.3 AC.CT.	0-200 Ma. 0-200 Ma. 10 Amp. 10 Amp.	800
0-600 0-150 Bias 6.3 AC.CT.	0-200 Ma. 0-5 Ma. 10 Amp.	815
0-1000 Ripple 10 mv. 6.3 AC.CT.	0-50 Ma. 10 Amp.	1020
0-1200 Ripple 10 mv. 6.3 AC.CT.	0-20 Ma. 10 Amp.	1220
200-1000 Ripple 20 mv.	0-500 Ma.	1250
0-1000 Ripple 20 mv.	0-500 Ma.	1350
100-400 Regulation 0.01% Ripple 1 Mv. 6.3 AC.CT.	0-150 Ma. 10 Amp.	2000
0-30 Ripple 0.1%	0-30 Amp.	3030
0-3 Regulation 5 Mv. Ripple 1 Mv.	0-100 Ma.	3100

*All AC Voltages are unregulated. All units are metered except Models 131, 315 and 3100
All units designed for relay rack mounting or bench use.

The Kepco Voltage Regulated Power Supplies are conservatively rated. The regulation specified for each unit is available under all line and load conditions, within the range of the instrument. Write for specifications.

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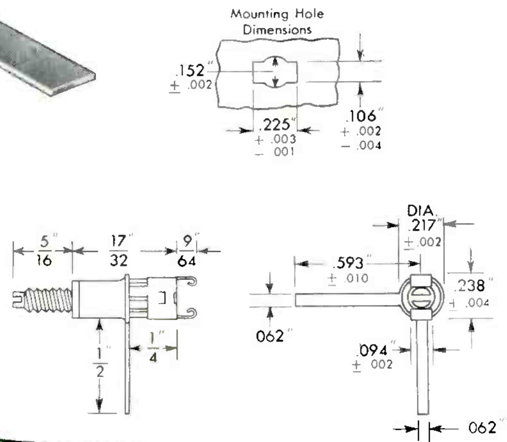
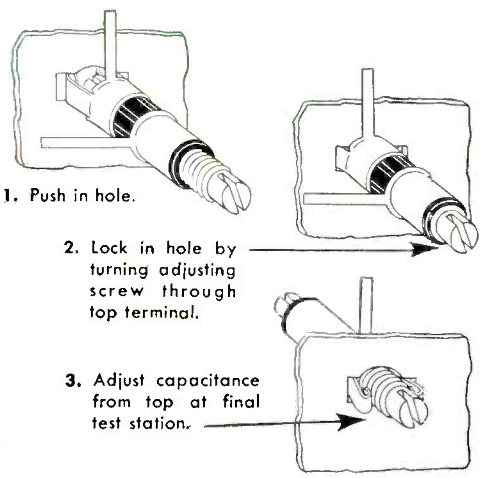
REAL Miniaturization... PLUS Low Loss for UHF...

ERIE STYLE 535 TUBULAR TRIMMER





The chassis punch-out required for the Style 535 is identical to that for the tubular ceramic trimmers that are in general usage.

Simplicity of design makes possible the extremely small size of the ERIE Style 535 Trimmer. The same simplicity of design results in very low inductance and unifrom, straight-line, noiseless adjustment. It can be mounted close to associated circuit elements, and the ribbon type leads help to minimize inductance in UHF circuits.

When mounted, the high temperature, polystyrene body, extends only 17/32" from the underside of the chassis, and is only 7/32" in diameter. As shown at the left, the operator works from only one side of the chassis when installing the trimmer . . . a production cost saving feature . . . no additional hardware required.

The ERIE Style 535 Tubular Trimmer combines the desirable features of small size, easy mounting, stable performance and economical price. Capacity range is from 0.7 to 3.0 mmf and working voltage is 500 volts. Write for full information and samples.

ERIE components are stocked at leading electronic distributors everywhere.

ERIE TRADE MARK RESISTOR CORP.

ERIE RESISTOR CORPORATION . . . ELECTRONICS DIVISION

Main Offices: **ERIE, PA.**

Sales Offices: Cliffside, N. J. • Philadelphia, Pa. • Buffalo, N. Y. • Chicago, Ill. Detroit, Mich. • Cincinnati, Ohio • Los Angeles, Calif.

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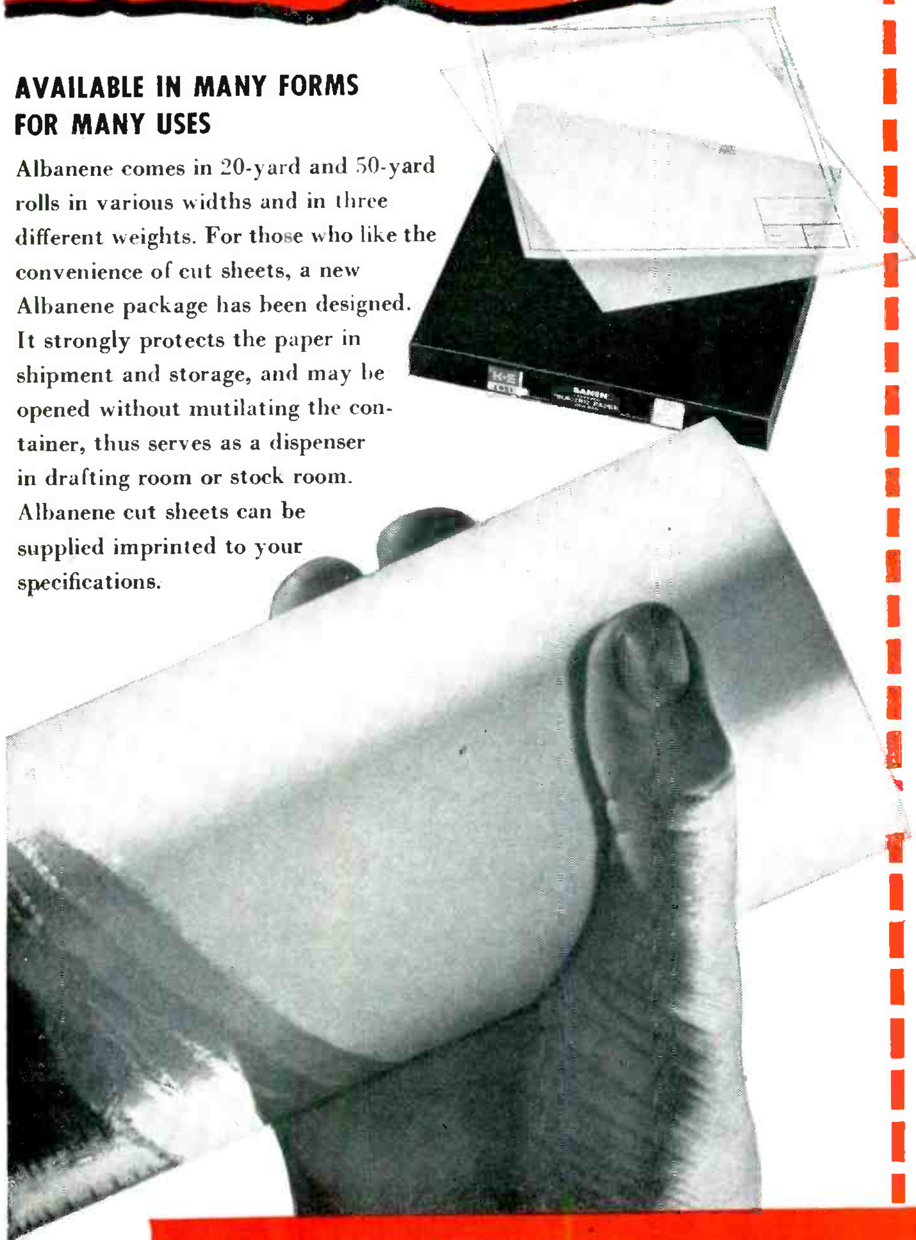
Transparent . . .

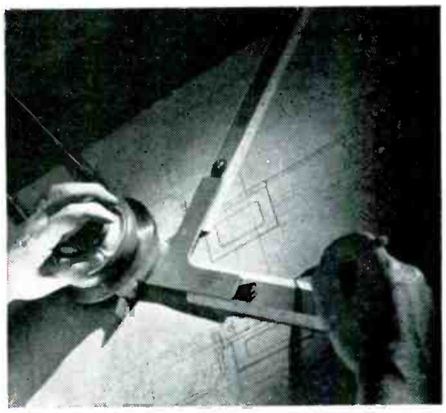
and Better !

The Right Angle

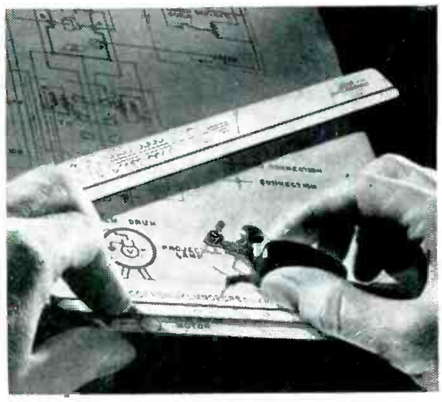


AVAILABLE IN MANY FORMS FOR MANY USES

Albanene comes in 20-yard and 50-yard rolls in various widths and in three different weights. For those who like the convenience of cut sheets, a new Albanene package has been designed. It strongly protects the paper in shipment and storage, and may be opened without mutilating the container, thus serves as a dispenser in drafting room or stock room. Albanene cut sheets can be supplied imprinted to your specifications.



Once you've discovered the pleasure of drawing on Albanene, the next logical step is to save time, trouble and eyesight with a K&E PARAGON* Drafting Machine. You control your calibrated straight edge with a light touch of one hand, for parallel lines and lines at any angle.



Make your lettering letter-perfect and save wear and tear on your nerves by using a LEROY* lettering outfit. Template grooves guide your pen so the finished result looks like printers' type, and the whole process is relaxing. There's a wide choice of sizes, styles and symbols.

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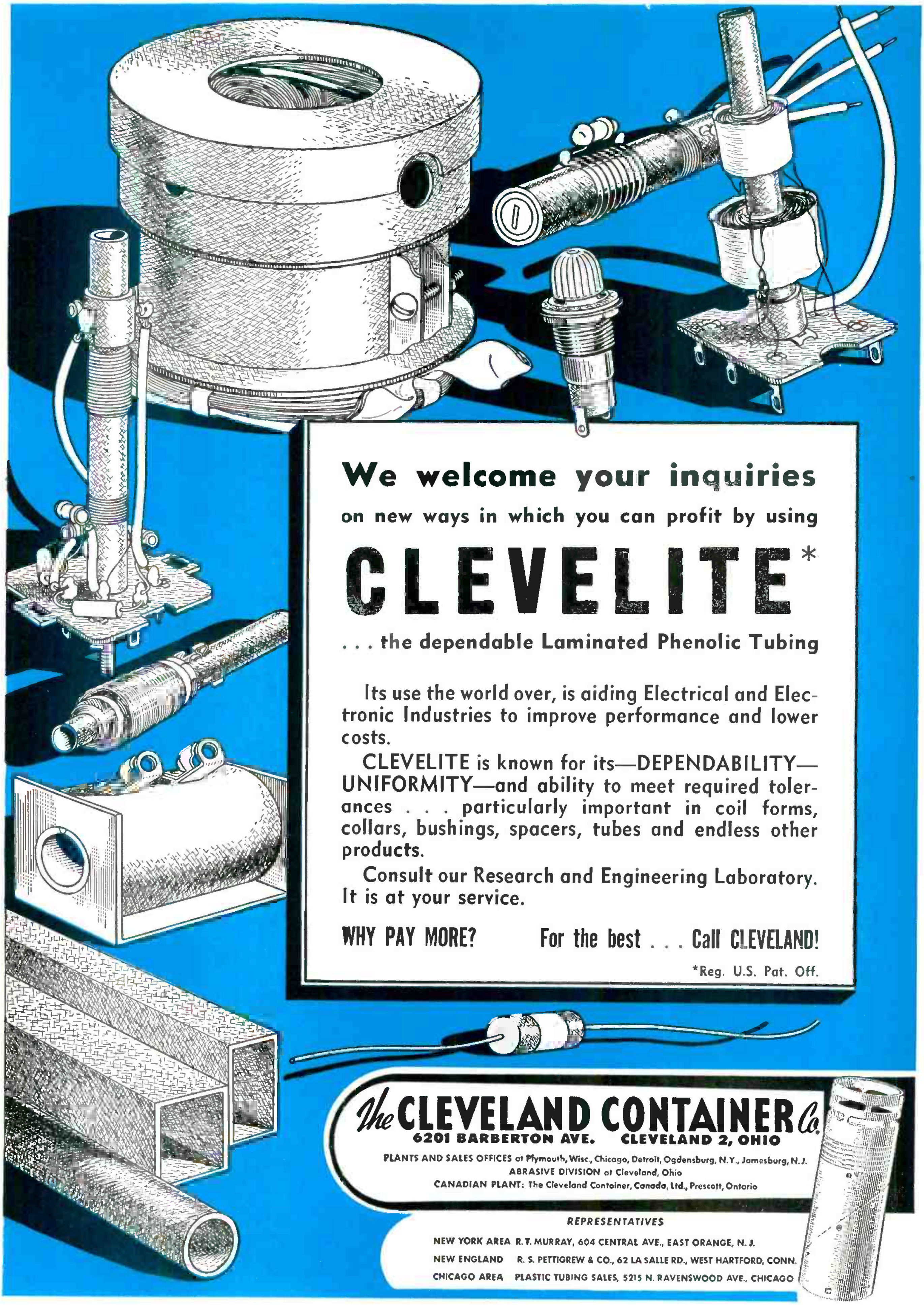
We welcome your inquiries
on new ways in which you can profit by using
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Its use the world over, is aiding Electrical and Electronic Industries to improve performance and lower costs.
CLEVELITE is known for its—DEPENDABILITY—UNIFORMITY—and ability to meet required tolerances . . . particularly important in coil forms, collars, bushings, spacers, tubes and endless other products.
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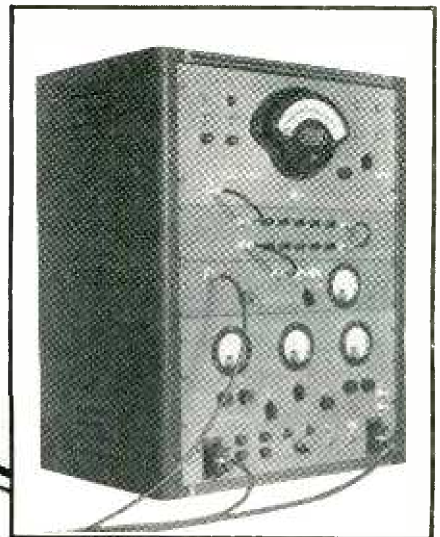
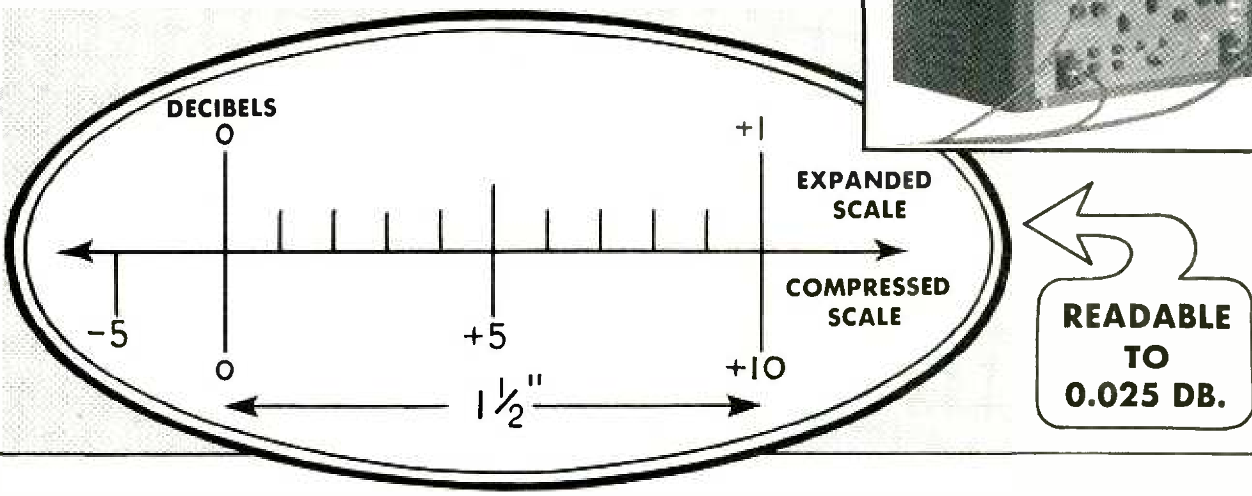
WANT EXCEPTIONAL PRECISION FOR

MICROWAVE-UHF-VHF

GAIN OR LOSS MEASUREMENTS?

YOU CAN HAVE IT WITH *the NEW* MICROWAVE GAIN SET





- **Readable to 0.025 db.**
- **Accuracy within 0.1 db of attenuator calibration.**
- **Measurements with available power as low as —80 dbm.**
- **Available with or without RF-Heads. May be used in conjunction with klystron signal source and local oscillator for any frequency range.**
- **Extremely well regulated to prevent disturbance of measurements due to drift of gain or tuning.**

The Microwave Gain Set is a complete system for making precision measurements of gain or loss in microwave components or systems. The IF amplifier-metering portion, available separately as the Model 620-A Amplifier-Detector Set, having an input frequency of 70 mcs, may be used with other signal sources and local oscillators to provide measurements down to the VHF range. It consists of a preamplifier, calibrated attenuator, amplifier-detector, and power supply. The 500-A Double Klystron Power Supply and "Centilators," Microwave Signal Sources, both optional, are also available. With its high gain and high ultimate accuracy, the Microwave Gain Set is capable of accurate loss measurements in the vicinity of zero loss, as well as where losses are as great as 80 db.

SEND FOR DETAILED FOUR-PAGE BROCHURE ON THE NEW GAIN SET

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PRECISION-MOLDED MYCALEX 410

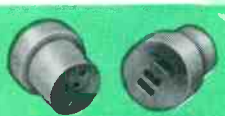
TRANSISTOR SOCKETS

Mycalex 410 Transistor Socket shown actual size

Mycalex 410 Transistor Socket enlarged to show detail

—now in the pilot production stage
—engineered in advance of actual need

In keeping with the MYCALEX policy of progressive design in advance of needs, these Transistor Sockets were engineered months ago and are now in small scale pilot production. They'll be available in quantity in advance of actual needs.

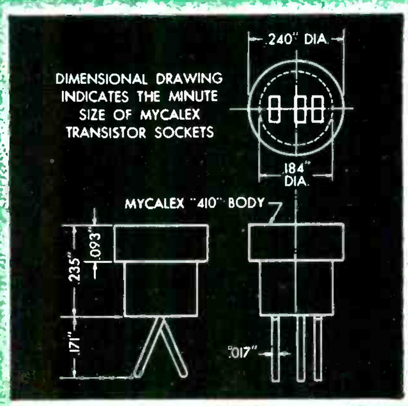


Achievement in PRECISION MOLDING!

The production of Mycalex Transistor Sockets is a real accomplishment of precision molding in miniature. The holes for the leads are the smallest ever molded. All tolerances are exceedingly close. Mycalex production engineers are proud of their achievement . . . particularly because low-cost, mass production techniques can be adhered to.

The body is precision-molded of MYCALEX 410, glass-bonded mica insulation for lasting dimensional stability, low dielectric loss, immunity to high temperature and humidity exposure combined with maximum mechanical strength. The loss factor is only 0.014 at 1 MC and dielectric strength is 400 volts/mil.

Contacts can be supplied in brass or beryllium copper. The sockets are readily solderable. The socket bodies will not warp or crack when subjected to high soldering temperature. They function in ambient temperatures up to 700° F.



Mycalex Low-loss Tube Sockets and Multiple Headers

A complete line of tube sockets including sub-miniature types is available in Mycalex 410 and Mycalex 410X glass-bonded mica insulation. Comparative in cost to ordinary phenolic sockets they are far superior in every respect. Dimensional accuracy is unexcelled. For complete information on standard and custom Tube Sockets or Multiple Headers, call, wire or write . . . there is no obligation, of course.

MYCALEX TUBE SOCKET CORPORATION
Under Exclusive License of Mycalex Corporation of America
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

SIN 1919 MYCALEX THE INSULATOR

MYCALEX CORPORATION OF AMERICA
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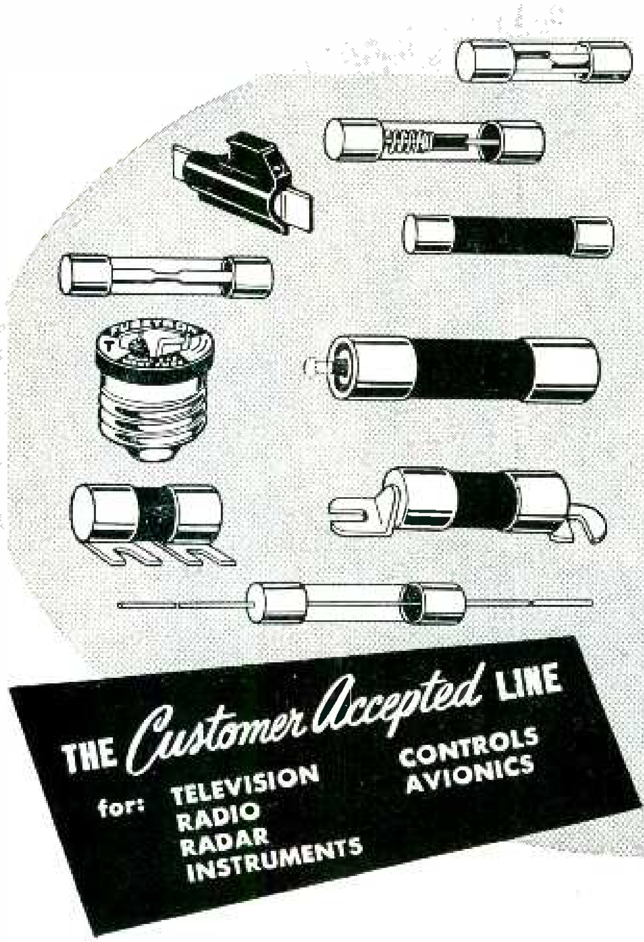

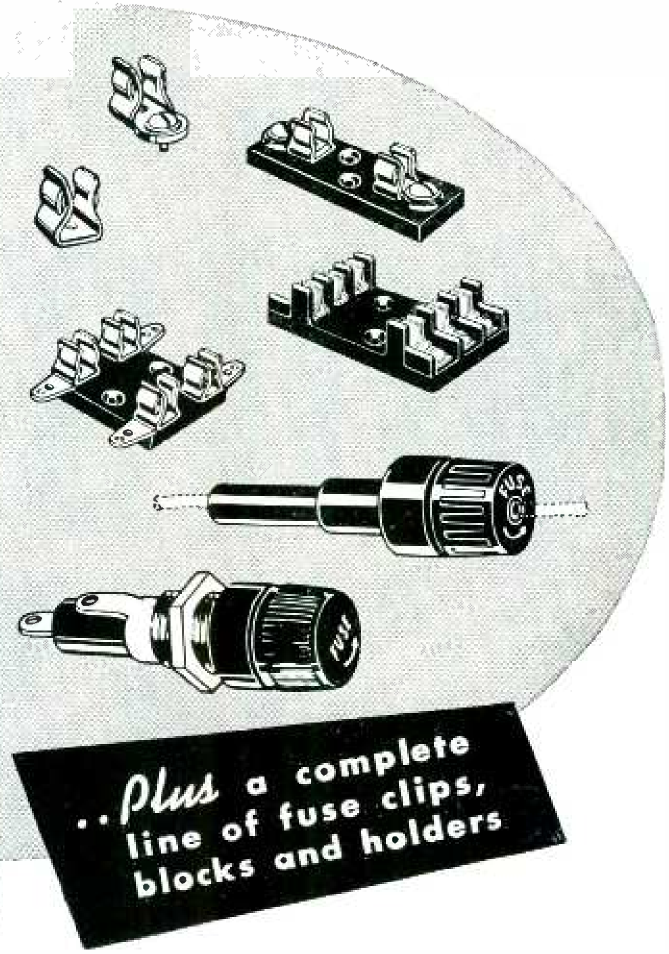

For more than a third of a century BUSS has lead in the research, design and development of fuses for electrical protection. To maintain this standard of unquestioned high quality, each and every BUSS fuse for the electronic field is tested in a highly sensitive electronic device that rejects any fuse that is not correctly calibrated — properly constructed — and right in all physical dimensions.

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BUSSMANN Mfg. CO., *Division McGraw Electric Company*
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Do You Have A Protection Problem?

Let our fuse engineers help you select or design the right fuse or fuse mounting to meet your needs. Submit a sketch or description that shows the type of fuse contemplated, number of circuits; type of terminals, and the like. We welcome your requests — and our staff is always at your service.

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

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Company..

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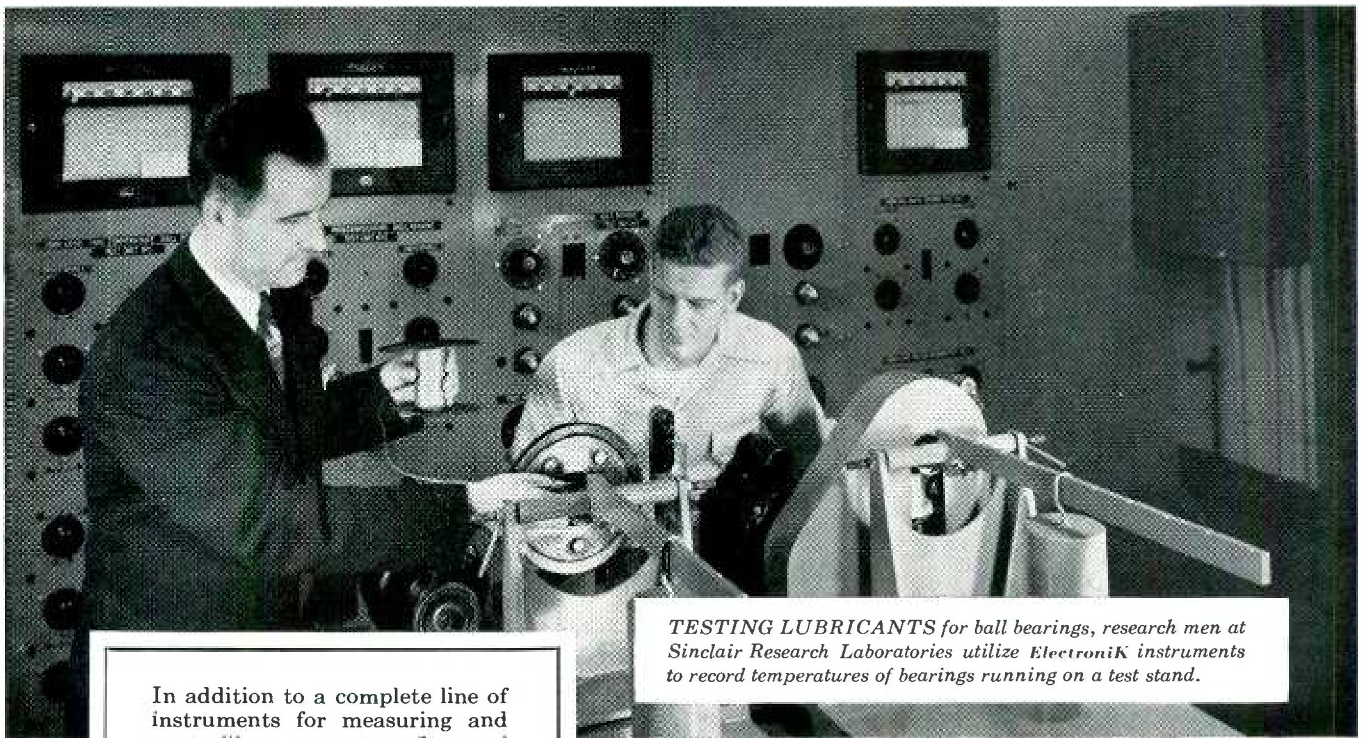
How many research hours in a day?



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In addition to a complete line of instruments for measuring and controlling temperature, flow, and dozens of other variables, Honeywell offers these special *ElectroniK* instruments of interest to research men:

Function Plotter: automatically plots the relation of two independent variables.

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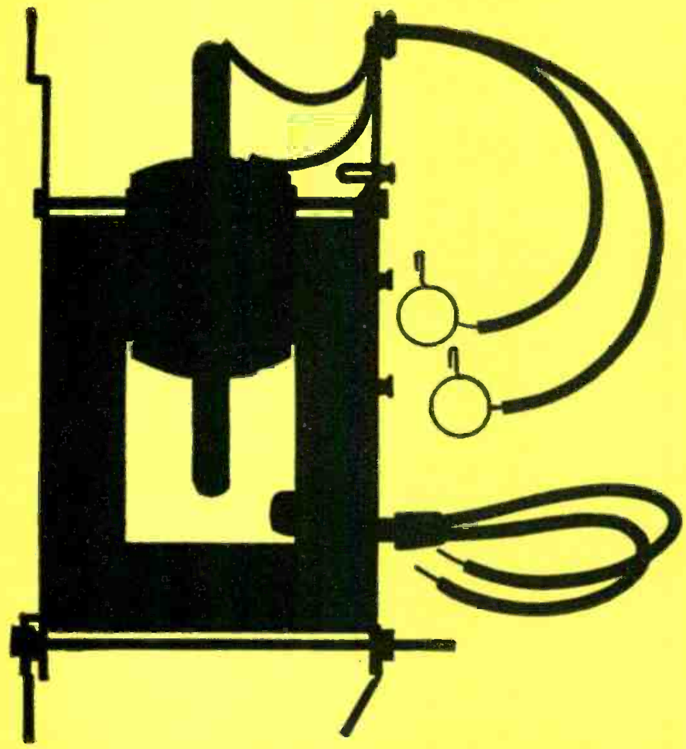

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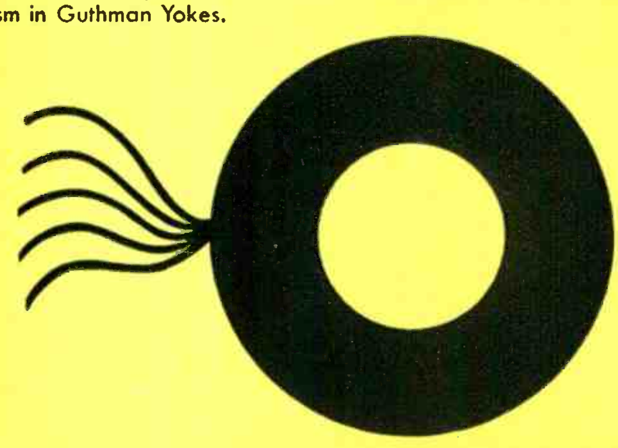
For reliability in high voltage specify Guthman Flybacks—they wont break down even under the most severe voltage requirements. Wire used in Guthman Flybacks is fabricated in our own plant and is quality controlled from raw material to finished product guaranteeing a superior uniformity of performance.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



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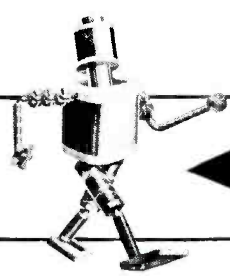

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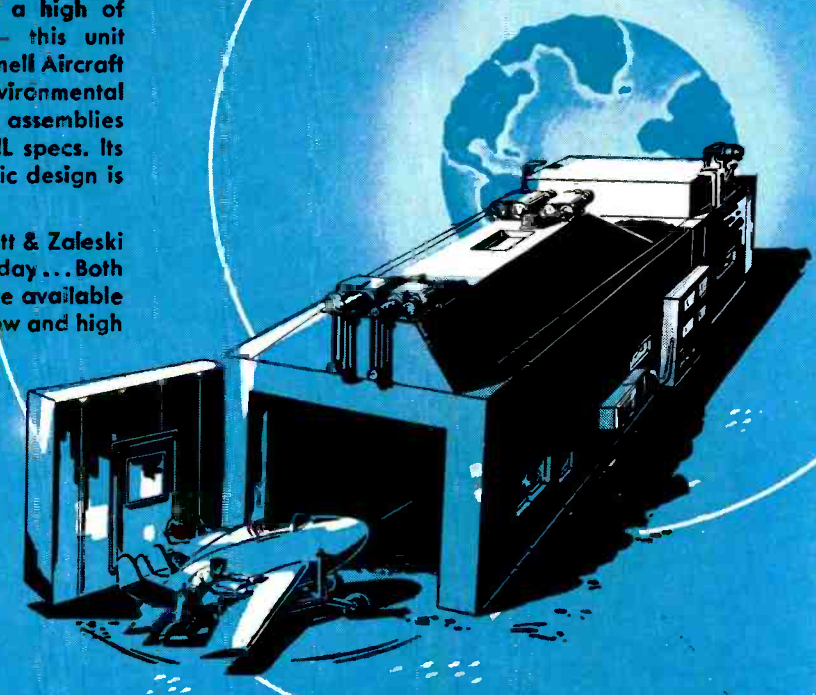

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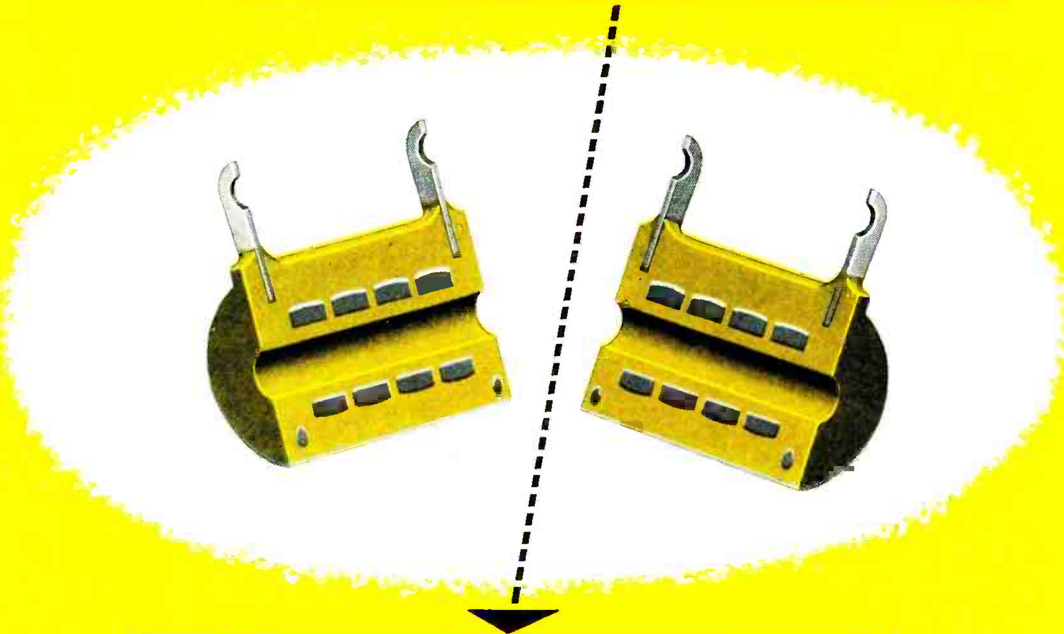
The Inside Story



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ACCURATE WIRE WOUND RESISTORS

HERMETICALLY SEALED IN CAST EPOXY. EXCEEDS MIL R-93A SPECIFICATION

Scientific progress has made the demand and we believe the CE series resistors are the answer: —

In the cross-section above, we illustrate the single homogenous mass that means so much to stability and provides the ample moisture vapor barrier of this new resistor. Bobbin and encapsulation become one homogenous mass, surrounding the resistance wire with a minimum of strain.

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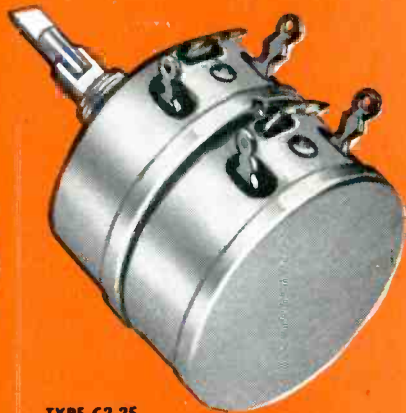
NEW HIGH QUALITY MINIATURIZED "DIME-SIZE" CIVILIAN CONTROL—*Performance Fully Equals Larger Types.*
TYPE 70, 3/4" diameter variable composition resistor. Wattage rating: .3 watt for resistances through 10,000 ohms, .2 watt with 350 volts maximum across end terminals for resistances over 10,000 ohms. Also available in concentric shaft tandem construction C45-70 as shown above.

TYPE C2-45

TYPE C2-35

TYPE C2-252

TYPE C2-25



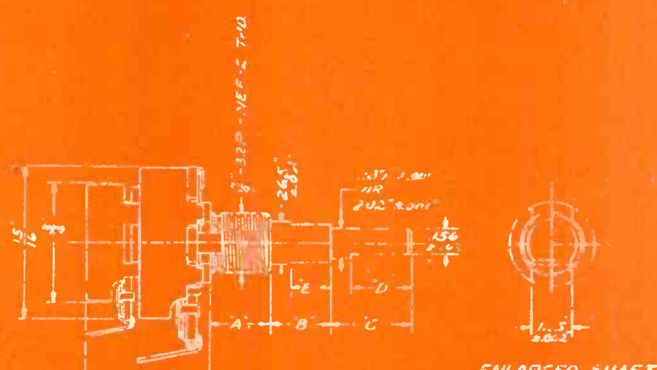
TYPE GC-45, 15/16" diameter variable composition resistor. Wattage rating: 1/2 watt for resistances through 10,000 ohms, 1/3 watt for resistances over 10,000 ohms through 100,000 ohms, 1/4 watt with 500 volts maximum across end terminals for resistances over 100,000 ohms. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-45 as shown above.

TYPE GC-35, 1 1/8" diameter variable composition resistor. Wattage rating: 3/4 watt for resistances through 10,000 ohms, 2/3 watt for resistances over 10,000 ohms through 25,000 ohms, 1/2 watt with 500 volts maximum across end terminals for resistances over 25,000 ohms. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-35 as shown above.

TYPE GC-252, 2 watt, 1 17/64" diameter variable wirewound resistor. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-252 as shown above.

TYPE GC-25, 4 watt, 1 17/32" diameter variable wirewound resistor. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-25 as shown above.

Typical concentric shaft tandem with panel and rear sections operating separately from concentric shafts **(TYPE C45-70 ILLUSTRATED).** Similar construction available for all military resistors.



ENLARGED SHAFT END VIEW

TYPE C45-70

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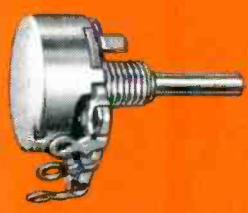
TYPE 45, (JAN-R-94, Type RV2)
1/4 watt, 15/16" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

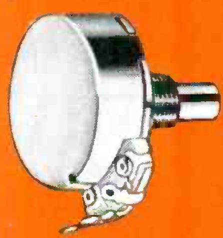
TYPE 35, (JAN-R-94, Type RV3)
1/2 watt, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

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 including concentric shaft tandem construction. Attached switch can be supplied.

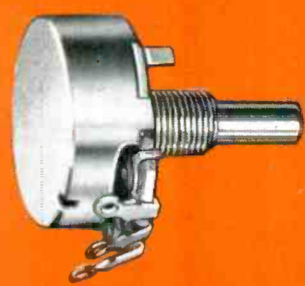
TYPE 25, (JAN-R-19, Type RA30)
(May also be used as Type RA25)
4 watt, 1 17/32" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



TYPE 65, (Miniaturized)
1/2 watt 70°C, 3/4" diameter miniaturized variable composition resistor.



TYPE 90
1 watt 70°C, 15/16" diameter variable composition resistor. Attached switch can be supplied. Also available in concentric shaft tandem construction.



TYPE 95, (JAN-R-94, Type RV4)
2 watt 70°C, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

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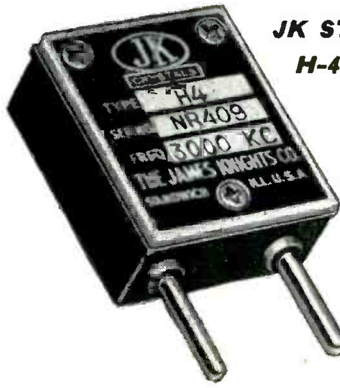
Her *Ship-to-Shore* is *Ship Shape*

Her decks may be awash but there's fair weather in the radio shack. Despite wind and waves the Captain's message will reach the home port. In fair weather or foul, you'll find JK Crystals rate a Navy "E" for their part in keeping marine communications "ship shape."



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A versatile crystal the JK H-4 is widely used as a replacement crystal in marine and other communications systems. Pressure mounted, dust and water proof, stainless steel electrodes. Frequency range 1800 kc to 15 mc. Military type holder. Another of the many JK Crystals available to serve every need.

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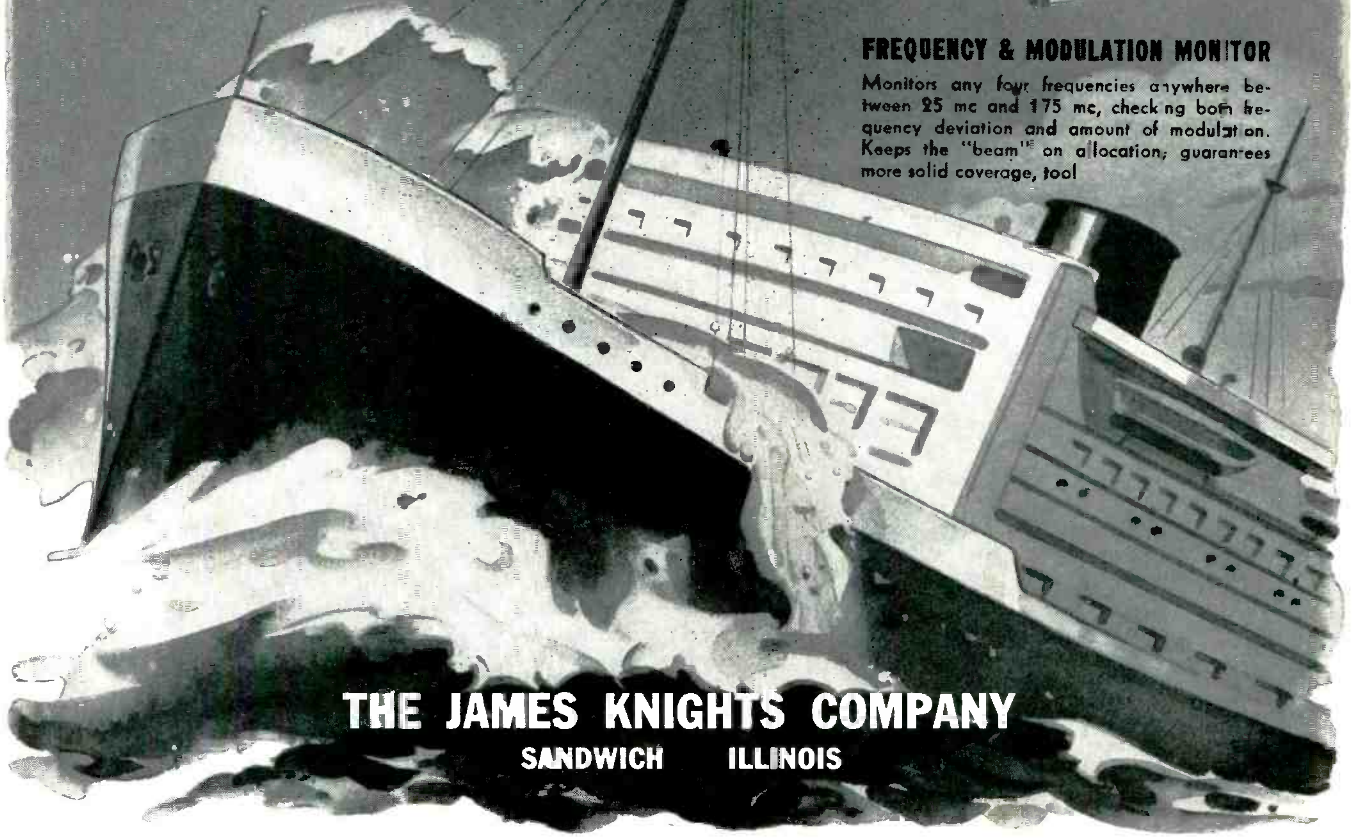

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for mounting forced-air-cooled tubes

Now available as a standardized line, these Lapp insulated supports for mounting forced-air-cooled tubes facilitate design of transmitter and other high-power circuits. They are simple, compact and efficient. For high frequency tubes they are available either in Lapp porcelain or Lapp steatite; for standard broadcast frequencies in Lapp porcelain.

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You're busy solving the functional design problems of that new project. It's taking all your working hours. But what about the chassis or housing? That's where more problems arise.

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By calling Karp in *early*, your "packaging" problems can be ironed out as you solve your functional problems. And with its creative engineering staff, its vast assortment of available dies, its 77,000 square feet of facilities, Karp can show you how to cut costs and delivery time. We'll be glad to talk it over with you.

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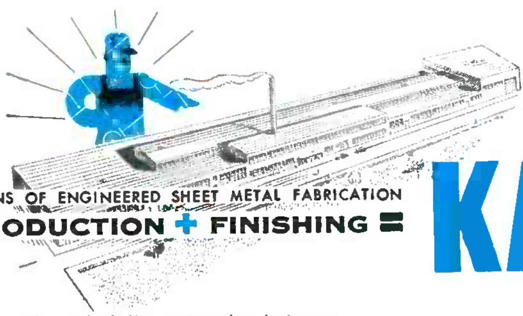

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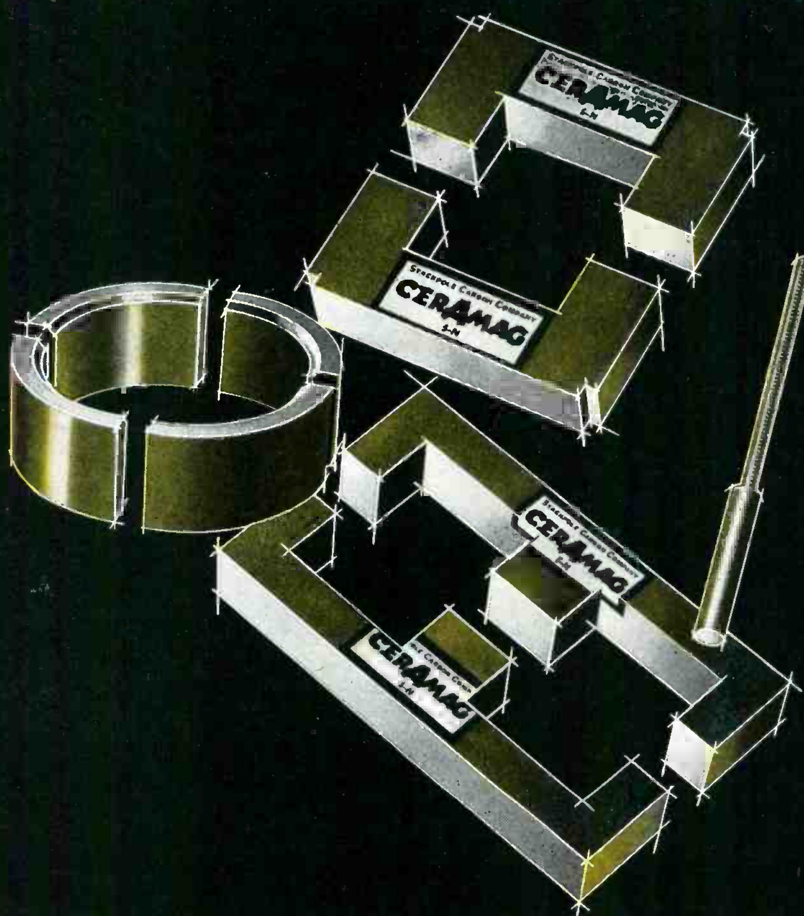
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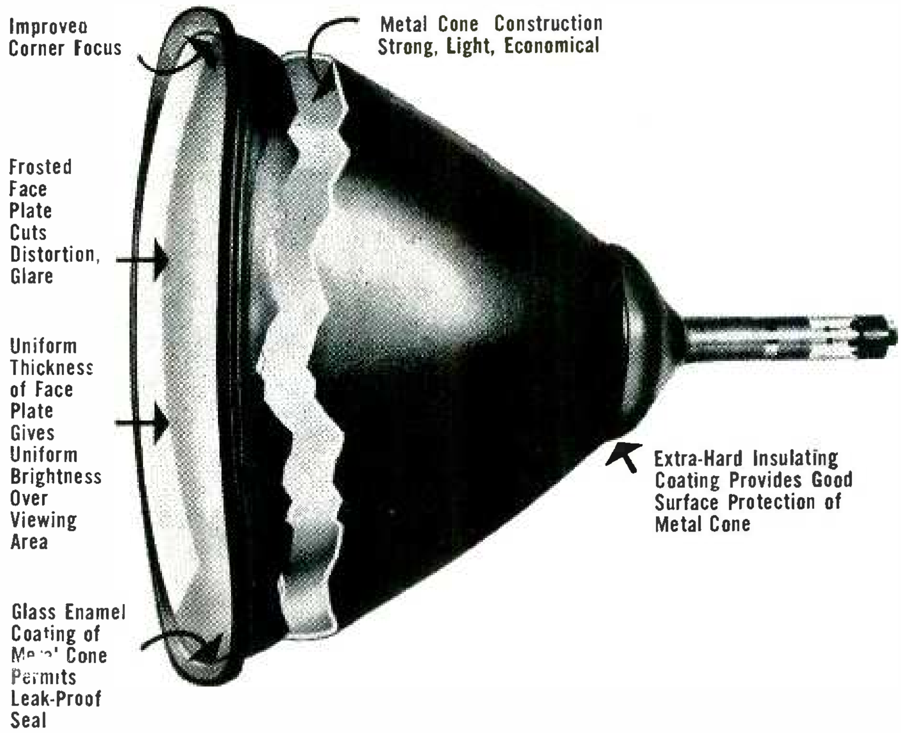
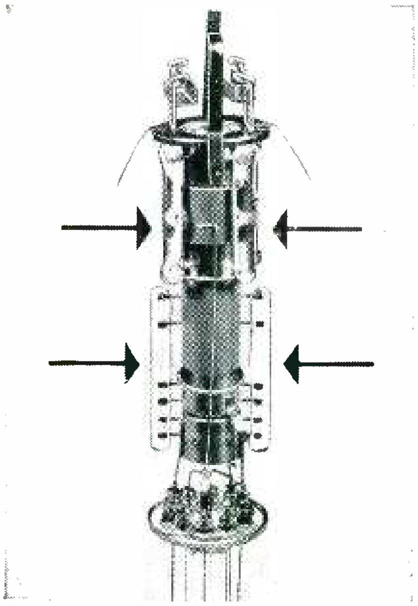
Two 21-inch Metal Cone Picture Tubes Announced by Westinghouse

21AP4 and 21MP4 now available for immediate delivery

Manufacturers faced with problems of handling, cost and uniformity in large picture tubes now may order Westinghouse 21-Inch RELIATRON™ Metal Cone Picture Tubes for immediate delivery. The new tubes—almost 33⅓% lighter in weight—are manufactured under the most rigid quality control system in the country. Superior face plate quality assures greater freedom from blemishes and glass imperfections. Uniform face plate thickness greatly reduces optical distortion over the viewing area. The etched glass of the face plate eliminates glare from external light sources.





Improved Gun Employs Glass Beads. Westinghouse makes the new metal cone electrostatic focus tube with glass-beaded assembly. This assures accurate element spacing within close tolerances to improve spot size and picture uniformity.

The 21-Inch RELIATRON Picture Tubes feature still another important improvement. The face plate is sealed to the metal cone using an intermediate glass-enamel frit.

PRODUCTION SAVINGS

The 21-Inch RELIATRON Picture Tubes introduce new economies throughout TV set production. Their lighter weight cuts shipping costs. The 21MP4 tube is electrostatically focused, requiring no focusing coil or focusing magnet. The 21AP4 is designed for magnetically focused operation.

Metal cone tubes give increased mechanical strength, and because of their light weight are easier to handle and assemble in TV receivers.

BETTER PICTURES

Metal cone picture tubes permit the use of spherical face plates of uniform thickness that allow receiver manufacturers to use standard available deflection components that produce pictures of consistently high quality.

Employment of the Westinghouse 21-Inch RELIATRON Metal Cone Picture Tubes enables you to meet the growing demand for larger screen TV receivers, to deliver a better picture, and at the same time, to realize important savings in your production operations.

The new RELIATRON metal cone tubes now are available in quantities which permit immediate delivery of production-size orders. For complete details, write Dept. A-201.

RELIATRON™ TUBES

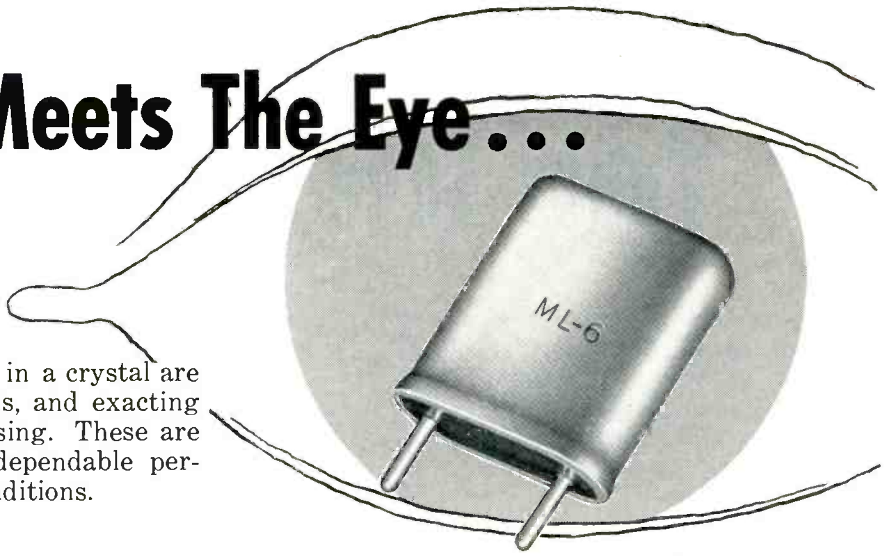
YOU CAN BE SURE... IF IT'S **Westinghouse**

ELECTRONIC TUBE DIVISION

Westinghouse Electric Corporation
Box 284, Elmira, N. Y.

ET-95016

MORE Than Meets The Eye...



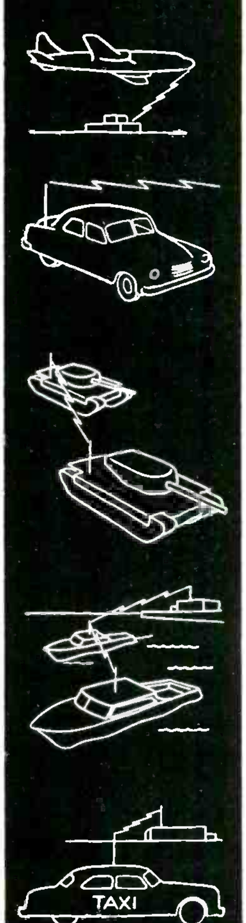
UNSEEN, but all-important in a crystal are the skills, precision standards, and exacting tests that go into its processing. These are the things that add up to dependable performance under toughest conditions.

Midland CRYSTALS

Give You

CRITICALLY CONTROLLED QUALITY

TOP PERFORMANCE IN EVERY APPLICATION OF 2-WAY RADIO

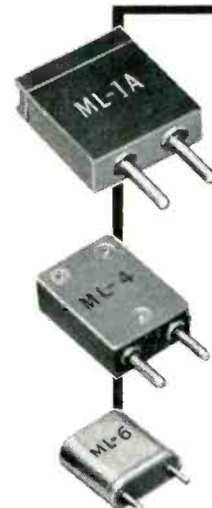


MIDLAND QUALITY starts with highly critical selection of raw quartz, inspected and precisely graded for its intended use. Midland optical and mechanical measurement facilities are unexcelled in the industry.

FOR EXAMPLE, STRICT ADHERENCE to prescribed angular relationships is required to give oscillator plates the properties best suited to specific jobs. Constant vigilance is maintained through Midland processing steps to be sure that no deviation of angle or improper contour develops.

THIS CRITICAL QUALITY CONTROL extends through to final mounting, sealing and testing — assuring you the best crystal unit science and top-level craftsmanship can produce.

Whatever your crystal need — conventional or highly specialized . . .



***TYPE ML-1A—RANGE:** 2.0 — 15.0 mc

Supplied per Mil type CR-1A when specified.

***TYPE ML-4 — RANGE:** 1.0 — 10.0 mc

Supplied per Mil type CR-5; CR-6; CR-8; CR-10 when specified.

***TYPE ML-6 — RANGE:** 1.4 — 75.0 mc

Supplied per Mil type CR-18; CR-19; CR-23; CR-27; CR-28; CR-32; CR-33; CR-35; CR-36 when specified.

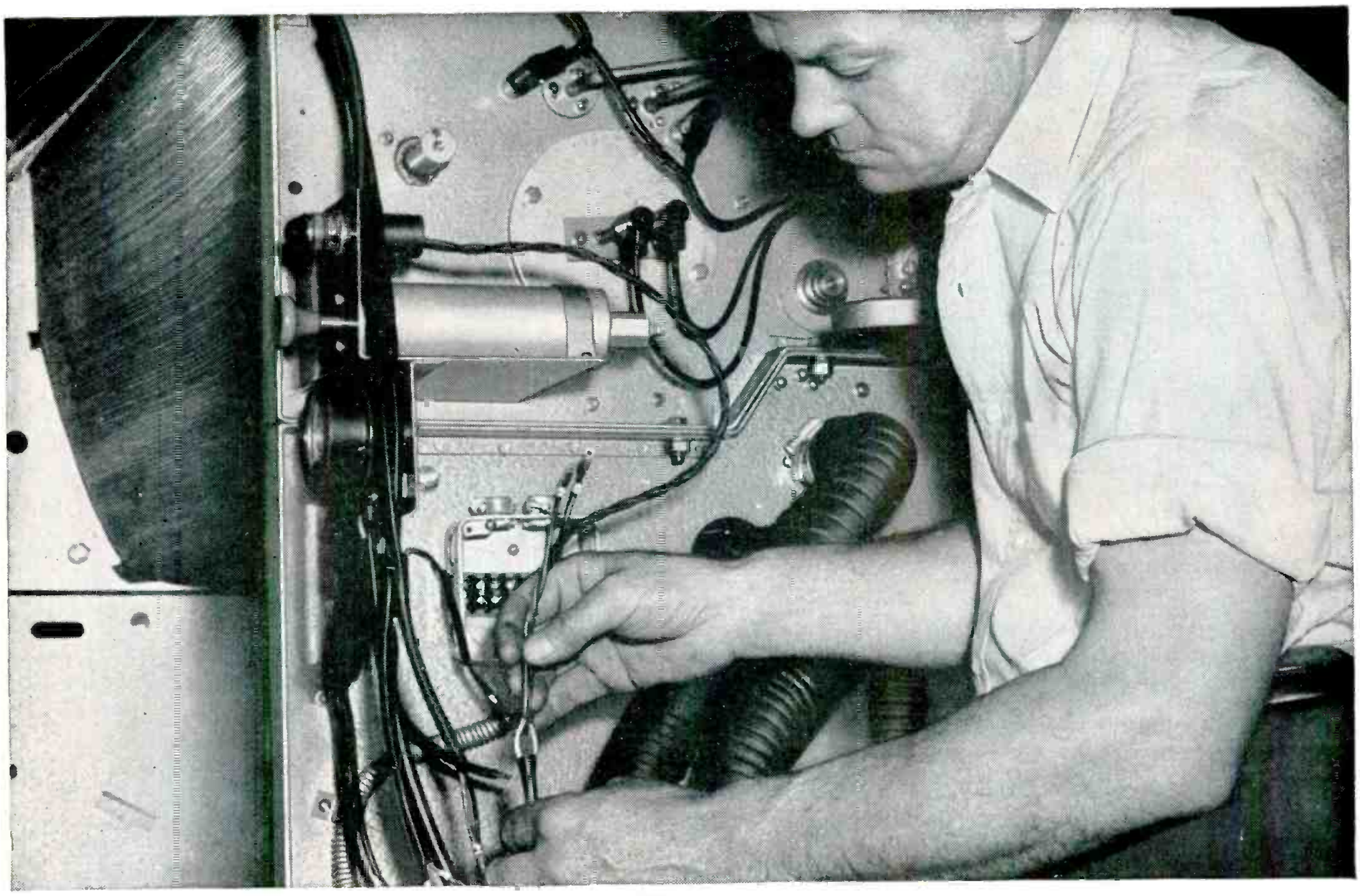
When It Has to Be EXACTLY RIGHT . . . Contact

Midland

MANUFACTURING CO., INC.

3155 Fiberglas Road **Kansas City, Kansas**

Manufacturer of Quartz Crystals for Electronic Frequency Control



Ozalid saves time and money in Printmaster wiring
. . . with smooth, flexible Irvington FIBRON® Tubing

The job of wiring Printmasters and other duplicating and copying machines is simplified by the smooth interior surface and unusual flexibility of Irvington Fibron Extruded Plastic Tubing, according to the Engineering Department of Ozalid Division of General Aniline & Film Corporation. The tubing slips over the wires easily and quickly—thus saving time and money in assembly.

Ozalid's choice among the many available types of Fibron Tubing is IRV-O-LITE XTE-30—an unusually effective insulation for normal operating conditions. For more severe service—particularly where high ambient temperatures are encountered—many leading manufacturers of electrical equipment turn to Temflex 105. This Irvington Fibron Tubing is UL approved for 90° C. operation in oil—as well as for continuous service at 105° C.

Specifically formulated for *high-temperature* operation, Temflex 105 has the added advantage of retaining its flexibility at temperatures as low as —40° C!

There's a type of Fibron Tubing for just about every type of service requirement—why not look into the *entire* line? Just mail the coupon for the Fibron Catalog.

Look to
IRVINGTON
for insulation leadership
INSULATING VARNISHES
VARNISHED CAMBRIC
VARNISHED PAPER
VARNISHED FIBERGLAS
INSULATING TUBING
CLASS "H" INSULATION

STANDARD OF THE WORLD
IRVINGTON INSULATION

Send this convenient coupon now

Irvington
VARNISH & INSULATOR COMPANY
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Plants: Irvington, N. J.; Monrovia, Calif.; Hamilton, Ontario, Canada

Irvington Varnish & Insulator Co. EL-1/53
11 Argyle Terrace, Irvington 11, N. J.
Gentlemen:
Please send me your catalog on IRV-O-LITE XTE-30, Temflex 105 and other types of Fibron Extruded Plastic Tubing.

Name..Title..................
Company..
Street...
City...................................Zone..........State...............

MOLONEY *HiperCore* ELECTRONIC CORES

...NOW AVAILABLE IN QUANTITY IN OVER 1000 STANDARD SIZES

STANDARD TEST

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 HiperCore Electronic Cores now available in quantity to manufacturers of electronic equipment whose product is manufactured for ultimate use by U. S. Government. Produced in lamination thickness from 1 mil to 12 mil and in standard widths from 1/4".

Better transformer performance is assured when HiperCore Electronic Cores are used because these wound cores have greater flux carrying capacity and lower losses than other types of cores of comparable sizes. The overall result, in addition to better performance, is a lighter, smaller core. Because HiperCores are wound cores, they permit accelerated production through savings in assembly time.

Rigid core production control permits these cores to test well within industry tolerances. Typical test requirements for various types are listed in the panel above. Special tests for specific operating conditions will be made if desired. ME52-22

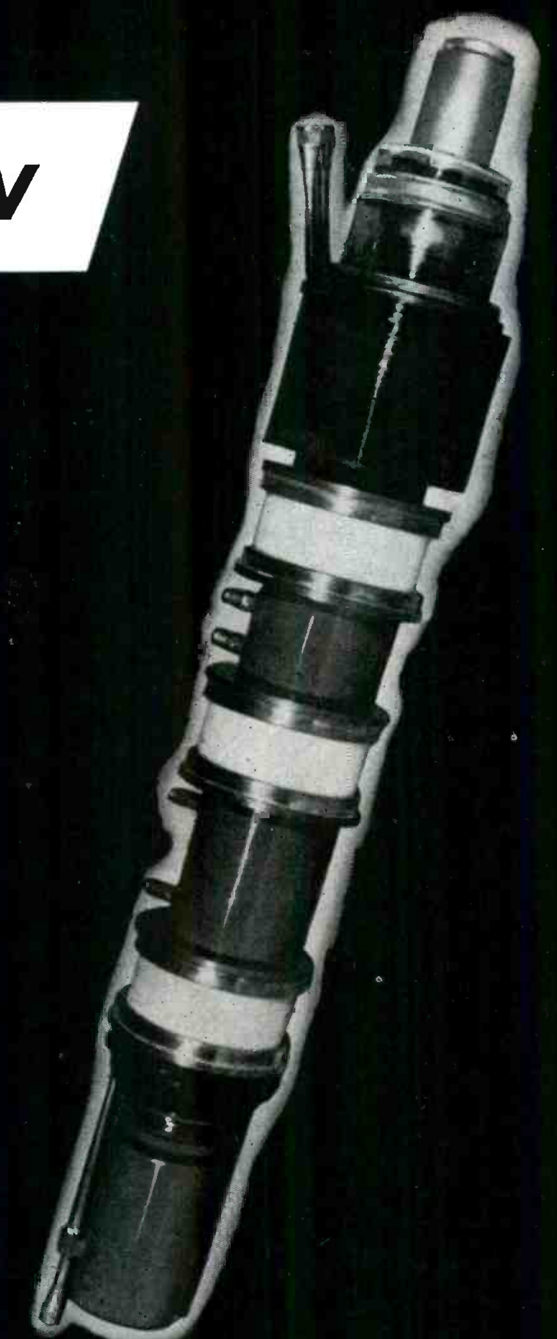
Write today for information concerning your needs.

MOLONEY ELECTRIC COMPANY

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers Step Voltage Regulators • Unit Substation

MOLONEY ELECTRIC = BETTER PERFORMANCE / GREATER RELIABILITY / LESS MAINTENANCE

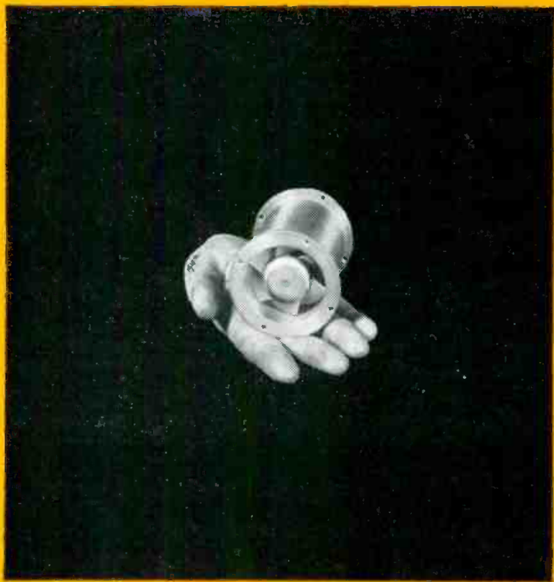
SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

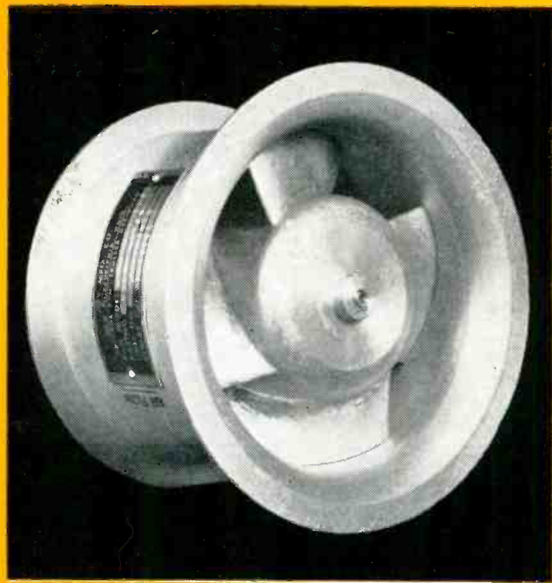


3K20,000LK
Length 37 inches • Weight 35 pounds

Want more information? Use post card on last page.

From VERY SMALL ... to LARGE CAPACITY





JOY AXIVANE® FANS

are available to meet any ELECTRONIC COOLING NEED

Joy AXIVANE Electronic Cooling Fans are expressly designed to meet the needs of this exacting field of service. They are built in a complete range to suit any requirements, such as: spot cooling of ventilated units where local high-temperature conditions arise; heat removal from pressurized or hermetically-sealed units; or heat removal where space is so restricted that natural ventilation through the unit or over its surface is insufficient. Important operating advantages of these fans are their strength, high resistance to shock and vibration, and efficiency in low or high-pressure service. Aluminum and magnesium construction keeps weight at a minimum.

Available in sizes from 2″ I.D. up, these Joy Fans are built to meet all present Air Force and Naval electronic specifications. They can be furnished with totally enclosed or explosion-proof motors, if desired.

In general, keep these facts in mind: that the light, compact design, low power consumption and high overall efficiency of Joy AXIVANE Fans provide more satisfactory cooling for electronic equipment in either air-borne or surface units. ● If you have a problem in heat dissipation from electronic units, let us place at your disposal JOY's experience as the world's largest manufacturer of vaneaxial-type fans.

Consult a Joy Engineer

Over 100 Years of Engineering Leadership

W&D I 4064

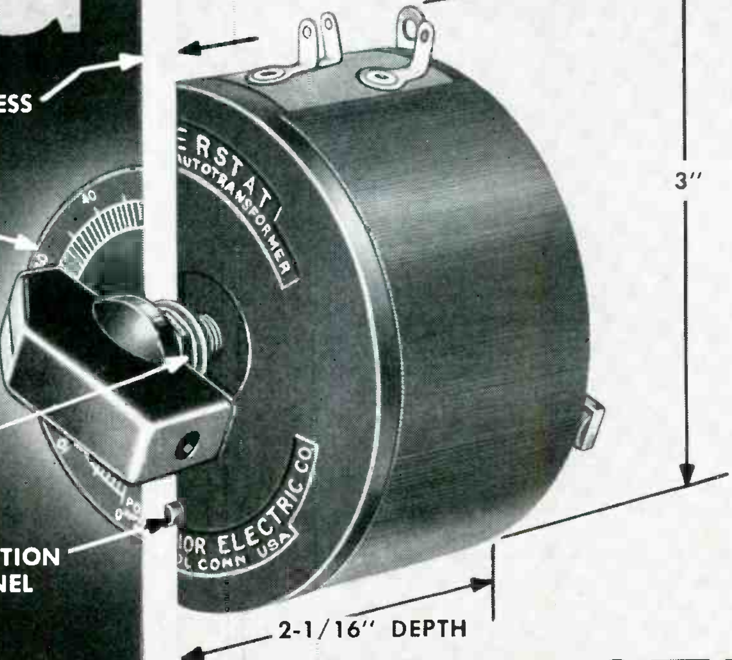
JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

SMALL . . . IN SIZE

BIG . . . in PERFORMANCE



TYPE 10 POWERSTAT

VARIABLE TRANSFORMER

RATED:

INPUT:	120 Volts, 60 Cycles 1 Phase
OUTPUT:	0 - 120/132 Volts, 1.25 Amperes 150/165 VA

APPLICATIONS

of POWERSTAT Type 10 are as innumerable as is the need for a variable a-c voltage control in today's low wattage electric and electronic equipment. It is ideal as the variable a-c voltage component in electronic tube testers; low wattage power supplies and rectifiers; low wattage heaters, furnaces, plastic molding equipment . . . and in any a-c voltage application where 50, 100 and 150 watt rheostats are now being employed.

A COMPACT VARIABLE A-C VOLTAGE CONTROL FOR LOW WATTAGE APPLICATIONS

To date, the many low wattage (50 . . . 100 . . . 150 watts) applications requiring variable a-c voltage control have had to be content with the inefficient, heat dissipating rheostats and other resistance types of control. With the introduction of the new POWERSTAT Type 10, the many advantages of POWERSTAT variable transformers are available for these low wattage requirements. A continuously adjustable output voltage from 0 to 120 or 132 volts is at the fingertips to control loads up to 165 VA. Type 10 does not have to be tailored to the load — it will deliver a variable voltage to any load up to its capacity. Type 10 is highly efficient — *does not* control by dissipating power in the wasteful form of heat. Other features: glass smooth commutator surface . . . advanced winding technique . . . superior core and coil design . . . rugged construction . . . single hole mounting . . . can be installed under a 3" chassis saving valuable space.

For additional information on the new, compact POWERSTAT Type 10, send for Bulletin P252.

Write to: 201 Mae Avenue, Bristol, Connecticut

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

. . . and plan to see the new, compact POWERSTAT Type 10 at The Superior Electric display, booths 108, 110 at the I.R.E. Show, March 3-6

WHAT ABOUT

Stability

IN *PRECISION WIREWOUND* RESISTORS?

Stability—the most intangible and least understood resistor characteristic—is extremely important in critical electronic applications requiring mass-produced precision wirewound resistors. Unfortunately, a truly stable resistor of this type has never been made. If it could, such a resistor would never change in ohmic value despite environment, power dissipation, or time. The only way to obtain stability is to minimize the factors that work against it—unfavorable environment, power dissipation, and time.

ARTIFICIAL AGING IMPROVES STABILITY — The processes of winding, terminating, and impregnating a resistor produce strains in the winding. These must be relieved if the resistor is to remain stable at various temperatures. This is done by artificial aging—periodically subjecting the resistor to high ambient temperatures and power dissipation.

Hidden material and manufacturing faults can destroy stability. The effect of such faults can be accelerated by overload testing and temperature cycling at extremes of high and low temperatures. After this, unstable resistors may readily be detected by measurement and eliminated.

HUMIDITY AND IMPREGNATION—Absorption or adsorption of moisture by the winding, bobbin, impregnant, or label can appreciably lower resistance. Unless impregnation is adequate, the wire may corrode at the terminating points. In the presence of a polarizing voltage electrolysis may also take place. Shallcross uses high grade steatite bobbins, carefully inspected wire, special "BX" impregnation, and a three-layer acetate label for protection against humidity. For severe humidity—including salt water immersion—Shallcross manufactures resistors which are hermetically sealed in steatite.

POWER DISSIPATION AND BREAKDOWN—Electrical energy, when converted to heat, affects stability as mentioned in connection with the artificial aging process. The potential gradient concurrent with high power may also cause insulation breakdown between turns, thus lowering resistance permanently or temporarily.

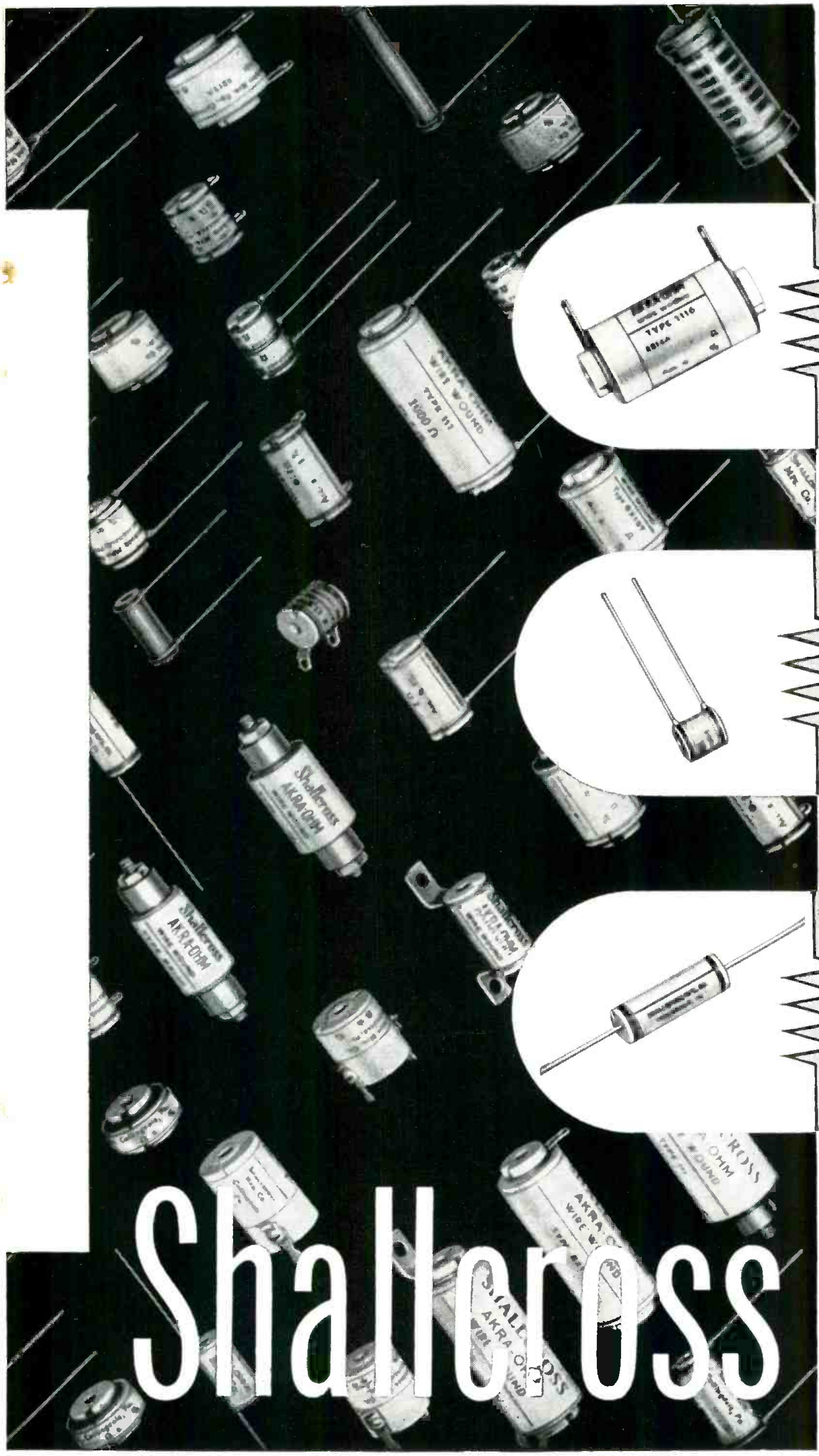
The effects of power dissipation may be minimized by using wire and bobbins of the largest practicable sizes. If size is restricted, the resistor must be operated within the conservative ratings and deratings of JAN and Mil Specifications. Within these ratings, and in normal indoor environments, a stability of 1/10 tolerance can be expected without special treatment.

TIME—The insulating elements of the best resistor will deteriorate with time. However, an aged and selected resistor operating in a fixed environment with negligible power dissipation can have a stability of ±0.001%. Under severe conditions, but within commercial ratings, a standard Shallcross resistor will have a stability better than 1/3 tolerance.

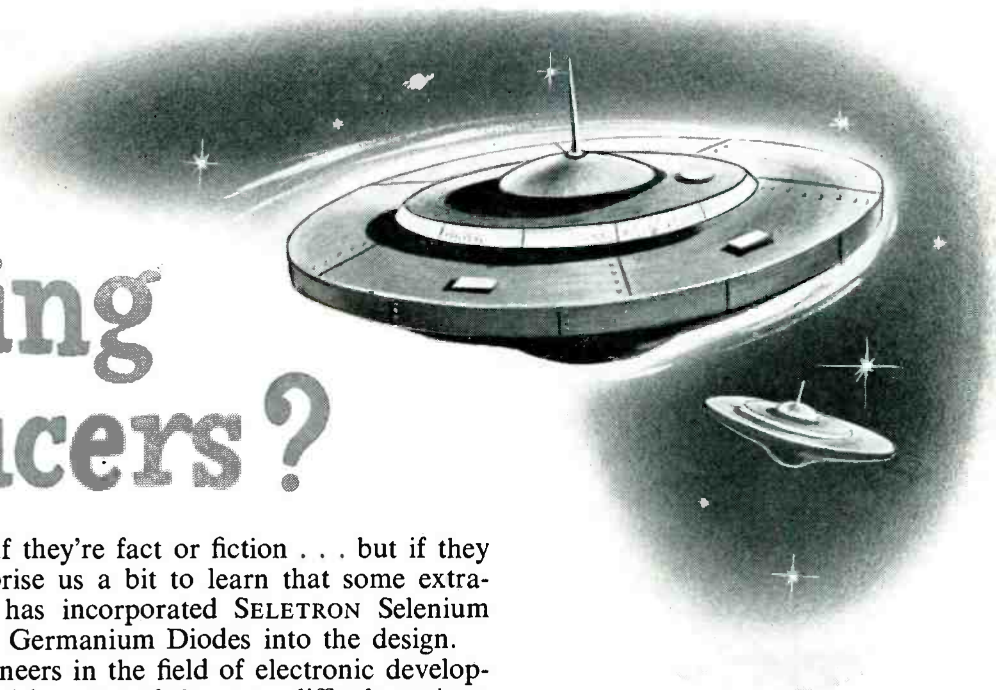
Further details on Stability and other resistor characteristics are available in Shallcross Bulletin R-3C.

SHALLCROSS MANUFACTURING COMPANY • 522 PUSEY AVENUE, COLLINGDALE, PA.

The second of a series to promote a better understanding of the performance characteristics of precision wirewound resistors.


Shallcross

Flying Saucers?



Frankly we don't know if they're fact or fiction . . . but if they *are* fact it wouldn't surprise us a bit to learn that some extra-terrestrial manufacturer has incorporated SELETRON Selenium Rectifiers and R. R. Co. Germanium Diodes into the design.

That's because—as pioneers in the field of electronic development—we've had our hand in some of the most difficult projects and met some of the stiffest requirements ever cooked up! Making drawing board dreams come true are daily chores at Radio Receptor Co.!

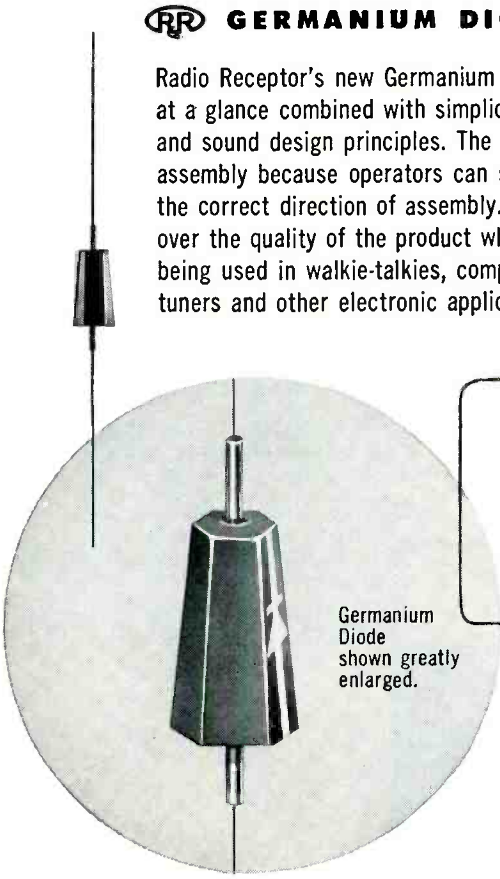
Seletron

RR GERMANIUM DIODES

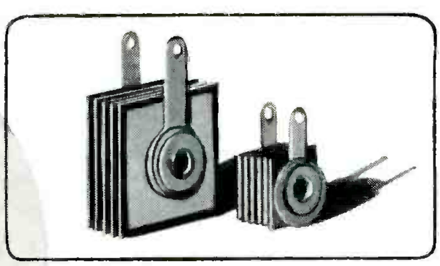
Radio Receptor's new Germanium Diodes feature polarity at a glance combined with simplicity of construction and sound design principles. The tapered shape speeds assembly because operators can see at a glance the correct direction of assembly. Users are enthusiastic over the quality of the product which is currently being used in walkie-talkies, computers, TV sets, tuners and other electronic applications.

SELENIUM RECTIFIERS

Seletron Selenium Rectifiers, in both miniature and industrial types, are in constant demand by an increasingly large number of engineers throughout the world because they are completely dependable under the most grueling conditions. Years of experience have given Radio Receptor Co. a deep insight into the idiosyncrasies of rectification.



Germanium Diode shown greatly enlarged.



Our Germanium Diodes and Seletron Selenium Rectifiers may hold the answer to many of your problems. Radio Receptor Engineers will be glad to study your requirements and submit their recommendations on both of these products.

Germanium Transistors available in limited quantities.

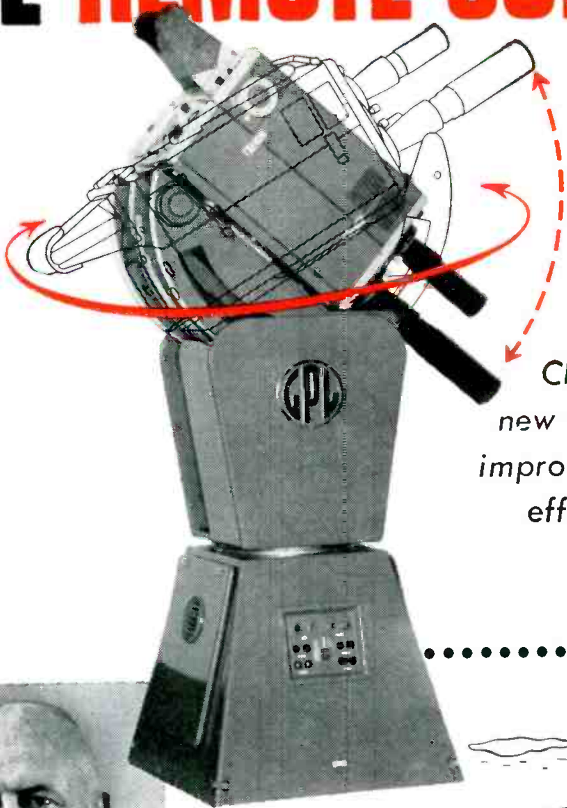
Seletron and Germanium Division

RADIO RECEPTOR COMPANY, INC.

RR ***Since 1922 in Radio and Electronics*** RR

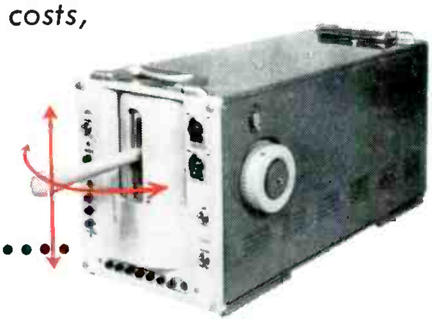
SALES DEPT: 251 West 19th Street, New York 11, N. Y. • FACTORY: 84 North 9th Street, Brooklyn 11, N. Y.

GPL REMOTE CONTROL CAMERAS



make debut as WHUM-TV puts UHF in Major Operation

Channel 61 in Reading uses 4 of new GPL chains to cut costs, improve studio-field efficiency



Humboldt Greig, president of WHUM-TV, says: *"We picked GPL cameras to gain a truly major reduction in costs by adding remote control. In fact, we feel these will be self-liquidating cameras due to the savings. We have tested them under the roughest conditions with our mobile unit in the past two months and encountered absolutely no difficulties."*

Marking two major milestones in television, WHUM-TV introduces both high powered UHF and remote control for new techniques in camera operation.

For the opening 30 live-hours per week from this 260,000-watt UHF station, 4 GPL image orthicon chains will be used with remote control pedestals. From as far as 1,000 feet away, all actions of pan and tilt, lens change and focus and iris are easily controlled.

Each camera has a "memory" of 6 pre-set positions. With a four-chain set-up, a director has a choice of 24 camera shots. Pushing a "pre-set" button automatically swings the camera on target . . . with lens, focus and iris in correct adjustment. Speed and ease of operation save time, camera handling, and dollars.

For field operations—covering sports and news—WHUM-TV uses the GPL studio-field interchangeability . . . again cutting costs. Two cameras, complete with remote control pedestals, fit atop the station's mobile unit. Pedestals disassemble in minutes for easy transfer between bus and studio.

WHUM-TV is the first station to equip all its cameras with remote control . . . for tops in quality, for utmost in economy.

STATION OWNERS

Our engineers will be pleased to show you, without obligation, how you can get maximum efficiency and economy in either UHF or VHF operations with GPL studio and field equipment. Write, wire or phone:

General Precision Laboratory **GPL**

INCORPORATED

PLEASANTVILLE NEW YORK

Cable address: Prelab

Export Department:
13 East 40th St., New York City
Cable address: Arlab

TV Camera Chains • TV Film Chains • TV Field and Studio Equipment • Theatre TV Equipment

Want more information? Use post card on last page.

Hot off the griddle!

5 NEW ®Permacel HEAT-CURING TAPES...

NOW ROUND OUT A COMPLETE LINE OF 18 ELECTRICAL TAPES FOR EVERY PRODUCTION NEED.

1. **White Acetate Cloth**—P243
2. **Acetate Fiber**—P245
3. **Yellow Flatback Paper**—P271
4. **Yellow Crepe Paper**—P281
5. **Orange-Yellow Polyester "Mylar" Film**—P252

For further information write Dept. E

INDUSTRIAL TAPE CORP., NEW BRUNSWICK, N. J. Makers of TEXCEL® and PERMACEL® pressure sensitive tapes for plant, office and the home.

MICROWAVE RECEIVERS

WIDE BAND • HIGH SENSITIVITY

POLARAD SCORES AGAIN

The first . . . the only MICROWAVE RECEIVERS to cover wide frequency ranges.

1,000 to 10,750 mc.

Microwave receivers of high sensitivity, wide tuning range and selectivity. Image rejection is greater than 60 db. Gain stability better than ± 2 db, permits application as a field intensity meter. Extra large dials enable frequency to be clearly read to an accuracy of 2%. Video bandwidth is 3.0 mc. Input power required is 105-125 v, 50/1000 cps.

- Single Dial Tuning
- Low Noise Figure
- Tracked R.F. Preselection, Triple-Tuned
- Linear db Output Indication
- AM-FM Reception
- Video Output — 10 v Pulse across 100 ohms
- Audio — BFO
- Recorder Output
- Provisions for Using external Attenuators in I.F. Channel
- Frequency Calibration Accuracy —2%
- Separate Audio & Video Channels
- AFC
- Calibrated Tuning Meter

Polarad *Electronics Corporation*

100 METROPOLITAN AVE. • BROOKLYN 11, N. Y.
STagg 2-3464

Vibration Engineering that solves your problems

PROBLEM: To provide superior vibration control while simplifying suspension design

SOLUTION: The Isomode* Type 5 Mount that isolates all modes of motion

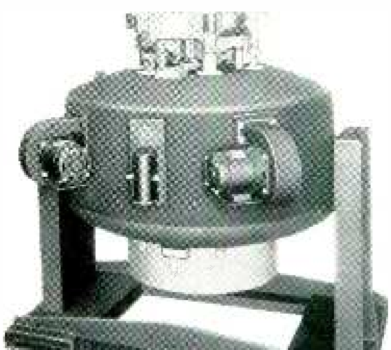
HOW to get optimum isolation into a product design? The answer is not always easy. But it was made much easier to find when Isomode Mounts were developed. They offer what's needed for outstanding results—namely, control of horizontal and rocking motions as well as vertical vibrations.

And here's why. Isomode Mounts have equal spring rates in all directions. They therefore absorb vibrations from all directions equally well. As a result, they can be mounted at any angle, permitting location of ideal suspension points and simplifying design.

In addition, Isomode Mounts have high load capacity in compact size, saving both space and weight. Large rubber volume for their size lends softness for good isolation, yet the mounts are stable, self snubbing and long lasting.

These mounts are an example of the kind of vibration engineering put to work for you at MB. Many companies have found it good practice to make MB their headquarters for vibration information. You will too—on vibration *isolation, control, testing, detection* or *measurement*. For more details on Isomode Mounts, be sure to write for Bulletin 410-5.

**Trade Mark Reg. U.S. Pat. Off.*



Model C-25

Model SD

A vibration exciter to meet your needs

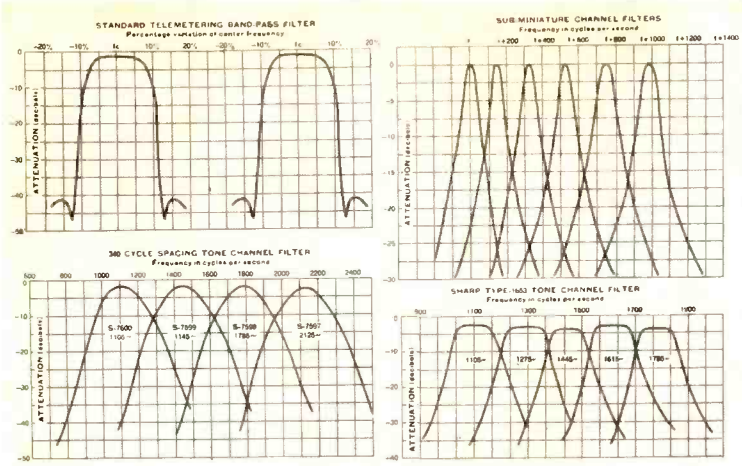
Whether your shake testing requirements are of large order or small, there's an MB Shaker for the job. Model SD, for example, has rated force output of 10 pounds; while the C-25 provides 2500 pounds. Model also available for 10,000 pounds. So if you have to vibration test to MIL-E-5272, be sure to check up with MB. Bulletin No. 1-VE-5 gives technical data on MB Shakers. Write for it.

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

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

EXPANDING PRODUCTION

in Toroids & Coils

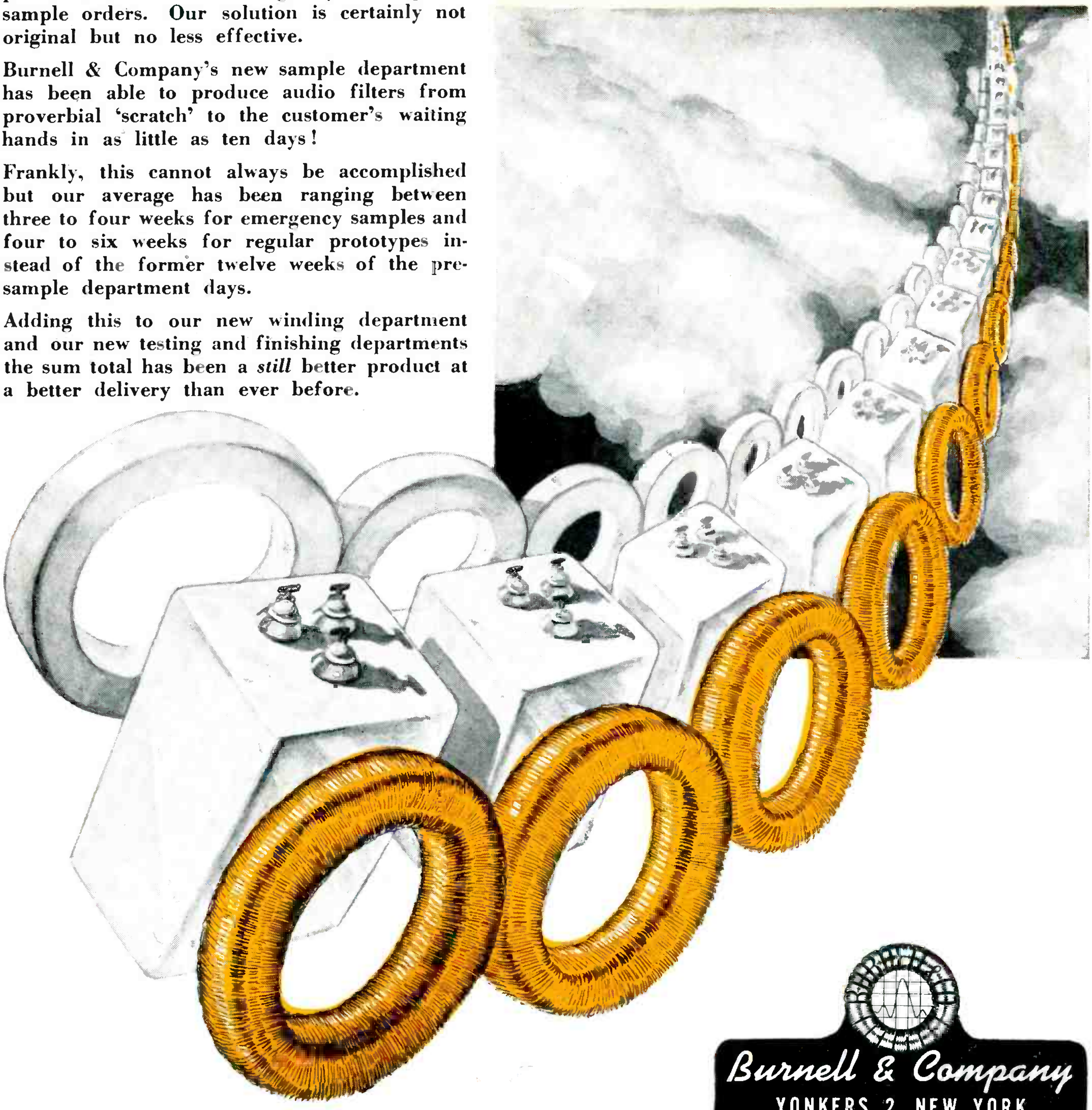


At every management meeting in Burnell & Company there is an unseen but highly respected visitor. He is the spectre of all our customers and his opinions carry weight. Recently he suggested that in addition to our other expansion measures that we must find a way to improve deliveries for emergency and special sample orders. Our solution is certainly not original but no less effective.

Burnell & Company's new sample department has been able to produce audio filters from proverbial 'scratch' to the customer's waiting hands in as little as ten days!

Frankly, this cannot always be accomplished but our average has been ranging between three to four weeks for emergency samples and four to six weeks for regular prototypes instead of the former twelve weeks of the pre-sample department days.

Adding this to our new winding department and our new testing and finishing departments the sum total has been a *still* better product at a better delivery than ever before.



EXCLUSIVE MANUFACTURERS OF COMMUNICATIONS NETWORK COMPONENTS

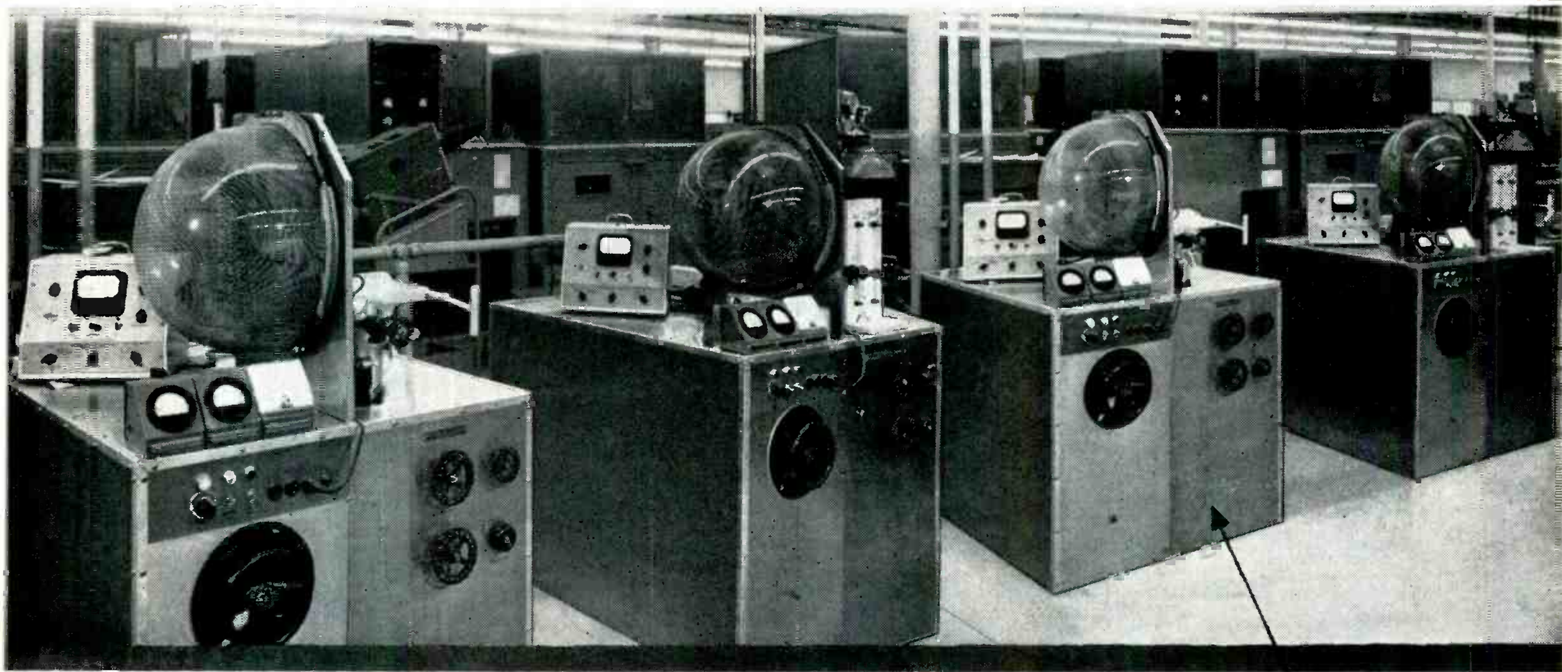
Burnell & Company
YONKERS 2, NEW YORK
CABLE ADDRESS "BURNELL"

Want more information? Use post card on last page.

As one of U.S.A.'s fastest growing electronic tube manufacturers, Bomac has established severe standards for their production equipment to assure an uninterrupted flow of tubes with minimum rejects.

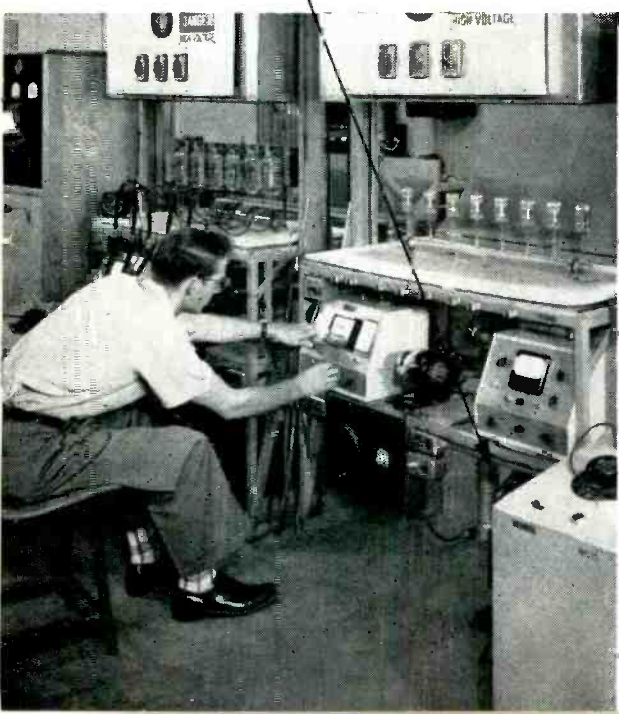
National Research high vacuum equipment meets these rigid standards so well that it was again specified exclusively in Bomac's recent expansion of facilities.

When you want the same — a single source for all your high vacuum equipment needs . . with a single unexcelled standard of quality — look to National Research. For further details write National Research Corporation, Memorial Drive, Cambridge, Massachusetts.



H-2-P Purifying Diffusion Pump. Over 50 liters per second from 10^{-3} to 10^{-6} mm. range. Operates against forepressures as high as 0.300 mm. Blank-off 2×10^{-7} mm.

Standard Vacuum Furnace. A versatile packaged unit to melt, pour, heat treat, degas, sinter, and anneal under high vacuum or controlled atmospheres. Temperatures up to 2000°C.



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HIGH VACUUM ENGINEERING AND EQUIPMENT

METALLURGY · DEHYDRATION · DISTILLATION
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National Research Corporation

Equipment Division

SEVENTY MEMORIAL DRIVE, CAMBRIDGE, MASSACHUSETTS

*Reg. U.S. Pat. Off.

Want more information? Use post card on last page.

CROSS TALK

► **GREETINGS** . . . From the staff of ELECTRONICS a simple but sincere *Happy New Year.*

We think the new year will indeed be happy from a business standpoint. Military orders could go up, probably will remain more or less level, might go down. If the last occurs this industry is in a better position than most to take up the slack by increasing its service to the civilian market.

► **BOOTSTRAPS** . . . Our business, right from the start, has shown remarkable ability to lift itself by its own technical bootstraps. In many instances aggressive engineering has opened up new markets without destroying the old ones.

Take television, for example. Replacement of existing receivers with sets having larger screens is proceeding at a healthy rate. New business centering around recently licensed stations is developing so rapidly that even as we write an industry committee is revising a year-old estimate of the market potential. And standards for compatible color tv are now far enough along so that this obvious lift will be ready long before uhf areas are saturated with monochrome.

Radio, then tv, knocked the phonograph market down but didn't knock it out. Long-playing records built an important market among high-fidelity fans and now binaural reproduction shows promise of doubling the expenditures of the upper fringe. The future of broadcast radio itself is in doubt but even here a bootstrap operation is conceivable in the light of past history. Meanwhile, rapidly increasing use of radio by industry is cushioning the blow.

► **PROGRESS** . . . The engineering liveliness that keeps electronics perennially young is by no means limited to assembled equipment. The transistor, most important component part to come down the pike since the tube itself, is everywhere in the news despite the fact that it was generally unknown four short years ago and is even now very much in the development stage.

Technical journals are bulging with early design data. Public demonstrations of electronic devices using transistors have been staged. Several new types have been announced. Point-contact units are being widely sampled. And the time schedule for production of junction transistors has been advanced. Unlikely as it seemed just a month ago, there is now evidence that several specialized devices employing transistors will find their way into limited commercial use in 1953.

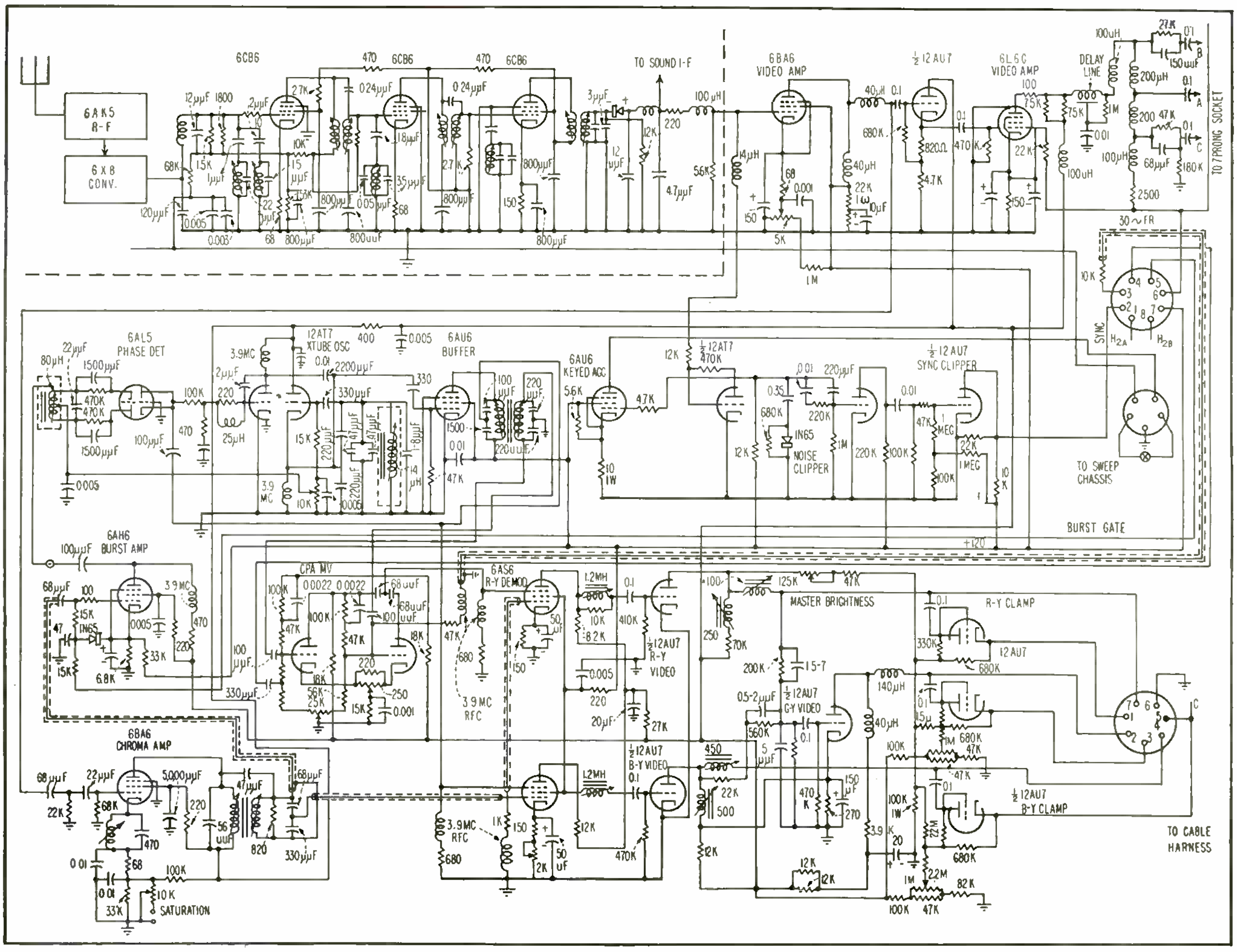
► **EXPANSION** . . . We've just returned from an editorial swing through Texas and Oklahoma. This is an area to watch, as heavy industry builds new plants to take advantage of low power costs and population follows. Here is not only a growing market for goods but also future manufacturing competition.

