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ELECTRONIC CLIMATE SURVEY SYSTEM

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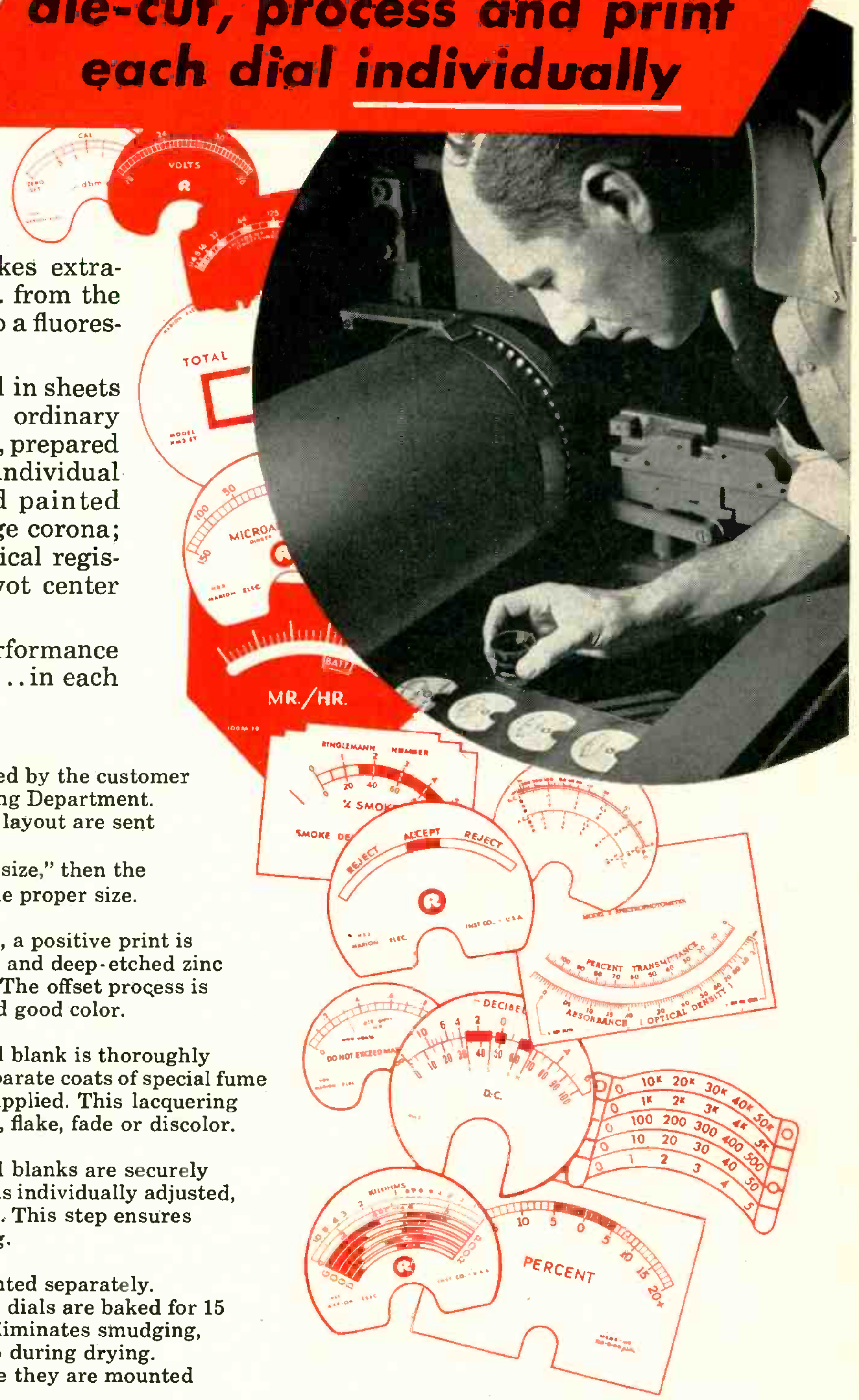
marion methods

die-cut, process and print each dial individually



Because the accuracy of an indicating instrument is completely dependent upon the accuracy of its dial, Marion takes extraordinary care with each dial . . . from the simplest black and white type to a fluorescent type of seven colors.

Marion dials are never printed in sheets and then stamped out, as are ordinary dials. Each Marion dial is die-cut, prepared and printed *separately.* This individual handling guarantees finished painted edges, which reduces high voltage corona; it also assures accurate mechanical registration of the dial with the pivot center of the instrument.

Precision and dependable performance are built into every Marion dial . . . in each step of manufacture.

Preliminary Operations . . . Dial data furnished by the customer is carefully checked by Marion's Engineering Department. After Engineering OK, data and suggested layout are sent to the Art Department.

The dial scale is drawn 4 to 6 times "life size," then the drawing is photographed and reduced to the proper size.

Preparation of Plates . . . After photography, a positive print is made. Color separations are made by hand, and deep-etched zinc plates for offset lithography are produced. The offset process is used to assure sharp printing definition and good color.

Preparation of Dial Blank . . . Each metal dial blank is thoroughly rinsed and vapor de-greased. Then, three separate coats of special fume and age-proof eggshell-white lacquer are applied. This lacquering technique gives a surface that will not chip, flake, fade or discolor.

Registering . . . After careful inspection, dial blanks are securely mounted on the printing press. Each blank is individually adjusted, and the printing plate is positioned exactly. This step ensures perfect registration for multi-color printing.

Printing and Drying . . . Each dial is then printed separately. After special inks of each color are applied, dials are baked for 15 to 20 minutes to set the ink. This process eliminates smudging, and minimizes the amount of lint picked up during drying. Dials are thoroughly inspected again before they are mounted on Marion instruments.

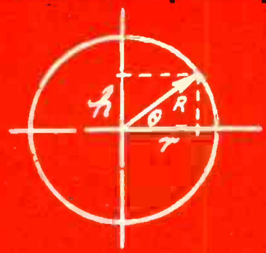
Other Marion Methods. Marion's method of assuring the top accuracy and service of each dial by individual handling is only one of a number of methods which Marion is presenting in the hope that some of them will help you as they have helped us. We will be pleased to send more information if desired.

MARION ELECTRICAL INSTRUMENT CO., 401 CANAL ST., MANCHESTER, N. H.

marion meters

MANUFACTURERS OF MARION Ruggedized PANEL METERS

MUIRHEAD MAGSLIP RESOLVER NO. 2



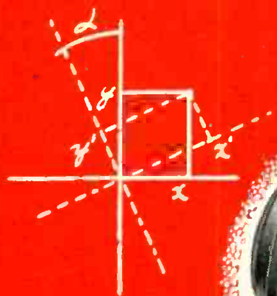
Given R & θ find h & r

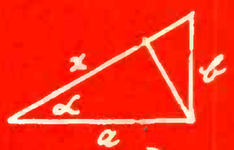
$h = R \sin\theta$

$r = R \cos\theta$

Change of Axes. $x' = x\cos\alpha + y\sin\alpha$

$y' = y\cos\alpha - x\sin\alpha$





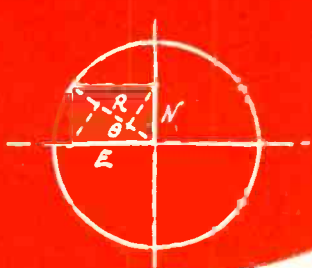
$x = \cancel{\sqrt{a^2 + b^2}}$

$x = a\cos\alpha + b\sin\alpha$

Given N, E determine R & θ

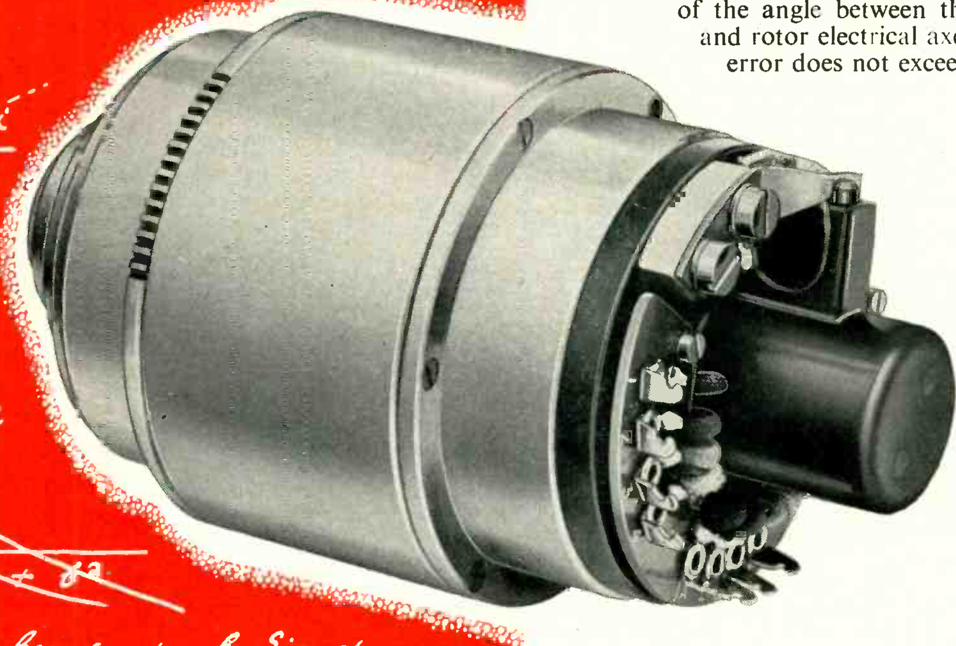
$R = E\cos\theta + N\sin\theta$

$\text{Zero} = E\sin\theta + N\cos\theta$



THE RESOLVER No. 2 is a special type of Magslip used for the solution of trigonometrical problems, such as the conversion of polar to Cartesian coordinates.

Each stator phase is energized in accordance with an applied computing voltage. No power is taken from this source, energization being obtained by means of an amplifier and a second (feedback) stator winding. The rotor voltages are proportional to the exciting voltages and to the sine and cosine of the angle between the stator and rotor electrical axes. The error does not exceed 0.1%.



MAIL THIS COUPON FOR DETAILS

Please mail Bulletin B-690 fully describing
MUIRHEAD MAGSLIP RESOLVERS

NAME ______________________

POSITION ______________________

COMPANY ______________________

ADDRESS ______________________

____

____

ELECTRONICS 75

MUIRHEAD & CO. LTD. BECKENHAM · KENT · ENGLAND

PRECISION ELECTRICAL INSTRUMENT MAKERS

FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RTMA)	Year Ago Mar. '51	Previous Month Feb. '52	Latest Month Mar. '52
Television sets	874,634	409,337	510,561-p
Home Radio sets	988,078	418,808	532,858-p
Portable sets	147,037	72,866	99,720-p
Auto sets	545,297	267,779	343,314-p

RECEIVER SALES

(Source: Licensee figures)	Feb. '51	Jan. '52	Feb. '52
Television sets, units	612,799	462,252	410,280
Electric radio sets, units	674,641	390,005	344,008
Battery sets, units	74,762	45,578	43,638
Auto sets, units	245,321	165,549	195,689
Television sets, value	$126,053,787	$82,105,399	$71,835,056
Electric radio sets, value	$18,589,012	$8,046,422	$6,488,686
Battery sets, value	$1,381,927	$893,100	$844,091
Auto sets, value	$6,926,752	$4,693,660	$5,539,061

RECEIVING TUBE SALES

(Source: RTMA)	Mar. '51	Feb. '52	Mar. '52
Receiv. tubes, total units	44,413,146	28,262,407	30,935,220
Receiving tubes, new sets	33,318,889	17,608,162	19,513,454
Rec. tubes, replacement	9,157,205	6,623,798	7,231,186
Receiving tubes gov't	257,447	2,877,177	2,776,796
Receiving tubes, export	1,679,605	1,153,270	1,413,784
Picture tubes, to mfrs.	608,396	330,431	370,206

BROADCAST STATIONS

(Source: FCC)	Apr. '51	Mar. '52	Apr. '52
TV Stations on Air	107	108	108
TV Stns CPs—not on air	2	0	0
TV Stns—Applications	402	521	536
AM Stations on Air	2,264	2,339	2,347
AM Stns CPs—not on air	110	74	68
AM Stns—Applications	263	320	324
FM Stations on Air	652	636	632
FM Stns CPs—not on air	16	14	14
FM Stns—Applications	10	6	9

NETWORK BILLINGS

(Source: Pub. Info. Bureau)	Mar. '51	Feb. '52	Mar. '52
AM/FM—ABC	$2,891,339	$3,177,970	$3,355,715
AM/FM—CBS	$6,793,966	$4,788,561	$5,154,077
AM/FM—MBS	$1,648,006	$1,600,399	$1,826,527
AM/FM—NBC	$5,085,636	$3,994,018	$4,184,074
TV—ABC	$1,539,470	$2,120,911	$2,076,782
TV—CBS	$2,993,902	$5,103,043	$5,643,123
TV—Dumont	$457,811	$748,544	$758,763
TV—NBC	$4,654,063	$6,813,549	$7,357,305

TV AUDIENCE

(Source: NBC Research Dept.)	Year Ago Apr. '51	Previous Month Mar. '52	Latest Month Apr. '52
Sets in Use—total	12,171,500	16,535,100	16,939,100
Sets in Use—netw'k conn.	10,333,600	15,642,200	16,024,900
Sets in Use—New York	2,300,000	2,890,000	2,930,000
Sets in Use—Los Angeles	900,000	1,125,000	1,155,000
Sets in Use—Chicago	915,000	1,110,000	1,135,000

COMMUNICATION AUTHORIZATIONS

(Source: FCC)	Mar. '51	Feb. '52	Mar. '52
Aeronautical	31,677	31,707	32,176
Marine	28,400	34,660	34,843
Police, fire, etc.	8,691	10,442	10,592
Industrial	8,510	12,237	12,475
Land Transportation	4,026	4,767	4,847
Amateur	91,375	105,016	106,832
Citizens Radio	471	833	878
Disaster	0	26	29
Experimental	469	359	458
Common carrier	838	895	922

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	Feb. '51	Jan. '52	Feb. '52
Prod. workers, electronic	269,500	270,500-r	272,500-p
Prod. wkrs., radio, etc.	181,000	169,600-r	171,200-p
Av. wkly. earnings, elect.	$60.61	$65.58-r	$65.37-p
Av. wkly. earnings, radio	$57.31	$61.73-r	$61.47-p
Av. weekly hours, elect.	41.2	41.8-r	41.4-p
Av. weekly hours, radio	40.5	41.2-r	40.9-p

STOCK PRICE AVERAGES

(Source: Standard and Poor's)	Apr. '51	Mar. '52	Apr. '52
Radio—TV & Electronics	226.6	295.7	292.5
Radio Broadcasters	211.7	286.9	286.2

INDUSTRIAL EQUIPMENT ORDERS

	Quarterly Figures		
(Source: NEMA)	Year Ago 4th '50	Previous Quarter 3rd '51	Latest Quarter 4th '51
Dielectric Heating	$370,000	$210,000	$560,000
Induction Heating	$1,120,000	$3,960,000	$3,400,000

INDUSTRIAL TUBE SALES

(Source: NEMA)	4th '50	3rd '51	4th '51
Vacuum (non-receiving)	$4,380,000	$8,420,000	$14,300,000
Gas or vapor	$2,100,000	$2,620,000	$3,170,000
Phototubes	$280,000	$280,000	$400,000
Magnetrons and velocity modulation tubes	$2,690,000	$3,740,000	$6,670,000

p—provisional; r—revised; e—estimated

INDUSTRY REPORT

electronics—JUNE • 1952

Trade Practice Rules Go to FTC

Commission will review radio-tv questions with industry this month, call public hearing in Fall

PROPOSED 'trade practice' rules for the radio and television industry have been submitted to the Federal Trade Commission by a special all-industry committee.

These rules will be distributed to 12,000 manufacturers, distributors and dealers in advance of FTC'S third Trade Practice Conference June 18, 19 and 20.

The proposed rules will reach a public hearing in the early Fall. Soon after, the Commission will take final action.

▶ **Promotion Highlights** — The rules as they now stand cover misbranding, misrepresentation and deceptive selling methods.

A number of them apply to color television. For example, prohibition of advertisements or representations that any set can be converted or adapted to permit the reception of color signals in color, or of a color signal in black and white, or of uhf, if such is not literally true.

If adaptation requires an attachment, or installation of new parts, or some substantial modification this must be stated conspicuously.

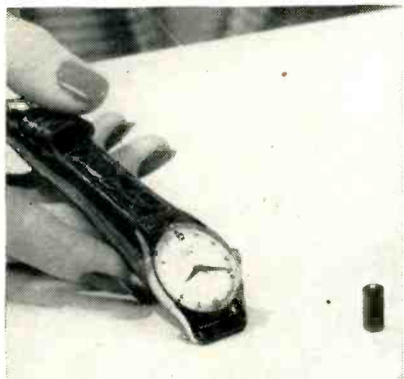
A number of the suggested rules apply to foreign broadcasting. The terms 'all-wave' and 'world wave' could not be used unless the set were constructed to receive all long-wave, medium and short-wave broadcasts and all other waves transmitted or broadcast, foreign as well as domestic.

If the claim is made that a set is free from interference and noise, it must be 'substantiated'.

Advertisements or representations concerning a-m, f-m, or tv receiving sets bearing on the lateness of the model, discontinued model, brand name, rebuilt model, serial numbers, size of picture and pricing, must 'in no way deceive the public'. No 'false claims' are permitted in selling built-in or indoor antennas. Uhf performance must be carefully described.

▶ **Approval Expected**—While the industry in general is expected to go along with the proposed rules, the wording of a number of specific rules will probably be sharply opposed in some quarters.

This will be especially true of those dealing with color and uhf.



Tickless Ticker

Hailed as an 'electronic' marvel powered by an 'energy capsule', Elgin's latest timepiece uses no tubes—not even a transistor. Its tiny 'synchronously controlled' motor, wound with 3,000 turns of wire 1/6 the thickness of a human hair, is merely driven for a year by a midget battery

VHF and UHF TV Transmitters Will Be Ready When Needed

Manufacturers, warming slowly after freeze, include two newcomers

THE END of the freeze upon the licensing of television broadcast stations has been hailed as the beginning of a new era for electronic show business. Opening of the vast new ultrahigh-frequency spectrum provides space for some 1,400 new stations, while better than 500 more stations can be placed in the newly rearranged very-high-frequency bands that so far have served the existing 108 stations.

Because receivers will not be purchased until there are television pictures on the air, the editors of ELECTRONICS have talked with engineers and salesmen about the availability of high-power transmitters, particularly uhf transmitters. Engineers seem generally optimistic that really high-power uhf transmitters can be built and operated. Salesmen are apparently pretty optimistic about delivery dates.

▶ **Ready and Waiting**—If salespeople are a little unrealistic in their brochures, the ultimate consumer—the broadcaster—is probably more unrealistic in his demands. The transmitter industry seems confident that the demand for and use of high-power uhf transmitters is some distance off. They think applications, hearings, red tape, construction problems, steel priorities and some flat license denials will provide enough time for final development, production and delivery to the select few initial customers.

As the table shows, the manufacturers are concentrating upon vhf high-power equipments and amplifiers, and rightly so. It is this vhf region that the broadcasters will generally seek to occupy first. Then too, some 30 vhf stations required to shift frequency will simultaneously be given a chance to increase power.

▶ **Burnt Children** — Remembering how they were caught with their inventories up at the freeze, most manufacturers have no intention of stocking warehouses with completed units. They will strive to keep just a little ahead of actual demand, maintaining at the same time some flexibility for last-minute design changes that are bound to occur especially at uhf.

Raytheon and Westinghouse are playing it even more cozy. While not ruling themselves out of the running, they can observe the preliminary bouts and make plans before getting into the fight. Collins engineers will meet shortly to map their campaign, with first consideration for uhf. If market and required power levels so dictate, they can build a resnatron uhf job.

Gates Radio Co. will shortly announce its entry into the field. Besides its own transmitters, diplexers, antennas, monitors and other accessories, it will supply cameras manufactured on the outside.

TV TRANSMITTER MANUFACTURING PICTURE

Manufacturer	VHF High Power Channels 2–6	VHF High Power Channels 7–13	UHF Low Power Channels 14–83	UHF High Power Channels 14–83
Collins	Plans to build, with uhf getting first consideration			
Du Mont	500 w, 5 kw air-cooled immediately 25 kw air-cooled Spring 1953	500 w, 5 kw air-cooled immediately 50 kw water-cooled Fall 1953	1 kw air-cooled during 1953	5 kw klystron water-cooled during 1953 12 kw in development 50 kw proposed
Federal	1 kw, 5 kw, 25 kw air-cooled during 1952	1 kw, 7.5 kw, 25 kw air-cooled during 1952	1.5 kw air-cooled during 1952	in development
Gates	500 w, 5 kw 120–180 days delivery	500 w, 5 kw 120–180 days delivery	500 w 1st or 2nd quarter of 1953	2.5 kw, 5 kw 1st or 2nd quarter of 1953
GE	5 kw air-cooled middle of 1952 35 kw amplifiers during 1952	5 kw air-cooled middle of 1952 20 kw amplifiers during 1952 50 kw in development	100 w during 1952 1 kw during 1953	5 kw klystron in production 12 kw klystron in development 60 kw specifications
RCA	except for 50 kw, will deliver when the broadcasters are ready		1 kw in production for delivery Fall 1952	no information available
Raytheon	Has plans but no production			
Standard	500 w, 5 kw, 10 kw, 20 kw air-cooled—available for installation 3rd quarter 1952	500 w, 5 kw, 10 kw, 20 kw air-cooled—available for installation 3rd quarter 1952	maybe 100 w probably air-cooled available 4th quarter 1952	klystron—not available until 2nd quarter 1953
Westinghouse	Has no television transmitters at present			

Aircraft Radio Circuits Cut Installation Costs

TOTAL cost of communications equipment for light airplanes can be reduced by incorporating better noise-reducing circuits — even though added components and manufacturing expense run as high as fifty dollars a set. This is the experience of the Narco Co., of Ambler, Pa., makers of over half the airborne omnidirection equipment now in use by some 8,500 planes in this country.

According to Narco engineers, extra cost of noise-reducing circuits is more than saved in most cases by the reduction of time spent shielding and filtering airplane electrical system to eliminate interference at the source.

Survey Spotlights Sales Habits

Reps, field offices and both combined do the national job, in this order

REPRESENTATIVES do the national sales job for 68.2 percent of the country's electronic equipment and component-part manufacturers. Field offices are used exclusively by 10.1 percent. Both representatives and field offices serve the remaining 21.7 percent.

These figures are the result of a survey just concluded by ELECTRONICS.

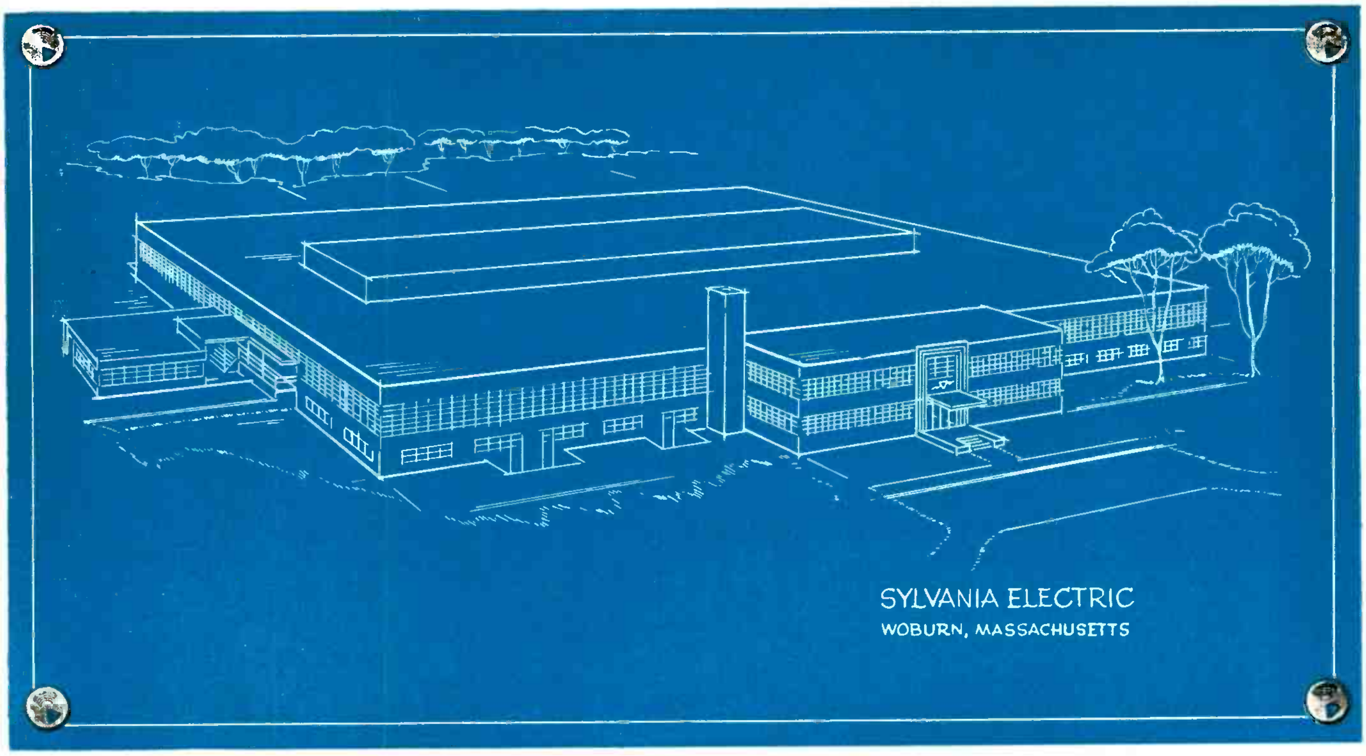
▶ **Breakdown**—Of the 68.2 percent using only representatives, 39.0 percent are component part makers, 17.6 percent equipment makers and 11.6 percent both equipment and parts makers.

Of the 10.1 percent using field offices exclusively, 5.8 percent manufacture equipment, 4.3 percent components.

Of the 21.7 percent using both representatives and field offices, 15.9 percent make component

(Continued on page 8)

Sylvania Electric Erecting New Headquarters For Its Electronics Division



Plant under construction at Woburn, Mass., 17 miles north of Boston. To make microwave components and semi-conductor devices.

To satisfy the growing need for electronic products, Sylvania will soon open a modern new plant at Woburn, Mass.

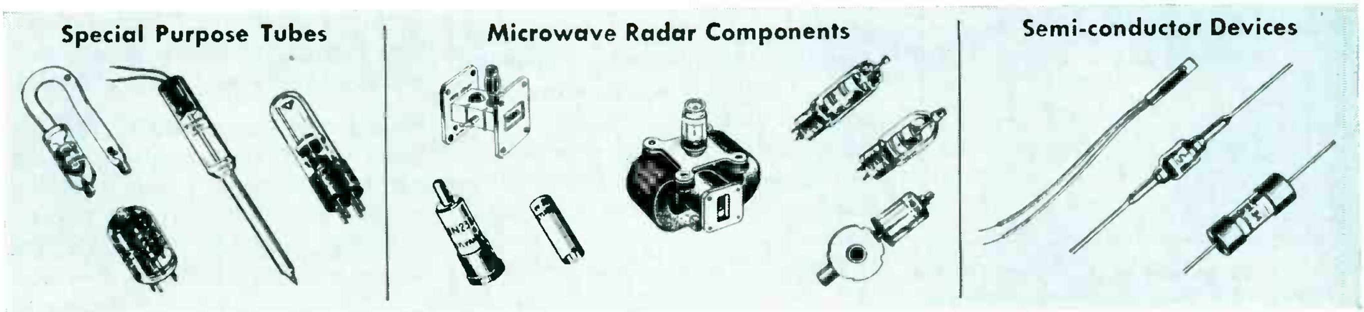
This building of advanced design will provide an additional 100,000 square feet of air conditioned laboratory and production facilities for the manufacture of electronic equipment and components. When completely equipped, it will represent an investment of four million dollars. The new plant will serve as headquarters for all present Sylvania electronic production facilities in the Boston area.

With these greatly expanded plant facilities, Sylvania is assuring you of the newest and best electronic components for radar, television, communications and industry.

SYLVANIA

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

ELECTRONIC DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

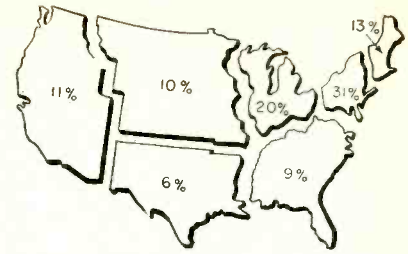


parts, 5.8 percent equipment and components.

The average number of representatives per company is 13.9. The average number of field offices is 6.1.

▶ **Commissions**—Commissions paid representatives range from 5 to 10 percent. Forty-five percent of the companies contacted have 'sliding-scale' plans, 55 percent do not. Thus the average commission varies from 3.7 to 8.4 percent.

When orders are taken in one territory and shipped to another, 42.3 percent of the factories split the commission, 57.7 percent give the commission to the ordertaker.



Geographically, Middle-Atlantic colleges dominate the young graduate supply picture

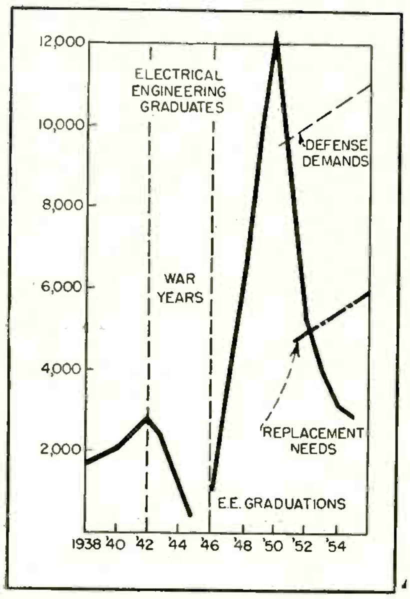
Supply of E. E. Grads Still Short

Industry fills only half its need this month. Worst is yet to come

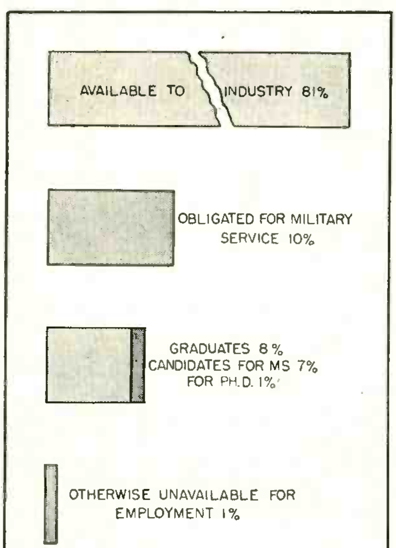
THIS MONTH'S crop of young engineering graduates will do little to ease the industry-wide shortage.

An ELECTRONICS' survey of 112 American engineering colleges (roughly 80 percent) reveals that only 3,450 graduate electrical engineers will become available for employment in June from these sampled schools. Ten percent of the graduates are reportedly committed to the armed forces, while another eight percent have applied for graduate work. The bar graph gives the overall picture.

▶ **Industry Needs**—Industry estimates that 5,000 engineers are needed to fill vacancies created by death and retirement and to meet growing commercial needs. Defense production could easily assimilate twice this number. Recruiters report only $\frac{1}{3}$ to $\frac{1}{2}$ acceptance of offers made along the college circuit.



Long-term trends show an increasing shortage of engineers for the next three years



Only 81 percent of this month's E. E. graduates are available to employers

The long-term trend of engineering graduations offers little consolation to harried employers. Normal scholastic attrition will reduce the supply of young E. E. graduates to a scant 2,900 by 1955. An intensive advertising campaign sponsored by the Engineering Manpower Commission of the Engineers' Joint Council, directed towards high-school seniors, may produce an up-turn in the curve after 1955.

The supply and demand curves for electrical-engineering graduates are extrapolated, using engineering-college enrollment figures and normal attrition rates. Data excludes military demands.

The map shows the geographical distribution of this month's E. E. graduates. Nearly $\frac{1}{3}$ of the graduates will come from colleges in the Middle-Atlantic area which encompasses New York, New Jersey, Pennsylvania and Delaware.

Shannon's Mouse Learns Fast

ABILITY in an individual might well be measured by his capacity for finding his way through a problem logically and then following similar logic in nearly identical situations. When the situation changes he must be able to combine new logic with old. Shannon's mouse does just this because it is motivated by an electrical brain that is the product of Claude E. Shannon, in the employ of Bell Telephone Laboratories.

▶ **Magnetic Rodent**—The mouse is actually a dressed-up bar magnet with three wheels, copper whiskers and a contact mechanism on his tummy. His playground is a maze about half the area of a desk top. The maze is studded with slotted posts into which can be fitted aluminum fence sections. The rewarding cheese is an electrical contact with bell attached.

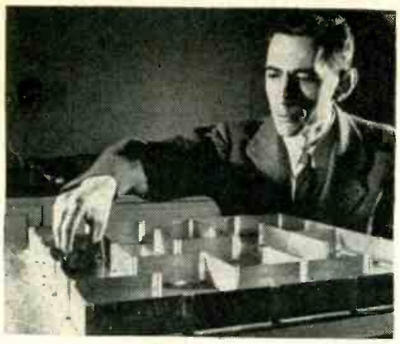
▶ **Learning**—In practice, the desired maze conformation is set up, the cheese is placed and the mouse set down at the chosen starting point. It may take him as long as two minutes, by trial

(Continued on page 10)

This complete guide to Sprague dry electrolytic capacitors designed to meet military requirements will gladly be sent to electronic engineers and purchasing agents on letterhead request. Sprague's new Catalog 11 is printed in large, clear type to facilitate ready reference to its 24 pages of military capacitor information. Write for your copy today to the Application Engineering Dept., Sprague Electric Company, 35 Marshall Street, North Adams, Massachusetts.

PIONEERS IN ELECTRIC **SPRAGUE** AND ELECTRONIC DEVELOPMENT

World's Largest Capacitor Manufacturer



Dr. Shannon places his mouse in a maze through which it is unerringly guided by an electric brain to the 'cheese' goal. Succeeding trips take about 10 percent of the time of the initial tour

and error, to reach the cheese. He is pulled along by a motor-driven electromagnet beneath the maze.

Whenever his whiskers touch the fence, he makes a fresh start. But once the shortest path has been established, the mouse on later trips proceeds directly to the cheese in 12 to 15 seconds. His thinking is done by an electric brain containing about a hundred relays and two motors.

U.S. Buys Mica

TOP-GRADE RUBY MICA for the national stockpile will be purchased from U.S. producers by the General Services Administration (GSA) under a three-year, 25,000-ton program designed to encourage domestic mica production.

By paying prices averaging almost four times current foreign prices, GSA hopes to quadruple present domestic output. Approximately 4,500 tons of mica are produced here annually but only about 300 tons is top-grade. One ton of this will yield less than ninety pounds of the quality suitable for stockpiling.

► **Mica Producers Protest**—Domestic mica producers have raised a vigorous howl because only top-grade ruby mica will be stockpiled. They contend that green mica is just as good for the purpose. But, until the electronics industry and the American Society of Testing Materials give the word, mica stockpile specifications will not be changed.

PRODUCTION AND DELIVERY FIGURES FOR TRANSISTORS

	Current Monthly Production		*Delivery Time (weeks)*		
Company	*Contact*	*Junction*	*Contact*	*Junction*	*Future Availability*
Federated Semi-Conductor	none	none			*modified junction*—1,000 per month by July 1952. Sample lots available now
General Electric	800	none	6–8		*contact*—substantial monthly increases, dependent on orders. *junction*—sample lots Oct.-Nov. 1952
Kemtron	none	none			*contact*—sample lots Sept. 1952
RCA	400	none	4–6		*contact*—2,000 to 3,000 per month by Dec. 1952 *junction*—sample lots Oct.-Dec. 1952
Radio Receptor	200	none	4–8		*contact*—5,000 per month by Dec. 1952 *junction*—undetermined
Raytheon	1,000	none	4		*contact*—monthly increases to meet orders *junction*—sample lots by Nov.-Dec. 1952
Sylvania	none	none			*contact*—sample lots by Aug. 1952 *junction*—undetermined
Western Electric	6,000	less than 100	4–8	not quoting	*contact*—substantial monthly increases, dependent on orders *junction*—some monthly increase

Transistor Supply Increases

Recent NPA amendment allows limited shipment to research and development organizations

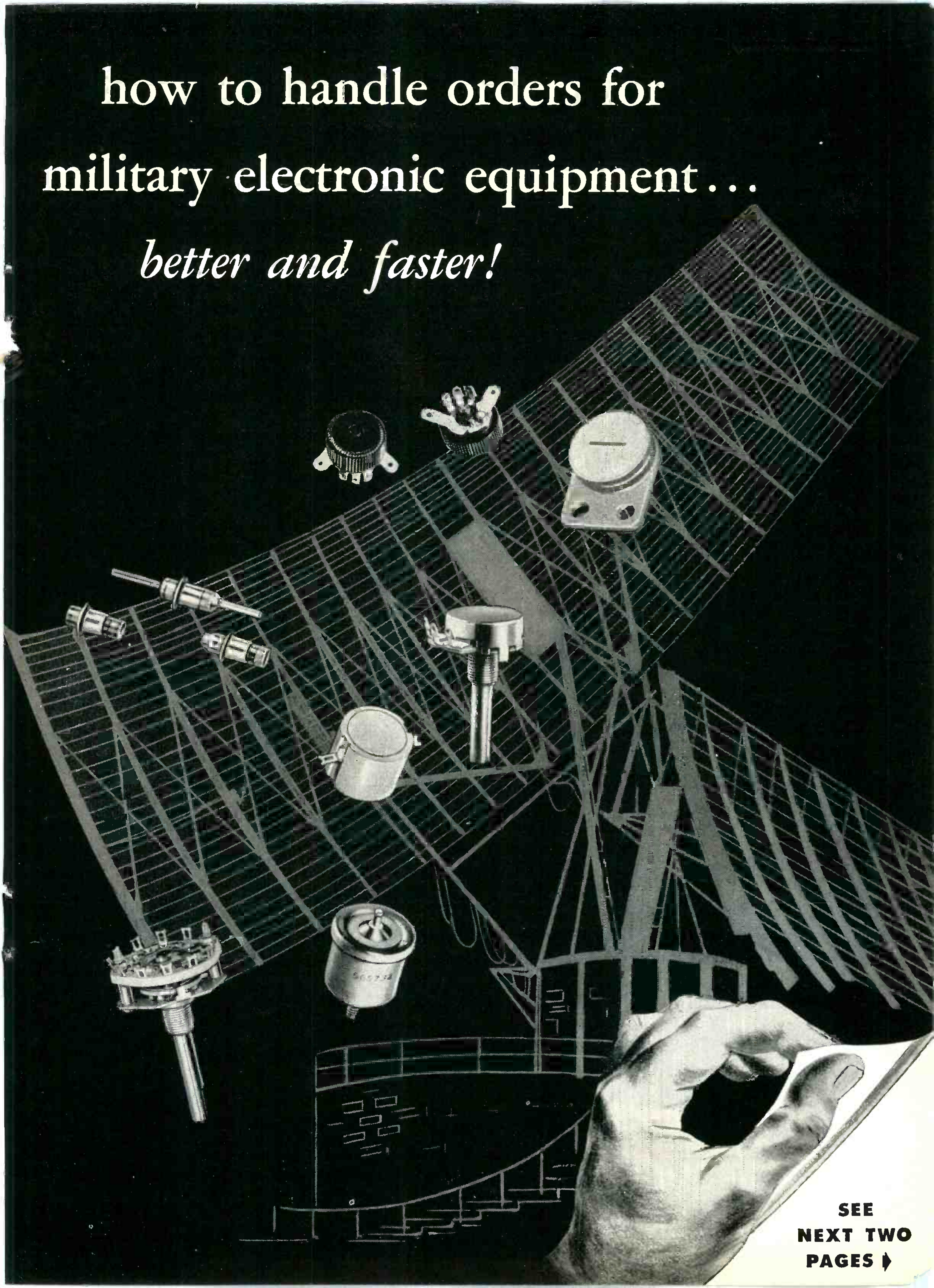
STILL NOT PLENTIFUL, even for military applications, transistors are nevertheless slowly but surely being made available for general experimental use. The accompanying table shows current availability and hopes for the future, according to Lt. Col. William F. Starr of the Electronics Production Resources Agency.

► **Allocations**—The military is allocating the transistor production of the Western Electric Company only. So far, this has been limited to military contracts accepted by that company.

With a recent amendment of an NPA regulation, other transistor manufacturers may deliver 100 percent of their production to laboratories and research organizations under certain conditions. Up to ten percent of their monthly production of each type transistor (point contact and junction) may go to any 'rated' order on their books.

But no one customer is to

(Continued on page 14)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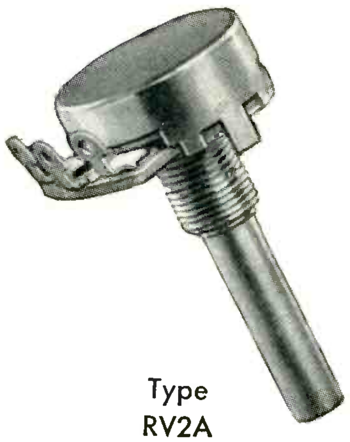
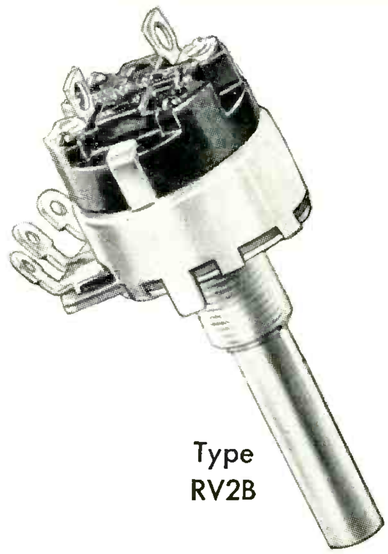


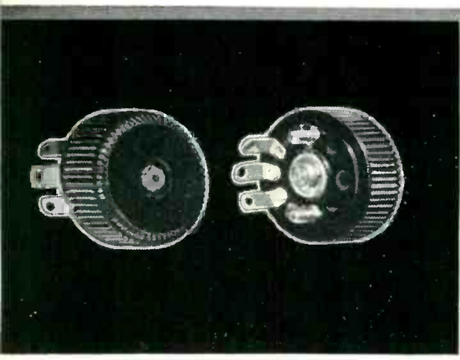
Type
RV2A



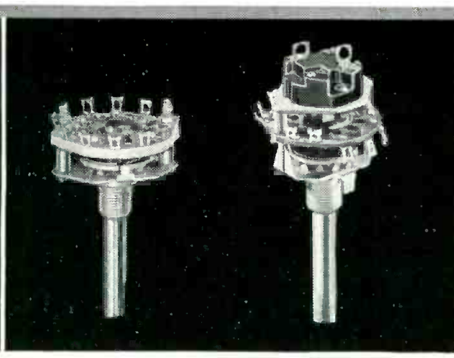
Type
RV2B

CENTRALAB MODEL 2 VARIABLE RESISTORS

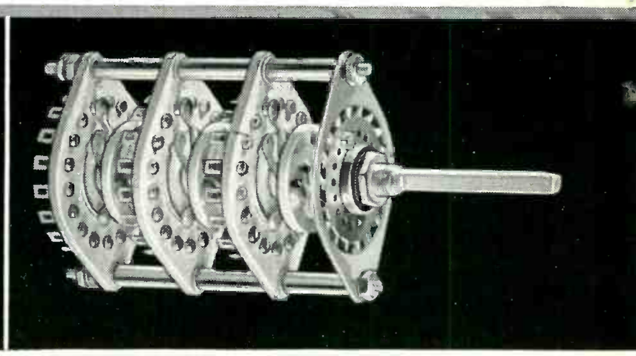
There's no prior contract approval or waivers required if you specify Centralab's Model 2 variable resistors on your next military order. They meet JAN R94, characteristic U requirements. Two types available — RV2A and RV2B — plain or with attached switches. Ratings from 2000 ohms to one megohm. For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



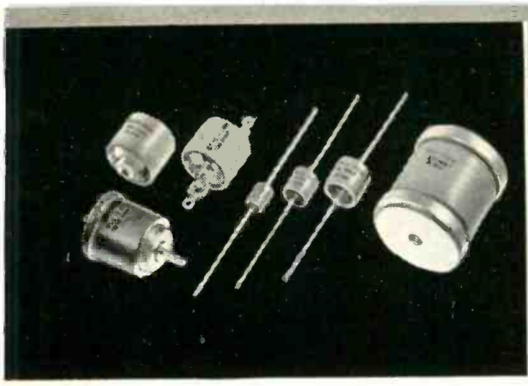
Model 1, miniature variable resistors . . . no bigger than a dime . . . available in Standard or Hi-torque types. Either with or without on-off switch. Also available with slot — front or rear — for screw-driver adjustment. Hi-torque units hold settings under conditions of vibration or shock. For complete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



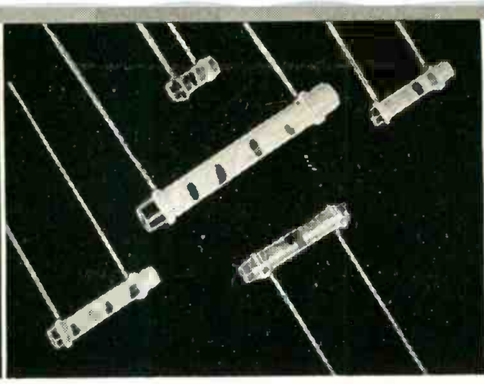
For miniature switches — specify Centralab's Series 20 with Steatite or Phenolic sections. Steatite is Grade L5. Meets JAN I-8 specs. Phenolic sections conform to JAN P-13 . . . Grade LTSE4. Available in 2 to 11 positions with stops, or 12 positions, continuous rotation—single or multiple sections—with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



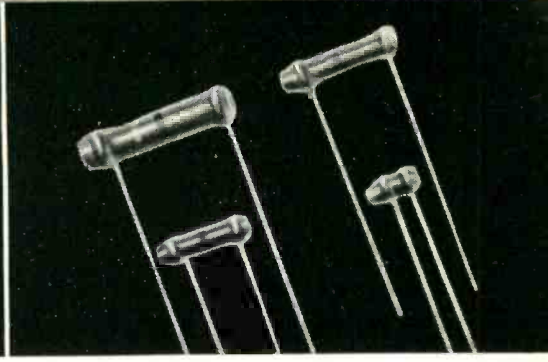
Centralab's Medium-Duty Power Switches. Use for R. F. or 110-115 V. application . . . 7½ amps. Voltage breakdown to ground — 3000 volts — RMS 60 cycles. Available with Grade L5 (JAN I-8) Steatite sections — shorting or non-shorting contacts. Models in 1, 2 or 3 poles, 18 contacts per section with adjustable 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.



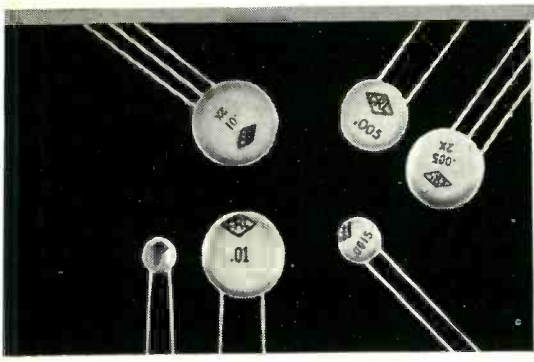
Centralab's Type 850 high voltage ceramic capacitors are especially designed for high voltage, high frequency circuits. Centralab's Type 950 high accuracy ceramic capacitors are especially developed for exacting electronic applications. Check bulletin No.'s 42-102 and 42-123.



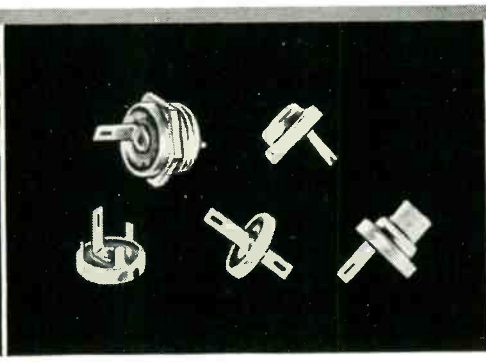
TC (Temperature Compensating) Tubulars — No prior contract approval or waiver necessary. Meet JAN-C-20A requirements. Type TCZ shows no capacitance change over wide range of temperature. Type TCN has special ceramic body to vary capacitance according to temperature. Bulletin No. 42-18.



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.

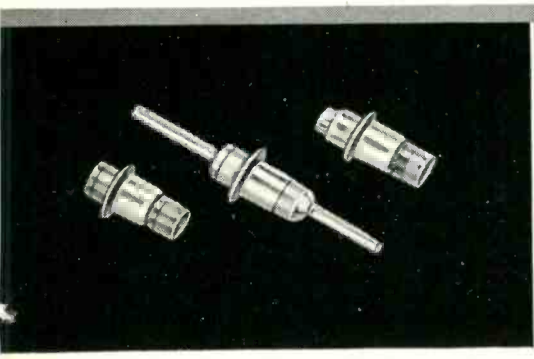


Ceramic Disc Hi-Kap Capacitors hold thickness to a minimum . . . have very high capacity in extremely small size. Use in h.f. circuits for bypass and coupling. Ceramic body assures low inductance. Other characteristics—humidity resistance, power factor, etc. — similar to BC Tubulars, Bulletin No. 42-4R.

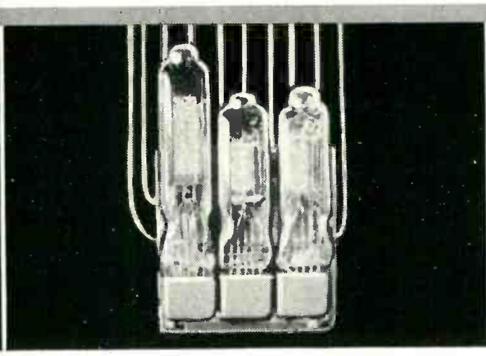


Something new in miniature ceramic capacitors! These "button types" are available in 5 different styles. Used for bypassing in low-power, high-frequency applications where small size, low inductance and light weight are essential. Check Bulletin No. 42-122 in coupon for more information.

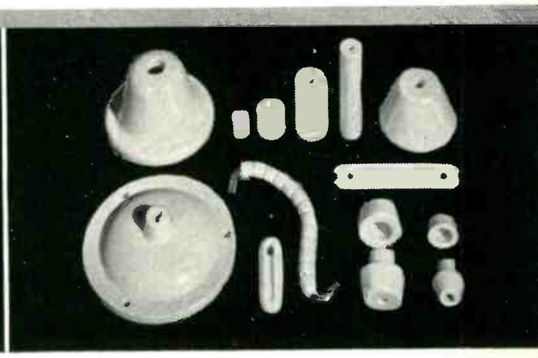
Centralab Ceramic Trimmers meet applicable portions of JAN-C-81. Very small size. Screw driver adjustment over full capacity range (180° rotation). Maintain stability in any position and under vibration. Spring pressure contact for rotor and stator. Bulletin No. 42-101.



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 $1\frac{1}{32}''$ (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.

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Experimental megaphone developed by General Electric is completely self-contained, with transistors and small batteries located in unit near mouth-piece

receive more than 50 transistors of each type in a given month.

▶ **New Type**—Latest news is that point-contact and *n-p-n* or *p-n-p* junction transistors (p 18, Feb. 1952) may have a competitor in what the manufacturer calls an '*n-p* junction' transistor, said to have properties of both point-contact and junction types. The device is being made by Germanium Products Corp., Jersey City.

Experts Cite Progress of All-Weather Flying

New 'Common System' of electronic navigation will serve commercial, private and military aircraft

GUESS-FREE flying with the aid of new electronic navigation and communication facilities has made real progress since the so-called 'common system' for all types of aircraft was adopted shortly after World War II, according to a panel of experts speaking in Dayton, May 12, at the National Conference on Airborne Electronics.

▶ **Status** — Equipment now installed or being installed will soon permit safe flight anywhere in the United States under virtually all conditions of weather. Plans call for some 500 omnidirectional range stations, of which 352 are now in operation. All but 50 of the planned stations will have distance-measuring facilities, thereby providing pilots with complete navigation information.

At major air terminals, extensive radar and blind landing systems are specified, with a total of 180 instrument-landing systems provided for. Already 98 landing systems are in operation, landing aircraft in all but the foulest weather, and 70 more are in various stages of survey and installation.

Airport surveillance radar now polices the air around ten major airports, and plans call for 73 more of these high-power radar sets, of which 43 are in various stages of completion.

Precision-approach radar, which serves as a check on the ILS equipment, will be installed in 57 high-traffic-density terminals; ten are already equipped and thirteen more well on the way.

New York-Chicago airways are now fully equipped with all these aids, permitting evaluation. Results to date indicate enthusiastic acceptance by pilots and ground control personnel alike.

▶ **Still Needed**—Improved means for presenting radar information are constantly being sought. Also under study are aircraft identification schemes and means for remote radar viewing.

Work is under way to increase the capacity of ground teletype links from 60 to 100 words per minute. Automatic relaying and message sequencing systems are being applied to make more efficient use of available ground communications facilities.

Marine Engineers Discuss Communication and Navigation Aids

BRITISH private enterprise is pushing hard for its favorite marine communication and navigation systems; and this in spite of international agreements to the contrary.

At the Atlantic City Radio Conference in 1947, Britain agreed that frequency modulation would be used on the international calling and safety frequency of 156.8 megacycles in North and South America, and would be recommended for the rest of the world. But two years later, the British Postoffice Department (whose engineers are at odds with those of the British Broadcasting Corporation over f-m) announced that it would employ amplitude modulation.

▶ **American Practice** — Engineers and mariners attending the Spring assembly of Radio Technical Commission for Marine Services at Kings Point, Long Island, heard C. M. Jansky, Jr. present details of an 11-channel f-m system centered on the international safety frequency. Large vessels plying the Great Lakes will use this communications net that is common to the United States and Canada. Neither this nor any similar marine system is directly capable of intercommunication with a-m systems and so could not be used in English ports.

▶ **Decca Navigator** — Sir Robert Watson-Watt, godfather of British radar and international consultant, said with a twinkle, "Americans should like Decca because it was invented bv an American (W. J. O'Brien) and has been developed by private enterprise" (the transmitting stations are operated by the Company and the navigators' equipment is leased).

According to a series of international agreements, loran and shipboard direction finders are the chosen facilities for navigation from 3 to 800 miles from land and the necessary radio transmissions

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an **OUNCE**

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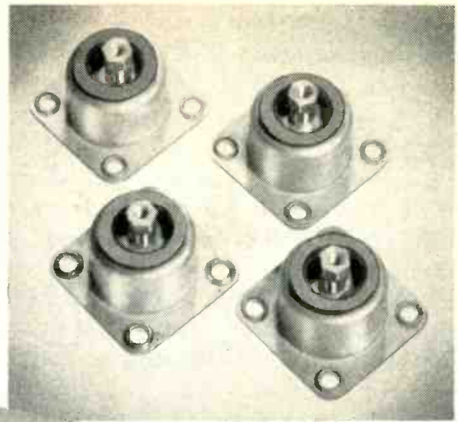

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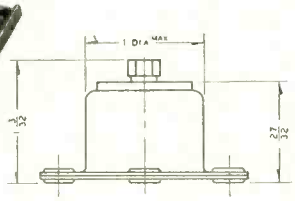
Protection

Photo courtesy Vapor Heating Corp.



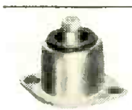
insures the reliability of your equipment.

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

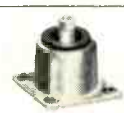
1. Less space — reduced height cuts cubage of mounted equipment.
2. Less weight — only 5/16 ounce per unit isolator.
3. Wide load range — 0.1 to 3.0 pounds per isolator.
4. Satisfy temperature (−67 to +170F), vibration, and other performance requirements of JAN-C-172A — special models available for extreme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

TYPE 6475

TYPE 6695



TYPE 6465



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

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SALES REPRESENTATIVES IN

Atlanta Chicago Cleveland Dallas Dayton Detroit Los Angeles Minneapolis New York Philadelphia Phoenix Rochester St. Louis San Francisco Seattle Toronto Washington are government operated. Decca, incomplete when the agreements were framed, now seems foolproof and operable up to 300 miles. It is inherently more accurate at short range, but wasteful of radio frequencies. Loran uses a single radio frequency for its Atlantic Coast and Gulf chains, whereas each Decca 'fix' requires four frequencies. Many more Decca stations (and frequencies) are needed to cover a given area than those required for loran.

Although the RTCM session at Kings Point was only a forum for discussion, the American viewpoint for standardization on f-m and loran was clearly defined. Refusing to be drawn into argument, the British politely indicated that they liked Decca, could find little fault with a-m, and felt that 'regional agreements' could find a way around the frequency allocations already set up.

Midget Wire-Recorder

On the market in West Germany is this 1⅜ by 4⅜ by 6 11/16-inch unit selling for 680 deutschmarks ($162). It runs on four internal dry batteries (two in parallel power a 9-volt motor) and holds enough 0.05-millimeter wire to operate continuously for 150 minutes at 30 centimeters per second

NPA Relaxing On Color-TV Ban

Move clears air but few polychrome sets will immediately find their way into homes as a result

MORE APPARENT than real will be the lift given color television by limited relaxation of NPA's ban on materials, which appears imminent.

Revised several times at the suggestion of other government agencies, the relaxation order gives a pale green light to manufacturers of color receivers designed for use in theatres and for educational and industrial uses. These are essentially 'closed-circuit' applications requiring relatively small quantities of materials.

Implied in the order is permission to produce 'home-type' color-tv sets in quantities sufficient to facilitate public demonstrations.

▶ **Jokers** — Manufacturers must prove that restraint of plans to produce even experimental color-tv sets represents a serious business 'hardship.' They must produce sets within present materials-allocation commitments. And they must assure the government that engineers will not be diverted from important military projects.

Further complicating the course of manufacturers wishing to get in on the ground floor with color is the fact that there are no color-tv broadcast programs on the air at the moment. Nor is there any indication that resumption of such programming is imminent. Expansion of monochrome-tv coverage resulting from lifting of the 'freeze' is, furthermore, expected to keep manufactures preoccupied for some time. Thus few color-tv receivers are apt to find their way into homes by any path in the immediate future.

Essentially, NPA's relaxation order appears to get that agency 'off the hook' on the only 'single item' ban on its books, and one that has been embarrassing internally.

Military Pressing for Better Components

New materials and techniques point way toward more reliable performance

CUTTING DOWN equipment 'out time' caused by component parts failures is a major headache of the military. For example, a recent study showed that 60 percent of Navy electronic equipment in the active fleet was not operating satisfactorily.

As a result, manufacturers are going all out to increase the reliability of each and every part going into electronic gear, as evidenced by the recent Quality Electronic Components Symposium in Washington.

▶ **Basic Building Blocks**—Electronic equipment, like the proverbial chain, is only as good as its weakest link. Resistors, capacitors and inductors as well as the oft-blasphemed tube have been responsible for a high percentage of unnecessary failures.

Such new components as glass and borocarbon resistors; glass, tantalytic and aluminum capacitors; ferrite inductor cores and magnetic ceramics show promise for increased reliability if used where specifically applicable. They lead the way toward desirable characteristics like satisfactory operation at higher temperatures and secondary advantages of savings in space and weight.

▶ **Other Parts**—Fuses, relays, wire and cable are also guilty of causing needless equipment failures. Delayed-action fuses, twin-contact relays, wire insulation of Teflon and other resins are the outcome of search for increased reliability along these lines.

One major cause of breakdown

(Continued on page 18)

apparently is due to improper design specifications, especially with vacuum tubes. To combat this situation, many companies have set up components sections to check and change, if necessary, components specified by other design engineers.

New Radar Eyes Aid Ships and Aircraft

MARINE NAVIGATORS are well ahead of their airborne contemporaries in the use of radar for collision prevention, according to Capt. Lawrence M. Harding, assistant engineer-in-chief, U. S. Coast Guard. He proposed a radar beacon system, which by permitting nearly every buoy, light or daymark to be identified, would insure better pilotage and safety for many of the 500,000 U. S. small boats.

▶ **Radent**—At present, a ship must go through a maneuver to indicate which 'blob' it is on a harbor controller's scope. Now pulses can be fed back through a communications channel and displayed on the harbor controller's scope as a tail immediately following the blob representing the ship.

Although this system uses a wide band of frequencies that is not now available, FCC could legalize its use. F. W. Herring of the Port of New York Authority says cash losses alone owing to harbor delays cost upwards of $225,000 a year.

▶ **In the Air**—Military-commercial bid for air leadership resides in the new lightweight radar, AN/APS-42, weighing 173 pounds, developed from Navy BuAer and American Airlines specs.

Because of its high operating frequency (9,375 megacycles) the device can 'see' thunderheads and other severe weather hazards. Such information is important to fast jet aircraft.

▶ **Facts and Figures**—The device can be used for radar mapping up to 200 miles and it will operate ground identification beacons at 150 miles.

Perhaps the new radar's greatest drawback for aircraft that can somehow struggle along without it is the cost: $13,000.

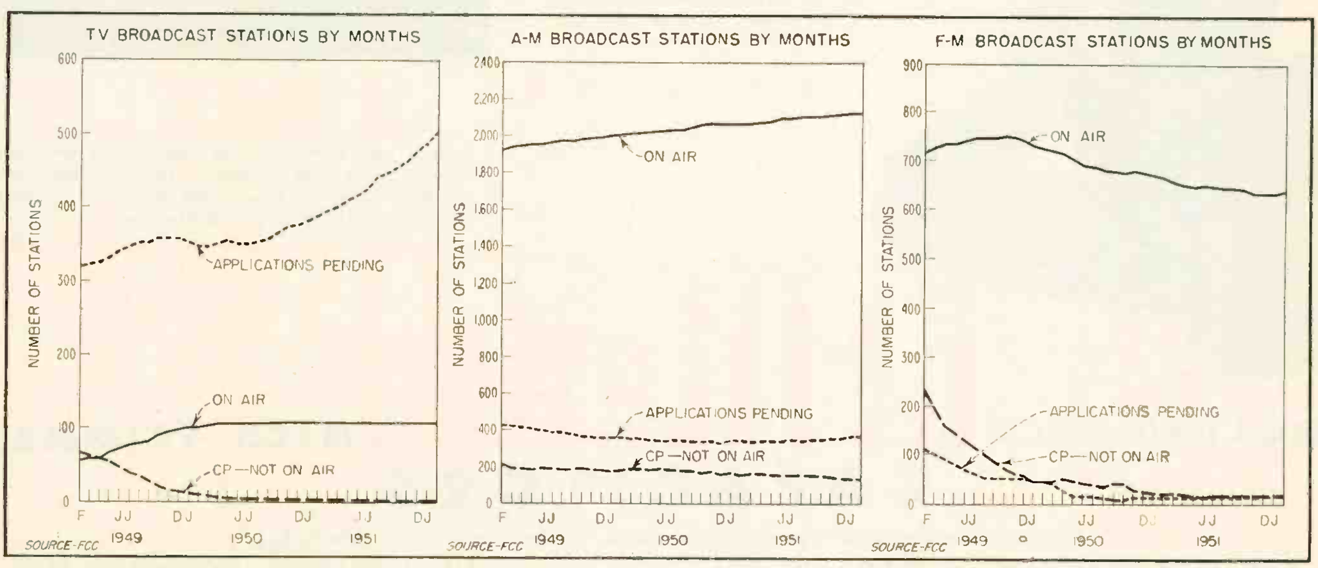
Radar identification system shows harbor control radar which ship is which. Pulses picked up by microwave horn (center) are fed back through communications radio set

What's Behind the Figures—Broadcast Station Statistics

Fourth of a series outlining background of entries in *Figures of the Month* page

FOURTH listing on the *Figures of the Month* page (p 4) comprises the monthly statistics on broadcast stations compiled by the FCC. The figures represent station totals on the last day of the month indicated.

Stations "on the air" include outlets actually licensed, or operating on special temporary authority. The entry "CP-not on air" refers to stations for which construction permits have been issued, but which have not yet been authorized to offer a program service to the public. "Applications" refers to the number of ap-



(Continued on page 20)

Q: *Are all brands of Resistors similar in Quality, Specifications and Performance?*

A: *Naturally, no! That's why **DAVEN** has earned the right to add a superlative in naming its line*

SUPER DAVOHM

PRECISION WIRE WOUND

RESISTORS

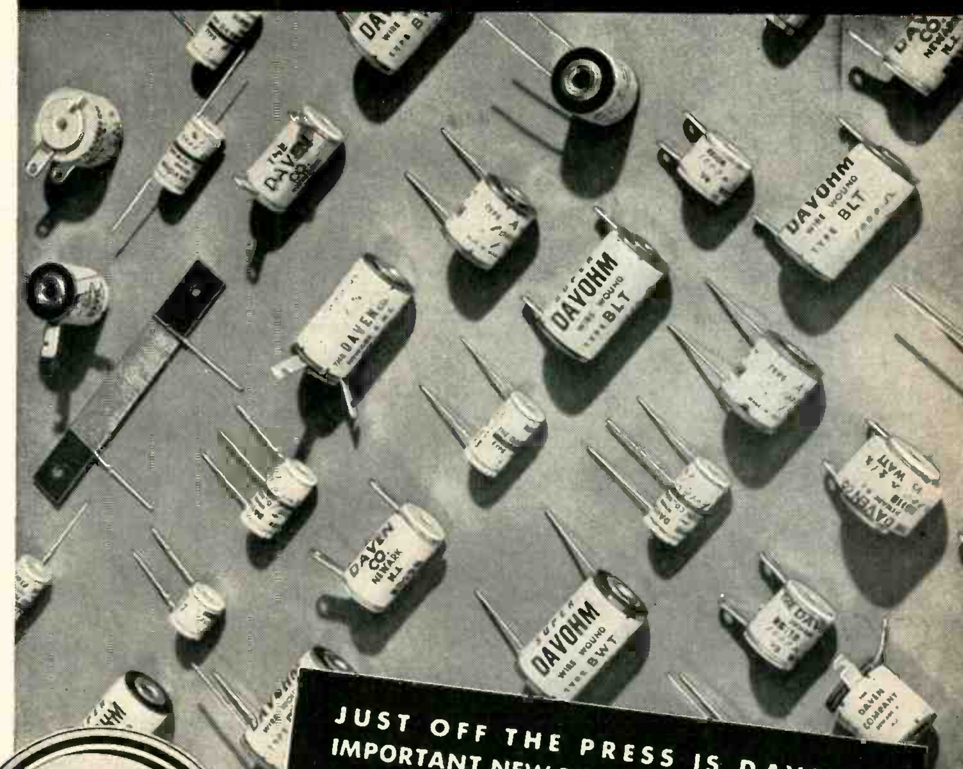
● Brands of Resistors vary as widely in the completeness of a line and in performance, as do brands of any other product.

DAVEN originated the first pie-type, wire wound Resistor more than a generation ago. Since that time, DAVEN has designed and manufactured Precision Wire Wound Resistors of every conceivable type to meet the increasing demands of the electronics industry.

SUPER DAVOHM RESISTORS are noted for their high stability and accuracy under extreme temperature and humidity conditions. DAVEN Resistors are made in accordance with JAN-R-93 specifications and are in use in all types of Army, Navy and Air Force electronic equipment.

DAVEN has developed special small precision Resistors for use in miniaturized assemblies. All types of mountings, sizes, tolerances and temperature coefficients are available from a large variety of standard types. That's why DAVEN can fill your precision Resistor needs.

Take advantage of DAVEN's advanced engineering and manufacturing techniques to help with any Resistor problem confronting you.



JUST OFF THE PRESS IS DAVEN'S IMPORTANT NEW BULLETIN ON RESISTORS.

Write for your copy today and prove to yourself, from the information supplied, that when you order Resistors you should specify only . . .

SUPER DAVOHM Precision Wire Wound RESISTORS

THE **DAVEN** CO.

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plications for broadcast authorizations on hand at the offices of the Commission at the end of the month, on which no authority to proceed with construction had then been issued.

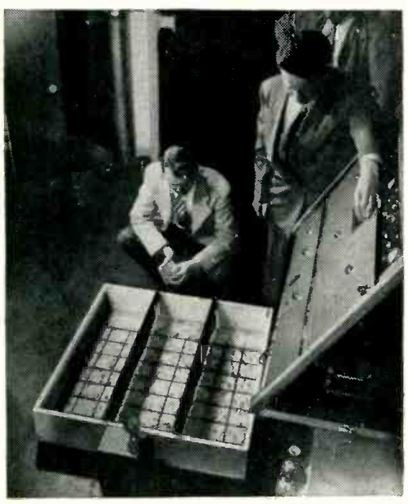
▶ **Three Services Charted**—The accompanying charts show the trends in stations on the air, construction permits and applications for the three classes of stations from early 1949 to the present.

The effect of the freeze on tv stations is clearly indicated by the static level of the "on air" and "CP" curves. The interest in new tv stations resulting from termination of the freeze order is shown in the steeply rising "applications" curve.

Amplitude-modulation stations on the air have had a steady growth during the past three years. Applications fell off slightly in late 1950 and early 1951 but are now rising.

The f-m curves show that the peak of activity, so far as stations on the air is concerned, occurred late in 1949. This was followed by a definite decline in 1950, but the situation as of the present seems stabilized. Interest in new f-m stations, as indicated by the CP and applications curves, is at a low ebb.

Protecting Small Fry



Biologists at Montlake Laboratory, Seattle, have found that positive-polarity electronic impulses attract salmon fingerlings away from dangerous areas. Commercial application of the idea could substantially swell the annual catch

Military Contract: Bid Cautiously

Getting an order does not necessarily mean making a profit, Services are told

MAKING A BUCK on a military contract after you get it is no mean task. This, at any rate, was the impression given by manufacturers discussing their problems with high government officials at the Armed Forces Communications Association national convention in Philadelphia.

▶ **Industry's Beef**—Among the things that reduce and frequently eliminate expected profit on military business are:

- Small initial billings, insufficient to permit anticipated production economies.
- Frequent minor design changes.
- Policy changes by top government 'brass' affecting contract interpretation.
- Over-zealous interpretation of fine-print specifications by inspection officers who live 'by the book.'

Further complicating the lives of manufacturers is the growing tendency of government auditors to squeeze a contract dry when 're-determination' occurs at the 40-percent completion point. A future worry is the possibility that a provision of the Walsh-Healy Act may, by July 1, be interpreted to mean that prime contractors have to assume responsibility for the labor policies of their subcontractors.

▶ **Military Problems**—The Military thinks many manufacturers lose money on government contracts because they are hot after the business and fail to study contract terms closely before taking the plunge.

The Services also say that spreading out contracts to a large number of firms, as directed by top civilian government officials, is frequently inconsistent with their needs and facilities.

TV Receiver Price Squeeze?

Sets cost more to make, dealers want more profit, public expects lower prices. Stalemate?

OUT of springtime doldrums, new television design and sales trends are slowly emerging.

"Inboard" pricing, wherein federal tax and warranty are included in the list price of the set, is just about here. Major holdouts are Emerson, Crosley and Philco. Dealers appear to be happy about the change because their margin is figured on the list price, and previous "outboard" prices gave them nothing for collecting tax and warranty money.

▶ **Price Cuts**—Practically every make and model of tv set was slashed in price this spring. Reductions were large enough in many cases to show, even with simultaneous change to inboard pricing by manufacturers.

Customary summer debuts of new models were advanced to April and May by some manufacturers, partly as sales shots-in-arm and partly to get around price-protection agreements with distributors and dealers. Behind the scenes is more price cutting, to push at least some of the 1.5 million inventory of sets down the channels of distribution.

Super-fringe receivers now demanded by the public cost more to produce, but can't be sold for more, so once again the manufacturers are squeezed. Chances of salvation this summer by political convention telecasts or too-slowly-unfreezing vhf get slimmer and slimmer.

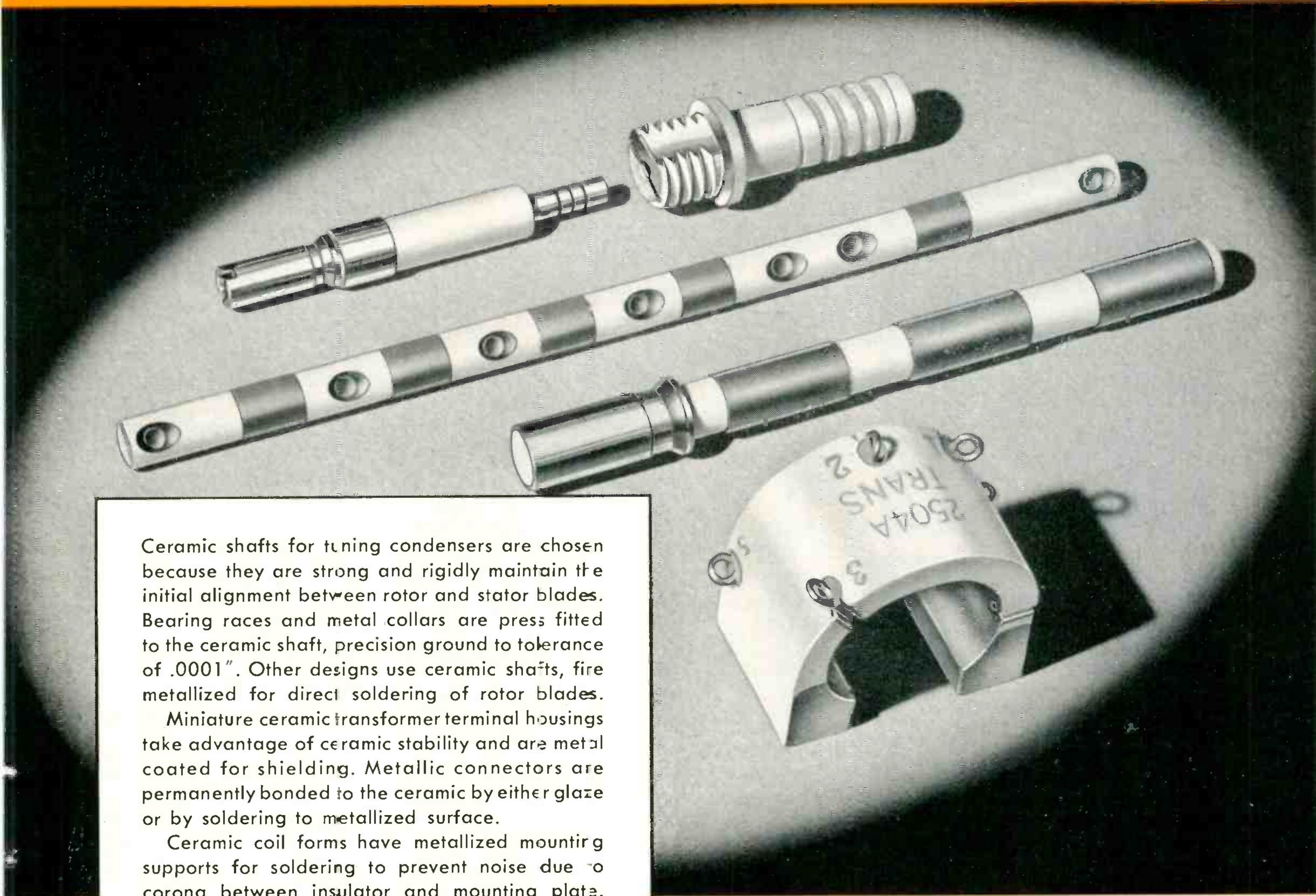
▶ **Preparing for UHF**—The present slow market precludes boost-

(Continued on page 22)

AMERICAN LAVA CORPORATION

Spotlights ALSIMAG®

METAL-CERAMIC COMBINATIONS



Ceramic shafts for tuning condensers are chosen because they are strong and rigidly maintain the initial alignment between rotor and stator blades. Bearing races and metal collars are press fitted to the ceramic shaft, precision ground to tolerance of .0001". Other designs use ceramic shafts, fire metallized for direct soldering of rotor blades.

Miniature ceramic transformer terminal housings take advantage of ceramic stability and are metal coated for shielding. Metallic connectors are permanently bonded to the ceramic by either glaze or by soldering to metallized surface.

Ceramic coil forms have metallized mounting supports for soldering to prevent noise due to corona between insulator and mounting plate.

Our broad experience in metal-ceramic combinations is available to you on request.

50TH YEAR OF CERAMIC LEADERSHIP

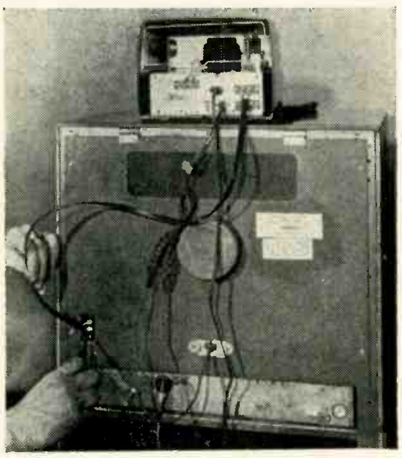
AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N. J., Mitchell 2-8159 • PHILADELPHIA, 1649 North Broad St., Stevenson 4-2823 SOUTHWEST: John A. Green Co., 6815 Oriole Drive, Dallas 9, Dixon 9918 • NEW ENGLAND, 1374 Massachusetts Ave., Cambridge, Mass., Kirkland 7-4498 LOS ANGELES, 5603 North Huntington Drive, Capitol 0901 • CHICAGO, 228 North LaSalle St., Central 6-1721 • ST. LOUIS, 1123 Washington Ave., Garfield 4959 ing of cost and list prices by building in uhf tuners, yet the public demands protection against obsolescence when uhf stations go on the air.

Strips for unused channels on tuners are the interim answer of many manufacturers, despite potentialities for interchannel interference and the limit to a total of 12 vhf and uhf stations combined.

Up to 30 stations will be within normal receiving range of some cities when all stations provided for by new allocations are on the air.



One minute's work with screwdriver changes over any Crosley receiver to get all 82 tv channels. New "Ultratuner," on top of set, has built-in loop for nearby uhf stations, will sell for around $40, works only on sets having continuous tuning through 127 megacycles

Adapters and converters that receive all 70 uhf channels are already in production in some plants, though at low volume. Immediate intent in many cases is to protect goodwill of existing customers rather than develop a big new market.

The history of radio reveals a precedent for this thinking; shortwave adapters and converters for radios were soon replaced by multiband radios.

The goal and shining hope among manufacturers today is for eventual widespread replacement of existing tv sets with all-in-one 82-channel sets.

MEETINGS

JUNE 8-12: National Association Electrical Distributors, Ambassador Hotel, Atlantic City, N. J.

JUNE 16-20: Summer Meeting, American Crystallographic Association, Camp Tamiment, Pa.

JUNE 23-27: AIEE Summer General Meeting, Hotel Nicole, Minneapolis, Minn.

JUNE 23-27: American Society for Testing Materials, Statler Hotel, New York, N. Y.

AUG. 11-21: Congress of U.R.S.I. Sydney, Australia.

AUG. 12-15: 1952 APCO Conference, Hotel Whitcomb, San Francisco, Calif.

AUG. 15-16: Emporium Section, IRE, Annual Summer Seminar, Emporium, Pa.

AUG. 22-31: Grand German Radio and Television Exhibition, Dusseldorf, Germany.

AUG. 26-30: Australian IRE Radio Engineering Convention, Sidney, Australia.

AUG. 27-29: Western Electronic Show and Conference, Municipal Auditorium, Long Beach, Calif.

SEPT. 8-12: National Instrument Conference and Exhibit, Cleveland, Ohio.

SEPT. 20: Cedar Rapids Section, IRE, Communications Conference, Roosevelt Hotel, Cedar Rapids, Iowa.

SEPT. 22-25: NEDA Third Annual Convention and Manufacturers' Conference, Ambassador, Atlantic City, N. J.

SEPT. 29-OCT. 1: Eighth Annual National Electronic Conference and Exhibition, Hotel Sherman, Chicago, Ill.

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

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

Business Briefs

► **Radio** business need not worry too much about tv just yet, according to a Joint Radio Network Committee report. The year 1951 showed a gain of 9 million home sets.

On January 1, 1952, there were 105 million radio sets in use; 43 million primary sets in households, 34 million secondary sets and portables, 23 million in autos and 5 million in a new category listed as "institutions, dormitories and barracks."

► **Magnesium-Can** dry batteries are being field tested by the Army. The metal is more plentiful than zinc.

► **Bids** for the installation of a complete tv service are sought by the Uruguayan State radio service SODRE.

► **Air Freight** (p 76, Jan. '52) is intriguing more electronic equipment makers. Faster of course, shipment by this means involves less handling, less vibration, less crating and, perhaps of greatest importance, permits complex instruments having subassemblies or separate units to be interconnected at the factory so that they are ready to plug in and run on arrival.

Latest converts include Beckman Instruments and Hoffman Radio.

► **Pacific T&T** plans to spend more than $2 million this year on initial installation of a network of microwave relay stations between Portland, Oregon and Seattle, Wash., designed to provide additional long distance facilities.

► **Transistor Division** and factory is being set up by National Union Radio Corp.

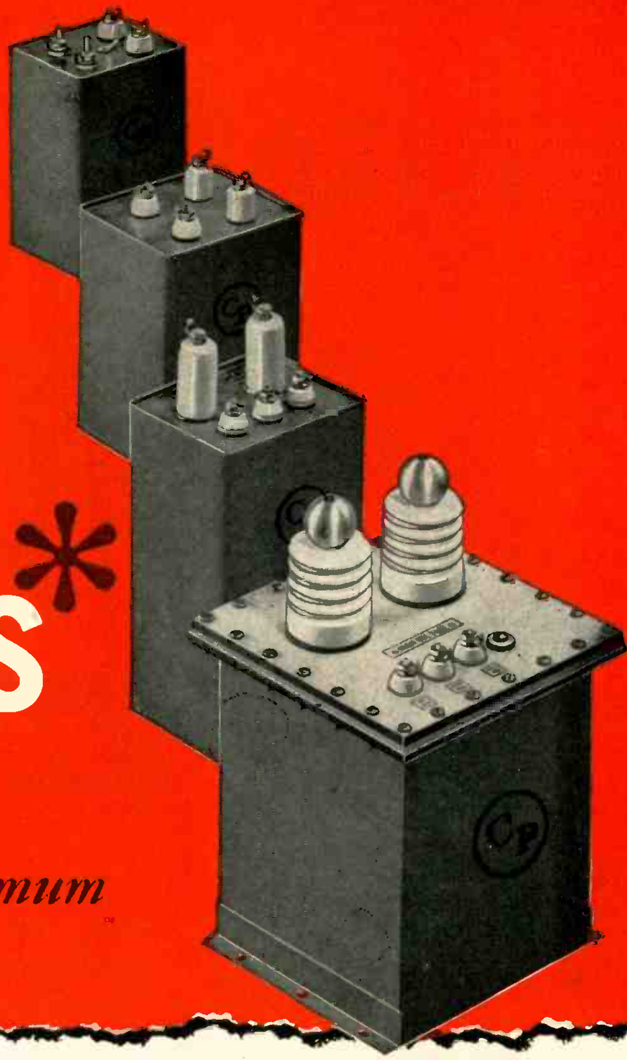
► **Holland** seeks foreign business and the Dutch Army is cooperating with the Utrecht Annual Trade Fair in exhibiting products for defense. Most orders are expected to go to the Dutch electronics industry and shipyards.

► **Brazilian** loudspeaker imports this year will be licensed only up to 25 percent of the value imported in 1950 because national manufacture now satisfies almost half of the country's requirements.

► **Economical** quartz paper developed by the Navy as an insulator appears to be an excellent material for use in radar antenna housings or radomes.

HiVolt Power Supplies*

where size and weight must be kept to a minimum



These hermetically-sealed, self-contained power supplies are designed to transform AC to high voltage—low current DC for many applications. Our exclusive engineering techniques and oil-filled construction assure smaller, lighter, more flexible units.

Applications:

- **radiation counters**
- **photoflash devices**
- **spectographic analyzers**
- **projection television sets**
- **dust and electrostatic precipitators**
- **oscilloscopes**
- **display tubes**
- **etc.**

Send us your requirements and we will recommend the best HiVolt Power Supply.

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* *HiVolt Power Supplies* . . . occupy as little as ⅓ the space; weigh as little as 20% of conventional supplies

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...Custom Designed for every Government and Military Application

CP dehydrators are readily adaptable to the critical requirements of the Armed Forces. Standardized parts permit rapid assembly of equipments suitable for practically any specialized need at minimum cost and without prolonged delay. Over a decade of CP experience in dehydrator design and manufacture insures products of long life and dependable service with an absolute minimum of maintenance. Inquiries are invited.

COMMUNICATION PRODUCTS COMPANY • Inc

MARLBORO, NEW JERSEY
Telephone: FReehold 8-1880

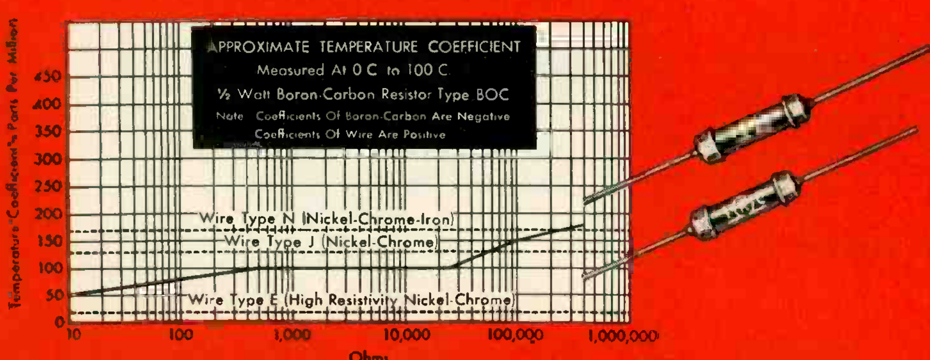
DIPOLE ANTENNAS, SWITCHES, Q-MAX LACQUER AND CEMENT

Ingenuity is *in resistors too!*

New Materials—New Techniques—New Advantages
Features in 4 New IRC Resistors

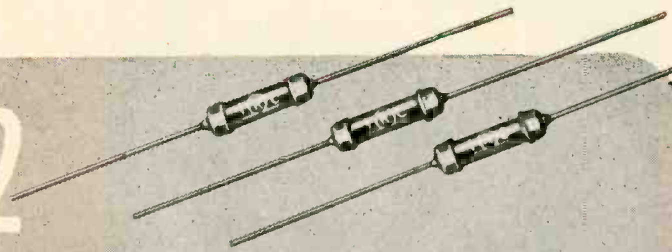
1 IRC Type BOC Boron-Carbon ½-Watt PRECISTOR Meets All Requirements of MIL-R-10509 Specification

No other non-wire-wound resistor combines the advantages of this all-new Boron-Carbon unit. Type BOC reduces the temperature coefficient of conventional deposited carbon resistors—provides high accuracy *and* long-time stability—replaces high value wire wound precisions at savings in space and cost. You'll find it adaptable to a host of critical circuitry needs—in electronics and avionics, communications, telemetering, computing and service instruments. Send for full details in Catalog Data Bulletin B-6.



Type BOC conforms to *all* requirements of MIL-R-10509. Exposed to a temperature of 65°C. for one hour, the new BOC shows a resistance change of less than .2%. High temperature operation with reliability is now possible. Voltage coefficient is less than 20 parts per million per volt. Load life is outstanding; on a 500-hour test at ambient temperature of 40°C., resistance change will not exceed 2%.

essential



2

New IRC Type DCC (Deposited Carbon) Small-Size, High-Stability Resistors

This is the latest small-size addition to IRC's famous line of deposited carbon PRECISTORS. Conservatively rated at ½ watt, it combines accuracy and economy—assures high stability, low voltage coefficient, and low capacitive and inductive reactance in high frequency applications. Recommended for:—Metering and voltage divider circuits requiring high stability and close tolerance—High frequency circuits demanding accuracy and stability—Other critical circuits in which characteristics of carbon compositions are unsuitable and wire-wound precisions are too large or expensive. Type DCC meets Signal Corps Specification MIL-R-10509. Complete technical data in Catalog Bulletin B-7.

4

New IRC Type WW Precision Wire Wounds Surpass JAN-R-93 Characteristic B Specifications

Here is the most reliable and stable of all wire-wound precisions... by unbiased test! Actually, new Type WW's far surpass JAN-R-93 Characteristic B Specifications. New *winding forms* hold more wire for higher resistance values. *New winding technique* and rigid insulation tests eliminate possibility of shorted turns or winding strains. *New type insulation* withstands humidity, assures long life, provides stability and freedom from noise. *New terminations* (except in small size WW-10) are rugged lug terminals for solder connection. Full data in Catalog Bulletin D-3.

	Original Resist.	1st Cycle % Chge	2nd Cycle % Chge	3rd Cycle % Chge	4th Cycle % Chge	Resist. at End of 100 hrs. load	Total % Chge	% Chge from Last Temp. Cycle to End of 100 hrs. load %	Resistance Chge at End of 100 Hrs. Load only % (no cycling)	
1	100,010	+.04	+.04	+.05	+.05	100,050	+.04	—.01	100,040	—.02
2	100,000	+.03	+.04	+.03	+.05	100,060	+.06	+.01	100,000	0
3	100,000	+.01	+.02	+.02	+.05	100,000	0	+.05	100,050	—.02
4	100,000	+.02	0	+.02	+.02	100,000	0	—.02	100,040	—.01
5	100,010	+.03	+.04	+.04	+.05	100,000	0	—.05	100,030	—.03
6	100,000	0	+.03	+.04	+.04	100,100	+.1	+.06	99,980	0
7	100,000	+.04	+.05	+.04	+.04	100,070	+.07	+.03	100,000	0
8	100,000	+.03	+.05	+.05	+.05	100,050	+.05	0	100,000	0
9	100,000	+.04	+.03	+.05	+.04	100,010	+.01	—.03	100,050	0
10	100,000	+.02	+.02	+.02	+.04	100,010	+.01	—.03	100,000	0
11	100,000	0	+.01	+.01	+.03	100,000	0	—.03		

Tested side-by-side with competing resistors, new IRC Type WW's proved superior to all. Severe cycling and 100-hour load tests resulted in virtually zero changes in resistance. Other stringent tests proved Type WW's high mechanical strength, freedom from shorting, resistance to high humidity.

3

New IRC Type FS Fuse Resistor

This completely insulated unit functions as a resistor under normal conditions and as a fuse under abnormal conditions. Small, compact, stable, it can be wired into a circuit as easily as a molded wire-wound resistor. Bulletin B-3.

For full information on these products, or assistance in adapting them to any specific application, write IRC. Types BOC and DCC are currently available on short delivery cycles to manufacturers of military equipment only.

Boron-Carbon PRECISTORS • Power Resistors • Voltmeter Multipliers • Insulated Composition Resistors • Low Wattage Wire Wounds • Volume Controls • Voltage Dividers • Precision Wire Wounds • Deposited Carbon PRECISTORS • Ultra-HF and High Voltage Resistors • Insulated Chokes

IRC

Wherever the Circuit Says —⁄\/\/\—

INTERNATIONAL RESISTANCE COMPANY

401 N. Broad Street, Philadelphia 8, Pa.

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J. P. ARNDT & CO., ADV. AGENCY

Mail Coupon Today for Full Details of These New IRC Resistors

INTERNATIONAL RESISTANCE CO.,
403 N. BROAD ST., PHILADELPHIA 8, PA.

Please send me full data on the following checked items:—

- ☐ Type BOC Boron-Carbon PRECISTORS
- ☐ Type WW Precision Wire Wounds
- ☐ Type DCC Deposited Carbon PRECISTORS
- ☐ Type FS Fuse Resistors
- ☐ Name and Address of Nearest IRC Distributor

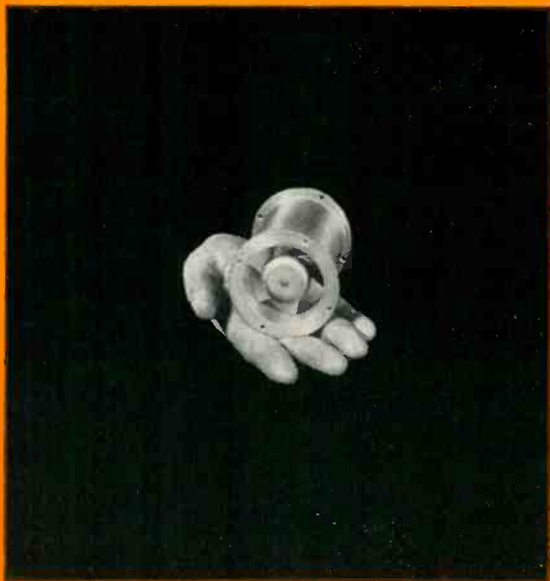
NAME ....

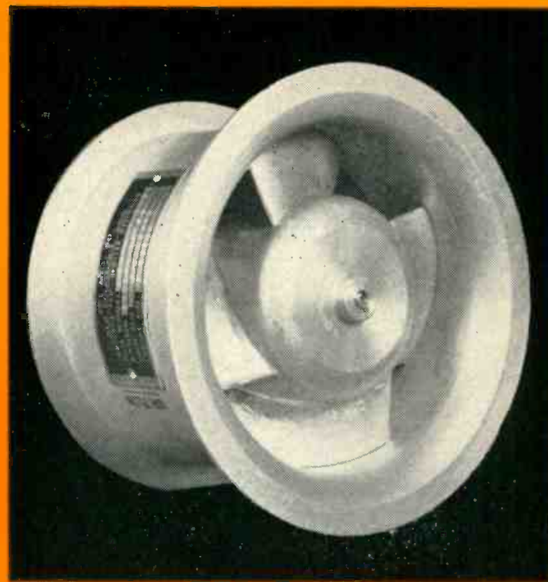
TITLE ....

COMPANY ....

ADDRESS .... CITY .... ZONE ... STATE ......

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

Five Kilowatt *KLYSTRON* For UHF-TV

High power over the entire Ultra High Frequency television range is now practical through another Eimac contribution to electronic progress.

Eimac
REG. U.S. PAT. OFF.
TUBES
The Power for TV

EITEL-McCULLOUGH, INC.
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Export agents: Frazar & Hansen, 301 Clay St., San Francisco, California

Simplicity is

NEW simplified Recording Potentiometer by WESTON

built to the same high standards of
accuracy . . . sensitivity . . . durability
as all instruments bearing this name.

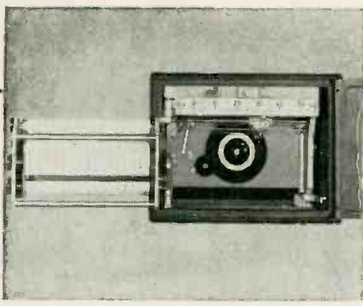


Chart frame swings out full 180° on straight pivots, chart remaining in time sequence. Charts easily installed in matter of seconds.

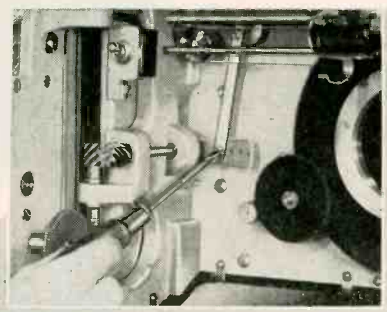
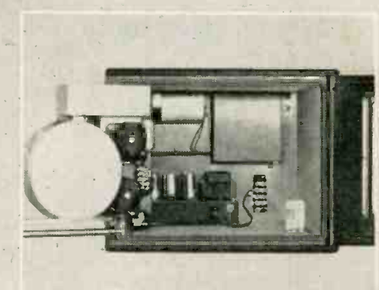


Chart speeds changed by simple screw-driver adjustment. Ranges quickly changed, too, by simply inserting correct range standard.



Note extreme simplicity both mechanical and electrical; as well as complete accessibility for quick maintenance and servicing.

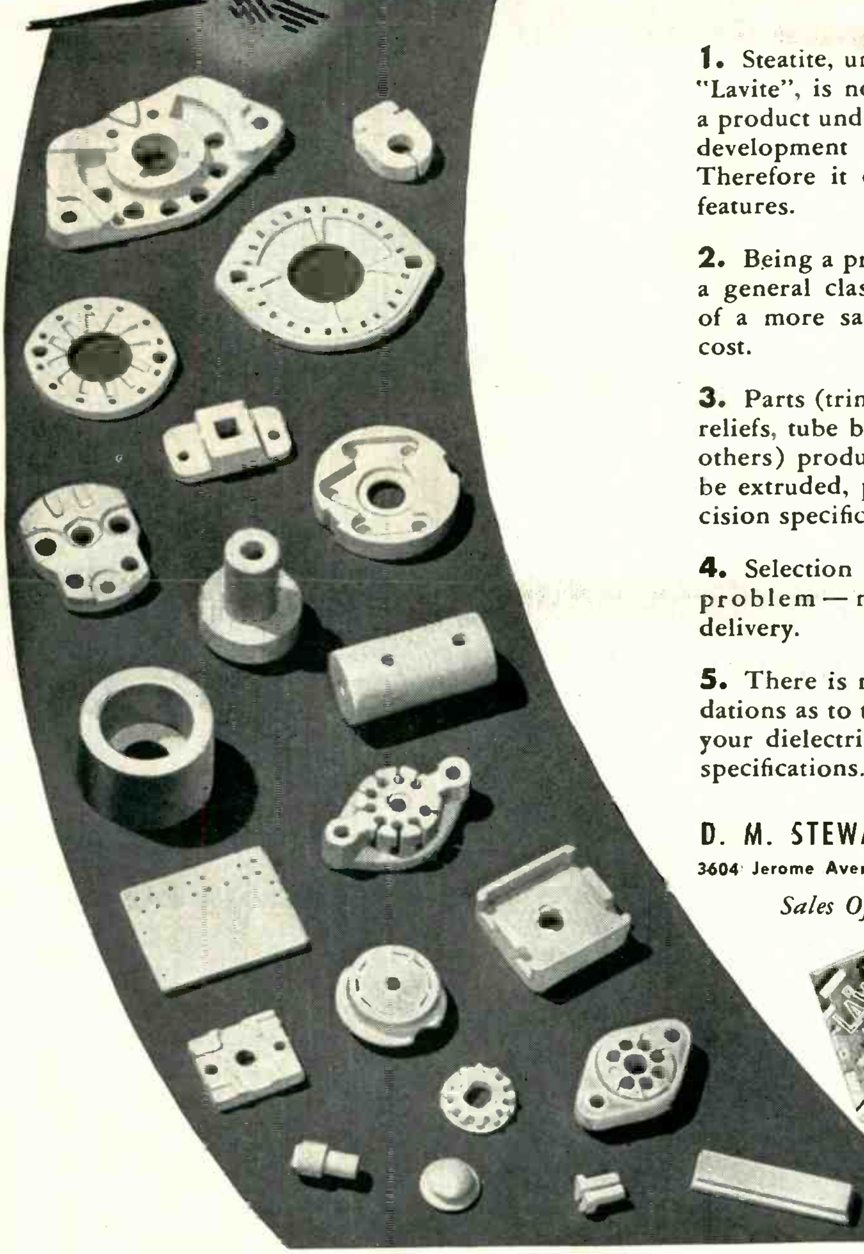
WESTON TAG

9128

WESTON *Instruments*

INDICATE . . . RECORD . . . CONTROL

about "Lavite" STEATITES



1. Steatite, under the familiar trade name "Lavite", is not a universal ceramic — but a product under perpetual research and re-development in the Steward laboratory. Therefore it claims individually superior features.

2. Being a private research — although in a general classification — you are assured of a more satisfactory product at lowest cost.

3. Parts (trimmer bases, coil forms, strain reliefs, tube base sockets and hundreds of others) produced of "Lavite" Steatite may be extruded, pressed or machined to precision specifications.

4. Selection of specific properties is no problem — nor is quantity on quick delivery.

5. There is no obligation for recommendations as to the use of "Lavite" Steatite in your dielectric ceramic parts — send your specifications.

D. M. STEWARD MANUFACTURING CO.

3604 Jerome Avenue Chattanooga, Tennessee

Sales Offices in Principal Cities

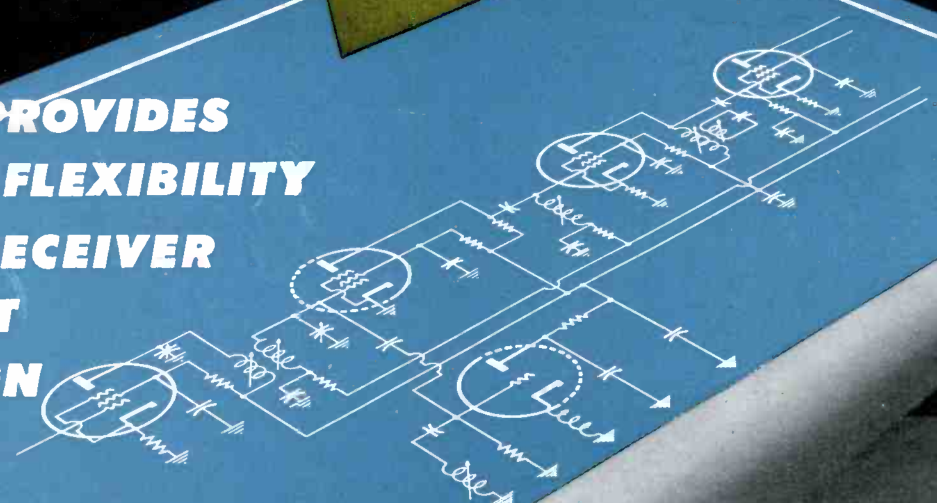
• Ask for booklet giving characteristic data on all "Lavite" Ceramics — ("Lavite" Steatite, "Lavite" Titanates, "Lavite" Ferrites, and others).

TUNG-SOL

6U8

miniature

triode-pentode

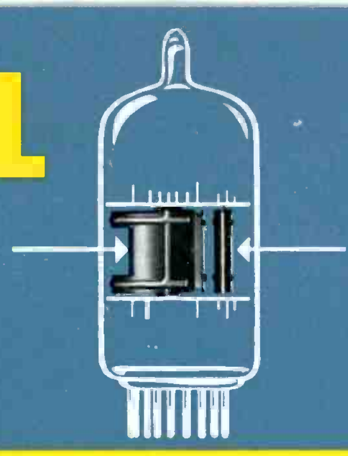


PROVIDES NEW FLEXIBILITY IN *TV* RECEIVER CIRCUIT DESIGN

see other side for additional information

TUNG-SOL

6U8



miniature

triode-pentode

✓ Completely independent sections
✓ Versatility in circuit application
✓ Improved circuit performance

This tube has two electrically independent sections—a triode and a pentode and is intended as a local oscillator mixer for FM and TV receivers. Each section is adequately shielded, and both are capable of exceptionally good performance at the higher frequencies.

Because the two sections are completely independent, a high degree of flexibility of circuit design is available—especially valuable in TV tuner oscillator use. Performance of the 6U8 triode at low voltages is superior to that of many types previously used for this service. It has sufficient reserve emission to operate efficiently under widely varying supply voltage conditions.

The pentode provides excellent gain with low local oscillator voltage injection resulting in low oscillator radiation from TV receivers. Use of the pentode section as the mixer permits the high (40 m. c.) I. F. so desirable to reduce interference and increase stability.

The construction and characteristics of the 6U8 provide designers with extremely desirable flexibility in combining circuit functions. The pentode section of the tube may be used as an I. F. amplifier, video amplifier, sound limiter or synchronizing separator. The triode performs satisfactorily as a horizontal or vertical oscillator, or sync clipper.

Wherever there is need for a triode and a pentode in a receiver, they can be combined in the 6U8.

MECHANICAL DATA

Coated unipotential cathodes—2			
Outline drawing	RTMA 6—2	Bulb	T—6-1/2
Base	RTMA E9—1	Miniature button	9-pin
Maximum diameter			7/8"
Maximum overall length			2-3/16"
Maximum seated height			1-15/16"
Base pin connections		RTMA basing	9 AE
	Pin 1—triode plate	Pin 6—pentode plate	
	Pin 2—pentode grid #1	Pin 7—pentode cathode grid #3, shield	
	Pin 3—pentode grid #2		
	Pin 4—heater	Pin 8—triode cathode	
	Pin 5—heater	Pin 9—triode grid	
Mounting position			Any

ELECTRICAL DATA

Interelectrode Capacitances	With Shield #315	Without Shield	
Pentode grid #1 to pentode plate	0.006	0.010 max.	μμf.
Pentode input	5.0	5.0	μμf.
Pentode output	3.5	2.6	μμf.
Triode grid to triode plate	1.8	1.8	μμf.
Triode grid to cathode	2.5	2.5	μμf.
Triode plate to cathode	1.0	0.4	μμf.
Cathode to heater (either section) approx.	3.0	3.0	μμf.

ELECTRICAL DATA

Ratings

Heater voltage (ac or dc)	6.3	VOLTS
Maximum heater-cathode voltage	90.0	VOLTS
Maximum plate voltage (pentode)	300.0	VOLTS
Maximum plate voltage (triode)	300.0	VOLTS
Maximum grid #2 supply voltage	300.0	VOLTS
Maximum plate dissipation (pentode)	2.8	WATTS
Maximum grid #2 dissipation	0.5	WATTS
Maximum positive dc grid #1 voltage	0	VOLTS
Maximum positive dc grid voltage (triode)	0	VOLTS
Maximum plate dissipation (triode)	2.5	WATTS

Typical Operating Conditions and Characteristics

	Triode	Pentode	
Heater voltage	6.3		VOLTS
Heater current	450		MA.
Plate voltage	150	250	VOLTS
Grid #2 voltage	...	110	VOLTS
Cathode resistor	56	68	OHMS
Transconductance	8500	5200	μMHOS
Grid #1 voltage (approx.) for Ib=10 ua.	-12	-10	VOLTS
Plate current	18	10	MA.
Grid #2 current	...	3.5	MA.
Plate resistance (approx.)	.005	0.40	MEG.
Amplification factor	40	...	

TUNG-SOL
ELECTRON TUBES

The TUNG-SOL engineering which has produced the 6U8 is constantly at work on a multitude of special electron tube developments for industry. Many exceptionally efficient general and special purpose tubes have resulted. Information about these and other types is available on request to TUNG-SOL Commercial Engineering Department.

TUNG-SOL ELECTRIC INC., NEWARK 4, NEW JERSEY

SALES OFFICES: ATLANTA • CHICAGO • CULVER CITY • DALLAS • DENVER • DETROIT • NEWARK

TUNG-SOL MAKES ALL-GLASS SEALED BEAM LAMPS, MINIATURE LAMPS, SIGNAL FLASHERS, PICTURE TUBES, RADIO, TV AND SPECIAL PURPOSE ELECTRON TUBES

JUNE, 1952

Why Resistance-thermometer Bridges can serve you

Use of a modified Wheatstone bridge for temperature measurements provides several characteristics of value in a variety of laboratory procedures.

One characteristic, of course, is ability to reach highest precision; here the equipment is unique and becomes a "must". However, other characteristics give the scientist options in other connections. Perhaps the sometimes higher cost, the larger size of resistance-thermometer units as compared with thermocouples and the relative slowness as compared with 20-gauge or finer thermocouples, have obscured such advantages as the following:

Wide Range. A temperature bridge with appropriate thermometers can cover as much or as little as you wish of the temperature range from −258 to +660 C . . . that is, from below the hydrogen point to above the antimony point. Furthermore, the instrument measures actual temperature . . . not temperature difference as a thermocouple does. This combination of values indicates usefulness for routine work as well as for secondary and primary standards.

Readability. The reading device for a bridge measurement moves several times further per degree C than is the case with other instruments. For example, with a Mueller Bridge the galvanometer spot moves 2 mm per 0.001° C; whereas with a thermocouple and a White or Wenner potentiometer the spot moves 0.7 mm, and a Beckmann differential thermometer's mercury column moves only 0.1 mm per 0.001° C. Other instruments of the three classes may show larger motions, but differences will be of the same order. Thus, the bridge method has outstanding advantages in readability.

"Average" Readings Supplied. The sensitive portion of a resistance thermometer is about as large as a mercury thermometer's bulb, whereas the sensitive area of a thermocouple is perhaps 1 or 2 mm sq. The resistance unit thus averages the temperature of an appreciable area, reducing the effect of non-uniformity in ambient fluid.

Sturdiness. Industrial-type resistance thermometers (Thermohms) are as sturdy as thermocouples and are installed in the same way. Among laboratory-type equipments, the most fragile resistance unit stands up quite definitely better than mercury bulbs under the small shocks and impacts which even the most careful user will impose. Furthermore, a broken or damaged resistance unit's case can often be replaced or repaired. These very practical advantages lead many scientists and test engineers to use the bridge method.

Remote Reading. Bridge instruments are inherently remote-reading; there is no need to consider accessibility, lighting, etc., of the primary element. This advantage is a real one, even when making small set-ups of equipment. On large or intricate set-ups, where vessels may be at various levels, and protection from light, body heat, etc., are possible additional factors, bridge measurements are often the only practical method.

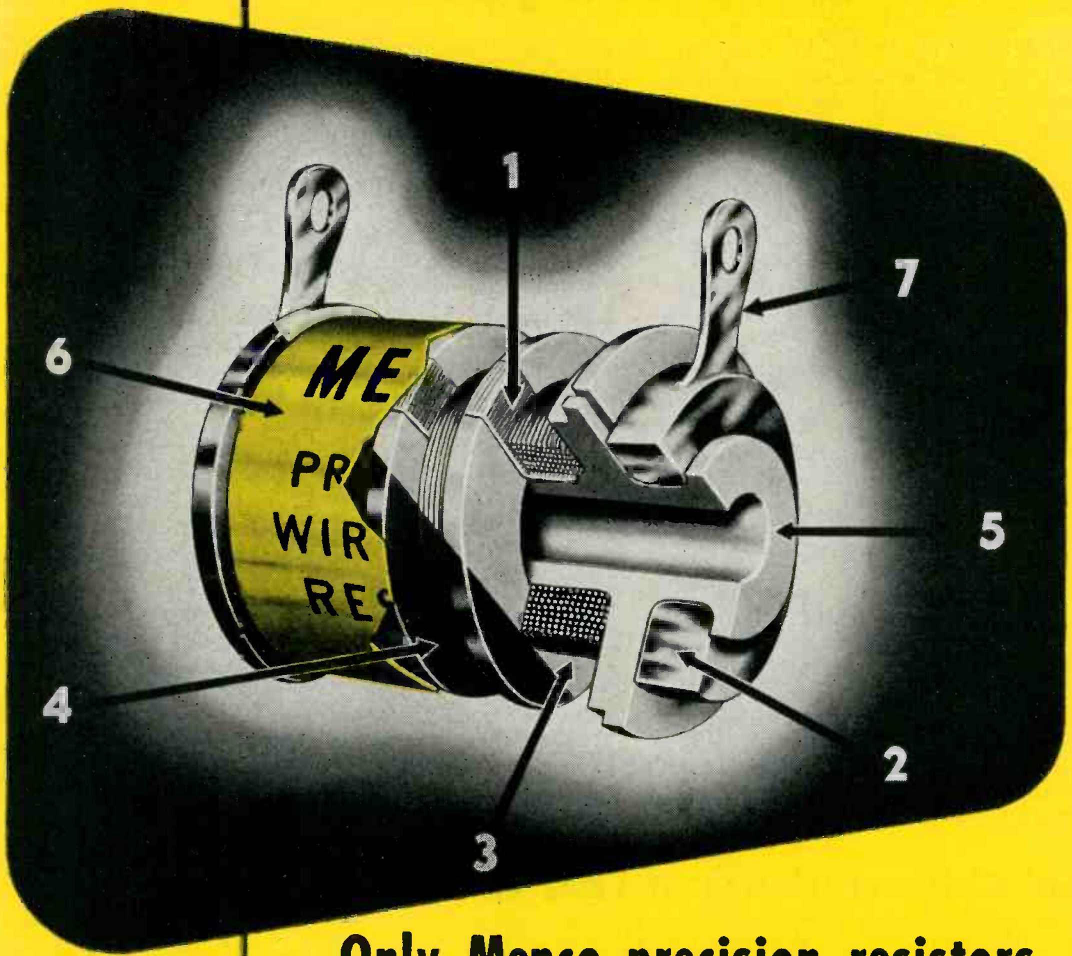
Principal Characteristics of L&N Temperature Bridges

Instrument	No.	Arrangement of Ratio Arms & Rheostat	Limit of Error
Type G-2 Mueller Bridge (Extreme high precision) Accessories needed: Precision Resistance Thermometer; H S Galvanometer	8069	Two ratio arms, 1000 Ω ea., adjustable to equality. Rheostat range 0 to 111.111 Ω in 0.0001 steps. Three shunted decades giving steps of 0.0001, 0.001 and 0.01 Ω; three decades of 0.1, 1 and 10 Ω resistors. Principal shunted and decade resistors thermostat controlled to 0.01 C	Certification by NBS recommended at extra cost. Limit of error is a few ten thousandths of an ohm or a few parts in a hundred thousand whichever is larger, provided a recently determined bridge calibration correction is applied.
Type G-1 Mueller Bridge (Excellent Precision) Accessories needed: Same as for Mueller Type G-2	8067	Two ratio arms, 500 Ω each, adjustable to equality. Rheostat range 0 to 81.111 Ω in steps of 0.0001 Ω. Three shunted decades giving steps of 0.0001, 0.001, 0.01 Ω; two decades at end of ratio arms of 0.1 and 1 Ω resistors, and binding posts on end of rheostat for connection of 0, 10, 20, 25, 25.5, 30, 40, 50, 60 or 70-Ω resistors.	±0.02% or a few ten thousandths of an ohm whichever is greater.
Resistance-Thermometer Bridge (Moderate Precision) Accessories needed: Thermohm Resistance Thermometer; Galvanometer	8063	Two ratio arms, 130 Ω nominal. Rheostat range 0 to 200.1 Ω. Two dial decades 9 (1 + 10) Ω, and a 100-Ω resistor removable by short-circuiting link, plus adjustable slidewire of 1.1 Ω.	±0.005 Ω up to 10 Ω ±0.05% above 10 Ω
Portable Temperature Bridge Accessory needed: Thermohm Resistance Thermometer	8062	This instrument is No. 8063 in portable form; all electrical characteristics are the same.	
Portable Temp. Indicator Accessory needed: Thermohm Resistance Thermometer	8015	Range As specified, for type of Thermohm specified	±0.3% of range
Portable Temp-Difference Indicator. Accessories needed: Matched pair Thermohm Resistance Thermometer	8025	Range 0 to 20 F temperature difference for any specified 20 F interval between the limits of 0 and 200 F	±0.1 F

For further particulars of any of the above equipments address our nearest office or 4979 Stenton Ave., Philadelphia 44, Pa.

LEEDS LN NORTHRUP

Jrl Ad EF2(3)

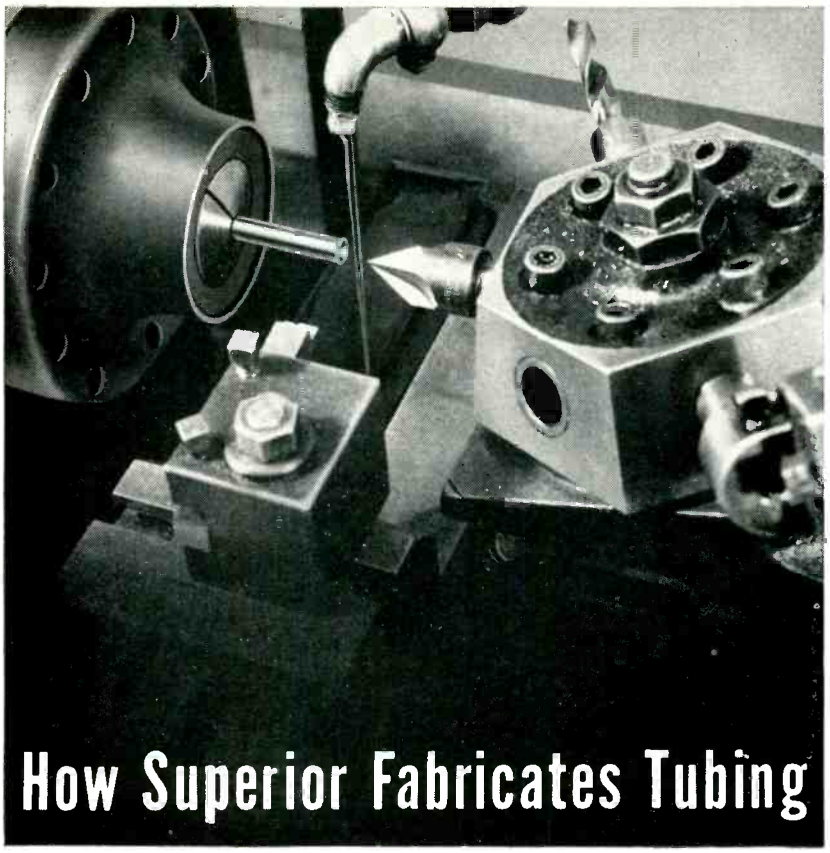


Only Mepco precision resistors give you *all* seven features

1. Crossover wire insulated from each winding by 2000v. insulation *(patented)*.
2. Special metal molded connecting feature, which bonds end of winding and terminal in a non-corrosive and mechanically secure manner—no solder or flux used.
3. Reversed and balanced PI-windings for low inductance, with use of only the finest resistance alloys.
4. Impregnated with approved fungus, moisture and salt waterproofing compounds.
5. JAN approved non-hydroscopic steatite bobbin, specially treated prior to winding in order to provide additional protection for fine enameled wire.
6. Protective fungi resistant acetate label.
7. Rigid hot solder coated brass terminals for easier soldering.

MEPCO

MEPCO INC., MORRISTOWN, NEW JERSEY



How Superior Fabricates Tubing

to give you the parts you need

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

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

Want it to meet rigid dimensional and metallurgical specifications?

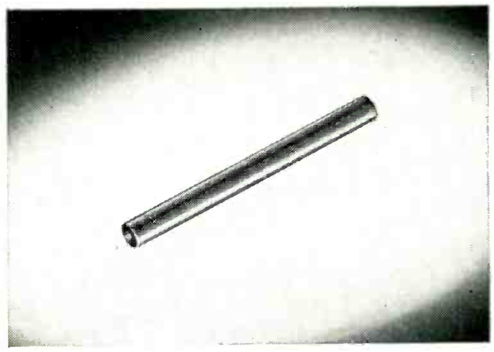
You're reading the right advertisement for all of these are Superior Specialties.

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

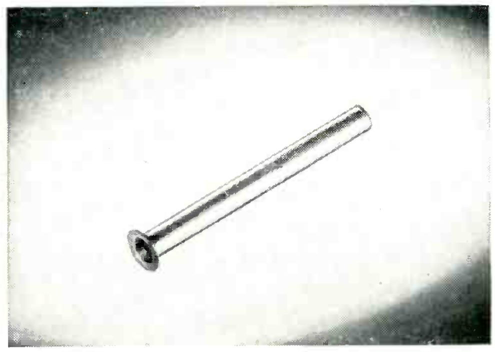
It's a job we like to do and know how to do. But there's more to the story than simple production of fabricated or semi-finished parts, or even top-quality tubing in any analysis and many sizes.

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

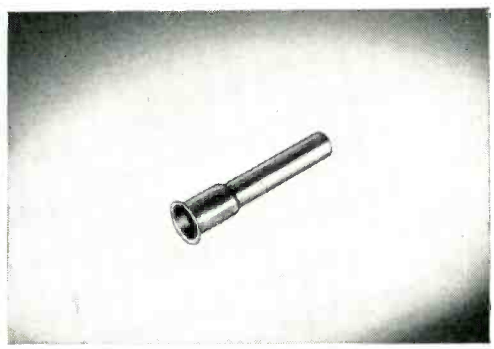
If you are a manufacturer or an experimenter in electronics and have a need for a tubular part of any kind, check with us. We can probably help by giving you quantity production of the parts you need. Write Superior Tube Company, 2500 Germantown Ave., Norristown, Pennsylvania.



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



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



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

This Belongs in Your Reference File ... 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, sublimation rate of the nickel base; also future trends of cathode materials are evaluated.

Superior

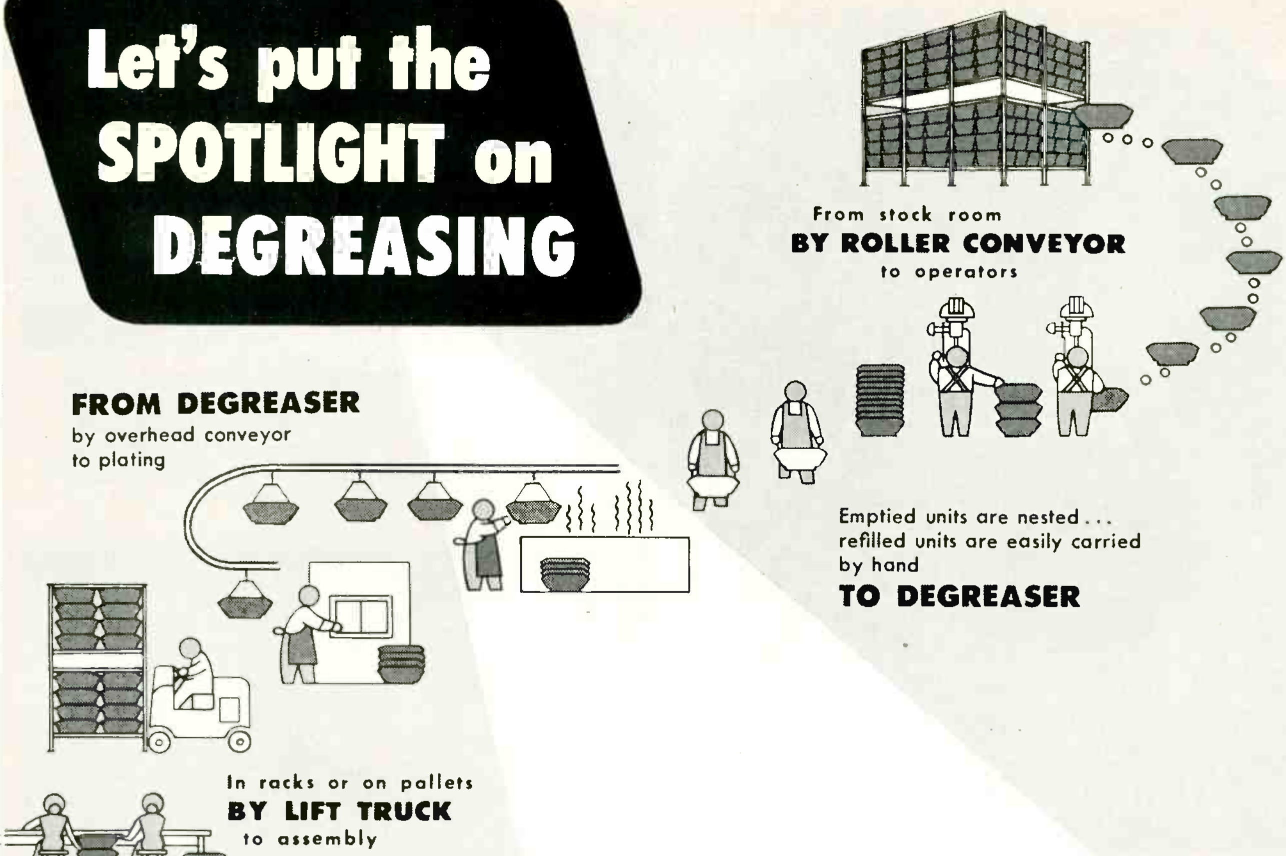
THE BI[...]E IN SMALL TUBING

All analyses .010" to ⅝" O.D.

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

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

Let's put the SPOTLIGHT on DEGREASING



EVERY MATERIALS HANDLING ENGINEER WILL WANT THIS BULLETIN!

Write for this bulletin describing the NesTier System, including complete information on racks, trucks, conveyor hangers, inserts.

Our service includes complete engineering advice to systematize small parts handling in your plant.

In answer to the many demands, this new NesTier has been added to the NesTier System. Designed primarily for degreasing operations, the "lanced-bottom" NesTier permits rapid drainage without allowing even the smallest parts to slip through.

Now, there is no need to transfer parts for degreasing. The lanced-bottom box has all of the advantages of the standard NesTier—saving of space by the nesting and tiering features, ease of transportation and handling, adaptability to conveyor systems and the visibility and accessibility of contents.

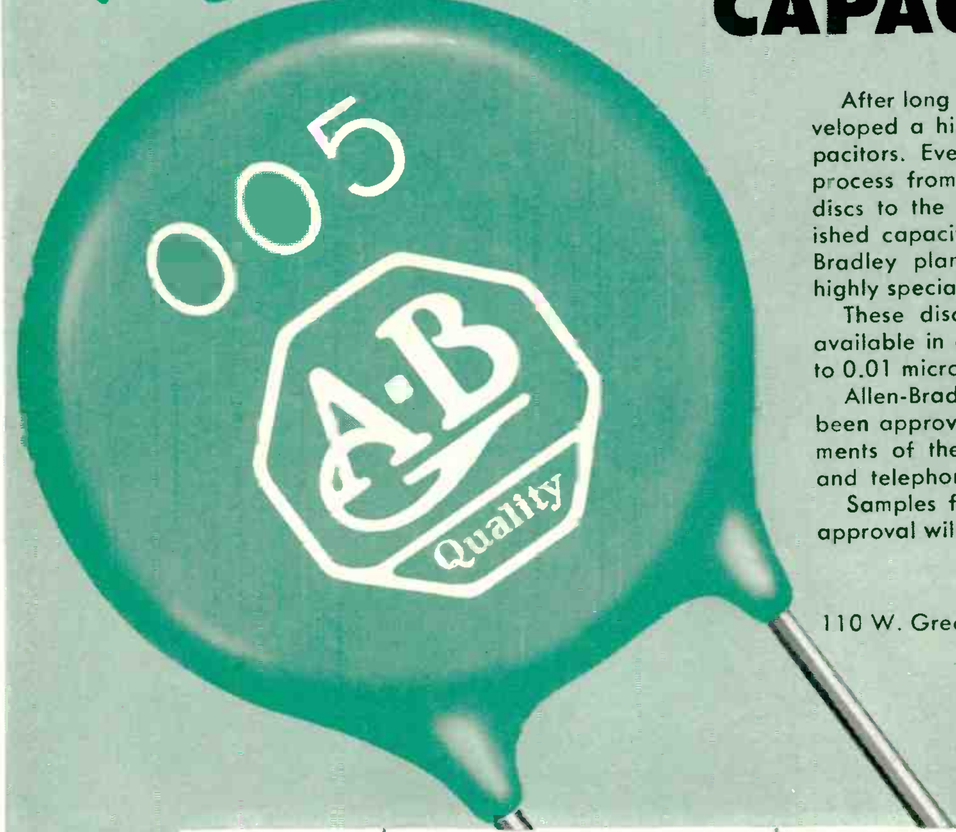
TWO SIZES. No. 220—16 ga. steel, 22⅝" long, 5/16" bails, weight 15 lbs. No. 175—18 ga. steel, 18¼" long, ¼" bails, weight 6 lbs. One piece welded construction, standard baked enamel, green.

NESTIER®
IT NESTS - IT TIERS

THE CHAS. WM. DOEPKE MFG. CO., Inc.
Metal Specialties Division — Rossmoyne, Ohio

New

A High Quality Line of CERAMIC CAPACITORS



After long research Allen-Bradley has developed a high quality line of ceramic capacitors. Every step in the manufacturing process from making the high K dielectric discs to the final impregnation of the finished capacitor is performed in the Allen-Bradley plant by expert operators using highly specialized production equipment.

These disc-type ceramic capacitors are available in capacities ranging from 0.001 to 0.01 microfarads.

Allen-Bradley ceramic capacitors have been approved by the engineering departments of the largest electronic, electrical, and telephone laboratories.

Samples for qualification tests and type approval will be supplied upon request.

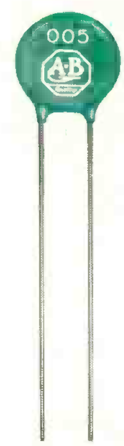
Allen-Bradley Co.
110 W. Greenfield Ave., Milwaukee 4, Wis.

Ceramic discs of high K dielectric are molded in the Allen-Bradley factory by precision methods. Allen-Bradley depends upon no outside manufacturers for ceramic discs. All manufacturing processes are A-B controlled throughout.

After the ceramic discs are sintered, silver paste is applied to each face. Heat treatment in continuous ovens reduces the paste to metallic silver. The characteristics of the capacitors are controlled with great accuracy during their manufacture.

Leads are soldered to silver surfaces.

Capacitor is insulated with phenolic resin.



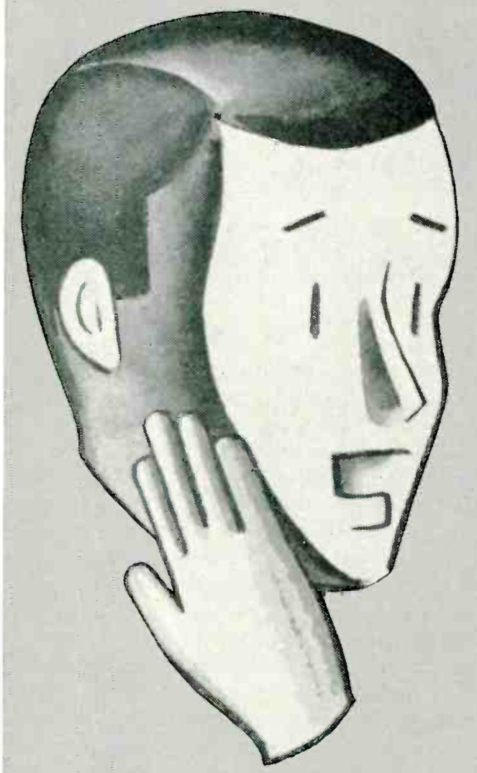
Wax impregnated to resist moisture.

The above five panels show the successive steps in the manufacture of Allen-Bradley high quality ceramic capacitors.

ALLEN-BRADLEY

RADIO & TELEVISION COMPONENTS

QUALITY



he got the shock of his life when he learned . . .

Heldor

SAVED HIM* 37%

on assembly of terminals in can covers!

THIS transformer manufacturer*—as more and more companies are doing today—received a quotation from Heldor on its terminals, and assemblies. He found that Heldor could furnish the terminal plus assembly in his can cover FOR LESS MONEY (37% LESS) than he had been paying for a competitive terminal alone.

He saved important money. Maybe you can, too! It will pay you to investigate Heldor's unique production and assembly facilities on terminals, can covers and cans.

Be Convinced!

MAIL THIS COUPON TODAY!

Heldor Bushing Terminal Co., Inc.,
225 Belleville Ave., Bloomfield, N. J.

Enclosed is

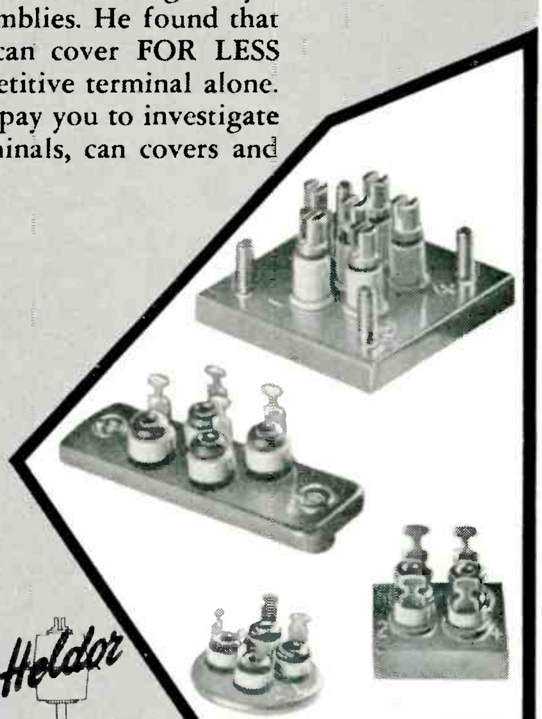
☐ Print ☐ Specifications for quotation on.................. pieces.
(quantity)

We are interested in assembly of HELDOR TERMINALS in
☐ our can covers ☐ HELDOR can covers.

Name .... Title ....

Company ....

Address ....



Heldor

HELDOR BUSHING & TERMINAL CO., Inc.

225 Belleville Avenue, Bloomfield, New Jersey

HERMETIC SEALING FOR EVERY REQUIREMENT

NEO-SIL HERMETIC SEAL TERMINALS — Applicable on MIL requirements. Will withstand thermal shock, vibrations, mechanical strains, and excessive pressures with no impairment of the seal or other functional characteristics. E-3LW terminals are now being used at 1000 psi static oil pressure and undergo 5000 psi tests for two minutes.

NEO-SIL OCTAL TYPE PLUG IN HEADERS — Applicable for MIL requirements. These units can undergo sustained vibrations, large temperature changes, and other strains without impairment to the seal or other functional characteristics. Available with eight and twelve pins.

NEO-SIL MULTIPLE PIN HEADERS — Applicable for MIL requirements. Presently being used on MIL-T-27 transformers. These units are available with 2 to 10 pins. These units can undergo conditions mentioned above with no impairment to the seal or other characteristics.

NEO-SIL FUSE HOLDERS, HERMETICALLY SEALED — Available for 3 AG and 4-AG fuses. These units are completely sealed from moisture with or without the cap or fuse inserted. They are applicable on pressurized and gas filled components.

NEO-SIL CABLES, HERMETICALLY SEALED — The cables are hermetically sealed at the plug on thru to the panel.

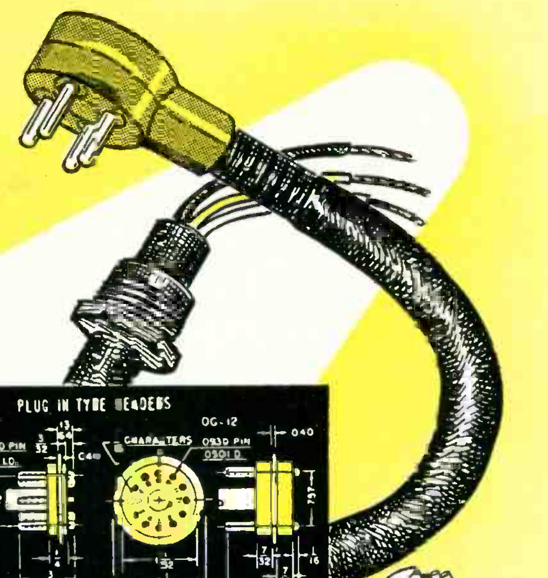
NEO-SIL ROTARY WATERSEAL PANEL ASSEMBLIES — These units have an excellent five year customer history on gas filled pressurized components. They are available for 1/4″ shafts and for potentiometers and switch bushings.

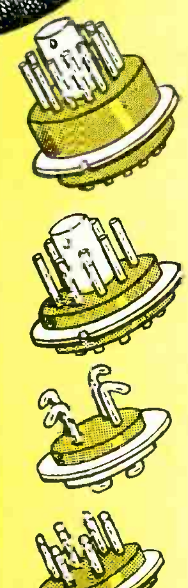
NEO-SIL LINE CORDS WITH PLUGS FOR EUROPEAN USE, HERMETICALLY SEALED — These units are completely sealed at the plug and are being used on pressurized units.

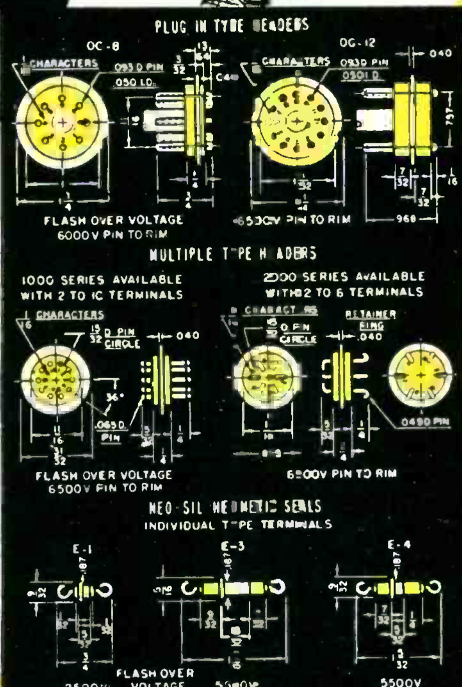
NEO-SIL GASKETS, METER, PANEL, COVER, ETC. — Molded from Neoprene for complete sealing.

NEO-SIL ADAPTERS, U. S. TO EUROPEAN, AFRICAN, SOUTH AMERICAN SOCKETS — Our 200A and 300A together will adapt virtually all standard plugs, sockets and lamp sockets of the above mentioned areas.

NEO-SIL COIL FORMS, CRYSTAL CONTACTS, and other molded bakelite and Neo-Sil rubber units.







TEST DATA

The result of the Electrical Testing Laboratories Inc., Report #330655, dated March 18, 1949, on this material shows the following:

Volume Resistivity at 500 Volts d-c

Room Temperature 25°C — R.H. 30 percent

Megohm-inches	*ohm-centimeters*
1.4×10^6	3.5×10^{12}

Dielectric Constant and Dissipation Factor

Dielectric Constant	*Dissipation Factor*	*Loss Factor*
	@ 60 cycles per second	
9.22	.058	5.32
	@ 1 megacycle per second	
6.17	.0455	.28
	@ 50 megacycles per second	
5.35	0.20	1.1

Dielectric Strength at 60 cycles
Volts per mil — 3[illegible]0

Durometer Average — 80 ± 5

Temperature — Rated as a Class A material conservatively + 175° to —70° centigrade.

The Flashover Voltages indicated were taken at a temperature of 68° Fahrenheit and 47% Relative Humidity.

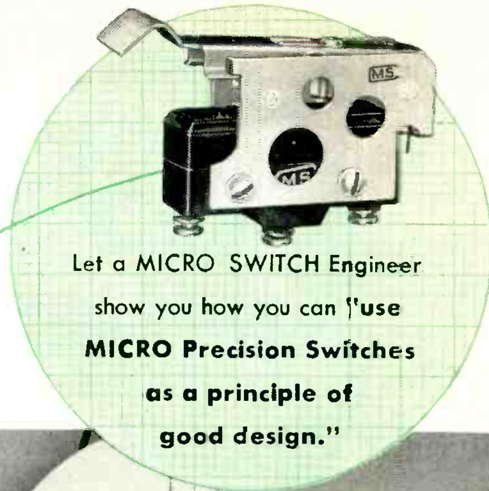
We welcome your inquires on any phase of design, development or production.

NEO-SIL CORPORATION

26 CORNELISON AVE., JERSEY CITY 4, N. J.

CHICAGO REPRESENTATIVE: GASSNER & CLARK COMPANY
6349 North Clark St., Chicago 26, Ill.

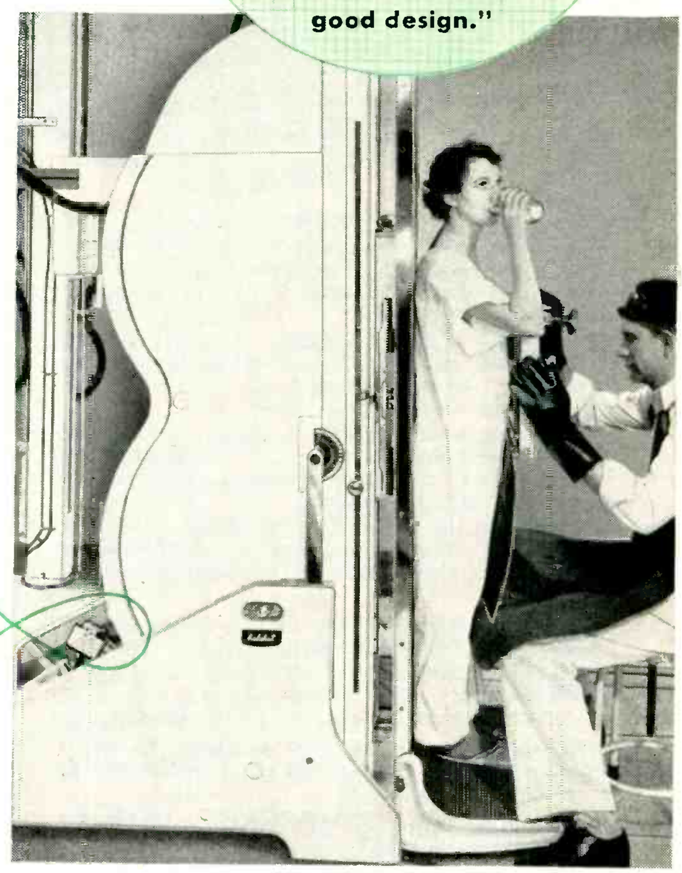
Advanced design of KELLEY-KOETT'S new X-ray table aided by MICRO Precision Switches

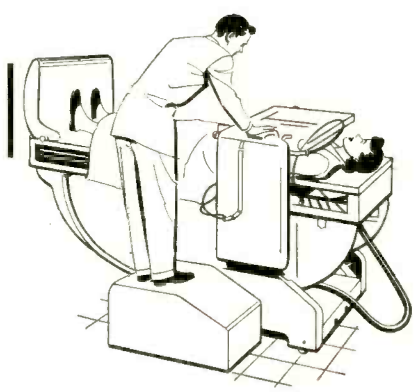


Human life can depend on the precise and dependable operation of an X-ray table! Full realization of this fact led the design engineers of the Kelley-Koett Mfg. Co., Covington, Kentucky, pioneer makers of X-ray equipment, to choose MICRO precision switches to perform vital functions in their versatile new Keleket "C" Supertilt Table. These switches limit the extremes of table travel, energize X-ray pilot lights, act as time delays on X-ray exposures, and synchronize timer action with magnetic contactor.

Small size, long life, dependability and precise operation of MICRO products have made them first choice of makers of equipment whose components must not fail. Cooperation between MICRO field engineers and electronic designers has resulted in the development of over 30 different varieties of door interlocks alone, which are widely used on electronic devices.

There is, or can be, a MICRO precision switch to exactly meet the needs of your design. Why not save time, money and unnecessary experiment? Let a MICRO field engineer help you select, or develop, just the right switch for your application. There are over 5000 varieties of MICRO precision switches today . . . each designed to fulfill a specific requirement such as yours. We invite you to contact the nearest MICRO branch office today.





Keleket "C" Supertilt Table in vertical position. MICRO unit shown is one of eight which perform key functions in table operation.

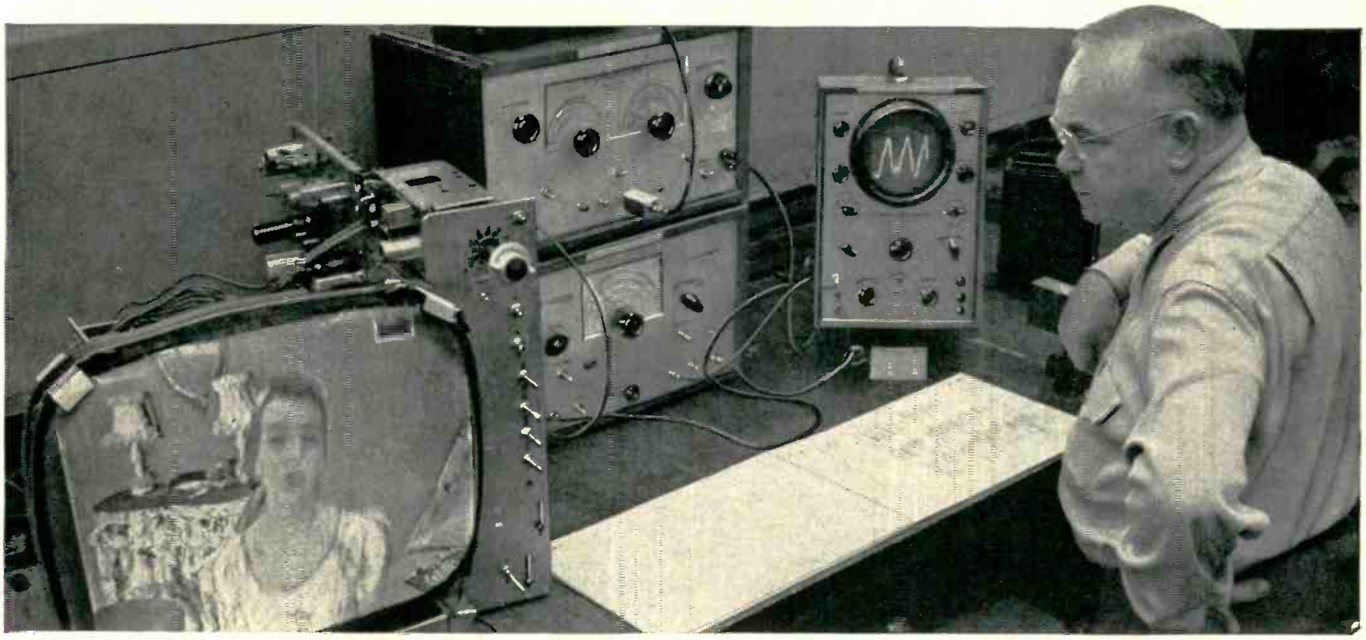
MICRO Snap-Action Switches . . .
Honeywell Mercury Switches

MICRO SWITCH
FREEPORT, ILLINOIS

HONEYWELL

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

TV DEVELOPMENT ENGINEERS DEPEND ON ACCURATE G-E LABORATORY TEST EQUIPMENT



CIRCUIT DESIGN. Making frequent changes in circuits, the TV design engineer appreciates the unique flexibility of this G-E equipment. For example, General Electric's continuous coverage permits him to examine in detail any segment of the spectrum. Phase shift control on the sweep output provides for full 360° rotation. Extreme electrical flexibility and stability make these instruments highly useful to engineers designing broad band electronic equipment.

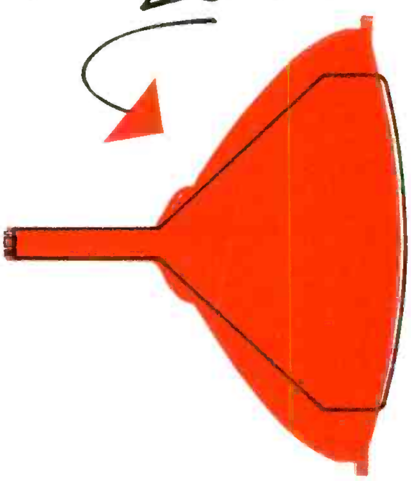
FACTORY TEST ALIGNMENT. Only 2 cables are connected to receiver during alignment. When receiver oscillators are lined up with the G-E crystal-controlled marker generator, the local station signal will fall where it belongs. The General Electric variable permeability sweep provides long-term extremely stable operation.

LABORATORY TIME-SAVER. Accurate, hand-calibrated dial permits development engineer to do 95% of his work without frequent reference to the crystal calibrator. No listening for or counting of "birdies." No time wasted making allowance for a printed dial, since the hand calibration matches precisely its associated capacitor.

***FREE*—NEW POWER SUPPLY CATALOG!** Photos and specifications of 14 new G-E units, ranging from 200 to 1500 volts. Write us for your copy. *General Electric Company, Section 462, Electronics Park, Syracuse, New York.*

GENERAL ELECTRIC

Actually shorter than 20" tube!



On March 3, Rauland unveiled the first "giant-screen" tube that makes attractive cabinetry possible.

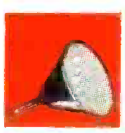
This new 27" tube, with 390 square inch picture area, minimizes cabinet problems in two ways. First, it has the compactness of rectangular rather than round cone and face. Second, by means of 90° deflection, depth has actually been held slightly shorter than present 20" tubes!

The tube employs Rauland's usual "reflection-proof" filter glass face plate with maximum reflection of only 2½% of incident light. It uses the Rauland tilted offset gun with indicator ion trap. It is offered with either magnetic or low-focus-voltage electrostatic focus. Weight is held at minimum by use of a metal cone.

If you want a picture of really spectacular size that can be housed in acceptable furniture, here is your answer.

A picture actually more than 70 sq. in. larger than the center spread of a tabloid newspaper. Rectangular for minimum cabinet height and width. And actually permitting a small reduction in depth from today's 20" cabinets!

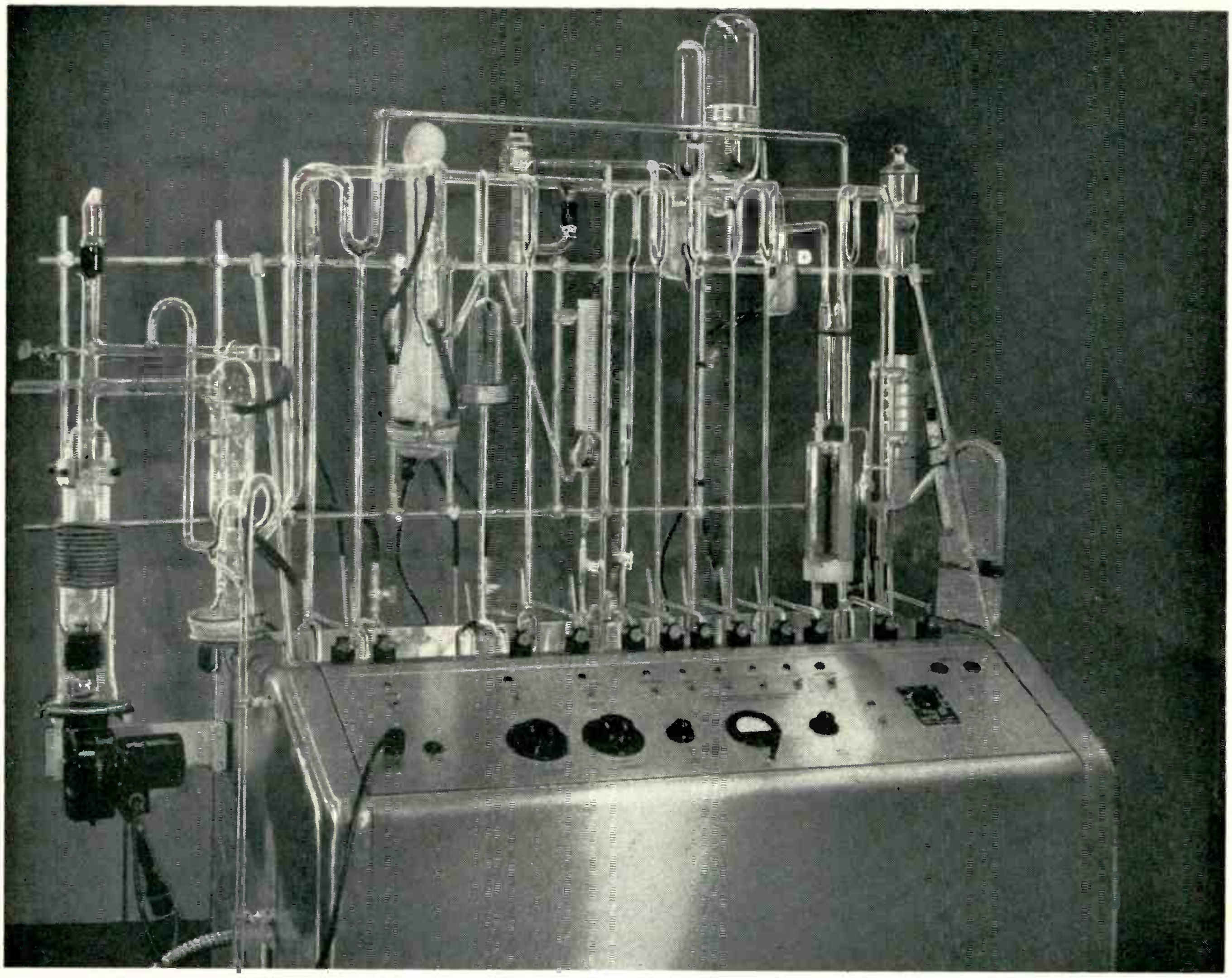
THE RAULAND CORPORATION



Perfection Through Research

4245 N. Knox Avenue, Chicago 41, Illinois

Vacuum Fusion Gas Analyzer



A packaged unit to determine the content of oxygen, nitrogen and hydrogen in metals

A wide variety of metals and alloys, including titanium, can be analyzed to determine the amount of oxygen, nitrogen and hydrogen contained either as combined or dissolved gas, in the range from one per cent to approximately 10^{-4} per cent by weight.

Total gas contents of titanium are reported within approximately the same range as for other metals, through the use of certain special techniques.

The apparatus incorporates the best features and techniques reported in the literature or known to our laboratory and has been employed for some time in connection with our own metallurgical research activities.

Operating procedure is relatively simple and can be readily mastered. Installation and final testing is performed by one of our trained analysts.

Write for details of Type 09-1240 Vacuum Fusion Gas Analysis Apparatus.

INDUSTRIAL RESEARCH · PROCESS DEVELOPMENT
HIGH VACUUM ENGINEERING AND EQUIPMENT

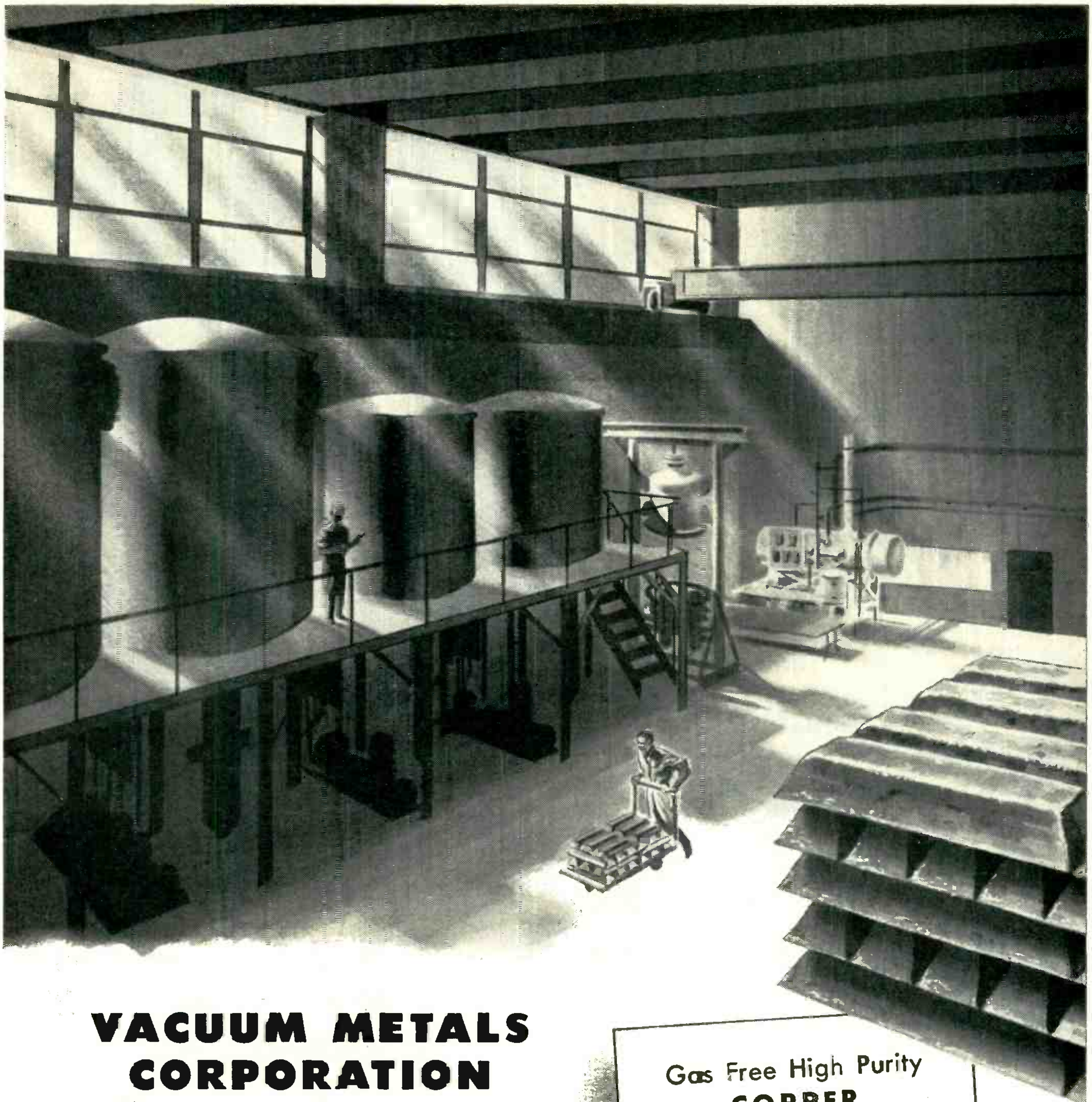
METALLURGY · DEHYDRATION · DISTILLATION
COATING · APPLIED PHYSICS

National Research Corporation

EQUIPMENT DIVISION

Seventy Memorial Drive, Cambridge, Massachusetts

In the United Kingdom: BRITISH-AMERICAN RESEARCH, LTD., London S. W. 7 — Wishaw, Lanarkshire



VACUUM METALS CORPORATION

offers new vacuum-metals capacity of

5 TONS PER DAY

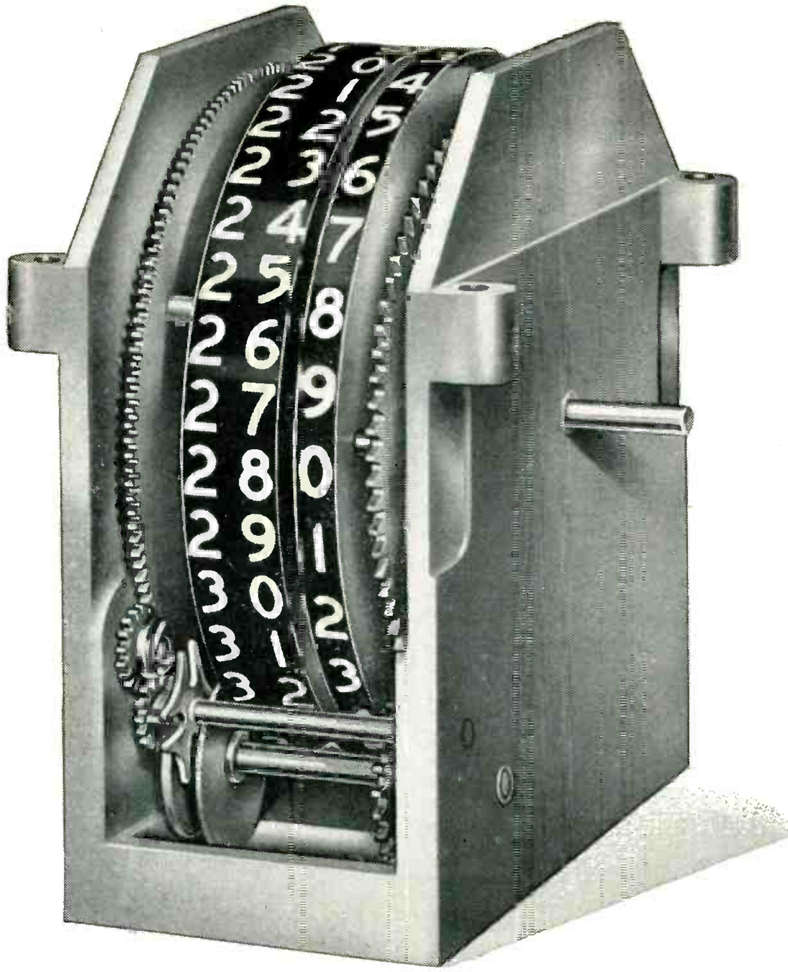
All of these metals are currently being vacuum melted to achieve maximum performance capabilities in critical applications. Such metals are of particular value in applications such as electronic and electrical parts, magnetic materials, bearing materials, diaphragms, instrument components, laboratory standards and Atomic Energy projects.

Write to us for further information about our facilities.

Gas Free High Purity
COPPER
Gas Free High Purity
NICKEL
Gas Free High Purity
IRON
GAS FREE ALLOY
Held to New Standards of Uniformity

HIGH PURITY METALS
HIGH VACUUM CASTING
SPECIAL ALLOYS
GF (Gas Free) METALS

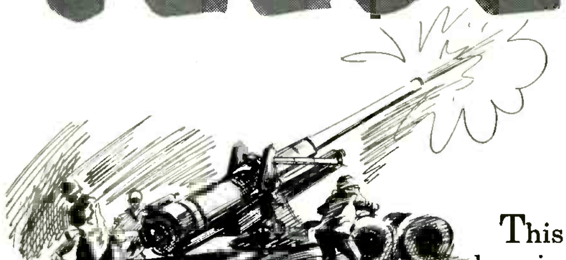
VACUUM METALS CORPORATION
Subsidiary of National Research Corporation
70 MEMORIAL DRIVE, CAMBRIDGE 42, MASSACHUSETTS



It helps Gunners to "Bear On Target"

Added Evidence that ———

Everyone Can Count on VEEDER-ROOT



This is a 360-degree bearing counter . . . equipped with high-speed Geneva transfer and large, readily readable figures . . . which speeds the work and heightens the accuracy of gunnery. And it might well be adapted to bring the same advantages to many other operations in defense work.

Now if your imagination is stirred by this suggestion, then you can count on Veeder-Root to help you add up to something that will really *count to YOUR advantage.*

VEEDER-ROOT INCORPORATED

"The Name That Counts"

HARTFORD, CONN. • CHICAGO • GREENVILLE, S. C.

Montreal, Canada • Dundee, Scotland

Offices and agents in principal cities

VR

"Counts Everything on Earth"

Why "dag" Colloidal Graphite is Best for CRT Exterior Walls

"Dag" Exterior Wall Coating has better adhesion . . . requires no baking . . . resists scratching . . . and is economical.

The smooth, uniform, conductive black film obtained with **"dag"** Exterior Wall Coating adheres tenaciously to all types of glass. Its adherent properties are so good that it resists scratching and readily withstands water immersion.

This specially processed electric-furnace graphite coating is dispersed in a lacquer-base vehicle and is easily applied to CRT surfaces by spraying. It dries so rapidly that tubes can be handled in 2 or 3 minutes after coating. Maximum adherence is obtained by drying at room temperature for 24 hours . . . but the same action will result with infra-red drying at 100° C. for ½ hour.

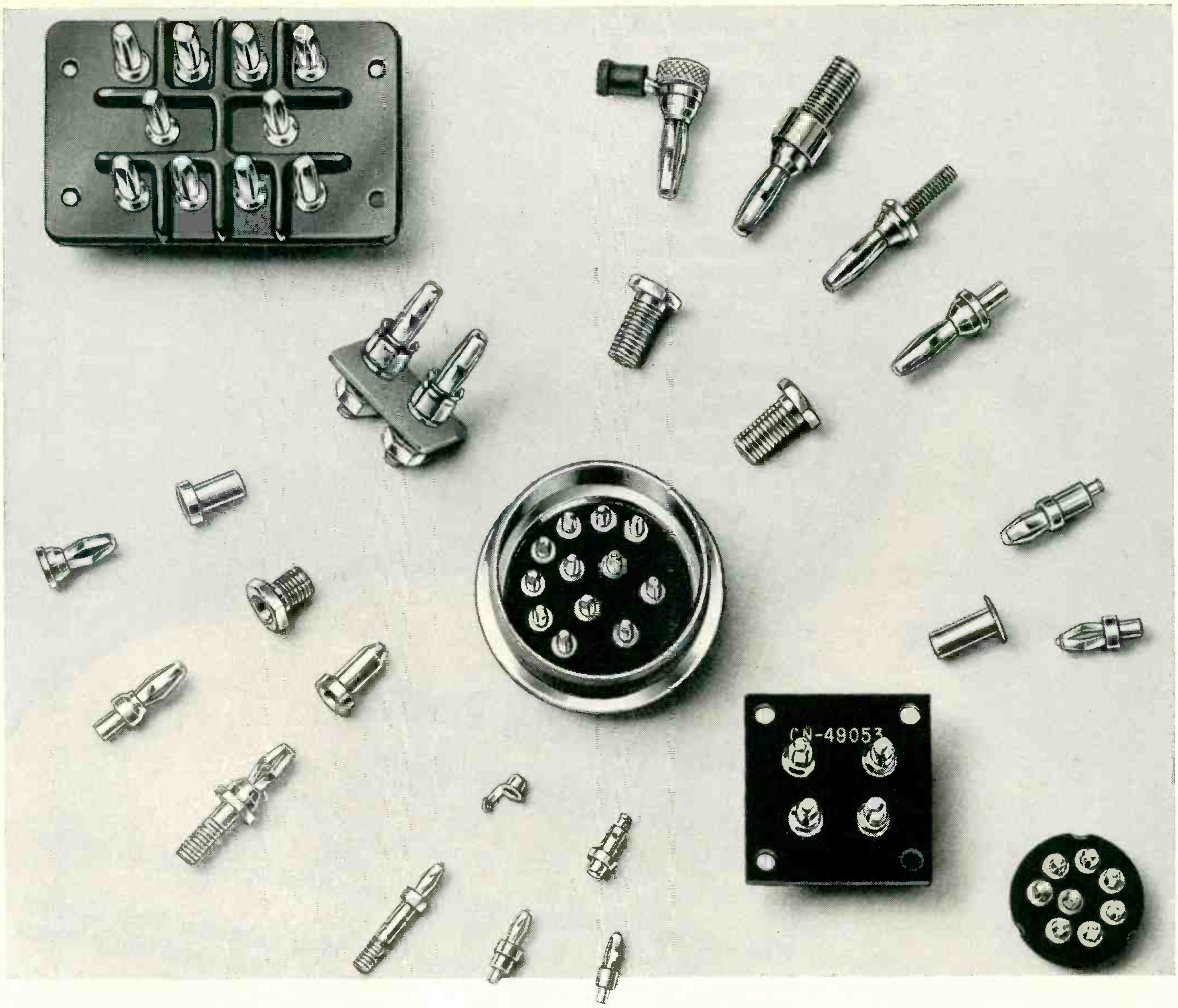
More information on the advantages of **"dag"** Exterior Wall Coating . . . as well as data on other **"dag"** dispersions for the electronics and electrical industries . . . is contained in a recent bulletin. Write today for your free copy of Bulletin No. 433-52F.

Acheson Colloids Company, Port Huron, Mich.

. . . also ACHESON COLLOIDS LIMITED, LONDON, ENGLAND

Units of Acheson Industries, Inc.

dag DISPERSIONS®



Dependability – Flexibility

Readily adaptable to any requirements, Ucinite Banana Plugs and Jacks, provide contact that can be depended upon under the most adverse conditions.

One-piece beryllium copper springs insure proper alignment and firm contact even under severe jolting and vibration. Spring ends are available in several sizes for limited space or for heavy electrical loadings.

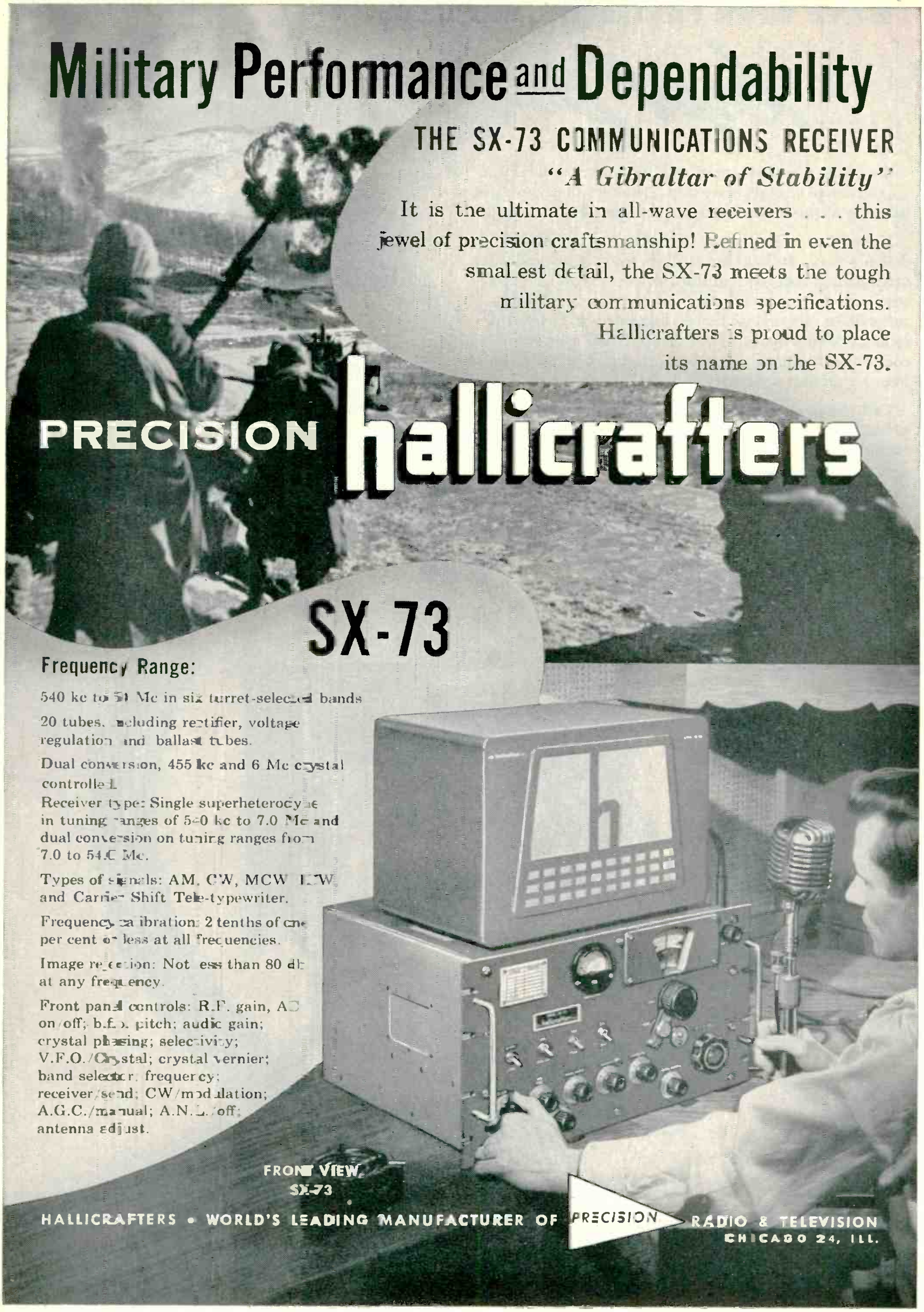
Mounting ends can be made in almost limitless varieties for staking or threaded assembly, for thin or heavy material, and with integral soldering tails. Mating jacks are also available for each spring size and for a variety of methods of assembly.

Best of all, Ucinite is ready to provide completely assembled mating connectors to your specifications.

ELECTRICAL ASSEMBLIES
Ucinite
RADIO AND AUTOMOTIVE

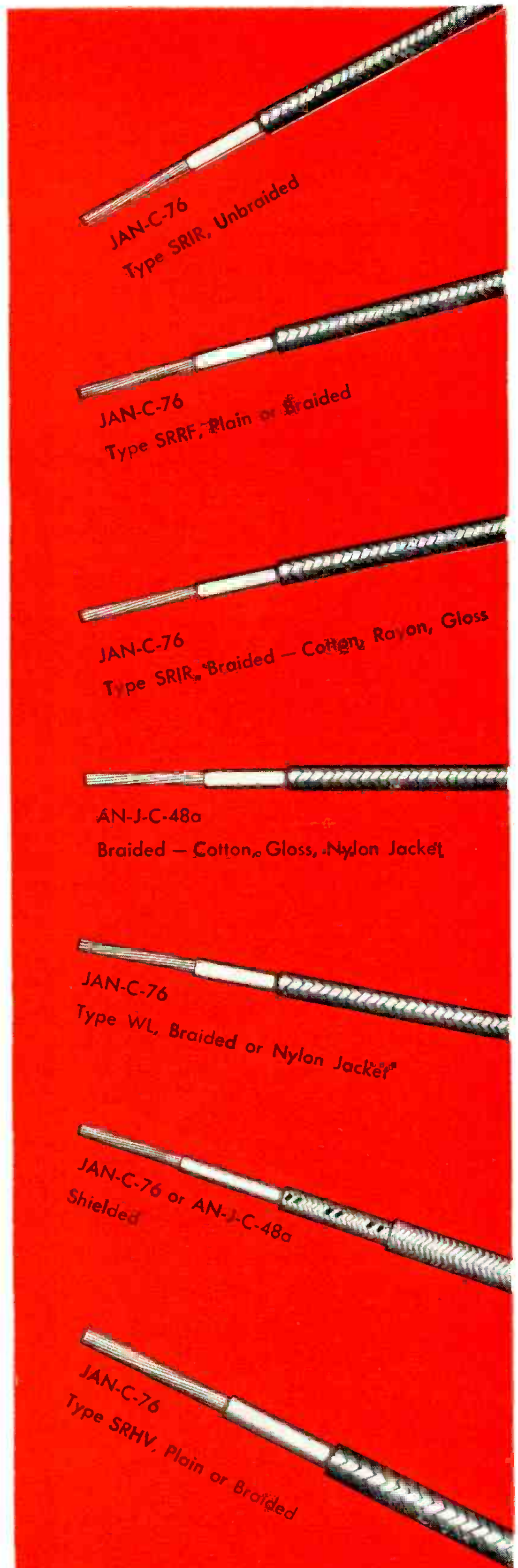
The UCINITE CO.
Newtonville 60, Mass.
Division of United-Carr Fastener Corp.

Specialists in
ELECTRICAL ASSEMBLIES, RADIO AND AUTOMOTIVE


Military Performance and Dependability
THE SX-73 COMMUNICATIONS RECEIVER
"A Gibraltar of Stability"
It is the ultimate in all-wave receivers . . . this jewel of precision craftsmanship! Refined in even the smallest detail, the SX-73 meets the tough military communications specifications. Hallicrafters is proud to place its name on the SX-73.
PRECISION hallicrafters
SX-73
Frequency Range:
540 kc to 54 Mc in six turret-selected bands
20 tubes, including rectifier, voltage regulation and ballast tubes.
Dual conversion, 455 kc and 6 Mc crystal controlled.
Receiver type: Single superheterodyne in tuning ranges of 540 kc to 7.0 Mc and dual conversion on tuning ranges from 7.0 to 54.0 Mc.
Types of signals: AM, CW, MCW, NFW and Carrier Shift Tele-typewriter.
Frequency calibration: 2 tenths of one per cent or less at all frequencies.
Image rejection: Not less than 80 db at any frequency.
Front panel controls: R.F. gain, AC on/off; b.f.o. pitch; audio gain; crystal phasing; selectivity; V.F.O./Crystal; crystal vernier; band selector; frequency; receiver/send; CW/modulation; A.G.C./manual; A.N.L./off; antenna adjust.
FRONT VIEW SX-73
HALLICRAFTERS • WORLD'S LEADING MANUFACTURER OF PRECISION RADIO & TELEVISION
CHICAGO 24, ILL.

Besto-Wire®

WIRE AND CABLE MEETS OR EXCEEDS GOVERNMENT SPECIFICATIONS



In our constantly expanding lines are scores of wires and cables that meet government approval specifications or exceed them.

In many cases you will find the wire that meets your requirements is one of our regular stock numbers — or our engineers will be glad to work with you to develop wires especially for your needs.

We have had years of experience in designing and manufacturing wire and cable for a wide range of applications in electronics, aviation and industry. Put this experience to work to help solve your problems wherever they concern wire or cable. We welcome your inquiries.

Ask us for our new complete catalog.
We'll be glad to send you a copy.

Besto-Wire

RHODE ISLAND INSULATED WIRE CO., Inc.

50 BURNHAM AVENUE CRANSTON, RHODE ISLAND

NATIONAL SALES OFFICES: 624 S. MICHIGAN BLVD., CHICAGO, ILL.

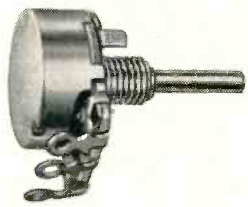
3 New Resistors

−55°C to +150°C

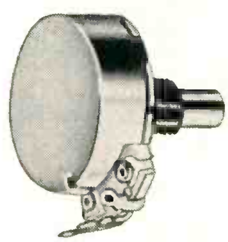
Complete aridity to saturation . . . An *unprecedented* temperature and humidity range

FOR MILITARY APPLICATIONS

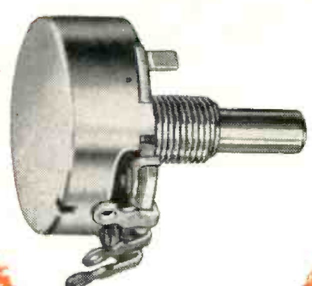
Highly recommended for use in jet and other planes, guided missiles, tanks, ships and submarines, portable or mobile equipment and all other military communications. Manufactured from specially developed materials, these absolutely unique variable resistors are now available in a *complete range of sizes*. (See chart at bottom of page.)



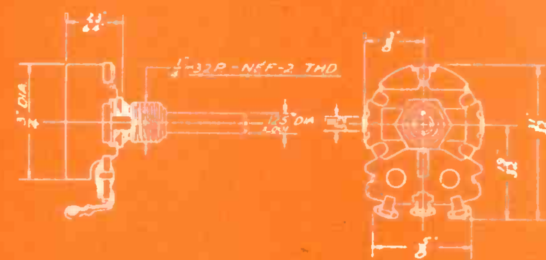
Type 65

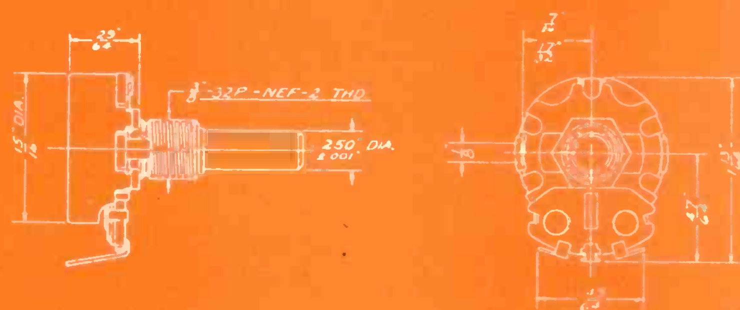


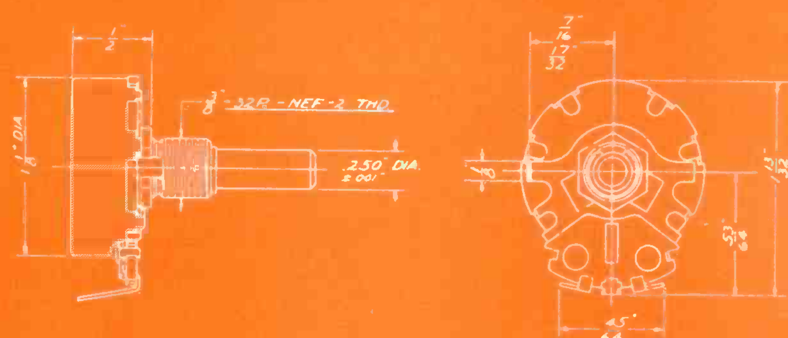
Type 90



Type 95







+150°C to −55°C

DIAMETER	TYPE 95 1 1/8"	TYPE 90 15/16"	TYPE 65 (miniaturized) 3/4"
Wattage and Voltage Rating	2 watts @ 70°C with 500 V max. across end terminals	1 watt @ 70°C with 500 V max. across end terminals	1/2 watt @ 70°C with 350 V max. across end terminals

Specialists in Precision Mass Production of Variable Resistors


Meets Military Specifications
JAN-R-94, Type RV-3A
CTS Type 35, 1 1/8" Diameter
Composition
JAN-R-94 Type RV-2B
CTS Type GC 45 with Switch
Composition
JAN-R-94, Type RV-3B
CTS Type GC 35 with Switch
Composition
JAN-R-94, Type RV-2A
CTS Type 45, 15/16" Diameter
Composition
JAN Type RV-4B
CTS Type FGC 95 with Switch
Composition
JAN Type RV-4A
CTS Type 95, 1 1/8" Diameter
Composition
MEETS ALL
JAN-R-19 SPECIFICATIONS
JAN Type RA 20A
2 Watt (CTS Type 252)
JAN Type RA 20B
2 Watt (CTS Type GC-252)
JAN Type RA 25A or 30A
3 or 4 Watt (CTS Type 25)
JAN Type RA 25B or 30B
3 or 4 Watt (CTS Type GC 25)
EXCEPTIONALLY GOOD DELIVERY CYCLE on military orders due to enormous mass production facilities . . . Please give complete details on your requirements when writing or phoning for further information.
FOUNDED 1896
CTS
CHICAGO TELEPHONE SUPPLY
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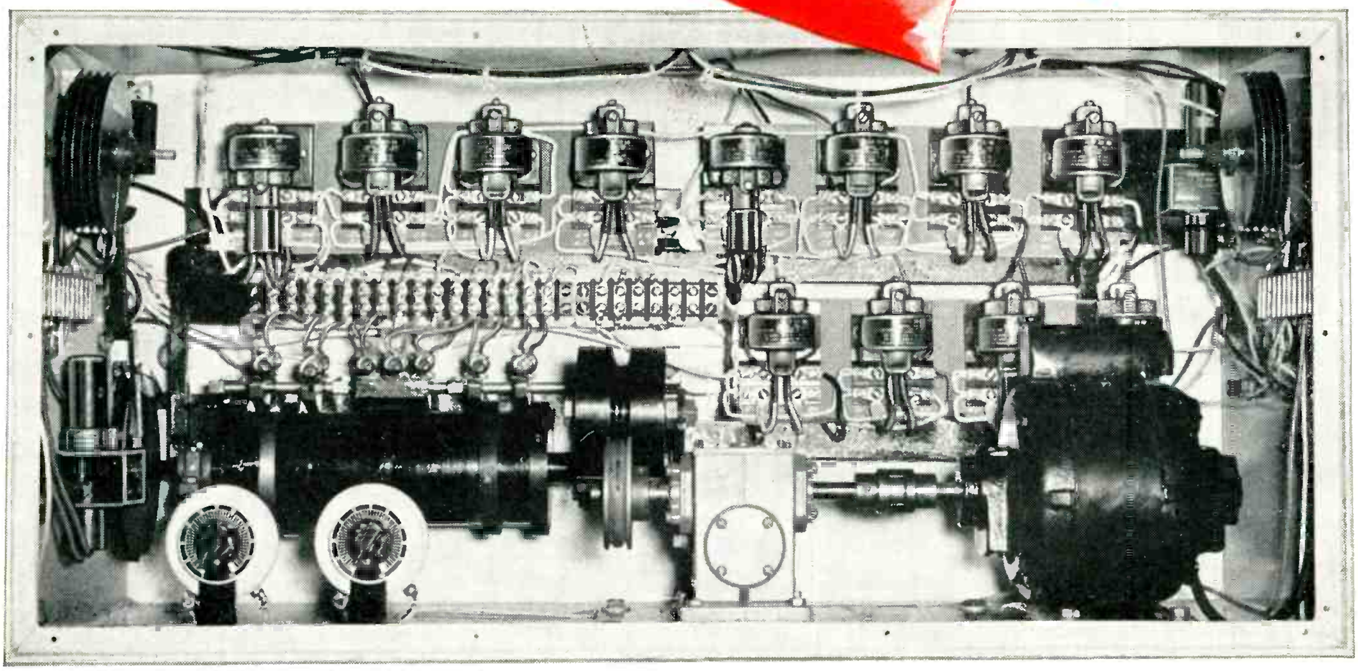
ADLAKE RELAYS AT WORK—
One of a series of advertisements on specific ADLAKE applications.

Dependable Control is IN THE BAG



with Adlake Mercury Relays

In manufacturing sugar and flour bagging machines, J. D. Merrifield & Son, of Rocky Ford, Colorado, rely on ADLAKE Mercury Relays. The 12 Mighty Midget Relays and 2 Time Delay Relays shown in the illustration above operate in the controls of one of their automatic scales, handling the control current which the sensitive contacts operating with the balance could not handle.

Like all ADLAKE Relays, they are sturdily constructed for continuing dependability without maintenance. They are hermetically sealed . . . armored against vibration . . . silent and chatterless.

Find out how ADLAKE Relays can assure trouble-free, low-cost operation in your business. Write for free illustrated Relay Catalog . . . no obligation, of course. Address The Adams & Westlake Company, 1107 N. Michigan, Elkhart, Indiana.

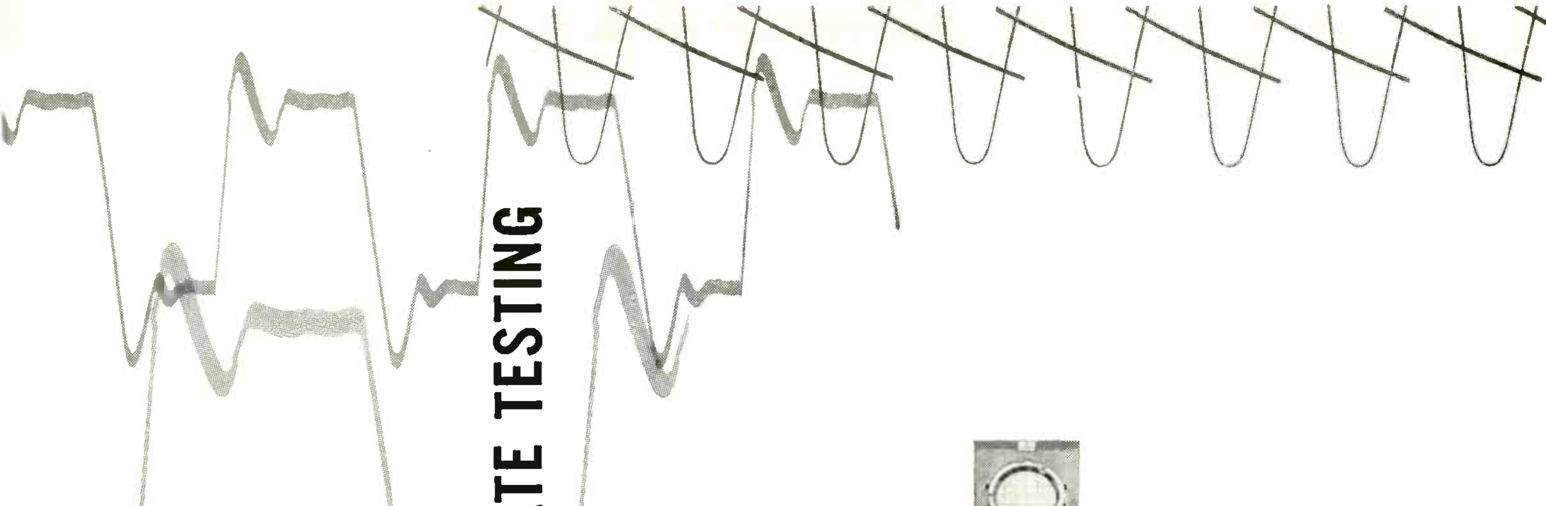
EVERY ADLAKE RELAY BRINGS YOU THESE "PLUS" FEATURES:

• HERMETICALLY SEALED—dust, dirt, moisture, oxidation and temperature changes can't interfere with operation • SILENT AND CHATTERLESS • REQUIRES NO MAINTENANCE • ABSOLUTELY SAFE • MERCURY-TO-MERCURY CONTACT—prevents burning, pitting and sticking

THE Adams & Westlake COMPANY

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

Adlake 95th year of serving the transportation and building industries



SIMPSON MODEL 480 GENESCOPE FOR ACCURATE TESTING

approved by
service managers of:

admiral

zenith

motorola

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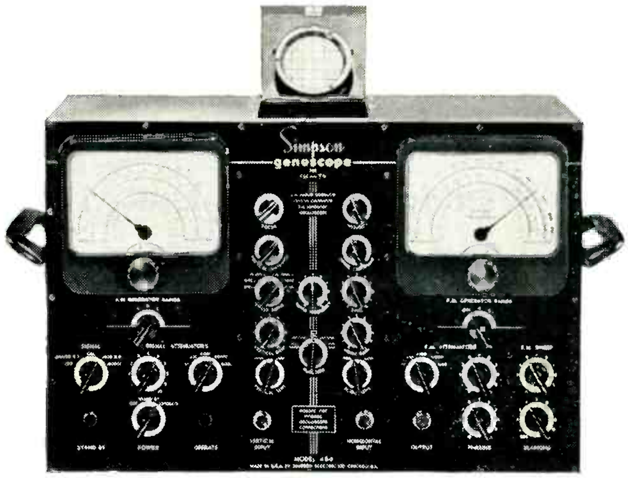
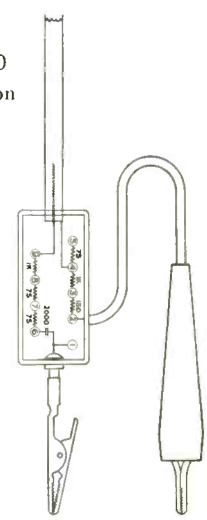
hallicrafters



• Provides all the necessary signal sources for proper alignment and servicing of FM and TV receivers • Includes the Simpson High Sensitivity Oscilloscope, complete in every detail and equipped with a high frequency crystal probe for signal tracing • Independent, continuously variable attenuators and step attenuators for both AM and FM units offer complete control of output at all times—from the high level required for front end adjustment to extremely low levels for fringe area peaking operations • Multiple shielding, generous bypassing and adequate line filtering reduces signal leakage to a negligible factor • A 0-15 megacycle sweep is provided by means of a noiseless specially designed sweep motor based on the principles of the D'Arsonval meter movement for fine control and lasting accuracy • The exclusive Simpson output cable (illustrated on the right) includes a variable termination network which is quickly adapted to provide open, 75 or 300 ohm terminations—the addition of a pad provides attenuation and isolation. The use of appropriate resistors across certain terminals will provide any other termination required. A .002 MFD blocking condensor can be added on any termination for use on circuits containing a DC component • The FM generator output voltage is constant within .2 DB per MC of sweep. Model 480 $395.00



Also available without the oscilloscope as Simpson Model 479 TV-FM Signal Generator. Model 479 $269.00

Simpson Instruments That Stay Accurate Are Available From All Leading Electronic Distributors

SIMPSON ELECTRIC COMPANY

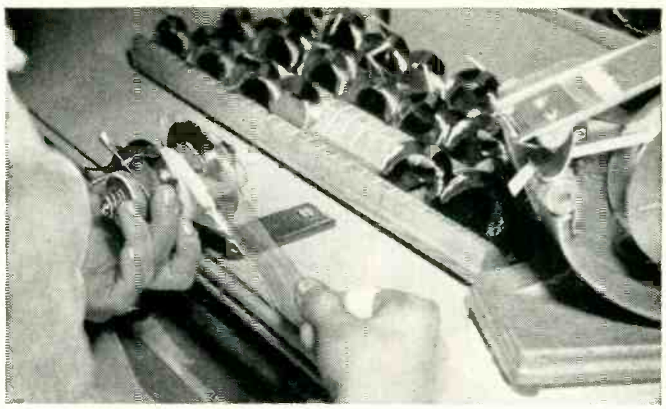
5200 W. Kinzie St., Chicago 44, Illinois • Phone: COlumbus 1-1221 • In Canada: Bach-Simpson, Ltd., London, Ont.

ONE TAPE does these three TV jobs!

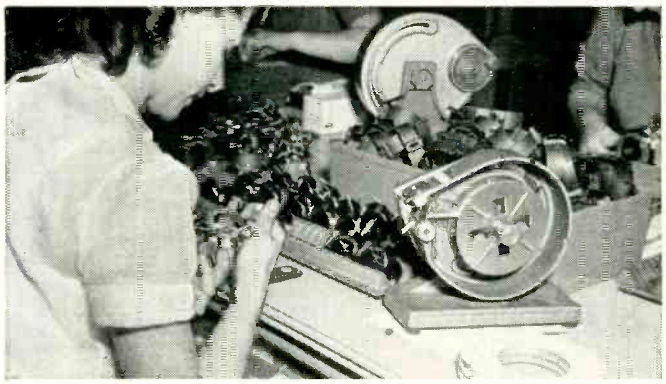
"Scotch" Brand Electrical Tape No. 10 Speeds Coil-Winding Operations at Electro Engineering & Mfg. Co.

Coil-winders in Detroit's Electro Engineering & Mfg. Co. find tape is tops for attaching insulation and holding coils together. And the TOP TAPE for multi-purpose use is "Scotch" Electrical Tape No. 10. This white acetate cloth tape needs no activating, no "babying." Makes coil-winding faster, easier. Sticks to the job.

There are over 30 other work-saving "Scotch" Electrical Tapes. And they're all completely described in "Tapes for Television." Send today for this big, FREE booklet packed with facts.

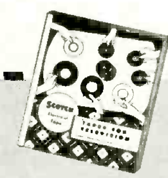


1 **TAPE ANCHORS** Saran ribbon to insulate horizontal coils from "ferrite" cores.



2 **TAPE ATTACHES** laminated plastic insulation to separate vertical from horizontal coils.

3 **TAPE HOLDS** coils together during assembly on simulated television tube neck.



Minnesota Mining & Mfg. Co.
Dept. ES62, St. Paul 6, Minnesota

Please send a copy of "Tapes for Television"

Name ....

Firm ....

Address ....

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

THE Erie TUBULAR TRIMMER STYLE 535...

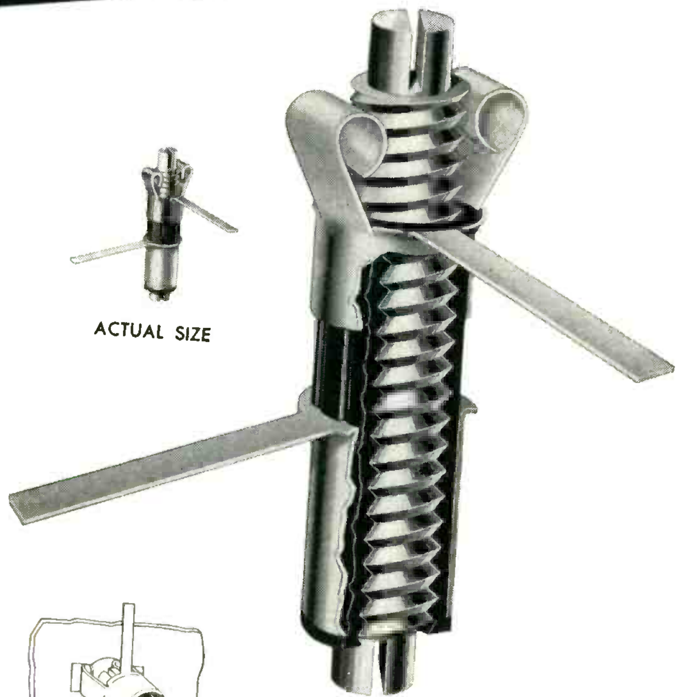
A "Natural" for Miniaturization and Low Inductance in UHF Circuits

THE ERIE Style 535 Tubular Trimmer combines economical price, compact size, and easy mounting, with features for UHF operation. Capacitance range is 0.7 to 3.0 MMF. When mounted it extends only 17/32" from the underside of the chassis. It is 7/32" in diameter, and high terminal is conveniently available to tube socket terminals at a level 1/4" from the underside of the chassis.

Design simplicity results in very low inductance, and uniform, straight-line, and noiseless adjustment. It can be mounted close to associated circuit elements, and the ribbon type leads help to minimize inductance in UHF circuits.

The Style 535 Trimmer as shown at the right, is unique in requiring work from only one side of the chassis when mounting. Ground terminal is provided for soldering to chassis when desired.

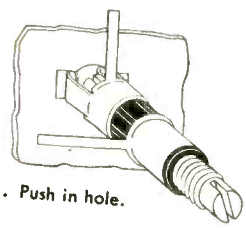
Write for descriptive literature and samples.



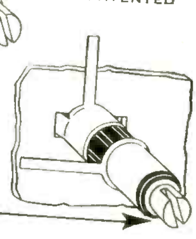
ACTUAL SIZE

STYLE 535

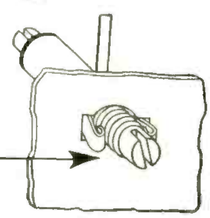
PATENTED



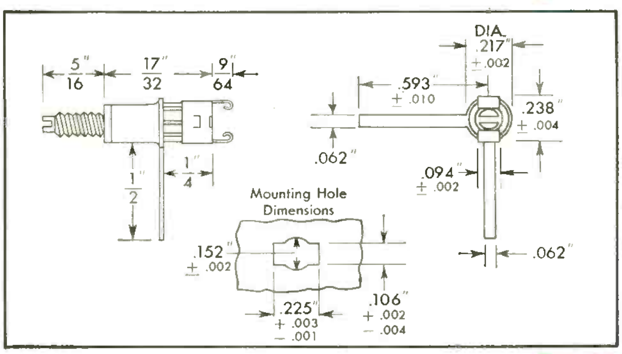
1. Push in hole.



2. Lock in hole by turning adjusting screw through top terminal.



3. Adjust capacitance from top at final test station.



Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND • • • • TORONTO, CANADA

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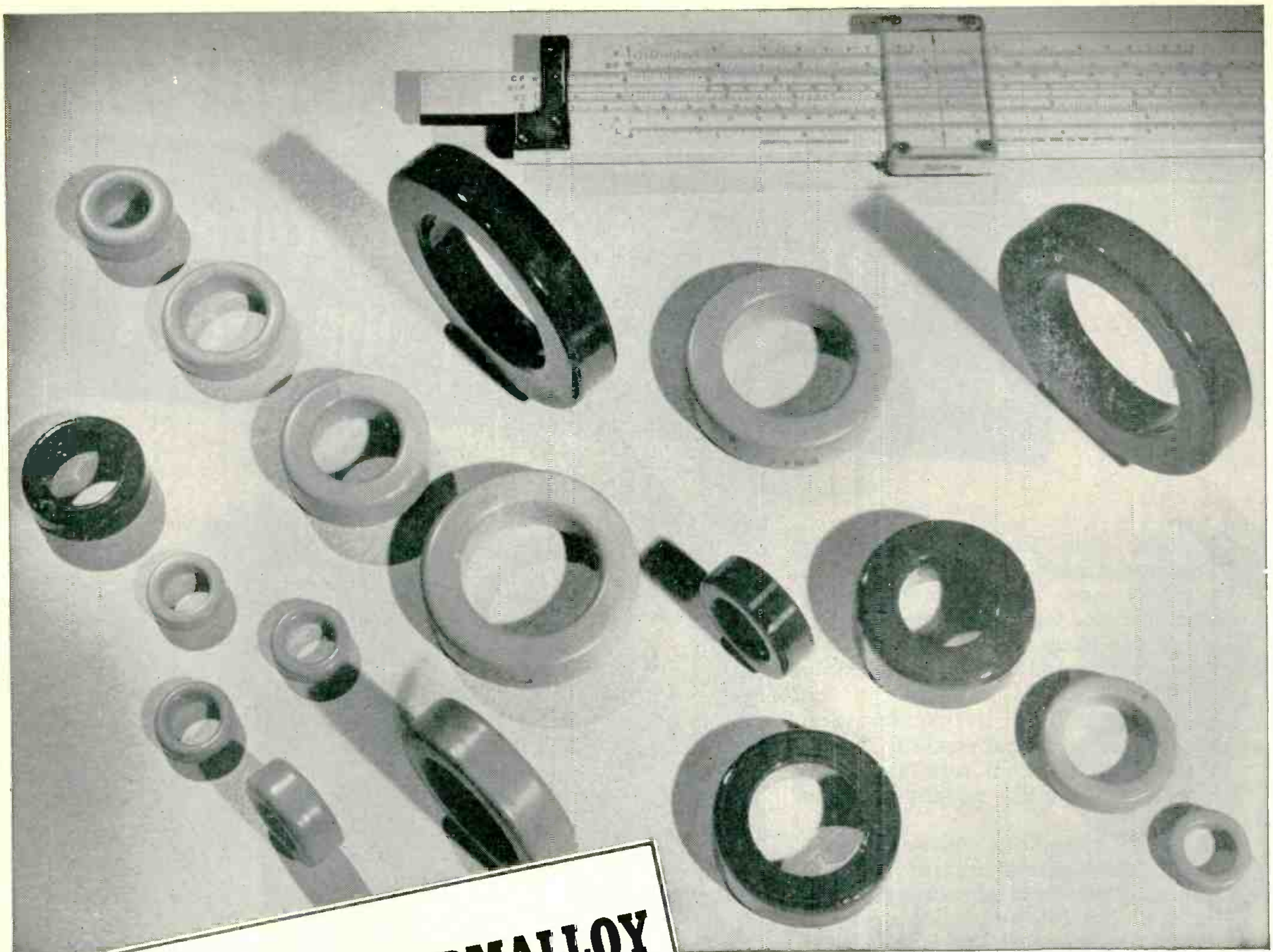
Detroit, Mich. • Cincinnati, Ohio • Los Angeles, Calif.



MOLYBDENUM PERMALLOY POWDER CORES*

(New technical data now available)

HIGH Q TOROIDS for use in Loading Coils, Filters, Broadband Carrier Systems and Networks—for frequencies up to 200 KC

COMPLETE LINE OF CORES TO MEET YOUR NEEDS

★ Furnished in four standard permeabilities—125, 60, 26 and 14.

★ Available in a wide range of sizes to obtain nominal inductances as high as 281 mh/1000 turns.

★ These toroidal cores are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.

For high Q in a small volume, characterized by low eddy current and hysteresis losses, ARNOLD Moly Permalloy Powder Toroidal Cores are commercially available to meet high standards of physical and electrical requirements. They provide constant permeability over a wide range of flux density. The 125 Mu cores are recommended for use up to 15 kc, 60 Mu at 10 to 50 kc, 26 Mu at 30 to 75 kc, and 14 Mu at 50 to 200 kc. Many of these cores may be furnished stabilized to provide constant permeability (±0.1%) over a specific temperature range.

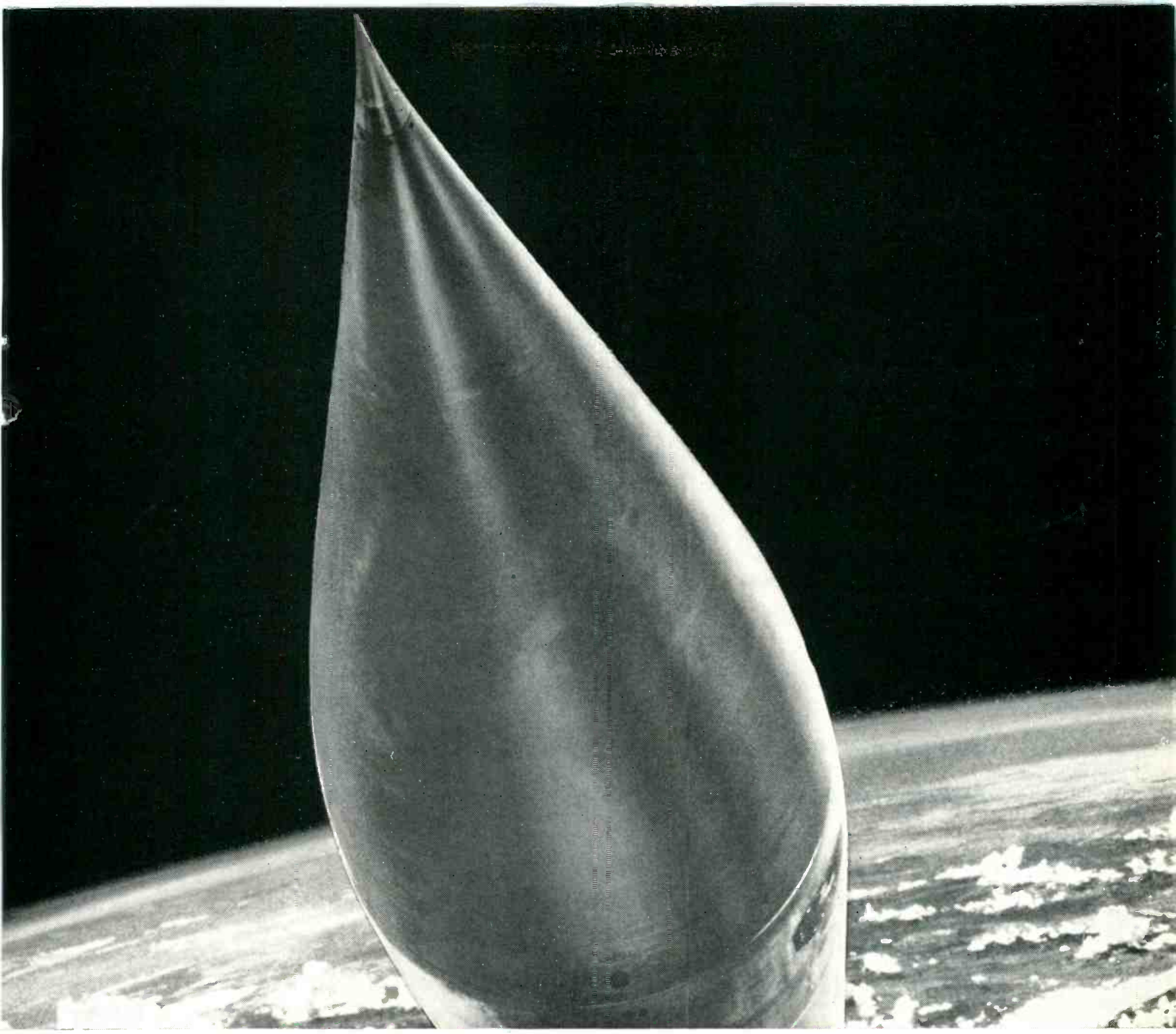
*Manufactured under license arrangements with Western Electric Company

W&D 4127

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois



TAKES ITS G's WITH A GRAIN OF SALT...

Accelerometer
(half size)

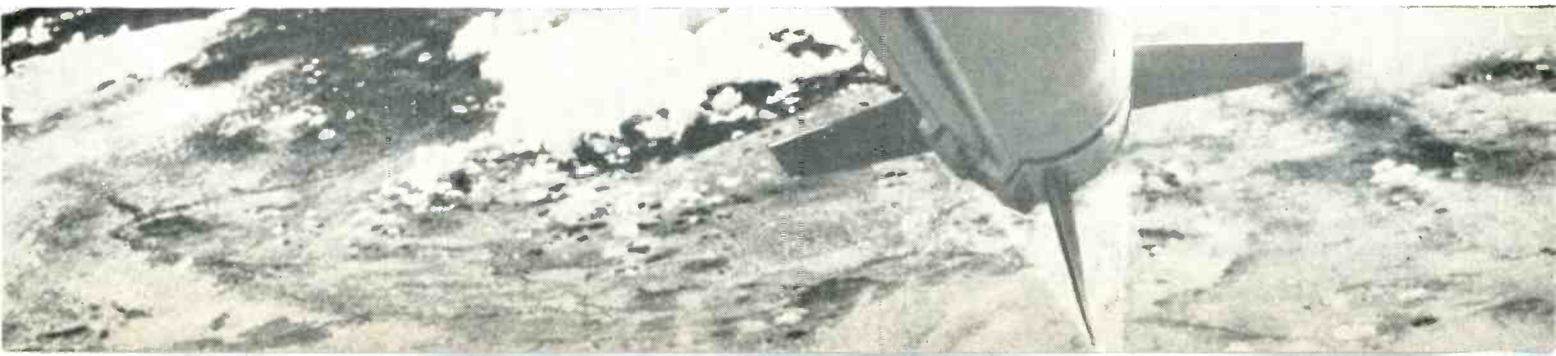
Literally, a few grains of salt in the form of barium titanate crystals have helped unravel complex mysteries of supersonic flight. For these elements are the heart of a new Bendix-Pacific miniature accelerometer which telemeters accurate G-measurements in guided missiles.

Bendix-Pacific standard telemetering assemblies, radar equipments, radio-control systems, servo components and other electronic devices are making a vital contribution to the rapid development of aircraft and guided missiles. The leadership of these products has been achieved through advanced design, reliability and ultra-compactness. To insure this leadership for the future, more than 400 people are working in the company's well-equipped Development Laboratory. Included among many important projects is extensive research work in electronic subminiaturization.

Your company, too, can profit from Bendix-Pacific's diversified experience. Substantial engineering inquiries in the fields of electronics, electro-mechanics, ultrasonics and hydraulics are invited.

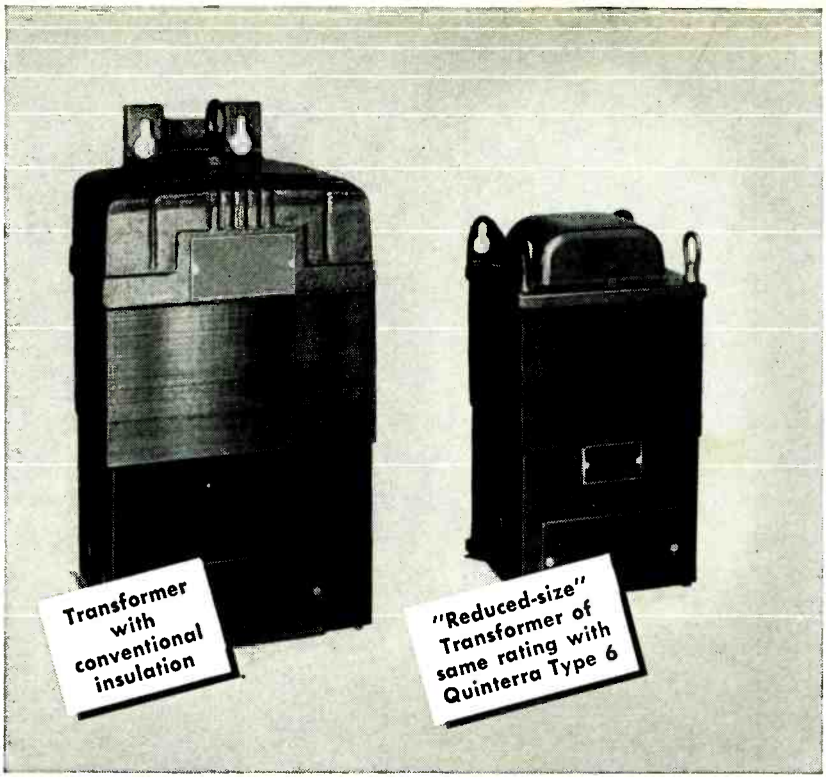
Pacific Division
Bendix Aviation Corporation
NORTH HOLLYWOOD, CALIF.

Bendix



Weight reductions average 30%

in new line of transformers employing *Quinterra** TYPE 6



Another example of savings permitted by this Johns-Manville purified asbestos insulation

A NEW LINE of dry type transformers announced by a prominent electrical manufacturer achieves savings in weight up to 50% in some models . . . 30% on the average. Contributing to these savings is the use of Quinterra Type 6 as layer insulation between the high and low voltage windings.†

Other manufacturers also report that Quinterra Type 6 permits substantial material savings. In addition, they state that this flexible insulation raises overload limits, increases safety, minimizes rejects, lengthens equipment service life, and lowers production costs.

Quinterra Type 6 possesses high thermal stability and lasting dielectric strength. It is a twin-ply, polyvinyl acetate treated purified asbestos insulation with a dielectric strength of 300 VPM. Even when its saturant is baked out by continuous exposure to 200 C, it retains the inherent dielectric of the base sheet which is at least 200 VPM . . . and it remains a dielectric up to 400 C.

Type 6 is the strongest Quinterra because it is made by combining and calendering two layers together into a dense, smooth surfaced insulation. Its good tensile and bursting strengths enable operators to achieve favorable production rates. Further economies result from its large square-foot-per-dollar coverage.

If you are a manufacturer of magnetic or resistance devices, Quinterra Type 6 may enable you to obtain substantial cost reductions. For samples and additional information, write Johns-Manville, Box 60, New York 16, N.Y.

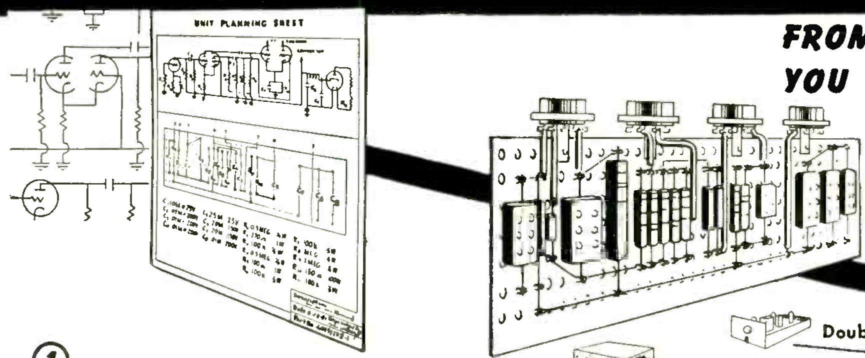
†Quinorgobord #1100, another J-M purified asbestos insulation, is also used as end filler strips.

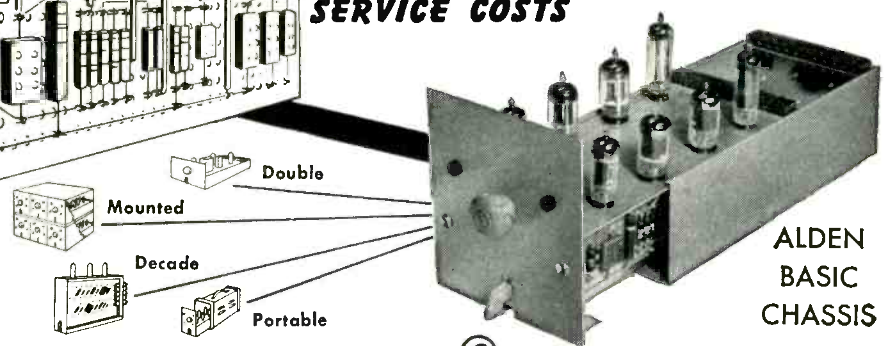
*Quinterra is the registered trade mark of Johns-Manville's purified asbestos electrical insulation.

JOHNS-MANVILLE JM PRODUCTS **Johns-Manville ELECTRICAL INSULATIONS**

BRING THROUGH EQUIPMENT FAST!

FROM STANDARD STOCK COMPONENTS YOU CAN SIMPLIFY DESIGN — SPEED PRODUCTION — AND CUT SERVICE COSTS





①

ORGANIZE CIRCUITS QUICKLY

Schematics of most electronic equipment can be broken down into circuit blocks of logically associated functions. These functional circuit blocks can be mounted readily either in the Alden "20" plug-in packages or Basic Chassis unit. Tube sockets and associated components quickly lay out on full scale Unit Planning Sheets for mounting on terminal cards. These special pre-punched, multi-hole terminal cards have wide flexibility to take an infinite variety of circuit variations. Both sides of card can be used to obtain maximum component density area. Using the Unit Planning Sheets, functional circuit units are all planned in one step.

②

GET EASY SUB-DIVISION OF LABOR

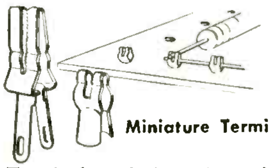
Solder terminals and sockets quickly rivet to Alden terminal card according to layout on Unit Planning Sheet. Components snap into the special Alden Miniature Terminals which hold them for soldering — (No twisting or wrapping of leads necessary) — With all tube sockets and their associated components mounted on one card — the wiring and soldering of circuits is an open, easy-to-work sub-assembly operation.

③

CUT SERVICE AND MAINTENANCE COSTS IN FINAL EQUIPMENT

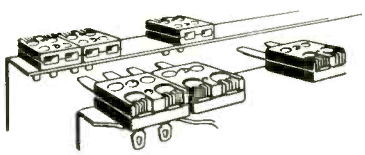
In field, shop, or office your equipment maintenance is reduced to 30 second changeovers. Basic replacement elements are small enough in weight and size to be shipped by parcel post for repair.

IT'S AS SIMPLE AS THIS!



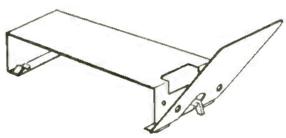
Miniature Terminals — 650 Series

Terminal cards have been designed to accommodate tremendous number of circuit variations — to make neat tube and component sub-assemblies with a minimum of wiring and simplified assembly techniques. Special Alden Miniature Terminals are new and radical punch press configuration — ratchet slot holds various size component leads for soldering — no twisting of leads with pliers. Figure "eight" shape accommodates cross wiring and buss leads. Terminals are punch press parts — so take a minimum of solder, reduce solder time, eliminate danger of cold solder joints.



Back Connectors — 462MIN Series

Alden Terminal Card System means minimum of inter-cabling — but even this cabling can be laid out easily and proceed as simple sub-assembly. Open sided chassis construction makes cable easy to wire to front panel, terminal cards and back connectors. The Alden Back Connectors are units that can be discretely positioned on the back of the chassis — isolating lines with incompatible voltages, currents, or frequencies. This design insures accessible solder terminals for soldering — avoids rat nests of congested conventional back connector wiring. Color coded, the Alden back connectors provide beautiful operational or service check points for all leads to and from chassis.

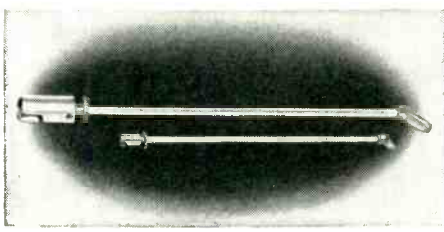


Hinged Front Panel Design

Hinged front panel design of chassis allows rheostats, indicator lights, jacks, etc. to be mounted on panel as another easy-to-work sub-assembly. This panel attaches easily to chassis — is wired — swung up and fastened with Alden Target Screws.

Target Screws

These screws have concave head with arced notch so power screw driver locates head quickly, no danger of it slipping out and marring panel surface — yet same screw can be unfastened with coin in order to hinge forward the front panel for servicing and check in the field.



"Serve-A-Unit Lock"

Assembled — the Basic Chassis simplifies operation of equipment — Slashes service and maintenance time. Smooth, positive insertion and removal of the chassis is provided by the Alden "Serve-A-Unit Lock." A simple twist of the handle and the chassis backs off with finger tip ease. It also pilots the chassis back into place — securely locking it for operation with the same facility.

WIDE VARIETY OF APPLICATIONS

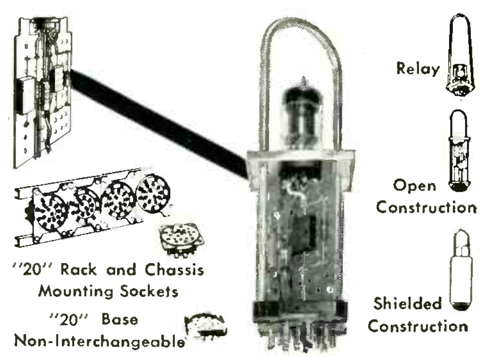
ON AIRCRAFT EQUIPMENT — Large manufacturers of aircraft equipment are using the Alden Method of unit construction to simplify design and save engineering time.

ON COMPUTERS — Recent large scale digital computer for Air Corps uses Alden "20" Plug-in Bases and Sockets throughout. One of country's largest manufacturers is building two large computers using Alden "20" Plug in Packages.

ON BUSINESS EQUIPMENT — Leading business machine manufacturers are designing with Alden components for greater accessibility and ease of servicing of their equipment.

FOR SMALLER UNITS ALDEN "20" PLUG-IN PACKAGES

Here is a plug-in package unit using the above method of converting schematic into finished assembly quickly. Simply mount the completed terminal card sub-assembly on the Alden "20" Non-Interchangeable base, dip solder the leads — add cover or housing and handle and it's completed — In operation, visual or instrument checks are easily made — if trouble occurs doubtful units are quickly isolated — these units easily unplug and a comprehensive inspection made. Spare units can be plugged in so equipment doesn't have to be inoperable while repairs are in process.



TO GET STARTED QUICKLY!

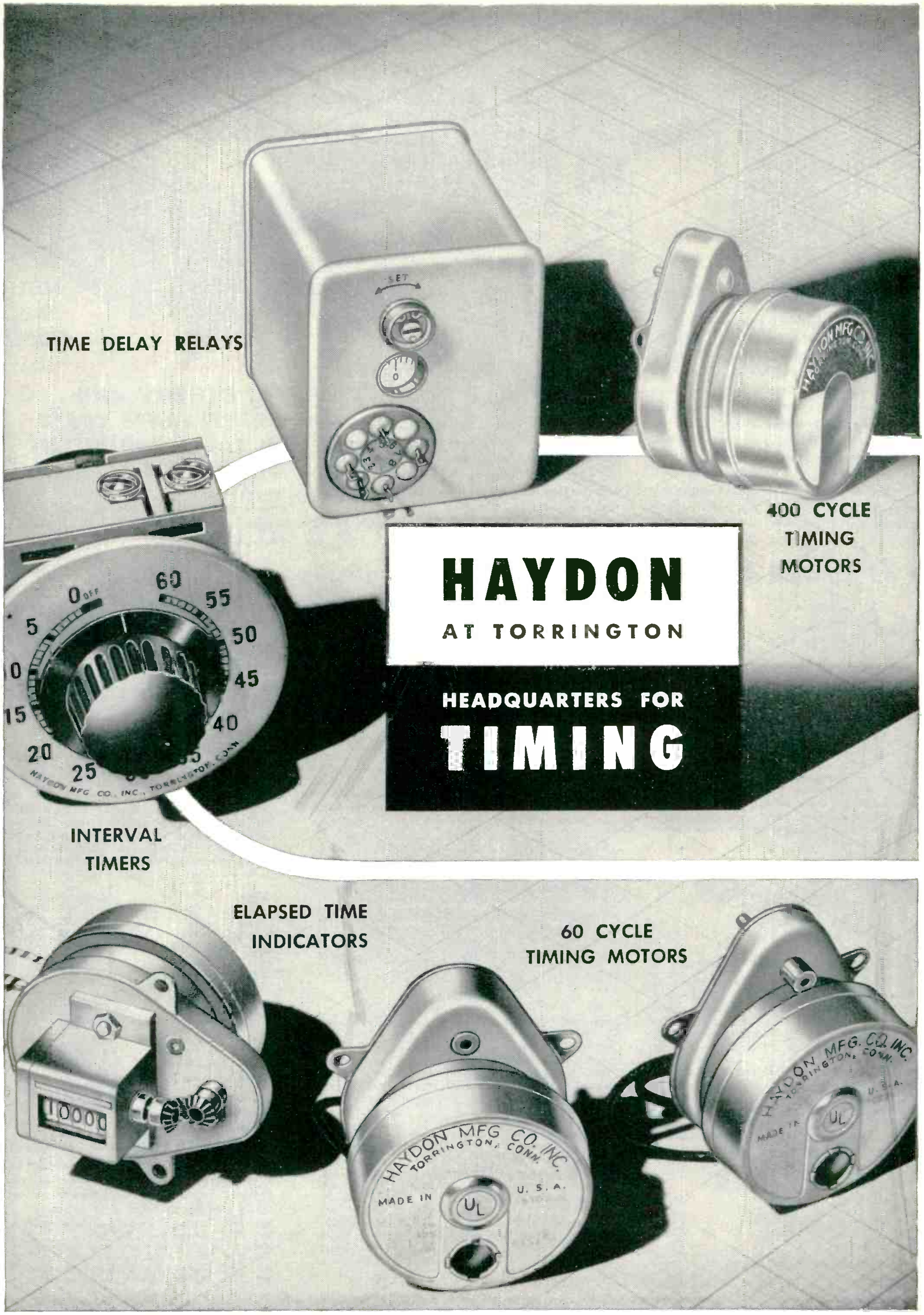
Send for these tremendously useful Laboratory Work Kits and have them in your lab for use on present equipment or immediately ready for next new project:

Kit #4	Alden "20" Plug-in Packages	$10.00*
Kit #24	Alden Basic Chassis	$26.50*
Kit #25	Terminal Card Mtg. System	$11.50*
Kit #26	Basic Terminal Staking Tools	$15.00*
Kit #8	Target & Cap Captive Screws	$ 3.00*
Kit #29	Color Coded Back Connectors	$ 4.50*

or send for free booklet, "Basic Chassis and Components for Plug-in Unit Construction.

*Prices shown are for sample kits only — For production runs send us your schedule.

ALDEN PRODUCTS COMPANY 127 North Main Street, Brockton, Massachusetts

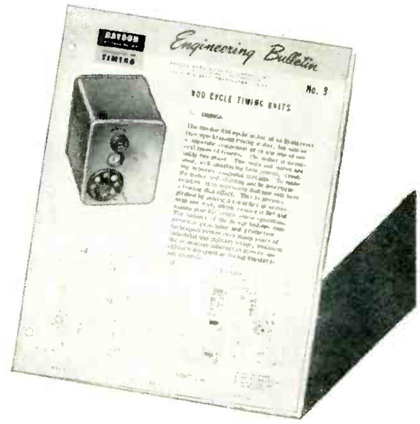

TIME DELAY RELAYS
400 CYCLE
TIMING
MOTORS
HAYDON
AT TORRINGTON
HEADQUARTERS FOR
TIMING
INTERVAL
TIMERS
ELAPSED TIME
INDICATORS
60 CYCLE
TIMING MOTORS
HAYDON MFG CO. INC.
TORRINGTON, CONN.
MADE IN
U. S. A.

TRIGGER-TRIP
TIME DELAY RELAYS

for 60 and 400 cycle A.C., also D.C.

The **HAYDON*** 5103 time delay relay is designed so that the synchronous motor performs its true function as a time standard. Switching work is accomplished by a relay coil, which, when energized, triggers the load switch for release at the end of the delay time. Hair trigger release point assures snap action.

The unit, which measures $2\frac{19}{32}''$ x $3\frac{11}{32}''$ x $3\frac{3}{4}''$ max., weighs only $1\frac{1}{2}$ pounds and is hermetically sealed. It has high initial accuracy and good repeatability, with a wide range of time delays from seconds to hours. Resetting is fast and positive, with reset time uniform for all delay ranges. Load switch may be independent of operating circuit. Designed for military usage. Write for Engineering Bulletin No. 3 for complete information.

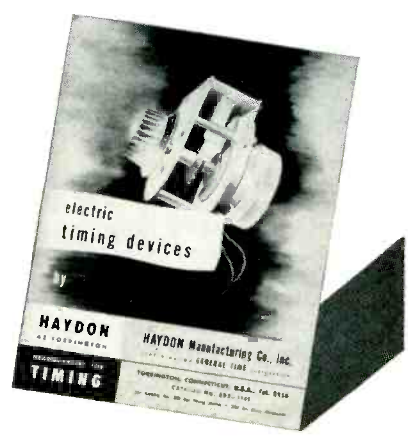


TIMING MOTORS

The many advantages of HAYDON timing motors are described in detail in the Timing Motor Catalog, which will be sent upon request. Actual size illustrations show just how small these motors are; diagrams and technical data explain the HAYDON system of controlled lubrication, which is one of the reasons the motors operate in any position. Slow rotor speed permits minimum of gearing for various output shaft speeds, assuring quiet operation and minimum wear. The HAYDON 400 cycle motor is described in detail in a separate publication, Engineering Bulletin No. 2. Write for the literature you need.

TIMING DEVICES

HAYDON specializes in a varied line of standard timing components and custom engineered timing devices for volume application. The basic element of all HAYDON timers is our own rugged industrial motor, which can be depended upon for long quiet operation. Complete engineering data is included in our Timing Device Catalog which will be sent promptly on request. For military applications, various motors are available either separately or in many types of timers; HAYDON engineers will be pleased to review your requirements and specifications.

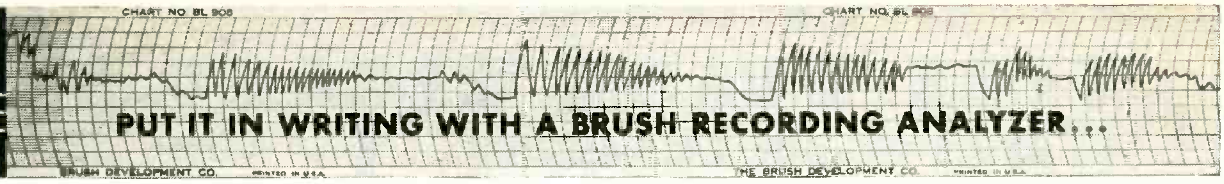


HAYDON Manufacturing Co., Inc.

Subsidiary of GENERAL TIME CORPORATION

2430 ELM STREET, TORRINGTON, CONNECTICUT

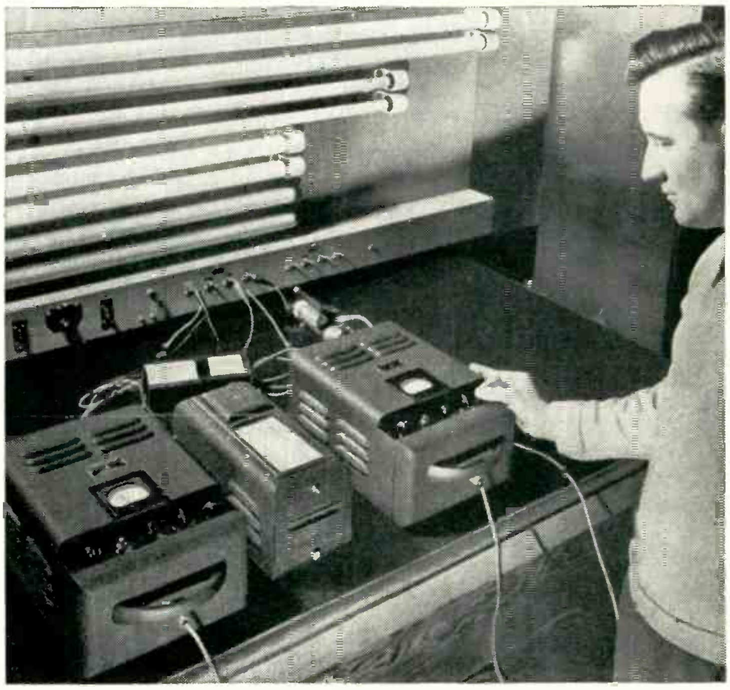
*TRADEMARK REG. U. S. PAT. OFFICE

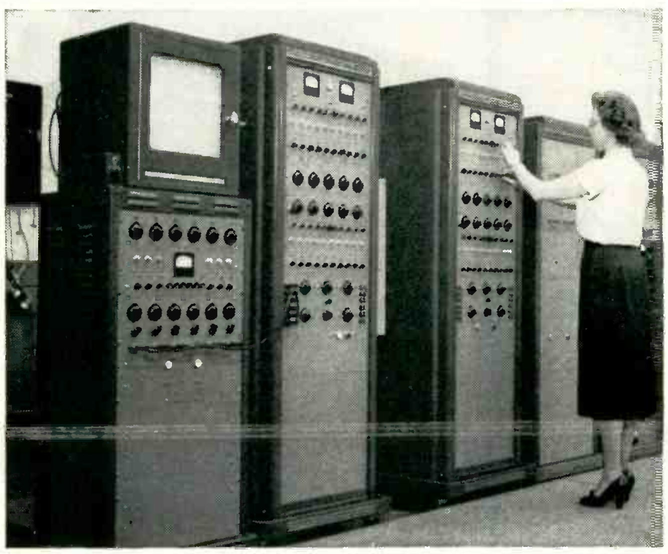


Records Voltage and Current On One Chart!

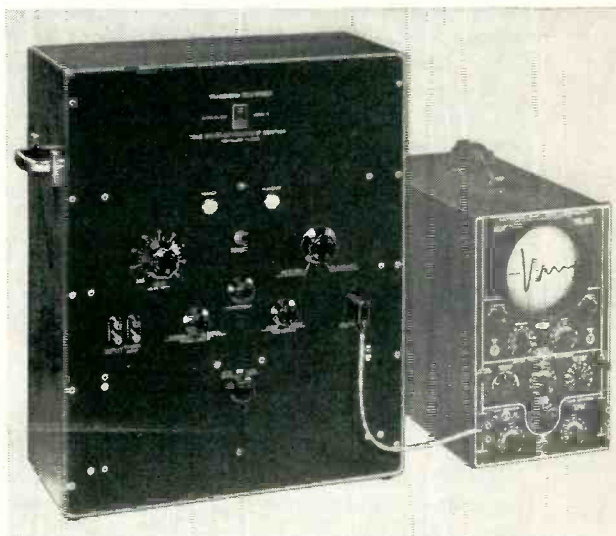
● This Brush Direct-writing Dual-channel Oscillograph plots starting voltage and current of a fluorescent lamp simultaneously . . . thus aids a leading manufacturer in design and test work.

Use the Brush Magnetic Oscillograph, in combination with the proper Brush Amplifier, to make an immediately available direct chart recording of physical and electrical phenomena. Direct-inking or electric stylus models available. Gear shift provides chart speeds of 5, 25, and 125 mm per second. An auxiliary chart drive is available for speeds of 50, 250, and 1250 mm per hour. Accessory equipment provides event markers where an accurate time base is required, or where it is desirable to correlate events.





RECORDS SIX VARIABLES SIMULTANEOUSLY. The Brush six-channel Magnetic Oscillograph is designed for simultaneous recording of six electrical phenomena, with a chart record immediately available. In this application the results of six different computations of an electronic differential analyzer are recorded. Instrument facilitates multiple strain measurement, vibration analysis, wind tunnel work, circuit analysis, etc. Either d-c or a-c phenomena up to 100 cycles can be recorded.



"PLAYS BACK" TRANSIENTS. The Brush Transient Recorder is designed to record and reproduce transient phenomena of 1/5 second or less. This instrument records transients on tape, then reproduces them for visual analysis on an oscilloscope. Signals can be shown complete, or expanded on the screen to show detail. Electrical transients or other transients which can be converted into electrical impulses can be studied.

For Bulletin 618 giving details on these instruments, write The Brush Development Co., Dept. K-31, 3405 Perkins Ave., Cleveland 14, Ohio. Representatives located throughout the U. S. In Canada: A. C. Wickman Ltd., Toronto.

THE *Brush* DEVELOPMENT COMPANY

BRUSH

Piezoelectric Crystals and Ceramics
Magnetic Recording
Acoustic Devices
Ultrasonics
Industrial & Research Instruments

Some Things Are WORSE THAN STRIKES

This editorial which appears in McGraw-Hill publications was written just prior to the resignation of Charles E. Wilson as Director of Mobilization. The principle it discusses is of basic and continuing importance in our struggle to maintain economic and personal freedom in America.

It is to be hoped that the managements of the steel industry will resolutely resist the efforts of the national Wage Stabilization Board to force them to establish the union shop in their plants. In essence, the union shop means compulsory union membership.

They should resist not because of any financial advantage to the owners of the industry. There would be none. They should resist out of a decent regard for those ideals of our country which we are now fighting in Korea to protect. Moreover, their resistance would, as a matter of fact, benefit the leaders of the organized steel workers by protecting them from the certain and bitter fruits of their "victory" in getting the government to impose the union shop on the steel industry. Their successful resistance would also prevent Premier Stalin and his co-workers from enjoying a hearty laugh at our expense.

Fun for the Russians

This is why the Politburo would find the establishment of the union shop in the steel industry, at the behest of the Wage Stabilization Board, so profoundly amusing. We are fighting in Korea because we believe that armed aggression, promoted by Russia, menaces our freedom. And we are spending hundreds of billions of dollars here at home for armament to protect our freedom at other danger points. When this rearmament program is threatened by a crippling strike, the federal government through its Wage Stabilization Board proposes to buy off the threat by plowing under a vital element of that freedom which we are trying so desperately to preserve.

When the union shop is adopted through voluntary agreement, as it has been in cases covering millions of workers, it deeply undercuts the freedom of the individual. To hold his job he is required to join the union and support it financially whether he wants to or not. In the case of such voluntary agreement, however, the government takes no direct part in thus destroying the freedom of its citizens. It is essentially a private transaction.

Tyranny is the Word

But in the steel case the federal government becomes a party to a direct attempt to impose the union shop. Instead of protecting its citizens in their right to earn a livelihood, the government forces certain of them to join and support a private organization which they have clearly indicated they do not want to join. This they must do to hold their jobs. Tyranny is the accepted designation of government coercion of this kind.

It may be objected that the Wage Stabilization Board merely recommends the union shop, does not order it. This was also true of the action recently taken by a President's Emergency Board, which also "recommended" that working agreements between the railroads and about a million non-operating railroad employees include a provision for the union shop. A government recommendation, however, can easily be given much of the force of an order, particularly by the calling of a strike to "uphold the hand of the government."

It seems entirely clear that in trying to impose the union shop on the steel industry the Wage Stabilization Board has completely lost its bearings. It was set up to handle labor problems to tide over an emergency. Now it comes up with a revolutionary modification of labor relations in the steel industry which, if adopted, would become a permanent part of the institutional machinery of the industry.

"Too Much Like Hitler"

Early in World War II an effort was made to have the federal government order the union shop for a group of organized coal miners. President Franklin D. Roosevelt, who will go down in history as one of organized labor's greatest champions, blocked it. "That," he said, "would be too much like the Hitler methods toward labor." But now, with supreme irony, the federal government fosters this Hitlerlike method toward labor ostensibly to advance our conflict with Stalin.

In persuading the Wage Stabilization Board to sponsor the union shop for steel workers, there is every reason to believe that the union leaders have trapped themselves. If the government imposes the union shop, a next step clearly becomes necessary. This is government regulation of the union in order to provide a modicum of protection for the minority that would be forced by the government to join against their will. It could be that for a time the government would ignore this obligation. But, having granted the union the power to eliminate the minority, it would sooner or later be forced to regulate the use of that power. Thus free collective bargaining and freedom itself would be the losers.

An Issue of Basic Principle

Resistance to a government-sponsored union shop for the steel industry is bound to bring harsh denunciation both from the administration and union leaders who have teamed to back it. Not only does the union shop relieve the union leaders of the problem of recruiting members, it also eliminates a group of workers that they stigmatize as "free riders"—namely, those who work for companies which have a working agreement with a union but do not join the union. In the basic steel industry about 10 per cent of those who work for companies with union agreements are not members of the union. Such a small percentage of non-members is obviously no threat to the "security" of the union, although that is what the drive for the union shop ostensibly is designed to protect.

In the reporting of the present labor dispute in the steel industry virtually all of the attention has been focussed on the handling of the issue of a wage increase and how large it should be. This, to be sure, is vitally important. Mobilization Director Wilson has said it is "a serious threat to our year-old effort to stabilize the economy." But certainly of comparable importance is the tremendous issue of principle raised by the government's backing of the union shop for the steel industry.

If the position of the Wage Stabilization Board on the union shop prevails, our government will have blunted the arms we are forging to fight for our freedom abroad by undermining a major bulwark of our freedom right here at home. At this critical time in the struggle to preserve and protect our freedom such a subversive course should be resisted to the limit.

McGraw-Hill Publishing Company, Inc.

PROBLEM:

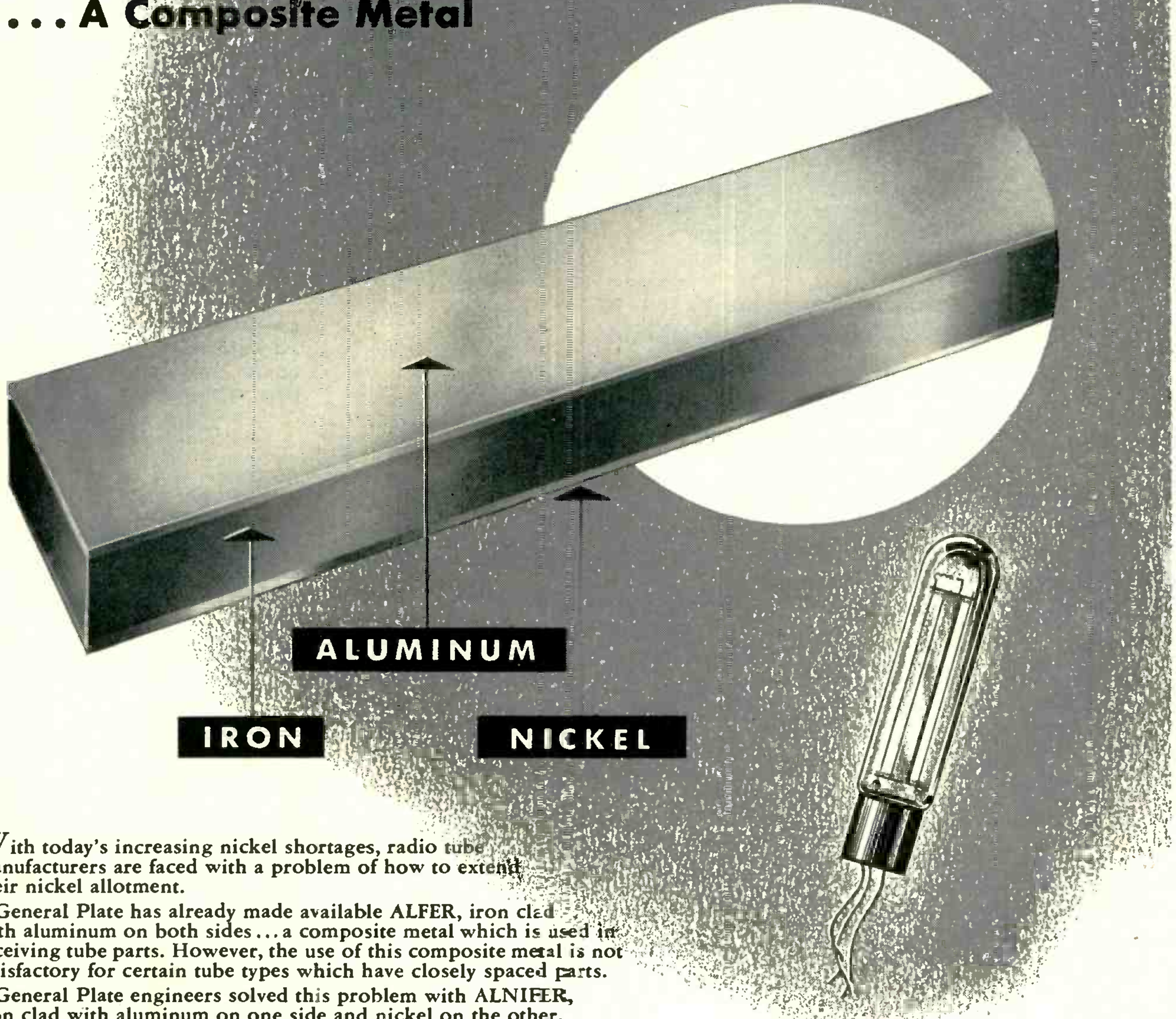
How to replace the use of pure nickel in close-spaced tubes

GENERAL PLATE

Provided a solution with

ALNIFER (aluminum-iron-nickel)

. . . A Composite Metal



With today's increasing nickel shortages, radio tube manufacturers are faced with a problem of how to extend their nickel allotment.

General Plate has already made available ALFER, iron clad with aluminum on both sides . . . a composite metal which is used in receiving tube parts. However, the use of this composite metal is not satisfactory for certain tube types which have closely spaced parts.

General Plate engineers solved this problem with ALNIFER, iron clad with aluminum on one side and nickel on the other.

General Plate can also supply NIFER, nickel-iron-nickel composite metal, for use where other materials are not satisfactory.

No matter what your problem, it will pay you to consult with General Plate. Their vast experience in cladding precious to base metals, or base to base metals can overcome your problems . . . often reduce costs.

General Plate products include . . . precious metals clad to base metals, base metals clad to base metals, silver solders, composite contacts, buttons and rivets, Truflex® thermostat metals, Alcuplate®, platinum fabrication and refining, #720 manganese age-hardenable-alloy. Write for information.

Have You a Composite Metal Problem?
General Plate can solve it for you

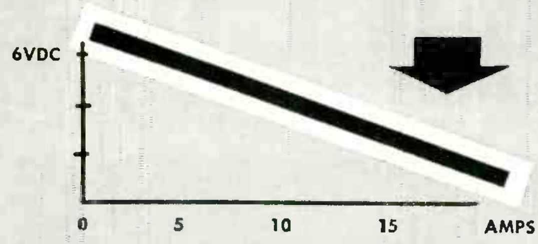
GENERAL PLATE

Division of Metals & Controls Corporation

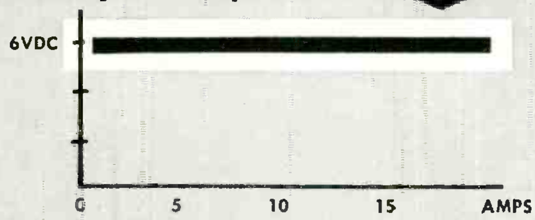
36 FOREST STREET, ATTLEBORO, MASS.

Problem •

Your present DC source gives you



What you require is



Solution • nobatron*

Sorensen NOBATRONS provide regulated DC voltage, stabilized against LOAD changes as well as LINE fluctuations. A wide range of standard models are available in capacities from 7 to 200 VDC, 5 to 350 amps.

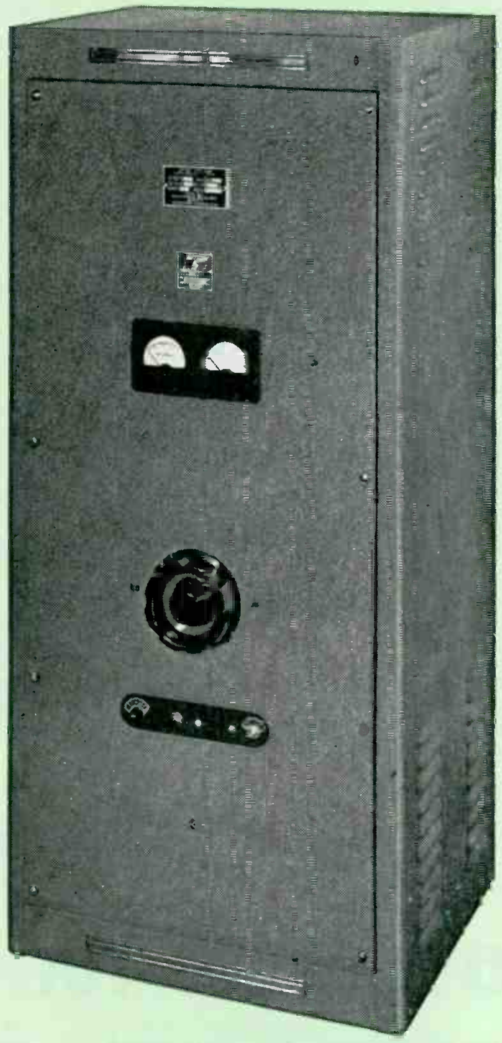
Model E-6-15

COMMON NOBATRON SPECIFICATIONS

Input Voltage range	95-130 VAC, single ϕ, 50-60 ~ High-current units 208/115, 3ϕ, 4-wire, wye.
Output voltage range	Adjustable $\pm$ 10% with rated accuracy, — 25% with lesser accuracy.
Regulation accuracy	$\pm$ 0.2% from 1/10 to full load.
Ripple voltage	1% RMS. Time constant 0.2 seconds.

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

for maximum Flexibility the nobatron Ranger



SR-10

Nobatron-RANGERS are continuously adjustable over wide output ranges, yet provide regulation accuracy of $\pm$0.25%. Other specifications are identical to those of the standard NOBATRONS.

Standard models with adjustable outputs of 3-30VDC, 3-135VDC, 100-300VDC.

Write for our new catalog giving full information on Nobatrons, Nobatron-Rangers, and other Sorensen Isotronic† products.

†Isotronic is a trade-marked word pertaining to the electronic regulation and control of voltage, current, power, or frequency.

Specify

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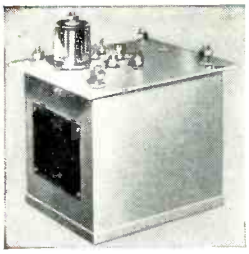
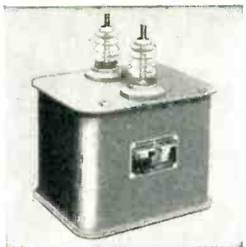
DIGEST

TIMELY HIGHLIGHTS ON G-E COMPONENTS



Rectifiers



Reactors

Transformers

Compact high-voltage components offered in wide range of ratings

G-E high-voltage components—designed for applications 5000 volts and higher where corona must be kept to a minimum—are available tailored to meet your needs.

All are oil filled and hermetically sealed to resist moisture, dirt, and dust. Conforming to MIL specs for military electronic equipment, these components are sturdily designed for reliable service under severe operating conditions, including mechanical shocks and widely varying temperatures.

In sending your design inquiries, include all functional requirements, limiting dimensions, and expected quantities. Write to *General Electric Co., Sect. 667-20, Schenectady 5, N. Y.*

Germanium rectifiers in industrial ratings!

For use where size and weight are important, new G-E industrial germanium rectifiers offer:

- lowest forward drop per amp—for best regulation
- highest output voltage per cell
- best current output
- smallest size per watt output
- lightest weight per watt output
- instantaneous rectification

For ratings and operating characteristics, see new Bulletin GEA-5773.

New hermetically sealed relay resists breakdown

G.E.'s new hermetically sealed aircraft relay for use in exposed locations has extra protection against permanent breakdown due to voltage surges. Special polyester compound used to mold contact arms into stack insulation is non tracking, provides greater arc resistance. More powerful magnet structure yields higher tip pressures for surety of make. Rated 28 volts d-c, 3 amp. See Bulletin GEA-5729.

EQUIPMENT FOR ELECTRONIC MANUFACTURERS

A partial list of the thousands of items in the complete G-E line. We'll tell you about them each month on these pages.