Already a modest electronics industry is building up around aircraft factories, chemical plants and petroleum refineries. Gear is for the most part highly specialized, ranging from geophones to mass spectrometers, but it is from such starts that national distribution frequently comes. And the Texans, in particular, are ambitious. We called on one who is a transistor licensee.

► **QUOTES** . . . At a recent symposium on airborne equipment it was said that "the carbon microphone is the world's most expensive loose connection."

Elsewhere, a scientist who kindly omitted any reference to raucous commercials maintained that "electrically charged hairs in the cells of the inner ear bend and flex in response to noise and act like variable resistances."

Then there is the wag who frequently, with some humanitarian if not technical accuracy, talks about "misguided missiles."



Circuits of chassis shown on front cover of this issue of ELECTRONICS

Compatible Color TV Receiver

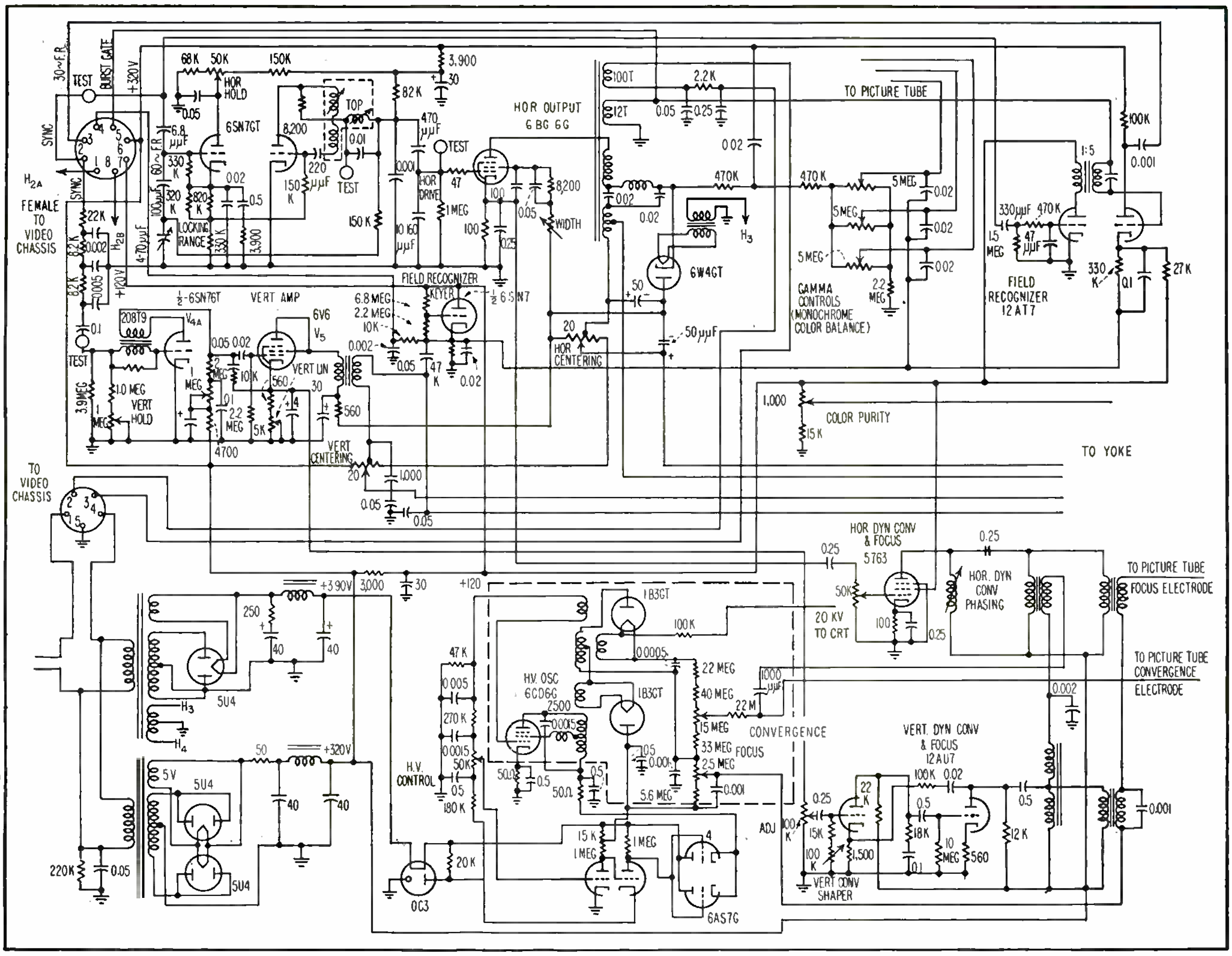
By **KENNETH E. FARR**

Westinghouse Electric Corp. Metuchen, N. J.

COLOR PICTURES produced by the receiver to be described are equivalent in size to a 12½-inch black and white picture. The receiver accommodates all vhf channels as well as UHF channels, and is capable of black and white as well as color reception. An overall block diagram showing the basic functions of the receiver is given in Fig. 1.

The upper portion of the block diagram is essentially a conventional black and white television receiver. It includes the tuner and i-f the video channel, deflection and sync circuits and a sound channel. The portion which shows the features particular to the color section includes the color decoders, color difference amplifiers, the color subcarrier generator, and the dynamic convergence and focus circuits which are peculiar to the RCA tricolor picture tube.

The essential monochrome elements of this receiver include the main signal and video channel, the sync and deflection circuits, and the intercarrier sound system. The sync separator, the tuner, i-f and sound portion are patterned closely after present black and white circuits. The i-f passband requirements for color reception are somewhat more critical but the essential difference from standard black and white in this portion of the receiver is in the video section. This has somewhat more gain and driving



Front-end and sound channel circuits are omitted for clarity

A straightforward approach to the problem of receiver design for the NTSC color system results in this 42-tube receiver. Used in numerous NTSC field tests of color tv, its performance on monochrome transmissions is comparable to current black and white receivers

capability than the average receiver, due to the requirements of the tricolor tube.

The receiver is designed for a compatible color television system, namely the NTSC system.[1] In this system, information is added to a standard black and white transmission to produce color in an appropriately designed receiver. A normal black and white receiver is capable of receiving a black and white picture from the transmission without any modifications.

There are several ways of specifying color. One way, which is probably the most familiar, is to break the colors down to three primaries—green, red and blue. Any visible color may then be specified in terms of the percentage of red, green and blue which could be used to duplicate the impression of this color as far as the viewer is concerned. Another method of specifying color is to describe the color sensation to the eye in terms of brightness, hue and saturation. Brightness is self-explanatory.

Hue is the attribute normally called color by the layman. That is, whether it is red, green, orange, and so on.

Saturation is a term which describes the amount of white mixed with the color, or as the artist would call it, the tint. This describes the difference between red and pink, for instance. Pink is a lower saturation red and 100-percent saturation would be the pure, strong color. Zero-percent saturation would be white.

The latter system of specifying color is utilized in the NTSC sys-

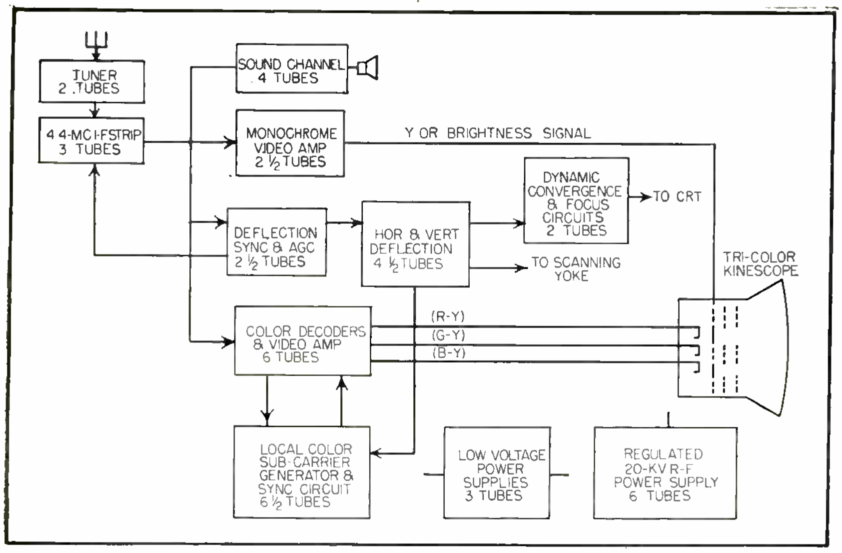


FIG. 1—Arrangement of stages in the overall receiver

tem. The brightness information is what is presently transmitted in the standard black and white system. This is modified somewhat in the NTSC system so that the black and white pictures represent the true brightness of all colors in accordance with the luminosity curve of the eye. To this brightness signal, two further degrees of information are added relating to the hue and saturation of the color.

Bandwidth

The brightness signal conveys the detail information or the resolution of the picture, and it should be transmitted at the full bandwidth of which the system is capable. It has been demonstrated,[2] however, that the eye is much less sensitive to detail in color than in brightness.

Translated into engineering terms, this means that less bandwidth is required for the hue and saturation signals than for the brightness signals. Taking advantage of this limitation of the eye, the hue and saturation signals can be transmitted over a much narrower bandwith without notable degradation of the picture. In actual practice, approximately four megacycles of bandwidth is used to transmit the brightness signal, and from 1 to 2 mc for the combined hue and saturation information.

This might seem to require at least a 5-mc channel. However, use is made of an additional phenomenon—the frequency makeup of a scanned television signal.[3] Since the scanning occurs at a constant repetition rate, frequency components of the signal lie in groups at line frequency and harmonics thereof. Definite gaps exist between these frequencies.

Figure 2 shows the frequency spectrum of the television video signal. The solid lines represent the harmonics of line frequency with 30 and 60-cycle sidebands corresponding to the field and frame information. The spaces between groups can be noted. This diagram shows the 200th and 201st harmonic of line frequency. The same pattern, however, exists from zero frequency up to the maximum transmitted in the signal.

The question might be raised that if there are no signal components present between these groups, what might happen if signals were placed there. From the theory of scanning,[3] it can be shown that a signal existing between the harmonics of line frequency, or more specifically at an odd multiple of half the line frequency, such as the 401st as shown here, will not be visible in the television picture. This is because it will be of opposite polarity on alternate lines and will thus integrate out to the eye.

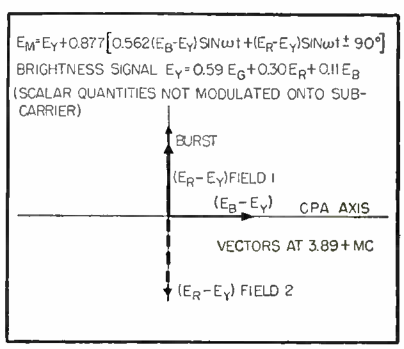


FIG. 2—Frequency spectrum of color signal

The hue and saturation information is amplitude modulated onto a color subcarrier whose frequency is such that all this color information falls in these odd multiples of half line frequency between the brightness components and thus have low visibility to the eye. This information, however, can be extracted by an inverse process in the color receiver and used to recreate the colors of the original subject.

The color subcarrier used is at the upper end of the brightness band, namely 3.898125 kilocycles, which is the 495th harmonic of half-line frequency. This high frequency was selected to further reduce the visibility of these color components in the brightness channel.

Hue and saturation information can be modulated onto a single subcarrier by using two subcarriers of the same frequency 90 degrees apart in phase. One piece of information is modulated onto one carrier and one onto the other. Synchronous demodulation at the receiver will recover each piece of information separately.

Suppressed-carrier transmission is used to further reduce the visibility of the color information on black and white receivers. Thus, only the sidebands are transmitted and the carrier, or subcarrier in this case, is reinserted at the receiver. This technique is not common in the television field.

To obtain maximum use of the bandwidth, vestigial sideband transmission is used with the upper sideband extending approximately 0.4 mc above the color subcarrier and the lower side band extending 1 to 2 mc below it. Thus, the entire color information is interleaved in the video frequency region of 3 to 4.5 mc.

A vector diagram of the color subcarrier with modulation is shown in Fig. 3. The equation at the top is the expression for the entire color signal. It is written as a brightness term E_Y plus another term which is the color information. The brightness signal is made up of 59-percent green, 30-percent red and 11-percent blue, in accordance with the color sensitivity of the human eye.

The color term consists of two parts. The plus or minus sign on the phase of the second part indicates color phase alternation. That is, this second term alternately leads and lags the first term by 90 degrees.

The vector diagram of Fig. 3 shows the various components of the color subcarrier. The vertical vector marked BURST is the color sync. It consists of about 9 cycles of color subcarrier transmitted on the back porch of each horizontal blanking interval. This burst is designated as the reference phase of the system. Lagging this burst phase by 90 degrees is the blue color signal $(E_B - E_Y)$. This signal is derived by substracting the brightness video signal from the blue video signal and modulating the color subcarrier with this difference. How this is accomplished in the actual equipment will be shown a little more clearly in what follows. It should be noted, however, that if the brightness signal is added back to the color difference signal, the blue signal E_B results.

Shown in phase with the burst is the red color difference signal. This phase is that obtained in the so-called odd field. On alternate fields, the phase is reversed 180 degrees, as shown dashed. This periodic reversal of the phase of this component of the color subcarrier, known as color phase alternation, is necessary when vestigal sideband color transmission is used. It cancels out the quadrature components that result from the single-sideband portion of the transmission, and cause cross modulation between the two components of the signal. The amplitude of these $E_B - E_Y$ and $E_R - E_Y$ vectors is a function of the color content of the picture is zero for black and white areas of the picture. Thus, the entire vector diagram with the exception of the burst disappears on black and white pictures.

No green signal is used as such

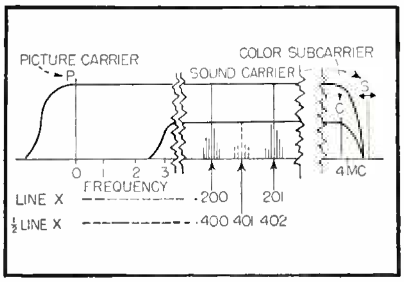


FIG. 3—Specification of NTSC signal. Color information is modulated onto subcarrier for vestigial sideband suppressed-carrier transmission

to make up a component of the subcarrier. The reason for this can be seen in the actual makeup of the $(E_G - E_Y)$ color difference signal.

$$E_Y = 0.59\,E_G + 0.30\,E_R + 0.11\,E_B \quad (1)$$

$$E_G - E_Y = E_G - 0.59 E_G - 0.30 E_R - 0.11 E_B \quad (2)$$
$$= 0.41 E_G - 0.30 E_R - 0.11 E_B$$

Similarly,

$$E_R - E_Y = -0.59 E_G + 0.70 E_R - 0.11 E_B \quad (3)$$

$$E_B - E_Y = -0.59 E_G - 0.30 E_R + 0.89 E_B \quad (4)$$

Each of these color difference signals contain all three of the color video signals. By taking 0.51 unit of the $E_R - E_Y$ signal, combining it with 0.19 unit of the $E_B - E_Y$ signal, and reversing the polarity of the combination, the $E_G - E_Y$ signal will result. This operation can be expressed by

$$-0.51\,(E_R - E_Y) - 0.19\,(E_B - E_Y) = E_G - E_Y \quad (5)$$

Thus it is not necessary to transmit the $(G - Y)$ signal as a separate vector, since it can be derived from the proper combination of the red and blue color difference signals in the receiver.

Typical Transmitter

A simplified block diagram of a color transmitter may make this somewhat clearer. In Fig. 4 is shown a color camera that splits the light from the image into red, blue and green components, and delivers signals corresponding to each of these three colors to a mixer. This mixer is essentially a linear adder which combines green, red and blue in the proper proportions to form the Y or brightness signal which is shown at the top of the diagram.

The mixer also produces the red and blue color difference signals which are shown written in both forms, for instance $(R - Y)$, and underneath $(0.6G - 0.7R - 0.1B)$, which is the actual make-up of this signal. The blue and red color difference signals then are passed through 2.5-mc filters to a pair of balanced modulators. These modulators are supplied with color subcarriers at 3.89 mc, which modulate the $(B - Y)$ signal in the reference phase and modulate the $(R - Y)$ signal at 90 degrees and 270 degrees, alternately at field rate. This is the color phase alternation described above.

The sync and color burst is generated and added to the output of the two balanced modulators, and this mixture is then added to the brightness signal to produce a com-

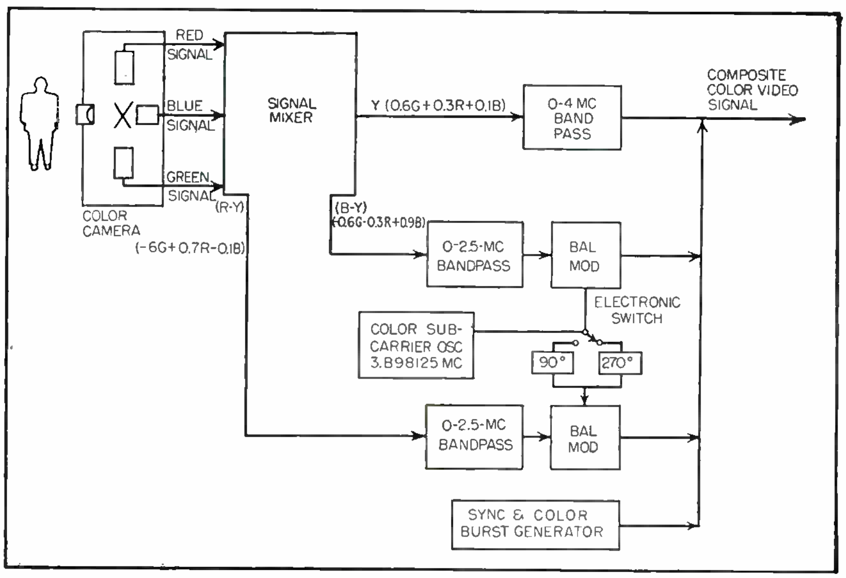


FIG. 4—Color transmitter video circuits

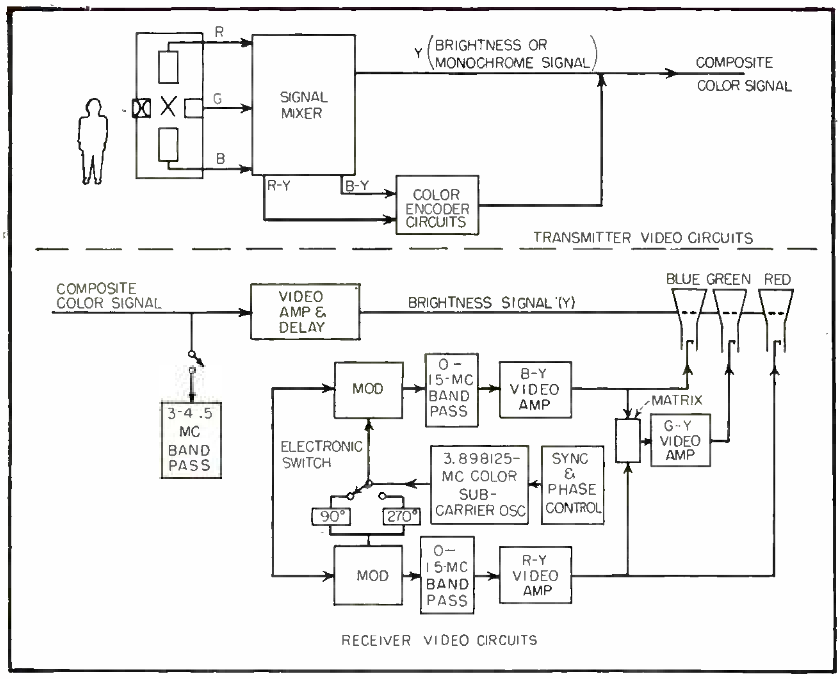


FIG. 5—Video circuit functions of receiver are inverse of those in transmitter

posite color video signal. The upper portion of Fig. 4, with the addition of the sync, produces a standard black and white picture. The lower portion of the diagram generates the color information which is added to this brightness information.

Figure 5 shows this transmitter schematic simplified further, and below it, for comparison, is shown the video section of a typical receiver. In the transmitter schematic, the brightness or monochrome signal circuits are at the top, and below them are the color encoder circuits, producing the color information that is added to the brightness signal. The receiver video circuits perform the inverse of this transmitter function.

The composite color video signal is supplied through the video amplifier to the grids of the tricolor kinescope. If the circuit shown in the lower portion of the block diagram is made inoperative, an ordinary black and white picture will be obtained. The color subcarrier information existing in the region of 3 to 4.5 mc in the composite video signal is applied through a bandpass circuit, to eliminate unwanted monochrome components, to a pair of modulators in a very similar fashion to that done in the transmitter. These modulators are supplied with a local subcarrier generated and controlled in phase by receiver circuits to be described later.

The color subcarrier modulates the information in the 3 to 4.5-mc region, beating it down to low-frequency even harmonics of half line frequency from zero to 1 mc. This demodulated information will then be the $(B - Y)$ signal, and the $(R - Y)$ signal as originally derived at the transmitter.

By combination of the $(B - Y)$ and the $(R - Y)$ signals in the matrix, which is simply a resistive mixing pad, the $(G - Y)$ signal is produced as was shown earlier. These three color difference signals are then applied to the cathodes of the blue, green and red guns of a tricolor kinescope or other suitable display device. Addition of the color difference signals to the brightness signal takes place within the kinescope. Thus the blue gun gets the Y signal on its grid, and the $(B - Y)$ signal on its cathode, and the effective signal applied between the grid and cathode of this tube then is B.

The same is true for the green and red tubes, so that finally the red, green and blue signals are used to control the beam current of the tube. The three images are superimposed to produce the complete color picture.

Turning to more specific details of the receiver design, it might be interesting to look at the receiver i-f passband requirements. Figure 6 shows the transmitted frequency spectrum of the composite video signal. The picture carrier is shown at zero frequency, with the lower vestigial sideband, the full upper sideband, and the sound carrier shown in their relative positions. The location of the color subcarrier and its components is also shown in the region of 2 to 4.5 mc.

Receiver I-F System

For proper reception of the vestigial sideband monochrome signal, the receiver passband should locate the picture carrier at the 50-percent response point, and the passband response should be down to essentially zero within the region of the vestigial lower sideband. This locates one edge of the i-f response rather critically. Since the color information is also a vestigial sideband transmission, it becomes necessary to locate the color subcarrier at the 50-percent response point on the *upper* slope of the i-f passband. This upper slope must be down to essentially zero at about 4.3 mc, which is the minimum width of the vestigial sideband called for in the NTSC standard proposal.

The sound carrier must, of course, be suppressed at least 26 db for intercarrier sound reception. Actually, it must be down somewhat further than this, approximately 30 to 40 db, to prevent an undesirable beat between the color subcarrier and sound carrier in the monochrome channel. The lower curve marked receiver i-f characteristic shows the idealized receiver passband for proper reception of the color signal. The receiver described has essentially this passband, centered at 44 mc.

Color Decoders and Video

In Fig. 7 is shown a block diagram of the color decoder section of the receiver. The composite video from the second detector is amplified in the chroma amplifier. The gain of this stage is adjustable from the front panel by the saturation control. Its function is to vary the saturation of the color in the picture. When turned completely off, a black and white picture results. As the control is advanced, the colors become more brilliant. If the control is set above normal, an appearance of fluorescent colors can be produced.

The output of the chroma amplifier, after going through a bandpass circuit, consists primarily of the interleaved color information. This is applied to the grids of the decoders or demodulators. The 3.89-mc local color subcarrier oscillator signal is applied directly to the suppressor of the $(B - Y)$ demodulator tube, and through a 90-degree phase shift network (which is simply a tuned circuit), to the suppressor of the $(R - Y)$ decoder.

The output of these decoders are the low-frequency color difference signals. These are applied to the cathodes of the red and blue guns of the tricolor kinescope. The $(G - Y)$ signal, derived from the matrix, is applied to the cathode of the green gun of the kinescope.

The d-c restorers are shown as they are actually connected from the common Y signal to the respective color difference signals. The signals seen by each restorer and by each respective gun of the kinescope are then actually the reconstructed red, green and blue signals. These color difference signals are restricted in bandwidth to about 1 mc in the receiver while the brightness signal has a 4-mc passband. This causes the color difference signal to suffer a delay relative to the brightness signal. To correct this condition and make the components coincident in time, a delay line is inserted in the monochrome channel. This line has a bandwidth of approximately 4 mc and introduces a delay of one micro-second.

Color Sync and Subcarrier Generator

The local color subcarrier generator and sync circuit is shown in block diagram form in Fig. 8. The 3.89-mc signal is generated at the transmitter by a crystal oscillator. In the receiver, this frequency must be generated and held to an exact phase relationship relative to that at the transmitter. This is accomplished by using the color synchronizing information or burst, consisting of about 9 cycles of the 3.89-mc subcarrier on the back porch following each horizontal sync pulse.

The signal from the output of the chroma amplifier is applied to the burst amplifier, which is a high-gain amplifier gated on by the horizontal retrace for the duration of the burst interval. The output of this amplifier then contains only the separated burst signal. This signal is applied to a 6AL5 phase detector where it is compared with the signal from the local 3.89-mc oscillator.

A d-c voltage is developed which is proportional to the phase difference between these two signals. This d-c voltage is applied to a reactance tube to control the phase and frequency of the local 3.89-mc oscillator. The output of this local oscillator, through a buffer stage, is used to modulate the $(B - Y)$ decoder directly, and through a tuned circuit introducing a 90-degree phase shift, it is applied to the color phase alternation multivibrator. This is a flip-flop multivibrator which reverses the polarity of this local oscillator wave at field rate. Thus the signal applied to the $(R - Y)$ modulator will lead that

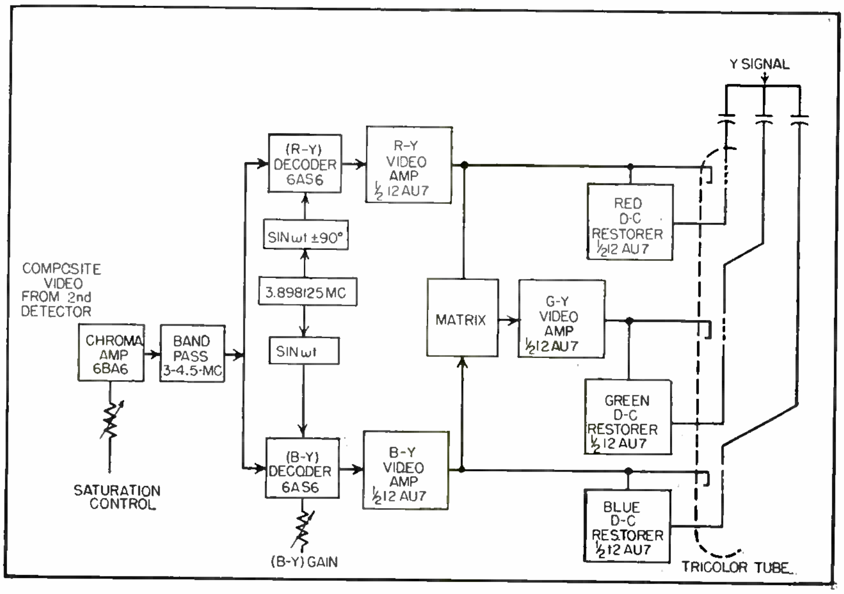


FIG. 7—Color decoder section and the signals handled

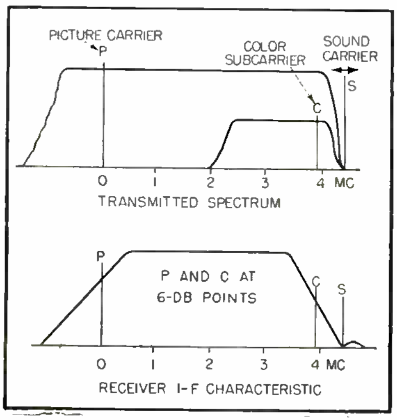


FIG. 6—Idealized receiver passband and location of color subcarrier

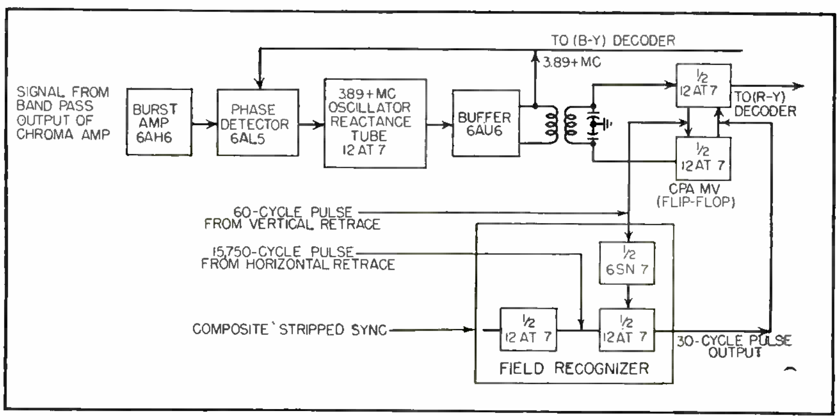


FIG. 8—Local color subcarrier generator and sync circuits

applied to the $(B - Y)$ modulator by 90 degrees in one field and lag it by 90 degrees in the next field.

Attention must be paid to the phase of this alteration. It must flip when the transmitter flips and flop when the transmitter flops. To accomplish this, a unit called a field recognizer is used.[4] The necessary sensing information is implicit in the ordinary black and white synchronizing signal, in the alternate field interlacing. The field recognizer gates in a horizontal sync pulse on alternate fields, thus producing a 30-cycle output.

The field recognizer circuit is shown in Fig. 9. The composite stripped sync is partly integrated and applied to the grid of a 12AT7 tube. In the plate circuit of this tube is a transformer having a secondary resonant at one-half the horizontal line frequency. The integrated stripped sync, consisting primarily of vertical sync pulses, excites this resonant circuit.

On one field the peaks of this damped wave will occur in phase with the horizontal sync pulses while on the alternate field the horizontal sync pulses fall on the axis of the damped wave. A voltage pulse from the horizontal retrace, picked up from a winding on the horizontal output transformer, is added to this damped wave, and the combined signal is applied to the grid of the other half of the 12AT7 tube.

The horizontal pulse at the beginning of one field will ride on the peaks of the damped wave and have higher amplitude than the horizontal pulses at the beginning of the next field, which are riding on

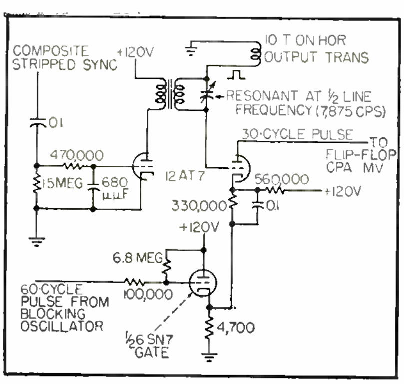


FIG. 9—Field recognizer circuit controls flip-flop multivibrator for color phase alternation

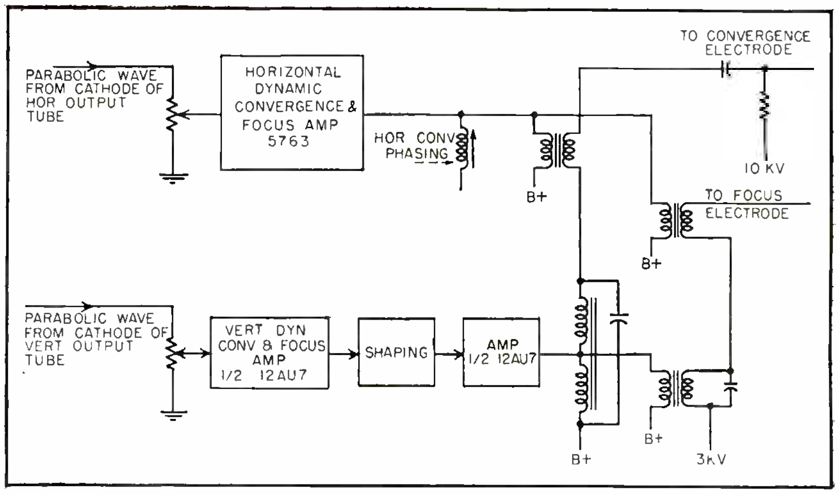


FIG. 10—Dynamic convergence and focus circuits control color registration on picture tube screen

the axis of the damped wave. By clipping the peaks of this composite wave in the output half of the 12AT7, one or two horizontal pulses are gated out on alternate fields. This then is the 30-cycle wave having a definite sense relative to the transmitted signal.

The 6SN7 gate tube, shown at the bottom of the diagram, gates on this field recognizer circuit only during the vertical retrace interval to improve its signal-to-noise ratio, since it is then only responsive for a fraction of the total time. The 30-cycle pulse from this field recognizer unit is applied to one grid of the cpa flip-flop multi-vibrator. The 60-cycle vertical retrace pulse is applied to the other grid, with the result that the flip-flop multivibrator is driven in the correct phase at all times.

Scanning Circuits

The horizontal and vertical scanning circuits are quite conventional. The main difference between those used in this receiver and those in standard black and white receivers is that somewhat more scanning power is required, since the tricolor kinescope has a 2-inch neck with a large yoke and requires more scanning current. The high voltage for the kinescope is a regulated r-f supply delivering 20,000 volts at about 300 microamperes for an average picture. Regulation is required in this supply to maintain color registration under variations in beam current.

Some special circuitry in conjunction with the scanning is required for the RCA tricolor tube to maintain correct color registration.[5] These circuits, known as dynamic convergence circuits, are outlined in Fig. 10. After the d-c potentials and magnets at the tube neck are adjusted to bring the beams from all three guns into registry at the center of the tube, a-c signals must be applied to the convergence and focus electrodes to maintain convergence and focus of the three beams over the entire face of the tube.

Parabolic waves derived from the cathodes of the horizontal and vertical output tubes are applied to amplifiers. Some phasing and shaping of these waves is done in these amplifier stages. The outputs of the two amplifiers are combined in series, through transformers, to form the combined dynamic convergence and focus waves, which are applied to the picture tube. By careful adjustment of the amplitude and phase of these convergence waves, good registration of the colors can be obtained over the entire face of the tube.

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Measuring Minute Capacitance Changes

Resonant bridge carrier system permits accurate resolution of minute mechanical motions that produce capacitance changes as small as 0.001 μμf or less. Equipment is unaffected by relatively severe extraneous disturbances

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VARIOUS METHODS have been developed for the measurement of minute changes in capacitance. The method to be described has been employed successfully to solve many problems in the measurement of physical quantities which heretofore have been considered very nearly insuperable. Other methods tried have fallen far short by comparison.

The system utilizes a doubly-resonant capacitance bridge circuit and a unique phase-amplitude-sensitive discriminator. The circuits are extremely stable and little affected by changes in circuit-parameter values other than in the bridge arms. A wide dynamic range of frequency response extending from 0 to 20,000 cps or more is an inherent property of the system.

Figure 1 is a functional block diagram of the system, and Fig. 2 shows a typical response curve.

Measurement System

In the bridge, resonance at a low radio-frequency carrier is induced in two modes. This bridge circuit is excited via a low-impedance transmission line from the crystal-controlled oscillator.

The bridge is initially balanced. When unbalance occurs, the resultant signal current is transmitted via another low-impedance transmission line to the signal amplifier. The output voltage of the amplifier is impressed on a special discriminator circuit in which the sense or direction of the bridge unbalance is determined. A d-c signal voltage of the proper amplitude and polarity is imposed on the output stage which serves as a voltage or current amplifier to drive an appropriate recording device.

Bridge Circuit

The arms of the bridge consist of four capacitors, one or two of which are active in the measurement process. It is the purpose of the bridge circuit to modulate

Complete system for measuring dynamic pressure under wing of aircraft in flight

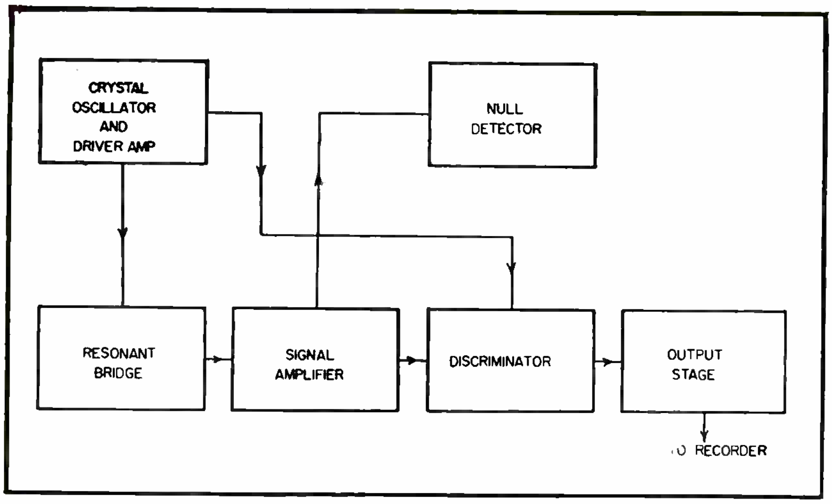

FIG. 1—Resonant bridge is key to high sensitivity of the capacitance-increment-measuring system shown in block diagram

the driving voltage in a manner such that only the sideband components of a modulated carrier-voltage wave are produced at the output terminals of the bridge. The bridge circuit is shown schematically in Fig. 3.

The inductive elements that link the driver amplifier to the bridge are critically coupled under operating conditions. A very high bridge-exciting voltage is thus developed with little actual driving energy. The driver transformer is resonated by the diagonal capacitance of the bridge from the point 1 to the point 3.

Likewise the detector transformer is resonated by the other diagonal capacitance. This condition of resonance is independent of that induced in the driver-transformer. The detector transformer is overcoupled to the amplifier to improve the sideband frequency response.

With the bridge in perfect balance, no voltage is developed across the detector-transformer even though a resonant condition exists which includes this transformer. Since the capacitors are part of a resonant circuit with the driver transformer, and the circulating current in each of the four arms is relatively high, the most minute unbalance in the capacitance of the arms produces a relatively large output voltage across the resonant detector-transformer.

The magnitude and phase of the output voltage are proportional to the degree and sense of unbalance, and to the magnitude of the quiescent resonant currents induced in the bridge arms.

Calibration

The method chosen for calibration is precise and accuracy may be made as high as desired by the exercise of reasonable care, and by the selection of high-quality materials.

As shown in Fig. 4A, one arm of the bridge is shunted by a series circuit consisting of a very small capacitor and a very large capacitor. If the large one is short circuited, the effective capacitance change induced in the arm may be derived quite easily.

Balancing

The bridge may be balanced at some physical distance from the gage by means of a cable as shown in Fig. 4B. This method is somewhat similar to the balancing method employed in the Wien Bridge circuit. The balancing controls are shunted by the cable capacitance and their effectiveness and range of compensation is reduced as the length of the cable is increased.

Stability

This measurement system has been designed around one particular theme; that there must be output signal to the recorder *only* when there is a change in balance in the bridge. The present limitation in practical use is not associated with the measurement system at all but rather turns out to be inconstancy in the capacitance of the bridge arms themselves.

It is imperative that the wiring in the bridge compartment be rigidly fixed relative to adjacent circuit components. This is accomplished by embedding the complete bridge section in a thermosetting plastic or resin.

It is essential that the driver

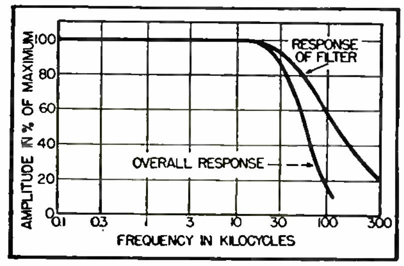

FIG. 2—Overall frequency-response of measurement system

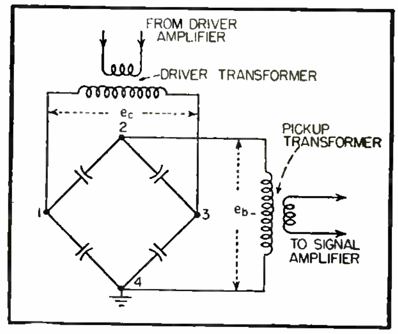

FIG. 3—Driver and pickup transformer windings resonate with their respective diagonal capacitances at operating frequency

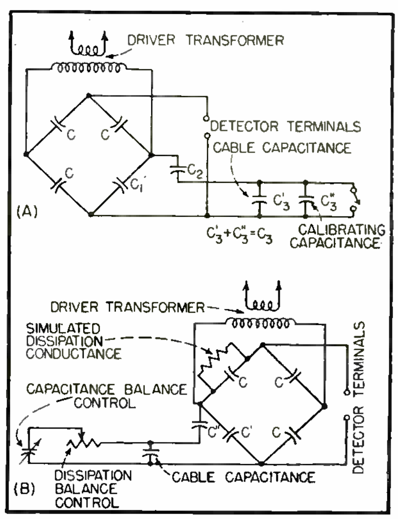

FIG. 4—Schematics showing circuits for calibration and remote balancing

and detector transformers be completely shielded from each other electrically to prevent induced stray currents in the detector transformer. Examples of this construction are shown in Fig. 5.

If these precautions are observed and good engineering practices are exercised in the construction of the electronic portion of the system, it will be found that this system is free from microphonics.

Many physical measurement problems require a transducer or gage with a high natural frequency. Since in most cases the sensitivity of a gage is inversely proportional to the square of its natural frequency, the burden of providing suitable amplification falls on the associated electronic measurement system.

The overall schematic diagram of the system is shown in Fig. 6. The oscillator uses the so-called bootstrap circuit wherein the crystal serves as an extremely sharp filter and is at the same time the frequency-determining element.

The signal amplifier consists of two stages of conventional pentode amplification. A precision step attenuator is ganged with a switch for selecting calibrating capacitors to suit the attenuator setting. Thus a known change in the bridge may be directly compared with the unknown capacitance change being measured.

Null Indicator

Initial balance must be obtained for both reactance and resistance and a null indicator is necessary to obtain this balance. A pentode amplifier tube is arranged in a special reflex circuit so that its voltage gain is utilized at the carrier frequency and at the same time it serves as a d-c amplifier for the metering circuit. The deflection of the null indicating meter is approximately logarithmic on an inverse scale.

Four distinct amplitude-modulated carrier wave voltages are developed in the discriminator and are impressed separately on diode rectifiers. The output current of each pair of diodes flows in an independent load resistor. The resultant signal voltages are filtered and fed to the grids of a push-pull output stage. The differential output voltage is directly related to the degree and sense of unbalance in the bridge.

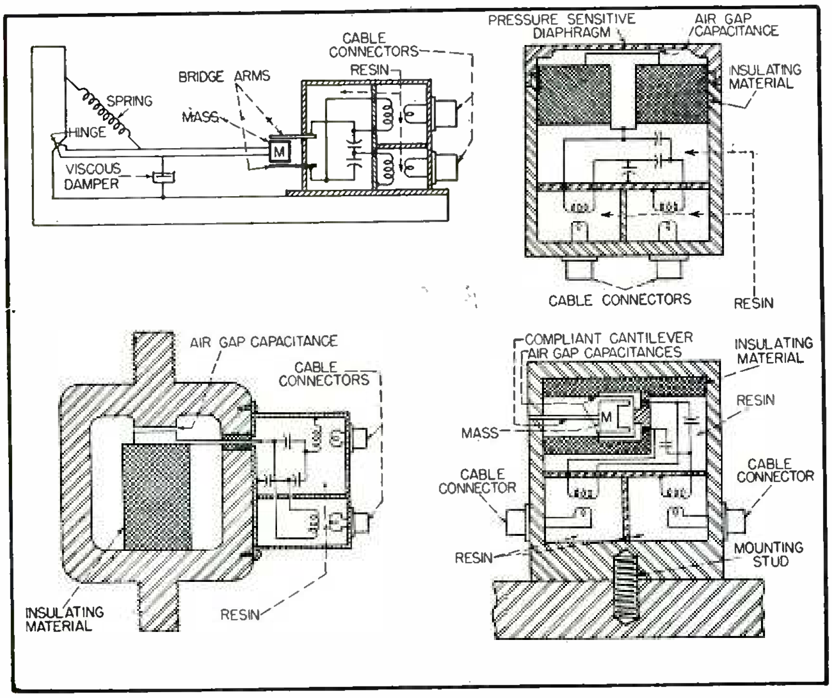

FIG. 5—Typical arrangements for measuring seismographic displacements, force, air pressure and acceleration

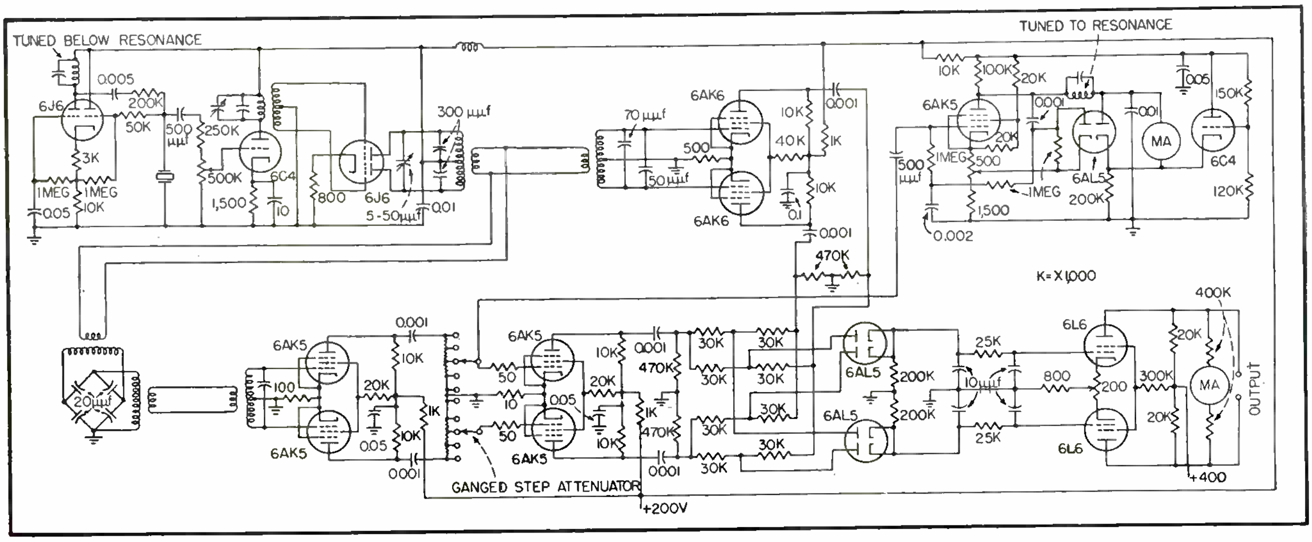

FIG. 6—Overall schematic of circuits used in resonant bridge carrier system

F-M Recording in

Information on tape from battery-operated magnetic recorder in guided missile is decoded and recorded. High accuracy in speed control is obtained by separate 4-kc channel on tape that minimizes speed variation between recorder and playback drive motors

Two methods of recovering information originating at a remote location consist of telemetering the information over a wire or space link and of recording the information on a medium such as magnetic tape and later transcribing this information into suitable form for evaluation. This paper is concerned with the second method.

Equipment was used in conjunction with a 198-channel, 100-track battery-operated magnetic recorder designed to fit into the nose of a missile during flight. Operating conditions of the recorder were such as to require the use of stainless-steel recording tape. Tape speed variations had to be held to closer than about 2½ percent tolerance.

After a recording is made of the pertinent flight data, the magnetic tape record is jettisoned and later recovered for playback and transcription at a ground station. The f-m transcriber accepts a multiplex signal from a playback head of the ground playback machine and records the information on a suitable graphical recording medium.

F-M Channels

Information at the input of the transcriber is in the form of two f-m signals, each occurring in a band or channel of frequencies separated from the other by 100 cycles. The first band, channel 1, ranges from 4,100 to 5,600 cycles and the second band, channel 2, ranges from 5,700 to 7,900 cycles. The transcriber separates the two channels of information, demodulates the information by discriminating the exact signal frequencies in each channel, and records this information as a function of time on a suitable graphical recorder.

Since the information in either channel is determined by the instantaneous signal frequency in that channel, any difference in the instantaneous tape speed of recording and playback will result in an erroneous signal frequency. Concurrent with the information signal, the transcriber is furnished a reference frequency from a second magnetic playback head for tape speed error compensation. This reference frequency is recorded on the magnetic tape as a constant frequency of four kc and, during playback, any difference in the instantaneous speed of recording and playback will result in variations of the reference frequency. These variations are detected in playback and are used to correct for errors in the information channels.

Principle of Operation

The basic idea of the f-m transcriber is illustrated in Fig. 1. The signal input is fed into the preamplifier where it is amplified and fed to two selective filters which separate the two channels. The information in each channel is then further amplified and limited. At this point the signals are fed separately into the signal discriminator where they are further limited and deprived of their harmonic content by the low-pass filters. The resulting signals are then of constant amplitude with the information in either signal a function of its instantaneous frequency. The signals are then fed through compensating amplifiers and R-C discriminators producing a voltage output in each case which is directly proportional to the recorded signal frequency.

Reference Signal

A second reference signal, originating from a second magnetic track on the same type as the information signals, is fed into the reference discriminator. This signal is amplified, limited and filtered in the

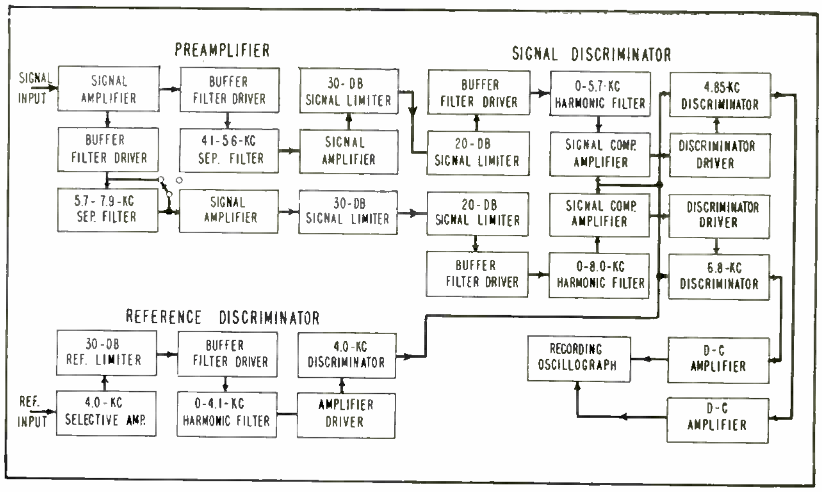

FIG. 1—Block diagram of the f-m transcriber

Guided Missiles

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same way as the information signals. The reference signal is then discriminated producing an output voltage proportional to the instantaneous reference frequency. If the reference frequency input is the same as has been recorded on the tape, the discriminator output will be zero. As this frequency deviates in either direction from the recorded frequency, due to tape speed variations during recording and playback, the reference discriminator output will be a positive or negative voltage.

The output voltage is fed into the signal discriminator, where it is used to shift the operating characteristics of the compensating amplifiers and signal discriminators in order to correct for the information signal-frequency errors due to the tape speed variations. The two information outputs of the signal discriminator are then fed to the d-c amplifier where the voltage variations are converted into current variations for application to the galvonometer elements of the recording oscillograph.

Signal Preamplifier

The circuit diagram for the signal preamplifier is shown in Fig. 2. Amplification is accomplished by three stages of conventional capacitance-coupled amplifiers with the separation filters sandwiched ahead of the last stage to prevent saturation of the filters at the higher voltage levels. The system was designed for input levels of from 100 microvolts to 10 millivolts rms and the amplifiers provide 60 db of amplification furnishing a maximum of 10 volts rms to the limiter.

Separation filters are of the L-C type with a characteristic impedance of 10,000 ohms. Specifications on the filters require that they be flat to within 20 db over the channel bandpass frequencies. They must also be down 40 db or more from the minimum value over the bandpass at frequencies greater than 100 cycles on either side of the band-

The complete equipment is housed in a single cabinet with five compartments

pass region. Provision is made to bypass the channel 2 separation filter in case it is desired to transcribe only a single channel. This will allow a wider bandpass region and increase the signal-to-noise level at the bandpass extremes.

To obtain the required degree of limiting necessary to realize the desired accuracy, it was necessary to clip the input wave severely and recover the fundamental by eliminating the harmonic content of the resulting wave. Considerable effort was spent to obtain symmetrical clipping to keep the fundamental component of the output wave constant with the expected variations in input level and to minimize the even harmonic content of the wave.

The entire limiter consists of five stages of symmetrical clippers resulting in a fundamental content constant to within 0.5 percent for input voltage variations down to 60 db below ten volts.

The clipping operation is obtained by driving the first half of the 6SC7 twin triode well beyond its cutoff point. The resulting wave at the cathode is then clipped on the positive half of the wave by driving the second half of the 6SC7 beyond its cutoff point. The potentiometer

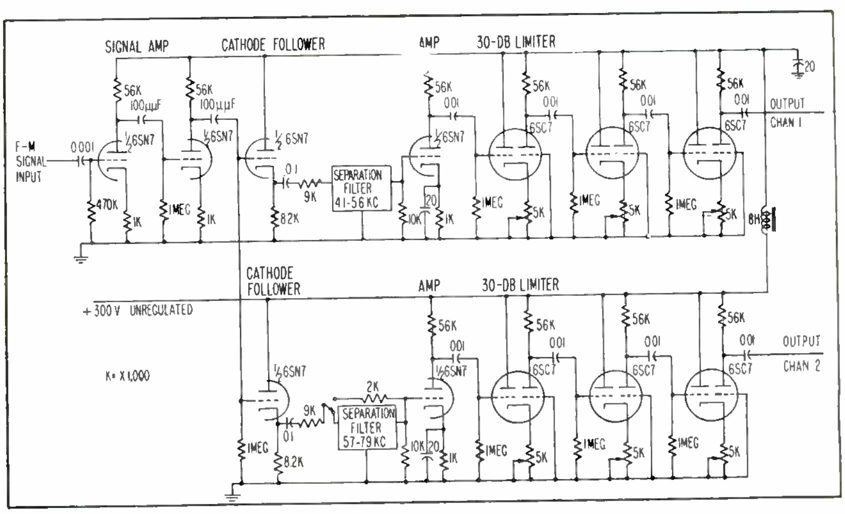

FIG. 2—Schematic diagram of the signal preamplifier unit

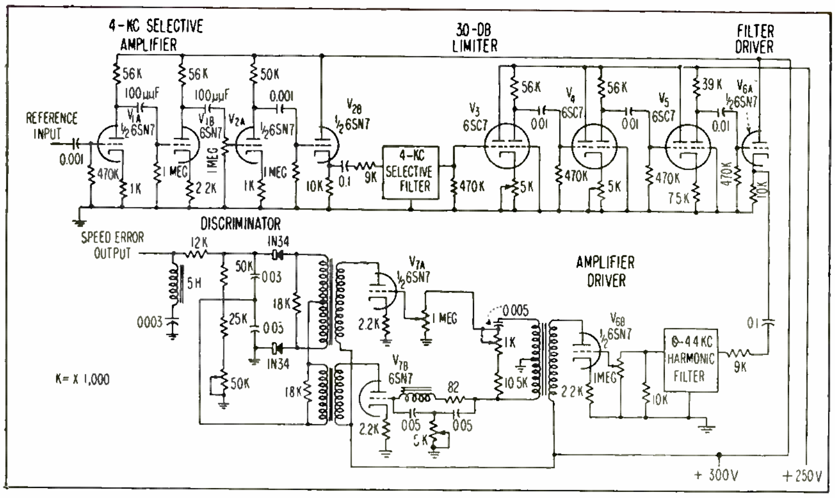

FIG. 3—Schematic diagram of the reference discriminator

in the cathode circuits adjusts for symmetry of the output wave.

Discriminator Circuits

The purpose of the reference discriminator is to provide an output voltage proportional to the instantaneous frequency of the reference signal input. The required voltage difference to correct for ±2.5-percent tape speed variation was determined to be of the order of ± two volts. This required a discriminator whose sensitivity was about 10 volts per kc, which is considerably greater than any standard discriminator circuit. A special discriminator was developed for this application.

Figure 3 shows the circuit of the reference discriminator. Amplifier and limiter sections are similar to those employed in the information channels. Output of the amplifier-driver is applied across an R-C phase splitting circuit whose output voltages are equal and essentially 90 deg out of phase over the frequency range of 4 kc ±2½ percent. One of the outputs of the phase splitter is fed directly to V_7 and then into a balanced rectifier. The second output is fed into a bridged-T network, amplified and fed to the rectifiers in push-push fashion.

In order to understand the discriminator action, consider Fig. 4 which shows a plot of the amplitude and phase characteristics of the bridged-T network. The inductor is adjusted so that f_o occurs at 4 kc. Next consider Fig. 5 which illustrates the discriminating action at the rectifier circuit. When the reference frequency is equal to f_o = 4 kc, e_2 will be in quadrature with e_1 and with magnitude zero. As the reference frequency deviates on either side of the design center frequency, a positive or negative voltage will occur at the output terminals of the rectifier.

The basic function of the signal discriminator is to supply two output voltages which are proportional to the instantaneous signal frequencies recorded. To perform this function, an R-C discriminator is used in conjunction with a compensating amplifier to make a highly linear frequency discriminator over the channel bandpass regions. To correct for tape speed variations, the capacitative arm in the discriminator circuits is instantaneously adjusted by the reference discriminator output voltage. The resulting effect is to shift the signal discriminator output characteristics in such a way that the output voltage is proportional to the signal frequencies recorded rather than those being played back.

The circuit diagram of one channel of the signal discriminator unit is shown in Fig. 6. The symmetrically clipped wave of the limiter is fed through the low-pass filter that removes the harmonics. The filter is flat to within 0.7 percent over the channel bandpass frequencies and is down greater than 40 db at the third harmonic of the lowest frequency in the channel region.

The discriminator consists of an R-C voltage divider and a rectifier circuit. The capacitance arm of the R-C circuit is composed of a fixed capacitor and a high Q variable capacitor[1] (6J6) in parallel. If e_{RC} is the voltage applied to the R-C network, the rectified output voltage will be

$$V_o \propto \frac{1-\dfrac{\omega}{\omega_o}}{\sqrt{1+\left(\dfrac{\omega}{\omega_o}\right)^2}}\, e_{RC} \qquad (1)$$

where $\omega_o = 1/RC$. Except for the denominator in Eq. 1, this is exactly the relation required for a pure ratio discriminator. To obtain the desired expression, a compensation amplifier was inserted between the harmonic filter and the R-C network whose transfer function is

$$\left|\frac{e_{AC}}{e}\right| = \frac{g_m R_p \sqrt{1+\left(\dfrac{\omega}{\omega_o}\right)^2}}{\sqrt{(1+g_m R_c)^2+\left(\dfrac{\omega}{\omega_o}\right)^2}} \qquad (2)$$

where g_m is the transconductance of the 6AC7, R_p is amplifier plate resistance, R_c is amplifier cathode resistance, e is a constant voltage

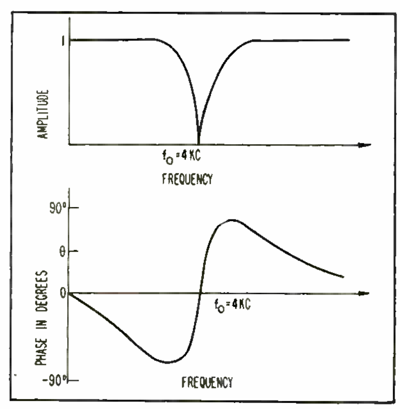

FIG. 4—Transfer characteristics of the bridged-T network

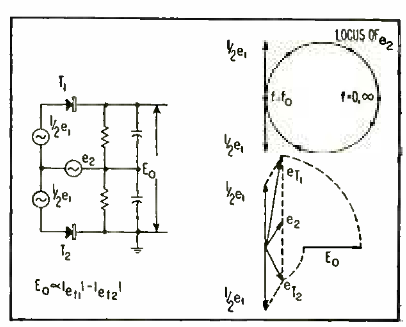

FIG. 5—Discriminating characteristics of the rectifying circuit

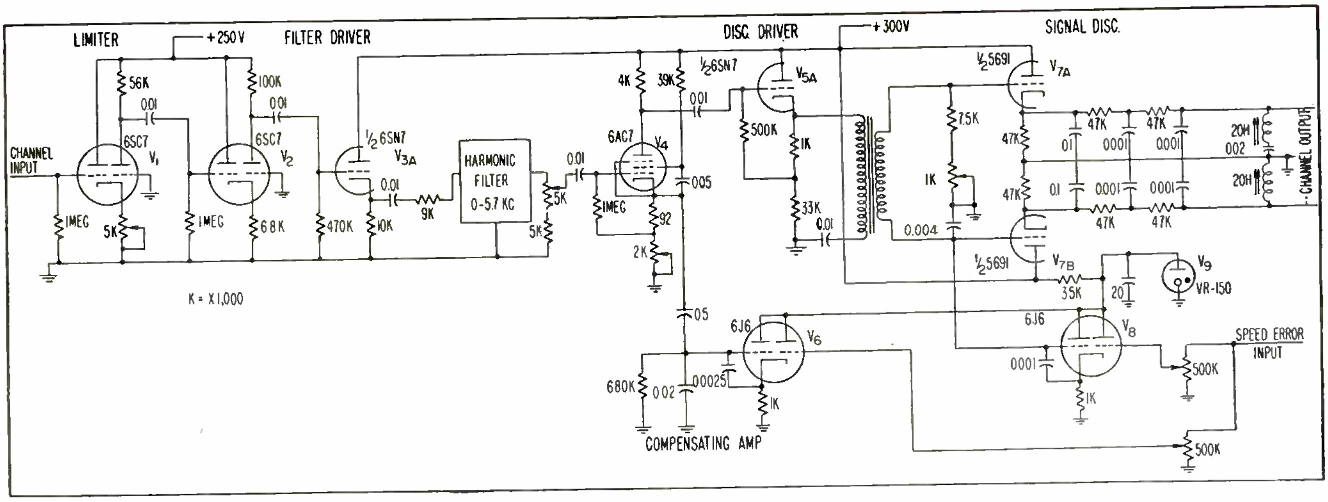

FIG. 6—Schematic diagram of the signal discriminator unit

input from the harmonic filter, C_c is cathode bypass capacitance and $\omega_w = 1/R_c\, C_c$.

It is evident that if $g_m R_c$ is sufficiently large, the denominator of Eq. 2 will be substantially constant over the channel bandpass region and the rectified output will become

$$V_o \propto \left(1 - \frac{\omega}{\omega_o}\right) e \qquad (3)$$

With the values used in the compensation amplifier circuit, Fig. 6, the denominator of Eq. 2 is constant to within 0.2 percent over the channel bandpass frequencies.

The reactance tube employed in both the R-C circuit and the compensating amplifier is used to vary ω_o in Eq. 3 to correct automatically for tape speed variations.

D-C Amplifier

The purpose of the d-c amplifier in the transcriber is to transform the voltage outputs of the signal discriminator into suitable form for application to the galvanometer elements in a recording oscillograph. This essentially requires that the d-c amplifier act as a voltage-to-current converter.

The circuit of one channel of the d-c amplifier is shown in Fig. 7. The circuit consists of two stages of cross-coupled d-c amplification[2] and a stage of 6AC5 current drivers. Sensitivity of the d-c amplifier is 22 ma per volt when loaded with a 45-ohm resistance. This sensitivity may be varied over a range of about three to one by use of the 1,000-ohm series potentiometer. Experimental tests show that the amplifier is linear to within 0.5 percent of its full-scale output of 20 ma. The output may be coupled to almost any standard recording galvanometer.

Conclusion

The transcriber was designed to decode and to record graphically

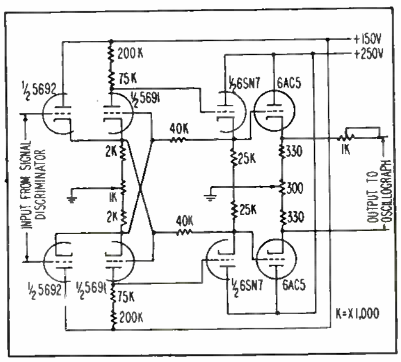

FIG. 7—Circuitry of the d-c amplifier

f-m information which had been remotely recorded on a multitrack magnetic tape. The problem of decoding f-m on magnetic tape is aggravated by errors introduced by variations between the recording and playback speeds of the magnetic tape. To correct for these errors, a constant reference frequency is recorded on one of the magnetic tracks and the frequency of this reference signal on playback is used to automatically adjust the information signal discriminators to produce an output voltage proportional to the original recorded signal frequencies.

The over-all linearity of the transcriber was checked by recording a series of known standard frequencies and on playback measuring the deviations recorded on the recording oscillograph. A resulting plot of the spot deviation as a function of signal frequency is linear to within 0.5 percent. Dynamic response is considerably more difficult to define explicitly because of the complex nature of the angular modulation process[3]. However, the instrument was designed to be flat out to 100 cycles.

The present limiting factor on dynamic response is the filter response at the output of the signal discriminators and this may be modified to increase the frequency response of the output signal. The only requirement of these filters is that they eliminate the channel carrier frequencies from the detected output. Beyond this they may be designed to cutoff at as high a frequency as desired.

The author wishes to acknowledge major contributions by J. N. Van Scoyoc, J. L. Murphy, W. Goss and H. L. Reichert of the Armour Research Foundation. Appreciation is also expressed for the cooperation of the United Aircraft Corporation, Hartford, Connecticut.

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High-Frequency

By R. L. WALLACE, JR., L. G. SCHIMPF and E. DICKTEN

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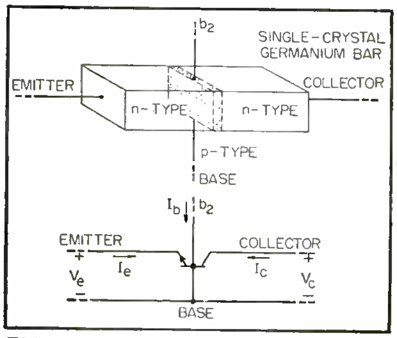

FIG. 1—The tetrode structure and the symbol used to represent it

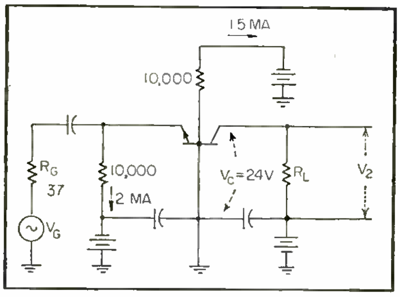

FIG. 2—Transistor tetrode used as a grounded-base amplifier

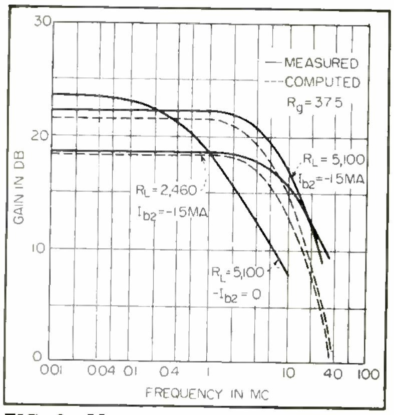

FIG. 3—Measured and computed gains for the circuit shown in Fig. 2

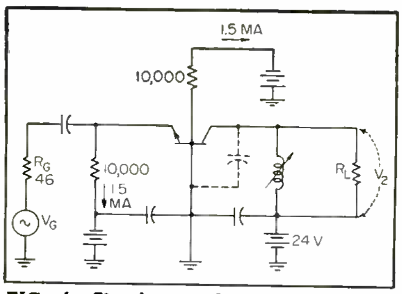

FIG. 4—Simple tuned amplifier circuit

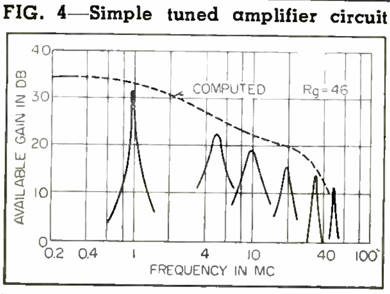

FIG. 5—Peaks of these response curves show the available gain in the circuit of Fig. 4. The dotted curve shows the computed focus of the peaks

If a fourth electrode is added to a conventional junction transistor and biased in a suitable way, the base resistance of the transistor is reduced by a substantial factor. Because of this reduction in base resistance, the transistor may be used at frequencies ten times or more higher than would otherwise be possible.

Two other factors that are responsible for the improvement in high-frequency response are that the cutoff frequency of the current gain α has been increased by using thinner p layers and that the collector capacitance has been reduced by decreasing the area of the collector junction to approximately 10^{-4} square inches.

The configuration of the junction tetrode and its symbol designation are shown in Fig. 1. The fourth electrode, designated b_2, is connected to the p layer in the same manner as the base connection is made but on the opposite side of the bar.

Performance of the tetrode transistor, as discussed in the succeeding portion of this paper, will be under the conditions of a fixed current bias I_{b2} applied between the base and the added electrode. A suitable value of this bias makes the potential of b_2 and —6 v with respect to base. Emitter and collector electrodes are biased about the same as in conventional junction transistors.

With these operating conditions, the part of the emitter junction near b_2 is biased in the reverse direction and does not emit electrons into the p layer. That part of the emitter junction in the immediate vicinity of the base contact is the only part of the emitter junction biased in the proper direction to serve as an emitter. All the transistor action therefore takes place near the base contact and this fact accounts for the reduction in base resistance r_b and the resultant improved high-frequency performance. Good high-frequency properties are not dependent on a critical setting of b_2 bias. All values between one and two ma have been found satisfactory.

For one particular junction transistor tetrode, with no bias on b_2, the base resistance was 1,100 ohms. As $-I_{b2}$ was increased to two ma, r_b decreased to about 40 ohms. As $-I_{b2}$ was increased from 0 to two ma, current gain decreased from 0.99 to about 0.75, causing an increase in bandwidth at the expense of gain.

Collector resistance r_c is reduced appreciably by the bias applied to b_2 in the direction of decreasing gain. Emitter resistance r_e is increased as $-I_{b2}$ is increased in the range from one to two ma but the total change in r_e is not very great.

High-Frequency Considerations

When considering the dependence of α on frequency, it is convenient to define an α cutoff frequency $f_{c}\alpha$ as the frequency at which the magnitude of α has been reduced from its low-frequency value by a factor of $1/\sqrt{2}$. This frequency is in the order of 15 to 20 mc.

It has been shown[1] that $f_{c}\alpha$ should be inversely proportional to the square of the thickness of the p layer and should be about 20 mc for

Transistor Tetrode

Sine-wave oscillators at frequencies up to 130 mc and tuned amplifiers with substantial gain at frequencies of 50 mc or higher are obtained by using junction transistors with an added connection to the base electrode biased negative at six volts

the *p* layers of roughly 0.0005 in. used in these transistors.

Figure 2 is a circuit in which the transistor tetrode is used as a grounded-base amplifier between a generator of internal resistance R_G and a load resistance R_L. A transistor having the following characteristics was used in the circuit: $r_e = 6.9$ ohms, $r_b = 92.5$ ohms, $r_c = 0.825$ megohms, $\alpha_o = 0.82$, $f_c\alpha = 18.5$ mc and $C_c = 1.5$ $\mu\mu f$.

Response

Measured response of this transistor in the circuit of Fig. 2 is shown in Fig. 3. With $R_L = 5{,}100$ ohms, the gain is 22.3 db and the 3-db point is at 5 mc. This is comparable with the performance of good vacuum tubes. If the transistor is used as a triode in the same circuit by making $-I_{b2} = 0$, the cutoff frequency is reduced to approximately 0.5 mc.

As shown in the lower solid curve of Fig. 3, reducing R_L to 2,460 ohms raises the cutoff frequency to 10 mc and reduces the low-frequency gain to 18.4 db.

If a grounded-base amplifier is driven by a resistive generator, the output impedance of the amplifier looks like a resistance and a capacitance in parallel. If the amplifier is loaded by a shunt inductance and resistance as shown in Fig. 4, the inductance will resonate with the output capacitance to give a peaked response. Maximum gain will be obtained at the frequency of resonance when R_L is adjusted for match.

The curves shown in Fig. 5 were obtained by varying the load inductance to obtain various resonant frequencies and then adjusting R_L at each frequency to give maximum gain. Measured gain at 50 mc is 11.8 db. Figure 6 shows the measured values of output impedance of the stage in terms of an equivalent parallel resistance and capacitance.

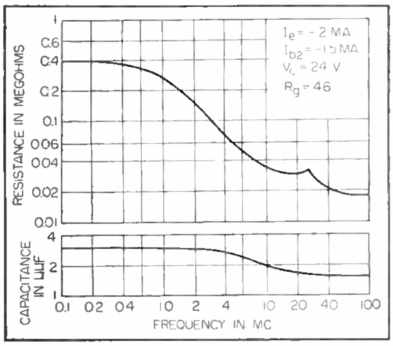

FIG. 6—Output impedance of a grounded-base stage in terms of shunt resistance and capacitance

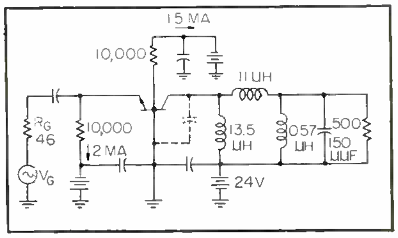

FIG. 7—Bandpass amplifier stage

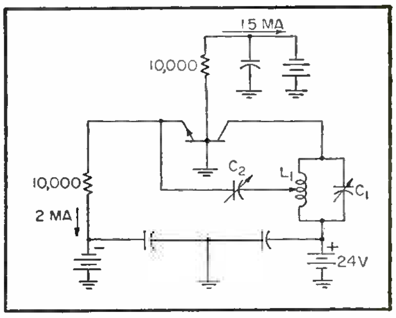

FIG. 8—An oscillator circuit suitable for use with junction tetrodes

Bandpass Amplifiers

The low values of output capacitance and resistance shown in Fig. 6 indicate that it should be possible to build reasonably wide bandpass amplifiers without much sacrifice in gain as compared to the values shown for narrow-band amplifiers in Fig. 5. The stage shown in Fig. 7 was designed to pass a 9-mc band of frequencies centered around 32 mc. The resultant gain is 15 db, giving a gain-band product of 280 mc.

The circuit of Fig. 8 was used to observe the performance of transistor tetrodes as oscillators at high frequencies. Provision is made for adjusting the value of capacitance in the feedback path to the emitter. At higher frequencies, the input impedance at the emitter tends to become inductive and it is necessary to adjust the capacitor.

Most of the tetrodes used in this circuit produced sinusoidal oscillations up to frequencies as high as 80 to 100 mc, with some at 100 and 130 mc. Between 40 and 75 mc, measured output was approximately one milliwatt for one transistor. At 100 mc, output is 0.25 milliwatt and at 115 mc, 0.06 milliwatt. Collector dissipation was held to about 30 milliwatts during the measurements.

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Press Safety Control Uses Radioactive Wristband

When operator's hand is in danger zone of punch press, gamma radiation from radium-plated disc is picked up by new infinite-life halogen-quenched Geiger tubes mounted on press. These trigger a thyratron that blocks operation of the press control solenoid

By M. E. SIMONTON and JOHN YEISER

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PROVIDING operator safety for hazardous work in industrial processes has long presented a difficult problem to plant administrative personnel, safety engineers and insurance underwriters.

To be practical, protective devices must be fail-safe and should not hamper or inconvenience the machine operator, thus providing incentive to avoid their use. Considerable ingenuity is displayed by production workers in tying down one pushbutton of a two-hand control or rigging flashlights onto photoelectric guards.

In the device to be described, wristbands containing small amounts of radioactive material are worn by the press operator. Whenever the bands are within range of the Geiger tube located at the boundary of the danger zone, the press is locked from operation. Thus both hands must be removed from the danger zone before the press may be set into motion. While the use of tracer techniques in industry is not new, it is believed that this is the first application of such techniques to production machinery.

To prevent operation of the press by persons not wearing wristbands, a timer is connected so that it will render the machine inoperative unless the wristbands have been used to actuate the control during the timing period.

Suppose the press operator leaves his work and, upon returning, has removed the wristbands. The timer will have rendered the press inoperative about 15 seconds after the last piece of stock was inserted. The operator must put on the wristbands and pass them into range of the detector to reset the timer and resume operations. This does not interfere with press operation as long as the bands are worn, because each time the operator inserts or removes stock the control is actuated and the timer resets. The timer also prevents operation of the press should any part of the radiation-detecting system fail.

Control Circuit

Inasmuch as radiation is being detected rather than measured, a rate meter is not needed. It is possible merely to use the voltage drop developed across grid resistor R_1 in Fig. 1 by the average GM tube current to trigger control thyratron V_1. Capacitor C_1, which integrates the GM tube pulses, is chosen as a compromise between the requirements for fast response (on the order of 0.1 second) and the necessity for reducing background fluctuation to a minimum. The thyratron is normally on, energizing the relay, and is turned off by an increase in GM tube current. One pair of relay contacts completes the circuit to the press control, and the other pair of contacts energizes the synchronous-motor driven time delay which, at the end of its timing interval, opens contacts in series with the press control solenoid. Sensitivity is controlled by the set-

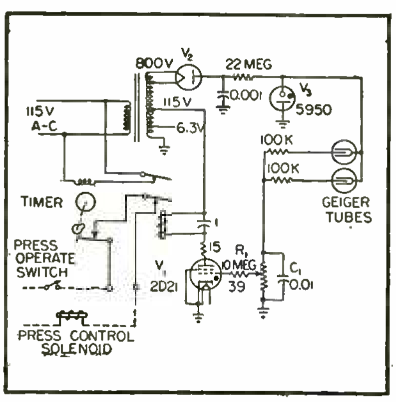


FIG. 1—Complete circuit, as designed for 100-percent fail-safe operation

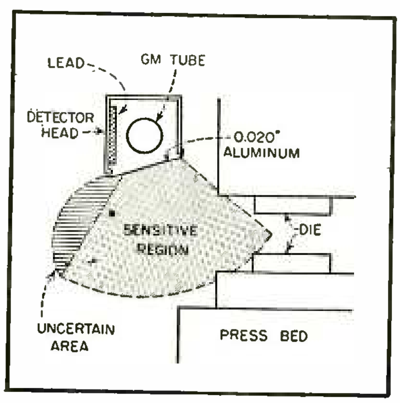
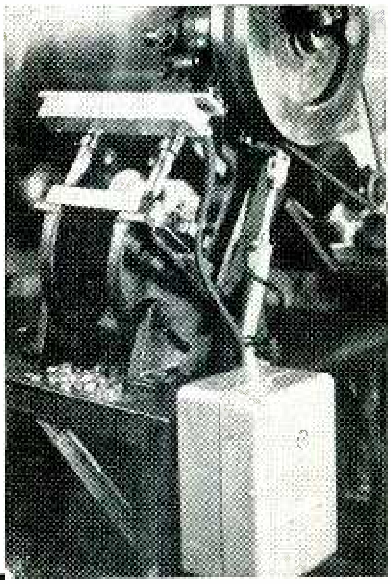
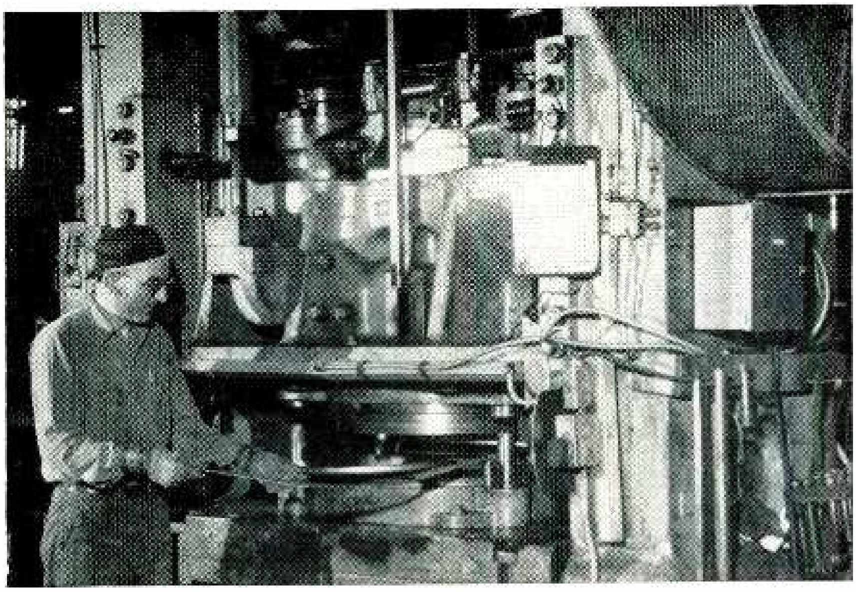


FIG. 2—Cross-section view through detector head, showing sensitive region



Radiation-type safety control installed on small motor-driven punch press



Installation of Hazatrol unit on 215-ton draw press. Geiger tubes are mounted horizontally in housing just above die, and control cabinet is at right on press

ting of potentiometer R_1.

The thyratron and relay are used in the normally on condition for fail-safe operation.

The power supply uses a conventional half-wave rectifier to supply negative 700 volts d-c to the Geiger tubes. Regulation is accomplished by corona regulator tube V_3.

Geiger-Tube Detector

The halogen-quenched Geiger tubes used are of all-metal construction and have a life unlimited by use. The recent development of these reliable tubes has made the use of radiation controls practical.

The tubes are shock-mounted in the detecting head, and have a ⅛-inch sheet of lead shielding on the side away from the danger area as in Fig. 2 to give a sharp transition zone. This is necessary to reduce the region of uncertain operation and to permit the press operator to hold stock in the machine with his hands close to, but not in, the danger area. As many tubes as are required to protect a given size of press are connected in parallel. The leads are brought out through flexible conduit to the control unit, usually on the press frame.

The manner in which the tubes are used, with a large series resistor, results in a nearly logarithmic response of the system to radiation. This is due to the fact that the signal voltage developed across R_1 is in effect subtracted from the high voltage supplied to the GM tube. At high radiation intensities, the tube terminal voltage becomes progressively lower, the Geiger pulses become smaller, and the average current is somewhat less than a linear function of count rate. The voltage developed across R_1 then varies approximately linearly with distance between radiation source and GM tube, as radiation intensity is proportional to the inverse square of this distance.

Since pulses are not being transmitted, there is virtually no limit to the length of cable that can be employed. The 100,000-ohm resistors in series with the Geiger tubes reduce the instantaneous current surges.

Wristbands

The radioactive material contained in the wristbands is radium, plated on nickel discs. These discs are backed with lead on the surface next to the skin. The maximum range of the equipment is limited by the amount of radiation which can safely be worn on the hands; 1.5 Rep per week is the accepted figure. A wristband safely below this amount (having about three times the amount of radium as the average luminous-dial wristwatch) will give a range of twelve to eighteen inches, inasmuch as the maximum sensitivity of the instrument is set by the cosmic ray background. Finger rings can also be made radioactive for use in applications where the operator must hold small work close to the die.

Press Controls

With the existence of a suitable electronic system, the safety problem is not yet solved in its entirety. Power presses differ from one type to the next as to clutching and tripping arrangements. In many of the larger presses, control may be accomplished by merely opening an electric circuit. Hydraulic or air controls are also common and are adaptable by use of suitable solenoid pilot valves. Mechanical foot-treadle and dog-clutch types of power machinery, a good example of which is a riveting machine, may be controlled by use of a secondary overtravel linkage inserted into the system at some convenient point. This overtravel mechanism is essentially a solenoid-operated pilot clutch. In all cases, nonrepeat action is desirable.

The system can also be applied to other control problems. The same basic circuit, used with a fixed beta source located in proximity to the detector, is being used as a floor level control on passenger elevators in the San Francisco area. Control is accomplished through interruption of the beta beam by a metal plate.

Stripping Techniques for

Evaluation of hand sanding, chemical stripping, wheel-type stripping, burning, solder-dipping and welding techniques for removing film-type insulations from magnet and wires. Suggestions and examples aid in choosing the best method for each job

By **R. GEORGE ROESCH**
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Wire stripping is the method or means used to remove the insulation from a wire, so the remaining wire may serve as a conductor when attached to other wires or terminals. Before soldering a wire to a terminal, the insulation must be stripped off to provide a clean, bright surface. The importance of obtaining good connections cannot be over-emphasized because over 90 percent of all conductor failures occur at or near the joints. Detrimental effects of poor stripping have shown up in coils as long as two years after the coil was wound.

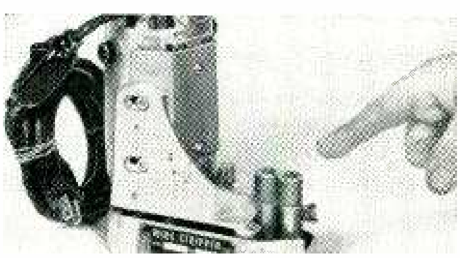
The demand for better and better insulated wires has resulted in wires that are harder to strip. Insulation has been made thinner to conserve space, tougher to resist abrasion, more flexible to withstand sharp bends, more resistant to heat, more adherent to bare copper, and more resistant to chemicals. Thus, in trying to provide better insulated wire, the wire manufacturers are making wire-stripping problems more difficult. No single method nor no single machine can possibly prove equally efficient under all conditions.

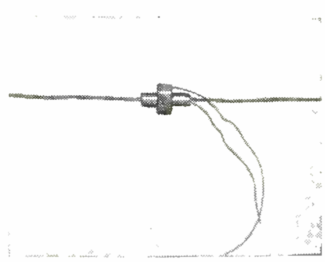
As a guide in the selection of the best method for a particular problem, the commonest methods of stripping film-insulated wires will be considered one by one.

Sandpaper, emery or crocus cloth may be used to remove any type of insulation which may be abraded from the wire. The selection of the best abrasive material depends upon the gage of the wire and the skill of its user. Extreme care needs to be exercised if fine wires are to be completely stripped without damage to the wire.

Time-wise, hand-sanding may or may not prove efficient, depending on specific conditions. There are some situations where it would be virtually impossible to improve upon a hand-sanding method.

Many chemical strippers are available. Generally speaking, these are suitable for nearly all film-type





CASE HISTORY NO. 1—A typical choke coil (right) wound with AWG 32 Formvar-insulated wire has two leads wrapped loosely around the coil. These are to be stripped as close to the coil as possible. Conventionally, an operator would unwrap and strip the leads, wrap them around the core again, trim off excess wire and solder and tin the joints.

By thinking in terms of wire processing, the procedure reduces to: (1) Wrap a stripped end of wire around the core wire and wind the coil as usual; (2) Strip the wire coming from the spool, stripping twice as much as needed; (3) Cut the wire in the middle of the stripped portion and wrap the finishing lead around the core wire; (4) Tin-dip both ends or solder and break off the excess wire. The stripped end of wire, as it comes from the spool, is used to start the next winding of another choke coil. The actual stripping operation can be performed either by using sandpaper or by using a small wheel-type stripper (left) that is conveniently located, even on a swinging bracket

CASE HISTORY NO. 2—The problem here involved stripping heavy stranded leads of a large multiconductor cable, one end of which was anchored. A selected pair of stripping wheels, driven by a flexible shaft, proved to be the best solution in this example

Insulating Films on Wire

insulations, except Teflon and Ceroc or similar insulations for which there may be no presently known solvent.

There are chemical strippers which have no unpleasant odor and which are not injurious to the skin, but allergies of individuals can cause varying reactions to almost any chemical.

Chemical Stripping

With all chemical strippers, care must be exercised to stop the chemical from creeping, which is often impossible, and to prevent the chemical from coming in contact with the coil or winding. Damage to a coil or winding destroys its value.

Chemical stripping leaves a clean, bright surface. Any size or shape of wire may be chemically stripped. For aluminum wire, chemical stripping seems ideal. Chemical stripping methods may be developed so the stripping can be done as rapidly as by any other method.

Cost-wise, comparisons must be made, considering the cost of the equipment used and the chemicals used, as against the overall production attained, per dollar of investment and expense.

For small-scale chemical stripping, just set up a line of test tubes. Fill with chemical stripping solution to the desired level. Use as many test tubes as are necessary, so that by the time the insulation has been wiped off the coil in the last tube in the line, the operator can start at the head of the line again.

If there is a chance that the fumes from the chemical will prove harmful to the winding, float a layer of thin oil on the surface of the chemical.

Wheel-Type Wire Strippers

Perhaps the best known method of removing film-type insulations is by the use of wheel-type wire strippers.

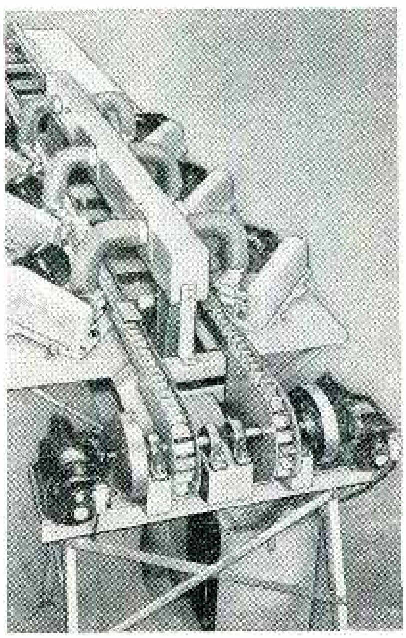
Wires as fine as AWG 50 can be stripped. Depending upon the handling methods, there may be no limit in either the size or shape of wires which can be stripped with stripping wheels.

The determination of the best handling methods is most important. It will frequently be found more economical to strip wires singly than in groups. Likewise, it may be faster to strip components singly than in groups, even though it may appear on the surface that the more wires you strip at one time, the faster the operation. Handling time is worth careful study.

Many sizes and varieties of stripping wheels are made, each for a particular type and size of wire. The commonest materials are brush wire and glass fibers, used separately or in combination in the stripping wheels.

There is an ideal relationship to be attained between the diameter of the stripping wheels, the surface speed of the stripping wheels, the surface characteristics of the stripping wheels, the density of the stripping wheels and the actual wires to be stripped. This ideal relationship can only be attained by experimentation on the production line, since handling methods produce different results.

Wheel costs are worthy of study. Accurate records should be kept to



CASE HISTORY NO. 3—Because a ballast coil was in very high production, the stripping operation was conveyorized as shown. Three girls on each side at the far end pick out the coil leads, apply a piece of tape, place the coils on the moving conveyor chain and dress the leads outward as above. The leads then pass automatically between the stripping wheels, after which the coils discharge at the front end onto a conveyor belt (not shown) going to the next position. Only two of the three wire strippers on each side are active, the third being a spare. Two strippers insure perfect stripping despite variations in lead positioning and variations in the wires or in their insulation. The two motors at the front end drive the conveyors. A vacuum system draws dust determine the cost of stripping wheels in terms of the number of wires stripped per pair of wheels. It may be that high-priced stripping wheels will prove most economical in terms of cost per-thousand-wires-stripped.

If the stripped wires are to be tinned, the selection of proper stripping wheels may eliminate a fluxing operation. If the operator of a wire stripper can dip the stripped wires directly into a solder pot, time will be saved and costs reduced.

Wheel-type wire strippers have one disadvantage, but it is the users' fault. They expect to be able to do any kind of a stripping job with the same wheel without considering its limitations.

The predominating advantage of wheel-type wire strippers is their versatility. It is only necessary to change from one kind of stripping wheel to another, in order to strip a different gage wire or strip a different kind of insulation from the wire. All film-type insulations may be stripped, including those which cannot be removed by chemical or burning methods. Fiberglas and other kinds of servings may also be stripped.

Litz wires of almost any number and gage may be stripped, using the proper stripping wheels. Even braided insulated wires may be unbraided and stripped on wheel-type wire strippers if care is used.

Burning or Open-Flame

Equipment has been developed for removing insulation by burning. The copper oxide thus formed is then removed by brushing.

Some insulations, such as Teflon and Ceroc, cannot be burned off. Aluminum wire may melt before the insulation melts. Wires finer than AWG 30 may melt before the insulation melts.

Since it is nearly always necessary to brush the wires after burning, an all-brushing method is generally preferable unless there is some other reason for using the burning method, such as sealing the serving on Litz wires before stripping.

Hot Solder

Formex, Formvar and similar insulations can be removed and copper wires tinned in the same operation. Some so-called Formvar films cannot always be uniformly removed by this method, hence erratic results may be encountered.

If the hot-solder method is used, the pot should contain 50-50 lead-tin solder at not less than 500 deg C.

Wires finer than AWG 30 are almost impossible to strip by the hot-solder method, because one cannot get them in and out of the pot fast enough.

Solder splatter may prove harmful. The tin content must be kept in balance with the lead content by replenishing the tin.

Frequently, insulated wires are twisted together and dipped in hot solder. This may result in high-resistance joints because all of the insulation is not always completely removed. If wires processed by this method can be readily untwisted, there is no complete mechanical bond.

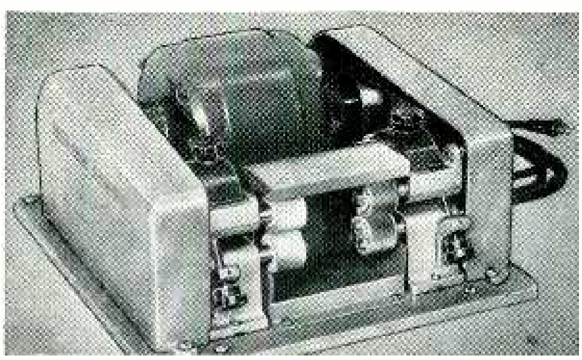
Cost-wise, the hot-solder method may be no less costly than any other method, even though the stripping and tinning is done in the same operation.

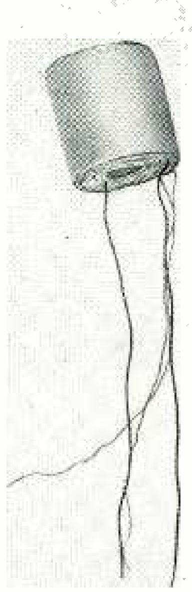
Brazing or Welding

Lead wires and coil leads are frequently welded. This method is not ordinarily used on wires under AWG 20. A high-temperature gas flame is applied to heat the twisted or spliced lead to a temperature that just melts the copper. By this method, all the film coating is burned off.

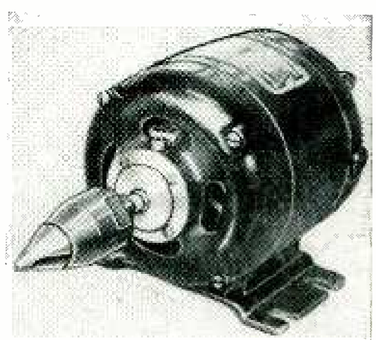
Low-Temperature Solder

There are some thermoplastic films which can be removed by using a resin-alcohol flux and the application of a soldering iron, or by dipping in 650-deg F lead-tin solder. Both wires must have the same insulation on them, or one of





CASE HISTORY NO. 4—Leads of a typical transformer coil (right) having two widely different gages of wire were to be stripped. Sizes were AWG 24 and AWG 36. A single machine has drawbacks; if the leads tangle, the small wire may be broken, and with the wheels set for the finer wire there will be excessive wire on the wheels and high wheel cost. The answer is the twin-headed stripper shown above, having one pair of wheels for each wire. Machine can be set for any size wire



CASE HISTORY NO. 5—Enamel-insulated telephone switchboard wires were to be stripped. The outer covering was removed with a hot-blade stripper, and the ends then inserted in the cone-shaped head of the above stripper to remove enamel. This machine is suitable only for AWG 20 to AWG 24 the wires must be a clean, bare wire.

As with all other stripping methods, the time-cycle needs to be considered. Some claim that the soldering operation is sufficiently faster when the wires are pre-stripped to more than offset the advantages of stripping and soldering at the same time.

Close-Up Stripping

One way to strip wires close up to a coil form is to use a one-wheel stripper with a stripper blade in contact with the stripping wheel. By passing the wires between the blade and the wheel and giving them a quarter-turn, the insulation can be stripped off to within ⅛ inch of the average coil.

If the coil is small and the wires very fine, AWG 36 or smaller, perhaps a small wheel-type stripper will be the best solution to close-up stripping.

High-Production Considerations

Think in terms of wire processing. Begin to study the operation as the wire leaves the spool or reel. Remember that wire stripping is only one of the many operations performed on each wire. Follow each wire through all operations, until that wire is connected to another wire or terminal. Consider all operations in conjunction with all others.

In following any given wire through its various processing operations, seek out the best time to perform the wire-stripping operation. Here are a few things to be considered:

(1) Speed at which the wire stripping operation should be performed, to tie in with prior and subsequent operations.

(2) Cost of the wire stripping operation, in terms of cost of equipment, amortization period, cost of using and cost of maintenance.

(3) Convenience of using, in terms of ease of operation, operator fatigue and operator training.

(4) Equipment used, in terms of location with reference to other operations, floor space required, accessibility and portability.

To arrive at some of the answers to the foregoing, it is necessary to take into consideration these other factors:

(1) Size, shape and weight of the winding on which there are wires to be stripped. Can the winding be taken to the stripping operation, or should the stripping equipment be brought to the winding?

(2) Size and shape of the wires to be stripped, plus the kind of insulation on the wires.

(3) Location of the stripped portion of the wire with reference to the rest of the wire or the winding. The less the amount of stripping, the lower the cost.

(4) Number of wires which must be stripped in the same operation and at the same time.

(5) Are the wires to be stripped relatively straight or are they kinked and tangled together? By any stripping method, these conditions will lead to trouble.

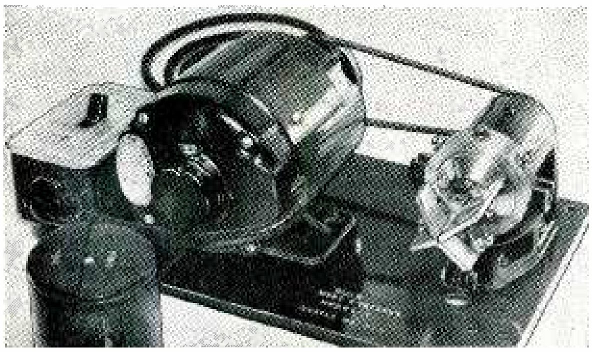
(6) Do the windings come to the stripping operation in a convenient and orderly fashion and leave there the same way?

(7) What is to be done with the wires after they have been stripped? How soon will they be connected to another wire or terminal? Will it be necessary to treat the wires to prevent oxidation and with what can they be most economically treated?

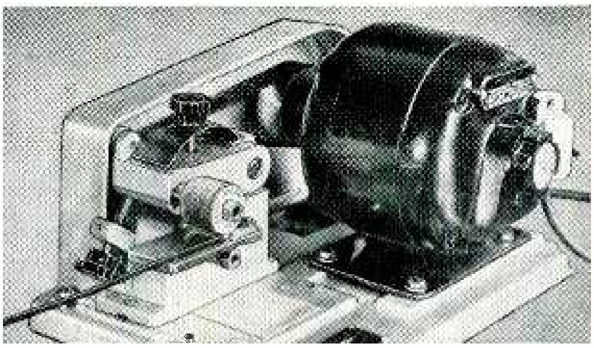
Conclusions

Do not try to put all wire-stripping jobs into one class and hope to find a single method or a single piece of equipment which will give satisfactory results in all cases.

Try to think in terms of wire processing, beginning with the spool or reel of wire and following the wire all the way through, until it is connected to another wire or to a terminal. This will invariably reveal ways to improve some operations and make the wire-stripping operation easier, resulting in higher quality and lower costs.



CASE HISTORY NO. 6—Location and length of stripped wires on ignition coils had to be controlled accurately. A rotary stripper having rotating blades was adjusted to the diameter of the bare wire, and the length of stripping was controlled by an adjustable stop inside the machine. Not suitable for wires finer than AWG 24. Housing at left foreground fits over cutting blades, and wire is inserted in conical hole in end of housing. Stripping blades can be removed for sharpening



CASE HISTORY NO. 7—To eliminate tedious sandpapering of short rectangular wires for removing ¼ inch of insulation from the ends, this one-wheel stripper was developed. A wheel setting is made for stripping the flat sides of the wire and a batch is stripped on both ends, by moving each side of each wire in turn across the entire face of the wheel from one side to the other. This insures even wear of the wheel. The setting is then changed for stripping each edge of each wire end

Television Switcher

Control console with six inputs and six outputs can be expanded with growth in studio operations. Relays normally furnished in console can be remotely operated if it is desired to shorten video lines

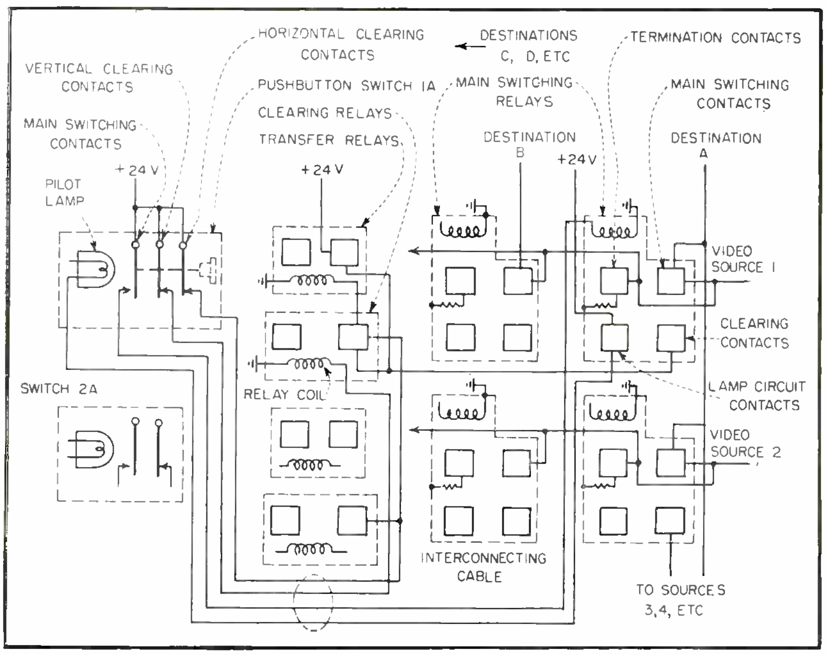


FIG. 1—Simplified block diagram of the switching action. Small squares are relay contacts, relay coils are shown as inductances and termination contacts are grounded through resistors

By **HARRY E. THOMAS**

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VIDEO transfer or switching is accomplished by connecting a signal source to some particular destination. Such a transition may be made gradually through electronic mixing circuits or abruptly by means of switches and relays. The common video switcher employed in studio equipment uses both types of transfer, the former for programming effects and the latter for rapid and convenient performance of multiple switching.

Rapid or abrupt video switching circuits may in turn be divided into two general categories; those employing direct pushbutton-actuated switches or those employing pushbutton keying switches together with relays to make the actual video transfer at some remote point.

In abrupt switching the transfer may be made by either gap or lap switching—the former meaning break-before-make and lap meaning make-before-break. The usual types of gradual transfer are called fading or lap dissolve. Fade from one signal to another implies complete extinguishment of one signal source before another source is gradually brought up to the appropriate signal level. A lap dissolve means a conjugate variation between two signals but with the signal levels overlapping each other at some predetermined value. These operations are usually accomplished by use of manually operated fader potentiometers associated with the input and output systems of the two sources. Automatic fade and dissolve may be done by variable-time-delay networks in the grid of the mixer amplifier.

Direct switching with interlocking pushbuttons has the advantage

for Broadcasters

Video transfer unit is compact enough to allow its use near the program director. Push-button operation of relays either mounted in unit or remotely controlled provides channeling as many as twelve inputs to six destinations. Manually operated fader can be used for lap dissolves through distribution amplifiers

of compactness by allowing for a location where the video lines can be connected directly to the switches. Low capacitance contacts make this method fairly free from discontinuity in the transmission line. For local switching with short direct runs of the video cables, this method is probably as compact as any other. Switch timing, however, is not adjustable, and complete interlock is not always mechanically convenient. Remote control is impossible.

Indirect switching allows the video transfer relays to be remotely located from the control panel. For master control or video control centers this results in the advantage of shortened video lines since relay racks can be located near video circuit terminations.

Selecting lap or gap switching sequence is of considerable importance in smooth operation of the studio and any system should have sufficient flexibility to allow for either type in at least part of the switching system. For local signals employing video signals linked to a common sync generator source, overlap switching is used to keep continuity of sweep and synchronizing conditions while transfer is made. For switching remote-to-local using independently synchronized signals, gap switching with fade to black is preferable since otherwise synchronizing circuits in receivers would be upset by the simultaneous presence of two nonsynchronous signals. This interval should not be over ten milliseconds to effect synchronism within one field.

Gradual signal transfer by lap dissolve switching or fading by manual control requires auxiliary equipment centering about geared-down potentiometers and electronic mixing. The manual execution is for convenience, arranged through lever control of two back-to-back potentiometers located directly at the switcher panel. The levers arranged for simultaneous operation move through an arc of about 90 deg arranged so that when they move together the fading is a smooth lap dissolve. At opposite ends of their control, both outputs are conjugate (one full on and the other full off). When automatic control of gradual transition is used, it is accomplished through the inclusion of adjustable time-delay circuits associated with the grid circuits in mixer amplifiers.

General Considerations

A system should operate quickly, smoothly and with a minimum of operations for any one transfer operation. A single push of the finger should form a complete operation.

Since controls are usually in the dim light of a studio control booth the pushbuttons should be illuminated and marked for quick cognizance; they should be in direct view of the operator.

A relay system should generally have mechanical features of reliability, replaceability, ease of switching and convenience of operation. The relays and switches, heart of the system, are preferably d-c operated and should be rugged enough to withstand all vibration and life-test standards including temperature and overvoltage operation.

Ease of adjustment is an important feature. Relays and switches should be accessible to bending and adjusting tools for arranging the lap or gap sequence. Dust covers should be provided for long unattended operation and the lamps, switches and relays should be readily replaced.

The design should provide flexibility by which the small station may have opportunity to add channels when facilities are expanded without unduly revising the whole studio setup by addition of new racks and rerouting of wiring.

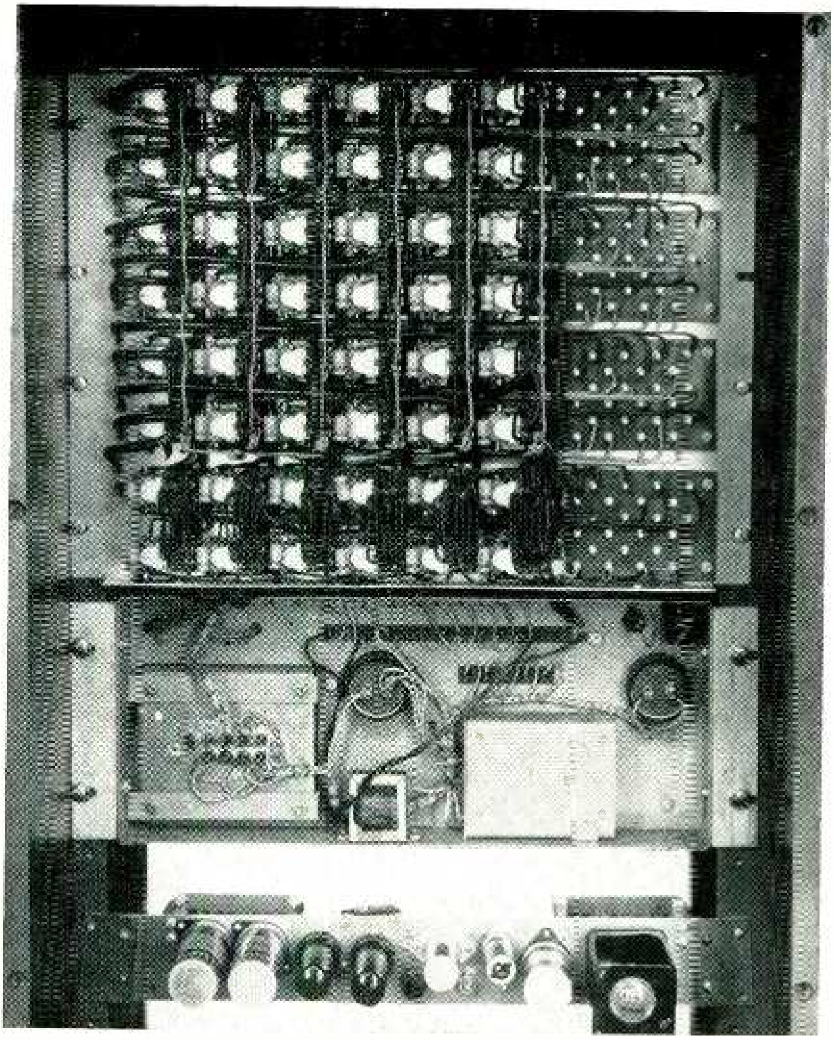
The switcher unit should have versatility within the studio to serve the dual purpose of a program director's console or to be usable in master control or video control positions. For a program director's console where short lines can run direct to the relay racks, it is advantageous to have the relays in the console. A director can thus have control of the switching and fading of two, three or four cameras and still be divorced from the intricacies of technical direction. The unit should be equally adaptable to master or video control positions where other requisites occur.