Components

Meters and instruments	Timers
Capacitors	Indicating lights
Transformers	Control switches
Pulse-forming networks	Generators
Delay lines	Selsyns
Reactors	Relays
*Thyrite	Amplidynes
Motor-generator sets	Amplistats
Inductrols	Terminal boards
Resistors	Push buttons
Voltage stabilizers	Photovoltaic cells
Fractional-hp motors	Glass bushings
Rectifiers	Dynamotors

Development and Production Equipment

Soldering irons
Resistance-welding control
Current-limited high-potential tester
Insulation testers
Vacuum-tube voltmeter
Photoelectric recorders
Demagnetizers

*Reg. trade-mark of General Electric Co.

General Electric Company, Section C667-20
Schenectady 5, New York

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Indicate: √ for reference only
X for planning an immediate project

☐ GEA-5729 Hermetically sealed Relays
☐ GEA-5773 Germanium Rectifiers
☐ GEA-5778 MIL-T-27 Transformers

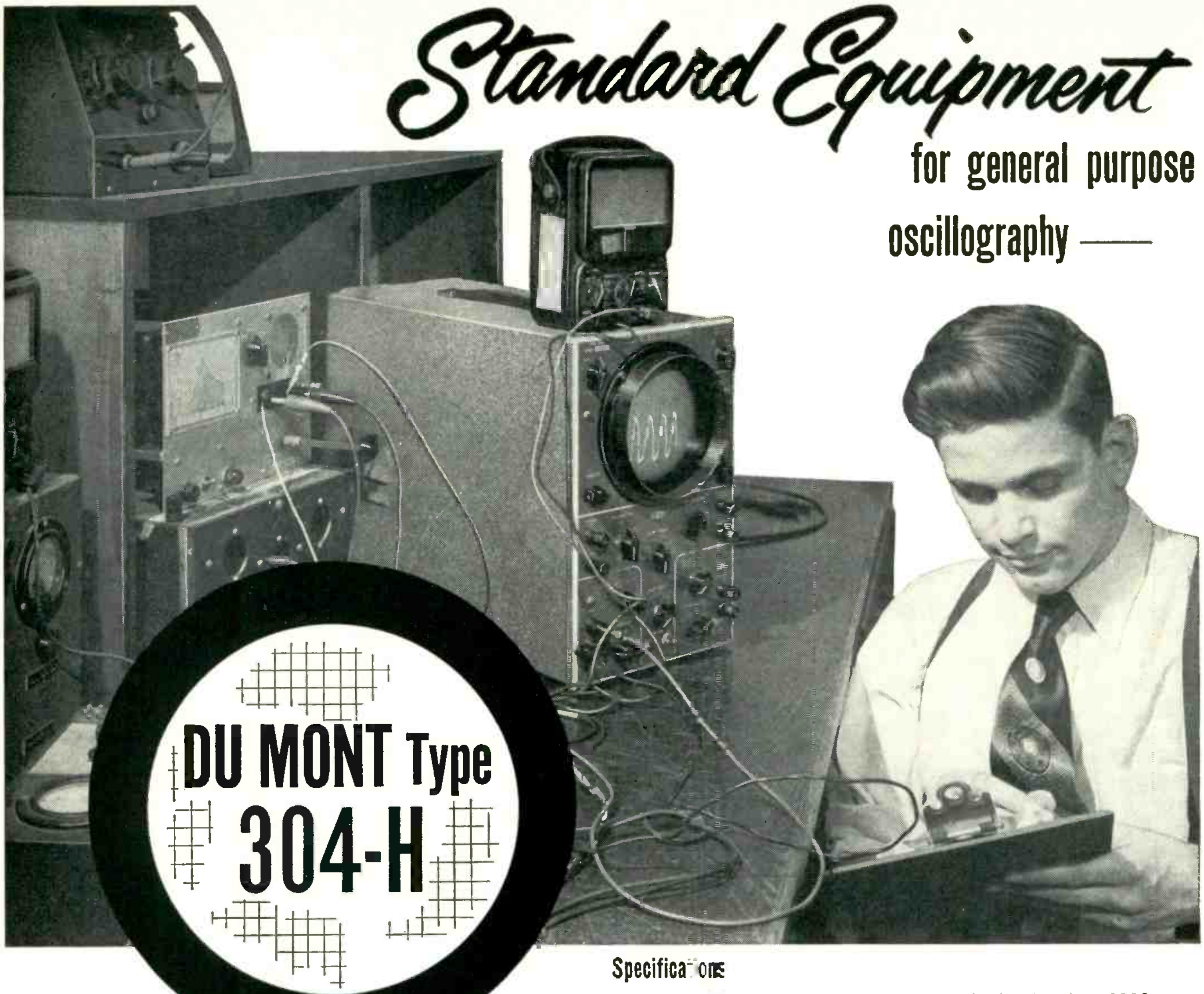
Name ....

Company ....

City .... State ....

Standard Equipment

for general purpose oscillography —



The unquestioned reputation of the Du Mont Type 304-H as *standard equipment* for general purpose oscillography is the result of performance unparalleled in its price class. Its capabilities, found previously only in far more expensive and elaborate instruments, won for the Type 304-H immediate and wide acceptance in industry and research.

Now a new feature is added to the Type 304-H, an illuminated calibrated scale to facilitate both visual observation and measurement, and analysis from photo-recordings.

Study the specifications below. At a glance they indicate why the Type 304-H is the most versatile oscillograph in the low price range—why it has become the *standard of performance* for general-purpose oscillography.

Price $333.00

Specifications

Cathode-ray Tube: Type 5CP-A. Acceleration, 3000 volts.

Y-axis: Deflection factor: Amplifier at full gain, 0.028 p-p (0.01 rms) v/in. Direct, 50 p-p (18 rms) v/in. ±20%. **Frequency response:** uniform within 10% to 100 kc., within 50% to 300 kc. **Input impedance:** to amplifier, 2 meg., 50 μμf; direct (balanced), 4 meg., 20 μμf; (unbalanced) 2 meg., 20 μμf.

X-axis: Deflection factor: Amplifier at full gain, 0.30 p-p (0.1 rms) v/in.; direct, 80 p-p (26 rms) v/in. ±20%. **Frequency response:** uniform within 10% to 100 kc., within 50% to 300 kc. **Input impedance:** to amplifier, 2 meg., 50 μμf; direct (balanced), 4 meg., 20 μμf; (unbalanced) 2 meg., 20 μμf.

Linear Time-Base: Both driven and recurrent sweeps variable from 2 cps. to 30 kc.

Primary power: 115/230 volts; 50-60 cps.; 100 watts.

Calibrated scale: Illuminated, with front panel dimmer control.

Line-frequency test signal: 0.5 rms volts at power-line frequency, available at front panel. **Sawtooth test signal:** 7.5 volts peak to peak at frequency of time-base generator.

Size: 13½" h.; 8¾" w.; 19½" d.; 50 lbs.

DUMONT

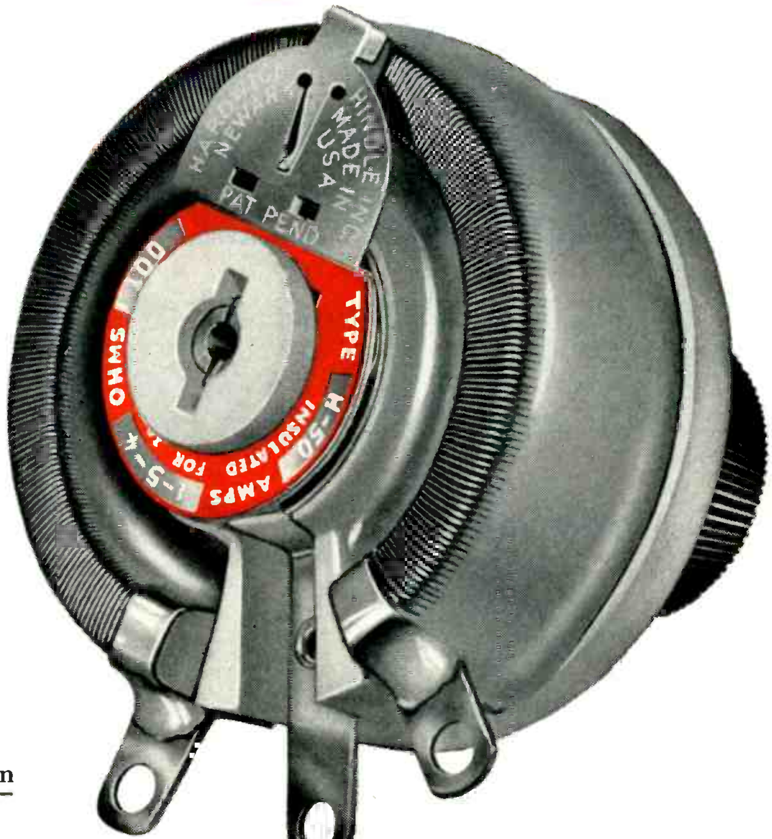
for Oscillography

Instrument Division, Allen B. Du Mont Laboratories, Inc., 1500 Main Ave., Clifton, N. J.

THIS IS IT

★ **the NEW H-50 Rheostat**

★ **another Hardwick, Hindle ten-strike!**



Instructions to our engineering department were:

"design a rheostat—completely new construction if necessary—that embodies all features essential to producing a rheostat that 'can take it' in the wide industrial field."

They did—and this is it.

1. Of course it is bonded with our new blue-gray enamel coating—thermo-shock-proof—assuring greater protection under most rugged service—under extremes of humidity and abnormal atmospheric conditions.

2. Still greater safety factor—more resistant to excess heat and shock.

3. Still higher terminal strength.

4. New trouble free construction—minimum number of parts—uniform torque, adjustable pressure, smoother electrical control, etc.

And please note; this new H-50 is designed to comply with current standards of:

(a) Military Specifications JAN-R-22.
(b) Underwriters' Laboratories.
(c) R.T.M.A.
(d) N.E.M.A.

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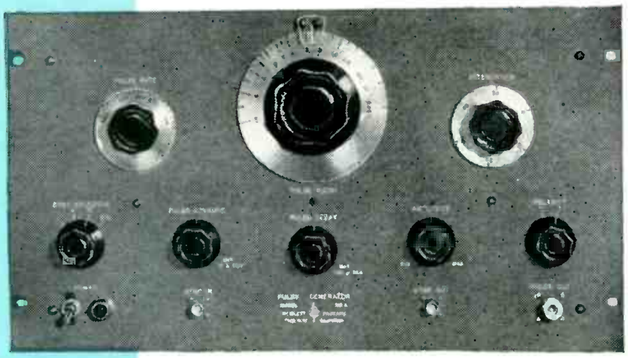
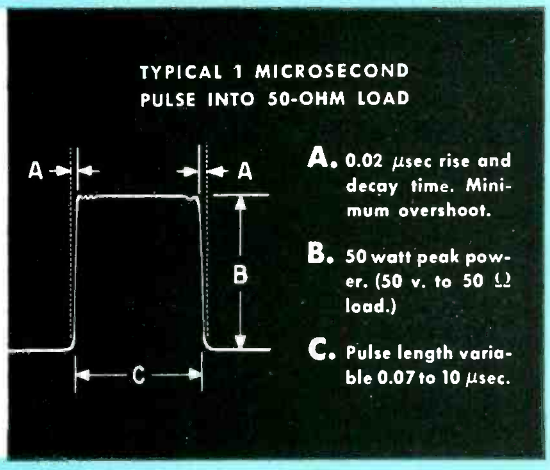
GENERAL PURPOSE PULSE GENERATOR



-hp- MODEL 212A



SPECIFICATIONS

PULSE LENGTH: Continuously variable, 0.07 to 10 μsec. Direct reading panel control.

PULSE AMPLITUDE: 50 v. into 50 Ω load. Pos. & neg. pulses. 100 v. open circuit.

AMPLITUDE CONTROL: Continuous control throughout range. 50 db in 10 db steps. 10 db fine adjustment.

INTERNAL IMPEDANCE: 50 Ω or less.

PULSE SHAPE: Rise and decay time approx. 0.02 μsec. (10% to 90% amplitude.)

REPETITION RATE: 50 pps to 5,000 pps. Internally or externally controlled.

SYNC IN: May be triggered by pos. or neg. pulse of 5 v. at rates up to 5,000 pps.

SYNC OUT: 50 v. into 200 Ω load. Approx. 2 μsec long. Approx. 0.25 μsec rise time.

PULSE DELAY: Main pulse delayable 0 to 100 μsec from sync output pulse.

PULSE ADVANCE: Main pulse can be advanced 0 to 10 μsec from sync output pulse.

POWER SUPPLY: 110/220 v.; 50/60 cps.

SIZE: Panel 10½" high, 19" wide. Depth 12".

PRICE: $550.00 f.o.b. Palo Alto.

Data Subject to Change Without Notice

CONTINUOUSLY VARIABLE, HIGH POWER PULSES OF SUPERIOR WAVE FORM!

THIS NEW -*hp*- 212A PULSE GENERATOR saves you time and work testing "fast" circuits as well as making everyday laboratory checks of other generators, rf circuits, peak-measuring equipment, etc. It is the first commercial pulse generator to successfully combine broad laboratory usefulness with the fast rise time, high power, variable pulsing and other features demanded in radar, television and nuclear work.

ACCURATE PULSES AT END OF LONG TRANSMISSION LINE

The pulse length is continuously variable from 0.07 μsec to 10 μsec, and is varied by a direct reading panel control. Extremely fast rise and decay time, together with freedom from ringing or overshoot provide a virtually distortion-free pulse. A low internal impedance (50 ohms or less) insures a pulse shape virtually independent of load. This low impedance also makes it possible to deliver accurate pulses at a distance from the instrument, if the transmission lines are correctly terminated.

The Model 212A's repetition rate is continuously variable from 50 to 5,000 pps. It can be controlled internally, or from an external synchronizing source. Synchronizing pulses are available from the instrument either in advance of or following the output pulse. An amplifier-attenuator output system gives a low source impedance, and makes possible continuously variable pulse amplitude, positive or negative.

Brief specifications of this new -hp- *instrument are shown in the adjoining column. For complete details... see your local* -hp- *representative... or write to the factory.*

HEWLETT-PACKARD COMPANY
2040A Page Mill Road • Palo Alto, California

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2040

ELECTRONIC MEASURING INSTRUMENTS

flying saucers again?

No, this time they're PRESTO Green Label discs . . . crossing the oceans on their way to such foreign ports as Ankara, Genoa, and Johannesburg . . . and to Mexico, Colombia and Brazil.

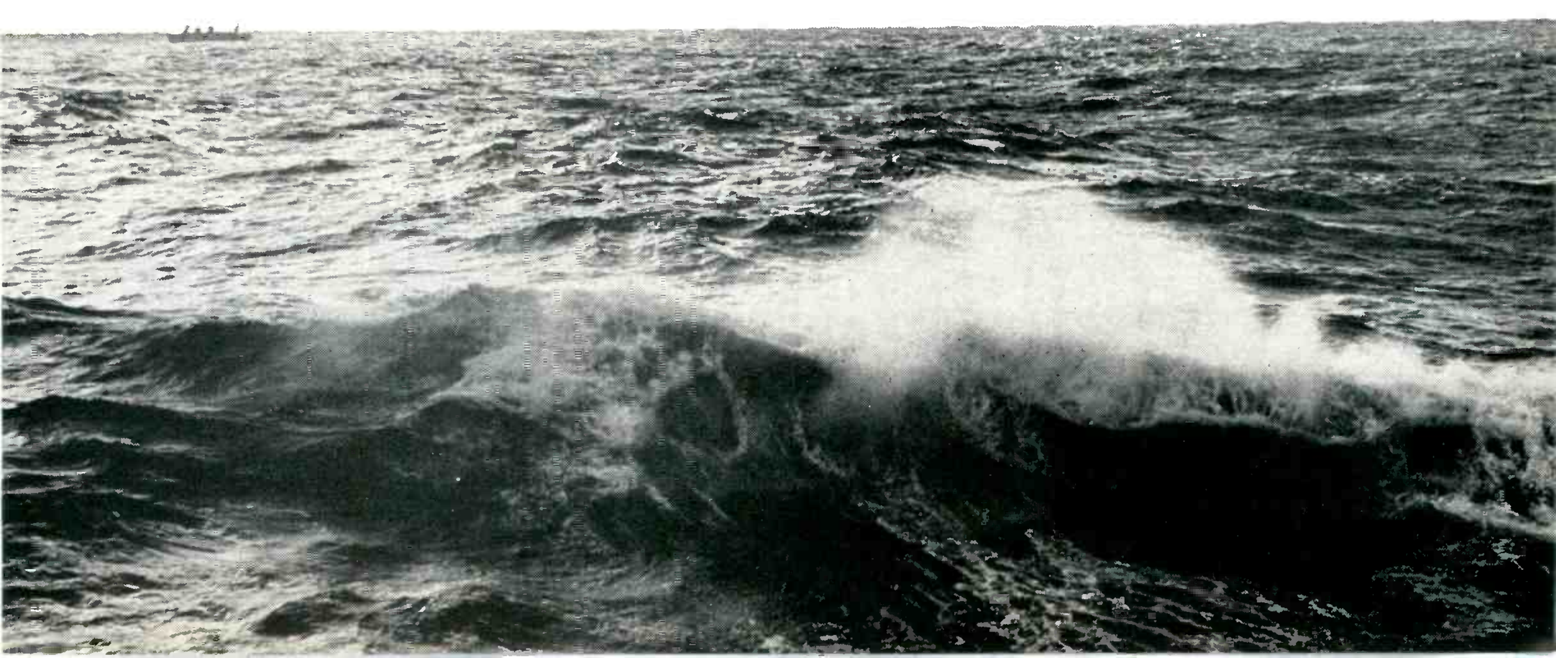
Every week, thousands of PRESTO recording discs are shipped overseas, despite U. S. dollar shortages, import license controls and other obstacles in the path of foreign trade. In one week, the week of February 28th, M. Simons & Son Company (Presto's foreign representative) shipped nearly 23,000 discs to these points around the world.

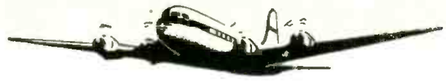
There must be a reason for this proven preference for PRESTO discs, particularly in the face of increased demands for magnetic tape. The reason is plain to us . . . and will be to you when you use PRESTO on your next job. PRESTO is the preferred disc because it is manufactured by the highest standards in the industry . . . made in the world's most modern disc plant . . . and tested for maximum performance.

PRESTO RECORDING CORPORATION
PARAMUS, NEW JERSEY

Export Division: 25 Warren Street, New York 7, N. Y.
Canadian Division: Walter P. Downs, Ltd., Dominion Square Bldg., Montreal

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISCS





versatile

Multi-channel -- telegraph AI or telephone A3.

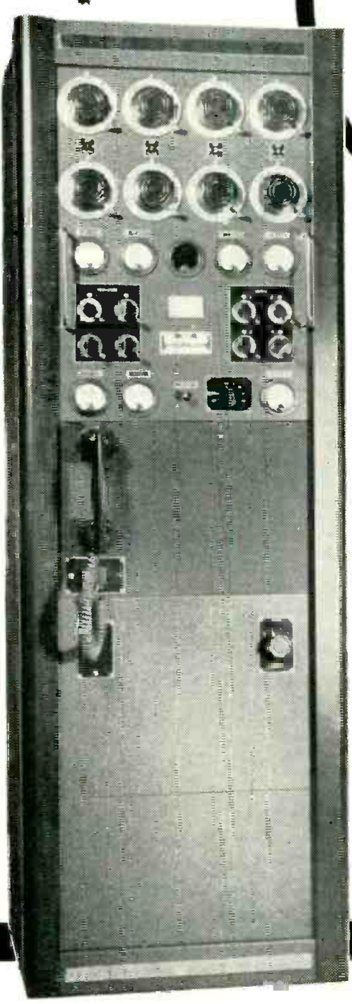
FROM GROUND TO AIR OR POINT TO POINT

STABLE

High stability (.003%) under normal operating conditions.

RUGGED

Components conservatively rated. Completely tropicalized.



Model 446 transmitter operates on 4 crystal-controlled frequencies (plus 2 closely spaced frequencies) in the band 2.5-13.5 Mcs (1.6-2.5 Mcs available). Operates on one frequency at a time; channeling time 2 seconds. Carrier power 350 watts, A1 or A3 AM. Stability .003% using CR-7 (or HC-6U) crystals. Operates in ambient 0° to + 45° C using mercury rectifiers;-35° to + 45° C using gas filled rectifiers. Power supply, 200-250 volts, 50/60 cycles, single phase. Conservatively rated, sturdily constructed. Complete technical data on request.

Here's the ideal general-purpose high-frequency transmitter! Model 446... 4-channel, 6-frequency, medium power, high stability. Suitable for point-to-point or ground-to-air communication. Can be remotely located from operating position. Co-axial fitting to accept frequency shift signals.

AER -O- COM

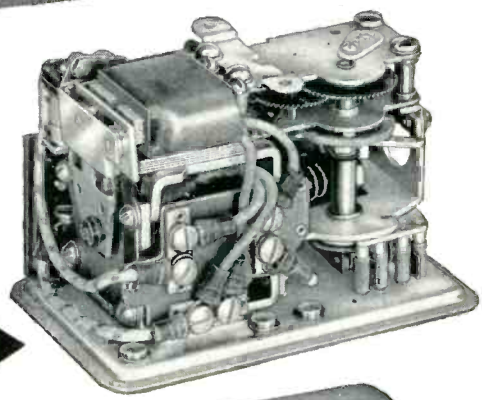
3090 DOUGLAS ROAD MIAMI 33, FLA.

Reg. U. S. Pat. Off.

Consultants, designers and manufacturers of standard or special electronic, meteorological and communications equipment.

Proven performance backed by 20 years' experience!

Mark-Time time delay relays



..for special *aircraft* applications!

MODEL 523 A *(illustrated above)* Solenoid Wound, Spring Driven Relay—sustained operating impulse, immediate switch throw, delayed time cycle.

In this model, the timer is wound practically instantaneously* as the control circuit is energized, and the switch throws over immediately. The time delay period begins when the control circuit is broken, but the switch remains thrown over until the expiration of the time cycle. At that moment, the switch returns to its original position. The unit is then ready for re-cycling when the control circuit is restored.

Important protective feature! If the circuit is restored before the expiration of the time delay period, the unit instantaneously* rewinds and restores the total time delay period without disturbing the thrown-over position of the switch. No matter how many times the control circuit is interrupted for lesser durations than the time delay period, this automatic rewinding of the unit when the control circuit is restored insures the expiration of the *full* time delay period before the switch can return to its original position.

**from .025 to .10 second, varying with coil arrangement and loading*

OTHER MARK-TIME Time Delay Relays are available for sustained operating impulse, immediate switch throw, immediate time cycle—sustained operating impulse, delayed switch throw, immediate time cycle—momentary operating impulse, immediate switch throw, delayed time cycle.

GENERAL SPECIFICATIONS

The prototype of these relays was skillfully designed to meet U. S. Army Air Forces specifications for an exacting special application during World War II, and has official Army Air Force approval for this purpose.

Operating Voltage
Coils can be wound for operating voltages from 6 to 220 volts, A.C. or D.C.

Operating Current
Momentary* winding load — 150 to 250 watts; holding load—1.5 to 2.5 watts, depending upon coil arrangement and loading.
**Duration of .025 to .10 second, varying with coil arrangement and loading.*

Switch Rating
10 amperes, 30 volts D.C.; 10 amperes, 125 volts A.C.

Time Delay Intervals
Delay periods may be obtained in ranges of .25 second to 15 minutes, as specified.

Switch may be furnished as DPDT, SPDT or SPST.

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MARK-TIME

Write today for our new Catalog giving full information, specifications and operating details of all MARK-TIME Time Delay Relays.

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MYCALEX

Glass-Bonded Mica
INSULATION

—for low loss at low cost!

CHARACTERISTICS OF MYCALEX GRADE 410

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

WRITE FOR 20-PAGE CATALOG
This comprehensive compilation of technical and manufacturing data includes complete dielectric information.

- LOW-LOSS FROM 60 CYCLES/SECOND TO 24,000 MEGACYCLES/SECOND
- MAXIMUM EFFICIENCY, UTMOST ADAPTABILITY, LOWEST COST
- AVAILABLE MOLDED TO PRACTICALLY ANY SHAPE OR SIZE WITH OR WITHOUT METAL ELECTRODES OR INSERTS

FCC Approval of UHF TV has introduced an era of engineering and manufacture to standards seldom before attained in mass production. Many materials, dielectrics in particular, fail to meet these more critical requirements. MYCALEX 410 is one exception. This dielectric can be molded to close tolerances with or without metal inserts—high efficiency to well over 24,000 megacycles. MYCALEX 410 can be molded in volume at low cost. It can be produced to closer tolerances than higher priced ceramics. Electrically and mechanically, MYCALEX 410 is the ideal dielectric for tube sockets, tuners, condensers, switches, coil structures and many other UHF components.

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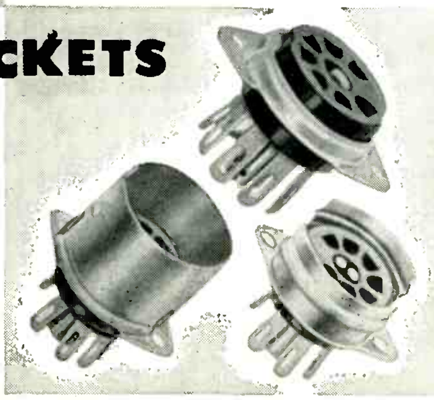
MYCALEX glass-bonded mica sockets are injection molded to extremely close tolerance. This exclusive process affords superior low-loss properties, exceptional uniformity and results in a socket of comparable quality but greater dimensional accuracy than ceramics—all at no greater cost than inferior phenolic types. These sockets are available in two grades, featuring high dielectric strength, low dielectric loss, high arc resistance and fully meet RTMA standards.

Write for Tube Socket Data Sheets



MYCALEX 410 is priced comparable to mica-filled phenolics. Loss factor is only .015 1 mc., insulation resistance 10,000 megohms. Fully approved as Grade L-4B under N.M.E.S. JAN-1-10 "Insulating Materials Ceramic, Radio, Class L."

MYCALEX 410X is low in cost but insulating properties greatly exceed those of general purpose phenolics. Loss factor is only one-fourth that of phenolics (.083 at 1 mc.) but cost is comparable. Insulation resistance 10,000 megohms.

SINCE 1919 MYCALEX THE INSULATOR TRADE MARK REG US PAT OFF

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IN World War II, the back-pack radio weighed 30 pounds, a tiring load for a soldier. Careful miniaturization, employing diodes wherever possible, has trimmed this bulk to 15 pounds, and today's radio is stronger, more reliable than its older brother.

● A pair of General Electric 1N81 diodes in hermetically-sealed, self-contained cases are of vital importance in the discriminator assembly of the AN/PRC-6, built for the U. S. Signal Corps.* In the circuit, the diodes make the RF signal intelligible and maintain balance at all times over the normally wide military requirements of ambient temperatures.

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**by Utility Electronics Co., Newark, N. J.*

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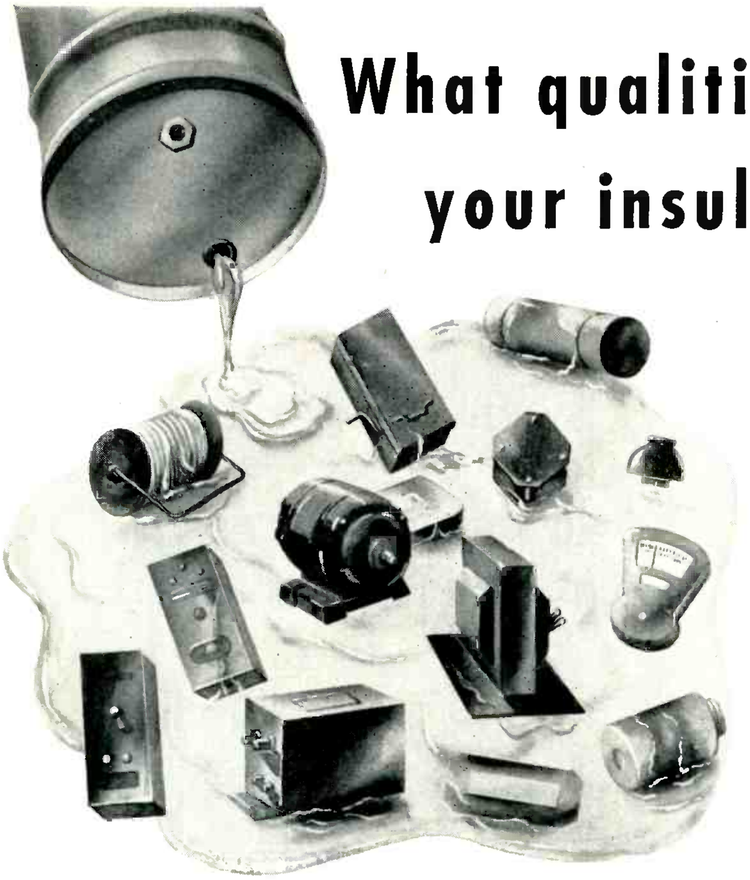

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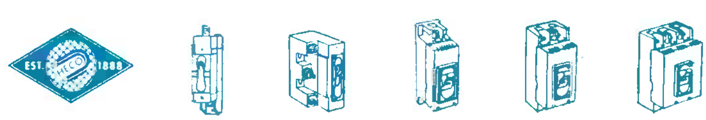
HEINEMANN *Circuit breakers*



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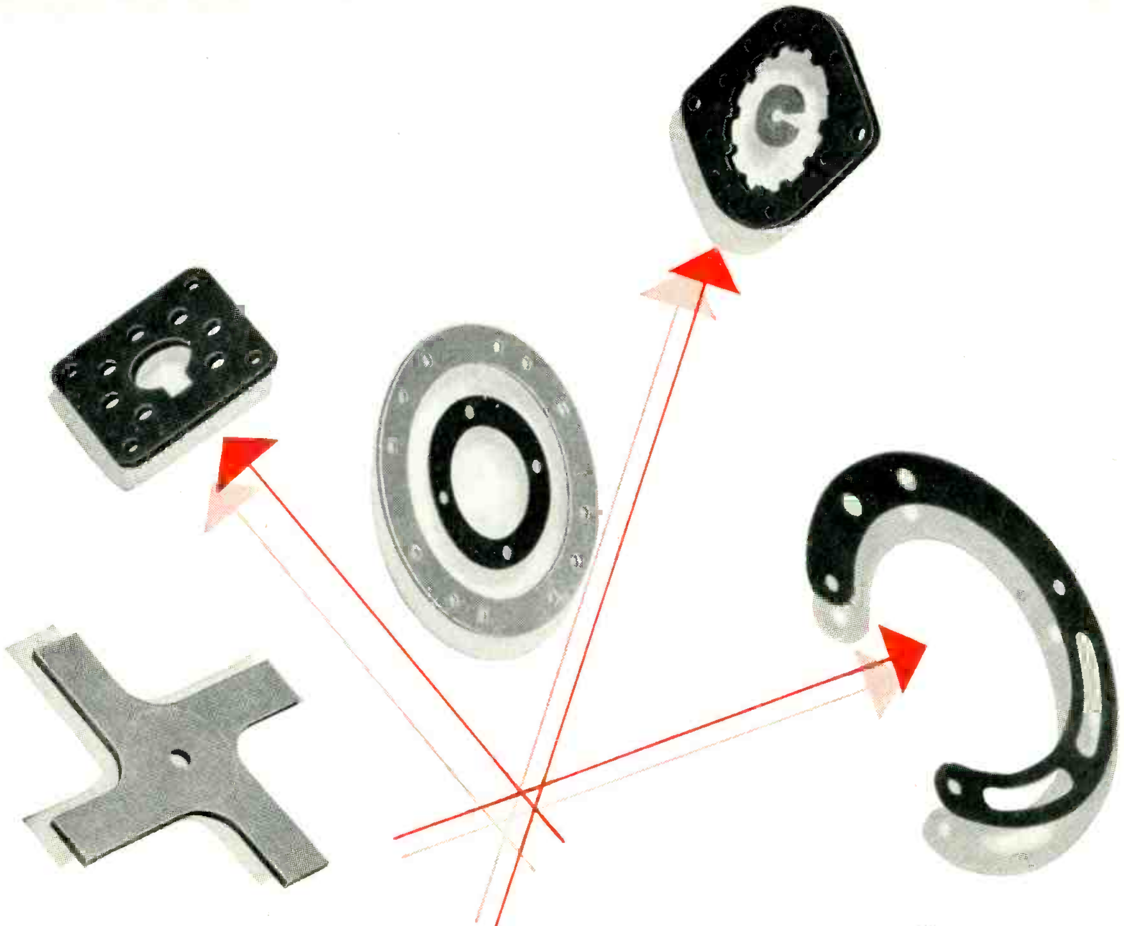

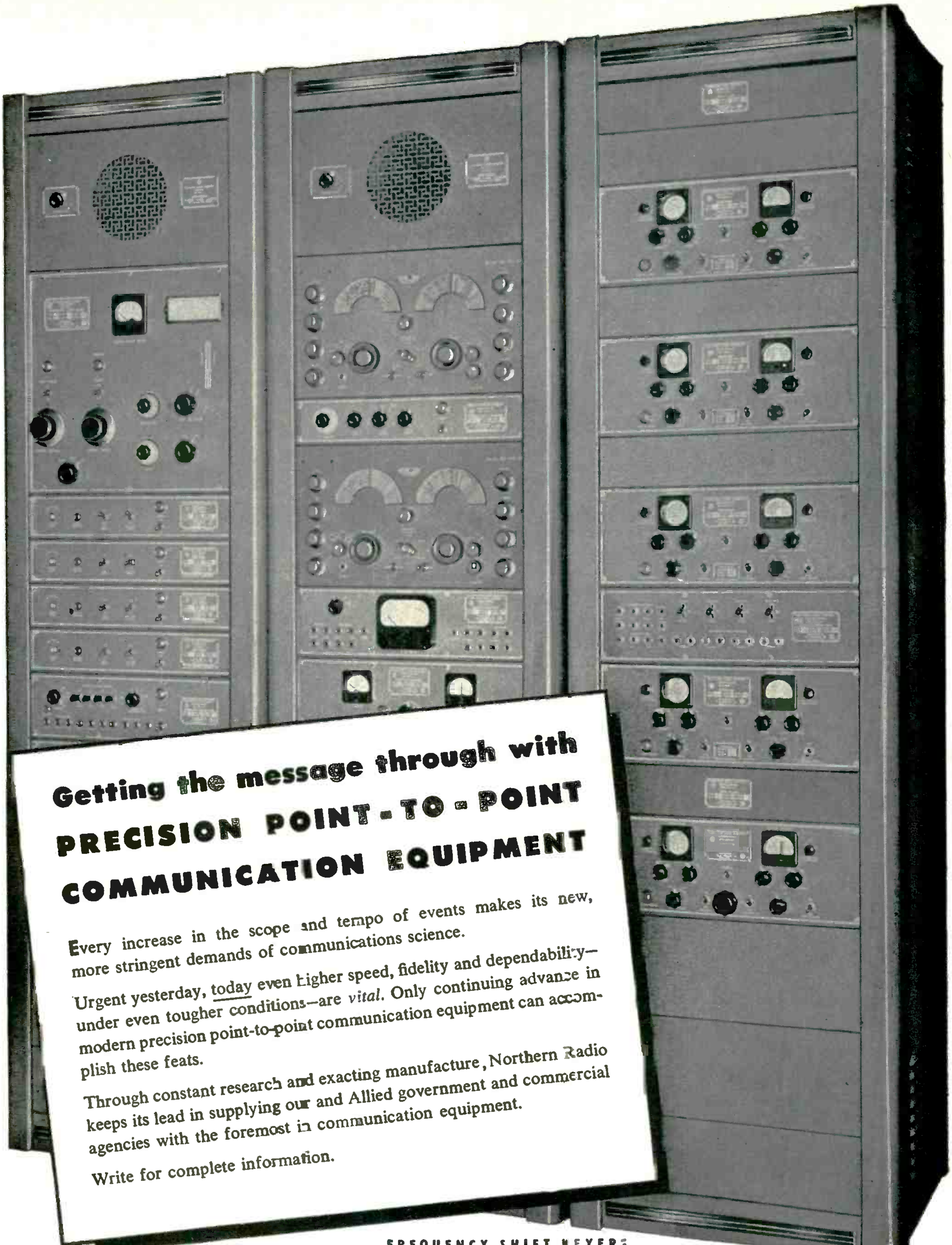

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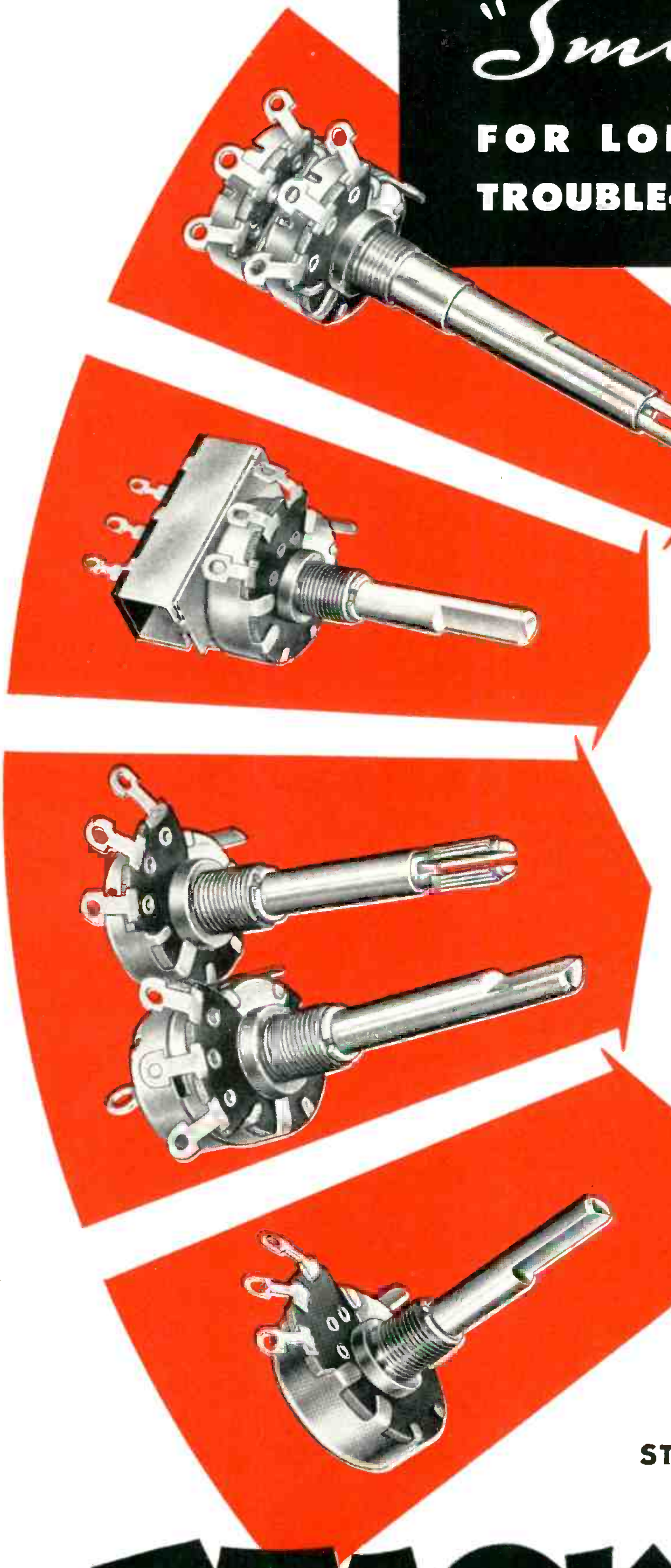

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*(*Designated as Type LX)*

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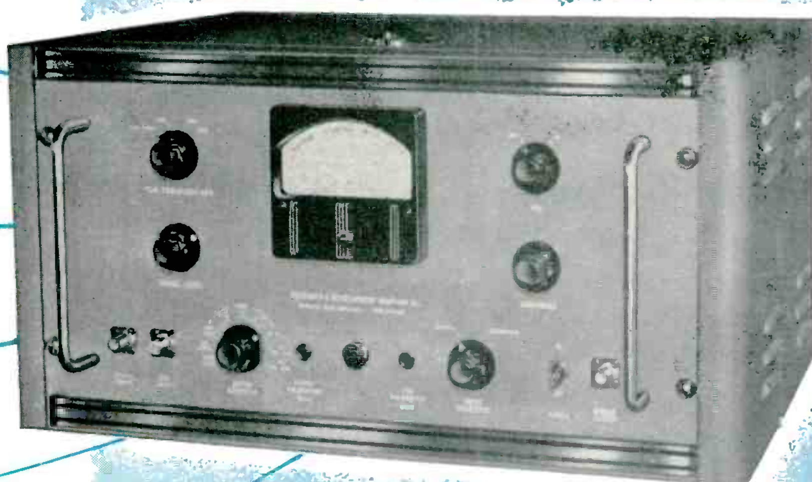

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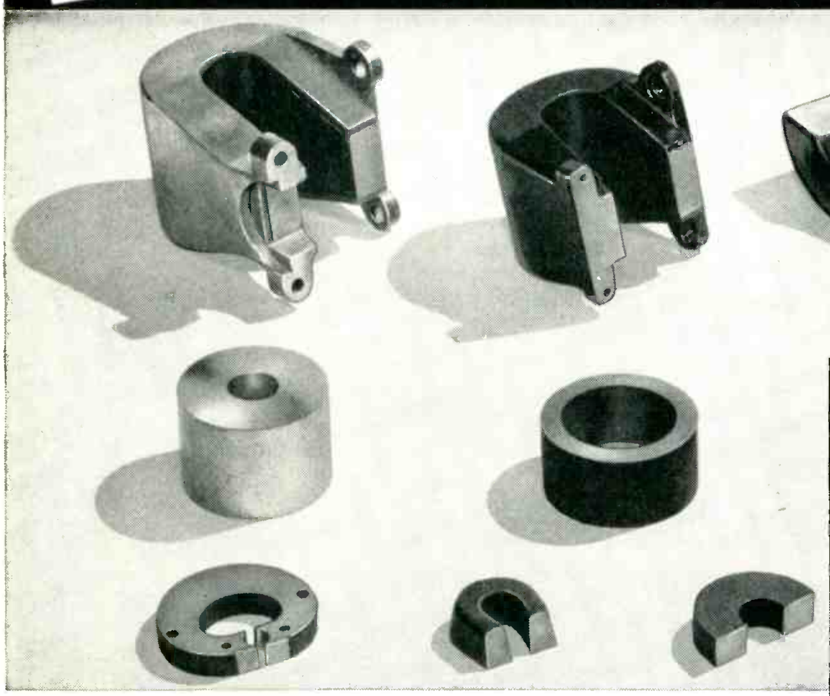

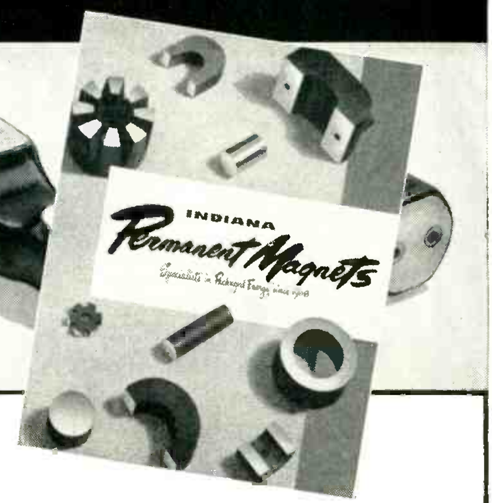

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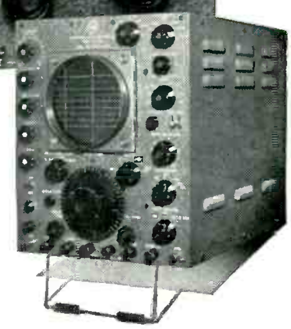

SPECIFICATIONS

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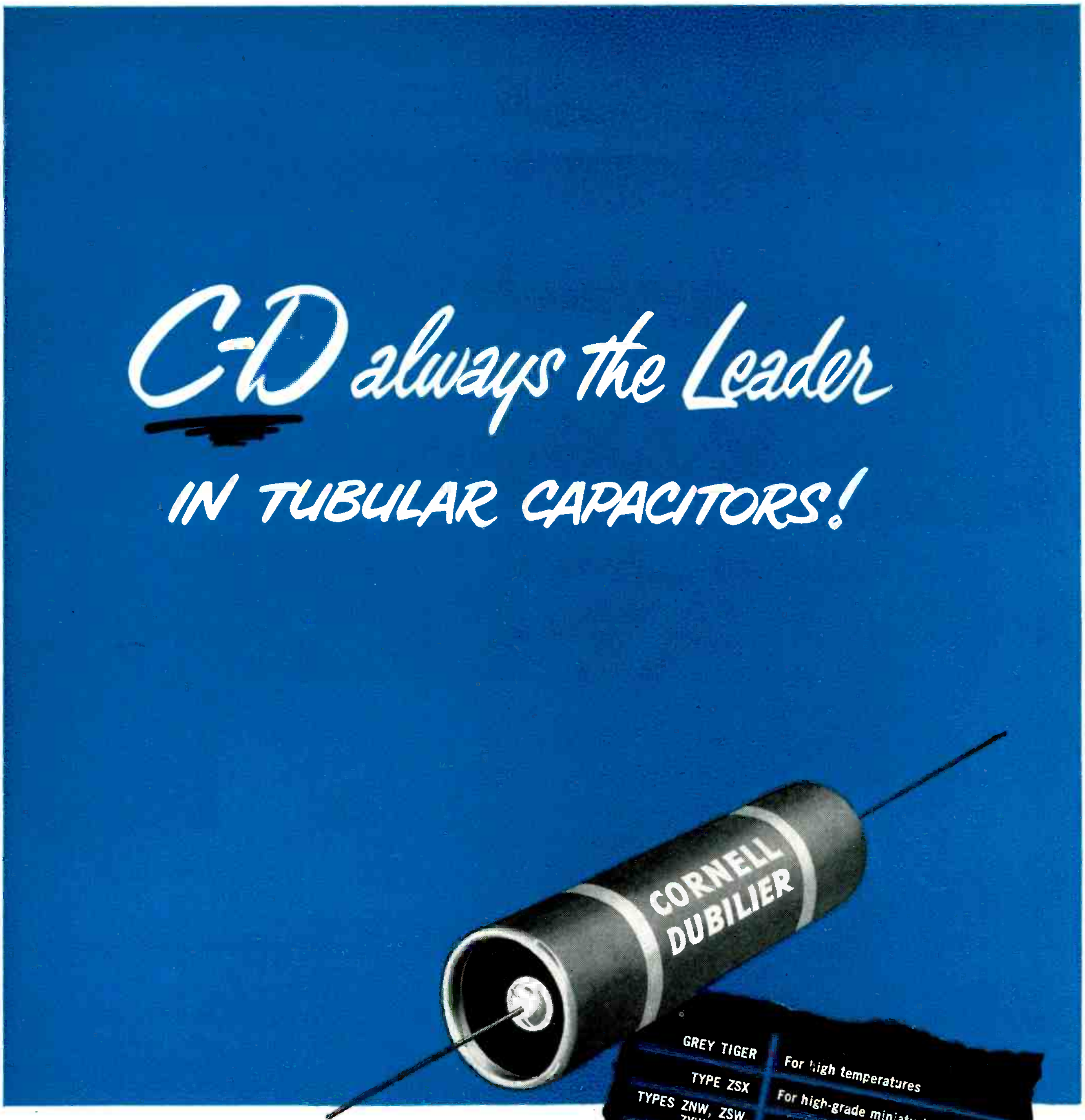

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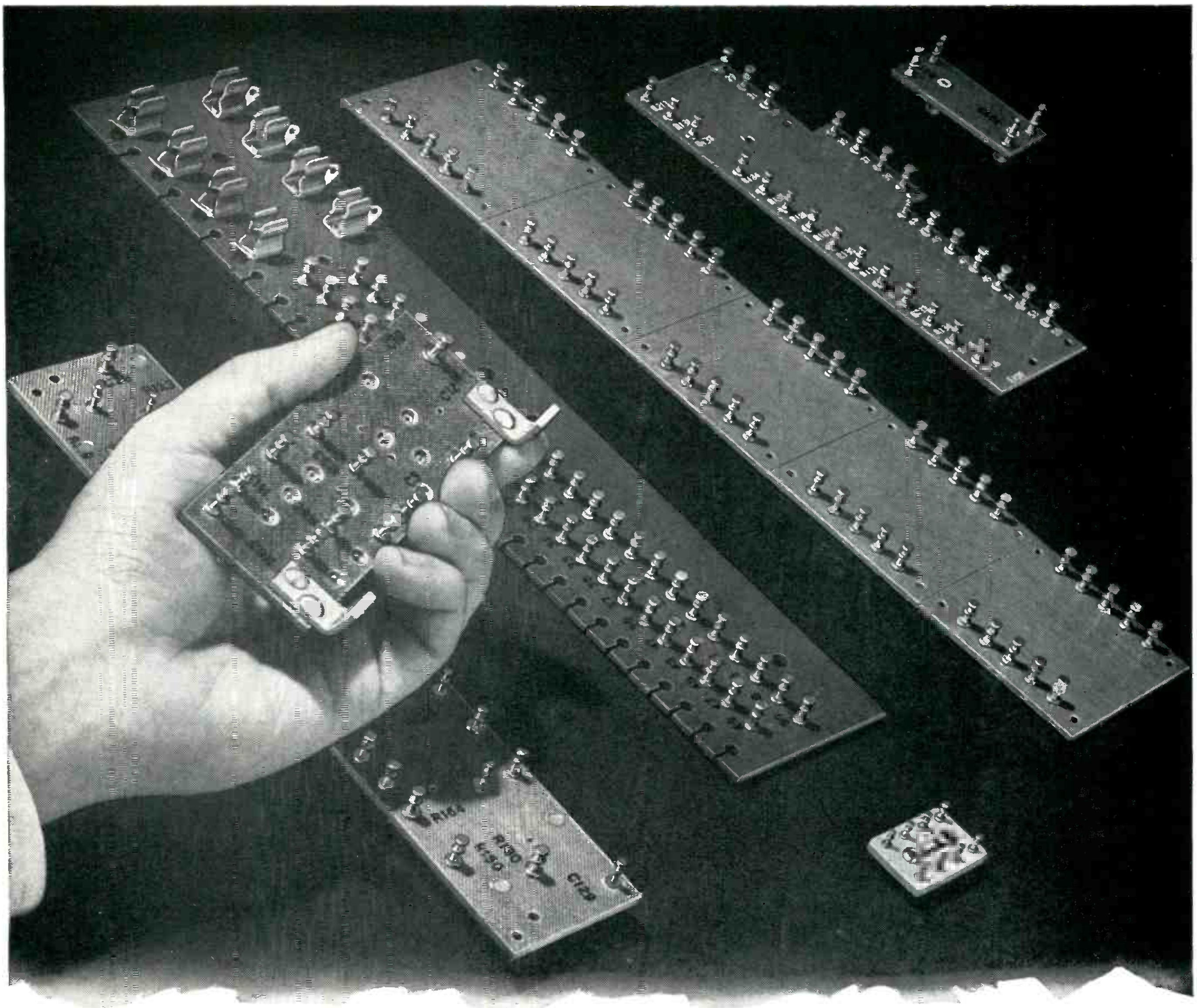

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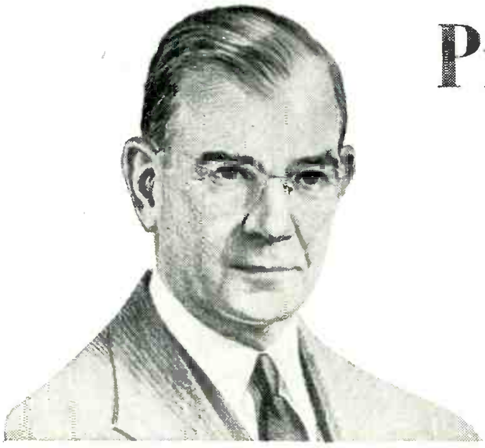
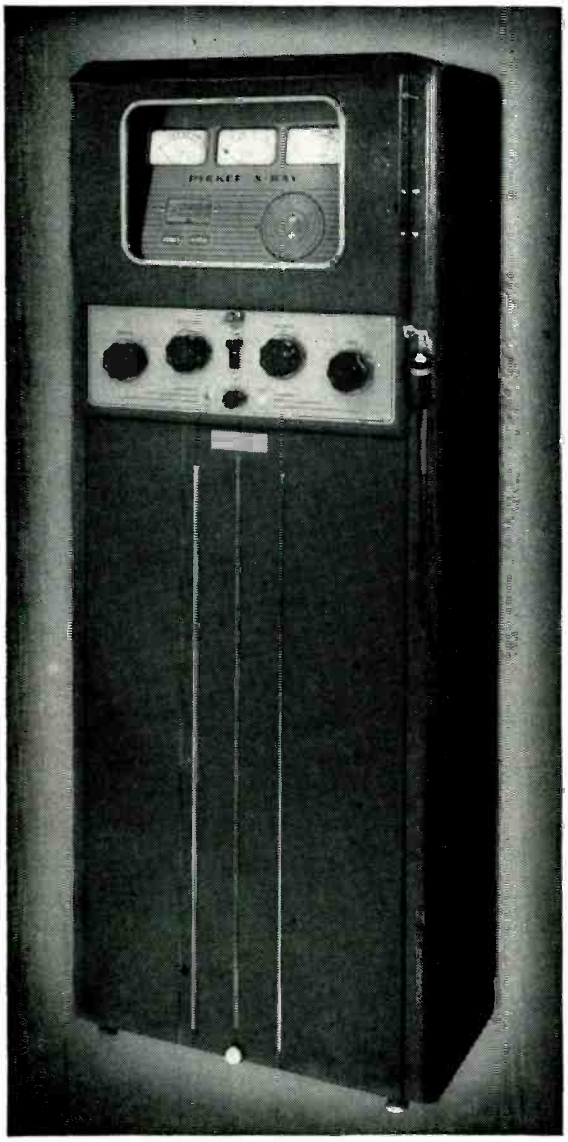
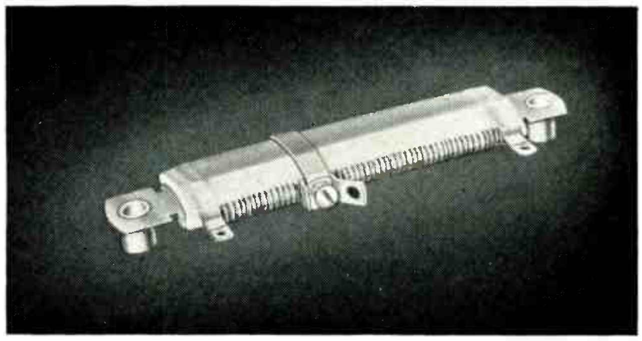


Picker X-Ray Corporation

"For accurate duplication of X-ray densities their resistors must be stable"

says O. N. Jones, The Ambos-Jones Company, Cleveland, Ohio, representative for Ward Leonard Electric Company





Duplicating densities of precise radiographs over prolonged periods demands exacting control of milliamperage through the X-ray tube. This means filament temperature must be accurately set.

That is why the absolute balance of thermal characteristics of Ward Leonard resistors is of utmost importance to the Picker X-Ray Corporation.

The only way to be sure that all resistor components will react the same to changes in temperatures is to balance their thermal characteristics. In this way, there is no loosening, no failure, due to unbalance. Heat affects all parts the same way, which, in turn, means longer life, *stable performance.*

This stability in the presence of thermal shock is one of the major reasons the Picker X-Ray Corporation uses Ward Leonard STRIPOHM resistors in their V-12, 200 milliampere, 100 PKV X-ray controls.

The performance of VITROHM wire-wound resistors, rheostats, and other electric controls under the severest operating conditions is proof of their complete dependability.

For correct, accurate current control, specify Ward Leonard VITROHM Resistors.

WARD LEONARD

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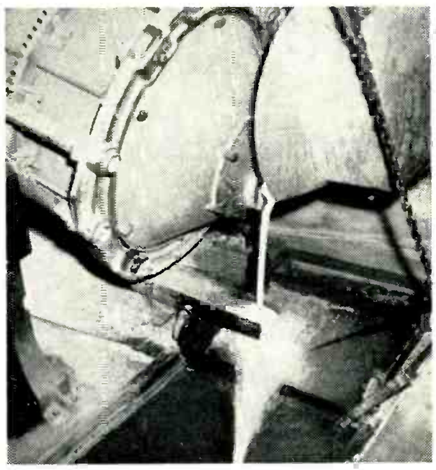
Result-Engineered Controls Since 1892

LIMIT BRIDGE FOR TESTING resistance accuracy of Stripohm resistors is operated by Theresa Collura (foreground).

TERMINALS ARE SPOT WELDED to Stripohm cores by Frances Baxter who has been with the company 10 years.

KATHERINE GRUNENTHAL (foreground), 27 years at Ward Leonard, is winding special alloy resistance wire on Stripohm cores.



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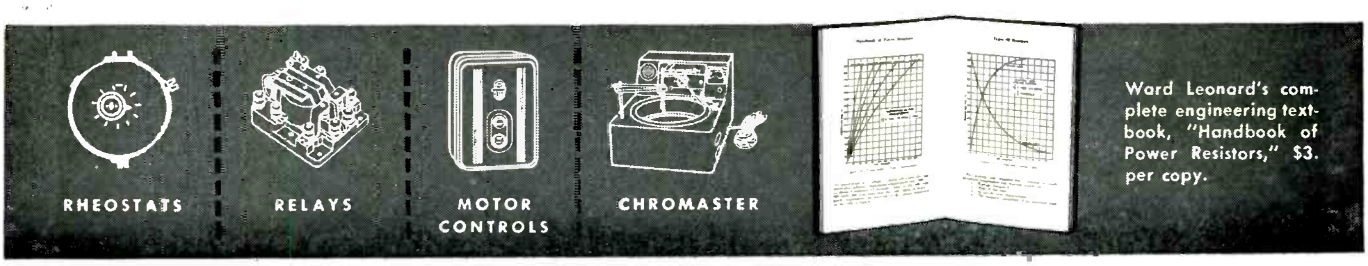
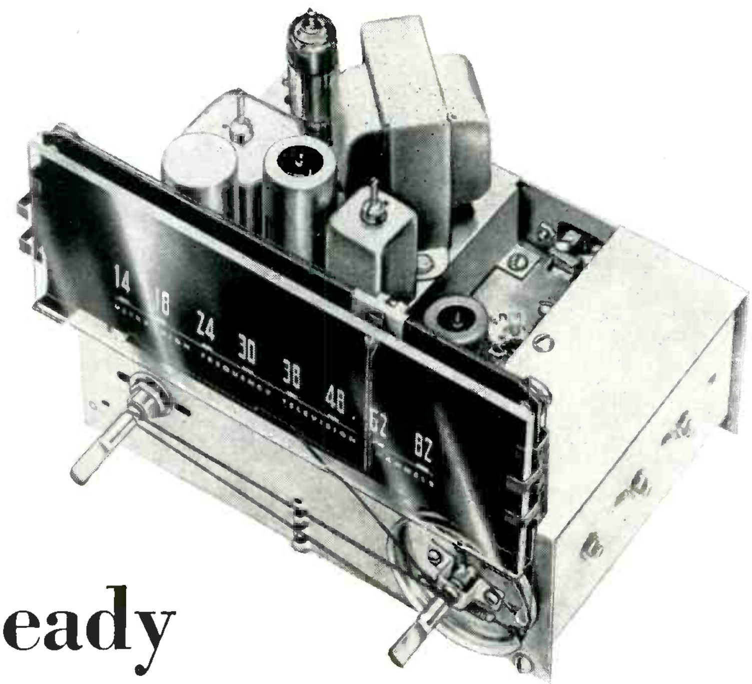


UHF



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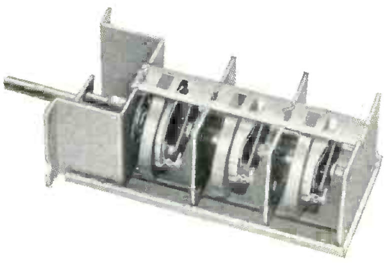

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CROSS TALK

▶ **STAFF** . . . Donald G. Fink has joined the Philco Corporation as Co-Director of Research-Operations, an extremely important post in this industry of ours that he is so very well equipped to serve. Mr. Fink has been Editor of ELECTRONICS since 1946. Effective June 1, the title of Editorial Director of the magazine is assumed by Keith Henney, who needs no introduction here. Mr. Henney produced the first issue of ELECTRONICS in April 1930, served as its Editor from 1935 to 1946 and has been continuously associated with the publication since its inception.

Effective June 1, W. W. MacDonald advances from the position of Managing Editor of ELECTRONICS to that of Executive Editor. In his new capacity he will be responsible for the editorial staff and for the production of the magazine and will work with Mr. Henney in the development of the publication's long-range policies.

Mr. MacDonald joined the McGraw-Hill Publishing Company in 1926. He became a member of ELECTRONICS' staff in 1941 and was appointed Managing Editor in 1944. During World War II, at such times as Keith Henney and Donald G. Fink were absent on government assignments, he had full responsibility for the editorial operations of the magazine.

No editorial policy changes are contemplated. The still-expanding staff will continue to deliver to readers the kind of fare that has made ELECTRONICS the outstanding leader in its field.

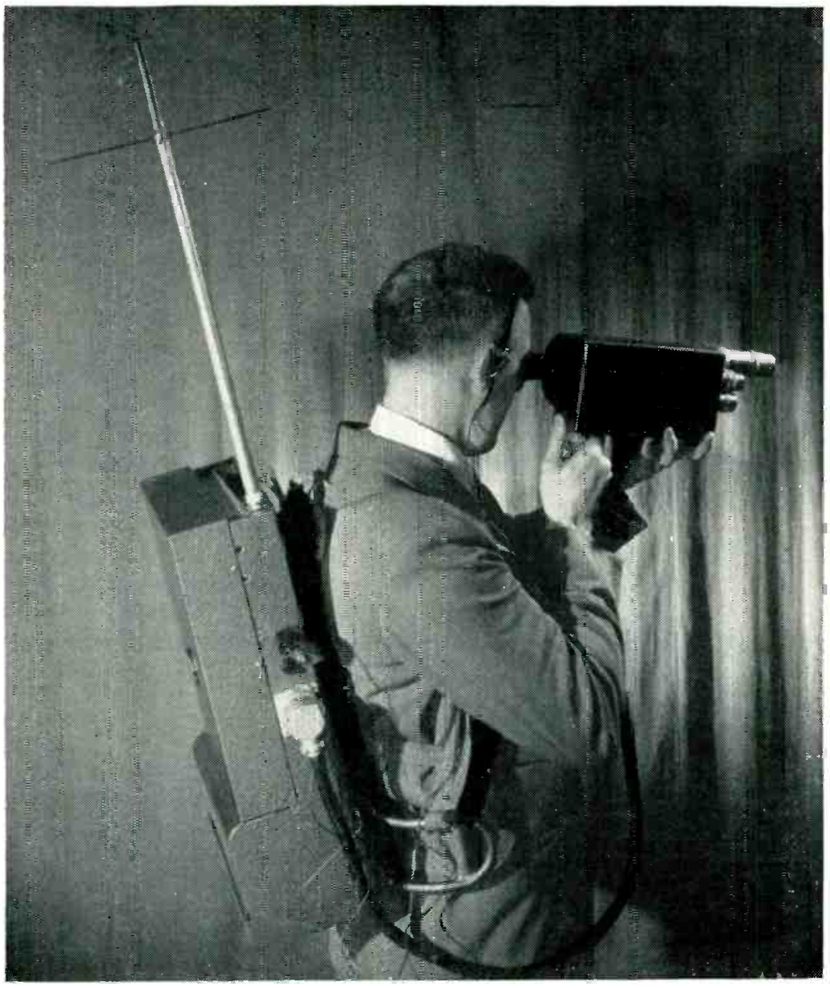
▶ **SCATTER** . . . Reviewed in this issue (p 102) is a report on work by the Bureau of Standards, Collins Radio Company and M.I.T., which led to the discovery of a new mode of vhf propagation, by scattering from turbulence in the ionosphere. Using high power (23 kw), a station operating on 49.8 mc in Cedar Rapids, Iowa, has been copied with unheard of consistency in Sterling, Virginia, 775 miles away, with field strengths sufficient for reliable radiotelegraph communication. The report makes no assessment of the practical applications of this discovery, so we are free to guess away at length.

First off, this appears to us to be the most consistent type of radio communication now known over distances of the order of 1,000 miles (it runs right through Dellinger fadeouts). Secondly, this research reveals that really long-distance relaying, including jumps over the largest over-water hops likely to be encountered anywhere between the continents, can be accomplished on very-high-frequencies, with bandwidth limited only by the transmitter power and differences in path length. Since a 300-kw or 3,000-kw transmitter is not out of the question technically, we may have here the mechanism for a transoceanic television relay. In any event this is an exciting discovery, a major step forward—perhaps ranking in importance with the discovery, three decades ago by the radio amateurs, that waves shorter than 200 meters had practical use.

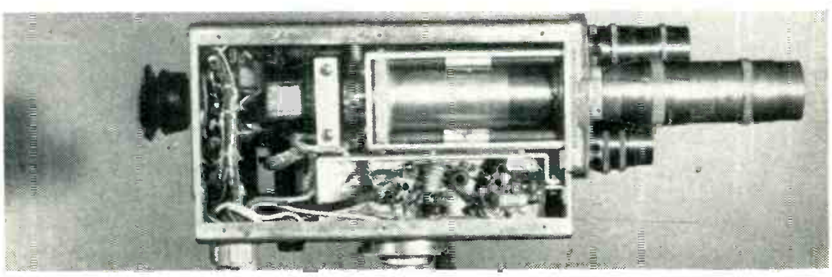
▶ **BUTTON** . . . Herbert Hoover, in his tribute to Lee DeForest at the Radio Pioneers Testimonial Dinner, remarked on the misuse to which Dr. DeForest's inventions were being put, using "huckster chatter" to describe the over-commercialism of radio and tv broadcasting. He asked DeForest to invent a "pushbutton by which we could transmit our emotions instantly back to the broadcasters". This suggestion is profound far beyond the jovial tone with which it was uttered. The broadcasters tend to cater to the sponsor or the agency; they would prefer to cater to the audience, but the only connection they have is through the Crosley and Hooper statistics. These latter are indexes of toleration, not affection. They should be replaced by the Hoover-DeForest button.

Pack-Carried

Compact battery-operated uhf television transmitter and control-signal receiver can be carried by one man along with camera and microphone, giving complete freedom from cables for program pickups within quarter mile of control station. First major use is expected to be at the Chicago political conventions this summer



Pack set weighs 45 lb with batteries and dynamotor, and camera adds only 8 lb more. Headphones are used to receive radioed instructions from control station. Camera may also be used on a tripod



Vidicon side of camera, with cover removed. Monitor picture tube is directly behind small camera tube. Microphone is built into camera just below black eyepiece of monitor, permitting cameraman to carry on a commentary when working alone

COMPACT TELEVISION equipment based on the Vidicon photoconductive pickup tube has been the subject of considerable work during the past few years[1,2]. All of the equipment so far described has been of the closed-circuit type for industrial and educational purposes. There are many television applications, however, where complete portability of the pickup equipment would be desirable, with no cable connections to the control point. This paper describes a completely portable battery-operated equipment serving as a complete pickup station with synchronizing generator, video and sound channels and radio links to and from a control point.

System Details

The basic unit consists of pack-carried control equipment containing all circuits for generating synchronizing frequencies for a standard 525-line, 30-frame interlaced picture, battery-operated power supply, deflecting circuits, video amplifier, sound pickup equipment, a 600-mc radio transmitter and a radio receiver for receiving instructions and control information from the control point. Cable-connected to this unit is a Vidicon camera, containing also a crt monitor used as a view finder.

A diagram of the entire system is shown in Fig. 1. At the control point there is a transmitter for instructing the remote operator and also to transmit a control frequency as a reference for the remote synchronizing generator. The signal from the portable point is received here and processed for utilization as a complete video and sound signal.

A block diagram of the portable

Television Station

By L. E. FLORY, W. S. PIKE, J. E. DILLEY and J. M. MORGAN
RCA Laboratories Division, Princeton, N. J.

equipment is shown in Fig. 2. The Vidicon camera picks up the scene to be transmitted and its output passes through a video amplifier and modulator to the transmitter. The sound portion is picked up, amplified and combined with the video signal for transmission. A synchronizing generator generates horizontal and vertical pulses in proper relation to produce a 525-line interlaced picture.

The vhf radio receiver in the portable equipment picks up audio instructions from the control point and, in addition, a 60-cps sine wave. This frequency is compared to the field frequency from the sync generator and, by means of a phase detector and afc circuit, locks the remote sync generator with the 60-cps line at the control transmitter.

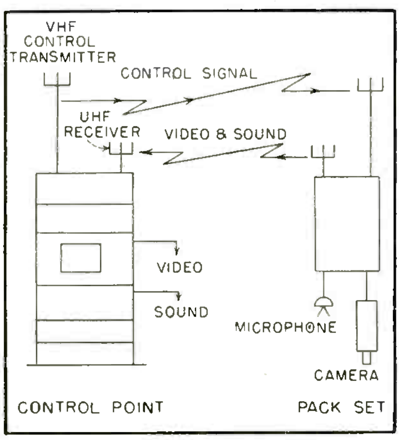


FIG. 1—System uses two radio links

Sync Generator

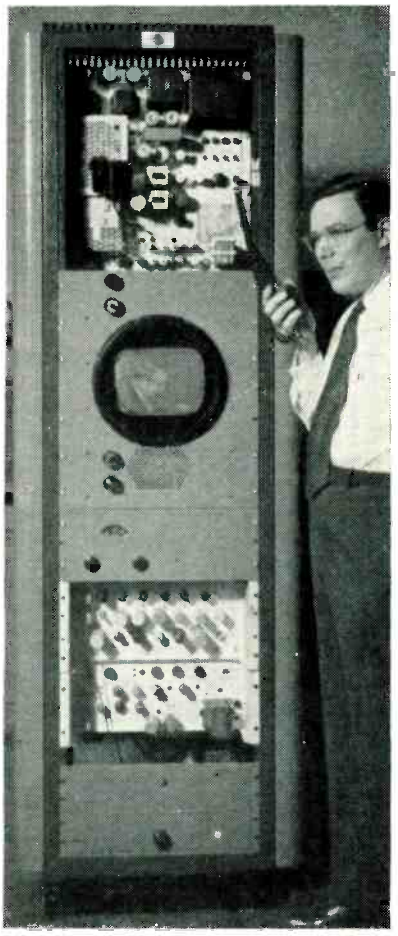
A schematic diagram of the synchronizing generator in the portable equipment is shown in Fig. 3. A blocking oscillator provides the basic frequency of 31,500 cps, twice the scanning line frequency. A second blocking oscillator operating as a counter divides this frequency by 15. Similar counters following this divide by 7 and 5 respectively. This counter chain divides the basic frequency by 525 to provide the field frequency of 60 cps.

The field frequency is compared in a phase detector with the 60-cps frequency received from the control station. The d-c voltage output of this detector is applied to the 31,500-cps oscillator as an afc voltage to maintain this oscillator at precisely the correct frequency. In addition, this voltage is applied to the grid circuits of the individual counters to cause a change in their natural period. This feature greatly increases the stability of the generator where operating locked to the reference frequency. By locking the generator in this manner to a frequency transmitted from the control point, its operation can be stabilized with respect to the local power-line frequency or any convenient 60-cps source.

UHF Transmitter

The transmitter operates at 593.96 mc and is crystal-controlled starting with a third overtone crystal at 49.496 mc. This frequency is tripled to 148.49 mc and then doubled twice to 593.96 mc. The 148.49-mc frequency is used as the local oscillator frequency for the receiver in the pack.

The two doublers and a final power amplifier make use of RCA 5876 pencil triodes in grounded-grid coaxial-line type tank circuits. Since the final amplifier is of the grounded-grid type it is necessary to modulate both its plate circuit and that of its driver to obtain a high percentage of modulation. These plate circuits are both made



Activities of roving cameraman are directed over radio link from this control station, which picks up the video and audio program signals broadcast from the pack set

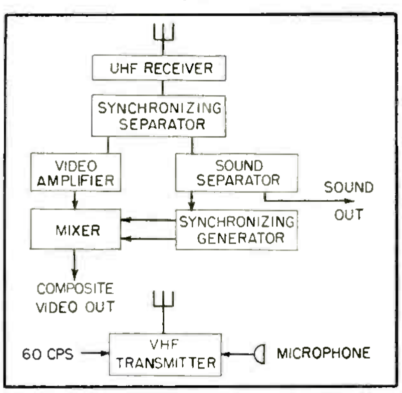


FIG. 2—Major sections of pack set

a half-wavelength long so that they may be open-circuited, thus minimizing the capacitance to be driven by the modulator. A power output of 2 watts may be obtained from the final amplifier stage.

The video modulator posed somewhat of a problem since some 100 volts of video are needed and efficiency is of great importance to save power and weight. A bootstrap modulator developed for the purpose is shown in Fig. 4. The modulator acts as a series impedance in the transmitter plate supply. The driver tube is a pentode with the grid resistor R of the modulator acting as its load resistor.

A video signal on the grid of the driver causes a signal to appear across R. This causes the current through the modulator to the transmitter to vary, thus modulating the transmitter output. A large voltage swing will appear at the cathode of the modulator and on the plate of the driver as well. Due to the pentode characteristic of the driver tube, however, this large plate voltage swing can be made to have negligible effect on the plate current of the driver. The effect is that of the driver tube working into a high apparent resistance. This circuit is quite efficient since the gain of both the driver and modulator are realized.

Pulse Duration Modulator

Positive sync modulation is used, so that the sync pulses are in the direction of increased carrier. Since a d-c connection exists from the grid of the driver to the transmitter, black level is established by a clamp circuit on the grid of the driver.

Sound accompanying the picture is transmitted on the video carrier in an unconventional manner. Referring to the schematic in Fig. 5, short pulses at horizontal line frequency are used to trigger a multivibrator which generates pulses of a length determined by its time constant. The length of these pulses is varied at an audio rate by applying the sound signal to a grid of the multivibrator. The result is a pulse occurring at horizontal frequency whose front edge is fixed but whose width varies with the sound modulation. This pulse is transmitted as a synchronizing pulse by applying it to the grid of the final r-f amplifier, as shown in Fig. 4. This adds it in a d-c manner to the video signal.

An oscilloscope trace of the sync pulse with back edge modulation is shown in Fig. 6. This shows the pulse in its proper position on the blanking pedestal of the video signal. The upper trace shows the unmodulated pulse, while the lower one shows the pulse with full modulation at 60 cps.

To recover the sound information at the receiving point the sync pulse, after separation from the video signal, is passed through a low-pass filter to remove the pulse repetition frequency. An upper frequency slightly less than half the pulse repetition rate may be transmitted by this method. Using television standards this means an upper audio frequency of about 7,000 cps.

The receiver which picks up instructions and the control frequency

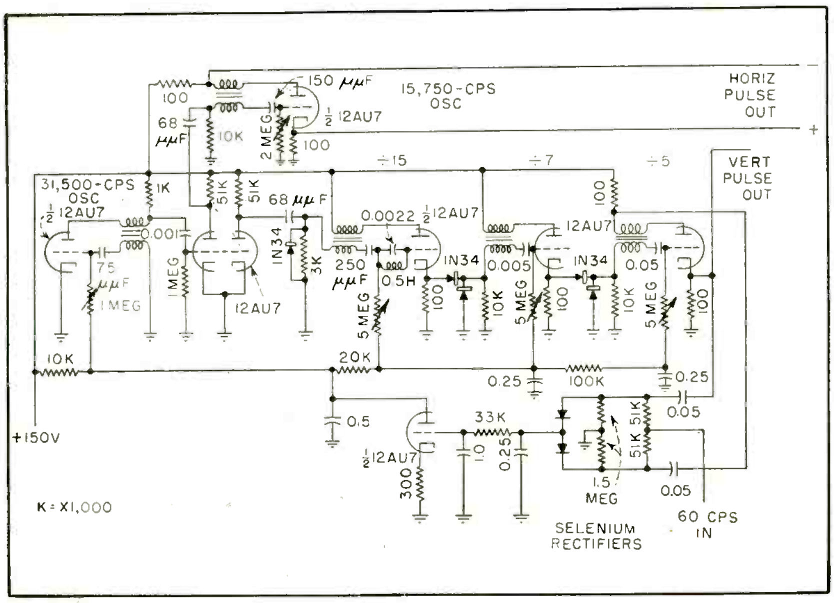


FIG. 3—Simplified circuit of synchronizing generator in pack set, with typical values

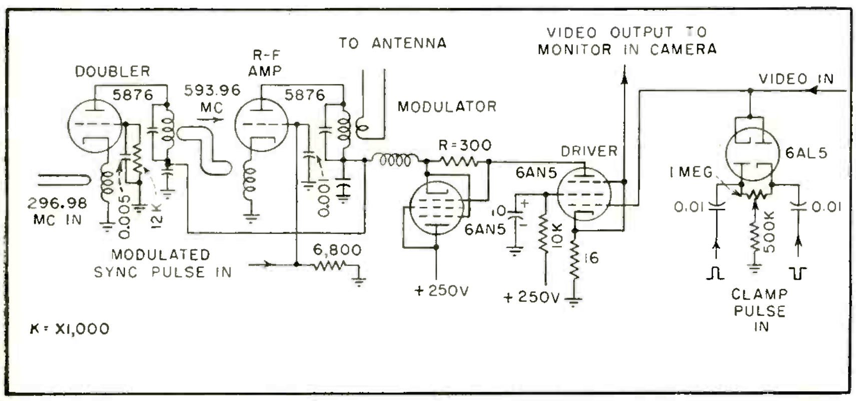


FIG. 4—Boot-strap video modulator circuit, with typical values

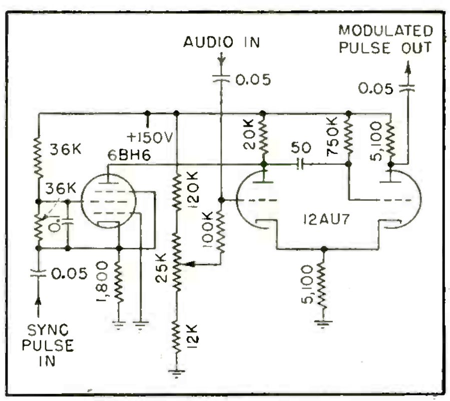


FIG. 5—Pulse-duration modulator circuit

is a rather conventional f-m receiver designed for operation on the single frequency of 154.49 mc with a 6-mc intermediate frequency. The local oscillator frequency is supplied by the transmitter oscillator. The output consists of a discriminator and high-pass circuit for voice and an a-m detector circuit peaked at 60 cps to pass the control frequency.

Power Supply

Power for the unit is supplied by silver-cell storage batteries of 60 ampere-hour capacity. By means of a dynamotor, voltages of 150 and 250 volts d-c are supplied to the plate circuits. Power consumption is about equally divided among the two plate supplies and the heater circuits. Total power consumed is about 150 watts, with an efficiency of around 60 percent. The batteries supplied are sufficient to operate the pack for about 1.5 hours on a single charge.

The camera designed for this equipment uses the C76192 Vidicon pickup tube[3]. A magnetic field for focusing the electron beam is provided by four Alnico rods with soft iron end plates. A two-stage video amplifier in the camera builds the signal up to a level to be carried by cable to the pack unit. A special 1-inch diameter monitor tube in the camera permits the operator to monitor the video signal being transmitted. Signal for the monitor is obtained from the cathode of the video modulator through a driver stage in the camera.

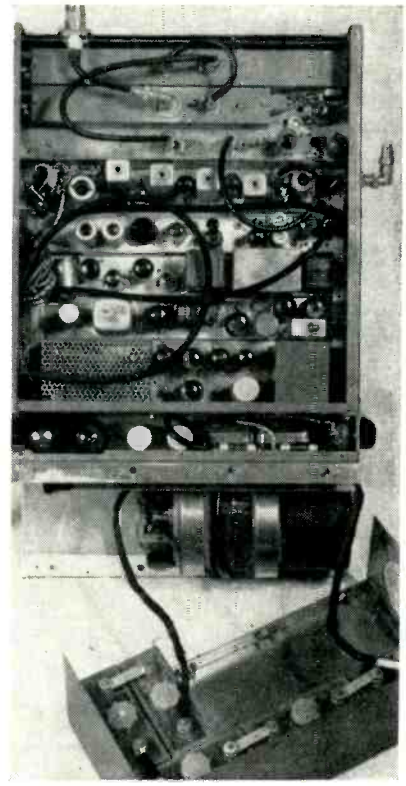
Control Station

A block diagram of the equipment at the control point is shown in Fig. 7. Here the signal from the remote transmitter is received on a uhf television receiver. After the signal passes the second detector it is passed through a synchronizing separator. This separator must be of a rather wider bandwidth than normally used to maintain the rise and fall of the horizontal sync pulses which carry the sound information. The video minus the sync pulse is recovered from one channel, while the sync pulse carrying the sound on its trailing edge is recovered from the other.

No vertical synchronizing is transmitted, so no problem of separating vertical from horizontal pulses exists. The horizontal pulses are passed into the sound separator which integrates the pulses in a low-pass filter to recover the sound, while the unmodulated leading edge is recovered by differentiation and clipping in another channel. This signal from the leading edge is then used to lock the line frequency of another synchronizing generator. Horizontal and vertical pulses are supplied by this local generator and may then be shaped and processed as desired, after which they may be mixed with the video signal to provide a composite video signal to any desired specifications. The order transmitter is frequency-modulated by voice for instructions and amplitude-modulated by a 60-cps reference frequency.

Performance

In outdoor tests the equipment has given good performance over distances up to at least a quarter mile with simple antennas. Sufficient tests have been made over a period of several months to indicate that this equipment will transmit a satisfactory picture with good reliability under conditions which might be encountered in practical use.



Back pack with covers removed, showing miniaturized rack panel construction. Storage batteries and dynamotor are in lower compartment. Jack at right supports antenna for uhf receiver

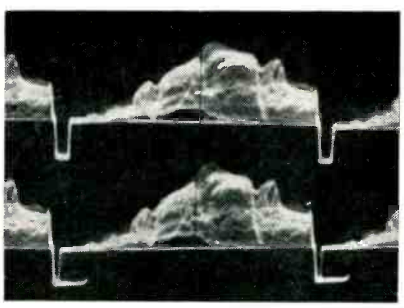


FIG. 6—Horizontal sync pulses for zero sound modulation (above) and full modulation (below), showing how duration of pulse varies with sound modulation

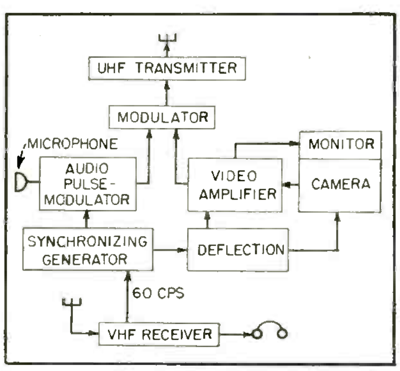


FIG. 7—Major sections at control station that feeds local television station or network

The authors wish to express their appreciation for the continued inspiration and encouragement of Dr. V. K. Zworykin, under whose direction the work was done, and for the contribution of Lars Person who was largely responsible for the sound modulator used.

Our thanks also go to Dr. H. F. Olsen and John Preston for the special microphones used, and to Dr. F. H. Nicoll for the special monitor tube. The pencil triode circuits used in the transmitter are from a design by G. H. Rose.

REFERENCES

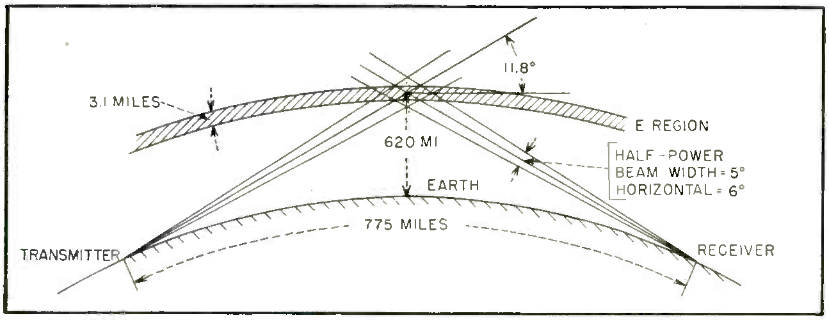
(1) R. C. Webb and J. M. Morgan, Simplified Television for Industry, ELECTRONICS, p 70, June 1950.

(2) V. K. Zworykin and L. E. Flory, Television in Medicine and Biology, *Electrical Engineering*, p 40, Jan. 1952.

(3) P. K. Weimer, S. V. Forgue and R. R. Goodrich, The Vidicon Photoconductive Pickup Tube, ELECTRONICS, p 70, May 1950.

Reliable VHF Signals

A newly discovered type of E-layer propagation transmits weak but consistent signals at 49.8 megacycles over a 775-mile test path with reception observed at even greater distances. During high-frequency radio fadeouts, the vhf signal improves slightly as the background noise weakens



Geometry of the E-region scattering upon which the successful experiment was predicated

PROPAGATION of radio waves in the so-called very-high-frequency range, encompassing the band from 30 to 300 mc, has been observed for many years to occur over distances well in excess of the optical horizon. For the shorter ranges, reception has been explained on the basis of unusual conditions in the troposphere, or simply upon the weather. Reception over the greater ranges depends upon ionospheric reflections.

Signals received at distances of several thousand miles, such as trans-Atlantic or transcontinental reception of prewar f-m and television stations can be accounted for by a high F-layer critical frequency. Sporadic E-layer propagation is responsible for signals up to about 100 mc being received strongly but erratically at distances usually not exceeding 1,500 miles.

The discovery of the new mode of weak but reliable propagation is predicated upon a continuous condition related to sporadic-E ionization, but not sporadic. Maximum reliable range for this mode was expected to approximate 1,250 miles. The work of Ratcliffe[1,2] and others has shown that it is possible for turbulence in the ionosphere to produce an incoherent scattering. A similar scattering in the troposphere that accounts for propagation in that region has been described by Booker and Gordon.[3]

The initial experiment to prove the hypothesis of vhf propagation as a result of scattering from turbulence in the ionosphere required a transmitter power many times that generally encountered in previous observations. Proof of the idea depended upon reception of the signal in the absence of other forms of ionosphere transmission.

In January 1951, a 49.8-mc, 23-kw, c-w transmitter was set up at the Collins Radio Co. plant in Cedar Rapids, Iowa. The receiving station operated by the National Bureau of Standards was located at Sterling, Virginia, 775 miles away. It employed a receiver with bandwidth of 3 kc and 3 db noise figure.

Receiving and transmitting antennas were identical horizontal rhombics with heights of 41 feet, leg lengths of 500 feet and tilt angles of 83 degrees. These antennas provided gains of about 18 db over dipoles at the same heights.

Calculations indicated a system transmission loss of 72 db when the expected mode of ionosphere propagation was compared with inverse-distance propagation figures.

The signal was picked up and reception continued without any failure of the transmission medium. During the first high-frequency fadeout or SID (sudden ionospheric disturbance) the vhf signal became even stronger, thus confirming the ionospheric mode of propagation. Reports from other organizations, including those from radio amateurs, indicated that the signal was being heard over a wide area. For a short time, receiving tests were made in Bermuda, 1,600 miles from the transmitter. Signals were occasionally heard there, but the reception occurred only at times of intense sporadic-E ionization.

Whistles

The fading characteristic of the received signal follows a Rayleigh distribution. At all times of the day, random heterodyne whistles can be heard, mostly descending in pitch. The whistles are caused by reflections from the moving head of ionization accompanying meteors in their passage through the E region to lower parts of the atmosphere. In accordance with their meteoric origin, the whistles vary greatly in intensity, being of long duration in the evening and more frequent and of short duration at dawn. A meteor giving a strong whistle often causes the signal level to rise abruptly, sometimes even blocking the receiver and remain high for periods ranging from several seconds to a minute or more. This enhancement of the signal accompanying strong meteor whistles almost always outlasts the whistle for some time. It is certain that the meteoric residue contributes to mean signal level.

Up to 1,250 Miles Distance

The received signal power was recorded automatically, using an averaging circuit with a time constant of 12 seconds. This long time constant facilitated reduction of the data by averaging the rapid fluctuations prior to recording. The estimated median of the recorded level was tabulated by hourly periods, with the medians of hourly measurements for June 1951 plotted in Fig. 1. The data are shown on a decibel scale with zero corresponding to one microvolt open circuit antenna voltage. One microvolt represents a received available power of 154 db below 1 watt.

In general, the signal power received exhibits a maximum near the middle of the day and a pronounced minimum between 20 and 22 hours EST. Following the minimum, the signal increases fairly steadily throughout the night. There is some tendency towards a second maximum in the forenoon.

The records indicate that there was pronounced enhancement of the signal during severe magnetic disturbances that caused high-frequency radio fadeouts. During more moderate disturbances, the signal shows some improvement or appears normal.

Analysis of high-frequency records during April and May showed 24 SID's occuring between 1½ hours after sunrise and 1½ hours before sunset for which simultaneous vhf data are available on the experimental path. In seventeen of these events, the received signal showed a noticeable enhancement ranging from 3 to 9 db during the period of the SID as established by fadeout observations on ordinary h-f radio communication paths. This enhancement became noticeable within a few minutes of the onset of the SID, and the received signal returned to normal at the end of the fadeout. In the remaining seven cases, the vhf signal remained normal.

Correlations

The important point is that there was no evidence of any weakening of the signal in these cases. Figures 2A and 2B show records of a fadeout on May 19. The vhf signal (Fig. 2A) shows increasing strength during the same time that a 6.08-mc signal from Ohio (also recorded at Sterling in Fig. 2B) essentially disappeared. The vhf transmissions were interrupted for a two-minute period every half hour. During these interruptions, the level of background noise was recorded. The diminution of cosmic noise during the SID is apparent.

These results are a strong indication that the received signal is returned from a part of the E region below the level of maximum ionization, and perhaps even from below the absorbing region, in the D region. This is further substantiated by earlier and independent observations of cosmic noise, which suffers a small but noticeable attenuation at the same frequency during SID's.

The information contained herein has been abstracted from the *Physical Review*. It describes a United States Government project conducted co-operatively by the National Bureau of Standards Massachusetts Institute of Technology and Collins Radio Co.—A. A. McK.

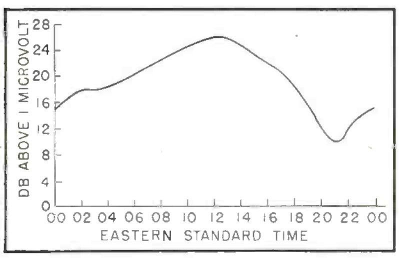


FIG. 1—Hourly median signal intensities for 49.8-mc transmission over a distance of 775 miles during June 1951

REFERENCES

(1) J. A. Ratcliffe and J. L. Pawsey, *Proc. Camb. Phil. Soc.*, 29, p 301, 1933.
(2) J. A. Ratcliffe, *Nature*, 162, p 9, 1948.
(3) H. G. Booker and W. E. Gordon, A Theory of Radio Scattering in the Troposphere, *Proc. IRE*, p 401, April 1950.
(4) D. K. Bailey, R. Bateman, L. V. Berkner, H. G. Booker, G. F. Montgomery, E. M. Purcell, W. W. Salisbury and J. B. Wiesner, A New Kind of Radio Propagation at Very High Frequencies Observable Over Long Distances, *Physical Review*, p 141, April 1952.

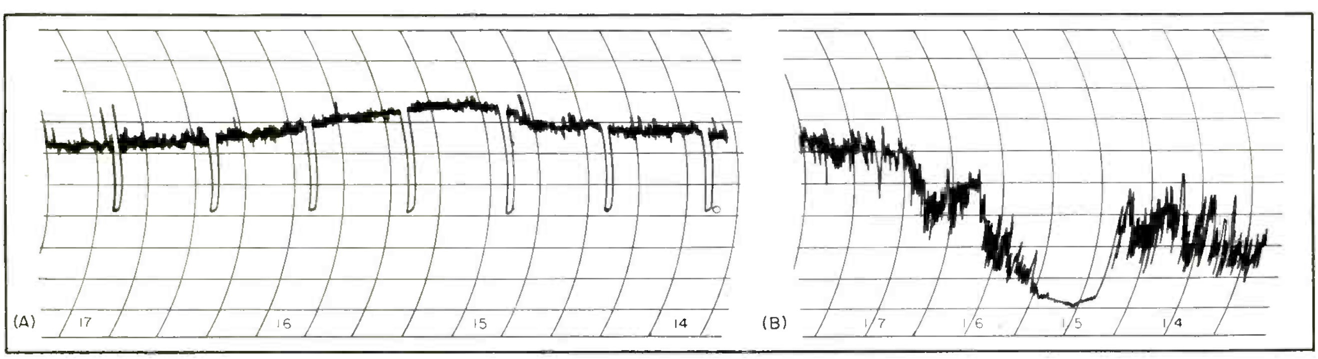


FIG. 2—Improvement of signal and decrease of background noise (A) for 775-mile vhf signal during SID from 1450 to 1615 EST and (B) SID fadeout for 6.08-mc transmission over 325-mile path during the same period

Liquid-Weighing Scale

Wide range of flow rates with accompanying high degree of accuracy is advantage of this system using weight of liquid rather than volume as control factor. Synchro system reacts to scale unbalance to throttle valve determining rate of flow

TO OVERCOME the inherent difficulties encountered in volume flow controls so as to obtain a much higher degree of accuracy and wider range of flow rates, this weight rate-of-flow control machine was developed.

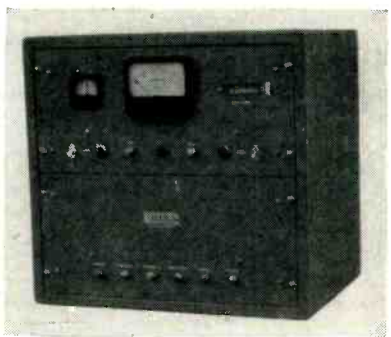
The method used has the principal advantage over volume flow of using none of the physical properties of the liquid other than weight. The instrument can be used for any liquid that will flow: an emulsion, a mixture, an unknown; or it can be used under gas pressure in an interphase with the gas. Such liquids as peroxide and liquid air, which present great difficulties when using the volume method, can be used in this instrument.

An accuracy of one-half percent within one minute intervals with an accumulated error of less than one part in 10,000 was attained. The range of flows is from 10 to 100 grams per minute with a total running time of eight hours.

Operating Principles

The basic method is to balance a container filled with a liquid on a special scale, as shown in Fig. 1. Balance is indicated by a linear variable differential transformer *A*. The balance weight *W* is then moved in by the constant speed motor *M* and lead screw *S*. As the weight moves in, the scale becomes unbalanced and an error voltage is developed which is amplified and applied as control voltage to a motorized valve *V*. The valve opens, allowing the liquid to flow from the container at a rate dependent upon the rate at which the weight moves in and upon the mass of the weight.

To obtain a flow rate of 100 grams per minute and a total running time of eight hours, it is necessary to use a starting weight of 48 kg of liquid. With an accuracy of ½ percent at 100 grams per minute, the required sensitivity is 0.5 gram. To obtain this, a scale accuracy of 0.5 gram in 48 kg or one part in 96,000 is required. This was obtained in part by using spring steel ligaments for the fulcrum points.



Rate control unit (upper panel) with error meter (left), rate meter (center) and revolution counter (right). Lower panel contains valve-control servo amplifier

The lead screw moves the weight a distance of 12 in. in eight hours or 0.025 in. per minute. Therefore, the lead screw accuracy needs to be ½ percent of 0.025 in. or constant pitch to within 0.000125 in. and end play limited to 0.00001 in. The lead screw accuracy was obtained by lapping a steel screw with a cast iron lap. The end play is reduced to a minimum by mounting the lead screw between centers and lapping in the centers.

The rate is controlled by a speed-control servo system. The motor speed is measured by a d-c tachometer which in turn is used as the sensing device to hold speed constant. This is shown in Fig. 2.

The flow-control servo system uses as a sensing device an Actcotran transformer. The error voltage from this transformer is proportional to the balance of the scale. Being proportional to balance it becomes necessary to obtain the first derivative of the error signal to obtain an error proportional to rate of flow. The flow-control servo obtains the first derivative and uses this signal to control the valve. A positional voltage is also used to control the valve so as to remove accumulative errors. This signal is obtained directly from the transformer and is mixed with the first derivative as valve control voltage, see Fig. 3.

Speed Control

A series-type universal motor with a gear reduction of 7,800 to 1 is used to drive the lead screw. The speed of the motor is measured by

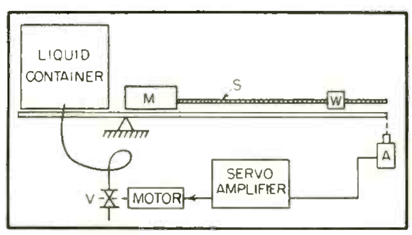
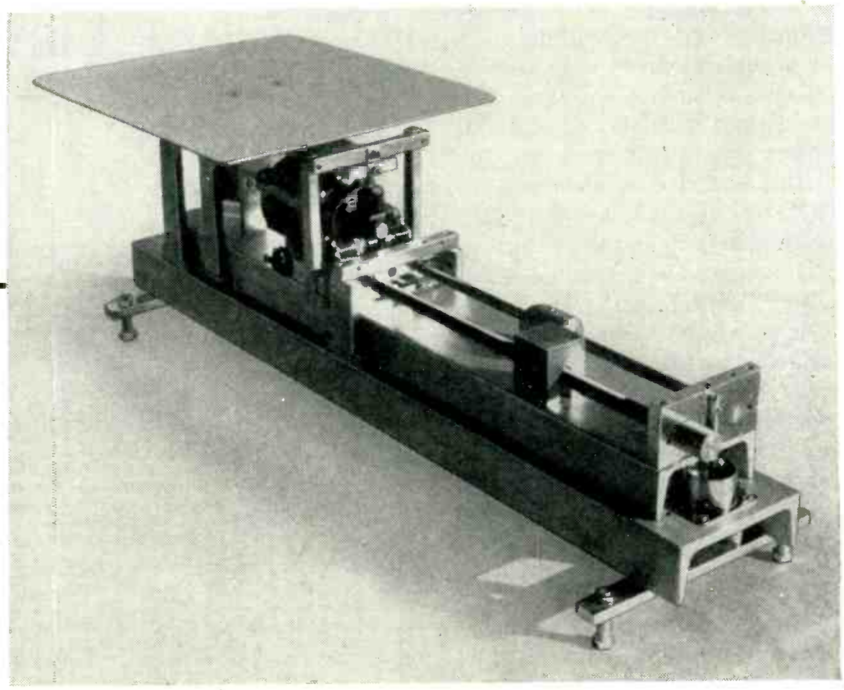


FIG. 1—Mechanical sketch of the weight rate-of-flow control equipment

Controls Rate of Flow

By SVEND R. PEDERSEN
Pedersen Electronics
Lafayette, California



Balance with covers removed to show mechanical construction

a d-c tachometer, see Fig. 4. Output from the tachometer is also used to control the motor speed. The tachometer voltage is compared with a voltage standard by a balanced comparator circuit to reduce variations due to heater-voltage variation. The signal from the comparator is further amplified by a pentode which in turn controls the grid potential on the high-vacuum full-wave rectifiers.

Output from the rectifiers supplies the power to run the series motor. It was found necessary to filter out the commutator ripple from the tachometer to prevent the amplifier from being saturated by the ripple. An a-c feedback voltage was introduced around the amplifier to prevent hunting and cause the motor to overshoot only once upon coming up to speed. It was also found necessary to insert a swinging choke in series with the motor to damp out oscillations.

To obtain a good voltage standard it was found necessary to use a small power supply with a VR-150 regulator to supply voltage to the selected VR-105 as a standard.

A depressed voltage standard is used so that the grids of the rectifiers may be operated negative with respect to the cathodes. A regulated power supply of 250 volts is used as plate voltage for the d-c amplifier and comparator. Regulation is obtained with a VR-150 and VR-105 in series.

Speed variation obtainable is 10 to 1 with a speed variation of less than 0.1 percent for a line voltage change between 105 and 125 volts. Speed variation is obtained by adding to the tachometer voltage using a potentiometer circuit across the voltage standard.

There are limit switches to disconnect the motor when the weight reaches the end of its travel, and because the beam is completely enclosed during operation, it is necessary to indicate whether or not the motor is running. An indicator is provided by placing a relay across the series choke in the motor circuit. The relay will close if the motor is drawing current and light a lamp on the control panel. The circuit operates such that if the motor speed varies because of binding, the lamp will go on and off, indicating trouble.

A counter is used to indicate the number of revolutions the lead screw has made. The counter is operated by a cam-actuated switch producing 100 counts per revolution.

Valve Control

The linear variable differential transformer is supplied with exciting voltage from a lightly loaded 6.3-volt filament transformer, as it is necessary to have a good wave form. Output of the two secondaries is connected in phase opposition. The output goes to a pentode amplifier with the return to a balancing network used to balance out that part of the induced secondary signal that is out of phase with the signal balanced by the moving core. Balance can be obtained that leaves

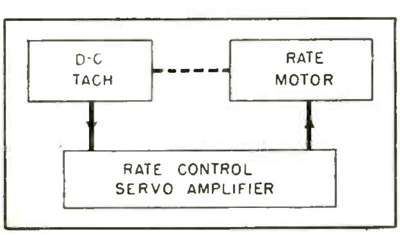


FIG. 2—Simplified block diagram of the speed-control system

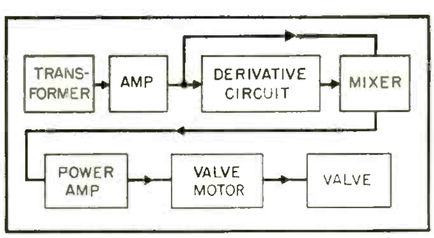


FIG. 3—Sequence of stages for flow-control servo setup

about 5 mv rms at 180 cps.

The signal is amplified by a pentode and then a triode. The triode output is coupled to an interstage transformer. A phase shift is provided at this point by the coupling capacitor resulting in an error signal in phase with the demodulator reference voltage. The demodulator consists of cathode followers operating near cut off with the cathodes in push-pull.

The error signal is applied to the grids in push-pull and the reference signal is applied in parallel. The resulting filtered output is a push-pull d-c signal whose polarity depends upon the direction of unbalance and whose magnitude is proportional to the amount of unbalance. This direct voltage is then differentiated by push-pull R-C circuits and applied to balanced modulators.

Balance Modulators

The balance modulators are push-pull pentodes whose plates feed an interstage transformer. A 60-cps modulating voltage is fed to the modulator cathodes. The modulating signal is large enough to overcome the cathode bias and cause grid current to flow during a portion of the cycle. This results in grid-leak bias to aid filtering of the 60 cps from the demodulator. The grids are sensitive only to the slow-changing d-c error signal.

A phase-shift network follows the modulator output transformer to bring the signal back in phase with the original error signal. After a triode amplifier, the first derivative signal (proportional control signal) and the positional control signal are mixed, using a 6L7 mixer. It is necessary to use this type of mixer to prevent a feedback loop around the derivative circuit.

A phase-inverter and power-amplifier circuit follow. Under normal operation, the 6L6's are in class-A and provide a very small amount of power. Under transient conditions, the 6L6's operate in class-AB and can provide large amounts of corrective power. Output from the power amplifier feeds one phase of a two-phase servo motor. The other phase is fed directly from the 60-cps power source through a phase-shifting capacitor.

Although the machine operates on the batch principle, its operation can be made continuous by the use of two machines, one taking over as the other finishes its run. Its range of flow may be made as low as fractions of grams per minute to hundreds of grams per minute. The instrument can be used to control incoming or outgoing liquids. Its original purpose was as a primary liquid control during continuous chemical processing. Another use is the control of liquid ratios such as primary and catalytic during chemical processing or rocket fuels during engine testing.

The balance developed for this instrument is unique in itself, being capable of the accuracy of an analytical balance with a very large capacity. Top weighing capacity of the balance is 100 pounds with a sensitivity of one part in 100,000.

The speed control, having a speed range of 10 to one and easily extended to 50 to one and an accuracy of better than 0.1 percent, may have many applications. The individual units or the instrument as a whole should prove to be very flexible and useful to perform tasks heretofore impossible or impractical in many scientific or industrial fields.

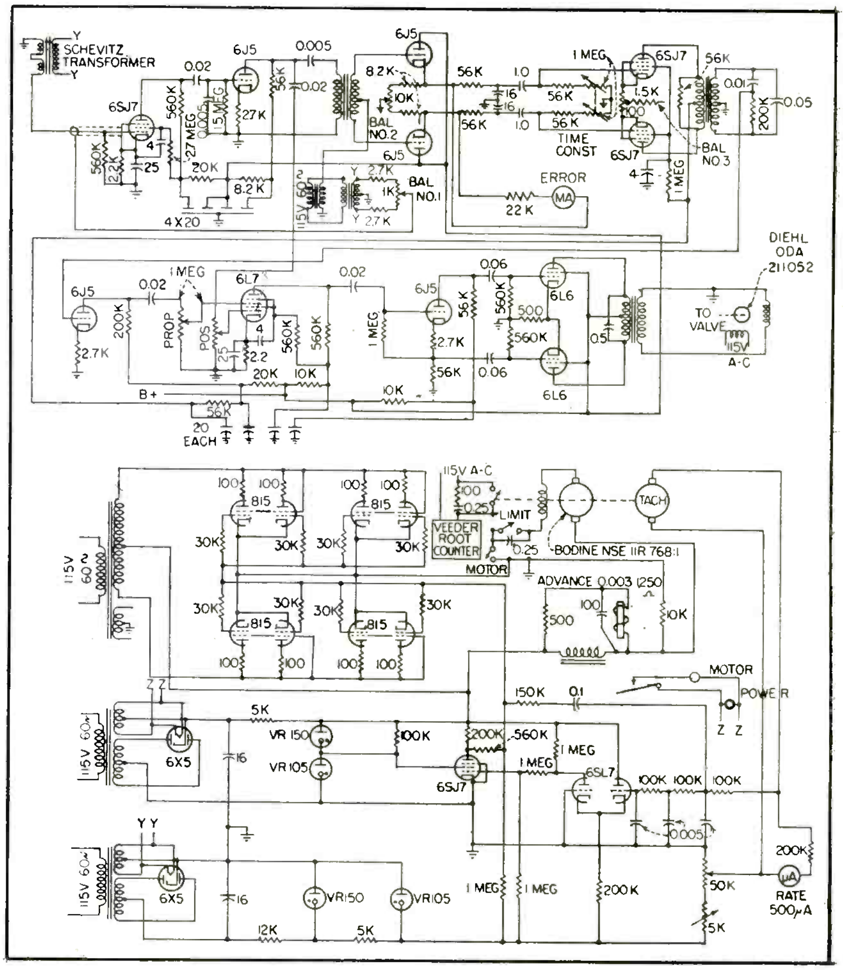
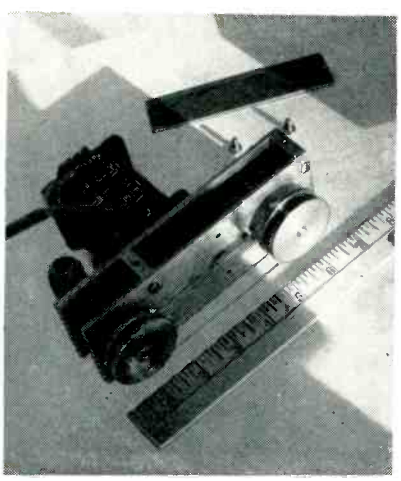
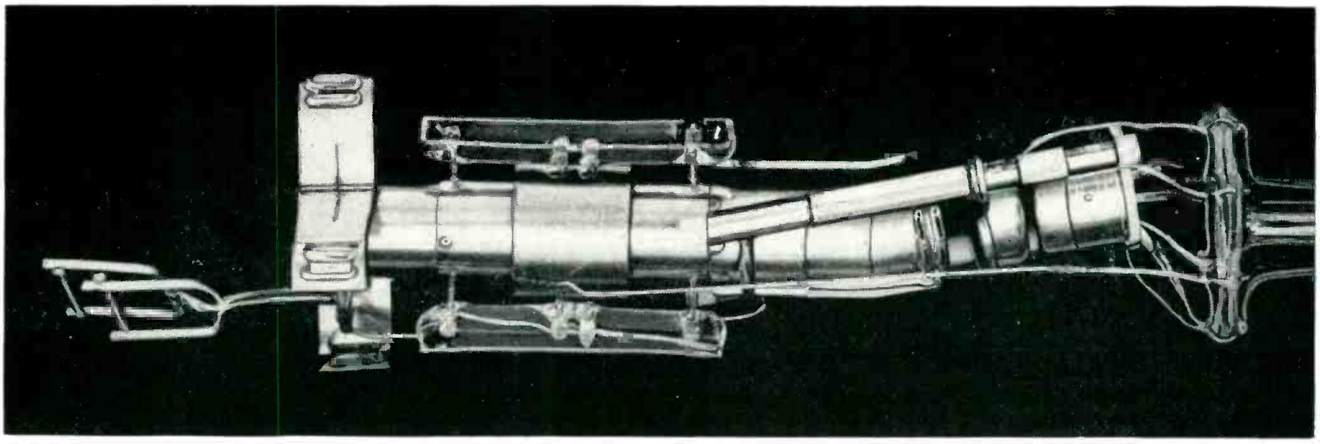


FIG. 4—Schematic diagram of the complete control that adjusts valve to determine rate of flow



Motorized valve uses string as clutch and to allow stem to move in and out



Structure of complete self-focusing electron gun. Two glass rods support the three self-focusing electrode cylinders, with supporting flange and getter at left and standard bent gun and press at right

Self-Focusing Picture Tube

Development, construction and performance of electrostatically focused television picture tubes requiring no external focusing adjustments. Variations in receiver voltages have no significant effect on focus. Focus lens geometry permits mass production

By A. Y. BENTLEY, K. A. HOAGLAND and H. W. GROSSBOHLIN

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SINCE the advent of large-scale television receiver manufacturing, the magnetically focused and magnetically deflected picture tube has been almost universally employed. Electrostatically focused cathode-ray tubes were well known and extensively utilized in oscilloscopes, but these early types had production and performance limitations in receivers. The chief limitations were the increased complexity of the electron gun and the inability of simple and inexpensive electrostatic lens structures to give good focus at the high beam currents required for satisfactory picture brightness levels.

Focus Voltage

Material shortages due to the international situation brought renewed interest in the material-saving aspects of electrostatically focused picture tubes. The first such tubes used conventional retarding-field lens structures similar to those of oscilloscope-type tubes. These required an external focus voltage that was an appreciable percentage of the final anode voltage, as indicated in Fig. 1A. This introduced the new problem of obtaining a variable voltage source of relatively high potential. Lens changes were then made to reduce the percent voltage required for focus to a value low enough so the focus voltage could be obtained from the B+ supply of the receiver, as shown in Fig. 1B. This decrease in percentage necessitated a reduction in the dimensions of the focus electrode parts, increasing the precision required in the fabrication of such lenses.

The possibilities of operating the focus electrode at 0 percent of the final anode voltage were also under consideration. It has been known for some time[1] that the retarding-field lens can be used in devices requiring focused electron beams, where the focus voltage is at cathode potential. The desirable features of such operation are that no external device or connection is required for focus, and the focus condition is essentially independent of variations in anode voltage. However, lenses of the conventional type were not found suitable for production use because the tolerances required in parts procurement and assembly were such as to preclude the possibility of precise control of focus characteristics.

From a theoretical point of view, the ideal electron lens should be as

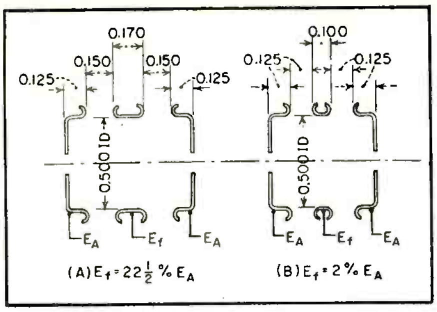


FIG. 1—Cross-section views of two conventional electrostatic lenses

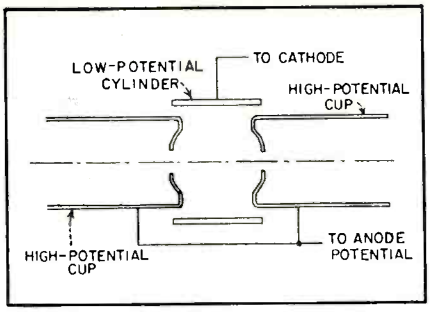


FIG. 2—Cross-section of new self-focusing electrostatic lens

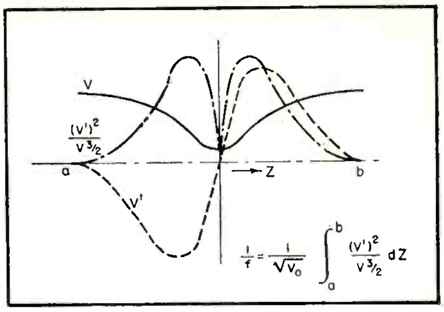


FIG. 3—Graphical utilization of electrolytic tank data for lens design

large as possible, because the aberrations of an electron lens are a function of the distance from the axis of symmetry relative to the maximum diameter of the lens. The lens should be highly symmetrical to avoid astigmatic distortion, hence should have no high field gradients subject to variations in regions close to the axis, and should be constructed in such a form as to minimize the effects of extraneous electrostatic fields which may be injected by mechanical supports or conducting leads. Finally, the lens design should be such as to minimize the number of dimensions which must be accurately controlled to establish the focal strength of the lens.

From a practical point of view, the lens must fit inside the neck wall, must be constructed so it can easily and accurately be jig-assembled and must be sufficiently rigid to withstand normal handling and processing stresses of the cathode-ray tube.

Final Lens Geometry

These factors led to selection of the geometry depicted in Fig. 2 for a zero-voltage or self-focusing lens. By using a low-potential electrode of larger diameter than the adjacent high-potential parts, the effective lens diameter is increased, the structure is selfshielding against the introduction of extraneous fields and, because of the overlapping, the length of the low-potential cylinder has no significant effect on the strength of the lens. Lens strength is controlled by the inside diameter of the low-potential cylinder and the spacing between the high-potential cups. All parts have large bearing surfaces conducive to maintaining a high degree of concentricity and spacing accuracy when jig-assembled.

Design Procedure

Having selected the geometry of the focus lens structure, the design of a self-focusing picture tube requires an evaluation of the electron gun and tube parameters, particularly with a view to the establishment of manufacturing tolerances which, if maintained, will result in satisfactory picture resolution. The problem was attacked by first considering the effects of lens dimension tolerances on focal strength. Determining these effects by a purely experimental approach would be costly and time-consuming, hence use was made of an electrolytic plotting tank to obtain the electrostatic field configurations from which focal strength could be computed.

Figure 3 illustrates the technique used to obtain focal strength factors from the tank data. The conventional approximation for focal length of a short lens as derived from the paraxial ray equation was used.[2] The potential V along the axis was measured in the tank using models approximately 25 times actual size. The derivative of this curve was computed, yielding the V' curve, and division of $(V')^2$ by $V^{3/2}$ at each point gave the broken-line curve which was integrated graphically. The area under this curve is inversely proportional to focal length.

Before accepting the results of these computations for manufacturing specification data, it was considered necessary to verify the procedure experimentally. This was not difficult since the geometry of the lens system was well-suited to making a number of experimental tubes with different values of spacing between the high-potential electrodes. The results of these experiments enabled a precise determination of the design-center dimensions. Cross-checking with the electrolytic tank verified the accuracy of the focal-strength computations.

To determine the variation permissible in the low-potential electrode internal diameter by making experimental tubes was difficult since jig modifications would be required for each diameter used. In this case, the tank procedure was particularly helpful.

Figure 4 shows the compilation of results for the variation in lens cup spacing and cylinder inside diameter as related to a normalized focal-strength factor. The curve of focus volts was obtained by measurement of the experimental tubes made with variations in cup spacing. As a further check on the procedure used, it was found that the ratio of slopes of the focus ring diameter curve to the curve for lens spacing was approximately the same as the ratio of design-center ring diameter to the design-center cup spacing. This showed that if all the dimensions of the lens are scaled up by the same factor, the focal strength is unchanged, which agrees with the principles of dimensional similitude.

Focal Strength

In the same manner, the effect on focal strength of a change in the amount of overlap of the low-potential ring electrode was investigated. The relation obtained is shown in Fig. 5. Note that with approximately 0.050 inch overlap, a change in focus ring length has little effect on focal strength. A lens construction which has a gap between the

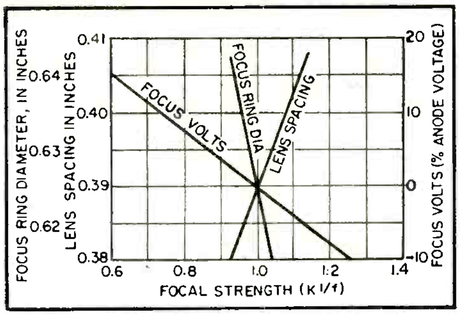


FIG. 4—Effect of lens parameters on focal strength

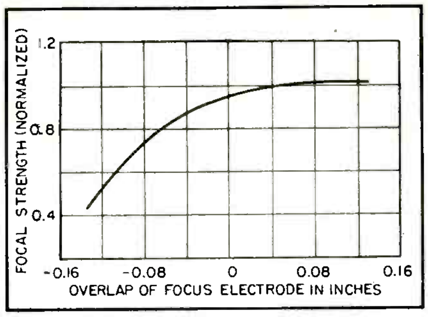


FIG. 5—Effect of focus electrode length on focal strength

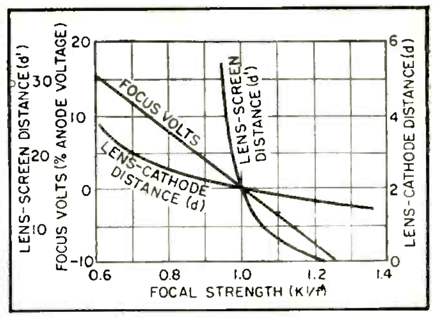


FIG. 6—Effect of tube dimensions on focal strength and focus voltage

low- and high-potential electrodes (shown on the curve by negative overlap) is highly susceptible to changes in focal strength by a change in the length of the low-potential electrode.

Knowing the focal-strength characteristics of the lens, it was found possible to apply the familiar thin-lens relationship between focal length and object and image distances to the problem of determining the change in lens strength required when changes in tube and electron gun dimensions are made. Figure 6 illustrates the way in which these changes are related to lens strength and focus voltage. These relationships were also verified experimentally.

Manufacturing Tolerances

In practice, the distance between lens cups is held to within 0.002 inch of design center. Focus electrode diameter is held to within 0.001 inch. The remaining tolerances are controlled so the tolerance deviation from zero will be no greater than 100 volts for an anode voltage of 13 kv and a video pattern beam current of 150 μa. Under these conditions 100 volts change in focus voltage results in a change in picture focus scarcely detectable to an experienced observer at two feet from the viewing screen. Viewed six feet from the screen there is no appreciable change in picture quality for a focus voltage range equal to 4 percent of the anode voltage.

In the establishment of the design center for the focusing voltage of a picture-tube type, it is necessary to consider the effect of beam current on focus voltage. This effect, of course, is inherent in both magnetic and electrostatic focus lenses in that variations in beam current will produce a change in final spot size which can be minimized by changing the strength of the focusing element.

Accuracy of Focus

Figure 7 shows the required change in low-potential electrode voltage necessary to maintain focus in the presence of changes in anode potential for various beam currents in the range encountered in normal television receiver operation. This curve was obtained from a 17-inch rectangular tube by using a light meter to observe the dip in raster brightness as the tube is focused. (When the spot is focused, current density is highest, and screen saturation will cause a slight reduction in brightness.)

For a beam current of 225 μa, the required focus potential remains constant at 0 percent over a range of anode potential from 10 to 20 kv. This current level corresponds to the highlights of an Indian Head video test pattern operating at normal contrast with an average current of approximately 150 μa. A number of subjective tests have indicated that this level corresponds very nearly to somewhat higher brightness picture level than normally encountered in receiver operation.

Fixing the design center for focus at this level and adjusting the gun design to give sufficient resolution will result in more than sufficient resolution at the lower currents even though the optimum focus voltage at these lower currents is higher than cathode potential. The situation is similar to the case of an externally focused tube, either magnetic or electrostatic, where the user establishes a compromise focus condition at a high current for normal viewing. In the case of the self-focused tube, the tube manufacturer establishes this condition by lens spacing adjustments. The guns are fabricated as two separate units which are welded together after dimensional checking of the focus lens unit.

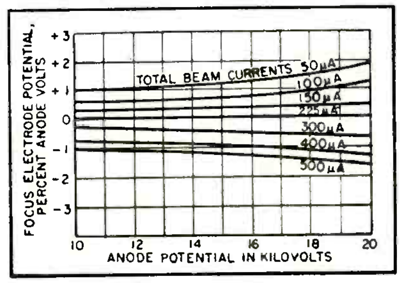


FIG. 7—Variation of focus electrode voltage with anode voltage in self-focusing tube

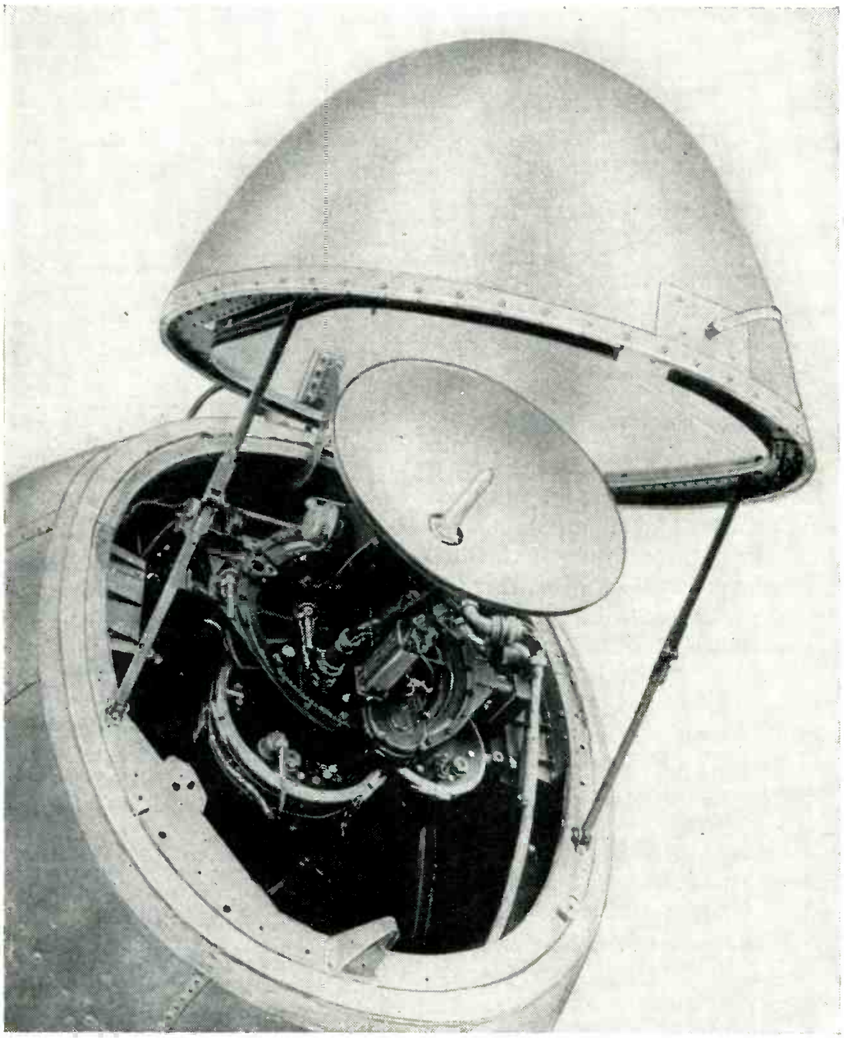
Conclusions

By using a focus lens design of such geometry as to minimize the number of factors which can affect focal strength and lens symmetry, it has been possible to mass-produce television picture tubes which require no external device or connection for focusing the electron beam. Since the quality of focus is built-in by the tube manufacturer, the use of the self-focus principle can result in an important advantage to the ultimate consumer. This advantage is the elimination of a control or focus device which may frequently be misadjusted during installation or servicing of the receiver. Furthermore, variations in operating potential which can occur during the life of the receiver have no significant effect on optimum focus of the picture tube.

REFERENCES

(1) Harley Iams, A Fixed-Focus Electron Gun for Cathode-Ray Tubes, *Proc IRE*, p 103, Feb., 1939.
(2) H. Johannson and O. Scherzer, Uber die electrische Electronen Sammellinse, *Zeit fur Phys*, No. 3, 4, p 183, 1933.