A large switching capacity in the way of input lines and output lines should exist in a console layout to give master control a wide surveillance of all studio, remote and film sources. Economy of design in simple inexpensive switches and relays is an attractive feature for the small station.

Electrical Characteristics

Electrically, the system should have the following characteristics.

True lap or gap switching are provided with flexibility to adjust for a certain amount of either. Crosstalk between the input and output



Rear view of the control console shows relays mounted on rack within. Below are power supplies for tally lights and relay operation on direct current. A single distribution amplifier is included

lines should be lower than 60-db interference on any one output from any other output. Transmission line mismatch should be of sufficiently low magnitude to maintain picture resolution and eliminate reflection troubles. Interference from relay transients, arcing contacts and induced hum on signal circuits should be of a low value and never visible on a monitored video signal. Gradual electronic transfer should be accomplished conveniently whether by manual or automatic means.

Ideally in such a system the actuation of any one button should perform the following functions. Input and output circuits should be automatically cleared; that is, all sources or signal destinations connected with the pushbutton under operation other than the connection to be made should be automatically disconnected. For instance, if the signal source buttons are arranged in horizontal rows and the destinations are in columns, the pushing of any one button should clear the column and also clear the row in which is located the selected button. Clearing can be accomplished by a separate operation, but in many cases, particularly during a program, such lost time is annoying and automatic clearing is a distinct advantage.

Objection to the feature of destination clearing or vertical clearing when two outputs are connected to one input is overcome by the provision of extra input facilities; for instance, when two outputs from the same input are desired, duplicate inputs are usually supplied through a distribution amplifier and these two sources punched up; that is, switched to the two desired destinations. In this way, either common input can be switched independently of the other with no interference encountered from vertical clearing.

After clearing, the relay actuated should complete the video switching desired, and connect some source to its desired destination; this is the central action of the complete system.

The active relay should apply power to illuminate the actuated pushbutton.

Sources disconnected by the clearing action should be automatically terminated by the switching relay.

Release of the actuated button should keep the system functioning or switched to the above desired set of conditions but in readiness for starting the complete cycle over again.

Equipment for Use

The FTL-89A, as a fundamental structure, is an indirect switching system arranged to be mounted as a completely self-contained unit in a 19-inch console. It is designed to be expanded from a six input-six output system to a six input-twelve output system. A fader mounted on the desk-top shelf is interconnected to the main switching system through a mixer amplifier to make available the various types of gradual transfer.

Although the switches and relays are mounted in a single console the system allows the relays to be remotely located so the pushbutton switch panel may be placed wherever most convenient. An auxiliary arrangement can be made to include a remote fader system where such is desired. Relay power is supplied from 110 volts a-c through a 24-volt self-contained power supply.

The circuit arrangement employs automatic clearing and internally illuminated pushbutton switches. Relays are accessible by an operator directly from the front of a console cabinet; lamps and switch adjustments are likewise available by tilting back the front panel. Automatic clearing, automatic termination of video sources and automatic holding after momentary pushbutton action are included. Adjustment of the switches allows for either gap or lap switching. A lap of several milliseconds can be attained and gaps of any time between zero and twenty milliseconds are possible.

Although the relay contacts on video sources and destinations are in parallel and add capacitance to ground, relays are closely spaced with sufficiently low capacitance to ground that the transmission line discontinuity is negligible. Cross talk between lines is likewise low.

Switching Details

The automatic clearing system uses auxiliary relays that conveniently tie in cycle-wise with the remainder of the system. This method was chosen in preference to mechanically actuated systems because the latter must clear the circuits by means of latch bars or auxiliary clearing mechanisms. Complete clearing of both source and destination circuits by this method in a simple mechanism may sometimes be mechanically difficult.

In the momentary pushbutton switch that is used (in which the actuating button when once operated returns to its original position) there is a need for a second set of auxiliary relays to maintain the system in operated condition while the switch is moving back to original position. These so-called transfer or holding relays have operating characteristics similar to the other relays in the system and likewise tie in with the overall switching cycle.

The internally illuminated pushbutton assembly utilizes a simple commercial switch with a 6.3-volt pilot lamp and a lens system incorporated in the pushbutton plunger. Pilot lamps are easily changed through the rear of the switch panel.

The fundamental switching cycle is accomplished by three contact operations in the switch itself besides four in the main video switching relay as shown in Fig. 1. Briefly, one break contact in the switch clears the sources in any one row of signal inputs; another clears the destinations in any column of signal outputs while the third makes contact to apply power to the relay directly connected to the button actuated and thus performs the control function or makes the desired connection between input and output.

The relay functioning can be best described in a direct example. When relay 4C has been actuated (input 4 and output C) one set of its contacts completes the desired connection of input and output. The second set of contacts automatically disconnects the terminating resistor from source 4 so that the connection of C output will not provide double termination. The third set of contacts applies filament power back through the interconnecting cable to 4C pushbutton to illuminate it. The fourth set of contacts operates through the transfer and clearing relays to hold power on the relay coil itself while the pushbutton is returning from its momentary contact.

With the pushbutton back in original position video switching has been accomplished. The horizontal and vertical clearing circuits are restored through closure of switch 4C contacts and the clearing and transfer functions disengaged. The system is ready for re-enactment of another cycle.

The timing of gap and lap switching is thus a function of the timing of break and make of the switch contacts since the time of relay opening of the clearing relays and the time of closing the main video switching cancel each other. By adjusting the gap between break of the clearing contacts and the make of the main video switching interval can be controlled.

Fading System

A two-channel video amplifier, for which one channel is shown in Fig. 2, permits the output of each of its channels being fed into a

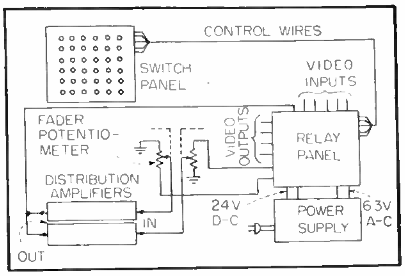


FIG. 3—Any two sources may be controlled or faded and fed back into video inputs for further switching

fader control potentiometer. By appropriate switching of two destination connections to the input of the video amplifier, its two outputs can be mixed in the control potentiometers. With the single fader output connected to another switcher source terminal, any two signal sources may be controlled, faded and routed out through any of the remaining channels. A sample block diagram of the unit interconnections to accomplish this effect is given in Fig. 3.

In order visually to tie the fader tally lights into the destination video outputs, they are colored to match the buttons of the bottom two rows of pushbuttons on the switcher panel. A row of red buttons located elsewhere on the panel is provided to indicate an important output—usually the line output to the transmitter or relay link.

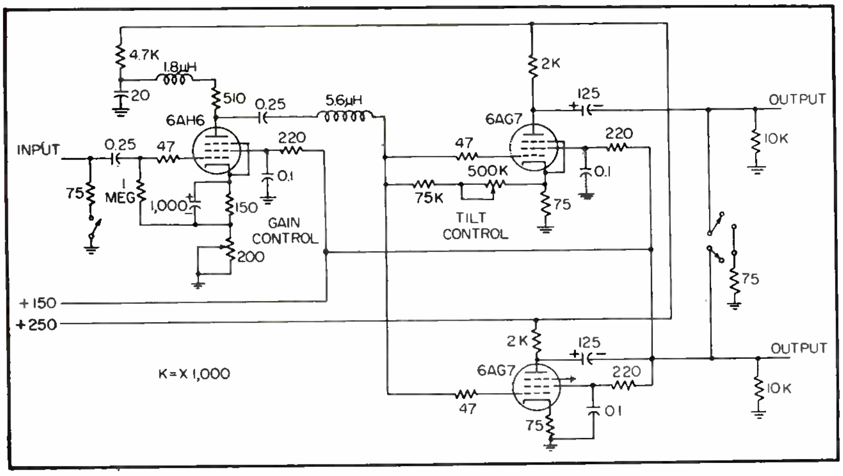


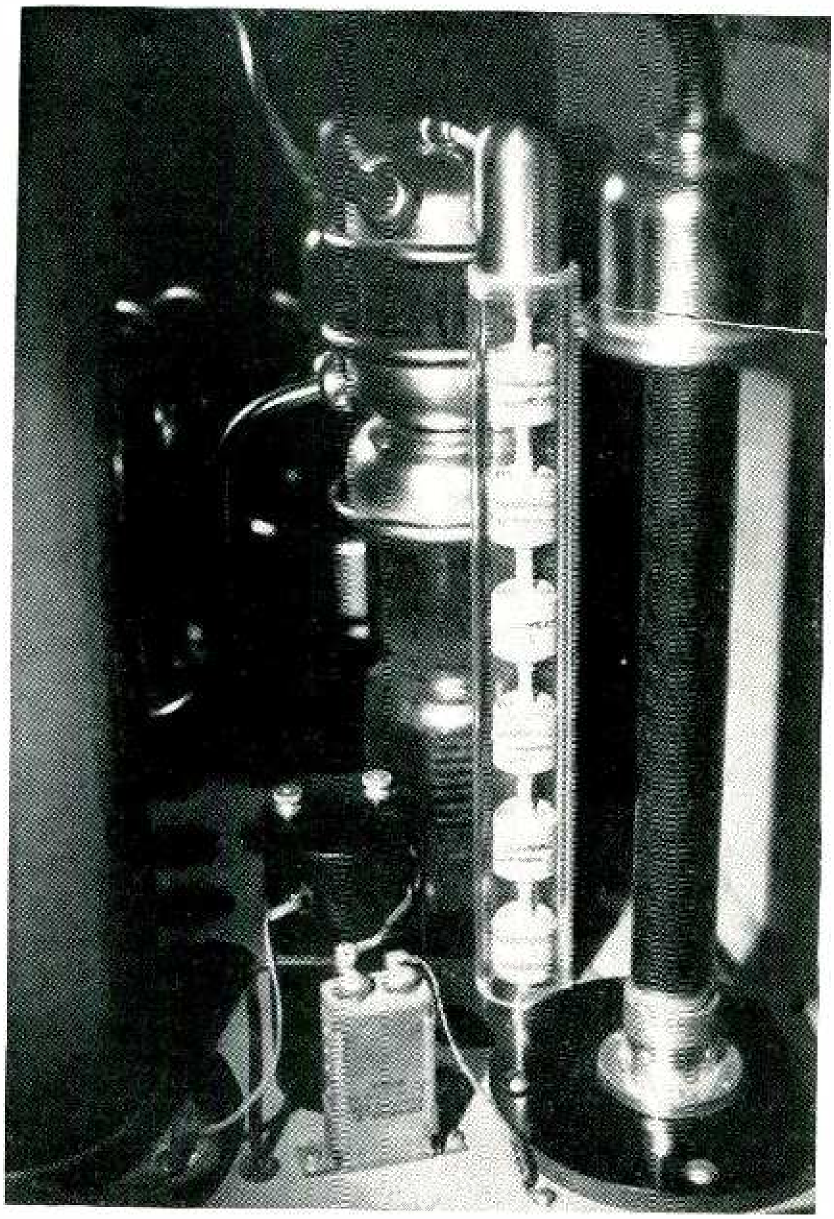
FIG. 2—One channel of two-channel distribution amplifier with frequency 3 db down at 10 mc. Output impedance is either 75 or 10,000 ohms. Tilt control maintains 60-cps square wave within ±2 percent

Electron-Microscope

Simple two-tube balanced amplifier operating tuning-eye tube detects power-supply fluctuations not indicated by panel meters or on the final viewing screen. Blurred photographs are eliminated when circuits are checked before operation. Worn controls show up quickly during servicing

PERFORMANCE of the electron microscope depends in large part upon the stability of the power supplies for the various lenses and for the high voltage used to accelerate the electron beam. The most critical power supplies are those for the high voltage and for the objective lens.

The electron microscope is commonly energized from a 1-kva constant-voltage transformer plus a regulated 370-volt d-c supply in the chassis for the plates of various tubes. In addition, individual electronic stabilizing circuits are used to correct fluctuations in the high-voltage unit as well as in the several lens supplies. The high-voltage ripple is usually not allowed to exceed 0.5 volt peak-to-peak at 50 kv. The objective lens current is held constant to within about 0.002 percent.



Capacitor voltage divider mounts on the high-voltage shelf of standard electron microscope. Lucite tube protects the stack from dust

Defocusing Causes

Minimal fluctuations having an adverse effect upon the image are not visible on the standard panel meter in the circuits involved, so that from time to time an oscilloscope or other instrument must be used to check the power supplies. Noisy reference batteries, poor contacts in the focusing controls and corona or other difficulties in the high-tension circuits may have deleterious effects upon the final image.

Balanced Amplifier

It appeared desirable in view of the number of sources of possible trouble to add a permanent monitoring unit to the microscope, which could be switched from circuit to circuit and would respond only to the fluctuations. It could serve as a check at all times on the stability of the power supplies and as a device for the localization and correction of troubles in these circuits.

Accordingly, a two-stage resistance-capacitance coupled amplifier

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Power Monitor

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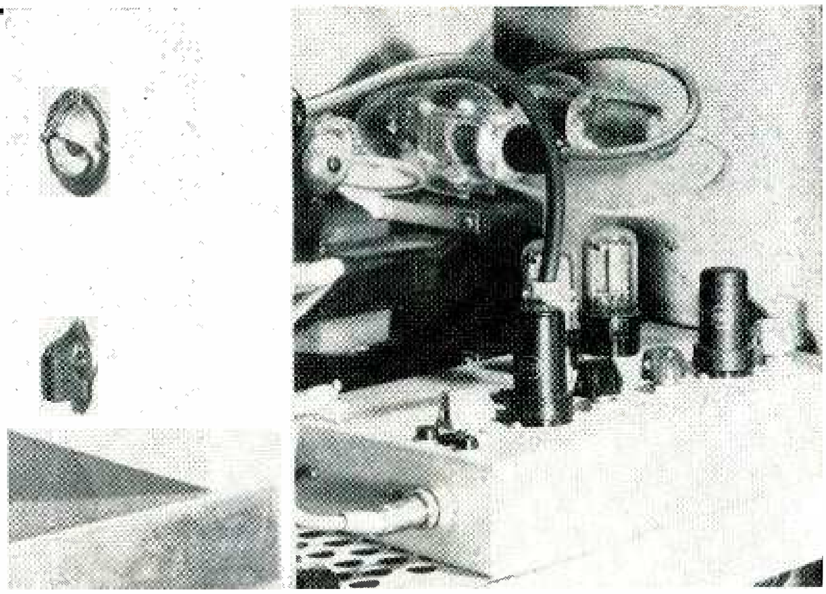
was constructed using two 6SC7 twin-triode tubes. These tubes have a common cathode and in a balanced circuit are quite insensitive to fluctuations in their own power supply. The input is capacitance-coupled to the various circuits to be measured by means of a double-pole five-position selector switch. One setting short-circuits the input terminals for balancing the unit itself. The other four positions as shown in Fig. 1 are connected to the condenser, objective and projector lenses and the high voltage, respectively.



Tuning-eye tube and selector switch are mounted on the front panel of the cabinet. Amplifier chassis fits into space behind panel

Voltage Divider

A capacitor voltage-divider was installed on the high-voltage shelf with terminals for connecting an oscilloscope if desired. It was necessary to include an r-f filter to eliminate pickup from the 75-kc oscillator of the high-voltage power supply. All leads to the various lenses, the windings of which are several hundred volts above ground potential, are shielded. The positive terminal of the high-voltage supply is grounded. The connections to the amplifier are made by plugs at the back of the control panel for easy disconnection when this part of the microscope requires servicing or other maintenance attention.

Output Monitor

The output of the amplifier may be brought to a high-resistance voltmeter on the panel or to a tuning eye tube. When switched to the various lenses, the slightest movement of the focusing controls produces large fluctuations in a zero-centered indicating meter or the tuning eye. Several previously unnoticed spots of poor contact in these controls were discovered the first time the device was used. Although the controls were set at the points where the fluctuations as seen on the eye were comparatively large, no change in the image could be noted visually on the final viewing screen. Examination of plates exposed under these conditions revealed, however, a slightly blurred image. The photographs were sharp when the disturbances were absent.

The instrument is capable of revealing fluctuations in the power supplies that are considerably less than those able to affect the image on the photographic plate. Extremely slow changes may not be detected but on the other hand these are not a serious factor for the photographic exposures are relatively short.

The device may be used to maintain the microscope at a high level of operating perfection, to detect and correct incipient difficulties and to function as a trouble-shooting instrument as needed.

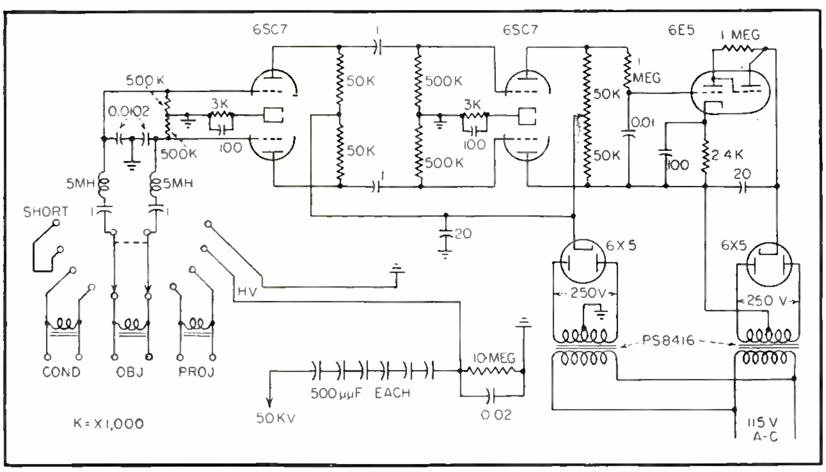


FIG. 1—Complete circuit diagram of the power-supply monitor for electron microscopes

Quick-Change Breadboard

Versatile breadboard design uses standard insert panels for individual sockets and larger components, arranged in any desired order between permanent ground and plate-voltage bus-bars. Finished assembly is sufficiently sturdy for rigorous field testing

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A TRULY versatile breadboard assembly system should provide a means for collecting and storing mounting panels so they can be inserted and fastened in whatever order the circuit demands. The design shown in Fig. 1 meets these requirements for any conceivable electronic circuit, by permitting the addition or subtraction of complete tube stages with minimum effort. Laying out a blank chassis and cutting mounting holes for components are practically eliminated.

Use of the versatile breadboard involves choosing a mounting panel for a particular socket or component, fastening the component to the panel, then inserting and securing the panel on the special chassis frame in its proper sequence according to the schematic diagram. Blank inserts are provided to permit adequate spacing between larger components. Without relying upon guesswork or broad experience, the average engineer can develop on this breadboard a prototype of a compact well-designed chassis. After working out circuit design problems and dressing critical leads, the breadboard can be immediately bolted to a blank panel and rack-mounted for field testing.

Special mounting panels can be manufactured in quantity for any conceivable type of component. Two

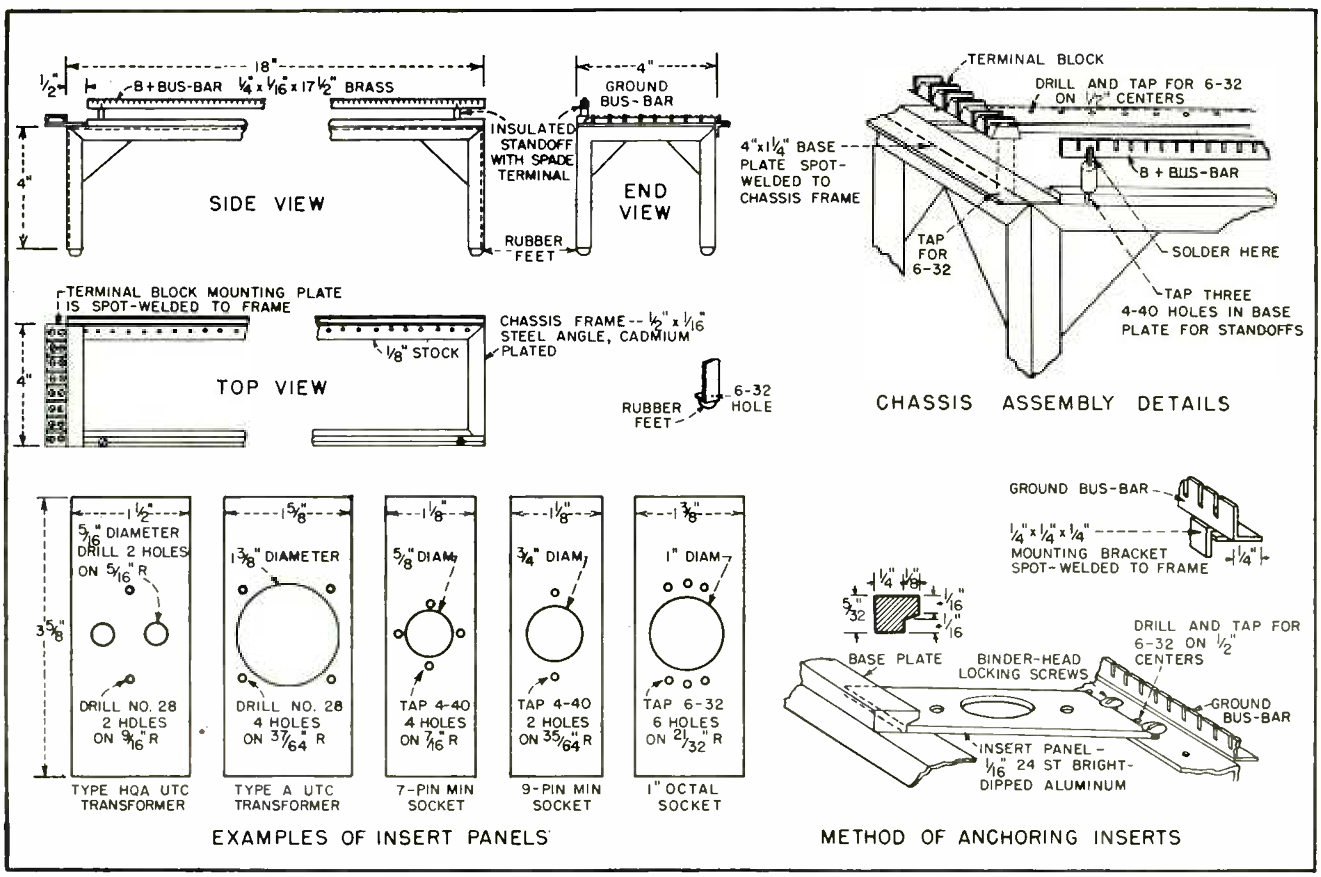
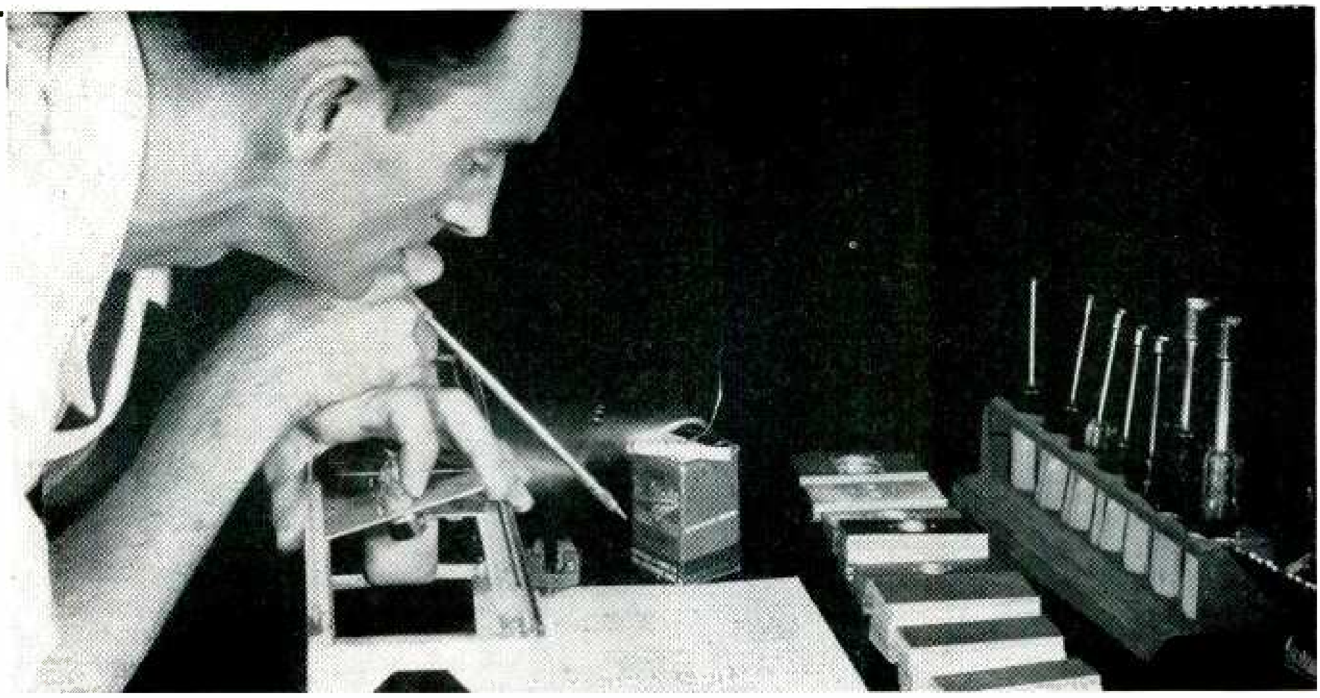


FIG. 1—Suggested construction and dimensions for versatile breadboard chassis capable of holding as many as ten tube stages. Blank insert panels of various widths are kept on hand for use as spacers, to get room for mall components wired between tube sockets.

for Circuit Research



With good stock of insert panels, complete circuit can be produced directly from schematic diagram, without laying out and drilling a single chassis hole

requirements must be met—the thickness of the panel should not exceed $\frac{1}{16}$ inch and the length or vertical dimension must be exactly $3\frac{5}{8}$ inches. For economy, 24ST bright-dipped aluminum is suggested for the construction of the mounting panels. The panels can be expendable, or reused, as desired.

Construction Details

Considerable time was spent in developing a bus-bar that would satisfactorily accommodate all soldered components. The final design was subjected to field tests over a period of months. Not one joint came unsoldered, nor did a single component vibrate loose. The bus-bars provide solid joints and yet permit much easier removal of components when necessary, since there are no wrap-around connections.

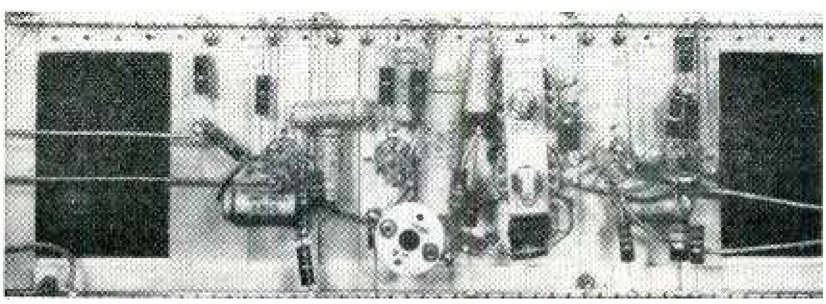
The ground bus-bar is $\frac{1}{4}$ x $\frac{1}{4}$ x 18-inch brass angle stock $\frac{1}{16}$ inch thick. The B+ bus-bar is $\frac{1}{4}$ x 18-inch brass strip $\frac{1}{16}$ inch thick. The notches in both bus-bars are milled with a 0.050-inch blade to a depth of 0.15 inch on $\frac{1}{4}$-inch centers. The finished bus-bars are silver-plated. Any metal which is a good conductor and which can be soldered is satisfactory as bus-bar material. A $\frac{1}{32}$-inch thickness might be more desirable than the $\frac{1}{16}$-inch strips for bus-bars.

The chassis frame is made of $\frac{1}{2}$-inch cadmium-plated steel angle iron $\frac{1}{16}$ inch thick, with $\frac{1}{8}$-inch thickness for the tapped-hole strip to insure that the tapped holes will remain satisfactory after repeated usage. Binder-head screws are used in these holes to secure the panels in position. Where circulating chassis currents are involved, the ground bus-bar should be riveted or screwed to the chassis directly opposite each critical tube or part.

Insert Panels

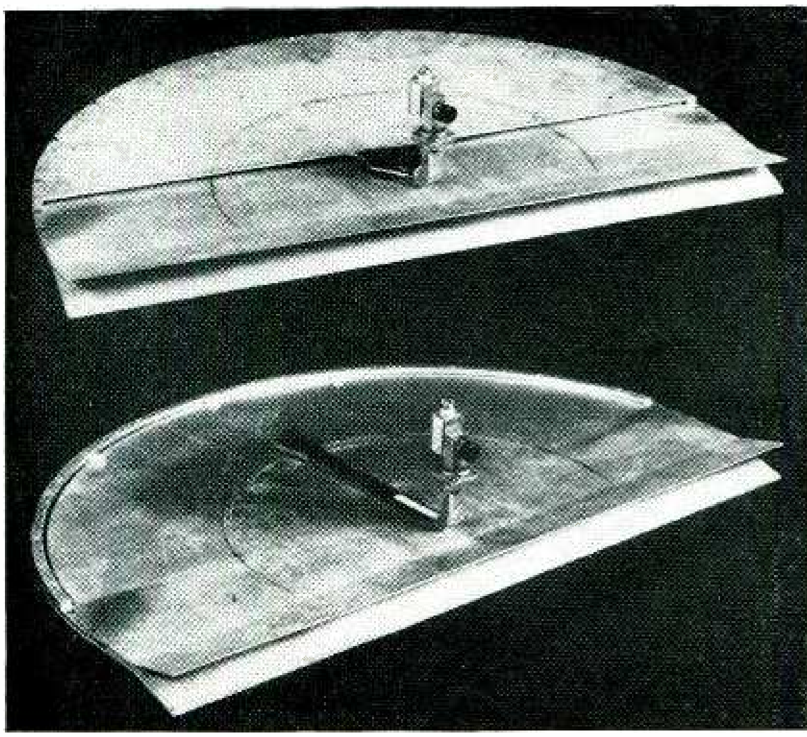
Dimensions for some panel holes are not given, primarily because these are suggested types of panels which may or may not appeal to everyone. Blank insert panels can be made up to any desired width, to serve as spacers.

All rights to this versatile breadboard design have been assigned to the United States Government by the author, for the best interests of the electronic field.



Top view of breadboard on which complete four-tube circuit has been wired. Tubes are upside down underneath, and remain that way during testing. Plate-voltage bus-bar is at bottom, and ground bus-bar at top in this picture

Wide-Angle Scan



Microwave Schmidt antenna is two-layer pillbox (top). With top plate removed (bottom), rotating feed horn, cylindrical reflector and coupling slit are visible

By H. N. CHAIT
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MILITARY and commercial radar systems frequently require that a volume in space be scanned by the radar beam. Scanning in some radar fire-control systems requires oscillation of the radar antenna array while in certain air-navigation approach-control systems, scanning is accomplished by mechanically switching the antenna feed system to produce dual narrow radar beams that alternately illuminate each side of the airport runway.

The problem of developing a microwave antenna system for more rapid scanning is under study at Naval Research Laboratory. One proposed solution is the organ-pipe radar scanner[1]. Another approach is the adaptation of wide-angle optical systems to microwave use. This paper describes some results obtained in adapting the Schmidt optical system, almost universally used in projection television receivers[2], to microwave use. A method for improving off-axis performance of Schmidt systems in general is also described.

The study has shown that the Schmidt system can be used at microwave frequencies to provide a good wide-angle scanning antenna. A 20-beamwidth scan has been obtained with the corrected Schmidt system without deterioration of beam characteristics. It is possible that this can be extended for systems with narrower beamwidths.

The Schmidt antenna was also found to be useful as a variable beamwidth antenna. Antenna beamwidth can be varied from three to at least 12 degrees simply by varying the feed-horn aperture size from about 0.9 to four inches. Sidelobe level was −20 db or lower at all times. Thus, a scanning system may be designed in which beamwidth can be varied over the scan sector.

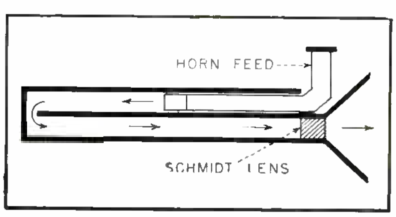


FIG. 1—Cross section of Schmidt pillbox shows path of microwave energy from horn feed to output aperture

The Schmidt microwave focusing system, shown in the photographs, consists of two parallel-plate regions separated by a common plate. The upper region contains the rotating feed horn and the lower region contains the correcting lens and output aperture.

In the lower photograph the top plate of the antenna has been removed to show the rotating feed horn. The long slit in the common plate is of proper dimensions[3] to effect coupling between upper and lower regions. The radius of the circular reflector of this 3.2-cm antenna is 18 inches providing an available aperture width of 36 inches.

A sectional view of the two-layer pillbox is shown in Fig. 1. The feed-horn aperture is located on the focal surface of the circular reflector and is pivoted about the center of curvature to produce the angular scan.

Energy leaving the feed horn propagates through the upper region of the pillbox until it strikes the circular reflector. The dimensions of the long slit in the common plate are so chosen that the energy passes from the upper to the lower region of the pillbox. Energy now propagates through the lower region of the pillbox and the correcting lens to free space. The correcting lens is made of polystyrene.

The lens corrects for aberrations introduced by the circular reflector

Radar Antenna

Microwave analog of Schmidt optical system permits 20-beamwidth scan with side-lobes 20 db down from peak intensity. Feed horn pivots about center of curvature to illuminate cylindrical reflector while special polystyrene lens restores plane wave front

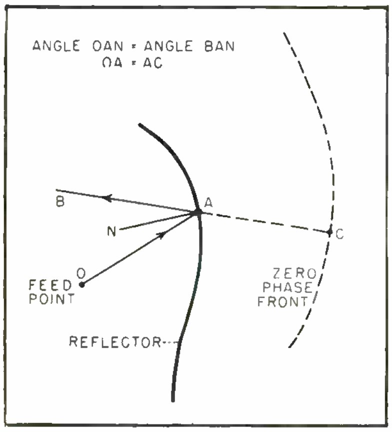


FIG. 2—Snell's Law construction illustrates zero phase front of a reflector

An exact solution was obtained by employing the zero phase front method[6]. The zero phase front of a reflector is found in the following manner. It is first assumed that all rays obey Snell's Law, that is, the angle of incidence is equal to the angle of reflection, and the incident ray, the reflected ray and the normal to the surface lie in a plane.

Referring to Fig. 2, if a reflected ray such as *AB* is extended backwards a distance *AC* equal to the distance between the feed point *O* and the point of reflection *A*, then the zero phase point of this ray is determined at *C*. The zero phase front is defined as the locus of the zero phase points for all rays striking the reflector.

Zero Phase Method

An exact solution may be found by use of the zero phase method. If the outer surface of the lens is made plane, the co-ordinates of the points on the inner surface of the lens are found to be

so that the outgoing wave can be considered plane. The parallel-plate mode utilized is the TEM mode although it is possible to design a similar pillbox using the TE_{10} mode.

Equations of Lens Surface

The optical Schmidt system[4] consists of a spherical mirror together with a thin, refractive lens located at the mirror's center of curvature. The focal surface is spherical in shape and concentric with the mirror. It is located approximately half-way between the mirror and the lens.

Optical workers have employed a variety of techniques[5] to determine the contour of the aspheric Schmidt corrector. In most cases a series-type approximation was used to simplify the calculations. Since the work at NRL required investigation of a system with a small focal-length-to-aperture ratio, an exact rather than an approximate series-type solution was needed in calculating the correcting lens for the microwave analog of the Schmidt optical system.

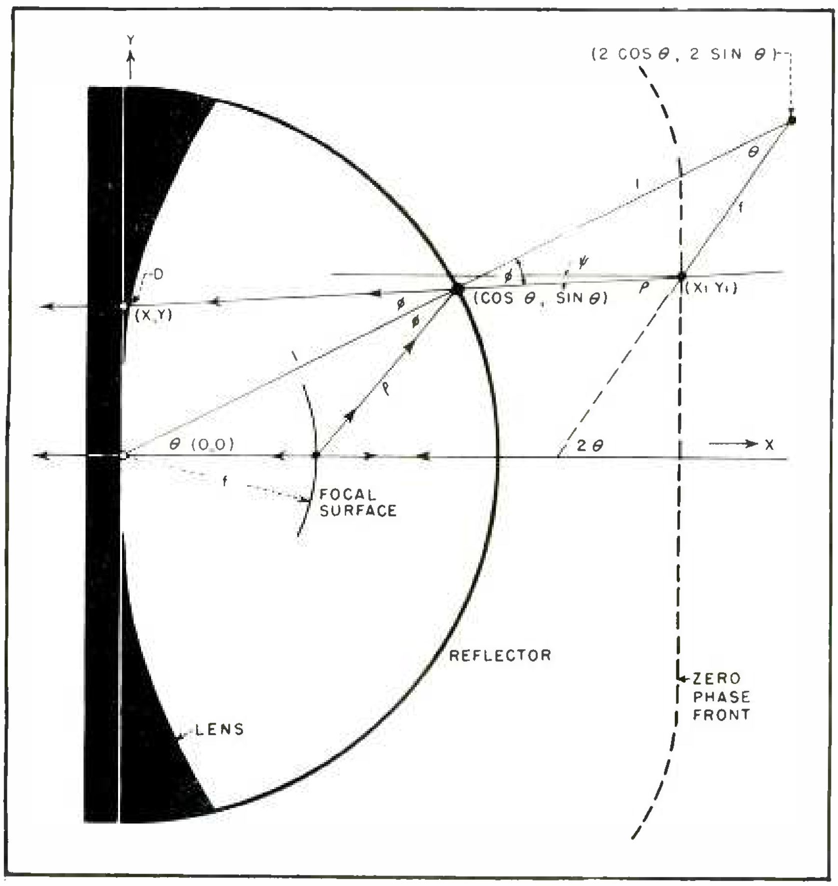
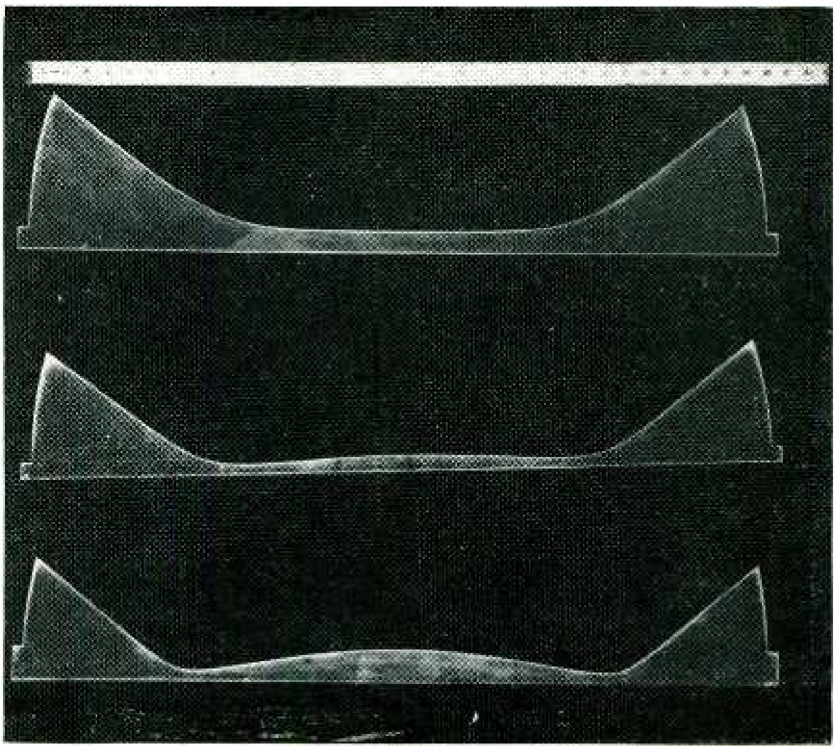


FIG. 3—Diagram of Schmidt optical system defines parameters used in solving for co-ordinates of correcting lens surface by zero phase front method



Correcting lenses made from polystyrene dielectric. From top downwards these lenses have focal lengths of 9.0, 9.9 and 10.8 inches

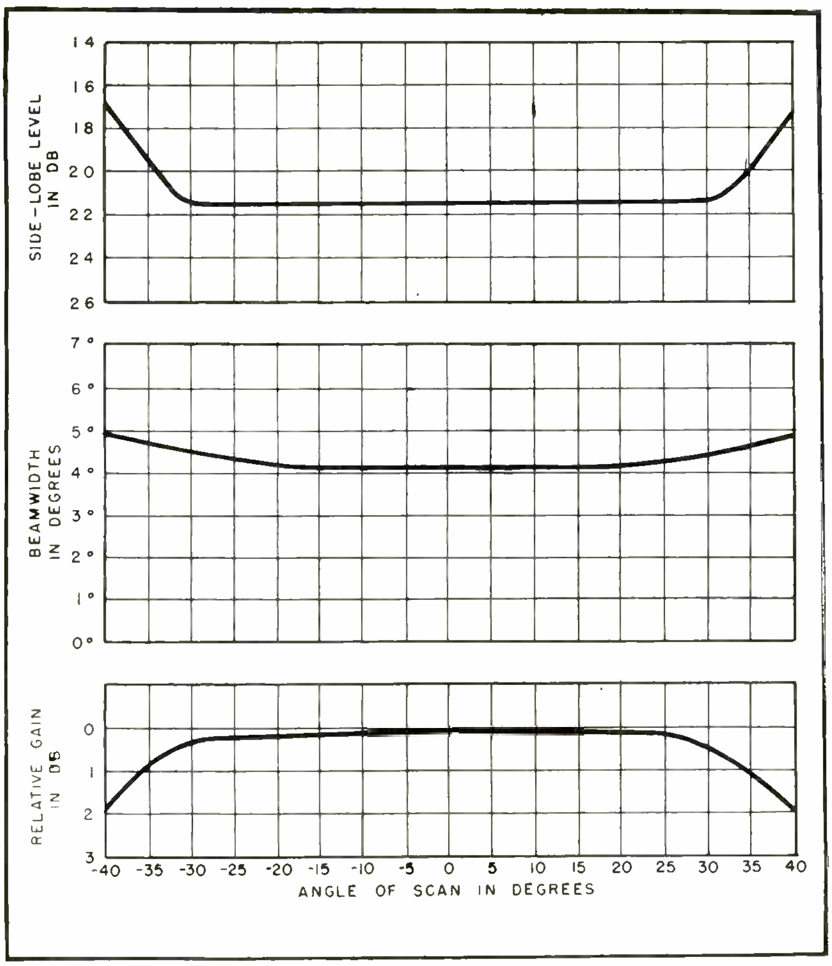


FIG. 4—Variation of side-lobe level, beamwidth and relative gain with scanning for Schmidt antenna with 9.9-inch focal length lens

$$\begin{cases} x = 1/\Delta\,[2\cos\theta - f\cos 2\theta - c\cos\psi] \\ y = 1/\Delta\,[(2\sin\theta - f\sin 2\theta)(1 - n\cos\psi) \\ \quad - c\sin\psi + n\sin\psi\,(2\cos\theta - f\cos 2\theta)] \end{cases}$$

where

$$\begin{aligned} \Delta &= 1 - n\cos\theta \\ \psi &= \theta - \phi \\ \phi &= \sin^{-1} f\sin\theta/\rho \\ \rho &= [1 + f^2 - 2f\cos\theta^{\frac{1}{2}}] \\ c &= 2 - f \end{aligned}$$

The above parameters are defined in Fig. 3, except for n which is the index of refraction of the material from which the lenses are fabricated.

The equations show that the lens contour is uniquely determined once the index of refraction n and the focal length f are chosen. The focal length is defined as the distance from the center of curvature of the reflector to the paraxial focus.

For any values of these parameters, the Schmidt provides perfect focusing when the beam is on axis. However, once the beam is moved off axis the system is no longer in perfect focus, but it was thought that the off-axis behavior of the Schmidt could be optimized by the proper choice of the parameters f and n.

Microwave Adaptation

For convenience it was decided to fix the index of fraction n and to investigate the properties of the Schmidt as its focal length f was varied. Polystyrene was chosen for the lenses because of its low loss, its availability in pieces of sufficient size and because its index of refraction ($n = 1.59$) at microwave frequencies is close to that of glass at light frequencies.

The choice of f was more difficult. However, it was possible to examine the effect of this parameter on the system by employing standard techniques from optics.

As a result of previous theoretical study, focal lengths of $f = 0.50$, 0.55 and 0.60 were chosen and three lenses were designed to fit the 36-inch reflector. The three polystyrene lenses are shown in the photograph. Their actual focal lengths from top to bottom respectively are 9.0, 9.9 and 10.8 inches. These actual focal lengths correspond to the normalized focal lengths quoted above.

Far-field radiation patterns of

the two-layer pillbox alone were first taken to check its design. These measurements indicated that the pillbox was satisfactory and could be used in further testing of the Schmidt system.

Side-lobe level, rather than beamwidth and gain, was used as a measure of merit of the various patterns of the Schmidt because the side-lobe level is more sensitive to changes in the system than either the beamwidth or gain.

The off-axis performance of each of the three lenses was checked by taking far-field radiation patterns as various feed horns were used as primary radiators. It was found that all on-axis patterns were equally good, that is, the side lobe level was at least 20 decibels below peak intensity at all times. However as the beam was scanned off axis, rapid deterioration of the beam occurred with certain combinations of feed horns and lenses.

Off-Axis Behavior

It was found that the lens designed for the normalized f = 0.55 had better off-axis characteristics, that is, lower side lobes and a narrower beamwidth, than the other two lenses when illuminated by the same feed horn. It was also found that the performance of this lens could be optimized by using a feed horn whose intensity is 10 db down from peak intensity at ± 40 degrees. If $f = 0.55$ then θ can be as great as ± 40 degrees without serious aberration.

Figure 4 shows the variation in side-lobe level, beamwidth, and gain (relative to the on-axis condition) as the beam is scanned. Notice that a total scan of 16 beamwidths can be obtained with a side-lobe level of 20 db or more below peak intensity. The deflection of the beam, as the feed horn was moved along the focal surface, agreed very closely with the angular deflection of the feed. In other words, the Schmidt has a beam factor of unity.

Off-Axis Correction

Ray tracing conducted on the Schmidt indicated that the physical aperture increased as the beam was scanned off axis. Referring to Fig. 5, it can be shown that the aperture AA' is equal to:

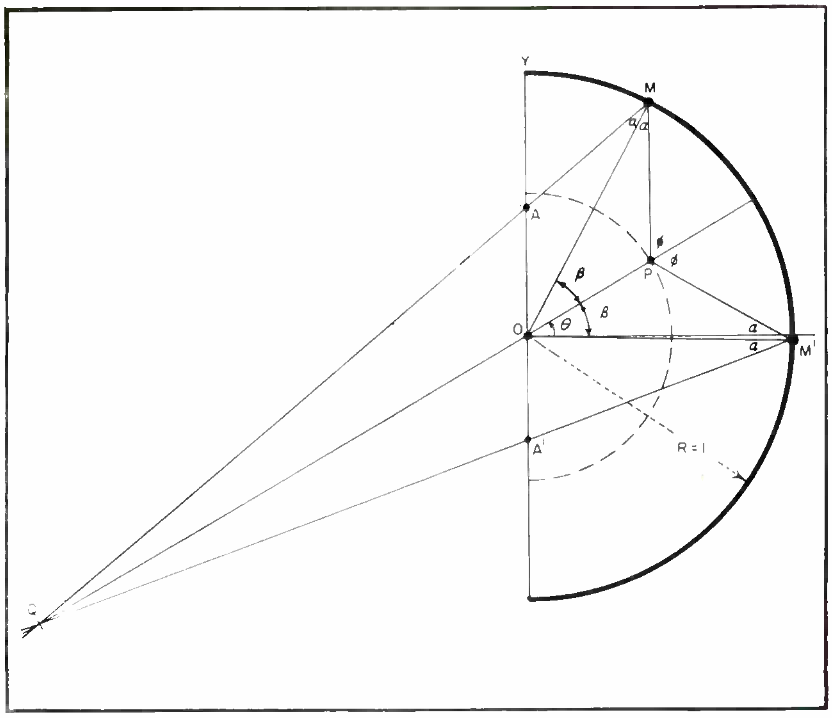


FIG. 5—Ray tracing with Schmidt system illustrates increase in physical aperture as beam is scanned off axis

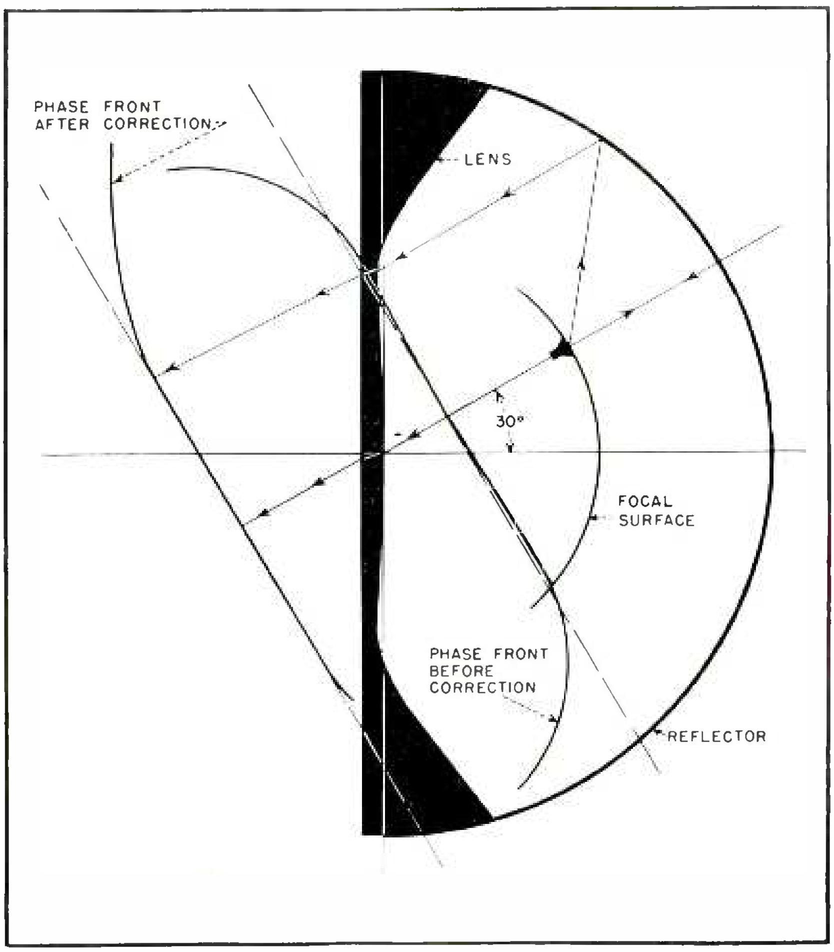


FIG. 6—Off-axis ray tracing shows that normal Schmidt lens overcorrects edges of wave front

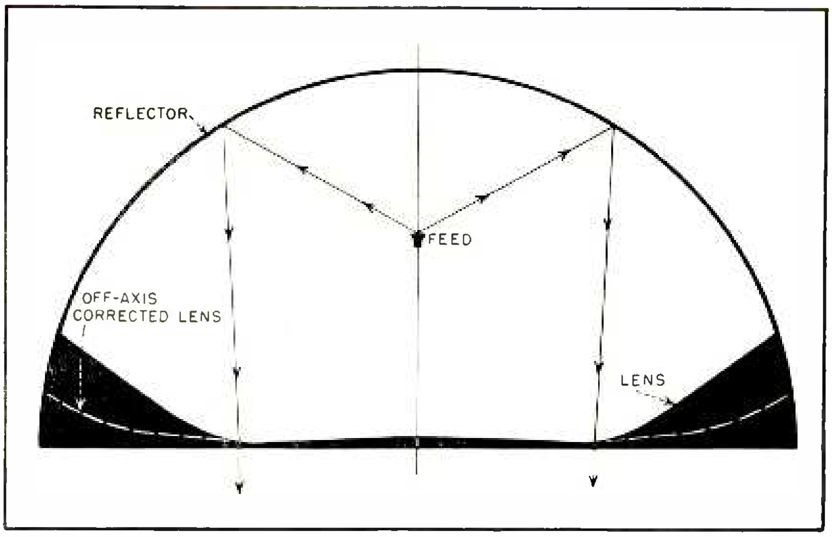


FIG. 7—Schmidt system showing profiles of both normal correcting lens and lens with off-axis correction

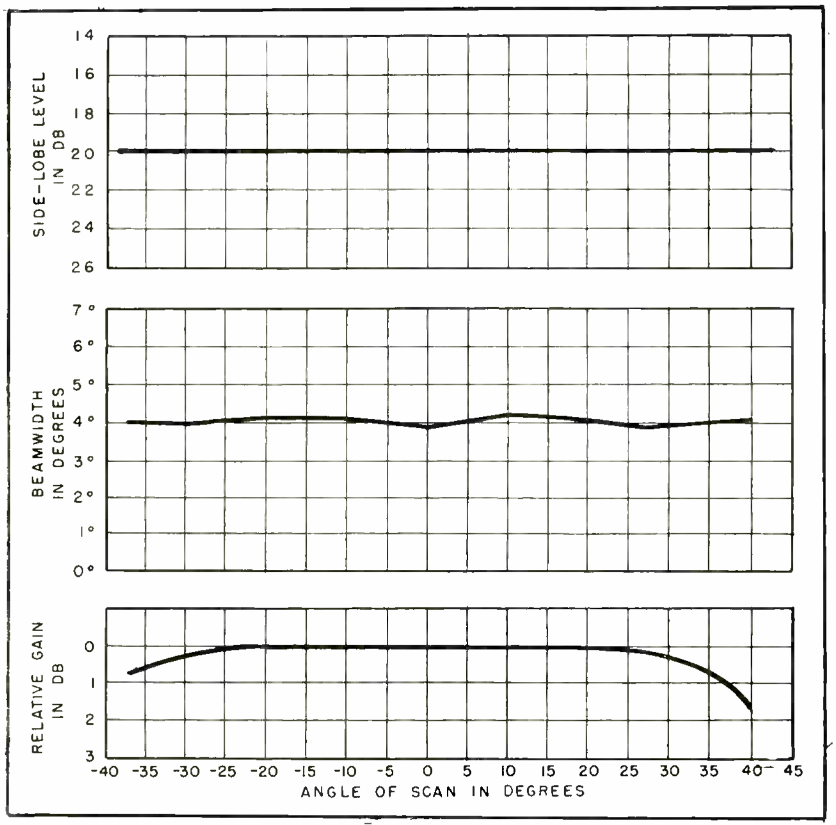


FIG. 8—Variation of side-lobe level, beamwidth and relative gain with Schmidt antenna using lens with off-axis correction

$$AA' = 2\cos\theta \sin\beta + \cos(\theta - \beta) \tan\left\{\theta + (\alpha - \beta)\right\} - \cos(\theta + \beta) \tan\left\{\theta - (\alpha - \beta)\right\}$$

where $\alpha = \sin^{-1} [r_o \sin\phi]$ and $\beta = \phi - \alpha$. The effective aperture is $AA' \cos\theta$. Using a value of $\phi = 60$ degrees (one-half the 10 db width of open waveguide), the value of $AA' \cos\theta$ was calculated and found to be constant within 2 percent from $\theta = 0$ to $\theta = 40$ degrees. Thus if the Schmidt provided perfect correction both the beamwidth and gain should remain constant over the entire field of view. Examination of Fig. 4 shows that this was not the case. The variation in gain and beamwidth is probably due to phase errors, which increase as the angle of scan increases.

Further off-axis ray tracing showed that the lens actually overcorrected the edges of the wave front as shown in Fig. 6, even though it did flatten the center.

An attempt was made to weaken the edges of the lens to provide better off-axis correction. A method[7] was derived which would allow calculation of the lens profile to provide approximate correction both on axis and at two symmetrically chosen scan angles.

The method consists of designing the lens in three sections. The center section is contained between the zero slope points, the zero slope point being the point at which a tangent to the lens is parallel to the Y-axis. These points correspond to values of $\pm\theta_o$ where $\cos\theta_o = \frac{1}{2}f$.

The upper and lower sections lie outside the zero-slope points. For the center section, the lens was designed as though the horn was at $\theta = 0$ degrees. For the upper and lower sections, the designs were based on horn positions of $\theta = -30$ deg. and $+30$ deg. respectively. A new lens was then constructed and tested in the same pillbox. Figure 7 shows the old and the new lenses. Figure 8 shows the variation in side-lobe level, beamwidth and gain as the beam is scanned. A 20 beamwidth scan is now possible with a side-lobe level of -20 db or lower with both constant beamwidth and fairly constant gain. This is quite an improvement over the old model which provided only a 16-beamwidth scan under the same restrictions.

The author wishes to thank M. L. Kales and K. S. Kelleher for their help and encouragement during the course of this development.

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Effect of Radiation on Resonant Lines

Two-wire transmission-line calculations are made considerably more accurate by including effect of line radiation. Problems are solved using graphs of theoretically-derived equations that have been verified experimentally

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RADIATION RESISTANCE is usually neglected in making calculations for resonant parallel-conductor transmission lines but results obtained in this manner are liable to serious errors.

A means for taking radiation resistance (which may be appreciable, depending on frequency and other factors) into consideration in making optimum design calculations is suggested.

Resistance Calculation

Recent measurements in this laboratory[1] have shown that the radiation resistance of certain resonant unshielded two-wire transmission line sections is given with good accuracy by the equation.

$$R_{rad} = 120\,\pi^2\,(d/\lambda)^2 \text{ ohms} \quad (1)$$

when d, the separation of the conductor centers, is small compared with the wavelength λ and large compared with the conductor radius r. The measurements were made for line sections an odd number of half-wavelengths long with open-circuit termination at each end, and for sections an even number of half-wavelengths long with short-circuit termination at each end. There are now[2] theoretical reasons for assuming that the same equation applies to all resonant sections of such transmission line with any combination of open-circuit and short-circuit terminations. Typical examples are shown in Fig. 1.

The usual analysis of uniform transmission lines, neglecting radiation losses, leads to the well-known equation for the Q of any low-loss resonant section

$$Q = \frac{\beta}{2\alpha} \quad (2)$$

where α is the attenuation constant in nepers per meter, and β is the phase propagation constant in radians per meter. The approximations involved in deriving this equation are valid with useful accuracy for line sections whose total attenuation does not exceed a few tenths of 1 db.

The input impedance at any point of antiresonance of the same sections, (see Fig. 1) is given by

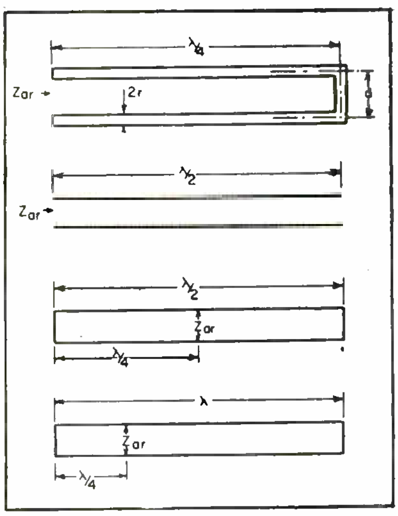

FIG. 1—Typical resonant transmission-line sections for which effect of radiation on the resonant properties is analyzed

$$Z_{ar} = \frac{Z_o}{\alpha L_o} = \frac{4}{\pi n} Q Z_o \text{ ohms} \quad (3)$$

where Z_o is the characteristic impedance of the line in ohms and $L_o = n\lambda/4$ is the line length for resonance.

In Eq. 2, β is directly proportional to frequency and is independent of conductor size, material or separation, at high frequencies. When dielectric losses are negligible, the attenuation constant α is given by

$$\alpha = \frac{R_c}{2Z_o} \text{ nepers per meter} \quad (4)$$

where R_c is the total conductor resistance in ohms per meter. The value of R_c increases as the square root of the frequency at high frequencies, while Z_o is independent of frequency.

For a line having two identical circular conductors of radius r meters, center separation d meters, and conductivity σ ohms per meter

$$Z_o = 120 \cosh^{-1}(d/2r) \quad (5)$$
$$\left\{(d/2r) + [(d/2r)^2 - 1]^{1/2}\right\} \text{ ohms}$$

$$R_c = \left(\frac{16f}{10^7\sigma}\right)^{\frac{1}{2}} \frac{1}{2r} \left\{1 - (2r/d)^2\right\}^{-\frac{1}{2}} \text{ ohms per meter} \quad (6)$$

where f is the frequency in cycles per second.

It follows from Eq. 2, 3 and 4 and the nature of the frequency

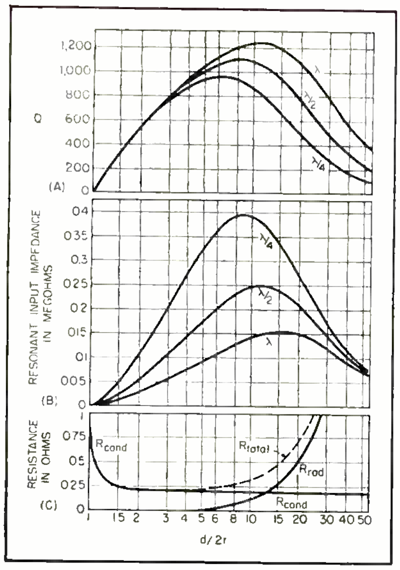

FIG. 2—Curves show resonant properties of two-wire line sections at 100 mc for 1/8-inch copper conductors

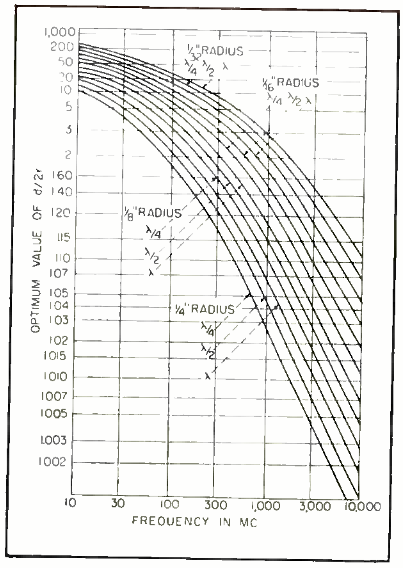

FIG. 3—Optimum separation of conductors for optimum Q expressed in conductor diameters

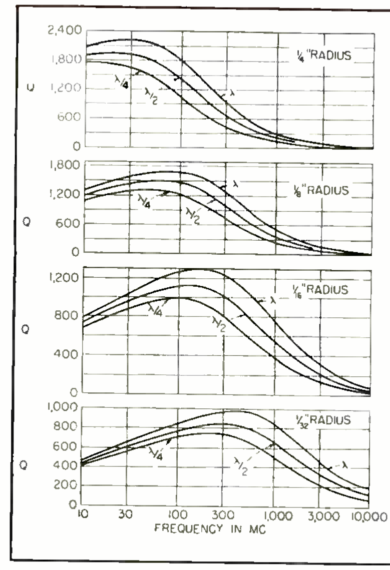

FIG. 4—Curves show Q values of resonant-line sections at optimum conductor separations given in Fig. 3

variation of the parameters involved, that both the Q and the antiresonant input impedance Z_{ar} should increase as the square root of the frequency for resonant line sections of constant electrical length (n constant).

When Eq. 2 is combined with Eq. 5 and 6 it is easily shown that the Q of any resonant section is a maximum at all frequencies for fixed conductor separation *I*, when the conductor radius is given by $d/2r = 2.275$, but that for fixed conductor radius the Q increases indefinitely with conductor separation.

Similarly it is found on combining Eq. 3 with Eq. 5 and 6 that, for fixed conductor separation the antiresonant impedance of any section is a maximum at all frequencies when the conductor radius is given by $d/2r = 4.43$, and that again for fixed conductor radius the antiresonant impedance increases indefinitely with conductor separation.

The calculations in the following sections show that when account is taken of radiation resistance all the conclusions of the last three paragraphs are either totally wrong or seriously in error for practical resonant sections of unshielded two-wire line at high frequencies.

Including R_{rad}

Combining Eq. 2 and 4, and using $\beta = 2\pi/\lambda$ and $L_o = n\lambda/4$, leads to

$$Q = \frac{\frac{1}{4}\pi n Z_o}{\frac{1}{2}R_c L_o} \qquad (7)$$

In this equation the denominator is one-half the total conductor resistance of a resonant line section of length n quarter-wavelengths.

Because of the approximately sinusoidal distribution of current along a high-Q resonant line section, the total distributed resistance $R_c L_o$ introduces only one-half as much loss as the same amount of resistance located at a point of maximum current. By definition, a radiation resistance is referred to such a point of maximum current.

It is evident, therefore, that the Q of a resonant line section whose total radiation resistance is R_{rad} ohms will be given by

$$Q = \frac{\frac{1}{4}\pi n Z_o}{\frac{1}{2}L_o R_c + R_{rad}} \qquad (8)$$

a result which is confirmed by more rigorous analysis.

When the two conductors of a line are separated by twenty or more diameters, the line currents are uniformly distributed around the circumference of each. For decreasing separation the currents become more and more concentrated on the adjacent sides of the conductors. This is the proximity effect, which results at high frequencies in the characteristic impedance of a two-wire line approaching zero and the distributed conductor resistance approaching infinity as the two line conductors approach contact. Equations 5 and 6 include this proximity effect for Z_o and R_c respectively.

It is to be expected that the conductor separation d occurring in Eq. 1 for radiation resistance is physically of the nature of a separation of effective current centers of the currents in the two-line conductors. It should therefore approach d for large values of $d/2r$ and should approach zero as the conductors approach contact and $d/2r$ approaches unity.

Since no analysis of this aspect of the problem seems ever to have been made, it will be postulated here for purposes of calculation that the effective separation of the conductor current centers for radiation resistance purposes, as modified by proximity effect, is given by

$$d_{eff} = d\,[1 - (2r/d)^2]^{1/2} \qquad (9)$$

an expression whose proximity effect term is similar to that in Eq. 5 and 6.

Substituting Eq. 5, 6 and 9 into Eq. 8 and using $L_o = n\lambda/4$ and $\lambda = 300/f_{mc}$, where f_{mc} is the frequency in megacycles, leads to

$$Q = \frac{\frac{1}{4}\pi\, n\, 120 \cosh^{-1}(d/2r)}{\left\{\frac{2250}{\sigma}\right\}^{1/2} n\, f_{mc}^{1/2} \frac{1}{2r}\left\{1 - (2r/d)^2\right\}^{-\frac{1}{2}} + \frac{\pi^2}{750} f_{mc}^2 (2r)^2 \left\{(d/2r)^2 - 1\right\}} \qquad (10)$$

which is the working equation from

which the Q of any resonant section of line can be calculated.

The corresponding equation for antiresonant input impedance can be written directly using Eq. 3.

It is not possible to draw significant conclusions from Eq. 10 simply by inspection, except to say that Q is no longer independent of n or proportional to the square root of the frequency, as was the case when radiation losses were neglected. The full implications of the equation can be found only by direct numerical solution.

Graphical Solution

Figure 2A shows the variation with $d/2r$, on varying d, of the Q of quarter-wavelength, half-wavelength, and one-wavelength resonant line sections having copper conductors of $\frac{1}{16}$-in. radius, at a frequency of 100 mc, as calculated from Eq. 10. Because of the radiation losses, the Q does not increase indefinitely with d, but has a maximum value at a relatively small value of d, about $1\frac{1}{2}$ inches for the quarter-wavelength section. The optimum conductor separation is somewhat greater for longer resonant sections, being almost three inches for a full wavelength section.

Figure 2B shows similarly the variation with $d/2r$, on varying d, of the antiresonant input impedance for line sections of the same lengths at the same frequency. The maxima in these curves occur at somewhat higher values of $d/2r$ than the maxima in the Q curves.

Figure 2C shows, for the same quarter-wavelength line section only, the variation with $d/2r$ of the two effective resistance components of the section, being the two terms of the denominator of Eq. 10. The increase of the conductor resistance term with proximity effect at low values of $d/2r$ and the increase of radiation resistance at high values are evident. The term $\cosh^{-1} d/2r$ in the numerator of Eq. 10 is mainly responsible for the maximum values of Q and Z_{ar} occurring at considerably higher values of $d/2r$ than the value that results in minimum total effective resistance for the line section.

It should be noted that the optimum values of $d/2r$ in Fig. 2A and 2B are not to be compared with the values of 2.275 and 4.43 respectively given above. These latter values are for the case where the line separation is fixed and the conductor radius is varied.

The value of $d/2r$ to give maximum Q has been calculated for quarter-wavelength, half-wavelength and one-wavelength line sections of copper conductors of $\frac{3}{32}$, $\frac{1}{16}$, $\frac{1}{8}$ and $\frac{1}{4}$-in. radius at several frequencies between 10 and 10,000 mc. The results are shown in Fig. 3.

The optimum $d/2r$ values were obtained either by plotting curves similar to Fig. 2A or by solving the equation obtained on differentiating Eq. 10 with respect to $d/2r$ and equating to zero, the two procedures being about equally tedious.

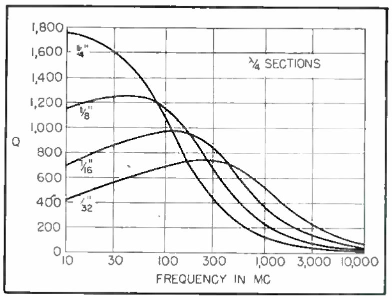

FIG. 5—Q curves for quarter-wavelength resonant sections of Fig. 4 are presented together for comparison

The most striking feature of these curves is the indication that, especially for the larger conductor radii, the optimum value of conductor spacing is very small. For example, for a quarter-wavelength section having conductors of $\frac{1}{4}$-in. radius, the optimum value of $d/2r$ at 100 mc is about 1.8; at 300 mc the optimum value is 1.17, and at 1,000 mc it is 1.03. These values correspond to actual spacings between the adjacent conductor surfaces of about $\frac{15}{16}$, $\frac{3}{32}$ and $\frac{1}{16}$-in. respectively.

Q Values

The Q values at the optimum values of $d/2r$ for the line sections of Fig. 3 are shown in Fig. 4. Up to a certain frequency the Q values increase with frequency though not as rapidly as the square root of the frequency for any of the curves shown. At higher frequencies they drop off fairly sharply. Longer line sections at a given frequency have higher Q values and their maximum Q occurs at higher frequency.

An interesting feature is that at frequencies above about 300 mc sections made from conductors of $\frac{3}{32}$-in. radius can have higher Q values than sections made from conductors of $\frac{1}{4}$-in. radius. This is shown more clearly in Fig. 5, where the Q curves for each of the quarter-wavelength lines of Fig. 4 are plotted together. This indicates also that at 300 mc, for example, the optimum quarter-wavelength section using conductors of $\frac{1}{16}$-in. radius has a higher Q value than the optimum sections with either larger or smaller conductors.

It follows that at any frequency there is an optimum conductor size for sections of any particular electrical length and that the section using this conductor size and the optimum value of $d/2r$ will have the absolute maximum Q value obtainable at that frequency and line length.

Figure 5 shows that at 300 mc a quarter-wavelength section made of copper conductors of $\frac{1}{16}$-in. radius with $d/2r = 2.7$ (from Fig. 3) has a Q value of about 850, and no higher Q value can be obtained for any quarter-wavelength line at this frequency. The center separation of the conductors for this section is slightly less than $\frac{3}{8}$ in.

If similar curves for larger and smaller conductor radii were added to Fig. 5, the envelope of the resulting set would give the maximum possible Q value obtainable at each frequency.

Curves similar to those of Fig. 3, 4 and 5 could also be calculated for line sections of maximum antiresonant input impedance.

A grant-in-aid from the National Research Council of Canada, and the assistance of Judith M. Veith on the calculations involved in this work are gratefully acknowledged.

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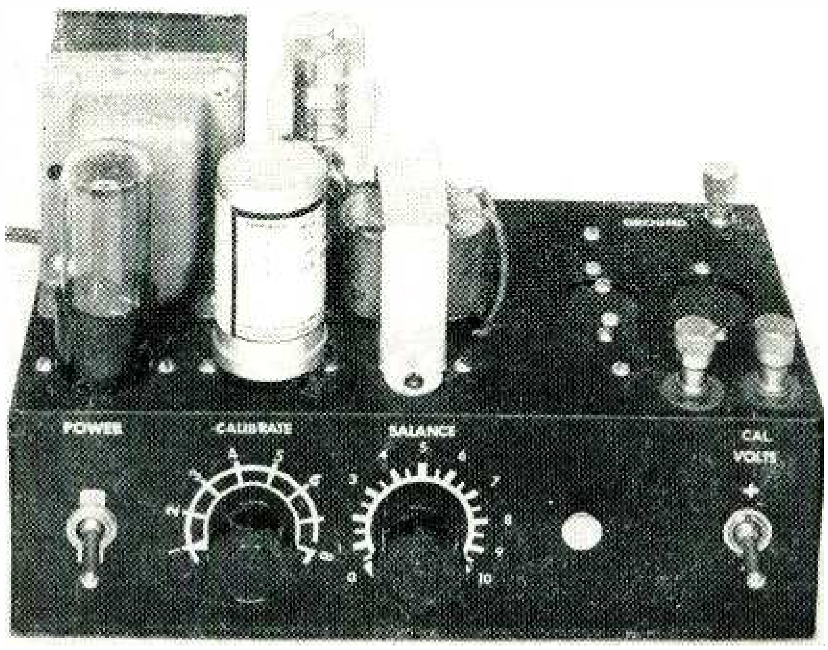
Bipolar Logarithmic

Simple circuit using two type 9004 biased diodes back to back measures d-c corona signals of both polarities over entire range from milliamperes to millimicroamperes. Used in studying earth's electric field during snowstorms and thunderstorms



Amplifier chassis, with power supply tubes on top; 9004 and 954 tubes are under the chassis

In a study of the earth's electric field during snowstorms and thunderstorms, it was necessary to measure the corona current to a corona point exposed 54 feet above the ground. The current range to be covered was approximately from 10^{-7} ampere to 10^{-3} ampere with either polarity. Because of the the wide range of current to be measured, a logarithmic device was needed.

The logarithmic relationship between retarding voltage and current in a temperature-limited diode having a pure metal cathode has been known[1] at least since 1914, and various experimenters have constructed logarithmic amplifiers using this principle or variations of it[2-6]. The theory of such tubes has been discussed in several places[7-9]. Ordinarily, only a single polarity of current has been considered during this early research.

A particularly interesting report[5] indicates that, under proper conditions, for one polarity the 9004 acorn diode has a logarithmic range of 10^9. For the present application, however, it was necessary to deal with both polarities. After trying several other circuits with unsatisfactory results, the one given in detail in Fig. 1 was constructed. As shown in Fig. 2, it consists essentially of two biased diodes back to back, shunted by a resistor R, the output of which is fed to a simple d-c amplifier which in turn feeds a 0.5-ma zero-center Esterline-Angus recorder.

In the case where the anode of a diode is biased negatively relative to the cathode (even when the cathode is not a pure metal), the relationship between diode current i and retarding potential $-V$ may be given by

$$i = i_o^{-Ve/kT}$$

where e is the electron charge, k is Boltzmann's constant, T is the absolute temperature of the cathode and i_o is a constant depending upon geometry and other factors.

In practice, this equation becomes invalid at various parts of the range because of such effects as positive ion current in the tube, shunting leakage or circuit resistance, currents to grids of following stages, saturation of the diode leading to a space charge situation (at the high end of the current range), photoelectric emission from the anode or grid, rectification from a-c pickup in high-impedance leads and even heater leakage or rectification. In fact, in the bipolar case where two diodes are required, it is virtually impossible to operate the circuit without a separate filament transformer for the heater of the diode with the high-impedance cathode.

For the temperatures of typical cathodes, the quantity e/kT corresponds to from 4 to 5 decades per volt. In Fig. 3 the output voltage of the two diodes back to back is sketched in qualitative fashion relative to the logarithm of the current. Naturally no logarithmic function goes through zero. Whether or not there is a shunting resistor, there must be a linear region near zero so that the actual relationship is of the form of a hyperbolic sine ($2 \sinh x = e^x - e^{-x}$, which is a function that is linear near zero and logarithmic far from zero).

Practical Circuit

The location of the region of transition from a logarithmic to a linear relationship may be changed by adjusting the shunting resistor R or by adjusting the biases applied to the two diodes. When the biases have fairly large values, the location of the linear range is determined by the shunting resistance R.

Corona-Current Amplifier

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Figure 3 has been drawn for this case.

The circuit as constructed actually had a logarithmic range from 3×10^{-9} to 3×10^{-4} amperes for both polarities. Unquestionably the ranges could have been extended to smaller currents, but since the smallest currents which could be measured already were less than required for this application, further development was not undertaken. The Victoreen 5800/VX41A has also been operated between 3×10^{-14} and 3×10^{-8} amperes as a logarithmic diode without reaching the ends of the range, and the Raytheon CK5886/CK571 has been worked over 7 decades.

The biases were adjusted as shown in Fig. 1 to yield the calibration given in Fig. 4. Changing the biases changes the circulating current through the diodes. On the assumption that the cathode temperature is proper, the relationship between current i and output voltage V is given as indicated in Fig. 3 as

$$i = \frac{V}{R} + i_o\, 10^{V_B/0.25}\left(10^{V/0.25} - 10^{-V/0.25}\right)$$

where i_o is a constant and V_B is the bias voltage.

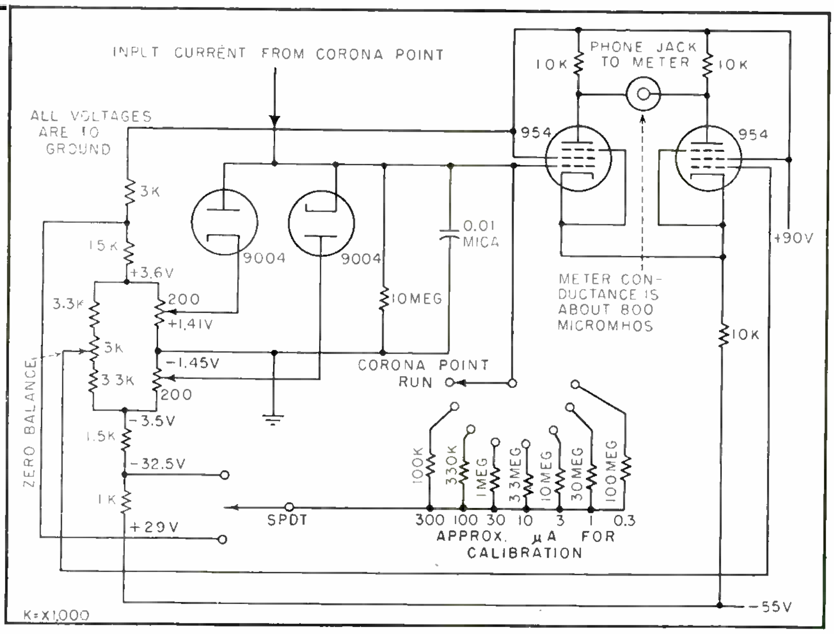

FIG. 1—Complete signal circuit of bipolar logarithmic amplifier. Power supply, not shown, uses 5Y3GT full-wave rectifier with VR150 across ungrounded filter to give 145 volts. Circuit ground divides this as indicated by voltage values. Separate filament transformer is used for the 9004 tubes

The practical amplifier shown in Fig. 1 has several built-in calibration points. The meter current is about 800 microamperes per volt input, corresponding to about 200 microamperes per decade of corona current. The equipment has been in service for about 15 months, and providing the tubes are replaced after their rated life, it behaves very well.

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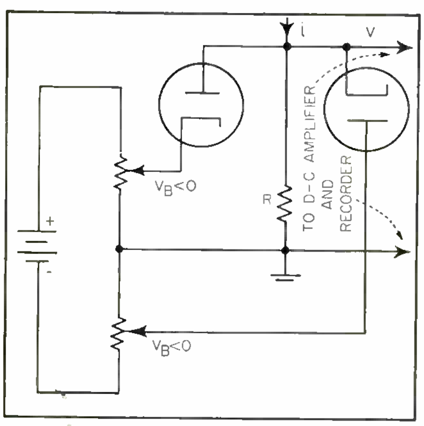

FIG. 2—Simplified circuit of bipolar logarithmic amplifier

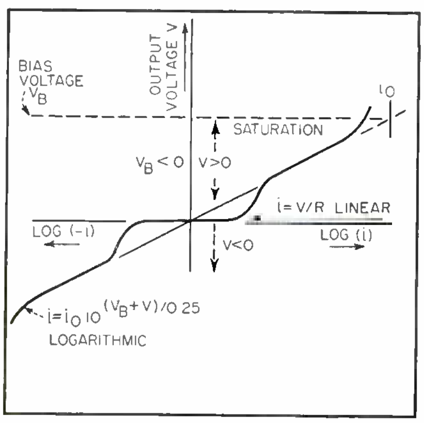

FIG. 3—Variation of output voltage with log of input current

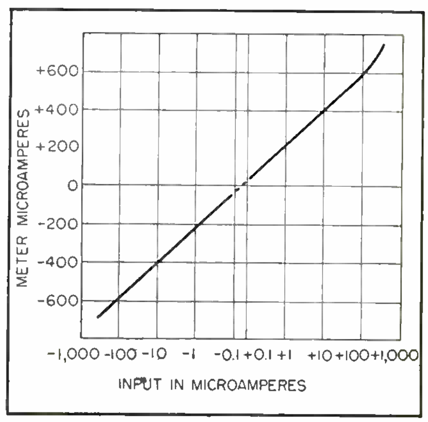

FIG. 4—Calibration curve for measuring circuit of Fig. 1

Test Scope Checks

Special design features of a new broad-band oscilloscope include sweep-delay circuit, sweep magnifier, time markers for sync pulses and vertical-amplifier calibrator. Individual lines or sync pulses of standard tv signal can be examined and identified

TELEVISION BROADCAST equipment frequently needs maintenance or adjustment that can best be accomplished with a cathode-ray oscilloscope. Station equipment to be tested includes synchronizing generators and video amplifiers as well as camera, monitor and switching equipment. Since any portion of the transmitted video signal must be presented accurately and in good detail, the test oscilloscope must have high input resistance, low input capacitance, good transient response and broad bandwidth. The instrument to be described contains a number of features designed for the purpose of tv testing, including a 10-megacycle bandwidth, an input impedance of one megohm shunted by 40 μμf, and a test probe (with ten times attenuation) that provides 10 megohms and by 14 μμf.

The sweep circuit of the oscilloscope has a range from 0.01 sec per cm to 0.1 μsec per cm and is a hard-tube, triggered type. Composite fields or complete frames may be observed by triggering the sweep from vertical sync pulses and selecting a slow-sweep rate that presents the desired amount of information during each sweep.

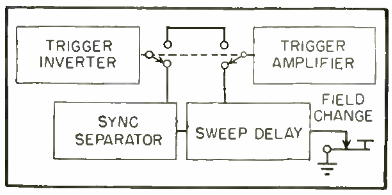

FIG. 1—Block diagram of the sweep-delay circuit

When individual lines or sync pulses are to be observed throughout the picture, the sweep must be set fast enough to spread out the desired information. It becomes necessary to delay the start of the sweep until the picture has progressed to the desired portion and then trigger the sweep with one of the horizontal-sync pulses.

The sweep delay introduced is adjustable through about 1.5 fields by means of a sweep-delay control. The sweep-delay circuit operates at the frame rate of 30 cps, so that individual lines are observed from only one of the interlaced fields at any time. A field-shift switch allows the operator to change to the other interlaced field. A block diagram of the sweep-delay circuit is shown in Fig. 1.

Sweep Delay

A trigger delay phantastron V_4 with 25-millisecond rundown time will accept alternate vertical-sync pulses from the sync separator. The field-shift switch, normally closed

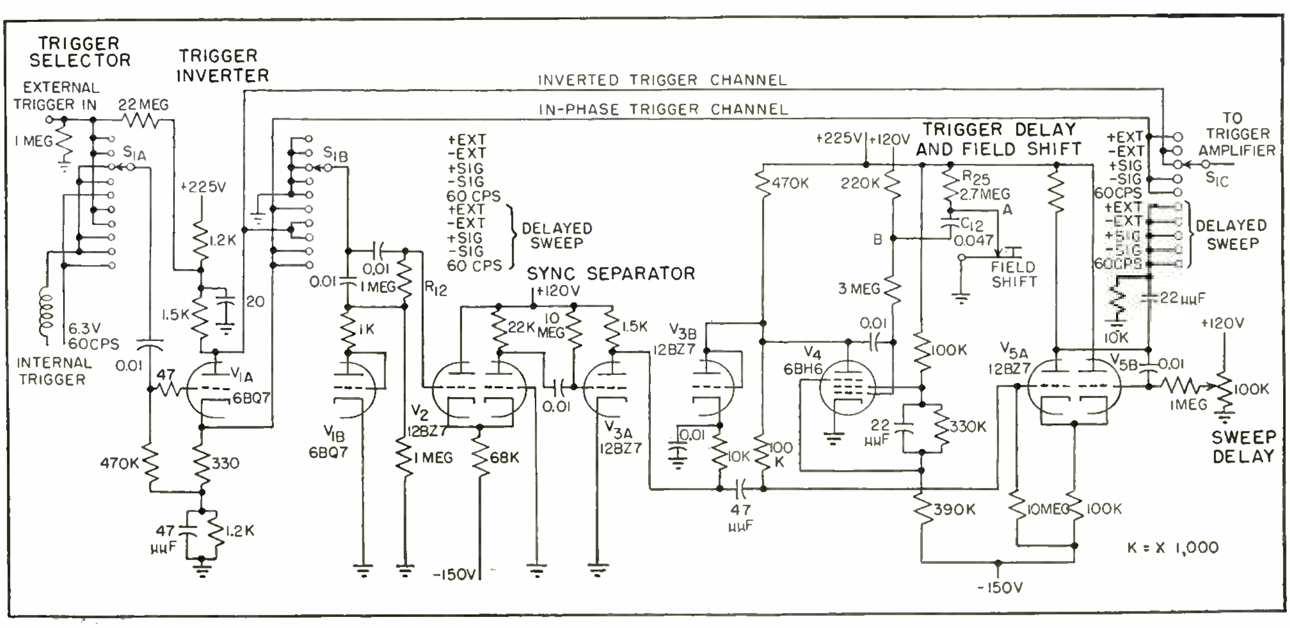

FIG. 2—Circuit of the trigger-delay and field-shift elements of the oscilloscope

TV Broadcasts

By CLIFFORD H. MOULTON

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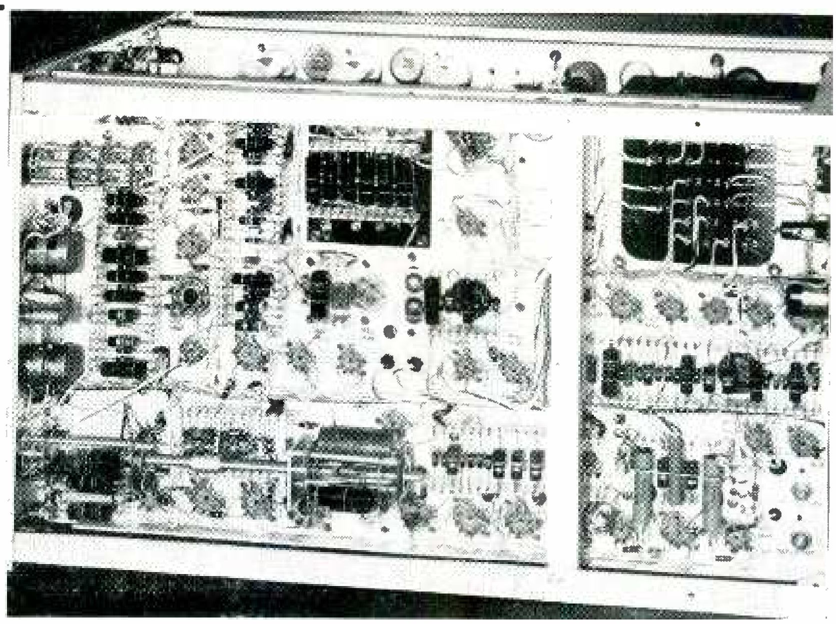
(Fig. 2), provides a unique means of forcing the phantastron to skip one extra trigger and hence change to the other field.

Reversed Phantastron

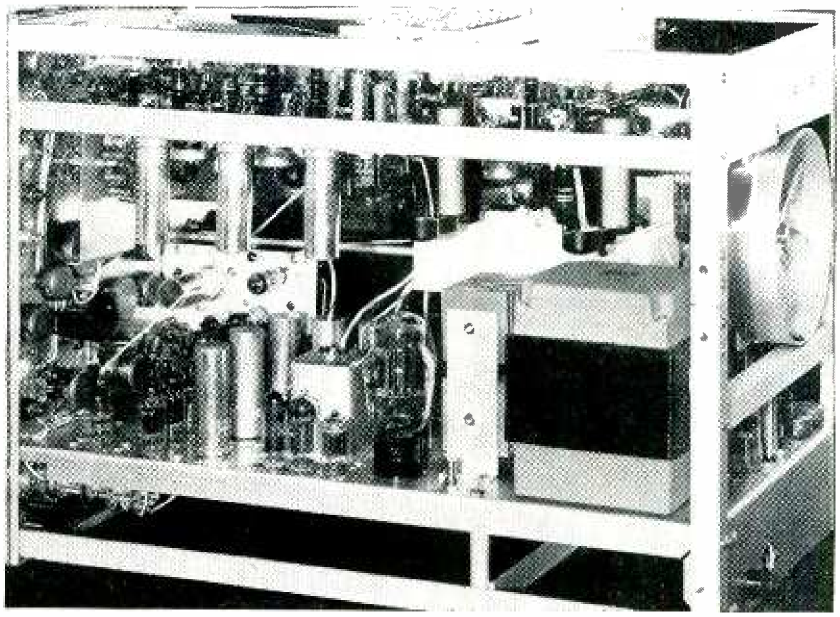
When the pushbutton is depressed R_{25} charges C_{12} so that point A approaches +225 volts. When the switch is released, point A is again grounded and C_{12} instantaneously forces point B 225 volts negative with respect to its normal voltage. This actually reverses the phantastron and forces it to run up for a short time instead of down. Point B returns to normal voltage approximately according to the time constant $R_{25}C_{12}$, interrupting the phantastron only long enough to skip one trigger. The comparator V_5 will always be triggered by one of the differentiated horizontal-sync pulses from the sync separator that are superimposed on the phantastron waveform.

Sweep Magnifier

It is frequently desirable to look carefully at a small detail on the screen without upsetting the sweep-circuit settings. A magnifier principle has been incorporated in this oscilloscope that gives either three or ten times magnification of any detail that has been positioned to the center of the screen by a three-turn horizontal-position control. With magnification on, the operator may explore the entire trace by slowly turning this control. If a detail is located with the magnifier on, the position of the detail with respect to the entire sweep may be determined by turning off the magnifier and observing which part of the trace is centered on the screen.



Underchassis view of the television oscilloscope looking towards front panel (left)



Blower (right) provides cooling for greater stability and longer component life

The principle of operation of the magnifier can be explained with the block diagram of Fig. 3. Normally the high-gain amplifier is held to unity gain by feedback networks R_1C_1 and R_2C_2. Three and ten-times magnification are obtained by switching R_2 and C_2 to allow corresponding voltage gains.

Time markers are inserted as intensification pips in the crt beam at time intervals of 1 μsec, 0.1 μsec, 0.05 μsec or 200 pips per television line.

These markers provide a means of accurately timing the sync pulses of a composite signal. A horizontal-sync pulse with markers is

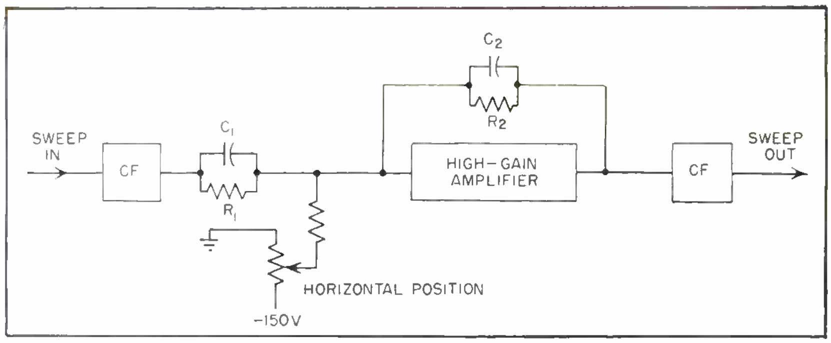


FIG. 3—Elements of the sweep-magnifier feature

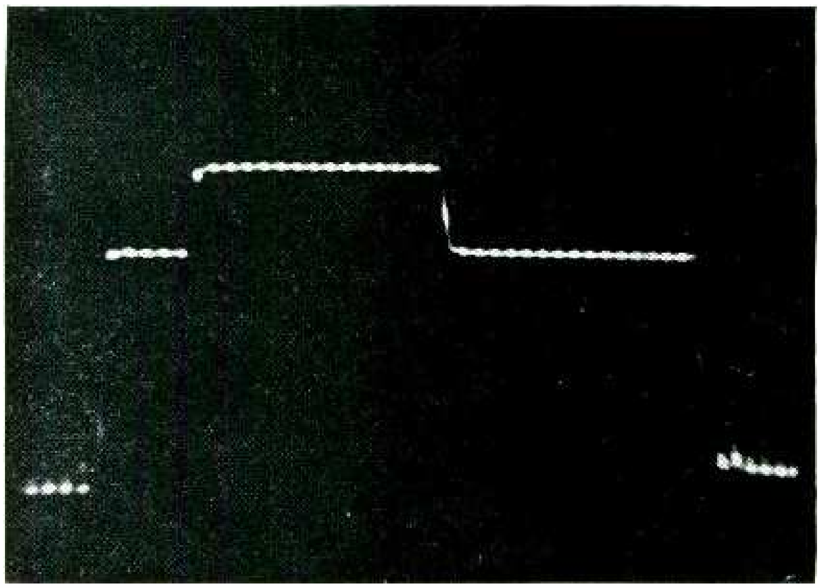


FIG. 4—Horizontal sync pulse with markers supplied from scope

shown in Fig. 4 above.

The marker oscillator is an electron-coupled Colpitts type with split capacitance from grid to cathode to ground. Cathode follower V_{1B} of Fig. 5 acts as a low resistance, damping the oscillator tuned circuit and preventing oscillations except during the sweep, at which time V_{1B} is gated off. Magnetic energy stored in the oscillator coil by cathode current from V_{1B} becomes oscillating energy when the tube is gated off at the start of a sweep.

Tube V_2 provides positive feedback that maintains the oscillations until V_{1B} is gated on again at the end of the sweep. The triode section V_{1A} amplifies the oscillator signal and provides sharp differentiated pulses to the grid of output amplifier V_3.

Pips spaced 200 per television line (0.005 *H*, where *H* is 62.5 μsec) are useful for adjusting both color and black-and-white equipment. Timing of sync pulses, specified by the FCC in terms of *H*, can be measured directly by counting the number of 0.005 *H* pips between specified points of the waveforms.

An improved circuit technique is employed in the crt unblanking circuit. With the new technique a given intensity control setting will result in the same crt beam current at any sweep speed or duty cycle. A separate floating high-voltage rectifier supplies a direct voltage coupling from the unblanking generator to the crt grid. The floating power supply is a radio-frequency type operating at about 25 kilocycles, and is part of the regular crt high-voltage supply.

A vertical-amplifier calibrator allows the operator to compare an observed signal amplitude to an internal square wave having an amplitude known accurately within 3 percent. The square wave has adjustable duty cycle from 1 percent to 99 percent allowing the duty cycle of the calibrator to be matched to the duty cycle of the observed signal. This adjustment minimizes error in amplitude comparison of an a-c coupled signal resulting from change in amplifier operating bias with the duty cycle of the signal.

A 60-cycle internal sweep with phasing through approximately 150 deg is provided to facilitate bandwidth measurements with a video sweep generator.

Positive and negative gate waveforms produced simultaneously with each sweep are provided so that if desired either intensification or blanking may be produced in a picture monitor to indicate the portion of the picture being observed by the oscilloscope.

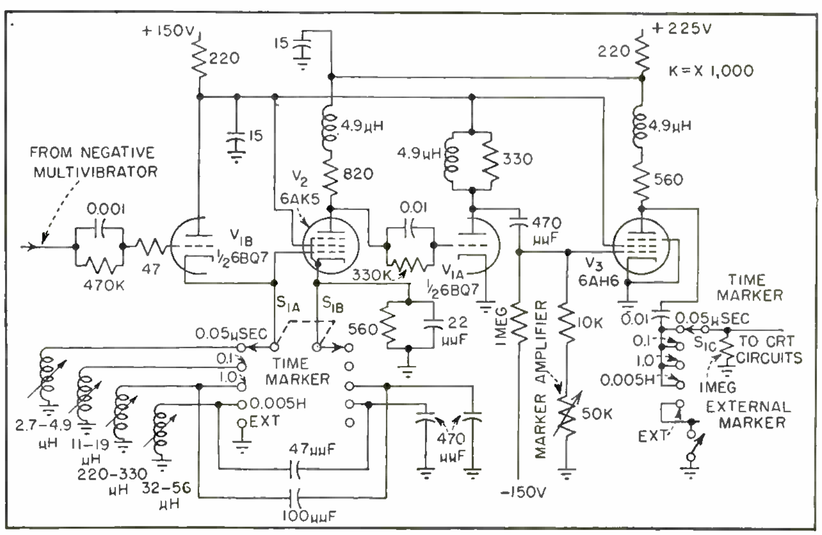


FIG. 5—Time-mark generator for providing pips shown in Fig. 4

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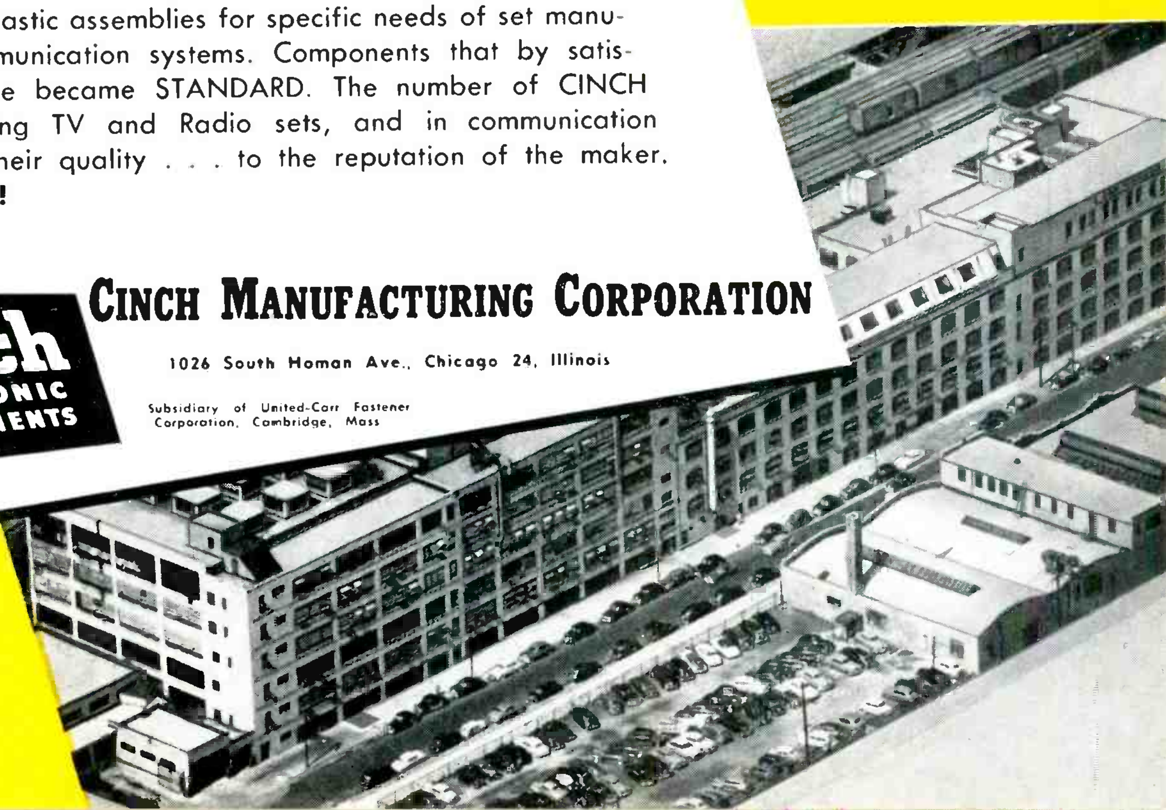

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Chart for TE_{11} Mode Piston Attenuator

Nomograph speeds finding attenuation constant for cylindrical waveguide operated in TE_{11} mode below cutoff. May be used to design piston attenuators with minimum frequency dependence over given range

By CHARLES M. ALLRED
National Bureau of Standards
Washington, D. C.

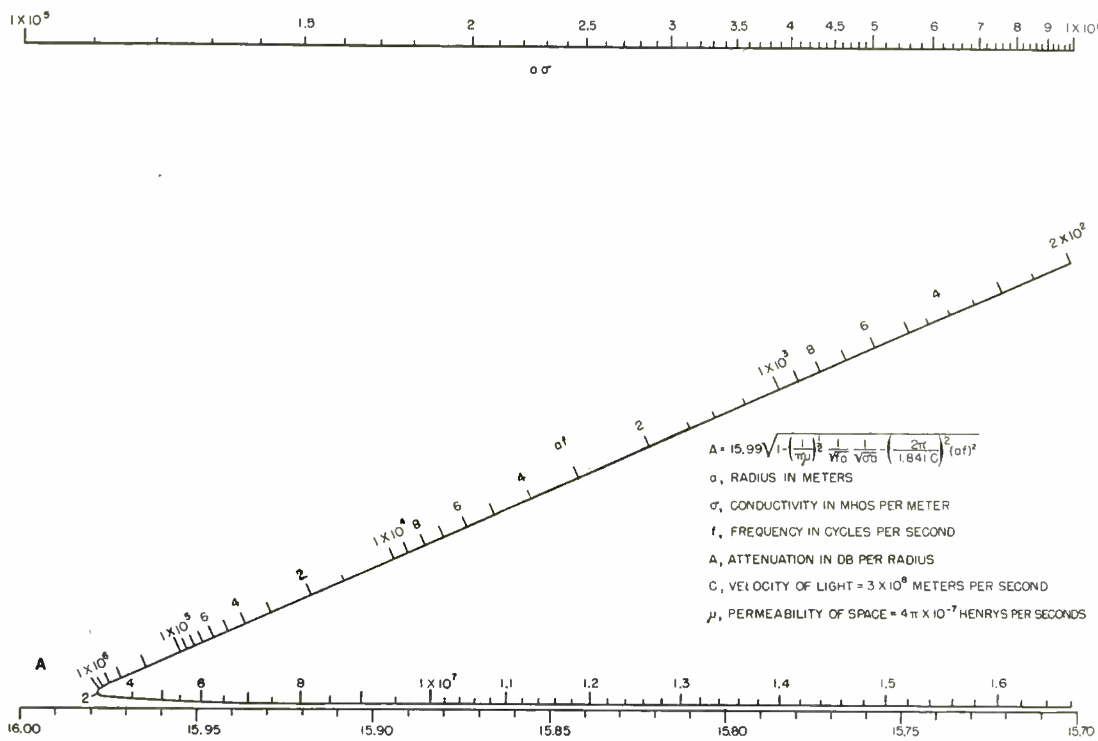
PISTON attenuators are useful because of their linear decibel scale and potentially high accuracy.[1] However, their attenuation constant is a slowly changing function of frequency due to the proximity of operating frequency to cutoff frequency and the frequency dependence of skin-depth.

The nomograph expedites determination of the attenuation constant, A, for the TE_{11} mode in cylindrical waveguide. Effect of skin-depth is negligible for the TM_{01} mode and nomographs for this mode and the TE_{11} mode for the case of infinite conductivity are available.[2]

The nomograph may be used to design attenuators having minimum frequency dependence over a given range and to determine that dependence after fabrication. In the latter case, consider radius $a = 2$ cm, conductivity $\sigma = 1.5 \times 10^7$ mhos per meter, and the frequency $f = 1 \times 10^9$ cycles per second; then $a\sigma = 3 \times 10^5$ mhos, $af = 2 \times 10^4$ meters per second and extension to the A scale of a straight line through these points gives 15.94 db per radius for A. In attenuator design, choose values of a and σ to place the operating point at the right of the $a\sigma$ scale and about the knee of the af scale.

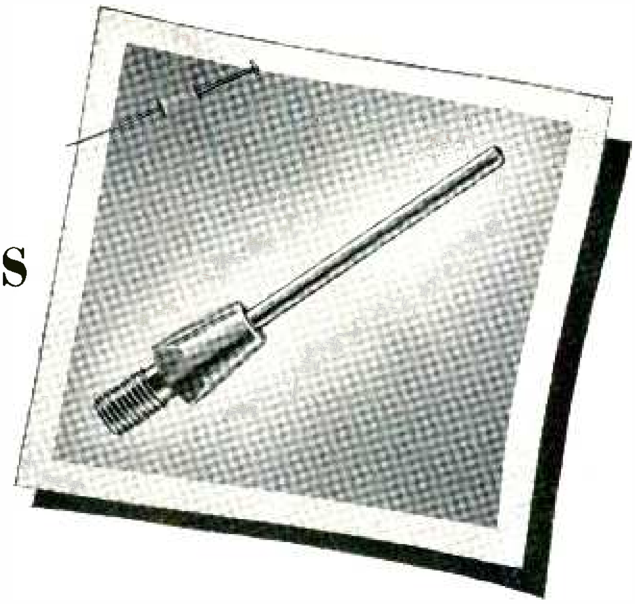
REFERENCES

(1) R. E. Grantham and J. J. Freeman, A Standard of Attenuation for Microwave Measurements, *Trans AIEE*, 67, p 535, 1948.
(2) R. E. Lafferty, Piston Attenuator Chart, ELECTRONICS, p 132 Feb. 1948.

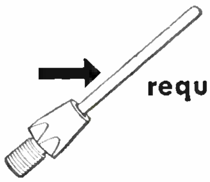
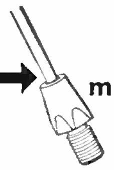
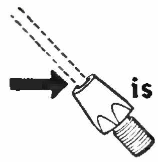
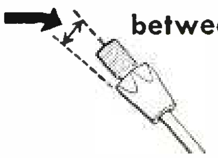


This TE_{11} mode piston attenuator chart shows dependence of attenuation constant on frequency, conductivity and radius in cylindrical waveguide

To Reduce Your Contact Assembly Costs



Use the same specialized experience that solved this problem . . .

This tungsten electrode  requires grinding to a tolerance of ±.00025 of an inch to insure absolute concentricity. This braze  must withstand the centrifugal forces of the highspeed generator in which it is mounted. The hole in the chuck  is held to a tolerance of ±.00025 of an inch. This angle  between the chuck and electrode is held to within ±6 minutes of a degree.

Originally Mallory produced only the tungsten electrode for this assembly. Another firm manufactured the chuck, and a third did the brazing and chrome plating . . . a complicated, costly process. Now, Mallory produces the entire assembly. The customer's problems of quality control, sub-contracting and divided responsibility are entirely eliminated . . . and his costs are lower.

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ELECTRONS AT WORK

Including INDUSTRIAL CONTROL

Edited by ALEXANDER A. McKENZIE

OTHER DEPARTMENTS featured in this issue:

Ultrasonic Thickness Measurement

BECAUSE THICKNESS is inversely proportional to resonant frequency, the latter can be used for thickness determinations. The Magnaflux Co. has used this principle in a measuring instrument that gives direct readings on the face of a calibrated oscilloscope.

In making the measurement a quartz-crystal probe, driven by a continuously varying ultrasonic wave, is held against the material. When the varying signal reaches the resonant frequency of the material the resonance causes a reinforcement of the crystal vibration, changing the loading on the oscillator producing the ultrasonic wave. By placing the oscillator signal on the vertical plates of an oscilloscope and synchronizing the horizontal sweep with variation in crystal frequency, a standing wave is produced with a pip at the frequency where resonance occurs. To allow direct determination, a screen calibrating thickness to frequency is placed over the tube.

Variation of the ultrasonic frequency is produced by a motor-driven sweep capacitor in the oscillator circuit. A cam arrangement triggers the horizontal sweep at the beginning of each frequency cycle. Five separate ranges allow a total frequency coverage from 8.8 to 0.23 mc, suitable for measuring steel thicknesses from 0.15 to 0.500 in. with the fundamental. Using harmonic readings the range can be extended to about 5.0 in.[1] For materials other than steel, measurements can be made by using the ratio of the speed of sound in the material to the speed in steel. In production use, the oscilloscope can be calibrated for the material being measured.

The crystal used to translate the electrical output of the oscillator into mechanical vibrations is an X-cut type radiating the ultrasonic waves perpendicular to the face of the crystal. For most surfaces, a flat crystal is used but on curved surfaces under six or eight in. in diameter a curved crystal gives a more pronounced indication on the oscilloscope screen. Five separate crystals driven over a two-to-one frequency range cover the entire range of the instrument. The thick-

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Frequency Increment Dial: ±300 kc in 5 kc increments.
Modulation: FM and AM controlled by Signal Generator.
Price: $345.00 fob Factory.

UNIVERTER—Type 207-B

A frequency converter for use with FM-AM Signal Generator 202-D. The 202-D is applicable to telemetering problems over frequency range of 175-250 mc. Additional output when using 207-B:

Frequency Range: 0.1 to 55 mc.
Output: 0.1 to 100,000 microvolts at X1 jack and approximately 7.5 times these values at high output jack.
Frequency Increment Dial: ±300 kc in 5 kc increments.
Modulation: FM and AM controlled by Signal Generator.
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UNIVERTER—Type 207-C

A frequency converter for use with FM Signal Generator 206-A. The 206-A is applicable to mobile communications problems over a frequency range of 146 to 176 mc. Additional output when using 207-C:

Frequency Range: 0.1 to 50 mc.
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FIG. 1—Thickness-measuring instrument being used with special jig-holder device to determine cylinder wall thickness in automotive engine

ness measurements in each range are also in a two-to-one relationship, for example from 0.080 to 0.160 in.

Since the readings depend on the loading of the oscillator circuit by the material under test, it is essential that the circuit be sensitive to loading. For this reason the Q of the circuit must be as high as possible. Low-loss materials and high-Q inductances are used as well as low-loss coaxial cable for the connection to the crystal probe.

The high sensitivity of the oscillator circuit presented difficulties in the design of the high-speed rotating sweep capacitor. Electrical noise was caused by the contacts and ball-bearing mountings of the rotor. The most efficient contact was found to be a silver-graphite brush riding on a silver pad at the end of the rotor shaft. Cone-type bearings that serve as both sleeve and thrust type bearings eliminated the mounting noise.

In addition to thickness measurements, the ultrasonic test unit can be used to test the bonding of metals. Poor bonding will produce a single peak at the point on the screen corresponding to the thickness of only one of the pieces. Good bonding will show a pip at the thickness of both pieces.

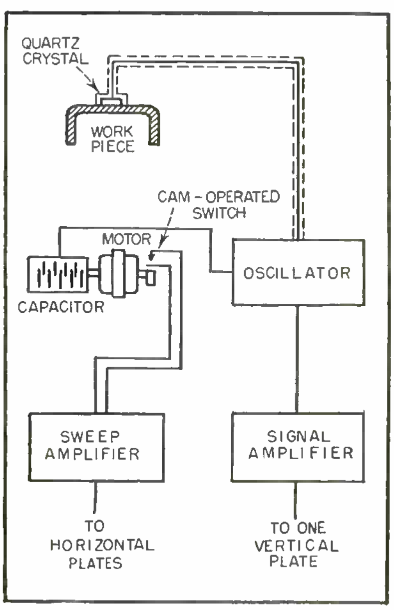
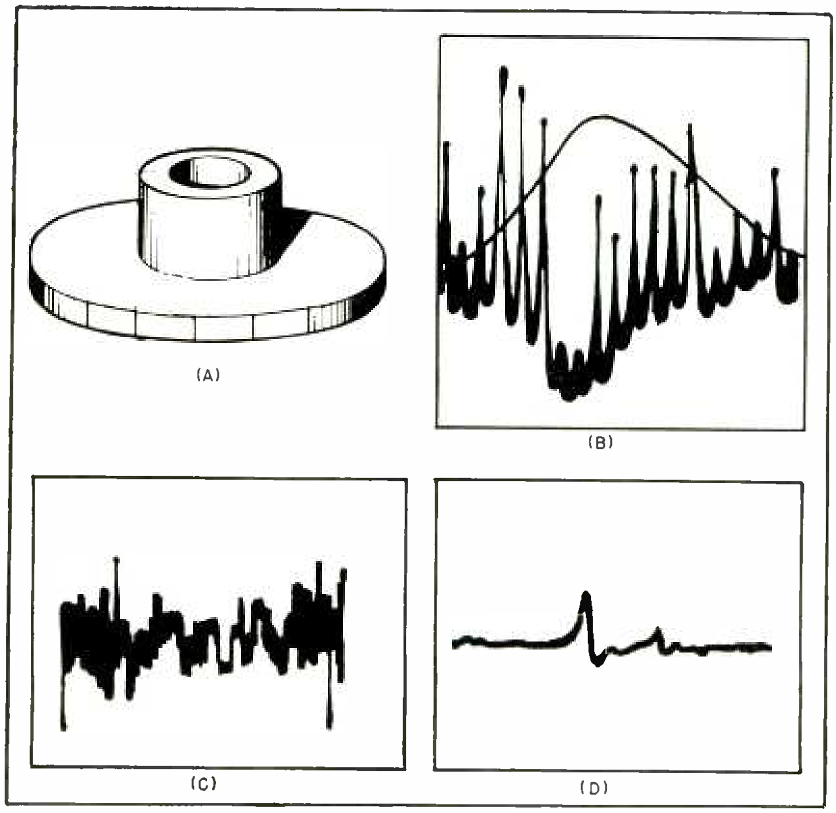


FIG. 2—Block diagram of ultrasonic thickness measurer. One vertical plate of oscilloscope (not shown) is grounded

REFERENCES

(1) C. B. Betz, Thickness Measurement by Ultrasonic Frequencies, *Electrical Manufacturing*, p 86, Aug. 1950.



Silver-plated steel disk specimen (A) has twenty equally spaced lines of steel. Waveform produced by corrosive activity of dilute hydrochloric acid solution is shown in (B). Aluminum-copper alloy specimen in a sodium chloride-hydrogen peroxide solution produced waveform (C). Effect of adding sodium chromate rust inhibitor to this combination is shown in (D)

Corrosion Detection By Rotogeneration

CORROSION, the oxidation of a metal in contact with a solution, causes a minute flow of current in the corroding solution at the point under attack. Since these currents are quantitatively related to the corrosive activity they can be used to observe the corrosion process. In the past, d-c instruments have been limited by the small potentials to be measured, difficulty of obtaining high gain from d-c amplifiers and the interference of the general instability of the corroding system.

To eliminate these difficulties, the Armour Research Foundation has developed a "rotogenerative" apparatus that uses the d-c corrosion currents to generate a-c potentials. The device, shown in Fig. 1, is described in the September 1952 issue of *The Frontier*. A motor is used to rotate the specimen under test, and corrosion currents rotating with the specimen produce a varying potential as they pass the stationary electrode. This potential may be regarded as a complex a-c

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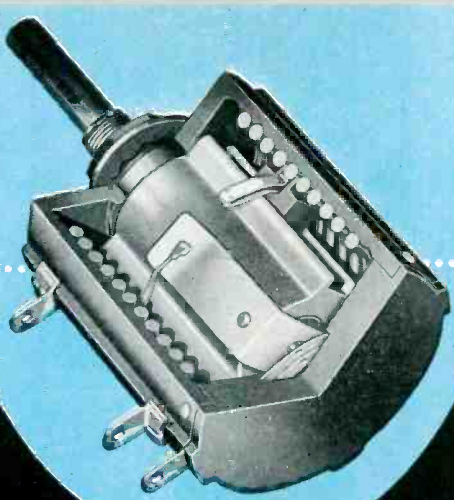

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MODEL C:

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.*

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MODELS AN, BN, & CN:

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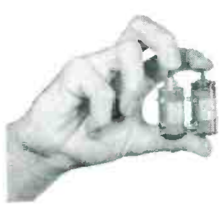

MODELS AJ, AJS, AJSP:

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.*

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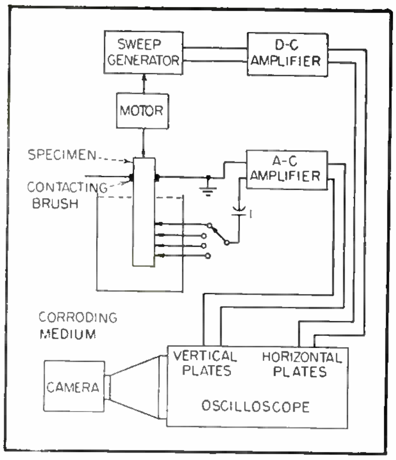


FIG. 1—Diagram of the "rotogenerative" apparatus for study of corrosion

waveform that can be amplified for observation on an oscilloscope.

A sweep generator driven by the same motor maintains the horizontal sweep of the oscilloscope at the same rate. In this manner, a standing wave is produced on the screen that can be correlated with the position of corrosive activity around the specimen. Changes in overall corrosion occur at a relatively slow rate and will not be amplified by the a-c instruments.

An alternative method of oscilloscope presentation uses the amplified corrosive-current signals to modulate the oscilloscope traces.

The resulting trace forms a picture of the surface of the specimen with the light and dark areas corresponding to the position and intensity of corrosive activity.

High-Temperature Carbon-Film Resistors

HIGH-STABILITY fixed-composition resistors capable of high-temperature operation result when a film of carbon is deposited on a ceramic base. The film is deposited when hydrocarbon vapor is decomposed by heat. This chemical process is known as pyrolysis and development of these deposited carbon-film resistors is being carried on at Battelle Memorial Institute under Air Force auspices. The resistors under development will have ratings of ½ to two watts and will operate at ambient temperatures of 200 C without deterioration or change in resistance. Figure 1A illustrates stability of carbon-film resistors at high ambient temperatures. Figure 1B shows results when ambient temperature is maintained at 400 F for an extended period of time.

Study shows that porcelain-base pyrolytic carbon-film resistors having values from ten ohms to five megohms, can be made to withstand operating temperatures of 200 C.

Variations in resistor characteristics that exceed specified limits are functions of geometrical variations of the conducting path in the resistive element.

The problem is to achieve a stable geometry of the conducting path in the resistor, which will remain stable during severe tests. Sources of unstable geometry are film nonuniformity, characteristics of the ceramic base in relation to those of the carbon films and nature of contacts to the carbon films.

A New Pyrolysis System

Uniformity and continuity of film thickness and structure is necessary for stable geometry of the conducting path. Some factors important in design of a pyrolysis system to produce such films are that film thickness is a direct function of the amount of hydrocarbon vapor contacting each unit area of the porcelain surface during exposure at high temperatures, structure of the film and its electrical

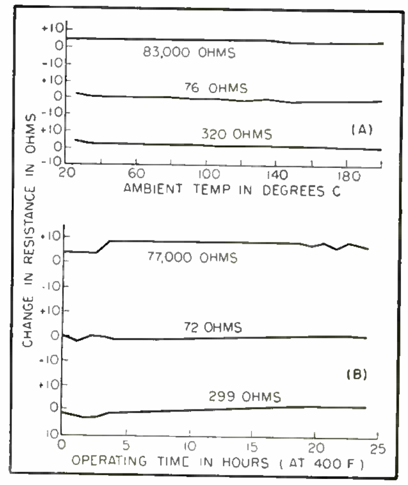
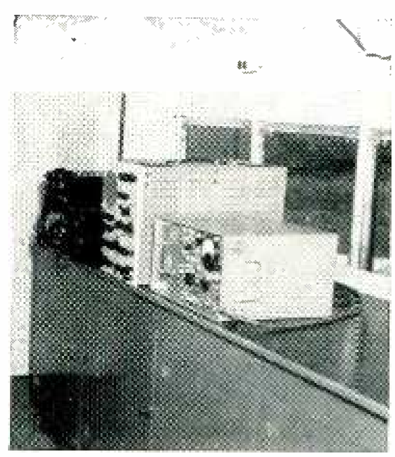


FIG. 1—Charts showing operating characteristics of carbon-film resistors

SIGNAL CORPS BUSES MEASURE NOISE



A fleet of 16 buses, specially adapted at the Fort Monmouth Army Signal Corps Laboratories, is used to measure noise output from electrical equipment that could cause interference with communications services. By taking the mobile measuring laboratories to the manufacturer, time and money are saved in shipping equipment for tests and duplication of measuring facilities. Bus visits are part of Signal Corps and other armed forces contracts where noise specifications are involved. Photographs show bues ready for action and interior view showing part of equipment

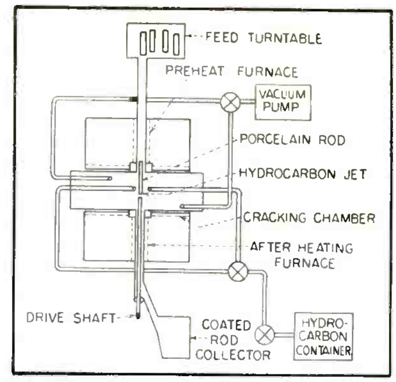


FIG. 2—Diagram of pyrolysis system showing how porcelain rods are coated with carbon film

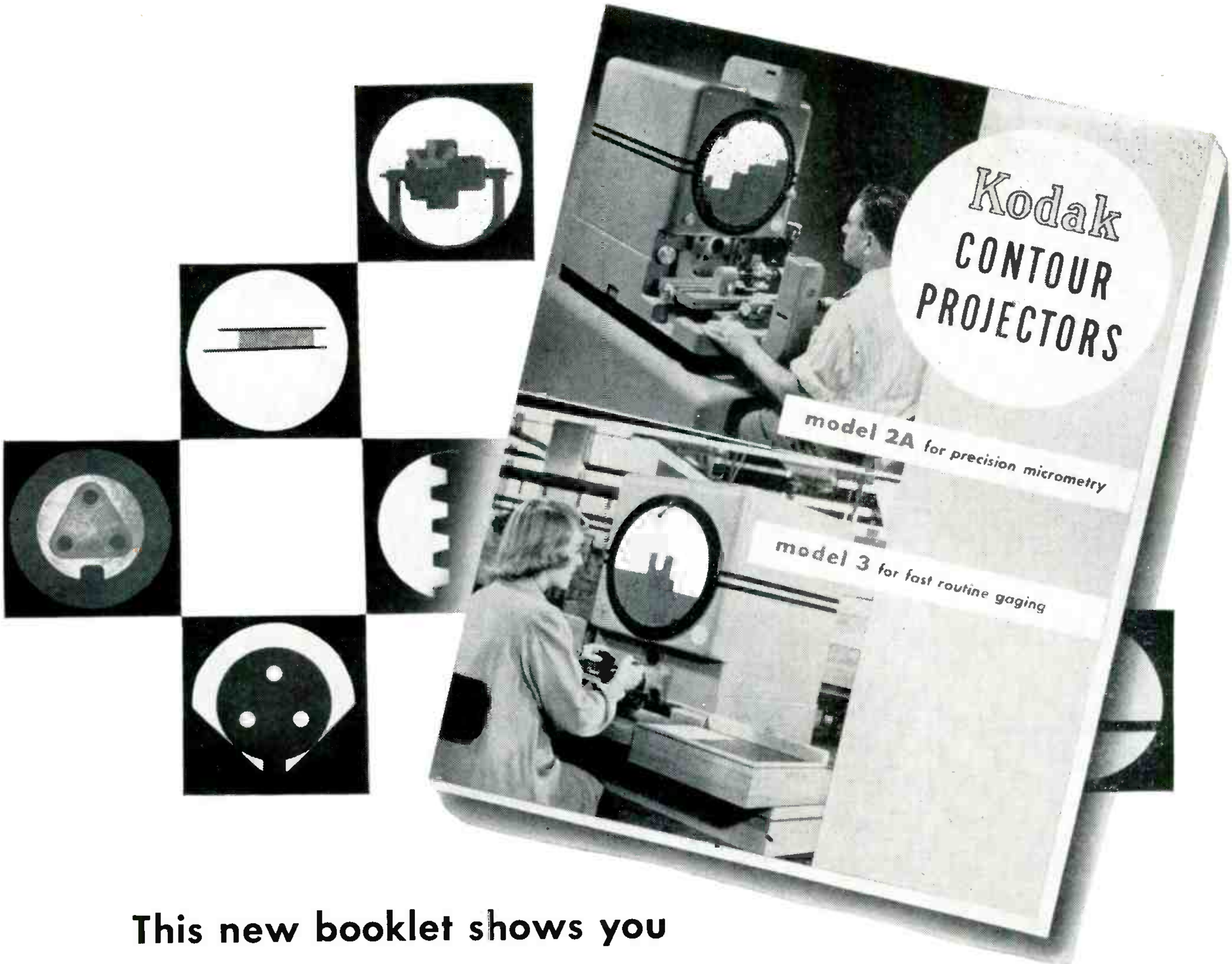
properties depend on the uniformity and invariance of the temperature of the procelain rod; amount of carbon deposition is related to rate of flow of the hydrocarbon vapor past the rod.

In addition, surface roughness, localized catalytic agents, and porosity of the porcelain can play an important part in production of uniform carbon films. However, these factors cannot be controlled by design of the pyrolysis system.

Figure 2 is diagram of a pyrolysis system. A ceramic rod approximately six inches in length is introduced into the preheating furnace where it is heated to uniform temperature per unit length and held at a constant temperature. After heating, the rod moves at a uniform velocity through the central furnace, which is maintained at some lower temperature. While in motion, it receives a carefully-regulated blast of a controlled amount of hydrocarbon from all sides. The rod then moves out through an after-heating chamber, which is held at an even lower temperature. To avoid carbon combustion and contaminations, the whole system is evacuated or filled with an inert atmosphere.

Process Control

Measurements of the porcelain temperature for unit length just before it is sprayed with hydrocarbon can be obtained by an optical pyrometer using a window at one end of the horizontal furnace to control porcelain temperature. The jet system can be designed to achieve the condition of equal amounts of hydrocarbon vapor striking each unit area of the rod



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at the same velocity. The total length of the rod can be uniformly coated, because of uniform movement through the vapor system.

An automatic feed and release of the rods provides the means for continuous operation. Calibrations of the various factors involved in processing a rod through this system against the resistance of the film produced will allow predetermination of any desired value of resistance.

The ceramic base upon which the carbon film is deposited is made of ball-milled alumina mixed with other ingredients such as silicon dioxide and calcium oxide in an alcohol binder. The bases are pressed and ground then fired at 2,950 F. A smooth surface for coating can be achieved by grinding with 600 carborundum powder in water. Gold contacts are used.

An Electronic Telephone

A MICROPHONE, amplifier and loudspeaker are part of an electronic telephone system developed by Societe le Teleampliphone of France. The device, known as the Neophone, makes it possible for several persons to speak into the same instrument for telephone conferences. The system does not use a talking-listening key.

Some of the proposed solutions for such a system are as follows: Basic to the various principles employed, one generally finds two amplifiers, each functioning in a single direction and almost always two terminal pieces, a transmitter and a loudspeaker. One system might be to block one of the two amplifiers while the other functions. This could be done by rectifying the signal with a diode element or a dry-disk rectifier in order to set in motion a relay that would cut off a tube in the amplifier circuit. With symmetrical circuits, each amplifier could function in turn, according to the necessities of the conversation.

A simple circuit uses negative rectification of the signal and a negative voltage obtained by carrying the bias of one of the amplifier tubes to cutoff. Unfortunately, such

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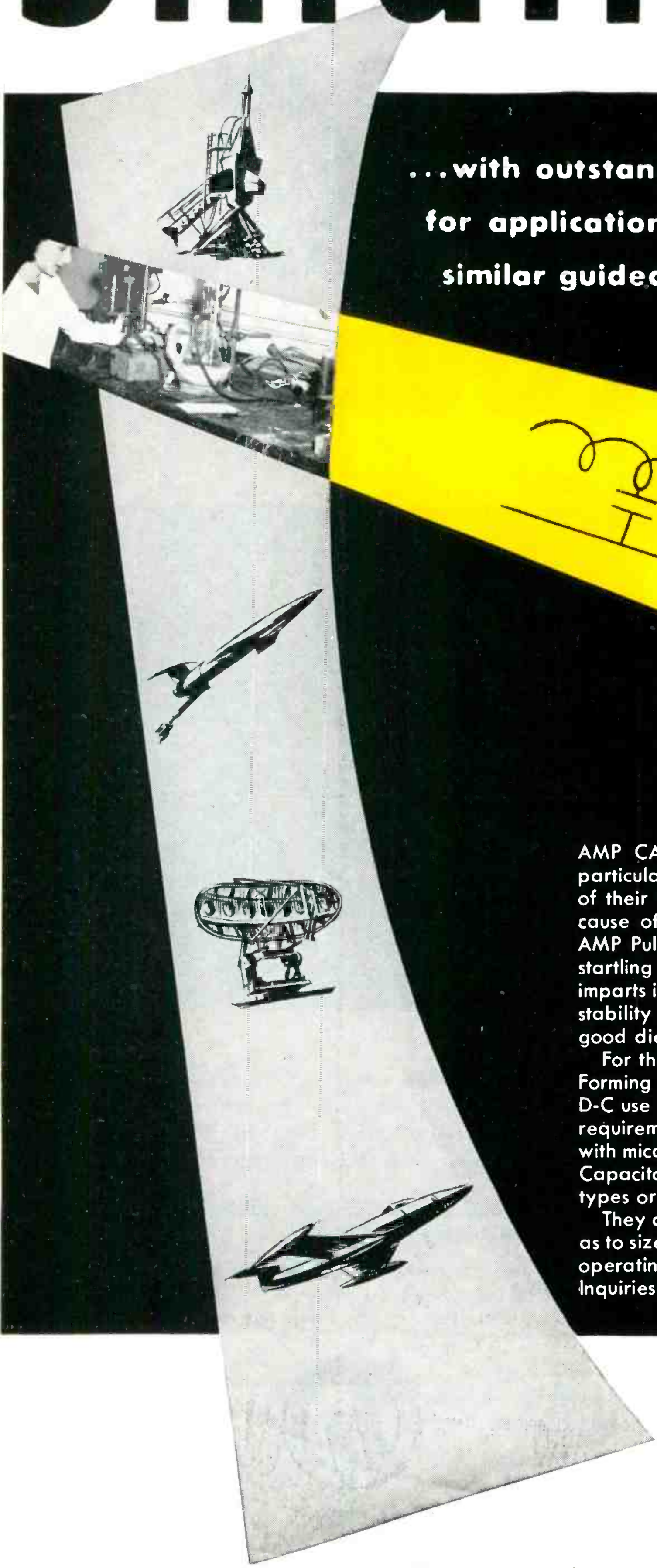

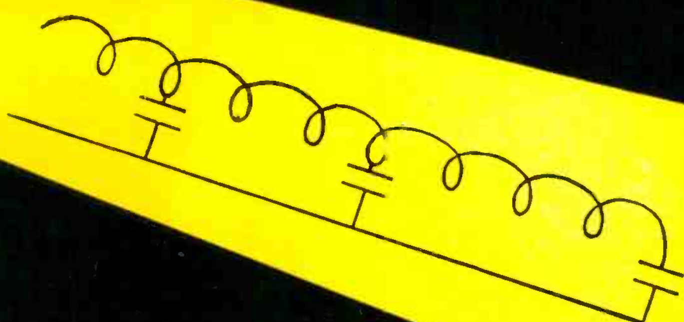

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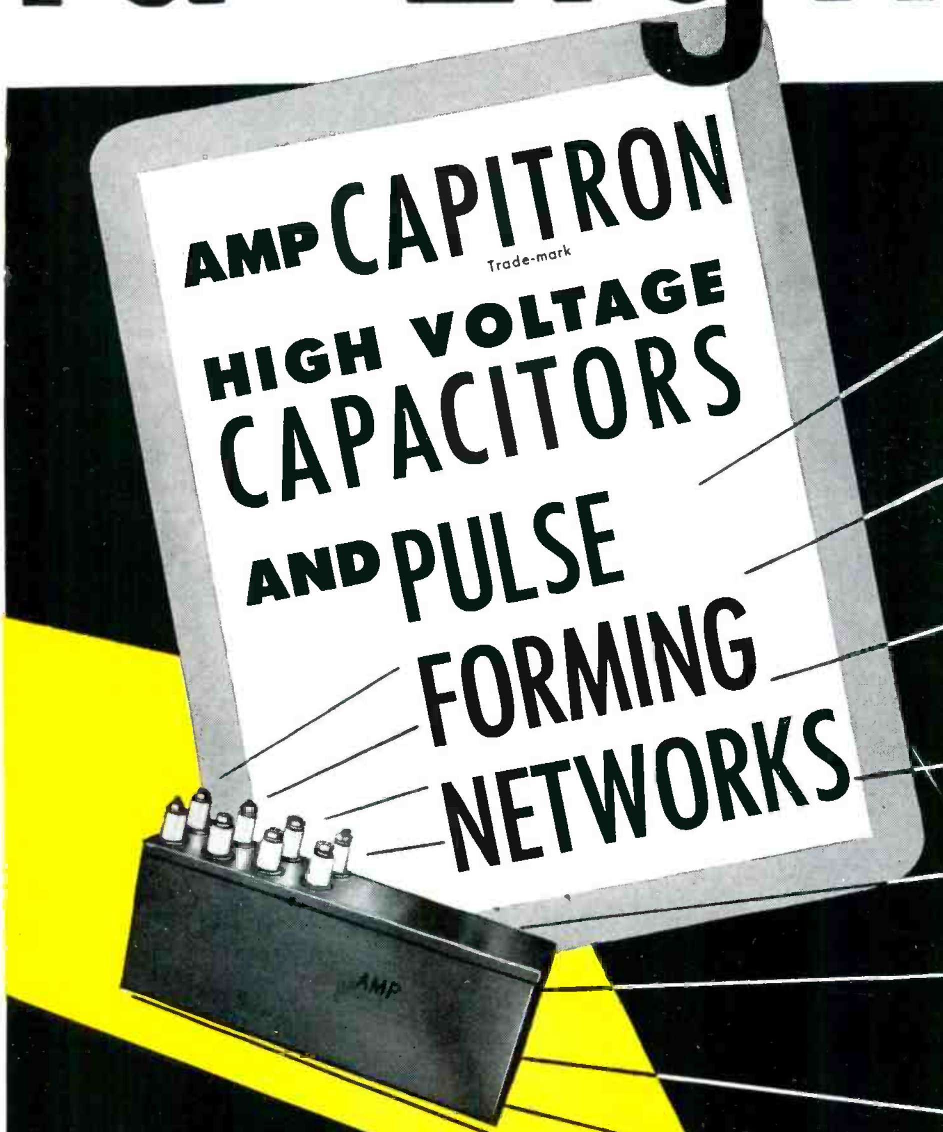

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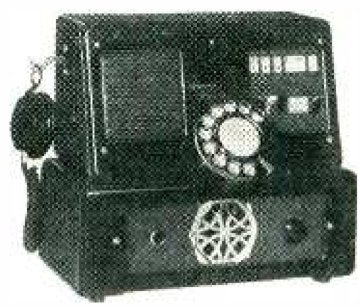
a system involves difficulties that render it useless; namely the Larsen feedback effect.

Two solutions seem likely. One is to use a circuit that is inverse to the one described previously. Such a system would start, from the off position, with two blocked amplifiers and only the necessary amplifier would be unblocked during conversation. Here again, the signal tends to interfere with the operation due to the two auxiliary amplifiers. For example, if the amplifiers are blocked by a tube at cutoff in each amplifier, one could rectify the signal positively and thereby restore the bias to its normal value. In order to transmit in full with this system, all the words, syllables



Earphone on the left allows reception of a call with the same privacy as with conventional sets if desired

and sounds, the operation must start very rapidly. It would be necessary to have extremely short time constants on all the rectifying and signal filter circuits.

A second solution consists of two amplifiers that are not blocked but are working at reduced gain. After blocking the idle amplifier, the gain of the other functioning amplifier is increased. The circuits are relatively simple with the idea being to prevent the overloading of one amplifier by blocking the other. The system which has given the best results uses a cutoff tube by counter reaction.

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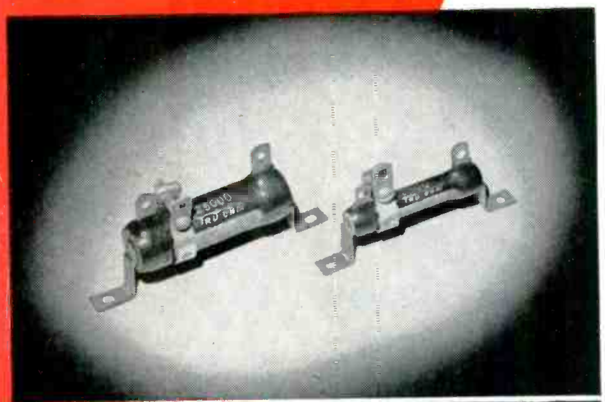

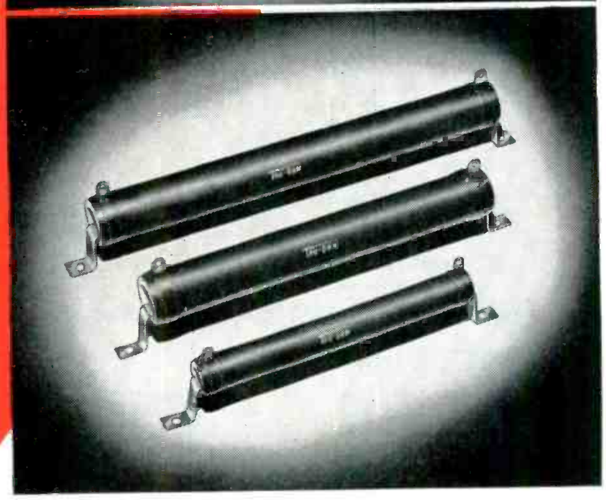

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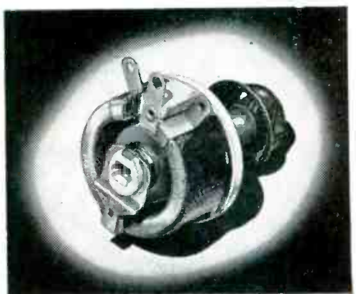

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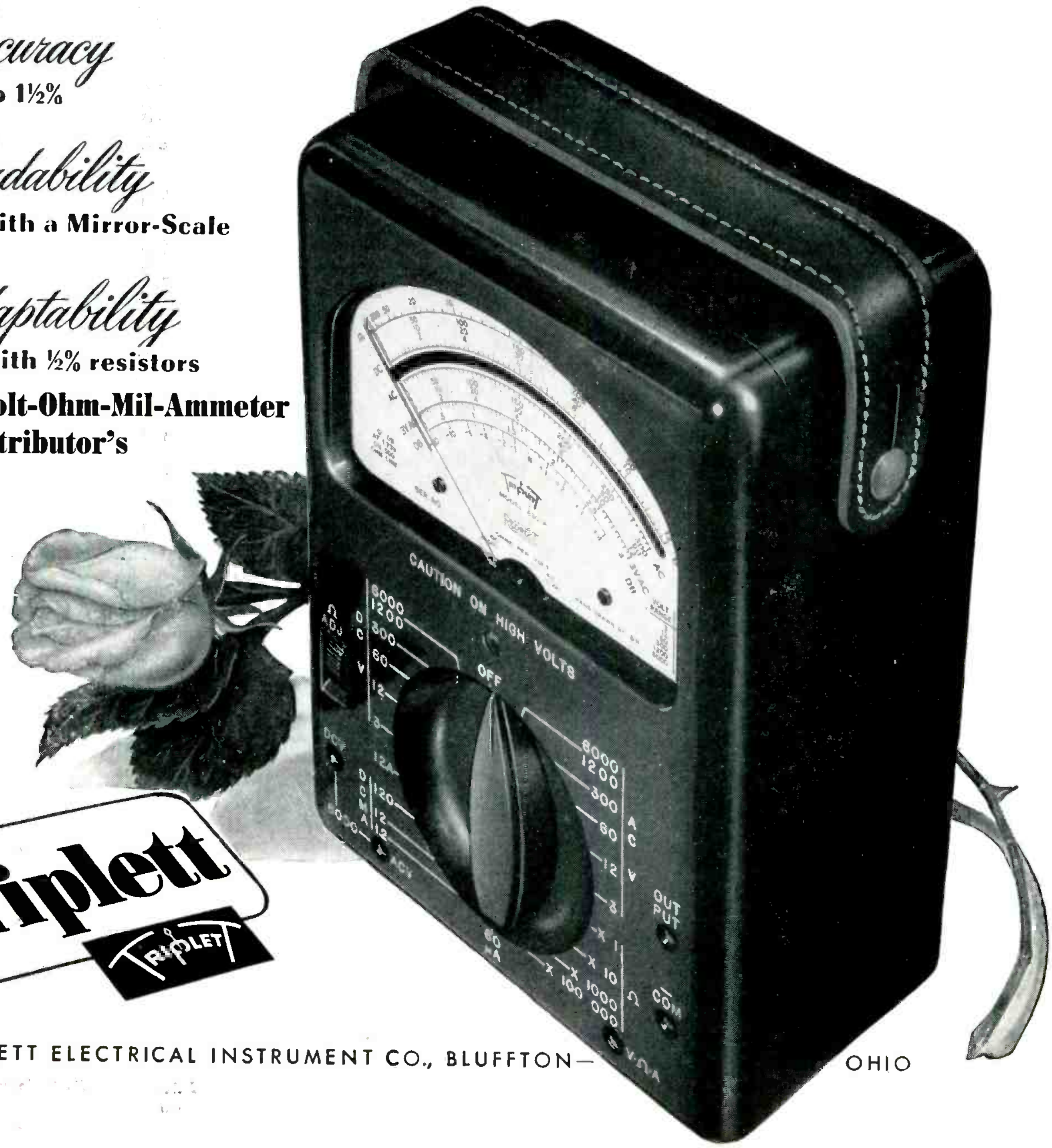

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there is no voltage on the grids, no counter reaction and no cutoff. The two amplifiers are practically free to use their entire sensitivity. Every impulse to the input of one amplifier, likely to start the Larsen effect, will start the cutoff by counter reaction, reducing the gain sufficiently to avoid the appearance of this effect. By tapping at each input, an auxiliary amplifier will permit blocking the idle amplifier and suppressing the counter-reaction of the working amplifier by biasing to cutoff. The same rectifier secures these two reactions simultaneously.

This latter system is the one actually used. It requires a system of very rapid time constants on the telephone networks to avoid the possible errors introduced by garbling of words. Sensitivity of the blocking circuits must be great enough to respond even on high-loss lines and yet not deliver prohibitive voltages on conversation at high levels.

Transmitter Circuit

For transmitting, the principal amplifier comprises a 6AV6, a 6SL7 and a 6AQ5 which drives an ensemble of two transformers connected differentially toward the line. The auxiliary transmission amplifier includes the same 6AV6 of the input, the same 6SL7 and a special 6AV6 which drives its two diodes by a push-pull transformer.

The counterreaction tube, a 6SL7, cuts off the 6AQ5 of the line by impressing on the cathode of the 6AQ5 a portion of the signal and by retransmitting it 180 deg out of phase on the grid of the 6AQ5.

On the receiving end, the circuits are almost symmetrical. In the principal amplifier a 6SL7 drives the 6AQ5 at its output. In the auxiliary amplifier, a 6AV6 drives its two diodes by a push-pull transformer. The 6SL7 counterreaction tube cuts off the 6AQ5 between cathode and grid. The 6AV6's are mounted in such a way that the voltage which drives the diodes is practically constant beginning at a certain level. The rectified voltage is limited to 15 v. For transmission, a controlled fraction of this voltage serves to block the 6SL7 at the receiving input and another por-

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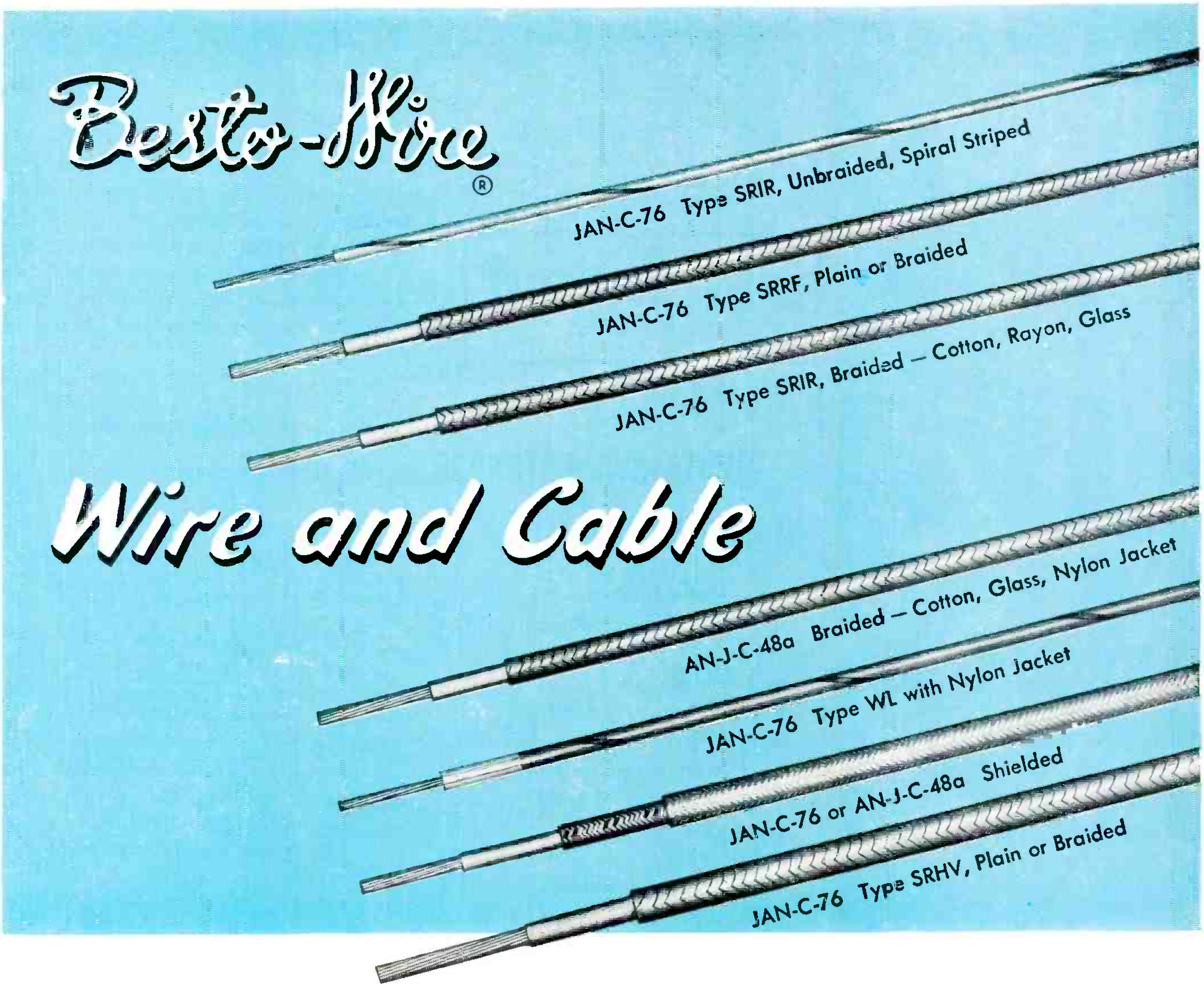

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tion blocks the 6SL7 of the transmission counter reaction.

For receiving, the 6SL7 transmission element is blocked and then the 6SL7 of the receivers. The time constants are such that the line blocking precedes the counter-reaction blocking and, inversely, the counterreaction unblocking precedes the line unblocking.

Thermal Relays Control Heater Voltage

By C. D. Geer & W. C. Broekhuysen
G-V Controls Inc.
East Orange, N. J.

Maintaining uniform heating of tube cathodes over wide variations in supply voltage, especially in the design of newer mobile equipment using miniaturized components is an important problem. Limitations of space and weight and variations in supply frequency often rule out conventional voltage-regulating devices for this purpose.

Several effective arrangements for regulating this heating by the use of miniature critical-voltage or critical-current relays of the thermal type have been developed recently.

A critical-voltage or critical-current relay is arranged to operate its contacts when the potential across its operating coil (or the current through that coil), reaches a predetermined value. In a thermal relay, contacts are actuated by the heating effect of the current passing through the energizing coil rather than by the electromagnetic effect as in magnetic relays.

Two general methods have been

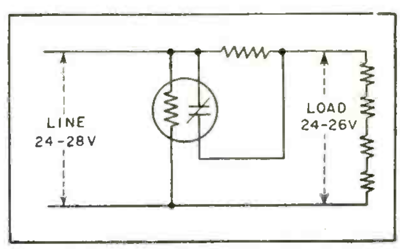
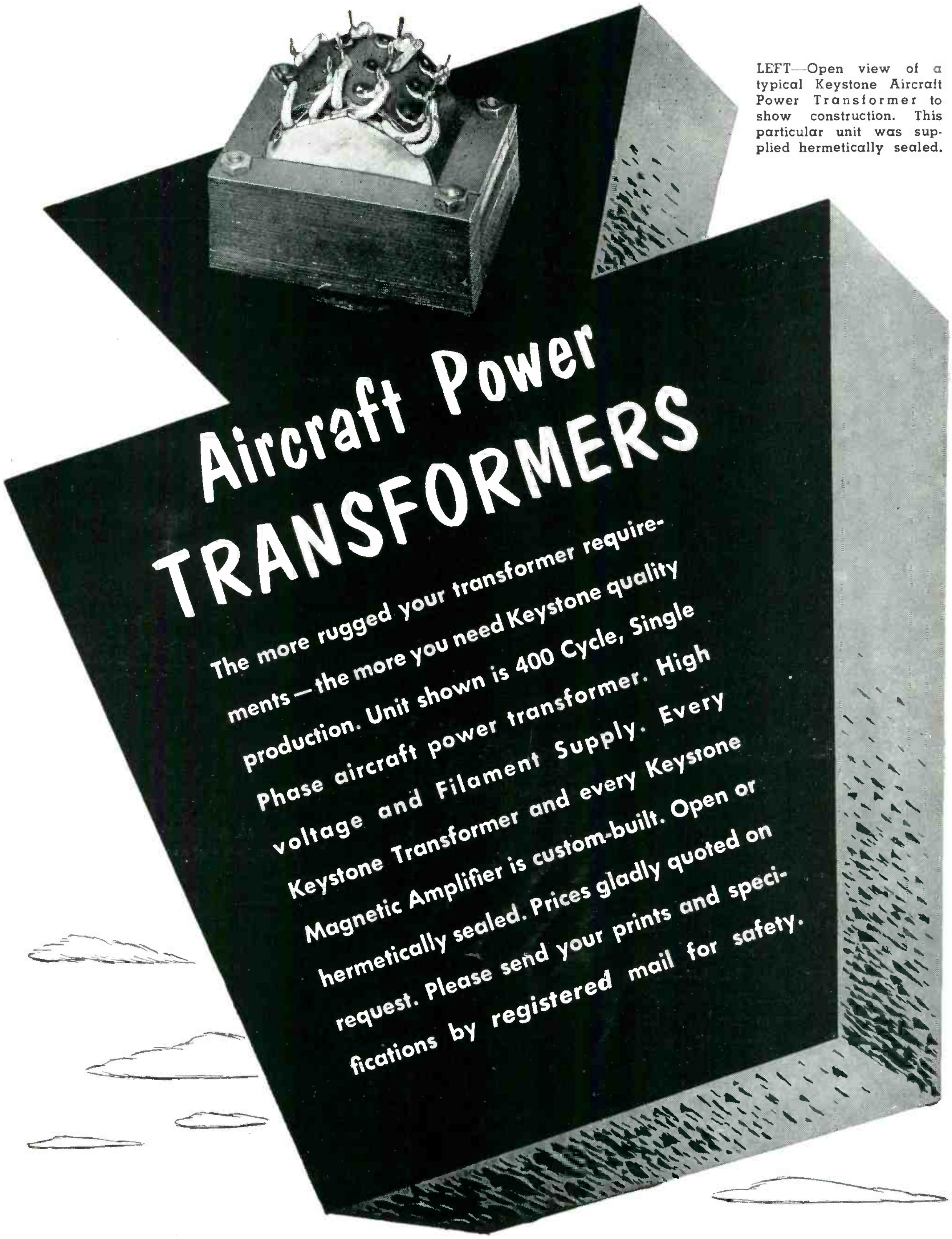


FIG. 1—Thermal-relay circuit for introducing a dropping resistor in series with vacuum-tube heaters when the supply voltage exceeds a certain value



LEFT—Open view of a typical Keystone Aircraft Power Transformer to show construction. This particular unit was supplied hermetically sealed.

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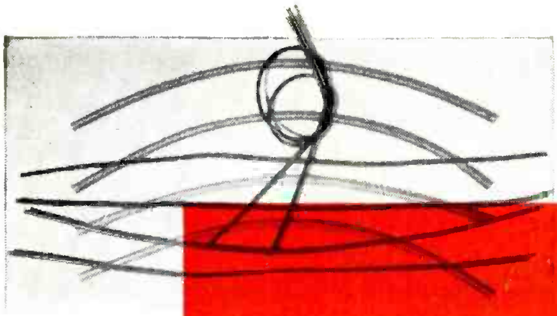

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	B-1	4000 v	X	X	—	
	C-1	2500 v	X	X	—	
	C-2	1500 v	X	X	—	
	C-3	——	X	X	—	
HYGRADE SN	A-1	7000 v	X	X	—	Excellent electric characteristics, high insulation resistance under high humidity, good dielectric flexibility after flexing.
	B-1	4000 v	X	X	—	
HYGRADE VF	A-1	7000 v	—	X	—	Extreme flexibility, constant dielectric strength, abrasion resistance, non-burning, non-corrosive, non-stiffening.
	B-1	4000 v	—	X	—	
	C-1	2500 v	—	X	—	
	C-2	1500 v	—	X	—	
HYGRADE H	A-1	7000 v	—	—	X	Extreme temperature resistance. Flexible over temperature range −65° C to 260° C.
	B-1	4000 v	—	—	X	
	C-1	2500 v	—	—	X	
	C-2	1500 v	—	—	X	
	C-3	——	—	—	X	
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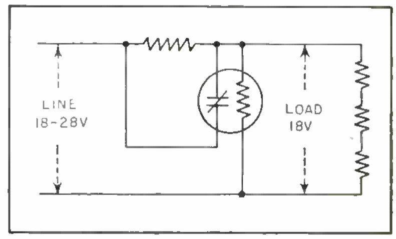

FIG. 2—Circuit used for producing a pulsating potential as described in text

used for reducing effect of voltage variations by means of thermal relays. The first method uses a critical-voltage relay to introduce a dropping resistor into the circuit when the supply voltage exceeds a certain value. Figure 1 illustrates a typical circuit. Four 6.3-v heaters are connected in series across a 24 to 28-v supply. A thermal relay, set to open its normally closed contacts when the voltage across its heater exceeds 26 v, is connected across the supply.

Whenever the supply voltage rises above 26 v, the thermal relay cuts a dropping resistor into the circuit to reduce by two volts the voltage applied to the cathode heaters. As the supply voltage rises from 24 to 26 v, the voltage per tube increases from 6 to 6.5 v. When the supply voltage goes above 26 v, the tube voltage drops back to 6 v, reaching 6.5 once more when the supply voltage goes to 28 v.

On decreasing voltage, the dropping resistor is cut out at the same voltage at which it was introduced.

Variation of cathode heater voltage is reduced to one half of the variation in supply voltage. For effective protection against overheating, the thermal time constant of the relay should not exceed that of the cathode heaters.

The second method produces closer regulation of heating over a substantially wider range of supply-

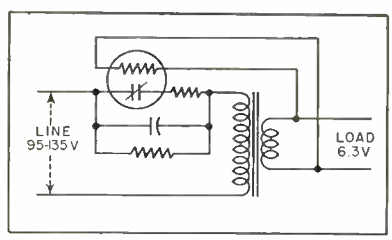

FIG. 3—Regulating contacts and resistor in the primary circuit of a transformer and relay heater in the secondary

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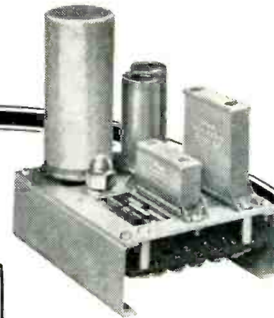

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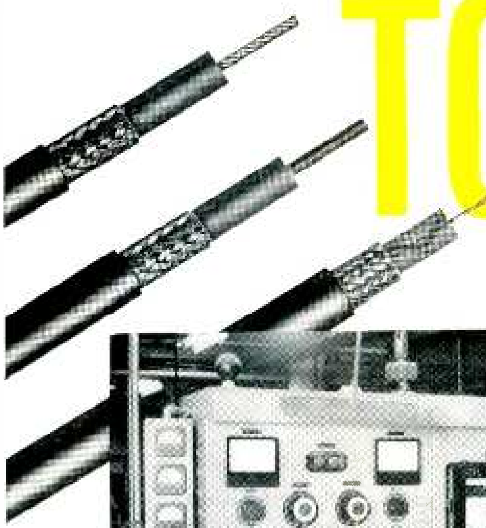

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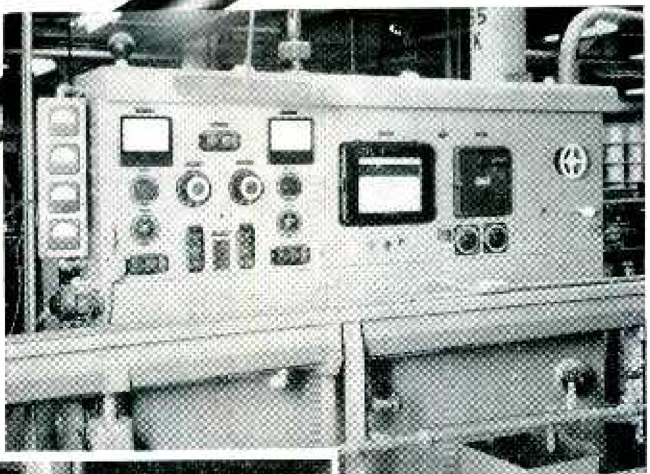

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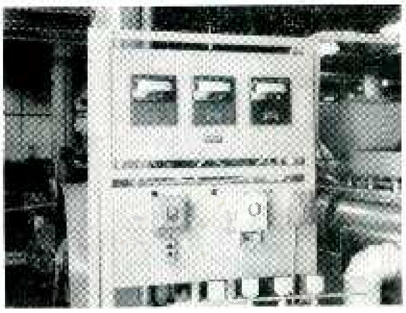

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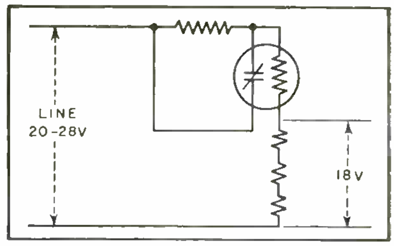

FIG. 4—Heater of the thermal relay placed in series with the cathode heater circuit

voltage variations. If the normally closed contacts of a thermal relay are connected so that, on opening, they interrupt the voltage applied to the heater of the relay, then these contacts will supply to the relay heater a pulsating potential of constant integrated heating value, regardless of voltage. As the voltage is increased, the proportion of ON time to OFF time is automatically reduced to compensate. The relay heater receives a pulsating potential with a heating effect equivalent to that of a continuous potential equal to its critical voltage setting. Any cathode heaters connected across the thermal relay heater will also receive this pulsating potential of constant heating effect regardless of supply voltage.

In actual operation, a resistor is usually connected across the relay contacts so that the potential is periodically reduced rather than completely interrupted but the net effect is the same. Figure 2 illustrates a circuit frequently used to produce a pulsating potential as described. It may be preferable to place the regulating contacts and resistor in the primary circuit of a transformer with the relay heater in the secondary, as shown in Fig. 3.

The heater of the thermal relay is sometimes placed in series with the cathode heater circuit as shown in Fig. 4. The result is to produce the effect of a constant current through the chain of heaters rather

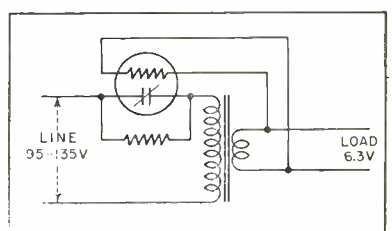

FIG. 5—Circuit for reducing interference caused by the opening and closing of the relay contacts

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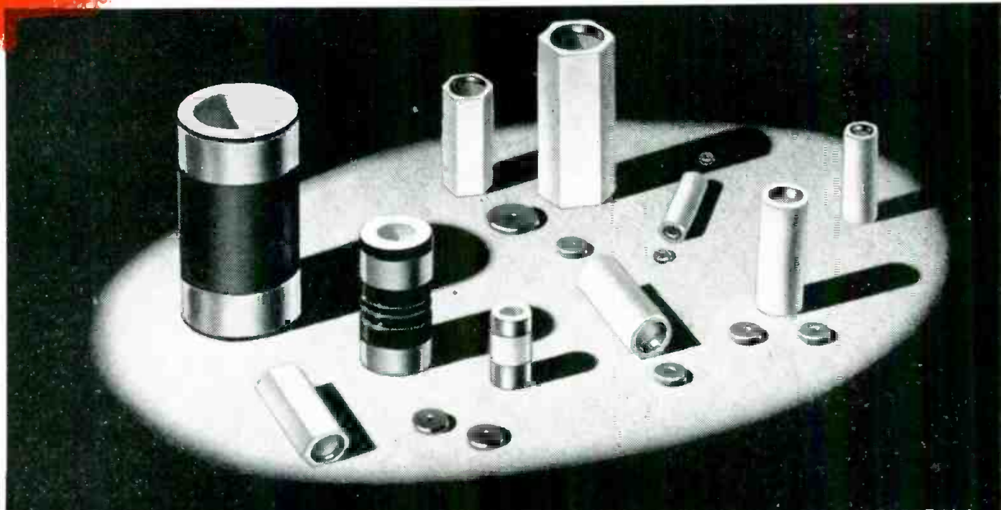

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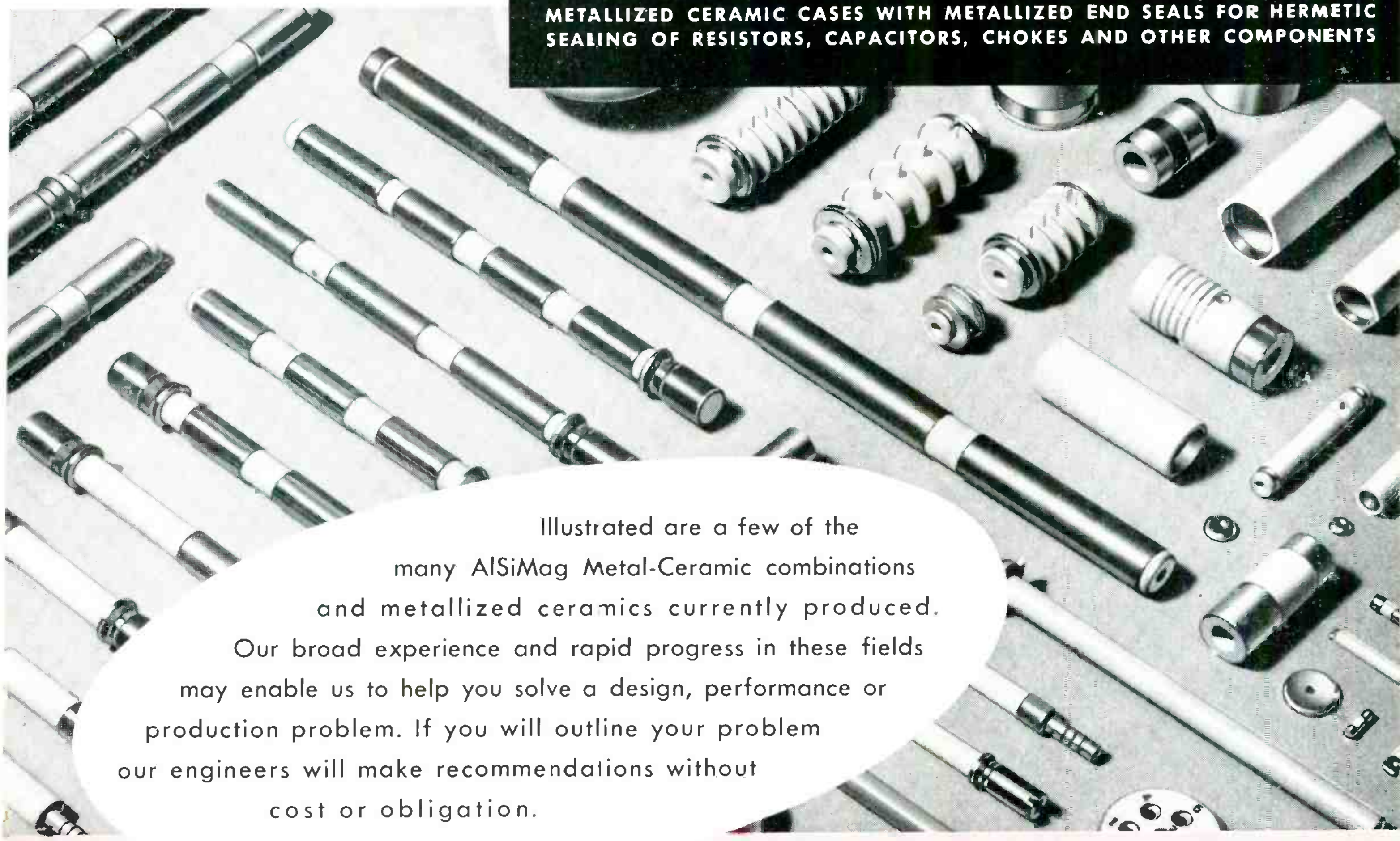

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Comparable to single saturated (B-C-3) sleevings but completely flexible, even after exposure to heat aging, since no hardening varnish is used. Non-fraying because of patented treatment of the basic braid.

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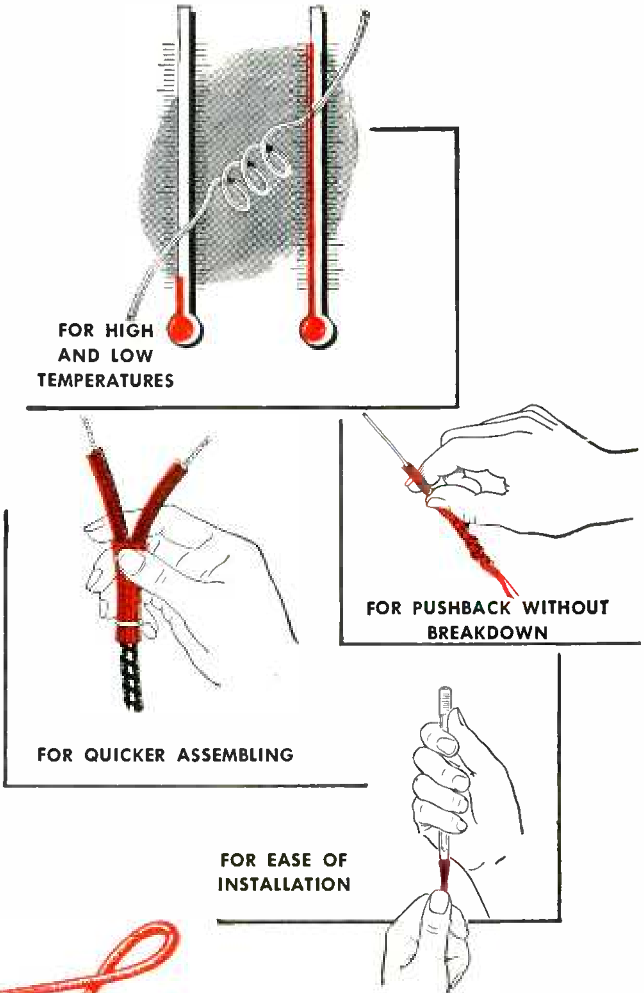

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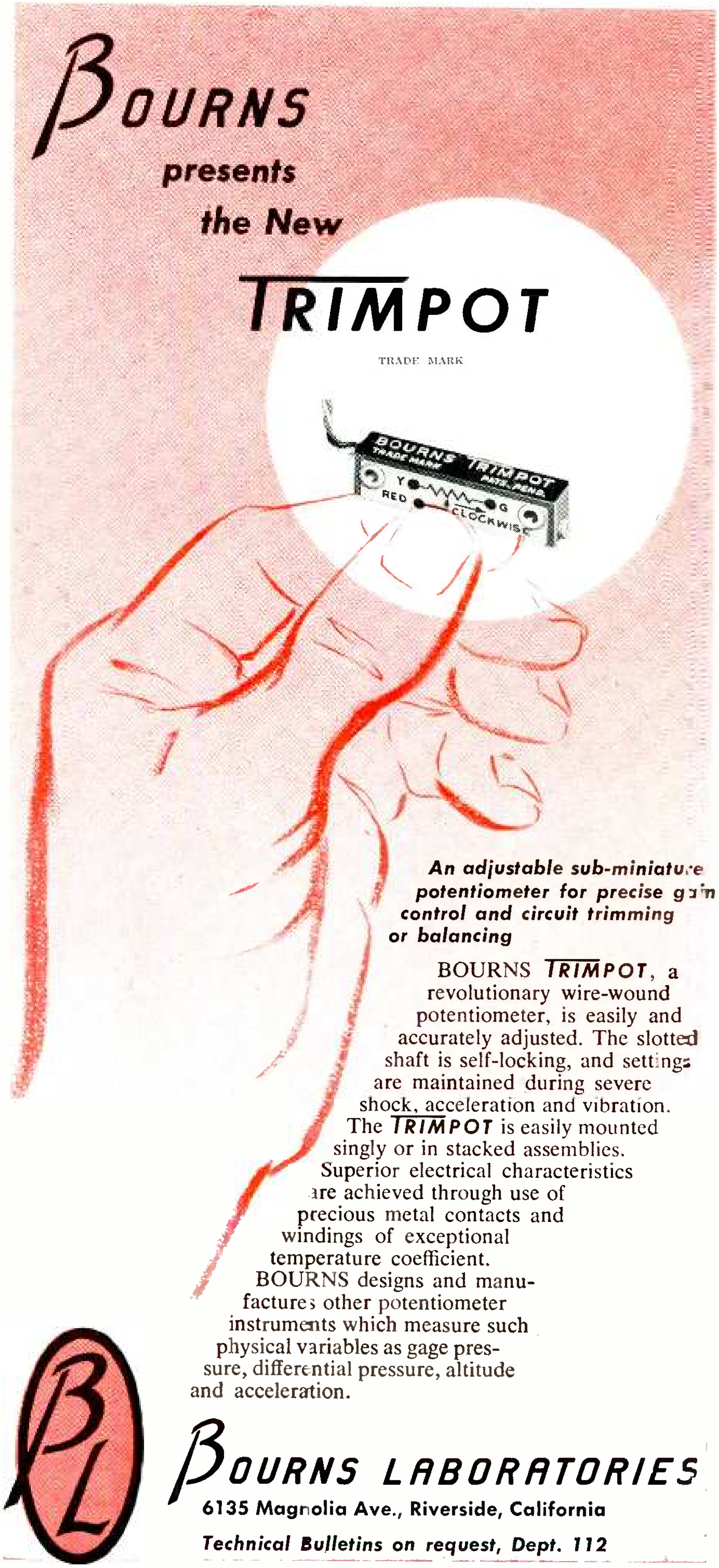

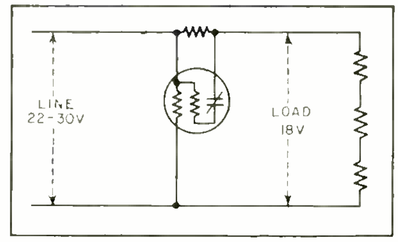

FIG. 6—Circuit incorporating a relay with two separate heater windings

than that of a constant potential across them.

In order to reduce the amount of heat that has to be dissipated at the upper end of the range, the resistor across the contacts in Fig. 3 may be replaced with a choke. The same is true for Fig. 2 if the supply is a-c.

Due to the resistor shunting the thermal relay contacts, the interference caused by the opening and closing of this contact is usually not serious. In cases where it is still found objectionable and where the usual type of line filter is not sufficiently effective, the interference can be further reduced by the circuit shown in Fig. 5.

In choosing circuit values for regulation of this kind, the supply voltage must be such that when it is at its minimum value it can produce the heater voltage desired, for the thermal relay can only reduce the supply voltage by interrupting it. It cannot increase it. The dropping resistor across the relay contacts must be such that at the highest supply voltage and with the smallest connected load, it will drop the heater voltage sufficiently. The thermal relay cannot produce a greater reduction in this voltage than that resulting from holding its contacts open continuously.

The thermal relay regulator offers the important advantage of being independent of frequency. In addition, it is small and light and has high efficiency.

An even wider, but as yet largely unexplored field is opened up by the availability of relays with tapped heater windings or with two separate heater windings. Just one circuit using such a relay is shown in Fig. 6. This circuit is similar to Fig. 1 with the addition of a second heater winding of much lower resistance connected in series with

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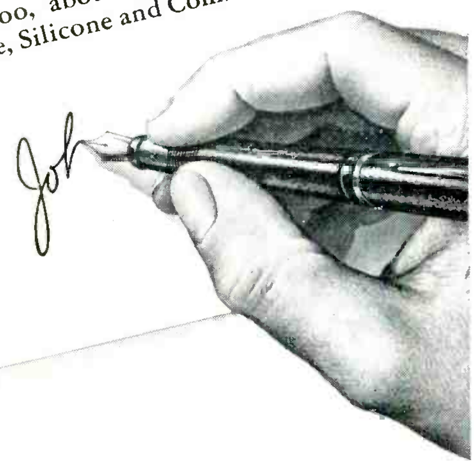

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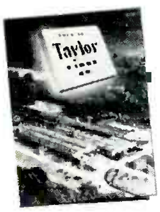

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Slide Rule Computes Radio Refractive Index of Air

By Stanley Weintraub
National Bureau of Standards
Boulder, Colorado

Studies of tropospheric radio propagation often require computing the refractive index of air from meteorological parameters. Computation becomes extremely tedious in making a climatic study of refraction (bending of ray paths) that requires computation of refractive indices from meteorological radiosonde ascents.

This has led to the development of numerous devices designed to facilitate computation[1], most of which are of low precision or limited usefulness. A slide rule method of computing N, where $N = (n - 1)\ 10^6$, n being the refractive index, has been developed by the National Bureau of Standards. This method attains a precision of ± 0.5 N-units under almost any conditions likely to be encountered in the troposphere, while being less tedious than other comparable methods now in use.

Details below are carried out with pressure in millibars, temperature in deg C and relative humidity as the parameters. The method is equally applicable when other

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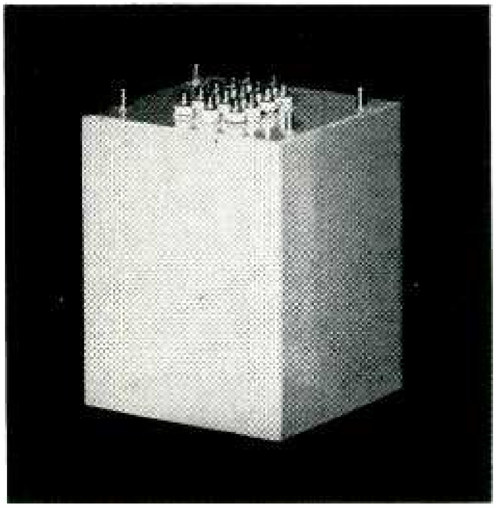

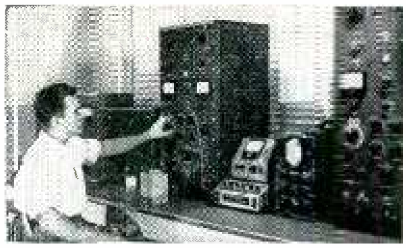

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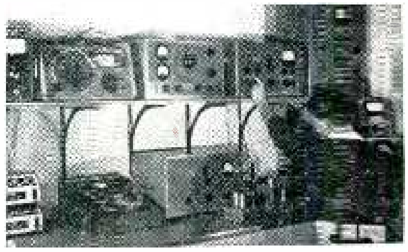

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units are used, such as millimeters or inches of mercury for pressure, deg F for temperature, and water vapor pressure, absolute humidity or dew point for humidity. The mixing ratio can also be utilized, but with somewhat less convenience.

Radio refractive index may be expressed with sufficient accuracy by the formula[2]

$$N = 77.6\,\frac{p}{T} + 3.73 \times 10^5\,\frac{e}{T^2} \qquad (1)$$

where $N = (n-1)10^6$, n being the refractive index; p, total pressure in mb; e, water vapor pressure in mb; T is the temperature in deg K, equal to $273 + t$, where t is in deg C.

The present method of computation employs two separate slide rules, one for each term in the formula. However, it is possible to use two sides of a standard slide rule.

The slide rule illustrated in Fig. 1, used to compute the term 77.6 p/T, is a standard 20-inch type with C, D, CF and DF scales modified by attaching a paper scale with rubber cement. This does not impair the slide rule for other purposes. The paper scale serves to relabel the graduations on the CF scale without obscuring them, so weather data in deg C is set up on the slide in deg K without the tedium of a formal conversion.

For example, the interval 273 . . . 283 is labeled by the new scale as 0 . . . 10 deg. By using all four scales, C, D, CF and DF, the setting and reading is confined to a small

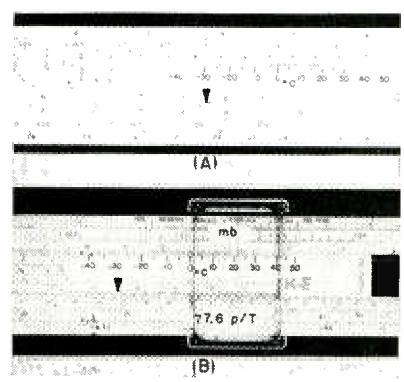

FIG. 1—Slide rules for the radio refractive index of air (A) for term 77.6 p/T and (B) for second term

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area of the rule, thus speeding the work. The computation of the first term is performed in the following manner:

1. The temperature in deg C on scale CF is set at the pressure in millibars on scale DF.

2. The value of this term is read on scale D opposite 77.6 on scale C. A distinguishing marker has been placed at this point on scale C in order to facilitate reading of the value.

The special slide rule in Fig. 2 is used to compute the second term, $3.73 \times 10^5\ e/T^2$. In terms of the parameters temperature T, and relative humidity RH, given as a fraction, this expression may be closely approximated by[3]

$$A\,(RH) = 3.73 \times 10^5\, e_s/T^2\,(RH) \qquad (2)$$

where e_s is the saturated vapor pressure[4]. $A = 3.73 \times 10^5\ e_s/T^2$ and is a function only of T.

The slide rule is constructed in the usual way by laying out distances proportional to the logarithm of A on one scale, and proportional to the logarithms of numbers in linear sequence on the other scale. The first decade of the latter scale represents humidities from 10 to 100 percent as well as values of the term from 1 to 10 in N units.

The A and B scales of a slide rule may readily be modified by cementing a new scale to the latter and laying off values of A on it. Indices of the temperature scale are placed at −42.7, −15.9 and +19.7 deg C, points at which A has the values 1, 10 and 100, respectively. These indices are marked by ×0.1, ×1 and ×10 in the figures, the appropriate multiplier to be used with each index. The second term is

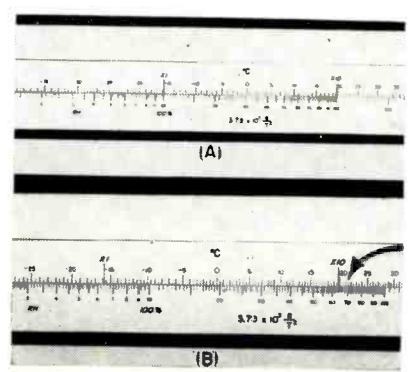
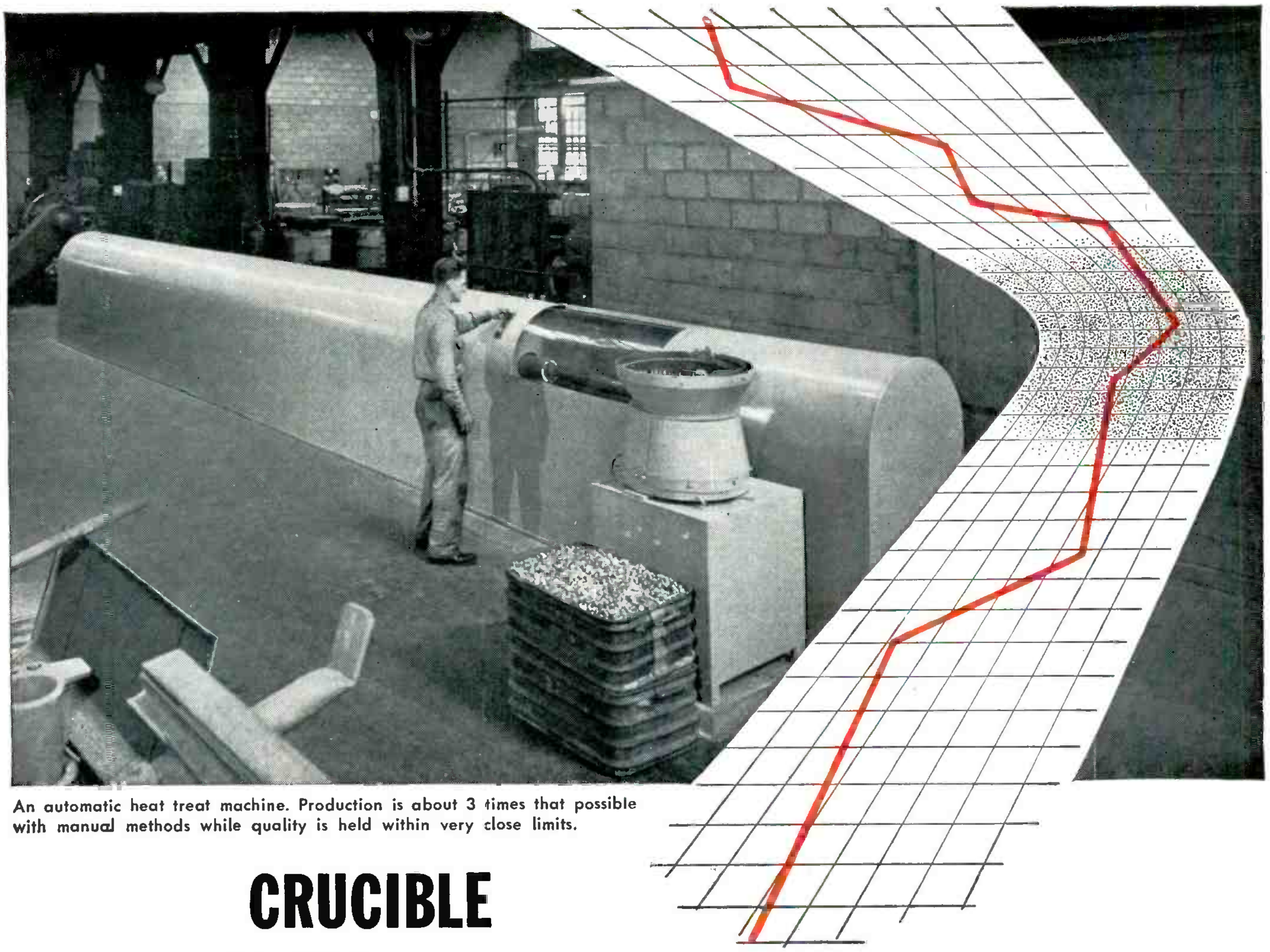


FIG. 2—Operation of slide rules for first term (A) and second term (B)



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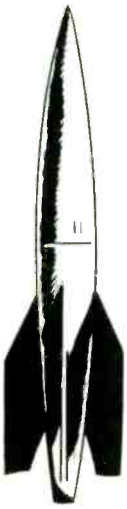

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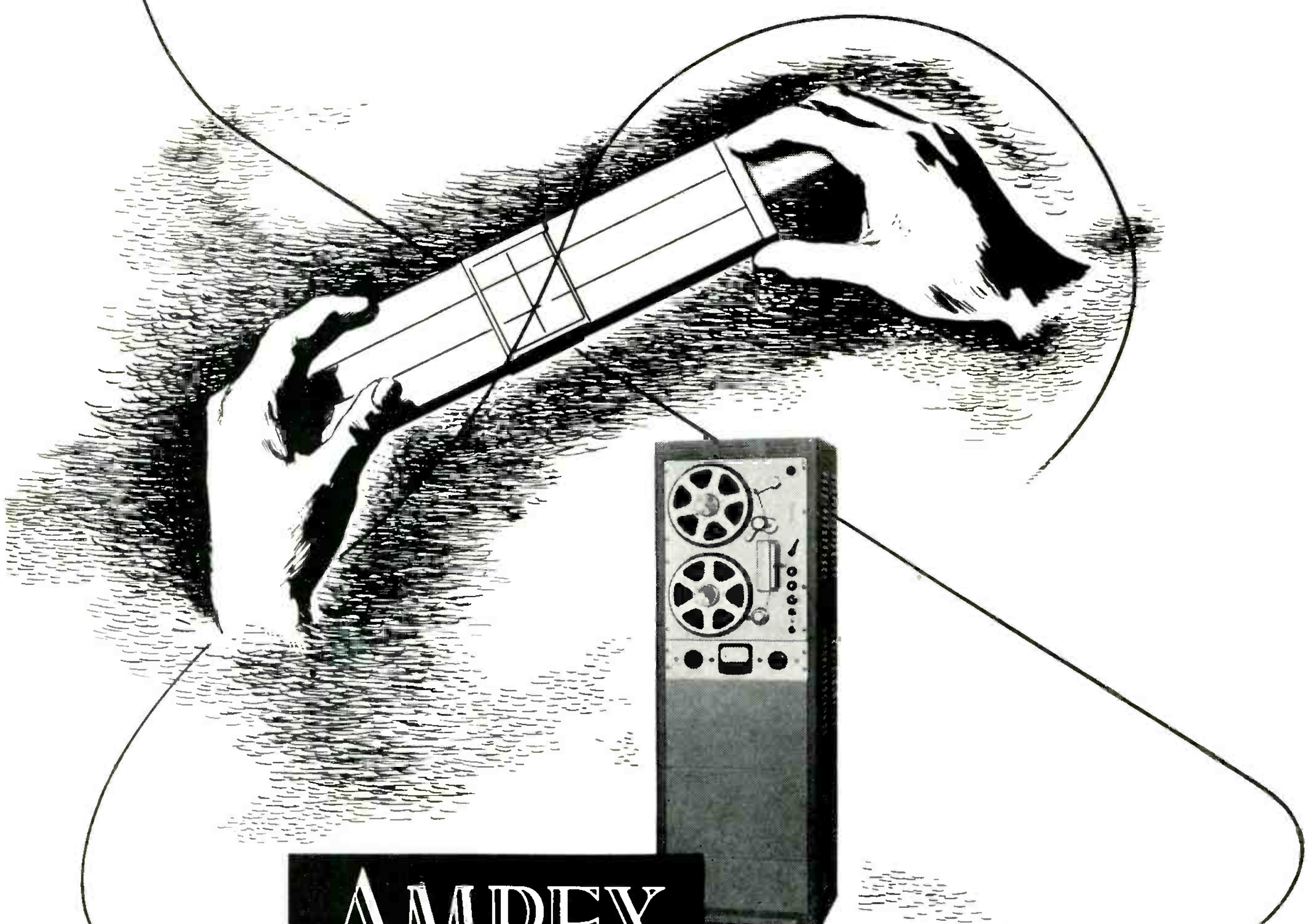

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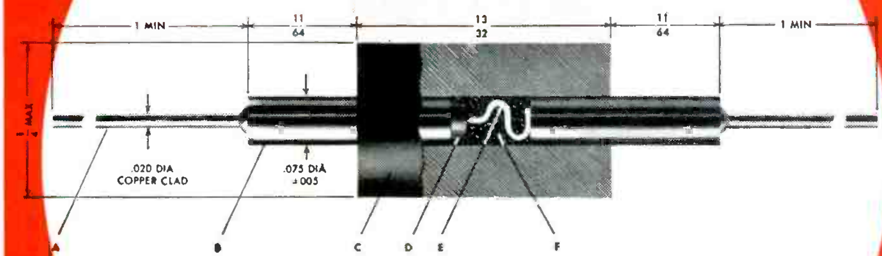

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computed as follows:

1. The index of the temperature scale is set at the relative humidity on the RH scale.

2. The value of the second term is read on the sequential scale opposite the temperature in deg C on the temperature scale.

The following is an example of a refractive index calculation from radiosonde data showing pressure, 1,014 mb; temperature, 21.5 deg C; relative humidity (RH), 64 percent.

1. To find the value of the first term, 77.6 p/T, set 21.5 on the paper scale of the first slide rule at 1,014 on scale *DF* (Fig. 2A). The value is read on scale *D*, opposite the marker at 77.6 on scale *C*, as 267.0.

2. To find the value of the second term, $3.73 \times 10^5\ e_s/T^2$ (RH), set the index of the temperature scale on the second slide rule at 64 on the RH scale (Fig. 2B). The value is read on the sequential scale, opposite 21.5 on the temperature scale, as 70.5.

3. The value of *N* is obtained by adding the first and second terms, found in (1) and (2) and is equal to 337.5.

This method may also be applied to a circular slide rule, which has the advantage of having a continuous scale. An example of the utilization of a circular slide rule for computing the second term is given in Fig. 3.

Values of $A = 3.73 \times 10^5\ e_s/T^2$ vs T at intervals of one degree over a range of -45 C to $+50$ C are given in Table I. Adaptations of the slide rule may be made to ac-

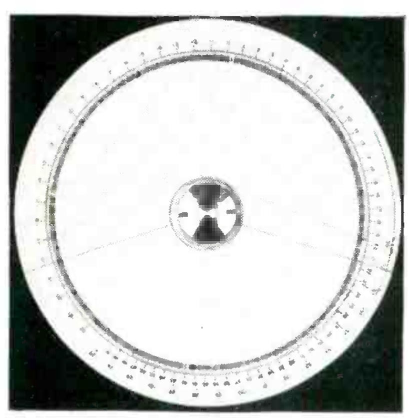
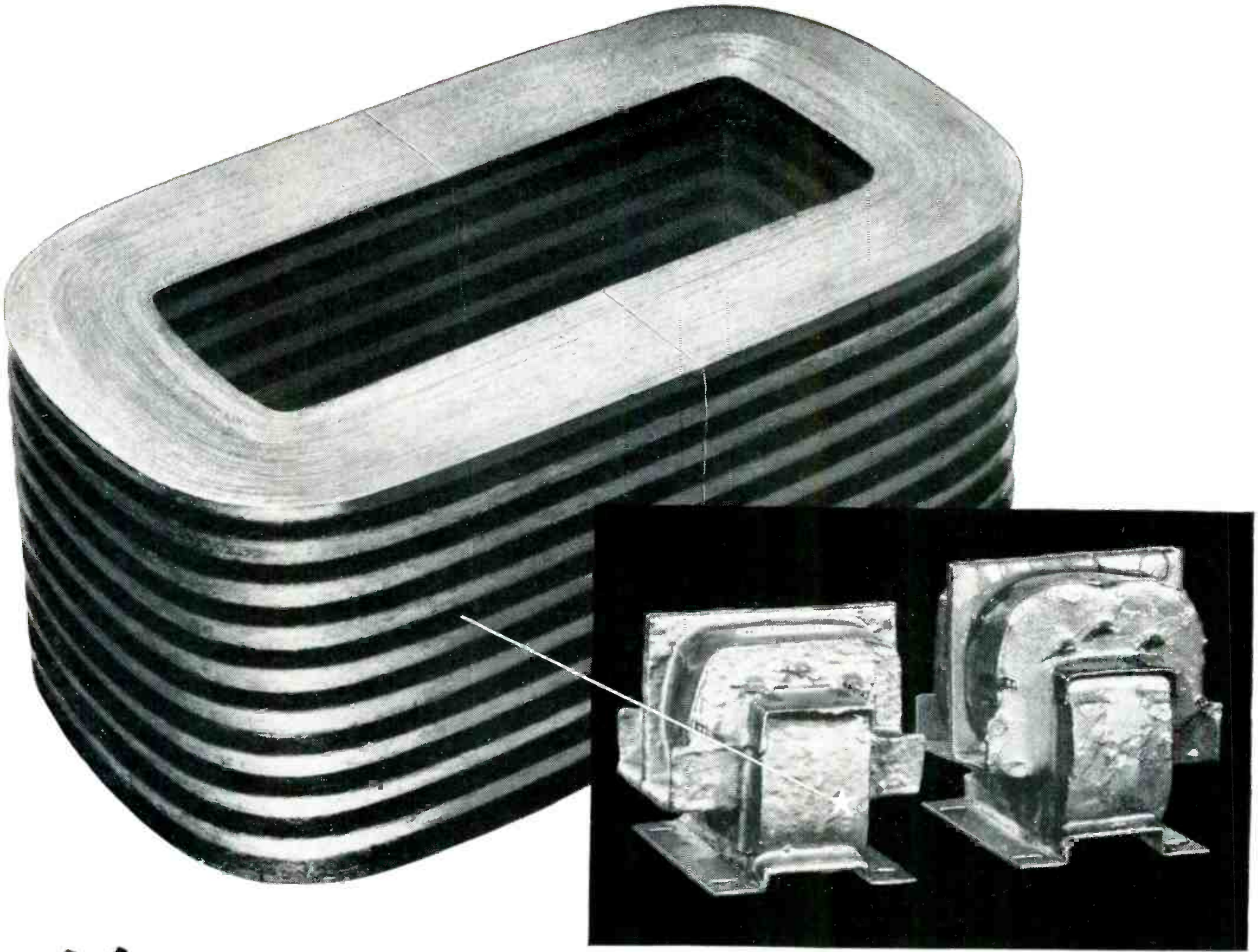


FIG. 3—Special circular slide rule for finding second term



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commodate it to variables other than those cited above as follows:

Vapor Pressure for Relative Humidity

When the water vapor pressure e in mb is used in the relation, Eq. 2 may be written

$$3.73 \times 10^5 e/T^2 = Be$$

where $B = 3.73 \times 10^5/T^2$ and is a function of T only. Distances proportional to the logarithm of B may now be laid out on one scale, as was done with A previously. The value of e is set directly on the same scale previously used for relative humidity. The operation of this slide rule is similar to that of the one using relative humidity.

Absolute Humidity

If the absolute humidity ρ_w in grams per cu cm is used, the second term[5,6] may be closely approximated by $1.72 \times 10^3 \rho_w/T$. This term is now in the same form as the first term, and a slide rule similar in construction to that shown in Fig. 1A can be made, using the A and B scales, to aid in its computation.

When the dew point is used, the slide rule for use with water vapor pressure can be utilized by adding a supplementary scale to the one on which the water vapor pressure was set that will relate dew point to water vapor pressure.[3,4]

Mixing Ratio

By using an approximation[7] for the mixing ratio w in grams per kilogram, Eq. 1 may be written as:

$$N = 77.6 \frac{p}{T}\left(1 + 7.73 \frac{w}{T}\right)$$

A slide rule similar to that for the first term in Eq. 1 may be used for the second term in the parentheses above. The first term may then be computed and multiplied by the parenthetic expression.

Use of Fahrenheit

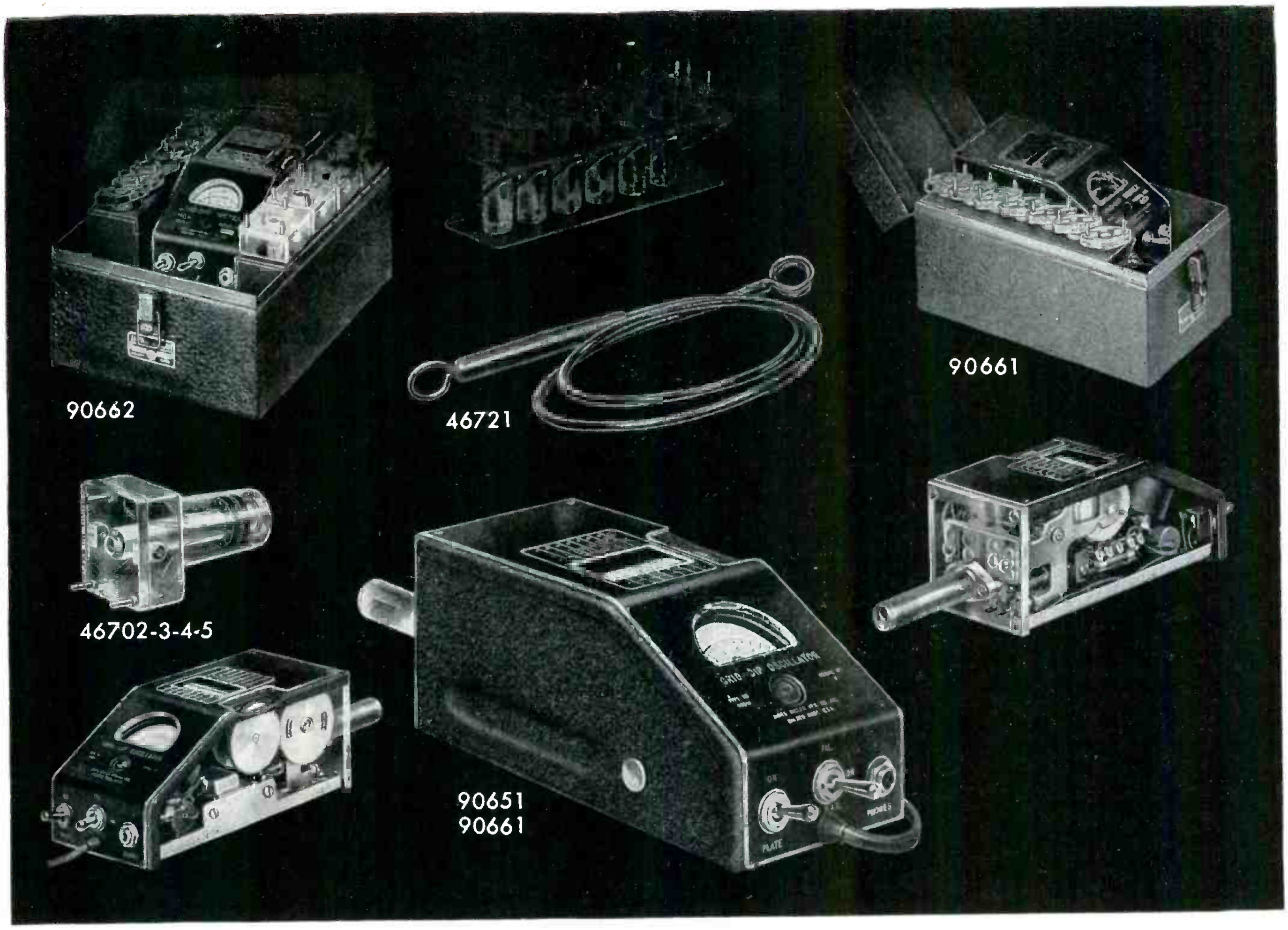
For temperatures given in deg F, and pressures in millibars, Eq. 1 becomes

$$N = 140 \frac{p}{T'} + 1.21 \times 10^6 \frac{e}{T'^2}$$

where T' is equal to $460 + t'$, t' being in deg F. The slide rules must be modified accordingly.

Mercury Pressure

If mm Hg are used, the constants multiplying pressure terms in the



Designed for Application

Grid Dip Meters

Millen Grid Dip Meters are available to meet all various laboratory and servicing requirements.

The 90662 Industrial Grid Dip Meter completely calibrated for laboratory use with a range from 225 kc. to 300 mc. incorporates features desired for both industrial and laboratory application, including three wire grounding type power cord and suitable carrying case.

The 90661 Industrial Grid Dip Meter is similar to the 90662 except for a reduced range of 1.7 to 300 mc. It likewise incorporates the three wire grounding type cord and metal carrying case.

The 90651 Standard Grid Dip Meter is a somewhat less expensive version of the grid dip meter. The calibration while adequate for general usage is not as complete as in the case of the industrial model. It is supplied without grounding lead and without carrying case. The range is 1.7 to 300 mc. Extra inductors available extends range to 220 kc.

The Millen Grid Dip Meter is a calibrated stable RF oscillator unit with a meter to read grid current. The frequency determining coil is plugged into the unit so that it may be used as a probe.

These instruments are complete with a built-in transformer type A.C. power supply and interminal terminal board to provide connections for battery operation where it is desirable to use the unit on antenna measurements and other usages where A.C. power is not available. Compactness has been achieved without loss of performance or convenience of usage. The incorporation of the power supply, oscillator and probe into a single unit provides a convenient device for checking all types of circuits. The indicating instrument is a standard 2 inch General Electric instrument with an easy to read scale. The calibrated dial is a large 270° drum dial which provides seven direct reading scales, plus an additional universal scale, all with the same length and readability. Each range has its individual plug-in probe completely enclosed in a contour fitting polystyrene case for assurance of permanence of calibration as well as to prevent any possibility of mechanical damage or of unintentional contact with the components of the circuit being tested.

The Grid Dip Meters may be used as:

1. A Grid Dip Oscillator
2. An Oscillating Detector
3. A Signal Generator
4. An Indicating Absorption Wavemeter

The most common usage of the Grid Dip Meter is as an oscillating frequency meter to determine the resonant frequencies of de-energized tuned circuits.

Size of Grid Dip Meter only (less probe): 7 in. x 3$\frac{5}{16}$ in. x 3$\frac{3}{8}$ in.

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Table I—$A = 3.73 \times 10^5 \frac{e_s}{T^2}$

deg C	A	°C	A
−45	0.797	3	37.1
−44	0.881	4	39.5
−43	0.972	5	42.1
−42	1.07	6	44.8
−41	1.18	7	47.6
−40	1.30	8	50.6
−39	1.43	9	53.8
−38	1.57	10	57.2
−37	1.72	11	60.7
−36	1.89	12	64.4
−35	2.07	13	68.3
−34	2.26	14	72.4
−33	2.47	15	76.6
−32	2.70	16	81.2
−31	2.95	17	85.9
−30	3.21	18	90.9
−29	3.50	19	96.1
−28	3.81	20	101.6
−27	4.15	21	107.3
−26	4.51	22	113.3
−25	4.89	23	119.6
−24	5.31	24	126.1
−23	5.76	25	133.0
−22	6.24	26	140.2
−21	6.75	27	147.7
−20	7.31	28	155.6
−19	7.90	29	163.8
−18	8.53	30	172.4
−17	9.21	31	181.3
−16	9.94	32	190.7
−15	10.7	33	200.4
−14	11.5	34	210.5
−13	12.4	35	221.1
−12	13.4	36	232.1
−11	14.4	37	243.6
−10	15.4	38	255.5
− 9	16.6	39	268.0
− 8	17.8	40	280.9
− 7	19.1	41	294.3
− 6	20.4	42	308.3
− 5	21.9	43	322.8
− 4	23.4	44	337.9
− 3	25.1	45	353.6
− 2	26.8	46	369.8
− 1	28.6	47	386.7
0	30.6	48	404.2
1	32.6	49	422.3
2	34.8	50	441.2

equations are to be multiplied by the factor 1.333. If in. Hg are used, the factor is 33.86.

The author wishes to thank H. E. Bussey, under whose supervision this method was developed, for supplying the original idea, and also B. R. Bean, who assisted in the design of the original slide rules.

REFERENCES

(1) L. J. Anderson, "Calculator for Atmospheric Refractive Index," Report 279, U. S. Navy Electronics Laboratory, San Diego, California, 1952.
(2) E. K. Smith, Jr. and S. Weintraub,

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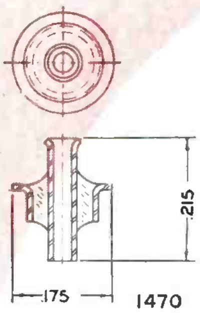

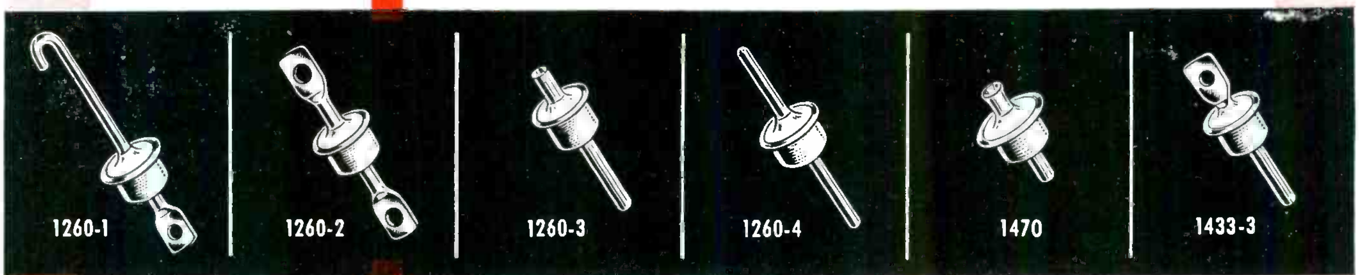

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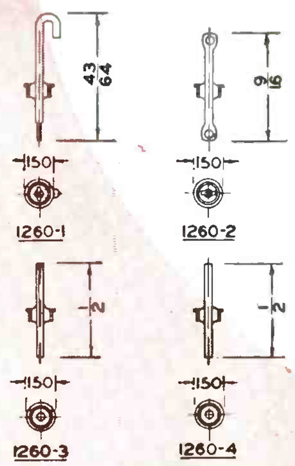

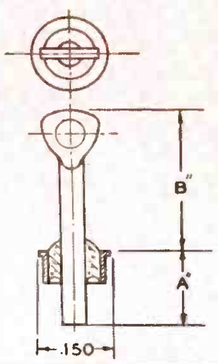

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"The Constants in the Equation for Atmospheric Refractive Index at Radio Frequencies," NBS Report No. 1938, Sept. 19, 1952.

(3) Smithsonian Meteorological Tables, 6th Revised Edition, p 367 and p 348, 1951.

(4) Same as ref (3) p 351 and 352.

(5) Same as ref (3) p 347 to 381.

(6) B. Haurwitz, "Dynamic Meteorology", McGraw-Hill Book Co., Inc., New York and London, p 7, 1941.

(7) Same as ref (6), p 10.

Multiple-Feedback Oscillators

USING A NUMBER of feedback circuits in connection with a single tank circuit has made possible the construction of oscillators able to operate over a wide range of frequencies with the L-C of the tank circuit remaining fixed. The circuits and the theory on which they are based are described in a patent by M. Morrison[1]. Some of the important points of the theory are as follows:

In a tuned-grid reactively loaded oscillator the generated frequency is determined by the frequency at which the grid must operate to produce the required grid operating voltage angle, the phase angle at which the grid operates under a given load.

Grid operating voltage angle will either lead or lag the plate voltage depending on the character of the load. Under reactive loads the plate voltage, current and grid voltage are always out of phase with each other.

If an attempt is made to bring the phase position of an oscillator operating under a reactive load into a phase position other than that naturally assumed, the frequency of operation will be shifted to a new out-of-phase position that will be consistent with the load conditions. On a reactive load the phase position cannot be corrected to any arbitrary position.

In a tuned-grid reactively loaded oscillator, the frequency generated is determined by the frequency at which the grid tank circuit must operate to produce the required grid operating voltage angle, which may be leading or lagging depending on the character of the load.

The frequency stability of a resistance-stabilized oscillator is not necessarily critical to the Q of the tank circuit, because the frequency stability depends on the grid oper-

ating voltage angle being maintained at the correct position with variations in other circuit parameters rather than the circuit dissipation.

Variation in tank-circuit Q with different applied tank circuit voltages plays an important part in compensating for variation in phase angle of the load current with different applied tank circuit voltages.

Changes in the inductance and/or Q of the load on an oscillator cause changes in the load-imposed current angle. For each change in this current angle there is required a correct change in grid operating voltage angle to maintain the operating frequency. Oscillator stability is attained when the grid tank circuit automatically adjusts the grid operating voltage angle for the new load-imposed current angle at the same operating frequency.

In a resistance stabilized grid-tank-circuit oscillator having an inductive plate load and a single-feedback circuit, a frequency is best stabilized against plate voltage variations and is most purely sinusoidal when the tank circuit is operating at a frequency considerably removed from the resonant value.

An oscillator tank circuit having an intermittent drain imposed on it distorts the sinusoidal character of the tank circuit voltage. Therefore an oscillator should not be

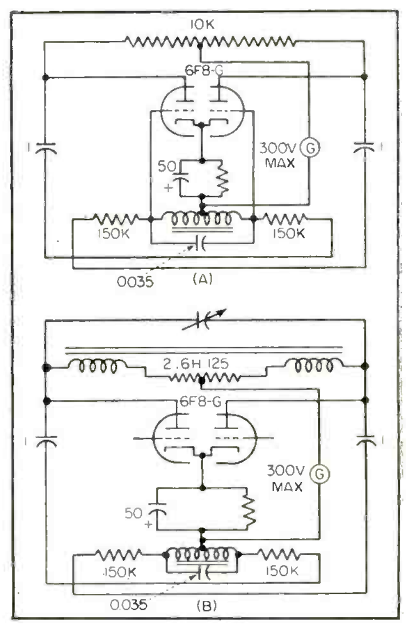

FIG. 1—Circuit arrangements for determining the effects of inductors on the operating frequency of an oscillator

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operated with these two factors in phase if sinusoidal operation is desired.

Inductively loaded oscillators have an inherent tendency to produce sinusoidal currents and distorted plate voltages. Capacitive loading induces distorted currents and sinusoidal plate voltages. Oscillators with capacitive loading are more difficult to stabilize than those with inductive plate loads, but are more sensitive to synchronizing currents than the latter.

If the oscillator in Fig. 1A were removed and adjusted independently to a given frequency, it could be placed back in the circuit. By adjusting the feedback control resistor the whole circuit could then be made to oscillate at the same frequency. If, however, the center-tapped resistor in the plate circuit were replaced by inductances, as in Fig. 1B, it would be found that the circuit will not oscillate at the given frequency but at a higher one. It will also have a lower output with the same plate impedance, because it will be found that the grid voltage is lower. To bring the oscillator to the given frequency it is necessary to place a variable capacitor across the inductance and increase the capacitance until the frequency and grid voltage reach the same values as in the original circuit. This shows that an oscillator can be made to operate at various frequencies by varying the L-C of the parallel oscillatory circuits and that an oscillator operating under inductive plate loading must operate at a frequency higher than the

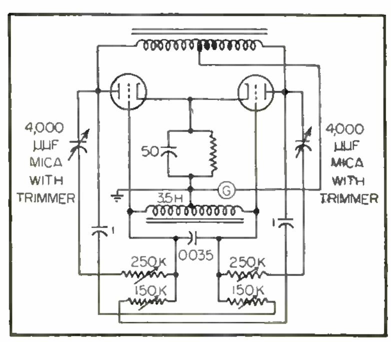

FIG. 2—An oscillator circuit with a wide range of operating frequencies. Because of the small size of the plate circuit capacitors stabilization is difficult

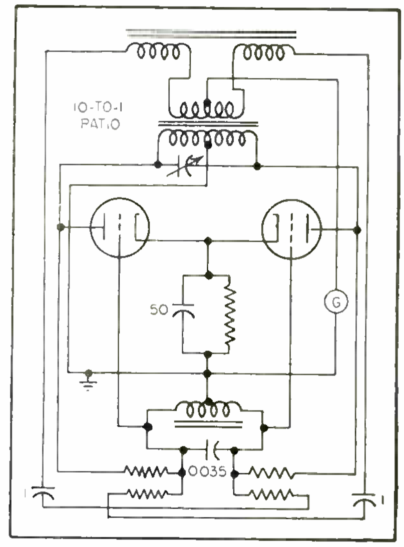

FIG. 3—A circuit similar to Fig. 2 but using a 10 to 1 current transformer to eliminate the small capacitors, making it easier to stabilize the oscillator

resonant frequency of the tank circuit.

Applying the information derived from the oscillators in Fig. 1, the multiple-feedback oscillator circuits in Fig. 2 and 3 may be explained. The tank circuits have fixed L-C combinations and a conventional feedback circuit to supply feedback current in phase with the plate voltage.

If the tank circuit of Fig. 2 is to work at resonance with the tank circuit, feedback current must be in phase with the grid operating voltage angle. This is accomplished by a direct feedback circuit comprising two 150,000-ohm resistors and a second feedback circuit with two 4,000-$\mu\mu$f variable mica capacitors. This second circuit provides a current having an out-of-phase position of such magnitude and phase difference relative to the reverse feedback circuit that it will cause the desired magnitude of feedback current and proper grid operating voltage angle to maintain the oscillator operating at the proper frequency. Although there are only two phases of feedback current used here, any number can be employed to obtain the proper phase angle and current magnitude to produce the desired phase relation to the reference phase of the circuit.

In this oscillator circuit it is not necessary for the L-C of the tank circuit to be set at the resonant

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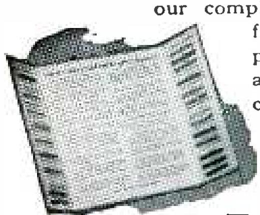

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frequency of the oscillator. It may be set at many other values for the same operating frequency if the polyphase feedback circuits are adjusted to provide the required grid operating voltage angle for the load at the operating frequency.

The oscillator of Fig. 3 uses a special current transformer, with a 10 to 1 ratio to accomplish phase alteration of the feedback current. The transformer, with a variable capacitor across the output, is constructed and adjusted to provide feedback load current in phase with the a-c component of the plate load current.

REFERENCES

(1) M. Morrison, Vacuum Tube Oscillator System, Patent No. 2,587,750, Mar. 4, 1952.

Measurement of Flashlamp Characteristics

THE MOST INTENSE light source commonly available is the brilliant flash produced by the discharge of a capacitor through a gas at reduced pressure. In appearance the light is an intense white and produces an effective duplication of daylight illumination for photographic purposes. Intensities as high as 10^6 candles per sq cm have been obtained in single flashes in lamps where the average power input is 10 megawatts during the flash. Light output efficiencies in the order of 50 lumens per watt have been measured in single-flash, high-current discharge tubes.

A testing circuit has been developed to measure the electrical and radiation characteristics of flash discharge in gas-filled tubes. Shown in Fig. 1, the device uses a triggering circuit to produce synchronous current pulses for repetitive flashing. Current, potential, power input to the discharge and light output are measured and recorded on an oscilloscope.