Anticollision Radar



Open plastic radome shows scanning dish and radar transmitter-receiver mounted in nose of Viking aircraft

By MARVIN HOBBS
Department of Defense Washington, D. C.

JET passenger aircraft cruising at speeds some sixty percent above those of present craft will require sure means of avoiding turbulent cloud formations and early warning of mountain ridges. Computations show that a radar transmitter with peak power of 80 kilowatts is necessary to provide two minutes warning for aircraft approaching each other when both planes are travelling 450 mph.

The 3-cm British equipment to be described is limited to a power of 10 kw to keep it light and compact. It is, therefore, used primarily to detect cumulonimbus clouds and areas of turbulence associated therewith, for warning of high ground in the flight path of the aircraft and for navigation by indicator mapping.

Gyrostabilized Antenna

A sector of space ahead of the aircraft is searched and reflections are translated onto the screen of an indicating unit that displays the range and angular position of the obstacles being scanned. To prevent distortion of the display and loss of accurate information during aircraft maneuvers, the scanning antenna is stabilized in roll and pitch angles, using a vertical gyroscope as a reference. The beam can be tilted up and down with respect to the reference platform. Thus, the vertical extent of cloud responses may be determined and optimum mapping and high-ground warning conditions selected.

Prior to its contemplated use in the Comet jet aircraft, extensive tests were carried out on conventional aircraft to study the capabilities of a low-power airborne search radar in these applications. The test programs were divided into two periods, one of which was conducted in a Hythe-class flying boat and the other in a Viking land plane. The first period was devoted almost exclusively to investigating the detection and avoidance of cumulonimbus clouds. The latter period involved primarily an investigation of the operational value of the radar as a high-ground warning and avoidance facility.

Cloud Detection

In the tests relating to cloud detection, some 34 hours were flown in the Singapore area. Observations were made on a wide variety of cloud types and detection was found to include growing cumulus clouds at various stages of development as well as the heavier cloud formations of this type. Smaller cumulus clouds with vertical depths between 25,000 feet and 13,000 feet were detected generally at various maximum ranges from 10 to 30 miles. Clouds as large as 40,000 feet in depth could be detected at a range of 40 miles with reliability. No response was obtained from stratus and stratocumulus types. A layer of altocumulus cloud having a vertical depth of 12,000 feet could not be detected.

Responses from reflecting types of clouds were found to be similar. Over open sea there was no difficulty

for Commercial Flights

British airborne search equipment designed for all-jet commercial passenger carriers with cruising speeds of 500 miles an hour detects thunderstorms and mountains. A safety-circle technique employing tilt device for the radar paraboloid gives predetermined range warning of approaching high ground

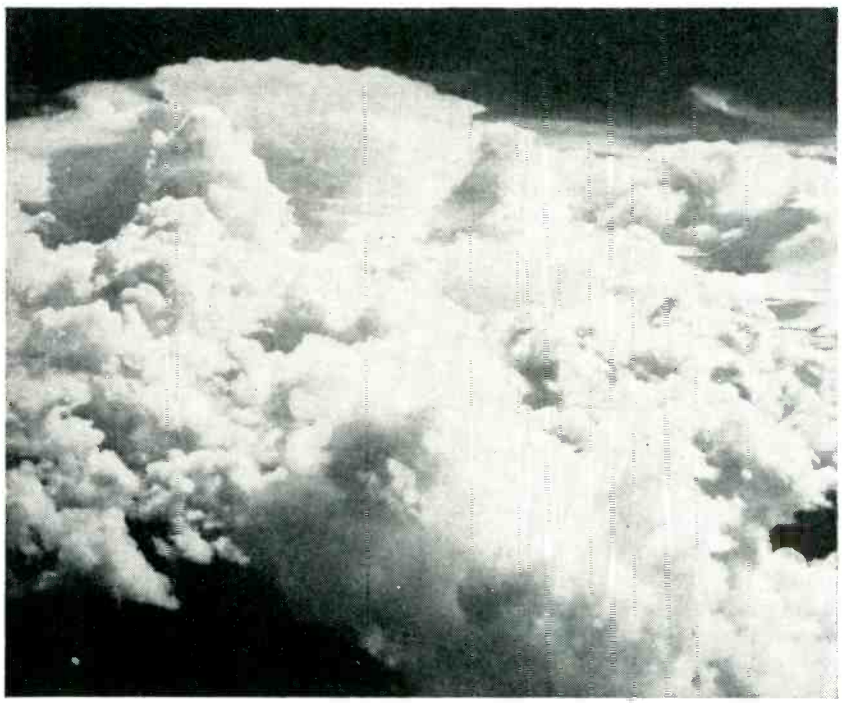
in recognizing a cloud response, but when flying over land the terrain responses hindered cloud recognition. However, with a knowledge of the aircraft's exact position and the surrounding terrain, discrimination between the cloud and terrain could be made by the shadow angle behind the cloud response.

The photograph shows a typical group of growing cumulonimbus clouds, photographed from a range of 20 miles. The cloud top is 28,000 feet and the base is 1,500 feet; aircraft altitude is 10,000 feet. The radar indicator display produced by this cloud formation in Fig. 1A is at a slightly greater range than that in Fig. 1B and shows only the four main cores. Figure 1B shows additional responses that appear at 15 degrees to the left when the range dropped to 20 miles, and are from cumulus clouds at the middle left of the photograph. Cumulus clouds in the foreground of the main cumulonimbus group did not produce a response until the range was down to 10 miles.

By tilting the paraboloid of the radar antenna relative to the dipole assembly, the limits of the plane of scan can be set within 10 degrees above or below the horizontal. This degree of tilt is adjusted from the control unit shown in Fig. 2 and may be used to determine the vertical extent of the cloud response area by adjusting it in both directions until the response disappears and noting the angles at which this occurs.

Avoiding Thunderclouds

Measurement of the vertical depth, which involves the combination of the tilt angle and the range and bearing information, shows whether lateral or vertical diversion of the turbulent area is necessary. It was found that the large vertical depths usually encountered made lateral avoidance somewhat more convenient. Results obtained indicated that cumulonimbus clouds, capable of producing severe tur-



Group of growing cumulonimbus clouds with typical anvil near left top. Veil at extreme left is formed from ice crystals. Strong updrafts make them dangerous for aircraft

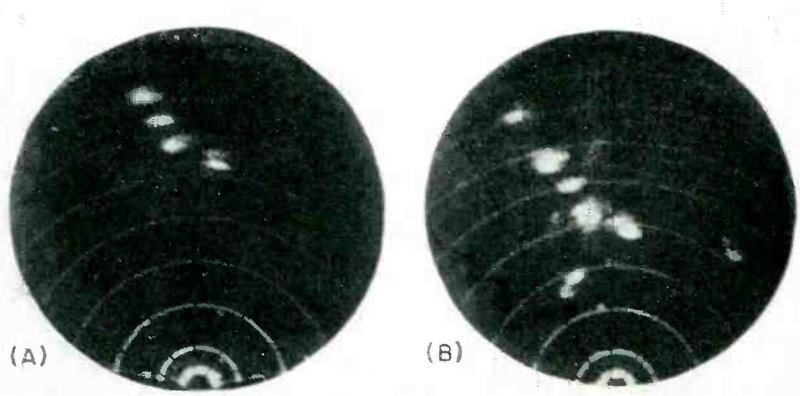


FIG. 1—Target display of the cumulonimbus cloud formation in the photograph. Display at (A) shows a range of 26 to 36 miles; that at (B) is 20 to 36 miles

bulence, could be detected up to 40 miles range. Clouds that did not respond at ranges greater than 10 miles usually caused slight discomfort and in general were harmless.

Figure 3 shows a view of two cumulonimbus clouds separated by a decided gap. In the tests this was observed on the cathode-ray-tube indicator before it was seen visually and the aircraft was directed through this opening solely by radar data.

Terrain Warning

The observation of high-ground warning with this system is based on the so-called safety-circle technique. The microwave energy radiated by the antenna of the radar system is beamed so that the terrain directly below and for a certain distance ahead of the aircraft is not illuminated. Thus, a blank sector in which no reflections are present is shown on the indicator. Its radius will depend upon the height of the aircraft, the nature of the forward terrain and the beam-tilt angle of the radar paraboloid. For a given forward clearance height and a given beam-tilt angle, the safety circle will have a certain range. Reduction of this range will indicate a reduction of terrain clearance and the risk of possible collision.

Since the indicator provides a bearing indication of ± 75 degrees in the direction of the aircraft's flight path, safe avoidance routes over mountainous areas can be determined.

Figure 4 illustrates the application of the safety-circle method. The tilt angle is selected so that the lower edge of the beam cuts the line of desired clearance height H_c at the required warning range R_w. As the aircraft proceeds on the course, the radius of the blank sector varies according to the nature of the terrain.

This variation is shown in the diagram at *A*, *B* and *C* with appropriate indicating unit displays. At *A* and *B* the radius of the blank sector is greater than that of the safety circle, indicating that the aircraft has more than minimum clearance height. At *C* the responses begin to invade the safety circle, that is the arc of radius R_w. Therefore, while still R_w miles away from the obstacle the pilot is given warning that either the course or altitude of the plane must be altered or increased to avoid it. In the case illustrated, a 30-degree turn to left or right will take the aircraft on a safe course.

Without scanner stabilization, the angle of the lower edge of the beam will vary with aircraft altitude and the usefulness of the equipment for high-ground warning would be very limited. On the 10-mile scale in test flights of the Viking installation, errors no greater than plus 300 at 4,250 feet and minus 180 at 2,120 feet were encountered. Tilt angles between 0 and minus 5 degrees were used, but there was no correlation between tilt angle and clearance error. Range varied from 3 to 8 nautical miles. At greater ranges, the accuracy decreases primarily owing to the difficulty of obtaining a high-accuracy reading on the 40-mile scale.

Radar Mapping

The tests with the Hythe flying boat and the Viking showed results in navigation by indicator mapping to be very much as might be expected in light of the knowledge of PPI radar mapping over the past several years. The most satisfactory results were obtained when the area being scanned was marked by bold features such as coastlines, large rivers, lakes and isolated regions of high ground.

Different types of flat terrain were found to give corresponding variation in response intensity under similar operating conditions. The strongest intensity was provided by areas composed of soft sand, vegetation, and dense forestry, while areas of hard sand and rock were often found to give little or no response. Abrupt changes in the type of terrain, such as between flat or rolling and mountainous areas, could be distinguished easily.

The feature of indicator mapping was found to be of considerable value in approaching airports in areas surrounded by high ground. During the tests at Hong Kong, it was possible to negotiate the harbor entrance and circle the landing area well below the level of the surrounding hills through the use of radar data and charts only.

It was also found possible to measure accurate ground speeds by timing the approach over a prominent target such as a high cliff, when the change in range was of the order of 15 to 20 miles. Ranges obtained on ships varied from 5 to 6 miles for small wooden-hulled vessels to 25 miles for medium-sized ships. Other aircraft were sighted at ranges from 5 to 15 miles, depending upon the size and aspect angle of the plane in question.

Equipment Features

The radar transmitter section employs a 10-kw 3-cm magnetron feeding into a duplexer. The pulse width is 1 microsecond and the pulse repetition rate is 700 pps, controlled by a thyratron network modulator. The antenna consists of an 18-inch paraboloid, illuminated by a back-fed dipole and reflector. An arc of 150 degrees in azimuth is swept once per second. The radiated cone of r-f energy subtends an angle of 6 degrees and is scanned 75 degrees on each side of the aircraft. The plane of scan can be

FIG. 2—Control unit of the lightweight airborne radar used in tests. The tilt of the antenna is shown by the small meter at the center

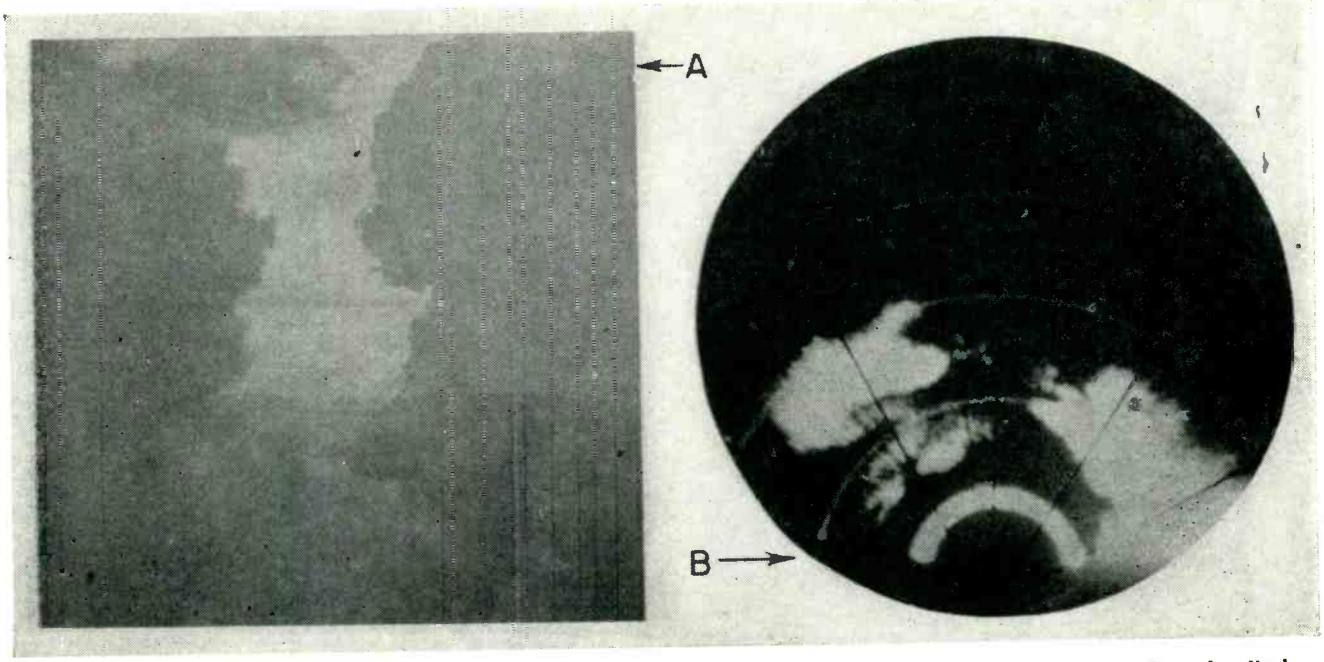


FIG. 3—Gap between two cumulonimbus clouds at (A). Before it was seen, the aircraft had been directed to it by the radar display at (B)

set from 10 degrees above to 10 degrees below the horizontal.

The antenna stabilization system employs a gyroscope as reference. Any departure of the platform from the horizontal causes the gyroscope to produce misalignment signals, which are fed to a servo amplifier that in turn controls the servo motors. The direction of these motors is such that the platform is returned to the zero signal position. The stabilization limits are 45 degrees in roll and 10 degrees in pitch; the rates of follow are 30 degrees per second in roll and 10 degrees per second in pitch with a lag not greater than 2 degrees in both planes. The stabilization system can be disconnected and the scanner electrically locked to the aircraft axes by limit switches. The azimuth drive, tilt drive, roll and pitch stabilization motors in the scanning unit are 400-cycle three-phase machines and the stabilization motors are fitted with feedback generators.

Receiver

The receiver section is associated with the transmitter unit and consists of two channels, both of which are fed from crystal mixers with a common klystron local oscillator. In one of these mixers the local oscillator frequency is mixed with a small portion of the magnetron output and the difference frequency is fed to the afc amplifier and discriminator unit. The output of this unit controls the frequency of the local oscillator, so that the i-f of 45 mc is maintained despite drift of the magnetron or local oscillator frequencies. The output of the second mixer is fed to the video i-f amplifier that has a bandwidth of 2 mc and includes a limiter stage and cathode-follower output. The noise factor is in the neighborhood of 2.5 db and the reserve gain is such that the limiter can be completely blocked by noise. The i-f amplifier, the afc amplifier and the power and modulator sections are constructed as separate units that plug into the main frame to provide optimum accessibility for servicing. Total weight of the units is only 180 pounds.

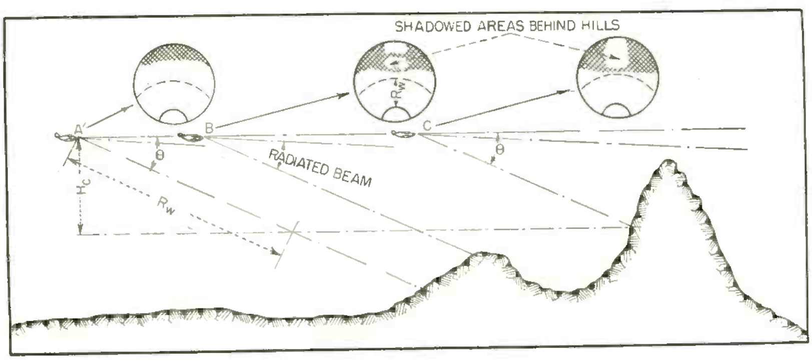
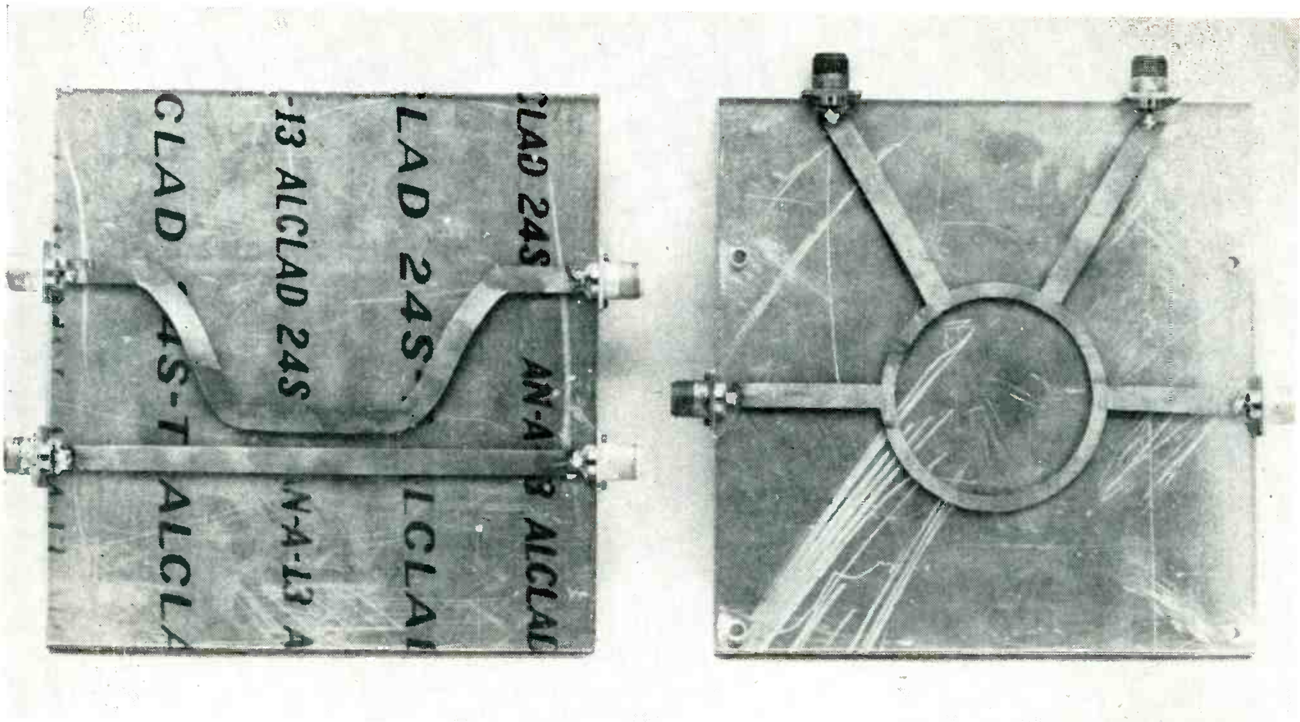


FIG. 4—Desired height and slant range of obstacle is set into radar by antenna tilt. Dashed line shows approach to danger area as explained in text

Circuits for the time base, range markers and delayed high-voltage switching for the transmitter are included in the synchronizer unit along with the necessary power supplies. Two time bases, corresponding to 10- and 40-nautical-mile ranges are provided. Markers produced by ringing circuits can be superimposed on the display at intervals of 2 miles on the 10-mile range, and 5 miles on the 40-mile range.

Data for this article was supplied through the courtesy of E. K. Cole, Ltd., who developed the equipment, and released with permission of the British Ministry of Civil Aviation. Tests were conducted by British Overseas Airways Corporation.



Directional coupler and hybrid junction or magic tee utilizing flat-strip techniques. Strips are between transparent plastic sheets. Top sheet of aluminum, left off to show strips, connects to outer part of each coax fitting, as also does bottom sheet

Etched Sheets Serve as

Flat-strip transmission system evolved from coax operates successfully above 1,000 mc. The metal-and-plastic sandwiches can be produced at low cost by printed-circuit etching techniques, replacing heavy and costly hybrid junctions and other waveguide components used in airborne radar and microwave communication equipment

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THE MICROWAVE printed circuit possesses all of the virtues of other printed circuits, such as light weight, cheapness, ease of manufacture and miniaturization, along with the ability to be used at frequencies as high as 10,000 mc. The basis of the new technique is the planar or flat-strip transmission system which was developed during World War II but which has remained unpublished and relatively unknown in the postwar period, and for which an adequate theoretical analysis has not been available.

The strip transmission line was first used as a power division network by V. H. Rumsey and H. W. Jamieson, and was applied to a production antenna system during World War II. This work is described in a report by V. H. Rumsey published by the Combined Research Group at NRL during the war years, and in a U.S. Navy antenna instruction book.

All of the conventional microwave components, such as hybrid junctions, directional couplers, power division networks and filters, can be readily fabricated by this technique.

Planar Transmission System

The planar transmission system upon which the microwave printed circuit technique is based is fundamentally an evolution of the coaxial transmission system. This evolution can be seen from Fig. 1.

If the coaxial line is deformed in such a manner that both the center and outer conductors are square or rectangular in cross-section, and then if side wells of the rectangular coaxial system are extended to infinity, the resultant flat-strip transmission system, while possessing all

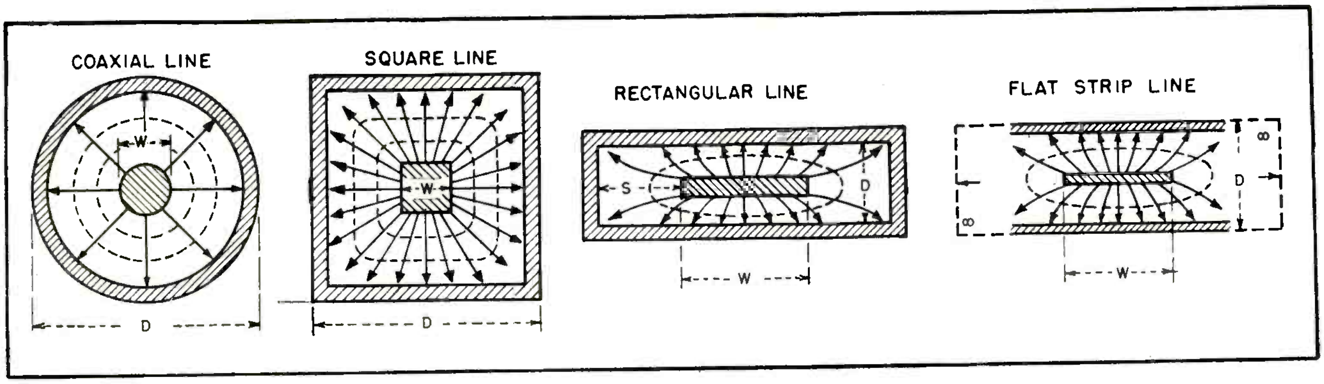


FIG. 1—Evolution of new flat-strip transmission line from ordinary coaxial line

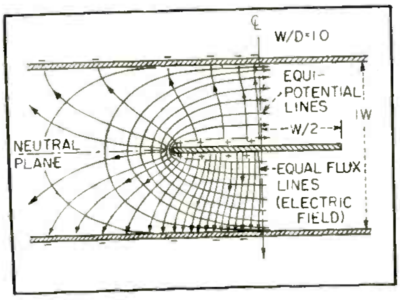


FIG. 2—Flux plot of flat-strip transmission system

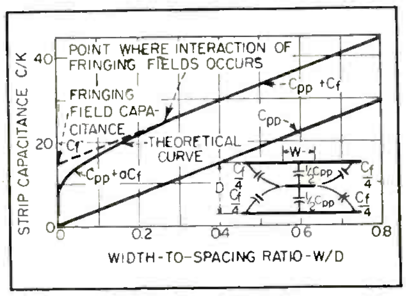


FIG. 3—Capacitance data for zero-thickness center strip

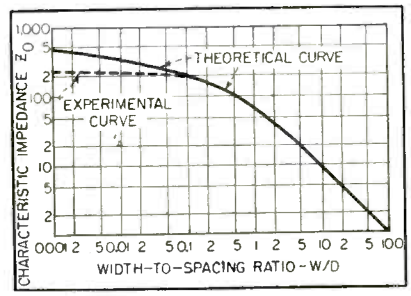


FIG. 4—Impedance data for zero-thickness center strip

Microwave Components

of the advantages of the coaxial system, has a form factor which is adaptable to the printed circuit technique.

The field distribution in this flat-strip system can be seen from the flux plot in Fig. 2. This flux plot, which was obtained experimentally, indicates the basic field structure of this type of transmission system. The neutral plane, not crossed by electric field lines, shows clearly. Almost all of the field is concentrated in the region of the strip. Since no potential difference exists between the outer plates, no energy is propagated in the lateral dimension.

A cursory examination of the flat-strip line would lead one to believe that the capacitance of the line, which determines its characteristic impedance, could be readily calculated from the parallel-plate capacitance formula. For wide low-impedance strips this is true, but for strips which have a characteristic impedance in the order of 50 ohms the capacitance due to the fringing effects at the edge of the center conductor is an appreciable portion of the total capacitance and produces a noticeable effect, as shown in Fig. 3. As the strip is narrowed for even higher impedance, the effect of interaction between the fringing fields at the two edges of the center conductor becomes apparent. This effect, which becomes appreciable for very narrow strips, must be taken into account in the analysis of high-impedance transmission lines. As the width of the inner strip increases, the fringing field becomes a smaller proportion of the total field and its effect on the impedance is thereby reduced.

Impedance of Line

The flat-strip line, like the coaxial line, operates in the TEM mode. The important characteristic of any transmission system operating in this mode is the characteristic impedance Z_o, which can be calculated from the known relation[1]

$$Z_o = \sqrt{L/C} \qquad (1)$$

where L is inductance per unit length, C is capacitance per unit length and Z_o is characteristic impedance.

The velocity of propagation V of the principal mode in such a transmission system is

$$V = 1/\sqrt{LC} \qquad (2)$$

Combining Eq. 1 and 2 then gives

$$Z_o = 1/\sqrt{V\ C} \qquad (3)$$

In any two-conductor line the velocity of propagation is the velocity of light c in the medium filling the space and having a dielectric constant ϵ and a magnetic permeability μ, hence

$$V = c = 1/\sqrt{\mu\,\epsilon} \tag{4}$$

This gives

$$Z_0 = \sqrt{\mu\,\epsilon}/C = \frac{\epsilon}{c}\sqrt{\frac{\mu}{\epsilon}} \tag{5}$$

Capacitance of Line

The only analysis or calculation required to determine Z_0 is that for the capacitance per unit length of the system under study. An approximate calculation based upon the well-known parallel-plate capacitance formula gives some insight into the operation of this line.

The parallel-plate capacitance in $\mu\mu$f per unit length for the case of three parallel planes is

$$C_{pp} = 0.8976\,\frac{W/D}{(1-t/D)}\,\epsilon \tag{6}$$

where W is center conductor strip width, D is plate spacing, t is center conductor thickness, ϵ is dielectric constant and C_{pp} is parallel-plate capacitance.

The use of the parallel-plate capacitance formula to compute the characteristic impedance is permissible for impedance values below 25 ohms. The fringing field capacitance C_f becomes appreciable for impedances greater than this and must be added in the calculations. The impedance then is

$$Z_0 = \left(\sqrt{\frac{\mu}{\epsilon}}\right)\left(\frac{(1-t/D)}{(0.8976(W/D)+(1-t/D)C_f}\right) \tag{7}$$

Letting C_f equal a constant (which can readily be determined experimentally), this formula for the characteristic impedance holds, with engineering accuracy, until the impedances reach the order of 100 ohms. At this point the interaction between the fringing fields becomes important; it is then a function of W/D and t/D.

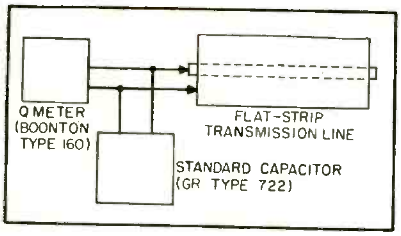


FIG. 5—Experimental setup for measuring characteristics

In Fig. 3 and 4 the parallel plate capacitance and characteristic impedance values are plotted. The experimental curve can be seen to differ from the parallel-plate capacitance C_{pp} by a constant fringing capacitance except in the region of very low W/D ratios, where the fringing capacitance becomes a function of W/D. This curve is plotted for a zero-thickness center conductor.

The mathematical analysis of the flat-strip transmission line[2] is tedious and involved, and would be out of place in an article of this type. The two general methods of analysis for this structure are the boundary-value solution of Laplacés equation and the solution by methods of conformal mapping.

Experimental Evaluation

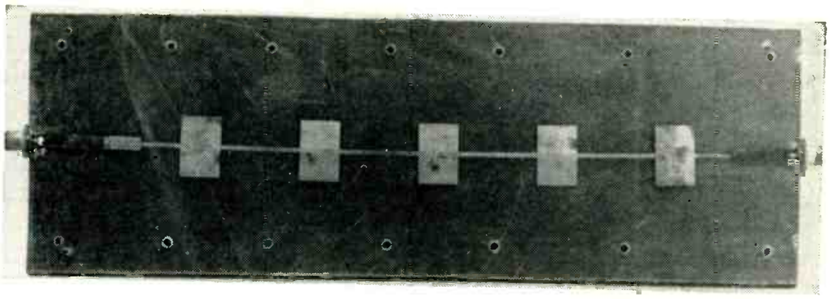
An experimental evaluation of flat-strip transmission system is relatively easy, and checks the theoretical values closely. These measurements, which for convenience can be made at low radio frequencies, utilize simple, readily available test equipment. A Q-meter and a precision standard capacitor are connected across the transmission system as in Fig. 5.

The standard capacitor is set at 100 μf and the Q-meter is balanced. The transmission system is then disconnected and the standard capacitor adjusted to rebalance the Q-meter. The difference in standard capacitor readings is then taken to be the capacitance of the transmission system. From this, the characteristic impedance Z_0 in ohms is calculated as

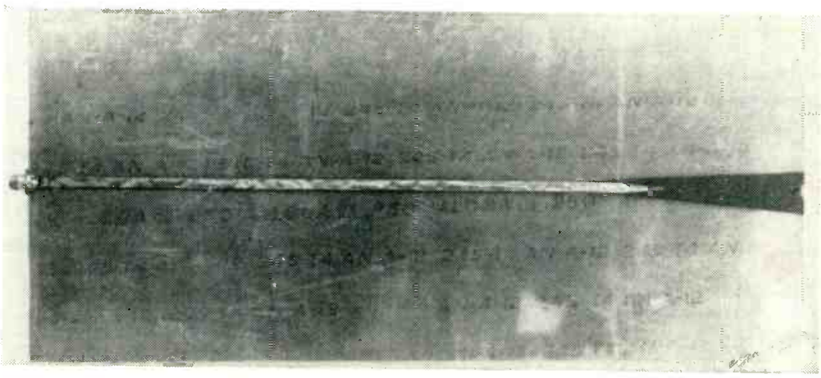
$$Z_0 = \frac{\sqrt{\epsilon}}{3C} \times 10^{-2} \tag{8}$$

where C is in μf per meter. These measurements were taken for a series of strips varying over a wide range in widths and thickness and between plates whose spacing was also varied. It was possible with these various strip widths and plate spacing to make a series of measurements over a range of W/D from 0.001 to 1,000. The measurements of the low W/D ratios are of doubtful accuracy, however, because of the difficulty in eliminating the stray end capacitances in these particular cases.

The results of these measurements, as plotted in Fig. 3 and 4, show that the experimental and theoretical results are in close agreement for all characteristic impedances below 100 ohms. Since



Flat-strip version of low-pass microwave filter having a cutoff frequency of about 440 mc. Top sheet of aluminum is left off, to show strip pattern sandwiched between transparent plastic sheets



Matched load, made by applying resistive paint over end of flat-strip line this is the region of primary interest from an application point of view, both the theoretical and experimental approaches are adequate for the majority of practical applications.

Although the theoretical and experimental data presented to this point is for the center conductor imbedded in a uniform dielectric, this method of construction is not practical in many of the applications. Two alternate types of lines are illustrated in Fig. 6.

The dielectric sandwich transmission line—the one used in all of the subsequent material given in this paper—when limited to a very thin center conductor, such as a metal foil or a printed conductor, has the same characteristics as the case for which the theoretical and experimental data was evaluated. This system is ideally suited for the printed circuit technique and has been widely used by the author.

The compensated stub-supported transmission line is of value when the losses due to a continuous dielectric sheet cannot be tolerated, when the weight of the structure is of paramount importance, when thick center strips are to be used,

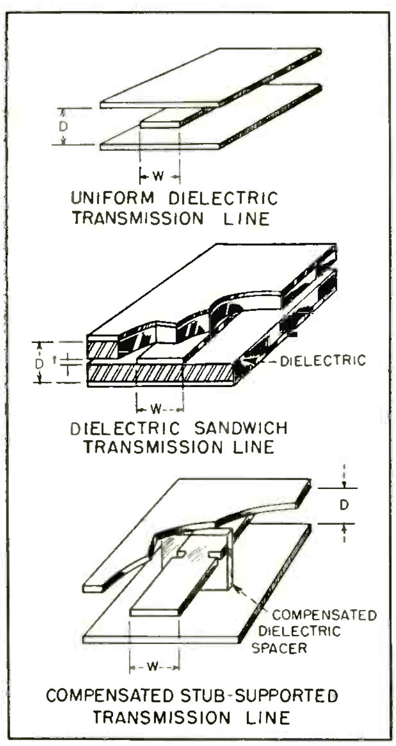
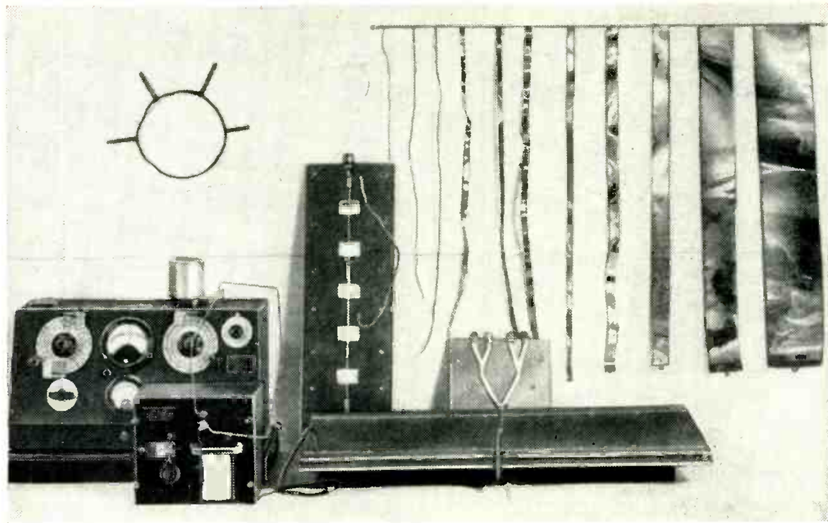


FIG. 6—Types of flat-strip transmission systems



Experimental setup for measuring characteristics of various flat-strip configurations

or when high power is to be carried by the system.

Applications

The planar transmission system can be readily adapted to printed circuit techniques by using two sheets of solid dielectric as spacers between the outer conductors, the center conductor being supported between the sheets. This center conductor can be printed on one of the dielectric sheets with a conducting paint by the standard silk-screen printing process. Experimental work can also be readily accomplished by using thin metal-foil center conductors which can be cut with a pair of scissors and glued to one of the sheets.

Since the characteristic impedance of the system is a function of strip width, it is readily adaptable to circuits requiring impedance changes.

In most practical applications care must be taken in effecting a transition from regular coaxial transmission line to the flat-strip transmission line in order that higher modes shall not be excited. A TEM mode, which will propagate between the plates, can be excited by a nonsymmetrical junction. This and other modes can be eliminated by placing shorting pins between the outer conductors in the region of the junctions, thus insuring that the outer conductors are at the same potential.

A very practical junction which is well matched and excites no higher-order modes consists of a regular type N connector which is inserted between the edges of the planar line, this line consisting of two ¼-inch polystyrene sheets between metal conductors. This junction is matched to a 50-ohm center conductor over a wide band of frequencies.

Since the lateral attenuation in the printed circuit structure is high—in the order of 75 db per inch for one of the circuits tested by the author—it is possible to have several circuits quite close together without annoying coupling or cross-talk between circuits mounted on the same sheet.

Power Splitter

The power division network illustrated in Fig. 7 is based upon the action of the quarter-wave transformer[3]. If a transmission line is cut to a quarter wavelength, it possesses the property that any impedance placed at one end of the line will look like another impedance from the other end of the line. The characteristic impedance is the geometric mean of the end impedances.

If two 50-ohm lines from the output junctions are combined at point A, the resultant parallel impedance will be 25 ohms. The quarter-wave line transforms this impedance to 100 ohms at junction B where the parallel impedance of the two 100-ohm ends of the quar-

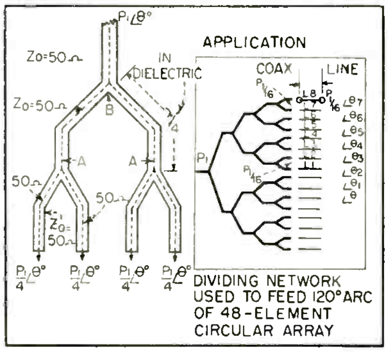


FIG. 7—Microwave power divider made by etching flat strip

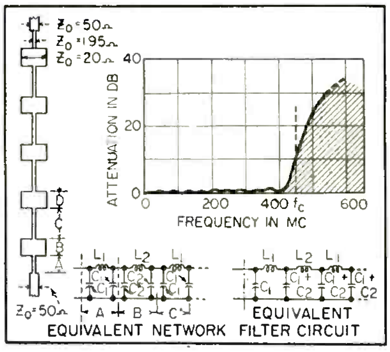


FIG. 8—Low-pass filter construction and characteristics

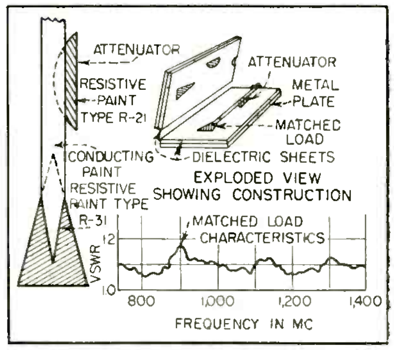


FIG. 9—Printing technique for matched load and attenuator

ter-wave transformer is 50 ohms. This junction is then connected to the input terminal with a 50-ohm line. Power entering the circuit at the input terminal will be divided into four equal components at the output terminals and the 50-ohm characteristic impedance is maintained throughout the division. A sixteen-element power divider utilizing these four-to-one dividing networks has been constructed and used successfully in exciting an experimental antenna array.

Printed Circuit Filters

Another application to which this technique is ideally suited is the construction of microwave filters. A short section of uniform transmission line can be represented by a pi-type equivalent circuit. The circuit of a low-pass filter is a ladder network, hence by a judicious choice of short sections of transmission line connected in series, it is possible to construct a low-pass filter. In Fig. 8 the design of a filter of this type is illustrated. By varying the strip width or characteristic impedance, the ratio between capacitance and inductance of the individual sections may be changed. When these sections are arranged in series they have an equivalent network which can be shown to be essentially the equivalent circuit of a low-pass filter.

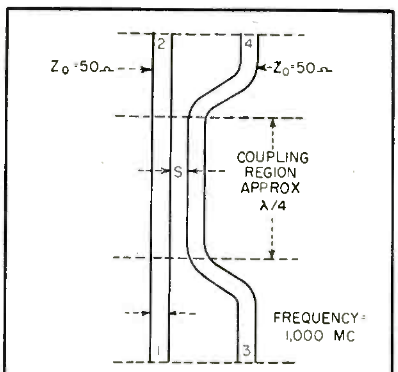
An experimental model of this filter was designed, constructed, and tested in half a day—an illustration of the flexibility and speed of this method. The filter has a reasonably good low-pass characteristic and has a rate of attenuation in the attenuation band which exceeds 30 db per 100 mc.

Attenuators or Matched Loads

By printing resistive paint on the dielectric sheets prior to printing the conductors, it is possible to construct attenuators and matched loads, as shown in Fig. 9. The resistive elements were painted on the dielectric spacers with type R-21 resistive paint. The center conductor, which was cut from a thin strip of copper foil, was then placed between the sheets. The matched load was tested over a considerable frequency range and proved to have a reasonably good match over this range.

Future Applications

Other experimental microwave circuits have been successfully fabricated by this technique, as shown in Fig. 10. It seems quite conceivable that the entire r-f circuitry of a modern microwave receiver could be successfully constructed by this method. This would mean a great reduction in cost and fabrication time and would lend itself to the production of throw-away systems for use in such expendable weapons as guided missiles, rockets, radio-controlled bombs and proximity fuzes.



S	POWER AMPLITUDE				DIRECTIVITY
	1	2	3	4	
1/64"	1	-1 db	-10 db	-32 db	32
1/16"	1	-1 db	-16 db	-34 db	21
1/8"	1	-1 db	-21 db	-40 db	19
1/4"	1	-1 db	-29 db	-43 db	15
1/2"	1	-1 db	-34 db	-45 db	13

FIG. 10—Printed version of directional coupler, and effect of spacing on coupling and directivity values

The technique also lends itself to the miniaturization of r-f circuits since the dimensions of such circuits built by this method are a function of the dielectric constant of the media upon which the circuit is printed. The reduction in size is approximately the square root of the dielectric constant used. Another technique can be used for circuits which must be long in one dimension, such as a microwave filter. This scheme involves using flexible dielectric material, rolling the circuit up in a manner similar to the construction of a paper capacitor, and enclosing it in a can.

All of the possible applications of this technique cannot be foreseen. It was felt by the author, however, that the material in this paper should be brought to the attention of other research and engineering groups at this time.

REFERENCES

(1) John J. Karakash, "Transmission Lines and Filter Networks," Macmillan.
(2) N. A. Begovitch and A. R. Margolin, Theoretical and Experimental Studies of a Strip Transmission Line, Internal Technical Memo No. 234, Hughes Aircraft Co., May 12, 1950.
(3) R. M. Barrett and M. H. Barnes, National Conference on Airborne Electronics, IRE, Dayton, Ohio, May 23-25, 1951.

Improvements Extend Magnetic-Amplifier Applications

Magnetic amplifiers become more versatile as their characteristics are improved by introduction of new circuits and components. The author reviews the major component situation and shows its effect on current and potential applications

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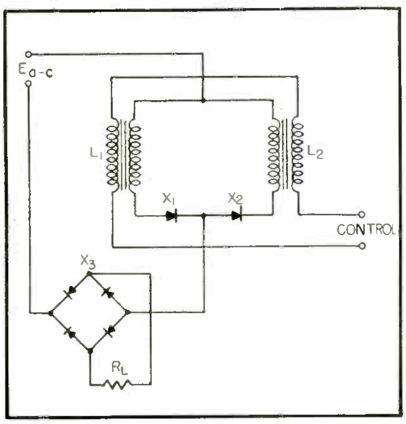

FIG. 1—Typical magnetic amplifier circuit used to illustrate voltage and current relationships

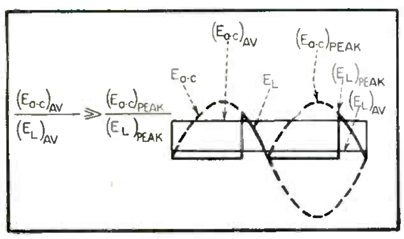

FIG. 2—Waveforms show peak and average voltages in magnetic amplifier circuit

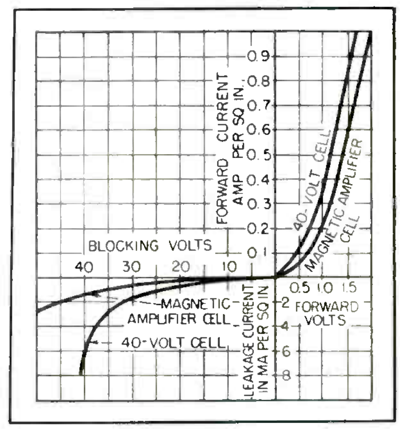

FIG. 3—Curves show desirable characteristics for special magnetic amplifier selenium rectifier

LARGELY responsible for the upsurge in magnetic amplifier work in the last five years is the development of new materials and improved components. So extensive is the resulting progress that magnetic amplifiers are currently the subject of considerable investigation among the services and in private industry. This article summarizes recent advances.

Core Materials

In the early days, magnetic amplifiers employed saturable core reactors made of ordinary transformer grade steel. Three-legged core construction was usually used and high-gain amplifiers necessarily consisted of a multitude of stages.

Improvement in gain was readily achieved through the use of grain-oriented silicon steels (3 percent Si, 97 percent Fe): Hypersil, Trancor XXX or Selectron type C (cut) or toroidal (gapless) cores. Further advances and other applications led to the use of Mu-metal (75 percent Ni, 2 percent Cr, 5 percent Cu, 18 percent Fe), Supermalloy (79 percent Ni, 5 percent Mo, 15 percent Fe), 4-79 Permalloy (79 percent Ni, 4 percent Mo, 16 percent Fe) and finally to the use of toroidal cores made of tape using grain-oriented 50 percent Ni-50 percent Fe material with high saturation flux density, narrow and rectangular hysteresis loops under the various names of Deltamax, Hypernik V, Orthonik, Permeron and Orthonol.

Rectifiers

Rectifiers in magnetic amplifier circuits are usually of the selenium type. Germanium crystals are often used where small currents are encountered.

Advances in the art of selenium rectifier manufacture during recent years have been startling. Early cells were rated for 14 volts rms. Since then, ratings have successively increased to 16, 22, 26, 33, 40 and presently 50 volts rms. In each case the current rating per square inch of selenium rectifying area remained the same, 0.32 d-c amp per square inch for

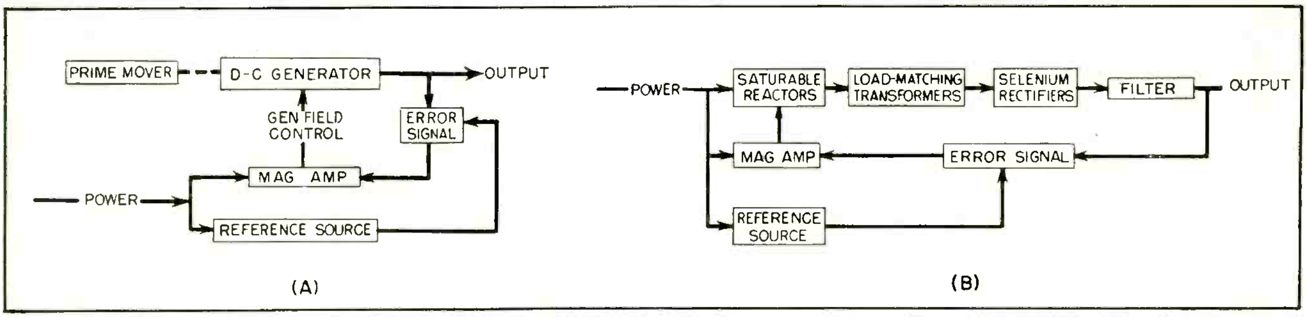

FIG. 4—Block diagrams show d-c generator voltage regulator (A) and regulated d-c power supply (B) using magnetic amplifiers

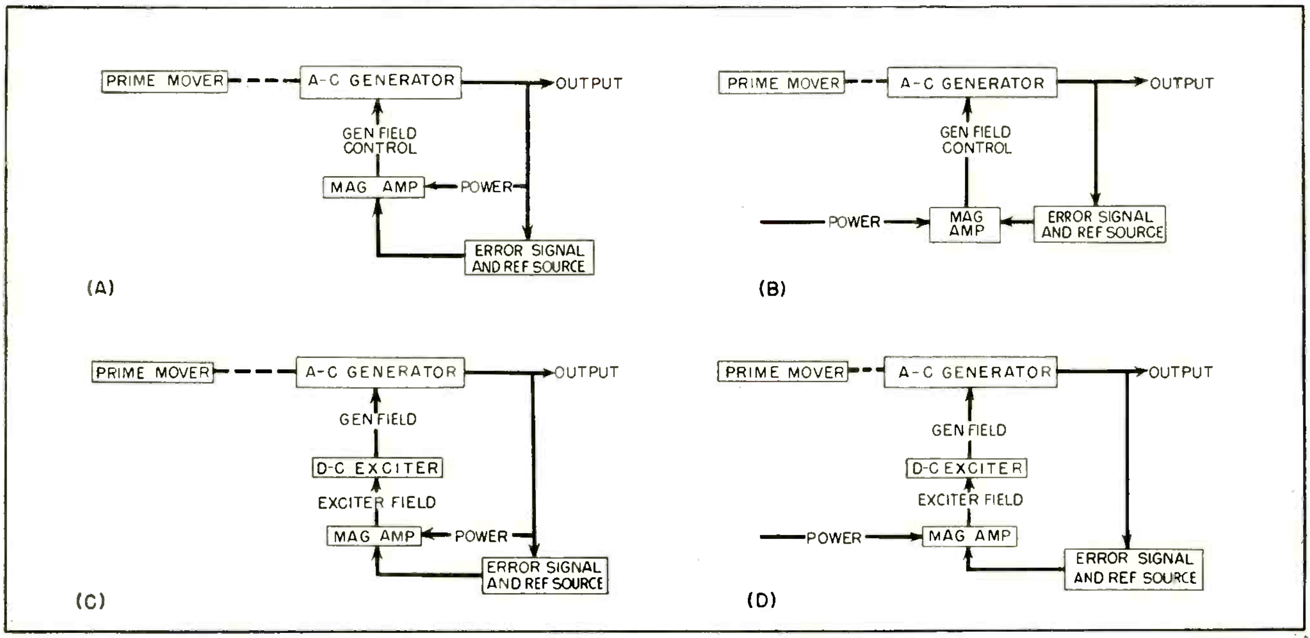

FIG. 5—Magnetic amplifiers can be used in various ways to regulate output of a-c generators

a full-wave bridge.

In spite of the increased voltage rating of today's selenium rectifier plates, their life expectancy in an ambient temperature of up to 35 C is 20,000 to 100,000 hours. At the same time, the forward voltage drop of a rectifier with high-voltage cells is less than the voltage drop of a similarly rated rectifier with more than one low-voltage cell, because the forward drop of a high-voltage cell is only slightly higher than that of a low-voltage cell. This results in the further advantage of improved rectifier regulation.

Improvements of rectifiers available on today's market do not stop here. Rectifiers for operation in higher ambient temperatures are available. These can be operated at ambients up to 75 C, with little or no derating, with a life expectancy of 5,000 to 20,000 hours, and with somewhat decreased life expectancy in even higher ambients. Rectifiers for operation in adverse surroundings are also available. Such rectifiers receive finishes, or are hermetically sealed, to withstand high humidities, salt spray, fungus and acids.

Furthermore, rectifiers made especially for high-gain magnetic amplifier applications are now available. Such rectifiers have guaranteed forward to reverse current rating ratios of 300 to 3,000. In magnetic amplifiers low leakage means more economic high gain.

Voltage Rating

As a further aid in high-gain magnetic amplifier design, today's selenium rectifiers may be processed to withstand peaks of higher than rated voltage continuously for a short portion of each cycle. This makes it possible to reduce the number of rectifier plates in those cases where the amplifier is operating continuously far below maximum output. Referring to Fig. 1, for example, assume that the supplied voltage E_{a-c} is equal to 120 volts rms, and that the maximum load voltage (across R_L) is 30 volts d-c. Under sinusoidal conditions, a single-phase full-wave bridge with one 40-volt plate per arm would be sufficient. In a magnetic amplifier circuit of this kind, using ordinary rectifier plates, three 40-volt (or equivalent) rectifier plates per arm would be required for X_3 in spite of the low d-c output from the bridge.

The accepted method of rating rectifiers is simply misleading. A 40-volt rectifier cell is not, in reality, a plate good for 40 volts rms applied, but good for $\sqrt{2}$ times 40 peak volts applied. It is apparent from Fig. 2 that the peak voltage across X_3 in Fig. 1 is almost the peak of the applied voltage E_{a-c} necessitating what seems to be an unnecessary number of rectifier plates in series per arm. If special selenium rectifiers, however, are used that will stand peaks of higher than rated voltage continuously for a short portion of each cycle, two, or even one, 40-volt rectifier plate per arm might be sufficient.

Current Rating

With regard to rectifier rating nomenclature, another point should be mentioned in connection with magnetic amplifier design. Just as rectifiers are rated for rms voltage instead of peak voltage, they are rated for d-c current instead of watts. Both forward and reverse losses enter into this problem. The rating of a rectifier cell is based on the total watts loss which will cause a certain rise in cell temperature. With normal ambient temperatures, up to 35 C, this rise is usually, in the case of selenium rectifiers, required to be no more than 30 to 35 C for long rectifier life expectancy.

Examining the problem of reverse losses, it becomes apparent that they decrease with lower applied voltage and with lower reverse current-vs-voltage characteristic (See Fig. 3). From these two factors the following conclusions can be drawn: (1) If lower voltage than rated voltage is applied to the ordinary selenium rectifier cell, higher than rated forward currents can be drawn with the same amount of rectifier heating. (2) A special magnetic amplifier cell with low leakage current (high reverse resistance) can be operated with at least the rated forward current of an equivalent nonmagnetic amplifier type cell, in spite of the slightly greater forward voltage drop, see Fig. 3, and therefore slightly higher forward losses.

Assuming, for discussion purposes, reverse losses to be constant, what about the forward losses, as regards magnetic amplifier circuits? With reverse losses constant, forward losses determine the rating of the rectifier. As in the case of voltage ratings, d-c current ratings for rectifiers have meaning only under sinusoidal conditions. In fact, rms current value ratings would be just as meaningless under nonsinusoidal conditions, inasmuch as we are dealing with a nonlinear device. Power is not equal to I^2R but equal to the summation of the various instantaneous values of i^2r.

C. E. Hamann treated this subject in a recent A.I.E.E. conference paper, which dealt with resistance-capacitance loading of selenium rectifiers. He developed Table I, which shows the order of derating necessary with pulses of different duration. This table was derived graphically and is based on a particular make of selenium rectifiers. A similar table can easily be derived graphically or mathematically for any other make of rectifier.

It should be concluded therefore that for use in high-gain magnetic amplifiers the type and the size of rectifier plates, as well as the number required in series, cannot be simply picked out of a manufacturer's table of standard selenium rectifiers giving only rms or d-c volts and d-c current ratings.

APPLICATIONS

High-gain magnetic amplifiers find wider use from week to week, as illustrated by the following examples:

Voltage Regulators

Direct-current generators with ¼ percent ripple are being controlled to ¼ percent regulation by means of high-gain magnetic amplifiers of the

Table I—Derating Factors for Different Length Pulses

Type wave	Sine half wave	Step function	Step function	Step function	Step function	Step function	Step function
Conduction period	180°	360°	180°	120°	90°	72°	60°
Average current	0.160	0.193	0.166	0.152	0.143	0.134	0.126
RMS current	0.252	0.193	0.237	0.263	0.287	0.300	0.308
Peak current	0.501	0.193	0.332	0.455	0.570	0.670	0.755
Watts	0.142	0.142	0.142	0.142	0.142	0.142	0.142

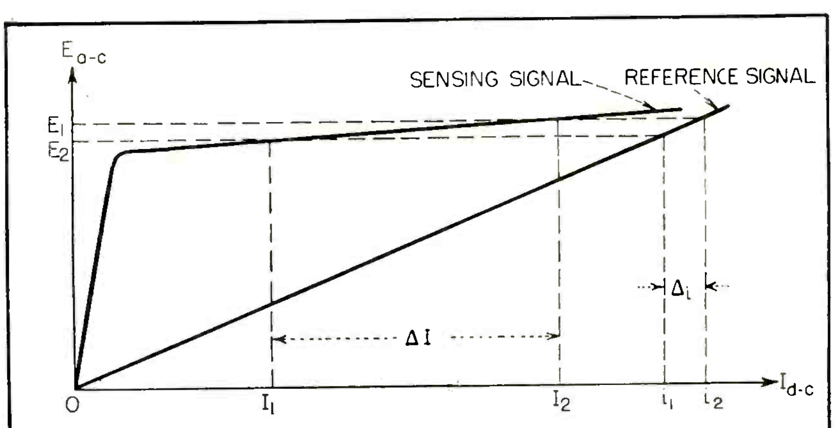

FIG. 6—Voltage-sensing curves for a-c generator voltage regulator

type shown in Fig. 4A. The magnetic amplifier is usually of the simple self-saturating type having only one control winding. The output voltage is continuously adjustable by means of changing the reference voltage or the slider setting on the sensing potentiometer, or both.

Regulated rectifier d-c power supplies are using high-gain magnetic amplifiers, especially where the input power source is three-phase and the regulation requirement is 1 percent or better. Such a supply will regulate the output with respect to line voltage and frequency as well as load changes and readily can take short duration overloads without damage to the components. A typical system is shown in Fig. 4B.

The aging problem is usually small inasmuch as the regulator automatically compensates for such changes everywhere except in the reference source. To minimize the problem further, any rectifiers in the reference source (which is small as compared to the rest of the system) are usually made oversize. Even so, a resistor adjustment compensating for any possible aging can be provided.

The output voltage is again continuously adjustable by means of changing the reference voltage or the slider setting on the sensing potentiometer, or both.

Alternating-current generators with frequencies from 60 to 10,000 cycles have been successfully regulated to ½ percent by means of high-gain magnetic amplifiers. These fall into several categories: (1) self-excited (Fig. 5A, 5C), (2) separately excited (Fig. 5B, 5D), (3) controlling a d-c exciter feeding the main generator (Fig. 5C, 5D), and (4) controlling main generator field directly (Fig. 5A, 5B).

The output on such units is continuously variable.

Referring to Fig. 5A, the error signal is usually provided by means of saturable reactors operated in the saturated region and compared with a practically linear current (obtained directly from the a-c source through a transformer, a resistor and a rectifier) which acts, relative to the error signal, as a

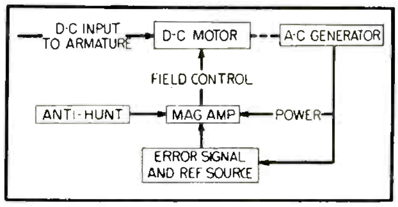

FIG. 7—Direct-current motor speed regulator using field control

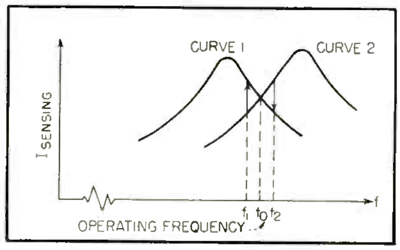

FIG. 8—Frequency-sensing curves for d-c motor speed regulator

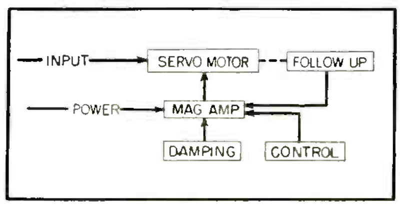

FIG. 9—Position servo system using magnetic amplifier

reference source. Referring to Fig. 6, as E_1 changes to E_2, the magnetic amplifier receives an error signal which is equal to ΔI minus Δi.

To obtain even more perfect regulation and yet stay within a single-stage high-gain design, other control windings are often added to the magnetic amplifier which sense output current and output power factor.

Battery Chargers

Automatic battery chargers using high-gain magnetic amplifiers may be of the regulated d-c or regulated rectified a-c type.

The regulated d-c power supply floats across the battery through a resistor determining the charging rate. The charger, containing a rectifier in its output, prevents current reversal and consequent battery discharge without the use of a reverse-current relay. Overcharging may be prevented by inherently changing from a constant voltage to a constant current charger at a given current value.

To maintain fully charged batteries at all times, battery chargers may also be designed to change the charging rate proportional to the discharging rate.

The regulated rectified a-c generator type may use high-gain magnetic amplifier field control and finds application in variable-speed engine driven generators. In such a system the output of the generator before rectification may serve as the power to the magnetic amplifiers.

Speed and Frequency Regulators

The types of speed and frequency regulators using high-gain magnetic amplifiers are numerous. There are d-c motors with field and/or armature control. There are also variable-speed d-c motors which are being speed regulated automatically to whatever speed they are set using the above schemes.

Other examples are variable speed d-c motors which are being speed regulated automatically at whatever speed they are set, using the Ward-Leonard system of regulating the d-c generator which drives the d-c motor. And finally there are variable speed induction motors where the clutch slip is controlled by a magnetic amplifier, and induction motors the speed of which is being controlled by magnetic amplifiers controlling saturable reactors in the line.

Figure 7 shows a typical field control speed regulator using a high-gain magnetic amplifier. The d-c armature input may be derived from either available d-c or rectified a-c. Such a system is available commercially and it regulates to better than ¼ percent in overall speed with input line voltage changes of two to one and from no load to full load. The regulator derives its power from the generator output and uses two series-tuned circuits which sense generator output frequency and provide a nonlinear signal. As in the previously described voltage regulator, the difference between this nonlinear sensing signal and the linear reference source provides the regulator error signal.

Figure 8 shows a typical graph of the series-tuned sensing circuits. The currents from each of the two series-tuned circuits are fed into similar control windings on the magnetic amplifier reactors, but phased to produce opposing fluxes. As a consequence, at the operating frequency (to which the machine is to be held), zero net flux is set up by the two sensing windings. Therefore, a departure from the operating frequency (to f_1 or f_2) in Fig. 8 would result in producing an error flux proportional to the difference in ordinates of the two tuned circuit curves as shown by the respective arrows.

In a system of the kind discussed here, circuit variations are of course possible. The power to the magnetic amplifier may come from some outside a-c source, perhaps from the same a-c that is rectified and used as armature input. Another variation possible, important in those cases where the regulated motor is not driving a generator, is the use of a tachometer generator, a-c or d-c, to provide the error signal instead of series-resonant circuits. Such a scheme is also usable in variable-speed applications.

These high-accuracy speed regulators usually require anti-hunt circuits. The input to such a stabilizing circuit is not shown in Fig. 7 as it may originate at numerous points in the system.

Positioning Servos

Figure 9 shows a positioning servo using a high-gain magnetic amplifier which might be used in such applications as automatic boat steering, automatic valve control or automatic gun positioning. Such a system may use a d-c or two-phase motor. Power to the amplifier may be of 60-cycle, 400-cycle or of higher frequency. The control may be provided by a rheostat, a temperature-sensitive element or the output of some other automatic device. The followup might be a potentiometer, or the control element. Mechanical or electrical damping may be used.

Figure 10A and 10B show typical high-gain magnetic amplifiers for two-phase and d-c motor controls.

Industrial Controls

Industrial control applications of high-gain magnetic amplifiers are becoming more and more commonplace. Automatic controls of motors in textile industry, automatic photocell controls, automatic safety devices, and automatic temperature controls are some of today's robots using high-gain magnetic amplifiers.

Figure 11 shows an automatic speed-matching device using a high-gain magnetic amplifier. It is used to maintain speed differentials, adjustable from positive to negative, between a master and a controlled belt. This differential, wherever set, is closely maintained automatically as the master belt speeds up or slows down.

Figure 12 shows a high-gain magnetic amplifier punch press control. It will automatically stop the press or perform some other function when the slightest increase in load is detected. Such an increase in load could be caused by a piece of scrap lying across the piece being punched. This type of magnetic amplifier monitor makes it possible to have less personnel to supervise the operation of a number of presses than would be required without such a monitor and requires less maintenance, if any, than would be required with other automatic monitors.

The principle involved in the system shown in Fig. 12 is that of an amplifier which senses even the slightest increase in motor current drawn. Such a device must be very sensitive and lend itself easily to compensation for line voltage changes. A single stage high-gain magnetic amplifier is such a device.

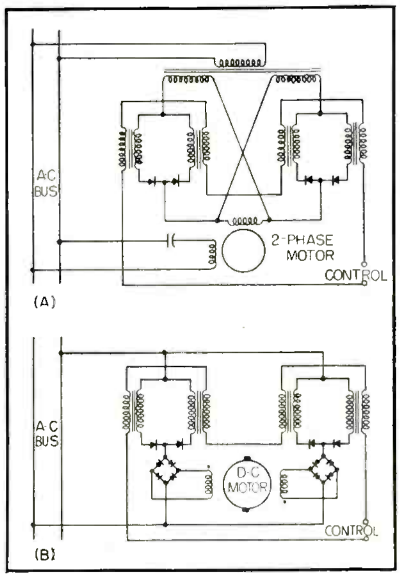

FIG. 10—Push-pull magnetic amplifier circuits for 2-phase (A) and d-c (B) motor control

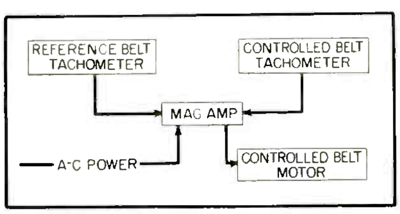

FIG. 11—Automatic speed-matching system uses magnetic amplifier

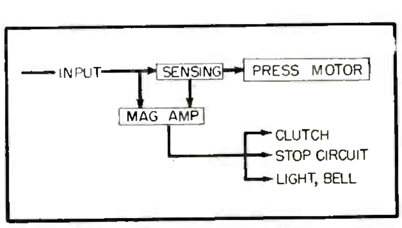

FIG. 12—Punch-press monitor can be made extremely rugged and reliable with magnetic amplifiers

Future Products

Present research is expected to provide selenium rectifiers with a rating of more than 50 volts per plate, lower leakage currents than half a milliampere per square inch, and applicable in ambients up to 150 C.

The use of germanium power rectifiers in high-gain magnetic amplifiers is being investigated. Such rectifiers are much smaller than selenium rectifiers of comparable rating and offer a higher reverse resistance.

A number of circuits are being developed by the Naval Research Laboratory promising high gains with less than one cycle response.

Amplifiers have been developed to respond to frequencies up to the megacycle range. A broadcast receiver using the magnetic amplifier for the r-f, i-f and audio system, a transistor as the oscillator, crystals as detectors, static magnetic converters as the frequency multiplier power supply seems feasible.

Systems consisting of a combination of magnetic amplifiers, transistors and dielectric amplifiers are also being studied.

Magnetic amplifiers in their present form are invading industry and, with continuing research, their future appears to be a bright one.

Operating Klystrons in

Klystron transmitters offer ease of adjustment and modulation, but suffer characteristic distortion when used with long transmission lines and mismatched terminations. Evaluation and correction methods for these effects are discussed

KLYSTRONS have recently found application as transmitting tubes in the development of f-m microwave relay systems. The available magnetrons were unsuitable because they could not be frequency modulated. Klystrons may readily be frequency modulated and deliver power output of about 1/10 watt which is adequate for narrow-beam, point-to-point communication.

When a klystron is used as a transmitter, its load is very different in one respect from what it is when used as a local oscillator. The difference lies in the length of waveguide between waveguide termination and klystron. Waveguide lengths may be as great as 200 ft if the termination is an antenna located atop a tower. If the antenna is only 10 ft away, it is still many wavelengths from the transmitter at microwave frequencies.

When the length of transmission line between a klystron and a mismatched termination is more than several wavelengths, phenomena arise which are referred to as long-line effects. These phenomena occur because the phase of the load presented to the tube changes rapidly with frequency. Long-line effects become increasingly apparent with either increases in length of transmission line or termination mismatch.

The literature contains reports on long-line effects exhibited by magnetrons. However, since the magnetrons were being amplitude modulated, the problem was somewhat different than for frequency-modulated klystrons. There have also been reports on klystron long-line effects, but the discussions have been mainly limited to conditions causing actual discontinuities in klystron characteristics, rather than covering the more prevalent conditions under which distortions without discontinuities are present.

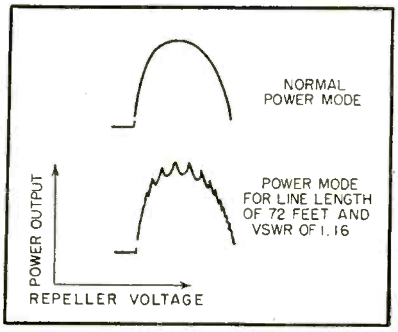

FIG. 1—Oscillograms illustrate klystron power mode distortion by load

The main emphasis here is placed upon distortion of the f-m characteristic, because of the importance of linearity of this characteristic to the problem of transmitting undistorted information. Magnitude of distortions caused by load is given in terms of the klystron pulling figure, a quantity which is generally known or easily measured discontinuities in klystron characteristic caused by load variations are also discussed.

Experimental results are presented which corroborate the theory developed for both distortions and discontinuities in klystron f-m characteristics.

Long-line effects are analyzed by by the use of equivalent circuits for both klystron and load.

Long Transmission Lines

Consider a waveguide whose termination has some mismatch, the magnitude and phase of which is essentially constant over the frequency range of interest. The phase of the input impedance will vary with frequency because the electrical length of the waveguide varies with frequency. The amount of phase variation is determined by the length of waveguide.

The electrical length θ of a waveguide section is $2\pi d/\lambda_g$, where d is the mechanical length of line and λ_g is the waveguide wavelength. If a change in frequency of only a few percent occurs, the corresponding change in θ is given by:

$$\Delta\theta = \frac{d\theta}{df}\Delta f = \frac{2\pi A\ \Delta f d}{\lambda_g^2} \qquad (1)$$

where A is approximately constant, and equals $-\ d\lambda_g/df$.

Equation 1 shows that for a given change in frequency Δf, the change in electrical length of line, hence the change in phase of input impedance, is proportional to the mechanical length of line d.

As as illustration of the large changes in electrical length that occur for long lines, Fig. 1 shows a klystron power mode, power output versus repeller voltage, which has been distorted by its load. The difference in the frequency of adjacent pips corresponds to a difference of ½ wavelength in electrical length of line. Thus, as frequency is varied from one pip to another, a complete cycle of load phase occurs.

Basic Equation

The schematic diagram and equivalent circuit[1] for a reflex klystron and its load are shown in Fig. 2. Note that the Y_e term accounts for the driving action of the electron beam; that C and B_r represent the resonant circuit and as such are the main frequency determining elements; that the transformer ac-

F-M Microwave Links

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counts for the impedance transformation from waveguide to coax; and finally, the G_L and B_L represent the load as it appears at the coaxial output of the klystron.

The electronic admittance Y_e has a susceptance component which affects frequency, since it is in parallel with the resonant circuit. Thus, when the repeller voltage is varied, altering the electron beam, the susceptance varies, causing the frequency of oscillation to vary. It is in this way that desired frequency modulation is obtained.

In a similar manner, load susceptance transformed to the tube side of the transformer affects frequency of oscillation. If this susceptance varies as the tube is frequency modulated, it will introduce undesired distortion of the f-m characteristic.

The condition for steady oscillation requires the total admittance be zero. Using this fact, an equation can be written which sets the algebraic sum of all admittances equal to zero.[2] Taking the imaginary part of this equation and performing some manipulations, Eq. 2 is obtained:

$$\left(\frac{G_r}{n^2} + G_L\right)\tan\varphi + \frac{4\pi C}{n^2}\,\Delta f + B_L = 0 \qquad (2)$$

where φ, the relative transit angle, depends on the time spent by the electrons in the repeller region and is controlled by repeller voltage.

Equation 2 is the basic equation governing klystron frequency characteristics.

Simplifying the Basic Equation

Before solving Eq. 2 for the f-m characteristics, the $\tan\varphi$ and $4\pi C/n^2$ terms will be replaced by more

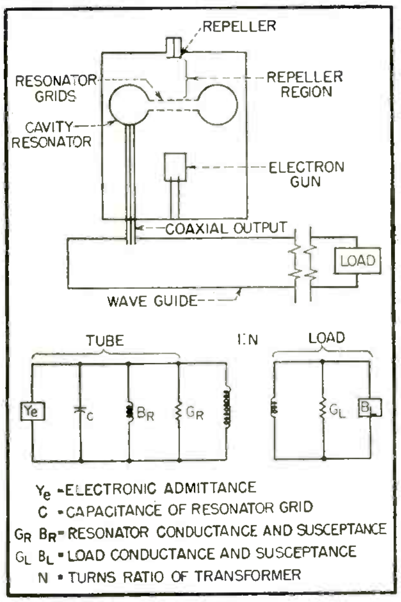


FIG. 2—Schematic diagram and corresponding equivalent circuit of a reflex klystron

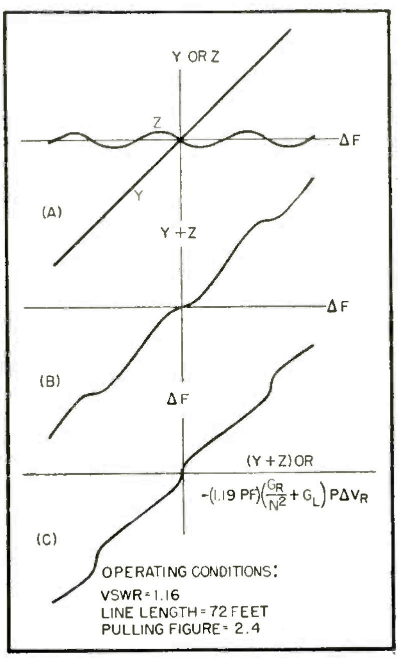


FIG. 3—Graphical solution for simple distortion of the f-m characteristic

familiar and easily measured quantities.

The $\tan\varphi$ term may be replaced by $p\Delta V_R$, where p is a constant and ΔV_R is the increase in repeller voltage. This substitution may be obtained by applying the fact that when the waveguide load fed by the klystron is non-reflecting ($G_L = 1$, $B_L = 0$), Δf is known to be proportional to ΔV_R.

Using the definition of the pulling figure, the $4\pi C/n^2$ term may be replaced by 1/1.19PF. The pulling figure is defined as the total change of frequency that occurs when all phases of a 1.5-vswr load are presented to the tube. Thus the PF is a measure of how sensitive the tube frequency is to changes in the load.

Since the PF is measured with repeller voltage held constant, the $\tan\varphi$ term drops out and Eq. 2 reduces to $\Delta f = -\frac{n^2}{4\pi C} B_L$. From transmission line theory, the total possible change of B_L for a 1.5-vswr load is 0.84 while the corresponding Δf is by definition equal to the PF.

Thus, $\mathrm{PF} = \frac{n^2}{4\pi C}\,0.84$

Substituting into Eq. 2 for $\tan\varphi$ and $4\pi C/n^2$ terms, Eq. 3 results.

$$\left(\frac{G_r}{n^2} + G_L\right) p\Delta V_R + \frac{1}{1.19PF}\,\Delta f + B_L = 0 \qquad (3)$$

Graphical Solution

The manner in which the load can distort a klystron's f-m characteristic is seen by solving Eq. 3 for frequency as a function of repeller voltage.

First, Eq. 3 is rearranged:

$$\Delta f + (1.19\text{PF})\, B_L = -(1.19\text{PF})\left(\frac{G_r}{n^2} + G_L\right) p\Delta\, V_R \qquad (4)$$

Assuming the load consists of a waveguide whose mismatched termination is constant, the susceptance presented to the klystron is

$$B_L = \frac{(\text{vswr}^2 - 1)\sin 2\theta}{2\,[1 + (\text{vswr}^2 - 1)\cos^2\theta]} \qquad (5)$$

As shown in Eq. 1, θ is a function of frequency. Therefore, from Eq. 5 it is seen that B_L is also a function of frequency; in fact, a periodic function of frequency because of the sine and cosine terms.

If the waveguide termination does vary over the frequency range involved, the procedure for analysis is identical, although a different curve for the load characteristic would have to be inserted at the appropriate point.

To solve Eq. 4 graphically, let $y = \Delta f$ and $z = (1.19\text{PF})\ B_L$. Note that from Eq. 4, $y + z = -(1.19\text{PF})\ (G_r/n^2 + G_L)\ p\Delta V_R$. Variations in G_L are not taken into account because they are of minor importance.

The graphical solution of Eq. 4 is found by plotting y and z separately in Fig. 3A, adding these two curves to obtain Fig. 3B, and replotting Fig. 3B with coordinates interchanged (Fig. 3C). Values of mechanical length of waveguide, frequency, vswr, and pulling figure are the same as those used to obtain the oscillogram of the experimental frequency characteristic shown in Fig. 4B. Thus, Fig. 3 shows calculated f-m characteristics, while Fig. 4B presents experimental corroboration.

Note from Fig. 3 that if the vswr is unity (waveguide termination is perfect) the B_L and z terms are always zero, and the f-m characteristic is a straight line.

To obtain the oscillograms, the klystron was frequency modulated at an audio rate. The recovered audio from an f-m microwave receiver was connected to the vertical amplifier of an oscilloscope whose horizontal amplifier received a portion of the modulating voltage. In this way, the klystron frequency versus repeller voltage was plotted on the face of the oscilloscope.

All the experimental data were taken using Raytheon QK-307 klystrons at an operating frequency of 6,745 mc, using waveguide whose cross section was $1\frac{1}{2}$ in. $\times$ $\frac{3}{4}$ in. The vswr's were measured at the generator end of the line.

Figure 3 illustrates a case of simple distortion. Figure 5 shows a graphical solution for a value of vswr such that a discontinuity exists in the f-m characteristic, with the result that two frequencies of oscillation are possible for the same repeller voltage. However, the two frequencies will not exist simultaneously. The actual frequency of oscillation will depend upon whether the repeller voltage is increasing or decreasing. Experimental corroboration of this calculated f-m characteristic is shown in Fig. 4D.

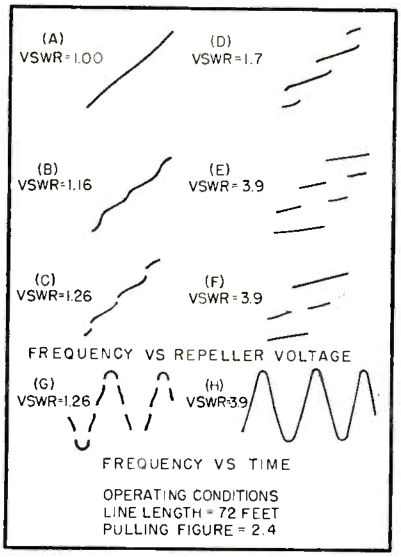


FIG. 4—Oscillograms showing effect of vswr on klystron f-m characteristics

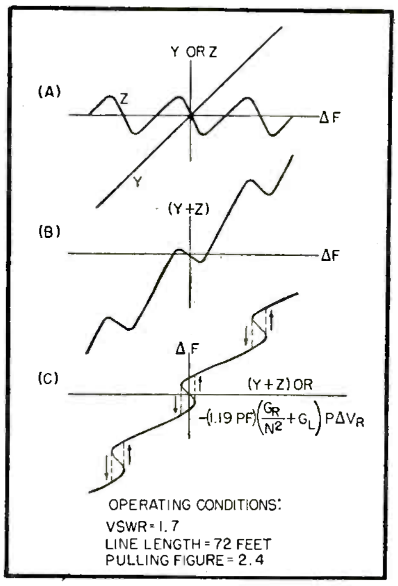


FIG. 5—Graphical solution illustrating discontinuity of the f-m characteristic

Figure 6 shows a calculated f-m characteristic for a vswr large enough to have three possible frequencies of oscillation for the same repeller voltage. Figure 4E shows the experimental corroboration of the calculated f-m characteristic of Fig. 6. Figure 4F was obtained using the same conditions as Fig. 4E except for the range of repeller voltage, which was reduced to show how gaps which are present may be traversed.

Portions of the graphical solutions of Fig. 5 and Fig. 6 whose slopes are negative do not appear in the oscillograms of Figs. 4D and 4E. These sections represent highly unstable points of oscillation and therefore are not observed experimentally.

Percent Harmonic Distortion

The percentages of harmonic distortion occurring under certain load conditions were measured. The results, shown in Fig. 7, agree with the conclusions drawn from the graphical solutions. In general, increasing line length, vswr, or PF, results in increasing distortion.

Critical Load Conditions

As the load condition which will cause a discontinuity is approached, the maximum slope of the f-m characteristic approaches a vertical line. This is illustrated in Fig. 4B and 4C. From the graphical solution, Fig. 3, it is seen that the maximum slope of the f-m characteristic occurs when load susceptance is zero and the load slope is at its maximum negative value. The symbol which will be used for the maximum negative slope of load susceptance is $dB_L/df_{-\max}$. For this phase of the load, load conductance is at its maximum value, $G_{L\max}$, and therefore its slope, dG_L/df, is zero.

By using this information, Eq. 4 may be differentiated with respect to repeller voltage and solved for maximum f-m sensitivity $df/dV_{R\max}$.

$$\frac{df}{dV_{R\max}} = \frac{C_1}{1 + 1.19\text{PF}\ \dfrac{dB_L}{df_{-\max}}} \qquad (6)$$

where C_1 is a constant.

A discontinuity will occur in the f-m characteristic when the slope at some point becomes vertical or infinite. The f-m sensitivity will be infinite when the denominator of Eq. 6 is zero, or when

$$1.19\text{PF}\,\frac{dB_L}{df_{-max}} = -1 \qquad (7)$$

In terms of length of waveguide and vswr, $\frac{dB_L}{df_{-max}}$ may be shown to equal $Kd\ (1 - \text{vswr}^2)$, where K is

$$\frac{2\pi}{\lambda g^2}\,\frac{d\lambda_g}{df}$$

By substituting for $\frac{dB_L}{df_{-max}}$ in Eq. 7 and solving for the vswr, Eq. 8 results.

$$\text{vswr} = \sqrt{1 + \frac{1}{1.19\text{KPF}d}} \qquad (8)$$

Figure 8 shows a family of curves calculated by the use of Eq. 8 along with a set of experimental data. Experimental results are in good agreement with the calculated values. Other experimental checks show Eq. 8 to be valid at least up to PF's of 12. These curves show the maximum vswr that can be tolerated before a discontinuity will occur in the f-m characteristic. Note that the critical vswr is the same for all load conditions where the PFd products have the same value.

Another way of describing the critical load condition is that a discontinuity will occur when the rate of decrease of load susceptance with frequency equals the rate of increase of tube susceptance with frequency. That this is true may be seen by tracing the steps of the graphical solution of Fig. 3 for equal and opposite slopes of the two curves shown.

Discontinuities in other klystron characteristics, such as the power mode, caused by the long-line effect occur for exactly the same load conditions as given in Eq. 8 for the f-m characteristics. This applies only to the center portion of the klystron mode as exceptions were observed for the side portions of the mode.

Conclusion

The problem of minimizing long-line distortion is a problem of minimizing the length of line between klystron and load termination, the vswr presented to the tube, and the pulling figure of the tube. If after reducing these factors, objectionable distortions or even discontinuities exist, there is another technique which can be applied under certain conditions. The necessary conditions are a combination of line length and frequency deviation such that less than a cycle of load impedance occurs. In such cases, the load may be phased such that operation is over the more linear portion of the f-m characteristic, i.e., between the distortion bumps.

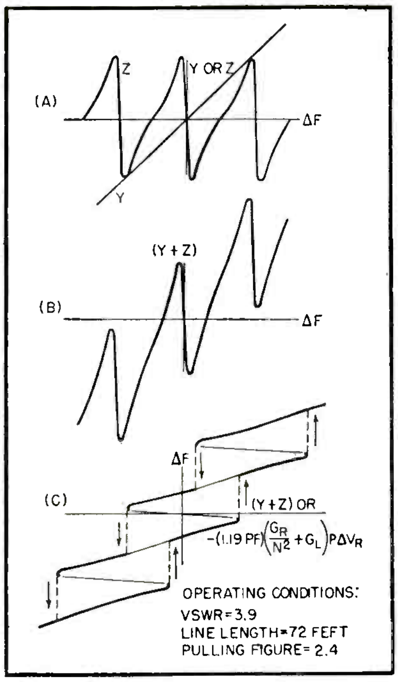


FIG. 6—Calculated solution for a triple-valued f-m characteristic

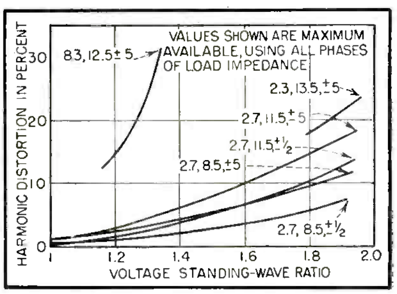


FIG. 7—Experimental results show distortion. Numbers on curves represent pulling figure, line length (ft) and deviation (mc)

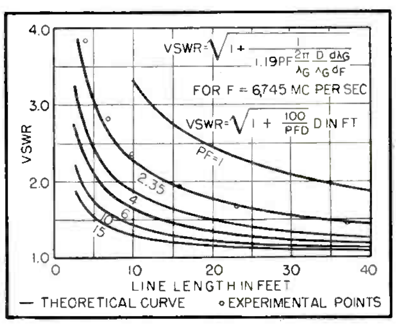


FIG. 8—Critical load curves showing maximum tolerable vswr's

Figure 4H presents the results of using this technique under extreme conditions. It shows a sine wave obtained using the f-m characteristic of Fig. 4E with the deviation range reduced and the load phased to prevent discontinuities.

The information in this paper may be used to determine criteria for allowable reflections from various components of a microwave system (assuming the nominal pulling figure of the transmitter tube is known) or for determining criteria for the allowable pulling figure of the transmitter tube (assuming the nominal load reflections are known).

A new technique for measuring pulling figures has been developed, which consists of measuring the vswr and line length necessary to produce a discontinuity and then calculating the PF using Fig. 8 or Eq. 8. This new method avoids the problems of measuring small frequency changes and of frequency drift.

Other Types of Oscillators

Although the theory developed is presented in terms of klystron oscillators, the extent to which it will apply to any other oscillator will depend upon the degree to which that oscillator is represented by the equivalent circuit used in this presentation. An example of an oscillator to which the theory can be expected to apply is the f-m magnetron presently being developed. The important features which this oscillator has in common with a klystron are: (1) the main frequency-determining element is a high-Q resonant cavity, (2) the electrons alter the frequency by shunting the resonant circuit with some susceptance, and (3) the load alters the frequency by shunting the resonant circuit with a susceptance.

The magnitude of the load reaction will depend upon coupling between tube and load in the same way that it does for a klystron.

REFERENCES

(1) Hamilton, Knipp, and Kuper, "Klystrons and Microwave Triodes," p 404, Vol. 7, Radiation Laboratory Series, McGraw-Hill Book Co., Inc., N. Y., 1948.
(2) *op. cit.*, p 297.

Ballistics Photography

Equipment provides microsecond flashes up to 3,000 per second for ballistics photography during outdoor range tests. As many as eight flash lamps may be independently positioned at distances up to 150 feet from mobile trucks

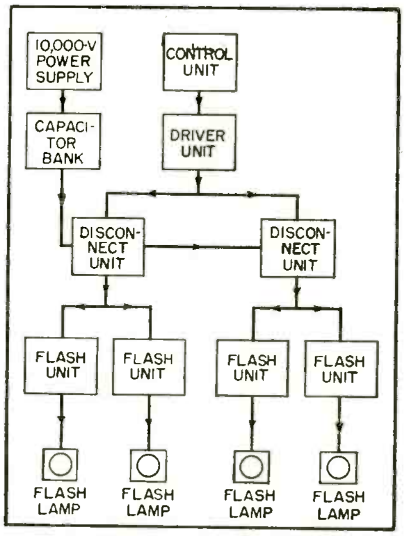
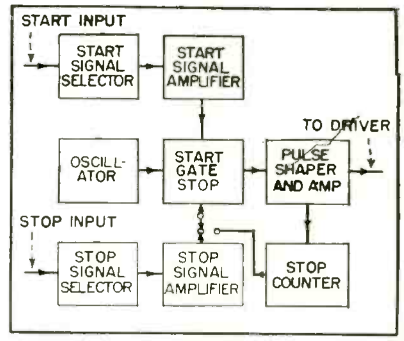


FIG. 1—Block diagram of the mobile flash equipment

FIG. 2—Block diagram of the control unit components



MOBILE flash equipment to provide light flashes of microsecond duration at repetition rates up to 3,000 per second has been developed for use in conjunction with daytime range tests of rockets and other supersonic projectiles.

In this branch of field photography time resolution of the order of one one-millionth of a second is required. Such performance is not provided by commercial high-speed cameras with mechanically-limited exposure time of about 100 μsec.

The demand for the services of the mobile flash equipment was such that two trucks were outfitted. The two facilities may be operated either independently or in conjunction with each other.

The mobile flash equipment includes a control unit, driver unit, four flash units and a high-voltage power source. The relation of these components is shown in Fig. 1. The installation also includes a system for precise timing of the lamp flashes. This system consists of an audio oscillator, a timing signal receiver and a comparison oscilloscope.

One of the flash lamps used with the equipment

The control unit provides the gate for the start and stop of the flashing of the lamps. The start and stop signals synchronize the flashing of the lamps with the passage of the projectile to be photographed. The control unit responds to signals that may be either negative or positive pulses of one-half volt or more or to the opening or short-circuiting of a control line. The gate can also be opened and closed by manual, push-button control, closed automatically after a preset count of from 1 to 32 flashes, or left open for continuous flashing of the lamps.

Flash-Rate Control

The flash rate, controlled by an oscillator in the control unit, may be varied from less than 1 per second to 3,000 per second. After passing through the gate, the oscillator signal is shaped and amplified. A block diagram of the control unit is shown in Fig. 2. Figure 3 is the circuit diagram of the unit.

Driver Unit

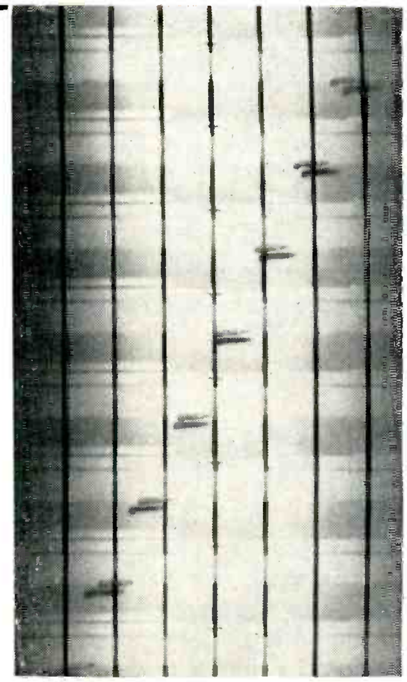
The driver unit consists of two pulse amplifiers of five channels each. The two may be operated independently or fed in parallel from the control unit. In each amplifier the signal from the control unit is passed through a 6SN7 cathode-follower to drive a 6L6 blocking oscillator as shown in Fig. 4. The signal from the latter goes to a 6L6 cathode follower which drives an 807 pulse amplifier and inverter. The inverted pulses are fed to the five output stages, each of which delivers a 500-volt signal from an 807 cathode-follower.

Normally, four channels of one of the amplifiers of the driver unit are used to drive the four flash units

Uses Mobile Flash

By ERNEST C. BARKOFSKY

Head, Ballistics Instruments Section
U. S. Naval Ordnance Test Station
Inyokern, China Lake, California



A 40-mm projectile in flight at 1,392 fps

and the fifth channel is used to provide a calibration signal.

When the two flash installations are used together, the two amplifiers of the driver unit are fed in parallel from the first control unit. The flash units of the second facility are driven from the first driver unit.

Flash Units

Each of the four flash units contains the resonant-charge and thyratron-discharge circuits for its associated flash lamp. The principal elements are shown in Fig. 5. The choice of the 1.25-henry inductance as the charging reactor was dictated primarily because it was available as a surplus item. The reactor is in series-resonance at 650 cps with the 0.06-μf flash capacitor, charged to 18,000 volts in one-half the resonant period, or 0.77 milliseconds. The capacitor is almost instantaneously discharged through the hydrogen thyratron and then again resonant-charged.

For flash rates less than 1,300 per second, the hold-off diode maintains the discharge capacitor at the peak voltage. For flash rates greater than 1,300 per second, linear charging takes place and the peak flash voltage is not reached until after several charge-and-discharge cycles.[1]

Details of the circuit of the flash units of the mobile flash equipment are given in Fig. 6.

Flash Lamps

The mobile flash equipment is normally operated with General Electric FT-125 flash lamps, one of which is shown in the photograph. When the flash lamp is energized by the 0.06-μf capacitor resonant-charged to 18,000 volts, the energy dissipated in the lamp is 5 watt-seconds. Under these conditions of small loading, the efficiency of the lamp is about 7 lumens per watt. The flash duration is one microsecond, as measured at the one-half

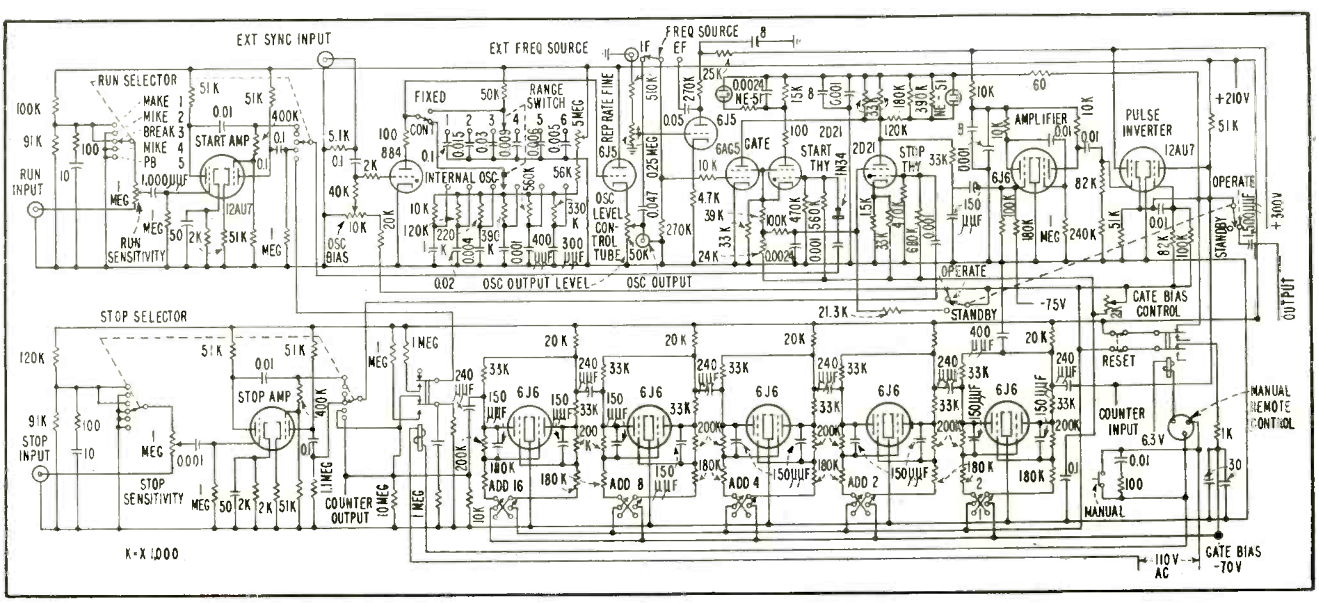


FIG. 3—Control circuits for the mobile flash equipment

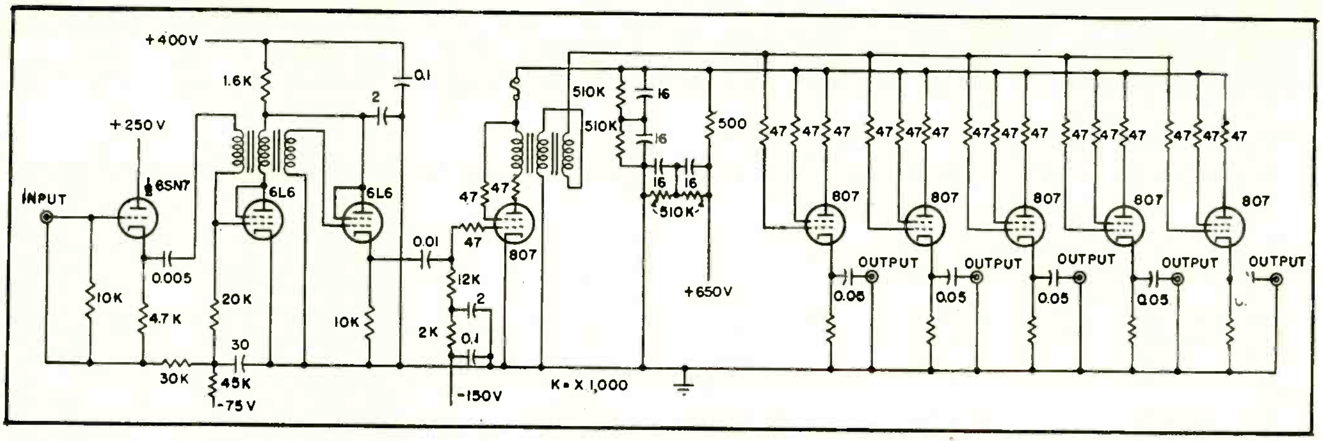


FIG. 4—Driver circuit with two channels of five outputs each. All d-c supply voltages are regulated except for the 650 volts for the 807's

peak intensity level. The peak intensity is of the order of 50,000,000 lumens.

When a flash duration greater than 1 μsec is tolerable, greater light intensity can be obtained by increasing the discharge capacitor. A gain of 2½ in light output can be obtained by the use of a 0.12-μf discharge capacitor. The flash duration then becomes 1.5 μsec.

Power Source

The high-voltage power source consists of a 10,000-volt d-c power supply and a 50-μf energy-storage capacitor bank. The 10,000-volt power supply does not directly provide energy for the flash lamps but serves only to charge the 50-μf, energy-storage capacitor bank. Since the capacitor bank is of finite capacity, each flash cycle will lower the potential of the bank and each flash will be somewhat less bright than the preceding flash.

Precision Timing

The accuracy requirements of some of the range tests have demanded that special provisions be made to supply light flashes at accurately timed intervals. When precision timing is required, an external oscillator is used to drive the internal oscillator of the control unit. The external oscillator is set to the desired frequency by oscilloscope comparison of the output with a 1,000-cycle modulation of a signal transmitted by NOTS for range timing. The 1,000-cycle note is obtained from a secondary time standard at NOTS. It is estimated

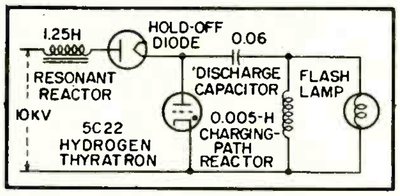


FIG. 5—Resonant-charge and thyratron-discharge circuit diagram

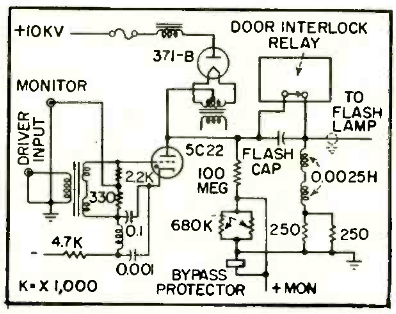


FIG. 6—Flash unit circuit includes safety devices to prevent accidental damage to equipment and personnel

that light flashes with an accuracy of 0.1 percent in time interval can be obtained in this manner.

Range Test Results

The mobile flash equipment has been utilized to provide light flashes of high intensity and microsecond duration for the photography in a number of range tests. The photograph to be described illustrates the application of the equipment to one type of test.

A 40-millimeter projectile in flight at 1,392 feet per second is shown in the accompanying photograph. The velocity determination was obtained from the photographs of the projectile taken at a flash rate of 2,000 per second and with a separation of 12 inches between the vertical stripes shown in the figure. The pattern on the ogive of the round permitted the determination of the spin rate of 385 revolutions per second. What appears to be part of the projectile breaking away at the base is actually a sabot used to impart spin to the round.

The photograph was taken with a Scotchlite background, camera lens opening of f/4, and flash lamp at 18 feet from the background. The start signal for the flashing of lamps was obtained from a microphone response to the shock wave accompanying the projectile.

Acknowledgments

R. C. Hopkins was the engineer in charge of the electronic design and development work. Details of the circuit designs were executed by S. E. Dorsey. Installation was performed by W. W. Eaton. A. H. Milam contributed much in the development of the equipment as an operating facility. M. A. Seaholm is in charge of the equipment. The advice and encouragement of L. M. Biberman as Head of the Ballistics Instruments Branch are appreciated.

This equipment is a small part of the ballistics research and development program originated by A. L. Bennett.

REFERENCE

(1) G. N. Glascoe and J. V. Lebacqz, "Pulse Generators," McGraw-Hill, New York, 1948, Chap. 9.

Area Monitoring by AEC

Measurement of the radioactive background rate against which increasingly sensitive detectors operate is made by fully automatic equipment now used at the Atomic Energy Commission in New York City. Minute-by-minute changes are shown

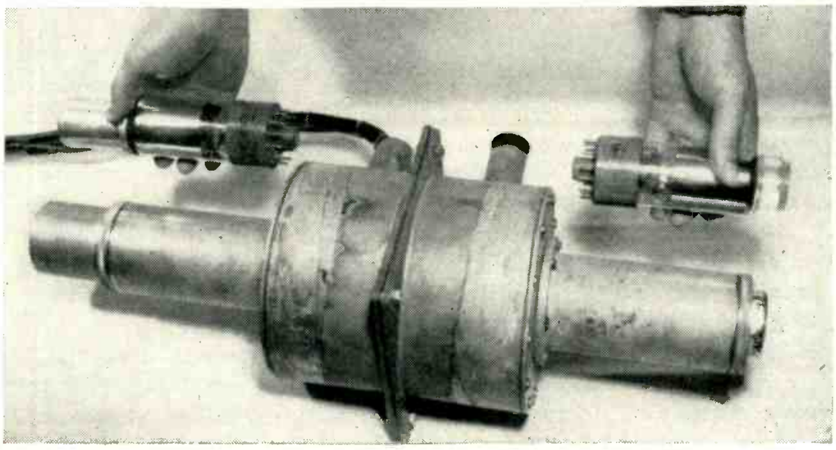
By A. A. McKENZIE
Associate Editor
ELECTRONICS

ALTHOUGH generally unknown to the public and little appreciated by engineers, there is radioactivity present to a greater or lesser extent almost everywhere throughout the world.

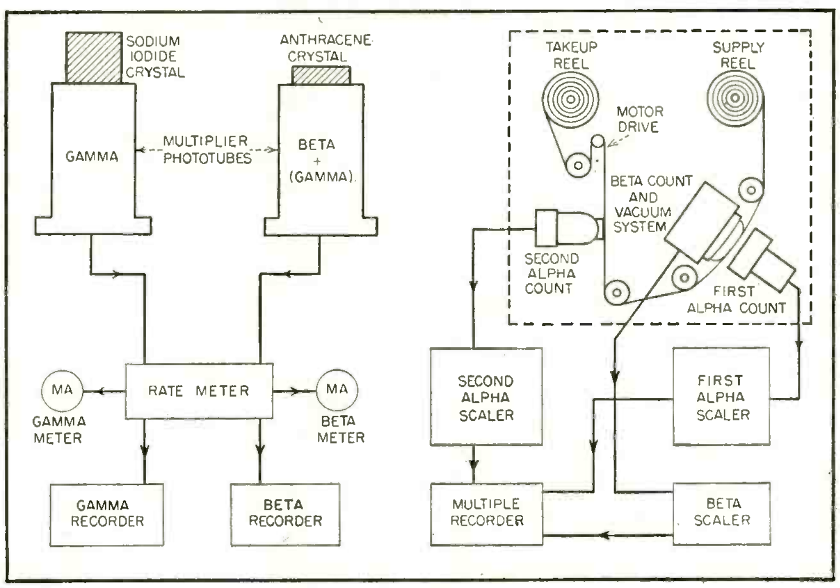
Under certain conditions, the ambient background of radioactivity may bulk so large as to swamp out the weak activity some equipment was designed to detect. Progress in nuclear reactors for experiment or power and experimental military explosions are bound to affect the radioactive background.

As a means of determining the effective background in New York City the AEC has established a station, as shown in the block diagram, at which a minute-by-minute record is plotted of gamma and beta incident radiation. Hourly collections of atmospheric dust are monitored for alpha and beta radiation and the same samples checked twelve hours later for the amount of long-lived alpha activity.

What to the layman might appear an alarming rise in the background activity can usually be explained by a rainstorm that has brought down some high-floating material, or a sudden shift in wind that has carried more industrial smoke (always slightly radioactive) directly across the monitoring station.



Mounting for direct-radiation scintillation counters. Brass assembly is set vertically and protected from weather by thin plastic bag



Simplified block diagram of the direct-radiation (left) and dust-monitoring (right) equipment used for area monitoring

An alpha particle is the nucleus of a helium atom having a double positive charge. Because of its relatively high mass and charge, it has a high specific ionization and is incapable of penetrating thicknesses of a material greater than, for example, a sheet of paper.

Beta particles are high-speed electrons having a considerably smaller mass than the alpha particle and a single negative charge. The specific ionization of the beta particle is considerably lower, allowing it to penetrate greater distances than the alpha particle, for example, about ¼ inch of lucite.

Both alpha and beta particles are like bullets having a definite range in a particular material depending upon their initial energy. Gamma rays on the other hand are extremely short wavelength electromagnetic radiations that are highly penetrating. They may penetrate inches of lead before they are considerably attenuated. Unlike alpha and beta particles, they do not have a definite range. For a given energy and absorbing material, a fixed percentage of the incident gamma ray intensity will be absorbed for each additional equal thickness of absorber. The thickness absorption curve is therefore exponential.

Scintillation Counters

Although Geiger counters are still useful and necessary, specialized counting of particular types of nuclear products is now better accomplished with scintillation counters made possible by the development of better multiplier tubes and more efficient crystals. The phototube detects the minute glow that occurs when a particle excites crystals of fluorescent material on or close to the face of the multiplier tube.

In its simplest form, a scintillation counter for alpha rays can be made by dusting the face of the phototube with fluorescent powder. High-energy gamma rays and beta rays, owing to their characteristics will have little effect upon the powder surface and produce no appreciable illumination. A thicker crystal that will absorb most of the energy of the beta particle is necessary for efficient counting of betas. For efficient detection of gamma rays, high-density crystals having high gamma-ray absorption have been developed resulting in the conversion of more gamma rays to light and therefore more pulses.

The beta counter held at the right in the illustration comprises a phototube, plastic light conducting guide, and an anthracene crystal approximately ¼ inch thick. The anthracene crystal being relatively thin and having a small absorption coefficient for gamma does not efficiently stop gamma rays. The plastic light-conducting guide is made slightly concave to conform to the convex face of the phototube. The crystal, light guide and phototube are cemented together with a cement having an index of refraction closely matching those of the glass and crystal surfaces to prevent excessive losses due to reflection.

Light is excluded from the housing for the crystal and phototube by a thin film of aluminum foil shown in the end of the housing at the right. The whole assembly is mounted vertically above the roof of the equipment house. The left-hand counter for gamma radiation comprises a much thicker crystal of thallium-activated sodium iodide. The end of the crystal housing is shaped to fit the face of its phototube and the optical coupling matched with oil.

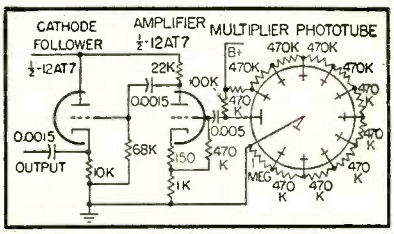


FIG. 1—Output from multiplier phototube in direct-radiation monitor requires preamplifier shown

In the dust monitor, the beta counter using an anthracene crystal is essentially the same as that mounted on the roof of the monitor house. Both alpha counters employ screens of powdered silver-activated zinc sulphide. Outside air is drawn through a spot on the roll of filter paper for fifty minutes. At the end of this time, sample readings are taken by the first alpha and the beta counters. This action continues for five minutes, at which time all counters, including the second alpha are switched off. A portion of the last five minutes of the hour is required for rolling the filter-paper tape a little more than a spot diameter.

At the end of 12 hours, the first spot will have moved to the second alpha counter where it is counted for the full 55-minute interval. This long counting period is required because most of the alpha radiation at the first counter results from radon-gas daughter products and these are well decayed in the 12-hour period.

Every twelve hours the pump is left off for an hour to obtain a background count since the equipment, including the tape stor-

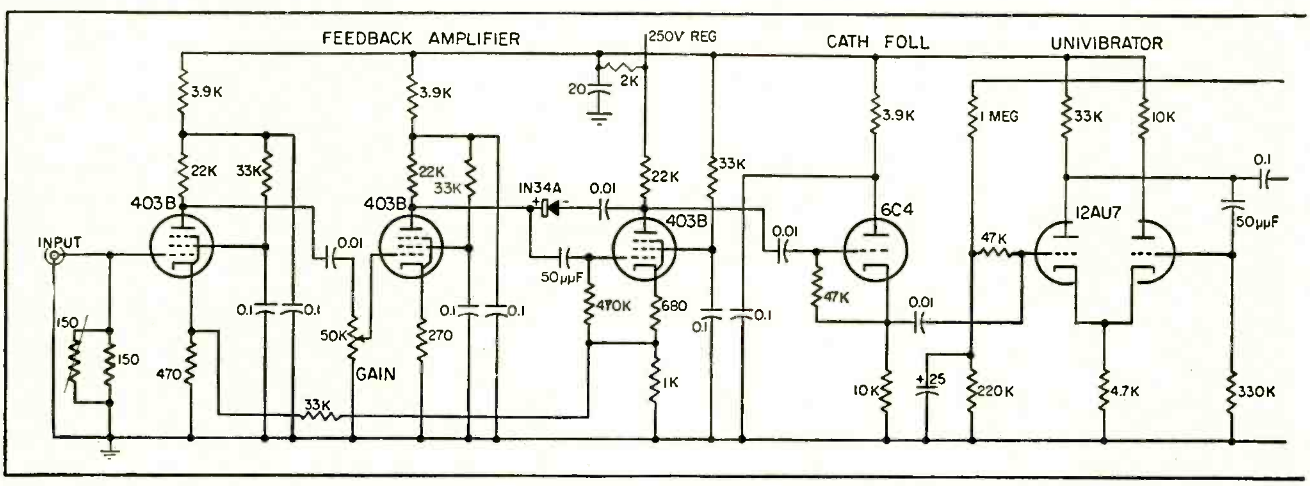


FIG. 2—Rate-meter recorder circuit. Similar circuits are used both

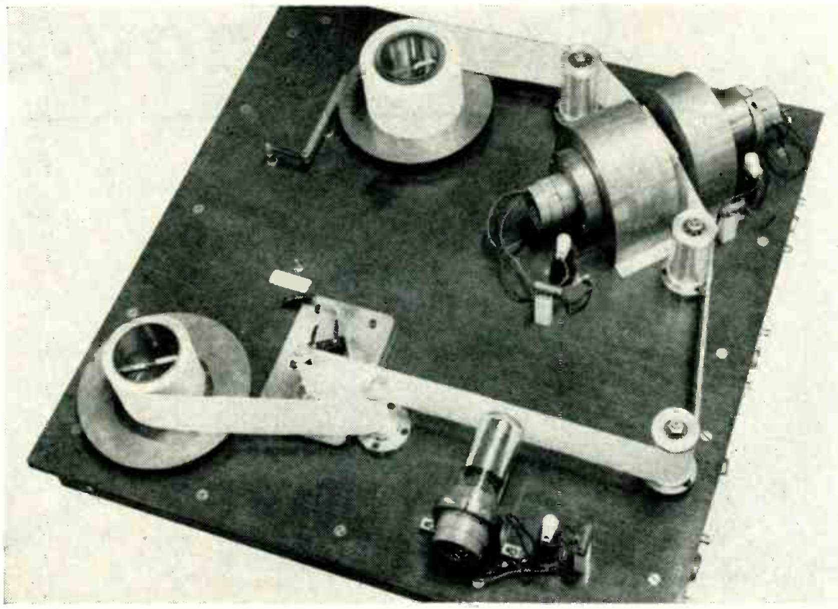
age, may have become contaminated.

Circuits

The head end of the direct-radiation area monitoring equipment shown in Fig. 1 comprises a multiplier phototube with 1,000 volts applied through a voltage divider to the various dynode stages. The anode of the tube supplies a negative pulse that is amplified in one half a dual triode and fed to the second half connected as a cathode follower. Output from this tube goes through coaxial cable from the roof to the interior of the monitor house.

This signal goes into a three-stage feedback amplifier with gain control, shown in Fig. 2. The crystal diode in the feedback loop is used to eliminate overshoot of the pulse that might give double counting. The resultant pulse goes through a type 6C4 cathode follower to feed a 12AU7 connected as a one-shot multivibrator. The univibrator will deliver a pulse of constant amplitude and width if the incoming pulse is equal to or greater than a specified voltage. The output of the univibrator is likewise taken through a cathode follower to minimize loading and to provide a low-impedance source to the 6AL5 diode and integrating circuit.

A negative bias of from two to five volts on the 6AL5 assures complete cutoff of the diode between pulses. The rectified pulses are then integrated by the R-C network. A calibration control allows setting up the equipment in terms of counts per second on a meter connected to the output.

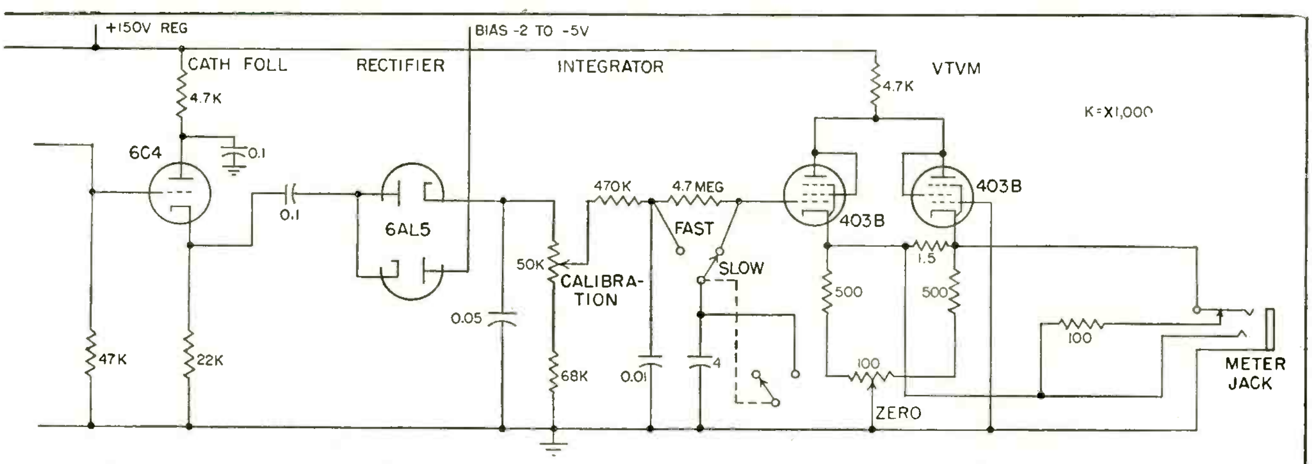


Dust monitor shown in block diagram. Filter-paper strip moves from vacuum system upper right to second alpha counter lower right in twelve hours

The equipment operates with a time constant of 20 seconds determined from statistical requirements. The fast-slow time constant switch reduces the time constant to 2 seconds facilitating testing of the equipment. The vacuum-tube voltmeter circuit comprising a pair of 403B tubes is a balanced type in which variations of filament and plate voltage have little effect. The unit feeds either a one-milliampere meter, an Esterline-Angus recorder or a one-volt full-scale Brown recorder. The circuit shown is used for the gamma channel. The beta amplifier is practically identical.

In the two alpha dust channels, the multiplier phototubes feed cathode followers to drive the coaxial lines to conventional scalers. The scalers operate stepping switches that convert the count into a proportional voltage recorded on a multipoint recorder. The beta dust channel is identical except for the use of additional gain in the scaler amplifier.

The equipment was developed and constructed by the following members of the U. S. Atomic Energy Commission Instruments Branch: H. D. LeVine, H. J. DiGiovanni, R. T. Graveson, M. E. Cassidy, J. Blume.

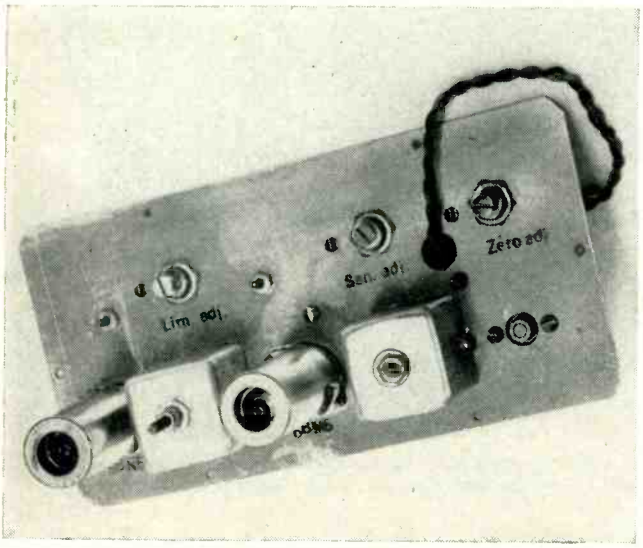


for the beta and gamma direct-radiation scintillation counters

Frequency-Deviation

By NORRIS C. HEKIMIAN

Central Radio Propagation Laboratory
National Bureau of Standards
Washington, D. C.



Completely assembled deviation meter requires only a micro-ammeter calibrated in kilocycles and a power supply

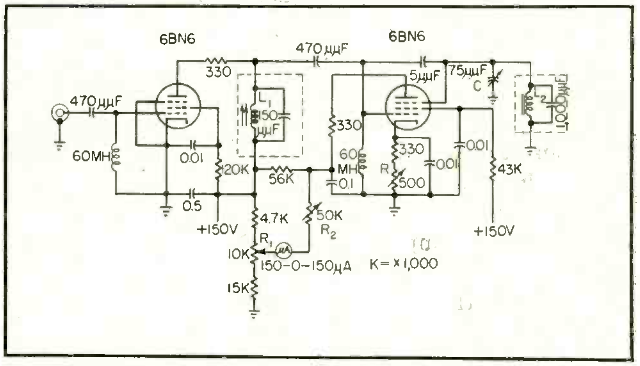


FIG. 1—Schematic circuit diagram of the frequency-deviation meter showing the adjustment controls

FREQUENCY-DEVIATION meters of conventional form consist essentially of one or more stages of amplitude limiting followed by a frequency-discriminating detector and an output indicator. An output indicator of the panel-meter variety generally has a center-scale zero for on-frequency signals as referred to a standard frequency.

The frequency-deviation meter finds use as a visual aid in tuning both a-m and f-m receivers, in the rapid and moderately precise determination of unknown frequencies within the range of the meter, in quick signal-generator set-ups, and other similar applications.

This article describes a deviation-meter circuit, shown in Fig. 1, employing two type 6BN6 gated-beam tubes[1,2] in a cascade limiter-discriminator bridge arrangement. Features of this arrangement are: simple circuitry with no complicated interstage or discriminator transformers, two-tube operation, direct provision for an indicating meter without further circuitry or detector loading, low power requirements (150 v at 10 ma), and stable operation.

The circuit has only two inherent drawbacks. A variable-input loading is presented by the first limiter stage owing to the limited grid-current flow of the 6BN6[2], and there is an interaction of the controls that is frequently encountered in discriminator circuits. The variation in input loading can be lessened by adding a conventional input stage driving the first limiter, but this is omitted here for simplicity. The input loading varies with signal level and has a minimum resistive part of about 10^4 ohms, which is acceptable for many applications.

Circuit Characteristics

Operationally, the circuit is a stage of conventional limiting followed by a modified form of the familiar quadrature-grid frequency discriminator. The variable width pulses of plate current from the detector are integrated and applied to the indicating meter in a bridge arrangement. Chokes are used in the signal-grid returns in place of grid resistors to prevent grid-leak biasing of the 6BN6 which may result in plate-current cutoff.

The 330-ohm plate resistors aid in limiting action and are recommended for best operation. Nominal electron stream and interelectrode coupling to the quadrature grid are insufficient at the low frequency of operation used and must be augmented by a small capacitance of approximately 5 μμf. This value is not critical. Coils L_1 and L_2 resonate at 450 kc with circuit capacitances. Values of Q are 60 and 100 for L_1 and L_2 respectively.

Although the original model was designed to monitor from 447 to 453 kc, the range can be modified by alterations in the quadrature-grid tuned-circuit Q or by adjustment of the calibrating resistance in series with the output indicating meter. It should be noted that the calibrating resistance R_2 should not be reduced below a value sufficient to prevent burnout of the indicating meter with zero or insufficient input signal. The particular limit depends upon the characteristics of the indicating meter that is used in the circuit.

Alignment

An alignment procedure is outlined, using a stable standard-voltage signal generator, high-impedance d-c voltmeter, and a good communications receiver together with a calibrated audio generator and an oscilloscope for final calibration. If a well-calibrated signal

Meter Plots Drift

Two type 6BN6 gated-beam tubes in a limiter-discriminator bridge are used to measure small deviations of signal frequency about a mean. Easily constructed from available parts and stable in operation, the unit can be quickly aligned from the instructions given

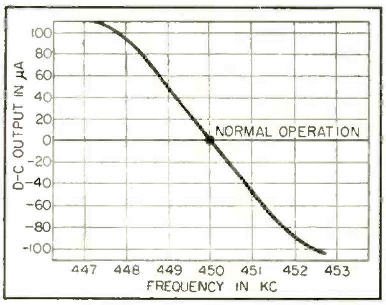


FIG. 2—Discriminator characteristic of the deviation meter

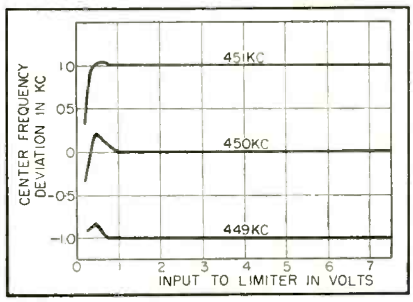


FIG. 3—Limiter characteristic at three frequencies

generator is used, such as the Ferris 16C, calibration can be made with good accuracy by direct reading of the generator dial.

Calibrating Procedure

(1) With the standard-voltage signal generator set to the desired center frequency, replace the indicating 150-0-150-μa meter with a high-impedance d-c voltmeter. After warmup, start with zero input signal and gradually increase the signal input to one or two volts. At the lowest level usable note the direction of voltmeter reading for increasing signal input.

(2) At the lowest usable input signal, tune the interstage tank circuit for a maximum in the direction of meter reading corresponding to increasing signal input.

(3) Adjust the quadrature grid-tank capacitor C and the bridge-zero control R_1 simultaneously for approximately a normal discriminator response on the output meter as the signal generator is rocked slowly through a range of approximately 10 kc about the center frequency. The generator output should be set at roughly one volt for this adjustment.

(4) With the signal generator at center frequency, vary its output slowly from 0.2 to 2.0 volts, and adjust the cathode rheostat R for minimum amplitude effect on the output meter. Care must be taken that the signal frequency does not shift during this operation. Monitoring of the signal with a stable receiver and beat frequency oscillator is recommended.

(5) With the calibrating resistor, R_2, set at maximum replace the high-impedance d-c voltmeter with the indicating 150-0-150-μa meter and repeat the third step as often as necessary for best uniformity of discriminator characteristic.

(6) Calibration can be made simply by reading the signal-generator frequency dial, or for more precise results, by placing a calibrated audio generator across one pair of oscilloscope input terminals and the audio output from the communications receiver across the other. With the signal generator set at center frequency, the receiver is adjusted for zero beat on fundamental or harmonic of the signal generator and direct comparison can be made with the audio generator as the signal generator is swept through the 10-kc range. Care should be taken when harmonic operation is used to insure that the calibration is referred to the fundamental, not a harmonic.

(7) Desired full-scale calibration can now be made by adjusting the calibrating resistance R_2 using the procedure in the sixth step.