The test apparatus consists of a 10 in. disk of Dow metal driven at 3,600 rpm by a 1/20-hp synchronous motor. A 0.2 mm radial slit on the periphery of the disk passes light from a movie exciter lamp to a multiplier phototube to provide

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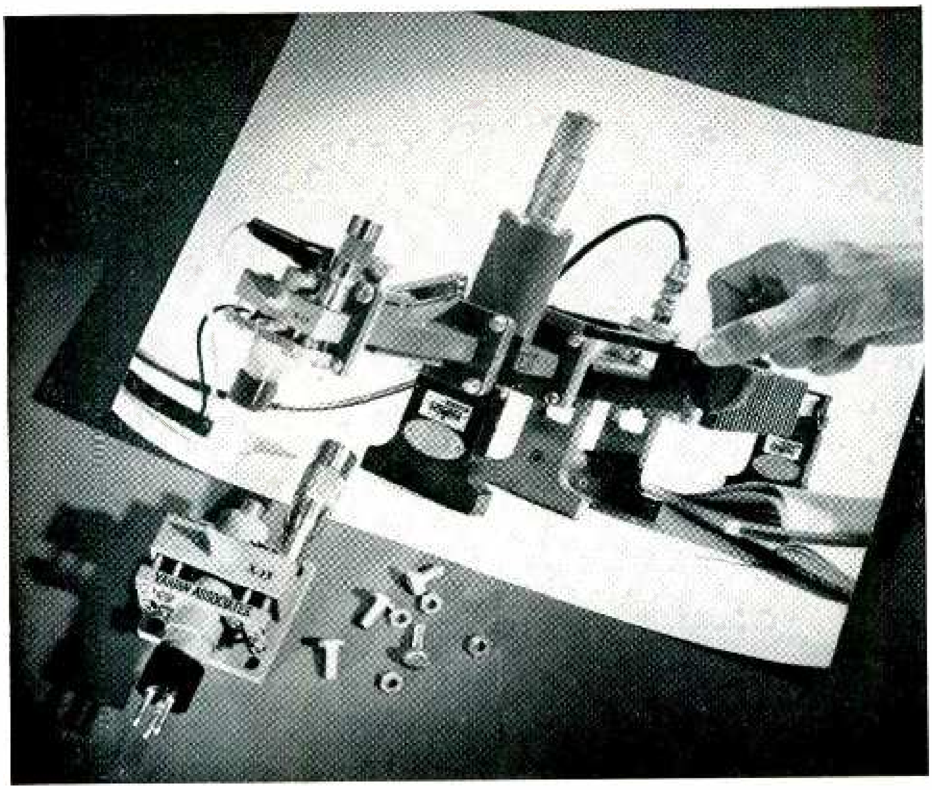

IN LABORATORIES throughout the electronic field, the Varian X-13 Klystron is widely used as a general-purpose x-band signal source. In the typical setup above (checking load reflection), note the compactness, the convenience of connection, and the way the tube bolts directly to the waveguide.

OUTPUT POWER typically reaches half a watt at center frequency and exceeds 150 milliwatts over the full frequency range 8.2 to 12.4 kmc. The X-13 exhibits extremely low microphonic levels and operates directly into matched waveguide. Tuning is done with a single control. The tube is air cooled and has clearance dimensions of 4½ by 2½ by 2½ in., weight of only 6 oz.

Typical Power Output - Varian X-13 Klystron
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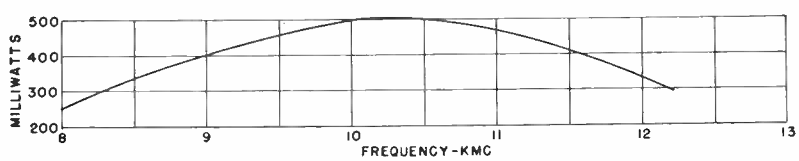

OTHER VARIAN KLYSTRONS extend and expand the functions of the X-13. An extensive line of tubes with designs based on that of the X-13 offers a wide selection of output powers, types of tuning devices and terminations, as well as capabilities for withstanding vibration and shock ranging far beyond 30 times gravity.

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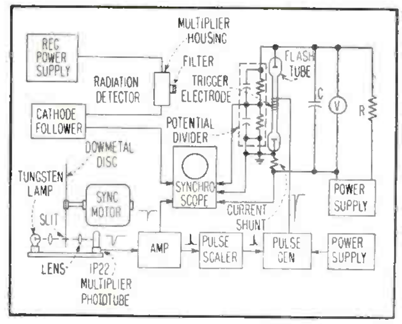


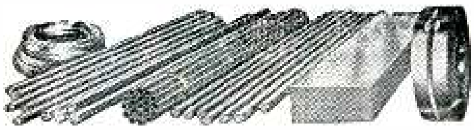
FIG. 1—Block diagram of flashlamp testing apparatus

sharply defined current pulses. These pulses are amplified and used to trigger the oscilloscope sweep and also to initiate the discharge in the flash tube.

A scaler circuit provides pulsing rates lower than the 60 pps set up in the multiplier tube. Consisting of six binary stages, the scaler is arranged so any desired number of stages may be inserted in the circuit to reduce the pulsing rate by a factor 2^n, where n is the number of stages used. Thus, in addition to the 60 pps rate there are six other rates available, 30, 15, 7.5, 3.75, 1.88 and 0.94 pps.

Discharge of the tube is initiated by an external trigger electrode located near the center of the quartz envelope. A capacitor across the electrodes is charged to a potential less than the breakdown voltage of the gas used. When a rapidly changing potential is placed on the trigger electrode it produces sufficient ionization of the gas for discharge to occur. The potential of the capacitor decreases in a few microseconds from an initial value between 1,500 and 3,000 to a few hundred volts. The dielectric strength of the nonionized gas is restored in a few tenths of a millisecond after initiation of the high-current arc.

To provide high-voltage pulses for initiating the discharge, the amplified photocurrent pulses are transformed to sharp positive pulses by a thyratron tube. These pulses are then impressed on the grid of a hard tetrode tube, normally biased to cut off, reducing the plate impedance from a high to a very low value. The trigger electrode is connected directly to the plate of the tetrode, and when a



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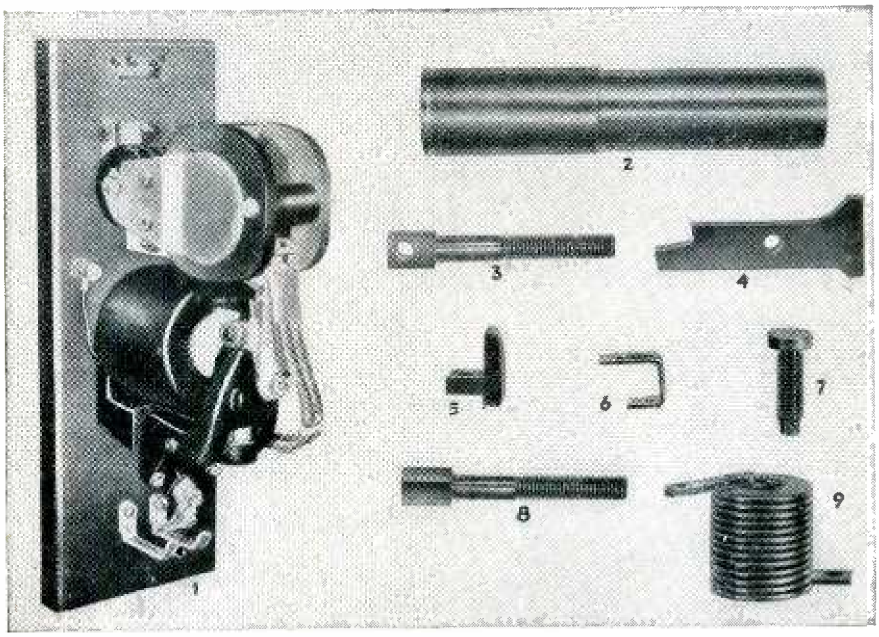

Vari-Time Magnetic Contactor and copper-base alloy parts, courtesy The Clark Controller Co., Cleveland, Ohio.

Copper and its Alloys Ideal for Heavy Duty Contactors

D.C. Magnetic Contactors are used as motor starters, crane controls, press controls, furnace controls, etc. They must be capable of handling anywhere from 25 to 900 amperes, open and close rapidly with a minimum of arcing and burning, and withstand corrosion even when exposed to the elements. In order to meet these requirements. high conductivity copper and alloys such as free cutting brass and Phosphor Bronze are used to manufacture those parts which form the electrical circuit. Some parts such as the studs, contact tips and arc horns, which require machining, are less costly to produce because of less tool wear and spoilage when using copper or brass.

Vari-Time Contactor

Illustrated is a Clark Controller Vari-Time Magnetic Contactor (1) which contains a special core providing an adjustable time delay before closing after the coil has been energized. The timer (2) consists of a core tube machined from free-cutting brass bar stock. The I.D. of the tube is reamed smooth and has a tolerance of ± .0005″. Other copper-base alloy parts are the core cap and valve seat, both machined from free-cutting brass and a washer made from commercial bronze. The assembled core is filled with a special oil of controlled viscosity, and then the core tube is sealed with the core cap which is soldered in place. The timing is adjusted by an adjustable stop stud on the front of the contactor which varies the gap between the armature and the front of the core. The entire VT Core is so designed and constructed as to give exceptionally long life. At various times, after years of hard service, Vari-Time cores have been taken apart and rigidly inspected with no appreciable wear or deterioration.

Other copper alloy parts used on the contactor are as follows:

Blowout Stud (3) — This stud is machined from high conductivity hard copper square bar stock and then silver coated. It holds the blowout coil to the slate and also provides a terminal for power connection.

Rear Contact Stud (4) — This extruded part is made from free cutting brass rod which is silver coated after being drilled and tapped. To this stud are connected the other end of the blowout coil, the stationary contact tip and the rear arc horn.

Contact Tips (5) — A heated billet of high conductivity copper is forced through a die producing an oversized cross-section of the tip. This extrusion is then cold drawn through a sizing die which also imparts the correct hardness to the copper. Two contact tips are used on each contactor.

Front Arc Horn (6) — The front arc horn is formed from a Phosphor Bronze Grade A (95% copper, 5% tin, 0.15% phosphorus) strip while the rear arc horn. not illustrated, is formed from a high conductivity copper strip. Both arc horns are silver coated. The horns extinguish the arc by lengthening it until it is broken.

Stop Stud (7) — Machined from Phosphor Bronze Grade B-1 alloy, this stud acts as a stop for the contact arm.

Connector Stud (8) — This part is machined from high conductivity hexagon-shaped copper rod. It connects one end of the connector assembly to the slate, and also serves as a power terminal connection.

Before you decide what copper alloy to use for a particular application, many factors must be taken into consideration. Bridgeport Brass produces many alloys. each one with its own distinctive properties. Contact the nearest Bridgeport branch office for assistance with any of your metal problems. (9247)

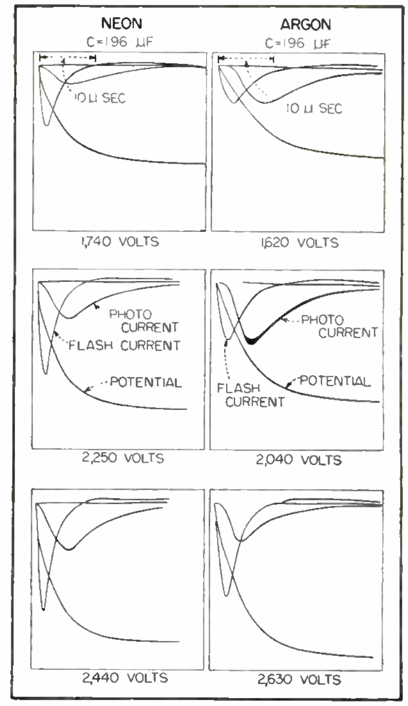

FIG. 2—Typical traces of flash current, potential and photocurrent

positive pulse causes the tube to conduct, the potential of the electrode drops from several thousand volts to a very low value. Observations using the fast sweep of the synchroscope indicates that the change occurs in less than 0.1 μsec, or at a rate greater than 10^{11} v per sec. Using 6,000 to 8,000 v on the trigger electrode it is possible to pulse all the tubes in a perfectly consistent manner at any rate for which overheating of the electrode did not occur.

Measurements are made on a Navy radar synchroscope having sweep ranges of 1, 2, 10, 25 and 60 μsec with the sweep triggered by the pulse from the pulse generator circuit. The low-impedance input circuits are properly matched with well-shielded coaxial cables. Identical cables are used to give proper phase relations between current, potential and light pulses.

Measurement of tube potentials is carried out by means of a compensated and shielded voltage divider. Check measurements showed that tube potential errors are not more than ±5 percent. Current pulses are obtained by the use of a specially constructed bifilar element having a resistance of 0.089 ohm. The average deviation in mean current values as determined by com-

paring the charges delivered by the capacitor with the charges obtained by graphical integration of the synchroscope current trace amounted to ±3 percent.

Radiation measurements in the ultraviolet region are made with a 1P28 multiplier phototube with a Corning 9863 filter to give an overall response extending from 2,400 A to 4,200 A with a peak at 3,350 A. In the visible region a 931A multiplier is used without a filter. A six-stage multiplier with Cs-Ag-0 cathode is used in conjunction with a Wratten A (No. 25) filter provides a response range from 6,000 to 12,000 A with a peak at 8,500A in the near infrared region.

Since peak light intensities ranging up to 10,000,000 lumens are encountered at the highest flash energies, considerable attenuation is required to limit the operation to the region of linear response of the multipliers. To provide a fixed amount of attenuation a piece of exposed photographic film is placed over the opening in the multiplier housing.

This article is abstracted from a paper entitled "Electrical and Radiation Characteristics of Flashlamps" by H. N. Olsen and W. S. Huxford, which appeared in the *Journal of the Society of Motion Picture and Television Engineers*, p 285, Sept. 1950.

Phonograph Needle Drag Distortion

MOTION of a phonograph needle in a direction tangental to the record groove will cause what is known as drag distortion. If present in a record playing system this distortion may result in spurious tones having greater amplitude than those originally recorded.

Phonograph records are usually recorded laterally, with the audio frequency motion of the needle at right angles to the groove. For accurate reproduction the playback needle should duplicate the exact motion of the recording stylus. If forces act on the reproducing needle to cause longitudinal motion, its movement will no longer duplicate

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that of the recording stylus and distortion will be introduced.

Some of the causes of this longitudinal motion are; the varying force that the sides of the groove exert on the needle; the pinch effect due to the uneven width of the record groove and the change in friction with changes in velocity and pressure of the needle in the groove.

In a series of experiments made by the National Bureau of Standards it was found that when playing a recording consisting of a pure tone of constant amplitude, drag distortion will produce only

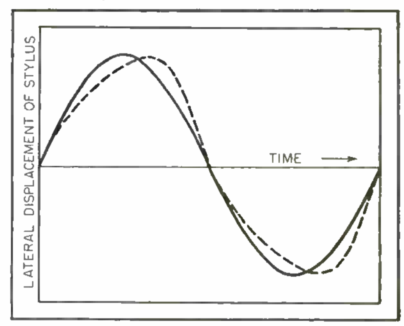

FIG. 1—Graphical reproduction of drag distortion in a pure sine wave recording. Solid line is path of ideal stylus having only lateral motion. Dotted line shows distorted path followed by needle free to move longitudinally as well as laterally

even harmonics with the second harmonic predominating.

Two methods were tried to measure the longitudinal motion of the needle. A photoelectric arrangment with longitudinal needle motion modulating a light beam did not prove satisfactory. The second method, in which the longitudinal movement frequency-modulated a 50-mc oscillator was found to be more accurate. Two small metal plates were mounted near the needle so that any longitudinal motion would vary the capacitance between the plates. With the plates connected across the tank coil of the oscillator, an f-m signal was picked up on a standard f-m receiver. When tuned properly, the output of the receiver varied with the instantaneous longitudinal position of the needle. A dual-beam oscilloscope indicated simultaneously both the

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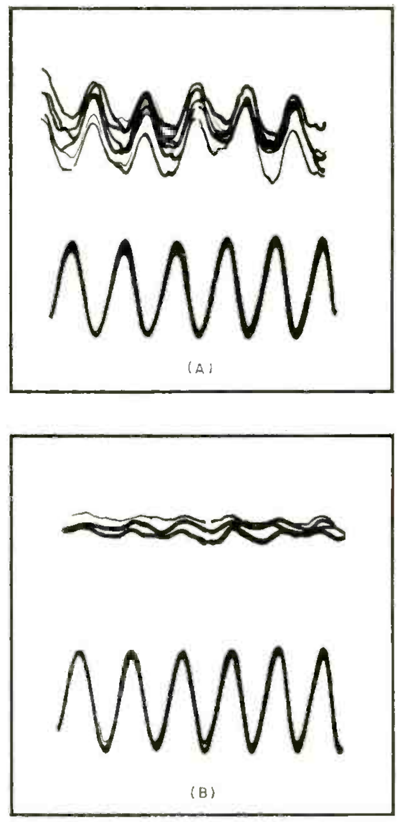

FIG. 2—Dual oscilloscope presentation with upper waveform showing longitudinal oscillation (A) at 300 cycles and diminished-amplitude waveform (B) with needle tied back. Improved lateral waveform (lower oscillogram) is apparent at (B)

longitudinal displacement of the needle tip and the output of the pickup.

In tests made with recordings of pure tones from 20 to 10,000 cps an unrestrained needle showed significant motion. When the needle was tied back with a piece of wire longitudinal motion was minimized.

Signal Generator System for Low Output Levels

By Jack W. Herbstreit

National Bureau of Standards
Boulder, Colorado

Low STANDARD signal generator calibration voltages were necessary for recent measurements of signal strengths of transmissions from Cheyenne Mountain in Colorado as received at points far beyond the radio horizon.

Primary object of the measurements, made in the frequency range 92 to 1,047 mc, was to es-

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tablish the interference levels to be expected in this frequency range. It was necessary to measure signal levels far below those which would ordinarily be considered useful for communications.

Narrow-band, crystal-controlled receivers were used to measure the signals transmitted from unmodulated crystal-controlled transmitters. Use of these narrow-band receivers effectively reduced cosmic and receiver noise levels at 100 mc to such an extent that useful measurements could be made of the available received signal energy at 170 db below one watt, corresponding to a 50-ohm signal generator output level of only 0.022 microvolts.

The method adopted was to use a heterodyning system with two standard signal generators and a crystal mixer, Fig. 1, the desired frequency being either the sum or difference frequency of the two signal generator frequencies[1]. Since the desired frequency is displaced from the output frequency of either of the signal generators, leakage fields from the signal generator are effectively eliminated.

When a square-law mixer is used, the output voltage at the sum or difference frequencies, E_{sd}, is directly proportional to the product of the two signal-generator voltages E_1 and E_2. When a linear mixer is used, the output voltage E_{sd} is proportional to the signal-generator voltage E_1 when $E_1 << E_2$ and also E_{sd} is independent of E_2.

In both cases, if E_2 is made much larger than E_1, the output voltage E_{sd} is proportional to E_1 when E_2 is fixed. The mixers actually used had over-all characteristics other than square-law or linear. The output voltage E_{sd}, however, was found to be proportional to the E_1 as long as E_1 was very small in comparison to E_2, since the mixing then occurred only over the very small portion of the characteristic curve which is essentially linear.

The fact that the mixer output voltage E_{sd} is proportional to the smaller input voltage E_1 is made use of in obtaining calibrated voltages from the mixer for calibrating signal-strength recording re-

ceivers at very low signal voltages. This may be expressed mathematically:

$E_{sd} = E_1 \times f(E_2)$ (1)

for mixers operating over an essentially linear portion of characteristic ($E_1 << E_2$). where $f(E_2)$ is, for a fixed value of E_2, simply a constant of proportionality.

The constant $f(E_2)$ is determined experimentally by direct calibration of the output voltage of the mixer against the output voltage of a standard signal generator tuned to f_{sd}, the same desired frequency as the mixer output. This calibration is made at a voltage level sufficiently high that leakage from the standard signal generator is effectively zero (say $E_{sd} = 10$ microvolts). At the same time, the voltages of the mixer signal generators at their fundamental frequency should be completely out of the receiver pass band on the fundamental or spurious response points and should not be so high or so close in frequency to the desired sum or difference frequency that the receiver is overloaded.

Figure 1 is a block diagram of the heterodyne standard signal-generator arrangement. A 1N34 crystal is used as the mixer. The 1N34 mixer with a load resistance of 50 ohms is approximately square law in the low signal range and thus $f(E_2) \cong kE_2$.

With this mixer, or any other essentially square law mixer, it is convenient to insert an appropriate attenuator pad in the output of the mixer and then adjust the output voltage E_2 until $f(E_2) = 0.1$ or 0.01 as determined by a direct calibration. Then the output voltage E_{sd} can be read directly on the attenuator of the signal generator supplying E_1 after multiplying by the appropriate decimal constant. With a constant $f(E_2) = 0.01$, E_1

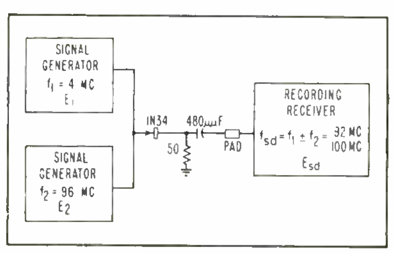

FIG. 1—Block-schematic diagram of heterodyne signal-generator method described in text

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PROPERTIES	UNIT	A-106	B-90	C-159	D-216	E-212	G-254	H-419	H1-1102	I-141	J-472
Initial Perm. at 1 mc/sec	–	20	95	250	410	750	410	850	550	900	330
*Max. Perm.	–	100	183	1100	1030	1710	3300	4300	3800	3000	750
*Sat. Flux Density	Gauss	1500	1900	4200	3100	3800	3200	3400	2800	2000	2900
*Residual Mag.	Gauss	1000	830	2700	1320	1950	1050	1470	1500	700	1600
*Coercive force	Oersted	5.0	3.0	2.1	1.0	.65	.25	.18	.35	.30	.80
Temp. Coef. of initial perm.	%/°C	.15	.04	.40	.30	.25	1.3	.66	.80	.30	.22
Curie Point	/°C	300	260	330	165	160	160	150	125	70	180
Vol. Resistivity	ohm-cm.	$1x10^7$	$2x10^5$	$2x10^6$	$3x10^7$	$4x10^5$	$1.5x10^8$	$1x10^4$	$2x10^4$	$2x10^5$	$5x10^7$
Loss Factor: At 1 mcs/sec	–	.0005	.00016	.00007	.00005	.00008	.00008	.00030	.0004	.0003	.000055
At 5 mcs/sec	–	.0007	.0011	.0008	.0012	.002	.00075	.00155	.001	.005	.0004

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

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is set at 100 microvolt for E_{sd} = 1 microvolt and E_1 is set at 1 microvolt for E_{sd} = 0.01 microvolt.

An example of the calibration procedure for the mixer signal generator in Fig. 1 is as follows: A calibrated 92 or 100-mc standard signal generator is connected directly to the input of the 92 or 100-mc recording receiver and adjusted to a convenient signal level E_{sd} which is appreciably above leakage, say 10 microvolts. The output reading of the measuring receiver is recorded as the reference output. The calibrated standard signal generator is then removed and the mixer signal generators shown in Fig. 1 are substituted.

For $f(E_2)$ = 0.01, E_2 is set to an output voltage 100 times that of the calibrated standard signal generator voltage used to obtain the reference output (E_2 = 1,000 microvolts when E_{sd} = 10 microvolts). Voltage E_1 is then adjusted to a convenient value greater than 10 times the highest E_2 which is expected to be used and an appropriate attenuator pad is selected so that the receiver again has the reference output. For these particular values of E_1 and attenuator pad, the mixer output voltage will be 0.01 E_2.

Other useful applications of the heterodyne principle described above in laboratory receiver measuring procedures are for bandwidth measurements at very high frequencies and as a method for tuning relatively unstable high-frequencies signal sources to a narrow bandwith receiver. In both of the latter mentioned cases, frequency of E_2 is set relatively close to the desired frequency and the frequency of E_1 is a relatively low frequency. Relatively high percentage changes in frequency of E_1 are then small percentages of the desired frequency. This permits much greater ease in adjustment to the final desired frequency. For even better frequency stability, voltage E_2 may be derived from a crystal-controlled source.

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(1) G. F. Gainsborough, A Method of Calibrating Standard-Signal Generators and Radio Frequency Attenuators, *Jour. I.E.E.*, 94, p 203, 1947.

(2) F. E. Terman, "Radio Engineers Handbook", McGraw-Hill Book Co., Inc., New York, 1943, p 565.

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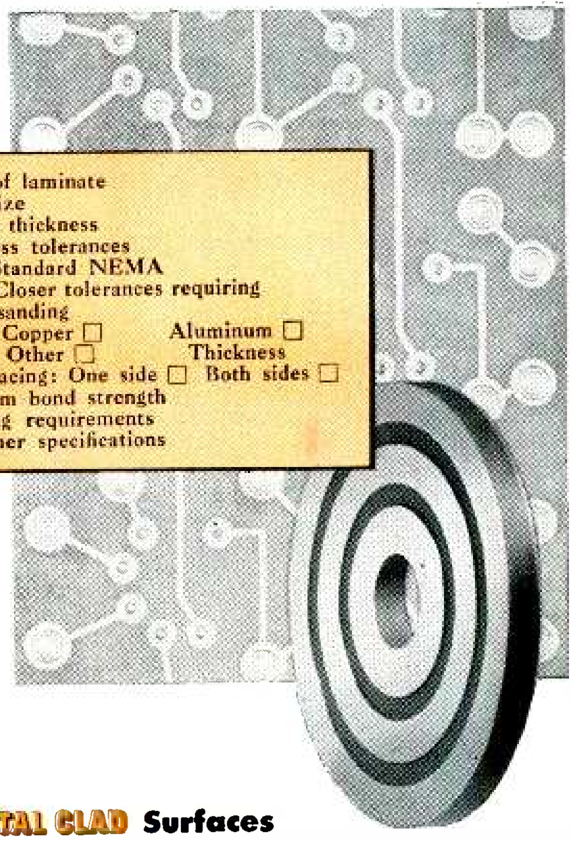

Grade of laminate
Sheet size
Overall thickness
Thickness tolerances
a. Standard NEMA
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Metal: Copper ☐ Aluminum ☐
Other ☐ Thickness
Metal facing: One side ☐ Both sides ☐
Minimum bond strength
Punching requirements
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Did you know that C-D-F supplies a full range of metal clad laminates in both Dilecto and Teflon grades? With mounting interest in printed circuits it pays to consider the respective advantages of these new C-D-F materials . . . it also pays to line up all the Information Wanted facts and discuss your specific application with your C-D-F sales engineer (Offices in principal cities). He's a good man to know!

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Teflon* METAL CLADS

Glass fiber cloth is first coated with Teflon resin and laminated into C-D-F GB-112T sheet stock. This base withstands high heat (200°C. maximum operating temperature) with the dissipation factor and dielectric constant extremely low over a wide frequency range. No adhesive film is needed to bond metal to the Teflon laminate, thus the inherently good electrical properties of the core material are maintained. GB-112T has practically zero water absorption, so a METAL CLAD with this core offers consistent high insulation resistance with excellent stability of dielectric loss properties.

METAL CLAD Surfaces

Copper foil (usually .00135" or .0027" thick) is bonded on one or both faces of the sheet grade of Dilecto selected. The foil used is a special grade of electrolytic deposition copper particularly adaptable for cementing onto laminated materials. An adhesive film is placed between the metal and the Dilecto, and cemented during the pressing and curing cycle. When closer tolerances are required C-D-F sands the Dilecto to the required thickness before bonding. Aluminum, silver, or other alloys of various metals may be supplied.

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One of the most important physical properties of a metal clad product is its peel strength, the pounds pull required to separate the foil surface from the core material. Working with years of laminating know-how, C-D-F has been successful in obtaining the following average test values for its METAL CLAD sheet stocks:

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XXXP-26 plus .0027" copper . . .	7 to 10
XXXP-26 plus .0015" aluminum ..	9 to 12
GB-112 Teflon plus .00135" copper ..	6 to 9

Sheet sizes: Dilecto grades — 38 x 38", 38 x 42"
Teflon grades — 16 x 36"

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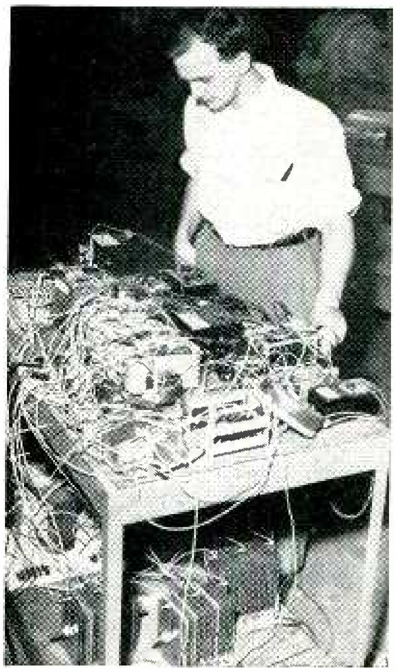
Production Techniques

Edited by JOHN MARKUS

OTHER DEPARTMENTS featured in this issue:

Magnetic Amplifier Breadboard



Appearance of breadboard setup for two-stage self-excited magnetic amplifier voltage regulator being designed for use in the atomic-powered submarine Nautilus

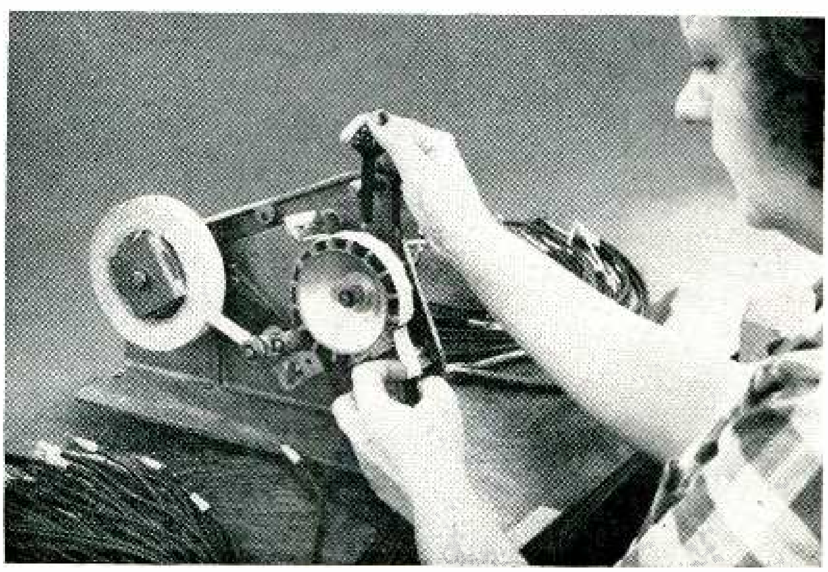
WHEN TRYING out new magnetic amplifier circuit arrangements in Bogue Electric's Paterson, N. J. plant, engineers use sheets of quarter-inch Pressdwood as the chassis and a two-level steel caster-mounted table as the chassis frame. Most parts are heavy enough to stay in position without need for mounting. Brackets of wire-wound resistors and other smaller components are fastened to the Pressdwood with small metal screws. All connections are made to terminal screws on the parts, using leads having spade lugs or eyelet lugs. Interconnections are made on terminal strips having pairs of screw terminals, just as in the final design of industrial magnetic amplifiers.

Automatic Cutter and Splitter for Adhesive Tape

AN AUTOMATIC dispenser that slits tape into narrower strips and simultaneously cuts the tape to desired lengths is used in the Crosley Division of Avco Mfg. Corp. to make one roll of tape go twice as far. The machine permits purchasing economical one-inch-wide pressure-sensitive tape, reducing tape costs and tape handling time as compared to use of half-inch rolls of tape.

The machine is set to cut the tape into 1½-inch lengths for wrapping around the end of coaxial cable after stripping. One movement of a hand lever on the dispenser ejects a length of tape for immediate application to the cable in this television receiver subassembly operation.

The tape dispenser is commercially available as the Big Inch model 4-0, manufactured by Bitter Packages Inc., Shelton, Conn. It can be set to slit one-inch tape into two, three or four narrow strips by loosening a thumbscrew adjustment and flipping appropriate



Automatic dispenser with side cover removed. Cutoff blade at top of spoked wheel is operated by hand lever simultaneously with tape feed mechanism. Slitter blades are under spoked wheel, behind thumb screw

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blades into position. When the full width is required, all blades may be disengaged. The tape cutoff blade may be set to give 1 in., 1½ in., 2 in. or 2½ in. lengths. The machine is designed to take 6½-in. diameter rolls.

Trays for Precision Parts

MULTIPLE-CAVITY plastic trays are being used to protect delicate precision parts when transferring them from one operation to another on production floors. Plastic covers are provided for use when individual trays are handled. One company uses only the bottoms for interdepartmental handling, as the trays are designed with interlocking construction for easy stacking. Each tray then forms a cover for the tray underneath.

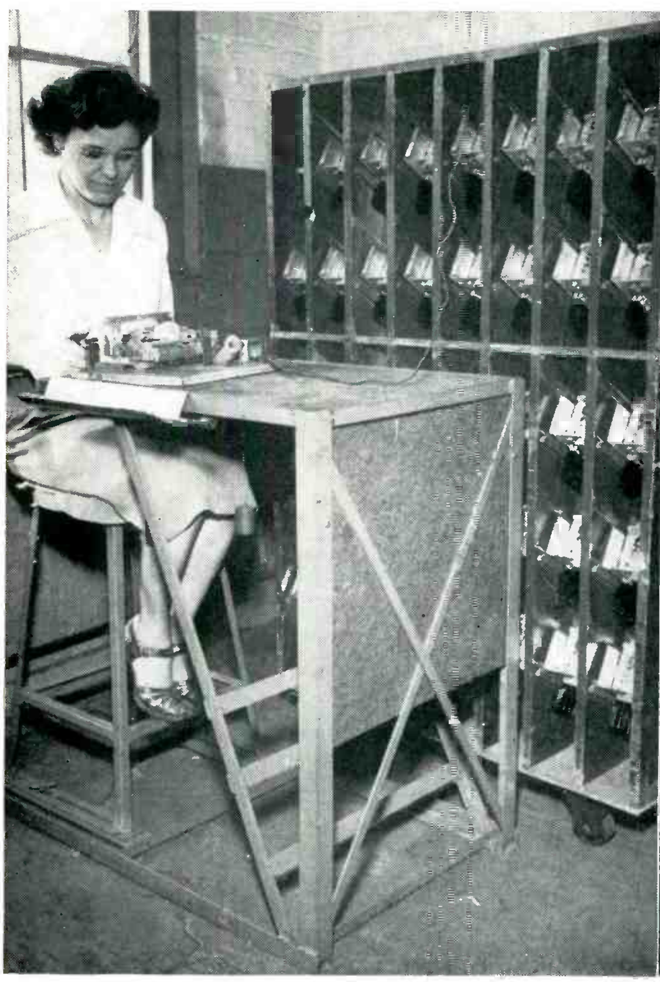
Examples of plastic parts-handling trays fabricated to order by Mercury Plastics, Springfield, Mass.

The new parts trays are produced from a low-pressure formable plastic sheet material known as Boltaron, which is chip-proof, acid-proof and oil-resistant. Availability of the material in a large variety of colors permits color-coding for individual departments. Inventory of a day's production is simplified and readily accounted for because each tray holds a definite number of parts.

Easy-to-Reach Storage Racks and Trays

MAKING NEEDED materials easily available to workers is one important goal of production engineers at this time. With labor costs rising, a saving of as little as one second in time needed to reach for a chassis or part can amount to a substantial yearly boost in output and lowering of cost.

Chassis-transporting racks using inexpensive wood construction are equipped with rubber-tire casters in Sylvania's Buffalo plant, for movement of auto radio tuner units. Two casters are fixed and two are on swivels. The slides on which the tuners rest are slanted inward so no unit can fall out. The capacity of



Tuner-storing rack and movable inspection table

Hand-carried racks for housings

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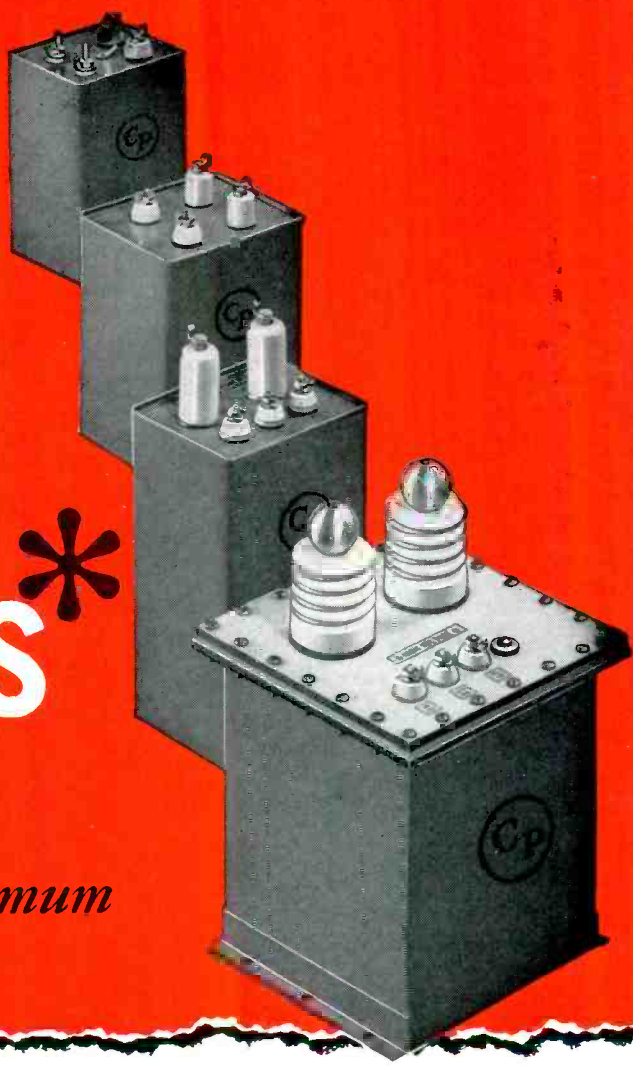

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the rack is doubled by arranging to load from both sides, with a sheet of Masonite serving as a divider in the middle.

An additional doubling of flexibility and efficiency is achieved in the same plant through use of movable combination chair-tables for inspection of incoming material. These can be slid easily by one man to any desired location. The metal-frame stool, of conventional design, is welded to slotted plates that fit over the table frame. By loosening two knobs, the operator can slide the stool toward or away from the bench to the most comfortable position, then lock the stool in place. An extension cord plugging into a nearby power outlet brings power to the bench when needed for a test set. The entire table assembly is slid out of the way when not needed.

Wooden tote boxes with a somewhat similar slanting-shelf arrangement are used in the plant of Argus, Inc. for transporting and storing various assemblies. Here the racks are smaller, have no casters, are accessible from only one side, and are carried by means of a handle fastened to the top. Wood crossboards at the base minimize tipping of the rack.

Hundreds of transparent boxes on wood racks are used for stocking precut lengths of various sizes of

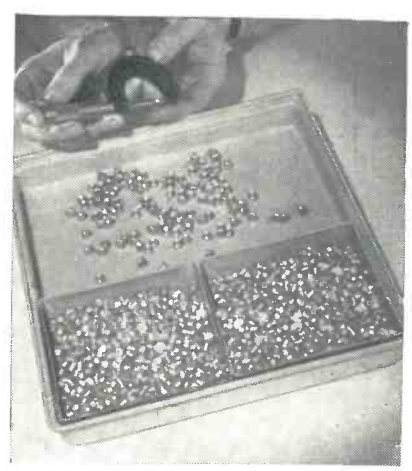
Rack for plastic boxes containing precut wires

Closeup of wire-storing boxes

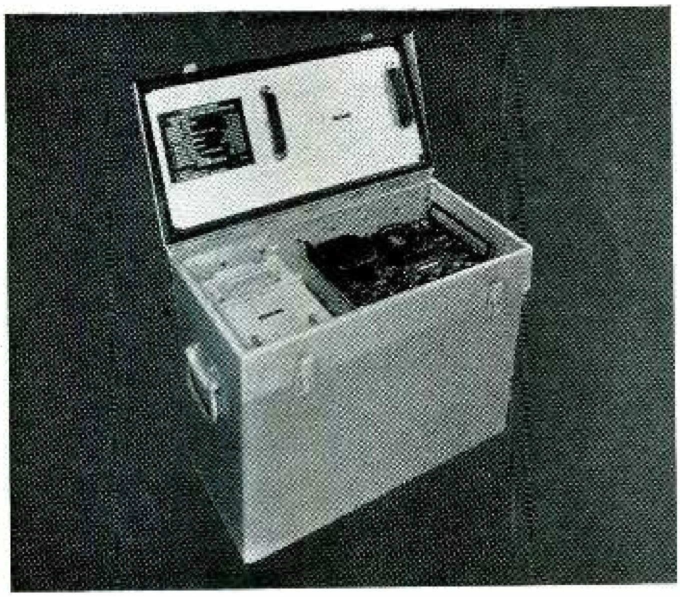
wire in the Ampex plant in Redwood City, California. The wires are machine-cut in quantities and stored in the plainly marked boxes, making it a simple matter for workers to select the materials needed for construction of wiring harnesses. Gummed stickers are used as labels. In the quantities employed, the rectangular boxes cost about 12 cents each; these are approximately 3 inches wide, 7 inches long and 1½ inches high including their covers. The circular boxes, approximately 6 inches in diameter and 1½ inches high, cost about 15 cents each. The source of supply was Southern California Plastic Co., Glendale.

The real advantage in using these plastic boxes is that no complicated system of inventory control of precut wires is needed. The person in charge of the department can tell at a glance which boxes need a new supply of wire, with no need to open the boxes.

A definite procedure is used for withdrawing wire from the storage rack. When the lead man on an assembly line needs a given size and length of wire, he takes an unmarked plastic box over to the rack, fills it from the appropriate storage box.



Plastic inspection tray set




NE-11-20-S SPECTRUM ANALYZER

Description

The Spectrum Analyzer is test equipment designed primarily for use with aircraft radar and beacon equipment operating over a frequency range of 8470 to 9630 mc/s. Housed in a compact portable carrying case, the whole assembly weighs approximately 90 pounds.

In operation, the Spectrum Analyzer displays on an oscilloscope a pattern representative of the distribution of energy among the various frequencies in the output of a pulsed oscillator. This equipment is equal to our government models TS-148/UP.

Applications

This very sensitive micro-wave receiver will provide accurate measurement of the spectra of radio frequency oscillations in radar and beacon equipment. It will also measure, within its own range, frequencies of echo boxes, magnetrons, test sets, local oscillators and a variety of resonant cavities. It can also be used to check magnetron pulling and AFC circuits, and as a frequency-modulated oscillator to tune T/R Boxes and R/T Boxes in transmitter-converters.

The Analyzer is so sensitive that the magnetron signal can usually be picked up at some distance from the source, thus making the equipment easy to use in any convenient location.

Specifications

Power Supply	50-1200 Cps; 105-125 Volts; 125 Watts
Frequency-meter Range	Calibrated directly from 8470 mc/s to 9630 mc/s
Sweep Frequencies	Continuously Variable from 10 to 30 Cps
Attentuation (Spectrum Amplitude)	Uncalibrated. Variable from 3 to 70 db.
Operating Temperature Range	—40°C. to +55°C.
Frequency swing of analyzer r-f oscillator (sawtooth FM)	40 to 50 mc/s
Overall i-f bandwidth at half power points	50 kc/s

Sensitivity to CW — Spectrum Amplified Pos. — 80 db. below 1 watt for 1 inch of deflection on Oscilloscope Screen.
— Spectrum Position — 55 db. below 1 watt for 1 inch of deflection of Oscilloscope Screen.

Maximum dispersion of spectra	1.5 mc/s per inch
Maximum error	± 5 megacycles

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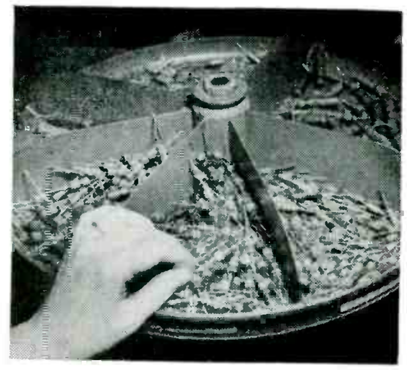


Rotating holder for small parts

then marks the length and size of the wire on his own plastic box with a grease pencil. When the assembly run is completed, he returns the unused wire to the proper box on the storage rack and erases the grease pencil mark from his box, leaving it free for another use.

Plastic tray sets without covers have recently been made available in a nonchipping Boltaron plastic that is light in weight, durable, and noncontaminating. When used for inspection, the insert trays are set into the larger tray for segregation of rejects. At assembly-line work positions, the insert trays can hold hardware and small parts within easy reach of the operator. The trays are available in various colors from Durable Formed Products, Inc., 6 Greene St., N. Y. C.

Another type of work-position tray, seen at many bench positions

Transferring materials from stockroom bins to containers on cart

23,698

HOURS of SERVICE

...and still no change in Performance Quality!

That's what Earl F. Lucas, Chief Engineer

WPAT

Paterson, N. J.

says about

Federal's F-5680

2.5 KW POWER TRIODE

WPAT
NORTH JERSEY BROADCASTING COMPANY, INC.
93 on your dial
66 HAMILTON STREET, PATERSON 1, NEW JERSEY
ARmory 4-3400

October 7, 1952

Mr. C. J. Harrison,
Federal Telephone and Radio Corporation,
Transmitting Tube Division,
100 Kingsland Road,
Clifton, N. J.

Dear Mr. Harrison:

It may be of interest to you to know of the performance of your type 5680 tubes in our Federal type 196-A AM transmitter.

To date the original tubes show a total of 23,698 hours of service, and are still going strong. Periodic comparison with our spare tubes shows no performance differences, so I anticipate many more hours of use.

Very truly yours,
Earl F. Lucas
Chief Engineer

Here's another record of the long life and operating stability of Federal Tubes!

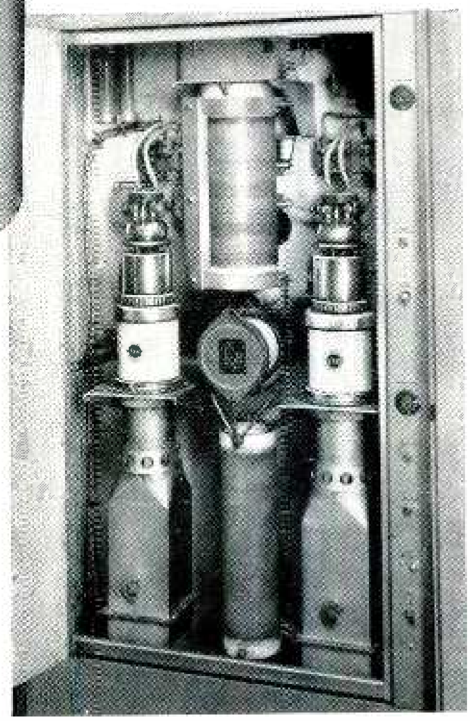
STILL on the job after 23,698 broadcast-hours! That's the record Federal's F-5680 has scored to date for WPAT, popular 5,000-watt station of the North Jersey Broadcasting Company, Inc.

Moreover, says Chief Engineer Lucas, "periodic comparison with our spare tubes shows no performance differences, so I anticipate many more hours of use."

Based on amazing service records of other Federal broadcast tubes, WPAT's F-5680 should be on the job *for years to come!*

Here's *proof* of the solid-rock ruggedness and dependable performance built into *all* Federal tubes by Federal craftsmen—drawing on tube design and production experience dating from the very birth of the industry...*on experience with hundreds of broadcasters!*

Get the facts of longer-life Federal tubes...write to Dept. K-813.



Federal F-5680 Power Triodes— in WPAT's Federal 196-A AM Transmitter—providing one of the most powerful signals in the New York-New Jersey area.

"Federal always has made better tubes"

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Federal Telephone and Radio Corporation

VACUUM TUBE DIVISION

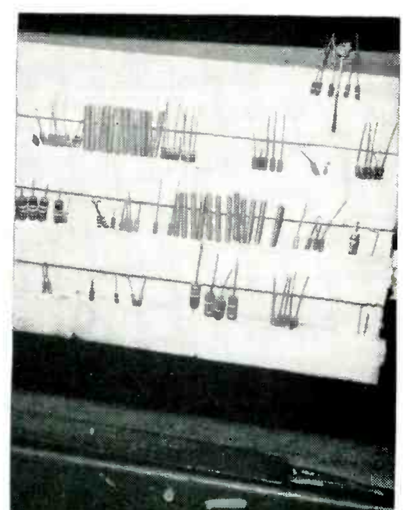
100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

Loading work-position racks from supplies on cart

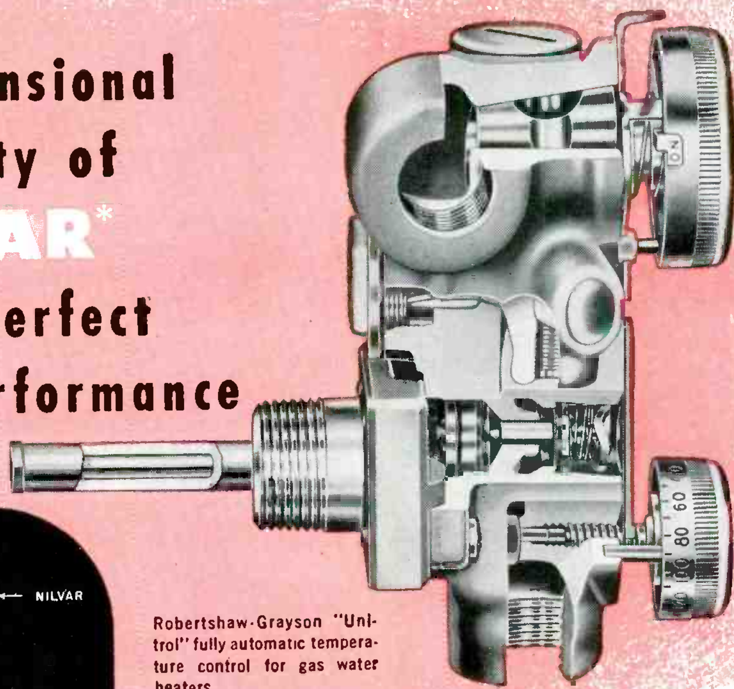
in Sylvania's Buffalo plant, is the Rota-Bin. Based on the theory that in high-speed production you pay for reach, this tray brings from 4 to 8 different types of small parts within the same constant reach distance of the operator. The tray has four permanent dividers, and four more can be inserted at the 45-degree positions to give 8 compartments in all. The tray turns freely on its vertical shaft. Masking-tape labels on the rim identify the contents of each compartment for stock boys as well as for operator.

The close relationship required between stockroom and assembly line for continuous output of electronic products has received major attention in RCA's Camden plant. Elaborate self-nesting stock bins with hinged doors are stacked up



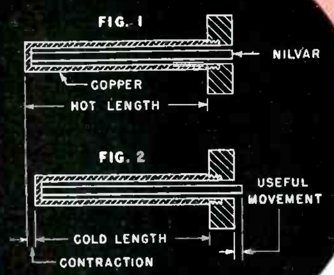
Repair-parts holder made from corrugated cardboard

The Dimensional Stability of NILVAR* Spells Perfect Product Performance



Robertshaw-Grayson "Unitrol" fully automatic temperature control for gas water heaters

Schematic diagram shows how useful movement of Nilvar rod corresponds faithfully to the dimensional changes of the copper tube.



How Robertshaw-Fulton built a better Water Heater Control with Driver-Harris NILVAR

The new "Unitrol" Robertshaw-Grayson gas water heater control streamlines three essential controls into one valve body: a snap action thermostat, a snap action pilot, and a large-capacity gas cock. This reduces inventory for the water heater manufacturer and simplifies part stocking for the dealer.

The "Unitrol" provides a thermostat capable of delivering maximum amount of useful movement, by employing a copper tube enclosing a Nilvar alloy rod. The tube expands and contracts very appreciably in response to immersion temperatures. But the Nilvar rod, because it is dimensionally stable, does not vary in length. Since the free end of the Nilvar rod actuates the working gas valve, the slightest movement of the temperature-sensitive copper tube is fully utilized to control flow of gas to the burner.

Says Robertshaw-Fulton: "The outstanding dimensional stability of Nilvar actually permits minute changes in water temperature to regulate the heat supplied by the burner, thus assuring extremely accurate operation."

Nilvar has a temperature coefficient of expansion as low as .000001 per degree C., lowest of any alloy; comparable to that of quartz. Somewhere in your engineering operations such extraordinary dimensional stability may solve a problem—help to perfect product performance. We shall be glad to make recommendations based on your particular needs.

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

Nilvar is produced only by

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

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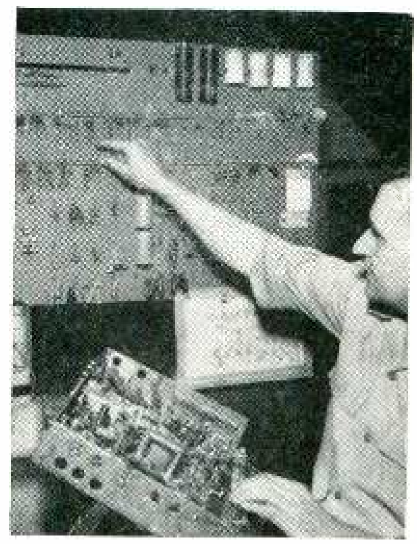
from the floor to a height of about 7 feet in the stock room. Each bin has its own prominently displayed number, keyed to a master list identifying its contents. Parts are transferred from the bins to bags and boxes on a caster-mounted truck resembling a tea cart. From this cart, the stock man refills bench-position trays as he moves down the assembly line one or more times a day.

Two ingenious ways of keeping a large number of different types of parts within easy reach at repair positions may be seen in Sylvania's Buffalo plant. The simplest version uses corrugated cardboard as a backing sheet. Strips of corrugated cardboard are cemented to this horizontally, to provide vertical individual receptacles for the leads of resistors and capacitors and for shafts of tuning slugs. The entire parts-storing sheet is wired to a metal strut alongside the test position.



Plywood repair-parts holder

The more elaborate rack uses a plywood backboard having a variety of supports. Long springs threaded through screw eyes stretch horizontally across the rack, with leads of small parts pressed between the turns of the springs. Spring clips, sometimes called tool holders, are used to support spare electrolytics. Other parts are hung on cup hooks, wood pegs and steel nails. A wood

HOW MANY *db*- AT 5,000 MEGACYCLES? AT 25,000 MEGACYCLES?

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The use of metallic-film-on-glass techniques to provide attenuation at microwave frequencies is no longer new. This type of PRD attenuator is now well recognized for its constancy of attenuation with time as well as for its insensitivity to variations of humidity and temperature.

PRD has now augmented this line of attenuators with units employing metallized mica elements to provide broader-band characteristics for the millimeter region of the microwave spectrum. As a consequence, it is now possible to offer complete coverage of the range from 2,600 to 40,000 megacycles per second in designs varying from a simple level set attenuator to a precisely calibrated secondary standard. Write today for our complete new catalog of microwave test equipment — address Dept. E-1.

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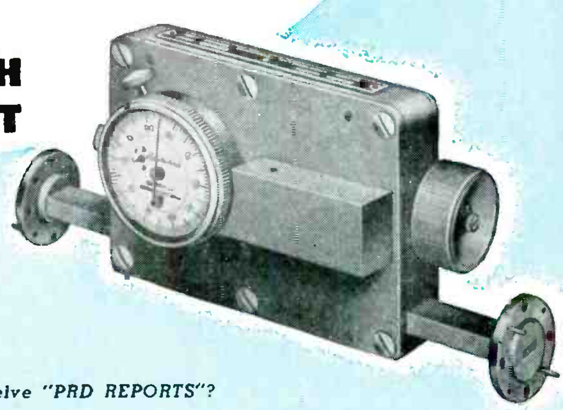

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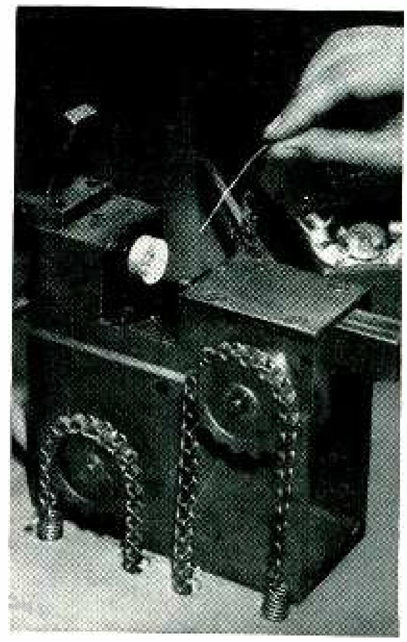
strip with drilled-out recesses provides individual shelves for spare potentiometers.

Chains Aid Soldering

TO IMPROVE the accuracy of positioning when soldering the antenna loop in the cavity of a pencil triode, foot-operated chain drives are used to bring the loop up to position and bring up a needle-point gas flame. The operator then applies solder by hand. Both feet thus participate in the soldering operation, giving the equivalent of four hands as is



Setup for soldering antenna lead inside cavity for RCA uhf pencil triode. Solder is applied to inside wall of cavity after needle-point gas flame at right end of fixture has heated wall from outside

so often needed for intricate soldering operations.

As shown in the photo, the chains work against springs that move the positioning lever and gas flame out of the way for unloading and loading.

The positioning lever moves the right-angled piece of antenna wire to the correct position for a butt joint to the cavity wall. The gas flame moves up to the outside of the wall in this region, to heat the wall so solder will flow down it to the butt joint without disturbing

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for Value — for Service — for Dependability

FIRST IN COMMUNITY TV: this ultra-rugged Synkote coax cable (RG 59/U and 11/U) is *double-shielded* and *double-jacketed*, transmits signals over long distances with virtually no radiation losses.

NEW FOR UHF: Synkote "Ovaltube" twin-lead is a tubular air-dielectric construction, features low attenuation. Fits ordinary hardware, can be made weathertight in seconds. Uniquely practical, nothing else like it.

30 CONDUCTOR CABLE: — a Synkote custom-engineered cable designed and manufactured from simple specifications *read over the telephone*. Difficult-looking, but "duck-soup" to Plastoid engineers.

"JUMBO" TWIN-LEAD: — 185 mil web—the strongest TV lead-in ever introduced. Withstands gales, extreme heat, cold and humidity. Low loss — gives excellent reception in fringe areas.

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You want to be sure that the wire you buy will give dependable service. SYNKOTE wire is *warranted by Plastoid* to be made of the finest materials, and will meet all applicable specifications.

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Possibly, you may know what general characteristics you desire, but not how to put these into wire. Plastoid's large staff of engineers can transform your generalized requirements into a finished wire or cable. Simply give us your electrical and physical requirements — we'll design the cable.

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Plastoid's modern manufacturing facilities mean faster production . . . more rapid deliveries to you.

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Remember, "bargains" seldom save you money. In the long run, it pays to pay a fair price and get dependable wire. For true wire economy specify SYNKOTE — manufactured only by Plastoid Corporation, Long Island City, New York

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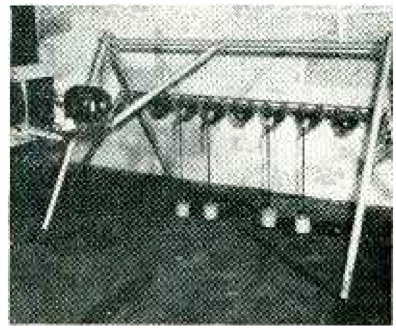
the position of the antenna lead. The part is ejected by a hand lever, falls into a chute and slides into a tray.

This soldering setup is used in the Harrison, N. J. plant of the RCA Victor Division.

Cable Life Tester

AN ELECTRIC motor drive imparts an oscillating movement to a horizontal pipe from which handset cable connectors are suspended, for life tests of the sleeves that serve as waterproof gaskets through which



Setup used by Utility Electronics for life-testing up to seven cables at a time. Weights are heavy enough to pull out cables when breaks occur

the cable enters the connector. A weight suspended from each cable holds it vertical as the overhead rod moves back and forth over a 90-degree arc. The cable connectors are attached to standard cable receptacles mounted on brackets that are in turn fastened to the pipe with U bolts.

Tube-Holding Tool

INSERTION of miniature tubes in radio receivers is simplified by use of a Crosley-designed holding tool. A solid fiber or Formica rod slightly greater in diameter than the tubes was drilled out at one end to the diameter of a miniature tube. The other end was drilled to take the shank of a screwdriver with a tight fit. Four slots were then cut in the tube-holding end to a depth of 1½ in., and rubber bands placed around this end to obtain tube-gripping action.

With this tool, the operator can easily remove a tube from the rack-supported cartons at the back of the bench, even though the tubes are

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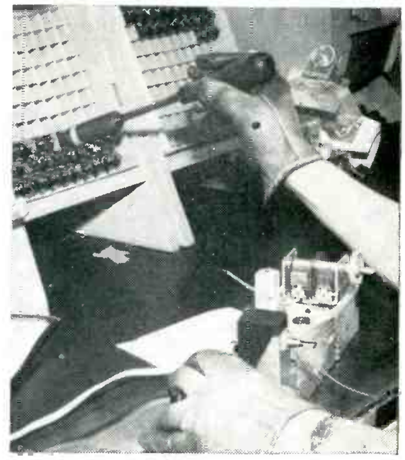

Picking tube out of carton with holding tool

beyond convenient arm reach. Once a tube is picked up, the tool can easily be turned in the fingers to align the tube correctly with respect to the socket.

When the tube is pushed in with the tool, socket contacts grip the pins tightly enough to hold it while the tool is withdrawn. A felt pad inside the tool permits applying pressure to the top of the tube without danger of breaking the glass tit.

Jig Borer Speeds Die-Making

FLAT DIES for punching chassis holes or stamping out parts for electronic components can be made without preliminary layouts on the

Use of new jig borer in Sylvania's Buffalo plant for drilling required holes in punching die for auto-radio switch contact

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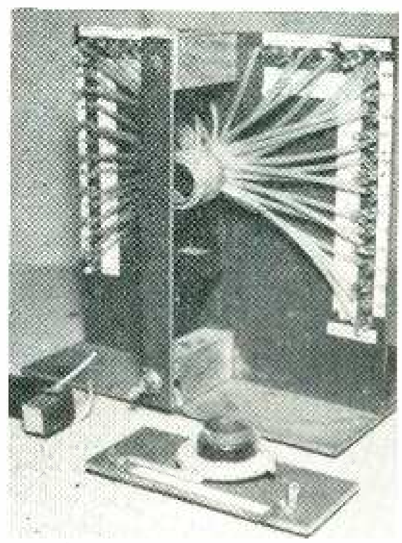
metal, through use of a precision jig borer made by Moore Special Tool Co., Inc., Bridgeport, Conn. The only requirement is that all dimensions on the layout drawing be made with respect to the left side and rear of the die.

After the die stock is locked in position on the carriage of the machine, the two crossfeeds are zeroed in with respect to the left and rear sides of the stock. Now, by setting the precision micrometer dials on the crossfeed wheels to the indicated blue print coordinate values, the operator can center the drilling spindle precisely over the desired location. This eliminates laying out and marking the center of each hole beforehand.

Transformer Designer

DESIGN of exactly the optimum horizontal output transformer for a new television receiver circuit is achieved in a few minutes without calculations through use of special test transformers developed by CBS-Columbia engineers. Two models are in use, differing primarily in mechanical construction. Both have 42 taps on the primary winding, one with 15 turns between taps and the other with 18 turns between



Rear view of early model of test transformer, with half of core removed. Core is replaced after swinging Bakelite locking strip out of way and placing secondary coil (in foreground) over other leg of mounted half of core. Each tap is labeled with number of turns from start of primary lettered on masking tape

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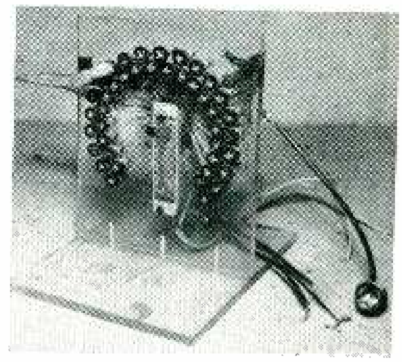


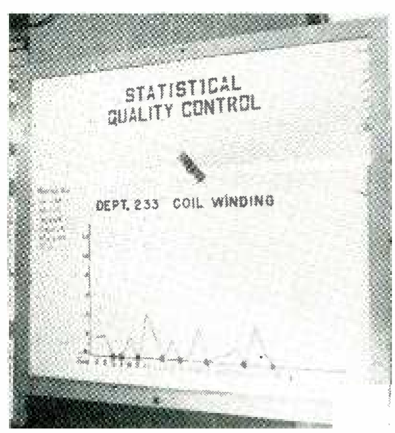
Deluxe version of test transformer, mounted on Lucite panel

taps. Both permit quick removal of half the Ferroxcube core for changing the secondary coil. The earlier model has terminals for taps, while the refined version has jacks into which a test lead can be inserted for quick change of primary coil design.

The test transformer is connected directly into the television receiver circuit, with its top cap connector going directly to the top cap of the horizontal output tube.

Plastic-Faced Quality Chart

TRANSPARENT plastic sheets mounted over large inked charts permit using the charts over and over again on statistical quality control bulletin boards in Crosley Division's Cincinnati television receiver plant. Hourly or daily records are plotted on the plastic covering with a china marking crayon, using a ruler as a guide. These can easily be wiped off with



Example of monthly quality control chart with plastic facing. Working days in month are hand-crayoned on plastic as horizontal scale

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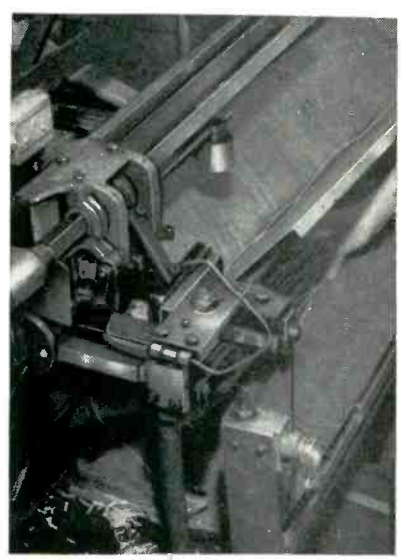
a cloth at the end of the time period for the chart, to put on new scale values and new curves. A thumbtack with the letter Q on it is pushed in each time the curve hits zero, to emphasize perfect work. Monthly averages are added in crayon at the left of the chart.

Cutting and Stripping Long Leads

ADDITION of a solenoid-operated V trough at the output end of a standard Artos wire cutting and stripping machine makes it possible to catch and collect long wires automatically without getting them tangled. This enabled one operator to handle three such machines in Crosley's Cincinnati television receiver plant.

In one setup, the machine makes two 14½ in. passes and then cuts, to obtain a 29 in. lead. This lead slides down the added V trough smoothly because of the downward slant and smooth surface of the trough. After cutting, solenoids pull the hinged sides of the trough apart, dropping the lead neatly on a collecting table underneath. Two snap-action switches were added to the machine to insure that the trough opens only after the wire has been cut and not after a pass.

In contrast, a new model CS-10 machine for cutting long leads is also shown. This machine, made by Artos Engineering Co. of Milwau-



Standard Artos machine with a V trough for catching long leads

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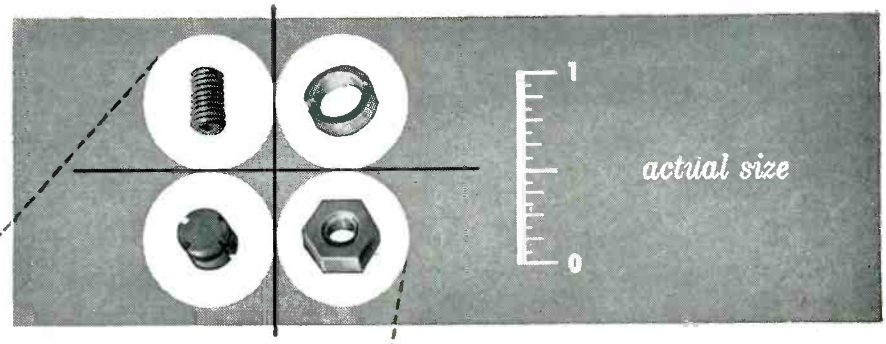

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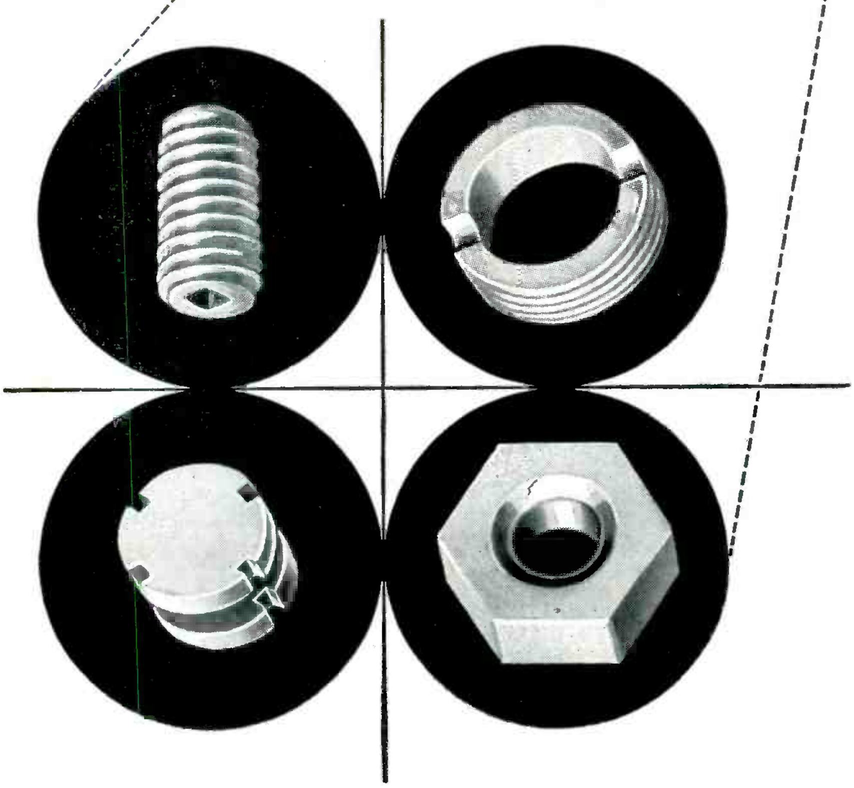
iron cores



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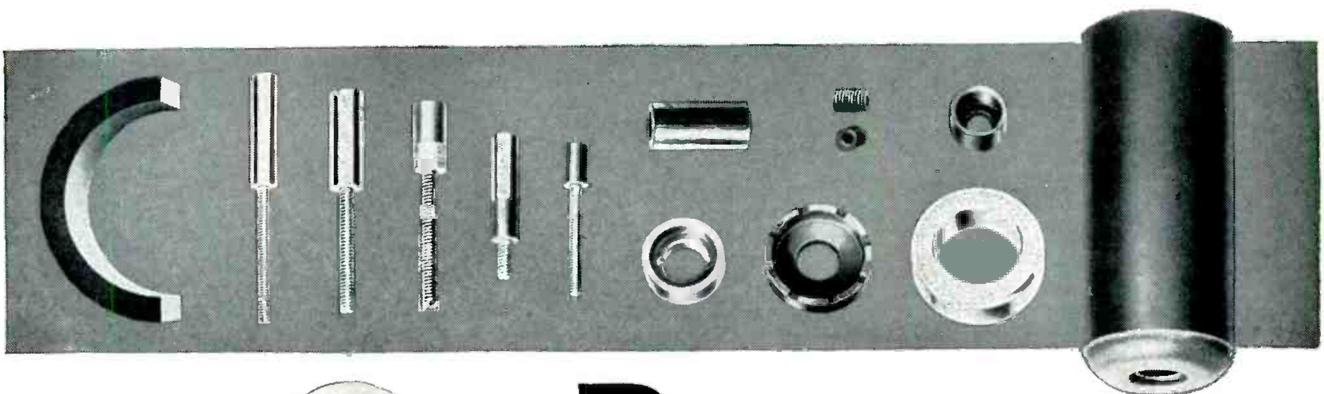
PYROFERRIC services are available for the engineering of your core production requirements . . . your letterhead request for Catalog 22B will bring you complete information including the manufacture of iron cores, their electrical properties, materials, design considerations, standardization data, uses and other helpful information.



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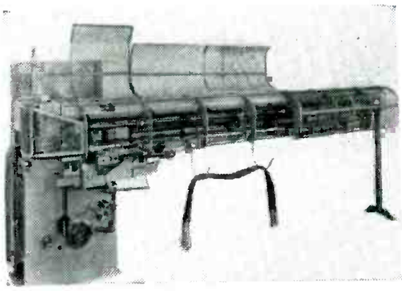
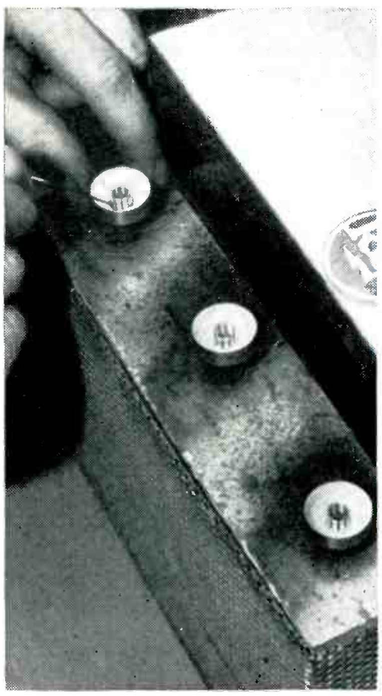


Special machine for automatically cutting and stripping leads up to 45 feet long

kee, Wis., is available in six different models having various cutting ranges and production rates. Three of the models are capable of cutting 400 45-foot lengths per hour, and up to 1,200 pieces per hour in shorter lengths down to a minimum of 40 inches. These machines use a travelling gripper to pull out the desired lead length, and have hooks to catch and collect the cut wires.

Three-Iron Soldering

THREE soldering irons are mounted with points up to speed soldering of contacts to cavity sections for the RCA type 5794 fixed-tuned



Protective metal cage encloses three vertically mounted electric soldering irons having machined tips on which three cavity sections are resting oscillator triode for 1,680-mc radiosonde service. The operator solders at one position while the other two positions are heating. She then removes the soldered piece, replaces it with an unfinished piece and proceeds to solder at the next position.

A heavy asbestos top plate minimizes burning of fingers as the operator removes soldered pieces and places new ones over the appropriately machined tips of the soldering irons. Three working positions give sufficient time so the operator can solder, unload and load continuously.

Capacitor Test Set

INCOMING INSPECTION of capacitors to check for adherence to tolerances is carried out with a rugged bridge-type test set in the Tarrytown, N. Y. plant of Simmonds Aerocessories Inc. Preliminary sorting and checking facilitates production of electronic fuel gages by making available the exact capacitor values needed.

The bridge is constructed in

Using test bridge to check values of mica capacitors. After value is measured, operator uses rubber date stamp to stamp exact value in $\mu\mu f$ directly on the capacitor, then places each capacitor on the stack having that value. Units on bench range from 1,947 $\mu\mu f$ at lower left to high of 1,990 $\mu\mu f$ at lower right, with each pile having a different value three sections for easy servicing. The 5-kc oscillator circuit is shown in Fig. 1, the bridge circuit is shown in Fig. 2 and the null detector in Fig. 3. The accuracy achieved with these circuits is plus or minus 3 μμf from 50 to 4,000 μμf. Continued accuracy is assured by frequent checking against labo-

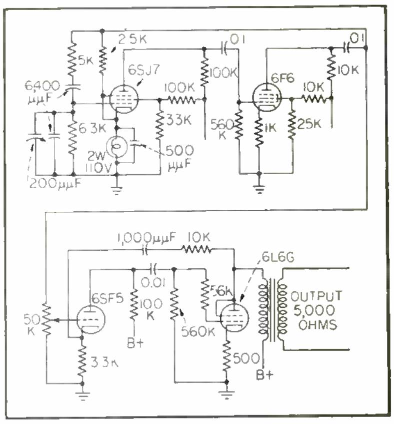


FIG. 1—Circuit of 5-kc RC oscillator

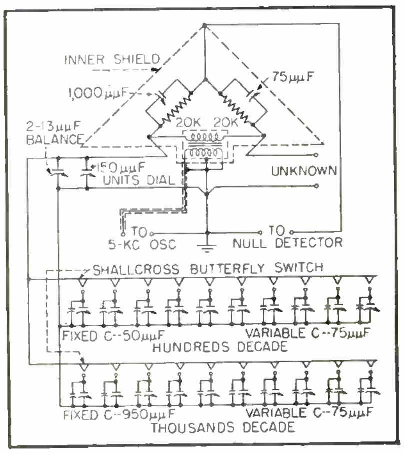


FIG. 2—Capacitance bridge circuit

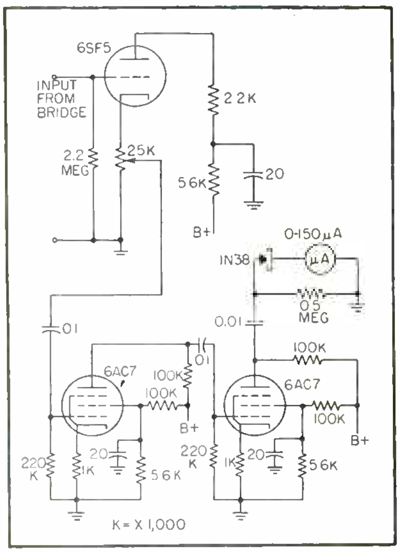


FIG. 3—Circuit of null detector used with capacitor test bridge

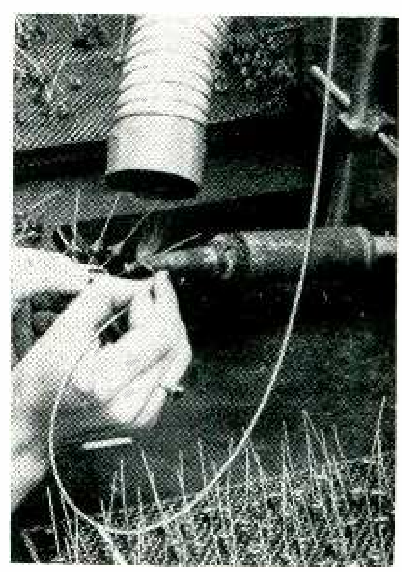
ratory standard capacitors that have been certified by the National Bureau of Standards.

Various types of test fixtures are used in connection with the bridge to provide quick connections to each capacitor in turn. The fixtures are designed to insure precise positioning, eliminating measuring errors that would be particularly serious with smaller sizes of capacitors.

Central Vacuum System Draws Off Soldering Fumes

FLEXIBLE metal tubing about two inches in diameter, connected to the central vacuum system in Crosley's Cincinnati television plant, is used at each soldering position to keep the area clear of fumes produced by soldering operations. The tubing is easily bent to a position that is just a few inches away from the tip of the soldering iron and yet is out of the way of the operator.

When soldering small parts such as the peaking coil shown, a special stand is used to hold the soldering iron. This leaves the left hand of the operator free to hold a cluster of the small parts while applying solder to each in turn with the right hand as they are held on the



Vacuum-system duct used to pull off soldering fumes, and stand for supporting soldering iron rigidly at optimum working position soldering iron tip. The stand and clamp are of the type used in chemical laboratories, and were purchased commercially at far less than it would have cost to make them. The slide that locks the clamp at the desired heighth on the vertical rod was made in the Crosley shop. Total cost of the entire holder was about $2.25.

Label-Positioning Mirror

To BALANCE out a moving-conveyor assembly line for television sets, the operation of pasting a tube layout diagram on the back of the chassis was assigned to one work position. The back of the chassis was facing

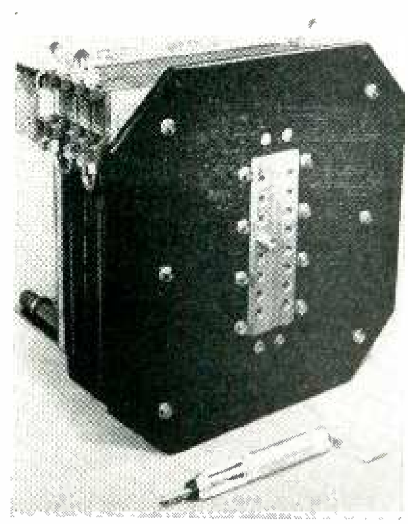
Method of using mirror to aid in positioning a chassis label in Sylvania's Buffalo plant

away from the operator here, hence she could not see it and might possibly cover adjustment holes with the gummed label.

The problem was solved by hanging a small mirror from the back shelf of the bench. The mirror hooks over the edge of the shelf, so that it can easily be slid lengthwise or removed as desired.

Inserts Protect Threads Tapped in Copper

WORK COILS used with induction heaters must be removed frequently and replaced with new coils to accommodate differing sizes and shapes of parts being heat treated. These coils, also known as induction blocks, are secured to threaded holes in the outlet plates of the out-



Outlet plate of induction heater transformer, with one insert partly installed and fifteen others already in the threaded holes. Wire-inserting tool is shown below

put transformer of the heater. The problem of thread wear and thread stripping at this point has been solved by the use of stainless steel wire inserts made by Heli-Coil Corporation, Danbury, Conn. The thread inserts provide much higher resistance to wear and corrosion than unprotected threads, and permit higher loading.

The $\frac{3}{8}$-16 wire inserts, resembling

Example of induction heater using wire thread inserts in transformer panel face. Fixture in foreground is bolted to the generator and its inductor blocks are mounted securely on the transformer panel with cap screws that go into the insert-protected holes. The fixture serves to locate a sprocket during heating and hardening of its teeth coil springs, are inserted with a special tool. Once installed, they insure good electrical and physical connections between inductor blocks and transformer outlet plates in induction heating units such as those manufactured by the Tocco Division of Ohio Crankshaft Co. Another use for the inserts, still experimental, is for protection of threads in insulating materials.

Cold Soldering Technique for Printed Circuits

AS A substitute for lead-tin solders for making electrical connections in printed circuits, a composition of powdered silver and Araldite resin known as cold solder has merit in that only low curing temperatures are required. Formula No. 1 consisted of 14 grams Araldite 101 (made by Ciba Co.), 35 grams DuPont Silver Powder V-9 and 1.5 grams Araldite Catalyst HN-951. This was mixed at 150 F for ten minutes. Since the mixture is too viscous (viscosity of vaseline) for hand mixing, a mechanical means will have to be used until a suitable solvent for lowering the viscosity is found.

Test joints for measuring bond strength were made using metal strips 1 in. × 3 in. × 0.005 in., cemented together at the ends so that they overlapped ½ in. The cement was applied by means of a spatula and the strips pressed together. Specimens prepared in this manner were allowed to cure at room temperature over night. Other specimens were cured at 100 C for one hour. Joints made with strips of copper, aluminum and brass were tested to see if different metals had any bearing on bond strength. The specimens were ruptured on an Olsen tensile Test Machine. Ultimate shear strength in lb per sq in. averaged 1,720 for aluminum to aluminum, 1,640 for copper to copper and 1,830 for brass to brass.

Formula No. 2, using 0.5 gram more catalyst to accelerate curing time, gave lower shear strength values (1,300 for Cu-Cu cured 1 hr at 100 C, and 1,400 for Cu-Cu cured overnight at room temperature).

A variety of electrical connec-

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tions were tested using cold solder as the bonding agent. For example, several sizes of composition resistors were soldered on a printed-circuit base plate and the assembly was then subjected to a temperature of −65 C. The soldered connections were strong enough to withstand pressure applied by the fingers.

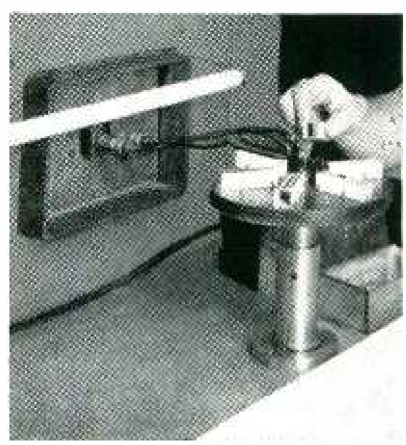
Resistance measurements were made on the cold-soldered joint. Resistance values of the joints varied between 0.1 to 0.01 ohm at room temperature.

The information presented here was abstracted from a technical report, "Development and Application of Automatic Assembly Techniques for Minaturized Electronic Equipment", prepared by Stanford Research Institute for the Wright Air Development Center.

Induction Soldering Setups

TWO DIFFERENT techniques for bringing work to be soldered up to the work coil of a high-frequency induction heater eliminate loss of time in waiting for parts to cool enough so they can be handled. One technique uses a rotary work table, and the other a jig that holds sixteen parts at a time.

In soldering the seams on tin-plated steel housings for signal drops, Federal employs a rotating table located in front of the induc-



Six-position pedal-operated work table brings tin-plated steel housings under work coil for soldering of seams. Strips of precut solder are in wood box, and unsoldered housings are stacked neatly on table. Finished housings go into bin on floor at right of operator

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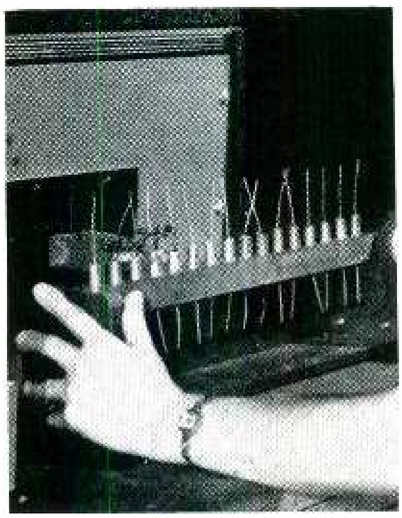
tion heater. The operator brushes on flux and places a strip of tape solder along the seam, then sets the piece on the work table at the position just ahead of the heating coil. He then operates the foot pedal to move the piece under the coil and turn on the generator. An electronic timer controls the soldering interval; it takes about 2 seconds for the solder to melt and fill the seam.

The six-position work table allows ample time for the solder to harden and cool. The finished piece is removed just before a new piece is put on. Clearance between the piece and the lower edge of the work coil is $\frac{1}{16}$ inch. A fluorescent tube hung in the electromagnetic field of the generator lights up when power is on, to serve as an indicator and a warning that the equipment is energized.



Jig used to push each of 16 paper capacitors in turn between loops of work coil to obtain soldered hermetic seal

End plates of metalized paper capacitors are hermetically sealed to the metal housings by induction soldering in Astron's plant. A simple jig having holes drilled part way through a wood crossbar to take 16 capacitor units is used to bring each part in turn to the work coil. The operator energizes the machine by foot pedal each time a part is in position. A power application of a few seconds is adequate to fuse the circular solder preform, thus soldering the housing to the outer ring of the glass-to-metal seal for the lead. Each part is left in position for about 15 seconds to permit the solder to harden, before the jig is pulled back and moved for soldering of the next part.

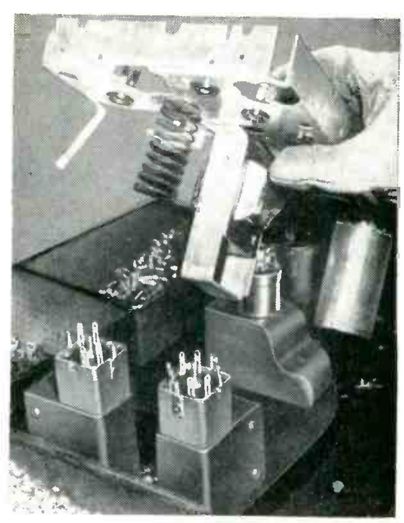
After leads have been soldered to one end of a batch of 16 capacitors, each unit is pulled out and turned over in the jig for soldering of the other leads. The finished leads project downward through small holes in the center of each large hole.

Parts-Mounting Fixture

BOLTING of four large components to an auto-radio chassis is speeded through use of a simple positioning fixture that holds the parts upside-down in their correct final positions. The chassis can then be placed over all of them in one operation. Nuts are quickly applied with an air gun, after which the mounting tabs for the electrolytic capacitor are twisted.

Wherever feasible, magnetic chucks are used in air guns to hold the mounting nuts. A small piece of Alnico in the chuck provides ample lifting power for steel Palnuts.

When driving brass nuts, a large piece of beeswax is kept alongside the working position. The driver is jabbed into this after about each dozen nuts, to maintain the stickiness required to grip the nut.



Fixture used in Sylvania's Buffalo plant to hold two i-f transformers, an electrolytic capacitor, a vibrator and a vibrator transformer so that the chassis can be placed over all of them at once

NEW PRODUCTS

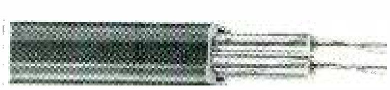
Edited by WILLIAM P. O'BRIEN

Control, Testing and Measuring Equipment Described and Illustrated . . . Recent Tubes and Components Are Covered . . . Forty-Two Trade Bulletins Reviewed

OTHER DEPARTMENTS featured for this issue:

Junction Transistors

RAYTHEON MFG. CO., 55 Chapel St., Newton 58, Mass., announces the immediate availability of two *pnp* germanium junction transistors types CK721 and CK722. Although CK722 may be had in production quantities, CK721 will be limited in quantity until April 1953. Both types have noise factors averaging 22 db at 1,000 cycles. Type CK721 has an average power gain of 38 db while CK722 averages 30 db. The units require a volume of 0.03 cu in. and leads may be soldered or welded into the circuit or cut for insertion into standard subminiature sockets.



UHF Transmission Line

ANACONDA WIRE & CABLE CO., New York 4, N. Y., has developed a new all-weather uhf transmission line for tv service. Known as type ATV-270, the line serves as lead-in from roof-top to receiver. Design characteristics include a high-strength Copperweld conductor surrounded by polyethylene spiral thread that acts as a centering medium, allowing the conductor to float within its individual polyethylene tube. The brown polyethylene jacket assures better protection against weather and greater resistance to abrasion, assuring longer life of lines and greater protection against mechanical damage. The new cable has been tested and found equally reliable over the entire range of both vhf and uhf channels. Considerable savings on critical materials, particularly on copper, are represented in the new line.

TV Scanner

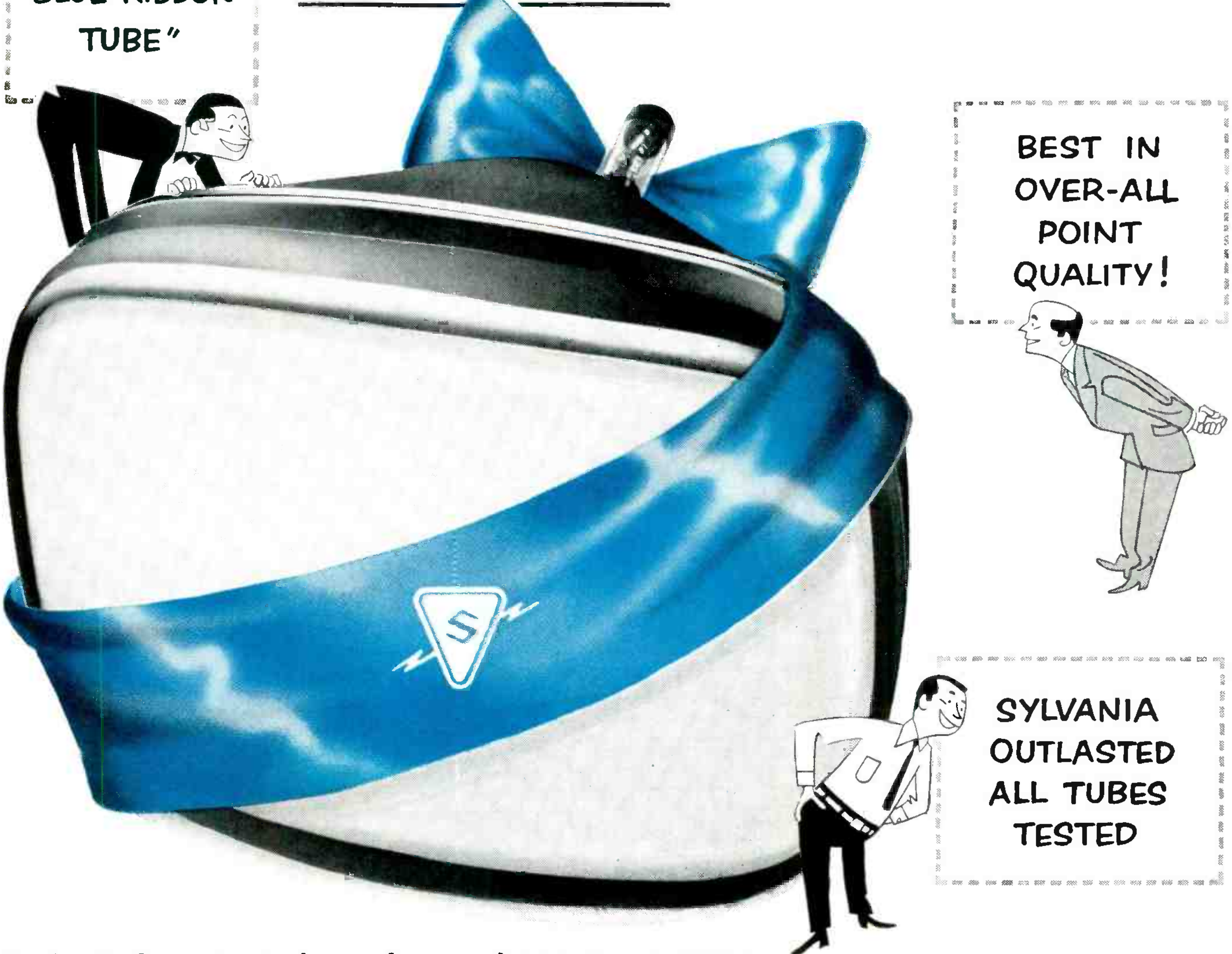
FEDERAL TELECOMMUNICATION LABORATORIES, INC., Nutley, N. J., has developed an improved version of its Poly-Efex Scanner, FTL-93A, for tv station application. Incorporating advanced circuits and expanded operational features, the scanner now allows a single operator to take complete charge of a station's program sources and to present them in the most effective manner. The unit, basically a dual flying spot scanner, has in addition to its two self-contained slide sources, a four-channel video switcher and a special effects or montage section. An integral gamma correction circuit has been built into the unit to compensate for the nonlinearity of the raster produced by the c-r tube. This gives an over-all effect of greater contrast range.

Sensitive Relay

NEOMATIC, INC., Los Angeles, Calif., announces the sensitive relay, a hermetically sealed unit especially well adapted for use with transistors and germanium diodes. The hermetic seal may be either air or an inert gas. Sensitivity runs as low as 10 mw and the unit will operate as low as 0.0008 ampere. Contacts are spdt to 3 amperes, 24 v d-c; 115 v a-c, noninductive. Coil resistances are available from 4 to 20,000 ohms. Standard temperature range is −55 C to +85 C. The unit is noteworthy for high-speed

SYLVANIA PICTURE TUBES

Lasted Longer than others tested!



Only Sylvania tubes showed NO FAILURES after 1400 hours . . . *at accelerated voltages*

Exhaustive tests conducted under the supervision of an outside impartial laboratory, the United States Testing Company, showed Sylvania Picture Tubes lasted longer than any others tested.

These tests included the picture tubes of nine leading manufacturers. All tubes were placed in identical test racks and tested under identical accelerated voltages. At the end of 1400 hours, only the Sylvania Picture Tubes showed *no failures*.

These tests definitely establish the outstanding dependability of Sylvania Picture Tubes. They prove that these tubes will best uphold your reputation for fine performance in the sets you manufacture, sell or service. Send today for complete details about Sylvania Picture Tubes. Sylvania Electric Products Inc., Dept. 3R-1001, 1740 Broadway, New York 19, New York.

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

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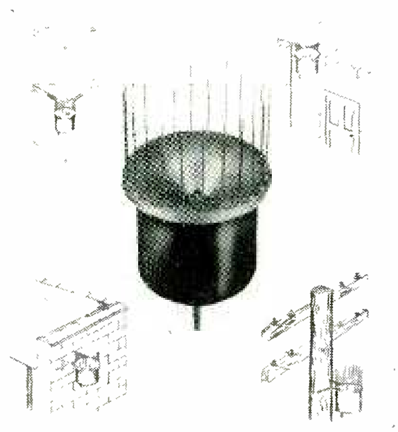
operation, operating as rapidly as 2 to 3 milliseconds, depending somewhat upon coil inductance. Its small size is an additional feature. Weight is 2.14 oz.



Weather Sensing Equipment

MOTOROLA, INC., 4545 W. Augusta Blvd., Chicago 51, Ill., has developed a weather sensing unit known as the Snow Detector. Designed primarily for the de-icing of microwave antennas, it also has numerous other applications. The unit, only 7¼ in. in diameter, detects precipitation when the ambient temperature drops below 37 F. Fully automatic, it will turn on heating elements whenever icing conditions exist. Up to 30 amperes at 117 v a-c can be switched without external relays. The heaters will then remain on until the icing hazard is past, being automatically turned off by the detector.

Regulated Rectifier

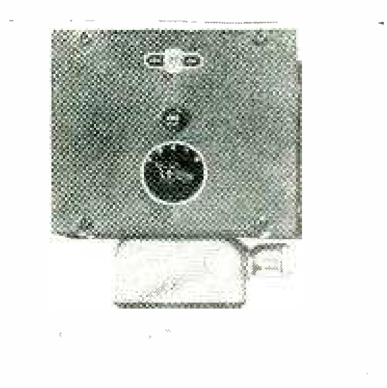
INET, INC., 8655 South Main St., Los Angeles 3, Calif., has announced a new type of high-performance a-c to d-c regulated rectifier. Named the MagniVolt, it combines ruggedness and close regulation of low voltage in a highly dependable low-cost unit. Regulation by the instrument is better than 1.0 percent for no load to full load with ±10-percent a-c line variation. Response is faster than 0.2 second, even under extreme contrast of load conditions. The rms ripple is less than 1.0 percent. The MagniVolt is designed to operate on 115 v, single phase, 60-cycle current. It is built in standard models ranging from 1.2 v to 28.0 v and from 2.5 amperes to 30.0 amperes. It features a magnetic amplifier that contains no moving parts or vacuum tubes.

Transmitter

RADIO LABORATORIES, INC., 1846 Westlake Ave. North, Seattle 9, Wash. Model 75 transmitter was designed for marine, aeronautical and fixed station use. Any two frequencies may be monitored simultaneously, using the crystal receiver for one and the tunable receiver for the other. The crystal receiver features a new improved noise limiter, a variable squelch circuit, plus automatic blanking of the tunable receiver. When a carrier is received on the crystal receiver it electronically disables the tunable receiver so the message may be clearly received. The transmitter features eight independent, separately-tuned channels for maximum efficiency. Also available are 35 watts of audio for paging, public-address or deck horn operation.

Voltage Tester

HOLUB INDUSTRIES, INC., 413 DeKalb Ave., Sycamore, Ill., has announced a voltage tester having only one test lead and other new design features. It is called the Hi-Test and indicates a-c or d-c voltage from 115 to 600 v. The second test prod is permanently mounted in one end of the tester making it easy to hold the tester in one hand and still press the prod firmly against contact or wire. The voltage scale is located in the end of the tester opposite the prod where it is always in full view. Flashover between ends of the solenoid coil is completely eliminated as the wires are brought out of the case at opposite ends of the coil. Overall length of the tester is 8½ in.; test lead with 4-in. plastic handle, 48 in.; and weight, with carrying case, 10 oz.



Selenium Rectifier Power Supplies

RAPID ELECTRIC CO., 2881 Middletown Road, New York 61, N. Y., has announced a new line of selenium rectifier power supplies

the RIGHT COMBINATION for *maximum performance at minimum cost*

NO SPLICES. As always, plastic-base Audiotape in 1200 and 2500 ft reels is guaranteed *splice-free.*

NO FRICTION SQUEAL. Perfected anti-friction process eliminates annoying tape squeal—prevents "tackiness" even under extreme temperature and humidity conditions.

MINIMUM DISTORTION. Audiotape's oxide coating is especially formulated to give *maximum undistorted output.* Comparative tests show its marked superiority in this respect.

MAXIMUM UNIFORMITY. All 7" and 10" reels of plastic-base Audiotape are *guaranteed* to have an output uniformity within ±¼ db – and a reel-to-reel variation of less than ±½ db. And there's an actual output curve in every 5-reel package to prove it!

PRECISION TIMING. Improved reel design with 2¾" hub reduces timing errors by eliminating the tension and speed changes formerly encountered at the beginning and end of the winding cycle. Ratio of OD to hub diameter is the same as the standard NAB 2500 ft reel.

CONSTANT PITCH is another advantage of the new reel design resulting from the more uniform tape speed throughout the winding cycle.

SLOWER ROTATIONAL SPEED, due to larger hub diameter, minimizes vibration and avoids possible damage to tape on fast forward and rewind.

REDUCED HEAD WEAR can also be expected, because the maximum tape tension is materially decreased.

audiotape gives you all these advantages at no extra cost!

* Trade Mark

This new 1200 ft plastic reel with 2¾" diameter hub is now being supplied on all orders for 7" reels unless otherwise specified . . . at no increase in price. Remember – with Audiotape, there's only *one* quality – the finest obtainable! Audiotape is available in all standard size reels from 150 to 5,000 feet.

AUDIO DEVICES, Inc.

444 Madison Ave., New York 22, N.Y.

Export Dept. 13 East 40th St., New York 16, N.Y., Cables "ARLAB"

audiodiscs audiotape audiofilm audiopoints

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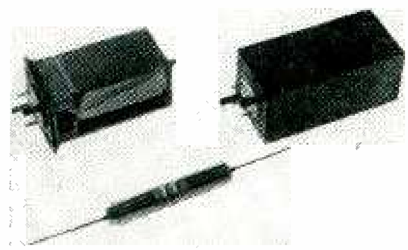
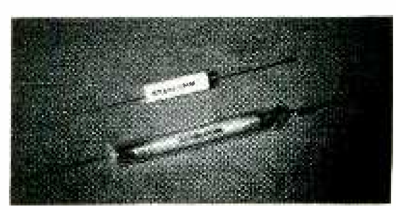
designed for installation at individual work stations. Each of the two models currently in production, a 300-watt unit and a 500-watt unit, operates from a 115-v 60-cycle line, and furnishes from 90 to 135 v of filtered d-c output. Output voltage may be varied in approximately equal steps by a 5-position tap switch. Output ripple is less than 5 percent at full load. Both units are rated for continuous duty at full load. Over load protection is built into the circuit.



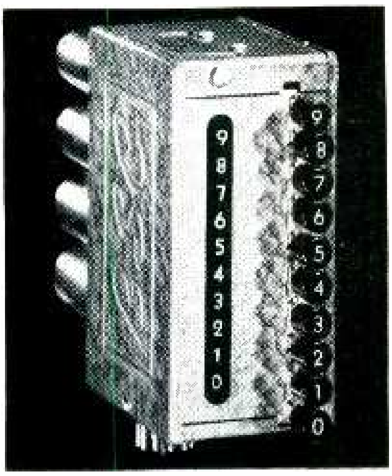
Ball Relay

MAGNEX CORP., 90-28 Van Wyck Expressway, Jamaica 18, N. Y., has announced a shock-proof hermetically-sealed relay of unique design, capable of operating at speeds over 100 cps, for use on d-c circuits. It uses magnetic balls as the contact medium providing new contact surfaces on each operation and preventing misoperation under vibration in locations such as aircraft and automobiles. A special non-magnetic plating on the balls and the pole pieces provides a long life contact and avoids sticking caused by current interruption. The special material used also prevents contact holding due to residual magnetism. The pole pieces are insulated from each other and are the terminals of the circuit to be closed.



Carbon Film Resistors

CHASE RESISTOR CO., 9 River St., Morristown, N. J., is producing two high stability carbon film resistors. For maximum stability these are sealed in glass envelopes, evacuated, baked at high temperatures under vacuum, and finally sealed in helium of spectroscopic purity. These units are stable to 0.01 percent under all environmental conditions, and have long time drift of 0.01 percent per year or less. They can be supplied in networks with ratios and temperature coefficients held to close tolerances. Less expensive units are made by solder-sealing resistors in ceramic tubes with metallized ends. The stability of these is less than that of the glass-helium sealed resistors, but much better than that of varnished resistors, particularly under conditions of high humidity and temperature.



Decimal Counting Unit

BERKELEY SCIENTIFIC Division of Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif. Model 730 preset decimal counting unit is a direct-reading electronic counter capable of producing output information at any selected count. It will operate at speeds up to 40,000 counts per second and resolve pulse pairs separated by as little as 5 μsec. Each counter is a plug-in unit designed for ease of replacement and simplification of maintenance problems in high-speed counting equipment. Units are completely interchangeable. The preset decimal counting unit counts from 0 to the preset number and produces an output pulse. By employing additional circuits this output pulse can be used electronically to reset the unit.

Octal Sockets

SYLVANIA ELECTRIC PRODUCTS INC., Warren, Pa. Designed to specification JAN-S-28A, the company's new octal sockets are available with either grade L-4B or better ceramic insulating base or with type MFE low-loss phenolic plastic insulation. Mounting saddles are brass nickel-plated with four ground lugs hot tinned for solderability. Saddles are available with 0.156-diameter mounting holes or with threaded extrusions for 6-32 screws. Contacts are available in either phosphor bronze or beryllium copper, silver plated. The sockets are designed for high tube retention and pin contact even under severe vibrating conditions.

Testing Tool

KAPNER HARDWARE, INC., 2248 Second Ave., New York 29, N. Y., has introduced a testing tool that permits instant tracing of the cause of trouble in the high voltage section of any tv receiver. It will instantly indicate the presence or absence of high voltage. It will check if high voltage supply is operating properly. Operation of horizontal am-

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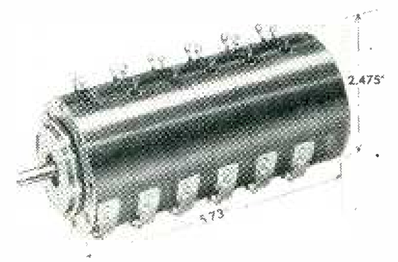
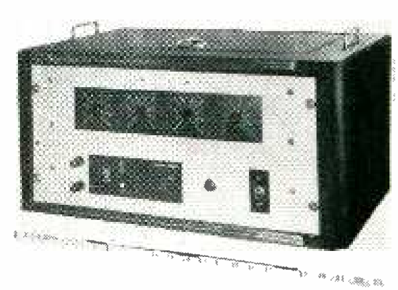
plifier and high voltage transformer are easily checked. The Detecto probe is equipped with a built-in lamp that lights up if high voltage is present.



Ganged Potentiometer

THE G. M. GIANNINI CO., INC., Pasadena, Calif., has produced a vernier phasing ganged potentiometer known as the Gangpot. Gangpots are available with from two to six individual sections; a 6-section unit operating on 1.5 oz-in. of shaft torque. Assembly is without external clamps or bolts. Mechanical rotation is 360 deg continuous; electrical rotation may be 360 deg or less. Sections are available in resistances from 2,000 to 300,000 ohms and each will dissipate 4 watts continuously at 25 C. Sections may have linear or nonlinear outputs, one or two brushes, and taps as desired. A simple screwdriver vernier phasing for each section permits phasing to 0.2 deg over an angle of 22 deg.

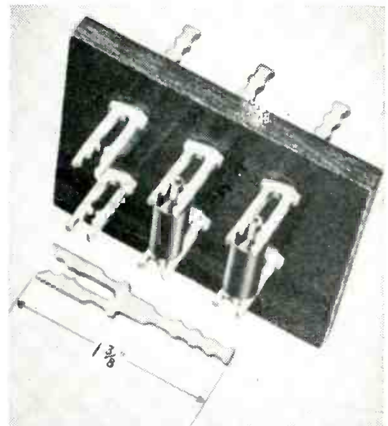


Meter Calibrator

BRUCK INDUSTRIES INC., Syosset, L. I., N. Y., has developed an instrument designed specifically for the rapid calibration of d-c volt and milliammeters and for testing and adjustment of d-c type analog computers. The M-DC-1 calibrator is completely self contained. It consists of four major components: two regulated power supplies, a normalizer and the calibrator proper. The normalizer is referenced to a built-in standard cell. The output can be preset on four decade dials, and is maintained automatically constant and accurate to within 0.1 percent over 90 percent of its range, independent of load, input voltage or ambient conditions. Both the normalizer and the calibrator are controlled and compensated by electromechanical transducers in conjunction with high gain 60-cycle amplifiers and all manual operations are completely eliminated.

Oscilloscope Probe

LINEAR EQUIPMENT LABORATORIES, INC., Brightwater Place, Massapequa, N. Y. The new model HF2A Lo-C Oscilloprobe introduces no signal attenuation. Measurements of low-level signals in high impedance video circuits can be readily made without affecting the true waveforms. Heretofore such measurements required engineering interpretations, as the relatively large input capacitances of conventional probes distorted the signal under observation. The dynamic output impedance is approximately 60 ohms and the maximum undistorted output is 1.5 v rms. The input voltage range can be selected by a three-position switch. Signals up to 150 v rms can be applied to the probe without overload. Input impedance on all ranges is 4.5 megohms with 1.5 $\mu\mu$f.



Diode Clip

COMPUTER RESEARCH CORP., 3348 W. El Segundo Blvd., Hawthorne, Calif., has developed a new diode clip that permits quick, easy insertion and removal of diodes. The clips will accommodate most types of diodes now in use. They require no rivets or other fasteners for mounting. The clip is simply pressed into a hole on the diode board. Spring tension holds the diode securely in the clip, and a special plating assures excellent surface contact. Other advantages include greater ease in removing defective diodes, faster assembly of diode boards and quicker initial checkout of finished equipment. They also facilitate preventive maintenance tests and the keeping of performance records on individual diodes.

Pressure Transducer

CONSOLIDATED ENGINEERING CORP., 300 N. Sierra Madre Villa, Pasa-

IF THE WIRING FAILS

SO DOES YOUR PRODUCT'S REPUTATION

FOR DEPENDABLE PRODUCT WIRING USE

UNILECTRIC WIRING SYSTEMS

TRADE-MARK

Year after year — for over ten years — UNILECTRIC has produced millions of wiring systems, for more than 150 leading manufacturers of electric and electronic products. From controls to complex armed forces equipment, these wiring systems have consistently met the most exacting requirements and provided substantial savings to each customer.

To assure utmost dependability plus cost saving engineering assistance, low cost production and "on-schedule delivery" investigate UNILECTRIC today.

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SCOPE DOLLY

Model 1

- Convenient Height and Viewing Angle
- Adjustable to Hold Portable Scopes
- Ball Bearing Swivel Rubber Tired Casters
- Lightweight Aluminum Construction
- Recommended by Laboratories Wherever Used

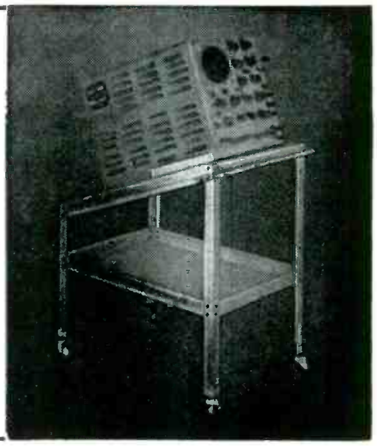
$35.00 FOB LOUISVILLE, KY.

Formerly manufactured by UNIQUE DEVICES

Now manufactured and sold by

TECHNICAL SERVICE CORPORATION

3116 Michigan Drive Louisville 5, Kentucky



Specify GM SERVO MOTORS

PRECISION ENGINEERED

RELIABLE PERFORMANCE • RUGGED CONSTRUCTION

In the operation of • GUNFIRE CONTROLS • ROCKET CONTROLS
GUIDED MISSILES • AIRCRAFT CONTROLS • INDUSTRIAL CONTROLS

G-M Servo Motors can be supplied to meet rigid military specifications with regard to humidity, temperature range, vibration and altitude. Available in 2, 4 or 8 pole construction and for frequencies from 60 to 400 cycles.

Write today for complete information.

¾ ACTUAL SIZE

Another product of **GM LABORATORIES INC.** 4336 NORTH KNOX AVENUE CHICAGO 41, ILLINOIS

The Spotlight's On DALOHM *Miniature* POWER RESISTORS!

WIRE WOUND—SILICONE COATED RESISTORS

Complete welded construction from terminal to terminal. Temperature coefficient 0.00002/ deg. C. Ranges from 0.1 Ohm to 55,000 Ohms, depending on Type. Tolerance 0.05%, 0.1%, 0.25%, 0.5%, 1%, 3%, 5%.

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.

DEPOSITED CARBON RESISTORS

Dalohm precision deposited carbon resistors offer the best in accuracy, stability, dependable performance and economy. Available in ½ watt, 1 watt and 2 watt sizes.

Carefully crafted in every respect, Dalohm resistors are true power in miniature — provide the answer to those space problems.

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DALE **DALE PRODUCTS, INC.**

In Canada: Teletronics Corp. Ltd. Toronto and Montreal

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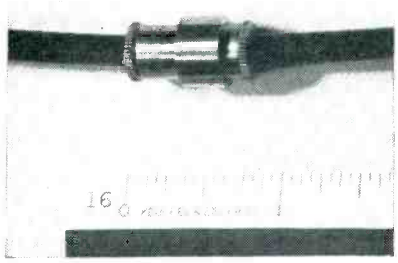
dena 8, Calif. Extremely rapid transient pressure surges and high-frequency pressure pulsations, both frequently encountered in present-day processing equipment, vehicles and hydraulic systems, can be easily and accurately measured with the new type 4-301 pressure transducer. It may also be used for measuring static or slowly varying pressures over an extremely wide temperature range in both gaseous and liquid systems. The transducer's output may be either recorded on an oscillograph, when extremely rapid pressure changes must be analyzed in relation to time, or it may be used to indicate pressure changes on meters or oscilloscopes, which can be monitored visually or photographed. Output is linear within ±0.5 percent of full scale. The pickup, complete with cable and plug, weighs only 9 oz and measures 1½ in. in diameter.

Preservative and Noise Eliminator

GRAYBURNE CORP., 103 Lafayette St., New York 13, N. Y., has developed a new chemical solution for the elimination of noise and the preservation of moving contacts in home radios and television sets. The formula cleans and preserves all controls and contacts without any harm to insulation and soldered joints. It has been so prepared that each drop has the same chemical content as any other. Perfect equalization has resulted in a sediment-free solution that does not clog contacts. Known as Q-T, it contains only the pure basic materials and has no artificial coloring.

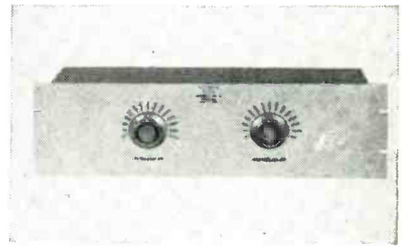


R-F Coax Connector

TELETRONIC LABORATORIES, INC., 1835 West Rosecrans Ave., Gardena, Calif., has developed a new miniaturized r-f coaxial cable connector designed for use at microwave frequencies with either RG-55/U or RG-58/U coax cable. It shows a vswr of less than 1.3 over the entire band, operating between 8,400 and 9,600 mc. Compression-sealed against moisture and atmospheric changes, this smaller, lighter connector is manufactured from brass, Teflon, phosphor bronze and beryllium copper.

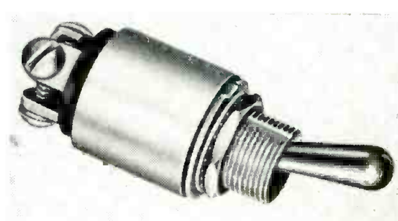
Indicator Light

HETHERINGTON, INC., Sharon Hill, Pa., has developed a new indicator light for edge-lit AN-P-89 aircraft panels. Known as the type L2000, the light flange-mounts on the back-up plate and the socket extends through the edge-lit panel. The plastic lens screws into the light socket from the front of the panel. The light 1¼ in. long overall and weighs less than ¼ oz. A 327 miniature lamp is used for 6, 12 or 28-v operation, and amber, blue, green, red or white plastic lens is available. The molded-in terminal will not vibrate or pull loose.



Filter

CINEMA ENGINEERING CO., 1510 West Verdugo Ave., Burbank, Calif., is in production on its new variable high and low-pass filter, type 6517-D. This sound effects filter is used for sound and electronic lab research and control; and for sound recording, transmission and reproduction control. Minimum input level is −70 dbm; maximum, +28 dbm. Insertion loss is zero. It features wide frequency spectrum with overlapping cutoff frequencies; zero phase distortion over the transmission range; and clickless steps of control. All inductors are toroidally wound.



Toggle Switch

HETHERINGTON, INC., Sharon Hill, Pa., has introduced a new aviation type (MIL-S-6745) miniature toggle switch with a unique cylindrical design that reduces size approximately 25 percent by comparison with conventional rectangular switches. Features include exceptionally effective contact wipe; positive cam-roller snap action that makes it impossible to tease the switch off contact; and strong lever operating action to break any contact welding that may result from an accidental overload. Four circuit arrangements are available: on-off and spdt maintained contact

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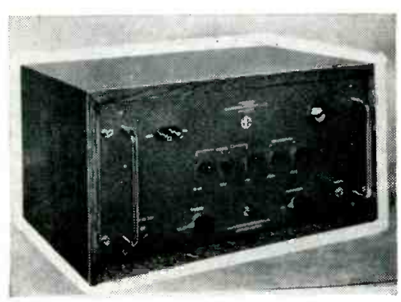
types, and momentary on or momentary off and on-momentary on types.

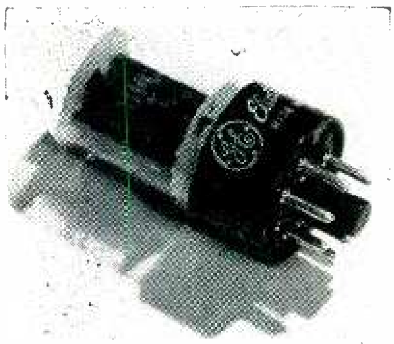
Relay Racks

PREMIER METAL PRODUCTS CO., 3160 Webster Ave., Bronx, N. Y., announces the manufacture of a line of table-type relay racks rigidly constructed of 16-gage cold-rolled sheet steel. The base is of one-piece construction, similar to a chassis. Panel mounting holes are tapped for 10/32 machine screws in Western Electric spacings. Racks are shipped knocked down with all necessary bolts for easy assembly. They are available in two different sizes—25 in. x 21 in. x 12 in. with panel space of 21 in. x 19 in., and 32 in. x 21 in. x 12 in. with panel space of 28 in. x 19 in. A complete catalog of the company's products for the electronic and electrical industries is also available.



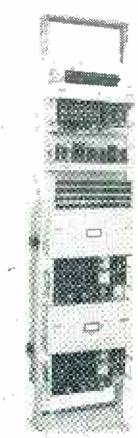
Frequency Calibrator

MEASUREMENT ENGINEERING LTD., Arnprior, Ontario, Canada. Model CFR-1 portable self-contained secondary frequency standard provides accurate frequencies in the range of 10 kc to 500 mc with a stability of 1 part per million. Designed originally for the military, it is manufactured to Joint Canadian Navy-Army-Air Force specifications, which are similar to but not identical with JAN specifications. Electrical and mechanical features, uses and circuit description are given in a loose-leaf perforated catalog sheet.



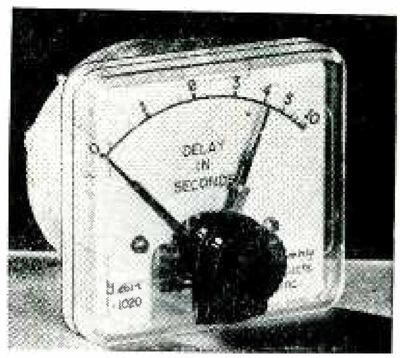
Vertical Deflection Amplifier

General Electric Co., Schenectady 5, N. Y., has announced a new high-perveance triode for vertical output service in television receivers. The tube, type 6AH4-GT, is expected to be particularly useful in receivers with large-deflection-angle picture tubes. Typical operating characteristics with 250 v on the plate include: heater voltage, 6.3 v; grid voltage, −33 v; plate current, 30 ma; transconductance, 4,500 μmhos; amplification factor, 8.0; and plate resistance, 1,780 ohms.



Carrier System

Lenkurt Electric Co., 1113 County Road, San Carlos, Calif. Up to 24 broad-band voice channels can be transmitted over a wide-band radio channel with the new type 33C carrier telephone system. Designed specifically for application to radio links, this frequency division multiplex system is comprised of three eight-channel groups. A single group or less can be installed initially and expanded to the maximum capacity in the future as traffic increases. Because the problem of channel co-ordination common to wire line carrier operation does not apply to radio operation, the channels have been spaced at 5-kc intervals. Two frequency allocations are available: one uses frequencies up to 135 kc; and the other, frequencies up to 150 kc. Each channel includes a broad speech band of approximately 300 to 3,400 cycles with provision for out-of-band signaling at 3.9 kc.



Time Delay Relay

ASSEMBLY PRODUCTS INC., Main at Bell Street, Chagrin Falls, Ohio. This new moving coil, permanent magnet-type relay, model CMR-TD, offers adjustable time delays for many ranges of voltage and current, both a-c and d-c. The dial is calibrated directly in delay in seconds. The timing is adjusted by hand-setting a pointer to the time indicated on the dial. Full-scale ranges of less than 10 seconds can be furnished. Timing is relatively unaffected by changes in temperature or barometric pressure. Delay action results from the magnetic drag inherent in sensitive microammeters. There are no capacitors, dash pots nor motors. Contacts are self-locking and rated at 5 ma, 100 v d-c for one million operations. Ratings up to 500 ma can be supplied for a reduced number of operations. Contacts are locked by an

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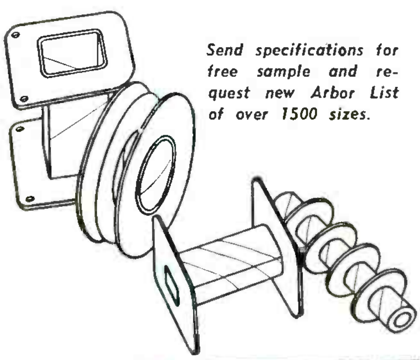
PRECISION Coil Bobbins are finished to your exact specifications. Only the finest dielectric materials are used.

Cores furnished in an infinite variety of sizes and shapes—kraft, fish paper, acetate, or combinations. Flanges cut to specifications—plain or fitted with leads, slots or holes; embossed or recessed.



Send specifications for free sample and request new Arbor List of over 1500 sizes.

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Also Mfrs. of Precision Paper Tubes

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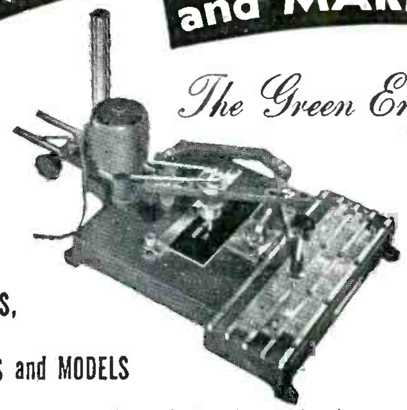
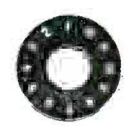
The Green Engraver

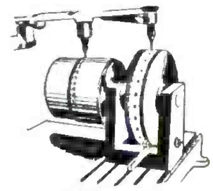


ENGRAVES,
ROUTS,
PROFILES and MODELS



STENCIL

NUMBERED RING



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The Green Engraver zips out precision work on metal, plastics, wood, glass, hard rubber etc. . . . engraves panels, name plates, scales, dials, molds, lenses, instruments, instruction plates, directional signs . . . by simple tracing. *Routing, profiling and three dimensional modeling indicate its versatility.* Electric etching attachment available.

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RAHM TRANSDUCERS . . .

Typical Data

Linearity:
with pressure: ±0.25% to ±0.75%
with altitude: ±0.5% (0-70000 ft.)
Resolution: 0.15% to 0.4% of pressure.

Design Features

Operation from −60°C to +160°C and to 60G acceleration.
a-c or d-c output usable without amplification.

Special Features

Protection from corrosive media or atmosphere. Multiple output from single instrument. Output non-linear with pressure.

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FOR
PRESSURE
ALTITUDE
AIR SPEED
ACCELERATION

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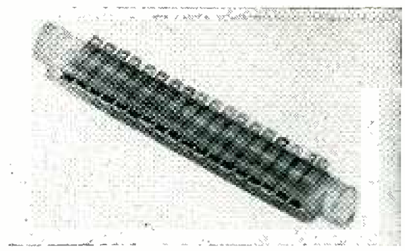
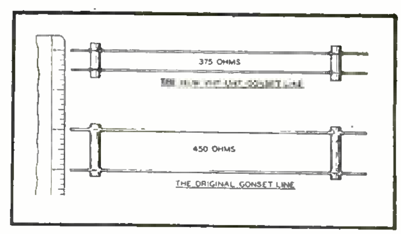
extra coil in the meter. Relays with nonlocking contacts can be supplied for special applications.



Printed Circuit Connectors

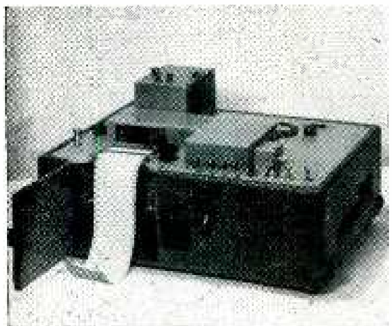
DEJUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City 1, N. Y. The series PC miniature printed circuit connectors have precision phosphor bronze contacts, silver and gold plated, tinned on the solder end for easy soldering at assembly. They feature positive polarization, minimum insertion and disengagement force, and a molded body from melamine mineral filled. Literature on minature, subminiature, power and E-Z release connectors is available on request.



Open Wire Line

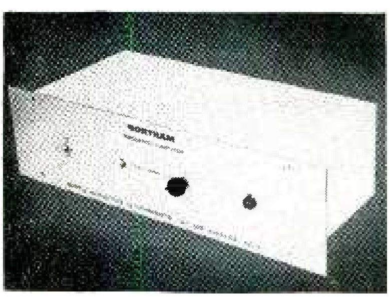
GONSET CO., 801 S. Main St., Burbank, Calif., has released a new, closer-spaced open wire transmission line more suited for uhf tv use than the more standard 1-in.-spaced line. Using No. 18 gage solid copper wire spaced ½ in., it utilizes polystyrene spacers and is similar to the standard 1-in. line except for spacing. The closer spacing restricts the field and minimizes the dissipation losses and reflection bumps that occur at uhf when open wire line is brought close to almost any physical object. Surge impedance is 375 ohms, sufficiently close to 300 ohms that the new line may be used interchangeably without concern over mismatch. Attenuation is approximately 2 db per 100 ft at the low end of the uhf band

and approximately 3 db at the high end (dry). Unlike conventional ribbon line using a web of polyethylene, the uhf attenuation increases only moderately when the line is wet. The line is also well suited to use at vhf.



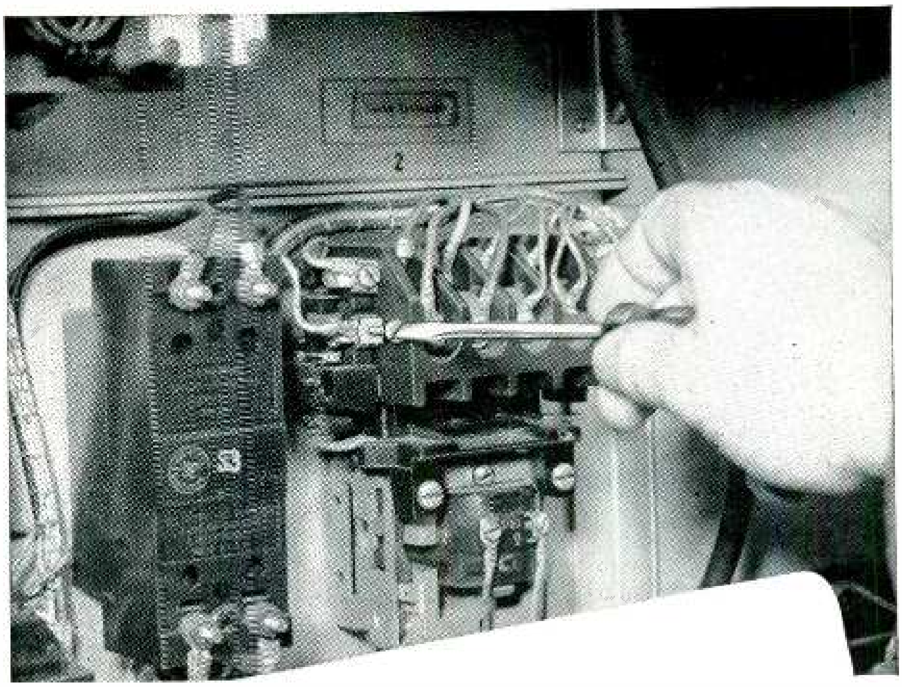
High-Speed Level Recorder

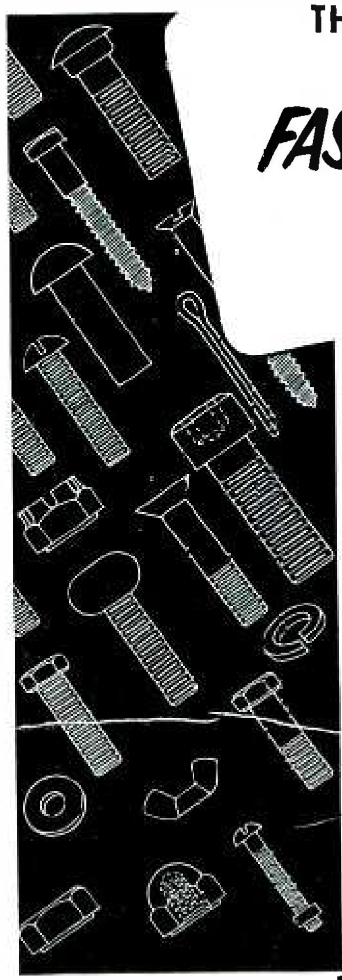
SOUND APPARATUS CO., Stirling, N. J. Recent electronic and mechanical design changes have been made in the model HPL high-speed level recorder. Frequency response has been improved. Sensitivity has been increased and can be adjusted from 7 to 12 mv. A new semiautomatic electronic damping is provided that controls the writing stylus and is particularly useful when the input potentiometers or writing speed are changed. The electronic chassis is an integral part of the recorder and can be easily substituted with circuits of different functions. Mechanical changes have been made for a more convenient chart roll insertion and manual chart setting. A chart rewinding mechanism has been added.



Frequency Computer

NORTH AMERICAN INSTRUMENTS, INC., 3445 Cahuenga Blvd., Los Angeles 28, Calif. The Northam frequency computer is the result of





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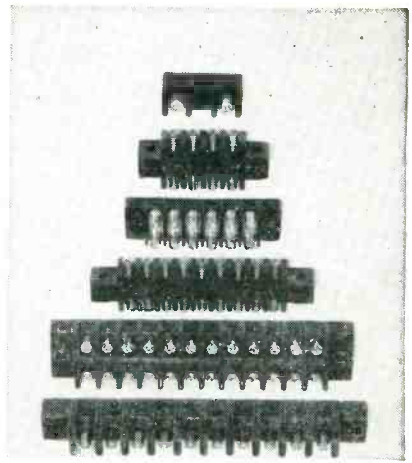
a development for the Navy to provide a simple and accurate frequency measuring unit for a flowmetering system. This system is used for the continuous measurement of flow of difficult fluids. The frequency computer is operable with pulses as low as 1 mv in amplitude. Ranges of 5 to 100 cps and higher with an accuracy of ±0.5 percent full scale are available. An internal frequency reference is incorporated to provide overall system standardization. The frequency computer, in addition to its flow meter application, may be used as a tachometer, with a photoelectric or magnetic pickoff; as a frequency deviation meter; or in other applications where accurate measurement of frequency is desired.



Terminal Boards

GENERAL PRODUCTS CORP., Union Springs, N. Y. The terminal boards illustrated represent a few of the many types, sizes and ratings that are available. They are in strict accordance with Navy Dept., Bureau of Ships drawing 9000-S6505-73214 and Bureau of Ordnance drawing 564101, both to latest revision. The many sizes, types and ratings available permit their use in a variety of electrical and electronic power, lighting and signalling applications. All terminal boards are molded of high-impact, high heat resistant electrical grade molding compound. Identifying numbers are molded into each barrier adjacent to the terminals, thus eliminating the need for marker strips. The terminal studs are

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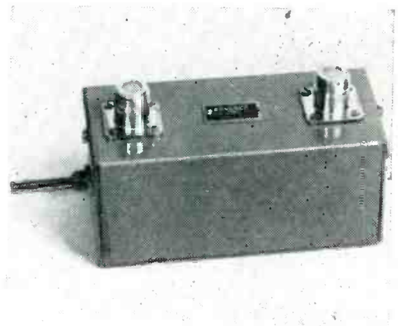
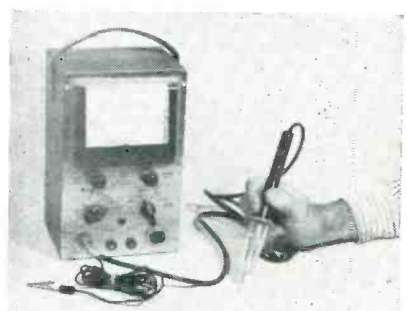
molded in and have a minimum tensile strength of 80,000 psi. Terminal nuts and connectors are supplied where required.



Step Variable Delay Line

ADVANCE ELECTRONICS CO., P. O. Box 394, Passaic, N. J. For variable time delay where faithful reproduction of input signal pulses, complete freedom of time jitter and no limit on repetition rate are desired, the type 601 step variable delay line is extremely valuable. It consists of 44 sections of lumped-parameter L-C networks. Time delay is variable in step of 0.2 μsec up to 2.2 μsec. Characteristic impedance is 190 ohms nominal for both input and output. Maximum rise time is less than 0.1 μsec at any step. Cutoff frequency is 6.37 mc nominal. Maximum input voltage is 500 v peak. Accuracy is ±1.0 percent of maximum delay.



Multiplier Probe

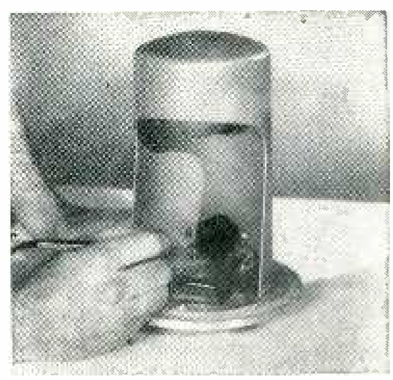
INSULINE CORP. OF AMERICA, 3602-35th Ave., Long Island City 1, N. Y., has available a multiplier probe that extends the d-c voltage ranges of standard vtvm's 100 times. The device is of special value to tv engineers, servicemen, x-ray workers and other technicians who have occasion to measure very high voltages. If the meter has a normal top range of 300 v, it reads up to 30,000 v; if it has a range of 500 v, it reads up to 50,000 v. Complete safety for the user is assured by a heavily insulated handle fitted with a finger guard. The probe is 8½ in. long and has a 5-ft flexible cord and an accompanying grounding wire.

Single Phase Inverter

EICOR, INC., 1501 W. Congress St., Chicago 7, Ill., has developed a 40-va single phase inverter designed to operate at a nominal input of 28 v, d-c, with an output of 26 v, 400 cycles, a-c. A novel method for mounting the thermistor-resistor combination is incorporated in the design, achieving a minimum size package. The combination is mounted on the a-c end bracket—affording easy access for adjustments and repairs. Speed of the inverter is controlled by a centrifugal governor. The unit is self-cooled by an internal fan.

Portable Sound Recorder

BROADCAST EQUIPMENT SPECIALTIES CORP., 135-01 Liberty Ave., Richmond Hill 19, L. I., N. Y., has available the Tapak portable, self-powered walk-about type of sound recorder, suitable for making on-location magnetic tape recordings in a form ready for direct broadcast. It turns out finished continuity ready for immediate airing or playback. This entails ability to monitor continuously while recording, to erase when desirable, to play back material for on-the-spot evaluation and to edit conveniently in the field. The unit, including microphone, headphone and spare tape all fit inside a 14-in. x 10-in. x 5½-in. space. Rewind is 44 in. per second. Tapak operates continuously (with cover open, removed or closed) for up to 19 minutes with 0.0017-in. thickness tape or 15 minutes with 0.0022-in. tape. It may be rewound while operating without disturbing speed.



Industrial Abrasive Unit

THE S. S. WHITE DENTAL MFG. CO., 10 E. 40th St., New York 16, N. Y. Cutting by means of a high-velocity stream of gas-propelled abrasive particles, the recently developed Airbrasive unit provides a fast, accurate method of doing a number of high precision operations. The cutting action is accomplished without the usual increase in temperature and without the pressure and vibration ordinarily experienced with other cutting methods. This is of particular significance when working on materials such as germanium, whose physical or electrical properties might be affected by heat and shock. The unit's place in the electronics field also includes printed circuit applications and work on spiral wound carbon resistors. It operates on 110 v, 60 cycles

KEL-F

(trifluorochloroethylene) loses none of its properties in temperatures as high as 390°F. Matter of fact, it runs the temperature gamut all the way up from –320°F. . . . a range of 710 fahrenheit degrees!

You'll find reason upon reason for liking this high polymer thermoplastic. For one thing, it has an excellent memory. Press it out of shape and it returns, once pressure is released, to its original form.

KEL-F has unusually high chemical and electrical resistance. Conducts little heat. Resists "wetting". Humidity, moisture and fungus bother it not at all.

Largest Single Sheet

Besides rods, tubes, compression and injection molded forms, we are now making this versatile insulating material in the *biggest single sheets* ever known—up to **5 ft. discs.**

Lowest Cost Ever

Expanded production now enables us to offer KEL-F in all its forms at the *lowest prices* in history. We'll be glad to quote on your own requirements. Write today for KEL-F Brochure #202.

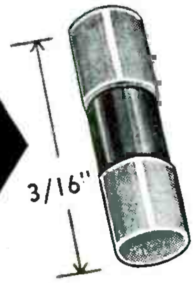
ELECTRONIC MECHANICS INC.

101 CLIFTON BOULEVARD, CLIFTON, NEW JERSEY

MICROWAVE RESISTORS TELEWAVE TYPE R

SMALLEST RESISTOR AVAILABLE

(Ideal for Miniaturization)



TYPICAL APPLICATIONS

- Power measurement at any frequency
- Matched terminations for waveguides or coaxial lines
- Resistive power pickup loops
- RF pads or attenuators
- Dummy loads
- Temperature measurements
- Impedance matching

TYPE R RESISTORS employ noble metal film deposits on specially selected heat resistant glass.

FILM THICKNESS offers negligible skin effect, at microwave frequencies.

POWER CAPACITY of 1/4 watt provides high power handling ability.

PHYSICAL STRUCTURE is ideally suited to impedance matching in standard coaxial line and waveguides.

FINISH. Coated with a special silicone varnish to protect the film.

SPECIFICATIONS

Resistance: 50 ohms standard, other values on request.
Tolerance: 5% or 10%
Wattage: 1/4 watt continuous duty at 25°C
Size: 1/16 inch diam. x 3/16 inch long
Terminals: Tinned sections 1/16 inch long
Film Length: Type R-063 — 1/16 inch
Type R-093 — 3/32 inch
Temperature Coefficient: approx. 0.0019 ohms/ohm/°C.
Power Sensitivity: Approx. 10 ohms/watt

AVAILABLE FOR IMMEDIATE DELIVERY

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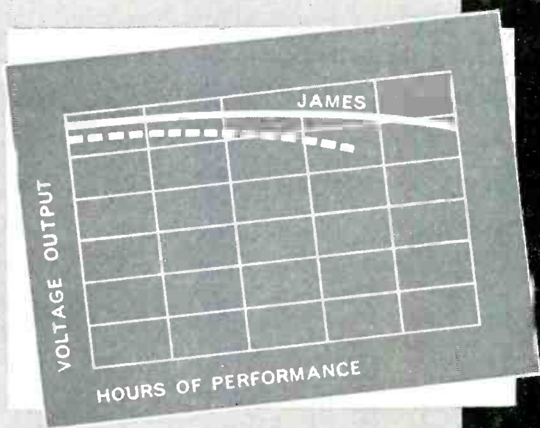

high receiver voltage insures high system performance

JAMES "Red Ball" design results in higher voltage output, lower "hash" influence ...your assurance of longer life and increased receiver performance. Try the JAMES model designed for your specific communications equipment and you will know why JAMES is specified where "vibrators must not fail."

See your Distributor or write directly for FREE booklet on "Improving Vibrator Life Through Good Maintenance."

JAMES VIBRAPOWR COMPANY
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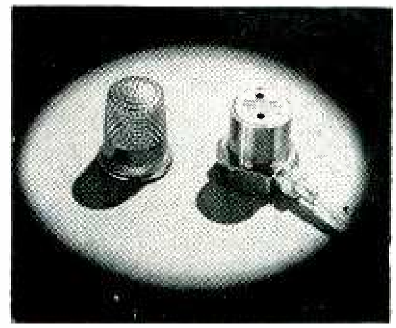
a-c, and measures 8½ in. × 15 in. × 12½ in. high and weighs 42 lb.

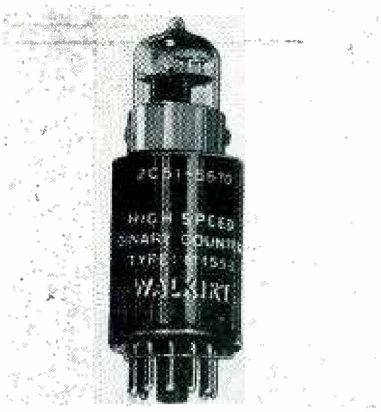


Accelerometer

ENDEVCO CORP., 180 E. California, Pasadena 1, Calif. A new thimble-size accelerometer provides an improved research instrument for the measurement of high-frequency shock and vibration. It is designed for missile, aircraft and vibration table measurements. The instrument gives a self-generated output of 5 mv per g. Output is flat (+5.0 percent) over the range from 5 cps to 5,000 cps and is stable to within 5.0 percent over a temperature range of −20 C to +70C.

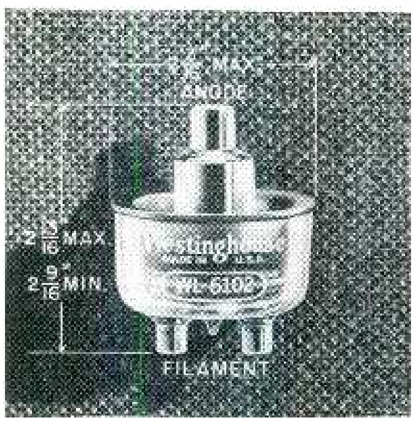
C-R Tube Analyzer

THE JACKSON ELECTRICAL INSTRUMENT CO., 20-32 S. Patterson Blvd., Dayton 2, Ohio. Model 707 dynamic c-r tube analyzer completely and accurately tests all tv picture tubes, deflected types. It will also analyze both magnetic and electrostatic oscilloscope, radar and other special purpose c-r tubes, without removal from chassis or carton. Four classes of tests are made: a beam current test, grid test, gas test and inter-element leakage test. The instrument is designed around a highly sensitive, balanced bridge-type vtvm. A continuously variable line voltage adjustment is provided to assure accurate readings.



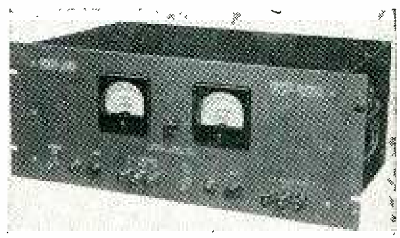
Binary Counter

THE WALKIRT CO., Inglewood, Calif., announces the type 1552 high-speed binary counter for all types of counting and frequency division to rates in excess of 3 mc. It has an 11-prong, octal-type, base plug that allows access to all tube elements and other important circuit points. Input is 75 v negative pulses with a rise time of 0.2 usec. Output is 125 v with a rise time of 0.2 usec. Power is 17 ma at 250 v. The unit operates over an ambient temperature range of −40 C to +70 C.



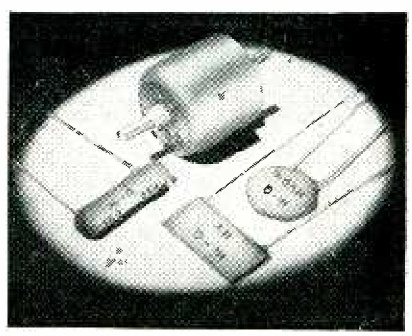
H-V Rectifier Tubes

WESTINGHOUSE ELECTRIC CORP., 401 Liberty Ave., Pittsburgh 30, Pa., has available two new high-vacuum diodes for industrial use in high-voltage rectifier applications. Type 6102 (illustrated) is designed for use in rectifier applications involving peak inverse voltages up to 40 kv. Maximum average current is 150 ma and peak current is 900 ma. It is intended for oil-immersed operation and is only 2 13/16 in. long and 2 3/16 in. in diameter. Type 6103 is for use in applications involving peak inverse voltages up to 20 kv. It has the same average and peak current as the 6102. It is provided with an integral radiator for forced-air cooling. The tube is only 2 15/16 in. long and 2 3/16 in. in diameter. It weighs 8½ oz.



Voltage-Regulated Power Supply

KEPCO LABORATORIES, INC., 131-38 Sanford Ave., Flushing 55, N. Y. Model 141 voltage-regulated power supply features one regulated B supply and one unregulated filament supply. It is distinguished by excellent regulation, low ripple content and low output impedance. The B supply is continuously variable from 100 to 400 v and delivers from 0 to 150 ma. In the 100 to 400-v range output voltage variation is less than 0.5 percent for both line fluctuations from 105 to 125 v and load variations of minimum to maximum currents. Ripple is less than 5 mv peak to peak. The unregulated filament supply is 6.3 v, 10 amperes, unregulated, center tapped and ungrounded.



Ceramic Capacitors

AEROVOX CORP., Olean, N. Y. Voltage ratings of from 1 to 20 kv are

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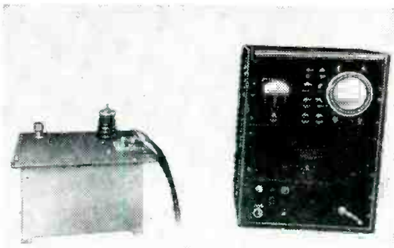
now made available in Hi-Q ceramic capacitors of the slug, disk, plate and tubular types. In the new slug type, utilizing thick disk dielectrics, the strength of the capacitor is greatly increased by an exacting jacketing procedure in conjunction with a newly developed plastic that provides excellent arc-resistant properties. Terminals are silvered brass integrally soldered to silver electrodes fired directly to the ceramic dielectric. Insulation resistance is in the order of 50,000 megohms. Working voltage is 20,000 v d-c and flash test 27,000 v d-c. The high-voltage tubulars have been developed specifically for use in horizontal sweep and deflection sections of tv receivers, and come in standard capacitances from 4.7 to 1,000 $\mu\mu$f, voltage pulse ratings of 1 to 7 kv and capacitance tolerances of $\pm$5.0 percent.

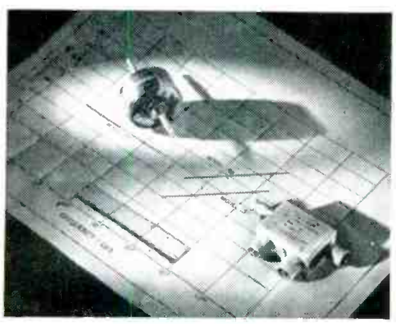
Insulation Tester

THE HERMAN H. STICHT CO., 27 Park Place, New York, N. Y., has developed a new model P-1 plug-in type Megohmer insulation tester for portable or bench use. It was specifically developed to meet the need for a direct-reading megohmmeter where a large number of tests have to be performed in one location such as in production testing. The unit has a true ohmmeter movement that is independent of voltage variations and requires no adjustment whatsoever during normal operation. It is provided with a self-contained power unit to step up and rectify 115-v 60-cycle a-c supply. Output voltages of 500 v d-c and 1,000 v d-c are available. The instrument comes in single-range or double-range models. Ranges available are 100 or 1,000 or 2,000 megohms.



Corona Ionization Detector

NETWORK MFG. CORP., 213 West 5th St., Bayonne, N. J. The corona ionization detector is designed for testing corona initiation and extinction levels in coaxial cables, transformers and other insulated electrical components. It will perform corona test requirements of JAN-C-17A specifications for coaxial cables and MIL-T-27 for transformers. It is especially useful for the study of insulating materials and dielectrics before rupture by breakdown. It is suitable for nondestructive testing of valuable specimens.



Wideband Directional Couplers

SIERRA ELECTRONIC CORP., 810 Brittan Ave., San Carlos, Calif. Widely applicable tools for measuring numerous parameters relating to transmission lines, the new wideband directional couplers are available in three models. Model 137 operates over the entire frequency range from 30 to 1,500 mc with a sensitivity rising from —70 to —35 db. Model 138 covers the same frequency range but has a sensitivity ranging from —55 to —20 db. Operating in a 51.5-ohm coaxial line, these couplers are usable from 0.1 w up. Frequency-independent at a sensitivity of —50 db over the

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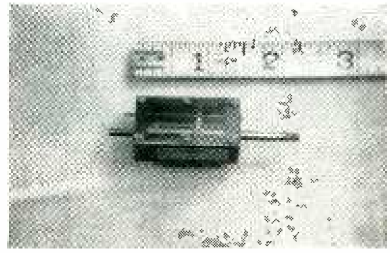
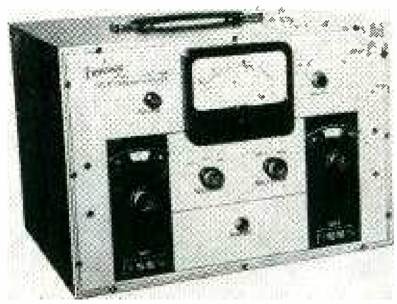
30-kc to 1-mc range, the model 139 coupler is applied to balanced two-wire lines at power levels ranging up to 15 kw.



Subminiature Potentiometers

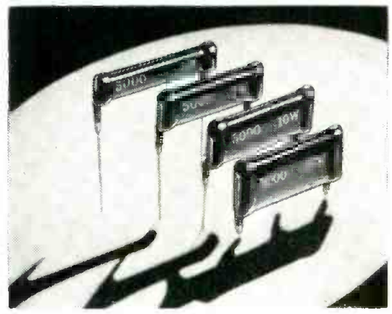
GALETRONICS, INC., Pasadena, Calif., is manufacturing a new line of subminiature precision potentiometers for the telemetering and electronics industries. The rotary type RC can be furnished up to 320,000 ohms with a resolution of 0.1 percent, in a ⅞ in. diameter case. Type LE (illustrated), a rectilinear potentiometer in a case 1⅜ in. long, can be furnished up to 1,000,000 ohms with a resolution of 0.05 percent.



Field Strength Meter

ERWOOD, INC., 1770 Berteau St., Chicago 13, Ill., has introduced a uhf-vhf field strength meter. The unit was designed to determine the strength of signals available at any given location and covers all the frequencies used today in broadcasting tv and f-m programs. It is also useful in determining the relative efficiency of different types of antennas as well as the optimum heights. The vhf range is continuous from 52 to 218 mc, with sensitivity at 60-percent meter deflection per 100-mv input. The uhf range is continuous from 470 to 890 mc, with sensitivity at 50-percent meter

deflection per 100-mv input. The meter uses 11 tubes. Power consumption is 70 watts, 110 v a-c.

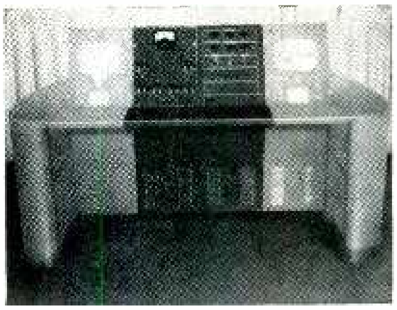


Wire Wound Resistor

HAMILTON-HALL MFG. CO., 227 N. Water St., Milwaukee, Wisc. The Hall-Ohm resistor is completely impervious to high humidity and the abuses encountered during assembling operations. The unique coating will not chip or flake and provides excellent surface radiation. These resistors are available up to 25,000 ohms resistance value and up to 20 watts dissipation.

UHF Signal Generator

MEASUREMENTS CORP., Boonton, N. J. Model 84-TV standard signal generator, with frequency range of 300 to 1,000 mc, is useful for determining the characteristics of tv receivers for the uhf band, and other equipment operating within that range. Output voltage is continuously variable from 0.1 μv to 1 v across a 50-ohm load. Output impedance is 50 ohms and vswr is 1.3 to 1 or better. Provision is made for operating the filament of the oscillator tube from an external d-c supply to remove residual hum. Modulation, continuously variable from 0 to 30 percent, may be obtained from an internal 400-cycle oscillator. Provision is also made for applying external modulation within the range of 50 to 20,000 cycles. Percentage modulation is indicated by a panel meter.



TV Console Unit

RADIO CORP. OF AMERICA, Camden, N. J. This versatile two-section console, which provides centralized audio and video control and monitoring facilities, is a practical basic unit for almost any tv station, large or small. The type TC-4A console ties together transmitter operation and primary program sources. Add-on console units of the same flexible construction, may be added as program functions are expanded.

Sound Analyzer

HERMON HOSMER SCOTT, INC., 385 Putnam Ave., Cambridge 39, Mass. Type 420-A sound analyzer separates noise, sound and vibration signals into their component frequency bands. The high and low-pass filters can be independently adjusted in steps of 0.5 octave. A simple interlock permits the pass-band width to be fixed in any multiple of 0.5 octave. The position of this pass-band can then be adjusted throughout the audible range by a single control. The analyzer exceeds all proposed speci-

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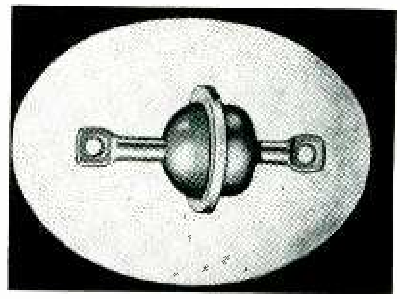
fications of the ASA for filter-type sound analyzers. Weight of the unit is 20 lb, and measurements are 10 in. × 10 in. × 6 in.



Thermosetting Plastic

MELKOR RESEARCH LABORATORIES, INC., 11740 Detroit Ave., Cleveland 7, Ohio, has developed a new plastic material that withstands continuous temperatures of 200 C and also possesses a high dielectric strength. It is particularly advantageous where hermetic sealing and gas sealing under pressure is needed for perfect functioning of electrical components. The terminal shown is being manufactured in three sizes—3/16 in., 5/16 in. and 3/8 in. mounting holes. Chief applications of the new terminal are in the assembly of instruments meters and various types of electric and electronic equipment requiring hermetic sealing.

Oscillograph Tube

RADIO CORP. OF AMERICA, Harrison, N. J. The 7-in., c-r tube 7VP1 is designed especially to give sharp focus and to provide high brightness of the trace in general oscillographic applications. Utilizing electrostatic focus and electrostatic deflection, it has a small, brilliant spot and high-deflection sensitivity

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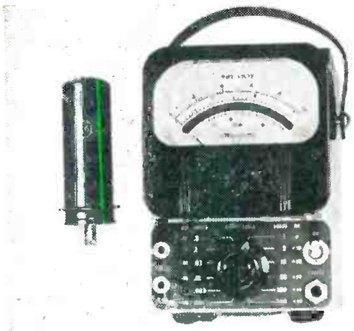

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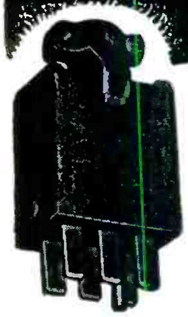
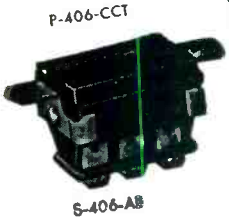


P-406-CCT



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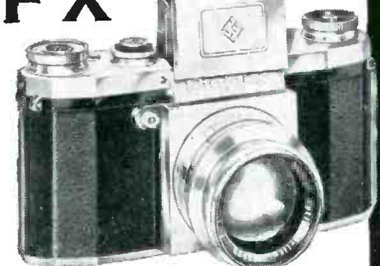

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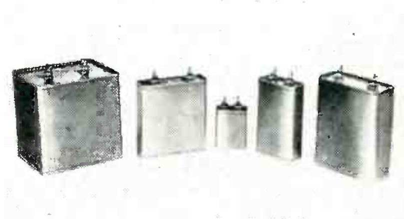

Capacitors

INDUSTRIAL CONDENSER CORP., 3243 N. California Ave., Chicago 18, Ill. The Stabelex D series of capacitors are particularly adapted for use in equipment subjected to extreme altitude and climatic changes or similarly difficult operational variables. They have an unusually low temperature coefficient of capacitance, as is evidenced by only a 0.8-percent change in capacitance from +20 C to −80 C. Power factor is 0.00025 at 1 kc. These capacitors have time constants in excess of 4,800 hours.

Sensing Switch

THOMPSON PRODUCTS, INC., 2196 Clarkwood Road, Cleveland 3, Ohio, has developed an airborne sensing switch actuated by a 115 v a-c, 380 to 1,000-cycle motor. It has two independent double-throw r-f circuits which are switched at a rapid rate (15 to 35 cps) to furnish

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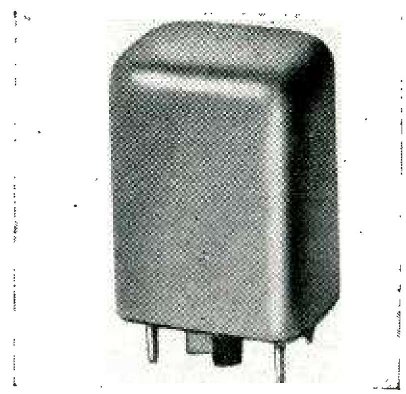
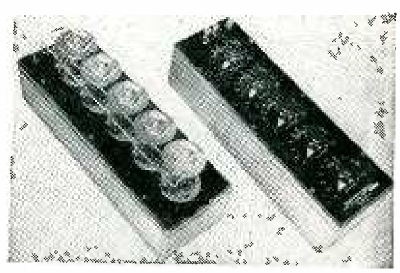


Tiny Hermetic Transformers

UNITED TRANSFORMER CO., 150 Varick St., New York 3, N. Y., has announced stock hermetic sealed transformers that cover the entire range of audio requirements for subminiature equipment. They include input, interstage and output transformers, as well as a reactor. Overall case dimensions are only $\frac{1}{2}$ in. × $\frac{11}{16}$ × $\frac{29}{32}$ in. The units weigh only 0.8 oz. This miniaturization is made possible through the use of special nickel-iron alloy laminations and fine wire windings on nylon bobbin. Mounting is effected through a unique single threaded-stud arrangement with case tabs to prevent twisting.



Resistance Boxes

THE DAVEN CO., 191 Central Ave., Newark, N. J., has available its new type 750 resistance boxes. The units are complete assemblies of

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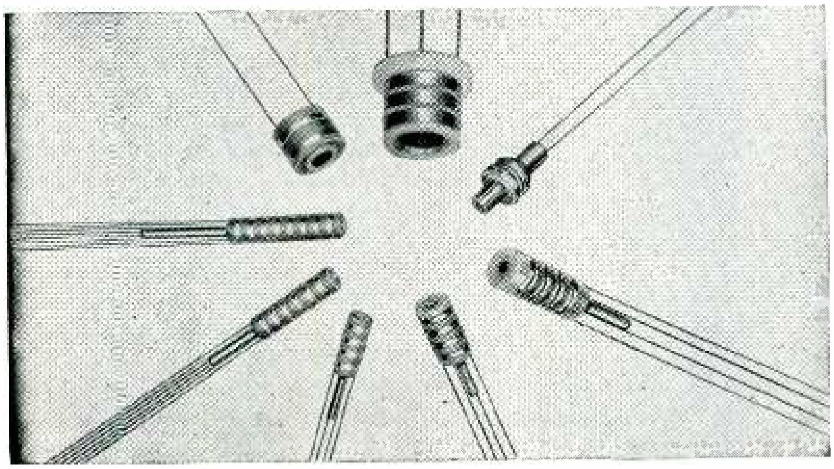

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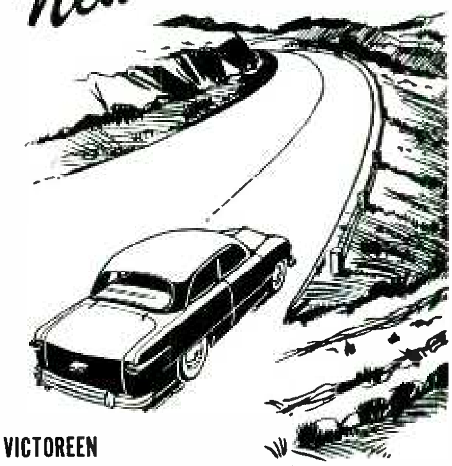

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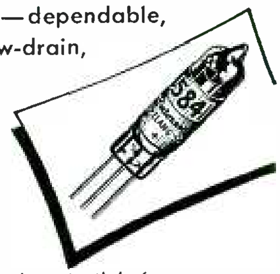

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5841	900	2.0-50	1.5
VXR1000	1,000	2.0-50	1.5
6143	1,200	2.0-50	1.5
VXR1500	1,500	2.0-50	1.5
6119	2,000	2.0-50	1.5
VXR2500	2,500	2.0-50	1.5
VXR10,000	10,000	5.0-50	2.0
VXR15,000	15,000	5.0-50	2.0

*Other voltages within the 50 to 15,000 volt range, available from stock or made to order. Write for further specifications.

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two or more type 275 decade units. The cabinet shielding consists of a full copper lining making electrical contact with the metal panel for complete isolation of the resistive elements. There is no electrical circuit between the shield and resistance elements. Three terminals are provided, two for the resistance circuit and the third as a ground connection to the shield. These precision boxes may be used as laboratory standards, as direct-reading resistor elements in bridge circuits, as shunt or series elements in transmission networks, as dummy loads, or other applications where accurate, stable, adjustable resistance elements are applicable. They are equally suitable for the college or industrial laboratory, production test circuits, direct current, audio-frequency work and many applications in the radio-frequency range up to 10 mc when properly applied.

Resistance Meter

SOUTHWESTERN INDUSTRIAL ELECTRONICS CO., 2831 Post Oak Road, Houston 19, Texas, has announced a new combined ohmmeter and leakage tester. Model C-3 resistance meter is a compact, portable instrument designed for production testing of transformers and capacitors, with a useful range of 1 ohm to 1 million megohms. The four ohmmeter ranges are powered by a 1.5-v battery. The six-megohm ranges apply a maximum of 105-v to the unit under test, providing a quick and accurate indication of insulation resistance or dielectric leakage. Accuracy is ±3.0 percent of full-scale deflection for all ranges except

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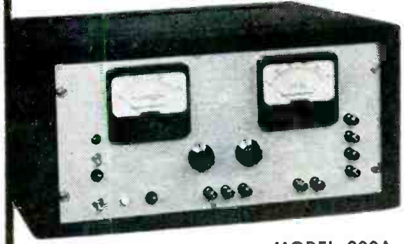

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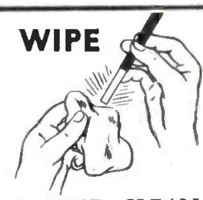

3. WIPE CLEAN. Operation completed in seconds.

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Trade-Mark

M. S. C.
(Mass Spectrometer Checked)

RARE GASES

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LINDE Rare Gases are mass spectrometer checked to assure you gases of known purity and uniformly high quality. Available in commercial-size cylinders and glass bulbs.

LINDE, the world's largest producer of gases derived from the atmosphere, can meet your individual needs of purity...volume...mixture...containers...

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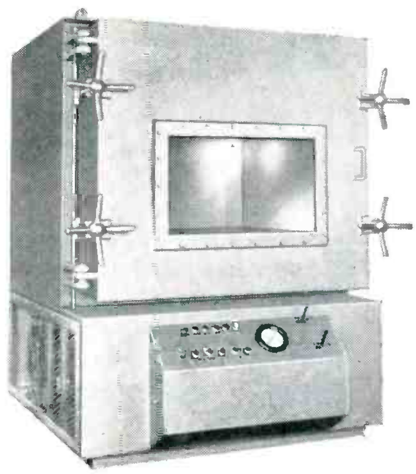
New ALTITUDE SIMULATION CHAMBER

- Altitude Range to 120,000 feet.
- Temperature Range from 300°F. to −140°F.
- Micrometer Temperature Adjustments hold ±2°F.
- Compact Design . . . Requires less Floor Space
- Humidity Cycle available



Providing extreme flexibility in temperature and vacuum ranges, M & M Altitude Simulation Chambers give you precise control and easier, simpler operation that will reduce test costs considerably. Custom-quality built in every detail, M & M Chambers are designed to meet Government altitude simulation test standards. Available with many optional features to speed testing, such as Program Heating, Cooling, and Humidity Cycles, Automatic Recorder for controlling and integrating temperature, humidity and altitude. Write for details on Altitude SIMULATION Chambers as well as M & M Cold Temperature Test equipment.

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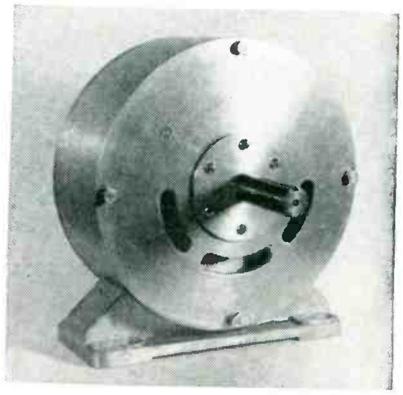
MURPHY & MILLER — M&M — LO-TEMPERATURE

the highest megohm range which is ±5.0 percent.



Permanent Magnet Generator

GEORATOR CORP., Arlington 9, Va., announces an improved electric generator that avoids brushes entirely by a permanent magnet construction. The generator is adapted for aircraft use, for field or laboratory supply of 400 cycles, for portable power units, for mounting in marine craft or vehicles, or for operation of newer high-frequency portable power tools. Outputs range from 250 va to 25 kva. Usual voltages, single or three-phase are provided.

Stainless Steel Strip

AMERICAN SILVER CO., 36-07 Prince St., Flushing 54, N. Y., has available stainless steel strip, rolled to precision tolerances and ultrathin gages. Stainless steels are being produced in strip up to 8 in. wide and down to 0.0005 in. thin—to tolerances as close as ±0.0001 in. The strip is available in any quantity from one pound to thousands of pounds. Typical uses for stainless steel strip in the electrical, electronics and communications industry include: nonmagnetic components, instrument paneling, corrosion-resistant parts (such as springs, stampings and ball-bearings), name plates, veneers and decorative trim.

Instrument Resistor

SHALLCROSS MFG. CO., Collingdale, Pa., has announced type 245S, a

new 1-watt precision wire-wound resistor for decades and other applications requiring low resistance values with close tolerances, low temperature rise and low inductance. The new resistor can be calibrated to a tolerance of ±0.1 percent or better and is available in values from 0.1 ohm to 1,000 ohms. A single layer bifilar winding protected by a moisture resistant lacquer coating is used for all values. The Steatite bobbin and axial wire leads at the same end make it easy to mount the resistor directly on decade switch decks or other similar equipment. Size is 1⅛ in. long by ⅜ in. diameter.

Line Voltage Booster

Radio Apparatus Corp., 55 New Jersey St., Indianapolis 4, Ind., has designed the V-15 booster for areas where line voltage is below normal. This compact, portable booster provides full rated performance from any 110-v electrical device requiring between 500 and 1,500 w. The meter reads actual line voltage and load voltage-switch increases 5 v per step. It can raise 85 v to 120 v with a 1,250-w load. Television servicemen will find the booster valuable for checking line voltage and to provide adequate power supply to test equipment when servicing in low-line-voltage areas. Measurements are 7⅜ in. high, 4⅞ in. deep and 5⅞ in. wide. Weight is approximately 10 lb.

Literature

Fabricated Mica. Mica Fabricators Association, 420 Lexington Ave., New York 17, N. Y., has available a handbook that brings together pertinent facts on natural sheet and block mica with particular emphasis on characteristics required in the electrical industry. It is expected that the book will serve as a guide for manufacturers of electrical, radio and electronic equipment in selecting the best and

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DRY TYPES

78 Standard Industrial, Laboratory and Government Types.

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Our engineers will design and create to your requirements. Send us your specifications.

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Water activated "One Shot" Batteries.

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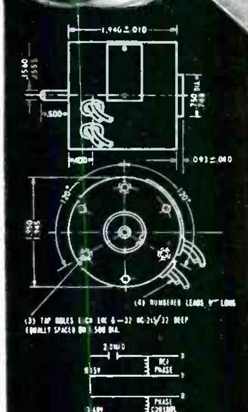
TYPE A09C-1

MOTORS--- PRECISION ENGINEERED

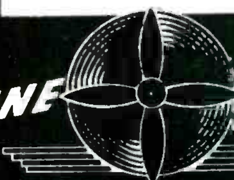


This two phase Servo Motor, totally enclosed has our newly developed low inertia lamination, rotor inertia .059 oz. in. delivers 3 oz. in. of stall torque with an input of 8 watts per phase.

The motor is ideally suited for plate circuit operation, and similar types can be supplied wound 2 or 4 pole with a wide range of torque and impedances.

SPECIFICATIONS
Conform to the Standards of the Gov't specifications.
Continuous duty

WEIGHT	12 oz.	VOLTS	115
R P M	1500 Average	CYCLES	60



AIR MARINE MOTORS INC.

2183 JACKSON AVENUE SEAFORD, L. I., N. Y.

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All Original BEEDE ELECTRIC METERS

HAVE ALNICO MAGNETS

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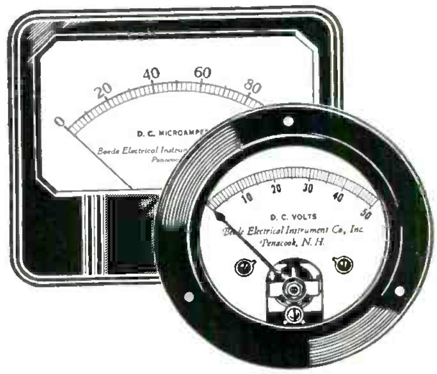
ALL ORIGINAL
BEEDE METERS
ARE INDIVIDUALLY INSPECTED AND TESTED FOR
"ON THE DOT" ACCURACY



CATALOG or INFORMATION on REQUEST

BEEDE

ELECTRICAL INSTRUMENT CO., INC.
PENACOOK, N. H.

founded by
WALTER E. BEEDE—1880-1947

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most economical grade and quality of mica available for any given application.

Potentiometer Noise. The Helipot Corp., 916 Meridian Ave., South Pasadena, Calif., has available the reprint of a paper entitled "Electrical Noise in Wire Wound Potentiometers". The 8-page bulletin describes the source and nature of the six major types of electrical noise found in potentiometers. It develops and assigns a unit of measurement to electrical noise, and describes how each source can be isolated and measured. Diagrams and sketches show sources and measuring circuits. Results of the latest studies of the subject undertaken by the company are presented.

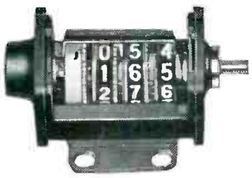
Transformers. Altec Lansing Corp., Peerless Electrical Products Division, 9356 Santa Monica Blvd., Beverly Hills, Calif., has released a new 15-page transformer catalog and price list containing 92 items, representing an increase of 50 percent over previous issues. It lists many new items including the line of 20-20 Plus transformers, and also describes facilities for the design and manufacture of Class A, B and H transformers, which are built to meet JAN-T-27 and MIL-T-27 specifications.

Industrial Instrumentation. Berkeley Scientific, division of Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif. A 32-page booklet briefly describes electronic instruments providing direct-reading digital presentation of information, and their principal industrial applications. It covers high speed counting, counting plus control, precise interval timing, measurement of rpm, pressure, temperature, flow, viscosity, velocity, frequency and distance.

Signaling Temperature Controllers. Thermo Electric Co., Inc., Fair Lawn, N. J., has published an 8-page Catalog Section 55 illustrating and describing their new "Thermo Electronic" signaling temperature controller and resistance bulbs. Illustrations, chief features

PRODUCTIMETER "SPECIALS"

for Radar and Electronic Applications




Companion shutter counters used as dual direction indicators. One counter adds while the other subtracts. Shutter blanks out counter which is on negative side of 000.

"Y" 2-figure Rotary Counter used in navigating instruments.

High-speed, non-reset "Y" type counter for building into radar instruments.

Special Model "Y" with window at rear designed for use in radar equipment.

These are a few of the "specials" developed by Durant for Radar and Electronic applications. When one of the many standard Productimeters is not the exact answer to a problem, Durant engineers modify, combine, or develop entirely new counters to meet the particular requirements of the job.

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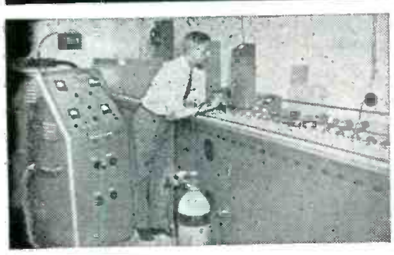
1912 N. Buffum St. Milwaukee 1, Wis. 112 Orange St. Providence 3, R. I.
Representatives in Principal Cities

PRODUCTIMETERS SINCE 1879 *Count Everything*

YOUR PRODUCTS HERMETICALLY SEALED



- Meet Military Specifications
- Insure reliability
- Unexcelled high altitude operation
- Provide permanent protection from dust and corrosive atmospheres
- Forever free from humidity effects

Our engineers will design suitable enclosures for your electronic parts. We assemble and seal your units in dry air or inert gas. All assemblies are evacuated and 100% leak tested by the Veeco Mass Spectrometer. Write for complete information.

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PERMAG services include:
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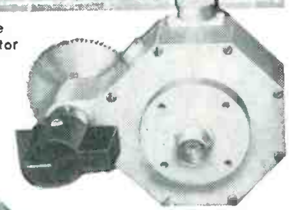
NOW an RF STEP ATTENUATOR

0-500 MC.



Geared Drive output connector accessible through front panel

Direct Drive for use with output cable

New Model AT-120 RF is designed to meet size and weight restrictions with tight performance specs.

- Flat attenuation characteristic from DC to UHF
- Low VSWR
- Perfect Shielding
- Supplied with attenuation values to your specifications:
  Up to 120 db total; Up to 20 db per step; Up to 10 steps
- *Output impedance;* nominal 50 ohms unbalanced or optional at lower frequencies
- *Output and input:*
  BNC jacks or attachments for RG55U or RG58U Cable
- Available with crystal diode voltmeter mount for monitoring input level at 1 to 2.0 volts.
- Special mechanical features provide flexibility of mounting and drive.
- *Dimensions:* Diameter — 2½"; Depth —1½"
- *Weight:* 10 ounces.

Suitable for Standard Signal Generators, Precision Microvolters and many specialized test equipment applications.

Write for detailed performance data depending on the attenuation values desired.

TRAD TELEVISION CORPORATION
1001 FIRST AVENUE ASBURY PARK, N. J.

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and operating principles are included.

Attenuators. Kay Electric Co., 25 Maple Ave., Pine Brook, N. J. A single-page bulletin covers models 20 and 21 high-frequency switchable attenuators. An illustration, description and technical specification are included.

Nickel Containing Alloys for Permanent Magnets. The International Nickel Co., Inc., New York 5, N. Y., has published a 16-page booklet showing 8 graphs and a list of sources of supply on nickel containing alloys for permanent magnets. It reviews the commercially available p-m alloys, especially the Alnico family. Advantages and limitations of these are high-lighted. Characteristics of ductile permanent magnets (Cunife and Cunico) and of special permanent magnets (silver or platinum) alloys are described. A table gives representative magnetic properties and composition of 23 alloys.

X-Ray Trouble Chart. North American Philips Co., Inc., 750 South Fulton Ave., Mt. Vernon, N. Y., has available a new 11 × 15 in. chart titled "Locating Common Electrical Faults in X-Ray Generators." Developed to aid plant engineers and laboratory technicians, the chart lists symptoms, suspected location, trouble possibilities and methods for locating and correcting generator troubles common to all makes of x-ray generator equipment. It shows nine different trouble symptoms, 14 possible locations, 31 trouble possibilities and the corresponding correction procedures.

Electric Tachometers. The Bristol Co., Waterbury 20, Conn., has published a 20-page bulletin (No. S1402) describing a full line of recording and indicating electric tachometers. The instruments described include models for measuring speed of rotation or travel, processing time, speed ratios, sum or difference of speeds and average of speeds. Featured in the bulletin are the recently announced electric Dynamaster recording tachometers. Engineering information and com-

plete specifications on magnetos and the various types of magneto drives are given. The bulletin is liberally illustrated with photos and drawings showing methods of application, reproductions of actual chart records and dimensions.

UHF Antennas. Technical Appliance Corp., Sherburne, N. Y. Catalog 83 announces a line of antennas designed specifically for uhf reception. Included in the line described are parabolic-reflector types, yagis, modified X (Bow-Tie) and Vee-type antennas. With the exception of the modified-X design, all the antennas discussed are of the sharp directivity type. The modified-X will be marketed for areas where reception from channels in opposite directions is required.

Dynamic Temperature and Strain Recorder. Allegany Instrument Co., Inc., 1000 Oldtown Road, Cumberland, Md. An 8-page folder discusses the model 204 dynamic temperature and strain recorder designed for the quantitative study of strains, temperatures and d-c potentials. Besides the general description and uses are included component descriptions and performance specifications.

Radiation Detection Instruments. Radiation Counter Laboratories, Inc., 5122 West Grove St., Skokie, Ill. Illustrated price list No. 12 is a new 16-page brochure describing in detail all types of radiation detection and health instruments. Included are electronic instruments; Geiger, proportional and scintillation counters; health instruments; shields and safety devices. Cataloged for the first time is complete reactor control instrumentation.

Circuit Breakers. Heinemann Electric Co., 307 Plum St., Trenton 2, N. J., has published a new manual explaining operating principles of basic circuit breaker designs, and providing engineering data on factors of application. Included are simplified diagrams showing the three basic types of circuit breakers in general use today with brief descriptions. Through colored charts and dia-

A NEW RACK-MOUNTING
5" BASIC SCOPE

A new 5" rack mounted basic oscilloscope of high quality parts and design.

- **Push-Pull input with blanking post.**
- **Potted power transformer.**
- **2,200 volt anode supply for short, medium and long persistence screens.**
- **Astigmatism control on panel.**
- **1/4" lucite safety glass and grating.**
- **Flanged bezel for scope cameras.**
- **Mu metal C. R. tube shield.**
- **Standard 8 3/4"x19" rack panel in black or grey engraved crackle.**

All high quality parts and workmanship are used in this excellent indicating unit. Balanced input signal connections are at rear of C. R. tube with low capacity leads. Furnished with 5UP1, 5UP7 or 5UP11 as requested. Available for immediate delivery.

Manufactured by

TINKER & RASOR

P.O. Box 281 San Gabriel, California

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WAXES
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Zophar Waxes, resins and compounds to impregnate, dip, seal, embed, or pot electronic and electrical equipment or components of all types; radio, television, etc.

Cold flows from 100°F. to 285°F.

Special waxes non-cracking at −76°F.

Compounds meeting Government specifications plain or fungus resistant.

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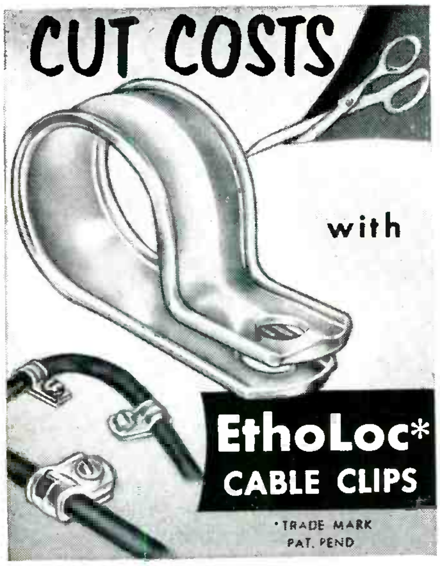

Made of tough, durable Ethyl Cellulose plastic. This cable clip will hold wires or groups of wires neatly and securely in position . . . no possibility of shorts or grounds. Only one fastener is required (screw, nail, rivet or eyelet) with these loop type supports.

Write for samples details, prices

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ALSO MFRS. OF ALL NYLON CABLE CLIPS

5267 N. Avondale Ave. • Chicago 30, Ill.

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, T5 1/2, T6 1/2, MT-IC, ST19, T14, ST128CT-9.

Manufacturers of Electronic Components

JAMES IPPOLITO & CO., INC.
401 CONCORD AVENUE, BRONX 54, N. Y.

grams, explanations of temperature factors, inrush current effects, tripping and reset time, and time delay curves are provided. Also discussed are the questions of quick or slow make-and-break, and wire deterioration rates at various ampere values.

Rectifier Bulbs. General Electric Co., Schenectady 5, N. Y. A new 8-page, two-color data manual on Tungar bulbs (used for rectifying a-c power to d-c) has been announced. Designated GEA-5677, the bulletin contains charts and graphs illustrating the characteristics, construction, operation and application of Tungar bulbs.

Infrared Analyzer. Minneapolis-Honeywell Regulator Co., Brown Instruments Division, Wayne and Windrim Aves., Philadelphia 44, Pa. Instrumentation data sheet 10.16-7a describes a newly designed selective infrared analyzer produced by Process Controls Div. of Baird Associates. The data sheet illustrates and discusses the application, operation, design features and uses of the unit for plant stream service. It also discusses the ability of the equipment, which incorporates a Brown Electronik potentiometer, for use as a process control medium.

Slide Rule Instructions. The Frederick Post Co., 3650 N. Avondale Ave., Chicago, Ill., has published a new self-instruction text showing the practical application of mathematical principles. The text is divided into three distinct sections and deals with the improved principles of the Versalog slide rule as it applies to electrical, mechanical and civil engineering. Each section of the 120-page booklet presents a practical, easy-to-comprehend guide to the efficient use of the Versalog in these specialized fields.

Relays for Industry. Automatic Electric Co., 1033 W. Van Buren St., Chicago 7, Ill. A complete line of telephone-type relays, including hermetically sealed (in metal and glass containers) subminiature, and plug-in types is described in a new, color-illustrated brochure

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recently released. Ask for circular No. 1702-A.

Printed Circuits. Photocircuits Corp., Glen Cove, N. Y. Printed circuits, their function, fabrication and application are comprehensively outlined and described in a new 8-page brochure. Lower wiring costs, reduced assembly time, circuit reproducibility, improved reliability and miniaturization are the advantages shown by this method of wiring. The brochure includes information on methods of application, materials, electrical characteristics with tables of values, components such as capacitors, resistors, tube sockets and switches. Assembly methods are described and costs are suggested.

Accessories for Testing Machines. Tinius Olsen Testing Machine Co., 1022 Easton Road, Willow Grove, Pa. Detailed information on instrumentation, tools and accessories for universal testing machines is given in catalog No. 46. Electronic recorders; electronic strain instrumentation; mechanical extensometers; tension compression, wood and plastics testing tools; and control accessories are only a few of the topics covered in the 24-page catalog.

Delay Lines. Electronic Systems Co., 578 E. 161st St., New York 56, N. Y. A recent booklet deals with custom-built delay lines that are offered now as stock items. The delay lines described are constructed to meet military specifications, including temperature specifications ranging from −55 C to +80 C. Next to each model number are listed the delay in μsec, bandwidth in mc and price.

Radiotelephones and Direction Finders. Applied Electronics Co., Inc., 1236 Folsom St., San Francisco 3, Calif. Eight radiotelephone models, two radio direction finder models and various accessory units are described in an 8-page catalog identified as form 852. Besides a description of the basic design features of these units, the catalog includes a full tabulation of models showing number and types of channels, frequency ranges,

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receiver sensitivities, transmitter power outputs ranging from 40 to 500 peak, tube complements, power requirements, dimensions and weights. Accessory units listed include a sectionalized spun glass whip antenna, plug-in crystals, a model 106 mobile p-a system, indoor and outdoor extension speakers, microphones and press-to-talk hand sets.

Small Predetermined Counters. Durant Mfg. Co., 1929 North Buffum St., Milwaukee 1, Wisc. Bulletin 501 covers the SP small predetermined Productimeters designed for both stroke and rotary application, to control production to exact quantities required, and eliminate losses due to over-runs and under-runs. Complete description, specifications, dimensional data, and switch capacities are included.

Picture Tube. Hytron Radio and Electronics Corp., Salem, Mass. A recent series of engineering data sheets give a technical description of the type 27EP4, a 27-in. rectangular, 90-deg, all-glass, magnetically focused picture tube. Terminal connections are shown and dimensional drawings included.

Coax Connectors. Mendelsohn Speedgun Co., Inc., 457 Bloomfield Ave., Bloomfield, N. J., has published two four-page bulletins covering the types C and N coaxial connectors. Listed with dimensional drawings for both types are plugs, cable jacks, panel jacks, bulkhead jacks, receptacles, angle adapters, angle plugs, tee adapters and straight adapters.

Picture Tube Comparison Chart. Sylvania Electric Products Inc., Emporium, Pa., has available a wall chart for tv picture tube comparison. It lists 136 types and includes in tabular form information on the face, body, focus, deflection and maximum length of each.

Pressure Pickup. Consolidated Engineering Corp., 300 North Sierra Madre Villa, Pasadena 15, Calif., has issued a 12-page brochure on its type 4-310 flush-diaphragm pressure pickup, a small

instrument that features negligible temperature sensitivity, resistance to acceleration effects and wide adaptability to many test conditions and mounting requirements. Included are diagrams showing the transducer used in a direct recording system and in a carrier amplifier system. Operating characteristics are also given.

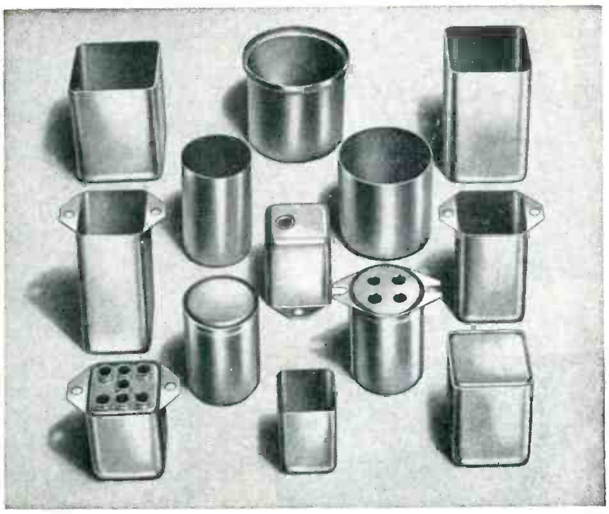
Calibrator. Bruck Industries Inc., Syosset, N. Y. Catalog sheet 06 gives general and technical descriptions and specifications for the type M-DC-1 meter calibrator. The instrument described is needed in industry, research and test laboratories where d-c meters are used and must be checked for accuracy; and it is particularly useful as an accessory equipment in the design of electronic analog computers.

Radiant Heating. The Thermflex Division of Radio Ceramics Corp., 109 South Superior St., Angola, Ind., has published a brochure dealing with printed circuit techniques as applied to electric heating. Description, illustrations, applications and chief advantages are included.

Printed Circuits. Erie Resistor Corp., Erie, Pa., has issued a bulletin describing and illustrating a complete line of five types of electronic printed circuits, each in a range of capacities: diode filters, triode plate couplers, vertical integrators, pentode plate couplers and audio output circuits. In the units described all plates are ceramic, lead wires are tinned copper wire and insulation is thermosetting dipped phenolic.

Precision Instruments. Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Wayne and Windrim Aves., Philadelphia 44, Pa. Catalog 1520 contains factual information concerning Electronik noncontrol precision instruments, which employ a potentiometer, Wheatstone bridge, or other measuring circuit to measure temperature, pressure, flow, pH and a host of other variables. It presents detailed specifications for each particular model. Also in-

drawn cases



hot tin dipped . . . fabricated terminal and vent holes . . . smooth, one-piece construction using cold rolled steel . . . draw depths up to 2½" . . . **inside fit covers for easy hermetic sealing in all sizes** . . . available as stock sizes and as special fabrications.

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P. O. BOX 71A **PHILLIPSBURG, N. J.**

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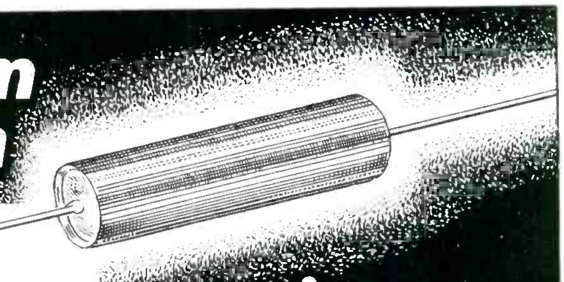

Unicon Polystyrene capacitors are characterized by extremely low losses. Exact values are given in the table.

Possessing very high electrical qualities, they are ideal elements for use in electronic analyzers and computers, in tuned circuits and wave filters, as standards of capacitance, in radiation detection, and power supply circuits.

Unicon Polystyrene capacitors are available in many different types of housings, as well as uncased for potted assemblies.

Prices on Unicon Polystyrene capacitors are reasonable, and delivery excellent.

Unicon always gives your capacitor problems the Optimum Solution.

unicon PLASTIC DIELECTRIC capacitors

TYPES IMMEDIATELY AVAILABLE

Property	Polystyrene	Teflon	Synthetic D
Capacity	.001 up	.001 up	.01 up
Voltage	100 up	300 up	200 up
Power Factor	.01%	.01%	0.5%
I. R.	10^6 meg/mf	10^6 meg/mf	10^6 meg/mf
Max. Op. Temp.	90°C	125°C	125°C
Soakage	.02%	.02%	1.0%
Temp. Coef	−100 ppm/°C	−100 ppm/°C	+500 ppm/°C
Bulk at lowest voltage given	5 in^3/mf	10 in^3/mf	1.2 in^3/mf

Capacitors made to your specifications.

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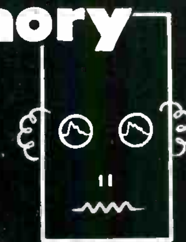
improve your memory



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In electronic computers, Andersen **SOLID** ultra-sonic delay lines are:

PHYSICALLY STABLE ELECTRONICALLY DEPENDABLE

and

SOLID delay lines mean minimum size and weight.

Spurious signals — 40db. or better.

Investigate Andersen **SOLID** ultra-sonic delay lines. Complete facilities for research and development.

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cluded is information on specially adapted Electronik instruments such as the electrometer, function plotter, scanning system, TV-Dial recorder, double-range precision indicator and console desk precision indicator.

UHF Antenna Systems. The LaPointe Plascomold Corp., 155 W. Main St., Rockville, Conn. An eight-page catalog called "UHF Antenna Systems—How, What and Where for Every UHF Area" was recently published. The brochure includes considerable important uhf data such as a page of questions and answers for the technician; a page on the Vee-D-X Mighty Match for separating vhf and uhf; two pages on newly developed uhf antennas; a page describing the new Vee-D-X universal mounting bracket and its many uses; and a page showing typical installations that combine both vhf and uhf.

Microwave Components. Titeflex, Inc., 500 Frelinghuysen Ave., Newark 5, N. J. A 12-page folder shows the company's facilities for manufacture of a wide range of microwave components. Rigid and flexible waveguides are described and illustrated, and complete technical specifications and dimensional drawings are included.

Instrumentation Catalog. Tektronix, Inc., P. O. Box 831, Portland 7, Oregon. Short form catalog 5207 illustrates and technically describes seven types of oscilloscope, two square wave generators, an amplifier, two preamplifiers, a time mark generator and a waveform generator. Prices for all are included.

Microwave Measurements. Kay Electric Co., 25 Maple Ave., Pine Brook, N. J. A 4-page brochure shows how microwave measurements may be simplified by using (1) the Mega-Nodes as primary standards for noise figure measurements on microwave receivers; (2) the new Centilators, as signal sources, swept, c-w or pulsed for measurements of frequency and transient response of microwave systems; and as experimental mi-

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Model SI-1 **$375.**

Strain Indicator

Also—complete line of high quality strain gage switches, balancing boxes and associated equipment.

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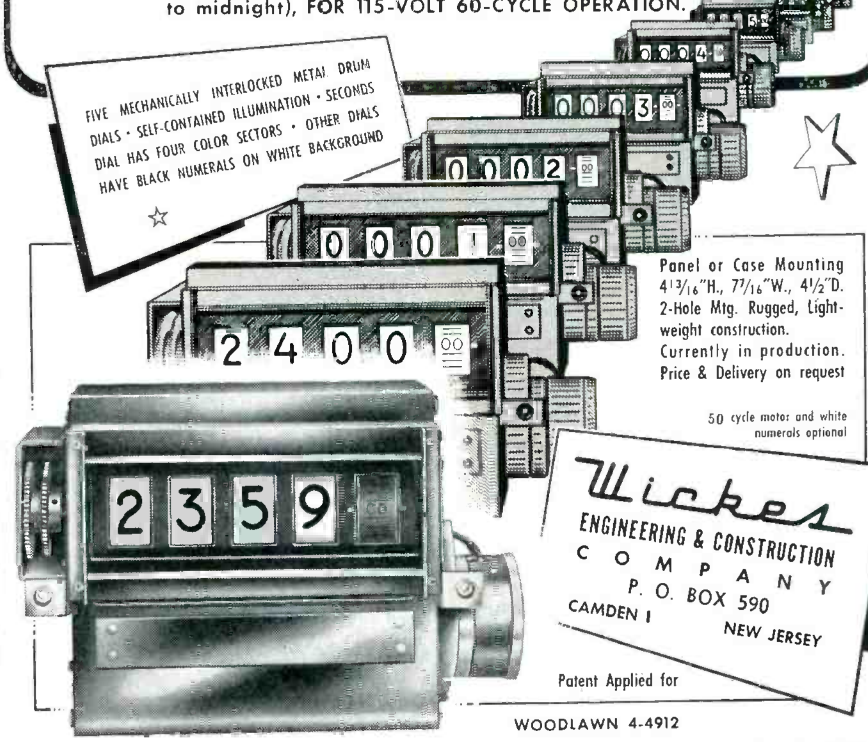

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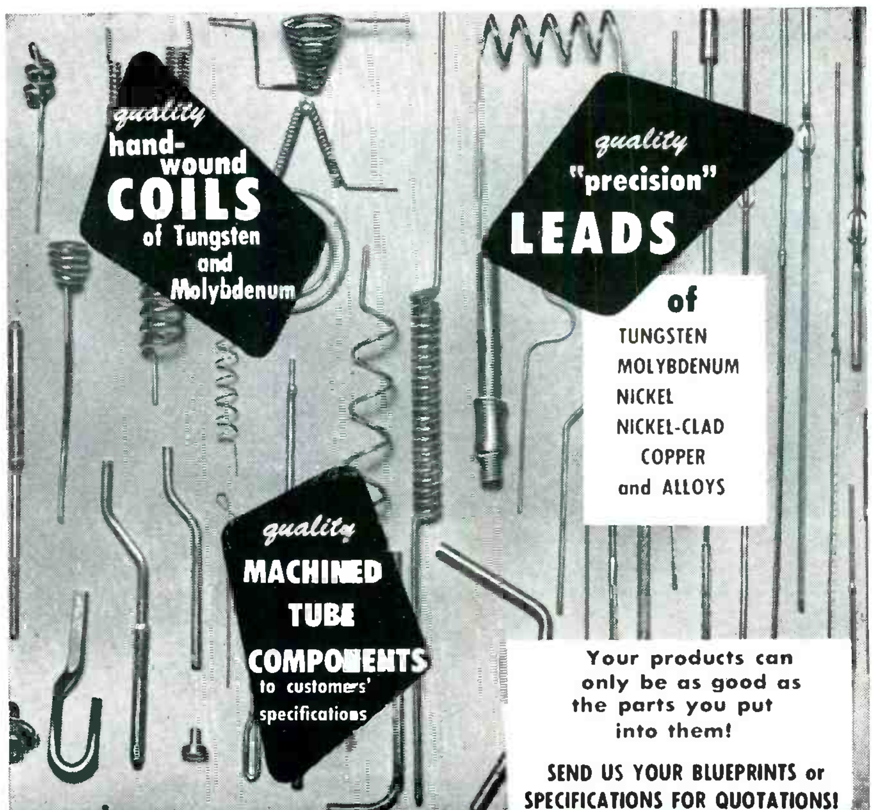

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508 25th St., Union City, N. J.

crowave transmitters; and (3) the Mega-Match as an X-band impedance match indicator that displays reflection coefficient of a line termination vs frequency over broad bands.

Industrial Freezers. Webber Appliance Co., Inc., 2740 Madison Ave., Indianapolis 3, Ind. Information on industrial freezers as well as complete temperature range testing units is now available in an 8-page folder. Included are data on performance characteristics, sizes, temperature range and applications regarding the company's industrial freezers and complete range testing units. The units described perform low temperatures to −165 F and on heat range to +350 F. Twelve models are illustrated with complete information regarding thirty-six standard models.

Counting Rate Meter. Measurement Engineering Limited, Arnprior, Ontario, Canada. A single-sheet loose-leaf perforated bulletin covers the A.E.P. 1902A general-purpose counting rate meter that is intended for accurate research measurements of the average rate of arrival of random pulses as derived from radioactivity detectors. Included are an illustration, electrical and mechanical features, uses and information on circuitry and operation.

Picture Tube Interchangeability Chart. Transvision, Inc., New Rochelle, N. Y. A recent 4-page folder lists most television picture tubes, giving the popular types that replace hard-to-get tubes. Where direct replacement is difficult, notes are included showing changes necessary.

Automatic Voltage Stabilizers. General Electric Co., Schenectady 5, N. Y., has announced a new 12-page, two-color bulletin on automatic voltage stabilizers ranging from 15 to 5,000 volt amperes. The booklet (GEA-5754) contains photographs and diagrams of the equipment, explains operation principles and construction, and gives complete specifications. It also describes the causes and effects of

voltage variations and lists typical applications for stabilizers.

TV Transformers. Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill., has announced its new simplified television transformer catalog and replacement guide, listing replacement information on over 4,400 tv models and chassis. Manufacturers' part numbers are conveniently listed in numerical order with the proper replacement listed next to them. The guide also features a separate section listing 117 tv replacement transformers with complete electrical and physical specifications.

Solderless Terminals. Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa. Two new illustrated booklets present the highlights of the industrial films, "All's Well That Ends Well" and "By the Millions." One demonstrates the use and application of solderless terminals with precision hand tools. The others shows how solderless terminals in strips fed from reels can be applied to write at rates of up to 4,000 per hour with automatic machines.

Auto Radio Replacements. Merit Coil & Transformer Corp., 4427 N. Clark St., Chicago 40, Ill., has prepared an 8-page replacement guide for auto radios that includes 4 pages on transformers and 4 pages on i-f/r-f coils. Ask for Form No. 3.

Acoustical Insulations. Gustin-Bacon Mfg. Co., Kansas City, Mo. A new four-page folder titled "A Complete Line of Glass Fiber Acoustical Insulations" includes all relevant details on Ultralite, Ultrafine and Ultraacoustic. The folder describes the physical properties of each of the three products, such as sound absorption and thermal conductivity. It points out the qualities the three have in common, including their principal uses, their ease of application and the choice of facings available with each. Sizes and dimensions for each are given, along with information on the engineering service the company makes available since each acoustical problem is different.

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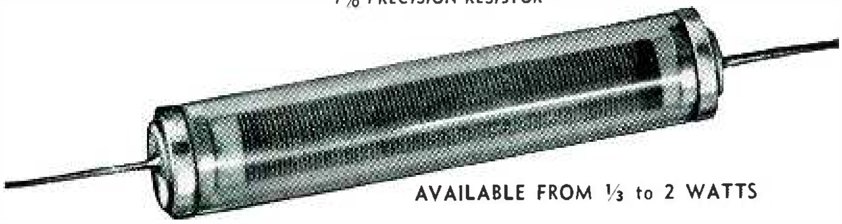
A DEPOSITED CARBON RESISTOR

HERMETICALLY SEALED

1% PRECISION RESISTOR



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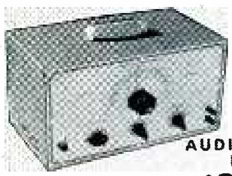
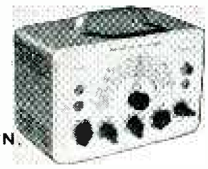
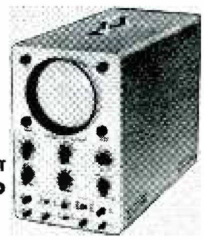


AUDIO GEN. KIT $29.50



R. F. SIGNAL GEN. KIT $19.50



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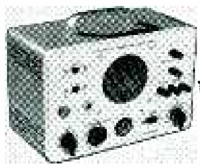

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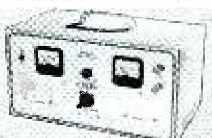

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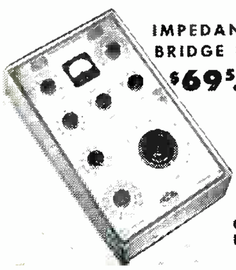

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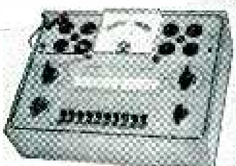

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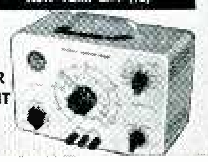

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PLANTS AND PEOPLE

Edited by WILLIAM P. O'BRIEN

OTHER DEPARTMENTS

featured for this issue:

Radio Engineers to Honor Sarnoff, Others

FIRST recipient of the newly established Founders Award of the IRE will be David Sarnoff, chairman of the board of RCA. The award, which will be given only on special occasions and not annually, was established to recognize an outstanding leader in the radio industry and to commemorate the three radio pioneers who founded the IRE forty years ago—Alfred N. Goldsmith, editor of the *Proceedings of the IRE* and consulting engineer; John V. L. Hogan, president of Hogan Laboratories, New York, N. Y.; and Robert H. Marriott, deceased.

Other awards announced by the Institute's board of directors are as follows:

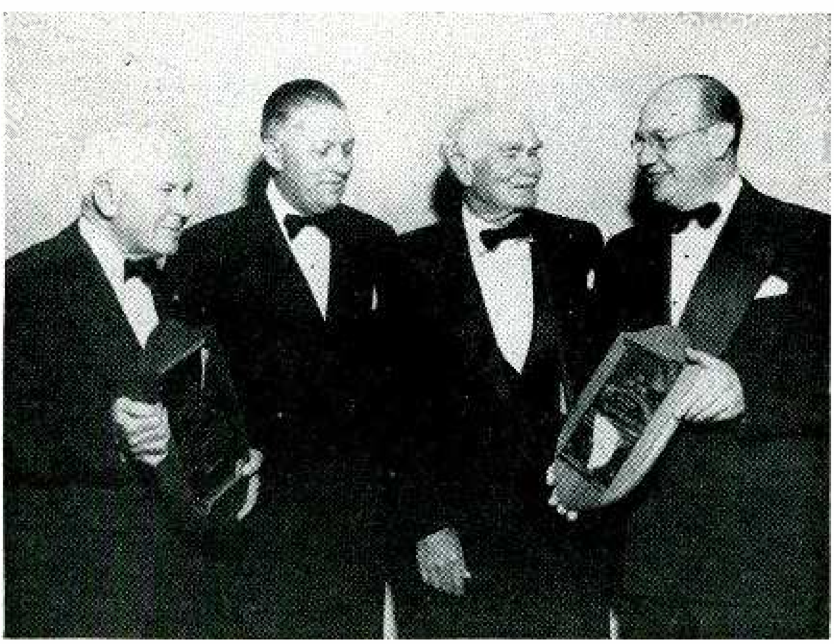
Robert M. Page, superintendent of Radio Division III and associate to the director of research of the U. S. Naval Research Laboratory, Washington, D. C., was named recipient of the 1953 Harry Diamond Memorial Award, given annually to a person in government service, for his "outstanding contributions to the development of radar through pioneering work and through sustained efforts over the years."

The 1953 Browder J. Thompson Memorial Prize will go to Richard C. Booton, Jr., of MIT for his paper entitled, "An Optimization Theory for Time-Varying Linear Systems with Nonstationary Statistical Inputs." This award is bestowed annually on an author under 30 whose paper constitutes the best combination of technical contribution and presentation of the subject.

Edward O. Johnson and William M. Webster, Jr., of RCA Laboratories Division, Princeton, N. J., were named recipients of the 1953 Editor's Award for their paper entitled, "The Plasmatron, A Continuously Controllable Gas-Discharge Developmental Tube." The award recognizes literary excellence.

Presentation of all the awards will be made at the annual banquet to be held at the Waldorf-Astoria, New York City, on March 25, 1953, during the Institute's national convention.

WCEMA AWARD WINNERS



Robert A. Millikan, Assistant Secretary of the Navy John Floberg, Lee DeForest and A. M. Zarem, director of the Stanford Research Institute, study the plaques awarded Drs. Millikan and DeForest by the West Coast Electronic Manufacturers Association for their contributions to the electronics industry. Presentation was made following the association's tenth anniversary banquet in Los Angeles, Calif.

DuMont Fills Three Key Posts

PROMOTION of three members of the Instrument Division, Allen B. DuMont Laboratories, Inc., to new key posts within the division was recently announced.

The appointees and their new positions are as follows:

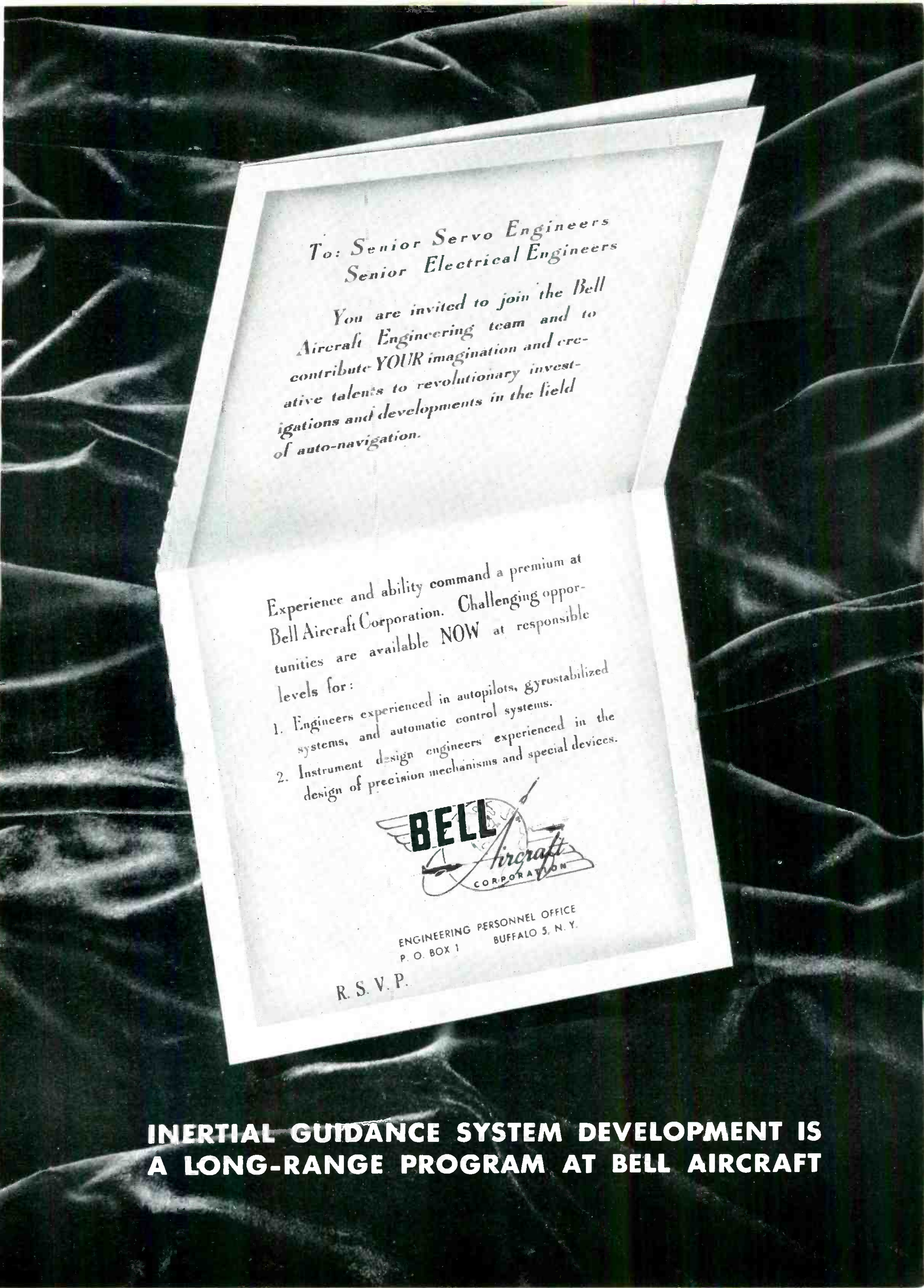
H. B. Steinhauser has been named manufacturing engineer. He was formerly a senior engineer.

L. E. Florant moves from an intermediate engineer to head of the engineering services section.

A. W. Russell is now head of the electrical design section. He was formerly a senior engineer.

Philadelphia Plant Acquires More Space

EL-TRONICS, INC., designers and manufacturers of nucleonic and electronic instruments, has announced the expansion of its research and industrial facilities by the acquisition of an additional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Senior Electrical Engineers
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17,000 sq ft of space in new and modern quarters. General offices, research and engineering are now located in the new building at Fifth and Noble Streets, Philadelphia, Pa. The entire plant facilities at 2647 North Howard St. are being devoted to production manufacturing operations.

Hunkins Advances at Federal

H. R. Hunkins, chief engineer

APPOINTMENT of Harold R. Hunkins as chief engineer in the Selenium-Intelin Division of Federal Telephone and Radio Corp., Clifton, N. J., has been announced.

Mr. Hunkins, who has been with Federal for eight years, is the former project manager for three of the company's government contracts. Previously he was in the Wire and Radio Transmission Division, first as product line manager, then as chief systems engineer and finally as sales manager. In his new position he directs the design of new products and the development of new processes and material for the Selenium-Intelin Division, which produces selenium rectifiers, high-frequency coaxial cable, television lead-in wire and other wire products in Federal's Clifton and East Newark plants.

Time and Place Set for Western Show

ESTABLISHING show dates of August 19 through 21, 1953 was the first order of business as the new WESCON (Western Electronic Show and Convention) board of directors recently held its first organizational meeting for next season in San Francisco. Location of the show will be the San Francisco Municipal Auditorium.

In 1952 a total of 15,092 individuals attended WESCON in Long Beach, Calif., and plans for 1953 envision a substantial increase, not only in general attendance, but also in the 1952 figures of 2,692 who registered for the technical sessions and 199 exhibitors who displayed products and services in 224 booths.

Composition of the new WESCON board of directors is as follows: (standing, left to right) W. D. Hershberger of the University of California, member; Leon B. Ungar of Ungar Electric Tools Inc., member; Howard G. Grove of West Coast Electronics Co., member; (seated) Noel E. Porter of Hewlett-Packard Co., secretary-treasurer; W. E. Noller of Remler Co., Ltd., vice-chairman; Heckert Parker, WESCON business manager; Richard G. Leitner of Packard-Bell Co., past chairman; Joseph H. Landells of Westinghouse Electric Corp., chairman; Jeanne Jarrett, WESCON recording secretary; and (foreground) Richard A. Huggins of Huggins Laboratories, vice-chairman. WESCON, as an operating organization, is jointly sponsored by WCEMA and the Seventh Region IRE.

IRE Elects Officers for '53

ONE of the nation's highest professional honors was recently accorded James W. McRae, vice-president of Bell Telephone Laboratories, New York, N. Y., with the announcement of his election as president of the IRE for 1953. He succeeds Donald B. Sinclair, chief engineer of General Radio Co., Cambridge, Mass., as head of the society.

J. W. McRae, new IRE president

S. R. Kantebet, general manager of the Government of India Overseas Communications, succeeds Harold L. Kirke, assistant chief engineer of the British Broadcasting System, as IRE vice-president.

Elected as directors for the 1953-1955 term are Stuart L. Bailey, partner of Janskey and Bailey, Washington, D. C., and B. E. Shackelford of RCA International Division, New York, N. Y.

Regional directors elected for 1952-'53 are as follows:

Region 2 (North Central Atlantic), John R. Ragazzini of Columbia University, N. Y.; Region 4 (East Central), Conan A. Priest of General Electric Co., Syracuse, N. Y.; Region 6 (Southern) Archie W. Straiton of the University of Texas,

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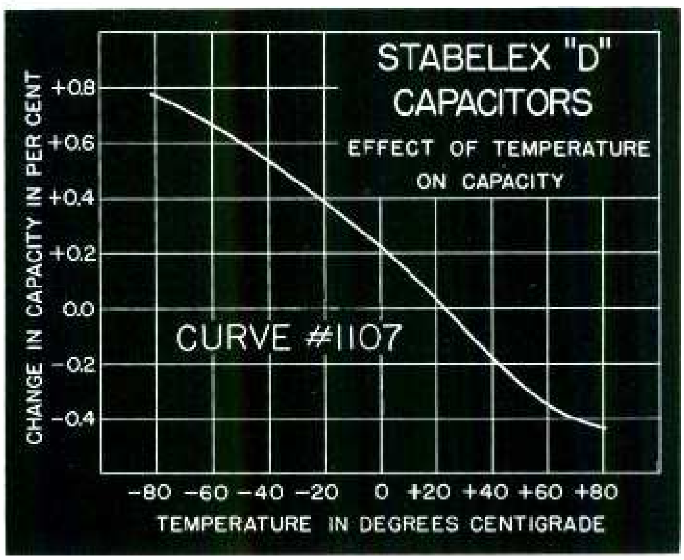

Curve #1107 illustrates the low temperature coefficient of capacity. This low coefficient, therefore, makes these capacitors highly desirable in circuits, the constants of which depend on unvarying capacity.

Performance curves illustrating various characteristics of the Stabelex "D" Capacitor will appear in this magazine each month.

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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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Complete information performance curves, characteristics, and suggested applications of the various types now available will be found in this catalog.

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Austin, Texas; Region 8 (Canadian) John T. Henderson of the National Research Council, Ottawa, Ont., Canada.

Magnavox Names V-P

RICHARD A. WILSON, general manager of industrial and defense products of The Magnavox Co., has been appointed a vice-president of the company.

Before joining Magnavox, he was manufacturing manager of the apparatus division of RCA, Indianapolis, Ind.; vice-president and director of the Hudson American Corp., Brooklyn, N. Y.; vice-president and director of Reeves-Ely Laboratories, New York City; division manager of P. R. Mallory & Co., Inc., and executive vice-president and director of the Elizabethtown Corp., subsidiary of the Muzak Corp., New York City. He was also vice-president and a director of Muzak.

Hycon Ups Crisp

RAYMOND F. CRISP was recently appointed manager of technical services for Hycon Mfg. Co., Pasadena, Calif. Prior to his recent assignment, he had held the position of chief electronics engineer for the company.

New England Plant Expands

THE ANDERSEN LABORATORIES INC., 37 Talcott Road, West Hartford, Conn., has completed an addition to the plant that doubles its facilities. The expansion was made necessary by the broadening demand for solid ultrasonic delay lines, particularly in the electronic computer field. It will increase the facilities for research and development as well as manufacture.

RTMA Sets Up Reliability Group

WITH a view toward helping the military obtain higher reliability in

electronics apparatus, the engineering department of the RTMA has announced the establishment of an Electronic Applications Committee. The committee, under the chairmanship of Lewis M. Clement of the Crosley Division, Avco Mfg. Corp., will collect and disseminate information on the design, manufacture and installation of electronic equipment as an aid to obtaining more reliable military apparatus. It plans to work and cooperate with other associations, research laboratories, manufacturers and government agencies in furthering its program.

The following duties have been assigned the new committee:

(1) To act as a central collecting agency to which all reports and data from surveys relating to reliability of equipment in the field would be referred.

(2) To set up routines with various RTMA and JETEC committees so that data collected in the course of their operations could be referred to proper groups for study and action.

(3) To correlate data from various types of users to determine if their needs follow certain patterns that would be of interest to manufacturers. It may be found that a general class of components or tubes would serve many groups of users.

Announce New Chief Engineer

F. CLARK CAHILL has been appointed chief engineer of the engineering and production division of Airborne Instruments Laboratory, Inc., Mineola, L. I., N. Y. He formerly served in the Laboratory's research and engineering division as supervisor of the radar section.

With Airborne since its founding as an independent electronic research and development laboratory in 1945, he was associated during World War II with the Radio Research Laboratory at Harvard University, an organization sponsored by the government's Office of Scientific Research and Development, as the head of a war research work division. During this same period, he also was associate director of

F. C. Cahill

the affiliated American British Laboratory in Great Britain.

In his new position with the Laboratory's production division, which recently moved into a new and modern plant in Garden City, L. I., N. Y., he will direct production engineering activities.

Avco Elects V-P

LEONARD F. CRAMER, assistant general manager of the Crosley division of Avco Mfg. Corp. since 1951, was recently elected a vice-president of Avco. Prior to joining Avco, Cramer was executive vice-president of the Allen B. DuMont Laboratories and was the first manager of WABD, pioneer tv station of the DuMont network. He will be in charge of Crosley's entire radio-tv activities.