Figure 2 illustrates the normal discriminator characteristic referred to in the alignment procedure. Limiter characteristics at three signal frequencies are illustrated in Fig. 3 for indication of the limiting obtained. The reading of the calibrated output meter, in kilocycles, is plotted against input signal voltage.

Stability

One model of this deviation meter was used in a 1,600-hour continuous comparison test of two receivers to monitor the difference frequency of two crystal oscillators and gave completely satisfactory service throughout the entire period. The apparent change in difference frequency at the end of 1,600 hours was less than 200 cycles, possibly owing in part to crystal-oscillator drift. Operation was with regulated high voltage at all times and with regulated heater voltage most of the time.

Two improvements that can be made, at the loss of some simplicity, are use of a separate d-c amplifier for independence of detector adjustment and for driving less-sensitive indicating or recording meters, and the aforementioned stage of conventional amplification for buffer action.

REFERENCES

(1) General Electric Engineering Bulletin ET-B28, The Gated-Beam Tube and Its Application in Intercarrier Television.
(2) Robert Adler, A Gated Beam Tube, ELECTRONICS, p 82, Feb. 1950.

Wind Recorder for MICROCLIMATOLOGY

Velocity and direction of very light winds make inked traces on battery-operated, spring-driven paper-tape recorders. Employs novel low-inertia speed tranducer and keep-alive circuit useful in other recorders to speed pen response

By GEORGE WEST

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SMOG studies and other meteorological problems have created a new interest in the analysis of local wind-flow patterns. This field, known as microclimatology, requires portable, sensitive, rapid-response instruments as contrasted with those normally used in fixed-station operations to supply the information upon which everyday weather forecasting is based.

Detailed records of fluctuating wind speed and direction ranging from thresholds below one mile per hour up to strong winds of 30 mph require transducers with minimum drag and inertia and a flexible time-scale of recording. The overall design must permit rapid change of location and continuous unattended operation for periods of several days.

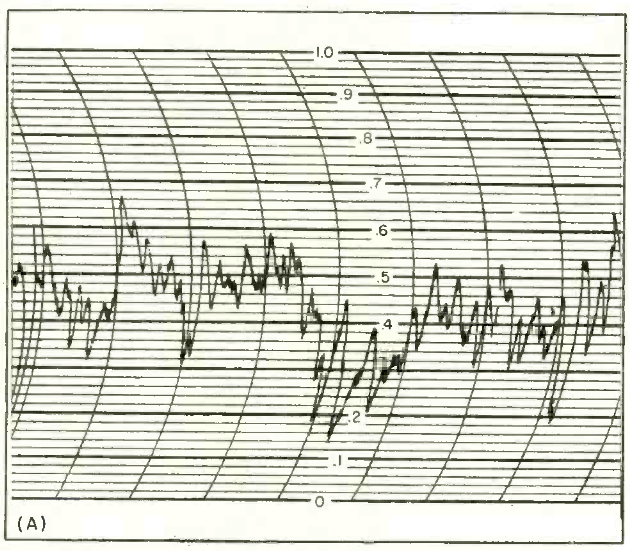
To meet these requirements a new climate survey system has been designed. Illustrated both here and on the cover of this magazine is a system consisting of three units. It comprises a wind-speed transducer or anemometer, a wind-direction transducer or wind vane, and a translator unit, which drives standard recording milliammeters of the spring-actuated type.

Operation of the Units

The anemometer unit contains a light source and phototube[1] separated by a rotary cylindrical shell that is turned by the wind-driven cups of the unit. Holes in the shell permit pulses of light to fall upon the phototube. The resulting signal is carried by cable to the translator unit where its frequency is measured and translated into a proportionally varying d-c voltage. This is recorded on a paper-strip chart as illustrated in Fig. 1.

The wind vane turns a potentiometer whose position establishes the voltage of a d-c signal that is recorded on a second identical recorder. Power for the operation is derived from a battery pack located in the base of the wind translator unit.

Essential features of the anemometer and wind vane circuits are shown in Fig. 2. When the anemometer cups (upper left) rotate in the wind, turning the perforated in-



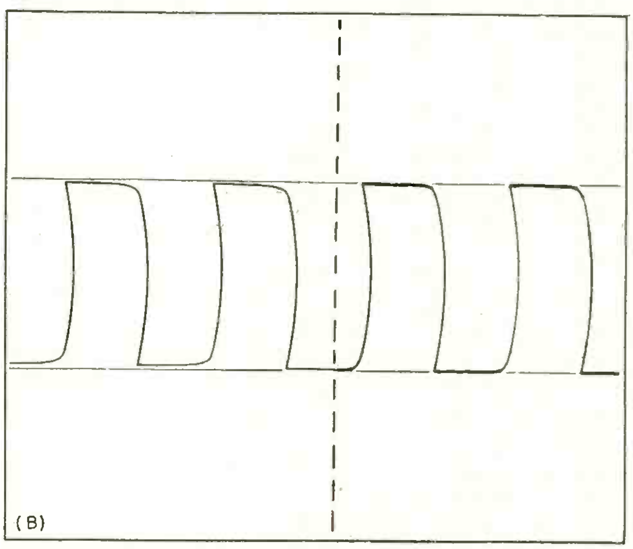
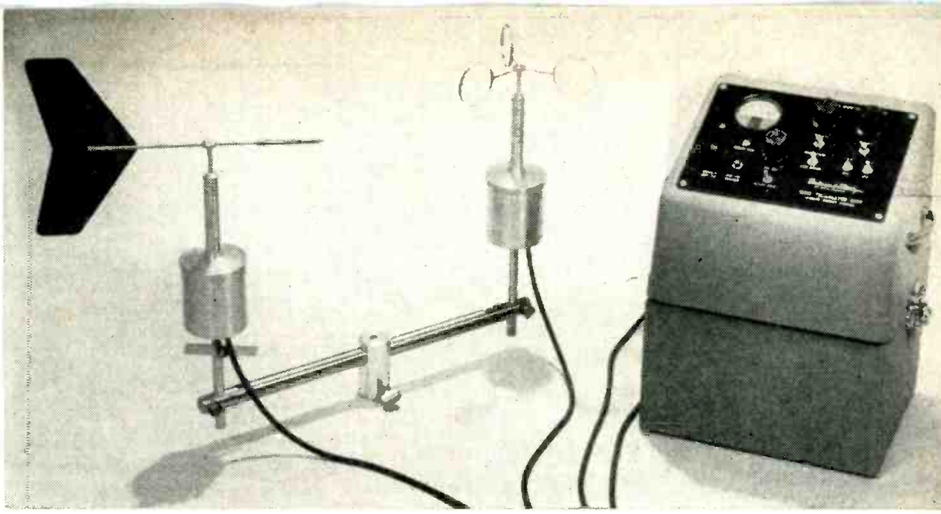


FIG. 1—Wind velocity recording on 0-to-10 mph scale at 1.5-in.-a-minute chart speed (A) and response to square wave (B) illustrating keep-alive technique explained in text

THE FRONT COVER

Equipment pictured on the front cover and described below is used in rocket and guided-missile research, agricultural pollenization investigations, flood forecasting and forest-fire fighting determinations



Complete field unit showing exposed equipment at left and battery-operated recorder right. Spring-driven recorders not shown are plugged into control cabinet

terrupter shell, light from lamp L is modulated into a series of pulses that fall on the phototube. As the conductance of the phototube varies, the grid voltage of the 1U4G pentode varies from about 20 volts positive, under phototube illumination, to some 20 volts negative when the light is interrupted. Resulting plate-current swings cause the spdt relay K_1 to be actuated at a frequency proportional to the anemometer cup speed.

The combination of K_1, C_1, and C_2, together with the external recording milliammeter, forms a relay-type frequency meter[2, 3, 4] that operates as follows. With the relay armature in A position, C_1 is charged to a potential determined by the voltage of B_3 and the setting of potentiometer P_1. In B position, C_1 is discharged almost completely into C_2, the smoothing capacitor.

Since the capacitance of C_2 is 200 times that of C_1, the current i_m, delivered to the recording meter is smoothed sufficiently to give a narrow trace closely proportional to anemometer speed. The back-voltage across C_2, which prevents complete proportionality, can be taken as the IR drop across R_7 and the meter resistance in series. Resistor R_7 is chosen so that this nonlinearity of the frequency meter occasioned by the back voltage across C_2 compensates to a major degree for an opposing nonlinearity in the cup-speed to wind-speed relationship of the anemometer. Thus, the overall calibration of the combined frequency meter and anemometer is considerably more linear than that of either component when it is considered separately.

Limiting resistors R_5 and R_9 keep the surge current accompanying the charging and discharging of C_1 to a value that avoids damage to the relay contacts. These resistors must be small enough so that the R-C value will not exceed one tenth of the highest pulse frequency encountered. Since the instrument has two wind-speed ranges, 0 to 10 and 0 to 30 mph, the value of C_1 is changed by a switch. In the present design, the pulse-measuring capabilities of the system for wind speed of 30 mph are approximately 20 pulses per second.

Although the circuit described involves a fairly substantial battery drain for the electron-tube and light-source filaments, it represents a great improvement in ruggedness, simplicity, and reliability over the alternative of attaching delicate contacts directly to the anemometer shaft.

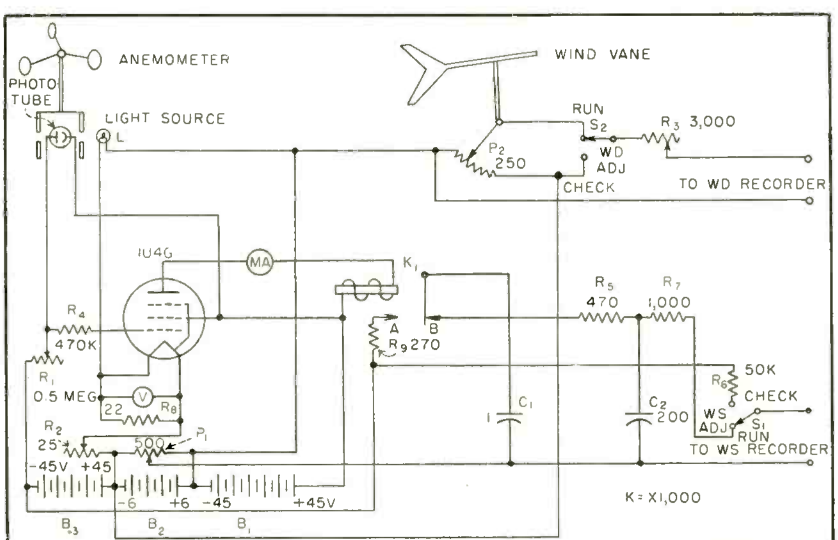


FIG. 2—Anemometer and wind-vane circuits. Phototube wind-speed transducing system permits measurements well below 1mph

Wind-Vane Circuit

A recorder deflection closely proportional to wind direction is determined by the moving contact of P_2, an accurate platinum-alloy wire-wound low-torque potentiometer mechanically coupled to the wind-vane shaft as shown at the upper right of Fig. 2. This potentiometer, with a nominal 360-degree full-rotation has a dead space of less than 2 degrees of angle between the fixed contacts.

As the wind-vane direction varies between 0 and 358 deg from an arbitrary azimuth, the direction recorder, which, in series with R_3, acts as a high-resistance voltmeter, deflects from 0 to full-scale reading. During the additional 2-deg rotation of the vane, the deflection drops back to 0.

The resistance value of this potentiometer is established high enough to give good battery life and low enough (compared with the sum of the resistances of the wind-direction recorder plus R_3) to keep within the objective accuracy limits ±3 deg azimuth.

Keep-Alive Circuit

In recording rapid fluctuations with a direct-writing deflection-type meter, record fidelity can be greatly improved by maintaining almost imperceptible oscillation of the pen arm. This is accomplished electrically in the climate survey system by means of the circuit shown in Fig. 3.

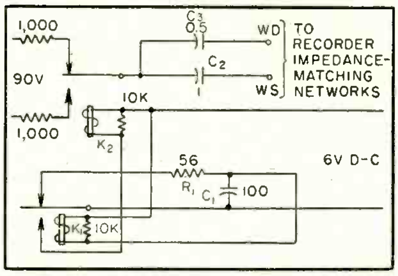


FIG. 3—Keep-alive circuit improves recorder fidelity by modulating pen with small-amplitude square wave

In operation, relay K_1 oscillates from one contact to another at a rate determined by the combination of R_1, C_1. Keep-alive relay K_2 is so connected that its motion follows that of K_1 impressing, through capacitors C_2 and C_3, square waves of approximately 90 volts on top of the signals being fed to the wind-speed and direction recorders.

The effect of this feature can be seen in the chart of Fig. 1B. In this, the trace to the right of the dashed line is somewhat thicker than that to the left. This thickness represents the amplitude of the keep-alive modulation. The relatively squarer tops of the wave shapes at the right show where the pen, in responding to a change, attains full amplitude with a very small radius when the keep-alive circuit is in operation. Without it, the pen follows a larger radius and is asymptotic to the full-current amplitude throughout almost the entire duration of the individual cycle.

Field Adjustments

The instrument can be standardized quickly in the field. Adjustment of the anemometer frequency meter to a standard calibration is required to eliminate the effect of voltage changes in battery B_3. This is accomplished by pressing pushbutton switch S_1 to the check position and adjusting P_1 until the wind-speed recorder indicates the correct operating voltage as given on the calibration chart that accompanies the instrument. Similarly, wind-vane voltage is adjusted to produce a proper full-scale deflection by pressing pushbutton switch S_2 to the check position and adjusting R_3 until the direction recorder reads full scale. These pushbutton switches are located directly below the related adjusting controls so that the calibrations can be performed simply with one hand.

By means of shunting resistor R_8, the 1U4G filament is operated in series with the anemometer light source L. Current through these is kept at the optimum value for good operating efficiency and long life, by adjustment of R_2. Filament voltage indicated on voltmeter V across the tube filament is established at the lowest value compatible with minimum filament deterioration. Resistor R_8 is chosen so that lamp L is operated at about half its rated voltage. This is possible because of the high infrared response of the phototube.

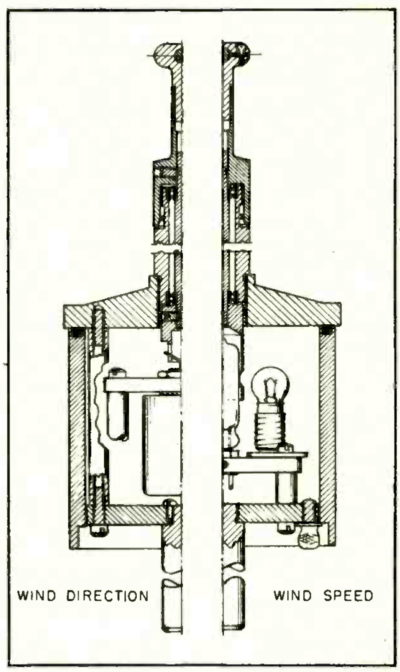


FIG. 4—Mechanical detail of anemometer and wind-vane units. Anemometer is shown at right and wind vane at left. Housing design is common to both

Adjustment of R_1, which governs the relay-current swing, is normally made only to accommodate individual phototube characteristics, or changes in these caused by extremes in ambient temperature. The plate-circuit milliammeter is used to check the swing of relay current which is between 0 (for about half of the pulse cycle) and a current well above the drop-in point of the relay. In practice, the voltmeter and milliammeter are the same instrument, positioned in the circuit by means of a switch.

Instrument Accuracy

Wind-velocity accuracy in the climate survey system is ±5 percent. The wind-direction threshold and the wind-velocity threshold are both less than one mph while wind direction accuracy is ±3 deg azimuth.

Since the direction recorder is adjusted to a full-scale value by pressing switch S_2 to the check position, the calibration accuracy of the meter is eliminated from consideration. In the same way, calibration of the speed recorder is independent of its exact full-scale reading. In this case, it can be seen that the frequency giving a full-scale deflection is determined by $1/R_tC_1$ where R_t is the resistance of the meter plus R_7, and C_1 is the charging capacitor. These components must be of high quality.

Other items of equipment located on the wind translator unit include terminals and receptacles for the attachment of the two wind transducer units and the two spring-driven recording milliammeters.

REFERENCES

(1) S. Pakswer, Lead Sulphide Photoconductive Cells, ELECTRONICS, p 111, May, 1949.
(2) Ronald L. Ives, Capacitor Discharge Recorder Applications, ELECTRONICS, p 104, Feb. 1949.
(3) W. E. K. Middleton, "Meteorological Instruments," p 129, University of Toronto Press, 1943.
(4) Donald L. Ives, Continuous Recording of Aerial Wind Speed, *Bul. Amer. Met. Soc.*, 28, p 41, 1947.

Vacuum-Tube Testers

According to a proposed classification by RTMA, there are four general types of testers currently being used to evaluate performance of tubes. This description of the devices and the meaning of their readings will be particularly useful to industrial electronics and other maintenance technicians

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A VACUUM-TUBE'S worth is customarily measured by its ability to regulate flow of current through an impedance. Its emitter must be able to supply maximum required current and the control elements must influence this current according to a given signal. Testers to determine values of amplification factor, plate resistance and transconductance would show a tube's ability to function as a voltage or power amplifier for a given set of conditions.

However, no available portable tube tester measures these coefficients, although devices are available that perform quasidynamic as well as other useful tests on electron tubes.

A classification of testers has been proposed by RTMA for four classes as shown in the box. This article describes the usefulness of testers in each class.

Emission Testers

Testers falling in Class I usually subject the tube to a test wherein all elements except the heater and cathode are tied together. An alternating voltage is applied between these elements and the cathode, and the self-rectified current is read on a suitable d-c milliammeter as illustrated in Fig. 1A. A simple emission test supposedly tests the cathode to ascertain if it is capable of delivering maximum rated current. However, in this test, elements other than the cathode are certainly effective in determining the tube current and more information is obtained than simply the condition obtaining at the cathode.

For instance, if the grid became opened, the tube current would in most cases change markedly. The test is obviously hard on the control grid and the only practical application that the test approximates is operation of the tube as a diode. However, the test does depend to a certain extent upon the control characteristics of the tube as well as the emission capabilities of the cathode. Testers of this type are generally the lightest in weight, smallest physically, and fastest to operate. Also they comprise the lowest priced testers. They can usually be purchased for around \$50 to \$100.

Control-Emission Testers

The basic test circuit of the class II tester usually takes the form shown in Fig. 1B where separate alternating voltages are applied to the elements and the self-rectified plate current is read on a d-c milliammeter. The plate and grid voltages can be in or out of phase, the best test probably resulting when grid and plate voltages are out of phase such that the grid is negative and cannot draw current when the plate is positive. Testers of this type generally provide a good dynamic test in that the electrode voltages are swung through a wide range of values yielding an operating locus that is in many ways similar to that in which the tube is employed as an amplifier.

This operating locus is illustrated for a triode in Fig. 2. This tester would be expected to be more sensitive to discrepancies in the control action of the grid since a

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RTMA Tube-Tester Classifications

CLASS I—Emission type tester, a device incorporating a circuit in which the indication is primarily related to the emission of the tube being tested.

CLASS II—Control-emission type tester, a device incorporating a circuit in which the indication is jointly related to the emission and control characteristics of the tube being tested.

CLASS III—Control type tester, a device incorporating a circuit in which the indication is primarily related to the control characteristics of the tube being tested.

CLASS IV—Mutual conductance type tester, an instrument incorporating a circuit which permits quantitative measurement of g_m

separate voltage is applied to it and the calibration made on this basis. This type would also be more desirable than an emission tester for such things as matching tubes for amplifier use. Devices in this class are usually priced in the neighborhood of $100 to $150. They are heavier and larger than emission testers, and require more settings for a given test because of more complicated element and supply switching.

Control Testers

Testers falling into Class III have appeared on the market under various trade names. The basic circuit of this class usually has the general form of Fig. 1C. It will be noticed that this differs from Class II in that a signal voltage is applied to the grid in addition to the a-c or unfiltered d-c bias voltage, and provision is made in the plate circuit for extracting the signal component and measuring it.

It is impossible to measure true g_m with a circuit of this nature, and the reading is simply an artificial calibration. Mutual conductance readings by instruments of this type should be made on a relative scale, 0 to 100 percent of normal conductance. Testers of this type provide a good dynamic test but in the opinion of the author afford little more information than Class II testers. The cost, weight, size and speed of operation are comparable to Class II devices.

True Dynamic Testers

Testers in Class IV are true dynamic mutual conductance testers and are invariably designed for laboratory use and not portable field use. Testers of this type provide all necessary d-c operating potentials and means of metering the d-c element voltages and currents. The circuit is basically that shown in Fig. 1D. In addition to the negative bias an alternating signal voltage is applied to the control grid.

If the a-c plate load is negligible compared to plate resistance, g_m is simply the quotient of the signal component of plate current and the signal component of grid voltage. Class IV testers usually measure g_m by measuring the signal component of plate current in milliamperes while maintaining the a-c plate load at a low value, and reading on a scale determined by the magnitude of grid-signal voltage. Corrections are usually applied for low-plate-resistance tubes where the a-c plate load is not negligible compared to plate resistance. Testers of this type are obviously capable of applying a more thorough test to a tube since g_m can be measured for any operating condition. Class IV testers, being laboratory instruments, are large, heavy, require considerable time to set up, and are quite expensive, ranging from $500 to $1,000 in cost.

Electrical and Gas Tests

Since a tube cannot operate properly if two or more of the elements are shorted, testers of all classes usually incorporate a short and leakage test. The short test is advisably made before element voltages are applied. The short-and-leakage test circuit usually takes the form of simply a neon glow bulb as a continuity indicator connected in a resistance-capacitance circuit to control its sensitivity. This indicator circuit is then connected in series with a voltage source that is impressed across the two tube elements to be tested. If the elements are shorted the neon bulb will glow.

In addition to the short and leakage test, a gas and grid emission test is also desirable. Excessive grid current due to the presence of a small amount of inert gas or to grid emission can be detrimental to proper tube operation especially in circuits where the grid-circuit resistance is large. Inert gas may

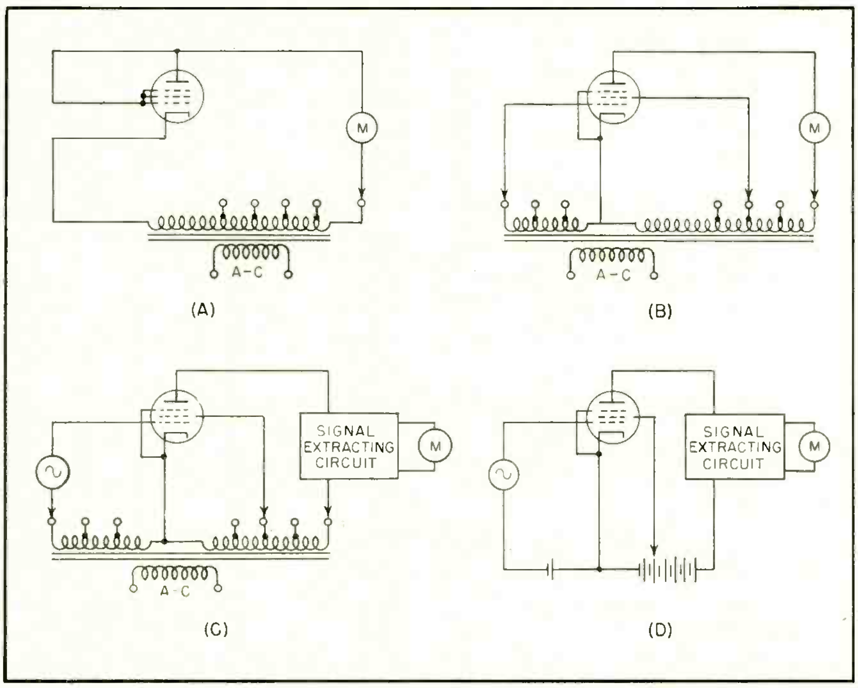


FIG. 1—Basic circuits of the four proposed classes of tube testers. Actual circuits used are more complex because they involve switching

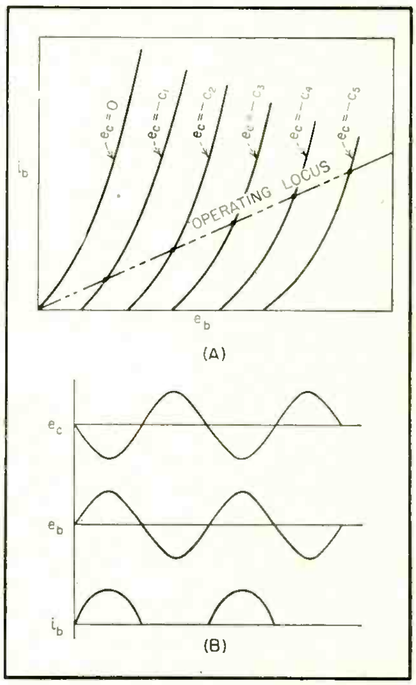


FIG. 2—A triode with grid and plate voltage out of phase

be evolved from the tube's envelope or elements after long use or overloading. Grid emission may be caused by undue heating of the grid structure.

Grid Indications

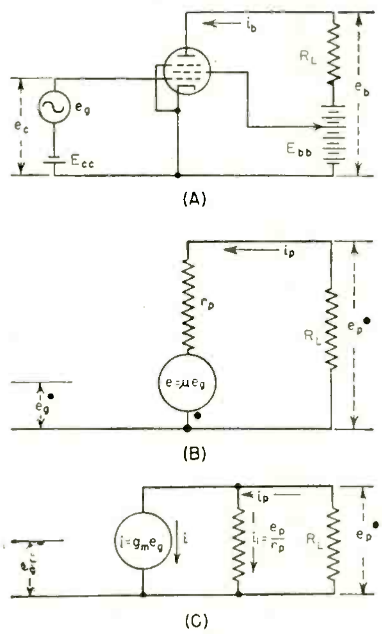
In Class IV testers, grid current is usually metered and excessive grid current is at once apparent. In Class II and III testers, the gas test usually amounts to inserting a high resistance in the grid circuit. Grid current flowing through this high resistance causes a voltage drop, thus changing the voltage that appears between grid and cathode, and consequently the plate current of the tube. Grid current has several components due to electron current, positive-ion current, grid emission, leakage, photoelectric emission, soft X-ray bombardment and secondary emission. As long as the grid is more than a volt or so negative the more important components are positive ion current and grid emission. Thus for a gas test of the latter type to be valid, the grid should always be negative with respect to the cathode when the tube is passing current.

Power Tubes

The value of the gas-test resistor must be chosen with discretion since large power tubes may be expected to operate with higher grid currents than small receiving tubes. Most testers provide only one grid resistor for the gas test and this usually is in the neighborhood of 200,000 ohms. Due to the simplicity of the element switching and the fact that the grid is positive with respect to the cathode, testers of Class I do not provide a gas test.

This is not to imply, however, that a tube that is very gassy will not give some abnormal indication in Class I testers. The presence of ionized inert gas in the tube tends to reduce space charge and increase tube current. Thus tubes with abnormally high indications in an emission tester should be regarded with due suspicion. If oxygen, or water vapor is allowed to enter the tube it will react chemically with the coated cathode. It decreases the emission, causing a low indication on the tester.

FUNDAMENTAL RELATIONS



Typical amplifier stage and two forms of its linear equivalent circuit

Plate current change may be written as differential

$$di_b = \frac{\delta i_b}{\delta e_c}\, de_c + \frac{\delta i_b}{\delta e_b}\, de_b \qquad (1)$$

where i_b, e_c, e_b are instantaneous plate current, grid voltage and plate voltage respectively. From this expression we can define the vacuum-tube coefficient μ, r_p, and g_m.

If e_b is held constant then $de_b = 0$, and

$$\frac{\delta i_b}{\delta e_c} = \frac{di_b}{de_c}\Bigg|_{e_b\,=\,\text{const}} = g_m \qquad (2)$$

This quantity has the properties of a conductance and is termed the grid-plate transconductance or mutual conductance of the tube.

If e_c is held constant then $de_c = 0$, and

$$\frac{\delta i_b}{\delta e_b} = \frac{di_b}{de_b}\Bigg|_{e_c\,=\,\text{const}} = \frac{1}{r_p} \qquad (3)$$

This quantity has the properties of a conductance and is termed the dynamic plate conductance or the reciprocal of the dynamic plate resistance of the tube.

If i_b is held constant then $di_b = 0$, and

$$-\frac{de_b}{de_c}\Bigg|_{i_b\,=\,\text{const}} = \frac{\delta i_b/\delta e_c}{\delta i_b/\delta e_b} = g_m\, r_p = \mu \qquad (4)$$

This quantity is dimensionless and is termed the amplification factor of the tube.

If the differentials of plate current and voltage and grid voltage are considered to be a-c or signal components, Eq. 1 may be written as

$$i_p = g_m\, e_g + \frac{e_p}{r_p} = \frac{\mu e_g + e_p}{r_p} \qquad (5)$$

where i_p, e_p, and e_g are the a-c or signal components of plate current, plate voltage and grid voltage respectively. It should be borne in mind that μ, r_p, and g_m are constant over only a small range of static operating points and only to the extent that the characteristic curves of the tube can be approximated as straight, parallel, equidistant lines.

In other words, one set of values of μ, r_p, and g_m define the dynamic behavior of the tube at one static operating point. Consideration of the linear equivalent circuit of a typical amplifier stage as shown in Fig. 1 will show that the stage gain and power sensitivity can be conveniently expressed as

$$\text{gain} = \frac{e_{out}}{e_{in}} = \frac{e_p}{e_g}$$

$$= \frac{\mu R_L}{r_p + R_L} = \frac{g_m\, r_p\, R_L}{r_p + R_L} \qquad (6)$$

$$\text{power sensitivity} = \frac{\text{Power output}}{(e_g)^2} = \frac{\mu^2 R_L}{(r_p + R_L)^2} = \frac{g_m^2\, R_L}{[1 + (R_L/r_p)]^2} \qquad (7)$$

where R_L is the total a-c plate load.

Also solving the circuit of Fig. 1 for g_m and μ yields

$$g_m = (i_p/e_g)\,[1 + (R_L/r_p)] \qquad (8)$$

$$\mu = -\,(e_p/e_g)\,[1 + (r_p/R_L)] \qquad (9)$$

Vertical Antenna Impedance Characteristics

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IMPORTANCE of a knowledge of the impedance characteristics for vertical, guyed, uniform cross-section antenna towers will be readily appreciated by engineers associated with standard-band broadcast station allocations. The resistive and reactive components of an antenna base impedance are basic in the design of an antenna array with reference to the determination of matching networks and the calculation of power distribution within an array of towers.

Previous curves of impedance have been drawn from theory and from a limited number of measurements and as a result their accuracy and application is somewhat limited. The three sets of curves shown were derived from data submitted for more than one hundred broadcast antenna arrays. These submissions include measurements of the impedance values for over one hundred and fifty vertical towers.

Source of Data

The Canadian broadcast station licensees submit proofs of performance for their antenna arrays to the Department of Transport, notwithstanding whether the array is directional or omnidirectional. These proofs include confirmation of pattern shape, field strength radials and estimations of field strength contours as well as the impedance measurements over usually a limited frequency range. It is from this material that the data were compiled for presentation herein.

The larger portion of arrays currently in use are composed of guyed, vertical, uniform cross-section steel towers and the curves of Fig. 1 and 2 are representations of the impedance values for this type of radiator. The measurements for both square and triangular cross-section towers are plotted since it was not possible, within the accuracy of the curves, to separate one from the other.

Derivation of Curves

It was found as a first approximation that the majority of points plotted fell within plus or minus 10 percent from a mean value for both the resistive and reactive components of impedance and therefore for each physical tower height a range of resistance or reactance is indicated. It is expected that measurements of other towers will normally fall within this range. For design purposes it is recommended that the mean value for the pertinent height be utilized.

Actual physical height is used since it was found that electrical height was meaningless because of the varied assumptions for velocity of propagation in the towers. It is therefore evident that there is no rule for velocity of propagation that is universally applicable.

Figure 3 is a plot of the expected field intensity at one mile per kilowatt radiated with physical height as abscissa. The curve is derived from measured values.

Miscellaneous Types

The proofs of performance in some instances included data on self-supporting towers, shunt fed, top-loaded and T or L type radiators. There were not sufficient data for a particular type to enable a realistic curve plot but a comparison of the miscellaneous tower types with the vertical, uniform cross-section impedance curve is a point of interest.

By way of explanation a few examples of tower descriptions and impedance values follow:

Top Loaded. (a) Steel guyed, series fed, top loaded. Top loading is capacitance hat, four-foot diameter wheel with 16 spokes. Height = 90 feet.

Freq. (kc)	Phys. Ht.	Resis. (ohms)	Reac. (ohms)
1,450	47.7°	18.1	$-j93.0$

(b) Steel, heavy, especially bolted, square uniform cross-section. Top loading—grid—eight foot square on top of radiator. Height = 100 feet.

Freq. (kc)	Phys. Ht.	Resis. (ohms)	Reac. (ohms)
1,400	51.2°	14.8	$-j70.0$

Shunt Fed. Steel, guyed tower

IN A NUTSHELL

Many intangible elements prevent antenna design from being an exact science. Consequently, experience is an especially valuable asset in this phase of engineering. To make intelligent and rapid estimates, and to check antenna design computations, a knowledge of typical values is extremely useful, if not essential.

This article presents in capsule form a summary of typical broadcast antenna characteristics, prepared by an expert whose job it is to check performance claims for antennas used by stations licensed by the Canadian Department of Transport

Graphic summary of operating characteristics exhibited by more than 150 vertical broadcast station towers in operation in Canada. Analysis shows majority of towers to have characteristics within ten percent of mean values plotted

of uniform cross-section, approximately nine-inch diameter. No top loading. Shunt feed at 21 feet 7 inches from ground level. Height = 152 feet or 154 feet above ground level.

Freq. (kc)	Phys. Ht.	Resis. (ohms)	Reac. (ohms)
1,490	82.9°	64.8	$+j157.7$

Tapered. Guyed tower, tapering from bottom to top insulated at base for series feed. Height = 293 feet.

Freq. (kc)	Phys. Ht.	Resis. (ohms)	Reac. (ohms)
560	60.0°	19.0	$-j134$

Inverted L. Steel tower of uniform square cross-section. Top loading 75 feet of horizontal inverted L with elbow bearing of approximately 30 deg azimuth. Height = 96 feet

Freq. (kc)	Phys. Ht.	Resis. (ohms)	Reac. (ohms)
1,400	49.1°	22.0	$-j28.9$

Self Supporting. Self-supporting steel tower. Height = 300 feet.

Freq. (kc)	Phys. Ht.	Resis. (ohms)	Reac. (ohms)
1,230	135°	157	$-j82.9$

The effect of a small capacitance hat is indeed surprising, taking for example the second top-loaded element described. The tower, although having only 51.2-deg physical height, has a resistance comparable to a tower of approximately 61-deg physical height and a reactance comparable to a tower of 62-deg physical height. It is evident then that where there are restrictions on tower heights it is advantageous to make use of top loading, thereby effectively increasing the height of the radiator with respect to efficiency and impedance.

The author of this report is grateful for the concise and comprehensive manner in which the Canadian consultants and the engineers of the Canadian Broadcasting Corporation have presented their submissions.

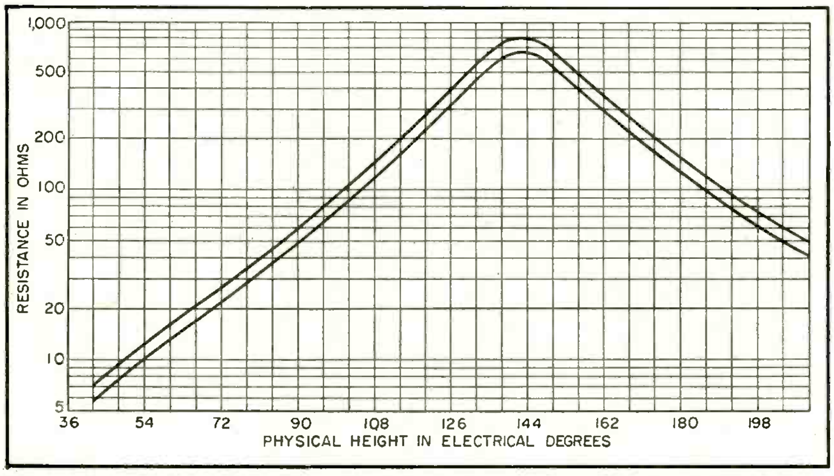

FIG. 1—Curves show approximate limits for resistive component of antenna impedance for various physical heights

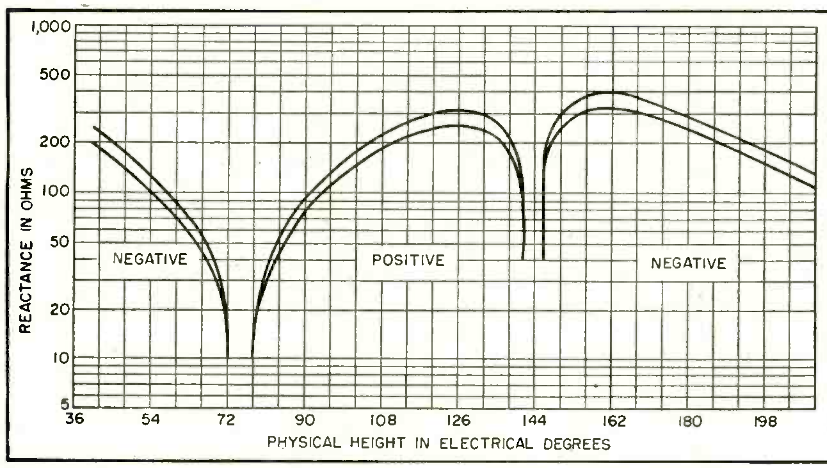

FIG. 2—Reactive component of impedance vs physical height curves taken from actual measurements are closely grouped around mean value

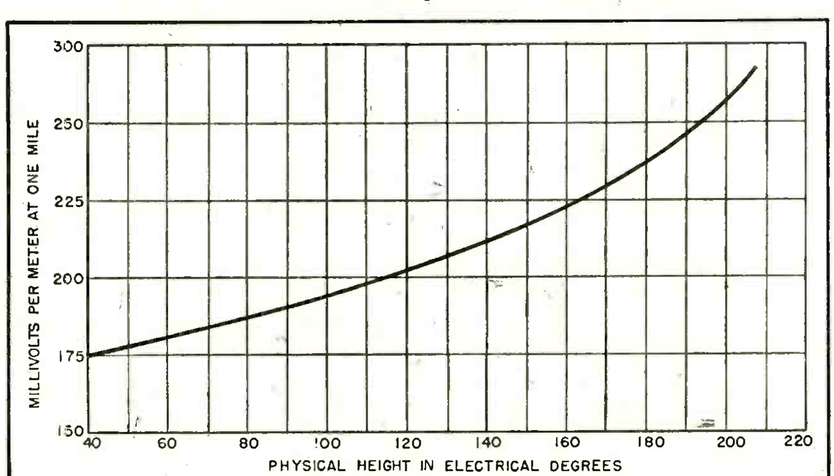

FIG. 3—Curve shows field intensity at a mile for various antenna heights as derived from over 100 measurements on typical arrays

Meteorological

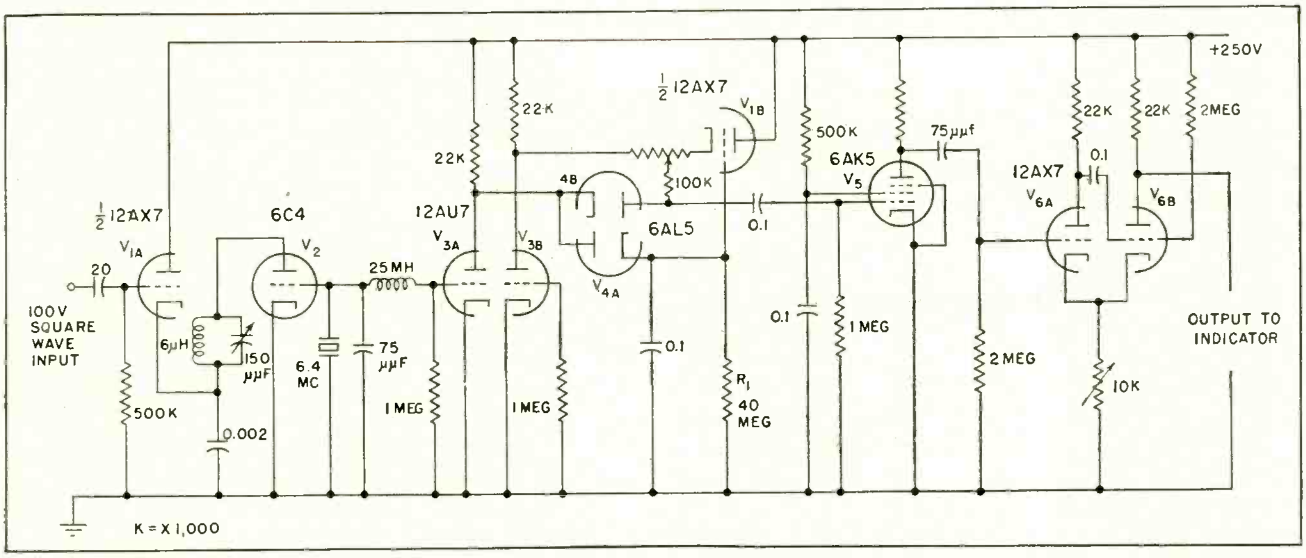

FIG. 1—Pressure-measuring system determines changes in crystal Q caused by changes in atmospheric pressure damping

Atmospheric pressure, temperature and dew point are determined by measuring their effects on specially-mounted crystals. Frequency and Q comparison circuits should find other applications with appropriate modifications of sensing crystal holders

By PAUL GOLDSMITH and EDWARD A. ROBERTS

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Electrical Engineering Research
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Illinois Institute of Technology
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QUARTZ CRYSTALS for frequency control applications are cut at angles that will produce low temperature coefficients of frequency. To further insure stability of operation, temperature control and hermetic or vacuum sealing are frequently employed to prevent atmospheric conditions from affecting the crystal.

Sensitivity to meteorological variations can be obtained by the selection of other crystal orientation angles and by proper exposure of the crystal to the ambient air. This paper describes methods of utilizing quartz crystals and associated electronic circuits to detect and measure changes in pressure, temperature and humidity. These sensing elements are especially useful for remote indication, since changes in the physical properties of the crystal due to meteorological variations are converted to electrical quantities that are readily transmitted and easily measured electronically.

Measurement of Pressure

Two methods were investigated for the measurement of atmospheric pressure. The first utilizes the change in crystal Q due to the damping effect of the atmosphere on a vibrating crystal.

The circuit for detecting these changes in Q of the sensing crystal is shown in Fig. 1. This circuit measures a fixed ratio of decay amplitudes of a pulsed crystal. Since the elapsed time between any two amplitudes, a_0 and a_1, is given by the equation

$$t_1 - t_0 = \frac{2L}{R} \ln a_0/a_1 \qquad (1)$$

where L and R are the inductance and resistance of the equivalent circuit parameters of the crystal, the elapsed time is also proportional to the Q of crystal. The Q is inversely proportional to atmospheric pressure in the thickness longitudinal mode, or to the square root of pressure in the thickness shear mode. From decay time measurements made by this method, the atmospheric pressure of the air surrounding the crystal may be determined.

A loran indicator type AN/APN-4

Measurements with Quartz Crystals

has been used for the measurement of elapsed time between a predetermined crystal amplitude ratio, although any commercial time-interval measuring instrument could be used. This timing device serves the additional purpose of supplying a 25-cycle square-wave voltage for pulsing the crystal oscillator circuit. This voltage is obtained from the final dividing circuit of the indicator, and therefore synchronizes the pulses generated during the crystal decay period with the loran timing sweep.

Triggered Oscillator

The square-wave output of the loran indicator is fed into cathode follower V_{1A} (Fig. 1). The crystal oscillator is pulsed with the square wave output of V_{1A}. The pulsing voltage is impressed in series with the plate tank and causes oscillations in the grid circuit to build up and decay exponentially.

The crystal used for pressure sensing has a high Q and vibrates in the thickness shear mode at approximately 6 mc. After the pulse has ended, the crystal decay current flows through the circuit elements in parallel with the active branch of the crystal. These elements consist of the input impedance of the oscillator and all capacitances in parallel with the crystal.

A decrement corresponding to the true Q of the crystal is achieved only when the resistance paralleling the crystal is either much greater or much less than the reactance of the paralleling capacitance. A 75-μμf capacitor is connected across the crystal to keep this paralleling resistance to reactance ratio high.

The output of the crystal oscillator circuit is taken directly from the grid of V_2. On this grid is a negative bias voltage and a superimposed alternating component, both of which vary in magnitude directly with the amplitude of the crystal vibrations.

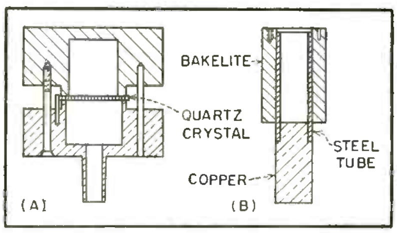

FIG. 2—Section drawings of crystal holders for pressure (A) and dew-point (B) measuring systems

This output is coupled through an r-f choke to the decrement amplifier V_{3A}. The r-f choke eliminates the high-frequency component while passing the variation of d-c grid bias of the pulsed crystal circuit.

The crystal decrement is amplified to approximately 100 volts. The initial amplitude is maintained across the capacitor connected from ground to V_{4A} and R_1. This voltage is impressed on the grid of cathode follower V_{1B}.

Decay Output

A matching amplifier V_{3B}, operated at zero grid bias, develops a d-c plate voltage that equals the plate voltage of V_{3A} when the crystal is allowed to decay completely. The cathode resistor of V_{1B} therefore has the initial value of decay voltage established at the cathode end and the final decay voltage value at the other.

The ratio of peak voltage at the plate of the decrement amplifier V_{3A} to any point on the cathode resistor of V_{1B} is not changed by variations in supply voltage or by changes in maximum amplitude of the vibrating crystal. The cathode

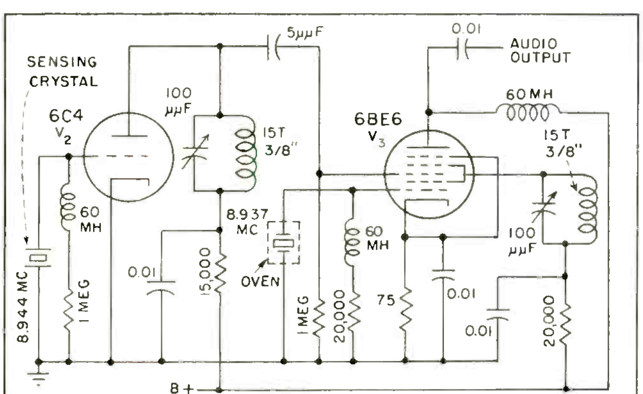

FIG. 3—Frequency comparison circuit measures drift of crystal subjected to bending by unknown pressure applied to one side

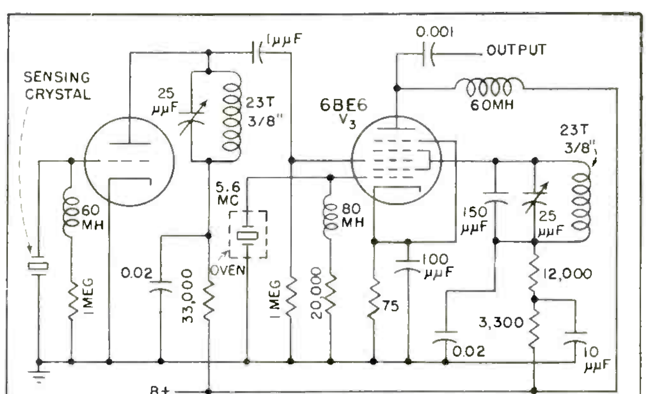

FIG. 4—Temperature is determined by measuring frequency difference between crystal at unknown temperature and standard

resistor therefore serves as an amplitude ratio selector for which the elapsed time between the selected amplitudes must be accurately determined.

The function of diode V_{4B} and its associated plate resistor is to generate a voltage pulse at the exact time when the crystal amplitude has decayed to the predetermined ratio. When the ratio of decay voltages at the cathode of this diode becomes greater than that selected at the cathode of V_{1B}, this tube conducts, and the steady voltage on the plate decreases exponentially at this time.

The purpose of the time marker amplifier V_5 is to provide a signal with a steep leading edge to trigger the single-shot multivibrator pulse generator V_6, which produces a positive output pulse occurring at the time when the crystal amplitude has decayed to the predetermined ratio.

The output pulse is connected to the video input jack on the loran indicator, and the pulse appears on the lower timing trace. Since this lower trace begins exactly at the time when the square wave of voltage used to pulse the crystal drops to zero, the time difference from the beginning of this trace to the pulse provides an accurate measurement of the Q of the crystal.

Other Effects

Atmospheric variations in temperature and humidity may produce responses in the pressure-sensing element. These meteorological cross effects have been investigated to determine necessary corrections for the sensing crystals. These corrections follow the standard relationship between density, temperature, humidity and pressure for air. An additional temperature cross effect may result from couplings to spurious modes of vibration of the crystal. These coupled modes change the internal dissipation of the crystal as a function of temperature. Proper dimensioning of the sensing crystal minimizes this second-order effect.

The second method of pressure sensing utilizes the change in frequency of a vibrating quartz crystal produced by the bending of the crystal under differential air loading. The sensing crystal for this application is used as a diaphragm over an evacuated cup as shown in Fig. 2A. An AT or BT-cut plated crystal with a low temperature coefficient may be utilized. This type of crystal can be clamped at its outer edge without appreciably affecting activity or other performance characteristics.

The pressure sensitivity is proportional to the sixth power of the bending length to thickness ratio. It is therefore important that this ratio be kept as high as possible without breaking the crystal from the pressure differential. Experiments indicate that this ratio may be as large as 80 for circularly-shaped quartz crystals without exceeding the maximum breaking strain. Frequency changes of 1,400 parts per million per atmosphere can be achieved for this type of crystal.

A circuit of a pressure indicator is shown in Fig. 3. The sensing element is an 8.944-mc AT-cut crystal located in the grid circuit of oscillator V_2. The output of this stage is applied to the signal grid of the pentagrid converter V_3. Under differential pressure, the sensing crystal bends and the output of V_2 varies in frequency as a function of pressure.

The reference element is an 8.937-mc AT-cut crystal, enclosed in a temperature-controlled oven, located in the oscillator grid circuit of the pentagrid converter. The audio difference frequency is obtained at the plate of V_3.

For this pressure-sensing crystal, a correction is necessary for ambient temperature changes. Since this crystal indicates pressure by a change in resonant frequency, it is necessary to correct for frequency changes resulting from the crystal temperature coefficient. For this reason, AT and BT-cut crystals are used for sensing elements since the temperature error is a minimum.

Temperature Measurements

Figure 4 shows the circuit used to measure temperature by measuring change in crystal frequency. The temperature coefficient of frequency of a vibrating crystal is a function of the thermal coefficients of stiffness and expansion. The magnitude of this coefficient of frequency, therefore, depends upon the mode of vibration and the orientation of the crystallographic axis. For quartz the maximum value of the temperature coefficient of frequency is in the order of 10^{-4} per degree centigrade.

This value is approached in Y-cut plates oscillating in the thickness shear mode. As the Y-cut crystal is rotated about the X axis, the temperature coefficient decreases through zero, and it is possible to obtain any coefficient between -90 and $+90$ parts per million per degree centigrade by selection of the angle of cut. Crystals designated as AT and BT cuts are examples of this type of crystal with the angle of rotation selected to produce a near-zero temperature coefficient.

Several thickness shear elements with temperature coefficients ranging from $+90$ to -80 parts per million per degree centigrade were used in tests to determine their activity characteristics over a wide temperature range. The Y-cut crystals, while having the highest temperature coefficient ($+90 \times 10^{-6}$), exhibited a number of frequency discontinuities, while crystals rotated 30 degrees or more about the X axis showed satisfactory frequency spectra over the entire temperature range. Frequency-temperature characteristics for two of these crystal cuts are shown in Fig. 5.

The negative temperature coefficients are typical of all thickness shear crystals rotated more than +35 degrees from the Y cut. While somewhat larger temperature coefficients could be attained by further

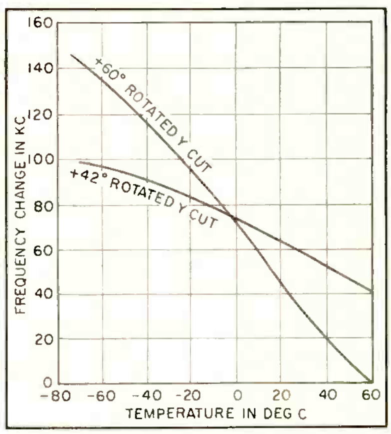

FIG. 5—Temperature-frequency characteristics for two typical crystal cuts

rotation about the X axis, the coupling efficiency to the crystal would be reduced and it would become more difficult to stabilize the associated oscillator circuit.

A 60-degree positive-rotated Y-cut wire-mounted crystal, 16.97 mc, 0.01 cm in thickness, is used as the sensing element in the temperature indicator. A temperature-controlled 5.6-mc BT-cut serves as the reference crystal as shown in Fig. 4. The converter output is an r-f signal equal to the difference between the sensing crystal frequency and the third harmonic of the reference crystal frequency.

The temperature indicator has a sensitivity of 0.001 C, and an accuracy of ±0.1 C, over the range from +60 to −60 C. The indicator will read 63 percent of its final value in approximately two seconds when the crystal is exposed to the atmosphere and subjected to a ventilation velocity of ten feet per second. Changes in air pressure and humidity have negligible effects on the temperature-sensing crystal.

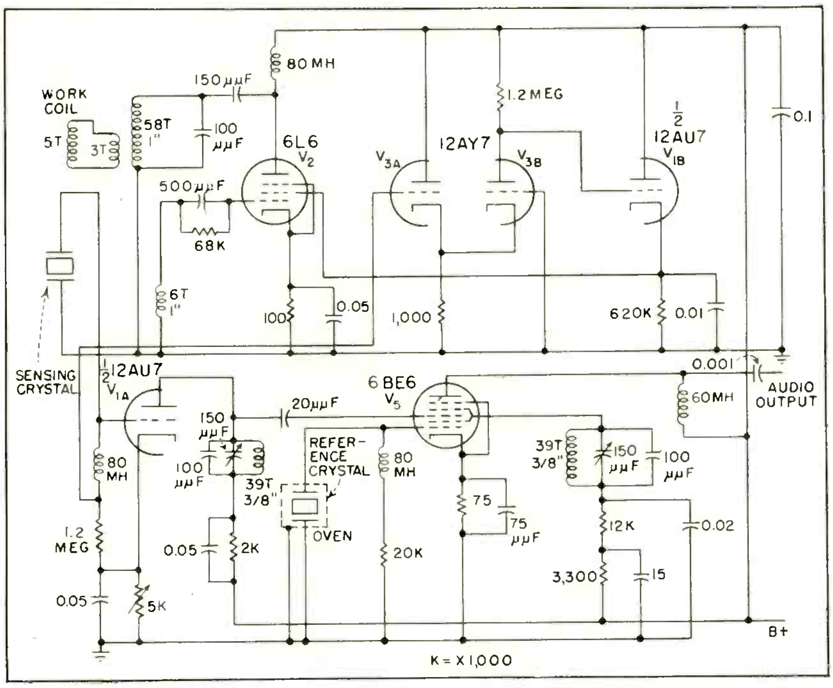

FIG. 6—Dew-point circuit measures crystal damping caused by condensed moisture on crystal plate

Dew-Point Measurements

The method of determining atmospheric dew point with an oscillating crystal involves the deposition of moisture on the sensing element and using the resulting change in oscillating characteristics to maintain the crystal at the dew-point temperature. Practical considerations such as choice of frequency and crystal mounting have indicated that a thickness shear mode quartz crystal is best suited for this application.

An oscillating crystal is cooled by a cold source, and when the dew point is reached, moisture begins to condense on its exposed surfaces. The presence of moisture decreases the amplitude of oscillation of the crystal, which in turn causes the heat source to heat the crystal and dissipate the condensate.

A dew-point indicator has been designed using induction of eddy currents into the plated surfaces of a pressure-mounted sensing crystal to maintain the crystal at the dew-point temperature.

Indicator Crystal

The sensing crystal of the dew-point indicator is a 4.971-mc, AC-cut gold-plated crystal. The crystal is seated on the upper surface of the dew-point crystal holder shown in Fig. 2B. The copper tube is immersed in a solution of alcohol and solid CO_2. A coil form accommodates the work coil of an induction heating stage. This coil form is cemented into place on a coil form holder and the entire unit is assembled above the crystal. Sample air is passed in through one side of the coil form holder and out through the other side after passing over the crystal surface.

The schematic diagram of the dew-point indicator is shown in Fig. 6. The negative d-c grid voltage of V_{1A} is a function of the crystal amplitude, and decreases in magnitude when moisture condensation takes place.

This d-c grid voltage is applied to V_3, consisting of cathode follower V_{3A} and cathode-coupled amplifier V_{3B}. The amplifier is normally biased for maximum conduction. The plate of the amplifier is connected to cathode follower V_{1B}, and the output of this stage is used as the screen grid supply for the induction heating stage.

The heating stage consists of a feedback oscillator V_2 with an inductively-coupled work circuit. The pancake-wound work coil is used to induce eddy currents into the plating of the sensing crystal.

Moisture condensation causes the d-c grid voltage to decrease in magnitude putting a positive bias on the cathode of amplifier V_{3B}. This increases the d-c plate voltage of the amplifier and produces a corresponding increase in the feedback oscillator screen supply voltage. The crystal begins to heat due to the increased power output of the feedback oscillator until a stable operating temperature equal to the dew point is reached.

Since both heating and moisture condensation take place on the same surface, the time lag between appearance of condensate and the corresponding increase in heating is small, and stability of operation is readily achieved. Accuracies of ±3 C have been obtained over the dew-point range of from −5 C to 35 C.

Acknowledgments

The authors acknowledge the contributions of H. Ekstein and J. K. Tyson, Armour Research Foundation, to the theoretical phases of this work. Scientific personnel of the Meteorological Branch, Evans Signal Laboratory, sponsors of this research program, have been especially helpful with suggestions.

Series-Peaking Network Design

Nomograph permits rapid determination of series inductance and load resistance values for given cutoff frequency and shunt capacitance, and comparison of different circuit parameter combinations which give equal results

By JOSEPH F. SODARO

Project Supervisor
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SERIES-INDUCTANCE peaking network compensation has the advantages over shunt peaking of greater amplification, smaller phase-angle error, and rapid attenuation beyond the cutoff frequency.

The basic series-compensated circuit is shown in Fig. 1. Each capacitance is a summation of the tube socket, wiring and associated tube interelectrode capacitance. The value of L is computed from

$$L = \frac{1}{8\pi^2 f^2 C'} \text{ henrys}$$

in which f is the cutoff fre-

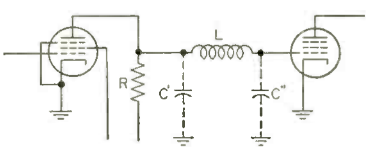


FIG. 1—Basic series-peaking network

quency. The value of R is calculated from

$$R = \frac{1}{2\pi f C' \sqrt{2 \frac{C''}{C'}}} \text{ ohms}$$

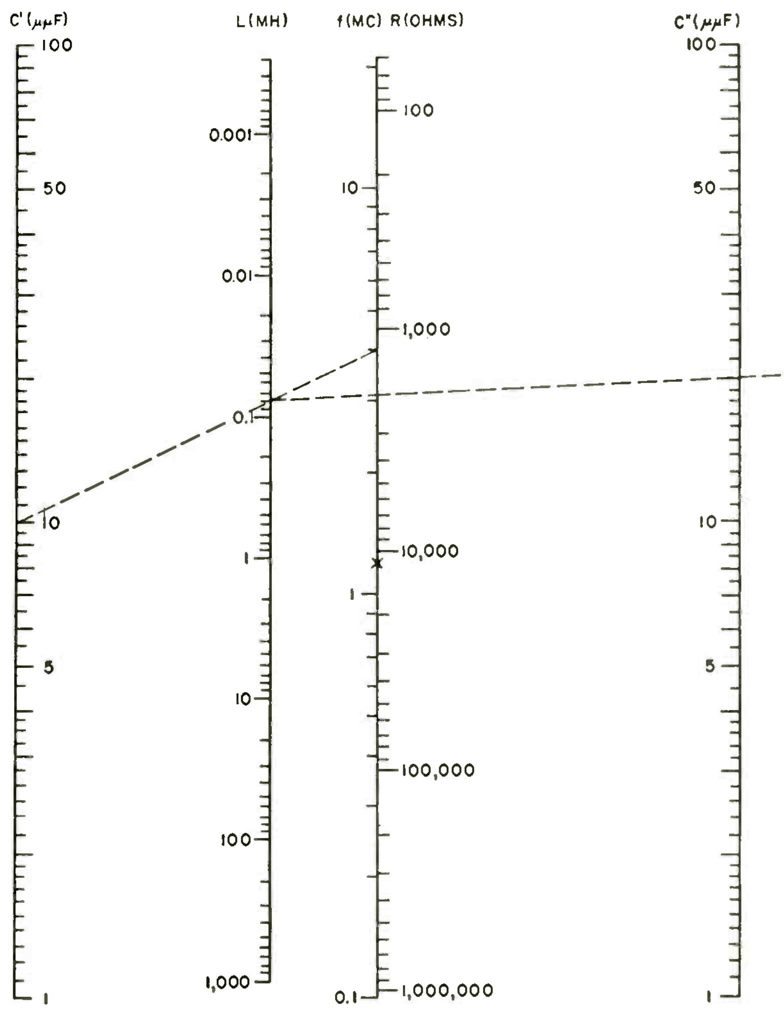
If the ratio C''/C' is made equal to 2, the most satisfactory overall performance is obtained.[1] The Q of the series inductor should be 20 or more.

The nomograph is used by constructing a straight line from f to the measured or calculated C'. The intersection of this line with the L scale shows the required inductance and provides a turning point from which a straight line is drawn to the measured or calculated C''. The intersection of this line with the R scale shows the required load.

In the example $C' = 10$ μμf, $C'' = 20$ μμf and $f = 4$ mc. The series-peaking inductance L becomes 0.08 mh and R is 2,000 ohms.

REFERENCE

(1) K. R. Sturley, "Radio Receiver Design", Part II, p 427, Chapman and Hall, 1945.



Pulse Delay-Line Design Chart

Simple chart permits rapid determination of capacitance and inductance values for delay and pulse-forming lines having impedances from 10 to 10,000 ohms and for delays from 0.01 to 1,000 microseconds

By C. A. EPP
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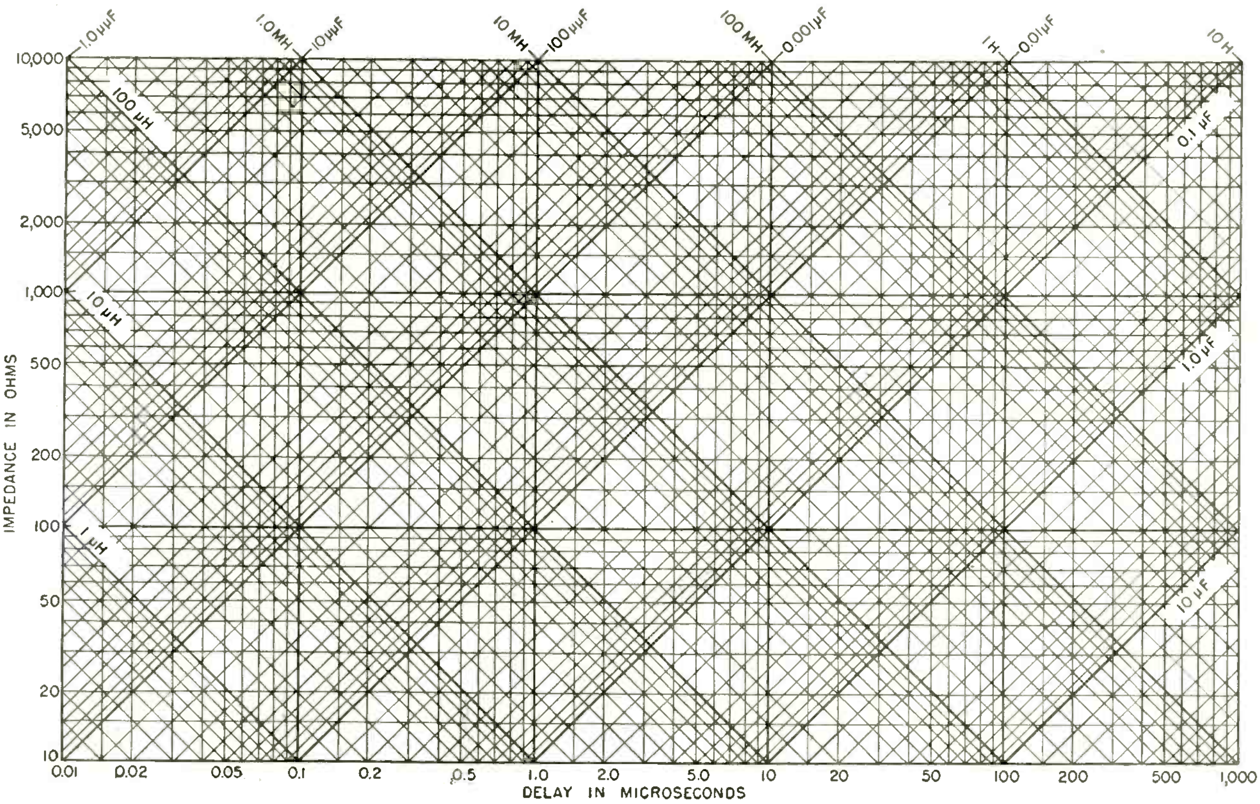
The accompanying chart has been found useful in determining the value of capacitance and inductance in a delay or pulse line when the time of delay and the impedance of the line are given. For determining values for a pulse-forming line, the time of delay shown on the chart must be doubled to give the pulse length, since the pulse front travels out and back.

Example: For a delay of 10 μsec and an impedance of 1,500 ohms, find L and C. Enter chart at Delay = 10 μsec and at Z = 1,500 ohms. Then L = 15 mh and C = 0.0065 μf. The above values would produce a 20-μsec pulse in a pulse-forming line. The values for L and C are totals of all sections. Therefore, for a 5-section line, L = 3 mh and C = 0.0013 μf.



Delay line chart shows inductance and capacitance values, given required delay and line impedance

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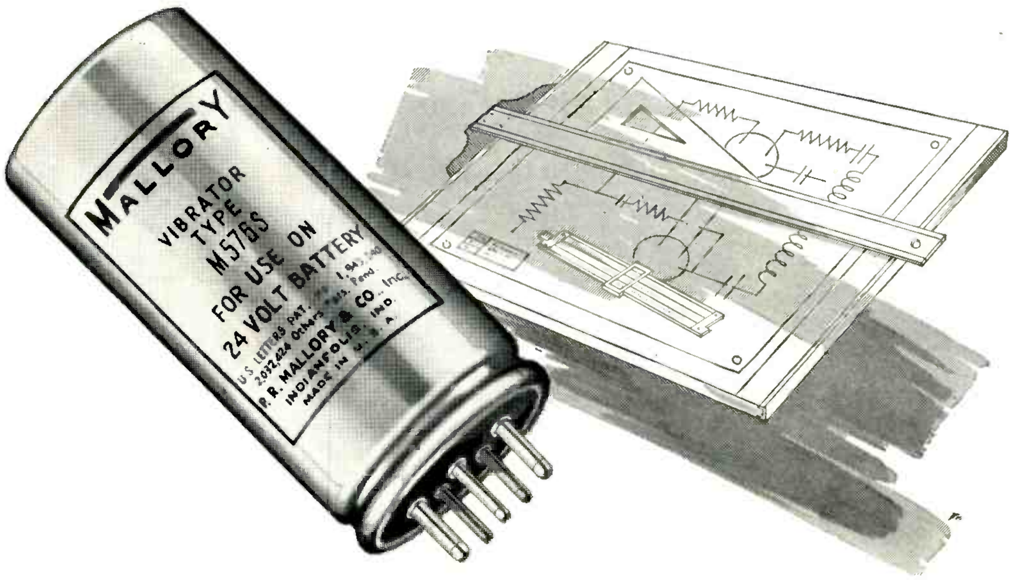

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ELECTRONS AT WORK

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Air Traffic Control System

By GEORGE HEATH
*Design Engineer
Electronics and X-Ray Division
Westinghouse Electric Corporation
Baltimore, Maryland*

ONE OF THE COMPONENTS of a new and still experimental air traffic control system is known as the Rho-Theta Transponder. The transponder, a radar safety beacon, is a means by which the ground control officer at a busy airfield can positively identify the aircraft he sees as small dots on his radar screen.

The transponder is a small airborne beacon designed to be used in conjunction with the CAA aircraft traffic control radars and blind-landing guidance radars. It will extend the reliable range of the ASR S-band surveillance radar to 100 miles and extend the range of the PAR X-band precision approach radar to 15 miles.

The radar safety beacon is a device that, upon reception of the original radar pulse, triggers its own transmitter to give a strong reply. The beacon, therefore, may be said to be an amplifier of the echo signal. It is not necessary that the beacon transmitter be of high power to give a reply much stronger than the echo signal from usual targets, nor is it necessary that the beacon reply on the same frequency as the radar signals.

The equipment introduces the extremely advantageous feature in an air traffic control system of enabling the ground controller to identify the plane he is hearing over the plane-to-ground communication system.

On his radar screen the ground control officer sees whatever the plane's transponder sends. In the usual case this would be a single reply. The identifying feature comes about when the pilot keys his microphone to talk to the ground control officer. In this case the transponder sends out a double-pulse reply. Thereby enabling the ground controller to immediately identify that plane on his radar screen.

Receiver-transmitter and control units for the equipment

While the aircraft is in the traffic control area, it will first be interrogated by the surveillance radar and the transponder will receive on S-band. As the plane is vectored into position for a landing approach, the transponder will be switched over to receive the X-band PAR radar. The PAR radar will then receive a strong transponder signal during the final landing approach.

Block Diagram

Figure 1 is a block diagram of the equipment. Switch S_1 is oper-

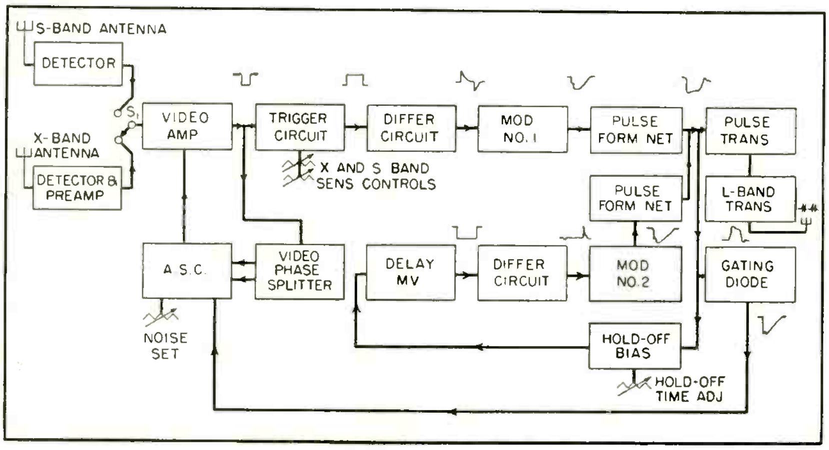

FIG. 1—Simplified block diagram showing waveforms when transponder is interrogated and a double-pulse reply is being transmitted

3 UNIVERTERS

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Frequency Increment Dial: ±300 kc in 5 kc increments.
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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.
Output: 0.1 to 100,000 microvolts at X1 jack and approximately 7.5 times these values at high output jack.
Modulation: FM controlled by Signal Generator.
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ated from the control box at the pilot's position and determines whether X-band or S-band signals will be received. The S-band detector is mounted in the transponder and connects to the S-band antenna, a quarter wave stub, through RG-8/U coaxial cable. To minimize r-f losses at X-band, a detector and preamplifier assembly are mounted to the waveguide at the X-band antenna.

Video signals from the preamplifier are cabled to the receiver-transmitter unit through RG-62/U coaxial cable. The video amplifier is a high-gain amplifier and consists of three feedback pairs. The diagram of a typical pair is shown in Fig. 2.

The amplifier has ample reserve gain to compensate for a general decrease in gain with tube life and production variations between sets. An automatic sensitivity control circuit is used to control the gain of the video amplifier. This control functions to maintain a constant noise level at the output of the video amplifier. This is desirable in order that the sensitivity controls at the trigger circuit may be adjusted to make the trigger circuit function sporadically on noise peaks but function steadily on signals just above the noise level.

To prevent saturation and possible blocking of the video amplifier by strong S-band or X-band signals, the sensitivity control circuit samples the video signal and controls the amplifier gain so that the video signals at the output of the amplifier are held at a constant level without saturation.

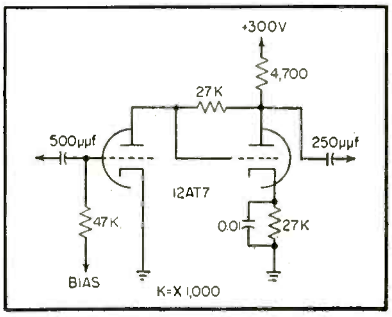


FIG. 2—Diagram of typical stage in video amplifier showing feedback pair

Output from the trigger circuit is shaped and applied to a miniature hydrogen thyratron in a line-type modulator circuit. A pulse forming network is used to determine the duration of the modulator pulse. This voltage pulse is stepped up approximately four to one by the pulse transformer and the voltage used to fire the transmitter.

Delay Multivibrator

To develop the second transmitted pulse, a sample from the first modulator is applied to a delay multivibrator through a hold-off circuit. The output from the delay multivibrator is passed through a shaping circuit and used to control modulator number 2. The transmitter can be then fired a second time producing two transmitted signals spaced 16-μsec apart each time the transponder is interrogated. This second transmitted signal is the signal used by the ground controller to identify an airplane.

The function of the hold-off circuit is two-fold. First it prevents the delay multivibrator from being triggered except when the pilot's microphone is keyed and second, it provides a timing circuit that allows the second pulse to be transmitted for 10 seconds after the microphone key has been released.

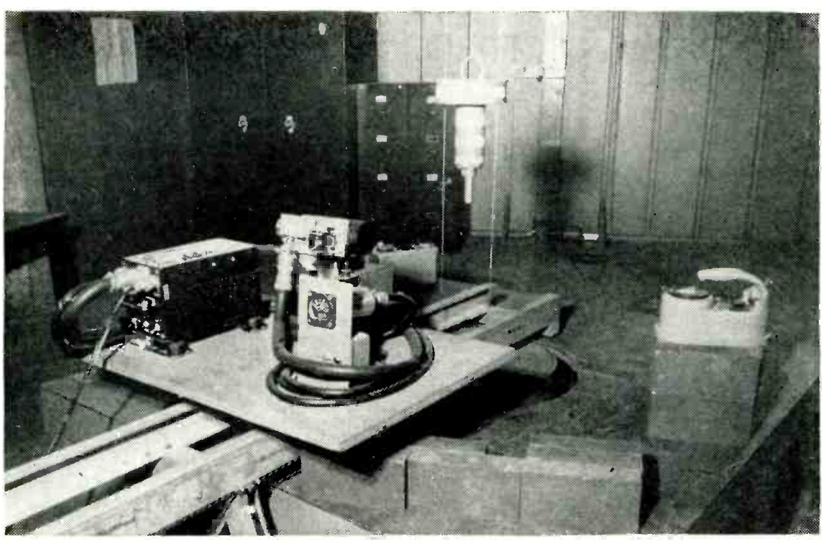
In the receiver-transmitter unit, the receiver section is located adjacent to the transmitter. This introduces the problem of preventing the transmitter signal from setting up a false sensitivity-control bias voltage which would result in erroneous gain control information being supplied to the video amplifier. To prevent this from occurring, a negative blanking pulse is introduced into the circuit from the primary of the pulse transformer. This effectively blanks the circuit for the duration of, and for a short time following, the transmitted signal.

The transmitter operates in the L-Band region, 1,500 mc, and uses a planar triode in a cathode-tuned re-entrant cavity-type oscillator. Probe coupling is used to extract power from the transmitter cavity. The transmitter operates with a 1,400-volt positive pulse applied to the plate of the planar triode and delivers a nominal output of 180 to 200 watts peak power. Coaxial cable is used to couple the transmitter to the antenna which is a half wave dipole at L-Band.

TV Observes Gamma-Ray Detectors

Industrial television finds novel uses at the Naval Air Development Center, Johnsville, Pa. Plans are afoot to install a camera chain and monitor kinescope to observe calibration tests of airborne gamma-ray detecting equipment. Slugs of cobalt 60, a powerful radioactive isotope, are used in these tests.

Normally, fission products are kept deep within a 7,200-pound lead cylinder and handled during tests from a remote control point. The container is located in a basement room at the end of a 35-foot concrete tunnel. A 15-inch, solid-con-

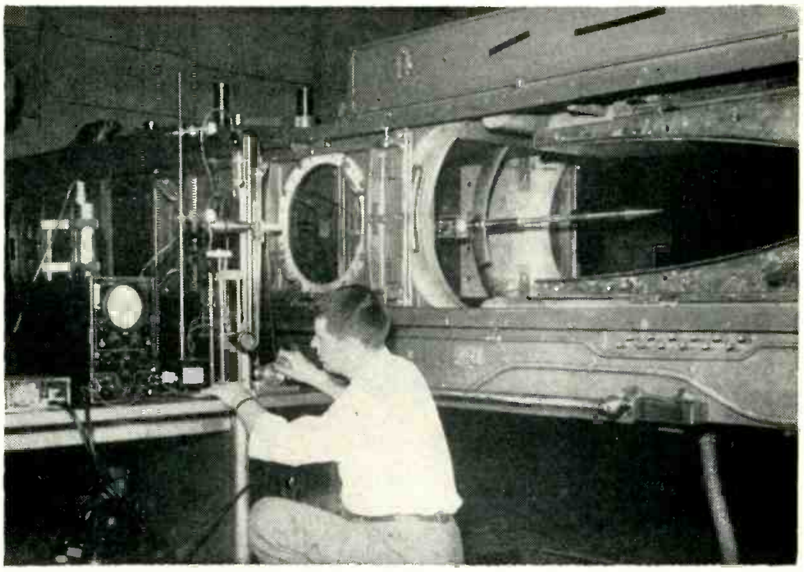

Interior of hot room showing gamma-ray detecting equipement under test

crete shield may be rolled into place to afford additional protection during tests. Television observation is particularly useful in calibration of integrating gamma-ray detectors.

Industrial television is likewise used in connection with NADC's human centrifuge to be placed in operation this month for aeromedical studies. An image-orthicon camera observes the subject as he is accelerated within an oblate spheroid-shaped gondola at the end of a 50-foot rotating boom. Signals are carried to monitor kinescopes by coaxial cable. Pick-up from the rotating boom is accomplished from rubidium-laminate slip rings.

Strain-Gage Balance Measures Drag Force

PRECISE MEASUREMENT of drag force acting on supersonic wind-tunnel models at Naval Ordnance



Electronic strain-balance measures total drag force on supersonic wind-tunnel model

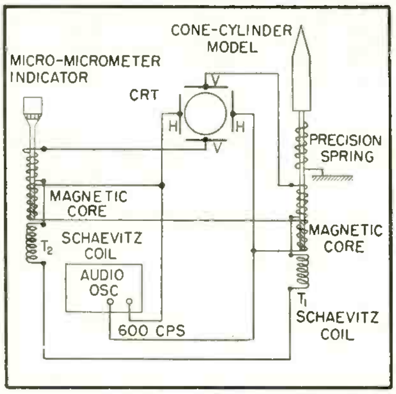


FIG. 1—Scope indicates balance of two variable and linear differential transformers

Laboratory, White Oaks, Md., is obtained using the electronic strain-gage balance shown in block diagram form in Fig. 1.

The projectile model under test is mounted as shown in the photograph with drag force producing deflection of the precision spring. This strain results in displacement of the magnetic core of a variable and linear differential transformer T_1. Balance, as indicated by the crt is restored by adjustment of the precision micro-micrometer which creates a like displacement of the core of T_2. Strains of 1/10,000 inch may be read from the micrometer dial with estimation to 1/100,000 inch possible.

The electronic strain-gage balance has been used to measure skin friction on cone-cylinder models in NOL's 40 by 40-cm supersonic wind tunnel at speeds from Mach 1.2 to 5.18. Skin friction effects account for only two percent of total drag. Wave drag, accounting for 70 percent of the total, may be calculated mathematically while the micromanometer, also shown in the photograph, gives a precise measurement of base drag, the remaining component of total drag.

Microwave-Antenna Ferrite Applications

BY N. G. SAKIOTIS A. J. SIMMONS AND H. N. CHAIT

Antenna Research Branch, Radio Division I
Naval Research Laboratory, Washington, D. C.

A PROBLEM of long standing in the field of microwave antennas is the design of rapid scanning antennas. A scanning antenna which requires no physical motion of either the secondary focusing system (reflector or lens) or of the primary feeding source has been a goal of the microwave antenna designer ever since the inception of the scanning problem.

A possible means of producing

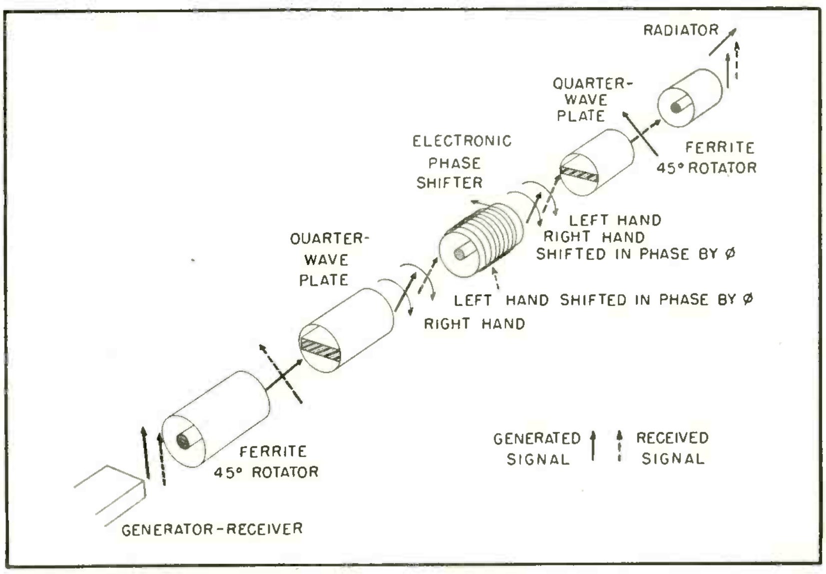


FIG. 1—Bilateral phase shifter employing a ferrite cylinder

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phase shift is by use of a material whose dielectric constant ϵ or whose permeability μ may be changed by means of external d-c or low-frequency electric or magnetic fields. Such materials inserted in waveguide or coaxial line would, upon application of the external field, cause a change in electrical length of the transmission line equivalent to a shift in phase.

Materials of variable ϵ such as the titanates have proved too lossy for antenna applications but materials of variable μ such as the ferrites show promise.

The characteristics of most interest at microwave frequencies is the variation of μ with an applied magnetic field. This variation takes place in an anisotropic fashion as is evidenced by the rotation of the plane of polarization of a linearly polarized wave propagated in a direction parallel to the direction of applied magnetic field.

Waveguide Switch

The linearly polarized wave is thought of as a combination of right and left-hand circularly-polarized waves[1] and the ferrite anisotropy causes a relative phase shift between these two components. The plane of polarization of the resultant linear wave is rotated through a prescribed angle when the d-c field is applied. This rotation makes the device useful as a waveguide switch.

With magnetizing current off, the output polarization is the same as the input. With current on, the output polarization may be rotated 90 deg and passed through a different channel. Such a switch could have many applications such as scanning by switching rapidly from one primary feed to another or as a T-R device separating receiver and transmitter functions in radar.

For general scanning purposes, the phase-shifting properties due to the variation of μ are of major interest. For use as a phase shifter, a single circularly polarized wave may be passed through a section of hollow waveguide containing the ferrite. The phase of the output wave relative to the input is varied by the axial d-c magnetic field.

An interesting property of fer-

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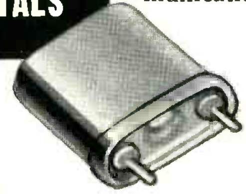

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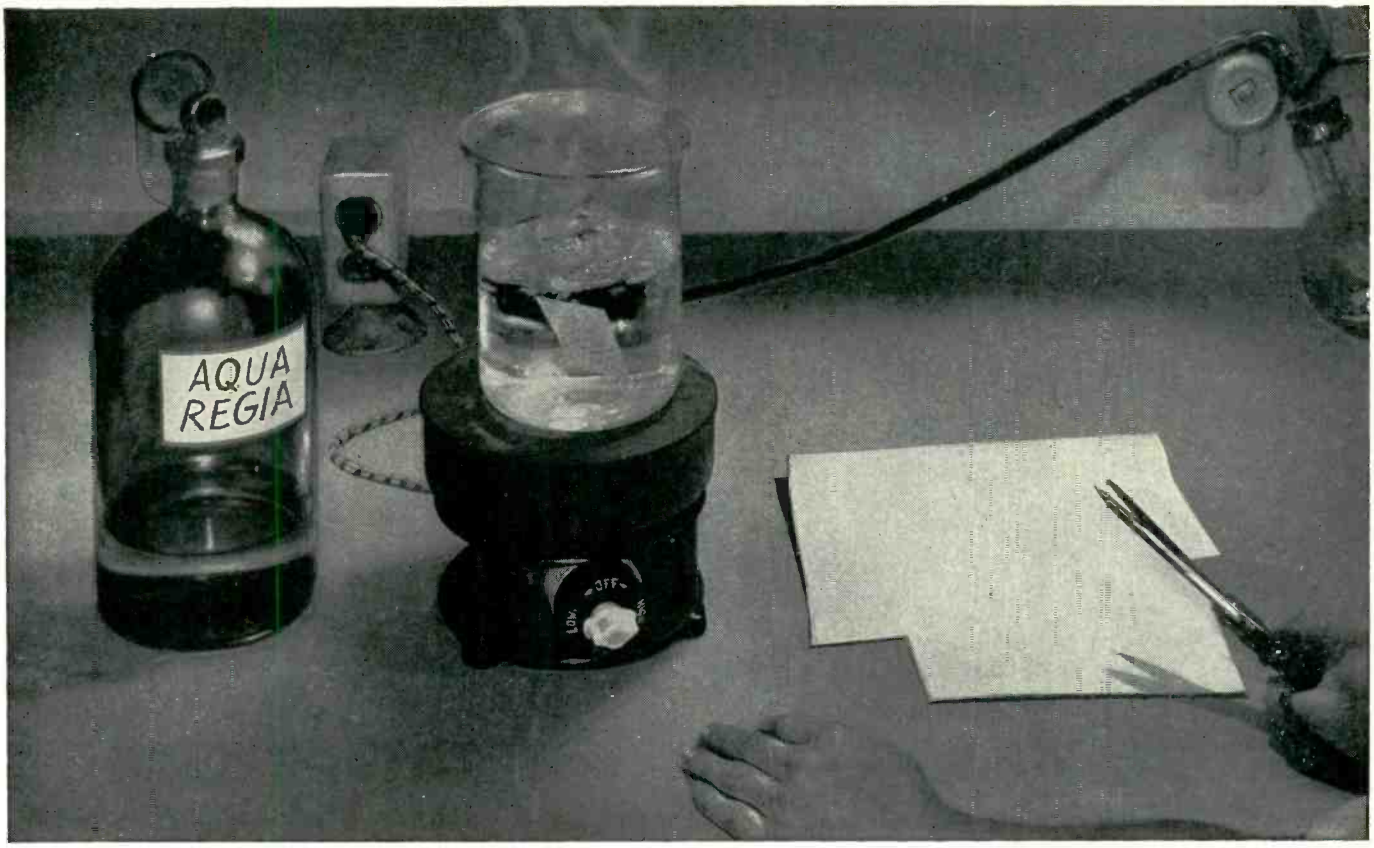

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rite materials is that the reciprocity principle is not obeyed. A wave traveling in the direction of the external magnetic field is affected differently from one traveling in the opposite direction. For scanning purposes, this nonreciprocity is undesirable since the beam of the radar antenna on reception should be directed at the same point as that of the antenna on transmission.

The nonreciprocity problem may be solved in various ways. One solution is to combine transmission line sections containing ferrites in a manner as shown in Fig. 1. The solid vectors represent transmission, the dotted represent reception. The phase-shifting element will shift a right-hand wave traveling in one axial direction exactly as much as a left-hand wave traveling in the opposite direction. By

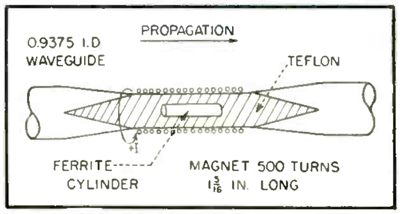


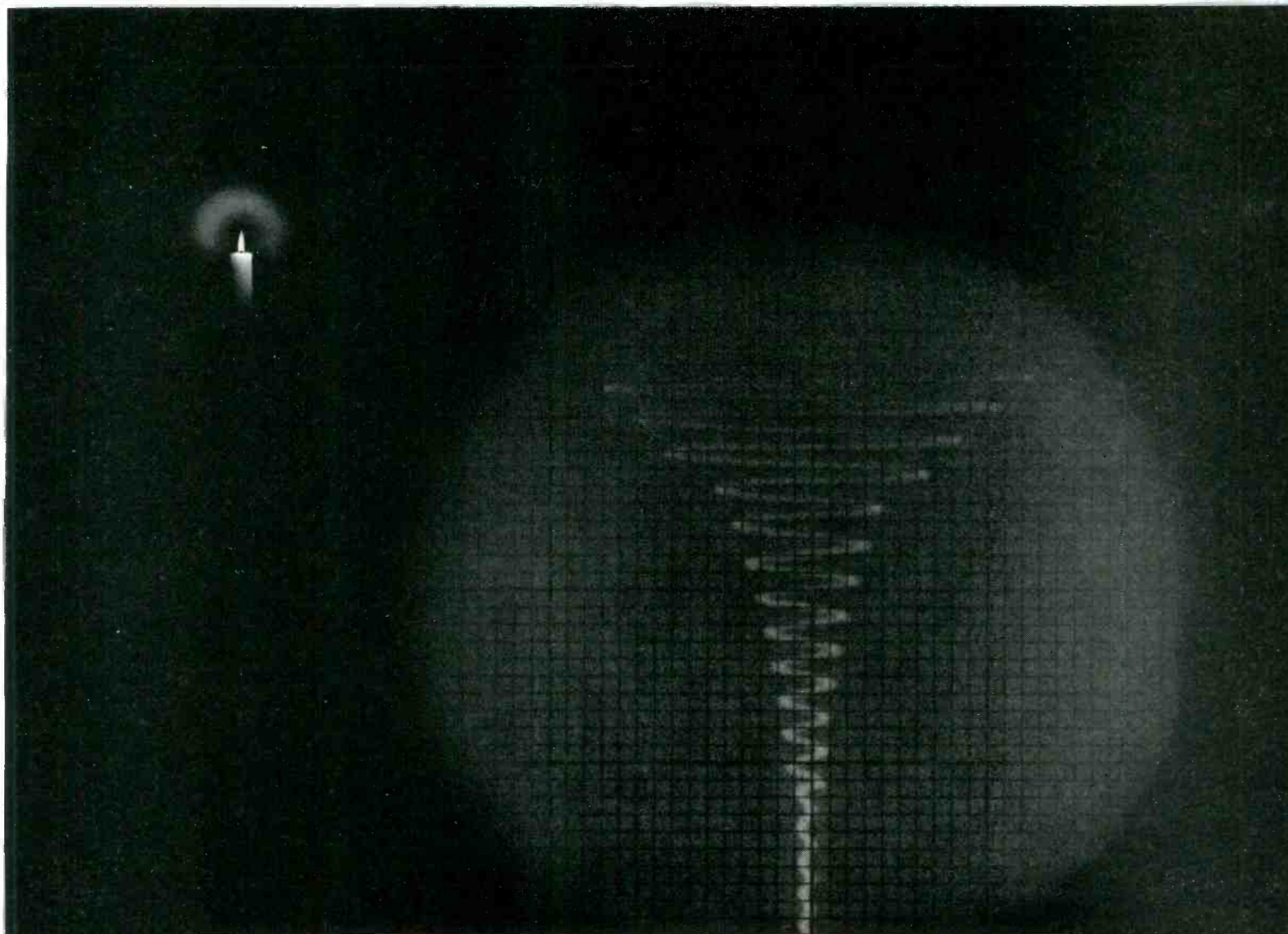
FIG. 2—Sample and sample holder for a ferrite cylinder

eliminating the 45-deg rotator on the generator-receiver end, the received polarization is at 90 deg to the transmitted polarization, permitting the use of polarization switching as a T-R device.

Research

A research program is under way to investigate the properties of ferrites in waveguide at X-band. Both circular and rectangular waveguide are being investigated, with circular and linear polarization and with longitudinal and transverse applied magnetic field. Sample dimensions and the sample holder for a cylindrical rod of Ferramic A (General Ceramic and Steatite Corp.) are shown in Fig. 2. The sample holder is modeled after one used by C. H. Luhrs and Company.

The effect of size and shape on the properties of the ferrites as well as the theoretical propagation modes in ferrite-filled waveguide are being studied. One result of



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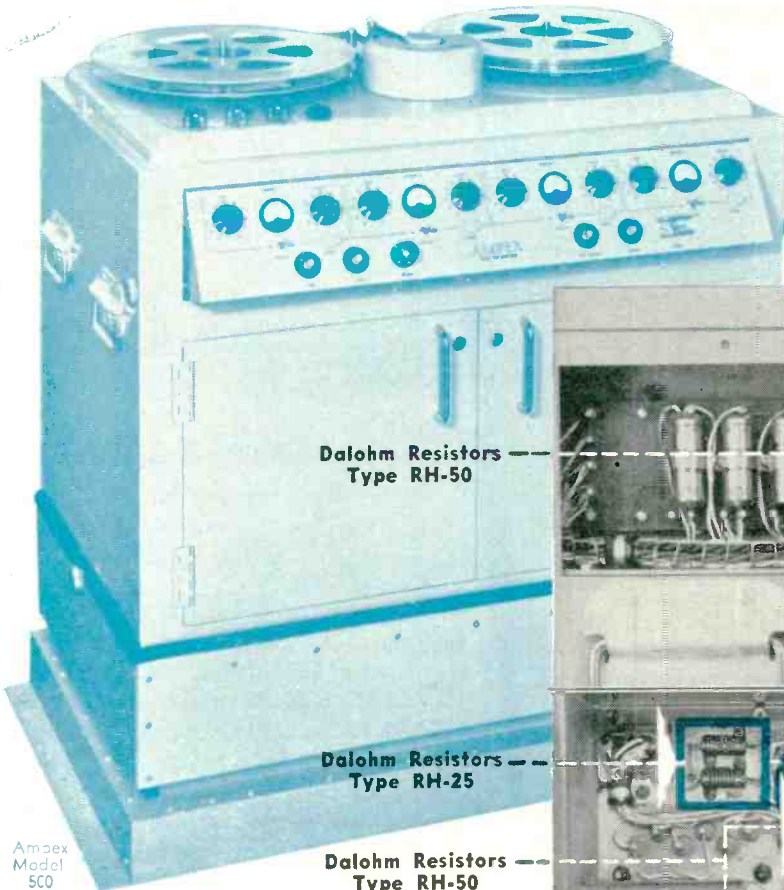

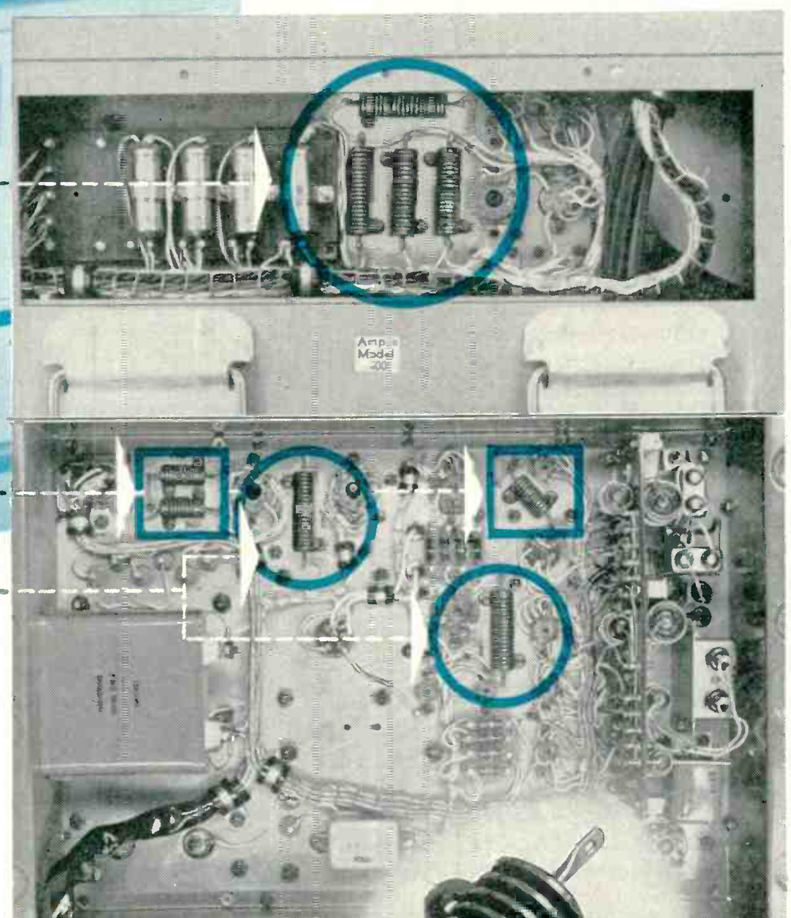

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tests so far shows that the phase shift per unit length for a given diameter rod is a function of length, increasing as length increases because of the change in demagnetization factor as the rods get longer.

It is expected that the information obtained from current research will be used in the design of many new type microwave components such as electronic phase shifters, switches, duplexers, modulators, attenuators and polarization changes.

REFERENCE

(1) D. Polder, On the Theory of Ferromagnetic Resonances, *Philosophical Magazine*, **40**, p 99, 1949.

Space-Charge Reactance Tube

BY LAVERGNE E. WILLIAMS

*Electrical Engineering Department
University of Connecticut
Storrs, Connecticut*

PRESENCE OF SPACE CHARGE in the grid-cathode region of triodes and pentodes affects the dynamic capacitance between the grid and cathode of the tube. Published theory states that the dynamic grid-cathode capacitance of ideal parallel-plane tubes (no initial electron velocity) increases by one-third when the plate current is space-charge limited and this change in capacitance is not a function of the operating conditions of the tube.[1]

The fact that the grid plane is not an equipotential plane causes the dynamic grid-cathode capacitance to vary with the operating conditions of the tube in an orderly reproducible manner. This

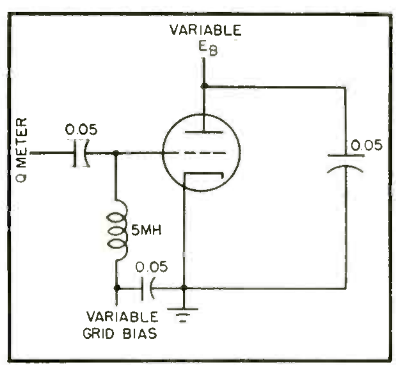

FIG. 1—Circuit for measuring the change in grid-to-cathode and plate capacitance as a function of the operating conditions of the tube

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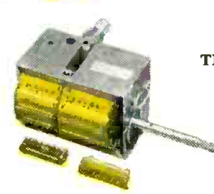

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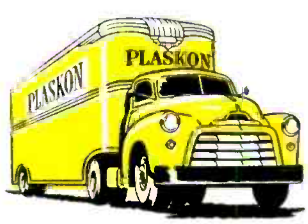

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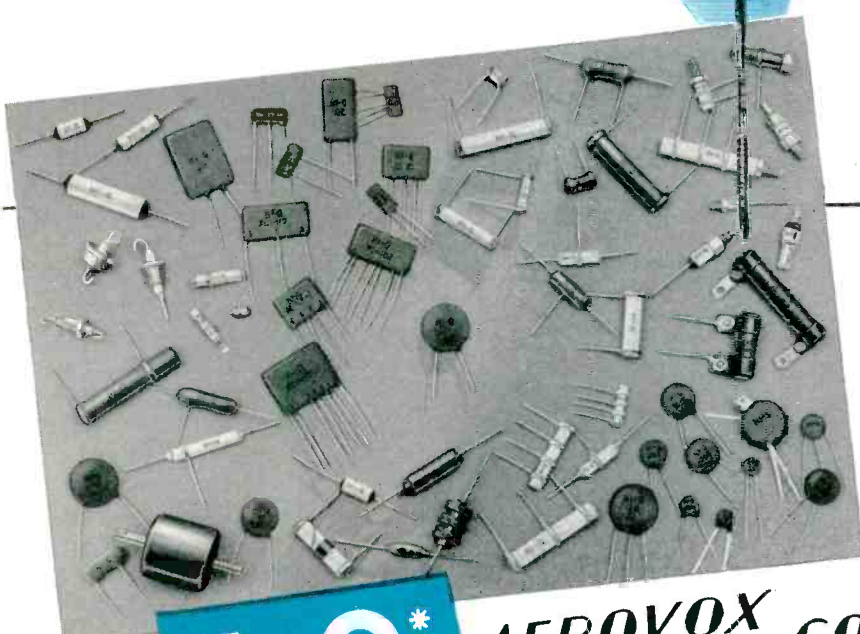

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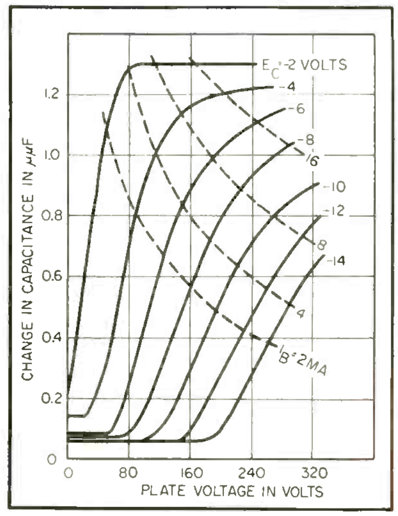


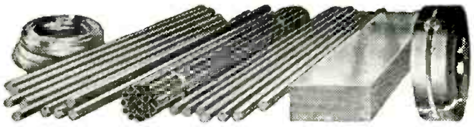
FIG. 2—Change in grid-to-plate and cathode capacitance with change in plate voltage for a 6J5

capacitance variation is a reasonably linear function of the plate and grid bias on the tube and it is of the order of one μμf or more for typical receiving-type tubes.

Capacitance Characteristics

The circuit shown in Fig. 1 illustrates how the dynamic capacitance from grid-to-plate and cathode can be measured experimentally. The tube is operated with its plate (or screen) by-passed to ground and the input capacitance is measured at various static operating conditions by means of a Q meter. Dynamic capacitance can be defined as the change in charge divided by the change in voltage, therefore, the Q meter voltage should be maintained as small as practicable (less than one volt) in order to approach a true dynamic value.

Figures 2 and 3 are plots showing how the grid-to-cathode and plate capacitance of one typical receiving type tube varies as a function of the operating conditions of the tube. Many other types of tubes, including disc seal and miniature tubes, were tested and they all exhibited similar characteristics. The curves are valid at all frequencies as long as transit time and lead inductance effects can be ignored. These data were checked at frequencies ranging from 300 kc to over 20 mc. Since the capacitance change is not a function of frequency, it is obvious that the Miller effect does not contribute to



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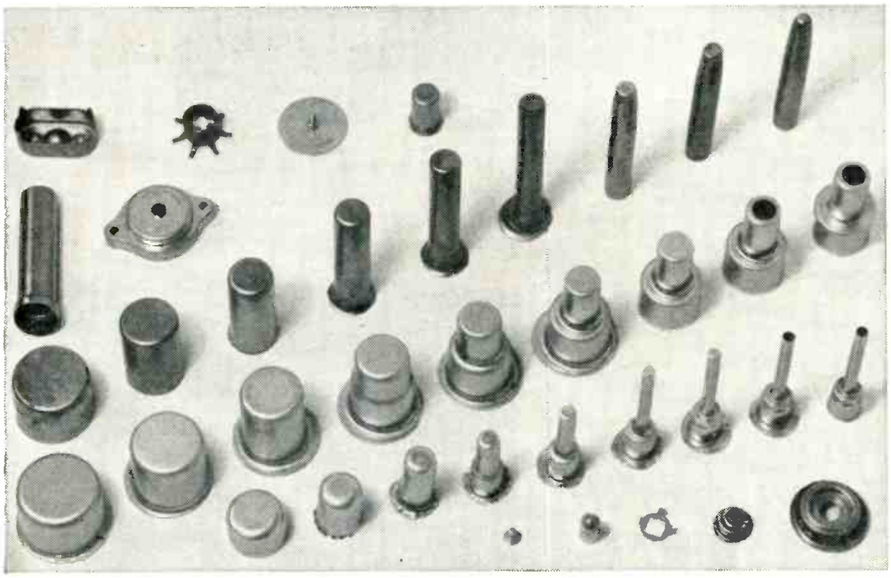


Surprisingly complicated items from sheet metal can be made on eyelet machines. Courtesy The Formatic Company, Naugatuck, Connecticut.

Cutting Costs Through Eyelet Machine Operations

If you have occasion to use, say, over 50,000 pieces of a fairly small article made from sheet metal, it is worthwhile to investigate eyelet machine production as against that made by single press operations.

The eyelet machine was originally designed for making small metal eyelets for shoes. With the development of larger machines, other items such as screw shells and socket shells and stampings were added. Today, standard eyelet machines can handle metal up to about .050" thick and can draw shells up to 3" deep. The eyelet machine can combine such operations as blanking, cupping, drawing, piercing, trimming and even roll-threading and side piercing.

Long Runs

Economy of eyelet machine operation depends on long runs. Tool costs are higher than for the single press method because more steps are performed in bringing the metal to the final shape in gradual stages. Also, setting-up time is generally longer, taking from two to three days. For jobs that can use an eyelet machine day in and day out, a remarkably low cost per piece can be achieved which more than offsets the higher tool cost.

Other advantages are less waste of material when getting started with a new job. In a matter of minutes you can tell if the finished product is correct as to dimensional specifications. On the other hand, it may take weeks to obtain the finished part which has to undergo the number of operations required with single press operations. This saves material by keeping spoilage to a minimum because of wrong tooling or incorrect radii and other dimensions.

Other economies are 1. no intermediate annealing operations; 2. no handling of separate batches for each operation; 3. no danger of injury and accumulation of dirt on parts while waiting for available presses; 4. better control on number of pieces required. Once the job gets into production, finished items leave the eyelet machine in a constant stream. This means quicker deliveries, less handling and a correspondingly lower unit cost.

Expert Tool Designing

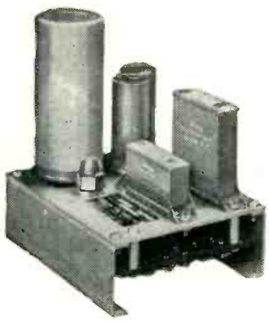
From the production standpoint eyelet machine operation is more difficult than single press operation. The eyelet machine toolmaker is a highly skilled mechanic, who must be a master at tool construction capable of performing all of the operations which the machine can do. In designing tools the increase in length of a shell is the result of reducing the outside diameter without appreciably thinning the wall. Operations must be so balanced that the metal does not become hardened too much in the early stages; otherwise, it will be too hard in temper to withstand subsequent operations. Deep shells are generally run with a slight flange to permit easy stripping and for freedom from edge cracking.

On long runs for brass or for ferrous materials, carbide dies are often used to withstand wear and permit closer tolerances. Good lubricants must be used to reduce friction between the metal and the dies.

Correct Temper and Quality

The copper-base alloy must be free from imperfections such as spills and blisters. The grain size must be comparatively fine in order to impart strength which is necessary to resist breakage when the metal stretches during forming and drawing operations. Some jobs require metal with small grain size because a smooth surface suitable for polished finishes is called for.

Bridgeport recognizes the importance of supplying eyelet metal of the correct temper or grain size for each job, uniformity of anneal, and the highest quality. In general, eyelet machine operations are so severe that poor quality metal will cause interrupted production and excessive spoilage. When working on a new job, the Bridgeport Laboratory will be glad to help specify the correct alloy and temper which will give the highest performance. (8339)



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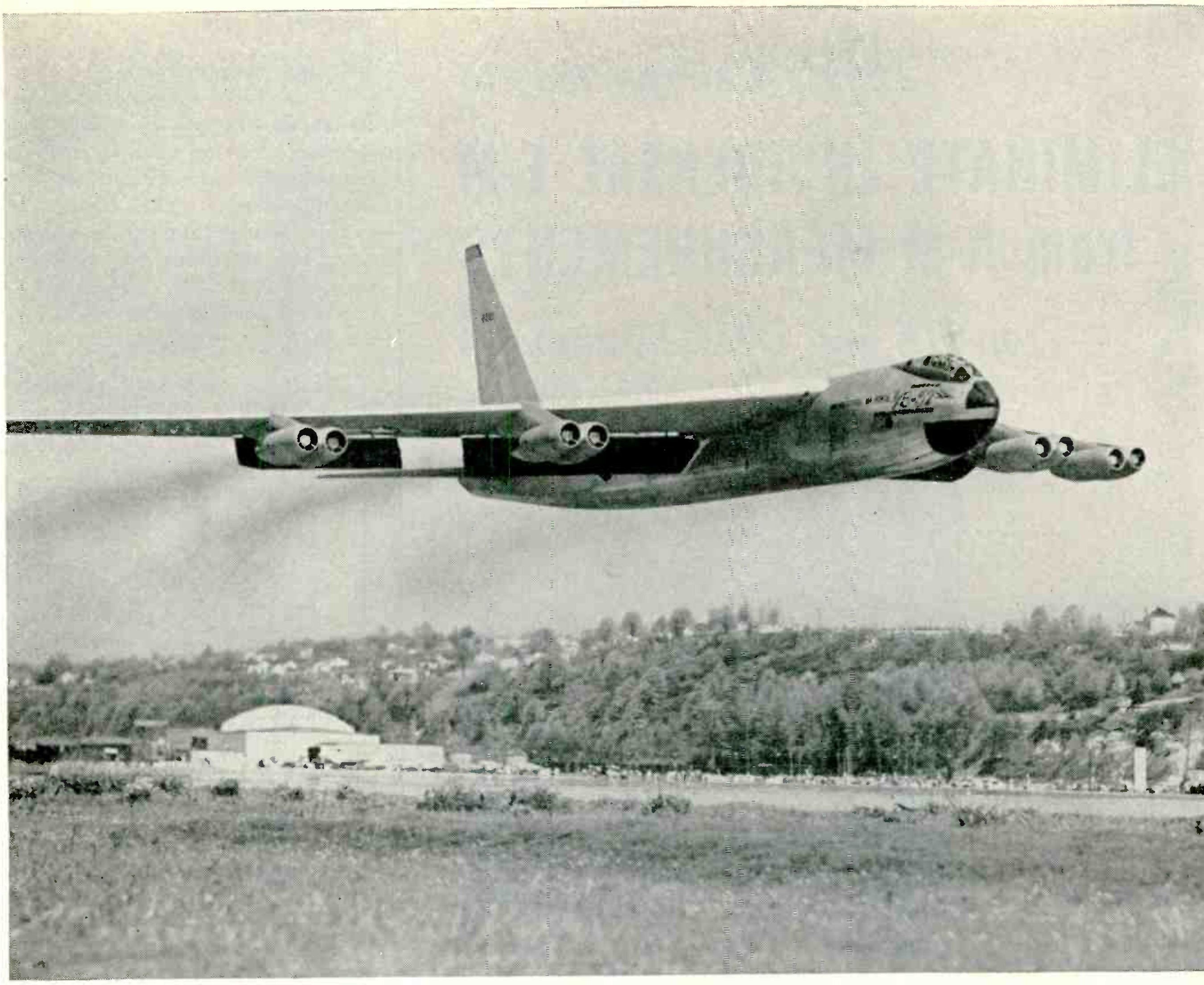

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the capacitance variations.

It has been reported that the measured change in capacitance between grid and plate is small in comparison to the change between grid-to-cathode.[2] The change in grid-to-cathode and plate capacitance can, therefore, be considered to be nearly the same as the change in grid-cathode capacitance.

The Reactance Tube

The linear portions of the curves shown in Fig. 2 and 3 suggest that the circuit of Fig. 1 would be very

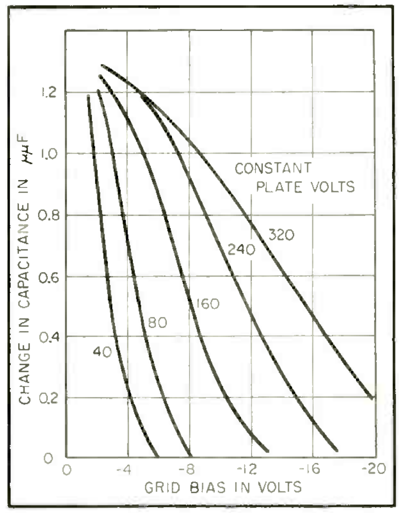

FIG. 3—Change in capacitance as a function of grid bias for 6J5

useful for many reactance tube applications. One such application is illustrated in Fig. 4. It consists of a Hartley oscillator that is frequency modulated by varying the grid bias on the reactance tube. The static characteristics of the modulated oscillator are shown in Fig. 5. As can be seen from these curves, the frequency deviation was quite linear up to + 20 kc provided that the alternating oscillator voltage was kept small compared to the grid bias on the reactance tube.

To calculate the shift in resonant frequency that can be produced by the reactance tube, consider the equation for the resonant frequency of a high Q tuned circuit.

$$f_O = \frac{1}{2\pi\sqrt{L_O C_O}} \quad (1)$$

Differentiating Eq. 1 with respect to C_o and solving for df

$$df = \frac{-f_O}{2C_O} dC \quad (2)$$

If the alternating tank circuit

voltage is small, a few volts, the instantaneous resonant frequency can be determined for each operating point of the reactance tube by merely substituting the proper value of dC from the capacitance curves into the equation. If the alternating voltage is large enough to vary the operating point beyond the linear range of the dC, the dynamic path of operation has to be determined and the average dC for an entire alternating cycle has to be evaluated and substituted into Eq. 2.

Other Applications

Since transit time and lead inductance are the only high frequency limitations on the use of the space-charge reactance tube, it should prove extremely valuable for many high-frequency applications where the loading effects, reactive and resistive, of conventional reactance-tube circuits are objectionable. It should be possible to utilize this principle to make electronically tunable high-frequency filters.

It may be possible to reduce noise and interference in a wide-band f-m receiver by feeding some of the discriminator output back to a tunable narrow-band filter in the front end of the receiver. In this way, the receiver would be continuously tuned to the instantaneous frequency of the incoming signal. Fig. 6 shows how a cavity can be tuned with a lighthouse tube.

It is interesting to note that if the modulating signal is applied to the plate circuit of the reactance tube, the capacitance can be modulated at a frequency comparable to or higher than the frequency of signal applied to the grid.

The variations of grid-to-cathode

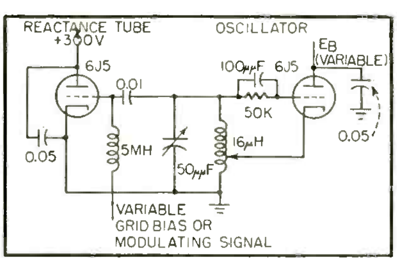

FIG. 4—Circuit for frequency modulating an oscillator with the space-charge reactance tube

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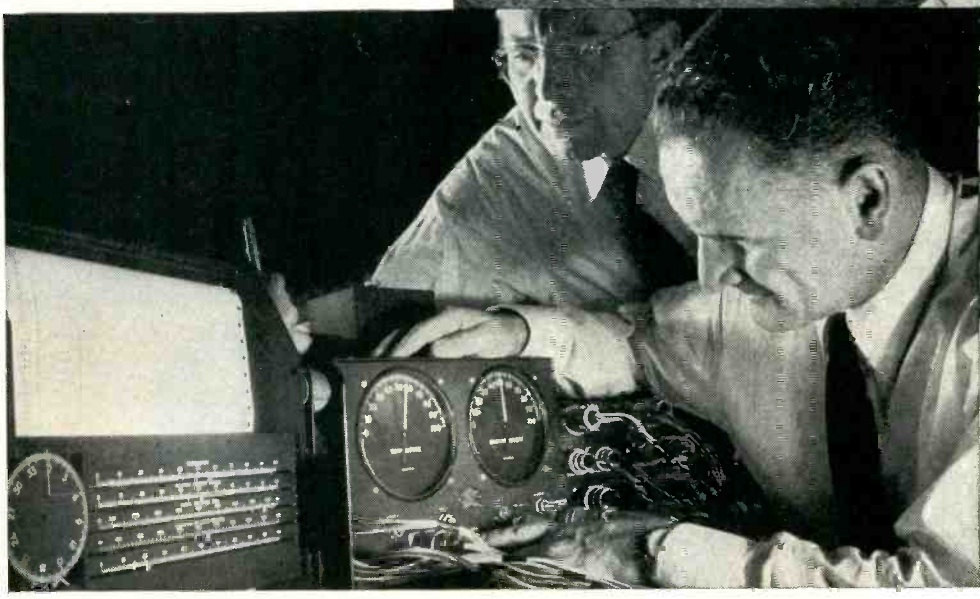

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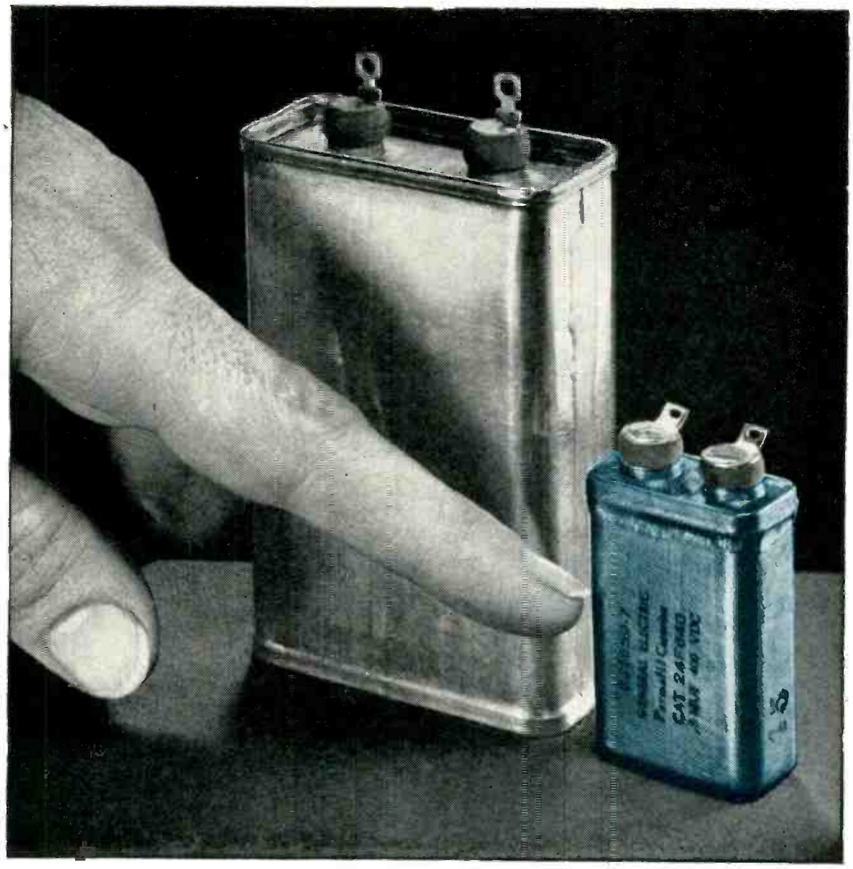

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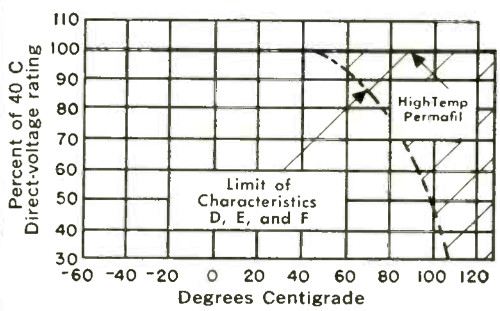

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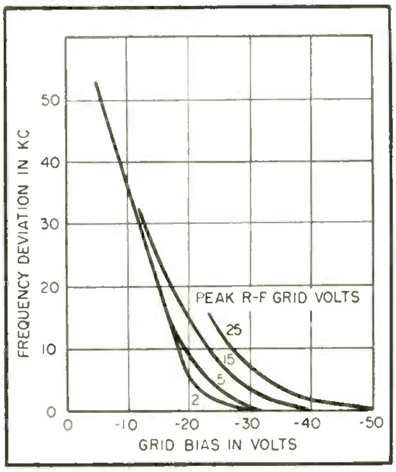

FIG. 5—Static characteristics of f-m oscillator shown in Fig. 4. Carrier frequency is 6.2 mc

capacitance with space charge as described are responsible for certain detrimental effects found in electronic equipment and the method of analysis shown here should prove useful in evaluating these conditions. Drift in self-excited oscillators is caused largely by such capacitance variations. It is also the cause of detuning in high Q circuits that are in parallel with the input to an amplifying tube. This condition occurs when an avc voltage shifts the operating point of a tube in a high-frequency narrow-band receiver.

Conclusion

The variation in interelectrode capacitance with the operating conditions of amplifying tubes has been neglected as a useful tool in the electronic art. Satisfactory space-charge reactance tubes for frequency modulating oscillators can be made and there appear to be many other applications of this principle that warrant further study.