Wiener Joins SKL

FRANCIS M. WIENER has become section head in the engineering department of Spencer-Kennedy Laboratories in Cambridge, Mass. Dr. Wiener comes to SKL from the Bell Telephone Laboratories at Murray Hill, N. J., where he worked on acoustic diffraction theory and the fundamental communication aspects of speech, as well as on classified problems for the Office of Naval Research.

AES Names Fellows

SEVERAL outstanding engineers in the audio industry were recently raised to the rank of Fellows in the Audio Engineering Society at the annual banquet in New York City. They are:

Lindsay Black of Bell Telephone Laboratories, Inc.; Harold Burris-Meyer of Stevens Institute of Technology; Isabel Capps of Frank L. Capps, Inc.; James Y. Dunbar of William J. Scully Acoustic Corp.; Price Fish of Columbia Broadcasting System; Ernest W. Franck of Reeves Soundcraft Corp.; Lewis S. Goodfriend of Audio Instrument Co., Inc.; John K. Hilliard of Altec Lansing Corp.; William F. Jordan of Fox Movietone News; Harry F. Olson of RCA Laboratories; Norman Pickering of Pickering & Co.; John Preston of RCA Laboratories; Albert A. Pulley of RCA Victor; Richard H. Ranger of Rangertone, Inc.; H. I. Reiskind of RCA Victor; C. R. Sawyer of Bell Telephone Laboratories; Hermon H. Scott of H. H. Scott, Inc.; J. T. Mullin of Bing Crosby Enterprises; J. P. Smith of Daven Co.; S. Edward Sorenson of Columbia Records, Inc.; W. E. Stewart of RCA Victor; Myron J. Stolaroff of Ampex; W. J. Temple of Brooklyn College; and S. F. Lybarger of E. A. Myers & Sons, Inc.

Beckman Builds Eastern Plant

BECKMAN INSTRUMENTS, INC., South Pasadena, Calif., manufacturer of scientific and industrial instruments and precision components comprising a line from pH meters to computers, has started construction on a new 20,000-sq ft building in Mountainside, N. J.

To be used as eastern sales and service offices for the parent company and as an eastern manufacturing facility for the Beckman subsidiary, Helipot Corp., manufacturer of helical potentiometers, the new plant will employ more than 150 people.

Langevin Appoints Engineering Director

WILLIAM W. DEAN has been appointed director of engineering of

W. W. Dean

the Langevin Mfg. Corp., New York City. He will direct all engineering activities of that concern, manufacturers of broadcast and sound systems, audio equipment and transformers.

Mr. Dean was associated with General Electric Co. for eleven years prior to joining the Langevin organization on Nov. 1. Since 1945 he has been audio facilities project engineer in the broadcast engineering section of GE at Electronics Park. During the war years he was in the radio transmitter engineering department where he did development work on high-power transmitters and military radio equipment.

Resonant Moves to New Quarters

OPEN for business in its new Belmont, Calif., home is the Resonant Co., subcontractor for Dalmo Victor, of San Carlos, Calif., in the manufacture of microwave components. The new plant covers a 31,000-sq ft area.

Zenith Appoints Associate Director

ROBERT ADLER, a member of the corporation's research division since 1941, has been appointed associate director of research for Zenith Radio Corp., Chicago, Ill.

During the past eleven years Adler has been responsible for numerous contributions to the advancement of the electronics industry and the improvement of communications equipment used by the armed services.

One of the most significant is the gated-beam tube for television, which represents an entirely new concept in the field of vacuum tubes. The use of this tube has greatly simplified the sound system in tv receivers, markedly improving reception by screening out certain types of sound interference while lowering the cost of the sound channel.

He was also instrumental in originating and developing a synchronizing circuit that permits better picture stability even in fringe areas of tv reception.

Fontaine Rejoins Bendix

RAYMOND P. LANSING, vice-president and group executive in charge of six eastern divisions of Bendix Aviation Corp., has announced the appointment of A. P. Fontaine as staff assistant.

Fontaine, recently vice-president and general manager of Consolidated Vultee Aircraft Corp. and previously with Bendix in 1944-46, returns to the company to help di-

A. P. Fontaine

rect vastly expanded operations in aircraft control, navigation and instrument equipment, electron tubes, ignition systems, meteorological instruments, precision electrical units and many other products. These operations at six of Bendix' 17 manufacturing divisions embrace nearly half the company's 40,000 employees.

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NEW BOOKS

Radio Spectrum Conservation

REPORT OF THE JOINT TECHNICAL ADVISORY COMMITTEE, IRE-RTMA. *McGraw-Hill Book Co., New York, 1952, 220 pages, $5.*

ANYONE who, during the past 25 or 30 years, has watched the radio spectrum grow in extent but become parceled out piecemeal as circumstances demanded will read this excellent survey with mixed feelings. In the first place he will hope to find strong language applied to our methods of conserving a natural resource which, having an infinite life, has limited boundaries; and secondly, he will have a feeling of relief that, at last, a calm, dispassionate, objective survey of this type has been made. In his hope for excoriation, the reader will be disappointed but he will not be deprived of the pleasure of thinking what he would have said had he the chance! As befits engineers dealing with the facts of nature, this report is restrained, it is thorough, and should be the property of all who have anything to do with the communication spectrum.

The book is remarkably easy to read, couched, as it is, in layman's language for the most part. Where the going is rough, the layman can skip into easier reading. This means that non-technical administrators and legislators can get a judicial point of view on a matter of utmost importance and urgency. For if we continue to hand out channels without due regard to their properties for the services intended, the next step will have to be taken—those who do not make the best use of their franchises will have to be a ousted—a job that no one wants and few would undertake.

In five chapters, much information is packed. The first deals with the history of the allocation of the radio spectrum, then follows a long and very important chapter on the propagation characteristics of the spectrum which is divided into five reasonable portions whose characteristics are relatively similar; next an ideal approach to the allocation problem, a critique of present allo-

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Front and Back View, showing assembly details

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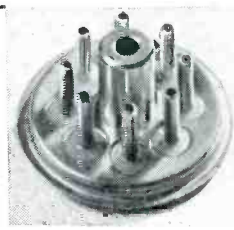

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cations and, finally, a chapter on the dynamic conservation of spectrum resources. An extensive bibliography and an appendix containing the charter of JTAC complete the book.

A highly recommended report of an important public service undertaken by busy men, this book could be made the basis for an excellent study course in allocations, if such a course were ever contemplated.
—K.H.

Electrodynamics

Lectures on Theoretical Physics, Vol. III. BY ARNOLD SOMMERFELD, *University of Munich. Translated by Edward G. Ramberg. Academic Press Inc., New York, 371 pages,* 1952, $6.80.

THE THIRD volume, "Electrodynamics," of Arnold Sommerfeld's "Lectures on Theoretical Physics," has now been translated into English. The reputation of Sommerfeld is too widespread to require biographical introduction. His translator, Mr. Ramberg, has spent most of his life in the United States and is eminently qualified, having been awarded the degree of Ph. D. in Physics by the University of Munich.

The subject of this volume is Maxwell's equations, presented from the viewpoint of Hertz and extended to their more general implications as far as the theory of relativity, matter and energy. Among the other philosophers whose approaches are followed, the outstanding are Einstein, Lorentz, Minkowski and Schwarzschild.

In general, the first half of the book (Parts I & II) is devoted to an axiomatic development of classical electromagnetic theory from Maxwell's equations, while the second half (Parts III & IV) deals with the generalizations and extensions thereof following the theory of relativity. Dimensional analysis, the historical origins of physical concepts, and the limitations of these concepts as valid descriptions of the universe are critically examined. The book may be read separately from the rest of "The Lectures," to which only occasional reference is made, principally for mathematical justification.

The Maxwell equations are specialized for static fields and some elementary problems of electrostatics and magnetostatics are treated. The discussion of circuit theory is brief but its relation to the field theory is well stated. The sections on general electromagnetic fields includes an extensive treatment of "wave fields of cylindrical symmetry". Sommerfeld's original solutions to the problems of propagation over a conducting plane and along a straight wire are given as follows:

Parts III and IV deal with the invariance of Maxwell's equations in four dimensions and the special theory of relativity. The Lorentz force is derived in a natural way. Application is made to the behavior of a single electron. Minkowski's equations, which are Maxwell's equations for moving media, are developed and analyzed. Special topics of the general theory of relativity are discussed briefly.

A set of rather formidable problems is appended. As the solutions to these problems are given in detail, they form a supplement to the text.

Special attention is paid to the philosophy of various systems of units. The MKS rationalized system is generally employed, occasionally with suffixes Q for coulomb (electric pole strength) and P for magnetic pole strength, where the author feels the need for these restrictions. The reader appreciates the author's continual effort to purify concepts and to clarify terminology; the term "wave resistance" is an example of the commendable results.

The organization of the book is somewhat loose. This is sometimes disturbing, and detracts from the readability and the reference value of the text. On the other hand, the frequent discursions are enlightening in themselves, and impart a freshness uncommon in textbooks. Many well labeled figures illustrate the text. The notation has been revised to correspond to current American practice, with minor exceptions. The use of the dot to represent differentiation (either

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NEW BOOKS (continued)

total or partial) with respect to time is to be regretted. The arrangement of the table of symbols, and its lack of several minor symbols, again lowers the ready reference value.

The prerequisites for the reader are, at least, a well rounded background of classical physics with emphasis on electromagnetics, and a mathematical preparation through vectors and tensors, as far as an introduction to the special functions of Bessel, Hankel and Mathieu.

Sommerfeld's presentation is in the form of a philosophical treatise rather than a textbook or reference handbook. Each topic usually receives just enough attention to cover the basic principles, stopping short of the simple concepts, theorems, rules and design formulas of recent years. Therefore it is best adapted for side reading by the advanced student of physics and electromagnetics.—

WALTER K. KAHN AND HAROLD A. WHEELER, *Wheeler Laboratories, Great Neck, N. Y.*

Technical Reporting

BY JOSEPH N. ULMAN, JR., *Massachusetts Institute of Technology. Henry Holt & Co., New York, N. Y.*, 1952, 290 *pages*, $4.75.

AS AN editor who, in nearly thirty years of technical publishing, has read, edited, rejected with regret, published, listened to and written literally thousands of technical reports and papers, far too many of which were dull, or too long, or written wrong-end-to, or just plain awful for any number of reasons, this reviewer unhesitatingly recommends this book to technical people whether they be students or Ph.D's with a long record of accomplishment behind them. For the facts are that engineers and scientists do not take with enough seriousness the importance of being able to tell others about their work. They do not seem to realize that oral and written reports of their work are their salestalk; that advancement in their job or their profession often depends upon a simple, concise, easy-to-understand description of

what they have been doing. And anyone who has had the humiliating experience of losing credit for an accomplishment simply because he did not write up his notebook with completeness as well as with clarity knows the value of good writing.

It is all in this book—the fine points, the mechanics—how to write lab reports, technical papers, memos and job-seeking letters, visual means for presenting information, and how to deliver a talk that will keep your audience awake as well as inform them on a highly technical subject. The do's and don't are set forth in a way anyone can read, enjoy and learn from.—K.H.

Harmonics, Sidebands, and Transients in Communication Engineering

BY C. LOUIS CUCCIA. *McGraw-Hill Book Co., New York*, 1952, 465 *pages*, $9.00.

THIS book summarizes under one cover the use of practically all the mathematical tools with which every practicing communications engineer should be familiar. The text is written in such a fashion that it is easily usable by any graduate from a recognized engineering college. It is an excellent textbook for an undergraduate or a graduate course which is constructed around its content.

The mathematical tools are presented in the first four chapters covering Functions of a Complex Variable, Trigonometric and Complex Fourier Series, Fourier Transforms, and Laplace Transforms. The development of these tools is the smoothest, clearest and most logical presentation the reviewer has ever seen under one cover. Mathematical rigor is replaced by "horse sense" and physical reasoning. The use of each idea is more than adequately illustrated by practical engineering problems.

Chapter 5 through 22 show the applications of the mathematics to the solutions of problems of linear and non-linear networks and the representation of communications waves. Most of the illustrations are of problems encountered by every communications engineer. A few are fictitious from the practical standpoint but are very useful for illustrating techniques of solution.

Most of the chapters are followed by groups of excellent problems which range in difficulty from the "Substituting in the formula type" to those requiring a real engineering insight. Throughout each chapter is scattered a bibliography, listing, in most cases, the works of the communication pioneers.

The reviewer has found a phenomenally small number of mistakes and no blunders in the text.—CHARLES A. HACHEMEISTER, *Associate Professor of Electrical Engineering, Polytechnic Institute of Brooklyn.*

Advanced Antenna Theory

BY S. A. SCHELKUNOFF. *John Wiley & Sons*, 216 *pages*, $6.50, 1952.

THIS recent book by Dr. Schelkunoff is an advanced treatment of certain phases of antenna theory. The author assumes that the reader has a fair degree of mathematical maturity so that the book will be of interest mainly to those engineers who have an adequate mathematical background.

After an introductory chapter on spherical waves, the second chapter concerns itself with the mode theory of antennas. This chapter, which constitutes more than a third of the book, treats the method of antenna analysis which was originated by Dr. Schelkunoff. In addition to discussing the well-known problems of the conical antenna and the spherical antenna, such problems as the end-fed antenna and the problem of a current element above a circular ground plane of finite size are also treated. The chapter closes with a discussion of waves on thin wires. There is a very interesting physical explanation of the formation of plane waves on parallel wires and of the radiation loss at the ends of the wires.

Chapter 3 is a discussion of the

theory of spheroidal antennas. Chapter 4 is on integral equations and treats the basis for the method used by Hallén in his theory of cylindrical antennas. In chapter 5, the theory of the cylindrical antenna is further developed and various solutions are obtained. The last chapter on natural oscillations contains an excellent discussion of equivalent networks. One of the more interesting points is the network representation of the radial wave impedances which had previously been used by Chu to demonstrate the impracticality of super-gain antennas. The chapter closes with a discussion of the resonant properties of thin wires.

A comprehensive set of problems which will enable the reader to test his skill is followed by a set of appendices containing integrals and numerical data useful in antenna theory.

The book represents an excellent treatment of the present status of the theory of dipole antennas. As such, the book will prove valuable to engineers and mathematicians interested in this branch of the antenna field.—HENRY JASIK, *Consulting Engineer, Westbury, New York*

Musical Engineering

BY HARRY F. OLSON, *RCA Laboratories. McGraw-Hill Book Co., 1952, 369 pages, $6.50.*

A ONE-VOLUME encyclopedia on all the interrelated elements that enter into the production and reproduction of vocal and instrumental music, written from the engineering viewpoint. It should be useful, and interesting, to all engineers in the radio, sound picture and recording field. Each engineer will have his own special interests, of course, but the author, drawing from his long experience has placed a vast quantity of material in his book, covering virtually all aspects. It should help to bridge the gap between the musicians whose work is largely subjective and who have very faint knowledge of the science, and the engineer whose work is purely objective and whose knowledge of the

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fine points of why music has such universal appeal may be quite limited.

The descriptions of musical instruments is very interesting and show how our modern devices have grown, by cut and try, from very primitive noise and music makers. The complexities of musical scales is made clear from the engineering standpoint as is the theory of music, musical terminology and the relations between musical symbolic notation and the physical characteristics of tones.

The nine chapters give only an inadequate indication of the great amount of information packed between the book's covers: sound waves, musical terminology, musical scales, resonators and radiators, musical instruments and their characteristics, properties of music, theater, studio and room acoustics, sound-reproducing systems.

Although the chapter headings might indicate that most of the book is concerned with music per se, this is not the fact for there is much engineering as well.—K. H.

Sound Recording and Reproduction

BY J. W. GODFREY AND S. W. AMOS, *British Broadcasting Corporation, England. Iliffe and Sons Ltd.*, 1952, 272 *pages. Available from British Book Centre of New York at* $6.75, 122 *East* 55*th Street, New York, New York.*

"Sound Recording and Reproduction" presents an introduction to three general methods of sound transcription. It is intended as a training manual for technicians concerned with disc, film, and magnetic tape recording and reproduction. As such it offers a concise and clearly presented exposition of the history, development and basic concepts employed in the recording and reproduction of sound as practiced by a typical broadcasting organization.

Major emphasis in this manual is given to disc recording and reproduction, the mechanical parameters, equalization and processing. A brief introduction to magnetic tape and sound film recording is also included. Discussion of the chronological development of equipment actually in use by the British Broadcasting Corporation is integrated with fundamental design considerations. Several appendices of special interest and convenience to recording engineers are included. "Sound Recording and Reproduction" provides an interesting alternate to the more familiar idiom of American technical presentations on the subject. It gives a different slant to everyday problems of sound recording in that differences in the use of the language often illuminate the simplest explanation of well known engineering problems. — PRICE FISH, *Columbia Broadcasting System*

THUMBNAIL REVIEWS

ESSENTIALS OF MICROWAVES. By Robert B. Muchmore, Hughes Aircraft Co. John Wiley & Sons, 236 pages, 1952, $4.50. Elementary explanation of Maxwell's laws and the many devices and phenomena following these laws.

ASTM 50 YEAR INDEX. American Society for Testing Materials, 1916 Race St., Philadelphia. 216 pages, $6.000, 1952. Detailed author and subject index to all ASTM technical papers and reports dealing with materials, particularly their properties and testing, appearing in ASTM publications during period 1898 through 1950.

TITAN—SYSTEM No. 41. Geology, geochemistry, metallurgy, chemistry, physics and technology of titanium, the world's literature up to January 1, 1950. Available from Walter J. Johnson, Inc., 125 East 23 st, New York or Stechert-Hafner, Inc., 31 East 10th, New York. 511 pages plus index, 1952, $27.20.

ADVANCES IN GEOPHYSICS: Edited by H. E. Landsberg, Airforce Cambridge Research Center. Vol. 1, 362 pages, 1952, $8.50. To keep geophysicists and meterologists abreast of research in the field.

TABLES OF BESSEL FUNCTIONS $Y_0(x)$, $Y_1(x)$, $K_0(x)$, $K_1(x)$, $0 \leqq x \leqq 1$. National Bureau of Standards Applied Mathematics Series 25, 60 pages, 40 cents, Government Printing Office, Washington 25, D. C. Tables computed at much closer intervals than existing tabulations. Useful to nuclear physicists and other design engineers and physicists.

CORRECTION. By error, the price of "Survey, R-F Transmission Lines and Waveguides" by E. S. Winlund, published by the Radio Club of America, was stated in the November ELECTRONICS to be $1, whereas the correct price is $1.50.

BACKTALK

Mobile Radio Service

DEAR SIRS:

I WAS very much interested in the article beginning on page 140 of the October 1952 issue of ELECTRONICS, by Maurice E. Kennedy, entitled, "Servicing Mobile Radio Equipment".

I became interested in this field two years ago and approached one of the larger manufacturers of two-way equipment for information, but I did not even receive a reply to either of the two letters I sent. This is in marked contrast to statements made in Kennedy's article: ". . . 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. . . ."

I found Mr. Kennedy's article very helpful in that it is very specific, and I am at this time looking into local possibilities in this field, with a view to obtaining the necessary license and equipment.

Would it be possible for you to inform me who the manufacturers are who are referred to in the paragraph quoted above?

W. A. GEIGER
W. A. Geiger Radio Shop
Ellenburg, Washington

(Editor's Note: It occurred to us that the information requested in this letter might be of value to many of our readers. We wrote to a representative selection of manufacturers of two-way mobile radio equipment and asked them to outline the facilities they make available to servicemen. The following are excerpts from the letters we received in reply.)

FEDERAL

"Federal Telephone and Radio Corporation does make available to servicemen information of the kind described in your article. Information of this category can be obtained by any qualified field service organization by writing to our Mobile Radio Service Department.

"Field service assistance to servicemen is limited, at the present time, to resolving service problems beyond the ability of the local service organization. In some areas of the country, it is possible for a serviceman to obtain direct assist-

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Radio and electronics manufacturers in the West know from experience that Western Coil Co. is completely reliable, its products completely dependable. Western has the facilities to serve you—in design, development and manufacturing. We invite your inquiries relative to your needs and problems.

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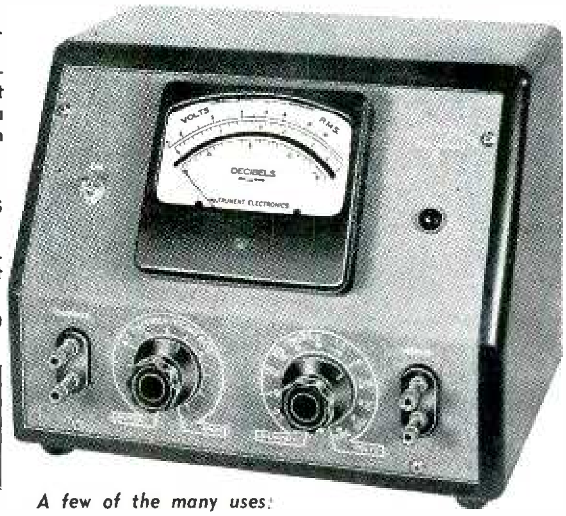

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Also MODEL 45
WIDE BAND
VOLTMETER
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5 Cycles 1600 kc

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- Low level phonograph pickups.
- Acceleration and other vibration measuring pickups.
- Sound level measurements.
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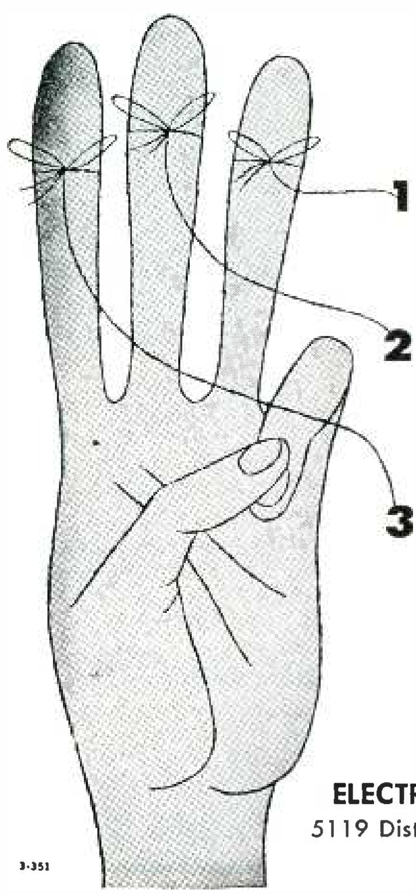

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J. J. McDEVITT
Manager
Mobile Radio Communications Dept.
Federal Telephone and Radio Corp.
Passaic, New Jersey

GENERAL ELECTRIC

"We make available to all our customers who so request, and to their servicemen, service bulletins concerning not only General Electric Company equipment, but also allied equipment. This year we have issued 70 odd to date and expect to issue 25 more before Christmas. All customers, of course, receive instruction books with the equipment.

"These bulletins are obtained usually by the customer requesting us to send bulletins, using a postcard he receives with his instruction manual or by direct requests from our various Field Representatives on behalf of customers. A surprisingly large percentage of our customers are using this free service.

"We have in addition an "Authorized Service Shop" program. This program insures that the serviceman who has "Authorized Service Shop" status will have all instruction manuals and service bulletins applicable to our equipment at his fingertips. We make special effort to see that these shops obtain service bulletins normally not of interest to many customers; such as installation and maintenance instructions covering antennas, alternators and so on.

"We maintain a field group to assist the "Authorized Service Shop" wherever possible in training and guidance. This same group helps customer service personnel with their problems. In addition, customer problems peculiar to a customer installation are referred back to Syracuse when they cannot be solved in the field."

C. C. FALLON
Field Service—Commercial Products
Commercial and Government Equipment Dept.
General Electric Company
Electronics Park, Syracuse, New York

LINK

In answer to your inquiry concerning servicing information, the Link Radio Corporation does make available service information to any interested parties. We normally supply service manuals with equipment shipped from the plant. Additional manuals are available by writing to the Technical Services Division of the Engineering Department and a minimum charge of $2.50 is made to cover handling costs. In addition to this, Engineering Bulletins and Production Change Notices are available to all persons servicing our equipment by writing for same, including the Model No. and Serial No. of said units. There is no charge for this latter service.

To answer your second question, Link has a number of representatives throughout the country who are available to inspect individual service organizations who might be considered for servicing our equipment. These arrangements are made through the New York Plant and interested parties should write to the Engineering Department.

STUART MEYER
Chief Engineer
Link Radio Corporation
New York, N. Y.

MOTOROLA

"Much of the two-way radio communications equipment in use in the field today is serviced by qualified technicians operating out of authorized service stations. These stations are privately owned and operated and function under a working agreement or franchise with Motorola, Inc. For these authorized companies, we offer engineering consultation, warranty service assistance, business management guidance and a complete technical manual library supported by a continuing program of technical bulletins and service hints. In addition to this basic service, the contract includes a formal arrangement for discount procurement of replacement parts and servicing equipment.

"The above arrangement is restricted to those service stations operating under Motorola Communications and Electronics Division franchise. This does not extend to unaffiliated service stations or to Motorola dealers concerned only with the consumer

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products.

"Many of the larger users of our equipment employ their own maintenance technicians. These companies and individuals are supplied with complete servicing literature and are assisted on unusual problems by our field engineers and authorized service stations.

Harold A. Jones
Manager
Technical Information Center
Communications & Electronics Div.
Motorola, Inc.
Chicago, Illinois

RCA

"The RCA Service Company through its national organization services RCA mobile equipment either under service contract or at a flat rate on a demand basis. The company's service technicians are specially trained and kept posted with the latest information on this equipment.

"Buyers of our mobile communications equipment receive standard instruction books with the equipment. These instructions include information on both operating and servicing. Customers and their independent service organizations (in the case of customers who do not use our service staff) also receive special technical service notes on the equipment they have purchased."

E. C. Cahill
President
RCA Service Co.
Camden, New Jersey

Quarantine

Dear Sirs:

In carrying out his obviously distasteful but necessary duty of quarantining the highly "insanitary" 40-DB Feedback Amplifier (letter to Electronics for October 1952 *re* our article in the March 1952 issue), Mr. E. F. Good forgot to include another damning reason why innocent audio experimenters should be sternly discouraged from contact with so fundamentally "unfit" a design.

Not only are 0.1-percent matched resistors demanded for the feedback chain and phase-splitter stage (according to the Good book), but other "absurd" requirements are some ultra-special tubes that can

HOW TO GET 0.05% Accuracy!
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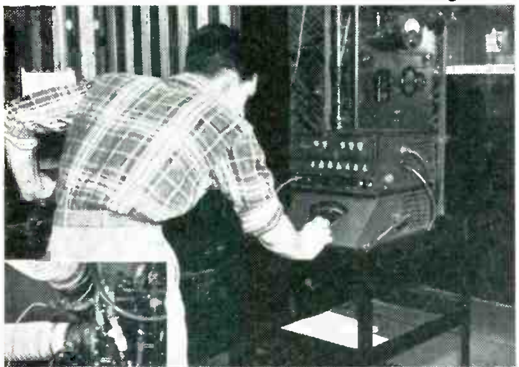

Stratos Division of Fairchild Engine & Airplane Corp., measures the impeller speed of their superchargers without direct contact with the impeller. A magnetized nut on the impeller shaft generates a signal which is registered by the STROBOCONN to measure impeller r.p.m. to an accuracy of 0.05%.

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The 6T-4 measures all types of repetitive frequencies, both constant and variable — no waiting or computation. Frequencies become continuous, visual patterns for the duration of the signal, from which precise analysis and measurement can be made at any instant. Whether your problem is determining frequency drift under varying conditions, measuring natural or line frequencies, calibrating precision oscillators or tachometers, or measuring rotational speeds, you can always be sure of accuracy to 0.05%.

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Dow Corning 4 applied by brushing to AN connector receptacle of pilot's "jack box" prevents interference caused by moisture at this critical junction in aircraft communications system.

Dow Corning 4 applied by brushing to AN connector on V. H. F. Transmitter/Receiver excludes moisture without appreciable change in resistance across properly mated pin and socket connections.

Arrows show where Dow Corning 4 is used on variable inductance rollers in a Collins-Western Electric V. H. F. Transmitter/Receiver to lubricate, minimize resistance and reduce leakage losses.

Photos courtesy Braniff International Airways.

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provide far better μ-matches than ordinary 6SJ7's and 6L6's. For even the best JAN types admit variations in gain up to ±25 percent (2 db per tube or 4 db for a pair).

The audio-amplifier literature (at least outside the pages of ELECTRONICS) has indeed included so many dubious designs in recent years that Mr. Good has strong justification for his skepticism. But if that skepticism extends to the practical as well as the theoretical field, he might (as many others have done) throw together the 40-db feedback amplifier, using quite ordinary resistors and tubes, and taking no extraordinary matching pains. And when he discovers that what shouldn't work, actually does work, we are sure that he'll be good enough to lift his quarantine warning.

He may be shocked to discover, for instance, that deliberately unbalancing this circuit by the insertion of output tubes mismatched by a plate-current factor of 5 to 1, or by mismatching one of the phase-inverter load resistors by as much as 10 percent (neither of which, we hasten to add, is recommended as normal practice)—the only discernible result is a less than 0.5-db reduction in undistorted power output.

Or he might go so far as to remove the mutual impedance between the halves of the output circuit by using a separate transformer for each 6L6, and then achieve maximum unbalance by bypassing one of the exciter-tube cathodes to eliminate the 40-db feedback entirely from one-half of the push-pull stages. Getting rid of the center-tapped output autotransformer makes it meaningful to measure the output unbalance at the 6L6 plates. What started out as a 40-db unbalance proves to be reduced to between 4 and 5 db at the output.

Of course, many of those who have actually built and used this amplifier have shared Mr. Good's dubiety to some extent—at least to that of adding one of the many varieties of manual-balancing adjustments currently so dear to the hearts of most American and British amplifier designers. Doing so

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they may have helped to equalize the output tube lives, but no matter how they twiddled the knobs, they didn't affect the quality of output sound, whether judged by acute ears or measured instrumentally.

It is of course quite true that when 6L6's are operated in the current vogue at maximum or over-maximum ratings, well-regulated screen supplies indeed are advisable. It should be re-stressed, however, that the present design calls for operation of the output tubes at a modest 14 watts or so of plate dissipation—under which condition the omission of screen and cathode bypasses results in no perceptible change in undistorted power output.

The proof of any pudding is in the eating—and of any amplifier design in the hearing and measuring. Even though Mr. Good may not have any 0.1-percent resistors handy, we hope he'll try out this circuit, subjecting it to the most rigorous listening and distortion-measurement tests he can devise.

BENJAMIN B. DRISKO
Hingham, Mass.

R. D. DARRELL
New York City

On a Limb

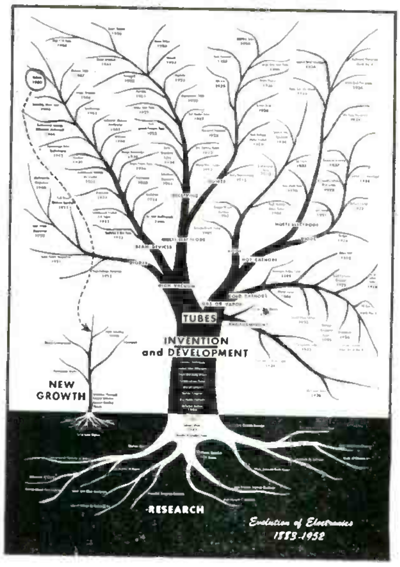
DEAR SIRS:
THE MEN who developed the Vidicon (P. K. Weimer, S. V. Forgue, R. R. Goodrich and A. D. Cope—see ELECTRONICS, May 1950, p 70) have an acute feeling of having been pricked by the branches of your sapling rather than of having reclined comfortably on the strong limbs of your oak tree (see "Evolution of Electronics" ELECTRONICS, Sept. 1952, p 98). The unique aspects of the Vidicon represent a solid state problem in photoconductivity of insulators rather than a tube problem in electron optics.

ALBERT ROSE
Radio Corporation of America
Princeton, New Jersey

(Editor's Note: We asked tree-designer Bill White about this one. His answer is as follows:)

Falling Leaves

DEAR SIRS:
MR. ROSE is certainly correct in pointing out that the Vidicon de-



pends as much, if not more, for its action on the semiconductor science as on the use of an electron beam. Therefore, I might well have included it also on the semiconductor tree rather than merely a general reference to the selenium photocell as a development.

Perhaps, in keeping with the analogy to growing things, I should have attempted somehow to portray the Vidicon as a hybrid.

You, with admirable foresight, provided a spare unnamed twig at the top of each main branch. Such an unnamed twig also appears at the top of the semiconductor sapling. I certainly will "write in" the Vidicon alongside this top twig and suggest that others also make this addition.

W. C. WHITE
Electronics Engineer
Research Laboratory

(Editor's Note: The change required to give the Vidicon its rightful place on the electronics industry's sapling is indicated in the accompanying reproduction of the "Electronics Tree".)

Ternary Memory

DEAR SIRS:

I WOULD like to clear up two points in connection with my article entitled, "High Speed Counter Uses Ternary Notation" which appeared in the October 1952 issue of ELECTRONICS (p 118).

The title used implies that the feature of the counter is ternary notation. Actually, the interesting

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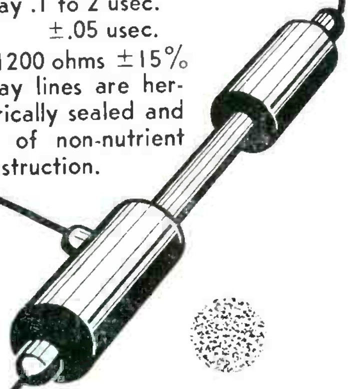

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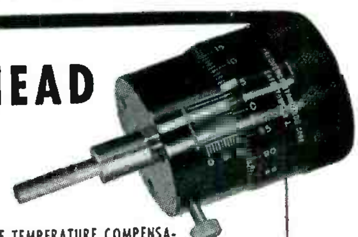

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and original feature is the ternary *memory* circuit. The notation is a property merely of the indicating system and could be changed to suit the need.

A second point, which had me puzzled for a while, occurs in the bankhead, presumably written by your staff. It took a lot of thought to figure out the meaning of the statement "Circuit described operates reliably up to 175,000 counts per second using only nine stages." In the first place, the circuit is not restricted to any number of stages. Secondly, what has the number of stages to do with the speed of the counter?

After some deliberation, I concluded that what the statement means is that after nine stages, the input repetition rate will be divided by 3^9, permitting the use of a mechanical counter with a speed of seven counts per second or higher, to realize the maximum speed of the ternary counter with regularly spaced pulses.

RICHARD WEISSMAN
Cook Research Laboratories
Chicago, Illinois

Vhf Dx

DEAR SIRS:

HAVING read your account of vhf transmission from Cedar Rapids, Iowa to Sterling, Va. in the June 1952 issue of ELECTRONICS, I thought your readers might be interested in a series of experiments conducted between my amateur station, W3QKI, and that of Mr. J. A. Kmosko, W2NLY at South Plainfield, New Jersey. By quite a coincidence we began scheduled transmissions also in January of 1951. There were, however, the following noteworthy differences:

(1) Our stations were separated by approximately 330 miles, over fairly rough terrain, including the Appalachian Range in eastern Penna. Thus we were working over about half the distance as from Collins to NBS.

(2) Frequency was at 144 mc or about 3 times Collins' frequency of 49.8 mc.

(3) Transmitter power was about 400 watts as compared to 23 kw

at Collins, or about 17 db less.

(4) Antenna gains were about 10 db and 20 db or a net circuit gain of some 30 db. Collins to NBS antenna gain totaled about 36 db.

(5) Receivers employed bandwidths of about 1 kc, and noise figures of about 2.5 db, which gave us a possible edge on receiver performance.

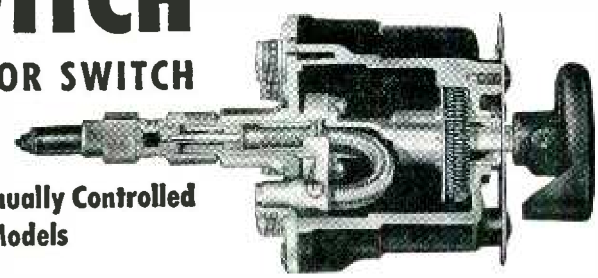
Results

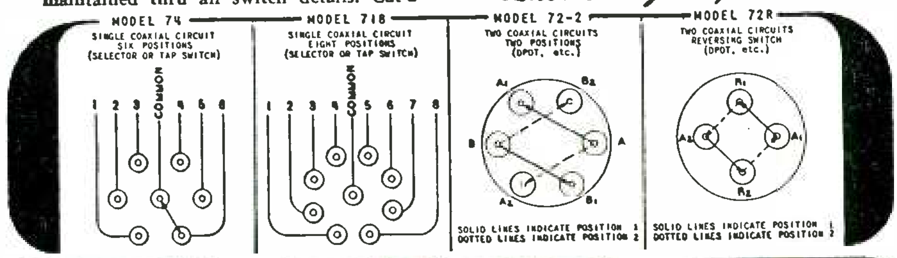
Starting on January 29, 1951, we carried out schedules three nights a week, each time at 10 p.m. These schedules continued through the month of July, reducing to once a week toward the end. It soon became apparent that we could exchange very weak signals with consistency. Due to severe, rapid fading it was difficult to exchange much information, but the amazing fact was that signals were so consistently weak, always fading in and out rapidly, and never reaching more than the same few db above noise level.

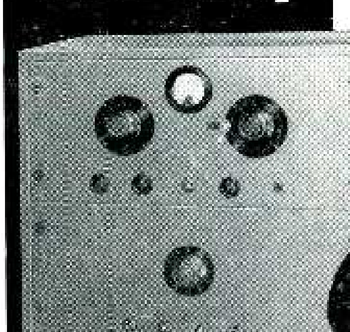
Both stations are familiar with super refraction through the troposphere, as well as aurora reflection, and have contacted frequently by these mediums, but the consistent scheduled contacts were definitely of a different nature. After reading the story of Collins' transmissions to NBS at Sterling, Va., I feel it is quite likely that the same, or a similar reflecting medium was used between Erie, Penna. and S. Plainfield, N. J.

One final, significant clue. During August 1951 both stations dismantled antennas, and replaced them with larger and higher arrays. Tests from both stations indicated that average ground wave signals at 100 miles or so had increased considerably in strength, which of course is what we thought we wanted. But, attempted schedules have failed completely since. Apparently our angle of radiation is now too low. A new antenna under construction at W3QKI has a tilt mechanism for controlling the angle, and it is expected that results will prove interesting as well as useful.

HERBERT JOHNSON
W3QKI
Erie, Pennsylvania







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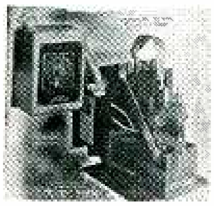

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In our modern plant at York, Pennsylvania, this new division of Bendix Aviation Corporation is producing a new electronic product. This division has a big future; and this is your opportunity to get in on the ground floor, with excellent possibilities for rapid advancement. We need the following:

- **ELECTRONICS ENG.**
- **MECHANICAL ENG.**

Also We have many openings for men qualified by education or experience in all phases of electronics.

YOU BENEFIT

With the Bendix York Division, you will benefit from high wages, paid vacations and holidays and ideal living conditions in a beautiful suburban area.

Write, Wire or Phone, Department Y-1

Bendix

AVIATION CORPORATION
YORK DIVISION

Phone: York 5521 York, Penna.

electronic designers

For design and layout of UHF equipment, Microwave components and systems.

radio engineers

Minimum 5 years' experience. For research and development in radio and radar systems and components.

engineers

Experienced in the design and development of components for the magnetic deflection of Cathode Ray Tubes.

What can Kollsman mean to you?

OPPORTUNITY

The progressive, growing Kollsman organization offers continuing opportunities in the design and development of America's finest aircraft instruments.

CONVENIENCE

An easy-to-reach modern plant, located in a quiet, residential section of New York.

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The finest facilities at your disposal . . . . friendly, cooperative co-workers . . . many liberal benefits including completely paid life, hospitalization, surgical, accident and health insurance.

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KOLLSMAN INSTRUMENT CORP.

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interested in

COLOR TELEVISION!

Sylvania is leading the field in its development of an all-electronic compatible color television receiver. Your imagination and engineering talent can be used in furthering this development. Here is your chance to get real professional recognition.

Sylvania, a sound, well established firm, is still expanding, still reaching out for new ideas. If you are interested in challenging assignments and definite opportunity for personal growth.

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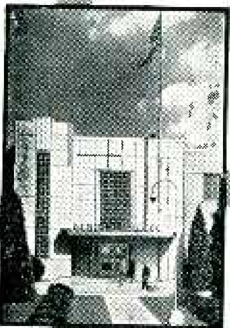
All replies will be held in strict confidence. Send your personal resume' to

JOHN WELD
Supervisor of Employment
Department B

Sylvania Electric Products, Inc.

Radio & Television Division
254 Rano Street
Buffalo 7, New York

MAKE THIS YOUR HOME FOR IMPORTANT WORK UNDER IDEAL CONDITIONS



- TV RECEIVER DESIGN ENGINEERS
- ELECTRONICS ENGINEERS
- FIELD ENGINEERS
- TEST & INSPECTION ENGINEERS
- LAB. TECHNICIANS

NEEDED TO WORK ON: Radar, G.C.A., Mobile Radio, Auto Radio, Airborne Communication & Navigation Equipment, Television, Antennas, Microwave Equipment, Servo Mechanisms, Guided Missiles and Test Equipment Design.

YOU BENEFIT AT BENDIX RADIO: from high wages, a modern, air-conditioned plant, paid vacations and holidays, group insurance and a good chance for advancement.

Housing immediately available in the beautiful suburban and country areas that surround the Bendix Radio plant.

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DIVISION OF BENDIX AVIATION CORPORATION
BALTIMORE-4, MD. Phone: TOWSON 2200
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ENGINEERS

SYSTEMS RADAR SERVO COMPUTER

You gain MORE with W. L. MAXSON. Top salaries . . . greater opportunities . . . more responsibilities. Advance with W. L. Maxson.

BACKGROUND: Practical and research experience in advanced Electronic Circuits and Systems Engineering DESIGN & ANALYSIS, related to: Instrumentation, Fire Control, Communications, Navigation, or Optical Fields. Ability in management and supervision desirable.

If your skills are now being fully utilized in a vital defense industry please do not apply.

Kindly send resume and salary requirements to

The W. L. MAXSON Corp.
460 W. 34th ST., NEW YORK 1, N.Y.

We desire personnel of the highest caliber—experienced in the field of airborne automatic electro-mechanical control equipment.

ENGINEERS

MECHANICAL DESIGN
ELECTRONIC
SERVO

DESIGNERS-LAYOUT MEN

ELECTRONIC
MECHANICAL

This work deals with the manufacture and development of highly complex equipment of the most advanced type in a new and expanding division of an established firm with 20 years of successful experience in the precision instrument field.

We cite a few of the good reasons why you might like to join our organization . . .

SALARY increases are based on merit and initiative—two weeks VACATION, HOSPITALIZATION BENEFITS, GM's own INSURANCE PLAN—POSITIONS ARE PERMANENT due to long range manufacturing and developing programs—EXPENSES incident to interviews and moving all absorbed by company—HOUSING and LIVING CONDITIONS among the best and finest of any along Lake Michigan.

- We have a Junior Engineering Training Program of one year for inexperienced engineering graduates. Opportunity to become acquainted with all phases of industry.
- For the convenience and direct use of engineers in our Engineering Department, we have our own model shop where highest skilled mechanics are employed.
- Educational opportunities for advanced degrees available at U. of W., Marquette. Technical engineering offered at Milwaukee Vocational School.

. . . all inquiries answered—write or apply . . .

★ *AC SPARK PLUG DIVISION*

GENERAL MOTORS CORPORATION

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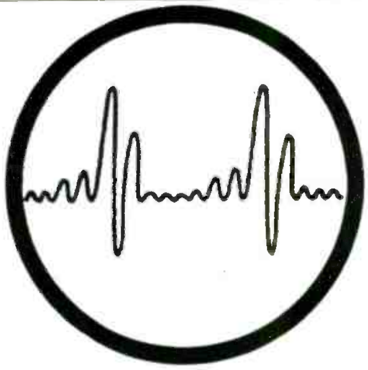
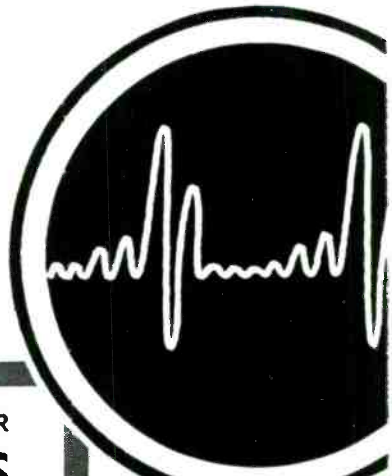
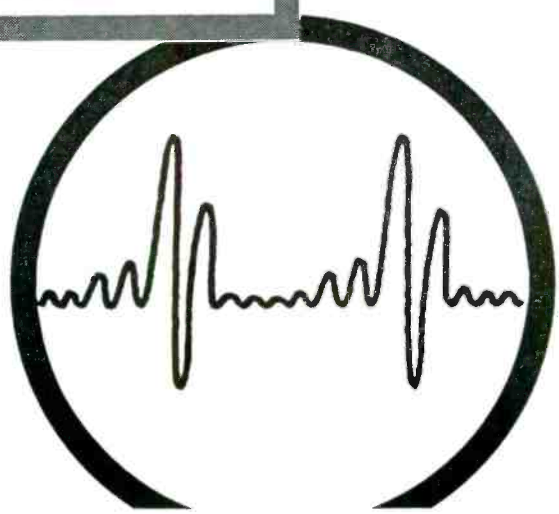
BS–MS–Ph.D:

Responsible positions in mechanical, electrical or electronic engineering, physics or engineering physics for advanced development and design of special equipment and instruments. Prefer men with minimum of two years' experience in experimental research design and development of equipment, instruments, intricate mechanisms, electronic apparatus, optical equipment, servomechanisms, control devices and allied subjects. Positions are of immediate and permanent importance to our operations. Southwestern location in medium sized community. Excellent employee benefits. Reply by letter giving age, experience and other qualifications. All applications carefully considered and kept strictly confidential.

Ind. Rel. Manager
Research & Development Dept.
PHILLIPS PETROLEUM COMPANY
Bartlesville • Oklahoma







STAVID ENGINEERING, INC.

has openings for

GRADUATE ELECTRONIC and MECHANICAL ENGINEERS

Experience in Design and Development of Radar and Sonar necessary.

Broad knowledge of Search and Fire Control Systems; Servo Mechanisms, Special Weapons, Microwave, Antennas and Antenna Mounts, etc. Mechanical Engineer should also have experience in packaging of Electronic Equipment to Gov't specifications including design of complex cabinets, shock mounts and sway brace structures.

FIELD ENGINEERS

Qualified to instruct in the operation and supervise installation, maintenance and repair of Radar, Sonar and allied electronic equipments in the Field.

A chance to grow with a young and progressive company; salary and advancement commensurate with ability; liberal vacation, sick leave, 9 paid holidays, group life, sickness and accident insurance plans, and a worthwhile pension system.

Personnel Office, 200 W. Seventh St.
Plainfield, N. J. - Tel. Pl. 6-4806

UHF and MICROWAVE ENGINEERS

This rapidly growing Organization in south central Wisconsin, approximately 100 miles from Chicago, has several openings for Junior and Senior Engineers in the U.H.F. and Microwave fields.

UNUSUAL SALARY OPPORTUNITIES

exist under ideal working conditions in large, well-equipped laboratories. Personnel benefits such as sickness, accident, and life insurance in addition to a very liberal pension system are offered.

For more information concerning the positions that are open we invite you to write to Personnel Director, Department A.

GIBBS MANUFACTURING & RESEARCH CORPORATION
Janesville, Wisconsin

ENGINEERS

FOR ATOMIC WEAPONS INSTALLATION

Mechanical Engineers, Electronics and Electrical Engineers, Physicists, Aerodynamicists, and Mathematicians. A variety of positions in research and development open for men with Bachelors or advanced degrees with or without applicable experience.

These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates the Laboratory under contract with the Atomic Energy Commission. The Laboratory offers excellent working conditions and liberal employee benefits, including paid vacations, sickness benefits, group life insurance and a contributory retirement plan.

LOCATE IN THE

Healthful Southwest

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. Albuquerque lies at the foot of the Sandia Mountains which rise to 11,000 feet. Cosmopolitan shopping centers, scenic beauty, historic interest, year 'round sports, and sunny, mild, dry climate make Albuquerque an ideal home. New residents experience little difficulty in obtaining adequate housing in the Albuquerque area.

THIS IS NOT A
CIVIL SERVICE APPOINTMENT

Make Application to the
PROFESSIONAL EMPLOYMENT DIVISION

SANDIA Corporation

SANDIA BASE
ALBUQUERQUE, N. M.

ELECTRONIC ENGINEERS & PHYSICISTS

OUR STEADILY EXPANDING LABORATORY OPERATIONS ASSURE PERMANENT POSITIONS AND UNEXCELLED OPPORTUNITY FOR PROFESSIONAL GROWTH IN

RESEARCH & DEVELOPMENT

GUIDED MISSILES
TELEVISION
ELECTRONIC NAVIGATION
SOLID STATE PHYSICS
VACUUM TUBES
RADAR

ADDRESS INQUIRIES TO *THE EMPLOYMENT DEPT.* **CAPEHART FARNSWORTH CORP.**
FORT WAYNE, IND.

ELECTRONICS ENGINEERS WANTED
SOUTHERN CALIFORNIA

Attractive opportunities offered to Engineers experienced in and qualified to design aircraft flush antennas and radomes.

Complete modern facilities for laboratory testing and evaluation available.

Salary dependent upon experience and ability.

Contact Mr. J. C. Buckwalter,
Chief Engineer

DOUGLAS

DOUGLAS AIRCRAFT COMPANY, Inc.
LONG BEACH, CALIFORNIA

ELECTRONIC ENGINEERS
Mechanical Designers for Research and Engineering

To work in the design and development of new electronic equipment. Excellent working and living conditions, good salaries and exceptional employee benefits. Write, giving full details including education and experience. Personal interviews will be arranged.

THE NATIONAL CASH REGISTER COMPANY
Main & K Sts., Dayton 9, Ohio

FLORIDA CALLS ELECTRONIC ENGINEERS

Graduate engineers for R & D in microwave components and receivers, SONAR, transistors, nonlinear circuitry and computers.

Ideal sports, living & working conditions with excellent pay, unusual employee benefits and profit sharing.

Write for application to:

RADIATION, INC.
MELBOURNE, FLORIDA

WILCOX ELECTRIC COMPANY, INC.
of
KANSAS CITY, MISSOURI
requires

ENGINEERS!

with Experience in

- HF and VHF systems
- Aeronautical Equipment
- Application of Advanced Circuit Technique
- Ability to combine associated engineering skills in electronic systems

also needed

PROJECT ENGINEERS (2)

who can accept responsibility for successful completion of a system design

These positions are available in a company which supplies equipment to the major airways of the world.

Write stating Education & Professional history to:
A. E. HARRISON, Director of Engineering
WILCOX ELECTRIC COMPANY, INC.
1400 Chestnut Street
Kansas City 27, Missouri

ELECTRONIC ENGINEERS

FOR DESIGN & DEVELOPMENT WORK IN
RADAR
COMPUTERS
DIGITAL TECHNIQUES

with a young progressive company, send resumé of experience and education, with salary requirements, to

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Expanded sales policy affords unusual opportunity to represent manufacturer of highest quality open type and hermetically sealed relays and electrical or electronic assemblies. Direct to industry—no jobber sales. Liberal arrangement, prompt quotations and deliveries, good business tactics assured. In reply please mention territory travelled, number of salesmen employed, lines you carry and firms you represent. Write.

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NATIONAL MANUFACTURER
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D.C. POWER SUPPLIES
Desires

Sales Engineering Representatives

Write: Stating present lines and territory.
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THE BOX NUMBER . . .
when answering the classified advertisements in this magazine. It's our only means of identifying the advertisement you are answering.

ELECTRONIC ENGINEER WANTED!

An established business organization engaged in development and manufacture of products for VHF and UHF Television Application, requires an individual qualified to work independently, to organize, and to supervise development projects.

This position is to be permanent and will offer the opportunity for unlimited advancement to a successful career. Offers stimulating and congenial surroundings in a newly acquired plant.

Attractive Salary

Write stating qualifications

Blonder-Tongue
LABORATORIES
526-536 North Avenue
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THE DE HAVILLAND AIRCRAFT OF CANADA LTD.

is requiring experienced engineers for development work on special new projects. Applicants should possess an honours degree together with at least two years industrial experience. Preference will be given to Canadian Nationals.

Employment is offered in four general categories as follows:—

(a) *Physicists.* Men with a sound background of basic physics to work on optical, electronic and mechanical devices.

(b) *Servo Engineers.* A thorough knowledge of basic servo-mechanism theory is essential together with experience in the design and operation of electronic servo systems. A knowledge of air-operated servos would be an advantage.

(c) *Gyro Engineers.* Applicants should have had first hand experience in development work on electrically driven gyros preferably from both the electrical and mechanical viewpoints. A knowledge of production techniques is essential.

(d) *Electro-Mechanical Engineers* to work on accelerometers, proportional relays, high-frequency motors and similar devices. A knowledge of production methods is desirable.

Successful applicants are to be sent to the U.K. for a period of one to two years to work on the research and development team of the parent De Havilland Company. After this period, they will return to Canada continuing the work at De Havilland, Toronto. There, a team of engineers will be built up with the U.K. trained personnel as a nucleus.

Please apply to: Mr. D. G. Simpson

The De Havilland Aircraft of Canada Ltd.

Postal Station "L", Toronto, Canada

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-6205, Electronics
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WANTED

WANTED

- AN/TRC-1 Equipments.
- T14 Transmitters.
- R19 Receivers.
- TS32 Test Oscillators.

Any condition or quantity

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WANTED

Federal type
101B Voice-frequency Ringers
Signal Corps type TA-3/FT.

W-4814, Electronics
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WE BUY...

all kinds of

DOGS

SURPLUS MATERIAL
Aircraft & Electronics

- *Amplidynes*
- *Dynamotors*
- *Motor Generators*
- *Switches*
- *Wire*

or What Have You?

ATLAS EQUIP. CO.
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WE BUY

All kinds of surplus electronic equipment and components.

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Western Electric gray-finished
EQUIPMENT CABINETS
For 19" panels. Heights of 2' 6", 3' 6", 7' 0" and 7' 6".

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MN-53A Marker Beacon Receivers
28 VDC 110 RPM G.E. #5BA10AJ18D motors
28 VDC 120 RPM Delco #5069625 motors
28 VDC G.E. #5BA50LJ57 motors
Westinghouse type CA or CV percentage differential relays.

Furnish full details and prices.

HARBER INDUSTRIALS
3520 W. Ogden Ave. Chicago 23, Ill.

Will buy "ALL"

ART-13 / type T-47A, $200.00.
ART-13 / type T-47, $150.00.
BC-348 unmodified, $75.00.
BC-348 modified, $55.00.
APN-9, $200.00.
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R77 Receivers, $400.00.
ARC-1, $600.00.
BC312, $65.00.
BC342, $60.00.

Ship via Express C.O.D., subject to inspection to:

H. FINNEGAN
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Watch—
the *Searchlight Section*
for
Equipment Opportunities

WILL PAY TOP PRICE

DM 35 DYNAMOTORS
IN QUANTITY
Must Be in Excellent Working Condition

W-6278, Electronics
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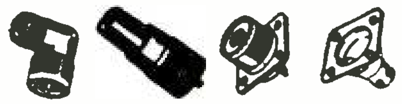
MFD	VDC	Price	MFD	VDC	Price	MFD	VDC	Price	MFD	VDC	Price
2	400	$ .55	.1	1500	$ .69	1	6000	$9.95	1	25KV	$85.00
5-5	400	1.65	.5	1500	1.25	.1	7000 R'd	1.79	.001	50KV	24.50
1	600	.55	3	1500	2.50	.1-.1	7000	5.95	.025	50KV	42.50
2	600	.69	4	1500	2.95	.1	7500	2.85	.2	50KV	85.00
2	600 R'd	.69	.1-.5	2000	.95	.075-.075	8KV	6.50	.25	50KV	95.00
2-2	600 R'd	1.65	.25	2000	1.50	1	10KV	29.50	7.5	220VAC	1.95
3	600	.95	.3	2000	1.30	.1	12KV	8.95	1-3	330VAC	1.95
4	600	1.65	1	2000	1.95	1	15KV	45.00	10	330VAC	3.95
4	600 R'd	1.65	3	2000	3.75	.045	16KV	4.70	12.75	330VAC	4.10
5	600	1.75	12	2000	8.95	.05	16KV	4.95	15	330VAC	4.50
6	600	1.85	1	2500	2.75	.075	16KV	8.95	5	440VAC	3.10
8	600 R'd	1.85	1-1	2500	3.85	.25	20KV	19.95	2.9	660VAC	3.50
8-8	600	1.95	32	2500	15.80	1	20KV	54.00	7	660VAC	4.25
4-4-4	600	2.50	.5	3000	2.40				8	660VAC	4.50
4 x 3	600	2.50	1	3000	3.40						
10	600	3.25	2	3000	4.50						
1	1000	.65	.03	4000	1.25						
2	1000	.90	3 x .2	4000	2.95						
2	1000 R'd	.95	2	4000	6.95						
3.5-.5	1000	1.85	.1	5000	1.60						
4	1000	1.95	.2	5000	2.50						
6	1000	2.50	1	5000	4.88						
8	1000	3.25	2	5000	18.50						
1	1200	.85	5	5000	29.50						
1-1-1	1200	1.85	.01-.03	6000	1.65						

OILMITES

MFD	VDC	TYPE	Price
.02	600	OM-6002	$ .45
.05	600	OM-6005	.48
.1	600	OM-610	.51
.25	600	OM-625	.55
.5	600	OM-650	.60
1.0	600	OM-601	.85

COAXIAL CONNECTORS



83-1AC	$ .42	83-1RTY	$ .65	83-22R	$ .68
83-1AP	.30	83-1SP	.50	83-22SP	.80
83-1F	1.20	83-1SPN	.56	83-22T	1.95
83-1H	.12	83-1T	1.30	83-168	.15
83-1HP	.22	83-2AP	1.95	83-185	.15
83-1J	.75	83-22AP	1.40	83-765	.24
83-1R	.40	83-22F	2.10	83-776	.85
		83-22J	1.50		

FULL LINE OF JAN APPROVED COAXIAL CONNECTORS IN STOCK
UHL—N—PULSE—BN—BNC

UG-7/AP	$6.30	UG-22C/U	$1.65	UG-37/U	$17.50	UG-102/U	$.80	UG-176/U	$.15	UG-255/U	$2.45
UG-12/U	.95	UG-23/U	1.20	UG-57B/U	1.85	UG-103/U	.68	UG-177/U	.24	UG-260/U	1.20
UG-15/U	1.50	UG-23B/U	1.75	UG-58/U	.80	UG-104/U	1.40	UG-185/U	1.35	UG-261/U	1.20
UG-18/U	1.25	UG-23C/U	1.90	UG-58A/U	1.15	UG-106/U	.15	UG-191/AP	.80	UG-262/U	1.20
UG-18B/U	1.60	UG-24/U	1.30	UG-59A/U	2.15	UG-108/U	2.60	MX-195/U	.75	UG-273/U	2.25
UG-19/U	1.80	UG-25/U	1.35	UG-83/U	2.25	UG-109/U	2.60	UG-197/U	2.80	UG-274/U	2.75
UG-20B/U	1.80	UG-27/U	1.30	UG-85/U	1.75	UG-146/U	2.55	UG-201/U	2.25	UG-275/U	5.50
UG-21/U	.95	UG-27A/U	2.95	UG-86/U	2.50	CW-159/U	.60	UG-203/U	.85	UG-276/U	2.75
UG-21A/U	1.50	UG-28A/U	3.75	UG-87/U	1.60	UG-166/U	32.50	UG-206/U	1.80	UG-290/U	1.20
UG-21B/U	1.35	UG-29/U	1.55	UG-88/U	1.10	UG-167/U	5.85	UG-224/U	1.20	UG-291/U	1.35
UG-21C/U	1.45	UG-30/U	2.30	UG-89/U	1.35	UG-171/U	2.80	UG-236/U	3.85	UG-306/U	2.95
UG-22/U	1.35	UG-34/U	16.50	UG-90/U	1.60	UG-173/U	.40	UG-245/U	2.30	UG-414/U	3.25
UG-22B/U	1.50	UG-36/U	17.50	UG-98/U	1.85	UG-175/U	.15	UG-254/U	2.75	UG-625/U	1.35

QUOTATIONS UPON REQUEST ON ANY CONNECTORS NOT LISTED HERE

M-358	MC-277	PL-259A]	PL-325				
M-359	MC-320	PL-274	SO-239	93-C	49120	D-163950	ES-685696-5
M-359A	PL-258	PL-284	SO-264	93-M	49121A	D-166132	ES-689172-1
M-360	PL-259	PL-293	TM-201				

COAXIAL CABLE

Type	Price Per M Ft.	Type	Price Per M Ft.	Type	Price Per M Ft.	Type	Price Per M Ft
RG-5/U.......	$140.00	RG-13/U......	$216.00	RG-26/U......	$475.00	RG-57/U......	$325.00
RG-6/U.......	180.00	RG-17/U......	650.00	RG-29/U......	50.00	RG-58/U......	60.00
RG-7/U.......	85.00	RG-18/U......	900.00	RG-34/U......	300.00	RG-58A/U	70.00
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
RG-9A/U.....	275.00	RG-21/U......	220.00	RG-55/U......	110.00	RG-77/U......	100.00
RG-10/U......	240.00	RG-22/U......	150.00				
RG-11/U......	100.00	RG-22A/U....	285.00				
RG-12/U......	240.00	RG-24/U......	675.00				

ADD 25% TO PRICES SHOWN FOR QUANTITIES UNDER 500 FT.

2 φ LOW INERTIA SERVO MOTORS

KOLLSMAN—45 Volt 60 cycle 4 watts 1500 RPM—new $22.50
PIONEER—10047-2-A 26 volt 400 cycle with 40:1 reduction gear $10.50
PIONEER—CK 13 115 volt 400 cycle—includes damping signal generator (autosyn)..............$47.50

HIGH VOLTAGE TRANSFORMERS

G.E.—Pri. 115V 60 cy. Sec. 6250V 80 MA—12.5 KV insulation $18.50
G.E.—Pri. 115V 60 cy. Sec. 6250/3850/2600V 56 MA 12.5 KV Insulation $18.50

ANTENNAS

AT-4/ARN-1	$8.25
AT-38A/APT (70 to 400MC)	13.70
AT-49/APR-4 (300 to 3300MC)	13.70
AN-65A (P/O SCR-521)	1.50
AN-66A (P/O SCR-521)	1.75
A1A-3CM conical scan	125.00
ASB Yagi—5 element 450 to 560MC..........	9.00
ASB Yagi—Double stacked 6 element.........	14.70
ASA Yagi—Double stacked 370 to 430MC.....	29.40

RELAYS

Sigma type 4AH—2000Ω 4 ma DC coil—SPDT contacts—hermetically sealed 5 pin plug-in base $3.30
Sigma type 4R—8000Ω 1 ma DC coil—SPDT contacts—enclosed type 5 pin plug-in base..........$4.25
Stevens Arnold type 171 Millisec relay—900 ohm coil SPST NO contacts $5.50
Cutler Hammer and Square D type B-7A contactor—24 VDC coil—SPST NO 200 Amp contacts...$4.75
Price Bros. type 161-M—220 VAC contactor—SPST No double bk 30A contacts................$3.25
G.E. CR5181-1A6—115 V 60 cy. AC contactor—4PST 30 Amp contacts plus two auxiliary SPDT contacts $14.50
RBM—115 V 60 cy. AC coil—DPDT 3 amp Contacts $3.20

METERS

1 MA DC 3½" R Dejur Mod 310 (0-4KV scale).	$5.75
500 Microamps, DC—2½" round—Sun........	4.30
1ma. DC Fan type—4" scale (rem. from equipt).	3.95
500 ma. DC 2½" R.—General Electric.........	2.95
2 amp. RF 2½" Sq.—Simpson................	3.15
5 amp. AC 4" 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	1N45	.94
1N22	1.09	1N34A	.95	1N52	1.05
1N23	1.95	1N38	1.70	1N55	3.15
1N23A	3.25	1N39	6.25	1N60	.55
1N23B	4.25	1N40	10.60		

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"	1 Meg	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 "J" 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-16 110/220 V 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

AN/APA-23 Recorder	$147.50
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
FIMAC-35T Ionization Gauge..............	5.95
B-7/ABS-2 Receiver	49.50
FI-8 1020 cycle filter........................	2.95
BM-29 remote control unit..................	8.95
BM-14 remote control unit..................	8.95
BTA-1B 12/24 V dynamotor..................	40.00
BC-1206-CM2 Receiver	12.95
ASR-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
ATI and ATK TV Block Equip..............	Quote
BC-348 Receiver	Quote
BTA-1B Transceiver	Quote
T-47/ABT-13 Transmitter	Quote
Sperti IS21 vacuum relay switch (P/O AN/ART-13)	9.50

PULSE TRANSFORMERS

UTAH 9262 9278 9280	UTAH 9318 9340 9350
G.E. K541318	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	

SPARE PARTS FOR ARMY AND NAVY RADIO, RADAR & SONAR EQUIPMENT

AN/APS-2	AN/APN-4	AN/ARC-5	QCB
AN/APS-3	AN/APN-9	SF	QCJ
AN/APS-4	AN/ARC-1	SL	QCL
AN/APS-15	AN/ARC-3	SO	WEA
etc.	etc.	etc.	etc.

QUOTATIONS UPON REQUEST

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.......$37.50
15-A-1-400-50P, 15 KV, "A" Circuit, 1 microsec. 400 PPS, 50 ohms imped..................$32.50

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Telephones - MARKET 7-6771-2-3

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GUARANTEED BRAND NEW

TUBE SPECIALS

STANDARD BRANDS ONLY

Receiving Tubes

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- 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
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- 6AD7G 1.31
- 6AE6G .89
- 6AF6G .89
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- 6AG7 1.59
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- 6AK6 .99
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- 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
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- 6BC5 .88
- 6BC7 1.10
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- 6BD6 .99
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- 6BF5 1.10
- 6BF6 .83
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- 6BH6 .99
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- 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 .94
- 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
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- 12F5GT .79
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- 12J5GT .69
- 12K8 .83
- 12Q7GT .67
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- 12SA7GT .89
- 12SF5 .79
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- 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
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- 35B5 .87
- 35L6GT .81
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- 35Z4GT .69
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- 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
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- 2J50 39.50
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- 2J66 165.00
- 2K23 37.50
- 2K25 33.50
- 2K26 107.15
- 2K28 34.50
- 2K29 26.00
- 2K33 295.00
- 2K45 145.00
- 2K54 135.00
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- 3B23 4.75
- 3B24 5.25
- 3B24W 7.95
- 3B25 4.50
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- 3B27 4.20
- 3B28 7.75
- 3C24 1.85
- 3C27 6.95
- 3C37 32.50
- 3D21 1.98
- 3D21A 4.75
- 3E29 14.50
- 3J31 115.00
- 4-125A 29.50
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- 4B24 5.75
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- 6J4 7.95
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- 13-4 .80
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- 24G 1.85
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- FG-32/5558 6.75
- RK-34 .49
- 35T 4.95
- 35T Ion gauge 5.95
- 35TG 4.95
- 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
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- VR-75/OA3 1.51
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1F	5F	7DG	2J1G1	C-56701	C-78254
1G	5G	7G	2J1H1	C-56776-1	C-78410
1HG	5N	A	2J1M1	C-69405-2	C-78411
1SF	5SF	B	2J5A2	C-69406	C-78414
5B	5SG	M	2J5D1	C-69406-1	C-78415
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Model TS-127/U is a compact, self-contained, battery powered, precision (± 1 Mc) frequency meter which provides quick, accurate readings. Requires a standard 1.5V "A" and 45V "B" battery. Has 0.5 MIN. time switch. Contains sturdily constructed HI-"Q" resonator with average "Q" of 3000 working directly into detector tube. Uses 957, LS6 and 3S4 Tubes. Complete, new with inst. book, probe and spare kit of tubes. Less batteries.

Full data on request
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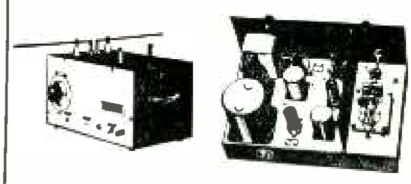

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Type BC-423-B, or tweeter, is a miniature keying unit, modulator and transmitter combined. A dipole mounted atop the tweeter case radiates a signal pulse at 205 megacycles modulated by pulses occurring at 4,098 CPS. Uses 2-6J7, 1-6F6, 1-955, 1-5W4 tubes. Operates from 115V. 60 cy. source. Brand new including tubes and instruction book....$29.50

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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

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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
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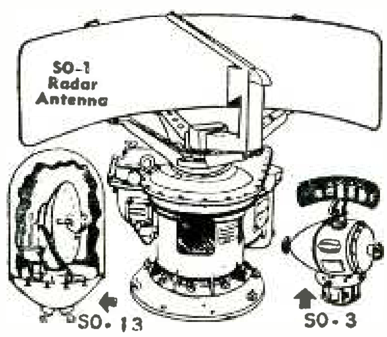
High speed ball bearings. Split stator silver plated coaxial type 5/10 mmfd. Brand new

Price $2.25

RADAR EQUIPMENT



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Type SO-1 (10CM) assembly with reflector, waveguide nozzle, drive motor, etc. New........$279.50
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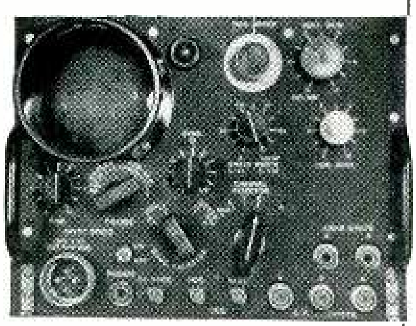
MODEL AN/APA-10 PANORAMIC ADAPTER



Provides 4 Types of Presentation:
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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**
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FILAMENT—400/2600 CPS. Input—0/75/80/85/105/115/125V. Output—5V3A/5V3A/5V6A/6.3V 0.5A. No. 7249010—New $1.95
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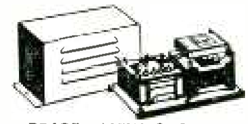

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GE Servo type 2CV1C1 400 cycle
Constant Output Line RC-730C
Synchro Amplifiers for Radar
Intercommunication type BC-605

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.

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W.E. KS-15138 Linear Sawtooth
W.E. KS-8732 for SCR547 Radar
W.E. KS-8801 Motor Driven

G. E. 400 CYCLE SERVO AMPLIFIERS

Type 2CV1C1

Brand New $29.50

Metal Dust Cover Included

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Complete BC-624C receivers and BC-625AM Transmitters including mounting racks, plugs, connectors, P.E. 94CM dynamotor. Brand new equipment with instruction manuals.

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U. S. Instrument Co. No. A-260 Combination headset and chest microphone. Brand new, including 20 ft. of rubber covered cable.........$17.50 each

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SCR522 Transmitter Receivers. Brand New
Fire Detector Wilcolator
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RT-7-AN/APN-1 Receivers
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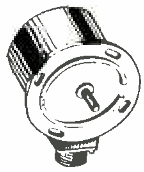
MICRO-SWITCH

S.P.ST NORMALLY CLOSED

BRAND NEW $.85 EACH

LINEAR SAWTOOTH POTENTIOMETER

W.E. No. KS 15138



The d-c potentiometer consists of a closed type die-cast aluminum alloy frame consisting of a continuous resistance winding to which electric power is supplied through two fixed taps 180 degrees apart. Two rotating brushes (180 degrees apart and bearing on the resistance winding) and two take-off brushes are provided for the output voltage. Varying the position of the brushes varies the output voltage in accordance with a linear sawtooth wave. The potentiometer is excited with 24-volt direct current, is arranged for panel or bracket mounting, is approximately 3-11/16 inches in diameter, 3 inches deep, 4¾ inches long, and has an approximate weight of one pound. External connections are made through a standard AN type connector.

Brand New $5.75

RADAR EQUIPMENT

Model S.Q. 10CM Portable Radar Set. Operates on 90-130 volt, 60 cy., 1 Phase. Presentation: A, B and P.P.I. Complete with tech. manual and full set of spare parts.

Model ASG-1 Radar with Parabola.
S.O.-11 Modulator unit.
Pulse Timer units for SD5 Radar.
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S.O. Radar Accessory Control Panels.
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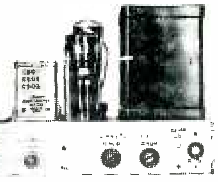
Spare Parts Kit for S.Q. Radar.

FLUXMETER

Used to calibrate field strength of magnets from 500 to 4000 gauss and indicate polarity. Probe has gap of 1¼". Beautifully built in hardwood case with hinged cover. Instructions for operation on under side of cover. Size 12¾ x 9 x 6 in. Ideal for lab and school use. New. An exceptional value at $29.50

AN/APA-10 POWER SUPPLY



Input:
80 or 115 volts.
400 to 2600 cycles

Output:
1200 volts D.C. at 1.5 MA.
400 volts D.C. at 130 MA.
Includes tubes: 1—5R4GY, 1—2x2, 1—6AK5, cathode ray tube socket, resistance capacitance filter, two focus controls, an intensity control and 6AK5 reinserter circuit. Brand new.
Complete $13.75

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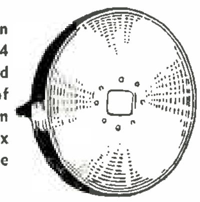
G.E. 400 cy. Cat. No. 80G184 K.V.A. .945S—.520P Volts 460/345/230/115 New $4.50

PARABOLOIDS



17½" diameter, spun magnesium dishes, 4 inches deep. Reinforced perimeter. Two sets of mounting brackets on rear. Opening at apex for waveguide dipole assembly 1½ x 1⅝".

BRAND NEW. . . . . PER PAIR $12.50

G. E. BATTERY CHARGER

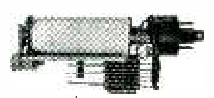
Charges 54 cell battery at from 1 to 10 ampere rate

Input 115V., 60 cy. 1 Phase.
The model 6RC89F16 Copper Oxide battery charger consists of a transformer, a secondary reactor, a copper oxide rectifying element, a ventilating fan, control circuits and auxiliary equipment necessary for proper operations. Transformer tapped for various supply voltage. Eight secondary taps for adjusting changing rate. Built into metal cabinet. Metered.

Complete with spare fan and fuses. New in original packing cases. Shipping weight approx. 305 lbs.

Price $255.00

RELAY



Clare octal base Relay No. 30FMX 115V, 60 cy. 0.140 amp. Res. 75 ohms. Makes two breaks one.

Brand new $2.45

RADAR REPEATER ADAPTERS

NAVY TYPE CBM-50AFO

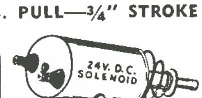
A repeater unit for video signals and trigger pulses designed to work in conjunction with standard Navy radar equipments wherein provision is made for operation of remote P.P.I. sets. This adapter provides four video and trigger pulse lines for operating one or more remote P.P.I. installations. The equipment contains its own D.C. power supply; 115 Volts, 60 cycles A.C. from ships' power supply line is required for operation. Dimensions are 31½ x 21 x 15 in.

Description:

A: Output Video Signal Lines.
B: Output Trigger Lines:
C: Video Amplifier Bandwidth. less than 3 db down at 5mc.
4 lines at +2 volts amplitude.
4 lines at +50—+65V. Amplitude.
Flat within 1 db from 60 cy. to 3.5mc.
Uses 8—6AG7, 1—OD3, 3—6SN7, 2—5R4GY.
Full details on request.

24V DC SOLENOID

2 LB. PULL—¾" STROKE



BRAND NEW
$1.45 Each

Reliance Specials

GEAR ASSORTMENT

100 small assorted gears. Most are stainless or brass. Experimenter's dream! .... Only $6.50

HAYDON TIMING MOTOR

1 R.P.M., 115 V., 60 Cycle $1.95

TIMING MOTOR

8 RPM 115V 60 cyc
E. Ingraham Co.
$1.79

400 CYCLE INVERTERS

Leeland Electric Co.

=10800 in: 20-28 V.D.C., 92 A. 8000 R.P.M. Out: 115V. 400 Cyc. 1 phase, 1500 V.A. 90 PF $24.95

3 AG FUSES

Amp.	Per 100	Amp	Per 100	Amp.	Per 100
1/8	$4.00	3/4	$4.00	8	$3.00
3/8	4.00	1	3.00	10	3.00
1/2	4.00	4	3.00	15	3.00
		5	3.00		

3 AG FUSE HOLDERS (Finger) 25¢

DELAY NETWORK—ALL 1400Ω

T 114—Approx. 2.2 micro sec. delay .... } 95¢
T 115 Similar to T 114 with tap brought out ..... } each

AC LINE CORDS 6 ft. long with molded plug .... 10¢

BALL BEARINGS

Mfg. No.	ID	OD	Thick	Price
MRC5028-1	5 1/2	6 1/2	1	$3.75
MRC7026-1	5 5/64	6 15/64	9/16	3.50
MRC106M2	1 17/64	2 7/16	25/64	1.75
MRC106M1	1 13/64	2 7/16	25/64	1.60
Federal LS11	1 1/8	2 1/2	5/8	1.75
Norma S11R	1 1/8	2 1/8	5/8	1.70
Federal AS41	1 1/16	1 1/2	9/32	1.50
Schatz	3/4	1 3/4	9/16	1.00
Norma 203S	5/8	1 9/16	7/16	.90
ND5202-C13M	1/2	1 3/8	1 3/8	1.00
ND 3200	25/64	15/32	11/32	.60
ND R6	3/8	7/8	7/32	.40
MRC39R1	11/32	1 1/32	5/16	.45
MRC38R3	5/16	55/64	13/32	.45

NEEDLE BEARINGS

TORRINGTON B108 ½" wide ⅝" 13'6" .... 30¢

Brand New Meters—Guaranteed

0-10 ma. D.C. 3½" .. $3.95 0-80 Amp. D.C. 2½" .. $2.50
0-1 Ma D.C. 3½" DeJur .. (Scale Reads 0-4 KV) .. $5.75

SELENIUM RECTIFIERS

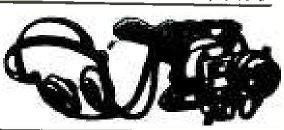
Full Wave 200 MA 115V $1.79
Half Wave 100 MA 115V .... .91

SOUND POWER HANDSET

BRAND NEW

Includes 5 ft. cord.—Uses no batteries or external power source. $18.50 pr

Sound Powered Chest Set RCA—With 24 Ft. Cord
Per Pair
USED $17.60
NEW $26.40



POSTAGE STAMP MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd
10	40	70	125	240	400	680	.0016	.004
20	47	75	135	250	430	800	.002	.0044
22	50	80	150	270	470	820	.0027	.005
23	51	82	160	300	500	910	.0033	.006
24	56	90	175	330	510	.001	.0036	.0065
25	60	100	180	360	580	.0012		.0068
33	62	110	200	370	600	.0013		.0082
39		120	220	390	650	.0015		.01

Price Schedule

10 mmf to 820 mmf .... 5¢
.001 mmf to .0016 .... 8¢
.002 mfd to .0082 mfd .... 15¢
.01 mfd .... 28¢

SILVER MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
10	50	100	170	360	510	.001	.0024	.0047
18	51	110	180	370	525	.0011	.0025	.005
22	56	115	208	390	560	.0013	.0027	.0051
23	60	120	225	400	570	.0015	.0028	.0056
24	62	125	240	410	680	.0016	.003	.006
25	66	130	250	430	700	.0018	.0033	.0068
27	68	135	255	470	800	.0022	.0039	.0082
30	75	150	260	488	900	.0023	.004	
40	82	155	270	500				

Price Schedule

10 mmf to 700 mfd .... 10¢
.0011 mfd to .002 mfd .... 20¢
.0022 mfd to .0082 mfd .... 50¢

PULSE TRANSFORMERS

UTAH—9262 9278 9289 9318 9340 9350
WESTERN ELECTRIC—D166173 D161310
KS8696, KS9800, KS9862, KS13161
GENERAL ELECTRIC—80-G-5
JEFFERSON ELECTRIC—C-12A-1318
DINION COIL—TR1048 TR1049
also 352-7250-2A; 352-7251-2A; T-1229621-60

COAXIAL CABLE CONNECTORS

15¢ UG175/U — $1.20 83-1F — 30¢ 83-1AP — 75¢ 83-1J — 40¢ SO-239 — 12¢ HOOD

83-1AC	$0.42	UG-23/U	$1.20	UG-175/U	$0.15
83-1AP	.30	UG-23B/U	1.75	UG-176/U	.15
83-1F	1.20	UG-23C/U	1.90	UG-185/U	.99
83-1H	.12	UG-24/U	1.30	UG-224/U	1.15
83-1HP	.22	UG-25/U	1.35	UG-255/U	1.95
83-1J	.75	UG-27/U	1.25	UG-260/U	.80
83-1R	.40	UG-27B/U	3.05	UG-261/U	1.10
83-1RTY	.65	UG-28A/U	3.75	UG-262/U	1.10
83-1SP	.45	UG-30/U	2.30	UG-274/U	2.30
83-1SPN	.50	UG-57B/U	1.70	UG-290/U	.90
83-1T	1.30	UG-58/U	.80	UG-291/U	1.05
83-2AP	1.95	UG-58A/U	1.10	UG-306/U	2.65
83-2J	2.10	UG-59A/U	2.15	UG-499/U	1.25
83-2R	1.70	UG-83/U	1.75	UG-625/U	1.00
83-22AP	1.40	UG-85/U	1.70	CW-123A/U	.50
83-22R	.68	UG-87/U	1.50	M-358	1.30
83-22SP	.80	UG-88/U	.90	M-359	.30
83-168	.15	UG-89/U	1.10	PL-258	.75
83-185	.15	UG-102/U	.80	PL-259	.45
UG-13/U	1.70	UG-103/U	.68	PL-259A	.50
UG-21/U	.95	UG-104/U	1.40	PL-274	1.20
UG-21B/U	1.05	UG-106/U	.12	SO-239	.40
UG-22/U	1.30	UG-146/U	2.00		
UG-22A/U	1.60	UG-167/U	5.70		

NEW COAXIAL CABLES

	Price per 1000 ft.		Price per 1000 ft.
RG 5/U*	$140.00	RG 22/U*	$135.00
RG 6/U	180.00	RG 22A/U	285.00
RG 7/U*	80.00	RG 24/U	675.00
RG 8/U*	100.00	RG 26/U	475.00
RG 9/U*	250.00	RG 29/U	50.00
RG 9A/U	275.00	RG 34/U	300.00
RG 10/U	240.00	RG 35/U	900.00
RG 11/U	100.00	RG 41/U*	295.00
RG 11A/U*	150.00	RG 51A/U	97.00
RG 12/U	240.00	RG 55/U*	110.00
RG 13/U*	216.00	RG 57/U*	325.00
RG 17/U	650.00	RG 58/U*	60.00
RG 18/U	900.00	RG 58A/U*	65.00
RG 19/U	1250.00	RG 59/U*	55.00
RG 20/U	1450.00	RG 62/U*	70.00
RG 21/U*	220.00	RG 77/U*	100.00

Add 25% for orders less than 500 feet.
* No minimum order—others 250' minimum.

UNIVERSAL JOINT ALUMINUM

¼" hole x ½" O.D.
1⅛" long **85¢**

SPAGHETTI SLEEVING—assortment—99 feet $1.00

TYPE "J" POTENTIOMETERS

100 S.S.*	1,500 1/4S.S.	15K 1/4	200K S.S.*
150 S.S.	2,000 1/4	25K S.S.	250K 5/8
300 S.S.*	2,500 S.S.	70K S.S.	250K S.S.*
400 S.S.	3,000 3/8	80K S.S.	500K S.S.*
500 S.S.	4,000 3/8	100K 7/16	1Meg S.S.
1,000 3/8	5,000 3/4*	100K S.S.*	
1,000 S.S.	10K 5/8	200K 5/8	

*Split Locking Bushing **$1.25 EACH**

TYPE "JJ" POTENTIOMETERS

Ohms	Shaft	Ohms	Shaft	Ohms	Shaft
1000	S.S.	30K-10K	3/8"†	1 Meg.	1/2"
10K	5/16"	3K-90K	1/4"	1 Meg.	S.S.
15K	S.S.			1 Meg.	S.S.

SD—Screw Driver
*—Split Locking Bushing
†—With Switch

PRICE—$2.00 EACH

JONES BARRIER STRIPS

2—140Y	$0.17	3—141W	$0.27	9—141Y	$0.71
3—140¾W	.21	4-141	.24	3—142	.24
6—140.	.28	5-141	.29	2—150	.43
10-140W	.59	5-141¾W	.41	3—150	.60
10-140¾W	.59	7-141¾W	.56		
3-141¾W	.27	8—141¾W	.64		

TIME DELAY RELAY

Raytheon CPX 24166
1 Min. Delay. 115 V., 60 Cycle

2½ second recycling time spring return • Microswitch contact, 10A • Holds ON as long as power is applied • Fully Cased •
ONLY $6.50

AN CONNECTORS

IMMEDIATE SERVICE
PHONE! WIRE! WRITE! YOUR NEEDS

PRECISION RESISTORS—¼ WATT—30¢

2	10.48	12.32	14.98	62.54	147.5	705
2.5	10.84	13.02	15.8	79.81	220.4	2,193
3.5	11.25	13.52	16.37	105.8	301.8	3,500
5	11.74	13.89		123.8	366.6	
6.68				125	414.3	59,148

PRECISION RESISTORS—½ WATT—35¢

.25	11.1	75	400	6,500	16,000	36,000
.334	13.15	87	723.1	7,000	16,700	37,000
.444	13.3		855	7,300	17,000	45,000
.502	15	125	970	7,500		47,000
.557	25	178	1,500	8,000	20,150	50,000
.627	44.73		2,500	8,500	21,300	56,000
.76	45	180	2,850	8,800	25,000	59,000
1.00	46		3,995	10,000	26,667	59,905
1.01	52	210	4,000	12,000	30,000	68,000
1.53	55.1	235	4,285	14,825	32,700	79,012
2.04	61	260	4,451	15,000	32,888	100,000
5.26	65	270	5,714	15,750	33,000	180,000
5.89	66.6	290	5,900	15,755	33,300	
	69	298.3		15,810	35,888	

PRECISION RESISTORS—1 WATT—45¢

.1	2.55	15	60	425	7,000	55,000
.11	2.58	18	125	1,530	8,250	56,000
.2	2.6	28	250		9,000	65,000
.31	2.66	30	270	2,250	10,000	68,000
.861		38	312	2,550	12,000	70,000
1.01	3.39	45.5	420	3,300	50,000	84,000
1.166	5.21	54.25		5,221		95,000

PRECISION RESISTORS—1 WATT—60¢

100,000	149,500	270,000	348,000	590,000
105,000	150,000	296,000	399,000	600,000
120,000	240,000	310,000	413,000	645,000
128,000	260,000	320,000	520,000	650,000
130,000			522,000	700,000
132,000				800,000

1 MEGOHM 1 WATT 1%—$1.50; 5%—60¢

PRECISION RESISTORS—2 WATT—75¢

4,385 5,000 6,000 10,000 19,917

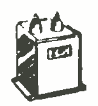
DIFFERENTIAL

115 V., 60 Cycle #C78249
Used $4.95
New $9.95

3⅜" dia. x 5⅜" long
Used between two C78248's as a dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted) $5.50
Mounting Brackets—Bakelite for selsyns, and differentials shown above .... 35¢ pair

OIL FILLED CONDENSERS

MFD	V.D.C.	Price	MFD	V.D.C.	Price
5.2	50	$0.35	.25	3,000	$2.25
6	400	.85	1	3,600	3.95
3 x 3	400	1.00	3 x .2	4,000	2.50
4	500	.85	2	4,000	7.95
4-4	500	1.30	3	4,000	10.95
8	500	1.35	.01	5,000	.95
1	600	.45	.01-.03	6,000	1.40
.5-.5	600	.40	.03-.03	6,000	1.50
2	600	.80	1	6,000	9.95
4	600	1.63	.02-.02	7,000	1.55
8	600	2.05	.02-.03	7,000	1.60
10	600	2.95	.1	7,000	1.95
4 x 3	600	1.75	.1-.1	7,000	2.25
8-8	600	1.79	.1	7,500	2.25
1	800	.60	.3-.3	7,500	4.50
1	1,000	.75	.075-.075	8,000	1.85
2	1,000	.95	.15-.15	8,000	2.95
3	1,000	1.70	.25	20,000	19.95
6	1,000	2.75			
8	1,000	3.25			
1	1,500	1.45			
.02	2,000	.65			
.1-.1	2,000	1.30			
.1-.5	2,000	1.65			
3	2,000	3.75			
8	2,000	7.95			



1 mfd
6,000
V.D.C.
G.E.
$9.95

OIL FILLED A.C. CONDENSERS

MFD	V.A.C.	Price	MFD	V.A.C.	Price
.2	750	$0.69	15	440	$6.25
8	660	7.50	4.4	375	2.15
6	660	5.95	25	330	7.50
5	660	5.45	20	330	6.75
4	660	4.95	4	330	2.25
3	660	4.45	3	330	1.45
2.9	660	4.35	1.75	330	.85
2	660	3.95	20	220	4.95
1	660	2.95	7.5	220	2.00

1N34 Crystal Diode .... 79¢

300 Twin Lead .... .02½ per ft. $15.00 per M

Dynamotor DM 33A .... $3.75 ea.

Chokes: 30 Hy. 80MA @ ... $1.29; 6HY, 80 MA @ ... 79¢

Power Tap Switch—OHMITE (#312-5 Taps) non-shorting 25A 150 V. A.C. $3.95

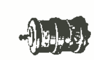
Timer—Industrial Timer Corp. 15 min. on 15 min. off continuous 115 V. A.C. Fully cased Plugs into octal socket $5.50

BC 221 FREQUENCY METER $80.00

Mike Connector Amphenol 80-81 Interchangeable with Amphenol 80-M cad plated .... 25¢

2J1G1 SELSYNS $8.95

400 CYCLE BRAND NEW



Minimum Orders $3 All orders f.o.b. PHILA., PA.

RELIANCE MERCHANDIZING CO.

Arch St., Cor. Croskey Phila. 3, Pa. Telephone Rittenhouse 6-4927

ALNICO FIELD MOTORS

(Approx. size overall) . . . 3¾" x 1¼" diameter) **Delco-Type** 5069230: 27.5 volts; DC; 145RPM **$19.95 ea.**

PM Motor, Delco Type #5069370: 27.5 volt; DC Alnico Field; 10,000 r.p.m.; dimensions 1" x 1" x 2" long; shaft extension ½", diameter 0.125" **$12.50**

PM Motor, Diehl Mfg. SS FD6-21: 27.5 volt; DC Alnico Field; 10,000 r.p.m.; dimensions 1" x 1" x 2" long; shaft extension ½" diameter 0.125" **$12.50**

AC CONTROL MOTOR

Diehl Mfg. Co., FPE-25-7, 20 Volts, 2 ph 1600 RPM, .85 amps **$15.00**

Diehl Mfg. Co., FPE-25-11: 75 to 115 volts; 11 amps. 60 cycle, 2 phase 2 pole. Low inertia motor, 5 watts output **$30.00**

AC CONTROL MOTOR, DIEHL FPE 49-2: 115 Volt; 60 Cycle; .32 Amp; 2 Phase; OUTPUT; 11 Watts; 2 Pole .... **$69.50 ea.**

A. C. SYNCHRONOUS MOTOR TYPE RBC 2505; Volts 115; Cycles 60; RPM 60; Mfg. HOLTZER CABOT ELECT. Approx. size: 2⅝" x 2⅝" x 2⅝" .... **$15.00 ea.**

400 CYCLE MOTORS

PIONEER: TYPE CK5 2 Phase; 400 cycles **$35.00 ea.**

EASTERN AIR DEVICES TYPE J49A: 115 V; 0.1A; 7000 r.p.m.; Single phase 400 cycle .... **$17.50 ea.**

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—IA Serial No. 207, 208 V., 400 cycles, 3 phase Kearfott Co., Inc. .... **$17.50 ea.**

SERVO MOTOR 10047-2-A; 2 Phase; 400 Cycle; with 40-1 Reduction Gear $10.00 ea.

SMALL DC MOTORS

(Approx. size....4" long x 1¼" dial.)

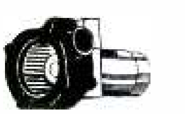
General Electric Type 5AB10AJ37; 27 volts. DC; .5 amps. 8 oz inches torque; 250 RPM; shunt wound; 4 leads; reversible..**$12.50 ea.**

General Electric. Mod. 5BA10FJ33; 12 oz. inches torque, 12 V DC, 56 RPM, 1.02 amp. **$15.00 ea.**

General Electric-Type 5BA10AJ52C; 27 volts, DC; .5 amps. 8 oz. inches torque; 145 RPM; shunt wound; 4 leads; reversible **$12.50 ea.**

GENERAL ELECTRIC DC MOTOR Mod. 5BA10AJ64. 160 r.p.m.; 65 amp; 12 oz.-in. torque; 27V DC................ **$19.95 ea.**

BLOWER



Eastern Air Devices. Type J31B; 115 volt; 400-1200 cycle; single phase; variable frequency; continuous duty; L & R #2 blower; approx. 22 cu. ft./min. **$15.00**

BLOWER ASSEMBLY

115 Volt, 400 Cycle, Westinghouse Type FL, 17CFM, complete with capacitor New .... **$12.50 ea.**

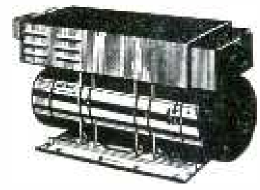
MICROPOSITIONER

Barber Colman AYLZ 2133-I 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.**

SENSITIVE ALTIMETERS

Pioneer Sensitive altimeters, 0-35,000 ft. range . . . calibrated in 100's of feet. Barometric setting adjustment. No hook-up required...**$12.95 ea.**

INVERTERS



10563 LELAND ELECTRIC

Output: 115 VAC; 400 cycle; 3-phase; 115 VA; 75 PF. **Input:** 28.5 VDC; 12 amp. .... **$80.00 ea.**

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.**

MG 153 HOLTZER-CABOT

Input: 24 V. DC, 52 amps; **Output:** 115 volts—400 cycles, 3-phase, 750 VA, and 26 Volt—400 cycle, 250 VA. Voltage and frequency regulated................ **$95.00 ea.**

PIONEER 12130-3-B

Output: 115 VAC; 1.15 amps. 400 cycle single phase, 141 VA. **Input:** 20-30 VDC, 18-12 amps. Voltage and frequency regulated .... **$89.50 ea.**

E-1616-2 EICOR, INC.

100 V.A.; 3 Phase; 115 Volts; 400 Cycle .95 P. F. **Input:** 27.5 Volts, 9.2 Amps; Continuous duty .... **$79.50 ea.**

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**

10486 LELAND ELECTRIC

Output: 115 VAC; 400 Cycle; 3-Phase; 175 VA; .80 PF. Input: 27.5 DC; 12.5 amp; Cont. Duty .... **$90.00 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.**

AMP METERS: D.C., 0-300 amps, 3" round type complete with external shunt. **$6.95 ea.**

ELAPSED TIME METER. Aero Instrument Co.—Model 1001. Records operating time of AC electrical and electronic equipment. Registers up to 9,999.9 hours in 1/10th hour increment . . . then automatically resets. Diameter 3½" with glass covered face. 120 VAC; 60 cycle. NEW..**$14.95**

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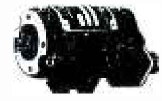
Free and rate gyro type 45600. Contains two 28 volt D C constant speed gyros . . . one operates horizontally, the other vertically. Vertical master gyro influences horizontal gyro position, which in turn will actuate a series of limiting switches controlling any number of electrical devices. Both gyros turn in excess of the 30,000 rpm. Size 8" x 4¼" x 4¼". Comes with metal cover................ **$22.50 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 5-⅜" x 3" dia..**$9.95 ea.**



PIONEER GYRO FLUX GATE AMPLIFIER Type 12076-1-A, complete with tubes **$27.50 ea.**

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General Electric Type 5ASB-31JJ3; 400 cycles out at 115 volts; 7.2 amps; 8,000 rpm.; size 6" long x 6" dia. **$99.50 ea.**

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Diehl Type FJE43-9 (Single Phase Rotor). Two stator windings 90° apart, provides two outputs equal to the sine and cosine of the angular rotor displacement. Input voltage 115 volts, 400 cycle.......... **$30.00 ea.**

Diehl Type FPE-43-1 same as FJE-43-9 except it supplies maximum stator voltage of 220 volts with 115 volts applied to rotor .... **$25.00 ea.**

Arma Resolver Type 213044: equal in size to size 5 synchro; 55-60 cycle; single phase primary, 2 phase secondary......... **$79.50**

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Eclipse-Pioneer: 716-3A (Navy Model NEA-3A) OUTPUT: 115 VAC; 10.4 amps; 800 cycle; single phase; 28.6 VDC; 60 amps @ 2400 rpm; spline drive; self exciting; wt. 60#. **BRAND NEW** in original box..... **$39.95 ea.**

POWER UNIT PU-6/TPS-1

Gasoline driven 2-cycle engine. Dual voltage generator; 120 VAC; 1400 watt; 400 cycle; 28 VDC; 14.3 amp. BRAND NEW **$295.00**

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110 volt, 60 cycle, brass cased, approx. 4" dia. x 6" long. Mfg. by Diehl and Bendix.

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REPEATER, BENDIX C-78410; 115 Volt, 60 Cycle .... **$37.50 ea.**

REPEATER, AC synchronous 115 V., 60 cycle, C-78863 .... **$15.00 ea.**

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6G Synchro Generator (115/90 volt; 60 cycle) **$60.00**

6DG Synchro Differential Generator (90/90 volt; 60 cycle) **$60.00**

2J5F1 Selsyn Control Transformer: 105-55 Volts; 60 Cycle **$50.00**

2JD5J2 Selsyn Motor: 115-90 Volts; 60 cycle **$50.00**

5JD5HA1 Selsyn Generator: 115-105 Volts; 60 cycle **$50.00**

2JIF1 GENERATOR: 115—57.5 Volt; 400 cycle .... **$12.50 ea.**

2JIH1 DIFFERENTIAL GENERATOR: 57.5 —57.5 Volt; 400 cycle............ **$12.50 ea.**

2JIG1 CONTROL TRANSFORMER: 57.5—57.5 Volt; 400 cycle.............. **$7.50 ea.**

PIONEER AUTOSYNS

AY-1.......26 Volt—400 Cycle........ **$6.95**
AY-5.......26 Volt—400 Cycle........ **$7.95**
AY27D **$25.50**
AY6—26 Volt—400 cyc........... **$4.95 ea.**
AY30D—26 Volt—400 cyc........ **$25.00 ea.**
AY14D **$14.00**
AY34 .... **$20.00**
AY20—26 Volt—400-cyc. .... **$12.50 ea.**

PIONEER TORQUE UNITS

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.**

TYPE 12602-1-A: Same as 12606-1-A except it has a 30:1 ratio between output shaft and follow-up Autosyn.......... **$70.00 ea.**

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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1N23	2.00
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2C34	.35
2C40	20.00
2C43	27.00
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2D21	1.75
2E22	3.75

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2J22	17.95
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2727	29.95
2J31	29.95
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2J36	105.00
2J38	17.95
2J40	35.00
2J42	189.00
2J49	109.00
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2K41	150.00
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3DP182	12.00
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726C	69.00
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807	1.69
808	3.50
810	11.00
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813	9.95
814	3.95
815	3.50
816	1.45
829	12.95
829A	13.95
829B	15.95
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832	7.95
832A	9.95
833A	49.95
834	7.95
836	4.95
837	2.95
838	6.95
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849	52.50
851	80.50
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861	39.50
866A	1.79
869B	57.50
869BX	35.00
872A	3.95
878	1.95
884	1.95
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889R	199.50

TYPE	PRICE
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931A	6.95
954	.35
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956	.69
957	.29
958A	.69
991	.65
F1148	.35
1280	1.95
1611	1.95
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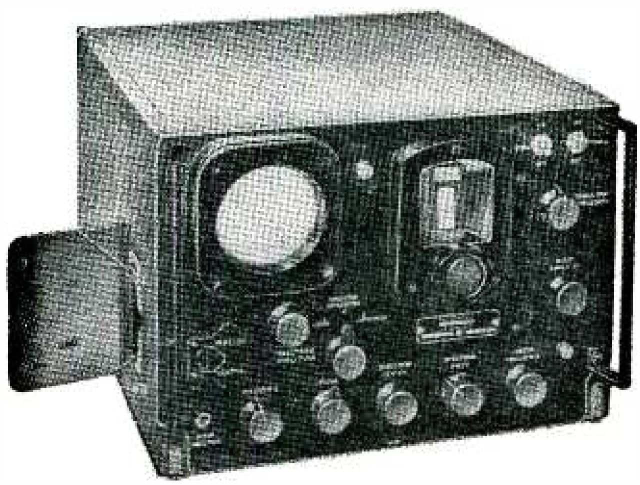
1616	2.95
1619	.89
1622	2.75
1624	2.00
1625	.45
1851	1.85
2050	1.85
2051	1.80
8012	4.25
8013	2.95
8013A	5.95
8019	1.75
8020	3.50
8025	6.95
PD8365	89.00
9001	1.75
9002	1.50
9003	1.75
9004	1.75
9005	1.90
9006	.35

Minimum Order $25.00



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Field type X Band Spectrum Analyzer, Band 8430-9580 Megacycles.

Will check Frequency and Operation of various X Band equipment such as Radar Magnetrons, Klystrons, TR Boxes. It will also measure pulse width, c-w spectrum width and Q or resonant cavities. Will also check frequency of signal generators in the X band. Can also be used as frequency modulated Signal Generator etc. Available new complete with all accessories, in carrying case.

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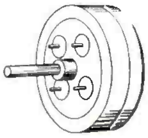

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$17.50 each

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Es, Fs, Is, Ls. Ten Sizes. Quantities Available.
Sample Kit, 6 lbs, Sufficient Quantity of Each Size for One Unit—Postpaid in U. S. A.
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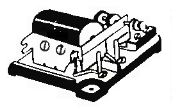
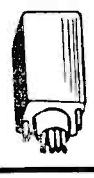
Low-loss Melamine Insulation, pictured actual size (4-40 Thread)....$7.50/C $67.50/M

ULTRA SENSITIVE RELAYS



KURMAN BK35 — Nominal Operating Characteristics, 11,000 Ohms. 0.4 Ma. 4V DC SPDT. Adjustable contacts and armature. #R277, 10 for 55.00, 100 for 475.00.

$5.95 each



SIGMA 5RJ; 5000 ohms Hermetically sealed SPDT; 1.5 ma. DC. #R281

$6.95 each

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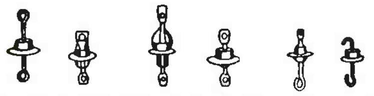

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SAMPLE KIT 96 Seals (8 ea. 12 types)	5.00	postpaid in USA
LAB KIT 300 Seals (20 types)	15.00	postpaid in USA

DELAY RELAYS

PARAGON Model 815; 115V, 60 cyc; Adjustable 0 to 100 sec; 2½ sec Recycling time; SPDT, 10 Amp contacts; #R944 .... $13.95

PARAGON Model 810B; 115V, 60 cyc; 60 sec Delay, 2½ sec Recycling time; SPST, n.o., 10 Amp contacts; #R945 .... $7.95

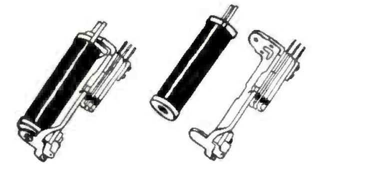
AMPERITE THERMAL TIME DELAY

Single Pole Normally Open 2.40 ea.

No.	Volts AC/DC	Delay Sec.	No.	Volts AC/DC	Delay Sec.
R946	115	60	R316	24	2
R947	115	30	R950	6	60
R948	115	15	R951	6	30
R943*	115	5	R952	6	15
			R953	6	5

* Edison Type 501

TELEPHONE TYPE RELAYS



These relays have been standardized so that coils and frames of most manufacturers can be interchanged without affecting adjustments. A wide variety of applicable combinations are thus possible from a comparatively small number of relays.

Listed below are frames and coils from our stock. They may be purchased separately. However, a complete relay consists of coil and frame. In ordering complete relays specify which coil with which frame, i.e.: F101 with K117.

Representative completed relays are also listed with voltage and current ratings. Values are indicative of sensitivity that may be expected from similar combinations.

107 COOK, 3-6VDC, 6 make, 1 break (5As, 1C), 12 ohm. Part of BC654, #R407........$ 3.95

CLARE, 6500 ohm, 8maDC, 3 makes (3As), R276 .... 4.25

5035A7 AUTOMATIC, 1300 ohm, 8maDC, SPST n.o. (1A), #R103.................... 1.75

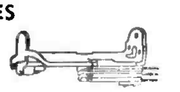
A18258 BENDIX (Cook 102) 8-12 VDC, Copper Slug, Slow Release, SPDT, 200 ohm, Part of SCR 522, #R365................. 2.49

R5229AI AUTOMATIC 6VDC, 3PST n.o. (3As), 75 ohms, Slow Release, #R412...... 2.50

R5021AI AUTOMATIC 1300 ohm, 20maDC, SPST n.c. (1B), #R413.................. 2.95

FRAMES

(For Cost of Relay Add Price of Frame to Price of Coil)



Stock No.	Contacts	Price each	Stock No.	Contacts	Price each
F101	1A	1.25	F111	1B, 2A	1.75
F102	2A	1.50	F114	1B, 3A	2.00
F103	3A	1.75	F108	1B, 1A, 1C	2.00
F104	4A	2.00	F107	2B, 1A	1.75
F105	5A	2.25	F112	2B, 2A, 2C	3.00
F106	1A, 1B	1.50	F118	2B, 5A, 1C	3.25
F107	1A, 2B	1.75	F113	5B, 2A	2.75
F108	1A, 1B, 1C	2.00	F121	5B, 1C	2.75
F109	1A, 1C	1.75	F122	1C	1.50
F110	1A, 2C	2.25	F123	2C	2.00
F111	2A, 1B	1.75	F109	1C, 1A	1.75
F112	2A, 2B, 2C	3.00	F116	1C, 4A	2.50
F113	2A, 5B	2.75	F117	1C, 5A	2.75
F114	3A, 1B	2.00	F121	1C, 5B	2.75
F115	3A, 2C	2.75	F110	2C, 1A	2.25
F116	4A, 1C	2.50	F115	2C, 3A	2.75
F117	5A, 1C	2.75	F108	1C, 1A, 1B	2.00
F118	5A, 2B, 1C	3.25	F118	1C, 5A, 2B	3.25
F120	1B	1.25	F112	2C, 2A, 2B	3.00
F106	1B. 1A	1.50			

FRAMES WITH MICROSWITCH

F125	1A, 1C (Microsw.)	1.75
F126	1A, 1A (Microsw.)	1.75

COILS

(For Cost of Relay Add Price of Coil to Price of Frame)

Stock No.	Ohms	Price each	Stock No.	Ohms	Price each
K101	0.75	1.25	K106	1100/500 Dual	2.00
K102	12	1.25	K111	1300	1.75
K103	250	1.25	K112	2000	2.25
K104	450	1.50	K113	3000	2.50
K105	500	1.50	K114	3600	2.50
K106	500/1100 Dual	2.00	K115	4600	2.75
K107	750	1.50	K116	6500	2.75
K108	900	1.75	K117	10,000	3.00
K109	1000	1.75	K118	40,000	3.25

A-C COILS

Stock No.	Voltage	Price each
K119	6V AC	1.75
K120	24V AC	1.75
K121	110V AC	2.50

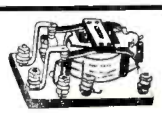
SLOW ACTION COILS

Stock No.	Ohms	Slow Action	Price each
K122	33	Make	1.50
K123	75	Release	1.50
K124	200	Release	1.50
K125	300	Make	1.75
K126	2000	Make	2.00

A = Normally Open; B = Normally Closed; C = Double Throw.

LEACH RELAYS

(Many Others in Stock)



Type No.	Coil No.	Volts D.C.	Ohms	Circuit	Stock No.	Price Each
1010	356C	22.5	325	1A	R212	1.50
1016	357D	24	375	1A	R286	1.50
1024AI	356A	24	265	2A	R214	2.25
1025SNBF	357CX	24	425	23	R216	2.00
1054B	356A	24	265	2A	R253	2.25
1077BF	355D	24	160	2C	R213	3.25
1154	371BL	50AC	...	2A	R 215	2.25
1204	355	12	95	2A	R217	2.25
1204	356A	24	265	1A	R218	2.00
1224DE	355	12	95	2A	R219	2.25
1251	366	2.4	4	1A	R220	2.00
1251	354D	12	67	1A	R221	2.0
1251	361	120	10,000	1A	R222	3.7
1254A	355	12	95	1A	R248	2.0
1257WC	354D	12	67	2C	R249	3.25
1257M	372D	24	250	1C	R250	3.00
2024DE	354C	12	42	4A	R251	3.25
2024DE	355D	24	160	4A	R252	3.25

LEACH LATCHING RELAY

Type No.	Amps	Volts D.C.	Ohms	Circuit	Stock No.	Price Each
2406DN	356A	24	265	1A, 1B	R285	4.50
Release	356A	24	265	1A		

LEACH SOLENOIDS

Type No.	Amps	Volts D.C.	Ohms	Circuit	Stock No.	Price Each
5023CG17	50	24	100	1A, 1B	R282	5.00
5030CSP	50	12	25	1A	R125	2.50
5058	200	24	10	1A	R283	6.00
7064-12C	50	12	40	1A	R284	2.25

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	$8.95
2 Amps.	2.20	5.60	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	36.00
10 Amps.	6.75	12.00	20.00	45.00
12 Amps.	8.50	16.00	25.50	52.50
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	.....	.....

RELAYS! RELAYS! RELAYS!

324 CANAL ST., N.Y.C., 13, N.Y. WAlker 5-9642

Universal general corp.

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.)

COMMUNICATIONS EQUIPMENT CO.

24 VOLT TRANSFORMERS

For operating surplus gear, toy trains, gadgets, etc. Operates from 115V, 60 cy., supplies 24 VAC at 1.2 Amp., herm. sealed and cased.......... A Great Buy at Only **$1.49**

RECTIFIER TRANSFORMERS

Pri: 115V, 60 Cy. Sec: 28V/3.1A, 26V/8.4A 7.3V/14A $12.95
Pri. 210/215/220/225/230/235/240V, 60 Cy., 1 Phase Sec: 11/10/7.5/5VCT @ 35A................$19.50
Pri: 115V 60 Cy. Sec: 20 V @ 10A.........3.95
Pri: 115V 60 Cy. Sec: 8.1V @ 1.5A.........1.39
Pri: 115V 60 Cy. Sec: 18.5V @ 3.5A.......2.79

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps Input

CT75B	600-0-600V/.6A, 2X5VCT/6.2A, 6.3VCT/3A, 6.3V/.3A			$12.95
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	1050 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	.050 A	5VCT/3A	2.25
CT-99A	2x110VCT	.010 A	6.3/1A, 2.5VCT/7A	3.25
CT-403	350VCT	.026 A	5V/3A	2.75
CT-931	585VCT	.086 A	5V/3A, 6.3V/6A	4.25
CT-456	390VCT	30 MA	6.3V/1.3A, 5V/3A	3.45
CT-160	800VCT	100 MA	6.3V/1.2A, 5V/3A	4.95
CT-931	585VCT	86 MA	5V/3A, 6.3V/6A	4.95
CT-442	525VCT	75 MA	5V/2A, 10VCT/2A, 50V/200 MA	3.85
CT-720	550-0-550V/250 MA, 6.3V/1.8A			8.95
CT-43A	600-0-600V/.08A, 2.5VCT/6A, 6.3VCT/1A			6.49
CT7-501	650VCT/200 MA, 6.3V/8A, 6.3V/5A			6.49
CT-444	230-0-230V/.085A, 5V/3A, 6V/2.5A			3.49

Filament Transformers—115V50-60 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, 2z7.75V/6.5A	14.95
FT-824 7,	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 A 5A, 29KV Test	24.50

Plate Trans.—115V, 60 cps

Item	Rating	Price
PT-699	300/150V/.05A, 300/150V/.05A	$2.79
PT-302	120-0-120V/350 MA	4.69
PT-108	17,600V/144 MA	120.00
PT-671	62V/3.5A	7.95

Special Fil. Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STF-370	220/440	3x2.5V/5A, 3KV Test 2.5V/15A	$6.95
STF-11A	220V	2x40V/.05A, 2x5V/6A 12.6V/1A	4.49
STF-608	220V	24V/0.6A, 5V/3A, 6.3V/1A, 6.3V/1A	3.45
STF-968	230V	2.5V/6.5A	3.50
STF-631	230V	2x5V/27A, 2x5V/9A	17.59

Special Plate Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STP-613	230V	230/.05A,230V/.05A	$1.79
STP-409	220/440V	136VCT/3.5A	5.69
STP-815	240/440, 3ph	1310V/.67A, 6KV Test	27.50
STP-129	230V	3850V/3.12KVA	42.59
STP-823	137V	222VCT/.3A	2.35
STP-08B	50V	2x750V/.001A	1.79
STP-622	210/220/230	5000V/1A	59.75
STP-945	210/220/230	550-0-550V/.3A	5.95

Special Comb. Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STC-16A	220V	260V/.03A, 100V/1A, 6.3V/4.2A	$4.69
STC-609	220V	220V/3A	6.95

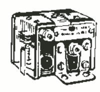
AUDIO TRANSFORMERS

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, 10 W 6V6 to PP 805'S $2.39
AT666 Intercon Input: Spkr (-4-8 ohms) to grid (250-000 ohms)..$0.69

This Month's Special

SA4A/APA-1 Motor Driven Coaxial Ant. Switch DPDT, Continuous Operation from 24VDC. Completely Enclosed............$24.50
MP-22 MAST BASE Mobile Antenna Mount. 4.59
SA1A/APN-1 Altitude Limit Switch for APN-1 Altimeter........................ 7.95
ALTITUDE INDICATOR for APN-1......... 12.50
C-387-D Final P.A. Coil for BC610 2-3.5 MC, Variable Link.......................... 4.89
RA-74 Power Supply for Super Pro......... 69.50
J-17/ARC-5 Junction Box for ARC-5........ 7.95
J-22/ARC-5 Junction Box.................. 3.49
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

G.E. RELAYS*



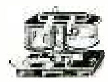
CR2792B116A3

SPST—50 Amp Contacts. Operates from 22-30 VDC. Coil Res. 200 Ohms. Completely enclosed in transparent plastic case, which may be removed for adjustments... **$1.59**

GE#CR2791B116W3

Same as above, except additional terminal brought out from contact arm..................... **$1.74**

GE#CR2791-F100D3

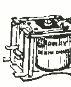


Differential: DPST, Norm. open. Dual coil, 1500 ohms per coil—25 Ma. Operating Current. Contacts: 20 Amp. **$2.25**

GE#CR2791F100G3

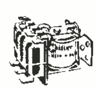
Same as above, except has extra 1A contact. Rated 5 Amp **$2.35**

GE#CR2791D101F3



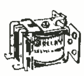
All Ceramic Insulation, DPDT, Coil—12VDC. 100 Ohms DCR. Contacts designed for fast operation. Rated at 5 Amps. **$1.25**

GE#CR2791B106J3



3PDT, 5 Amp contacts. Coil rated 22-30VDC. 150 Ohms DCR. Contacts are designed for fast operation, and enclosed by clear plastic cover **$1.35**

GE#CR2791B106C3



SPDT, Dual Contacts will handle 20 Amps. Coil: 18-28VDC 125 Ohms DCR **$1.25**

***THESE RELAYS AVAILABLE IN MFRS. QUANTITIES**

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
CW21AAX	13	12.6	400	.135	
	26	6.3	800	.020	
			9	1.12	
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.....................$44.50
PE-206: Input: 28 vdc, 38 amps. Output: 80 v 800-cy. 500 volt-amps. Dim: 13"x5⅓"x10⅓". Bew............$22.50
LELAND No. 10536: IN: 28 VDC, 12A. OUT: 115V, 115VA, 400 CY 3 PHASE. EXC. COND.......................$70.00

ELECTROLYTIC CAPACITORS

TWIST PRONG

Cap. Mfd	WVDC	Price
8	450	$0.16
30	300	.18
40	450	.38
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	85.00
.5	65.00

SELENIUM RECTIFIERS

F. W. BRIDGE

UP TO 18 VAC IN— UP TO 14 VDC OUT	
2A	$2.50
4A	4.00
6A	6.00
10A	7.50
12A	9.00
24A	18.00
UP TO 36 VAC IN— UP TO 28 VDC OUT	
1A	$3.00
2A	4.00
5A	10.00
10A	14.50
12A	18.00
24A	36.00
UP TO 54 VAC IN— UP TO 42 VDC OUT	
2A	$6.50
4A	8.50
UP TO 120 VAC IN— UP TO 100 VDC OUT	
2A	$11.00
10A	48.00
12A	60.00

NON-POLAR CAPACITORS

A.C. ELECTROLYTICS

CAP.	VAC.	PRICE
13-15	220-	$1.20
20-24	110-	1.00
26-30	220-	1.35
43-65	110-	1.25
43-48	110-	1.25
50-75	110-	1.25
53-60	220-	1.50
61-69	320-	1.60
64-72	110-	1.25
72-87	110-	1.25
75-84	110-	1.25
88-106	110-	1.50
107-129	110-	1.65
130-157	110-	1.75
130-150	70-	1.50
130-180	110-	1.85
158-191	110-	1.85
161-180	110-	1.75
189-210	110-	1.95
200-220	110-	1.95
270-300	110-	2.10
324-360	110-	2.40
378-420	175-	3.00
432-480	110-	2.75
485-540	110-	2.85

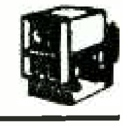
FILTER CHOKES

Stock	Description	Price
CH-366	20H/.3A	$6.95
CH-322	.35H/350 MA—10 Ohms DCR	2.75
CH-141	Dual 7H/75 MA, 11H/60 MA 5KV DC Test	4.69
CH-119	8.5H/125 MA	2.79
CH-69-1	Dual; 120H/17 MA	2.35
CH-8-28	2 x .5H/380 MA/25 Ohms	1.79
CH-776	1.28H/130 MA/75 ohms	2.25
CH-344	1.5H/145 MA/1200V Test	2.35
CH-43A	10HY/15 MA—850 ohms DCR	1.75
CH-366	20H/300 MA	6.95
CH-999	15HY/15 MA—400 ohms DCR	1.95
CH-511	6H/80 MA—310 ohms DCR	2.45
CH3-501	2x5H/400 MA	2.79
CH-188M	5HY 200 MA	1.79
CH 303	300H/.02A, 2500V Test	1.69
CH 932	SWING 9-60H/.4-.05A, 10KV	7.95

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**

INTERPHONE AMPLIFIER



Easily converted to an ideal Inter-Communications set for office, home or factory. Original. New w/conversion diagram **$4.75**

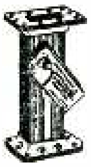
MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D. RATED CONCERNS SEND P. O. ALL MDSE. SUBJECT TO PRIOR SALE, AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE. PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK OR RAILEX.

131 Liberty St., New York 7, N. Y. Dept E-1 Chas. Rosen Phone: Digby 9-4124

COMMUNICATIONS EQUIPMENT CO.

MICROWAVE COMPONENTS

S BAND—3" x 1 1/2" W.G. 10 CM.



DIRECTIONAL COUPLER, Broadband. 20 db. Coupling. Type "N" Takeoff. Complete with all Hardware. Navy # CABY-47AAN-2. As shown...$37.50
WAVEMETER 2700-3400 MC. Reaction Type with counter Dial—Mfg., W.E. ...$92.50
REACTION WAVEMETER, Mfg. G.E. 3000-3700 MC. Misc. Head.....$125.00
LHTR LIGHTHOUSE ASSEMBLY. Part of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG. To Recvr. Uses 2C40, 2C43, 1B27. Tunable APX 2400-2700 MCS. Silver Plated...$49.50
BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Rice, each ...$47.50
MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated...$45.00
RT-39/APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr.-TR cavity, compl. recvr. & 30 MC IF strip using 6AK5 (2040, 2C43 1B27 lineup) w/Tubes.
721A TR BOX complete with tube and tuning plungers ...$12.50
McNALLY KLYSTRON CAVITIES for 707B or 2K28 ...$4.00
F 29/SPR-2 FILTERS, type "N" input and output Hi-Pass Over 1000 MC...$12.50
WAVEGUIDE TO 7/8" RIGID COAX "DOORKNOB" ADAPTER CHOKE FLANGE, SILVER PLATED BROAD BAND ...$32.50
AS14A/AP-10 CM Pick up Dipole with "N" Cables ...$4.50
OAJ ECHO BOX, 10 CM TUNABLE...$22.50
HOMEDELL-TO-TYPE "N" Male Adapters, W.E. #D167284 ...$2.75
I. F. AMP STRIP: 30 MC 120 d.b. gain, 2 MC Band-width, uses 6AC7's—with video detector. Less tubes ...$24.50
POLYROD ANTENNA, AS31/APN-7 in Lucite Ball, Type "N" feed...$22.50
ANTENNA, AT49A/APR: Broadband Conical, 300-3300 MC Type "N" Feed...$12.50
"E" or "H" PLANE BENDS, 90 Deg. less flanges ...$7.50

7/8" RIGID COAX—3/8" I. C.

ROTARY JOINT, Stub-supported. UG 46/UG 45 fittings ...$27.50
10 CM STABILIZER Cavity, tunable, standard UG46/UP 45 fittings...$45.00
RG 44/U RIGID COAX, stub support, 5 ft. sections, with UG46/UG45 connectors...$12.50
RIGHT ANGLE BEND, with flexible coax output pick-up loop ...$8.00
SHORT RIGHT ANGLE BEND, with pressurizing nipple ...$3.00
RIGID COAX to flex coax connector...$3.50
RT ANGLES for above...$2.50
RT. ANGLE BEND 15" L. OA...$3.50
FLEXIBLE SECTION, 15 L. Male to female...$4.25
7/8" RIGID COAX. BULKHEAD FEED-THRU...$14.00

X BAND—1" x 1/2" W.G. 3 CM.

CROSS-GUIDE COUPLER

MAIN SECTION, 7" long with 90 deg. bend (E-Plane), 2 1/2" radius. Broadbanded coupling figure is 20 db. individually calibrated ...$17.50
1" x 1/2" waveguide in 5' lengths, UG 39 flange to UG40 cover ...per length $7.50
Rotating joints supplied either with or without deck mounting. With UG40 flanges...each, $17.50
Bulkhead Feed-thru Assembly...$15.00
Pressure Gauge Section 15 lb. gauge and press nipple ...$10.00
Pressure Gauge, 15 lbs...$2.50
Dual Oscillator, Mount. (Back to back) with crystal mount, tunable termination attenuating slugs...$18.50
TR-ATR Duplexer section for above...$8.50
723AB Mixer—Beacon dual Osc. Mnt. w/xtal holder ...$12.00
Waveguide Section 12" long choke to cover 45 deg. twist & 2 1/2" radius, 90 deg. bend...$4.50
Twist 90 deg. 5" choke to cover w/pres nipple...$6.50
Waveguide Section 2 1/2 ft. long silver plated with choke flange ...$5.75
Rotary joint choke to choke with deck mounting..$17.50
3 cm. mitered elbow "E" plane...$12.00
UG 39 Flanges...$ .85
90 degree elbows. "E" or "H" plane 2 1/2" radius..$12.50
45 degree twist...$8.00
APS-4 Under Belly Assembly, less tubes. Write for price.

1 1/4" x 5/8" WAVEGUIDE

CG 98B/APQ 13 12" Flex. Sect. 1 1/4" x 5/8" OD...$10.00
X Band Wave GD. 1 1/4" x 5/8" O.D. 1/16" wall aluminum ...per ft. 75¢
Slug Tuner Attenuator W.E. guide, Gold plated..$6.50
Bi-Directional Coupler, Type "N" Takeoff 25 db. coupling ...$27.95
Bi-Directional Coupler. UG-52. Takeoff 25 db. coupling ...$24.95
Waveguide-to-Type "N" Adapter. Broadband...$22.50

K BAND—1/2" x 1/4" W.G. 1.25CM.

APS-34 Rotating joint...$49.50
Right Angle Bend E or H Plane, specify combination of couplings desired...$12.00

MAGNETRONS

Tube	Tube	Tube
2J27	2J49	720BY
2J31	2J61	725-A
2J21	700	730-A
2J22	706	QK 62
2J26	2J62	QK 61
2J32	3J31	QK 60
2J37	5J30	2J56
2J38	718DY	2J32
2J39		

THERMISTORS VARISTORS

D167018	$1.50	D171812	$1.50
D167332	1.50	D172155	1.50
D167613	1.50	D167176	1.50
D166228	1.50	D168687	1.50
D164699	2.50	D167208E, D171858	1.50
D163903	1.95	308A, 27-B	1.50
D166792	2.15	D168403	2.15

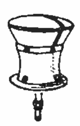
AMPEREX TUBES COMPLETE LINE

MAGNETRONS—THYRATRONS
SPECIAL PURPOSE
GEIGER-MULLER
AMATEUR — INDUSTRIAL
GERMANIUM DIODES
SEND FOR COMPLETE LISTING

TEST EQUIPMENT

- Signal Gen. RCA 710A, 370-560 MC......350.00
- Signal Gen. 20A Microvolter......175.00
- TS 10A Altimeter Test Set...... 32.50
- TS 16/AP Altimeter Test Set
- TS 36 Power Meter, 3CA1
- TS 47/APR Test Osc. 50-3000 MC......325.00
- TS 56/AP Slotted Line, 500 MC......325.00
- TS 127/UP Wavemeter, 300-700 MC...... 72.50
- TS 69/AP Wavemeter, 340-1000 MC...... 72.50
- TS 70/AP Pwr. Meter, 200-800 MC
- TS 110/AP Echo Box, 2400-2700 MC

MICROWAVE ANTENNA EQUIPMENT



AT49A/APR—Broadband Conical, 300-3300 MC. Type N Feed. (AS SHOWN) $12.50
AS-31/APN-7: 10 cm Polyrod in Lucite Ball. Type N Fitting Coax Feed..$22.50
Relay System Parabolic reflectors approx. range 2000 to 6000 Mc. Dimensions 4 1/2" x 3". New...$100.00
Dipole for above...$12.00
TDY "JAM" Radar rotating antenna, 10 cm. 30 deg. beam, 115 V AC drive. New...$150.00
Parabolic Peel. Radiation pattern approx. 25 deg. in horizontal 33 deg. in vertical planes...$35.00
Cone Antenna. AS 125 APR. 1000-3200 mc. Stub supported with type "N" connector...$14.50

30' SIGNAL CORPS RADIO MASTS

Complete set for erection of a full flat top antenna. Of rugged plywold construction telescoping into 3 ten-foot sections for easy stowage and transportation. A perfect set-up for getting out. Supplied complete: 2 complete masts, hardware, shipping crate. Shipping wt. approx 300 lbs. Sig. Corps No. 2A289-223-A. New ...$49.50 per set
AS14A/AP, 10 CM pick up dipole assy, complete w/length of coax and "N" connectors...$3.50
AS46A/APG-4 Yagi Antenna, 5 element array...$22.50
30" Parabolic Reflector Spun Aluminum dish...$4.85

10 CM GUN-SIGHT ANTENNA

SPHERICAL RADOME HOUSES DRIVE MOTOR, DISH, FEED AND GUNMOUNT. TOTAL DIAMETER: APPROX. 15 INCHES. DISH: 13" DIAM. FEED: DIPOLE AND DISK VERTEX. SCAN: CONICAL AT 2400 RPM. BEAMWIDTH: 25°-30°. ENTIRE UNIT MAY BE PRESSURIZED UP TO 15 LBS/IN., AND ENERGY MAY BE FED BY ANY FLEXIBLE COAX CABLE. COMPLETE UNIT WITH DRIVE-MOTOR AND RADOME...$325.00

PULSE TRANSFORMERS

G.E. # K2731 Repetition Rate: 635 PPS. Pri. Imp: 50 Ohms, Sec. Imp: 450 Ohms, Pulse Width: 1 Microsec. Pri. Input: 9.5 KV PK. Sec. Output: 28KV PK. Peak Output: 800 KW Biflar 2.75 Amp. $65.00
U-10198 Pri: 4-5KV, 97A Pk Sec: 18KV, 26A, PRR-350-500 Cy. Duration 1.3 usec...$42.50
D-166173: Video. Ratio = 50:900 Ohms 10KC—2MC ...$12.50
G.E.K.-2745 ...$39.50
G.E.K.-2744-A. 11.5 KV High voltage. 3.2 KV Low voltage @ 200 KW oper. (270 KW max.) 1 microsec. or 1 microsec. @ 600 PPS...$39.50
W.E. D169271 Hi Volt input pulse Transformer..$27.50
G.E. K2450A. Will receive 13KV, 4 micro-second pulse on pri. secondary delivers 14KV. Peak power out 100 KW G.E...$34.50
G. E. K2748A. Pulse Input line to magnetron....$36.00
Ray UX 7896—Pulse Output Pri. 5v. sec. 41v....$7.50
Ray UX 8442—Pulse inversion—40v + 40v......$7.50
RAY UX7361...$5.00
PHILCO 352-7250, 352-7251, 352-7287
UTAH 9332, 9278, 9341.
RAYTHEON: UX8693, UX5986...$5 ea.
W.E.: D-166310, D-16638, KS 9800, KS9948

DELAY LINES

D-168184: 0.5 microsec. up to 2000 PPS 1800 ohm term ...$4.00
D-170499: 25 .50 .75 microsec. 8 KV 50 ohms imp. ...$16.50
D-165997: 1 1/4 microsec. ...$7.50
RCA 255686-502. 2.2μ sec. 1400 ohms...$2.00

PULSE NETWORKS

G.E. #6E3-5-2000-50P2T, 6KV "E" circuit, 3 sections .5 microsecond, 2000 PPS 50 ohms impedance...$6.50
15A—1-400-50: 15 KV, "A" CKT. 1 microsec. 400 PPS. 50 ohms imp....$37.50
G.E. #3E (3-84-810) (8-2-24-405) 50P4T: 3KV "E" CKT Dual Unit: Unit 1, 3 sections, 0.84 Microsec. 810 PPS. 50 ohms imp; Unit 2, 8 sections, 2.24 microsec. 405 PPS. 50 ohms imp. ...$6.50
7-5E3-1-200-67P. 7.5 KV. "E" Circuit. 1 microsec. 200 PPS. 67 ohms impedance 3 sections...$7.50
7.5E3-3-200-6FT. 7.5 KV. "E" Circuit, 3 microsec. 200 PPS. 6 ohms imp. 3 sections...$12.50
#755: 10KV. 2.2usec., 375 PPS. 50 ohms imp...$27.50
#754: 10KV. 0.85usec., 750 PPS. 50 ohms imp..$27.50

PULSE EQUIPMENT

H/I-Volt Pulse Bulkhead. Feed-thru. Fits UG-36 Connector—as shown ...$15.00
APQ-13 PULSE MODULATOR. Pulse Width .5 to 1.1 Micro Sec. Rep. rate 624 to 1348 Pps. Pk. Pwr out 35 KW Energy 0.018 Joules...$49.00
TPS-3 PULSE MODULATOR. Pk. power 50 amp. 24 KW (1200 KW pk); pulse rate 200 PPS. 1.5 microsec. pulse line impedance 50 ohms. Circuit series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New with all tubes ...$49.50

400 CYCLE TRANSFORMERS

(All Primaries 115V, 400 Cycles)

Stock	Ratings	Price
352-7039	640VCT @ 250MA, 6.3V/.9A, 6.3V/6A, 5V/6A	$5.49
702724	9800/8600 @ 32MA	8.95
12033	4540V/250MA	17.50
K59584	5000V/290MA, 5V/10A	22.50
52J652	13,500V/3.5MA	14.65
KS9607	734VCT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3V/0.9A, 6.3V/2.5A 6.3/.06A, 5V/CA	6.95
352-7070	2X2.5V/2.5A (2KV TEST) 6.3V/2.25A, 1200/1000/75 OV @ .005A	7.45
352-7196	1140V/1.25MA, 2.5V/1.75A, 2.5V/1.75A —5KV Test	3.95
352-7176	320VCT/50MA, 4.5V/3A, 6.3VCT/20A, 2X6.3VCT/6A	4.75
RA6400-1	2.5V/1.75A, 6.3V/2A—5KV Test	2.39
901692	13V/9A	2.49
901699-501	2.77V @ 4.25A	3.45
901698-501	900V/75MA, 100V/.04A	4.29
UX8855C	900VCT/.067A, 5V/3A	3.79
RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/80MA, 5V/3A, 6V/1.75A	4.25
352-7098	2500V/6MA, 300 VCT, 135MA	5.95
KS 9336	1100V/50MA TAPPED 625V 2.5V/5A	3.95
M-7474319	6.3V/2.7A, 6.3V/.66A, 6.3VCT/21A	4.25
KS 8984	27V/4.3A, 6.3/2.9A, 1.25V/.02A	2.95
52C080	526VCT/50MA, 6.3VCT/2A, 5VCT/2A	3.75
32332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
68G631	1150-0-1150V	2.75
80G198	6VCT/.00006 KVA	1.75
302433A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.5A, 2.5V/3.5A	4.85

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FROM A to Z POWELL SERVICE IS BEST

AN Connectors—over 2500 different types in stock. Write for new four page reduced price list. World's best service on AN connectors, Liberal Discount!

BATTERY—BA 210—6V dry cell dated Nov. 1951, orig. cases guar......$.49
BA35—same except 1½V..........$.44

COAXIAL Cable, new current manufacture

RG 5/U	$.13	RG 58/U	$.07
RG 6/U	.19	RG 59/U	.07
RG 8/U	.12	RG 62/U	.07
RG 11/U	.12	K 109	.09
RG 17/U	.60	K 110	.12

price is per foot. Add 25% for quantities less than 250 feet of type.

COAXIAL Connectors—stock delivery, C of C. NEW LOW PRICES.

No.	Price	No.	Price
UG 9/U	$1.11	UG 185/U	$.99
UG 12/U	.95	MX 195/U	.89
UG 18 B/U	1.08	UG 201/U	2.25
UG 19 B/U	1.59	J 201	4.50
UG 20 B/U	1.61	UG 203/U	.75
UG 21/U	.95	UG 206/U	1.45
UG 21A/U	1.76	UG 212A/	3.25
UG 21B/U	1.19	UG 213A/U	3.99
UG 21C/U	1.54	UG 215/U	3.85
UG 21D/U	1.42	UG 224/U	1.15
UG 22A/U	1.97	SO 239	.40
UG 22B/U	1.50	UG 242/U	4.27
UG 22C/U	1.40	UG 245/U	2.25
UG 23/U	1.20	UG 252/U	5.25
UG 23C/U	1.58	UG 254A/U	2.66
UG 23D/U	1.89	UG 255/U	1.98
UG 24U	.90	PL 258	.73
UG 25U	.90	PL 259	.47
UG 27U	1.30	PL 259A	.58
UG 27A/U	2.25	UG 260/U	.89
UG 27B/U	3.15	UG 261/U	1.10
UG 27C/U	3.75	UG 262/U	1.06
UG 28A/U	3.75	UG 271/U	7.55
UG 29/U	1.40	UG 273/U	1.49
UG 29B/U	1.65	PL 274	1.10
UG 30/U	2.50	UG 274/U	2.31
UG 57B/U	1.72	PL 275	2.10
UG 58A/U	1.12	UG 275/U	5.50
UG 58/U	.78	UG 276/U	9.00
UG 59A/U	2.15	UG 290/U	.90
UG 59/U	1.49	UG 291/U	1.05
UG 59B/U	2.45	UG 296/U	3.75
UG 60A/U	1.51	UG 306/U	2.75
UG 83/U	1.75	UG 309/U	3.29
UG 85/U	1.70	UG 333/U	4.90
UG 86/U	2.40	UG 335/U	3.95
UG 87/U	1.50	UG 342/U	2.95
UG 88/U	.90	UG 349/U	2.70
UG 88 B/U	1.09	UG 352A/U	6.40
UG 89/U	1.10	M 358	1.50
UG 90/U	1.13	M 359	.30
UG 91 A/U	2.11	UG 413/U	2.00
UG 92 A/U	2.74	UG 414/U	1.95
UG93 A/U	1.63	UG 421/U	2.86
UG 94 A/U	1.68	UG 422/U	2.86
UG 96 A/U	1.53	UG 423/U	5.40
UG 97 A/U	3.75	UG 483/U	3.49
UG 98 A/U	3.15	UG 495/U	6.40
UG 100A/U	3.36	UG 496/U	2.95
UG 101A/U	4.00	UG 535/U	1.98
UG 102/U	.84	UG 536/U	1.54
UG 103/U	.84	UG 564/U	2.40
UG 105/U	1.40	UG 565/U	2.61
UG 106/U	.15	UG 566/U	9.65
UG 107B/U	3.75	UG 567/U	5.02
UG 108A/U	3.25	UG 568/U	1.60
UG 109A/U	3.67	UG 569/U	1.95
UG 110/U	13.50	UG 570/U	1.85
UG 115/U	1.65	UG 571/U	3.11
CW 123A/U	.45	UG 573/U	2.72
UG 131/U	7.50	UG 625/U	1.05
UG 146/U	1.99	UG 631/U	3.85
UG 160A/U	2.20	MX913/U	.49
UG 166/U	32.50	1PC2250	.39
UG 167A/U	3.48	1PC2350	.39
UG 171/U	2.50	1PC9175	.39
UG 173/U	.29	1PC27000	2.49
UG 175/U	.14	1PC28000	2.49
UG 176/U	.14	MC-10	.39
UG 180A/U	5.95	MC-20	.46
UG 181A/U	5.65	MC-210	.53
UG 182A/U	5.65	MC-250	.53

DIFFERENTIAL, Gear 643268, 1 13/16" OD x 1 ¾" shaft w two ball bearings, our #658 ....$3.95
DIFFERENTIAL, Dual, 206832, probably part of a gun director unit, add four pieces of information and give sum. Only 1¼" O. D. by 3 ⅜" long. Cost about $200. New in overseas pack. ONLY $5.50

EZY-MOUNT—Breadboard chassis in stock with individual mounts for various components, Kit EM666....$19.95

FILTER, Line—D170738, 60 db att. 150 KC to 30 MC—Permalloy torridal coils herm sealed, tiny, rated 10 AMP. $2.95

GEAR DRIVE—5:1—Crowe 296 tiny planetary. ¼" to ¼" — reg. $6.00. Sale $2.90

HEADER—8 different color seals, Fusite, 267535, 1"x1"x5/16, for herm. sealed relays transformers, etc......$.22
Many others in stock, write for list.

INSULATORS—Pillar, ceramic glazed, tapped both ends.

Dia.	High	Tap	Price
1/4"	1/2"	6–32	$ .05
1/2"	1/2"	6–32	.05
3/8"	1/2"	6–32	.05
cone	9/16	6–32	.09
3/8"	5/8"	8–32	.05
3/8"	5/8"	6–32	.05
3/8"	1"	6–32	.07
1/2"	1 1/2"	8–32	.08

JOINT—Universal Aluminum ¼" bore 1 ⅛" overall length ....$.85

KNOBS—National and Eby in stock include new Eby S67 bar........$.08

LAMP—Black Light—4 W-T5 ½" dia. x 5 ⅝"—New ....$.35
NE-51 09
NE-2 09
AR-1 Argon 2½W std. base........ .25

MOTOR 1 RPM Synchron......$3.50
30 RPM Telechron—6 Watt....$4.30

NETWORK — DELAY, 1400 ohm. alum. can. 1 ⅜ x 1 ⅜ x 3 ⅝", 2.1 micro second #661 ....$.95

NON-LINEAR Coil-RET-D164820 tiny saturable reactor used in BC 604 Useful as harmonic generator, in DC amplifiers etc. Permally tape core only .0004 inches thick. Cost twice this............$2.90

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OIL FILLED Subminiature Vitamin Q Condensers.

Mfd.	Volt	Type	Price
.0033	600	*774-606A	$ .74
.0082	400	G191P82294TA	.89
.01	100	G191P10391	1.35
.01	200	G91P10392	1.44
.01	400	G88P10394	1.49
.01	600	G91P10396	1.49
.01	200	G191P10392TA	.89
.012	200	G191P12392TA	1.44
.015	200	G191P15392TA	1.19
.015	400	G191P15394TA	1.44
.022	100	G191P22391	1.65
.027	200	G191P27392TA	1.44
.033	400	G191P33394TA	1.44
.033	200	G191P33392TA	.98
.043	200	G191P43352TA	1.29
.056	200	G191P56392TA	1.44
.068	200	G191P68352TA	.89
.082	400	G91P82394	1.49
.1	400	G191P10494TA	1.59
.15	100	G91P15491T	.98
.15	200	G191P15492TA	1.19
.18	200	G191P18492TA	.98
.18	400	G191P18494TA	1.44
.22	100	G191P22491	1.49
.22	400	191P22404	1.49
.24	100	G191P24451TA	1.19
.27	100	G191P27491	1.59
.27	200	G191P27492TA	1.19
.33	100	G191P33491TA	1.95
.33	200	G191P33492TA	1.19
.39	200	G191P39492TA	1.19
.39	400	G191P39494TA	1.59
.47	100	G191P47491	1.75
.56	200	G191P56492TA	1.80
.68	200	G91P68492	2.10
.82	400	G191P82494TA	2.10
1.0	400	G191P10594TA	2.35
1.0	200	*767-236	2.20
1.0	400	*767-78	1.80

* Not Vitamin Q but similar.

These ultra high quality condensers are made by leading manufacturers. Features:

- 20,000 megohms or more
- Subminiature
- Glass seal terminals
- As high as $7.70 regular

POTENTIOMETERS—50 & 100 watt.

Ohms	Watt	Cat. #	Price
12	50	WL	$1.41
500	50	D	1.41
500	100	O-K	2.19
800	50	O-J	1.48

POTENTIOMETERS, Wire-wound 2 or excellent wirewound controls are made by the leading manufacturers and are in original cartons. Priced ridiculously low, only 20% of list. Satisfaction guaranteed! Substantial stock, up to 7000 pieces of a size.

Ohm	Bush	Shaft	Cat. #	Price
2	5/8s	1/8sd	O-H	$1.04
3–3	1/2	1/2	I	1.04
15	3/8	1"	C	1.04
15	3/8	1 1/8	D-245	1.04
15	1/2	1 1/4	I	1.04
20	1/2	1/2F	D-245	1.04
25	3/8	1	D-245	1.04
30	3/8	1	C	1.04
50	3/8	1 1/8	D-245	1.04
50	5/8	1/8sd	O-H	1.04
75	1/2	7/16	O-H	1.04
100	3/8	1	D-245	1.04
350	3/8	1 1/8	O-H	1.04
500	3/8	11/16	D-245	1.04
5K	1/2	1/8sd	I	1.24
5K	3/8	7/8f	D-245	1.24
20K	1/2	1/8sd	D-245	1.40

POTENTIOMETERS, type JLU; 2K, 10K, 50K, 100K, 2.5 Megohms...$1.20

POTENTIOMETERS, Wire-wound 2 or 4 watt: 10, 20, 50, 100, 200, 250, 350, 400, 500, 750, 1K, 2K, 2.5K, 3.5K, 5K, 7.5K, 15K, 20K.....................$.45
50K, E50MP $1.10

POTENTIOMETERS, Precision WW. 1.5K—$2.25, 2K—$2.25, 5K—$2.25, 20K—$1.70.

QUICK honest answers to your inquiries.

RELAY—telephone style, 3600 ohm 5 milliampere, 2 micro switch, DPDT 10 A contacts. A 28000 Bargain..$6.45
RELAY, BJ, DPDT, 24VDC, orig. ctn, regular $4.65. Sale priced...........$1.65
RELAY, SD 1CXX100, 115vac. three pole norm. open, 6A................$3.50
RELAY, SD 1XBX103, 115vac. DPDT $3.50
RESISTORS—Deposited carbon ½ watt, very high short & long term stability, low noise, radial leads: 2.2K, 10K, 47K, 100K, 470K, 1Meg, 2.2Meg.........$.15
RESISTORS—Composition BTS ½ W. 10% All RMA values, many other types. BTS.............3¢ ea., 100 for $2.50

SELENIUM Rectifiers Stock delivery of Sarkes high quality units.

VDC	VAC	AMP	Cat. #	Price
10	13	2	D10	$3.05
10	13	4	D11	3.95
10	13	6	D12	4.50
10	13	12	D14	5.60
10	13	15	D15	8.90
10	13	22.5	D16	10.10
20	26	2	D17	5.55
20	26	4	D18	7.45
20	26	6	D19	8.00
20	26	12	D21	10.25
20	26	22.5	D23	18.20
40	52	2	D24	10.10
40	52	6	D26	14.65
40	52	12	D28	19.05
40	52	22.5	D30	34.30
60	78	2	D31	13.50
100	130	.5	D38	9.85
120	156	2	D47	23.95
120	156	4	D48	36.00

10VDC—full wave, others full wave bridge.

RECTIFIERS—low current bridge

VDC	VAC	MA	Cat. #	Price
20	26	10	A200	$ .70
20	26	50	A201	1.05
100	130	10	A204	2.00
300	390	10	A210	6.00

RECTIFIERS—high voltage half wave.

VDC	Peak Inverse	MA	Cat. #	Price
130	370	5	A221	$ .80
130	370	25	A222	.80
260	740	5	A224	1.50
260	740	25	A225	1.60
650	1850	5	A227	3.60
650	1850	25	A228	4.20
975	2760	5	A230	5.10
1300	3700	5	A232	10.90
1300	3700	5	A233	6.60
1300	3700	25	A234	8.20
1625	4600	5	A236	8.10
1625	4600	25	A237	10.20
1950	5515	5	A239	9.60
2275	6430	5	A242	11.10
2275	6430	25	A243	14.00

RECTIFIERS—small 130 VAC

35 Ma.	$ .54	250 Ma.	$1.42
65 Ma.	.66	300 Ma.	1.60
100 Ma.	.92	450 Ma.	2.13

TIME DELAY Relay—adjustable from 1-60 seconds, 1/16" spaced one second marks for accurate, easy setting. Contacts SPDT, 1000 W; 115 VAC oper. 2 second spring recycle when deenergized. Fully enclosed in attractive black bakelite 3" round case. Brand new. Reg. price $26.46. Model TD-1M.$11.95

TRANSFORMER—400 cycle, hermetically sealed, 117V in; 596 Vct. @ 157MA, 5V @ 2A, 6.3V @ 0.6A, 6.3V @ 4.5A, 6.3V @ 4.5A out 3 ¾ x 4 ⅝ x 5". Brand New. ONLY..............$4.95

TRANSFORMERS, Pulse — 901756-501 RCA. 15/16 dia. x 1⅝" high, 165 turns on primary, 330 turns secondary, core is ¼" stack of .007 inch "F" laminations. Magnetic Metals Co. Audio 58, used to form 7.3 microsecond pulses......$1.50
901756-502, RCA, same core & can as 501, 100 to 200 turns, used to form 2.2 microsecond pulses $1.50

UL Approved Cord Set, 6 ft., fresh. D709 Brown ....$.23

VIBRATOR Power Supply, PE204A Radiart, 12VDC in, supply plate and screen volts for telephone repeater EE99 plus TY14, 6" x 7" x 5¼" with cable & 18 contact Jones, spare VS-1 6 pin vibrator & schematic in case, orig. overseas pack, two to the case. Checked output, not simultaneously: 190V-0MA, 92V-40MA, 150V 16MA, 130V-42MA, 125V-28MA (ahead of filter) $5.95

WIRE, Non-Strip Rex, CJR red or blue #26-19/38 500 ft. spools. This tiny wire can be soldered without stripping, excellent for that intricate job. Reg. $16.50 per m., 500 ft..........$2.75

XTRA Care taken to make sure all shipments have the right time to the right place with the right packing.

YOU will be pleased with our stock and service on these regular lines too: Akro-Mils, Alpha, Automatic, Cannon, Carling, Chicago Transformer, Crest Labs., Eby, Electro Mfg's., Federal, Grayhill, Greenlee, JCT, Kings, Labelon, National, Sarkes, Switchcraft, Tuck, USECO, Vector.

ZENITH—Remote Control unit 115 VAC input 4½ RPM output either direction with control cable, switches, etc. Ideal for moving "hot" items in measurements labs. A dozen were used in a psycho lab for remote control of potentiometers. Plenty of torque. New in orig. ctn. Few left! HURRY! .$8.95

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UG CONNECTORS

KINGS — IPC — AMPHENOL — DIAMOND

THE MOST COMPLETE INVENTORY OF UG CONNECTORS AT PRICES THAT ARE UNBEATABLE

ALL CONNECTORS IN FULL COMPLIANCE WITH JAN SPECIFICATIONS

Type	Price
UG 7/AP	$6.75
UG 8/AP	6.25
UG 9/U	1.25
UG 10/U	1.95
UG 11/U	1.80
UG 12/U	1.25
UG 13/U	2.25
UG 14/U	1.75
UG 15/U	1.25
UG 16/U	2.25
UG 17/U	2.25
UG 18/U	1.60
UG 18A/U	1.65
UG 18B/U	1.15
UG 19/U	1.60
UG 19A/U	1.75
UG 19B/U	1.80
UG 20/U	1.90
UG 20A/U	1.95
UG 20B/U	1.85
UG 21/U	.95
UG 21A/U	1.60
UG 21B/U	1.00
UG 21C/U	1.05
UG 21D/U	1.50
UG 22/U	1.35
UG 22A/U	1.60
UG 22B/U	1.20
UG 22C/U	1.20
UG 22D/U	1.25
UG 23/U	1.25
UG 23A/U	1.60
UG 23B/U	1.50
UG 23C/U	1.10
UG 23D/U	2.10
UG 27A/U	2.50
UG 27B/U	2.95
UG 27C/U	3.95
UG 28A/U	2.95
UG 28B/U	3.95
UG 29/U	.95
UG 29A/U	1.95
UG 29B/U	1.75
UG 30/U	2.35
UG 30C/U	11.25
UG 32/U	19.00
UG 33/U	19.00
UG 34/U	6.00
UG 35A/U	18.00
UG 36/U	12.50
UG 37A/U	19.00
UG 38A/U	21.00
UG 39/U	1.50
UG 40/U	1.65
UG 45/U	3.75
UG 46/U	3.75
UG 49/U	19.00
UG 50/U	19.00
UG 57/U	2.00
UG 57B/U	1.85
UG 58/U	.70
UG 58A/U	.90
UG 59/U	2.25
UG 59A/U	1.90
UG 59B/U	2.60
UG 60/U	2.25
UG 60A/U	1.65
UG 61/U	2.35
UG 61A/U	2.25
UG 83/U	1.90
UG 85/U	1.75
UG 86/U	2.25
UG 87/U	1.55
UG 88/U	.95

Type	Price
UG 88B/U	1.10
UG 89/U	1.25
UG 90/U	1.25
UG 91/U	1.60
UG 91A/U	1.40
UG 92/U	1.40
UG 92A/U	1.75
UG 93/U	1.60
UG 93A/U	1.75
UG 94/U	1.60
UG 94A/U	1.35
UG 95/U	1.40
UG 95A/U	1.50
UG 96/U	1.60
UG 96A/U	1.70
UG 97A/U	3.75
UG 98/U	2.25
UG 98A/U	2.25
UG 100/U	1.75
UG 100A/U	3.25
UG 101/U	4.75
UG 101A/U	4.00
UG 107A/U	3.25
UG 107B/U	2.75
UG 108A/U	3.00
UG 109A/U	2.50
UG 110/U	12.00
UG 114/U	1.90
UG 115/U	1.85
UG 119U/P	7.50
CW 123A/U	.45
UG 131/U	5.00
UG 146/U	2.70
UG 148A/U	7.00
UG 149A/U	5.00
UG 154/U	7.50
CW 155/U	.45
UG 155/U	7.00
UG 156/U	5.50
UG 157/U	5.50
UG 158/U	45.00
CW 159/U	1.95
UG 159A/U	2.00
UG 160A/U	2.00
UG 160B/U	2.00
UG 166/U	45.00
UG 167/U	3.75
UG 167A/U	4.25
UG 173/U	.36
UG 174/U	19.00
UG 175/U	.12
UG 176/U	.12
UG 180A/U	6.50
UG 181A/U	6.50
UG 182A/U	6.50
UG 185/U	1.10
UG 188/U	1.20
MX 195/U	.95
UG 197/U	4.25
UG 201/U	1.95
UG 202/U	3.50
UG 203/U	.65
UG 204A/U	2.95
UG 206/U	2.00
UG 207/U	22.50
UG 208/U	22.50
UG 212A/U	2.75
UG 213A/U	3.75
UG 215/U	3.95
UG 216/U	12.00
UG 217/U	5.25
UG 218/U	9.75

Type	Price
UG 219/U	5.25
UG 220/U	10.00
UG 222/U	30.00
UG 223/U	5.00
UG 224/U	1.20
UG 231/U	2.50
UG 233/U	17.00
UG 234/U	17.00
UG 235/U	34.00
UG 236/U	9.50
UG 237/U	22.50
UG 240/U	12.00
UG 241/U	2.75
UG 242/U	3.50
UG 243/U	3.95
UG 244/U	3.30
UG 245/U	2.95
UG 246/U	2.50
UG 249/U	17.00
UG 250/U	17.00
UG 251/U	17.00
UG 252/U	5.95
UG 253A/U	6.00
UG 254A/U	2.35
UG 255/U	2.20
UG 256/U	14.50
UG 257/U	14.50
UG 259/U	5.25
UG 260/U	.90
UG 260A/U	1.10
UG 261/U	1.10
UG 262/U	1.20
UG 266/U	1.25
UG 269/U	3.25
UG 270/U	8.50
UG 271/U	8.50
UG 272/U	20.00
UG 273/U	1.75
UG 274/U	2.75
UG 275/U	5.95
UG 276/U	5.95
UG 279A/U	5.50
UG 286/U	4.25
UG 287/U	6.95
UG 290/U	.95
UG 291/U	.95
UG 294/U	1.95
UG 299/U	6.00
UG 306/U	2.75
UG 309/U	2.75
UG 332/U	3.50
UG 333/U	5.25
UG 334/U	6.50
UG 335/U	3.25
UG 347/U	2.50
UG 348/U	1.50
UG 349/U	2.95
UG 350/U	24.00
UG 352/U	6.75
UG 352A/U	7.50
UG 361/U	1.95
UG 400/U	24.00
UG 402/U	24.00
MT 412	.90
UG 413/U	30.00
UG 414/U	2.25
UG 419/U	1.95
UG 421/U	3.10
UG 422/U	3.10
UG 423/U	3.10
UG 447/U	1.50
UG 478/U	50.00
UG 479/U	30.00

Type	Price
UG 482/U	30.00
UG 483/U	3.75
UG 484/U	5.50
UG 486/U	2.10
UG 487/U	6.25
UG 491/U	1.95
UG 492/U	5.25
UG 492A/U	11.25
UG 493/U	6.75
UG 494/U	4.75
UG 495/U	6.75
UG 496/U	2.75
UG 499/U	2.25
UG 503/U	30.00
MX 504	.65
UG 504/U	30.00
UG 505/U	30.00
UG 506/U	30.00
UG 507/U	30.00
UG 516A/U	2.70
UG 519/U	24.00
UG 526/U	3.75
UG 530/U	4.25
UG 531/U	4.95
UG 532/U	5.75
UG 533/U	3.50
UG 536/U	1.95
MX 539/U	.75
UG 541/U	3.75
MX 543/U	.75
MX 554/U	2.00
UG 557/U	4.95
MX 564/U	.65
UG 564/U	2.75
UG 565/U	2.95
UG 566/U	7.95
UG 567/U	3.95
UG 568/U	1.95
UG 569/U	2.25
UG 570/U	2.50
UG 571/U	3.50
UG 573/U	3.50
UG 586/U	5.00
UG 589/U	1.25
UG 593/U	1.95
UG 602/U	3.00
UG 603/U	3.00
UG 625/U	1.45
UG 626/U	3.95
UG 627/U	4.50
UG 628/U	4.50
UG 629/U	2.95
UG 631/U	4.50
UG 632/U	4.50
UG 634/U	4.50
UG 635/U	4.50
UG 636/U	4.50
UG 642/U	4.95
UG 643/U	4.50
UG 701/U	12.00
UG 702/U	8.95
UG 703/U	8.95
UG 704/U	12.00
UG 705/U	12.00
UG 706/U	8.95
UG 707/U	14.00
UG 708/U	14.00
UG 709/U	18.95
UG 710/U	18.95
UG 711/U	18.95
MX 913/U	.65
UG 923/U	2.75
UG 931/U	3.00
UG 932/U	3.00

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Leon May

R.G. COAXIAL CABLES By FEDERAL

Type	Price per 1000 ft.	Type	Price per 1000 ft.
RG 5/U	$130.00	RG 34/U	$250.00
RG 5B/U	275.00	RG 35/U	850.00
RG 6/U	175.00	RG 39/U	180.00
RG 7/U	60.00	RG 41/U	350.00
RG 8/U	95.00	RG 42/U	210.00
RG 9/U	175.00	RG 54/U	50.00
RG 9A/U	225.00	RG 54A/U	60.00
RG 9B/U	375.00	RG 55/U	100.00
RG 10/U	200.00	RG 57/U	125.00
RG 11/U	95.00	RG 57A/U	400.00
RG 11A/U	160.00	RG 58/U	60.00
RG 12/U	190.00	RG 58A/U	65.00
RG 13/U	200.00	RG 58C/U	75.00
RG 13A/U	250.00	RG 59/U	55.00
RG 14/U	290.00	RG 59A/U	95.00
RG 14A/U	350.00	RG 62/U	65.00
RG 15/U	300.00	RG 63/U	120.00
RG 17/U	500.00	RG 63B/U	200.00
RG 17A/U	700.00	RG 65/U	750.00
RG 18/U	650.00	RG 71/U	120.00
RG 19/U	850.00	RG 74/U	350.00
RG 19A/U	1250.00	RG 74A/U	475.00
RG 20/U	1100.00	RG 77/U	80.00
RG 21/U	220.00	RG 78/U	80.00
RG 22/U	150.00	RG 79/U	220.00
RG 22A/U	260.00	RG 83/U	220.00
RG 22B/U	320.00	RG 87A/U	2990.00
RG 23/U	500.00	RG 89/U	360.00
RG 23A/U	600.00	RG 108/U	90.00
RG 24/U	275.00	RG 111/U	390.00
RG 25/U	400.00	RG 114/U	170.00
RG 26/U	400.00	RG 122/U	80.00
RG 27/U	400.00	RG 125/U	300.00
RG 28/U	600.00	RG 130/U	360.00
RG 29/U	30.00	RG 131/U	550.00

"UHF" COAXIAL CABLE CONNECTORS

No.	Jan No.	Description	1 to 99	100 to 999	1000 or more
83-1R	SO 239	RECEPTACLE	$.40	$.38	$.36
83-1SP	PL 259	PLUG	.50	.48	.45
83-168	UG 176/U	ADAPTER	.12	.11	.10
83-185	UG 175/U	ADAPTER	.12	.11	.10
83-1SPN	PL 259A	PLUG	.60	.55	.50
83-776	UG 203/U	PLUG	.65	.60	.55
83-1RTY		RECEPTACLE	.75	.70	.65
83-1H	UG 106/U	HOOD	.15	.14	.12
83-1HP		HOOD	.20	.18	.16
83-765	UG 177/U	HOOD	.24	.22	.20
83-1AC		CAP & CHAIN	.50	.48	.45
83-1BC		CAP & CHAIN	.35	.31	.30
83-1T	M 358	T CONNECTOR	1.50	1.25	1.15
83-1AP	M 359	ADAPTER	.35	.30	.25
83-1AP	M 359A	ADAPTER	.80	.75	.65
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	.80	.75	.70
83-22R	UG 103/U	RECEPTACLE	.80	.75	.70
83-22AP	UG 104/U	ADAPTER	1.25	1.15	1.00
83-22J	UG 105/U	JUNCTION	1.50	1.40	1.30
83-22T	UG 196/U	T CONNECTOR	1.65	1.50	1.40
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

TIME ELECTRONIC SALES

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PHOTOGRAPHIC	ELECTRONIC	AIRCRAFT
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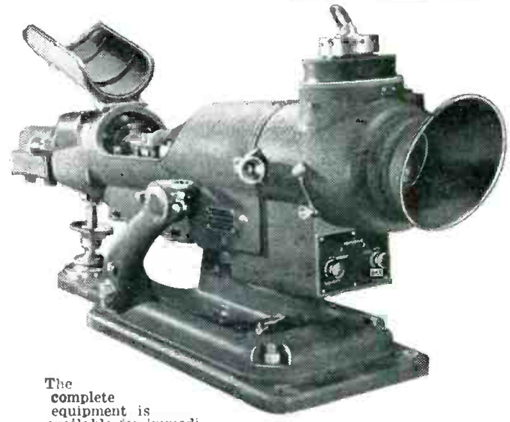
SCR-291
Direction Finding Equipment

A semi-portable radio direction finder using U-Adcock type antenna system for ground station operation. Instantaneous visual bearing indications are given on the fact of a 5" cathode ray tube with an illuminated 360 degree azimuth scale projected in the same plane. The indicator instrument is equipped with a motor driven goniometer and bearings may be read directly without any mental calculation.

An extremely efficient unit for the location of gun installations; radio stations and portable transmitting equipment. By the use of a dual installation and placing the units in diverse locations, the signal is received on the two separate indicators and the exact point of convergence can be readily and accurately calculated.

Illustrated herewith are the radio receiving and control equipment as well as the bearing indicator with goniometer.



The complete equipment is available for immediate delivery and includes Racks, Control panel, Telephone panel, Bearing indicator with goniometer. Receiver, Junction boxes, Phase inverters, Antennaes, Target transmitter, Connecting cables, Power cords, Transmission lines, and Gasoline driven Motor Generator.

Although the complete system contains a considerable amount of equipment, it is so designed to be easily dismantled and packed so that no unit weighs in excess of 500 pounds with the exception of the motor generators.

Frequency—1.5 to 30 mcs.
Tube Complement—2 RF and 2 IF Stages.
Power—115 Volt 60 Cycle—Single Phase.

AIRBORNE COMMUNICATION EQUIPMENT

RT18/ARC1 Trans/ceiver 10 & 20 Channel
AN/ARC3 Trans/ceiver
SCR 718C Absolute Dadar Altimeter
AN/ARNS ILS 3 & 6 Channel
RC-103 ILS
T47A/ART13 Transmitter
BC348 Superhet. Receiver
R5/ARN7 Radio Compass
SCR522 Trans/ceiver
RTA 1B Trans/ceiver
MN62A Radio Compass
CRTS3 Dual Channel Emergency Transmitter

LOOP ANTENNAS

MN24C	LP21A
MN20E	LP21LM
AT4/ARN1	LP21AM

BORESIGHT KITS

- To boresight free and fixed .30-Cal., .50-Cal., 20 mm. guns.
- For boresighting from beech or muzzle.
- Includes muzzle and breech sights, adapters, extension and right angle tubes.
- For precise optical alignment and laboratory use.

MARK I—Bell & Howell. TYPE J-1—Bell & Howell. TYPE J2—American Scientific. AN-I—Bell & Howell. For aligning optical axis of camera and gun sight on 16mm. GSAP Camera. MARK II—Model O—Western Union. Electrically operated using Type 2C light source. An excellent laboratory instrument and precision optical collimator.

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For photographic recording of oscillographs. For automatic developing of oscillograph paper.

ST. GEORGE RECORDING CAMERA—Originally designed for use with APQ-7 radar. An electrically operated 35mm automatic recording camera complete with control panels.

DEVELOPING OUTFITS—The following are electrically operated and completely automatic. They include geared motor drives, three stainless steel tanks and developing reels. Excellent for developing either film or paper.

Type B-5—9½" x 200'	Model K—7" x 75'
Type B-4—9½" x 200'	Type K-20—5½" x 50'

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Aircraft and Communications Inverters

MG-149F Inverter—Holtzer Cabot
Input: 28V DC—36 Amp.
Output: 26V 400 Cycle—500 V. Amp.—Single Phase
115 V 400 Cycle—750 V. Amp.—Single Phase **$65.00**

MG-149H Inverter—Holtzer Cabot
Input: 28V—OC—44 Amp.
Output: 26V—400 cycle—250 V. Amp.—Single Phase
115V400 Cycle 500 V. Amp.—Single Phase **$145.00**

MG-153F Inverter—Holtzer Cabot
Input: 28V—DC—52 Amp.
Output: 26V—400 Cycle—250 V. Amp.—Single Phase
115V—400 Cycle—750 V. Amp.—Three Phase **$125.00**

94-32270A Inverter—Leland #10285
Input: 27V—DC—60 Amp.
Output: 26V—400 cycle 50 V. Amp. Single Phase
115V—400 cycle 750 V. Amp.—Three Phase **$90.00**

PU-7 Inverter—Wincharger
Input: 28V OC—160 Amp.
Output: 115V—400 cycle—2500 V. Amp.—Single Phase **$100.00**

PU-16 Inverter—Wincharger
Input: 28V DC—60 Amp.
Output: 115V—400 cycle—6.5 Amp.—Single Phase **$90.00**

10563 Inverter—Leland
Input: 28½V OC—12 Amp.
Output: 115V—400 cycle—115 V Amp.—Three Phase **$75.00**

PE-206 Inverter—Leland
Input: 28V DC—38 Amp.
Output: 500V—800 cycle—500 V. Amp.—Single Phase
80V—800 cycle—500 V. Amp.—Single Phase **$40.00**

PE-218 Inverter—Leland—Wincharger—Gen. Electric
Input: 28V DC—92 Amp.
Output: 115V—380/500 cycle—1500 V Amp.—Single Phase **$40.00**

778-B Inverter—Bendix
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Output: 26V 400 cycle—60 V. Amp.—Single Phase
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2J26	$15	2K25	$20
2J27	15	2K48	100
2J30	100	3C22	70
2J31	40	4C22	25
2J32	30	4J31	75
2J33	30	4J50	75
2J34	40	4J52	185
2J48	35	700C	15
2J55	75	700D	15
2J56	125	706FY	25
2J61	30	723AB	15
2J62	35	725A	7
851	$45		

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AN/ARC12
More than one . . . 10 channel, crystal controlled, 225-350 Mcs., 24 V., D.C. **$1450**

Semler has one of the most complete and extensive stocks of Electronic Test Equipment. What are your requirements?

One only . . . Just released!
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1750 Channel, manufactured by Collins, crystal controlled, 225-400Mcs., 24 V., D.C. **$2500**
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FT243

Prong centers ½", Prong dia. 3/32"

Price $1.15 ea. (25 for $25.00)

FROM	TO	FROM	TO	FROM	TO
1915	1995	6100	6173.3	7906	7968
2030	2065	6225		8000	
2175	2155	6250		8025	
2300		6275		8050	
2320	2390		6292	8100	8175
2420	2490	6300	6375	9206	8275
2604		6400	6498	8300	8375
2605		6500		8385	
3105	KC	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	4190	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	5897.5	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		16585.55	
6175		7925		17170	

CR 1A/AR or FT241

Prong spacing ½", Prong dia. ⅛"

Price 79¢ ea. 12 for $9.00

FROM (Frequencies IN KC)	TO	FROM (Frequencies in KC)	TO
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2853		7625	
3988		7650	
4188		7738	
4285		7740	
4300	4374	7750	
4788		7760	
5020	5090	7770	
5100		7775	
5120	5180	7778	
5200	5295	7780	
5250		7790	
5300	5396	7800	
5410		7810	
5470		7825	
5500		7830	
5468		7850	
5470	5780	7851	7880
5810		7900	
5891		7910	
5910		7925	
5923	5960	7930	
6011	6080	7940	
6130	6195	7950	
6203	6275	7970	
6270		7975	
6300	6375	7990	
6370		8002	
6400	6499		8010
6490		8007	
6500	6590	8012	
6600	6685		8092
6744		8205	8298
6815	6877	8308	
6905	6980	8300	8370
7270		8407	
7330		8412	
7460		8405	8490
7500		8506	8561
7540		8645	
7541.6		8630	8650
7560		8985	
7600		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
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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)

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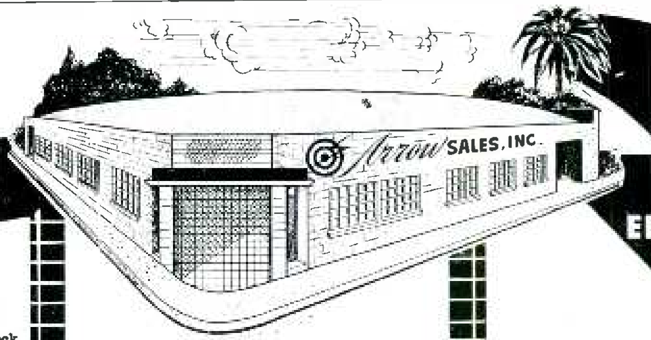

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Remit in full or 20% deposit on C.O.D. orders. Rated Firms send P.O. Order.

Minimum order $5.00 F.O.B. N.Y.C.

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Phone Barclay 7-5839-5840

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"SEARCHLIGHT"
First

TRANS. MICA CONDS.

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.000024	2500	.19	.0025	1200	.42
.00003	2000	.75	.003	6000	5.95
.000047	2500	.21	.0035	2500	.55
.00005	2500	.29	.004	2500	.65
.00008	1200	.21	.0043	2500	.79
.00009	3000	.75	.0045	600	.24
.0001	600	.22	.005	1200	.43
.0001	1200	.32	.006	600	.29
.0001	3000	.85	.006	1200	.45
.0001	5000	1.95	.01	600	.40
.00015	5000	1.95	.01	1200	.69
.0002	15KV	Quote	.01	15KV	Quoted
.00025	1200	.35	.015	2500	.95
.00025	5000	2.05	.0125	6000	Quote
.00027	2500	.35	.02	600	.27
.001	600	.23	.02	600	.39
.001	1200	.32	.02	1200	.85
.001	2500	.48	.02	2000	1.25
.001	4500	1.45	.03	600	.49
.001	8000	3.95	.033	600	.59
.0015	5000	2.25			
.002	1200	.40			
.002	2500	.50			
.0024	5000	2.35			

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 & 10,000 MMfd.

PRICE SCHEDULE

5 to 750 mmfd 4c
1000 to 1500 mmfd 6c
2000 to 5100 mmfd 10c
9100 to 10000 mmfd 26c

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 8c
1000 to 1700 mmfd 14c
100 to 800 mmfd 9c
2500 mmfd 16c

Special S. Mica Kit—100 @ $6.50

CHOKES

5 Hen	2 amps	14 Hen	.13 amps
2.6 Hen	.80 amps	15 Hen	.50 amps
7 Hen	.67 amps	Thord'n T60650	
8 Hen	.52 amps	Thord'n T19C45	
12 Hen	.10 amps	Specially Priced	

CERAMICON CONDS.

10, 56 & 100 mmfd @ .... .05
1000 to 5000 mmfd @ .... .06
.01 400 V

MICRO SWITCH

WLR-31—SPST-N.C. .... $ .29
Y23 RDT—SPST-N.C. .... .39
Many others specially priced

WANTED
Condensers of all types in any quantity. Also other standard components. Top prices.

CONDENSERS

MICRO & TOG. SWS. – RELAYS – "J" POTS

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

JAN APPROVED

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	1.29	3-3	150V	.35
.1	3000V	1.75	3-3-3	400V	.75
.1	7500V	1.75	3.75	1000V	1.59
.1	7500V	4.24	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
.1-	20KV	19.50	4	2000V	4.25
.15-.15	8000V	1.95	4	3000V	7.95
.2	10KV	10.95	4-4-4	600V	2.40
.25	2000V	1.25	5	330VAC	1.75
.25	3000V	2.15	5	600	1.35
.25	6000V	1.75	5	600V	2.49
.25	18KV	15.95	5	1500V	2.89
.25	20KV	19.95	5-1	400V	.89
.4	10KV	12.95	6	600V	1.45
.5	1500V	1.02	6	330VAC	2.49
.5	2000V	1.39	6	1000V	2.49
.5	3000V	2.69	6	1500V	3.25
.5	25KV	Quote	6	2000V	3.95
.5-1	2000V	.89	7	600V	1.45
.5-.5	600V	.69	7	800V	1.90
1	400V	.45	7	1000V	2.49
1	500V	.59	8	500V	1.35
1	1000V	.69	8	600V	1.75-2.15
1	1500V	1.35	8	660VAC	4.25
1	2000V	1.95	8	1000V	3.20
1	2500V	2.25	8	1500V	4.25
1	3000V	3.50	8	2000V	4.95
1	6KV	7.50	8 8	600V	1.75
1	5000V	4.99	10	600V	2.85
1	10KV	Quote	10	1000V	4.55
1	15KV	Quote	10	6000V	Quote
1	16KV	Quote	12	600V	2.40
1	25KV	Quote	12	1000V	4.95
1-1	7500V	Quote	14	1000V	5.25
2	600V	.59-.79	15	1000V	5.25
2 TLAD	600V	.80	17	25V	.69
2	100V	.85	24	1500V	3.50
2 TLA	1000V	1.29			

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. O
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 qus. disc. you may combine types.

OTHER AIRCRAFT TYPES

CH#	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.
8011K-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	24 GE			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

TYPE "AB" POTS $.95

OHMS	Shaft	OHMS	Shaft
50	1/8 S	3000	1/8 LS
60	1/8 LS	6000	1/4
150	1/4 S	5000	1/8 LS & 3/8
300	3/8 S	10000	3/8 & 1 1/7
500	3/8 & 1/8 S	10000	5/16
1000	1/8 S	15000	1/8 S
1500	1/4 S	20000	1 1/4 & 1/8 LS
2000	1/8 LS & 3/8 S	25000	3/8 & 1/8 S
2500	1/8 S	3000	1/8 S

— TRANSTAT —

115V. 1 phase. 100 amps., Kva. 11.5. Range 0-115 V. Amertran #29145. Specially priced.

CHANNEL CONDS.

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.025	600	$.19	.4	600	.30
.05	1000*	.22	[illegible]	400*	.21
2x.05	600	.30	.5	500*	.33
.1	500	.29	.5	600	.49
.1	600	.32	2x.5	600	.59
.1	2500	1.25	.5-.1	600	.39
2x.1	400	.34	1	400	.50
2x.1	600	.40	1	500	.58
3x.1	400	.40	1	500*	.58
3x.1	1000	.52	1	600	.63
.25	400V	.34			
.25	600V	.39			
2x.25	600	.48			

* Top Terms.

KITS

Bathtub cond .... 15 @ $1.00
Potentiometer .... 15 @ 1.00
S. Mica cond .... 100 @ 6.50
Mica cond .... 100 @ 3.50
Rotary Sws .... 10 @ 1.00
Filter, 2 4-600V conds.
2 SH, 165 Ma. Chokes .... @ 3.30

25 W. POWER RHEOS.

Ohms	Shaft	Price	Ohms	Shaft	Price
1.3-1.3	1/8S	$.98	851	1/2	.69
15	1/2	.69	200	1/2	.69
20	1/2	.69	225	1/8LS	.69
25	1/2	.69	225	1/4S	.69
37.5	1/2	.69	300	1/2	.69
50	1/8S	.69	350	1/2	.69
50-50	1/2	1.25	375	1/2	.69
75	1	.69	500	1/4S	.69
100	1/2	.69	2500	1/2	1.20
125	1/2	.69	5000	1/2&1/8S	1.20
150	1/2	.59			
175	1/2	.89			

100 ohm Lots of 100 .... $.54

METAL TUBULAR OIL CONDS.

Mfd	Wvdc	Price	Mfd	Wvdc	Price
.0025	400	$.10	.05	600V	.16
.005	600	.14	.05	1000V	.19
.01	300	.09	.1	400V	.17
.01	600	.15	.1	600V	.20
.01	2000	.19	.25	600V	.18
.02	400	.14	.5	600V	.19
.03	400V	.15			
.05	200V	.07			

Quas. of 100, 10% disc.

Write: ART HANKINS, *Owner*

MONMOUTH RADIO LABORATORIES

Box 159 Long Branch 6-5192 OAKHURST, N. J.

CAPACITOR HEADQUARTERS

MFD	BATHTUB COND. 400V	600V	1000V	CHANNEL TYPES 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	.85	1.15	—	—	—	—
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	—	YAB/T	WAB/T	

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JAN-C-25 TYPES AVAILABLE IN QUANTITY

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New Manufacture Hi-Capacity Oil Cond.
For Servo-Control-Network Applications
20-30-40-50-60 MFD/600 VDC, also AC rated

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10-20-40-80-100 MFD/100 VDC (Oils)
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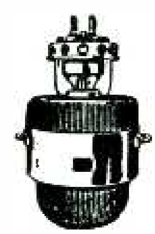

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OA2	.89	5C30/C5B	3.75	371B	.79	832A	8.50
OA3/VR75	1.04	5CP1	4.50	388A	1.29	841	.39
OB2	1.05	5D21	24.00	394A	4.75	843	.25
OB3/VR90	1.05	5FP7	1.95	417A	14.95	846	49.95
OC3/VR105	1.10	C5B	3.75	450TH	42.50	860	6.50
OD3/VR150	.85	5R4GY	1.49	530	16.95	861	21.50
1B22	1.95	C6A	5.75	531	6.75	864	.75
1B26	2.25	6AK5	.79	533	19.95	865	1.25
1B27	12.50	6K7G	.45	559	.95	866A	1.35
1B29	2.45	7BP5	14.95	HY615	.15	872A GE	3.59
1B36	7.50	7C4	.35	700A	17.50	874	.69
1B56	24.50	7E5	.39	701A	4.95	876	.59
EL1C	2.49	10Y	.39	702A	2.49	879	.49
1D8GT	.59	12A6	.59	703A	2.75	931A	4.25
1L4	.59	24G	1.49	704A	.89	954	.32
1R4/1294	.69	RK34	.39	705A	1.69	955	.45
1T4	.59	45 Special	.29	706AY-DY	39.50	956	.45
2C21/1642	.44	FG17	4.50	706EY-GY	39.50	957	.45
2C22/7193	.29	RK72	.75	707A	7.95	958A	.59
2C26A	.15	RK73	.75	708A	3.75	E1148	.29
2C34/RK34	.39	RK75	3.50	710/8011	.75	CK1005	.59
2C40	7.50	REL5	19.95	713A	.92	1608	3.95
2C43	14.95	FG81A	3.49	714AY	4.95	1616	.69
2C44	.95	VT90	.75	715A	4.95	1619	.35
2J22	7.50	VT98	19.95	715B	6.95	1625	.40
2J26	14.95	100TH	7.75	715C	19.95	1626	.40
2J27	14.95	HY114B	.50	717A	.98	1629	.30
2J39	19.50	VT127	1.75	721A	1.75	1636	2.95
2J40	26.50	205B	1.49	722A	1.89	1642	.59
2J61	39.50	211	.75	724B	2.49	1851	1.29
2J62	39.50	217C	6.95	725A	6.75	2051	.95
2V3G	.75	250TH	18.50	800A	1.75	7193	.30
2X2	.49	250TL	16.95	801A	.45	8011	.75
3B7/1291	.39	285A	4.95	803	3.75	8012	2.75
3B22	2.49	286A	6.95	805	3.50	8013A	2.95
3C24	1.49	304TH	6.50	807	1.59	8020	1.25
3C28	4.95	304TL	8.75	808	2.25	8021	1.95
3CP1/S1	1.49	307A	3.50	811	2.75	8025A	5.45
3D6/1299	.35	316A	.49	811A	3.50	9001	1.25
3D23	4.75	328A	4.95	812	2.75	9002	.95
3FP7	1.75	329A	7.25	812A	3.50	9003	1.25
3Q4	.49	331A	6.95	813	13.95	9004	.35
4B28	2.95	350B	3.95	814	2.95	9006	.25
4J42/700A	17.50	353A	3.95	829B	12.95	6 Amp Tungar Bulbs	2.4
5AP1	3.49	357A	14.95	830B	2.75		

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SCR-545A Search and Track. Complete trailer, power supply and spare parts. Nearly New. Write for description and price.

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- Filament, American Transformer Co. Spec. 29106, Type WS, .050 KVA, 50/60 cy. S.P., 35 KVA test, 12 KV d-c operating. Pri. 115 v., Sec. 5 v., 10 amps w/integral stand-off insulator and socket for #371,872, etc., rectifier tubes. $15.00 each. Transtat, line voltage regulator, 115 v. 60 cy. Range 103-126 v. 2.17 amp. Amertran Spec. #29144. $9.50 each.
- Battery Charger, G.E. Cat. #WS-99316. Pri. 105-115-125 V. 60 C. Sec. 105-90-75-60-45-30 v. @ 6 amps. each side of center tap. Voltage reduced 10% and 20% thru tapped primary; two x 5 v. 18 amp. C.T. (Tungar filaments) and two x 7 v. 10 amp. 7¼" h. x 8-¾" w. x 5½" d. Wt. 56 lbs. New, orig. packing. G. E. Price $52.00. $17.50, 2 for $30.00.
- Choke, swinging 15,000 v. d-c line, ripple frequency 120, 149 ohms. .02 amp. @ 900 henrys; .52 amp. @ 25 henrys; 48% ripple. Amertran Spec. #29107. $42.00.

*Capacitors

9.12 mfd., 1265 v. 60 c. a-c or 4000 v. d-c power factor correction 5.0 K.V.A.R. Cat. #2528908. $17.50
.25-.25. 6000 v. d-c or .125 @ 12,000 v. d-c., Fast Cat. #A7548 oil. $3.75.
1.25/1.25 mfd., 7500 v. Pyranol Cat. #26F360. $17.50

*Resistors

Fixed w.w. 160,000 ohm, 200 w. ferrule ends..$1.00
Fixed, w.w. 5,000 ohm, 200 w. ferrule ends.. 1.00

*Meters & Multipliers

Westinghouse Type R-5, 1 meg. precision meter multiplier resistors, wire wound, non inductive. ½% tolerance. Can be screwed together for any desired total. New. $4.00 each.
Ammeter, a-c, 3" Westinghouse NA-35 or Weston Model 476, 3 amps, f.s. deflection; scale calibrated 0-120, includes doughnut type current transformer w/200-5 ratio at 25-133 cy. $8.50.

*Relays

Allen-Bradley overload relay, 110 v. 60 cy. Cat. #810. Adjustable 6.3 to 18.1 amps. $7.95 each.
Westinghouse, 110 v. 60 cy. D.P.S.T. 15 amp. contacts with interlock. $4.95 each.

*Rectifiers, Dry Disc

Cu. S. FWB 1.8 v. d-c @ 1 amp....$.75 4 for 2.50
Selenium, FWCT, 2.2 v. d-c @ 3 amp .75 4 for 2.50
Selenium, HW. 36 v. d-c @ .2 amp. .75 4 for 2.50
Selenium, FWB, 54 v. a-c @ 1.6 amp........ 3.60
Selenium, FWB, 154 v. a-c .6 amp.......... 5.50
Selenium, FWB, 180 v. a-c .4 amp.......... 5.50

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1¼" dia. x 5"........................$ .90 ea.
1¼" dia. x 6"........................ 1.00 ea.
1¼" dia. x 8"........................ 1.25 ea.
All sizes with metal caps and bases.

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Variable output 0-15,000 v. d-c @ 500 mills. Input 115 v. 60 cy. single phase. Army type RA-38. Size 63½" x 53-¾" x 56-⅞". Wt. 2040 lbs. Units are new, comolete with soare tubes and remote control. Write for detailed information.

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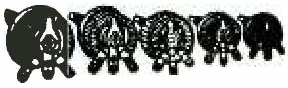

r	W	Ea.	r	W	Ea.	r	W	Ea.
.5	25	1.98	75	25	1.98	500	300	9.49
.5	50	2.81	75	75	3.90	585	150	6.59
.5	150	5.93	80	50	2.53	750	25	2.23
1	50	2.81	80	500	12.46	750	150	5.46
2	50	2.81	100	25	1.98	1000	25	2.53
2	100	4.68	100	50	2.53	1000	50	2.66
2	300	8.42	100	100	4.39	1200	225	7.20
3	100	4.67	125	25	2.23	1200	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			

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.0001	6kv	.0001	10kv	.001	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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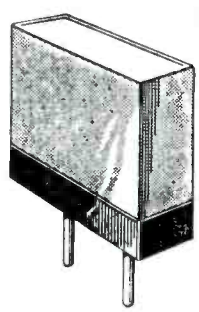

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2C40	12.50
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6AK5WE	1.50
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6H6	.75
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316A	1.25
327A	4.25
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394A	3.75
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417A	15.00
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807	1.25
807W	7.50
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832A	8.50
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835	17.50
837	1.25
861	20.00
872AS	3.00
874	.90
954	.25
955	.35
956	.35
957	.45
958A	.60
1616	.65
1625	.35
1626	.35
1630	.85
1632	.70
1633	.70
1644	.75
2050	1.25
2051	1.00

5643	7.50
5654	2.75
5670	5.50
5686	3.75
5687	5.25
5702	4.00
5705	1.50
5704	2.50
5726	2.10
5744	4.00
5763	1.50
5787	4.50
5829	2.25
6101	Write
6099	Write
8013	2.50
8020	1.25
8025	4.50
9004	.35
9006	.35
CE2	1.50
CE2A	3.50
CE2B	3.50
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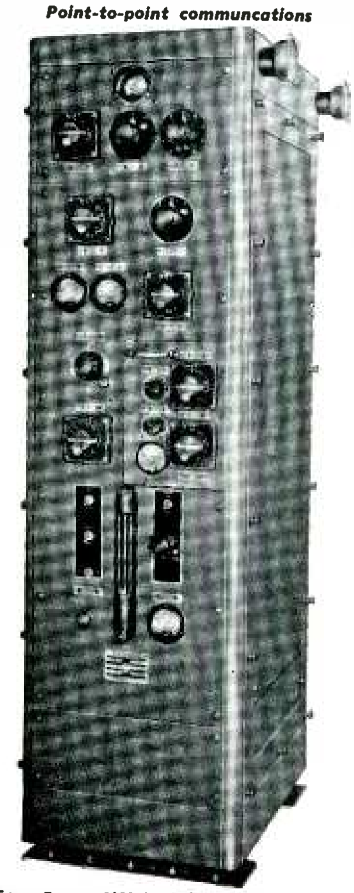

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Aviation Week
Business Week
Bus Transportation
Chemical Engineering
Chemical Week
Coal Age
Construction Method & Equipment
Electrical Construction & Maintenance
Electrical Merchandising
Electrical World
Electronics
Engineering & Mining Journal
Engineering News Record
E. M. J. Metal Mineral Markets
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CP 70 STYLE CONDENSERS VDC TYPE

MFD	VDC	TYPE
.00365	15 K	14F162
.0091	15 K	14F222
.0066	20 K	PL1391-978
.075	16 K	572
.045	16 K	D-4495
.51	10 K	LD
.49	10 K	LD
.35	30 K	
.33	8500	26F267
.25	600	CP65B
.25	1000	23F242
.25	3000	CP70E1EL254K
.25	6000	25F659
.25	7500	25F431
.25	10 K	D 9181
.25	15 K	8174
.25	20 K	TK 20002-2
.25	25 K	8118
.25	50 K	14F97
.15	8000	8020
.15	50 K	14F72
.15/.15	5000/8000	Vitamin "Q"
.05	600	OM6005
.05	1000	23F203-G2
.05	3000	23F636
.05	10 K	Y 3605
.02	600	P13356
.5	600	CP70BIEF504-V
.5	1000	TJU10005
.5	2000	XLNJW20-.5
.5	2500	2509
.5	3000	22F242 (CP70)
.5	4000	TJU 40005
.5	5000	26F549
.5	10 K	408936
.5	25 K	14F103
.2	4000	XLMSW40-.2
.2	50 K	14F126
.1	600	28F28
.1	1500	K34J-222-3
.1	1750	CSF48596-AP
.1	2000	23F378
.1	3000	TJU 30001
.1	7500	25F175
.1	12 K	26F628
.1	13 K	2FF313B
.1	15 K	26F359
1	400	CP69B2BE1105MK
1	500	9CE6A4
1	600	TJ 6010
1	1000	TJ 10010-2
1	1200	
1	1500	
1	1750	CSF48596
1	2000	TRS 2001
1	3000	TJU 30010
1	4000	TJU 40010
1	5000	23F49
1	6000	FP
1	6000	TK 60020
1	7500	
1	10 K	14F267
1	13 K	25F313
1	15 K	14F63
1	25 K	A 6734
1	25 K	TJ
1.5	1500	K7106149P1
1.5	2500	8487
2	200	TRS 202
2	600	26F167
2	1000	CP70B1FG205-X
2	1500	TRS 1502
2	2000	23F161
2	2000	CAY 4808-10
2	2500	2509
2	3000	TQ30020
2	4000	23F47
2	5000	23F188
2	32 K	43J861
2 x .875	400	23F279
2 x .05	2000	P720555-69
2 x .5	400	RAL 300
2 x .5	1000	9107
2 x .5	2000	P720555-9

CP 70 STYLE CONDENSERS VDC TYPE

MFD	VDC	TYPE
2 x .5	3000	25F526
2 x .5	9000	PC 2151
2 x .1	600	SPG621DB
2 x .1	7000	25F360
2 x .1	7500/7520	7520
2 1.25	7500	26F360
2 x 3	600	PC2401
2 x 8.5	1000	46D048
3 x .25	600	CP69B5EF254
3 x .05	500	B34584
3 x .5	500	
3 x 8	500	CSF481337-20
4	400	25F664
4	600	TJU 6040
4	1000	8788 (CP70)
4	1500	TRS 1504
4	2000	23F119
4	2500	TRS 2504
4	3000	CP70E1EL504V
4	4000	25F664-G2
4	5000	TJ 50040
4 x	600	4883
5	600	CAY 48733
5	1000	XLMW10-5
5	10 K	TK 10050G
6	600	CP70E1FF605K
6	1000	CP70B1EG605K
6	1500	CAY 48731-10
6	2000	XLMS20-6
8	200	TRS 208
8	220	TRS 202
8	600	22F136-G2 (CP70)
8	1000	
8	1500	TJH 15080
8	3000	Vitamin "Q"
10	400	25F471
10	600	26F524
10	1000	26F754

CP 70 STYLE CONDENSERS AC TYPE

MFD	VDC	TYPE
10	2500	23F397
12	600	TJ 6120
12	1000	0115
12	4000 peak	7418
12.5	4000 peak	545-A
15	1000	TJ 10150
15	1500	TJH 15150
25	2800	Vitamin "Q"
25	3000	Vitamin "Q"
30	600	CAY 48732-10
30	2500	Vitamin "Q"
50	100	KLHRAW1-50

40 KILOWATT TRANSFORMER AND CHOKE KIT FOR THE PRESS—WIRELESS PW-40. NEW

MFD	VAC	TYPE
.25	115	Hi Pass
.14	115	26F988
.05	300	PC 1344-3
.6	90	1C
1	150	25F757
1	220	21F319
1	330	67X1X
1	1200	PRF 1201
1.25	1000	26F556
2	330	26F406-G2
3	330	67X3B
3 x .6	90	1C

CP 70 STYLE CONDENSERS AC TYPE

MFD	VAC	TYPE
3 x 30	90	9C
3.75	330	KG 3037
3.5	220	21F319
4	150	CD 4880-5
4	440	67X23
5	440	67X24
6	330	KGM 3060
6	440	35-4-06
6	460	67X38
6	553	POS
6	660	67X38
7	660	26F306
8	660	21F50-G3
8	1500	22F57
10	220	ALMJW2.5-10
10	330	PRF 3310
10	330	Y 6845
10	660	25F688
12	220	MC 787
12	330	21F130
15	220	ALMJW2.2-15
15	330	25F801
15	660	26F495
16	600	PC 1330
16.5	236	P 7369
28	440	67X23
30	90	26F571-G3
50	330	26F447
500	100	KLHRAW1-50
500	330	KGH3500-3

VACUUM CONDENSERS

MFD	VDC	TYPE
12	20 K	VC-12
50	5 K	8047
50	20 K	VC-50
50	20 K	W-50
100	7.5 K	1L33

TYPE G. MICAS

MFD	Voltage	TYPE
.04	1 KV	G-1
.09	1.5 KV	G-1
.08	1.5 KV	G-1
.0025	2.5 KV	XPY25-225
.0008	3 KV	UC 2509-M
.02	3 KV	G-1
.00095	5 KV	CD 48274
.0015	5 KV	CRV 48416
.006	5 KV	CRV 48415
.01	5 KV	CD 48408
.00025	6 KV	PL-586-59
.0024	6 KV	G-1
.0006	6 KV	G-1
.0004	6 KV	488-26A
.0002	6 KV	1950-207
.006	6 KV	488-26A
.004	6 KV	G-1
.001	6 KV	G-1
.0012	7 KV	CRV-48157
.003	7 KV	UC 3048
.002	8 KV	UC 2371
.00002	10 KV	UC 3292
.000375	10 KV	CRV-48418
.00068	10 KV	MX-61
.00057	10 KV	CD-48879-2
.00025	10 KV	CRV-48155
.00015	10 KV	UC-3123
.0008	10 KV	CRV-48417
.0002	10 KV	48270-B5
.005	10 KV	UC-2617

TYPE G. MICAS (Con't)

MFD	Voltage	Type
.001	10 KV	UC-3296
.02	10 KV	PL-133-52
.0025	12 KV	XPXW
.008	12 KV	G-4
.00532	15 KV	1980-318
.00002	15 KV	MX-60
.0025	15 KV	1970-218
.002	15 KV	G-3
.01	15 KV	1940-225
.00035	20 KV	PL 289-51
.00025	20 KV	G-3
.00015	20 KV	1970-404
.0005	20 KV	PL-280-51S
.0003	20 KV	UC-3112K
.0002	20 KV	G-3
.0001	20 KV	G-3
.002	20 KV	G-3
.0025	25 KV	G-3
.002	30 KV	1940-217
.0005	35 KV	G-4
.001	35 KV	1940-214
.001	75 KV	PL 49-728

STANDARD BATHTUB CONDENSERS

MFD	Voltage	Terminal
.01	600 VDC	Side
.05	600 VDC	Side
.05-.05	1000 VDC	Side
.05-.05-.05	600 VDC	Side
.08	1500 VDC	Top
.1	600 VDC	Side, Top, Bottom
.1	1000 VDC	Side
.1-.1	400 VDC	Side
.1-.1	600 VDC	Side
.1-.1-.1	400 VDC	Side
.1-.1-.1	600 VDC	Side
.2	600 VDC	Side
.2	1000 VDC	Side
.25	400 VDC	Side
.25	600 VDC	Side, Top, Bottom

MFD	Voltage DC	Terminal
.25-.25	400 VDC	Side
.25-.25	600 VDC	Side, Top, Bottom
.25-.25-.25	600 VDC	Side
.3	600 VDC	Top
.5	300 VDC	Top
.5	400 VDC	Side
.5	600 VDC	Side, Bottom
.67	120 VAC	Side
.75	600 VDC	Bottom
1	100 VDC	Side
1	200 VDC	Side
1	300 VDC	Side
1	400 VDC	Bottom
1	600 VDC	Side
1	1000 VDC	Side
1-1	400 VDC	Side
1-1	600 VDC	Bottom
2	25 VDC	Side
2	400 VDC	Side
2	600 VDC	Side
4	50 VDC	Side
4	100 VDC	Side
4	450 VDC	Side
10	150 VDC	Side
20	150 VDC	Side
25	25 VDC	Side
25	50 VDC	Side, Top
30	150 VDC	Bottom
40	25 VDC	Side
50	25 VDC	Side
50	50 VDC	Side

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INDEX SEARCHLIGHT

January, 1953

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ADVERTISERS INDEX

TO THE ADVERTISERS

January, 1953

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	22F328	.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	1.05
.1	1500 DC	P70B1EH104K	1.70
.1	3500 DC	K5204513	2.95
.1	7500 DC	25F405	7.50
.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	3000 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	1.25
.25	1000 DC	27F255	1.25
.25	1000 DC	26F467	1.25
.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	25F388	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
.5	600 DC	65B144504K	.95
.5	1000 DC	23F331	1.45
.5	1000 DC	10050G	1.45
.5	1500 DC	481294	1.65
.5	1500 DC	21F628	1.65
.5	2000 DC	26F698	1.95
.5	3000 DC	30003	3.95
.5	4000 DC	28F128	6.95
.5	5000 DC	50005	8.95
.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	5.75
.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	25F391	1.65
.666	800 AC	21F333	1.25
.67	120 AC	26F663	.95
.7	1300 AC	21F485	1.50
.7-.7	800 AC	21F381	1.95
.7-.7	300 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.	1.05
1.0	1000 DC	Ldg. Mfg.	1.85
1.0	1150 AC	21F641	1.75
1.0	1500 DC	15010	2.25
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	4.95
2.0	2500 DC	Ldg. Mfg.	6.45
2.0	3000 DC	Ldg. Mfg.	10.95
2.0	4000 DC	22F985	14.95
2.0	5000 DC	23F50	17.50
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.	3.45
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	1.45
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	8.75
4.0	4000 DC	70E1EM405K	27.50
4.0-4.0	1000 DC	4223	5.25
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	5.25
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	37.50
50-50-50	90 AC	MK4	29.95
50.0	600 DC	Leading Mfg.	22.50

BATHTUB CONDENSERS

Mfd.	WVDC	Term.	Price
25	25	Top	$0.65
5	50	Bot.	.49
25	50	Side	.69
25	50	Top	.69
1	100	Side	.25
40	100	Side	.79
2x.1	200	Side	.25
.25	200	Side	.29
.5	200	Side	.35
1	200	Top	.39
2x.5	230AC	Side	.49
3x.1	400	Side	.45
.25	400	Top	.35
2x.25	400	Side	.39
.5	400	Bot.	.35
.5	400	Side	.39
.5	400	Top	.39
2	400	Side	.60
3x.01	600	Top	.39
.02	600	Top	.25
.05	600	Side	.20
2x.05	600	Top	.29
.1	600	Top	.35
.1	600	Side	.35
2x.1	600	Side	.39
2x.1	600	Bot.	.39
.2	600	Top	.25
.25	600	Side	.39
2x.25	600	Bot.	.49
2x.25	600	Top	.49
2x.25	600	Side	.49
.5	600	Bot.	.47
.5	600	Side	.47
.5	600	Top	.47
2x.5	600	Bot.	.59
2x.5	600	Side	.59
2x.5	600	Top	.59
1	600		.69
2	600		.95
.1	1000	Top	.39

WIRE, W11B, 1 Mile Reels, 2 cond. #19 twisted pair on metal reel...$14.95
TRANSFORMERS, modulation, Thordarson T47420A. Pri: 1500-750 Ohm. D B. level 250W. Ratio: 1 to 2.33–3.27. Cycles per sec: 90 to 20,000. 13¾"L. 9⅝H, 7½"W, 100#..............$15.00

MINE DETECTOR SCR 625

Detects metallic objects (ferrous or nonferrous) to 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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Cat. #	Mfd.	WVDC	Price
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14F2	7	5KV	52.50
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A7548	2x.25	6KV	17.50
TK60020	2	6KV	27.50
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7520	2x1.0	7.5KV	27.50
26F360	2x1.25	7.5KV	29.95
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10020	0.1	10KV	9.95
Inerteen	1.0	10KV	37.50
26F68	0.1	12KV	9.95
TK120065	.65	12.5KV	19.95
15020	.25	15KV	19.50
14F17	1	15KV	49.95
14F63	1	15KV	49.95
14F18	1.5	15KV	62.50
20020	.25	20KV	27.50
14F64	.25	20KV	27.50
37485	.25	20KV	27.50
26F585	.06	25KV	17.50
XSW200	.25	20KV	27.50
20005	0.5	20KV	45.00
14F22	1.0	20KV	72.50
14F139	.01	22KV	15.50
Inerteen	.5	25KV	57.50
25020	.5	25KV	57.50
14F24	.5	25KV	57.50
14F88	.75	25KV	72.50
Inerteen	1.0	25KV	82.50
A6734	1.0	25KV	82.50
Inerteen	.25	32.5KV	42.50
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OZ4	.59	6AQ5	.57	6V6	1.55
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1C5GT	.75	6AU5	1.19	6X5GT	.65
1D8GT	.65	6AU6	.59	6Y6G	.95
1G6GT	.65	6AV6	.55	6Y7G	.75
1L4	.67	6B4G	1.25	7A6	.75
1LA4	.85	6B7	.95	7B7	.75
1LA6	.95	6B8G	.75	7C5	.75
1LB4	.98	6BA6	.65	7C7	.75
1LC5	.75	6BC5	.75	7F7	.75
1LC6	.91	6BE6	.65	7N7	.85
1LN5	.75	6BF6	.72	7Y4	.59
1N5GT	.75	6BG6G	1.89	12A6	.65
1P5GT	.69	6BH6	.95	12A7	.90
1R4	.69	6BJ6	.95	12AH7GT	1.19
1R5	.65	6BQ6	1.25	12AT6	.55
1S4	.69	6C4	.55	12AT7	1.10
1S5	.65	6C5	.60	12AU6	.75
1T4	.65	6C6	.59	12AU7	.88
1U4	.67	6C8G	.85	12BA6	.69
1V	.65	6D6	.72	12C8	.69
1X2	.96	6D8	.85	12H6	.69
2A3	1.10	6E5	.79	12K8	.72
2X2	.50	6F6	.85	12SA7GT	.79
2X2A	1.55	6F7	.85	12SC7	.85
3A4	.65	6H6	.65	12SG7	.85
3A5	.85	6H6GT	.65	12SJ7GT	.65
3B7/1291	.42	6J5	.75	12SK7GT	.80
3D6/1299	.43	6J5GT	.55	12SL7GT	.75
3Q4	.63	6J6	.95	12SN7GT	.85
3Q5GT	.79	6J7	.95	12SQ7GT	.72
3S4	.74	6J7G	.60	12SR7	.72
3V4	.74	6K6GT	.65	14B6	.75
5R4GY	1.65	6K7	.79	14H7	.85
5T4	1.32	6K8GT	1.15	25L6	.90
5U4G	.69	6L6	2.25	25Z5	.65
5V4G	.98	6L6G	1.50	25Z6GT	.68
5W4	.79	6L6GA	1.50	41	.69
5Y3GT	.45	6L7	.85	43	.65
5Y4G	.67	6N7GT	.85	45	.75
5Z3	.85	6R7	.79	50A5	.89
5Z4G	.95	6SA7GT	.65	50B5	.75
6A3	.95	6SC7	.95	50C5	.67
6A6	.82	6SF7	.75	50L6GT	.65
6A7	.89	6SG7	.75	50Y6	.72
6A8GT	.95	6SH7	.65	53	.68
6AB7	.98	6SJ7	.75	75	.82
GAC5GT	1.05	6SK7GT	.72	80	.65
6AC7	.95	6SL7GT	.75	83	.95
6AG5	.75	6SN7GT	.75	83V	.92
6AG7	1.45	6SQ7	.65	84/6Z4	.75
6AH6	1.29	6SR7GT	.68		
6AJ5	1.95	6SS7	.80		

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OD3/VR150	.95	35T	3.25	872A	3.50
1B23	9.75	45 Spec.	.32	874	1.19
1B24	9.75	100TH	7.95	878	1.59
1B27	14.95	211	.65	885	1.39
1B29	2.45	250TH	19.95	902A	9.95
1N21B	3.25	250TL	17.95	918	1.10
1N23	1.25	262B	3.95	922	1.25
1N23A	2.39	274B	2.95	923	.95
1N23B	3.69	304TH	8.95	927	1.05
1N34	.76	304TL	8.95	930	.95
1N34A	.97	307A/RK75	3.95	931A	4.45
2AP1	10.95	316A	.65	954	.25
2C40	7.50	328A	8.95	955	.49
2C43	14.95	350A	6.45	956	.35
2C44	1.19	350B	3.95	957	.39
2C46	7.95	368AS	7.50	958	.56
2C51	6.25	371A	.95	959	2.95
2D21	1.35	371B	.69	991/NE16	.35
2E22	1.75	393A	7.95	1603	4.95
2E24	4.65	394A	3.95	1613	.79
2E26	3.15	417A	8.75	1616	.69
2K25/723AB	28.75	434A	27.50	1619	.24
2K28	32.50	446A	1.15	1622	2.45
2K33A	310.00	446B	3.75	1624	1.45
3AP1	9.95	575A	15.75	1625	.35
3B24	5.25	701A	5.75	1626	.25
3B24W	7.95	703A	5.25	1629	.25
3B26	3.59	705A	1.65	1630	.75
3BP1	5.95	707B	13.95	1632	.72
3C22	115.00	714AY	7.95	1638	.45
3C24/24G	1.75	715A	6.39	1851	1.55
3C45	15.95	715B	8.75	2051	1.18
3CP1	1.95	715C	19.95	5670	6.95
3CP1S1	1.95	717A	.98	8008	5.95
3DP1	4.45	721A	2.45	8011	.90
3DP1A	6.95	723A	9.50	8012	2.65
3DP1-S2A	8.95	723A/B	19.95	8013	2.59
3D21A	3.25	724B	3.25	8020	.98
3E29	13.95	725A	6.75	9001	1.50
3FP7	1.65	726A	18.95	9002	.98
3GP1	4.39	730A	29.50	9003	1.65
4-125A	27.50	800	1.75	9004	.35
4-250A	37.50	802	3.95	9005	1.45
4AP10	4.45	803	3.25	9006	.27
4C35	27.50	804	11.75	C1JA	9.95
4E27	14.95	805	3.75	C6A	7.95
5AP1	3.45	806	24.95	CJ6	6.39
5AP4	3.45	807	1.59	CK1005	.48
5BP1	4.45	808	2.69	F123A	7.75
5BP4	4.45	810	9.50	F127A	27.50
5CP1	4.59	811	2.85	F128A	89.50
5CP7	11.75	812	2.75	FG17	4.89
5D21	19.95	813	11.75	FG27A	4.95
5FP7	1.85	814	2.69	FG32	8.95
5GP1	4.85	815	2.35	FG57	14.95
5JP1	24.45	816	1.05	FG81A	3.49
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6AS7	4.45	832	6.75	HF300	22.45
6C21	21.00	832A	8.50	HY114B	.69
6J4	6.75	836A	3.49	HY115	.69
7BP7	6.55	837	1.45	ML101	55.00
7DP4	14.50	838	2.25	REL21	1.95
9LP7	4.95	845W	6.25	RK60/1641	2.25
10BP4	17.45	849C	27.50	RK65	26.50
10Y	.39	851	47.50	RK72	.48
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15E	1.35	861	22.50	WL616	34.50
		865	.98		

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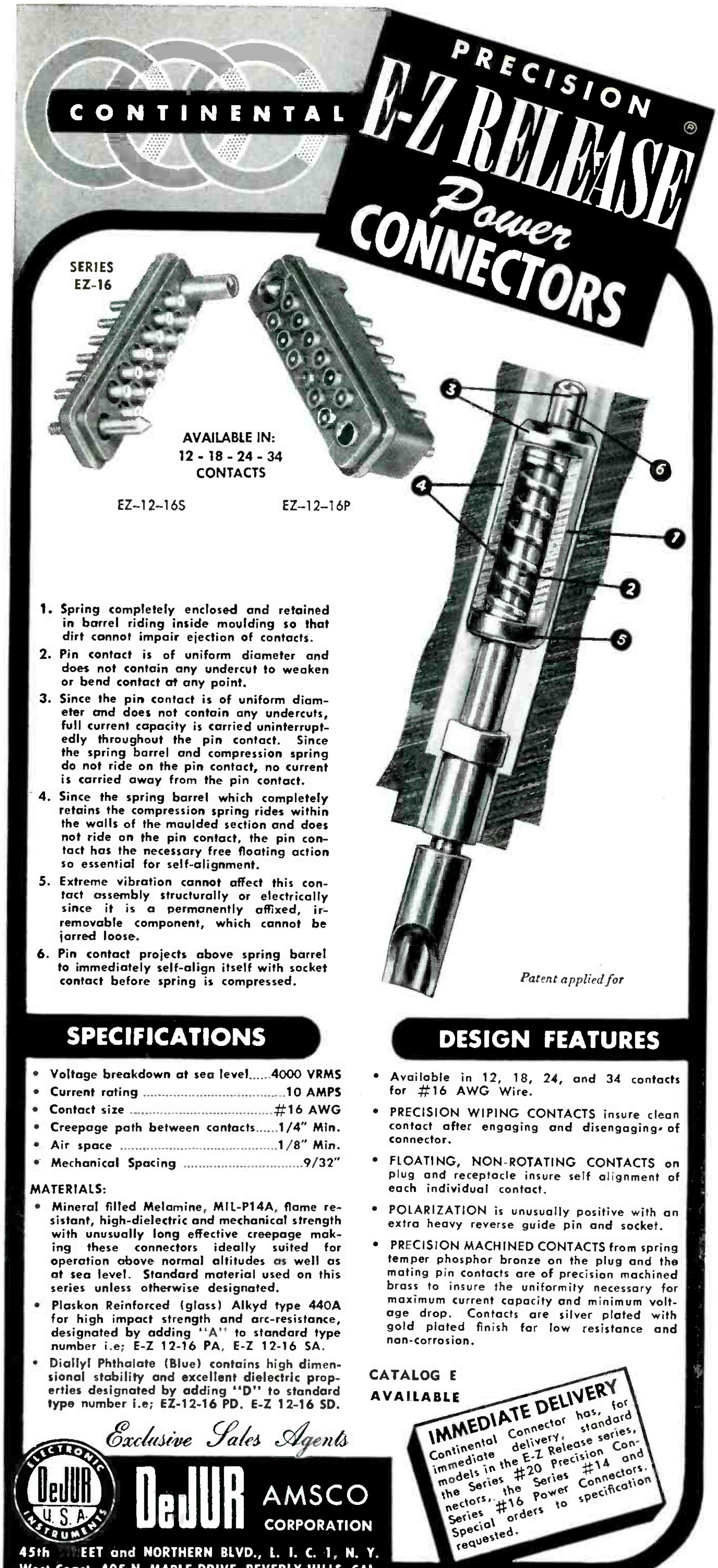
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CONNECTORS
SERIES EZ-16
AVAILABLE IN:
12 - 18 - 24 - 34
CONTACTS
EZ-12-16S
EZ-12-16P
1. Spring completely enclosed and retained in barrel riding inside moulding so that dirt cannot impair ejection of contacts.
2. Pin contact is of uniform diameter and does not contain any undercut to weaken or bend contact at any point.
3. Since the pin contact is of uniform diameter and does not contain any undercuts, full current capacity is carried uninterruptedly throughout the pin contact. Since the spring barrel and compression spring do not ride on the pin contact, no current is carried away from the pin contact.
4. Since the spring barrel which completely retains the compression spring rides within the walls of the moulded section and does not ride on the pin contact, the pin contact has the necessary free floating action so essential for self-alignment.
5. Extreme vibration cannot affect this contact assembly structurally or electrically since it is a permanently affixed, irremovable component, which cannot be jarred loose.
6. Pin contact projects above spring barrel to immediately self-align itself with socket contact before spring is compressed.
Patent applied for
SPECIFICATIONS
• Voltage breakdown at sea level.....4000 VRMS
• Current rating .....10 AMPS
• Contact size .....#16 AWG
• Creepage path between contacts.....1/4" Min.
• Air space .....1/8" Min.
• Mechanical Spacing .....9/32"
MATERIALS:
• Mineral filled Melamine, MIL-P14A, flame resistant, high-dielectric and mechanical strength with unusually long effective creepage making these connectors ideally suited for operation above normal altitudes as well as at sea level. Standard material used on this series unless otherwise designated.
• Plaskon Reinforced (glass) Alkyd type 440A for high impact strength and arc-resistance, designated by adding "A" to standard type number i.e; E-Z 12-16 PA, E-Z 12-16 SA.
• Diallyl Phthalate (Blue) contains high dimensional stability and excellent dielectric properties designated by adding "D" to standard type number i.e; EZ-12-16 PD. E-Z 12-16 SD.
DESIGN FEATURES
• Available in 12, 18, 24, and 34 contacts for #16 AWG Wire.
• PRECISION WIPING CONTACTS insure clean contact after engaging and disengaging of connector.
• FLOATING, NON-ROTATING CONTACTS on plug and receptacle insure self alignment of each individual contact.
• POLARIZATION is unusually positive with an extra heavy reverse guide pin and socket.
• PRECISION MACHINED CONTACTS from spring temper phosphor bronze on the plug and the mating pin contacts are of precision machined brass to insure the uniformity necessary for maximum current capacity and minimum voltage drop. Contacts are silver plated with gold plated finish for low resistance and non-corrosion.
CATALOG E AVAILABLE
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Continental Connector has, for immediate delivery, standard models in the E-Z Release series, the Series #20 Precision Connectors, the Series #14 and Series #16 Power Connectors. Special orders to specification requested.
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DeJUR AMSCO CORPORATION
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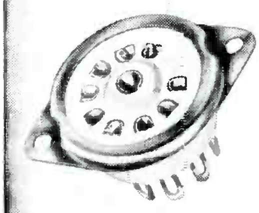


 Want more information? Use post card on last page.

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SEARCHLIGHT SECTION
(Classified Advertising)
H. E. HILTY, Mgr.

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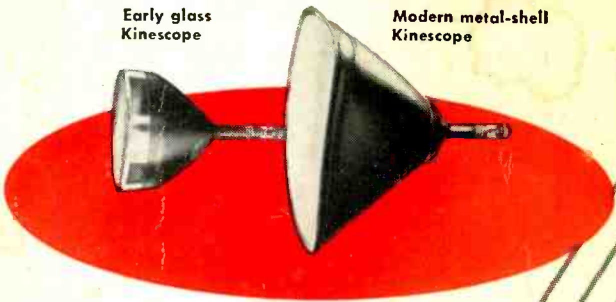
Early glass Kinescope

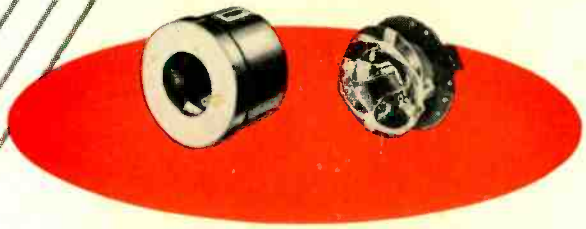
Modern metal-shell Kinescope



IN PRODUCT IMPROVEMENT RCA NEVER STANDS STILL

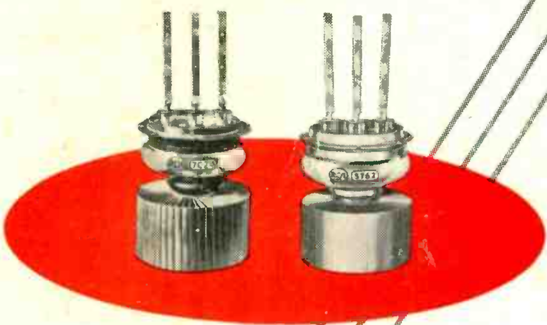
Early 50° deflecting yoke

New 90° deflecting yoke for 27" picture tubes



Early radiator design used on RCA-7C24

Improved design of radiator now used on similar type, RCA-5762, cools with only one-half the air flow

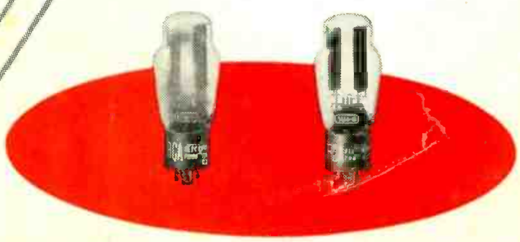


It is one thing to develop new products for the market. It's another thing to improve them . . . to conceive advanced designs . . . after they are on the market.

RCA engineers take nothing for granted—even after design has been "frozen." RCA engineers continue to work closely with equipment designers to solve problems dealing with the performance of tubes and components. RCA engineers never "let go" in their efforts to provide the ultimate in useful performance of the product.

Take the tubes and components illustrated here. ● The improved rectangular kinescope features a metal shell which permits use of a reflection-free faceplate having uniform thickness and high quality; it weighs less; it allows new flexibility in chassis layout. ● The improved plate radiator of the power tube reduces operating temperature, increases tube life, saves customers' money. ● The improved deflecting yoke provides beam deflection through a diagonal deflection angle of 90°—with inherent compensation for deflection defocusing. ● The improved rectifier tube has a greater reserve of emission, greater stability, longer life . . . is better suited for TV receiver requirements.

You can rely on RCA engineering leadership for continuous product improvement.



Early vacuum rectifier for receivers

Improved RCA-5U4G has greater stability, longer life.

RADIO CORPORATION of AMERICA

ELECTRON TUBES **HARRISON, N. J.**