The use of a space charge reactance tube was proposed in a

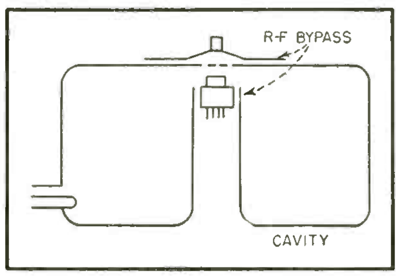

FIG. 6—Physical arrangement for tuning cavities with disc-seal tubes

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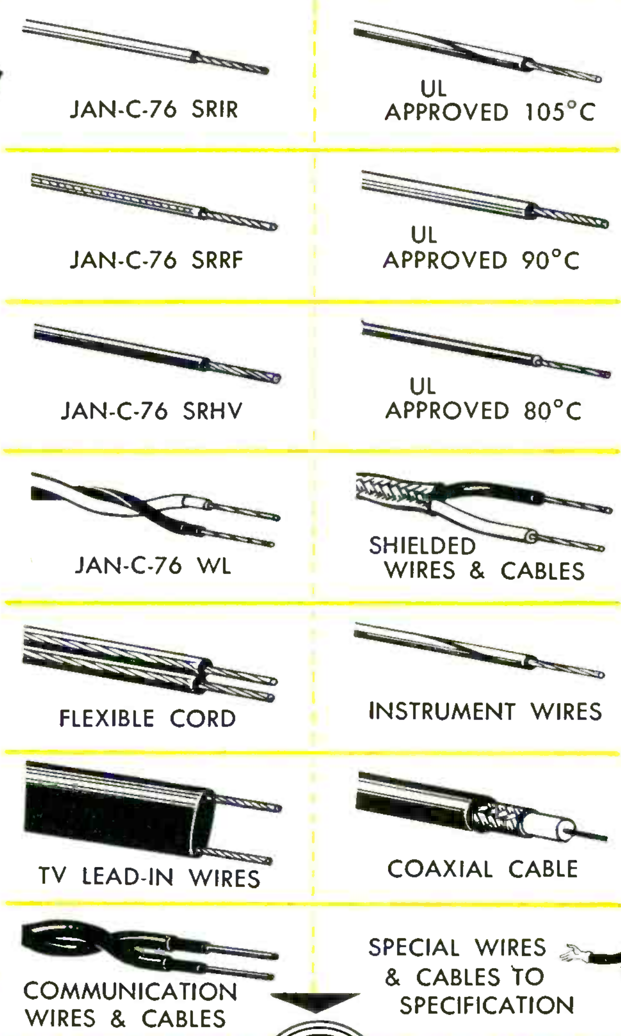

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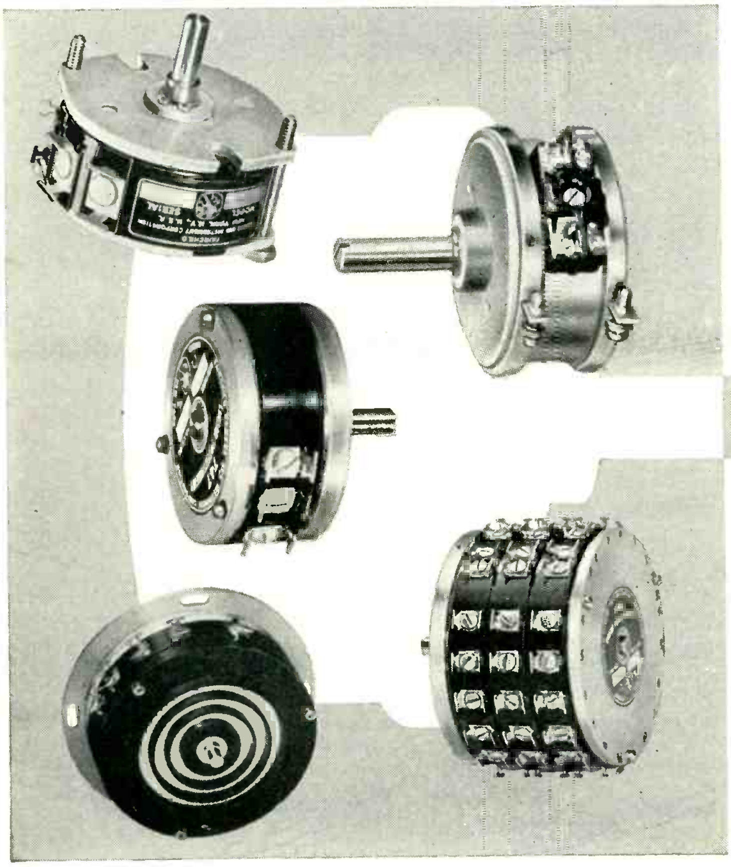

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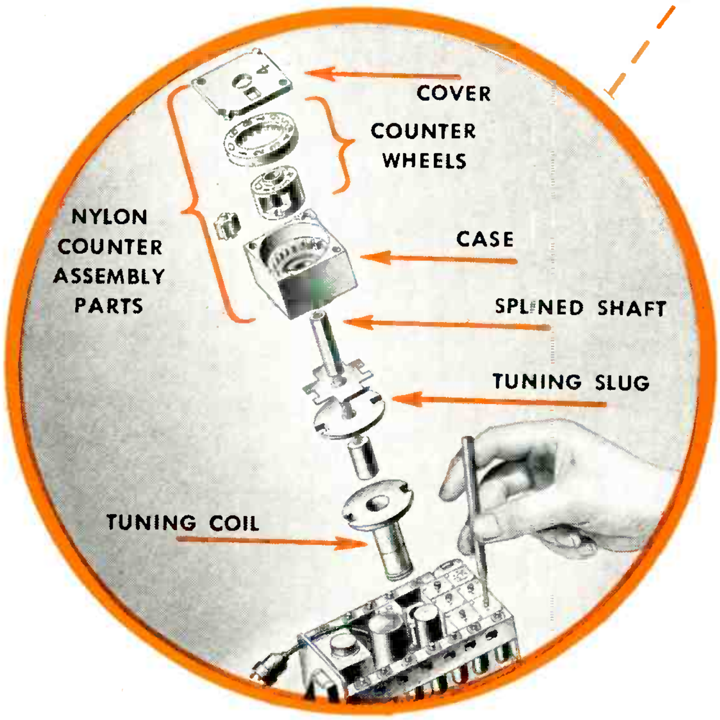

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progress report submitted to the Coles Signal Laboratory by the Allen D. Cardwell Mfg. Corp. The author wishes to express his appreciation to Professor Frederic P. Fischer of the University of Buffalo who worked with the author on the early phases of this project.

REFERENCES

(1) M. J. O. Strutt, "Modemc Mehrgitter Elektronenrokren", Edwards Brothers, Inc., 1943.
(2) T. I. Jones, Inter-electrode Capacitance of Values, *Journal Institute of Electrical Engineers*, 81, p 658, June 1937.
(3) Input Admittance of Receiving Tubes, RCA Application Note, AN-118, April 1947.

Cost Reduction in TV Power Supplies

By L. R. RUOFF
Dalworth, Inc.
Elmhurst, N. Y.

THE AVERAGE television receiver uses B voltages in the ranges of 135, 250 and 375 volts. The power supply must produce the highest of these at the output of the filter. The lower voltages are obtained by dissipating the excess through bleeders.

Bleeders are expensive, high-wattage, wire-wound resistors and in various sets will dissipate from 20 to 40 watts. A small portion of this power dissipation may have some value in certain sets, as a regulating load on the power supply, the balance is pure waste. Its elimination, which is here proposed, will permit definite savings to be made in power transformer copper and iron, as well as power resistors.

For illustrative purposes select the circuit of the 630TS, which is familiar to every engineer and technician in the industry, and which, with various modifications, is cur-

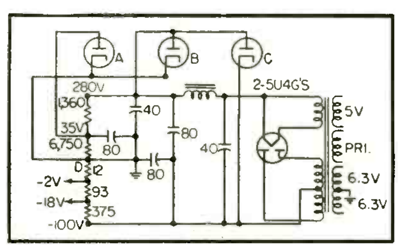
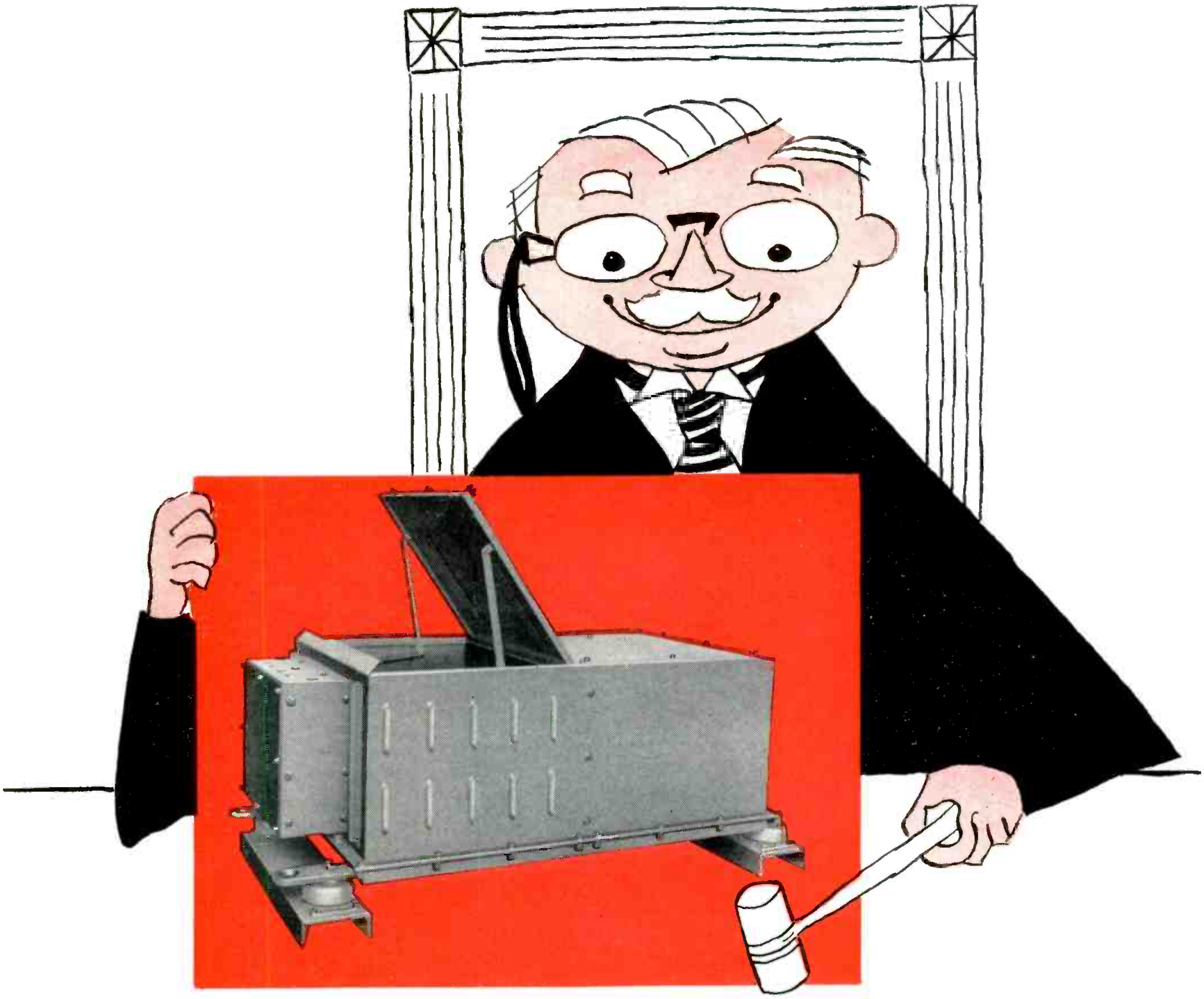


FIG. 1—Schematic of the power supply and voltage distribution to various tubes of a 630 set. Tube letter designations are explained in text



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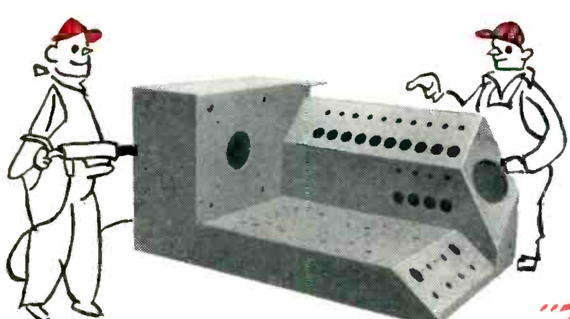

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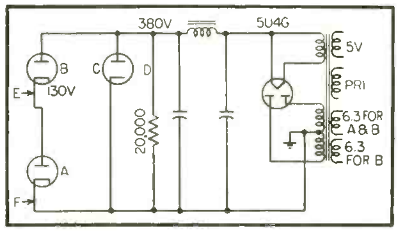

FIG. 2—Rearrangement of the circuit of Fig. 1 to conserve materials in power supply

rently manufactured in considerable quantities.

Figure 1 illustrates the power supply and voltage distribution to the various tubes of such a set using a permanent magnet focusing and centering device. The group of tubes using a 135-volt plate supply, with current requirements of approximately 100 ma, are represented by *A*. The tubes using a 275-volt plate supply and current of about 80 ma are represented by *B*. The *C* group of tubes use the entire 380 volts at about 100 ma and *D* is the regulator section of the bleeder, dissipating 20 ma. The total current is thus 300 ma at 380 volts, or 114 watts. The 1,360-ohm and 12, 93, 375-ohm sections of the bleeder dissipate 31.5 watts, the need for which can be eliminated by rearrangement of the circuitry. Figure 2 illustrates this rearrangement.

As before, the 380-volt potential is required by the tubes in group *C*. Group *B* will operate as well at 250 as at 275 volts, and group *A* may be reduced to 130 volts without effect on performance. Groups *A* and *B* thus add up to 380 volts and by literally stacking one on top of the other they may share the voltage but will both use the same current. Each acts as the bleeder for the other and by minor adjustments, perhaps for instance by switching a tube with noncritical requirements from one group to the other, the current requirements for the two groups may be made to coincide at approximately 90 ma. With the current required by group *C* this totals 190 ma or about 42 watts less than the original circuitry. This is also well within the capacity of a single 5U4G rectifier and a tube and socket with associated wiring may be added to the

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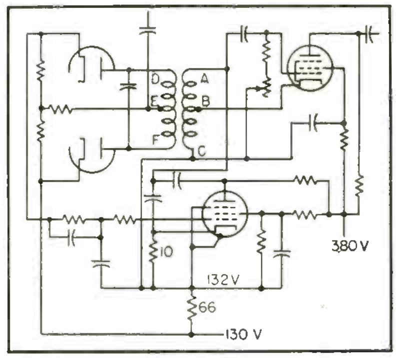

FIG. 3—Horizontal sync discriminator, oscillator and oscillator-control tubes at 130v above ground

previously mentioned economies. The 20,000-ohm resistor in Fig. 2 is a regulatory bleeder, which is not as necessary as before but may be used if desired, and the 19 ma dissipated will still not put the current requirements beyond the capacity of a single 5U4G rectifier.

Any negative bias voltages required by group *B* may be developed at point *E* (Fig. 2) and for group *A* at point *F*. To illustrate this, Fig. 3 is given, showing the horizontal sync discriminator, oscillator and oscillator control tubes elevated as a group to a point 130 volts above ground and supplying the −2 volts bias required by the grid of the 6AC7 oscillator control tube. The 130-volt point is the plate voltage bus for the entire r-f and video amplifier sections.

The author has a 630 set modified as follows. A 70-deg picture tube with 16-kv second-anode supply, 6CD6G horizontal output tube drawing 35 ma more current then the original, plus a phase-inverter push-pull audio arrangement drawing about 40 ma more than the original single side audio. Adding these to the original requirements of the circuit totals 375 ma. With the set modified along the lines presented above, however, the B+ current requirement is actually 250 ma and a single 5R4GY rectifier tube carries the load very nicely.

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quency mutual-inductance probes, the method is sensitive to height changes of as little as 0.0005 inch. It also has the advantages of not requiring direct visual observation of the mercury surfaces, the mercury columns need not have transparent windows, and readings can be made at a distance. Since no float or electrical contact is required, disturbance of the mercury surface is minimized.

Above the mercury surface in each column is mounted a mutual-inductance probe, Fig. 1, consisting of a primary and a secondary coil. When the primary coil is supplied with constant r-f current, the voltage induced in the secondary varies with the mutual inductance or coupling between the two coils. The

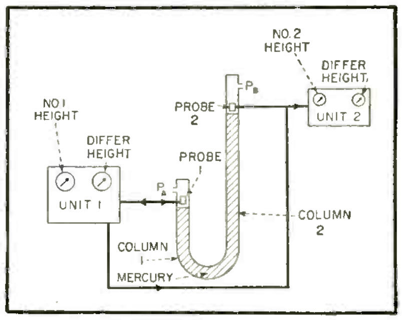

FIG. 1—Simplified diagram of electronic method for sensing differences in heights of mercury columns

mutual inductance, in turn, varies with the proximity of the mercury surface. The closer the mercury surface is to the probe, the greater is its shielding effect and the less the output voltage. The output voltage thus becomes an index of probe-to-mercury distance, and can be used to indicate this distance with high precision.

The electronic circuitry, except for the two probes, is contained in two small cabinets. Each cabinet is connected electrically to its associated probe and to the other cabinet. One zero-center microammeter on each cabinet is calibrated to indicate variations in the height-difference of the two mercury columns.

When the differential-height meters read zero, the probe-to-mercury distances in the two columns are identical. The difference in the mercury-surface heights is then equal to the difference in the probe

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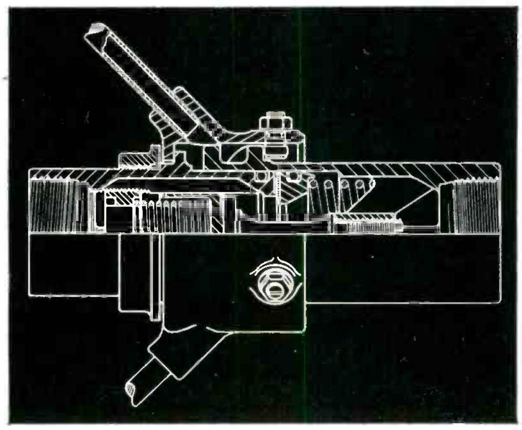

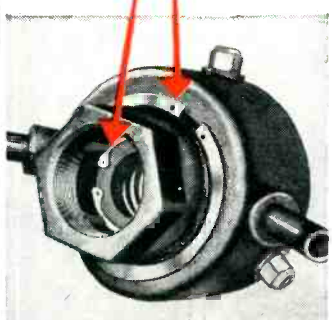

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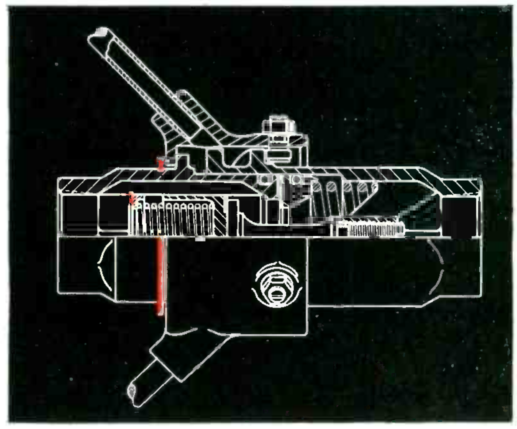

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Photic Stimulator for Medical Use

By V. F. Arnold
Marconi Instruments Ltd.
St. Albans, England

If convulsive fits of the type experienced by epileptics can be induced in persons with certain mental conditions such as melancholia and chronic depression, cure or relief can be obtained. These fits have been induced by means of drugs and, more recently, by currents passed through the head between the temples. Both methods have disadvantages.

Recently it has been discovered that stimulation by means of flashing light can produce fits in certain epileptics and also that this stimulation reduced the quantity of convulsant drug required to produce a fit. A group of medical workers in England decided to investigate the photic stimulation-drug combination as a substitute for the normal electric shock method of convulsion therapy.

In this experimental method a small dose of convulsant drug, insufficient to produce any noticeable effect, is administered to the patient. A powerful flashing light, the flash frequency of which is regular and controllable is then held before the patient's closed eyes and

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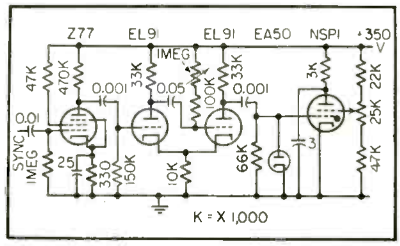

FIG. 1—Initial circuit which proved to be unstable because of lack of synchronization for the neon tetrode

in a few seconds gentle convulsions begin to occur. If the light is removed, the convulsions subside and it is the control of the convulsions which is the great attraction of this method. Encouraging results have been obtained. The development of a suitable light source is described herein.

The light source was required to produce flashes of fairly high intensity at a stable repetition frequency variable between about 5 and 25 per second.

Initially a small industrial stroboscope was used, Fig. 1. This instrument used a neon-filled tetrode lamp which could be triggered by negative pulses applied to its control grid. The lamp was primarily intended to be synchronized by a voltage derived from the object under examination. In addition by adjustment of the screen voltage, the lamp could be operated as a relaxation oscillator.

The synchronizing circuit consisted of an amplifier stage followed by a short-time-constant coupling which produced trigger pulses from waveforms fed in at the sync terminal to trigger a flip-flop. This flip-flop produced the lamp-triggering pulse by differentiation of the back edge of its anode waveform which was of variable width for phase control.

As the neon lamp had to be operated without synchronization, it was rather unstable and this together with a rather high minimum flash frequency of 10 per second were serious obstacles to satisfactory results.

Circuit Modification

It was decided to modify the apparatus so that the neon lamp would be triggered from a stable source with a minimum flash fre-

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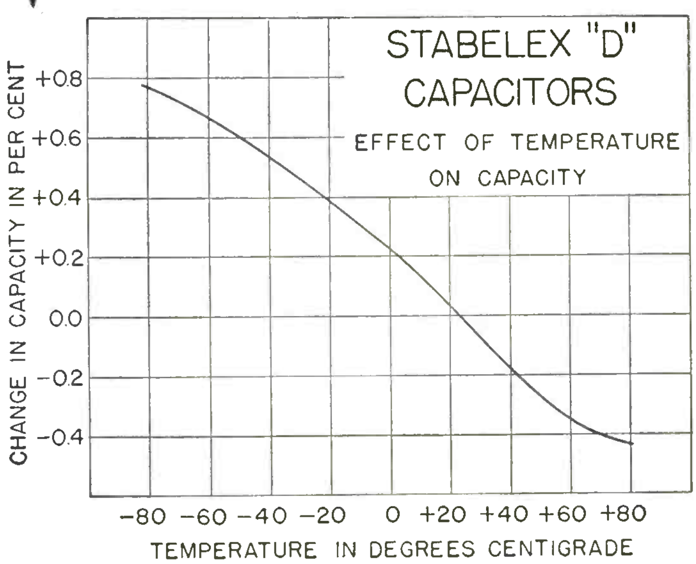

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quency of 5 per second. The first tube of the flip flop was converted into a transitron sawtooth oscillator with a frequency range of 5 to 50 cycles, Fig. 2. This sawtooth waveform was phase inverted in the second stage. Since the waveform applied to the grid was of about 100-v amplitude and grid base was 4 v, the anode waveform was almost square with a very fast negative-going back edge.

The anode waveform was differentiated in a short-time-constant coupling circuit and the positive pulses were removed by a diode. The remaining negative-going pulses had an amplitude of about 40 v and were of approximately 1 millisecond duration. These pulses were sufficient to fire the lamp and the stability was more than adequate.

The lamp used was a Ferranti Neostron. The 3-μf capacitor in the lamp circuit was charged through a resistor from the supply and was discharged by the lamp when triggered. The time constant of this capacitor and resistor must be short compared with the interval between flashes at the highest flash frequency so that the capacitor is always fully charged when the lamp is triggered. The screen voltage of the lamp was kept low to prevent spontaneous triggering.

With this new circuit, excellent results were obtained and the medical workers have published results of their work using this circuit.[1] An argon-filled lamp was also tried out but this was less effective.

Final Circuit

Clinical trials were continued and at a later date the medical workers formed the opinion that a more intense light might be an advantage and it was decided to use a Mullard

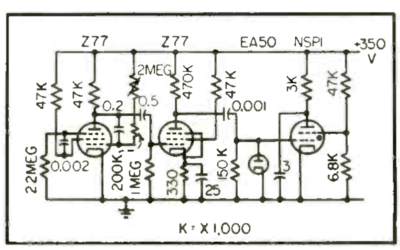

FIG. 2—Revised circuit using a transitron sawtooth oscillator

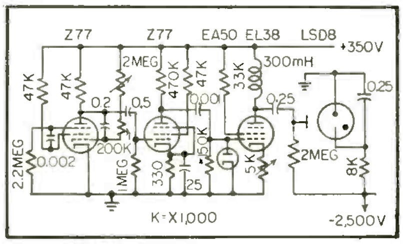

FIG. 3—Third circuit using xenon-filled flash tube

flash tube. The Neostron had been operated on the 350-v instrument supply but the new lamp required an anode voltage of 2.5 kv and a trigger pulse of about 3.5 kv.

An attachment was built to house the lamp supply unit and the trigger pulse generator. The high-voltage lamp supply was required to provide a current of 10 to 15 ma and presented no difficulties. In order to produce the trigger pulse it was decided to use the back emf of a choke when the current through it is suddenly interrupted. Initially for convenience a small smoothing choke was used with an isolated core. Later a 300-mh air-core choke was used with a saving of weight.

The choke was connected in the anode circuit of a line-scan pentode, Fig. 3, and the bias adjusted for a steady current of 60 ma. The neon lamp was removed and the negative trigger pulse was coupled to the control grid, cutting it off for the pulse duration. The required 3.5-kv pulse for the flash tube could be easily obtained from the choke. A ceramic holder was used for the lamp to prevent tracking.

The energy used in each flash of this lamp was about five times that of the neon lamp. The flash tube is xenon-filled and produces a blue-white light. The lamp was enclosed in a housing which incorporated a reflector, since the trigger electrode is mounted outside the lamp. Heavy ignition cable leads, enclosed in a thick sleeve were used to connect the lamp to the instrument. All metallic parts of the lamp housing were grounded and the housing was provided with a Bakelite handle.

This new lamp unit has now been in almost daily use for many months and the increased brilliance is con-

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ELECTRICAL PROPERTIES

Low power factor and dielectric constant of the 3797 type waxes recommend their use on high frequency electrical components.

3797 APPLICATIONS & PROPERTIES

Particularly recommended for:

a — Plunge dip coating applications in which relatively thin semi-transparent coatings are required.

b — Impregnations at atmospheric pressure when rapid penetration and minimum residual surface excess is sought.

Melting Point (Drip)	260/265 F
Flash Point	480 F
Fire Point	530 F
Viscosity, Brookfield, 325 F	8-10 cps
Penetration, 77/100/5	18-22
Power Factor, 77 F, 1 mc	0.003 max.
Dielectric Constant, 77 F, 1 mc	2.5

3797-B APPLICATIONS & PROPERTIES

Medium high viscosity and recommended for:

a — Plunge dip coating units which demand a moderately heavy protective coating.

b — Vacuum impregnations in which complete fill of internal voids as well as saturation of porous insulation is desired. (A data sheet for this application is available.)

Melting Point (Drip)	260/270 F
Cold Flow (M-R)	255/265 F
Penetrations: 32/200/60	12-15
77/100/5	17-21
115/50/5	25-33
Color	Tan
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Specific Gravity	0.94
Flash Point	480 F
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@ 305 F	208 cps Ave.
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Those who have witnessed this new method of convulsion therapy are impressed with the apparent advantages of the method over those at present in use and it is to be hoped that further work in this field will confirm the promise which is at present shown and that the new therapy treatment will be established.

REFERENCE

(1) P. O'Flanagan, J. I. Timothy and H. G. Gilson, *Jour. Mental Science*, 97, p 174, Jan. 1951.

Alarm Signal Generators

By M. B. FREEDMAN and T. E. ROLF

Special Devices Engineering Section
Engineering Products Department
RCA Victor Division
Camden, New Jersey

BELLS, SIRENS and horns through long association have become familiar to most people as attention commanding devices. With the advent of electron-tube amplification, the evolution of the speech reinforcing system into a means of communicating with groups separated from each other began. It was inevitable that designers would seek to incorporate signals into their systems.

In the interests of space reduction and to centralize the signal producing devices at the control centers, means were sought to synthesize the natural devices. The electric carillon under development at this company provided one means for producing alarm bell signals. In this device steel reeds having tonal characteristics similar to bells were associated with small magnetic pickup devices whose outputs were fed to amplifying and reproducing equipment.

One of the early signal gener-

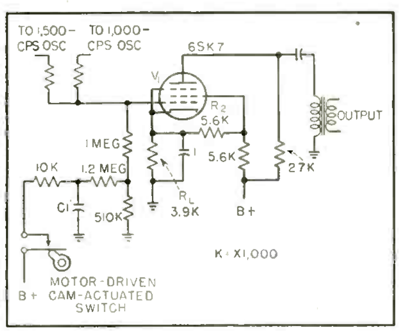

FIG. 1—Pulsed amplifier for bell signal

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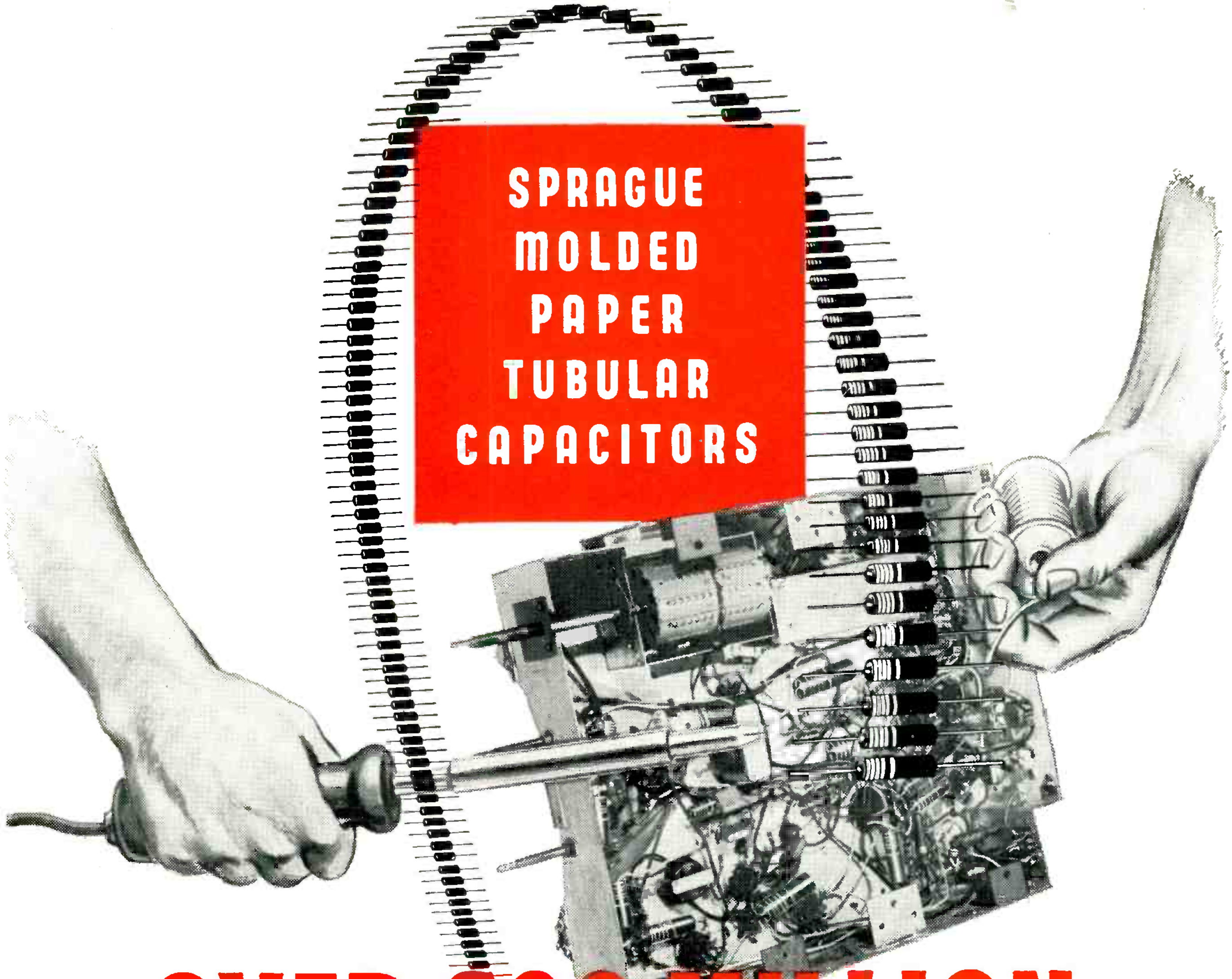

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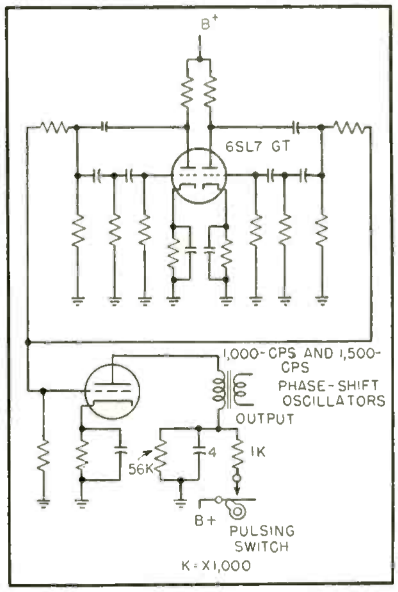


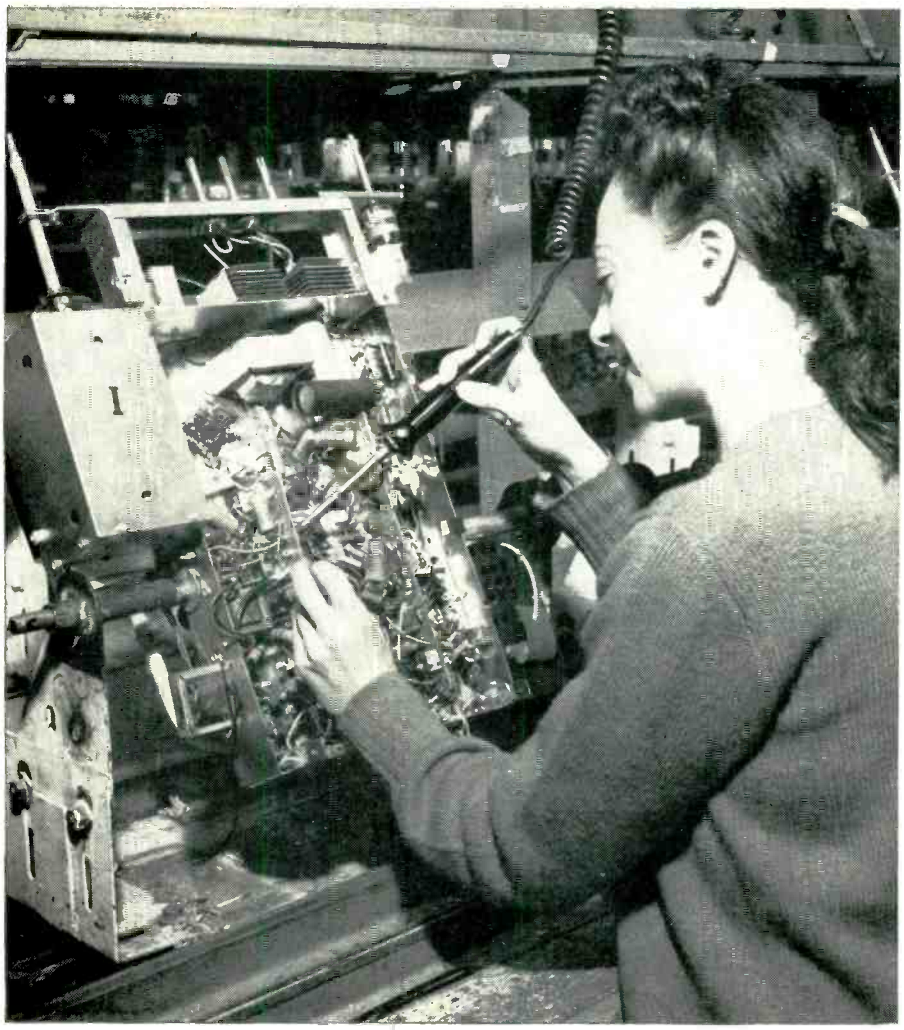
FIG. 2—Bell signal generator

ators for producing alarm bell signals in announcing systems contained one of these reeds with the approximate characteristic of an eight-inch gong. A motor-driven cog wheel actuated the striker and the output of the pick-up was fed to the announcing amplifiers. To reproduce a motor-driven horn signal one of the small carileon pickups was mounted adjacent to the steel diaphragm of a klaxon and the pickup output fed to the amplifier input.

The limitations of the announcing systems were factors in the ultimate choice of a bell signal. It was essential that the fundamental tone of the bell should fall in a frequency band where the reproducer would have adequate output and yet should be as low in frequency as possible to provide the effect of a large gong. Since the announcing systems under consideration were primarily for speech frequencies, the frequency range was limited approximately to the band between 300 and 5,000 cps.

Loudspeakers were designed as integral parts of the system and due to service conditions were restricted in their low-frequency response. A frequency of 500 cps for the fundamental tone of the gong was selected as the best compromise between the most desirable tone frequency and the greatest reproducer response.

Since the upper frequency re-



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sponse fell off rapidly above 4,000 cps the higher order harmonics of the bell tone were ignored. It was found that the second, third, and fifth harmonics of the bell tone provided sufficient realism to identify the tone.

Two oscillators were used, one at approximately 1,000 cps and the second at 1,500 cps. The two ferquencies were mixed in such relation that the beat note of 500 cps became predominant. The composite tone was then fed to a pulsed amplifier stage in which the tube was caused to operate at full amplification momentarily and then decay gradually, to provide an output simulating the characteristic strike

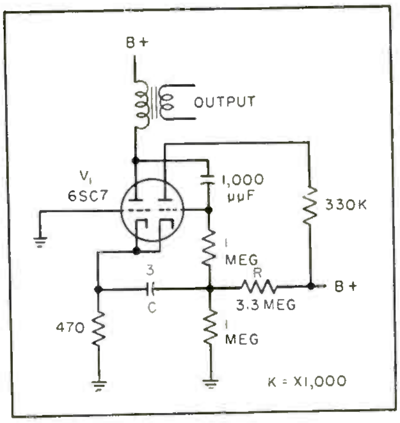

FIG. 3—Siren oscillator

and decay of a bell or gong.

Figure 1 shows such a pulsed-amplifier circuit. The amplifying tube V_1 is a remote cut-off pentode in which the grid is normally biased to cutoff by the bleeder circuit R_L R_2. The momentary application of a positive voltage to C_1 overcomes the initial bias, the difference voltage being such as to provide operating bias for normal gain.

After the voltages pulse, capacitor C_1 discharges slowly through its discharge network, allowing the grid bias to increase negatively and thus gradually reduce the gain of the stage. The time constant of the decay network is chosen as a function of the repetition rate of the gong signal to provide a suitable ratio between the minimum and maximum tone levels.

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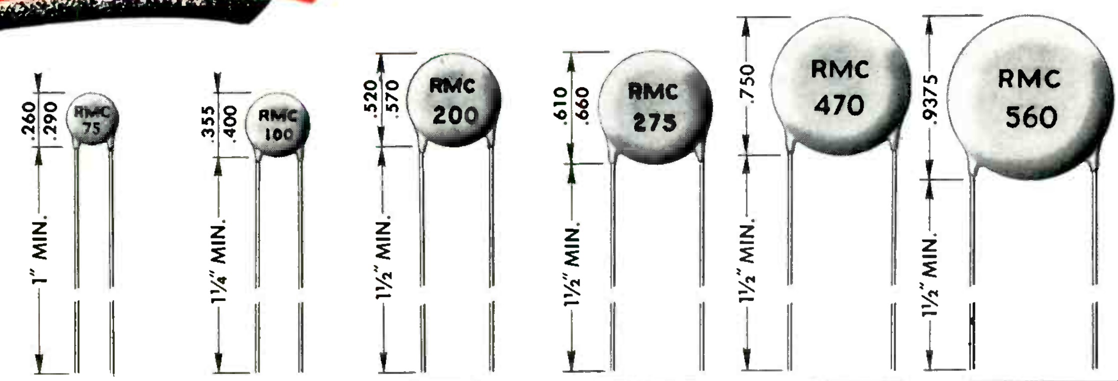

TC	1/4 Dia.	5/16 Dia.	1/2 Dia.	5/8 Dia.	3/4 Dia.	7/8 Dia.
P-100	——	2– 9 MMF	10– 30 MMF	——	——	——
NPO	2– 12 MMF	13– 27	28– 60	61– 75 MMF	76–110 MMF	111–150 MMF
N– 33	2– 15	16– 27	28– 60	61– 75	76–110	111–150
N– 80	2– 15	16– 27	28– 60	61– 75	76–110	111–150
N– 150	2– 15	16– 30	31– 60	61– 75	76–110	111–150
N– 220	2– 15	16– 30	31– 75	76–100	101–140	141–190
N– 330	2– 15	16– 30	31– 75	76–100	101–140	141–190
N– 470	2– 20	21– 40	41– 80	80–120	121–170	171–240
N– 750	5– 25	26– 50	51–150	151–200	201–290	291–350
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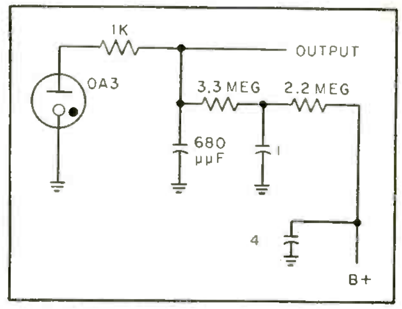


FIG. 4—Gas-tube simulated siren

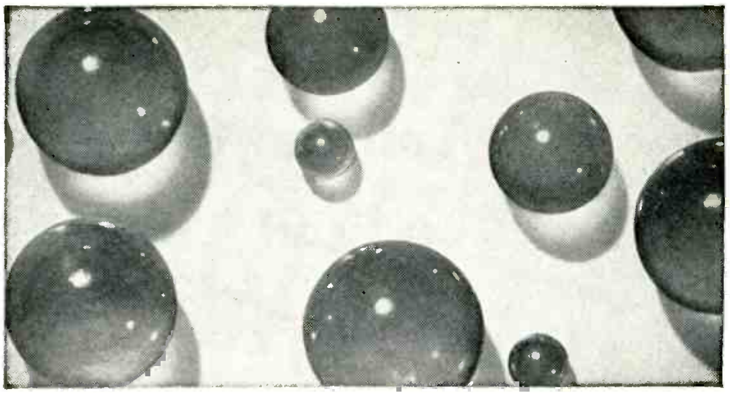
decrease after passing the knee with increasing negative grid voltage, provides the most natural sounding bell. Difficulties in maintaining the grid-bias voltage differential while holding reasonable manufacturing tolerances or avoiding selective assembly of resistors makes this circuit somewhat undesirable in production manufacturing.

The pulsed amplifier circuit of Fig. 2 has proven satisfactory in its decay characteristic as well as from a manufacturing standpoint. This circuit is still used in current designs. In this circuit, which is a standard amplifier insofar as circuit constants or tube selection is concerned, the plate voltage is applied as a pulse to the decay network and to the triode plate. As in Fig. 1, after the voltage pulse the plate voltage, now obtained from the 4-μf capacitor, decays gradually to zero and amplification ceases unless another pulse is applied. Here again the decay characteristics are determined by the repetition rate of the signal.

The oscillators used to produce the composite bell tone were R-C phase-shift types as shown in Fig. 2. Circuits producing essentially sine-wave outputs have proven most desirable from the standpoint of naturalness of tone and avoidance of spurious frequency components in the final output.

Attempts to simulate sirens and motor-driven horns electronically have resulted in several successful circuits using gas-tube oscillators and multivibrators.

The siren circuit of Fig. 3 utilized a cathode-coupled multivibrator to provide an oscillator in which the frequency is dependent



upon the voltage applied to the grid via the R-C delay network.

The circuit of Fig. 4 using type VR75 tubes was produced for a time and provided a very realistic siren tone. Because of the high voltage required for striking the tube and the necessarily high values of resistance required in the delay circuit, the successful operation of this oscillator was dependent upon a value of tube leakage current less than the maximum allowed in the manufacture of the tube. Excessive gas current caused sufficient voltage drop in the delay circuit to hold the anode voltage below the striking voltage.

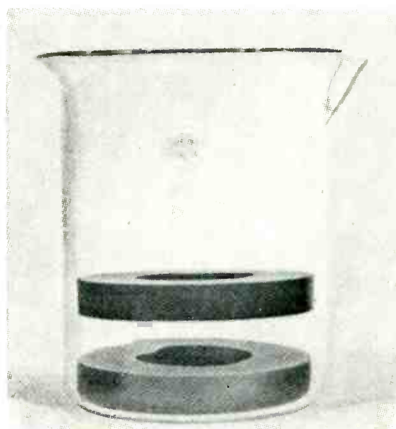
Additional circuits will be discussed by the authors in a second article to appear in a future issue.

Ceramics for Permanent Magnets

A NEW CLASS of sintered oxidic magnetically hard materials has been developed by the Philips Research Laboratories at Eindhoven, Netherlands. The oxides can be used as materials for permanent magnets even though they do not contain any nickel or cobalt. They have been given the name of Ferroxdure and have the approximate composition $BaFe_{12}O_{19}$.

Some of the applications for the new material are loudspeaker circuits, magnets for fixing one object to another, magnets for oil filters, magnets for focusing electron beams, electric generators and motors and magnetomechanic couplings.

Ferroxdure has an extremely

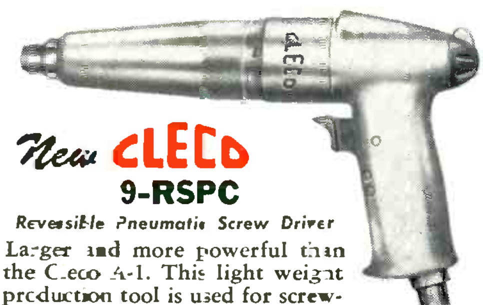


Two magnets of Ferroxdure as used in loudspeaker circuits magnetized in the direction of the axis

Photograph Courtesy General Radio Company, Cambridge, Mass.

CLECO
A-1 PNEUMATIC REVERSIBLE
SCREW DRIVERS

This little tool is doing a great big job!



New **CLECO**
9-RSPC
Reversible Pneumatic Screw Driver

Larger and more powerful than the Cleco A-1. This light weight production tool is used for screw-driving and nut running on many production jobs.

Capacity 1/4" machine screws or No 14 wood screws.

Write for bulletin. P-851.

So small it is almost hidden by the man's hand, this Cleco A-1 pneumatic screw driver is increasing production of potentiometers by running No. 8 nuts *fast!*

Ideal for similar small work, the A-1 is much easier to handle than larger tools. Operator fatigue is reduced and as a result, production is increased even further.

In spite of its small size and light weight, the Cleco A-1 is a rugged production tool built for years of service. Write for bulletin S-750 or, better yet, ask us for a demonstration in your own plant.

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high value of coercive force and low remanence and saturation magnetization. The high value of coercive force is due to a large crystal anisotropy. Combination of the two properties, large coercive force and low saturation magnetization, means that the material has a large resistance to demagnitization.

These properties open new methods of design for permanent magnets. The $(BH)_{max}$ value of the material is low and its specific resistivity is high so that it is well suited for high-frequency applications.

A complete description of the new ferromagnetic oxides is given in the January 1952 issue of *Philips Technical Review* in an article on page 194 from which the information presented here was abstracted.

Germanium Power-Rectifier Construction

By FRED J. LINGEL

Commercial and Government Equipment Dept.
General Electric Company
Syracuse, New York

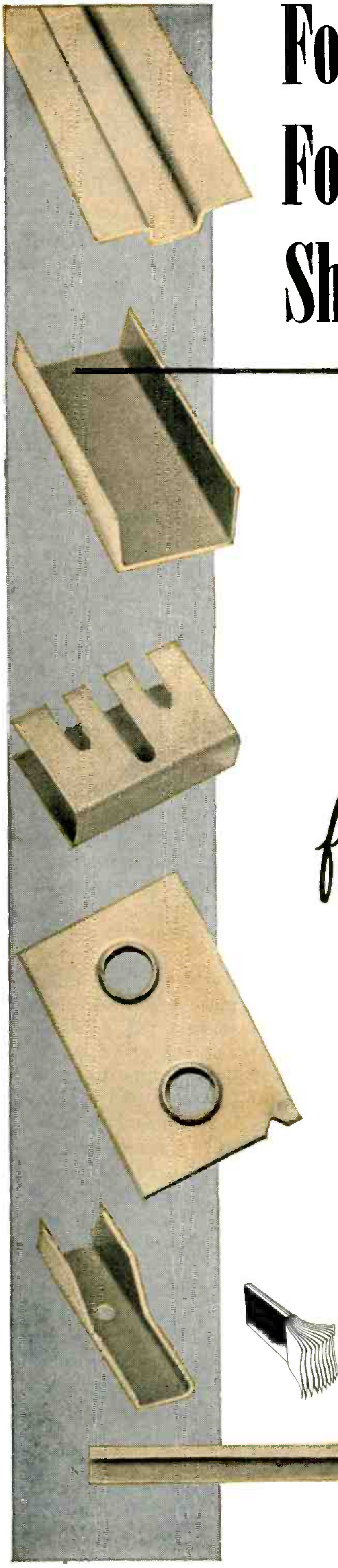
THE DOT-TYPE GERMANIUM power rectifier known as the G-10A and developed by General Electric has a forward resistance of two ohms at 350 ma, back voltage of 100 to 400 volts peak, frequency range from 0 to 50 kc, will withstand surge currents of 10 amperes and has a back resistance of 100,000 to 800,000 ohms for peak inverse voltages of 200 volts.

Construction

The sealed metal button design used has a protective wax or metal cap over the germanium pellet and a plastic coat over the rectifier and fin assembly. The rectifier button consists of a ⅛-in. square, 25-millimeter thick pellet of high-purity germanium mounted in the center of a butyl sealed metal cup as shown in Fig. 1.

The germanium pellet is soldered to a Fernico strip with a hard solder. The solder in addition to holding the pellet, serves to make the germanium directly in contact with it of strong *n* type. The Fernico strip is necessary in order to match the temperature coefficient of expansion of the germanium pellet.

A nickel-clad copper connecting



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Your C-D-F sales engineer can help you select the proper Dilecto grade for your post-forming requirements. If you would rather have C-D-F post-form your parts, he'll be happy to quote you on any quantity. Call him today (Sales offices in principal cities)—*he's a good man to know!*

Moisture resistant, light weight, mechanically strong Dilecto is formed from sheets of impregnated cloth or paper. Think... Dilecto may be the tough, versatile plastic for the product now on your drawing board!

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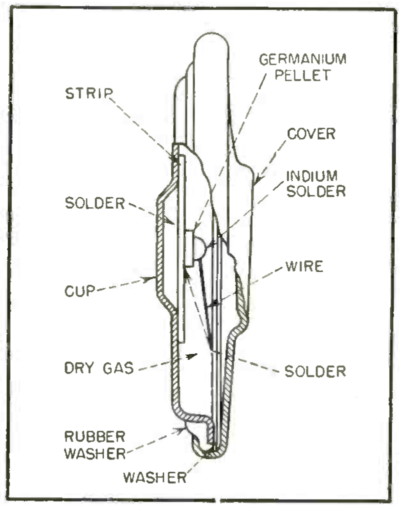

FIG. 1—Mechanical drawing of the germanium power rectifier

lead runs from the center of the pellet to the cover side of the button. It is fastened to the germanium with a soft metal solder of indium. In addition to holding the wire, the solder serves to make the germanium directly in contact with it of strong *p* type. Copper is used for the wire core because of its good electrical conductivity while the nickel coating prevents contamination of the solder by the copper at the processing temperature.

When the soldering operations are performed properly, a *p-n* junction is obtained with good rectifying properties.

The assembly of germanium, Fernico and nickel-clad lead wire is then soft soldered to the metal cup. The cup is assembled with insulator washers, rubber seal ring and cover. The assembly is then placed in an oven at 85 C and thoroughly baked to drive moisture from the rectifier junction. After a 12-hour bake, the unit is evacuated and filled with dry inert gas. Purpose of the heat evacuation is to remove the moisture from inside the button.

While the assembly is still warm, the cover is crimped over the rubber washer and sealed in a partial vacuum. The partial vacuum forces the rubber into position and helps insure complete protection for the rectifier assembly.

The rectifier button is preaged under a 200-ma load for 12 to 15 hours. Effect of the preaging drys the rectifier junction further and relieves strains on the lead.

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Fuse Headquarters for the Electronic Industries

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And a companion line of BUSS Fuse Clips, Fuse Blocks and Fuse Holders.

Behind each fuse or fuse mounting are 37 years of know-how in building products of unquestioned high quality, the world's largest fuse research laboratory and the world's largest fuse production capacity.

Each* BUSS *Fuse Electronically Tested.

To assure proper operation in the field, each and every BUSS fuse is tested in a highly sensitive electronic device that rejects any fuse that is not correctly calibrated — properly constructed and right in physical dimensions.

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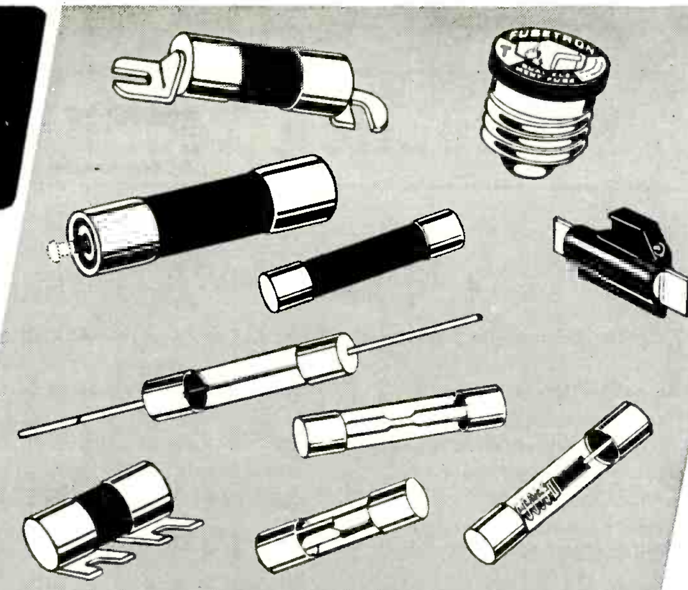

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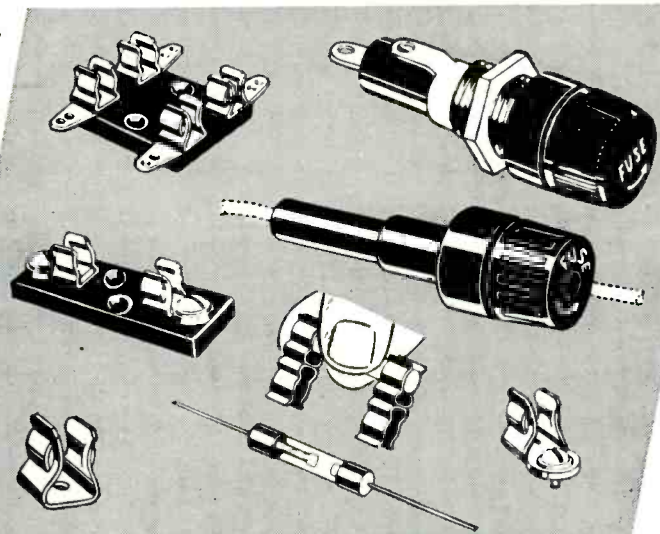

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FUSE HOLDERS, SPECIAL FUSE MOUNTINGS

IF . . . YOU HAVE A SPECIAL PROBLEM TURN TO BUSS

We welcome requests to help you in selecting the proper fuse or in designing a special fuse or fuse mounting best suited to your conditions. Submit sketch or description showing type of fuse contemplated, number of circuits, type of terminals and the like.

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MANUFACTURERS OF A COMPLETE LINE OF FUSES
FOR HOME, FARM, COMMERCIAL AND INDUSTRIAL USE.

Production Techniques

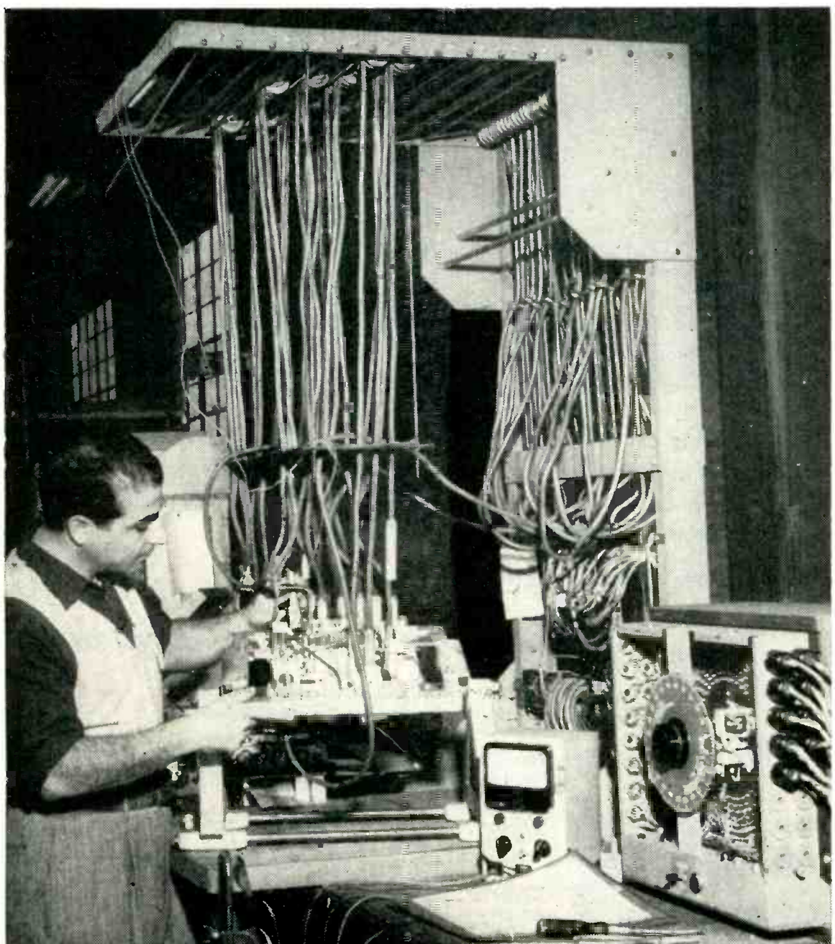
Edited by JOHN MARKUS

OTHER DEPARTMENTS featured in this issue:

Automatic Testing of Military Radio Sets

A COMPLETE resistance check of every circuit in a Signal Corps ground radio control set is made in a total time of approximately five minutes through use of a unique milking-machine-like arrangement of connectors with a Rotobridge at the Clifton, N. J. plant of Federal Telephone and Radio Corp. (IT&T associate).

An important part of the test setup is a universal chassis jack permitting almost instant insertion and removal of the chassis under test. Once in place, the chassis can be turned over at will for making test connections and for trouble-shooting in any circuit indicated to be defective by the Rotobridge. Some defects can be located and remedied immediately, while others are tagged for repair later. The Rotobridge stops when a defective circuit is encountered, giving the operator time to fill out a tag or clear up the trouble before pushing the reset button to continue with circuit-by-circuit testing.



High-speed setup for checking resistance of each circuit in chassis of military radio set

When setting up a chassis for test, one plug is inserted in each tube socket and each jack, and clip connections are made to terminals and to the chassis ground. Two duplicate test positions are used, so that the operator can be making plug-in connections to one chassis while the Rotobridge is testing the other chassis. Changeover from one chassis to the other is done automatically in the Rotobridge.

Testing Housing for Leaks

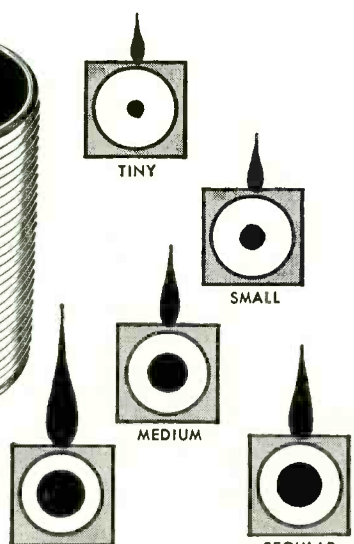
AIR PRESSURE obtained from a medical blood pressure measuring setup is used in conjunction with a fish aquarium to meet military specifications at Utility Electronics, East Newark, N. J. The specifications call for three-foot immersion in water when checking for leaks in the housing of the two-way hand-held radio transmitter-receiver.

To make the test, rubber tubing is first attached to a test hole in the housing. The housing is then held under water in the aquarium at any convenient depth and air in solder flux cores, too...

the right size is important!

AND ONLY
KESTER SOLDER
GIVES YOU
5
ENGINEERED CORE SIZES!

Just as in selecting the right hat size, it's important to select the correct core size in Flux-Core Solder to give you the proper predetermined amount of Flux needed to do the job right. Core size, which controls the ratio of flux to solder regardless of strand size, is always uniform with Kester.



Kester Solder meets all applicable Government and Military specifications

With five different core sizes, available only in Kester Solder, you're sure of the desired solder-spread and absolute control of flux residue. This is a "job-insurance" feature, only to be had with Kester, that will see you through satisfactorily in your production on those exacting government contracts, and all other soldering.

KESTER SOLDER COMPANY

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New method of testing for leaks in housing of military radio unit

pressure is built up inside by squeezing the rubber bulb repeatedly, to a pressure corresponding to a head of three feet of water or more. A dial gage indicates the pressure. A thumb valve on the bulb is then closed to hold the pressure, and the unit is carefully examined for bubbles.

The new technique is harmless even if the unit leaks, whereas the former method of testing deep under water without air pressure often resulted in water damage. Also, in the old method the housing had to be opened after a test to see if any water had entered through a leak, and the leak then had to be found by other means if not self-evident.

Motor Retwists Spread-Out Strands

Strand-twisting tool developed by Louis Friedman, production manager of CBS-Columbia plant

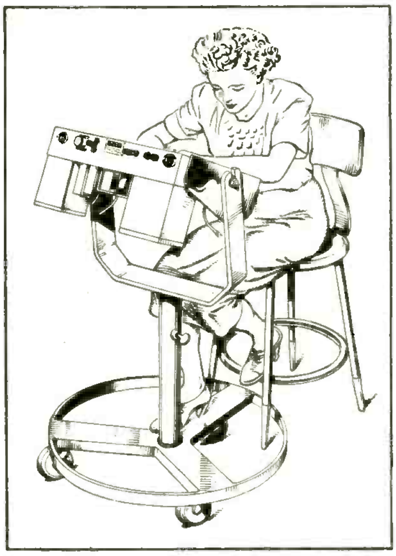
INSTEAD of twisting spread-out strands together by hand after stripping insulation by machine from stranded wire, operators in the CBS-Columbia television plant in Brooklyn, N. Y. merely insert the wire in a simple tool mounted on the shaft of a small electric motor.

Perfect twist and lay is obtained, as fast as the wires can be inserted and removed, when spring loading on the rounded inner members that do the twisting is exactly correct. Allen screws on the outside of the tool permit adjusting this tension when changing wire size. The entrance hole of the tool is coned outward to facilitate quick insertion of wires.

Chassis Cradle on Wheels

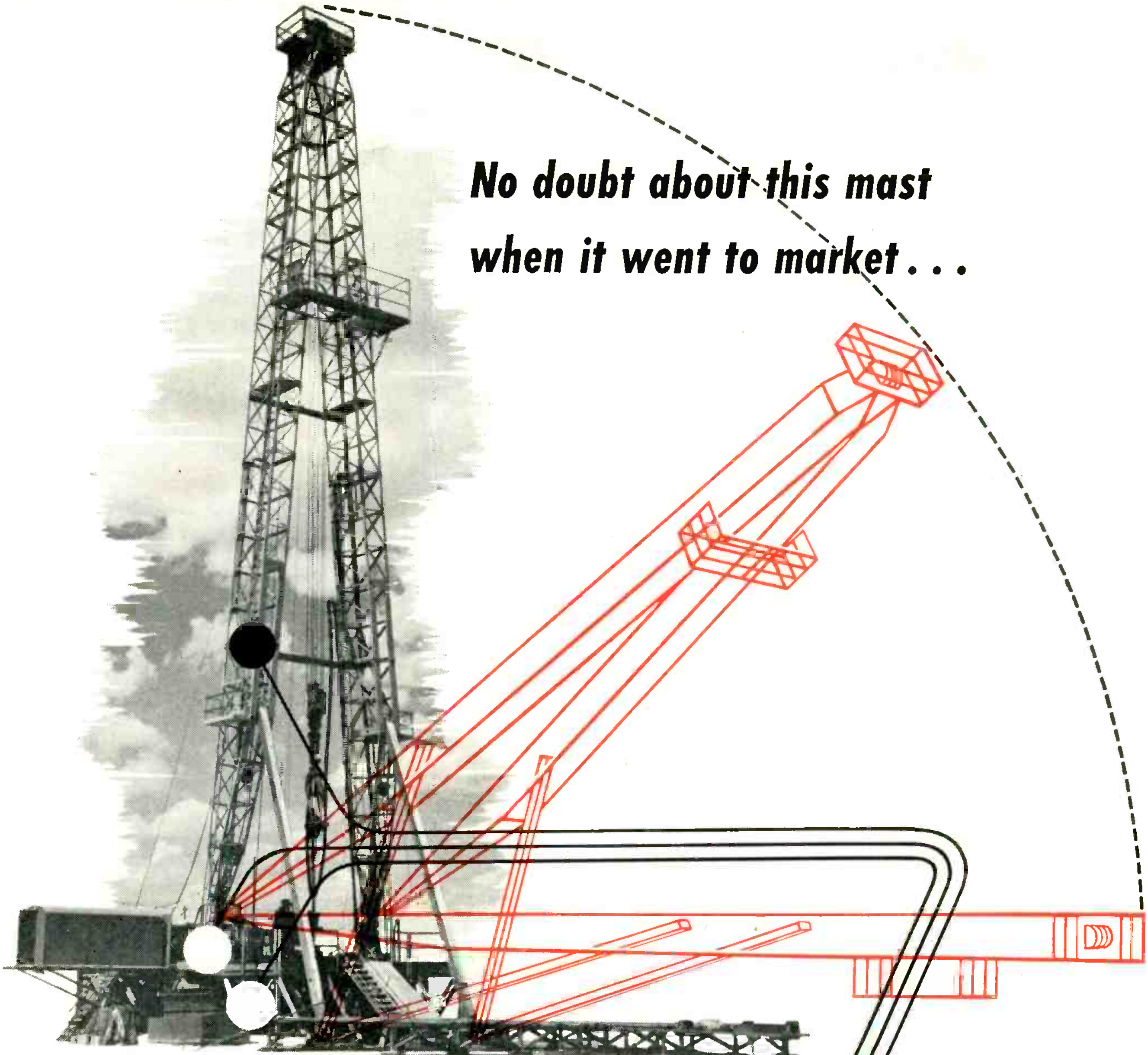
TO OBTAIN optimum working height along with the quick-turnover features of a chassis cradle, production engineers at Tracerlab Inc. in Boston have developed a U-shaped chassis cradle mounted on an adjustable floor stand. The circular steel base has three rubber-tired wheels with individual locking levers. Telescoping pipes, one welded to the base and one to the cradle, can be set for any desired height by means of a thumbscrew in the outer pipe.

As each chassis is designed, provision is made for two small holes on each side, to which can be bolted a steel side piece having a welded-on stud bolt projecting outward. This bolt drops into a slot in the top



Construction of cradle stand

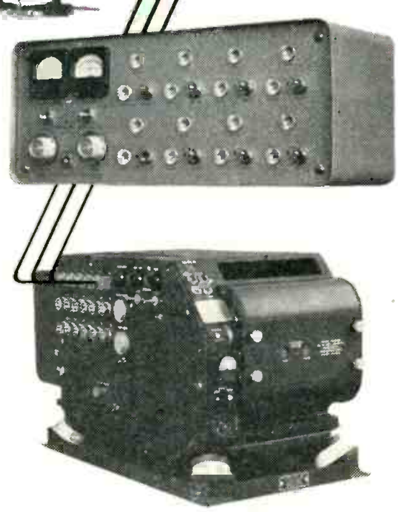
Method of using chassis cradles in aisles between benches for assembly of scalers and counting rate meters



No doubt about this mast when it went to market . . .

Raising a 35-ton mast of structural steel from horizontal to full vertical position is a problem in itself. Being certain that, once raised, the 143-ft.-high structure is able to support the tremendous weight of a string of drill pipe is still another problem. Add to these requirements the ability of the mast to be skidded across oil-field terrain, and you have a structural engineer's nightmare.

IDECO, in designing their "Full-View" drilling mast, had to know the complete stress and strain story of this structure. By using Consolidated Dynamic Recording Equipment—strain gages, bridge balance, and recording oscillograph—a complete stress analysis was made while the mast was being raised or lowered, or was standing vertically under a simulated pipe load. Thus the engineers removed any trace of doubt from the mast design. Consolidated's broad experience in applying instrumentation to design and production problems may be profitable to your business.



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CEC

Analytical Instruments for Science and Industry

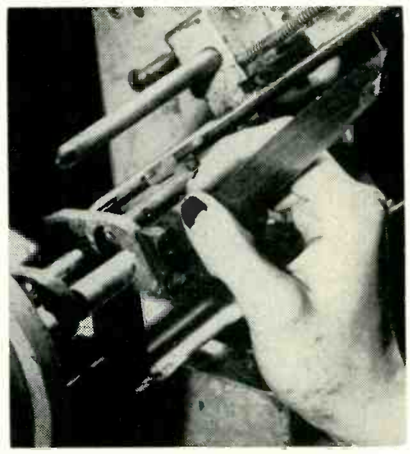
Recording Oscillograph

The 5-114 Recording Oscillograph records up to 18 simultaneous reactions as brief as one-hundred-millionth of a second. Produces clear, permanent records for future analysis. Applications vary from the field of medicine to rocket-propelled planes. Write for Bulletin 1500B.

of the U bracket of the cradle and has a large washer and nut for locking the chassis at the desired working angle.

Marking With Dyed Paste

WHEN winding capacitors from strips of metallized paper, the paper must be cut and then fastened after the desired length has been wound. At the Astron Corporation plant in East Newark, N. J., the fastening is done with liquid paste in which there is a blue dye. The paste is



Applying blue-dyed paste with ordinary sponge-tipped envelope sealer to anchor end of metallized paper and at same time identify outer-foil end of roll

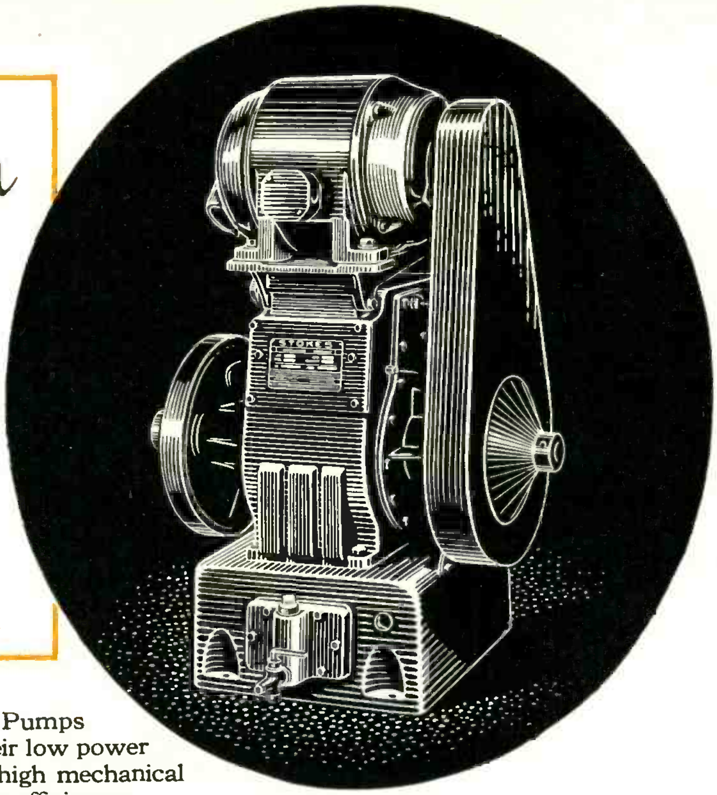
applied only on the side having the projecting outer-foil end. Thus the blue dye clearly marks the outer-foil end so that it can be positioned correctly in the tubular housing. The color is obtained by mixing Orasol Blue powder pigment with the liquid paste.

No-Cost Clamp for Wires

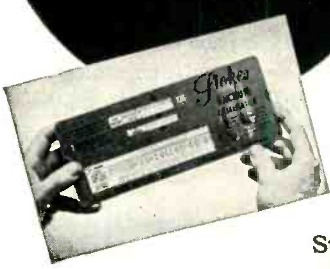
TO DRESS above-chassis insulated wires neatly without going to the expense of installing a special clamp, extra lead length of an under-chassis part is used for the

Using surplus length of an under-chassis capacitor lead to hold five insulated wires in position on top of Tele-tone television receiver chassis

STOKES vacuum equipment... efficient, durable, economical



Send for FREE Stokes Vacuum Calculator! This slide rule determines needed pump capacity for any job...shows Centigrade to Fahrenheit conversion. Other useful conversion tables and scales on reverse of rule.



Stokes Microvac Pumps are known for their low power consumption... high mechanical and volumetric efficiency.

Long trouble-free service can be expected from Stokes Microvac Pumps, perfected during more than 40 years of practical experience in the development of complete vacuum processing systems.

The four simple moving parts are easily accessible. All parts are precision-finished, standard, and interchangeable. Lubrication is fully automatic to all friction surfaces.

The large full-opening exhaust valve of corrosion-resistant Teflon is highly sensitive to pressure differential . . . exhausts air completely at each stroke without re-expansion.

An Oil Clarifier and a Devaporizer are available for continuous purification of lubricating oil when dirt and solvent vapors are present.

Stokes Microvac Pumps, air-cooled in the small sizes and water-cooled in five larger sizes, range in capacity from 15 to 500 cfm.

Stokes is the only manufacturer of equipment for complete vacuum systems, including Microvac mechanical pumps, oil diffusion pumps, McLeod Gages and Valves.

Consult with Stokes on the application of vacuum to rotary exhaust machines, house vacuum systems, vacuum impregnation, vacuum furnaces, vacuum metallizing, and to other applications in which vacuum deserves exploration.

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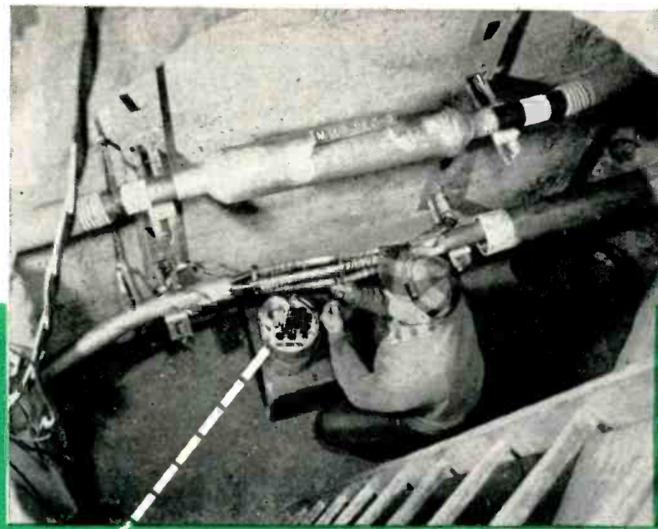
purpose. At the desired location for a clamp, a hole is punched in the chassis and the grounding lead of a nearby capacitor or resistor under the chassis is pushed up. The lead is soldered to the chassis at the hole, and surplus length above the chassis is bent over the wires requiring hold-down.

A simple grounding hole like this is easier and cheaper to make than a punched-out lance, and there is less chance of cold-soldered grounds. Several leads may be grounded in the same hole.

Chassis Lettering Techniques

SIMPLE labeled templates improve the accuracy and speed of rubber-stamping lettering on a chassis for small production runs. As used in the Television Transmitter Division at Allen B. DuMont Labs., Inc. in Clifton, N. J., rectangular holes are cut in a sheet of fishpaper to expose the chassis at each location requiring lettering. The correct lettering for each hole is then lettered on pieces of masking tape placed adjacent to the holes. To accommodate projecting terminals, the fishpaper is placed on a wood board and round holes are

Use of fishpaper template to speed positioning of rubber stamps for marking a chassis



An important splice in progress on a 3/c. 500 MCM. 26,400 V shielded paper-lead feeder cable for Public Service Electric and Gas Company's new Warren Point Substation at Fairlawn, N. J.

PUBLIC SERVICE

Public Service Electric and Gas Company insures continuity of service *with* NATVAR Splicing Kits

Veteran splicers in the Underground Department like Natvar splicing kits, because they provide exactly the right number of rolls of v.c. tape cut to proper lengths and widths, and exact quantities of other materials required for the job. Engineers and foremen like the kits because they give close "quality control" of the splicing operation, with a minimum of waste and spoilage.

Public Service is working around the clock to provide adequate service for one of the fastest growing areas in the country. Long range planning demands that additional facilities to meet the increasing load be built on a permanent basis.

For this reason, extreme care is exercised in the selection of equipment and materials for the expansion program. Natvar splicing kits, made up in units for various sizes and types of cable, speed underground splicing because of their convenience and insure uninterrupted service because of the uniformly high quality of the materials.

All Natvar flexible insulations have excellent physical and electrical characteristics, and are dependably uniform, no matter where or when purchased. They are available either from your wholesaler's stock or direct from our own.

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- Varnished tubing and sleeving
- Varnished identification markers
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- Extruded plastic tubing and tape
- Extruded plastic identification markers

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quickly made at the required locations with a plain steel punch and hammer, to complete preparation of the template.

After placing the template over the chassis, the operator takes from storage an envelope containing the correct rubber stamps for that chassis, arranges the stamps in logical order for stamping the chassis from top to bottom and left to right, then picks up the stamps one by one and marks the chassis. The stamps are put back on the

Fixture and stencils for placing lettering on both sides of a complicated chassis in one spraying operation. Stencil for bottom of chassis, in upright part of fixture, has cavities for under-chassis projections. Stencil for top of chassis, on hinged frame resting on table, is brought up after chassis is inserted in fixture

bench in the same sequence, for use on the next chassis. The labeled template aids in positioning the stamp quickly at the correct location and minimizes possibilities of using the wrong stamp for a terminal.

On larger production runs, chassis labeling can be speeded up by using special brass stencils and a spray gun. With these precision stencils, available from Jas. H. Matthews & Co., 3863 Forbes St., Pittsburgh 13, Pa., a large and complicated radar fire control chassis or similar unit can be lettered on both sides in less than a minute, with no possibility of error. This com-

Ultra-Sensitive

DC MICROAMMETER

RCA WV-84 A

Battery-operated . . . completely portable

FEATURES:

- Reads from 0.0002 microampere to 1000 microamperes in six ranges. Will indicate current flow below one-billionth ampere.
- Can be used with external battery to measure extremely high resistance values in the order of billions of ohms.
- Meter movement electronically protected against burnout.
- Can be used as a voltmeter (external multipliers included) to measure voltages from 0.1 volt to 10 volts at input resistances from 100 to 1000 megohms.
- Voltage drop for full-scale deflection on all ranges is only 0.5 volt. Has 50-megohm input resistance on lowest range.
- Battery-operated for excellent stability and complete freedom from effects of power-line voltage fluctuations. Readily portable.

$100.00, Suggested User Price (Batteries not included).

SPECIFICATIONS:

SIX DC CURRENT RANGES:
0 to 0.01, 0.1, and 1 microampere: 0 to 10, 100, and 1000 microamperes.

ACCURACY:
On 0.01-Microampere Range . ± 5% of full scale
On All Other Ranges . . . . ± 4% of full scale
Voltage Drop for Full-Scale Deflection . . . . .0.5 volt on all ranges

INTERNAL SHUNT RESISTANCE:
0.01-μamp Range . . . . .50 megohms
0.1-μamp Range . . . . .5 megohms
1-μamp Range . . . . .0.5 megohms
10-μamp Range . . . . .50,000 ohms
100-μamp Range . . . . .5,000 ohms
1000-μamp Range . . . . .500 ohms

POWER SUPPLY:
"A" Batteries . . . . .2, 1½ volts (RCA-VS106)
"B" Batteries . . . . .2, 22½ volts (RCA-VS102)

DIMENSIONS:
9½" High, 6¼" Wide, 5¾" Deep

WEIGHT:
9½ lbs. (incl. batteries).

Useful in laboratories, industrial plants, broadcast stations . . . for the measurements of minute currents, critical voltages, high resistance

The RCA-84A Ultra-Sensitive DC Microammeter is a battery-operated vacuum-tube microammeter designed for the measurement of minute direct currents. The instrument has six scales for reading currents from 0.0002 microampere to 1000 microamperes; a ratio of 5,000,000 to 1.

The amplifier circuit is designed so that the maximum meter current is limited to a safe value. This feature protects the instrument against meter burnout. The meter has a large face with wide scale divisions that are easy to read accurately. The meter movement is suitably damped to bring the pointer quickly to its reading position with negligible overswing and without oscillation. The selector switch opens the battery circuits when in the "off" position, and, in addition, functions as a polarity-reversing switch to eliminate the need for reversing leads when the current polarity changes.

The vacuum tubes employed have low-drain filaments. In addition, the circuit has been designed to keep the plate current low. Consequently, batteries have an exceptionally long life.

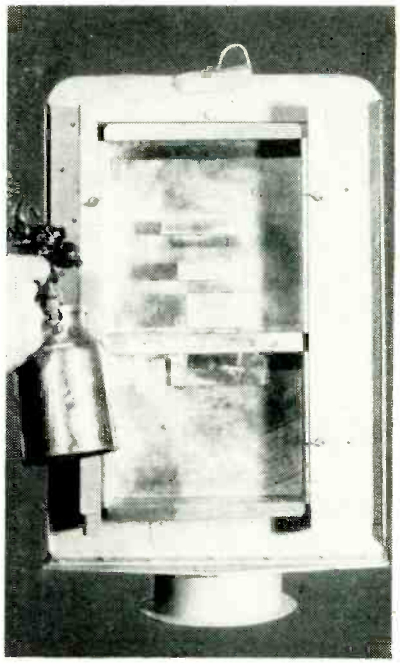
• • •

Ask your *RCA Test Equipment Distributor* for descriptive bulletin, or write RCA, Commercial Engineering, Section FX42, Harrison, N. J.

TMKS. ®

RADIO CORPORATION of AMERICA

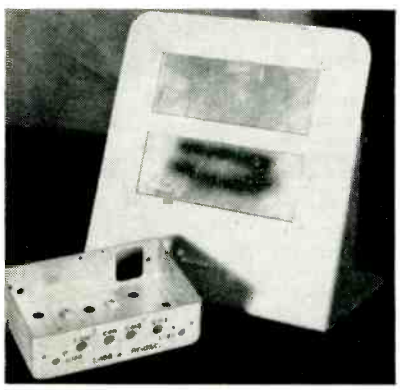
TEST EQUIPMENT — **HARRISON, N. J.**



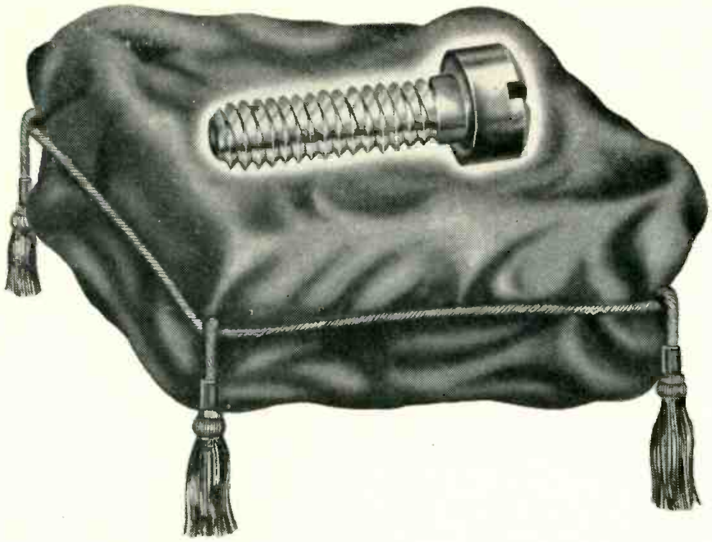
Spraying lettering on bottom of chassis through brass stencil. Fixture is on turntable so it can be turned around quickly for spraying top of chassis

pares to as long as 8 hours for conventional rubber-stamp techniques (without templates) on a chassis of comparable size.

The stencils are contour-formed to specification so as to fit snugly over the chassis, after which the codings, symbols and other identification data are cut in the brass. Many types of inks or paints can be sprayed, some for temporary markings to be removed after assembly and others for permanent marks. A fine-spray commercial spray gun is required; brushing is



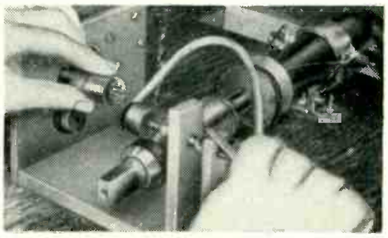
Two brass stencils and holding fixture for applying lettering to front and rear of a small r-f oscillator chassis. Guides behind fixture serve to position and hold two units at a time for spraying, doubling speed of operation



not normally recommended due to the fine characters.

The stencils need be cleaned only occasionally, by dipping in the recommended solvent of the paint or ink being used.

Solder-Sealing Lathe

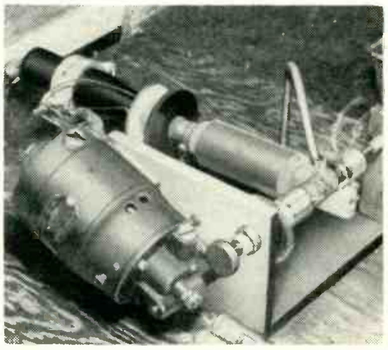


Inserting discriminator-stage base and housing in lathe preparatory to soldering. Note pool of molten solder in working face of soldering-iron tip

PLUG-IN i-f and discriminator stages for the AN/PRC 10 portable transmitter-receiver (described on p 98 of May 1951 ELECTRONICS) are completely solder-sealed in 1½ turns of a miniature lathe developed by RCA Victor, without bringing the internal temperature of the can above the permissible limit of 60 C.

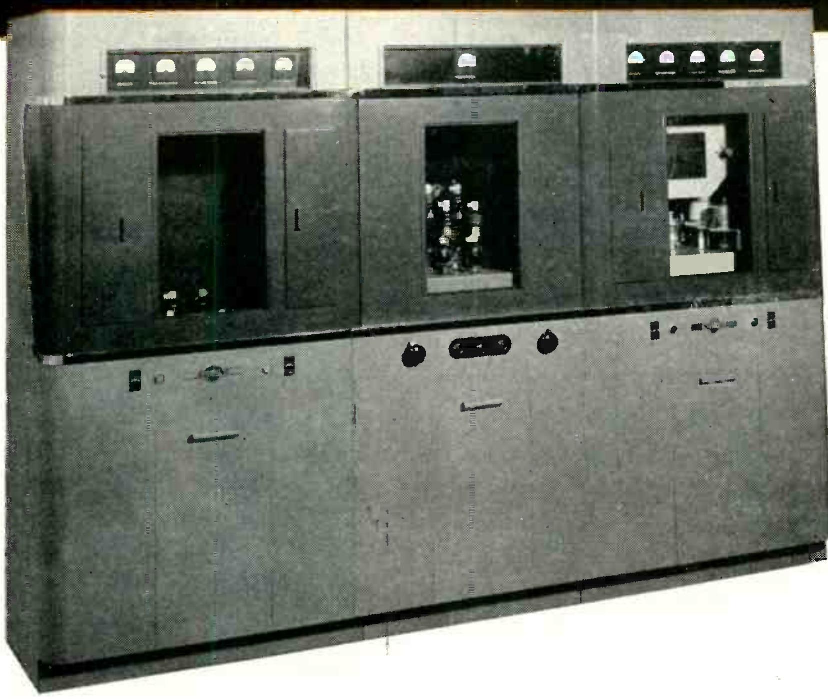
The operator places the can over the plug-in base assembly, inserts the unit in the lathe by pulling back the spring-loaded tailstock, then pushes down a foot pedal. This automatically starts the geared-down drive motor, brings up the soldering iron tip and ratchet-feeds solder to the joint. The soldering iron has a large tip, in the top face of which is a pool of solder,—to speed up transfer of heat to the joint.

After approximately 1½ turns,



Soldering housing to base. Solder is fed automatically to joint through copper tubing that serves as guide. Entire operation takes only about 5 seconds

NEW COLLINS 21E 5 KW BROADCAST TRANSMITTER



- ★ **Operating economy.**
- ★ **Simplified circuits.**
- ★ **Simplified frequency control — low temperature coefficient crystals (no oven required).**
- ★ **Single external unit — open, dry type transformer.**
- ★ **Built-in modulation peak limiting.**
- ★ **Full visibility of all tubes.**
- ★ **Complete accessibility.**

The new Collins 21E 5 kw broadcast transmitter is the completing unit to the great new line of advanced design Collins broadcast transmitters. Others in the new line include the 250 watt 300J and the 1000 watt 20V.

Smart, modern styling is combined with up-to-the-minute engineering in the handsome, thoroughly dependable 21E. Great simplification has been achieved in the circuits associated with the modulator and power amplifier driver stages through use of the recently developed high gain, long lived tetrodes. Employment of these efficient tubes also permits the use of low drain, low cost, receiver type tubes in the amplifier stages. Frequency control is by means of the new plug-in, super stability, low temperature coefficient crystals, which eliminate the need for crystal ovens.

Peak limiting automatically clips audio peaks at approximately 1 db above 100% modulation.

For 10 kw operation, the 5 kw 21E may be transformed into a 10 kw 21M. Any specified carrier frequency from 540 to 1600 kc is available.

FOR BROADCAST QUALITY, IT'S . . . COLLINS

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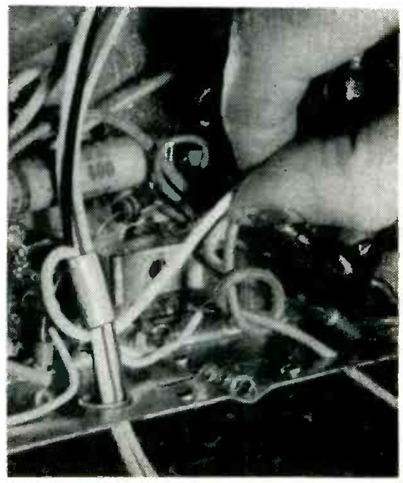
determined by watching the printed label on the can, the operator releases the pedal to stop the motor and lower the iron, then takes out the soldered unit and immerses it base-down in a pan of alcohol alongside for cooling.

A hole in the cover of the can is sealed later, after controlled low baking to get moisture out of the inside of the can.

Tape Replaces Cable Knot



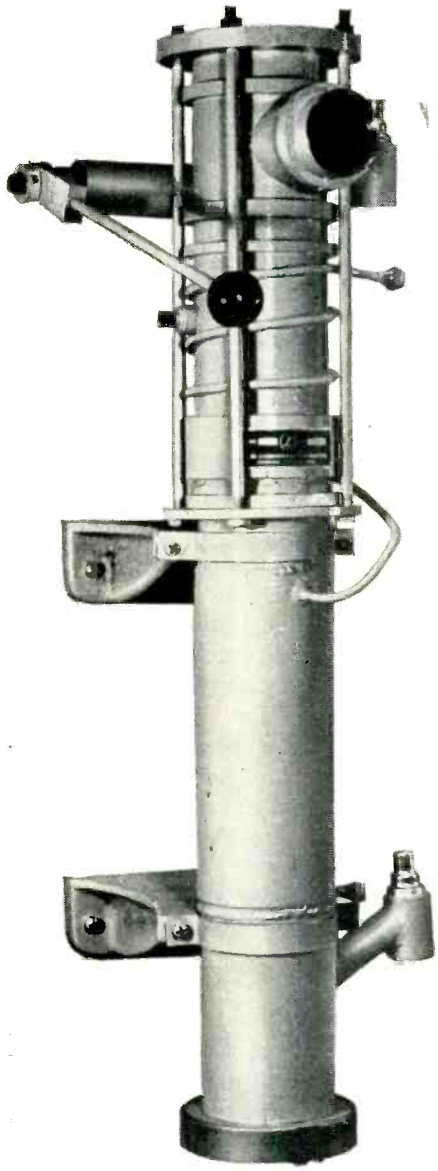
Method of using masking tape, with one lead tucked between wires back of tape, to protect terminals when battery cable is pulled

INSTEAD of knotting a battery cable on the inside of the chassis to prevent pull on terminals of a three-way portable radio, Emerson puts a piece of masking tape around the cable just inside the chassis, then loops one of the leads between the cable wires just back of the tape. This locks the cable in the set. The technique works only when two or more wires go through the same hole; on single antenna lead-in wires, knots are still used.

Electrode Spacing Checker

INTERELECTRODE capacitances of the two sections of a 6J6 twin-triode tube are measured and matched in a special two-unit capacitance bridge at the RCA Tube Department's Harrison, N. J., plant. After assembly of the electrodes but prior to sealing and exhaust, the electrode structure is plugged into the

LITTON INDUSTRIES NEWS



PRODUCTION EXHAUSTING TO VACUUM 5×10^{-8} WITH ALL-METAL LITTON OIL VAPOR PUMPS

In applications ranging from laboratory research to high vacuum under production conditions, Litton Model PB Vacuum Pumps are meeting today's requirements for higher vacuum more swiftly obtained.

Precision-built Litton pumps are of all-steel construction to eliminate glass breakage, avoid loss of engineering and production time and lengthen pump life. Each unit is water-cooled to insure complete independence of room temperature. Pump heaters are external and mount with a simple clamp for easy replacement. The nozzle assemblies are of stainless steel of high chromium content.

For evacuation problems such as organic distillation, etc., Model PB Pumps may be used without accessories. For other problems, a charcoal baffle system with a 2-inch side outlet is provided. This baffle has an adapting ring and collar which can be soldered to 2-inch tubing to form a manifold, or through a metal-glass seal to a glass manifold. Baffle systems are water-cooled, and contain a charcoal cell with a built-in heater and lead terminal. Heating voltage required is 18 volts.

An additional accessory is a high-vacuum valve which attaches to the charcoal baffle unit. This valve is available with its own side outlet. It is sufficiently tight so that a manifold may be let down to atmosphere—*and a new tube sealed on and roughed out by auxiliary pump*—while the Litton vapor pump is still operating. This can materially increase production speed by eliminating outgassing of baffles each time the system is opened to atmosphere.

Boiler, charcoal baffles and high-vacuum valves are easily demountable for cleaning. Units of the pumps are available individually so combinations may be selected appropriate to the research or production problem.

Specifications

Ultimate Vacuum under following conditions:

1. Pump and water baffle only, 1×10^{-6} mm. of Mercury (ion gauge indication).
2. Pump, water and charcoal baffles, 5×10^{-8} mm. of Mercury.
3. Pump, water, charcoal baffles and valve, 5×10^{-7} mm. of Mercury.

Speed (measured at 10^{-5} mm. of Mercury)

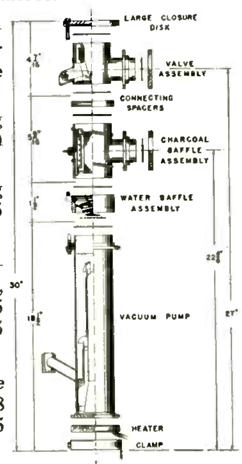
1. Pump only, at connecting inlet, 280 liters.
2. Pump and water baffle at inlet, 200 liters.
3. Pump, water and charcoal baffles, straight through type, at inlet, 75–100 liters.
4. Pump, water and charcoal baffles, and valves, straight through type, 50–75 liters.

High vacuum inlet, top—3⅜" ID., 3½" OD.
High vacuum inlet, side—2" ID., 2⅛" OD.
Forepump outlet—1" copper tubing.
Height of pump only—18½".
Height of pumps complete with baffles and valve—30".
Width, max. width at high vacuum outlet—7¼".
Construction—pump stainless steel. Auxiliaries—steel, tin clad.
Weight of pump only, with mounting brackets—16½ pounds.
Weight completely assembled—33 pounds.
Cooling—water.
Amount of oil—6 ounces.

Recommended oil—Litton Molecular Lubricant, Type "C," 375 watts.
Silicone Pumping Fluids, DC702, 400 watts.
Silicone Pumping Fluids, DC703, 425 watts.

Boiler heaters—Voltage available, 230, 208 and 115 volts; power, 375 watts.

Charcoal baffle heater—Voltage, 18 volts AC; power, 75 watts.



MOLECULAR LUBRICANT FOR USE WITH MODEL PB VAPOR PUMPS

Litton Molecular Lubricant "C" (Molube "C") is a highly refined petroleum product with a narrow boiling range. It has a vapor pressure of approximately 10^{-7} mm. Hg. at room temperature. In the presence of ionization, it will give an indicated pressure of 10^{-6} mm. Hg. It is designed for use in Litton Oil Vapor Vacuum Pumps and with anti-friction bearings operating within dynamic vacuum systems.

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DESIGNERS AND MANUFACTURERS of:
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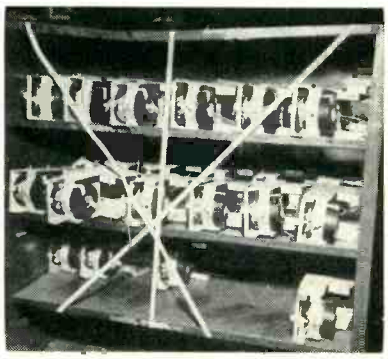
Bending grid support with tweezers to equalize interelectrode capacitances of 6J6 triode sections as measured by dual capacitance bridge. Before each test, tube structure is held in pipe at left and lint or dirt is blown out by air blast from copper tubing, controlled by foot-operated valve

socket of the test fixture in front of the capacitance bridge, and the grid-cathode capacitance is noted for each section.

For an acceptable tube, both values must be within a predetermined tolerance range. When the spacing is only slightly outside the acceptable range, the operator can often bend the electrode supports with tweezers to make the necessary correction.

Tape Blocks Use of Wrong Television Parts

WHEN two types of yoke assemblies are used alternately on a television receiver assembly line in Du Mont's East Paterson, N. J. plant, dolly



Use of masking tape to minimize chances of getting wrong type of deflection yoke onto television receiver assembly line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FIRST & FOREMOST IN MINIATURIZATION

racks containing the unwanted type of yoke are criss-crossed with masking tape as an eye-catching indication that the parts are not to be used. The tape technique makes it unnecessary to return the parts to the stockroom and bring them back out the next day.

Cabinet Tip-Ups

As TELEVISION sets get bigger and bulkier, efficient work on the inside and bottom of the cabinet becomes more and more of a problem to production men. Many different fixtures and props have been devised to prevent scratching the cabinet finish when tipping the cabinet for installation of the face plate and chassis bolts and for sealing the shipping carton.

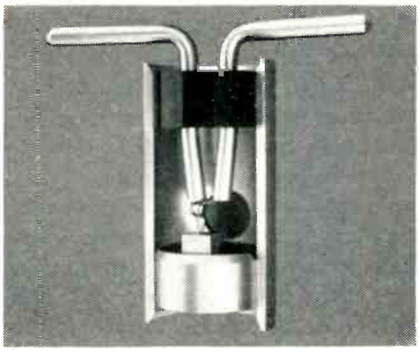
Padded bench at CBS-Columbia. Safety-glass plate being installed here was first cleaned with special lintless industrial absorbent tissues

Covering the top of the bench with a large sheet of sponge rubber and tacking the rubber also over the front edge of a shelf gives cabinet protection while installing the glass face plate in a table-model tv set at the CBS-Columbia plant in Brooklyn, N. Y. This setup is for small or special production runs, hence no conveyor line is employed. Corrugated cardboard on the wall at the back of the bench gives added protection when the set is tipped so its top rests against the shelf.

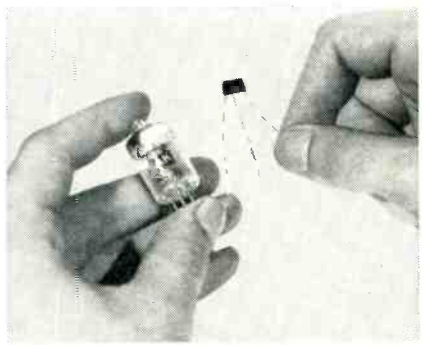
On production lines in the same CBS-Columbia plant, a hinged

THE TRANSISTOR

A picture report of progress



FIRST TRANSISTORS were of this point contact type (picture three times life size). Current is amplified as it flows between wires through a wafer of germanium metal. These transistors are now being made at the Allentown plant of Western Electric, manufacturing unit of the Bell System. They will be used in a new selector which finds the best routes for calls in Long Distance dialing.



NEW JUNCTION TRANSISTORS, still experimental, also use germanium but have no point contacts. Current is amplified as it flows through germanium "sandwich" —an electron-poor layer of the metal between two electron-rich ends. This new transistor runs on as little as *one-millionth* of the power of small vacuum tubes.

MUCH HAD TO BE LEARNED, especially about the surface of germanium and the effect of one part in a million of alloying materials. Transistors promise many uses—as amplifiers, oscillators, modulators . . . for Local and Long Distance switching . . . to count electrical pulses.

ASSEMBLY PROBLEMS, such as fixing hair-thin wires to barely visible germanium wafers, have been solved through new tools and mechanized techniques. Finished transistors withstand great vibration and shock. Engineers see many opportunities for these rugged devices in national defense.

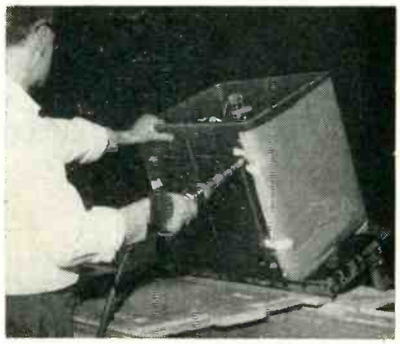
MOIST PAPER AND COIN generate enough current to drive audio oscillator using junction transistors. Half as big as a penny matchbox, an experimental two-stage transistor amplifier does the work of miniature-tube amplifiers ten times larger.

A tiny amplifying device first announced by Bell Telephone Laboratories in 1948 is about to appear as a versatile element in telephony.

Each step in the work on the transistor . . . from original theory to initial production technique . . . has been carried on within the Laboratories. Thus, Bell scientists demonstrate again how their skills in many fields, from theoretical physics to production engineering, help improve telephone service.

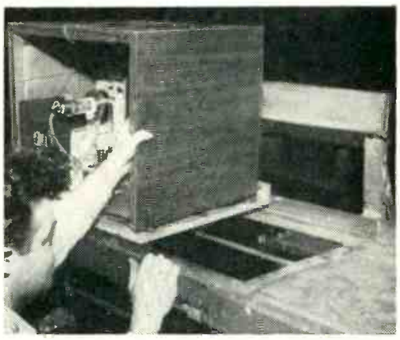
BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.



Hinged backrest used at CBS-Columbia is padded with strips of sponge rubber fastened with electrical insulating tape.

backrest is mounted opposite the operator on a bench-type line down which table-model cabinets roll on ball-bearing pallets, with the chassis inside but not bolted. An assistant on the other side of the line centers the chassis in the cabinet by eye, brings the hinged backrest up against the back of the set, then pulls cabinet and rest down together almost to a horizontal position, for ease of installing bolts with a compressed-air wrench. The first operator then pulls the



Small section of bench is pivoted and cut out in cabinet tip-up arrangement used by Emerson

Installing chassis mounting bolts through cutouts in pallet on Emerson production line

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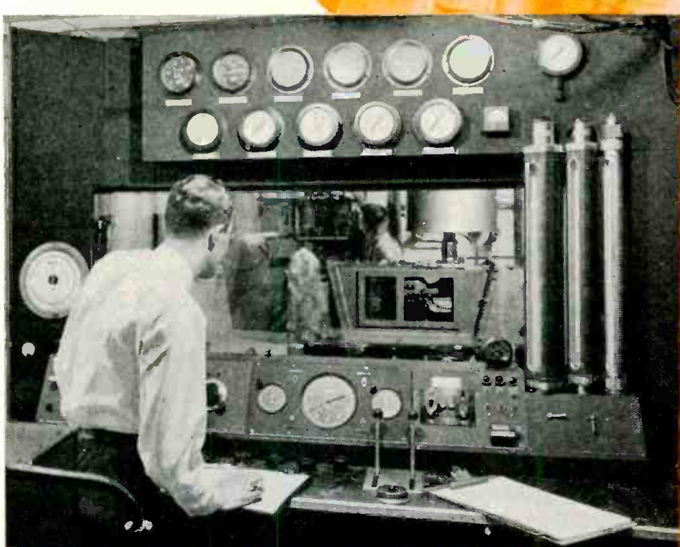
The performance testing of fuels and lubricants — for maintaining the quality of existing products as well as for developing new products — is an important function of Gulf Research . . . In their aviation engine test cell, shown below, our Chrono-Tachometer is a vital part of the elaborate instrumentation needed to control the test conditions and record the data required for comparative purposes.



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Method of tipping console on Admiral's tv line

set back onto its pallet and rolls it down the line to the next work position. For one-man operation, a mirror is mounted on the other side of the line so the wrench operator can do the chassis centering himself.

A more elaborate tip-up for cabinets on ball-bearing pallets is used by Emerson Radio & Phonograph Co. in their Jersey City plant. A padded backrest is rigidly attached to a section of bench that is cut out and pivoted on a shaft running down the center of the bench. Cabinet, pallet and bench section are then tipped back as a unit for insertion of chassis mounting bolts through large holes in the pallet.

A large felt-padded backrest positioned at about 60 degrees above horizontal is used in Admiral's Chicago plant for work on console tv sets. These come down a roller conveyor with their shipping-carton pallets already attached. Cabinet and pallet are tipped back off the conveyor together for insert-

Roller on simple wood frame facilitates tipping over consoles in cartons at Emerson plant

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The Type EM is housed in an aluminum case with an external cardboard insulating sleeve.

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Wagner Capacitor-Start Motors are well-known for years of dependable service in applications where starting loads are heavy. Wagner uses Sangamo Motor Starting Electrolytic Capacitors as standard equipment for capacitor-start motors.

These electrolytics are universal units for use in standard motors driving equipment such as refrigerators, oil burners, washing machines, motor driven tools and other similar applications.

Sangamo high temperature AC motor starting capacitors are of the dry electrolytic, non-polarized type and are available with either solder lug or screw type terminals. They are designed to give years of trouble-free service in continuous heavy duty applications.

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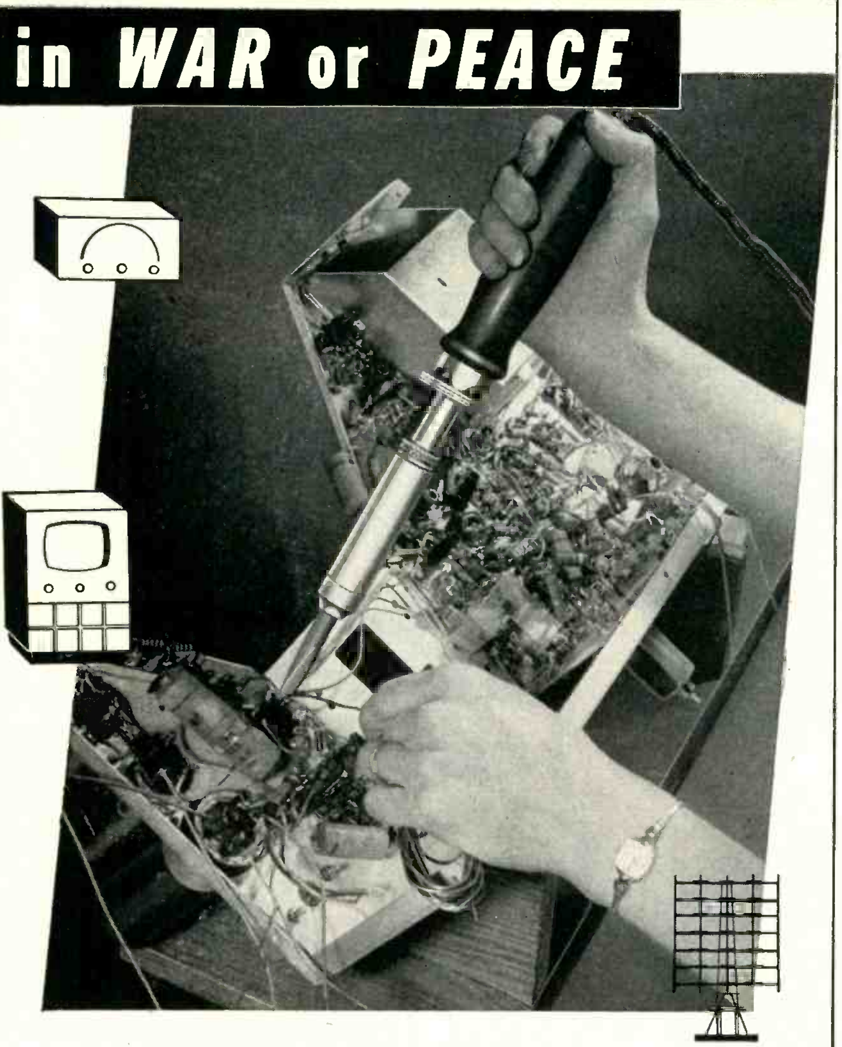


ing chassis bolts and for work on the lower chassis.

A steel roller mounted on an easily-moved floor stand is used in Emerson's plant so one man can up-end a heavy console in its shipping carton for sealing of bottom flaps after the carton is dropped over the set.

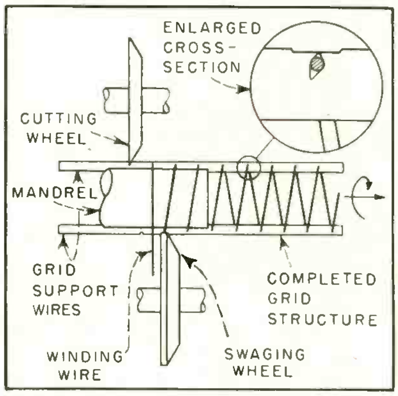
Grid-Winding Lathe

UP TO 1,000 electron-tube grids can be wound per hour with the new Brimar notch-and-swage gridwinding lathe, developed by Standard Telephones and Cables, Ltd., British associate of IT&T, and available in U. S. from International Standard Trading Corp., 67 Broad St., New York, N. Y.

Such high output is achieved by winding to the final profile on a mandrel, hot-stretching the strip of wound grids to straighten the support wires, and burning out the loose turns between grids during winding instead of after chopping into individual grids.

The operating principle of the machine is shown in the diagram. The completed grid length is pulled off the mandrel to the right, as indicated by the straight arrow, while the mandrel rotates as indicated by the curved arrow. The support wires run in two grooves in the mandrel, the cross-section of which normally determines the size and profile of the grid.

During rotation of the mandrel a notch is cut in each support wire in turn at the required pitch by the cutting wheel. After this, the winding wire is fed into the notch and, during the next revolution of



Operation of grid-winding lathe

Good names to know for —

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Since the inception of AC radio, Wilbur B. Driver Company has pioneered in the development and production of filament alloys, carbonized nickel and grid wire. Thus it is a logical conclusion that Wilbur B. Driver Company is the dependable source of supply for radio and electronic requirements . . . the choice when materials must be held to exacting and precise specifications.

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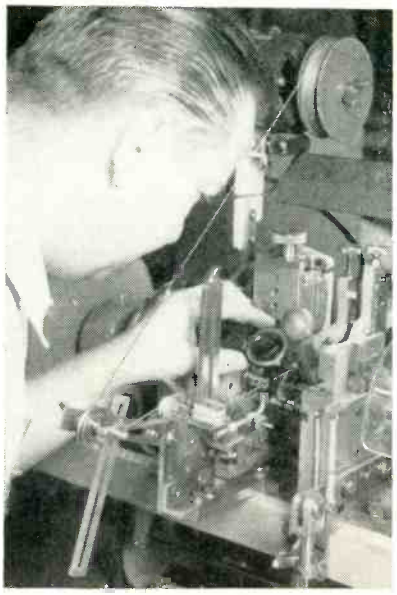
TOPHET FOR TOP HEAT



Using magnifying glass to study grid-winding action on Brimar lathe. Wire passes between two pieces of sponge material for final cleaning before being wound on mandrel

the mandrel, is swaged into the support by the action of the swaging wheel. The lateral motion of the strip is obtained from a lead screw that also controls the winding pitch. The grids are wound in lengths of approximately 12 inches and subsequently cut into individual grids.

The cutting head is mounted on a vertical slide controlled by a cam also driven by the leadscrew, so that the head is retracted to reduce or entirely eliminate the notches on the grid legs in between grids. The cutting wheel holder can be adjusted to the correct helix angle to avoid drag.

The draw bar that imparts horizontal motion to the grid strip carries at one end an electrically insulated hot-stretch head and clip, and at the other end the half-nuts that go around the feed screw. At the end of a 12-inch run of grids, the clip closes over the ends of the supports and tensions them while direct current passes through the strips. Duration of heating is automatically controlled by an electronic timing circuit. Micro-adjustable foot-operated blades then cut off the strip of wound grids at precisely the correct point for accuracy of subsequent cutting into individual grids. The half-nuts on

the feed screw then open and the drawbar slides back to its starting position in one continuous motion.

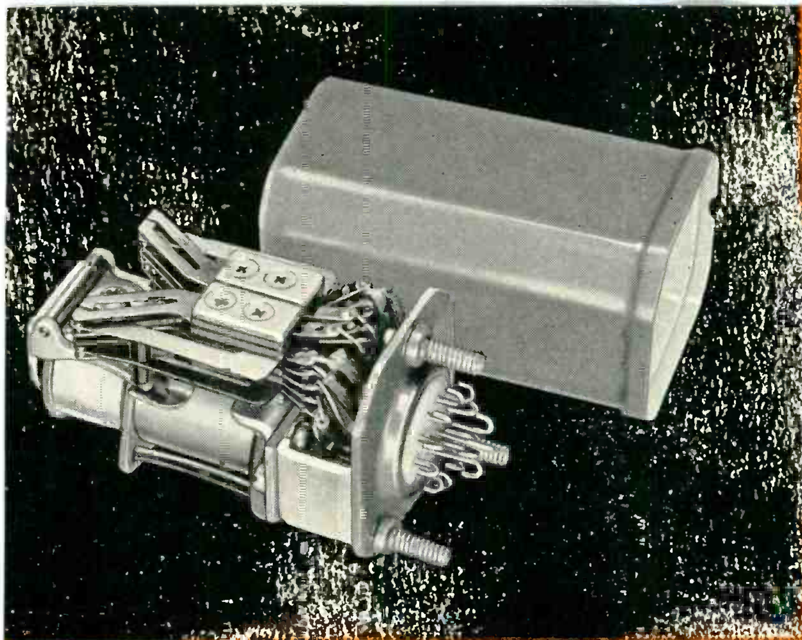
The loose unstaked turns between individual grids on the stick are burned out by two chisel-shaped electrodes fed with a d-c voltage. The electrodes are cam-operated and micro-adjusted to come in and start burning at exactly the correct turn. This burning operation eases the trimming needed to remove loose turns after chopping up the stick. When the final profile is wound, the only additional operation needed after chopping is degassing to remove the oxide film formed by the hot-stretch operation.

Floor Rails Speed Banding of Shipping Crates

PARALLEL lengths of 2 x 4-inch lumber nailed to the shipping-room floor permit easy insertion of banding metal strips under heavy wood crates for military electronic equipment at Utility Electronics, East Newark, N. J. The strips are spaced enough so a hand truck or fork lift truck can be run between the strips for unloading and loading crates.

MAGNETIC SHEET FLOATER

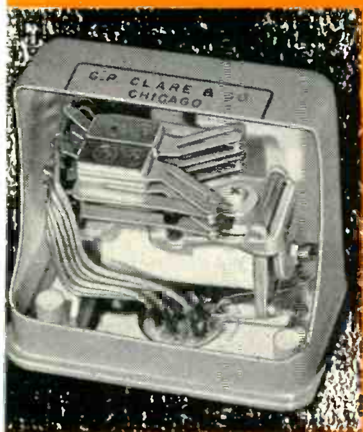
Punching of steel angle braces for 20-inch picture tube supports is speeded up by use of a Verson Sheet Floater to keep the top sheet of the unpunched stack at least one finger-thickness above the others, at the CBS-Columbia plant in Brooklyn. Five horseshoe permanent magnets behind a smooth steel plate do the trick



CLARE *Hermetically Sealed* RELAYS

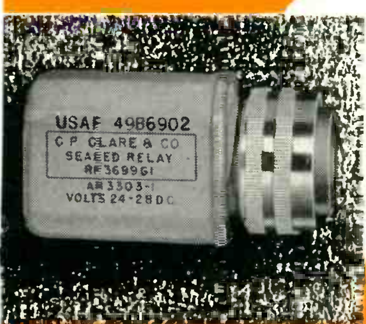
Clare Type "J" twin contact relay before sealing in enclosure.

Cutaway view of Clare Type "K" hermetically sealed relay.



offer designers wide range of relays and enclosures

Another type of enclosure (cutaway) shows compactness of assembly.



"AN" approved Clare hermetically sealed relay with "AN" plug connector.

Connection diagrams are clearly and permanently imprinted on enclosures by silk screen process.

Long established as leaders in the design and manufacture of superior relays for all types of industrial use, C. P. Clare & Co. are pioneers in the development of a method of hermetic sealing which insures their long-life protection against unfavorable atmospheric and environmental conditions.

Hermetic sealing, as practiced by Clare, injects an ideal atmosphere of dry inert gas and seals it in to provide permanent immunity from the natural enemies of relays—moisture, pressure and density changes, salt, corrosive fumes, dust and fungi.

Fifty and more different series of Clare hermetically sealed relays are now available to relay users. Within each series innumerable variations of coil and contact specifications are possible.

For a full treatment of the subject of hermetic sealing—the Clare way—as well as a description of many types of Clare hermetically sealed relays, write for Clare Sales Engineering Bulletin No. 114.

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Edited by WILLIAM P. O'BRIEN

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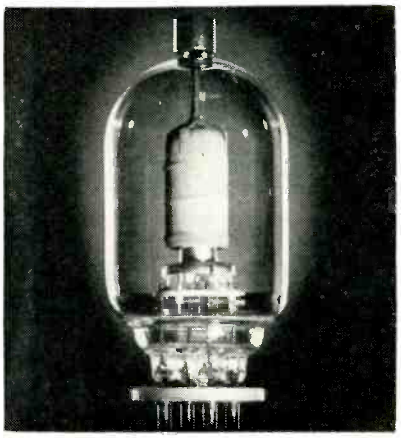
OTHER DEPARTMENTS
featured in this issue:

UHF Power Tetrode

RADIO CORP. OF AMERICA, Harrison, N. J., has announced a new 1-kw power tetrode, with ceramic-metal seals, for use in uhf tv transmitters. Designated as the 6181, the forced-air-cooled tube can be operated with full plate voltage and plate input at frequencies as high as 900 mc, and is capable of delivering a synchronizing-level power output of 1,200 w in broad-band tv service. Featured in the design is a coaxial electrode structure providing low-inductance, large-area, r-f electrode terminals insulated from each other by low-loss ceramic bushings.

TV Bypass Capacitors

ERIE RESISTOR CORP., Erie, Pa., is offering two new Ceramicon bypass capacitors designed primarily to supply high-voltage power supply filtering for tv receivers. Style 412 is rated at 20 kv and style 414 at 10 kv. The case insulation is of low-loss, molded thermosetting plastic. Ring convolutions are molded into the surface of the 20-kv capacitor to prevent surface leakages that are caused by ordinary handling and a consequent deposit of conductive materials. The convoluted design increases the effective surface creepage path by more than 14 percent.



Clipper Diode

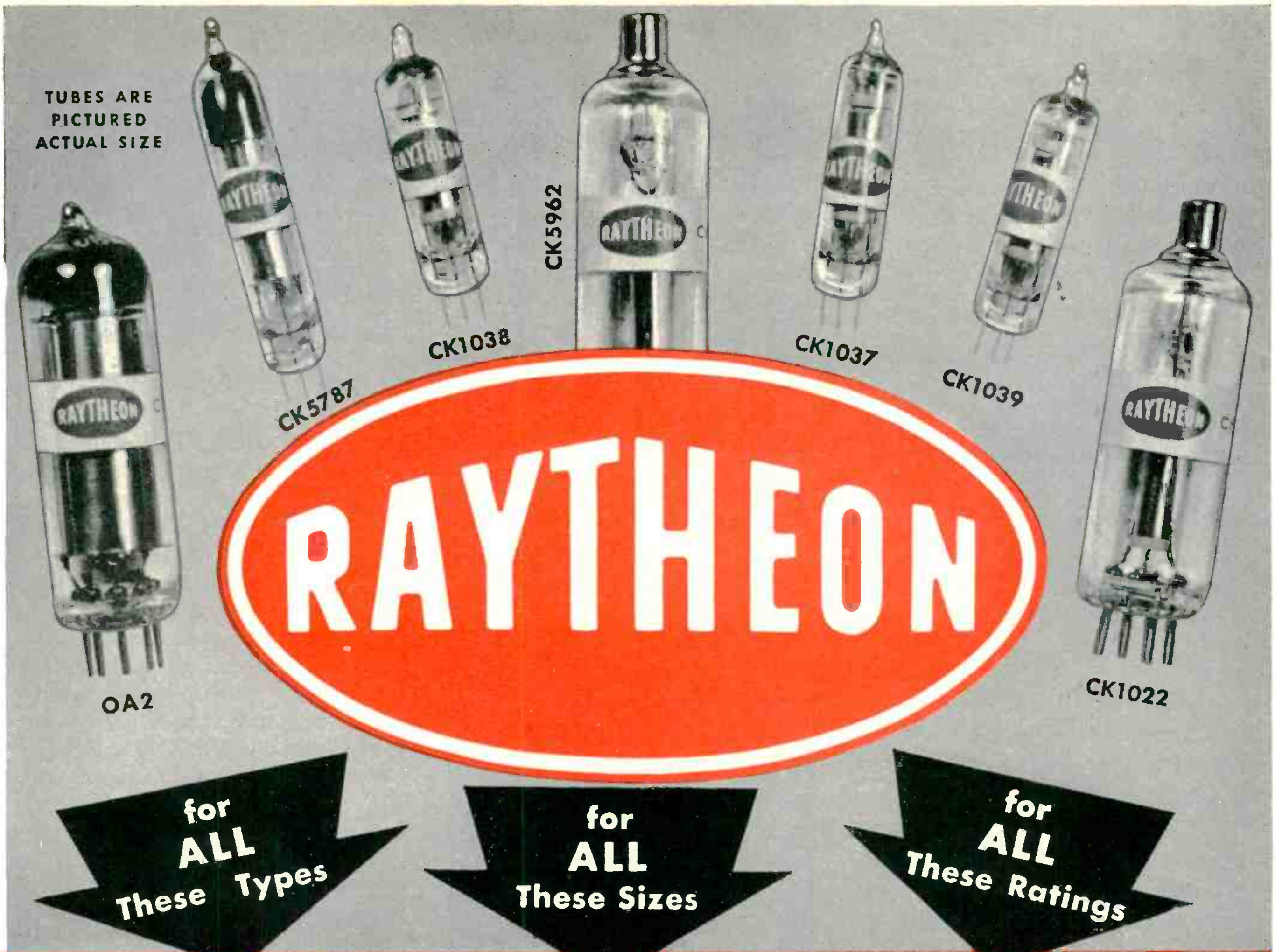
LEWIS & KAUFMAN, INC., Los Gatos 1, Calif. The type 719A clipper diode is designed for h-v pulse applications. It is recommended for use in pulse generators where the pulse-repetition rate is 2,000 pps or less and peak forward current is 10 amperes. Peak inverse rating is 25,000 v. Conservatively rated at 75 watts, the tube incorporates a new black-body heat-dissipating anode surface termed Sintercote. The heater draws 7 amperes at 7 volts. Maximum height of the tube is 5⅞ in. and maximum diameter is 2 9/16 in. It fits a standard No. 234 socket.

Signal Splitter

J. L. A. MCLAUGHLIN, P.O. Box 529, La Jolla, Calif. Type McL-10-VBX signal splitter, for use with communications receivers subject to adjacent channel and in-channel jamming, is essentially a selectable single-sideband converter that rejects the side frequencies containing the unwanted carrier. It features low r-f intermodulation distortion and variable bandwidth. Up to seven selectivity switch positions in either sideband provide a total of fourteen useful single-sideband widths of from 100 cps out to 10,000 cps for reception of c-w to broadcast quality a-m transmissions through jamming. The device will separate two carriers on the same assigned frequency and attenuate the unwanted one 60 db when the frequency difference is only 0.005 percent at carrier frequencies of 15 mc or more.

Unit Crystal Oscillator

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. Standard frequency harmonics of 1 mc, 100 kc and 10 kc, with output frequencies as high as 1,000 mc, are available from the type 1213-A unit crystal oscillator. Short period



VOLTAGE REGULATOR AND REFERENCE TUBES

TYPE	MAX. DIMENSIONS INCHES		MIN. STARTING VOLTAGE SUPPLY	OPERATING VOLTAGE (Approx.)	MIN. OPERATING CURRENT MA.	MAX. OPERATING CURRENT MA.	MAX. REGULATION VOLTS
	HEIGHT	DIAM.					
OA2	2.63	.75	185	150	5	30	6
OB2	2.63	.75	133	108	5	30	4
CK1017	2.69	.75	750	700	.005	.055	15
CK1022	2.69	.75	1100	1000	.005	.055	20
CK1037	1.75	.40	720	700	.005	.100	15
CK1038	1.75	.40	925	900	.005	.055	15
CK1039	1.75	.40	1230	1200	.005	.100	25
CK5651*	2.13	.75	115	87	1.5	3.5	3
CK5783*	1.63	.40	115	87	1.5	3.5	3
CK5787	2.06	.40	141	100	5	30	6
CK5962	2.69	.75	730	700	.005	.055	15
CK6213	1.38	.40	200	130	1.0	2.5	2

*Voltage Reference Tube

RAYTHEON MANUFACTURING COMPANY

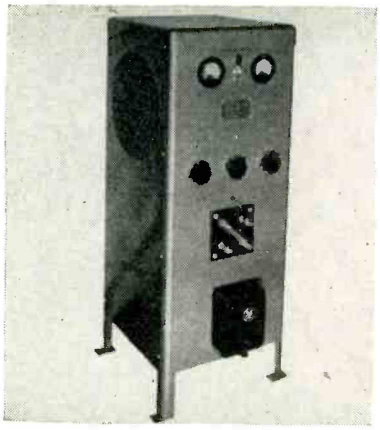
Receiving Tube Division

Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Calif.

RAYTHEON®

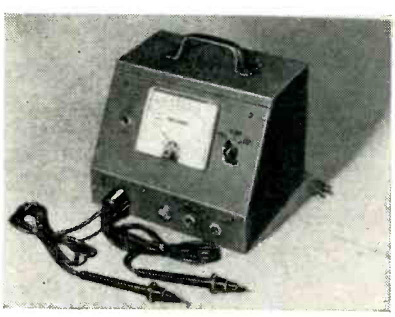
Excellence in Electronics

RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • RADIAC TUBES • RECEIVING AND PICTURE TUBES • MICROWAVE TUBES stability (several hours) is about 1 part per million (0.0001 percent). Usable 1-mc harmonics extend to 1,000 mc, and the 100-kc and 10-kc harmonics to at least 250 and 25 mc, respectively. With good receiving equipment the 10-kc harmonics can be used to 30 mc and higher.



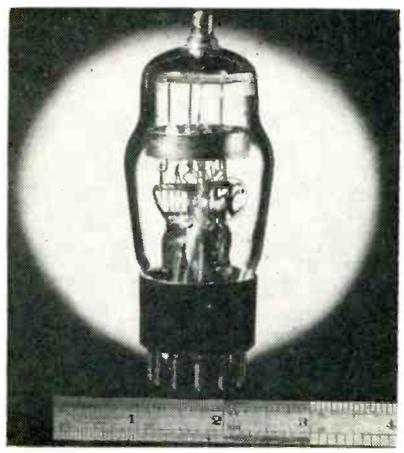
D-C Power Supply

ELECTRONIC RECTIFIERS, INC., 2102 Spann Ave., Indianapolis 3, Ind., has announced a new d-c power supply that operates on a-c line voltages of 208 to 230, three phase, 60 cycles. It supplies either 500 amperes at 3 to 7 v d-c, or 250 amperes at 6 to 14 v d-c. This is a full wave unit with a ripple voltage of approximately 4½ percent under load. The d-c voltage does not drop to zero when a single tap position is changed under load as is common to many power supplies employing a three-phase half-wave rectifier. The unit is equipped with Lextron magnesium copper-sulphide rectifiers that can be operated at temperatures from −40 to 284 F.



Insulation Tester

EASTERN SPECIALTY CO., 3617 N. 8th St., Philadelphia, Pa., has developed an insulation tester to meet the requirements of safety, instantaneous indication, direct reading in megohms, ability to discriminate between a complete insulation breakdown and leakage through insulation, and portability and compactness. In case the operator should get across the test leads, the dead short circuit is limited to a maximum of 100 μa, or 0.1 ma. The indicator is a direct-reading d-c microammeter, is calibrated directly in megohms and will measure insulation resistance up to 1,000 megohms. The circuit consists of a small Sola constant voltage transformer, a step-up transformer and a rectifier-capacitor network that delivers a steady filtered voltage of 1,500 v d-c.



High-Speed Vacuum Tubes

INTERNATIONAL TELEPHONE AND TELEGRAPH CORP., 67 Broad St., New York 4, N. Y., can supply two high-speed vacuum tubes for use in electronic systems using vacuum tubes in place of stepping switches. Type G10/240E unidirectional cold-cathode decade counter illustrated has 10 cathodes to indicate the number of the count, either visually at low speeds or by means of the voltage developed across the cathode load at high speeds. It can count pulses at repetition speeds between 0 and 20 kc. Dimensions are: overall length, 4.96 in.; seated height 4.4 in.; bulb diameter, 1.96 in. and weight, 2.29 oz. Type G1/370K primed cold-cathode trigger has an overall length of 2.1 in.; a seated height of 1.87 in.; a bulb diameter of 0.75 in. and weight of 0.17 oz.

Synchro Zeroing Device

ULTRASONIC CORP., 61 Rogers St., Cambridge, Mass., has announced the model U100 Synchronull, an instrument designed for zeroing synchros of all types, and proving a valuable test device in equipment manufacturing plants and in field engineering use. A simple switching operation automatically selects proper test-circuit connections for each type of synchro, as well as the proper sequence of test circuits for the zeroing operation. High sensitivity in the null-indicating tuning eye permits the ultimate in zeroing accuracy. Ten millivolts, corresponding to about 0.6 minute of angular error, can be clearly and instantly detected.

Receiving Tube

GENERAL ELECTRIC CO., Syracuse, N. Y., has announced the 6BK5 receiving tube which may lead to a considerable reduction in tv receiver manufacturing costs. Use of the new tube in conjunction with the 6BN6 in the sound circuit of tv receivers will result in the elimination of two additional tubes, associated components and several assembly operations. The 6BK5 is a power output pentode, while the 6BN6 is a combination limiter and discriminator. Used together they eliminate use of a first audio amplifier tube and a limiter tube. When operated with 250 v on the plate and screen, the 6BK5 can deliver 3.5 w

If it needs sealed terminals—

E-I has the ANSWERS! *

*Hermetically Sealed
MULTIPLE HEADERS

*Hermetically Sealed
TERMINALS

*Hermetically Sealed
OCTAL PLUG-INS

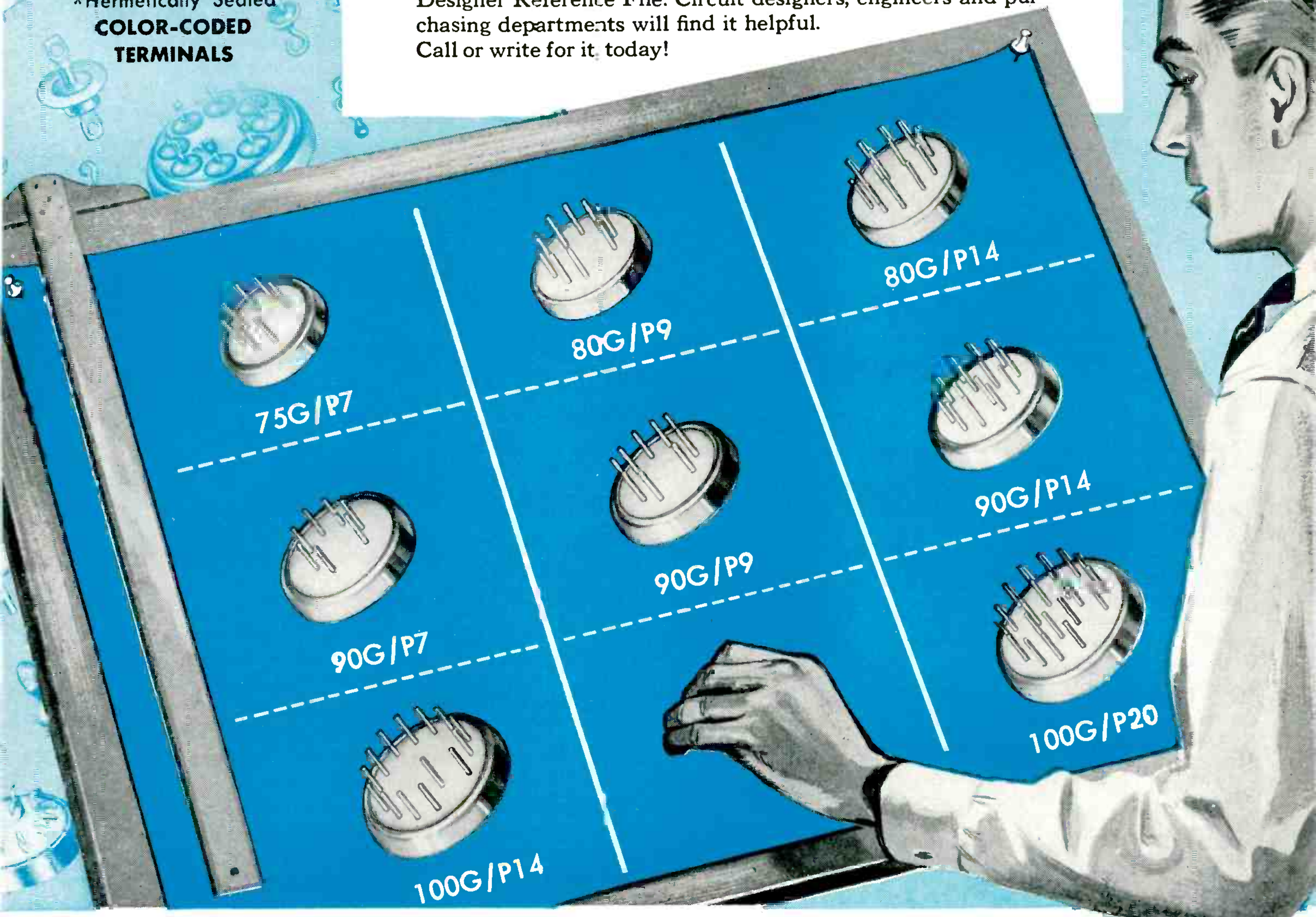
*Hermetically Sealed
END SEALS

*Hermetically Sealed
COLOR-CODED TERMINALS

When specifications call for sealed terminals, check with E-I for a quick, practical solution! For the E-I engineering staff is constantly adding to the long list of mass-produced, economy priced hermetically sealed leads and headers to keep pace with the ever changing needs of the electronics industry.

FOR EXAMPLE—here's the new Series G Plug-in Type Multiple Headers

Specially designed to specification and now available as a standard series. Another addition to the over 100 types to be had quickly at economical mass production cost. The complete E-I Standard line is described fully in a handy Engineer-Designer Reference File. Circuit designers, engineers and purchasing departments will find it helpful.
Call or write for it today!



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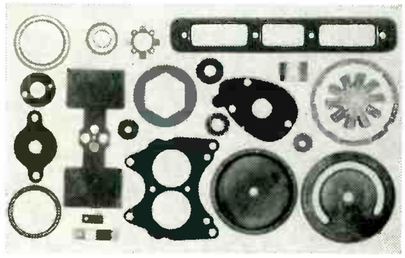
E I INC

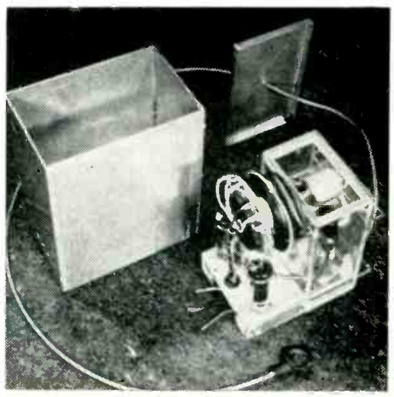
ELECTRICAL INDUSTRIES • INC
44 SUMMER AVENUE, NEWARK 4, NEW JERSEY

at 7-percent distortion. The grid driving voltage required for full audio output is only 5 v peak. Plate dissipation is 9 w.



Gaskets and Packings

AUBURN MFG. Co., 300 Stack St., Middletown, Conn., is now using the newest industrial materials to come out of the laboratory in the design and manufacture of gaskets and packings for improved service under many different conditions. The new materials include Teflon, Kel-F, Neoprene, silicon rubber, the phenolics and other plastics. The company has a complete design and fabricating service on gaskets, packings, washers, spacers, seals, shims and bushings.

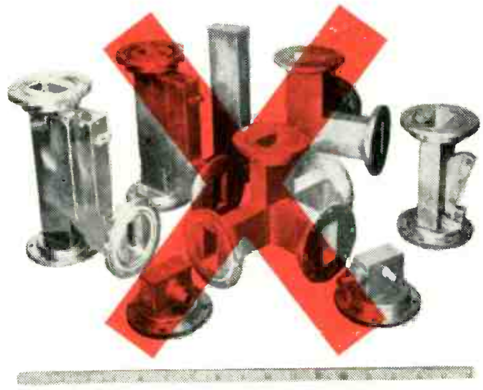


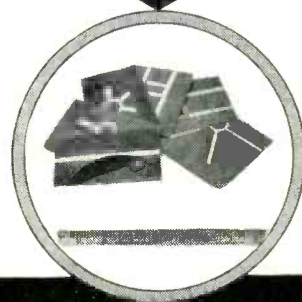
H-V Power Supply

NORTH AMERICAN PHILIPS CO., INC., 750 S. Fulton Ave., Mount Vernon, N.Y., has announced a high-voltage d-c power supply unit for use with c-r and Geiger counter tubes. The miniaturized unit operates at temperatures from −30 to 80 C and can be adapted for many applications, particularly airborne and radar equipment. Input is 315 v d-c, 50 ma. Output is 18 kv d-c, 150 μa maximum. The a-c ripple averages 1 percent. The unit is built to withstand 21 kv at 50-percent humidity. A Ferroxcube core is

for the FIRST time —

Conventional Waveguide Plumbing





New Microstrip

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Printed Microwave Plumbing

MICROSTRIP a new type of microwave plumbing is now available.

MICROSTRIP replaces costly bulky waveguide components.

MICROSTRIP is small, light, and inexpensive.

MICROSTRIP is ideal for experimental as well as mass production methods. Applicable to:

- Microwave Links
- Communications Systems
- Television Links
- Radar
- Guided Missiles
- Aerial Navigation Systems
- And Other Applications

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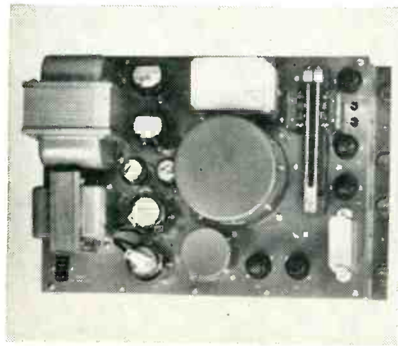
used in the h-v transformer to obtain high efficiency and compactness. Dimensions of the power supply unit are 6 in. wide, $5\frac{1}{4}$ in. high, and $3\frac{1}{2}$ in. deep.

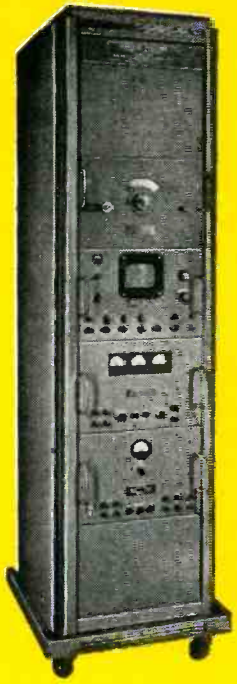


Power Supply Unit

AMPEX ELECTRIC CORP., Redwood City, Calif., has announced model 375 precision 60-cycle power supply unit that provides accurate frequency stabilization for operating laboratory and test equipment. Frequency stability is five parts per million per deg C. It provides 60 watts of useful power. Input may vary from 50 to 400 cycles and from 90 to 125 v. Output is constant at 60 cycles and adjustable from 0 to 150 v. The unit is designed for standard rack mounting.

R-F Coax Switch

THOMPSON PRODUCTS, INC., 2196 Clarkwood Road, Cleveland 3, Ohio, has developed model 10565 lightweight r-f coaxial switch that is actuated by a 24-28 volt d-c rotary solenoid and meets rigid military performance specifications. At frequencies to 11,000 mc it has a maximum vswr of 1.5 db and less than 0.2 db insertion loss. At 3,000 mc



All Band, Direct Reading

SPECTRUM ANALYZER

10 MC to 21,000 MC

The Model LSA is the result of years of research and development. It provides a simple and direct means of rapid and accurate measurement and spectral display of an rf signal.

Outstanding Features:

- Continuous tuning.
- One tuning control.
- 5 KC resolution at all frequencies.
- 250 KC to 25 MC display at all frequencies.
- Tuning dial frequency accuracy 1 percent.
- No Klystron modes to set.
- Broadband attenuators supplied from 1 to 12 KMC.
- Frequency marker for measuring differences 0-25 MC.
- Only four tuning units required to cover entire range.
- Microwave components use latest design non-contacting shorts for long mechanical life.
- Maximum frequency coverage per dollar invested.
- 5 inch CRT display.

Model LSA

The instrument consists of the following units:

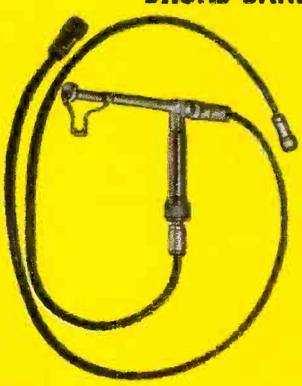
Model LTU-1 RF Tuning Unit—10 to 1000 MC.
Model LTU-2 RF Tuning Unit—940 to 4500 MC.
Model LTU-3 RF Tuning Unit—4460 to 16,520 MC.
Model LTU-4 RF Tuning Unit—15,000 to 21,000 MC.
Model LDU-1 Spectrum Display Unit.
Model LPU-1 Power Unit.
Model LKU-1 Klystron Power Unit.

Polarad PRECISION LABORATORY INSTRUMENTS

BROAD BAND MICROWAVE ATTENUATOR

Model SIJ

4 kmc to 12.4 kmc



Polarad's Broad Band Microwave Attenuator is intended for use as an external attenuator in microwave measurements with signal sources, receivers and for power measurements. Its useful frequency range is from 4000 mc to 12,400 mc. Model SIJ can be used as a standard calibrated attenuator or to couple a small amount of energy from a high level source for circuit protection, or for monitoring and for measurement purposes without introducing discontinuities or to insure rf circuit isolation.

By its use a Polarad Microwave Signal Source or a laboratory oscillator is converted into a signal generator.

Features:

- Continuously variable attenuation.
- Stub tuned, 50 ohm impedance.
- Waveguide beyond cut-off attenuator.

WIDE BAND VIDEO AMPLIFIER

Model VT 10 CPS to 20 MC

Designed for use as an oscilloscope deflection amplifier for the measurement and viewing of pulses of short duration and rise time. Excellent for TV, both black and white and color applications.

Model VT

Features:

- Flat frequency response from 10 cps to 20 mc ±1.5 db.
- Uniform time delay of 02 microseconds.
- Gain of 50 db.
- Frequency compensated high impedance attenuator calibrated in 10 db steps from 0-50.
- Fine attenuator covers a 10 db range.
- Phase linear with frequency over entire band.

MICROWAVE SIGNAL SOURCES

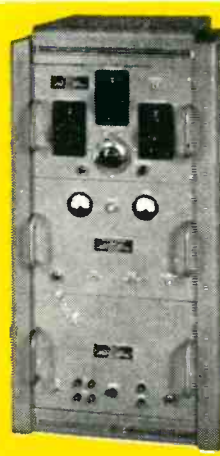
Models SSR, SSL, SSS, SSM, SSX

634 MC to 11,000 MC

For use as a reliable source of microwave energy in transmission loss measurements, standing wave determination, etc. Unidial Control for accuracy and ease of operation. Direct reading (no mode charts to consult). Frequency determination accurate to 1% through use of present calibration and temperature compensated klystrons.

Five Microwave Signal Sources are available to cover the frequency range from 634 MC to 11,000 MC. Units ruggedly constructed, mounted on aluminum castings to insure mechanical stability. Klystron reflector voltage automatically tracked with tuning of the klystron cavity to provide unidial control. Signal sources supplied complete with klystron.

FREQUENCY MARKER



Model FM-L

950 mc to 2,040 mc

Polarad's Frequency Marker, Model FM-L, provides accurate frequency determination to within 10 kc over the frequency range 940 to 2020 mc.

The Frequency Marker produces calibration signals at precisely determined frequencies and these signals may be displayed and compared with an unknown rf signal, whose frequency can then be accurately measured.

Features:

- Frequency standard accurate to one part in 10^6.
- Frequency determination accurate to ±10 kc.
- Ten mc, 1 mc, and interpolation markers available.
- Markers throughout entire frequency range, 940 mc to 2040 mc.

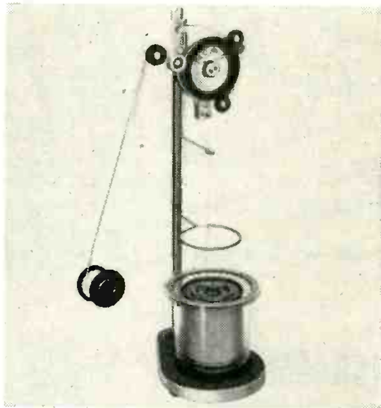
Polarad Electronics Corporation

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

crosstalk is in excess of 55 db. Power handling capabilities are 100 watts continuous c-w at 3,000 mc. Actuation time is less than 0.5 second with a minimum life of 10,000 cycles. Weight is 1.6 lb.

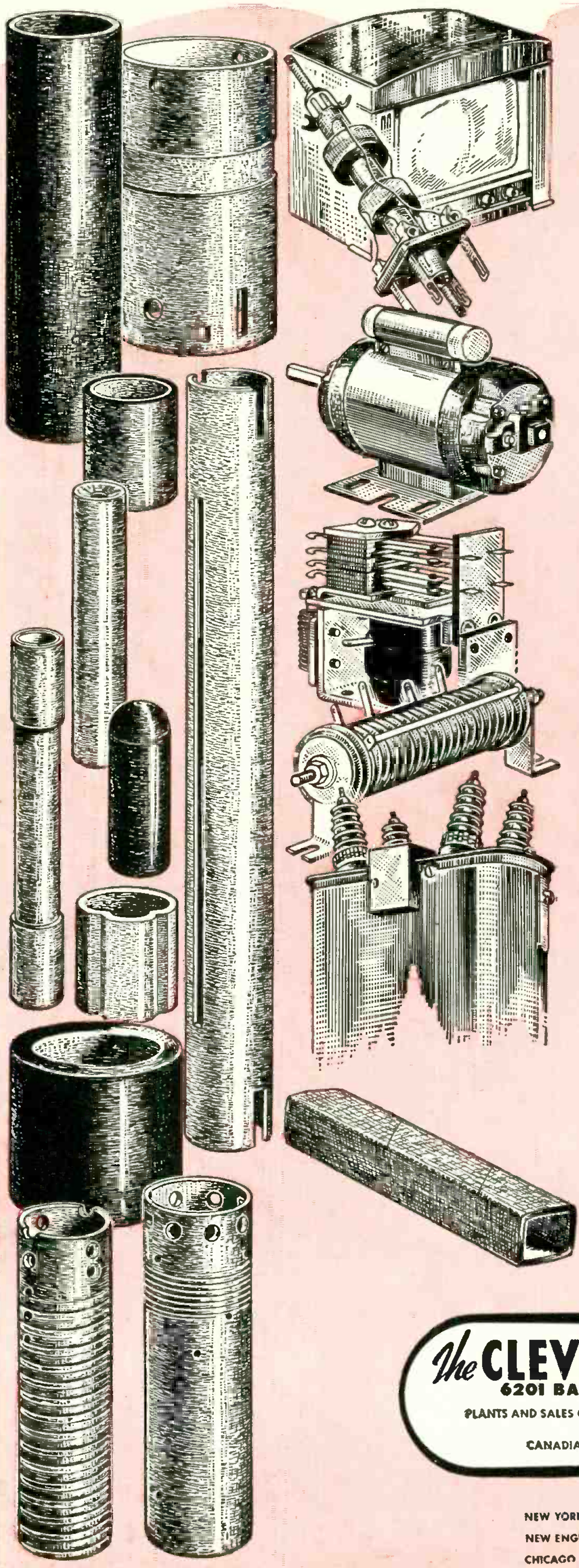
Receiving Tube

GENERAL ELECTRIC CO., Schenectady, N. Y. Type 6BX7-GT receiving tube will reduce vertical distortion on tv receivers which are operated from a low B-plus supply voltage. It is a twin triode designed for the vertical output stage of tv receivers as a combined vertical deflection amplifier and vertical oscillator. It will provide better linearity and more sweep at a lower driving voltage. Because it will operate at a lower voltage, use of the tube will also result in a saving of transformer copper. Among typical operating characteristics for each section are a cutoff voltage of 40 v with 250 v on the plate and 80 ma plate current at zero bias with 100 v on the plate. The tube has a maximum plate supply voltage rating of 500 v as vertical deflection amplifier.



Dereeling Tension

GEO. STEVENS MFG. CO., INC., Pulaski Rd. at Peterson, Chicago 30, Ill. A new T-100 dereeling tension is engineered to handle very fine wire in automatic winding equipment as well as manually controlled machines. Adjustment of tension is simple and is accurately maintained throughout the winding cycle. Sizes of wire handled are No. 30 to 50 on spools up to 3 in. diameter. The unit can be used in multiple or single winding. Space required for multiple winding is



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Phenolic TUBING

of *every type* for almost

EVERY APPLICATION

are Preferred because of their
Proven Performance and Low Cost!

In Radio and Television their use is almost universal. They have high insulation resistance and low moisture absorption. Their low dielectric loss is suitable for ultra high frequency applications.

In Electric Motors for armature shaft spacers, insulators, brush holders, and many similar force-fit applications requiring easy machining, Clevelite and Cosmalite are particularly suitable.

In Relays, Controls, Selenium Rectifiers, the various grades of Clevelite Phenolic Tubing have special properties that guarantee complete satisfaction.

In Transformers, X-Ray and Diathermy Equipment, Clevelite and Cosmalite tubing in various grades . . . rectangular and other shapes, supply the exact needs of the engineer.

TEN GRADES - TIME TESTED

Immediately Available at Low Cost

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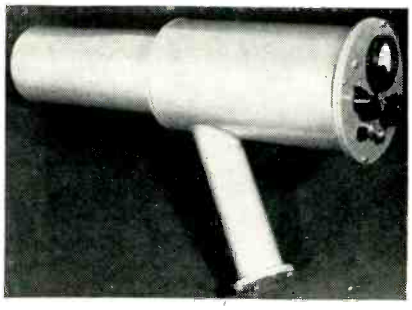
only 1¼ in. per head. Dimensions of the complete unit are 7 in. long × 5½ in. wide × 20¾ in. high. Dimensions of the head are 5½ in. long × ¾ in. wide × 5 in. high. Net weight of the complete unit is 4½ lb. A patented antikink ring prevents wire tangling or knotting.

Tubular Trimmer

ERIE RESISTOR CORP., Erie, Pa. Style 535 trimmer has been developed in response to the need for a compact, small, stable h-f trimmer at a low price. It is easily mounted in that no additional hardware is required. The trimmer has low inductance and extremely low loss, owing to employment of ribbon-type leads and high-temperature styrene dielectric. Adjustment is uniform, straight-line and noiseless. The unit can be used at uhf and is provided with a soldering tab for ground.



Gamma Scintiscope

R-C SCIENTIFIC INSTRUMENT CO., INC., 335 Culver Blvd., Playa Del Rey, Calif. Model CAX17P portable, battery-powered gamma scintillation survey meter is intended primarily for the detection of gamma radiation and medium and high energy beta particles to the total exclusion of alpha particles and has five ranges: 0–20, 0–200, 0–2,000, 0–20,000 and 0–200,000 counts per second full scale. Individual gamma pulses can be heard by the use of earphones so that radiation sources may be easily and quickly located with audible, as well as visual, means. It is between 50 and 100 times as sensitive as a standard Geiger counter to gamma radiation, thereby making it extremely valuable in locating imbedded sources of low intensity,

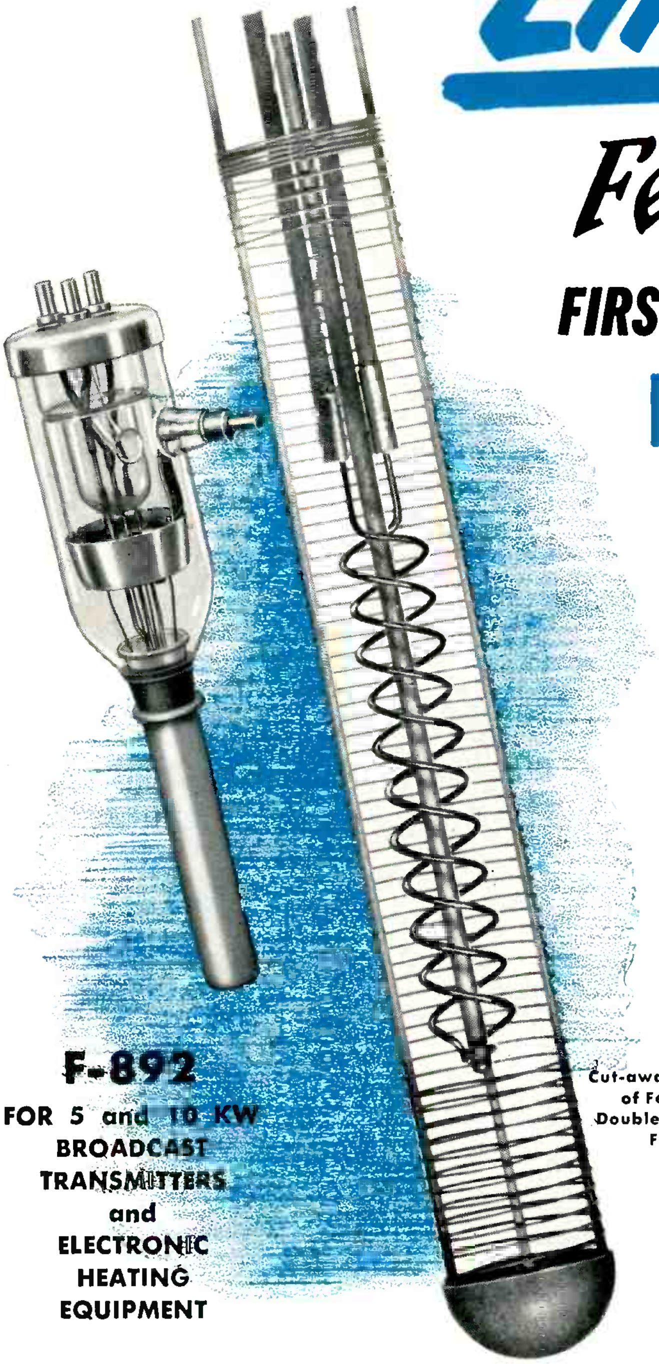
NOW...Filament-to-Grid Shorts *Eliminated!*

Federal's F-892

FIRST with the new, proved design

Double Helical Filament

- ***Does away with BOWING!***
- ***Greatly increases tube LIFE!***



F-892

FOR 5 and 10 KW BROADCAST TRANSMITTERS and ELECTRONIC HEATING EQUIPMENT

Cut-away View of Federal's Double Helical Filament

ANOTHER important Federal *"First"* is the new Double Helical Filament—for Federal's re-designed F-892!

The design has been completely checked and subjected to numerous filament cycling tests equivalent to two years' operation in normal broadcast equipment.

One tube filament was cycled 1500 times—1000 times with the starting current *twice* rated, and 500 times with the starting current *four* times rated—*without movement or distortion!*

Wound through 360° for mechanical stability and carrying opposing electrical fields which provide improved electrical stability, the F-892's Double Helical Filament definitely eliminates *bowing*—one of the primary causes of filament-to-grid shorts. For proof, all F-892's now in the field are still in service!

For full information on Federal's sturdier, longer-life, more dependable F-892, write to Vacuum Tube Division, Dept. K-513.

"Federal always has made better tubes"

Federal Telephone and Radio Corporation

FEDERAL TELECOMMUNICATION LABORATORIES, Nutley, N. J. . . . . a unit of IT&T's world-wide research and engineering organization.

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Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

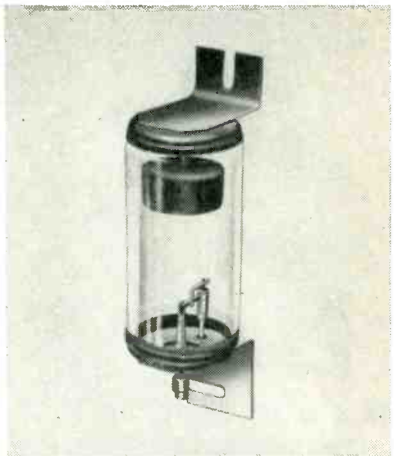
FEDERAL TELEPHONE & RADIO FTR

AN IT&T ASSOCIATE

such as encountered in prospecting or in locating contaminated areas.

Radioactivity Detector Kit

ALLIED RADIO CORP., 833 W. Jackson Blvd., Chicago 7, Ill., has announced the Super Scout, a radioactivity detector in kit form. It is a sensitive, portable Geiger counter that detects the presence of gamma rays, medium-to-high energy beta rays, as well as cosmic and x-rays. It instantly spots radiation from uranium, pitchblende, radium and other radioactive sources. Clicks heard in headphones and flashes of a neon bulb increase markedly in frequency as a radioactive source is approached. A sensitive G-M tube is used and power is obtained from a built-in vibrator power supply operating from two self-contained standard flashlight batteries. Weight of the detector is 3 lb. Easy-to-read instructions are included in the kit.



Air-Cooled Ignitron

NATIONAL ELECTRONICS, INC., Geneva, Ill., is producing an air-cooled type ignitron tube designed especially for the control of small resistance welders and for similar a-c control applications. Designated NL-1001, it is capable of controlling 600 amperes rms demand or 9 amperes d-c at 250 volts a-c. Because its glass sidewalls permit observation of the working parts the tube is also useful for demonstration and test work. Other maximum ratings are: rms anode volts, 600; ignitor volts, 200; ignitor current, 30 amperes; ignition time, 100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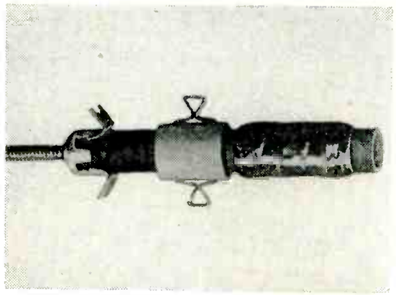
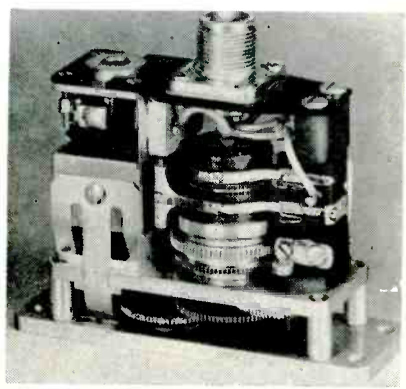
MINIATURE TRANSFORMERS
MINIATURE TOROID INDUCTORS
PULSE MODULATORS
No. 1030 LOW FREQUENCY "Q" INDICATOR
No. 1150 UNIVERSAL BRIDGE
SLUG TUNED DISCRIMINATORS
HIGH FIDELITY TRANSFORMERS
No. 1010 COMPARISON BRIDGE
FREEDSEAL TREATMENT
No. 1020B MEGOHMMETER
FILTERS
No. 1180 A.C. SUPPLY
A.C.-V.T. VOLTMETER MODEL 10-C FREED TRANSFORMER CO. BROOKLYN, N.Y. U.S.A.
NO. 1040 VOLTMETER
VOLTAGE RANGES: .001 volts to 100 volts in five ranges (.01, .1, 1, 10, and 100 volts full scale).
ACCURACY: 2% on full scale on all five ranges, on sinusoidal voltages.
FREQUENCY RANGES: 10 to 200,000 cycles, .1 db. variation from 20 cycles to 150,000 cycles; .50 db. variation from 10 cycles to 200,000 cycles.
INPUT IMPEDANCE: Equivalent to 500,000 ohm resistance in parallel with a 15 MMF. condenser.
STABILITY: Effect of variation in line voltage from 100 volts to 125 volts is 1%. Effect in changes of tubes is less than .5%.
METER: 4" suppressed zero 1 MA meter protected against overloads.
POWER SUPPLY: The instrument is entirely self-contained and operates on 100-125 volts, 50-60 cycles. Total consumption, 40 Watts.
DIMENSIONS: 4⅞" High, 5⅝" Wide, 9⅞" Long.
WEIGHT: 12 pounds.
No. 1110A INCREMENTAL INDUCTANCE BRIDGE
No. 1170 D.C. SUPPLY
SEND FOR COMPLETE TRANSFORMER AND INSTRUMENT CATALOGS
FREED TRANSFORMER CO., INC.
1722-B WEIRFIELD ST., BROOKLYN (RIDGWOOD) 27, N. Y.
EXPORT DIVISION:—458 BROADWAY N.Y.C. 13, N.Y.

μsec. The tube is designed for forced or free air cooling.



Variable R-F Chokes

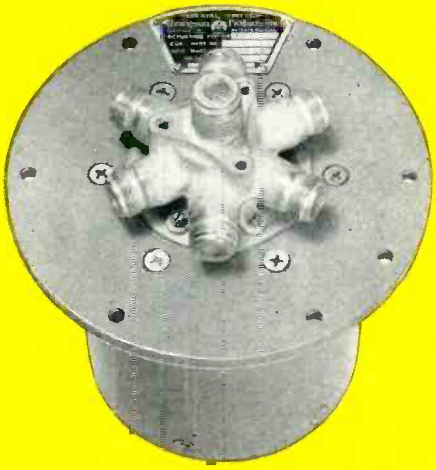
GRAYBURNE CORP., 103 Lafayette St., New York 13, N. Y., has released precision variable r-f chokes having an inductance variation of as high as 10 to 1. Because they incorporate the new Ferrite cores, these high-ratio Vari-Chokes possess these characteristics: greater compactness, increase in Q, reduction of d-c resistance, savings in copper, reduction in distributed capacitance and reduction in weight. Two standard models are available: model V-6 (0.65 to 6.0 mh) and model V-25 (5.0 to 43.0 mh).



On-Off D-C Timer

PACIFIC DIVISION, BENDIX AVIATION CORP., 11600 Sherman Way, North Hollywood, Calif., has introduced a new precision on-off d-c timer that can provide timing cycles from 3 seconds to several minutes. The timer has wide application for such operations as limiting the operating cycles on jet engine igniters, to sequence or limit the operation of solenoid valves or other units where safety of equipment requires delays in frequency or duration of operation. Accuracy of the timing mechanism is provided by a con-

THEY'RE NEW...
AND THEY'RE THOMPSON TOO!



Model CA-26, 1P6T, 115 volt, 60 cycle, AC motor-actuated Coaxial Switch for use with RG-9/U cable.

COAXIAL SWITCHES

designed, engineered, manufactured ...

by Thompson

Model CA-36, 1P3T manually-actuated RG-17/U Coaxial Switch with electrical and mechanical interlock.

Model CA-31, 2P2T Sensing or Lobing Switch, 115 volt, 380-1000 cycle AC motor actuator. Switching speed, 15—35 Rev/sec. For use with RG-58/U cable.

EVERY INCREASE in the scope and tempo of electronics creates new and stringent demands. Keeping abreast through development and manufacture of a reliable line of special-purpose electronic equipment is the business of Thompson experimental laboratories and manufacturing plants.

Like many other Thompson electronic developments, the three new coaxial switches illustrated were designed, engineered and manufactured to meet the rigid requirements of modern microwave components and accessories. Complete technical information is, of course, available upon request.

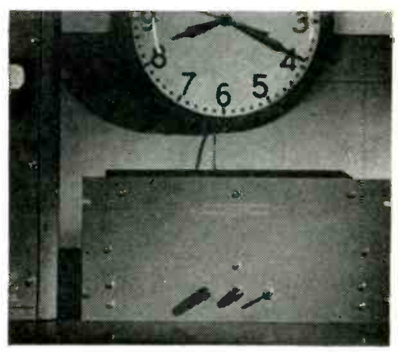
Whatever your problems may be—in coaxial switches, antennae, specialized test equipment or wave guide and coaxial components and accessories—Thompson's experience-proved research, development and production facilities at both Cleveland and Columbus, Ohio are at your service.

Thompson Products, Inc.

ELECTRONICS DIVISION · 2196 CLARKWOOD RD. · CLEVELAND 3, OHIO stant speed clutch which eliminates the use of clockworks or other cycling devices. The timer automatically resets itself instantaneously upon interruption of current to the holding coil. A conventional shunt-wound motor is used to drive the mechanism.

Twin Power Triode

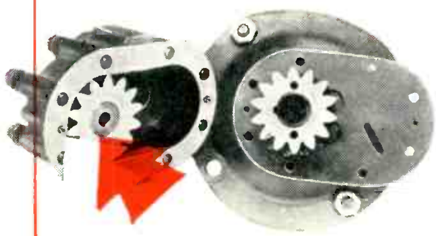
RADIO CORP. OF AMERICA, Harrison, N. J. Type 6082 low-mu, high-perveance, twin power triode is designed for use as the regulator tube in stabilized d-c power-supply units of aircraft receivers. It consists of two triode units in one envelope and utilizes a 26.5-v heater. Each unit has a mu of 2, a transconductance of 7,000 micromhos and a plate-dissipation rating of 13 watts. The tube employs a compact design in which special attention has been given to features which improve its strength both as to shock and vibration.



Frequency Multiplier

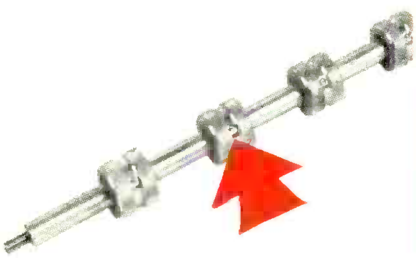
SIERRA ELECTRONIC CORP., 810 Brittan Ave., San Carlos, Calif. Designed to be energized by a 10-cps input at 5 v minimum, the model 134 clock-drive generator produces

REPLACING A HUB ON A GEAR . . . Rollpin, self-retained in shaft, is simply snapped into molded slot to position sintered gear. This application, by Ditto Inc., effects major savings in assembly. Rollpin's high shear strength is particularly valuable here.



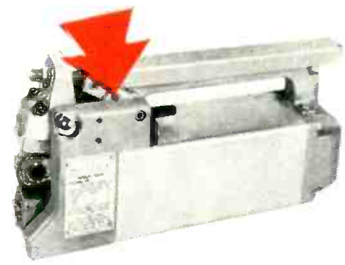
REPLACING A MACHINED PIN . . . In the lubrication pump assembly of the Cummins HR-400 diesel engine, two Rollpins are used as positioning dowels. Rollpins are self-retaining in production-drilled holes . . . quick to assemble and easy to remove.

REPLACING A HEADED PIN . . . In this hinge pin application, Rollpin is simply and inexpensively driven in place, greatly reducing assembly costs. Constant spring tension holds Rollpin firmly in place . . . eliminates loosening of hinge due to wear.



REPLACING A SET SCREW . . . Paper feed rollers are quickly, economically pinned to shaft by Rollpins in this office machine made by Ditto Inc. Flush fit affords neat appearance . . . spring tension assures positive, permanent positioning of rollers.

REPLACING A RIVET . . . Rollpin serves as guide shaft for spring-loaded electrical interlock contacts. The Square D Company reports that rivet failure previously occurred at the clinched end under normal operating impact and vibration.



REPLACING A BOLT AND NUT . . . Rollpins act as fasteners and pivots for the linkages in this Miller Electric Welder. Rollpins may be used with a free fit in outer or inside members depending upon product design requirements.

6 more examples of assembly-time saving with ROLLPIN

TRADE MARK

Rollpins are slotted, tubular steel, pressed-fit pins with chamfered ends. They drive easily into holes drilled to normal tolerances, compressing as driven. Reaming, tapering, extra assembly steps are eliminated. Rollpins are *locked* in place by the constant pressure they exert against hole walls. Inserted with an automatic press or by hand, Rollpins are readily removable with a drift or pin punch—and reusable again and again.

Elastic Stop Nuts with the famous red collar are another ESNA® product

ESNA
TRADE MARK

FOR DESIGN INFORMATION—fill out and mail our coupon. If your plans include applications similar to those on this page—or clevis pins, keys, taper pins or stop pins—you can't afford to be without details on how much faster and cheaper Rollpin can do the job.

Dept. R6-621, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free information on ESNA self-locking fasteners:

☐ Rollpin bulletin and sample Rollpins ☐ AN-ESNA conversion chart
☐ Elastic Stop Nut Bulletin ☐ Here is a drawing of our product. What fastener do you recommend?

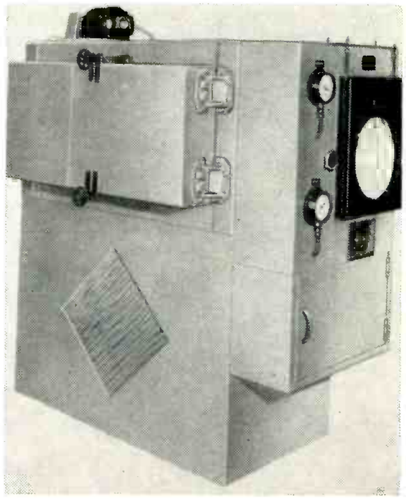
Name__________ Title__________

Firm__________

Street__________

City__________ Zone_____ State_____

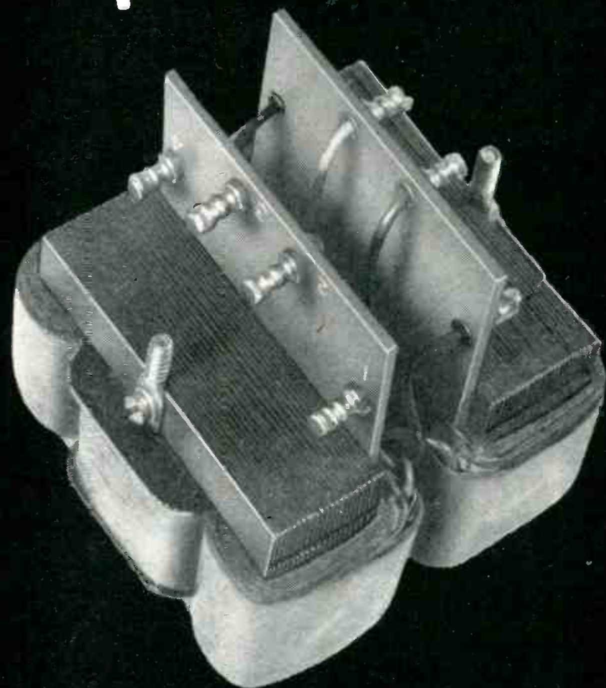
a 115-v 60-cps output of 5 watts. Developed for use in a continuous frequency-monitoring arrangement, the unit incorporates its own power supply and operates from standard 115-v 50 or 60-cps power, consuming 100 watts. It includes a control to permit adjusting the output voltage under various load conditions. In the basic application a secondary standard frequency, divided if necessary to 10 cps, is fed to the generator. Since the generator multiplies by 6, the output frequency is 60 cps ± 6 times the frequency error of the input. A standard Telechron clock is driven by the output signal and compared with a primary standard such as transmissions from WWV. Cumulative time error can be reduced directly to frequency error in the original secondary frequency standard.



Test Cabinets

STANDARD CABINET CO., 56 Washington Ave., Carlstadt, N. J., has available a line of controlled humidity, high and low-temperature test cabinets with ranges from —510 to +200 F at 20 percent to 95 percent relative humidity. Units are manufactured in sizes from one to 75 cu ft. Special sizes are available to order up to 1,000-cu-ft net working space. Electronic or pneumatic recording and indicating control systems are available as standard equipment on most models. This line of cabinets is finding increased use in the electronic manufacturing industry, where current military specifications require on-the-spot

MAGNETIC AMPLIFIERS



Typical Keystone Magnetic Amplifier, open unit. Also supplied hermetically sealed.

Keystone is noted for its specialization in magnetic amplifiers. No standard "line" . . . rather we build magnetic amplifiers of all sizes, your design or ours. We'll ship them right on schedule, open or hemetically sealed. If magnetic amplifiers for Servo systems are your problem, we'll give your inquiry prompt, intelligent attention. No obligation to consult our engineering department.

KEYSTONE PRODUCTS COMPANY

UNION CITY 2, N. J. • UNion 6-5400

testing of components, prototypes and production units. Full information, quotations and delivery dates are available from the manufacturer.

Bridge Balance

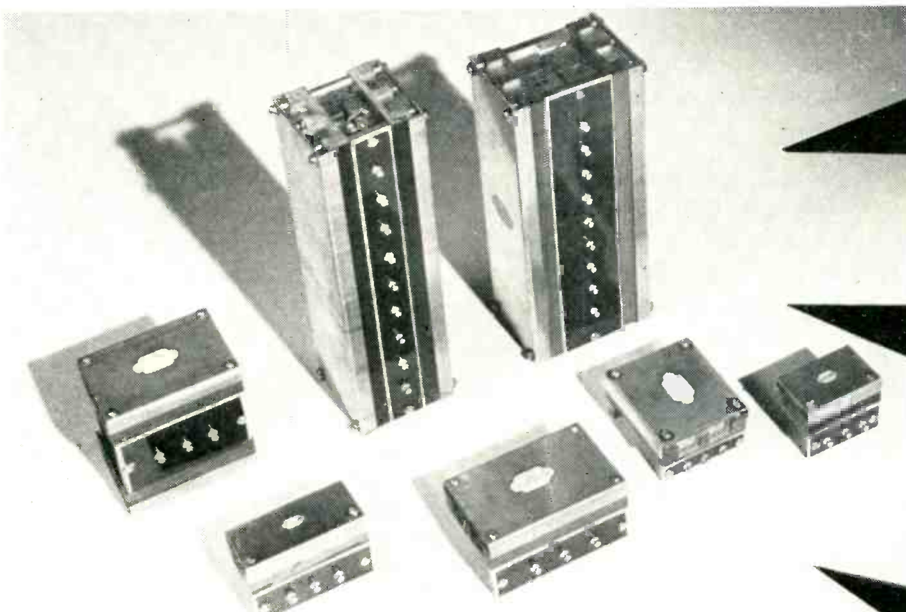
CONSOLIDATED ENGINEERING CORP., 300 N. Sierra Madre Villa, Pasadena 8, Calif., has available a new 8-channel bridge balance, type 8-108, that may be used for direct recording of the output of a wide variety of strain gages and strain-gage type pickups without use of amplifiers. Up to eight 120-to-350-ohm strain-gage bridges or strain-gage-type pickups, comprising four active arms may be connected to the instrument. Voltage across each bridge can be adjusted individually and continuously from the level of the supply voltage—28.5 v d-c maximum—down to a minimum of 2.0 v on a 350-ohm, four-arm bridge and 1.1 v on a 120-ohm, four-arm bridge.

Magnetic Tape Recorder

AMPEX ELECTRIC CORP., Redwood City, Calif., has announced a new magnetic tape recorder to meet exacting standards of h-f telemetering and applications in the use of rockets, guided missiles and computers. Model 500 is a precision instrument reproducing 100 to 100,000 cps with lowest possible flutter and wow, with less than 0.1 percent peak-to-peak limit. A new drive system accomplishes more than 5 to 1 improvement over best previous recorders. Provisions are made to record four individual data

ELECTRONIC **ELECOM** COMPUTER

REVOLUTIONARY DELAY LINES



LOWEST LOSS — ½db to 3db

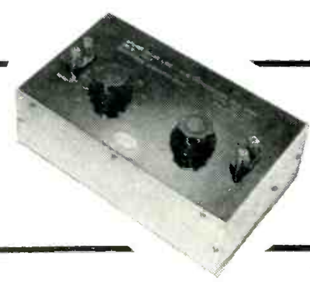
WIDEST RANGE — Up to 1 millisecond delay

MOST COMPACT — 100 μs delay 2 μs rise time in 2½" x 3½" x 9" space

For further information, please write specifying:

Required delay
Delay tolerance
Maximum rise time
Required impedance
Special features such as unusual temperature range, available space, tapping, etc.

DECADE DELAY LINES



ELECOM decade delay lines are entirely new items of laboratory equipment. Each line provides adjustment over a two decade range, and as much as 1.1 milliseconds delay with excellent rise time is obtainable in a single unit of relatively small size.

Specifications of other ELECOM components available. Please write.

ELECTRONIC COMPUTER CORPORATION

Designers and Manufacturers of Electronic Computers and Components

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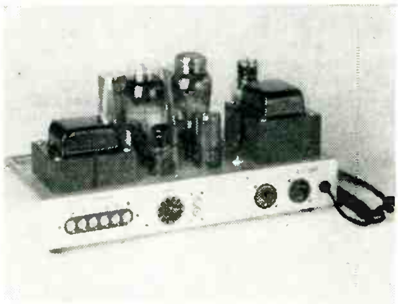
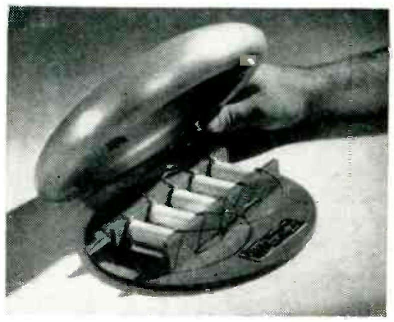
PLANT: 265 BUTLER ST., BROOKLYN 17, N. Y.

tracks. A signal-to-signal ratio is attained that is well over 40 db below 1.0 percent when measured in 15-percent bandwidths.



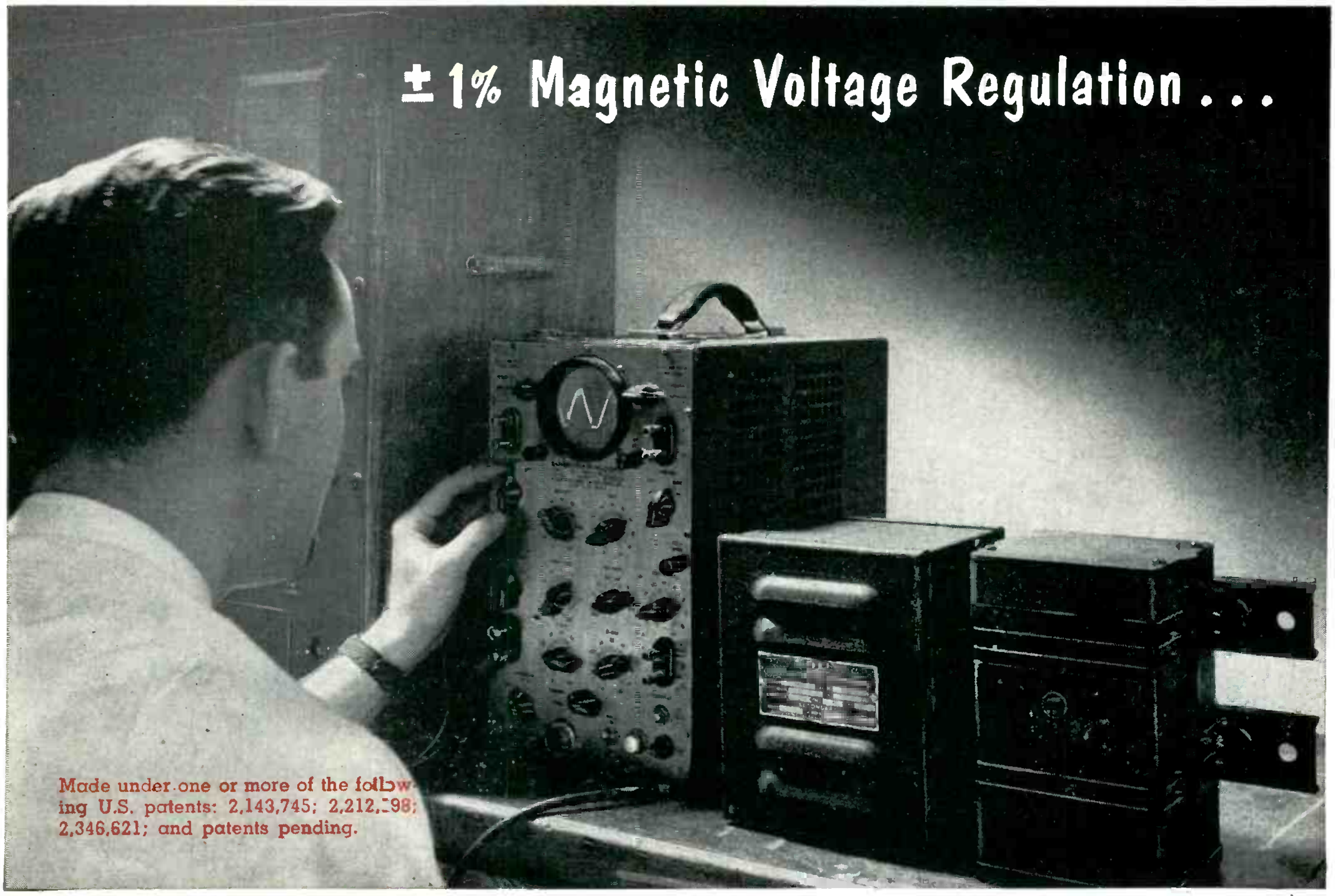
Power Amplifier

HERMON HOSMER SCOTT, INC., 385 Putnam Ave., Cambridge 39, Mass. Type 220-A power amplifier is designed for high-fidelity and laboratory use. Rated power output is 20 watts and frequency response is flat from 12 cycles to 55,000 cycles. Harmonic distortion is less than 0.5 percent at full 20 watts output; first order difference-tone intermodulation component, less than 0.1 percent at full-rated peak output; hum level, −90 db below full output; input for full-rated 20-watt output, 0.5 v on low-level input, 1.5 v on high-level input; input impedance, 0.5 megohm for low-level input and 1.5 megohms for high-level input.



Corona-Protected Resistor

ASTRO ELECTRIC CO., 1302 County Road, Belmont, Calif. Voltage drops from 5 to 100 kv, involving a maximum current drain of 1 ma, are secured for voltage measuring operations with the new type 1001 h-v resistor. Housed in a spun-aluminum corona shield, the unit contains five series-connected 1-megohm resistors rated at a precision of 0.1 percent at a temperature of 74 F. Each of these units, 2¾ in. high



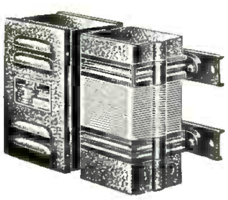
with less than 3% Harmonic Distortion

for Industrial and Defense PROCESS CONTROL, TESTING and RESEARCH

Now all the advantages of static-magnetic voltage regulation are available for harmonic-sensitive applications. All harmonic-neutralized regulators deliver ±1% regulated voltage with commercial sinusoidal output waveshape. They may be used for the most exacting applications in equipment having elements which are sensitive to power frequencies harmonically related to the fundamental. In addition, they have all the characteristics of the standard Sola Type CV static-magnetic regulators: no moving parts . . . no tubes or other expendable components . . . no manual adjustments . . . response 1.5 cycles or less . . . continuous, automatic regulation.

Seven fixed and two variable output models are available from stock.

FIXED OUTPUT, Type CVH



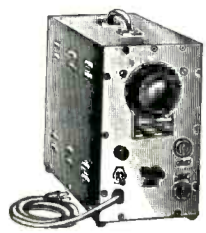
Stock units range in capacities from 30va to 2000va.

Type CVH units are especially suitable for meter calibration or for input to a rectifier when close regulation of the dc output is required. Units of 120va and under have line cord and output receptacle . . . 250va and over have screw type terminals in outlet boxes.

ADJUSTABLE OUTPUT, Type CVL — Solavolt

Two stock units of 250va and 500va are available.

The "Solavolt" will deliver any voltage from 0-130v stabilized within ±1%, and total harmonic distortion less than 3%. Each "Solavolt" is portable for laboratory or shop use. Any or all of their three regulated outputs may be used simultaneously within total maximum rating.



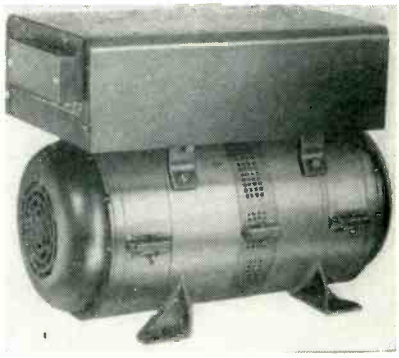
SOLA *Constant Voltage* **TRANSFORMERS**

The complete line of Sola Constant Voltage Transformers is described in a 24 page catalog. Write on your letterhead for a copy of D-CV-142.

Transformers for: Constant Voltage • Fluorescent Lighting • Cold Cathode Lighting • Airport Lighting • Series Lighting • Luminous Tube Signs Oil Burner Ignition • X-Ray • Power • Controls • Signal Systems • etc. • **SOLA ELECTRIC CO., 4633 W. 16th Street, Chicago 50, Illinois**

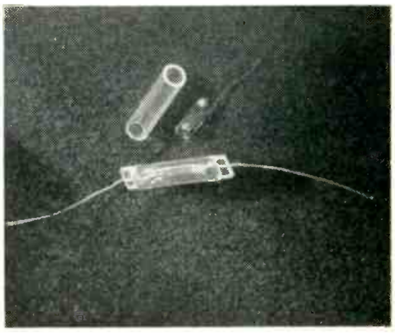
Manufactured under license by: ADVANCE COMPONENTS LTD., Walthamstow, E., England • M. C. B. & VERITABLE ALTER, Courbevoie (Seine), France ENDURANCE ELECTRIC CO., Concord West, N. S. W., Australia • UCOA RADIO S.A., Buenos Aires, Argentina

× 10 in. in diameter, bears a normal rating of 5 kv and a maximum rating of 7.5 kv. Each resistor is provided with top and bottom mounting arrangements which permit the vertical stacking and series connection of a number of identical units up to 20. Suitable metering taps can be brought out at any desired points.



Controlled Inverters for Aircraft

EICOR, INC., 1501 W. Congress St., Chicago 7, Ill., has successfully applied electronics in the control of frequency and voltage output of aircraft quality inverters by using thyratron control tubes. This makes it possible to control the frequency of the inverters within 2.5 percent and the voltage within 3.5 percent. At the same time, design problems were solved to enable the inverters to operate at altitudes between 0 and 45,000 ft, and at ambient temperatures between -55 and 71 C. The company is currently producing these units in the 2,500 and 5,000 va capacities and will soon add to their line several smaller sizes to meet demands.



Nylon Tubing

ANCHOR PLASTICS CO., 533 Canal St., New York 13, N.Y. Extruded

GREATEST ELECTRICAL INSULATION *News* SINCE FIBERGLAS

BH "1151"

FIBERGLAS *plus* SILICONE RUBBER

Meet BH "1151", a happy union of Silicone Rubber and Fiberglas for better, safer, longer electrical product operation.

After months of research and testing, BH "1151" Silicone Rubber Fiberglas Tubing and Sleeving is available to give you a truly superior electrical insulation.

BH "1151" is a Class H insulation of braided Fiberglas yarns with a coating of Silicone Rubber. It features remarkable high heat resistance combined with *permanent* flexibility. Suitable for continuous operation in a temperature range of –90°F. to 400°F., it will resist spot temperatures up to 600°F. It has average dielectric strength up to 7,000 volts, in rated grades, and exceptionally high electrical resistance.

BH "1151" meets all applicable NEMA specifications for Class H insulations. It offers absolute freedom in bending and handling without loss of rated dielectric strength. It will not crack or craze, maintains its protection in bent positions. Completely inorganic, it will not support fungus growth.

Made in colors for circuit tracing and coding, BH "1151" is available in continuous lengths for economy and convenience. It may be cut in short lengths and will not fray or ravel. Write for complete data and samples for production testing.

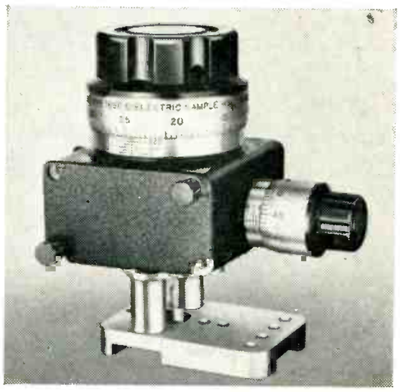
Address Dept. E-6

Bentley, Harris Manufacturing Co.
Conshohocken, Pa.

BH *Fiberglas SLEEVINGS**

*BH Non-Fraying Fiberglas Sleevings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2393530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.

nylon tubing is now being used with thermistors. Tubing about the diameter of a lead pencil is used to encase one type of glass-enclosed bead thermistor used in time-delay circuits. The thermistor is inserted in a length of tubing and the ends of the tubing pressed flat under heat in a hydraulic press for a given length of time to give the Nylon the set desired. Illustrated is the tube, the thermistor and the completed assembly. Connecting leads extend outside the Nylon casing. The tubing provides mechanical protection of the glass bulb, electrical insulation (no metal end caps are required) and protects against straining the glass bulb through flexure of the connecting leads. This application is just one of many possible uses.

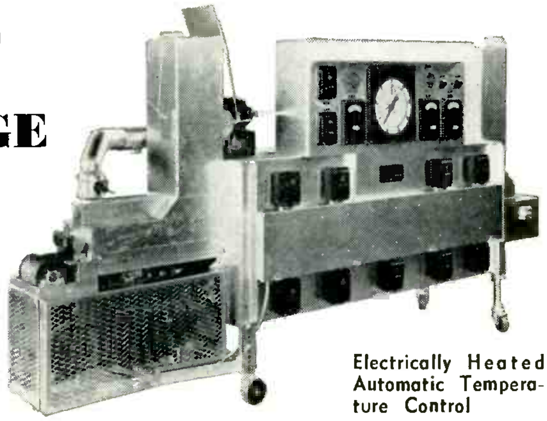


Dielectric Sample Holder

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1690-A dielectric sample holder is a micrometer holder for use in measurements of dielectric constant and dissipation factor on solid dielectric samples over the frequency range from 0.1 to 100 mc, and the holder can be used for accurate measurements of these quantities at audio frequencies as well. It uses a precision-ground micrometer screw to drive the movable grounded electrode and the spacing is indicated on a large calibrated drum readable to 0.1 mil. Spacing range is from 0 to 0.3 in. maximum. Both electrodes are ground to be optically plane within a few wavelengths and are 2 in. in diameter. A vernier capacitor with a range of 5 $\mu\mu$f is also provided for determining width of resonance

REDUCE your BREAKAGE

In the Manufacture of Radio & Electronic Tubes



Electrically Heated Automatic Temperature Control

ELECTRIC ANNEALER

for BULBS STEMS and Small Glass Articles

This Forter-Teichmann annealer was designed especially for the Electronic industry. It has now been in operation for the past year and a half.

An outstanding job is being done in nine plants of three of the largest manufacturers producing electronic equipment. One large manufacturer of tubes reports that reduced breakage has increased his production up to 4%.

Models and sizes to meet your specific requirements. Write for free information.

"Annealed Tubes are Better Tubes"

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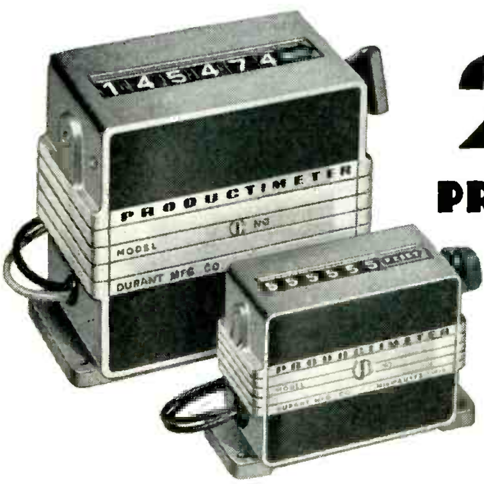
Phone EXpress 1-0820



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"CS" and "Y"
ELECTRIC PRODUCTIMETERS
The answer to all electric counting requirements

Two Companion Counters . . . Two Sizes . . .
Hi-Speed . . . Accurate . . . Long Life . . . Totally Enclosed

Speeds of 1000 counts per minute. Both counters give maximum readability. Design fits all mounting conditions . . . panel mounting or base mounting. Hardened steel working parts for long life and dependability.

New type case for compactness, rigidity, and protection against dust and moisture conditions. Operate accurately over wide current fluctuations.

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- **DESIGN DRAFTSMEN**
- **PHYSICISTS**

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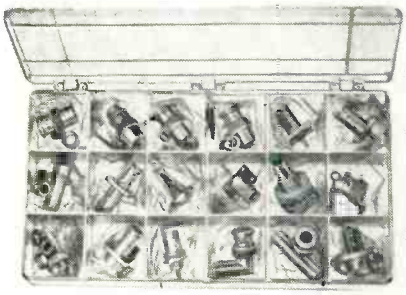
Check These Outstanding Benefits: Top pay, ideal working conditions, advancement on merit, graduate study opportunities, employee scholarships, paid relocation expenses, Baltimore location.

Send resume of experience and education to: Manager of Industrial Relations, Westinghouse Electric Corp., 2519 Wilkens Ave., Baltimore 3, Md.

If you are using your greatest skill in a defense industry, do not apply.

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

curves in the susceptance variation method.

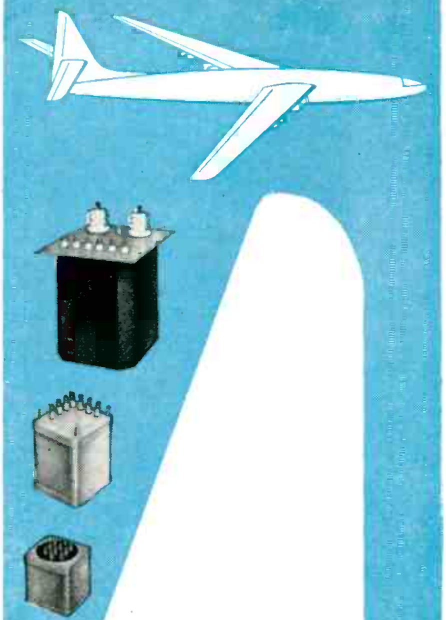


Connector Kit

WESTERN INTERNATIONAL CO., 45 Vesey St., New York, N. Y., is now producing a BNC connector kit. This sampling kit contains a complete assortment of the most widely used JAN connectors in the BNC series. The variety of connectors—plugs, jacks, panel jacks, receptacles, adapters, cap-and-chain and hoods—is designed for any setup involving small r-f coaxial cable.

Magnetic Converter

GENERAL ELECTRIC CO., Schenectady 5, N. Y., has introduced a small magnetic converter designed for use in converting low-level d-c error signals to a-c voltage in a wide variety of measurements systems. The magnetic-amplifier-type device, weighing only 3 oz and encased in the metal envelope of a standard 6L6 radio tube, can be used wherever precise control is required from small d-c signals. It has been developed primarily for use on 400-cycle power, giving a double-frequency output of 800 cycles. It may



Hermetically Sealed Transformers for Aircraft

If size, weight, performance, or quality production have any bearing on your Transformer requirements, it will pay you to *specify* GOSLIN, where these features plus high rating come to terms with better performance at lower cost.

GOSLIN Hermetically Sealed Transformers are available in all standard sizes, they are designed and built to meet the most stringent specifications.

Ounce for ounce, GOSLIN Transformers provide greater output performance than any comparable unit.

GOSLIN has the most modern production facilities and skilled engineers who have specialized for years in the design and development of all types of Transformers for aircraft application.

Write for complete engineering data and counsel.

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A DIVISION OF THE GOSLIN CORPORATION
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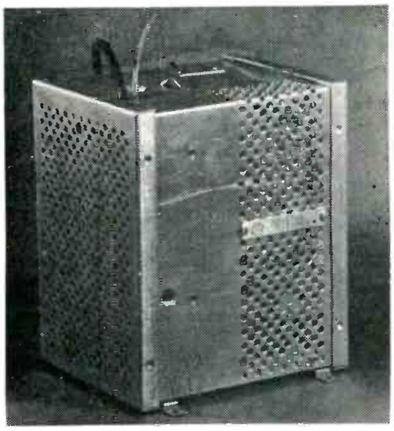
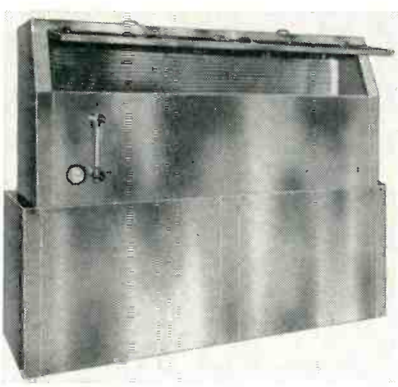
also be used on other frequencies by selecting a suitable value of the external capacitor that tunes the output.



H-V Regulated Supply

INDUSTRIAL TELEVISION, INC., 359 Lexington Ave., Clifton, N. J. The IT-99T high-voltage regulated d-c supply provides 5, 10 and 15-kv voltages for the operation of special oscillograph and other c-r tubes. Primary power requirements are 300 v at 45 ma d-c and 6.3 v at 1.4 amperes. A high-voltage bleeder provides the voltages required by high writing rate c-r tubes such as the 5RP4A type. The unit is entirely enclosed in an aluminum case $8\frac{3}{4}$x7x$5\frac{5}{8}$ in. and weighs 7 lb. It is particularly suited as a component of special purpose oscillographs, tv monitors and the like.



Industrial Water Coolers

STANDARD CABINET CO., 56 Washington Ave., Carlstadt, N. J., announces a line of industrial water coolers with capacities from 20 to 2,000 gallons per hour. Utilized in the tube manufacturing field where

instantaneous water at 32 F is required, the units feature fully automatic operation, stainless steel construction throughout, built-in heat exchanger and recirculation to maintain extremely low temperature.

Electronic Potting Materials

B. G. FORMAN CO., INC., 181 Throop Ave., Brooklyn, N. Y., has developed a new group of room-temperature-cure plastic casting materials for potting and encapsulating transformers and electronic assemblies. The Polyform G series is designed especially for the specific needs of the armed services. Chief features are quick setting time, thus eliminating the shrinkage problem; the materials absorb no moisture from the surrounding atmosphere, guaranteeing that the electrical characteristics of the embedded equipment will remain unimpaired.

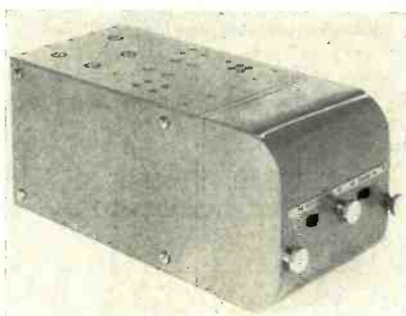
Null Indicator

MARION ELECTRICAL INSTRUMENT Co., Manchester, N. H., has introduced a ruggedized, hermetically sealed null indicator with mounting requirements and physical dimensions in conformance with JAN-1-6. Although center-point sensitivity is very high (1 μa per mm or higher), the meter's shaded pole face and shielded core construction gives sharply logarithmic attenuation as it departs from null point, and to provide ample overload protection. Stated maximum safe current is ten times actual rated full scale value. Two models are being made, the HS2 (2½ in. size) and the HS3 (3½ in. size). Each is available

with numerous current sensitivity and internal resistance characteristics.

Tube Tester

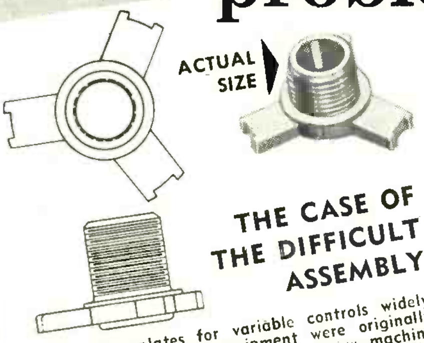
ELECTRONIC MEASUREMENTS CORP., 280 Lafayette St., New York, N. Y. Model 205 tube tester is designed to give test readings for all tubes, including noval and subminiatures, from 0.75 v to 117 filament volts through the standard emission method of testing. This instrument, using four-position lever-type switches and individual sockets for each tube base type, is available in either stationary or portable oak cases.



Oscillograph

MIDWESTERN GEOPHYSICAL LABORATORY, Tulsa, Oklahoma. Model 555 oscillograph was designed primarily for use where small size, accuracy and ruggedness had to be combined in one recording instrument. Its important features are: 14 channels, trace identification (beam interrupter type), electronic timer which places full paper width timing lines at 0.01 or 0.1-second intervals chosen by selector switch, and continuously variable paper speed from ½ to 12 in. per second. A variety of galvanometers is available

is your small parts problem here ?



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LOW ATTEN. Types	IMPED. Ohms.	ATTEN. db100ft of 100Mcs	LOADG. Kw.	OD"	
A 1	74	1.7	0.11	0.36	HIGH POWER FLEXIBLE
A 2	74	1.3	0.24	0.44	
A 34	73	0.6	1.5	0.88	

LOW CAPAC. Types	CAPAC. mmf/ft.	IMPED. Ohms.	ATTEN. db100ft 100Mcs.	OD"	
C 1	7.3	150	2.5	0.36	
PC 1	10.2	132	3.1	0.36	PHOTOCELL CABLE
C 11	6.3	173	3.2	0.36	
C 2	6.3	171	2.15	0.44	
C 22	5.5	184	2.8	0.44	
C 3	5.4	197	1.9	0.64	VERY LOW CAPACITANCE
C 33	4.8	220	2.4	0.64	
C 44	4.1	252	2.1	1.03	

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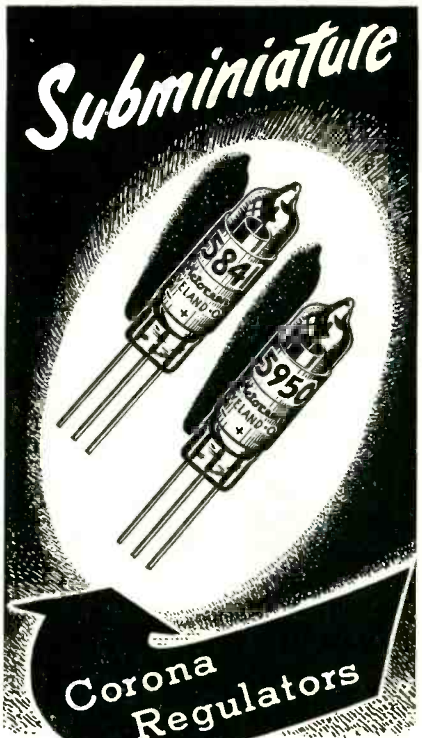


These miniature and sub-miniature corona voltage regulator tubes have been developed for high voltage, low current applications. Specifically designed for such uses as: counter tube power supplies, photomultiplier tubes, stabilizing the second anode potential of cathode ray tubes, reference voltages for regulator systems, nuclear and cosmic ray research. These tubes have been used in such applications as radio frequency and vibrator high-voltage power supplies. They have excellent regulation, exceedingly long life, and their small size gives them a high degree of space efficiency.

In sufficient quantities these corona regulator tubes can be supplied for any voltage between 450 and 2,500 volts.

CHARACTERISTICS

	5841	5950	6119
DC STARTING VOLTAGE (VOLTS MAX)	930	730	2050
DC REGULATED VOLTAGE (VOLTS)	900±15	700±15	2,000±30
REGULATED CURRENT RANGE (μa)	2-50	2-50	2-50
VOLTAGE REGULATION (2-50 μa) (%)	1.5	1.5	1.5
BULB SIZE	T-3	T-3	T-3
LIFE	Unlimited by use		

RATINGS

MAXIMUM REGULATOR TUBE CURRENT (μa) 200
MAXIMUM RELATIVE HUMIDITY (%) 100
AMBIENT TEMPERATURE RANGE (°C) .... −65 to +100

BETTER COMPONENTS MAKE BETTER INSTRUMENTS

Victoreen Instrument
Components Division
3800 Perkins Ave. Cleveland 14, Ohio

with undamped natural frequencies ranging from 100 to 3,500 cps. The oscillograph weighs 12 lb, operates on 24 v d-c and uses 3$\frac{5}{8}$-in. paper. Model A magazine (illustrated) has a capacity of 50 ft of paper; model B holds 100 ft.

Volt Ohmmeter

TRADE ASSOCIATES, INC., 128 South 1st St., Brooklyn, N. Y., has available a compact volt ohmmeter measuring only 2$\frac{1}{4}$ in. x 4 in. and made to test a-c and d-c voltages in ranges of 1, 10, 50, 100, 500 and 1,000 and d-c milliamperes at 1, 10 and 100. It has a resistance range to 1,000,000 ohms with 22,500-ohm center scale. The device is highly sensitive—1,000 ohms per volt. The meter is highly accurate—a new crystal rectifier is used—and resistors meet precision requirements.

Beam Power Tube

RADIO CORP. OF AMERICA, Camden, N. J. Type 6-46 vhf beam power tube provides large power output with small driving power and relatively low plate voltage. It is expected to find wide amateur application in the 2-meter band. The new tube is designed to handle 60 watts of power input at 175 mc. It measures approximately $1\frac{3}{4}$ in. in diameter and $3\frac{3}{4}$ in. long.

Control Knobs

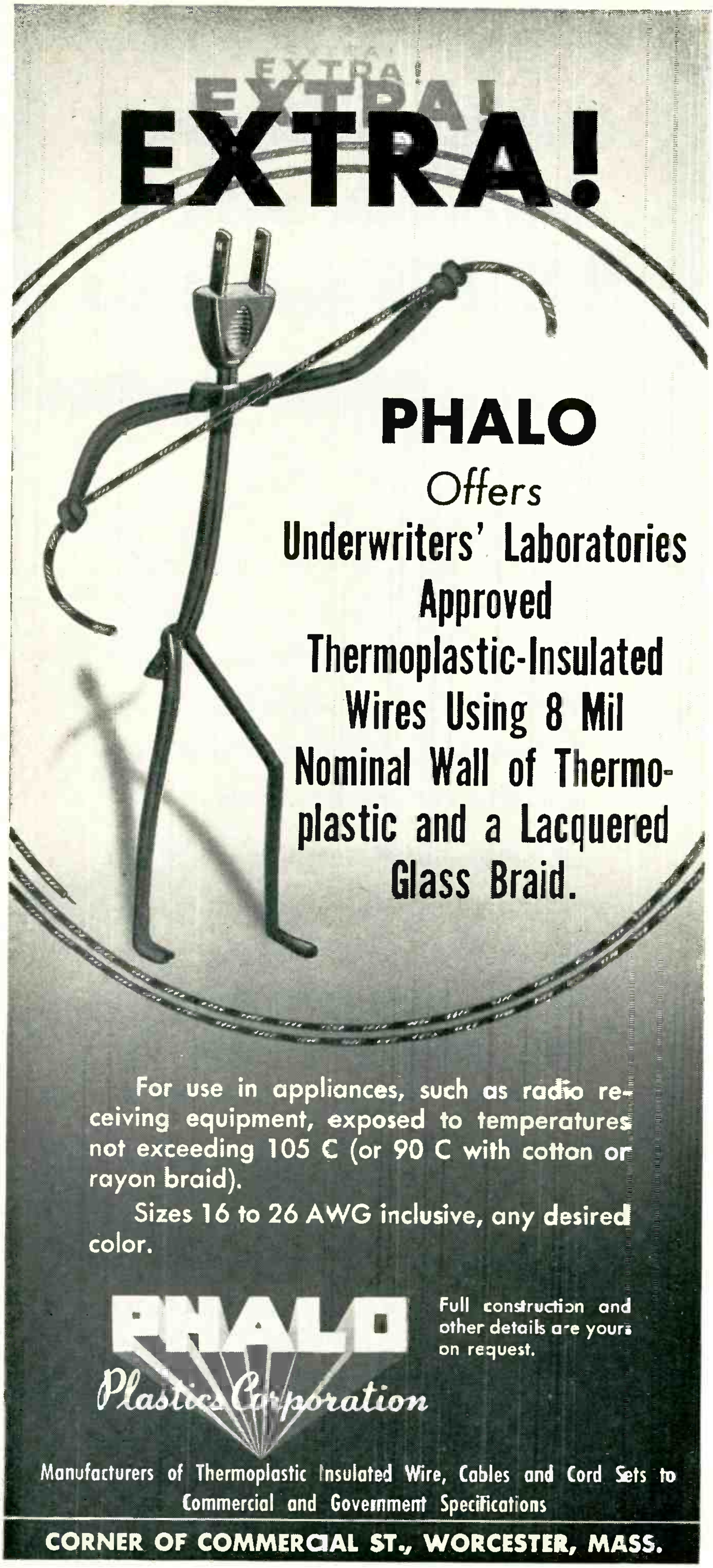
RAYTHEON MFG. CO., Waltham 54, Mass., has developed a complete selection of control knobs for use in the manufacture of both commercial and government electronic equipments. The selection breaks down into six types: round, skirted-round, dial-skirted round, pointer, skirted-pointer and crank knobs, ranging in size from 7/10 in. to $2\frac{1}{4}$ in. in diameter. The knobs are engineered from government approved materials, having been made of black injection molded cellulose acetate butyrate, incorporating anodized aluminum inserts with two plated hex socket set screws.

VTVM

FREED TRANSFORMER CO., 1718 Weinfield St., Brooklyn 27, N. Y. Model 10-40 vtvm is a high-impedance wide-frequency-range voltmeter that can be used at audio and ultrasonic frequencies. The instrument is composed of a precision five-step attenuator, an r-c coupled multistage amplifier, a balanced rectifier, a balanced d-c amplifier and a special meter in which the deflection is proportional to the logarithm of the current through it.

Literature

Galvanometers and Dynamometers. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. The complete line of standard galvanometers, dynamometers, d-c indicating amplifiers, and accessories for use in null-balance or calibrated deflection measurements is presented in the newly-revised 20-page catalog section ED. In addition to the usual galvanometers of the pointer or reflecting type, the publication describes and illustrates low-level d-c indicating amplifiers that can be used as null detectors, direct-reading instru-



ments and recorder preamplifiers. The catalog section includes a galvanometer selector guide. Equipment listings are complete and specifications are presented in tables to make comparison easy.

Electron Microscope Movie. North American Philips Co., Inc., Research & Control Div., 750 S. Fulton Ave., Mt. Vernon, N. Y., has available a 30-minute, 16-mm sound film dealing with electron microscopy. It explains the operation and application of the instrument and illustrates some of the work that can be performed with the aid of this research tool. Industrial and scientific groups interested in making arrangements for exhibition of the film should contact C. J. Woods giving place, date and hour desired for the showing.

Magnetic Alloys. The International Nickel Co., Inc., 67 Wall St., New York 5, N. Y., has available a 20-page bulletin entitled "Iron-Nickel Alloys for Magnetic Purposes (20 to 90 Percent Nickel)". Tables and graphs correlate chemical composition with magnetic properties, trade names and sources of supply. Typical applications suggest uses for the alloys depending on their predominant characteristics. Included are descriptions of alloys most suitable where magnetic shielding, high permeability, constant permeability, change in magnetic properties with temperature are required, or where a material with a rectangular hysteresis loop or one showing high magnetostriction are essential.

Product Index. P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind., has completed a product index providing specific information in condensed form concerning a line of electrochemical, electromechanical, electronic and metallurgical products. The catalog, designed to acquaint engineer and layman alike with basic data on available products, includes brief descriptions of the specifications, features and applications of the complete line of batteries, capacitors, contacts, rectifiers, resistors, switches, vibra-

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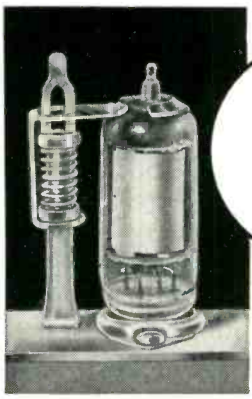
TUBE CLAMPS

Hold Tubes in Sockets under all Vibration, Impact and Climatic Conditions

83 VARIATIONS FOR STANDARD TUBES



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BIRTCHER TUBE CLAMPS can be used in the most confined spaces of any compact electronic device. Added stray capacity is kept at a minimum. Weight of tube clamp is negligible.

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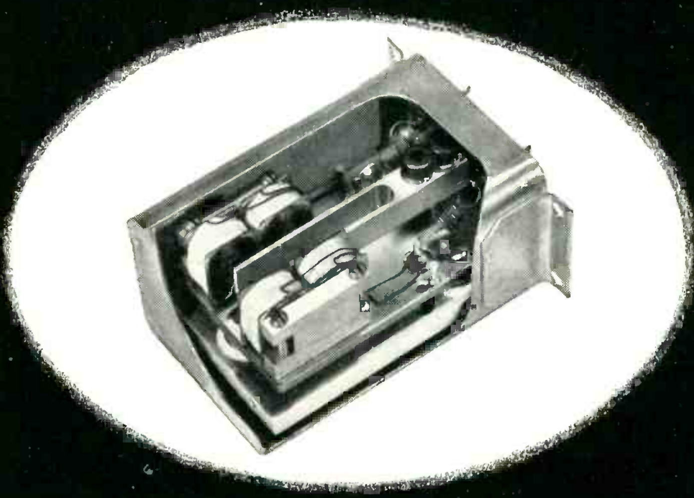
tuning fork resonator
for precision frequency control



Accuracy 1 Part in 10,000 (.01%) from −40° to +85°C., and 1 Part in 5,000 from −40° down to −55°C.

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SOLDER-SEALED & EVACUATED . . . Accuracy unaffected by barometric pressure, altitude, or relative humidity variations.

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tors, metals and ceramics, tuners and resistance welding supplies.

Lightweight Soldering Iron. General Electric Co., Schenectady 5, N. Y. Bulletin GED-1583 covers a new lightweight soldering iron. The device described is designed especially for radio, electronic and instrument manufacturers who need high-speed, pinpoint soldering accomplished in close quarters.

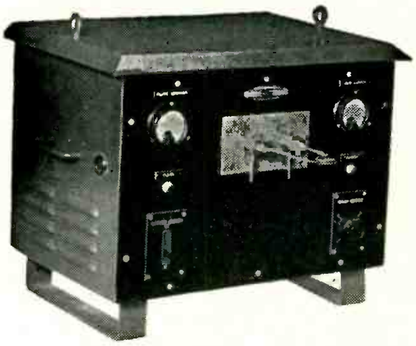
Equipment Catalog. Precise Development Corp., Oceanside, N. Y., has released the first of a series of catalog sheets listing company products currently marketed. Salient features of the products and a complete list of specifications are given. Among the units illustrated and described are the model 630 r-f, a-f and tv marker generator, models 909 and 907 vtvm's, model 635 universal a-f sine, square and pulse generator, model 912 r-f probe and model 999 h-v probe.

Audio-Visual Information. Audio-Master Corp., 341 Madison Ave., New York 17, N. Y., has obtainable a catalog incorporating latest developments in the audio-visual field-transcription players, p-a systems, 3-speed phonographs, recording tape, educational and classical music records, filmstrips on American history, 16-mm musical films and like topics.

Components Catalog. Cambridge Thermionic Corp., 437 Concord Ave., Cambridge 38, Mass., has announced a catalog on electrical and electronic components. The conveniently indexed publication contains useful data on terminal lugs, terminal boards, swagers, hardware, insulated terminals, coil forms, wound coils and other equipment. Photographs of components, complete with detailed descriptions and working drawings containing specifications are included.

Vibrator Maintenance. James Vibrapower Co., 4036 North Rockwell St., Chicago 18, Ill., has available a 4-page booklet outlining the proper connections and adjustment of oscilloscopes in wave form observation of vibra-

2 KW VACUUM TUBE BOMBARDER OR INDUCTION HEATING UNIT



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Simple . . . Easy to Operate . . . Economical Standardization of Unit Makes This New Low Price Possible.

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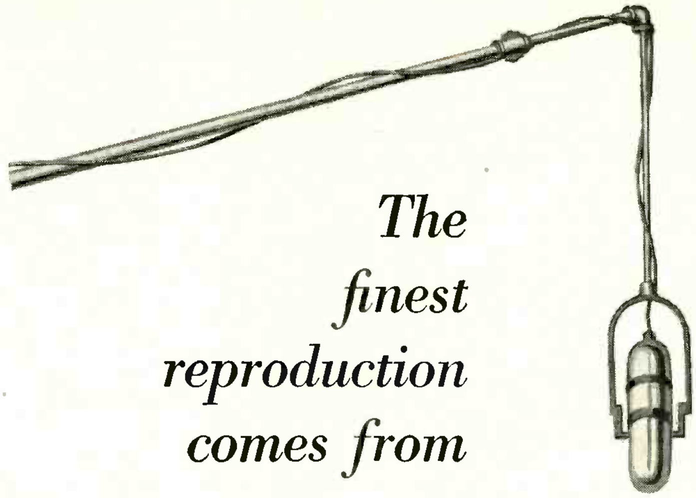

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EXCLUSIVE Highest signal-to-noise ratio of any tape recorder—permits recording with lowest possible distortion and dubbing or transfer without degradation of quality.

EXCLUSIVE Syncroll Drive insures exactly synchronous tape speed from start to finish. Comes up to stable speed faster. Gives you accurate timing of program and on-pitch reproduction. Splice tape from remote sections of roll when required—no change in pitch.

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EXCLUSIVE Pic-Sync Attachment—optional feature. Corrects for tape stretch and shrinkage. Provides absolute timing required for lip synchronous sound on tape with motion pictures and TV programs.

EXCLUSIVE Automatic Framing Control—available with Pic-Sync—brings the recorder into "frame" with movie projector or second tape machine when both are started from standstill, regardless of differences in starting times. Also ideal for editing.

Remember, invest in a Fairchild and you have tomorrow's recorder today . . . at lowest overall cost. Send for bulletin T11, giving complete data.

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FAIRCHILD RECORDING EQUIPMENT CORP.

154th STREET & 7th AVENUE • WHITESTONE, NEW YORK tors. There is also a complete chart of common waveforms and the interpretation of each. The publication will be of value to all service engineers and designers using vibrator power supply equipment.

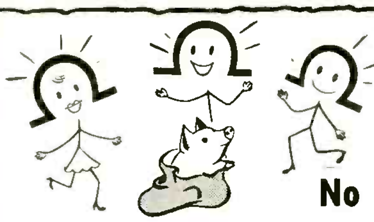
Auto Antennas. Ward Products Corp., Division of The Gabriel Co., 1523 E. 45th St., Cleveland 3, Ohio, has released a new three-color auto antenna catalog. In addition to describing the Eight-Ball, Phantom, Air King and other models, the catalog introduces the company's exclusive Elektron lead cable.

Components Catalog. DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y., has available a six-page two-color brochure illustrating in full detail a variety of Continental Connector components designed for such instruments as computers, radar equipment and plug-in units for packaging components. The connectors described have been made interchangeable with those now being used universally.

Terminal Catalog. Triad Transformer Mfg. Co., 2254 Sepulveda Blvd., Los Angeles 64, Calif. Catalog TH-52 covers a line of multiple and single terminals. It contains actual size illustrations, specifications and dimensional drawings, plus recommended installation procedure, general information and several typical installation applications.

Crossbar Switch. A. W. Vincent Co., 39 State St., Rochester 14, N. Y., has released four pages of reference data on a unit that may be used wherever it is necessary to switch lines to lines in any combination and at frequencies from 0 to 10 mc. A price and delivery schedule is also available.

D-C Power Supply. The Superior Electric Co., Bristol, Conn. Bulletin V1051 covers in detail the Varicell, a source of variable stabilized-regulated d-c voltages operating from a-c power lines. The bulletin is complete with photographs, circuit diagrams, out-



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line dimensions, ratings and descriptive data on the Varicell.

Radiation Counter Tubes. Amperex Electronic Corp., 25 Washington St., Brooklyn 1, N. Y. A 24-page folder describes and gives operational diagrams on the type 75 series gamma counters; the type 90 NB permanent-sensitivity beta-gamma counter; the types 100 and 200 series permanent-sensitivity mica-end window and alpha-beta counters; type 120 series end mica-window, beta counters; type 150 series mica-end window, beta-gamma counters; type 153C x-ray counter; type 230N alpha-beta Geiger counter; and type 240 alpha-beta gamma, and x-ray counters.

Combustion Indicator. Ess Instrument Co., Bergenfield, N. J. Bulletin 801 gives a two-page description of another photoelectric relay application in the form of a Hazegage combustion indicator. Since the proper ratio of air and fuel is a constant concern to design, plant and operating engineers, the bulletin is a ready reference to fuel savings through increased combustion efficiency. Wiring diagrams of installation and relay circuits are included.

Selenium Rectifier Stacks. General Electric Co., Schenectady 5, N. Y. A new 28-page, two-color booklet describes the basic characteristics and the applications of selenium rectifier stacks. Designated as GET-2350, the booklet is complete with charts, graphs and tables illustrating the principles of rectification and the characteristics, manufacture, circuit design and application of selenium rectifiers.

Controls Bulletin. Wirt Co., 5231 Greene St., Philadelphia 44, Pa., has issued bulletin 177 describing a complete line of wire-wound potentiometers and rheostats, and slide switches having a wide range of exacting applications in the electrical, electronic, appliance and test-equipment fields. The bulletin gives all pertinent details on potentiometers and rheostats rated from 3 to 5 w, made with Bakelite housings in values from 5 to 100,-

000 ohms, and supplied with shaft and bushings as required. Also covered are potentiometers and rheostats rated from 1.5 to 2 w with metal housings and furnished with bushings for mounting, or with slotted rotors and rivet mounting. Resistance range is 5 to 12,000 ohms.

Dry Type Transformers. Magnatran Inc., 248 Schuyler Ave., Kearny, N. J. Catalog No. 6-01 announces a line of indoor and indoor-outdoor dry type transformers. The transformers described incorporate easy-to-install features and meet all standards such as AIEE, ASAMEMA and UL. Ratings listed are 600 volts and below, single phase, 3 kva to 200 kva.

Constant Voltage Transformers. Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill., has published the No. CV-142 booklet, a 22-page up-to-date cross reference to its transformers. Ample space is given in the catalog to engineering notes and operating data. The publication includes clear photographs, schematic diagrams and dimensional diagrams of every unit offered. There are also charts showing performance, harmonic analyses, electrical and mechanical specifications. Lithographed in two colors, the new bulletin is punched to fit standard 3-ring binders.

Tachometer Indicators. Metron Instrument Co., 432 Lincoln St., Denver 9, Col. Technical data sheet No. 42HJK describes 0.25-percent accuracy tachometers for making high-accuracy speed measurements conveniently in a continuously indicating switchboard instrument. The instruments described have 10 overlapping or adjoining ranges instantly selectable by a rotary switch.

Potentiometer Pressure Transducers. Rahm Instruments, Inc., 12 West Broadway, N. Y. 7, N. Y. The single-page bulletin 152 covers the type PT pressure transducer designed for gage, differential or absolute pressure in which the brush of a precision potentiometer is actuated by a

change in pressure to produce a change in resistance-ratio or voltage. General data regarding available instruments and a typical wiring diagram are included.

Battery Information. National Carbon Co., A Division of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y., has available a technical bulletin providing designers of battery-operated electronic equipment with essential specifications on Eveready batteries. The information included applies principally to radio receivers. It can also be used in the design of portable radio transmitters, audio amplifiers, laboratory apparatus, test instruments and other battery-operated electronic equipment. Terminal sketches are given and maximum dimensions shown in tabular form.

UHF-TV Transmitting Antenna. The Workshop Associates, Division of The Gabriel Co., 135 Crescent Rd., Needham, Mass. A single-sheet bulletin announces a new transmitting antenna for uhf television. Advantages of the unit described are extreme reliability, light weight, high gain, good match, controllable horizontal coverage, low height and low cost. A cross-section view and typical vertical radiation pattern are shown.

Military Variable Resistors. Chicago Telephone Supply Corp., Elkhart, Ind. Data sheet No. 160 contains technical data on a complete line of military variable resistors. Included are two pages of dimensional drawings and photos and a one-page table of performance characteristics.

Impedance Measurements. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1602-A uhf admittance meter is fully described in Form 777-A, a four-page brochure. Several photographs, a schematic diagram, typical measurements, specifications and information on auxiliary equipment are included.

Decimal Counting Units. Berkeley Scientific Corp., Richmond, Calif., has announced a 4-page

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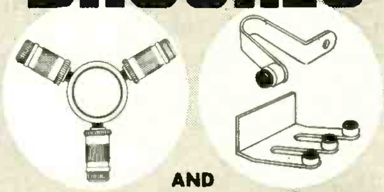

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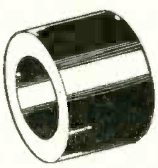

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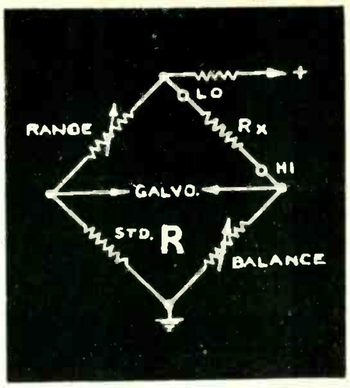

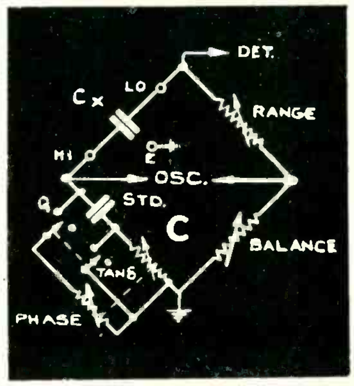

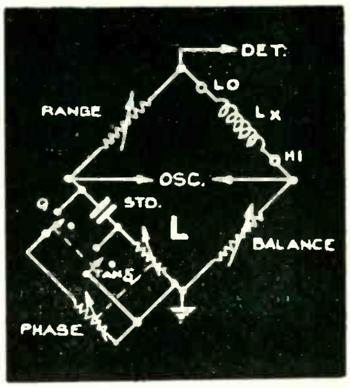

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folder illustrating and describing its models 700A, 705A, 706A and 707A decimal counting units. Construction details, basic design, typical applications and technical specifications for the line are given. The units discussed feature direct-reading decimal presentation, a range to one million cps and standard plug-in mounting.

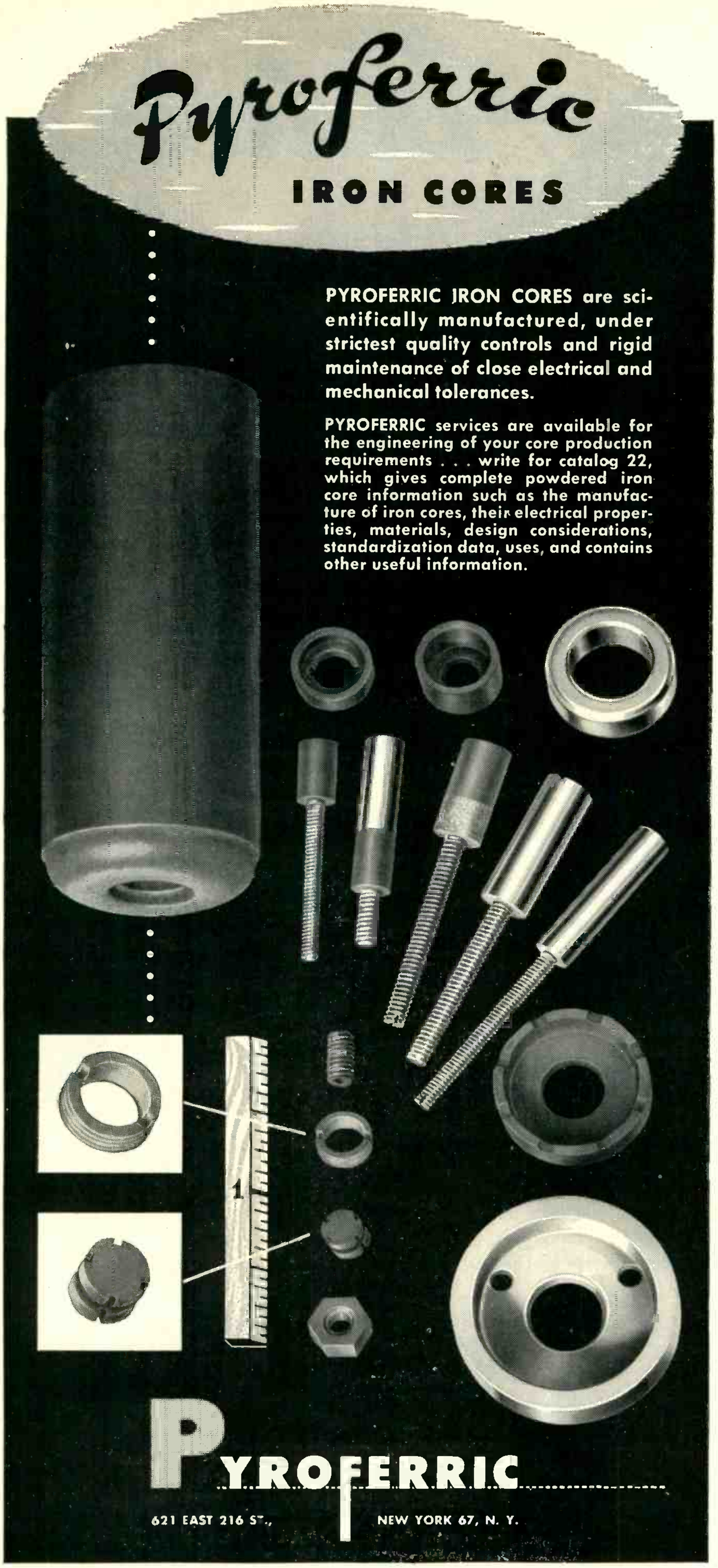
Phenolic Tubing. The Cleveland Container Co., 6201 Barberton Ave., Cleveland 2, Ohio. Clevelite and Cosmalite spirally laminated paper-base phenolic tubing are covered in a recent bulletin. Information is given on general properties, fabrication and the various applications of the product. A property chart on a variety of grades is included.

Fasteners. The Palnut Co., 61 Cordier St., Irvington 11, N. J., has isuued a 4-page folder dealing with fasteners for radio and tv coils and shield cans. Photographs, mechanical drawings and complete descriptions of the fasteners are included.

Resistance Units. Keystone Carbon Co., St. Marys, Pa., presents properties, performance characteristics and detailed application information on a line of negative-temperature-coefficient resistance units in an 8-page technical bulletin. The units described are electrical semiconductors in which resistance to the flow of current varies inversely with the temperature of the material. Types, dimensions, nominal wattage ratings and time constants for the standard sizes are tabulated. Ask for bulletin No. 13.

Metallized Paper Capacitors. Pyramid Electric Co., 1445 Hudson Blvd., North Bergen, N. J. Bulletin MP-1 contains eight pages of engineering data on a wide line of metallized paper capacitors. Included is information on construction, impregnating materials, standard tolerances, operating temperature ranges, capacitance in microfarads and sizes in inches.

Permanent Magnets. The Arnold Engineering Co., Marengo, Ill. Bulletin M-102 is a four-page



folder on Alnico permanent magnets. It shows demagnetization and energy curves for various types of Alnico, as well as tables of physical and magnetic properties. Such special magnet materials as Vicalloy, Remalloy, Cunico and Cunife are discussed. Included is technical information on Sintered Alnico.

Radiation Survey Instrument. El-Tronics Inc., 2647 N. Howard St., Philadelphia 33, Pa. Bulletin No. 501 illustrates and describes model PR-3 portable instrument for the measurement of radiation intensities. Ten typical applications are listed. The unit described operates from an inexpensive A and B battery complement.

Picture Tubes. Hytron Radio & Electronics Co., Salem, Mass., has issued engineering data bulletins on the types 21FP4A low-voltage electrostatic-focus and 21EP4A cylindrical-face rectangular all-glass, picture tubes. Each bulletin contains general, mechanical and electrical data, as well as terminal connection information and dimensional diagrams.

Cro. Allen B. DuMont Laboratories, Inc., 1000 Main Ave., Clifton, N. J., announces the type 303 quantitative 10-mc c-r oscillograph in a single-sheet bulletin. Illustrated in the bulletin is a single oscillogram that demonstrates signal delay, transient response, no high-frequency overshoot, undistorted deflection, sweep linearity and speed, time calibration and amplitude calibration.

Hermetically Sealed Relay. General Electric Co., Schenectady 5, N. Y. Bulletin GEA-5729 illustrates and describes the CR2791G hermetically sealed relay for electronic applications in aircraft, aboard ship and on portable units. Reasons for hermetic sealing, technical specifications, chief features, performance data and dimensional diagrams are included.

Components Catalog. DX Radio Products Co., Inc., 2300 W. Armitage Ave., Chicago 47, Ill., has published a 12-page catalog illus-

trating and describing its specialized products. Topics covered are: toroids, toroid filters, special assemblies, tuners, deflection yokes, ion traps, transformers and speakers.

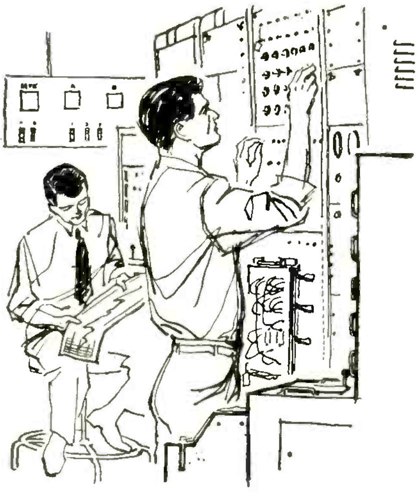
Tiny Zinc Die Castings. Gries Reproducer Corp., 780 E. 133rd St., New York 54, N. Y., has released a booklet presenting detailed data on the properties, design advantages and improved uses of tiny zinc alloy die castings. It includes a chart comparing relative cost, production and design features of various fabricating methods. A diagrammed reference guide explains how to take advantage of the many time and money saving features of the company's exclusive zinc die-casting technique. Another chart lists the composition and properties of zinc alloys.

Trimmer Capacitors. Sprague Electric Co., North Adams, Mass. Engineering bulletin 604 gives full details on the type A08 ceramic trimmer capacitors. The units described are designed for use in circuit applications where maximum stability of capacitor characteristics is of utmost importance.

Cam Milling & Jig Boring. Eisler Engineering Co., Inc., 750 South 13th St., Newark 3, N. J., recently published a new catalog showing interesting operations in cam milling and jig boring, and describing their plant facilities.

Subminiature Plugs. Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif. Volume IV No. 2 of the Cannonade features a complete new line of subminiature plugs for aircraft and components industries. The units described are suitable as rack and panel, box mounted, wall mounted or cord mounted connectors. Also shown is a photo review of connector applications.

Potentiometers and Bridge Instruments. The Bristol Co., Waterbury 20, Conn., has published bulletin P1245 describing a line of Dynamaster strip-chart electronic potentiometers and bridge instruments for industrial plant, pilot plant, process, research and laboratory use. The 36-page bulletin gives



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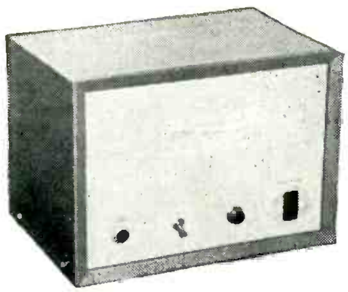

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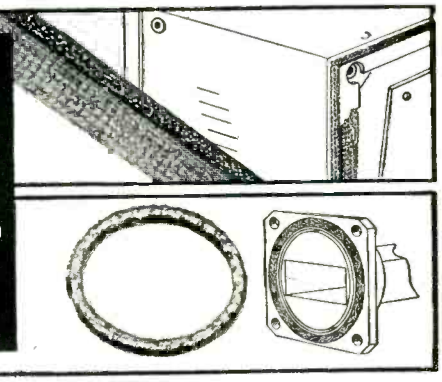

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information concerning a number of new instruments for recording and indicating such variables as temperature, pH, speed, voltage, power, current, smoke density, strain and other variables that can be measured in terms of d-c current, d-c voltage, resistance or capacitance.

Telemetering Receiving Stations. Bendix Aviation Corp., Pacific Division Development Laboratories, Olive and Lake Sts., Burbank, Calif. A complete description of the standard telemetering receiving stations developed by the company is now available in a new 18-page illustrated booklet. The literature illustrates and describes the construction and operation of the stations and their components.

Strip Chart Potentiometer. Minneapolis-Honeywell Regulator Co., Brown Instruments Division, Wayne and Windrim Aves., Philadelphia 44, Pa. The new two-second high-speed ElectroniK strip chart potentiometer is described and illustrated in specification sheet 179. Operating on the continuous-balance principle, the instrument pen and pointer discussed will travel full scale in two seconds. Drilling and mounting dimensional diagrams for the potentiometer are shown.

Variable Transformer. The Superior Electric Co., Bristol, Conn. Bulletin P252 is complete with photographs, outline dimensions, ratings and other descriptive material on the Powerstat type 10 variable transformer. The unit treated is the answer to variable a-c voltage control problems involving 50, 100 and 150 watts.

Mobile Antennas. Ward Products Corp., 1523 East 45th St., Cleveland 3, Ohio, has released Form 54-153, a 4-page brochure covering its line of mobile antenna rods, bases and springs. The folder describes nearly 20 separate standard rods, plus many special designs for particular applications, roof-top and motorcycle models, as well as bases and springs to handle standard rods.

PLANTS AND PEOPLE

Edited by WILLIAM P. O'BRIEN

Personnel Changes Announced

RECENT position changes in our field involve thirty people. A brief resumé is as follows:

Arnold A. Cohen, associated with Engineering Research Associates, Inc., St. Paul, Minn., since 1946, has been appointed director of telecomputing systems development for ERA. In his new capacity he will direct the development of special-purpose digital computers, and the application of digital techniques to control, instrumentation and communications problems.

Charles B. Raybuck, specialist in microwave theory, has been promoted from assistant chief engineer to chief engineer of Melpar, Inc., Alexandria, Va. Other changes at Melpar include **Arthur C. Weid** who moves from chief engineer to executive assistant to the executive vice-president of the company; and **William C. Tuller,** formerly director of engineering, who has been elected vice-president in charge of engineering of Melpar, Inc.

Philips B. Patton, with the company since 1948, has been elected vice-president of the Lenkurt Electric Co., Inc., San Carlos, Calif. He had previously been chief of the radio-telephone and telegraph section of the FCC's engineering department. Also at Lenkurt, **George F. Koth,** works manager of the organization, has been elected a vice-president of the company.


P. B. Patton


G. F. Koth

Marvin H. Kronenberg has been appointed a staff member of the CBS-Columbia Advance Development Laboratory. Before joining the corporation he was a member of the RCA Industrial Service Laboratory, and prior to this was chief engineer and president of Vision Research Laboratories, Inc.

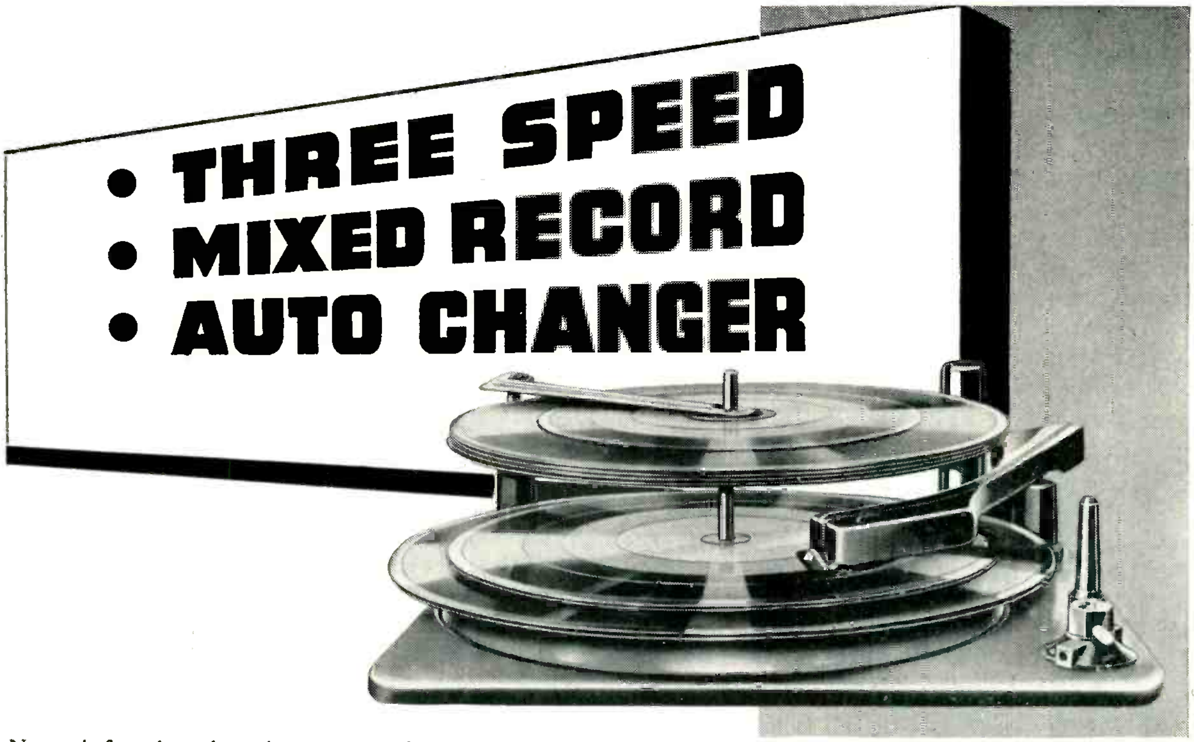
General Bronze Corp. has promoted **Ira Kamen** to vice-president of its Brach Mfg. Corp. Division. He was formerly a management executive directing the sale and engineering of RCA Antenaplex systems in the New York, New Jersey area.

Dale L. Bunday, former radio supervisor for the city of Fort Worth, Texas, has joined the General Electric Electronics Division as a district sales manager for communication equipment. His headquarters will be in Oklahoma City, Okla.

Robert I. Gaines, previously associated with Semco Services, Inc., consulting engineers, and Communication Measurements Laboratory, electronics manufacturers, both of New York City, has been promoted to the post of

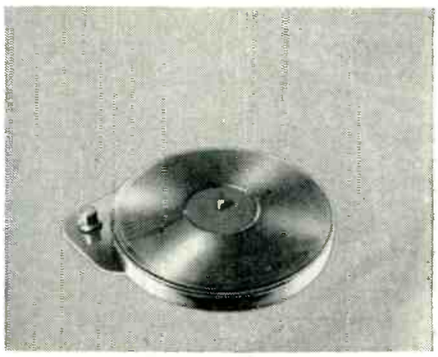
CELEBRATE BILLIONTH VACUUM TUBE

At a recent ceremony in the Emporium, Pa., plant of Sylvania Electric Products Inc., H. Ward Zimmer (right), the company's executive vice-president congratulates Matt Burns, manager of the Radio Tube Division, who holds the billionth vacuum tube produced since 1924. Next to Burns is George Rishell who produced Sylvania's first radio tube—type 201A—and set up the first tube production line. Rishell is holding the company's first tube. Harold Rainier, left, manager of the Renewal Sales Dept. and George Sommers, general sales manager for the division, also took part in the ceremony



UA5

GU4A



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Never before has there been a record changer equal to the B.S.R. Monarch, which without doubt gives tremendous sales appeal to any instrument in which it is mounted. It includes all features demanded by the discriminating listener and has a styling and colour that will blend with any cabinet design.

Simplicity of design guarantees long life and trouble-free operation. The controls consist of one knob only, no levers to adjust, no loose fitments, no confusing adjustments for playing the increasingly popular 7″ L.P. records.

A brilliant new three diameter selector enables different diameter records to be played automatically. The machine thinks for you by automatically adjusting itself for all three diameters.

Quality of reproduction is unequalled due to the outstanding performance of the latest B.S.R. reversible pick-up cartridge with two sapphire styli for standard and long playing records.

OUTSTANDING FEATURES

* Automatically selects and plays 12″, 10″, and 7″ records, *mixed in any order* at 33⅓, 45, or 78 R.P.M.
* Changer automatically stops after last record, motor is switched off and pick-up is returned to rest position.
* Carefully designed to reduce moving parts to the very minimum, giving long trouble-free life.
* New turn over pick-up has extended range up to 10,000 c.p.s. Self compensated accurately for the L.P. lower frequencies with the Turnover frequency at the correct point. Compliant enough to take the lowest frequencies.
* Operates on 100/125—200/250 volts, 50 cycles, A.C. mains. Models available for 60 cycles A.C. mains.

Careful design allows us to deliver this unrivalled unit anywhere in the world at competitive prices.

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export manager of the newly created International Division, Allen B. DuMont Laboratories, Inc.

Freeman A. Spindell, chief engineer of Browning Laboratories, Inc., Winchester, Mass., has been elected to the office of vice-president. In addition to his new duties, he will retain his responsibilities as chief engineer.

Kenneth C. DeWalt, manager of General Electric c-r tube operations since 1949, has been named manager of engineering for the GE Tube Department with headquarters in Schenectady, N. Y.


K. C. DeWalt


W. R. Chapin

Wells R. Chapin has joined the General Electric Company's Electronics Division as a district sales manager for radio and tv broadcasting equipment. He was formerly chief engineer of radio station WIL in St. Louis, Mo.

Fred Miller, formerly chief engineer for Kaye-Halbert Corp., Los Angeles, Calif., has been promoted to director of engineering and research.

Robert J. Tarlton, formerly general manager of the Panther Valley Television Co., Inc., has been named chief field engineer of Jerrold Electronics Corp., Philadelphia, Pa.

The Western Union Telegraph Co. has appointed **Leon G. Pollard** as electronics research engineer in charge of its laboratories at Water Mill, L. I., N. Y.

Milton S. Roth, previously associated with the Radiart Corp., Cleveland, Ohio, has announced the formation of a new firm, the Mike Roth Sales Co., Cleveland, Ohio, to represent manufacturers of electronic parts and equipment.

John M. Miller and **Robert M. Page** have been appointed to new research positions at the Naval Research Laboratory, Washington, D. C. Dr. Miller, who has been appointed scientific research administrator, will serve as the deputy director of research. Dr. Page has been named associate to the director of research.

William E. Daly, formerly with Shure Bros., Inc., has been named electrical development engineer at Magnecord, Inc., Chicago, Ill., manufacturers of magnetic recording equipment.

Henry M. Broderick, Jr., has been appointed chief engineer of radio station WDRC, Hartford, Conn. He had spent 11 years with WDRC as transmitter and control room supervisor.

Welcome W. Bender, associated with the organization since 1939, was recently appointed chief electronics engineer at The Glenn L. Martin Co., Baltimore, Md.

Ernest Weber, noted for his pioneer contributions to electromagnetic science, has been elected president of the Polytechnic Research and Development Co., Inc., New York, N. Y., microwave measurement equipment manufacturers.

Clyde W. Smith, formerly director of the airborne equipment division in charge of materials and equipment at the Navy Bureau of Aeronautics in Washington, D. C., has been appointed assistant to the president of Kollsman Instrument Corp., Elmhurst, N. Y.


C. W. Smith


A. W. Keen

A. W. Keen has been named manager of application coordination of Sylvania Electric Products Inc., New York, N. Y. He was formerly assistant to the manager of the company's product development laboratory at Kew Gardens, N. Y. He will now head a new department that will investigate the advanced applications of the electronic products of several Sylvania manufacturing divisions.

Merritt C. Chandler, formerly of Hughes Aircraft Co. and Sylvania Electric Products, Inc., has been named general manufacturing manager of the Battery Division of Sonotone Corp., Elmsford, N. Y.

William C. Cothron has joined Allen B. DuMont Laboratories, Clifton, N. J., as sales engineer for the television transmitter division. He was formerly engaged in independent tv design and research.

R. T. Capodanno was recently elected vice-president in charge of engineering at Emerson Radio and Phonograph Corp., New York, N. Y. He had been director of engineering for the company since 1949.

Lee Berryhill, formerly field operations supervisor, has taken over the duties of chief engineer of KRON-TV, San Francisco, Calif.

J. T. Cataldo, former research and development engineer with the Signal Corps Engineering Laboratories, Ft. Monmouth, N. J., has been appointed assistant general manager of International Rectifier Corp., El Segundo, Calif.

Plant Activities Report

COMPANY activities noted since the last report involve 16 plants. Here are the most recent doings:

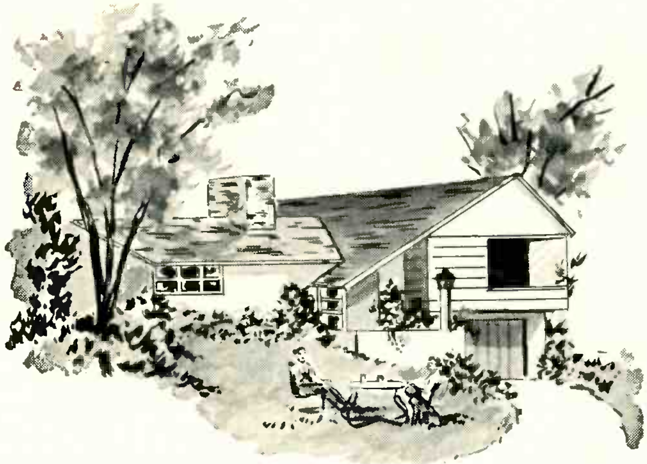
Barber-Colman Co., Rockford, Ill., has purchased the principal assets of the Wheelco Instruments Co., Chicago, Ill., manufacturers of indicating and control instruments.

Engineering Research Associates, Inc., St. Paul, Minn., has leased 11,000 sq ft of additional factory space to accommodate the Air Force's gyro production program.

Janette Electric Mfg. Co., wholly-owned subsidiary of Gerity-Michigan Corp., has begun full-scale operations at its new one-story modern plant, covering approximately 100,000 sq ft in Morton Grove, Ill.

Sylvania Electric Products, Inc., is about to build a new $500.000 plant and research laboratory near Mountain View, Calif., as soon as the company is granted a certificate of necessity. This is the first of Sylvania's plants to be located in the west.

Keystone Products Co., special-



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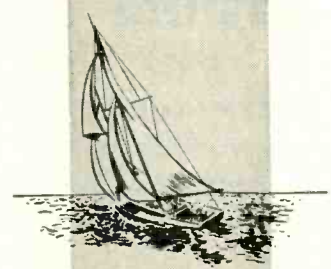

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A new joy in living, in famous North Georgia climate, only 8 miles from Atlanta, second highest large city in the U. S. 88 parks cover 1600 acres, and 22 excellent golf courses offer year-round enjoyment.

Atlanta and North Georgia are famous for their beautiful homes, and desirable, modern housing is available. Fine elementary and high schools, colleges and universities, plus vocational and professional schools serve the area. 10 radio and 3 television stations and more than 50 theatres bring in top entertainment. Best cultural advantages are offered, and 500 churches are affiliated with 40 creeds and denominations.

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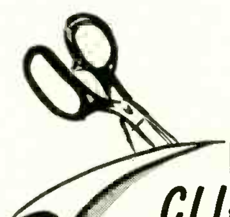
(If you prefer the West Coast, your application will be promptly forwarded to LOCKHEED at Burbank, Calif., where similar openings are available.)



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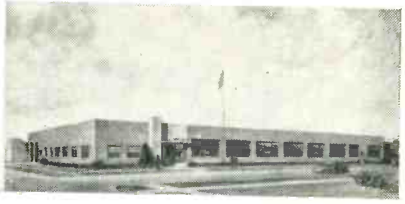
GEORGIA DIVISION

MARIETTA, GEORGIA

purpose and custom-built transformer manufacturer, has acquired a 50-percent increase in space in its own building in Union City, N. J. The company is now also specializing in the engineering and assembly line production of magnetic amplifiers.

The Durant Mfg. Co., manufacturers of Productimeter counting and measuring machines, have announced a 16,000-sq ft addition to their plant at 1929 N. Buffum St., Milwaukee, Wisc.

Cook Research Laboratories, a division of Cook Electric Co., recently moved to new and larger quarters at 8100 Monticello Ave., Skokie, Ill. The new facilities will enable even more efficient operation of the laboratories into the advanced fields of nuclear physics, servomechanisms, radar, sonar and special instrumentation including data recorders and general electronics.



Cook Research Laboratories' new quarters

Walter Kidde Nuclear Laboratories, Inc., New York, N. Y., were recently established with the primary objective of developing commercial atomic power. The organization will perform research, development and experimentation in the field of nuclear energy.

As a continuation of its expansion into the electronics field *Thompson Products' Electronics Division*, Cleveland, Ohio, has established an electronics laboratory at Inglewood, Calif. Complete equipment for the r-f testing of coaxial switches and waveguide dummy loads is being installed.

Natvar Corporation is the new name of the National Varnished Products Corp., manufacturers of flexible electrical insulation. The company's full range of products includes, besides those based on varnishes, the silicones, polyethylene and vinyl plastics.

Teletronics Laboratory, Inc., are now located in their new plant at

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Kinkel St., Westbury, L. I., N. Y. The new plant will increase available facilities about four times for the production of test equipment and special contract equipment.

Synthane Corp., Oaks, Pa., manufacturer of laminated plastics for industry, has completed an 18,000-sq ft addition to its plant.

Two new buildings will greatly increase production of the *Workshop Associates, Division of The Gabriel Co.*, Needham, Mass. The new buildings, in Norwood, Mass., will employ over 400 people, all devoted to producing Workshop commercial products, such as microwave, communications and uhf transmitting antennas.

Thomas A. Edison, Inc., West Orange, N. J., is building a new half-million dollar laboratory with a total of 13,000 sq ft of space adjoining the company's original buildings. The laboratory will work in the fields of storage and primary batteries, electrical instruments, dictating equipment, medical gases and hospital apparatus.

Radiation Counter Laboratories, Inc., recently moved to their new plant at 5122 W. Grove St., Skokie, Ill. This laboratory is completely devoted to the manufacture of instruments for the measurement of radioactivity, including nuclear reactor controls, G-M and proportional counters, electronic circuits and accessories.

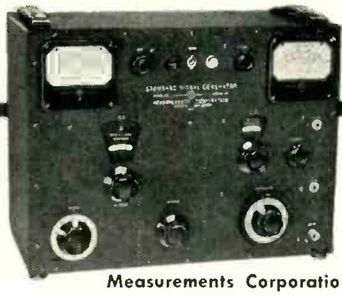
General Electric Co. is converting its Scranton, Pa., home dishwasher plant to the production of electronic tubes. The first tubes scheduled for production at the Scranton plant are the hydrogen thyratron transmitting tubes. Other types of industrial and transmitting tubes will be manufactured there after conversion is completed.

Carboloy Department of the General Electric Co. has begun construction of a 90,000-sq ft plant for manufacturing permanent magnets in Edmore, Mich.

OTHER NEWS

RTMA's First Annual Award

DAVID SARNOFF, chairman of the board of directors of RCA, was elected as first recipient of the



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STANDARD SIGNAL GENERATOR

20 Cycles to 50 Mc.

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MODULATION: Continuously variable 0 to 50% from 20 cycles to 20 Kc.

POWER SUPPLY: 117 volts, 50/60 cycles. 75 watts.

DIMENSIONS: 15" x 19" x 12". Weight, 50 lbs.

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Four models 6" 12" 18" 24"
Capacity—16 Gauge Steel

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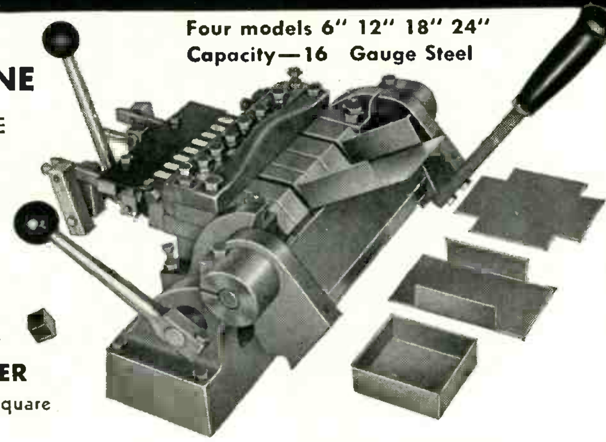

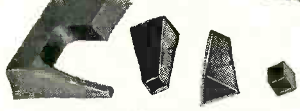

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for forming triangular, square and rectangular tubes.

Versatility from the word GO!! One box or 10,000—can be economically produced with the new Di-Acro Box Finger Brake. The complete box finger bar also serves perfectly for all standard brake operations. An Acute Angle Bar—quickly mounted—converts the brake to a bar folder for locks, seams, hems and sharp angles. The unique Di-Acro Open End Finger forms square or triangular tubes and other similar parts difficult to make. Real machine tool construction, with hardened and precision ground box fingers, assures permanent accuracy in producing duplicated parts. The Box Finger Bar can be easily mounted on all standard Di-Acro Brakes.

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300 Mc. to 1000 Mc.

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FREQUENCY CALIBRATION ACCURACY: ±0.5%.

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OUTPUT SYSTEM: 50 ohms.

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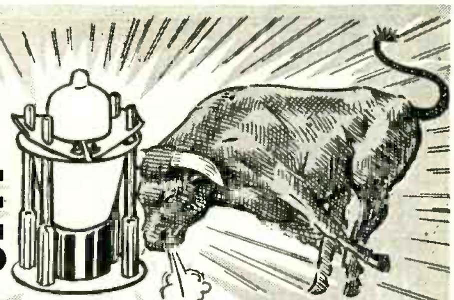
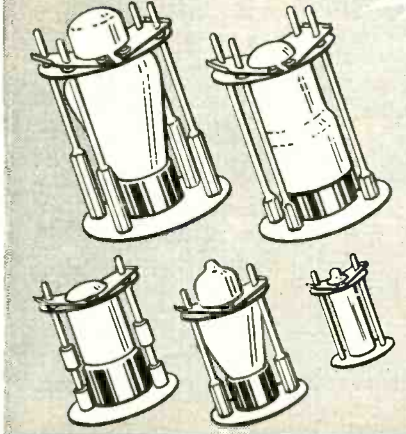
SHOCKPROOF VACUUM TUBE RETAINERS





These retainers are used to secure Vacuum Tubes and to resist side motion of Vacuum Tubes used in radio equipment which is subject to shock and vibrations. These retainers meet the requirement of all JAN specifications. The insulated portion is made of a melamine base Fibre Glass Phenol which provides 300 volts insulation to ground and withstands a temperature of 350 F. The insulated plate can readily be fastened or released by hand.

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RTMA annual award for outstanding contributions to the advancement of the radio-tv industry by the Association's board of directors during the April 24–25 meetings in Niagara Falls, Ontario. The award will be made at the industry banquet, June 26, at the Palmer House, Chicago, Ill.

General Sarnoff was honored, according to Leslie F. Muter, chairman of the annual awards committee, in recognition of many achievements which over a period of years have helped bring the industry to its present status.

RTMA Increases Membership

EIGHT new companies were admitted to RTMA membership by the board of directors at its Niagara Falls meeting held April 24–25. The new members are:

Crest Laboratories, Inc., of Far Rockaway, N. Y.; Haydon Products Corp., of Brooklyn, N. Y.; Macon Electronic, Div. of York Radio & Television Corp., Decatur, Ill.; National Electric Products Corp., of Pittsburgh, Pa.; Quincy Speaker Mfg. Corp., of Quincy, Ill.; Muntz TV, Inc., of Chicago, Ill.; Penta Laboratories, Inc., of Santa Barbara, Calif.; and Stone City Machine & Tool Co., Inc., Bedford, Ind.

1952 Harry Diamond Award

NEWBERN SMITH, chief of the National Bureau of Standards Central Radio Propagation Laboratory, has been awarded the 1952 Harry Diamond Memorial Award for his fundamental work in the field of radio wave propagation. Dr. Smith's work has formed the basis for the practical use of ionospheric observations in the operation of worldwide communication systems. He recently received additional recognition by being elected a Fellow of the IRE.

Army Contract

THE Thermex Division of The Girdler Corp., Louisville, Ky., has been awarded a $900,000 contract by the Army Signal Corps. The award covers radar tube testing equipment.

AEROPHYSICISTS, DESIGNERS, ENGINEERS—

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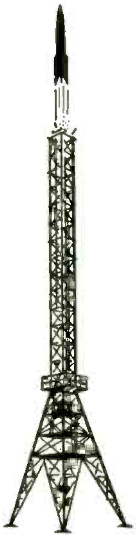

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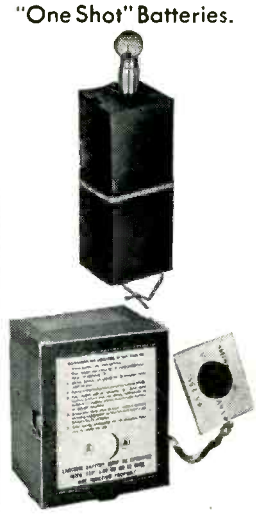

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NEW BOOKS

Short-wave Radiation Phenomena

By August Hund. *McGraw-Hill Book Co., 2 volumes, 1382 pages,* 1952.

Although the preface infers that these two volumes are to be used, at least in part, in an undergraduate course in radiation phenomena, there are no problems in the text. And although the first chapter is basic to what follows, the 143 pages on the fundamentals of electromagnetic theory are so presented that if a person were not on speaking terms with the subject he would never learn it from these pages. Very difficult concepts are meagerly expounded, whereas numerical substitution examples are expounded in detail. The illustrations are not consistent, right- and left-hand systems being used indiscriminately. Maxwell's equations are written for the right-hand system. There are incorrect usages of the mathematics which are not typographical.

In short, without a better-than-undergraduate background, the reader could not read Chapter I.

Chapter II on Fields of Elementary Electric, Magnetic Dipoles starts with the expression of Maxwell's Equations in various coordinate systems and proceeds with stock methods of evaluating the fields of the elementary radiators including mutual effects.

Chapter III on Fundamental Methods used in Electromagnetic Theory starts after 185 pages of using the theory. This chapter portrays the Poynting theorem, vector scalar potentials, and Hertz vector, Silberstein vector, etc. This is an excellent reference chapter for readers with a good background in the theory.

Chapter IV on Propagation Characteristics discusses group and phase velocities for propagation through dissipative media and wave-guides.

Chapter V on Transmission Lines and Radiation presents the usual material on the subject in addition to the correlation of the field concept of the transmission line with the circuit element concept. The Smith and similar charts

are conspicuous by their absence.

The reader is cautioned to examine each development for approximations which are not stated. For example, in working out the radiation from a Lecher wire feeder, the current in the wires is assumed to be sinusoidally distributed. Were this so, there could be only one mode of propagation. As the TEM mode is always present, the inference is that this is the only mode. The TEM mode is, however, capable of radiating only in the direction of the wires. Actual feeders do radiate but only where higher modes exist in the vicinity of geometric discontinuities in the line.

Chapter VI, Unobstructed Space radiation, is a compilation of the works on antennas and antenna arrays. The far fields are evaluated assuming a known sinusoidal current distribution in each component antenna. If one accepts this as approximating actual conditions, the information is very valuable inasmuch as it is all in one place and not scattered throughout a number of papers.

Chapter VII, Space Radiation in the Presence of Electromagnetic Obstructions, considers only very large obstructions (effectively infinite in extent) such as the ground. Reflection and refraction of plane waves at infinite plane boundaries along with image methods for antennas are the tools which are developed and later used in evaluating radiation fields from antennas in the vicinity of ground and atmospheric layers. A short discussion of plane wave components in waveguides is thrown in for good measure.

Chapter VIII on Electromagnetic Diffraction treats the long edge diffraction effects for long-range transmission over mountains in terms of Huygen's principle and the Fresnel wave interference theory which were later modified by Kirchhoff, Sommerfeld and others. Applications of these principles to propagation through orifices and radiation from waveguides, slots and antennas with reflectors are treated in some detail.

The reviewer is not very familiar with this type of problem but is of the opinion that much more and

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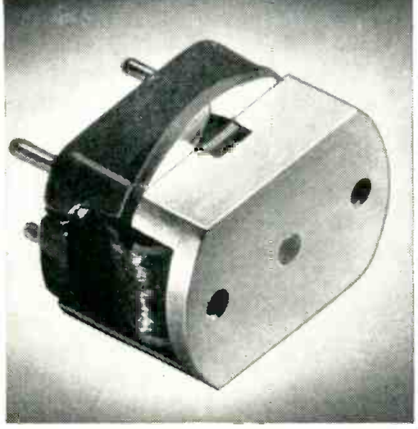

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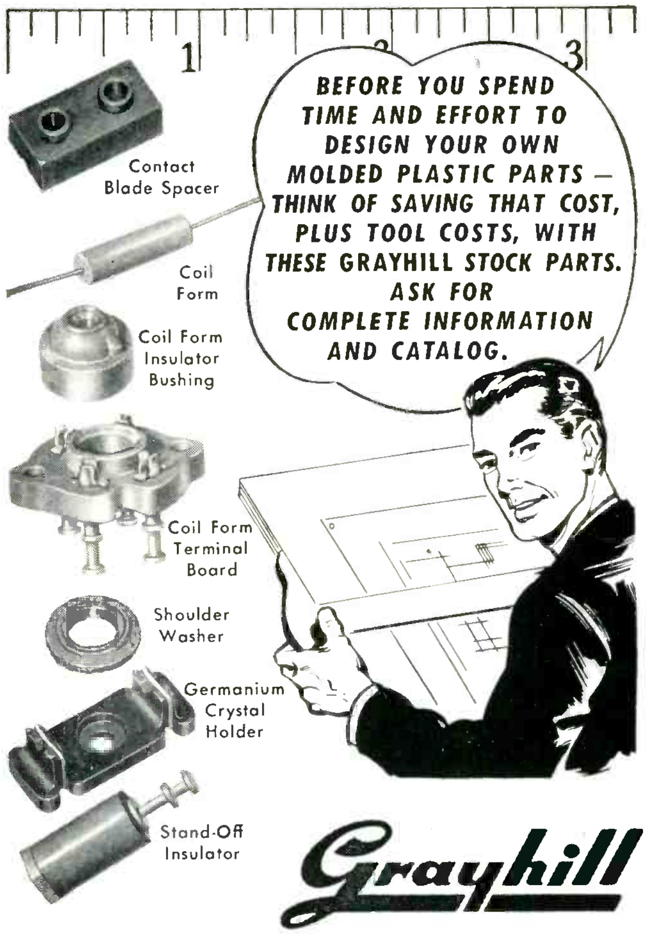

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better work has been done on this subject than is set forth in this chapter.

Chapter IX on Wave Guides and Cavities sets forth some of the usual material about waveguides including a bit on higher modes in coaxial cables. The subject of dissipative attenuation due to wall and dielectric losses is presented in the usual way. Very little is done with cavity resonators.

The use of waveguides in lenses is discussed. Types of tapered matching sections, twists and bends are shown but nothing seems to have been done regarding their properties.

Nothing was done to show the use of guides for measurements or the analogy to TEM transmission lines.

The reviewer confesses that he has not read all of the two volumes in detail. Such an undertaking would take at least two years. It is therefore possible that some parts of the book which might be considered contributory have been missed.

The books would be of value only to someone doing advanced engineering work. Even then it seems that one who has the background necessary to read the books already has other books and papers which present the subject matter more completely and ever so much more clearly.—CHARLES A. HACHEMEISTER, *Associate Professor, Polytechnic Institute of Brooklyn.*

Fundamentals of Automatic Control

BY G. H. FARRINGTON, *John Wiley and Sons, Inc. New York, N. Y.* 1951, 285 *pages*, $5.00.

READERS of ELECTRONICS are in general specialists in electronic fields. Automatic control is usually thought of by such readers in a rather limited sense with particular emphasis on servomechanisms. Since servomechanisms are only a rather specialized branch of the automatic control field, readers of ELECTRONICS should have a special interest in the broad base of knowledge available to the electronic servomechanism art from automatic control theory and analysis that have been developed over a period of years outside the electronic indus-

try. This book is excellently written to portray a clear picture of the theoretical principles involved in automatic control applications. It is basically and clearly definitive so that the reader is immediately made acquainted with the terms and definitions which cause so much confusion to one not rigorously acquainted with this field.

The nature of various control problems is thoroughly explored and mathematical methods used to facilitate each analysis. Control principles are treated with various electrical and mechanical analogies so that those skilled in the electronic field will quickly grasp the explanations of various control circuit phenomena.

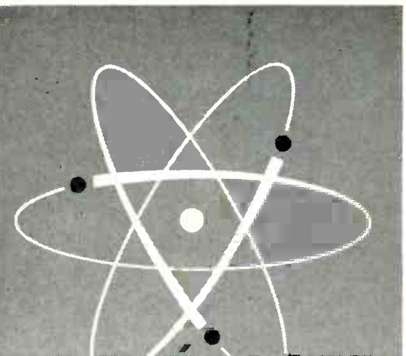
Control types and stability are defined and graphically portrayed with particular emphasis given to "on-off" and also proportional control. The definitions given follow rather closely the A.S.M.E. definitions but with a choice of wording rather more understandable to an electrical or electronic engineer than the particularly semantic terminology of the A.S.M.E.

Proportional control, of primary interest to all servomechanism engineers, is aptly covered with subdivisions into various types. Proportional plus derivative control wherein the potential correction is directly proportional to the first derivative of the deviation plus a linearly related and opposing change in potential is considered for its ability to allow high-accuracy control without hunting.

Proportional plus integral control is thoroughly treated to show the ability of this combination to reduce offset to zero.

A considerable portion of this volume is used to explain the mathematical methods of computation involved for the various types of control as well for many "plant" or systems characteristics for which regulation and/or control are required.

This book is not a "servomechanisms" book by our definition of servomechanism as related to mechanical motion. However, the control system and regulator field as covered by servo systems in general is well covered and it is felt that



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the engineer interested in the broad aspects of automatic control will find the book well worth study. It should certainly be a part of the library of any company engaged in the automatic control or servo field.
—OSCAR E. CARLSON, *Servo-Tek Products Co.*

Selection, Training and Use of Personnel in Industrial Research

PROCEEDINGS 2ND ANNUAL CONFERENCE ON INDUSTRIAL RESEARCH. *King's Crown Press (Columbia University), New York*, 274 *pages*, $4.50, 1952.

THIS reviewer found this symposium and the clinic that followed the papers an extraordinarily interesting survey on all aspects of the technical manpower problem. E. W. Engstrom's opening paper "What Industry Requires of the Research Worker" was especially provocative and inspiring. Among the other papers are "The Creative Mentality and Research Problems", "Selection Techniques for Research Workers", "Training of Young Researchers", "What Makes a Good Research Man?" etc. etc.

Anyone having a role to play in industrial research at any level will find these proceedings of interest and value.—K.H.

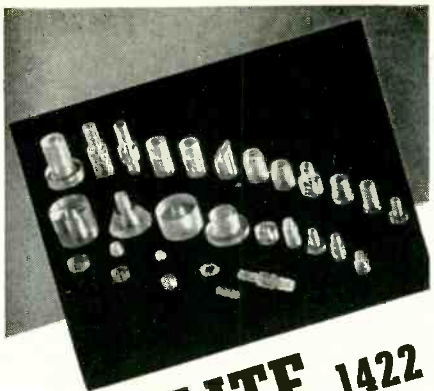
Radar and Electronic Navigation

BY G. J. SONNENBERG. *D. Van Nostrand Co., Inc., New York*, 1951, 272 *pages*, $6.00.

THIS small volume for navigators delves just deeply enough into electronic techniques to make comprehensible some of the characteristics of the systems that might otherwise prove troublesome.

Compiled from a European viewpoint, the book covers the Decca, loran and Consol navigation systems, echo (depth) sounders and radar. These chapters are preceded by one that sums up the technical fundamentals from electricity and magnetism, through cathode-ray tubes and propagation, to hyperbolic systems.

Although Consol is reportedly little used by American navigators, the chapter on this system was the most practical of any this reviewer



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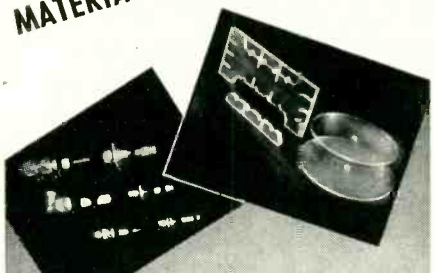

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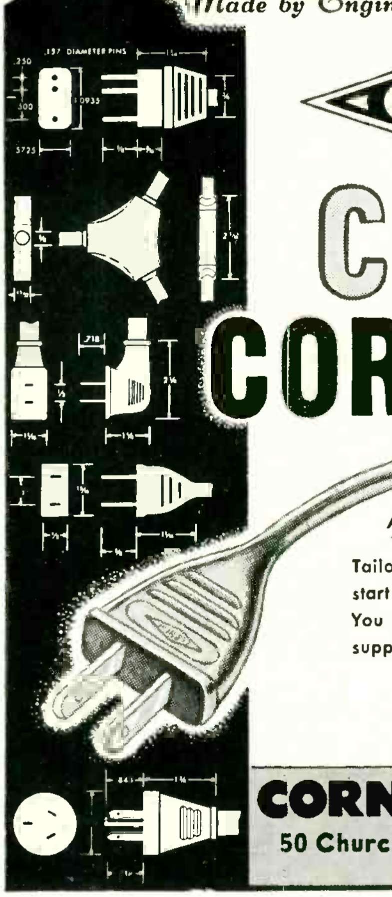

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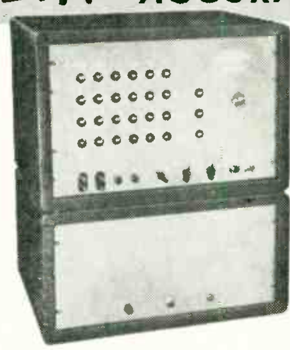

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had the opportunity of reading. The basic system has been excellently delineated elsewhere under its original German name, Sonne.

While it is a convenience to find all this information in one place, the American navigator may feel that the really useful material can be purchased at a small fraction of the price from the source, the Government Printing Office. The thirty pages devoted to Decca, for example, can have only an academic interest for him.

The author, laboring under a tremendous language difficulty, has done a surprisingly good job of discrimination as to sources and in organizing his material.—A.A.MCK.

Electrical Engineering

BY CLARENCE V. CHRISTIE. *Sixth Edition. McGraw-Hill Book Company, New York, N. Y.* 1952. 675 *pages*, $7.00.

AT EACH periodic revision of this well-known book, the author must have been faced with the problem of whether to revise the core material of the book, which probably has been responsible for its popularity (six editions since 1913), or to revise by adding contemporary topics to a relatively unaltered core. The latter approach appears to have been used in this case, resulting in a book which hasn't changed as rapidly as have the basic requirements of students entering the electrical-engineering field. Consequently, the new sixth edition of this text is still highly suitable for the power student, who was the only type of student for the first four editions (1913, 1917, 1925, 1931), and who needs the emphasis on power-frequency-sinusoidal circuit theory; it is less suitable for the communications and electronics student who must be equally facile with waves of all shapes and periods, and circuits in all manner of state.

This book appears to consist of three parts: (a) electric-circuit theory, (b) electrical machinery, (c) power-system analysis, as though it were written for three separate subjects. The portion on electric-circuit theory starts from fundamental electrostatics and elec-

trokinetics and continues through straightforward d-c and a-c circuit theory into complex a-c waves and polyphase circuits. Circuit theory is built up clearly using sine-wave plots, complex numbers, and vector diagrams. The common network theorems are stated and demonstrated by example. There is little on transients; the few transient problems are solved explicity by calculus.

Standard a-c and d-c machines and transformers are covered in the second part of the book; both the analytical, as well as the design and application viewpoints, are broached. Each of the machine types is approached from an elementary physical standpoint, with equations, formulas, and equivalent circuits being developed afterwards. There are separate chapters on a-c and d-c machine design which serve to introduce the reader to the problems, limitations, and practices involved in the construction of electrical machinery. Topics that can be treated in a dull and routine manner, such as synchronous-motor starting, alternator regulation, and so on, are made very readable by discussing them in conjunction with related problems of application and cost. A few pages are devoted to rectifiers with the concession that they have practically superseded rotating converters.

The third part of the book deals with transmission lines, symmetrical components, stability, and fault-current calculations, and appears out of keeping with the first two parts from the standpoint of completeness and maturity. This is reflected in the fine three-page discussion on transmission-line operation at the start of this section, a discussion that only a reader with moderate experience can appreciate. There is too little space assigned to the topics introduced in this part of the book to cover them adequately, particularly stability and fault-current calculations, unless an instructor supplements the text with much additional background material. These topics do not lend themselves to brief quantitative treatment.

The characteristically clear writ-

ing makes the book highly readable; little material, once introduced, is left unexplained or left for the reader to infer. There are numerous vector diagrams, air-gap-flux diagrams, circuit diagrams, and line drawings, but no photographic illustrations. Applicational and quantitative data are distributed throughout the text to give the reader a sense of dimension. Few references are given for further outside reading on the text material.

The 59 problems at the end of the book are the only ones for a student to solve, although there are many illustrative examples in the text itself.—ALEXANDER KUSKO, *Massachusetts Institute of Technology.*

Microphones

BY THE STAFF OF THE ENGINEERING TRAINING DEPARTMENT, *British Broadcasting Corporation. Published for "Wireless World" by Iliffe and Sons, Ltd., London,* 1951, 114 *pages,* 15 *shillings net.*

THIS little volume presents a thorough and elementary treatment of the principles of microphones, with special emphasis upon microphones used by B.B.C. The text is written on the technical college freshman level and would be of value to the student or the practical man desirous of learning more about the theory of microphones.

The first half of the book is devoted to principles of acoustical and microphone theory, nature of sound waves, operational forces, principles of electroacoustics and the interrelationships between diaphragms and the sound waves. The second half describes the velocity, moving-coil, condenser, and Rochlle-salt microphones used by B.B.C., together with equivalent circuits and pressure relationships. Some of the theoretical material is contained in five appendixes.

The principal limitation of the text is that—by American technological standards—it is about two decades old. The particular microphones described are presently obsolete or obsolescent in the American broadcast practice; most of them have been treated in the 1934 edition of Olson and Massa's "Ap-

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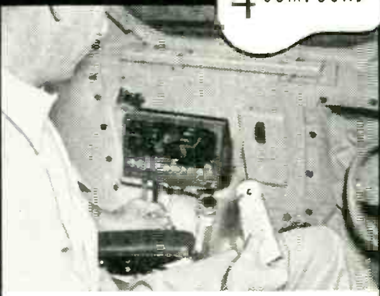

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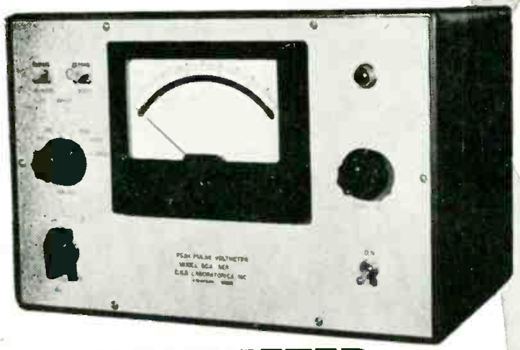

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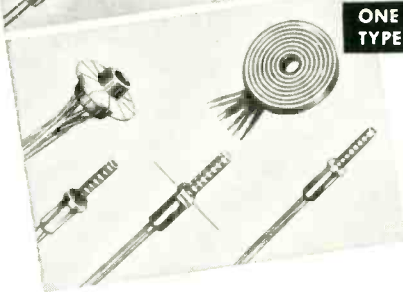

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INSTRUMENT CORP. OF AMERICA BLACKSBURG, VIRGINIA plied Acoustics". Some of the important developments during the past decade and a half, such as phase-shift cardioid microphones and miniaturized microphones, are completely omitted. Very little is said about practical applications, studio acoustics, placement techniques, wind screening, electrical consideration, etc. Some of the equations in Appendix 4 are in error; however, it is not likely that they would ever be used by microphone designers.

Despite these limitations, "Microphones" is a useful work, eminently suited for its intended purpose—that of serving as "a textbook for students and operational engineers employed at studio centers".—B. B. BAUER

THUMBNAIL REVIEWS

HOW TO SUPERVISE PEOPLE, Third Edition. By Alfred M. Cooper. McGraw-Hill Book Co., 1952, 254 pages, $3.50. How to handle people in shop, field or office. Although the main theme is for the factory supervisor the principles can be learned with advantage by the office boss also. How to develop leadership; to promote teamwork; prevent industrial accidents; train subordinates etc.

SCIENCE OF PRECISION MEASUREMENT. The DoAll Company, Des Plaines, Illinois, 256 pages, $3.50, 1952. Dealing primarily with products of the DoAll Company but a well-produced book covering the practice of dimensional quality control, that is, the use of gage blocks and instruments, sine bars, optical flats and statistical systems of quality control. Tables, glossary of terms, pages for notes etc.

THE MERCK INDEX, Sixth Edition. Merck & Co., Inc., Rahway, N. J. 1,167 pages, $7.50 ($8.00 thumb-index edition), 1952. New edition of a deservedly popular listing of chemicals and drugs; describes more than 8,000 individual substances, has more than 2,000 structural formulas and about 20,000 names of chemicals and drugs alphabetically arranged and cross-indexed.

COMMUNICATION OF TECHNICAL INFORMATION by Robert M. Dederich. Chemonomics, Inc., New York, N. Y. 116 pages, $5.00, 1952. A long essay on the problems of technical men orienting themselves in their respective organizations and communicating their technical ideas to other technical personnel or to non-technical management. The techniques of oral and written reports are covered plus a final (and best) chapter on the business of conducting oneself in conferences.

EVERYDAY HOUSEHOLD APPLIANCE REPAIRS. By William H. Crouse, McGraw-Hill Book Co., 295 pages, $4.95, 1952. A very practical book on servicing toasters, motors, refrigerators, radios, house heating systems etc. Not much detail on each appliance but sufficient so that the reader has a clear idea of how the device operates and, therefore, is in a position to repair it. Well produced by an expert at this type of book.

CONDUCTION OF ELECTRICITY THROUGH GASES, Third Edition. By K. G. Emeleus. A Methuen Monograph. John Wiley & Sons Inc., New York. 99 pages, $1.50, 1951. Second edition published in 1936 has been revised in light of more recent knowledge. Reviews theories held previously, and, like all this Methuen series, is a compact and concise essay on phenomena of considerable importance.

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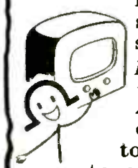

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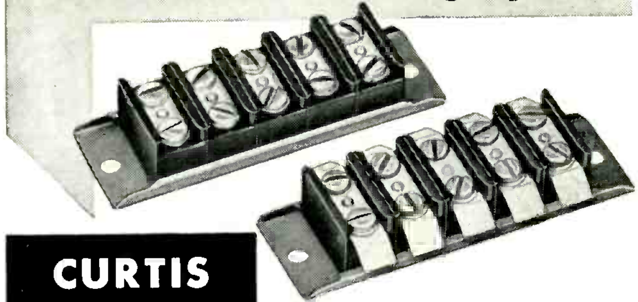

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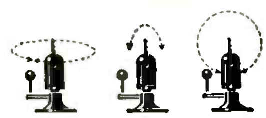

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BACKTALK

Medical Electronics

DEAR SIRS:

SINCE my article, "Electronics Engineering Needed In Medicine", was published (ELECTRONICS, p 82, Feb. 1952), I have received almost fifty letters about it. Although they were congratulatory, many contained inquiries regarding the application of electronics toward furthering the practice of medicine.

I was quite surprised to learn the eagerness of electronics engineers to apply their knowledge to our problems in medicine. As you can well imagine, the above-mentioned article merely scraped the surface of our needs.

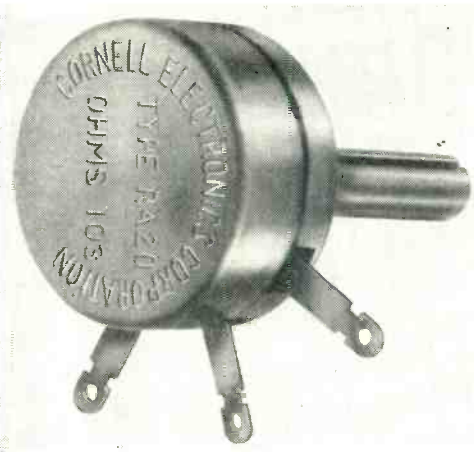
It occurred to me that you may be interested in setting up a department of medical electronics in ELECTRONICS. All questions regarding present and future devices to be used in medicine might be directed to this department. I would like to offer my services to answer the medical aspects of such inquiries. I would further suggest that an electronics engineer be selected to cover the engineering aspects. I sincerely feel that such a department would encourage needed progress in this direction.

Moreover, from the letters I have received, it would seem that brief explanations of the physiology of various bodily functions might also prove stimulating to your readers. An example would be a description of heart sounds, their significance and the common abnormalities. Another example would be the description of the contractions of the uterus during the process of birth. Some simple apparatus to measure the efficiency of these contractions would undoubtedly prove valuable to us.

I should like to pursue these thoughts further if they are of interest to you.

HERMAN I. KANTOR, M.D.
Dallas, Texas

(Editor's Note: The above-mentioned article has prompted a great deal of discussion in this office as well as Dr. Kantor's. We welcome any comments from readers as to the advisability of our printing in ELECTRONICS the type of information suggested in Dr. Kantor's letter. We do know that good technical articles on medical electronics received



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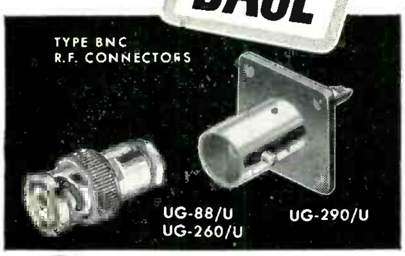

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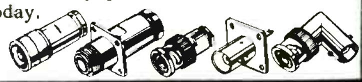

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wide readership. Unfortunately, they are almost as hard to get as gain at 1,000 mc. We will, of course, continue our efforts to keep our readers informed about this important and rapidly expanding branch of the industry. Any suggestions?)

Flat and Dull

DEAR SIRS:

THE EDITORIAL in March 1952 issue of ELECTRONICS, discussing the "flat, dull" tone of radio networks should open the door on some of the folklore of electronics. Why is it possible to transmit a perfect picture coast to coast requiring a 4,000-kc circuit and yet an audio channel sounds flat and dull? Let one who has been in the audio and network business for over 20 years ask a number of questions and answer a few.

First as to the folklore of electronics. Most engineers will say 99 percent of the public want soft booming music, a frequency range of probably 100 to 3,000 cycles. To contradict this, let me point to the large group of "high-fidelity" hobbyists who are springing up, as you might say, "in spite of the electronics industry". The next point in the folklore is the statement found in every radio textbook that the ear does not recognize phase distortion. I have never seen any data made on a high-fidelity system justifying this statement. Another thing casting suspicion on this statement is the present talk of "audio (?)" systems extending up to 200,000 cycles. We know they cannot hear these frequencies but they may be correcting phase-shift at 10,000 cycles.

As to the frequency width of networks, the Bell System made available an 8,000-cycle network in the 1930's and now has 15-kc networks available with few or no takers. One of the limitations, of course, is the 5,000-cycle limit on a-m broadcast transmitters. Another reason high-fidelity music was not broadcast was that the public would not adjust the tone control on their receivers to reproduce such music. This fact is probably true, not because of public taste, but because of what came out of the receiver. This included phase distortion as mentioned before, frequency distortion caused by nonlinear pentode audio amplifiers, poor response of

cheap speakers, resonant rattles in bass-reflex boxes, and more phase shift introduced by crossover filters for woofers and tweeters.

Three of my favorite records for demonstrating high-fidelity reproduction are: (1) Shostakovich "Polka" from the First Piano Quartet album, Victor, (2) The Banjo Kings, Good Time Jazz Co., record No. 43, and (3) "Third Man Theme", London ffrr, a zither recording. Finding good records for high-fidelity reproduction is really a chore. They, of course, must have the frequencies recorded, and must also have a low noise background. Why do we not use the term "signal-to-noise ratio" in connection with records? Many records are made with such a low audio level that they are unusable on a high-fidelity reproducer because of high frequency noise.

In conclusion, I believe there are a large number of people who would accept true high-fidelity audio systems, in fact are beginning to demand it; but before such systems can be generally available, the electronics industry including the networks, the record makers, and the set builders must revise their objectives and the method of reaching those objectives.

WALTER E. SELLMAN
Staff Supervisor, Plant Department
The Pacific Tel. and Tel. Co.

Metal Detectors

DEAR SIRS:

AT THE REQUEST of Dr. E. D. Cook, I have reviewed the article "Industrial Metal Detector Design" by Curtiss B. Schafer, ELECTRONICS, p 86, November 1951, and have the following comments.

The information given in the article is inadequate to tell one "how to design a metal detector for a specific application" as stated in the heading. The paper appears to be a collection of abstracts which are not clearly related to one another, but range from a brief introduction to the theory of metal detection to an example of an industrial metal detector which does not illustrate the type of coil assembly advocated under the section on theory.

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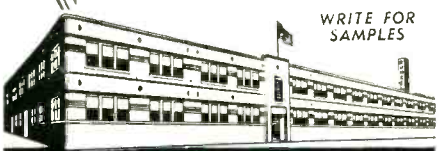

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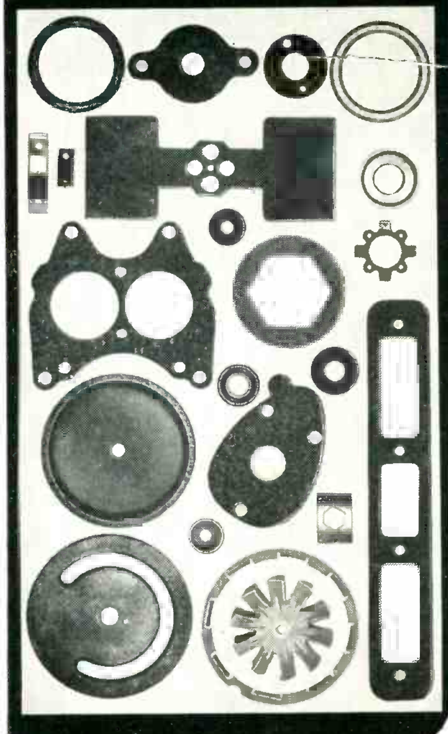

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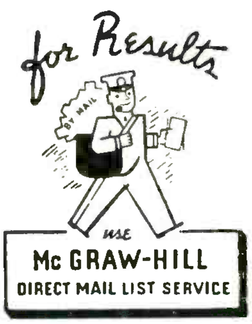

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tions involving the complex variable $(X + jY)$ are tedious to use without the plot of $(X + jY)$ referred to on page 88 of the article in question. Such a plot is given in a paper by Dr. C. W. Clapp which was cited as reference (4) and from which the above was apparently abstracted. The equation for ΔZ as given on page 88 is actually for the change in self-impedance of a single coil rather than for the change in mutual impedance of a pair of coils as stated by Mr. Schafer. The latter is expressed by Dr. Clapp's Eq. 11 while the former is Dr. Clapp's Eq. 12.

It should be pointed out that the effect of external fields on a pair of spaced secondary coils connected in series opposition is not canceled out as mentioned on page 86 of the article unless the fields have the same value at each coil. Fortunately, however, the operating frequency of the metal detector can be chosen to be sufficiently different from the frequency of any external fields so as to minimize their effect. Since the external fields may produce a signal comparable to the signal produced by a foreign metallic particle being detected, this factor requires consideration.

From a design standpoint, the power required of the oscillator-amplifier is not strictly a function of the aperture size as indicated by Mr. Schafer on page 89, but is also a function of the space and money available for the coil assembly. Since the radiated power is negligible at the usual frequencies of operation, if theoretical conductors of zero resistance were available for the coils the power would be zero regardless of the aperture size since only the coil inductance is used in detection.

It is then feasible, within limits, to reduce the power required by increasing the cross-section and the conductivity of the coil conductor if space is available outside the required aperture and funds permit. To maintain high detection sensitivity, however, this increase in cross-section of the coil winding should not be too great. With a new coil design recently developed, it has been possible to

achieve appreciable reduction in power for a given aperture.

While a perfectly symmetrical bridge arrangement as regards size, materials, etc., will cancel out the effects of ambient temperature changes, such perfect symmetry is more difficult to achieve than implied on page 89. Since the signals to be detected may be in the order of one part in 10 million for minimum particle sizes, even slight asymmetry can produce undesired signals due to temperature drift. Even with perfect symmetry, temperature gradients can produce undesired signals (see Mr. Schafer's reference 3). For freedom from such temperature effects and other drift factors, a stable automatic balancing circuit is essential and permits operation of a metal detector at maximum sensitivity with minimum adjustment. Both the inphase and the quadrature signals are automatically balanced by a circuit developed by the General Electric Company for general application in detecting both magnetic and nonmagnetic particles at high sensitivity.

It should be pointed out that when minimum particle sizes of magnetic or nonmagnetic metals are to be detected in the presence of large irregular masses of nonmagnetic or magnetic conducting material, respectively, the principle of quadrature signal separation referred to on page 88 cannot be readily applied. This is because the relative signal phase depends on size as well as frequency, conductivity, and permeability, and the phase of the undesired signal will vary from that which the detectors are adjusted to reject. Since the amplitude of the undesired signal may be large, the detector output signals caused by even small phase variations may be as great as the desired signals. Having cognizance of these factors enables one to take steps to minimize any undesirable effects.

It is hoped that these comments will help to clarify some of the points covered in Mr. Schafer's paper.

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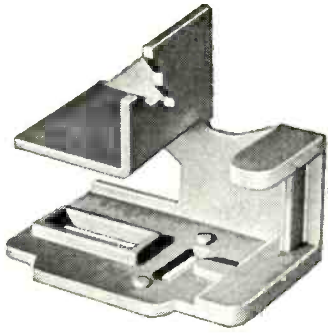

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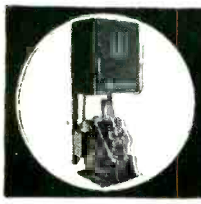

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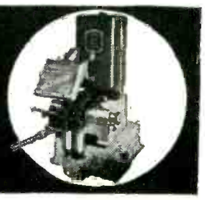

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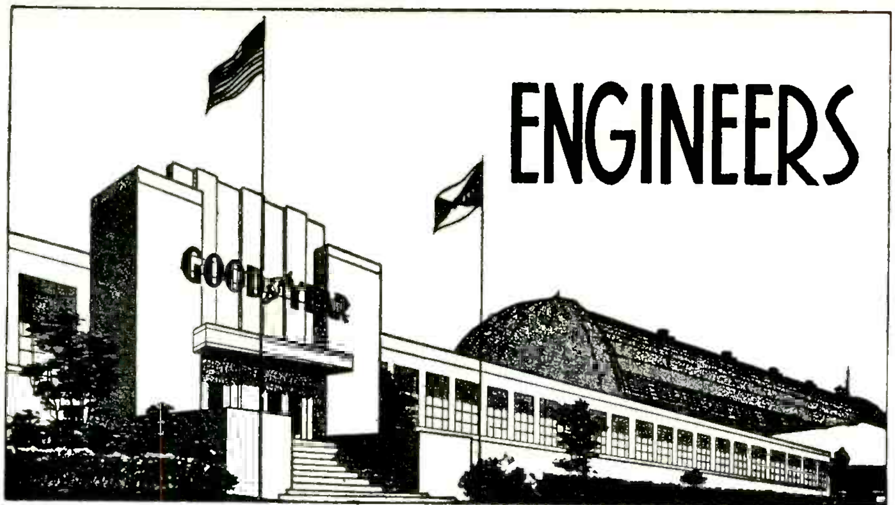

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Cornell Aeronautical Laboratory

4455 Genesee Street
Buffalo 21, New York

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.

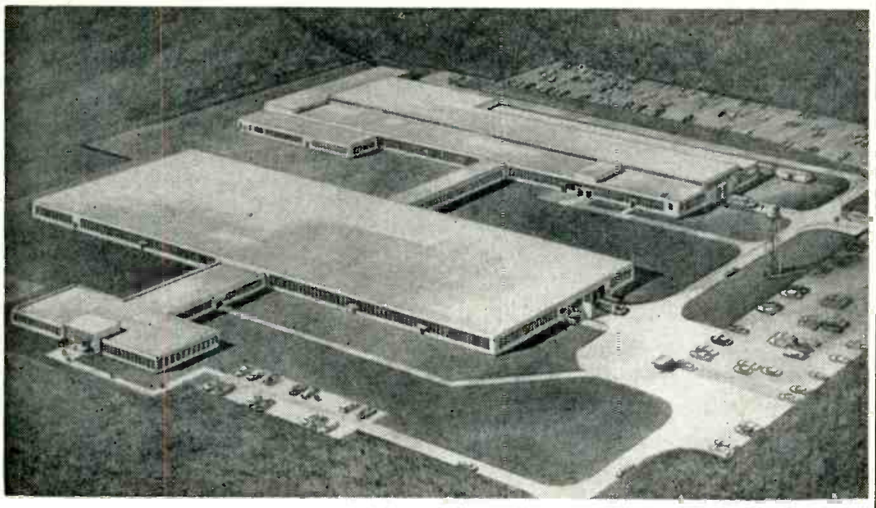
THE NATIONAL CASH REGISTER COMPANY
Main & K Sts., Dayton 9, Ohio

ELECTRONIC ENGINEERS
ENGINEERING PHYSICISTS

Several engineers required for development of electronic circuitry, electro-mechanical devices, analog and digital computing equipment.

Positions offer security in a Laboratory located in desirable residential area. Apply in writing and furnish information as to education and experience.

Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena 3, California



electronic engineers

A new plant now under construction with a major Navy contract for electronic gunfire control units and a progressive management. Job opportunities are open for Electronic Engineers for Navy Fire Control work involving computers, gyros, radar, and engineering positions at all levels.

Daystrom offers a sound chance of advancement, a post-defense future in one of the most modern plants in the country.

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or
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DAYSTROM
Instrument Division

PERSONNEL DEPARTMENT OF DAYSTROM, INCORPORATED
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SR. ENGINEERS — MIN. 3 TO 5 YEARS EXPERIENCE

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Interesting, Challenging, Varied Developments.
. . . Openings For . . .

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PROJECT & ASST. PROJECT LEVEL APPLICANTS

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Generous Salaries: Periodic Merit Advancement Increases In A Growing New Division of 74-Year Old Firm Offering Unusual Future Growth Possibilities.

- PULSE CIRCUIT DESIGN
- CRT DISPLAYS
- SERVO MECHANISMS
- COMPUTORS

Write Exp., Resume, And Salary Req'd.

•

THE AUSTIN COMPANY
Special Devices Division
76 Ninth Avenue, New York 11, N. Y.

ENGINEERS WITHOUT COLLEGE DEGREES...

We put *no limits* on your engineering future!!

● Are you capable of doing real professional-level engineering work? If you have *demonstrated* your ability to do first class engineering work but feel you are being handicapped by the lack of a college degree, get in touch with this company.

WE ARE a large manufacturer of Electronic Equipment (Military, Aviation, Automotive, Television) and have over 100-million-dollar backlog. Located on Eastern Seaboard.

● There are many responsible positions open in our organization which offer unlimited opportunity. We want them filled by competent men, regardless of their formal educational backgrounds.

P-4214, Electronics
330 W. 42 St., New York 36, N. Y.

ELECTRONIC ENGINEERS

Degree in Electrical Engineering Plus Maintenance or Repair Experience on SCR-584 Radar

ELECTRONIC ENGINEERING COMPANY OF CALIFORNIA
180 SO. ALVARADO STREET
LOS ANGELES, CALIFORNIA

HOUSTON, TEXAS

TRANSFORMER ENGINEER

Precision equipment manufacturer needs qualified, experienced engineer for audio and sub-audio transformer design and development. Experience with the high permeability alloys desirable. Knowledge of magnetic circuitry must be sufficient for development work on magnetic amplifiers. Salary commensurate with ability.

P-3864, Electronics
520 N. Michigan Ave., Chicago 11, Ill.

ENGINEER or PHYSICIST

Wanted for development and research on Thermistors. Preferably a man with experience in this field. Good opportunity with a progressive midwestern manufacturer in the electrical component field. Reply in confidence giving age, education, experience, and salary desired.

P-3700, Electronics
520 N. Michigan Ave., Chicago 11, Ill.

ENGINEERS

ELECTRONIC
and
Electro-Mechanical

MAKE YOUR MOVE IN THE RIGHT DIRECTION

POSITIONS THAT POINT TO A SUCCESSFUL FUTURE!

Minimum Requirements

Four years' experience in advanced research and development on Radar Systems, Computers, Wave Guide and Antennas, Servo-mechanisms, Pulse Techniques Gyroscopic Equipment and Related Fields.

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 CORPORATION
460 W. 34th St. New York 1, N. Y.

STAVID ENGINEERING, INC.

has openings for Graduate

ELECTRONIC ENGINEERS
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, Antenna and Antenna Mounts, etc.

Mechanical Engineer should have experience in packaging of Electronic Equipment to Gov't specifications including design of complex cabinets, shock mount and sway brace structures, Servo Mechanisms.

Positions are available in Field Service and Technical Writing.

Liberal personnel benefits including life, sickness and accident insurance, and a worthwhile pension system. Paid holidays and vacations.

Personnel Office
200 W. Seventh St.
Plainfield, N. J.
Telephone Plainfield 6-4806

ELECTRONIC *and* MECHANICAL ENGINEERS

As a leader in the field of electronic research and development, MELPAR constantly deals in new ideas and works with skilled men whose initiative and ability are an active factor in the development of these ideas.

We want to add to our distinguished group of engineers men whose background entitles them to the substantial salaries, advancement and recognition that is an integral part of MELPAR policy. Work is in pleasant Alexandria, just outside Washington, D. C., in a modern plant with extensive laboratory facilities.

If you have had Research, Development and Manufacturing experience in any of the following fields we would like to hear from you:

- **FLIGHT SIMULATORS**

Computers•Radar Beacons•Telemetering
Sub-Miniaturization•Microwave Receivers
•Microwave Transmitters

Send resume to:

PERSONNEL DIRECTOR, Dept. T.T.

MELPAR, INC.
Subsidiary Westinghouse Air Brake Co.
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MAKE THIS YOUR HOME FOR IMPORTANT WORK UNDER IDEAL CONDITIONS

- TV RECEIVER DESIGN ENGINEERS
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- FIELD ENGINEERS
- TEST & INSPECTION ENGINEERS
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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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Makers of the World's Finest Electronic Equipment

ELECTRONIC ENGINEERS

Electronic Engineers qualified by design experience on DC and wide band amplifiers, low power pulse circuitry, computers, telemetering or allied fields, should contact Tracerlab, Inc.

Tracerlab manufactures instruments of all types for the fast growing field of radioactivity and as one of the foremost leaders in this field, has much to offer its employees concerning security and fine opportunities for advancement.

Engineers who have had responsibility for design of electronic instruments in a manufacturing organization with supervision of Junior Engineers and Technicians are invited to write, giving a detailed outline of training and experience. Correspondence will be confidential. Selected applicants will be asked to come to Boston at our expense for interview.

Industrial Relations Department

TRACERLAB, INC.
130 High Street Boston 10, Mass.

POSITIONS OPEN

Location
KANSAS CITY, MO.

Electronic & Mechanical Engineers

ELECTRONIC ENGINEERS: Must have considerable development experience in radio transmitting and receiving equipment. Ability to fill position of Senior Project Engineer a requisite.

MECHANICAL ENGINEER: Must have development experience in mechanical design of electronic or similar precise equipment. Practical and theoretical knowledge of materials, finishes, sheet metal, and machine shop design are basic requirements. Position is one of considerable responsibility.

SALARY: Open.

These positions are permanent.
Write stating educational and professional history direct to:

Jay V. Wilcox, President
WILCOX ELECTRIC COMPANY, INC.
1400 Chestnut St. Kansas City 1, Mo.
Dependable communications since 1931

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MANUFACTURERS REPRESENTATIVES

To sell our custom built Electronic Transformers, Coils, Chokes, and Solenoids. We have most modern equipment including testing facilities plus engineering and manufacturing know-how.

DIT-MCO, INCORPORATED
505 W. 9th St. Kansas City 6, Mo.

SALES ENGINEER

Old established Toronto firm in radio and electronics industry requires the services of a sales engineer, with college degree in Communications Engineering or Electronics, to handle one of the world's leading lines of laboratory test equipment. Should have at least two or three years practical engineering experience. Must have ability to meet and handle people. Permanent position. Live in Toronto, but willing to travel throughout Canada. Please submit all pertinent information, including salary required to:

SW-3989, Electronics
330 W. 42nd St., New York 36, N. Y.

CHANCE VOUGHT AIRCRAFT, builder and designer of the "Cutlass" and "Corsair", has openings for top level technical personnel in electronics and aerophysics for supervisory positions in long range development and design programs on piloted and pilotless aircraft.

RELIABILITY SUPERVISOR to supervise the establishment and maintenance of optimum reliability of electronic and controls systems. Requires degree in electrical engineering, advanced studies in mathematics plus 7 to 8 years related experience.

GUIDANCE SUPERVISOR—to direct a group in the analysis, design and development of electronic guidance systems for pilotless aircraft. Requires special knowledge of guidance, design and control problems. Requires M.S. in electrical engineering with 7 to 8 years related experience.

AEROPHYSICS PROJECT ENGINEERS—to direct groups in the analysis and solution of problems establishing requirements and specifications for electronic and control systems in relation to aircraft performance. Requires intensive knowledge of physics, mathematics, aeronautical engineering and highly specialized knowledge in the field of automatic controls. Equivalent to PH.D. and 5 to 8 years related experience.

Excellent salaries and working conditions. Housing readily available in Dallas area. Liberal moving allowance. Submit resume of education and technical experience to engineering personnel office.

CHANCE VOUGHT AIRCRAFT
DIVISION OF UNITED AIRCRAFT CORPORATION
P. O. BOX 5907 • DALLAS, TEXAS

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 4½" R.—JBT	4.11
30 V DC 2½" R.—General Electric	3.95
3 amp. RF 3½" R.—Weston	6.00

OIL-FILLED 35 KV AND 50 KV ISOLATION TRANSFORMERS

Pri. 460V 60 cy. Sec. 115V 200 VA Insulated for 50KV DC—G. E. Form EIR—36" H x 13" D $125.00

Pri 115V 60 cy. Sec. 115V 250 VA Insulated for 35 KV DC—G. E. Form EIR—29" H x 12½" D.$125.00

2 φ LOW INERTIA SERVO MOTORS

KOLLSMAN—45 Volt 60 cycle 4 watts 1500 RPM—new $22.50

OIL FILLED CONDENSERS

MFD	VDC	Price	MFD	VDC	Price
2	400	$ .55	1	3000	3.40
5-5	400	1.65	2	3000	4.50
1	600	.55	.03	4000	1.25
2	600	.69	3 x .2	4000	2.95
2	600R'd	.69	2	4000	6.95
2-2	600R'd	1.65	.1	5000	1.60
3	600	.95	.2	5000	2.50
4	600	1.65	1	5000	4.88
4	600R'd	1.65	2	5000	18.50
5	600	1.75	.01-.03	6000	1.65
6	600	1.85	.1	7000R'd	1.79
8	600R'd	1.85	.1	7500	2.85
8-8	600	1.95	.1-.1	7500	5.95
4-4-4	600	2.50	.5	7500	8.95
4 x 3	600	2.50	1	7500	12.50
1	1000	.65	.075-.075	8KV	6.50
2	1000	.90	.5	10KV	16.50
2	1000R'd	.95	5	10KV	65.00
3.5-.5	1000	1.85	.1	12KV	8.95
4	1000	1.95	1	15KV	37.50
6	1000	2.50	.045	16KV	4.70
8	1000	3.25	.05	16KV	4.95
1	1200	.85	.075	16KV	8.95
1-1-1	1200	1.85	.25	20KV	19.95
.1	1500	.59	1	20KV	54.00
.5	1500	1.25	.125	27KV	37.50
3	1500	2.50	.001	50KV	24.50
4	1500	2.95	.025	50KV	42.50
.1-.5	2000	.95	.2	50KV	85.00
.25	2000	1.50	.25	50KV	95.00
.3	2000	1.30	1-3	330VAC	1.95
1	2000	1.95	10	330VAC	3.95
3	2000	3.75	12.75	330VAC	4.10
12	2000	8.95	15	330VAC	4.50
1	2500	2.75	5	440VAC	3.10
1-1	2500	3.85	2.9	660VAC	3.50
32	2500	15.80	7	660VAC	4.25
.5	3000	2.40	8	660VAC	4.50

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

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

Raytheon—Pri. 115V 60 cy. Sec. 8500/6450V CT 43 MA Hermetically sealed $22.50

ANTENNAS

AT-38A/APT (70 to 400MC)	$13.70
AT-49/APR-4 (300 to 3300MC)	13.70
AN-74B (125 to 150MC)	3.25
AN-65A (P/O SCR-521)	1.50
AN-66A (P/O SCR-521)	1.75
AIA-3CM conical scan	125.00
ASB Yagi—5 element 450 to 560MC	7.00
ASB Yagi—Double stacked 6 element	12.70
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

Leach type 1521—115 V 60 cy. AC coil—SPST NO double bk 15 Amp contacts—mycalex insul...$3.25

Cramer type 1C2H—110 V 60 cy. Interval timer—two SPST 15 Amp contacts (on 1 hr. off 1hr.)...$3.95

Sperti 1S21 vacuum relay switch (for AN/ART-13) $9.50

G.E. 561 vacuum relay switch SPDT 15 Amp contacts $3.50

Terms 20% cash with order, balance C. O. D. unless rated. All prices net F.O.B. our warehouse, Phila., Penna., subject to change without notice.

COAXIAL CONNECTORS

83-1AC	$ .42	83-1RTY	$ .65	83-22R	$ .68
83-1AP	.30	83-1SP	.50	83-22SP	.90
83-1F	1.30	83-1SPN	.60	83-22T	1.95
83-1H	.12	83-1T	1.30	83-168	.15
83-1HP	.25	83-2AP	1.95	83-185	.15
83-1J	.80	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

UHF—N—PULSE—BN—BNC

UG-7/AP	$6.30	UG/58/U	$.80	UG-177/U	$.24
UG-12/U	.95	UG-58A/U	1.15	UG-185/U	1.60
UG-15/U	1.50	UG-59A/U	2.25	UG-191/AP	.80
UG-18/U	1.25	UG-83/U	2.25	MX-195/U	.75
UG-19/U	1.80	UG-85/U	1.75	UG-197/U	2.80
UG-21/U	.95	UG-86/U	2.50	UG-201/U	1.95
UG-21A/U	1.50	UG-87/U	1.60	UG-203/U	.85
UG-21B/U	1.35	UG-88/U	1.35	UG-206/U	1.80
UG-22/U	1.35	UG-89/U	1.60	UG-224/U	1.40
UG-22B/U	1.65	UG-90/U	1.60	UG-236/U	3.85
UG-22C/U	1.65	UG-98/U	1.85	UG-245/U	2.30
UG-23/U	1.20	UG-102/U	.90	UG-254/U	2.75
UG-23B/U	1.90	UG-103/U	.68	UG-255/U	2.45
UG-23C/U	1.90	UG-104/U	1.40	UG-260/U	1.35
UG-24/U	1.30	UG-106/U	.15	UG-261/U	1.60
UG-25/U	1.35	UG-108/U	2.60	UG-262/U	1.60
UG-27/U	1.30	UG-109/U	2.60	UG-273/U	2.25
UG-27A/U	2.95	UG-146/U	2.55	UG-274/U	2.75
UG-28A/U	3.75	CW-159/U	.60	UG-275/U	5.50
UG-29/U	1.55	UG-166/U	32.50	UG-276/U	2.75
UG-30/U	2.30	UG-167/U	5.85	UG-290/U	1.35
UG-34/U	16.50	UG-171/U	2.80	UG-291/U	1.75
UG-36/U	17.50	UG-173/U	.40	UG-306/U	2.95
UG-37/U	17.50	UG-175/U	.15	UG-414/U	3.25
UG-57/U	2.30	UG-176/U	.15	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
M-359A	PL-258	PL-284	SO-264
M-360	PL-259	PL-293	TM-201

93-C	49120	D-163950	ES-685696–5
93-M	49121A	D-166132	ES-689172–1

COAXIAL CABLE

Type	Price Per M Ft.	Type	Price Per M Ft.
RG-5/U	$140.00	RG-22/U	$150.00
RG-6/U	180.00	RG-22A/U	285.00
RG-7/U	85.00	RG-24/U	675.00
RG-8/U	120.00	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	120.00	RG-54A/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	70.00
RG-19/U	1250.00	RG-59/U	60.00
RG-20/U	1450.00	RG-62/U	100.00
RG-21/U	220.00	RG-77/U	100.00

ADD 25% TO PRICES SHOWN FOR QUANTITIES UNDER 500 FT.

CRYSTAL DIODES

1N21	$1.19	1N27	$1.79	1N41	$11.25
1N21A	1.69	1N31	8.10	1N42	18.75
1N21B	3.50	1N34	.79	1N43	1.55
1N22	1.09	1N34A	.95	1N45	.94
1N23	1.95	1N38	1.70	1N52	1.05
1N23A	3.25	1N39	6.25	1N55	3.15
1N23B	4.25	1N40	10.60		

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"		

DUAL "JJ" POTENTIOMETERS

50	SS	500	SS	1 Meg	SS
100	SS	1K	SS	2.5 Meg	SS
250	SS	2500	SS	5 Meg	SS
330	SS	10K	SS	1K/25K	3/8"

TRIPLE JJJ POTENTIOMETERS

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

G. E. 5D21NJ3A Inverter-24 VDC to 115 VAC 400 cy 485 VA (New) $32.50

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 12121A 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-222A Signal Generator *$79.50
- I-72K Signal Generator $48.50
- C-D Quietone Filter Type IF-16 110/220V AC/DC 20 Amps. *$9.00
- TS-143/CPN Oscilloscope *$95.00
- Dumont 175A Oscilloscope *$225.00
- Gen. Radio 757-P1 Power Supply *$27.00
- I-130A Signal Generator *$85.00
- 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 *$95.00
- BC-221 Freq. Meter (late models) *$125.00
- Weston Model 1 D.C. Milliameter 150/1500 MA with leather case $75.00

All items New Except Where noted * (Exc. Used Condition.)

MISCELLANEOUS EQUIPMENT

I-82F Selsyn Indicator	$6.95
SCR-515 compl. w/dynamotor, control box	69.50
Amperex 1B98 Gamma Counter	9.87
Powerstat 1226—115/230V Input—0-270V out @ 9 amp.	37.00
EIMAC 35T Ionization Gauge	5.95
R-7/APS-2 Receiver	49.50
R-78/APS-15 Receiver	49.50
FL-8 1020 cycle filter	2.95
RM-29 remote control unit	8.95
RM-14 remote control unit	8.95
RTA-1B 12/24 V dynamotor	40.00
BC-1206-CM2 Receiver	12.95
ASB-4 Radar equip. Complete	69.75
RCA AVR-15 Beacon Recvr	18.50
Navy SD-3 Radar complete	1200.00
Navy DP-14 Direction Finder complete	385.00

PULSE TRANSFORMERS

UTAH 9262 9278 9280	UTAH 9318 9340 9350
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-2469A	Philco 352-7150
G.E. K-2744B	Philco 352-7071
AN/APN-9 (901756-501)	Philco 352-7178
AN/APN-9 (901756-502)	Raytheon UX-7350
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 187AW2F	W.E. KS-9563

AN/APA-23 RECORDER

Sweeps any receiver through its tuning range and permanently records frequency and time of received signals on paper chart. Power input—(motor) 27V DC 1.5A, and (recorder) 80/115V AC 60-2600 cy 135W.

Originally designed to record pulse or sinewave modulated signals received by AN-APR-1, AN/APR-2, AN/APR-4, AN/APR-5, BC-348, S-27, SX-28. BRAND NEW $147.50

SPRAGUE PULSE NETWORKS

7.5 E3-1-200-67P, 7.5 KV, "E" Circuit 1 Microsec. 200 PPS 67 ohms imped, 3 sections $4.30

7.5 E3-3-200-67P, 7.5 KV, "E" Circuit 3 Microsec. 200 PPS, 67 ohms imped, 3 sections $6.75

7.5 E4-16-60-67P, 7.5 KV, "E" Circuit 4 sections. 16 microsec, 60 PPS, 67 ohms imped $8.25

15 E4-91-400-50P. 15 KV, "E" Circuit .91 microsec. 400 PPS, 50 ohms imped. 4 sections $16.50

15-A-1-400-50P, 15 KV, "A" Circuit, 1 microsec. 400 PPS, 50 ohms imped $37.50

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST.   PHILA. 6, PA.

Telephones - MARKET 7-6771-2-3

LECTRONIC RESEARCH

GUARANTEED BRAND NEW

TUBE SPECIALS

STANDARD BRANDS ONLY

Receiving Tubes

OOA	$1.50
O1A	.67
OZ4	.74
OZ4A	.90
1A3	.71
1A5GT	.72
1A6	.72
1A7GT	.91
1AB5	.89
1B3GT	.99
1B4P	1.17
1C5GT	.85
1C6	.69
1C7G	.69
1D5GP	.69
1D7G	.69
1D8GT	.71
1E5GP	.71
1F4	.69
1F5G	.69
1F6	.71
1G4GT	.69
1G5G	.69
1G6GT	.69
1H4G	.89
1H5GT	.74
1H6G	.99
1H6GT	1.01
1J5G	.74
1J6G	.95
1L4	.69
1LA4	.87
1LA6	1.10
1LB4	1.01
1LC5	.81
1LC6	.93
1LD5	.93
1LE3	.93
1LH4	.82
1LN5	.91
1N5GT	.85
1N6G	.97
1P5GT	.69
1Q5GT	.99
1R4	.69
1R5	.89
1S4	.71
1S5	.81
1T4	.81
1T5GT	.71
1U4	.86
1U5	.81
1V	.69
1X2	1.09
2A3	1.28
2A5	.79
2A7	.89
2B7	.79
2E5	.94
2X2	.89
2X2A	1.85
3A4	.65
3A5	1.89
3A8GT	2.25
3B7	.57
3C6	1.15
3D6	.57
3LF4	.91
3Q4	.77
3Q5GT	.83
3S4	.77
3V4	.87
5AZ4	.69
5R4GY	1.59
5T4	1.91
5U4G	.69
5V4G	1.07
5W4	.82
5X4G	.87
5Y3GT	.59
5Y4G	.71
5Z3	.87
5Z4	1.11
6A4	1.35
6A6	1.17
6A7	1.05
6A8	1.08
6AB4	.99
6AB7	1.05
6AC5GT	1.19
6AC7	1.11
6AC7W	3.25
6AD6G	.98
6AD7G	1.31
6AE6G	.89
6AF6G	.89
6AG5	.87
6AG7	1.59
6AH6	1.39
6AJ5	2.50
6AK5	1.35
WE-6AK5	2.85
6AK5W	3.05
6AK6	.99
6AL5	.69
6AL5W	2.90
6AQ5	.89
6AQ6	.79
6AR5	.79
6AS5	.99
6AS6	3.30
6AS7G	4.53
6AT6	.63
6AU5GT	1.21
6AU6	.69
6AV6	.63
6B4G	1.60
6B5	1.20
6B7	.97
6B8	.99
6B8G	.85
6BA6	.72
6BA7	1.20
6BC5	.88
6BC7	1.10
6BD5GT	1.60
6BD6	.99
6BE6	.72
6BF5	1.10
6BF6	.83
6BG6G	1.92
6BH6	.99
6BJ6	.99
6BK7	1.60
6BL7GT	1.45
6BN6	1.59
6BQ6GT	1.26
6C4	.65
6C5	.75
6CB6	.89
6C6	.88
6C8G	.96
6CD6G	2.40
6D6	.88
6D8G	.83
6E5	1.10
6F5GT	.83
6F6	.99
6F6G	.99
6F7	.85
6F8G	.91
6G6G	1.06
6H6	.83
6H6GT	.83
6J5	.75
6J5G	.64
6J5GT	.64
6J6	1.09
6J7	.99
6J7GT	.79
6J8G	1.28
6K5GT	.99
6K6GT	.69
6K7	.83
6K7G	.88
6K8	1.22
6K8GT	.96
6L5G	1.06
6L6	1.87
6L6G	1.79
6L6GA	1.59
6L7	1.08
6L7G	.95
6N7	1.19
6N7GT	1.10
6P5GT	.96
6Q7	.99
6Q7G	.89
6R7	.99
6S4	.72
6S7	1.06
6S7G	.99
6SA7	.84
6SA7GT	.74
6SB7Y	1.05
6SC7	1.20
6SC7GT	1.05
6SD7GT	.94
6SF5	.83
6SF5GT	.80
6SF7	.69
6SG7	.91
6SH7	.89
6SH7GT	.89
6SJ7	.89
6SJ7GT	.89
6SK7	.89
6SK7GT	.89
6SL7GT	.96
6SN7GT	.89
6SN7WGT	2.30
6SQ7	.75
6SQ7GT	.75
6SR7	.81
6SS7	.99
6ST7	1.25
6T7G	1.09
6T8	1.11
6U5	1.19
6U7G	.88
6V6	1.60
6V6G	.89
6V6GT	.79
6W4GT	.72
6W6GT	.99
6X4	.59
6X5GT	.59
6Y6G	.99
6ZY5G	.89
7A4	.79
7A5	.88
7A6	.83
7A7	.83
7A8	.83
7AD7	1.44
7AH7	1.08
7B4	.83
7B5	.83
7B6	.83
7B7	.83
7B8	.89
7C4	.69
7C5	.83
7C7	.83
7E5	1.20
7E6	.58
7E7	.83
7F7	.99
7F8	1.59
7G7	1.32
7H7	.83
7J7	1.32
7K7	1.32
7L7	.97
7N7	.97
7Q7	.83
7R7	.94
7S7	1.11
7V7	1.11
7W7	1.11
7Y4	.73
7Z4	.89
10	.45
12A	.65
12A6	.71
12A6GT	.69
12A7	1.16
12A8GT	.77
12AH7GT	1.32
12AL5	.89
12AT6	.59
12AT7	1.15
12AU6	.79
12AU7	.95
12AV6	.63
12AW6	1.20
12AX7	1.08
12BA6	.72
12BA7	.95
12BD6	.99
12BE6	.70
12C8	.77
12F5GT	.79
12H6	.69
12J5GT	.69
12K8	.83
12Q7GT	.67
12SA7	.89
12SA7GT	.89
12SF5	.79
12SF5GT	.79
12SF7	.79
12SG7	.99
12SH7	.73
12SJ7	.79
12SJ7GT	.89
12SK7	.81
12SL7GT	1.03
12SN7GT	.99
12SQ7GT	.79
12SR7	.89
12SR7GT	.89
12X3	1.19
12Z3	.89
14A4	.97
14A7	.97
14B6	.93
14B8	1.09
14C5	1.29
14C7	1.15
14E6	1.09
14E7	1.29
14F7	.93
14H7	.93
14J7	.93
14N7	.93
14R7	.93
14W7	.93
14X7	.93
19	.89
19T8	1.16
22	1.16
24A	.79
25A6	1.16
25L6GT	.89
25Z5	.99
26	.79
27	.69
28D7	1.75
30	.72
30 Spec	.48
31	.62
32	.99
32L7GT	.87
33	.99
34	.99
35/51	.79
35A5	.89
35B5	.87
35L6GT	.81
35W4	.55
35Y4	.81
35Z4GT	.69
35Z5GT	.59
36	.69
37	.69
38	.69
39/44	.59
41	.71
42	.89
43	.89
45	.89
45Z5GT	.79
46	.81
47	.99
48	1.60
49	1.19
50	1.41
50A5	.91
50B5	.88
50C5	.88
50L6GT	.79
50Y6GT	.92
53	.95
55	.99
BK55B	.40
L55B	.32
56	.69
57	.89
58	.89
59	1.24
70L7GT	.91
71A	.79
75	.89
76	.69
77	.69
78	.79
79	.89
80	.65
81	1.41
82	1.19
83	1.11
83V	1.45
84/6Z4	.79
85	.79
89Y	.55
117L7GT	1.89
117P7GT	1.89
117Z3	.74
117Z6GT	.97
FM-1000	1.59

Cathode Ray Tubes

2AP1	$9.75
2AP5	9.75
3AP1	10.25
3AP4	10.25
3BP1	7.95
3CP1	2.25
3DP1	4.85
3DP1A	6.75
3EP1	4.95
3FP7	4.95
3FP7A	6.95
3GP1	4.95
3HP7	4.91
4AP10	4.75
5AP1	5.95
5AP4	4.75
5BP1	5.75
5BP4	5.75
5CP1	4.95
5CP7	9.50
5FP7	4.95
5HP1	5.75
5HP4	5.75
5JP1	26.50
5JP2	26.50
5JP4	26.50
5LP1	19.75
5LP5	19.75
5MP1	10.65
7BP1	8.75
7BP7	7.95
7BP12	14.95
7BP14	14.95
7CP1	14.95
9GP7	12.85
9LP7	9.95
10BP4	18.50
10FP4	24.50
12DP7	16.50
12GP7	16.50
12HP7	16.50
902P1	9.95
905	4.45

Photo Cells

1P23	$4.10
1P24	1.27
918	1.65
919	1.95
923	1.35
927	1.85
931A	6.95
1645	1.95

Thyratrons & Ignitrons

OA4G	$1.32
EL-C1A	4.75
2A4G	1.25
2B4	2.10
2C33	4.95
2D21	1.55
3C23	9.95
3C31/EL-C1B	3.95
3C45	17.50
4C35	28.75
EL-C5B	9.95
5C22	53.45
C6A	6.75
C6J	9.95
FG-17/555	75.25
FG-33	17.50
FG-41	122.50
FG-67	14.80
FG-81A	4.95
91	7.85
FG-95/5560	25.00
FG-104/5561	24.60
FG-105	19.50
FG-166	95.00
FG-172	39.50
FG-178	14.50
RX-233A	4.95
FG-235A/5552	94.50
FG-271/5551	62.50
393A	8.60
394A	4.77
GL-415/5550	39.50
KU-610	12.50
KU-623	39.50
KU-628	22.25
KU-634	39.50
WL-652/5551	62.50
WL-654/659	82.00
WL-672	22.00
WL-677	39.50
WL-681/5550	39.50
722A	3.75
884	1.85
885	1.90
1665	1.80
1904	14.80
2050	1.80
2051	1.15
5545	32.50

Transmitting & Special Purpose Tubes

OA2	$1.30
OA3	1.51
OB2	1.50
OB3	1.29
OC3	1.20
OD3	1.15
1B21A	2.85
1B22	3.25
1B23	9.95
1B24 (West)	12.95
1B24 (Sylv)	18.95
1B26	3.73
1B27	19.50
1B29	2.90
1B32	3.95
1B35	12.50
1B36	12.50
1B38	32.50
1B41	47.50
1B42	9.80
1B54	32.50
1H20	.88
1S21	9.50
1Z2	3.75
2B22	2.20
2C21	.75
2C22	.75
2C26	.49
2C26A	.49
2C34	.49
2C39	22.00
2C40	16.25
2C42	26.50
2C43	22.50
2C44	1.50
2C46	29.50
2C51	5.75
2E22	1.85
2E24	4.10
2J21A	9.95
2J22	9.95
2J26	26.50
2J27	24.50
2J31	39.50
2J32	42.50
2J33	39.50
2J34	39.50
2J36	85.00
2J37	13.70
2J38	17.50
2J39	49.50
2J40	39.50
2J41	175.00
2J48	27.50
2J49	65.00
2J50	39.50
2JB51	2.50
2J55	87.50
2J56	150.00
2J61	45.20
2K23	37.50
2K25	33.50
2K26	107.15
2K28	34.50
2K29	26.00
2K33	295.00
2K45	145.00
2K54	135.00
2K55	135.00
2X2A	1.85
3B22/EL-1C	2.95
3B23	4.75
3B24	5.25
3B24W	7.95
3B25	4.50
3B26	3.75
3B27	3.95
3C24	1.85
3C27	6.95
3D21	1.98
3D21A	2.25
3E29	14.50
3J31	95.00
4-125A	29.50
4A1	1.18
4B22/EL-5B	8.95
4B24	5.75
4B25/EL-6CF	8.95
4E27	17.25
4J36	150.00
4J38	120.00
4J50	375.00
4J52	400.00
5D21	26.50
5J23	24.50
5J29	18.50
6-8B	.85
6AN5	5.95
6AR6	3.35
6C21	29.50
6C24	52.50
6J4	7.95
7-7-11	1.19
10T1	.88
10Y	.45
13-4	.80
15E	2.35
15R	.95
REL-21	2.25
24G	1.85
HK-24	3.95
RK-25	3.82
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
RK-75	3.50
VR-75/OA3	1.51
75T	5.80
VR-78	.64
VR-90/OB3	1.29
VT-98 (Br)	65.00
C100E	2.30
100R	2.90
100TH	10.25
WE-101D	1.65
WE-101F	3.62
WE-102F	2.85
VR-105/OC3	1.20
WE-113A	1.32
HY-114	.75
WE-117A	.95
F-123A	8.95
WE-124A	3.80
F-127A	22.50
VT-127A	3.60
AB-150	12.50
VR-150/OD3	1.15
FG-190	12.15
HF-200	16.50
203A	7.40
203B	6.33
204A	49.50
CE-206	3.15
211	.95
WE-211D	12.50
WE-211E	12.50
212E	42.50
WE-215A	.24
217C	8.95
221A	1.95
227A/5C27	4.60
WE-231D	2.25
232CH	240.00
WE-244A	5.20
WE-245A	2.35
WE-249B	3.50
WE-249C	3.50
250TH	22.50
250TL	22.50
WE-252A	5.65
WE-254A	5.90
WE-257A	3.77
WE-274A	5.50
274B	2.85
WE-275A	6.95
WE-283A	4.25
WE-285A	5.57
WE-286A	7.90
WE-294A	5.75
304TH	9.75
304TL	9.75
307A	5.50
WE-309A	6.45
WE-310A	7.50
WE-313C	4.15
316A	.89
327A	4.25
WE-331A	9.75
WE-343A	185.00
WE-346A	2.75
WE-350A	6.95
350B	4.95
WE-356B	5.45
361A	4.75
368A	6.95
371A	.95
371B	.95
388A	2.95
WE-399A	4.70
417A	16.95
434A	17.50
446	1.95
446A	1.95
446B	2.25
450TH	42.50
450TL	42.50
451	1.39
471A/1B21A	2.75
SS-501	12.50
503AX	1.65
506AX	1.47
507AX	1.47
527	12.25
530	17.20
531	8.25
532A	3.95
WL-533	65.00
559	2.20
561	3.50
HY615	.49
WL670A	8.70
700A	24.50
700B	24.50
700C	24.50
700D	24.50
702A	2.95
702B	4.25
703A	6.95
704A	.95
705A	2.75
706AY	45.00
706BY	45.00
706CY	45.00
706FY	45.00
706GY	45.00
707A	9.95
707B	22.50
708A	4.85
709A	4.87
710A	1.70
713A	1.45
714AY	6.95
715A	6.75
715B	12.75
715C	26.50
717A	1.47
718AY	45.00
718BY	45.00
WE-719A	26.50
720CY	75.00
720DY	75.00
721A	4.90
723A	9.95
723A/B	18.50
724A	3.22
724B	3.22
725A	8.95
726A	8.50
726B	45.00
730A	25.00
731A	2.45
WL-787	9.80
788Y	1.40
800	1.88
801A	.48
803	4.95
804	8.95
805	4.50
806	24.50
807	1.70
808	2.65
809	2.40
810	10.95
811	3.60
813	9.50
814	3.95
815	2.75
816	1.45
826	1.45
828	13.48
829	9.95
829A	14.50
829B	14.50
830B	3.95
832	7.95
832A	9.95
836	3.50
837	1.85
838	3.25
841	.49
843	.59
845	5.75
845W	6.75
849	29.50
851	67.00
852	22.60
860	4.95
861	24.50
864	.39
865	1.28
866A	1.48
869B	45.00
872A	3.95
874	1.45
876	1.60
878	1.85
886	3.50
954	.39
955	.70
956	.49
957	.49
958A	.69
959	1.50
991	.45
1003	.90
CK-1005	.79
E-1148	.35
1201	1.20
1203	.69
1291	.69
1294	.69
1299	.69
1602	2.25
1613	1.20
1614	2.00
1616	1.07
1619	.39
1620	6.25
1622	2.30
1624	1.95
1625	.45
1626	.39
1629	.39
1630	.95
1631	1.38
1632	.75
1636	3.10
1638	.70
1641	1.95
1642	.75
1644	1.17
1655	1.90
1960	.70
5611	135.00
5651	3.05
5654	5.85
5691	7.75
5692	7.75
5693	6.40
UX-6653	.65
7193	.75
8005	5.95
8011	.87
8012	2.60
8013	2.75
8013A	4.90
8016	1.05
8020	1.39
8025	6.95
9001	1.75
9002	1.50
9003	1.75
9004	.55
9005	1.95
9006	.35
189048	3.79
189049	3.79
199698	2.69

SYNCHROS

ARMY ORDNANCE, NAVY ORDNANCE AND COMMERCIAL SIZE 1, 3, 5, 6, 7 and 8 GENERATORS, MOTORS, CONTROL TRANSFORMERS, DIFFERENTIAL GENERATORS AND DIFFERENTIAL MOTORS IN STOCK

AY-101D	1G	5F	7DG	N	C-44968-6	C-69406-1	C-78411
AY-120D	5B	5G	7G	X	C-56701	C-77610	C-78415
AY-130D	5CT	5N	A	2J1F1	C-56776-1	C-78248	C-79331
1CT	5D	6DG	B	2J1G1	C-69405-2	C-78249	C-78254
1F	5DG	6G	M	2J1H1	C-69406	C-78410	C-78670

SEND FOR COMPLETE LISTING — SYNCHRO CAPACITORS IN STOCK

Terms 20% cash with order, balance C. O. D. unless rated. All prices net F.O.B. our warehouse, Phila., Penna., subject to change without notice.

LECTRONIC RESEARCH LABORATORIES
715-19 ARCH ST. PHILA. 6, PA.
Telephones - **MARKET 7-6771-2-3**

MOTOR GENERATORS

2.5 KVA Diehl Elec. Co. 120DC to 120AC, 60 cy., 1 Ph., Complete with Magnetic Controller, 2 Field Rheos and full set spare parts including spare armatures for generator and motor. New condition $295.00
2 KVA O'Keefe and Merritt. 115DC to 120AC, 50 cy., 1 Ph. Export Crated. New....$195.00
1.25 KVA Allis-Chalmers. 115DC to 120 AC., 60 cy., 1 Ph. New with box of spares....$175.00
Same machine 230DC to 120AC....$175.00

INVERTERS

Onan M-G.-215H. Navy type PU/13. Input 115/230, 60 cy., 1 Ph. Output: 115, 480 cy., 1 Ph., 120W and 26V DC at 4 amps. New....$295.00
G.E. 5D21NJ3A. Input: 24DC. Output: 115, 400 cy., 485VA. New....$29.50
Leland Elec. Co. PE206A. Input: 28DC at 38 Amps. Output: 80V, 800 cy. 1 Ph., 485VA. New...$22.50
G.E. J8169172. Input: 28DC. Output: 115, 400 cy., 1 Ph. 1.5KVA. New....$32.50
G.E. 5AS1315511A. Model 218J. Input: 28DC. Output: 115, 400 cy., 1 Ph., 1.5KVA. Regulated. New....$59.50
Holtzer-Cabot M.G. 164. Input: 440, 3 Ph., 60 cy., Output: 70V, 146 cy. 3 Ph., 0.140KVA. New $67.50
Eicor. 32DC to 110AC, 60 cy., 1 Ph. at 2.4 Amps. New....$32.50

DYNAMOTORS

Navy type CAJO-211444. Input: 105 to 130DC. Output: either 26DC at 20 amps. or 13DC at 40 amps. Radio filtered and complete with line switch. New....$89.50
Type PE94CM. For SCR-522. Brand new in overseas cases....$19.50
Carter. 6VDC to 400VDC at 375MA. New...$39.50

AMPLIDYNES

G.E. 5AM21JJ7. Input: 27VDC. Output: 60VDC. 150 Watts, 4600 RPM. Type MG-27-B. New $34.50
Edison 5AM31NJ18A. Input: 27VDC, 44 Amps. 8300RPM. Output: 60VDC at 8.8 Amps., 530 Watts. New....$22.50
G.E. 5AM45DB20. Input: 115, 60 cy., 1 Ph., 3450 RPM. Output: 250VDC at 0.5 Amps. New..$165.00

SMALL D.C. MOTORS

G.E. 5BA50LJ2A. Armature 27VDC at 8.3 Amps. Field 60VDC at 2.3A. RPM 4000. H.P. 0.5. New....$27.50
Oster E-7-5. 27.5DC. 1/20HP, 3600RPM. Shunt Wound. New....$9.50
Dumore Co. type ELBG. 24VDC. 40-1 gear ratio. For type B-4 Intervalometer. New....$8.50

400 CYCLE BLOWER

Westinghouse. Type FL. 115V, 400 cy., 6,700 RPM. Airflow 17C.F.M. New....$9.50

SYNCHROS

Ford Inst. Co. Synchro Differential Generator. Mod. 3 Type 5SDG. 90/90V. 400 cy., Ord. Dr. 173020. New....$22.50
Armor. Synchro Differential Generator. Type 6DG. New....$60.00
Electrolux. Torque Motor. Power Drives MK10 Bu. of Ord. Dr. No. 499500. New....$6.50

PARABOLOIDS

Spun Magnesium dishes 17½" dia. 4" deep. Mounting brackets for elevation and azimuth control on rear. 1½ x 1⅝" opening in center for dipole. Brand new, per pair....$8.75

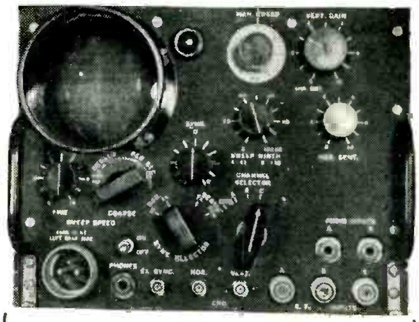
SOUND POWERED PHONES

Western Electric No. D173312, Type O. Combination headset and chest microphone. Brand new including 20 ft. of rubber covered cable....$17.50
Automatic Electric Co. No. GL-843AO. Similar to above but including Throat microphone in addition to chest microphone. Brand new with 20 ft. rubber covered cable....$10.0
U. S. Instrument Co. No. A-260. Complete with 20' cable and plug. Brand new....$17.50
W.E. Type 316B Laboratory Headsets. Price per set....$8.50

RELAYS

Struthers-Dunn 1BXX129, 110 A.C....$2.60
Advance type 455C, SPDT, 115 A.C....$1.95
Leach type 1154A, SPDT, 115 A.C....$2.35
Leach type 1054, BSN 20-28V D.C....$2.35
Clare Plug-in base No. 30FMX 115 A.C....$3.50
G.E. Plug-in base Sensitive K27J853....$4.50
Western Electric D-163781 Plug-in....$10.00
Guardian Time Delay type B-9-SPDT....$2.95
Haydon Time Delay 17717 110V/60....$4.75

MODEL AN/APA-10 PANORAMIC ADAPTER



Provides 4 Types of Presentation:
(1) Panoramic (2) Aural
(3) Oscillographic (4) Oscilloscopic

Designed for use with receiving equipment AN/ARR-7, AN/ARR-5, AN/APR-4, SCR-587 or any receiver with I.F. of 455 kc. 5.2mc. or 30mc. With 21 tubes including 3" scope tube. Converted for operation on 115 V. 60 cycle source.
Price....**$245.00**
Gov't Cost $1800.00.
AN/APA-10 80 Page Tech Manual....$2.75

TEST EQUIPMENT

TS-127/U Lavoie Freq. Meter—375 to 725 MC.
TS-47APR Test Osc. 40-500MC.
TS-487/U Peak to Peak VTVM.
AN/APR-1 Receiving sets.
R111A/APR-5A Receiver—1000 to 6000 MC.
AN/APR-4 Tuning Units TN-17 (75-300 MC).
AN/APR-4 Tuning Units TN-18 (300-1000 MC).
AN/APR-4 Tuning Units TN-19 (950-2200 MC).
TU-58 Range "A" Tuning Units (110-370 MC).
AN/APA-10 Panoramic Adapters 115V/60 cycles.

Repair Parts for BC-348 (H, K, L, R only)
Also BC 224 Models F. K. Coils for ant., r.f., det., osc., I.F., c.w. osc., xtal filters, 4 gang cond., front panels, dial assemblies, vol. conts., etc. Write for complete list and free diagram.

HIGH QUALITY CRYSTAL UNITS
Western Electric—type CR-1A/AR in holders. ½" pin spacing. Ideal for net frequency operation. Available in quantities. 5910-6350-6370-6470-6510-6610-6670-6690-6940-7270-7350-7380-7390-7480-7580-9720. All fundamentals in KC. Good multipliers to higher frequencies....$1.25 each

RADAR

Antenna-Trans-Rec Unit ASG-1.
Radar Set SQ complete with spares.
Modulator type SO-11.
Pulse Timers CUZ-50AGD (SD-5 Radar).
Radar Crystal Units 98.35kc, Raytheon.
1N21B Sylvania Diodes.
Repeater Adapters CRM-50 AFO.
SO Series Accessory Control Panels.
SO Series Transmitter-Receiver unit.
CARD 23AEK Bearing Control Units for SO Series.
Auxiliary Rectifier.

RADAR ANTENNAS

Type SO-1 (10CM) Complete assembly with reflector, waveguide nozzle, drive motor and synchros, etc. New in original cases....$279.50
Type SO-3 (3 CM.) Surface Search type complete with reflector, drive motor, synchro, etc., but less plumbing. New in original cases....$189.50
Type SO-13 (10CM.) Complete assembly with 24" dish with feedback dipole. Complete with synchros, drive motor, gearing, etc. New in original cases....$149.50
Also in stock — spare reflectors, nozzles, probes, right angle bends for SO-1 antennas.

RECTIFIERS

G.E. No. 6 RC89F16 for 54 cells 10 amps.
Mallory APS-20—In: 115/230/60/3. Out: 12/24V-65-130A.
Turret Trainer Supply. In: 220/60/3. Out: 28V-130A.
Complete specs on request.

TERMS: Rated Concerns Net 30, FOB Bronxville, New York. All Merchandise Guaranteed. Prices Subject to Change

400 CYCLE TRANSFORMERS

AUTO. 400 cy. G.E. Cat. No. 80G184. KVA .945S-.520P Volts 460/345/200/115. New....$6.95
FILAMENT. 400/2600 cy. Input: 0/75/80/85/105/115/125V. Output: 5V3A/5V3A/5V3A/5V3A/5V6A/5V6A/6.3V6A/6.35A. New....$3.95
PLATE WECO KS9560, 400/800 cy. Pri: 115V. Sec: 1350-0-1350 at .057A (2700 V. Total). Elecstat shlded. Wt. 2.3 lbs. New....$2.95
Plate. Thordarson #T46889. 1650 VA. Pri: 105-120V. 500 cy. 1 PH. Sec: 5600V. Center tapped. 1.5KV. insulation. Brand new....$49.50
PLATE & FIL. WECO KS9555, 400 cy. Pri: 115V. Sec #1: 930-0-930. Sec. #2: Three 6.3V windings....$4.95
FILAMENT. 400/2400 cps. WECO KS9553. Pri: 115V. Sec: 8.2V1.25A/6.35V1.5A Elecstat shlded. Wt. 0.5 lbs. New....$2.95
PLATE & FIL. 400/2600 cy. Pri: 0/80/115V. Sec: #1=1200VDC at 1.5MA. Sec. #2=400 VDC at 130MA. Fil. Secs: 6.4V4.3A/6.35VO.8A (ins. 1500V)/5V2A/5V2A....$4.95
RETARD. 400 cy. WECO KS9598. 4 Henry 100MA....$2.75

HIGH POT TRANSFORMERS

High Voltage Trans. Westinghouse Pri: 115, 60 cy. Sec: 15,000 C.T., 60 MA. Good for 1 Hi Pot test set up. C. T. ungrounded....$39.50

PULSE TRANSFORMERS

PULSE WECO KS-9563 Supplies voltage peaks of 3500 from 807 tube. Tested at 2000 Pulses/sec and 5000V peak. Wdg. 1-2=18 ohms. Wdg. 1-3=72 ohms. L of Wdg. 1-3=08211 at 100 cps....$7.50
PULSE. WECO KS-161310. 50 KC to 4MC, 1¾" Dia. x 1⅞" high. 120 to 2350 ohms. New....$6.75
High Reactance Trans. G.E. type Y-3502A.—60 cy.. Voltage 11200-135. Inductance H.V. Winding 135 Henries. Output: Peak Voltage 22.8KV. Cat. 8318065G1. New....$89.50

RAYTHEON VOLTAGE REGULATORS

Adj. input taps 95-130V., 60 cy. 1 Ph. Output: 115V. 60 Watts, ½ of 1% Reg. Wt. 20 lbs. 6½" H x 8¾" L x 4⅝" W. Overload protected. Sturdily constructed. Tropicalized. Special....$16.75

AMPLIFIERS

GE Servo type 2CV1C1 400 cycle
Constant Output Line RC-730C
Synchro Amplifiers for Radar
Intercommunication type BC-605

ANTENNAS

Coast Guard MR-162 Whips 23½ ft.
Microwave types, AT-38, AS-125
APT-2 Dipole Antennas
TDY Radar Jammer Horns
Paraboloids, Magnesium Dishes 17½" dia.
SCR-634-A (Part of RC-153-B Antenna).

POTENTIOMETERS

W.E. KS-15138 Linear Sawtooth
W.E. KS-8732 for SCR547 Radar
W.E. KS-8801 Motor Driven

LINEAR SAWTOOTH POTENTIOMETER W.E KS-15138

Has continuous resistance winding to which 24 volts D.C. is fed to two fixed taps 180° apart. Two rotating brushes 180° apart take off linear sawtooth wave voltage at output. Brand New...$5.50

MISCELLANEOUS

Cathode Ray Shields for 3" tube....$3.75
Variac type Motor Controls 600 watt....$13.50
10 CM Waveguide 90° elbow....$20.00
Adel Clamps assorted types—write for samples
Shock Mounts Lord #20....$.40
Shock Mounts U. S. Rubber #5150C....$.30
Commando Pole Jacks (Cook Elec. Co.)....$1.00
Switchboard Lamp Receptacles & Jewels....$.40
SCR522 Transmitter Receivers Brand New
TCR Transmitters 125 watt Ship to Shore
BC966A Transponders
RT7-AN/APN-1 Receivers
BC-423B Modulators
PC-1366M Jack Boxes—Large quantity
Sweep Generator Capacitors 5/10 mfd.

SWEEP GENERATOR CAPACITORS

High speed ball bearings. Split stator silver plated coaxial type 5/10 mmfd.
Brand new.... **$2.50**

HI-VOLT CAPACITORS

.25 Mfd., 20KV....$26.50
.25 Mfd., 15KV....$22.50
1 Mfd., 15KV....$44.50
1 Mfd., 7.5KV....$12.50
2 Mfd., 6.0KVA....$14.50

ELECTRONICRAFT
INC.
27 MILBURN ST. BRONXVILLE 8, N. Y.
PHONE: BRONXVILLE 2-0044

INDICATORS

ID-24/ARN-9....$12.50
ID-14/APN-1....$7.95
ID-60/APA-10 Panoramic Adapter converted for 60 cycle operation—complete with tubes and 80 page Tech. Manual....$245.00

Reliance Specials

TIMING MOTOR

8 RPM 115V 60 cyc
E. Ingraham Co.
$1.79

GEAR ASSORTMENT

100 small assorted gears. Most are stainless steel or brass. Experimenter's dream! ....Only $6.50

VERNIER DIAL or DRUM (From BC-221)

Dial—2⅝" dia. 0-100 in 360°. Black with silver marks. Has thumblock. DRUM—0-50 in 180°. Black with silver marks ....either 85c

SOUND POWER HANDSET

BRAND NEW
ncludes 6 ft. cord.—No batteries or external power source—used. $18.50 pr

AC LINE CORDS 6 ft. long with molded rubber plug 18c

Sound Powered Chest Set RCA— With 24 Ft. Cord

Per Pair
USED $17.60
NEW $26.40

400 CYCLE INVERTERS

Leeland Electric Co.

#10890 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

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
MRC7021-200	4 1/8	5 9/32	23/64	2.95
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	S/16	55/64	13/32	.45
FAFNIR 33Kdd	1/8	5/8	3/16	.35

NEEDLE BEARINGS

TORRINGTON B108 ½" wide ⅝" 13'16" 30¢

Brand New Meters—Guaranteed

0-10 ma. D.C. 3½"...3.95 0-80 Amp. D.C. 2½"...$2.25
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

SPAGHETTI SLEEVING—assortment—90 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 **$1.50 EACH**

TYPE "JJ" POTENTIOMETERS

Ohms	Shaft	Ohms	Shaft	Ohms	Shaft
1000	SD	30K-10K	3/8"†	1 Meg.	1/2"
10K	5/16"	3K-90K	1/4"	1 Meg.	SD
15K	SD			1 Meg.	SD*

SD—Screw Driver
*—Split Locking Bushing—
†—With Switch

PRICE—$2.00 EACH

JONES BARRIER STRIPS

2—140Y	$.17	3—141W	.27	9—141Y	.71
3—140¾W	.21	4—141W	.33	12—141	.64
6—140	28	5—141	.29	3—142	.24
10—140W	.59	5—141¾W	.41	2—150	.43
10—140¾W	.59	7—141¾W	.56	3—150	.60
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 • Micro-switch contact, 10A • Holds ON as long as power is applied • Fully Cased •
ONLY $6.50

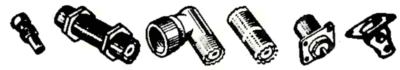
AN CONNECTORS
IMMEDIATE SERVICE
PHONE! WIRE! WRITE! YOUR NEEDS

NEW COAXIAL CABLES

	Price per 1000 Ft.		Price per 1,000 Ft
RG 5/U*	$140.00	RG 22A/U	$285.00
RG 6	180.00	RG 24	675.00
RG 7*	85.00	RG 26	475.00
RG 8*	120.00	RG 29*	50.00
RG 9*	250.00	RG 34	300.09
RG 9A/U	275.00	RG 35	900.00
RG 10	240.00	RG 41*	295.00
RG 11*	120.00	RG 54A/U	97.00
RG 12	240.00	RG 55*	110.00
RG 13*	216.00	RG 57*	325.00
RG 17	650.00	RG 58*	60.00
RG 18	900.00	RG 58A/U*	65.00
RG 19	1250.00	RG 59*	55.00
RG 20	1450.00	RG 62*	75.00
RG 21	220.00	RG 77*	100.00
RG 22/U*	150.00		

Add 25% for orders less than 500 feet.
* No minimum order—others 250' minimum.

COAXIAL CABLE CONNECTORS



15¢ UG 175/U	$1.30 83-1F	30¢ 83-1AP	80¢ 83-1J	40¢ SO-239	12¢ HOOD

83-1AC	$0.42	UG 13/U	$1.75	UG 87/U	$1.60
83-1AP	.30	21/U	1.20	88/U	1.35
83-1F	1.30	21B/U	1.35	89/U	1.60
83-1H	.12	22/U	1.30	102/U	.90
83-1HP	.25	22A/U	1.65	103/U	.68
83-1J	.80	23B/U	1.70	104/U	1.10
83-1R	.40	24/U	1.30	167/U	4.85
83-1SP	.60	25/U	1.30	175/U	.15
83-1SPN	.60	27/U	1.30	176/U	.15
83-1T	1.30	30/U	2.50	224/U	1.40
83-2AP	1.95	57/U	2.30	225/U	2.45
83-2J	2.10	58/U	.80	260/U	1.35
83-22AP	1.40	59A/U	2.25	290/U	1.35
83-22SP	1.15	60/U	2.40	306/U	2.95
83-22R	.68	85/U	1.75	499/U	1.25

DIFFERENTIAL

115 V., 60 Cyc., #C78249 **$3.95 ea.**

3⅜" dia. x 5⅜" long
Used between two C7824's as a dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted)..........$4.50
Mounting Brackets — Bakelite for selsyns, and differentials shown above ....35¢ pair

2J1G1 SELSYNS

400 CYCLE BRAND NEW

POSTAGE STAMP MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd
7	25	56	110	250	500	800	.001625	.0044
7.5	26	60	120	270	510	820	.002	.006
8.2	33	62	125	300	560	.001	.0027	.0062
10	39	68	150	330	580	.0011	.0033	.0065
15	40	70	160	370	600	.0012	.0035	.0068
18	43	75	175	390	620	.0013	.0036	.0082
20	47	80	180	400	650	.00136	.004	.01
22	50	82	200	470	680	.0015		
23	51	90	220		750			
24		100	240					

Price Schedule

7 mmf to 820 mmf.. 5c
.001 mmf to .001625 .... 8c
.002 mfd to .0082 mfd....................................15c
.01 mfd 28c

SILVER MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
8	40	82	155	270	470	800	.0024	.0039
10	50	100	170	325	500	.0011	.0025	.004
18	51	110	180	350	510	.0013	.0027	.005
22	56	115	208	360	525	.0015	.00282	.0051
23	60	120	225	370	560	.0016	.002826	.0056
24	62	125	240	390	570	.001625	.003	.006
27	66	130	250	400	680	.0018	.0033	.0068
30	68	135	255	410	700	.0022		.0082
39	75	150	260	430		.0023		.01

Price Schedule

8 mmf to 800 mfd...10c
.0011 mfd to .002 mfd....................................20c
.002 mfd to .0082 mfd....................................50c
.01 mfd $1.00

PULSE TRANSFORMERS

UTAH—9262 9278 9280 9340
WESTERN ELECTRIC—D166173 D161310
KS8696, KS9365, KS9565, KS9800, KS9862, KS13161
GENERAL ELECTRIC—K2731 K2729A 80-G-5
JEFFERSON ELECTRIC—C-12A-1318
DINION COIL—TR 1048 TR1049
also 352-7250-2A; 352-7251-2A; T-1229621-60

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	11.71	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	97.8	855	7,300	17,000	45,000
.502	15	125	970	7,500	19,860	47,000
.557	25	178	1,500	8,000	20,150	50,000
.627	44.73	179.5	2,500	8,500	21,300	56,000
.76	45	180	2,850	8,800	25,000	59,000
1.00	46	200	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	60	240	4,451	15,000	32,888	100,000
3.25	61	260	5,714	15,750	33,000	180,000
5.26	65	270	5,900	15,755	33,300	
5.89	66.6	290		15,810	35,888	
	69	298.3				

PRECISION RESISTORS—1 WATT—45¢

.1	2.58	15	60	425	7,000	55,000
.11	2.6	18	80	1,530	8,250	56,000
.2	2.66	28	125	2,215	9,000	65,000
.861	3.1	30	250	2,250	10,000	68,000
1.01	3.39	38	270	3,300	12,000	70,000
1,166	4.29	45.5	312	5,221	12,420	84,000
2.55	5.21	54.25	420		50,000	95,000

PRECISION RESISTORS—1 WATT—60¢

100,000	166,100	320,000	399,000	590,000
105,000	240,000		413,000	600,000
120,000	260,000	348,000	520,000	645,000
128,000	270,000		522,000	650,000
130,000	296,000			700,000
132,000	310,000			800,000
149,500				
150,000				

MEGOHM 1 WATT—1%—$1.50—5%—60¢

PRECISION RESISTORS—2 WATT—75¢

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¼" hole x ½" O.D. 1⅛" long **85¢**

OIL FILLED CONDENSERS

MFD	V.D.C.	Price	MFD	V.D.C.	Price
.25	20,000	$19.95	8	1,000	$2.95
.075-.075	8,000	1.95	4	1,000	2.25
.15-.15	8,000	2.95	3	1,000	1.75
2 x .02	7,000	1.60	2	1,000	.95
.03-.03	6,000	1.45	1	1,000	.75
.1	7,500	2.25	1	800	.60
.03	7,500	1.95	10	600	2.95
.1-.1	7,000	2.25	8-8	600	1.79
.1	7,000	1.95	8	600	2.05
.02-.03	7,000	1.65	4	600	1.63
.1	6,000	1.75	2 x 2	600	1.35
2	4,000	5.95	2	600	.79
3 x .2	4,000	2.50	4 x 3	600	1.95
.06	4,000	1.40	8	500	1.50
.25	3,000	2.25	4	500	.98
8	2,000	7.95			
3	2,000	3.75			
.5-.1	2,000	1.95			
.5	2,000	1.95			
.3	2,000	1.75			
.1-.1	2,000	1.65			
.02	2,000	.89			
4	1,500	2.50			
1	1,500	1.50			

8 MFD
2000
V.D.C.
$7.95

OIL FILLED A.C. CONDENSERS

MFD	V.A.C.	Price	MFD	V.A.C.	Price
2	750	$0.69	4.4	375	$2.15
8	660	7.50	30	330	8.50
6	660	5.95	25	330	7.50
5	660	5.45	20	330	6.75
4	660	4.95	10	330	4.95
3	660	4.45	6	330	3.25
2.9	660	4.35	4	330	2.25
2	660	3.95	3	330	1.45
1	660	2.95	1.75	330	.85
15	440	6.25	20	220	4.95
6	440	3.95	10	220	2.95
5-3	440	3.95	7.5	220	2.00

1N34 Crystal Diode 79c

300 Twin Lead...............02½ per ft. $18.95 per M.

Dynamotor DM 33A...............................$3.75 ea.

Chokes: 30 Hy. 80MA @...$1.29: 6HY, 80MA @...79c

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 $6.50

BC 221 FREQUENCY METER...........$95. to $125.00

Mike Connector Amphenol 80-81 Interchangeable with Amphenol 80-M cad plated..............................25c

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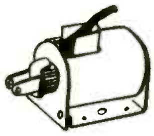
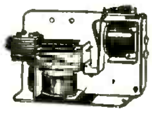


A.C. SOLENOIDS

GUARDIAN No. 1: 24 VAC, 6 ohms ⅛ to ½" stroke, 6 oz.-in. #R 804 .... $1.95

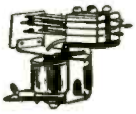
GUARDIAN No. 4: 115 VAC, 133 ohms ⅛ to 1⅛" stroke, 14 oz.-in. #R 805 ...... $3.95

GUARDIAN No. 4: 115 VAC, Intermittent Duty, 49 ohms ⅛" to 1⅛" Stroke, 2 lb.-in. #R904 .... $3.95



A.C. RELAYS

GUARDIAN: 24 VAC, 25 ohms, Interlocking Relay Breaks 3 Makes 2—Electrical reset #R 806 .... $2.49



GUARDIAN: 24 VAC, 48 ohm relay, Makes 4 Breaks 1 #R 807 .... $1.49

GUARDIAN: 24 VAC, 48 ohm relay, Makes 2 Breaks 2 #R 808 .... $1.49

Guardian	6VAC	2C, 1A	R910	$1.95
Sigma 41FZS7	110VAC	1C	R909	2.95
Ward Leonard 105	220VAC	1C‡	R911	3.25
G. E. HGA	110VAC	2C‡	R912	5.95
Guardian 200	24VAC	1A‡	R274A	.98
Guardian 200	24VAC	1A, 1C‡	R273A	1.10
Clare B19553†	24VAC	2C, 1A	R582	3.49
Leach 1154	50VAC	2A‡	R431	2.49
	12VAC	2A	R275	.98
Clare Type C†	110VAC	2A, 1B	R161	3.25
Amperite 26NO2	24VAC	1A	R316	1.50

Time Delay 2 sec., can be used on 110V with 1250 ohms.

Potter Brumfield KR11A	12–24VAC‡ or 6VDC	DPDT	R812	1.75

* A=Normally Open; B=Normally Closed; C=Double Throw.
† Octal Type Plug Base.
‡ Heavy Duty 10 Amp Contacts.

A.C. ACTUATORS

GUARDIAN 24 VAC 10 ohms #R 809 .... .69
GUARDIAN 24 VAC 15 ohms #R 810 .... .69
GUARDIAN 24 VAC 25 ohms #R 811 .... .69

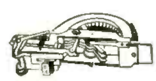
A.C. RELAY BANK FOR CIGARETTE MACHINES

Guardian No. 53317—Consists of 9 Guardian 24 VAC, 10 ohm relay actuators on metal strip. When each relay is energized the actuator pulls down and is held in place by a mechanical latching arm. It also operates 2 make 1 break contacts. Unit is prewired. #R 803 .... $7.95

HERMETICALLY SEALED RELAYS

Clare 5001; 24vdc; DPDT; 300 ohm; Octal Plug Base; #R678 .... $5.95
Struthers-Dunn 181CXC100; 12vdc; 3As, 3Bs; #R679 .... 5.95
Sigma 73351; 16vdc; SPDT; 2000 ohm; 8 ma; #R682 .... 6.95
Allied SKHX; 24VDC; 3A, 3B; 425 ohm; #R913 .... 5.95

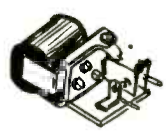
STEPPING SWITCHES



AUTOMATIC ELECTRIC TYPE 13 25 Position; Non-Bridging Wipers; Self Interrupter Springs; Norm. Oper Volts: 24VDC; Max 30VDC; 0.6 Amps; 30 Ohm.

Two Levels; #R905 .... 15.95
Three Levels with two wipers; #R906 .. 16.50
Four Levels with two wipers; #R907 ... 16.95
Six Levels with two wipers; #R908 .... 17.75

D.C. SENSITIVE RELAYS



Sigma 4F; 1 ma.; SPDT; 10,000 ohms; #R801 .... 3.95
Sigma 41FS7; 2 ma; SPDT; 10,000 ohm; @ #R914 .... 2.95
RBM 23024; 7 ma; 2A, 2B; 6500 ohm; #R915 .... 2.50
Allied FID; 8 ma; 24VDC; 1A; 3000 ohm; #R916 .... 1.95
RBM 23024; 6 ma.; 4PST n.o., (4As); 6500 ohm; #R802 .... 2.95
RBM 23025 6 ma., SPDT, 8000 ohm, #R428 .... 1.50
W.E (Whelock) KS9665 9 ma., 1A, 1B, 1C, 2000 ohm, #R426 .... 4.95
Kurman Midget 12 ma., SPDT, 1500 ohm, #R427 .... .98
Clare Type J (K102) 6 ma., SPDT, 3500 ohm, #R30 .... 3.50
Dumont 5 ma., 1A, 5000 ohm #R230 .... .98
Automatic 5035A7 8 ma., 1A, 1300 ohm, #103 .... 1.25
Cooke Type C 4 ma., 1A, 6500 ohm, #R596 .... 3.50
Claire B11613 (K101) 2 ma., SPDT, 6500 ohm, #R588 .... 4.95
Clare A8053 8 ma., 3A, 6500 ohm, #R408 .... 3.95
RBM 452-1041; 4 ma., 12,000 ohm; DPDT; Telephone Type; #R685 ..... 4.95

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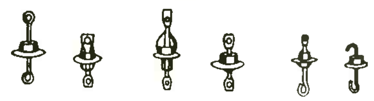

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ALLIED C5A 24VDC, SPDT, 300 ohm, #R432 .... 1.25
55251 **TELECHRON**, 24VDC, SPST n.o. (1A) 300 ohm, #R174 .... .90
55340 **PRICE**, 24VDC SPST n.o. (1A) 300 ohm #R170 .... .90
55342 **TELECHRON**, 24VDC. Makes 3 Breaks One, (2As, 1C) 300 ohm. Anti-Capacity Arms, Low Loss Bakelite Insulation #R171 .... 1.25
55526 **COOK**, 24VDC, Makes 2, Breaks One, (1A, 1C) 300 ohm Ceramic Insulation, #R107 .... .95
55528 **G.E.** 12VDC, 6PST n.o. (6As), 150 ohm, #R426 .... 1.50
55531 **COOK**, 12-24VDC. Makes 4, Breaks 2 (2As, 2Cs), 150 ohm #R405 .... 1.25
55589 **RBM**, 24VDC, DPST n.o. (2As), 300 ohm, #R245 .... 1.25
55836 **G.E.** 24VDC, SPDT, (2As), 250 ohm, #R402 .... ea. 1.25
55837 **G.E.** 24VDC, Double Make, 300 ohm, #R108G 1.00
55837 **RBM**, Same as #R108G, #R108R. 1.25
55837 ALLIED. Same as #R108G, #R108 1.50
D163221 AMER. TOTALIZATOR, 24 VDC, DPDT 300 ohms, Anti-Capacity Arms, #R134 .... 1.25
GUARDIAN, 24VDC, SPST, n.o. 300 ohms, Anti-Capacity Arm, Ceramic Insulation, #R106 .... .75
23012-0 **RBM**, 24VDC, SPDT, 250 ohms, #R172 .... 1.25
7251 **ARC**, 24VDC, SPDT, 300 ohm #R406 .... 1.25
7252 **ARC**, 24VDC, DPST, n.o. (2As) 300 ohm, Anti-Capacity Arms, Ceramic Insulation, #R354 .... 1.25
A21577 **CLARE**, 24VDC, DPST n.o. (2As) 250 ohms, #R352 .... 1.25
P3 **LEACH** (Pair on Bakelite Strip) Each relay; 6VDC, SPDT, 125 ohms, #R353 .... pr. 2.25
ZH77628-1 AUTOMATIC, 12VDC, Make One, Break Two (1B, 1C) 640 ohms Dual Telephone Type Contacts #R244 .85
73A23 ALLIED, 24VDC, Make 3 Break 1, (2As, 1C) 300 ohms, #R403 .... ea. 1.25
TB 302 PRICE, 24VDC, Make 3, Break 1, (2As, 1C) 300 ohms, #R404 .... ea. 1.25
RIO COOK, 12-24VDC, 3PST n.o. (3As), One contact 10A, 250 ohm, #R427 .... 1.50
RBM 23024; 7 ma; 24 VDC; 2A, 2B; 6500 ohm; #R915 .... 2.50
COOK; 24VDC; 4PDT; 220 ohm; #R917 2.50
COOK 482; 24VDC; DPDT; 500 ohm; #R918 .... 1.75
G.E. CR2791G110F2 24VDC; DPDT; 300 ohm; #R919 .... 1.50
CLARE A20545; 8VDC; 1B; 45 ohm; #R920 .... 1.25
AUTOMATIC 754A; 12VDC; DPDT 6 Amp; 200 ohm; #R921 .... 1.75
AUTOMATIC 754; 6VDC; DPDT 6 Amp; 50 ohm; #R922 .... 1.75
POTTER BRUMFIELD KR11D; 6VDC; DPDT; 75 ohm; #R923 .... 1.95
SIGMA 41F; 6VDC; SPDT; 62 ohm; #R924 .... 1.75
SIGMA 41F; 12VDC; SPDT; 340 ohm; #R925 .... 1.95

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Dumore DC Motor

Type E1Y2PB, 24 v. DC @ 5.0 Amps. Model 1028-263. Gear Head. 200 rpm. 10 min. 0.05 hp. Stock #SA-316.
Price $12.75 each.

SERVO MOTOR (DC)

Sperry 8001058 dual field control motor. 6 terminal-armature and 2" diam.-3¼" lg. Front flange mounting. Shaft ext. ¼", 5/32" diam. **Stock #SA-289 Price $9.75 each.**

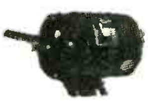
AIRCRAFT MOTOR

G. E. Type 5BA25AJ32A

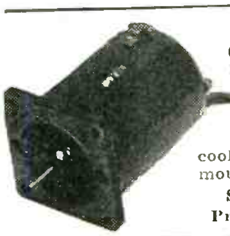
24 volts at 2.9 amps. 75 in/lb. torque. 3 lead shunt with brake. 1 minute rating. Double worm gear reduction. 4 rpm reversible.

Stock #SA-298 Price $39.50 each.

27.5 VOLT DC MOTOR



John Oster Type E-7-5 4 lead shunt. 1/20th hp. Internal fan cooled 4¾" lg. 3¼" diam. ⅞" shaft extension. 5/16" diam. 3650 rpm. **Stock #SA-310 Price $9.50 each.**



G. E. 1/10 HP DC Motor

G.E. Type 5BN58LA5

125 volts DC at 1.2 amps. 4000 rpm. Int. duty. Internal fan cooled. 3½" sq. front mounting flange.

Stock #SA-312
Price $19.50 each.

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G.E. Types 5AM45DB15 and 5AM73AB95. Type 45DB15 input 115 v. 60 cy. at 5 amps. Output 250 volts DC at 0.6 amps. Stock #SA-147.
Type 73AE95 input 115 volts 60 cy. at 9 amps. Output 250 volts DC at 1.5 amps. Stock #SA-257.

PRICES ON REQUEST

DELCO CONSTANT SPEED MOTOR A-7155

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DC step motor.
Stock #SA-272
Special at $3.75 each.

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Pioneer Type 12128-1B
Post War Model. Input 27.5 volts DC at 1 amp. Output 26 volts 400 cy. Single phase. P.F. 0.4. 6.0 VA. Stock #SA-295
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Production quantity requirements of the following Synchro "Exciter" Capacitors are available for immediate delivery.

Type 6C—connected 20-20-20 mfd.
Type 1C—Mk. 12—connected .6x.6x.6 mfd.
Type 3C—Mk. 1—connected 10x10x10 mfd.
Type 4C—Mk. 14—connected 3x3x3 mfd.

Quantity Quotations on Request

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Bodine Type NSH-11R Speed reducer motor. 200:1 gear ratio. Motor speed 2000 rpm. 75 v. DC at 0.28 Amps. Int. duty. 1/150 hp. Stock #SA-1001. Large Quantity. **Prices on request.**

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Holtzer Cabot—MG-149; MG-149F; MG-149H; MG-153; MG-153F.
Leland—10339; 10285; PE-218; 10486-846.
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Wincharger—PU-7/AP; PU-16.
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Kollsman Type 977-01600 115 volt 60 cycle input. 60 cycle output voltage proportional to shaft speed rotation. **Stock #SA-307. Price $29.50 each.**

AUTOSYN MOTOR

Bendix-Marine 851

32 v. 60 cycle excitation. Use as either generator or repeater. Stock #SA-158.
Price $24.50 each.

PIONEER AUTOSYNS

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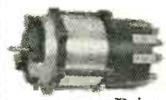
KOLLSMAN TELETORQUE



Kollsman Type 403 self synchronous units. (Synchro) 115 volt 60 cycle excitation. Use as either generator or repeater. Stock #SA-79.
Prices on request.

115 Volt D-C Motor

G.E. Type SD. 1/20 hp. 4 lead shunt. Reversible. Double shaft extension. Speed 1725 rpm. **Large Quantity.**

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12.5 HP D-C Motor

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G.E. Types
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General Electric 2J1F3
115 v. 400 cycle Selsyn Generator. Large quantity.
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OA3	1.50	2J26	27.75	5BP1	6.95	304TL	14.50	723A/B	17.95	866A	1.79
OB2	2.00	2J27	29.95	5BP4	6.95	307A	4.95	724A	4.95	869B	57.50
OC3	1.75	2J31	29.95	5CP1	6.95	310A	7.95	724B	6.95	869BX	35.00
OD3	1.50	2J32	69.95	5D21	22.50	311A	7.95	725A	9.95	872A	3.95
C1A	4.95	2J36	105.00	5FD7	2.75	323A	25.00	726A	6.95	878	1.95
C1B	6.95	2J38	17.95	5JP1	27.50	327A	3.95	726B	56.00	884	1.95
1B21A	2.75	2J39	17.95	5JP2	19.50	328A	9.95	726C	69.00	885	1.75
1B22	3.95	2J42	150.00	5JP4	27.50	350A	7.95	727A	3.95	914	75.00
1B23	7.95	2J49	109.00	WE6AK5	2.50	350B	5.95	728AY	27.00	931A	6.95
1B24	17.95	2J50	69.50	6C21	29.50	357A	22.50	801A	1.00	954	.35
1B26	4.95	2J61	75.00	C6A	8.95	368AS	6.95	802	4.25	955	.55
1B27	15.00	2J62	75.00	C6J	10.95	371B	2.95	803	7.95	956	.69
1B32	4.10	2K25	29.50	7BP7	7.95	385A	4.95	804	13.50	957	.29
1B38	33.00	2K28	35.00	7DP4	10.00	388A	2.95	805	5.95	958A	.69
1B42	19.95	2K29	37.50	12AP4	55.00	393A	8.95	806	25.00	959	1.69
1B51	19.95	2K45	109.50	15E	2.95	394A	7.95	807	1.69	991	.65
1B56	49.95	2V3G	2.10	15R	.95	MX408U	.75	808	3.50	E1148	.35
1B60	69.95	3B24	5.50	NE16	.68	417A	17.95	810	11.00	1280	1.95
1N21	1.35	3B24W	7.50	FG17	6.95	434A	19.95	811A	3.15	1611	1.95
1N21A	1.75	EL3C	5.95	RX21	3.95	446A	3.95	813	8.95	1613	1.38
1N21B	4.25	3C24	1.95	FG33	12.95	450TH	45.00	814	3.95	1616	2.95
1N22	1.75	3C31	5.95	35T	4.95	450TL	45.00	815	3.50	1619	.89
1N23	2.00	3DP1A	10.95	45 Special	.35	464A	9.95	816	1.45	1622	2.75
1N23A	3.75	3E29	15.50	RK39	2.95	471A	2.75	829	12.95	1624	2.00
1N23B	6.00	SN4	5.50	VT52	.25	527	15.00	829A	13.95	1625	.45
1N26	8.00	4A1	1.75	RK72	1.95	WL531	22.50	829B	15.95	1851	1.85
1N27	5.00	4B26	10.95	RK73	1.95	700A/D	25.00	830B	11.50	2050	1.85
1N43	2.50	4C27	25.00	100TH	10.00	701A	7.50	832	7.95	2051	1.80
1S21	6.95	4C28	35.00	FG105	19.00	703A	6.95	832A	9.95	8012	4.25
2B22	4.95	4E27	17.50	F123A	8.95	705A	2.95	833A	49.95	8013	2.95
2B26	3.75	4J25	199.00	203A	8.95	707A	17.95	834	10.95	8013A	5.95
2C34	.35	4J26	199.00	211	.95	707B	27.00	836	4.95	8020	3.50
2C40	20.00	4J27	199.00	217C	18.00	714AY	17.95	837	2.95	8025	6.95
2C43	27.50	4J31	199.00	242C	10.00	715A	7.95	838	6.95	9001	1.75
2C44	.90	4J32	199.00	244A	12.95	715B	18.00	845	8.75	9002	1.50
2D21	1.75	4J33	199.00	249C	4.95	715C	25.00	849	52.50	9003	1.75
2E22	3.75	4J37	199.00	250TL	19.95	717A	1.95	851	80.50	900[illegible]	1.75
2E30	2.75	4J38	89.00	274B	3.00	718AY/EY	48.50	857B	99.00	9005	1.90
2J21A	17.95	4J39	199.00	AR300	27.50	719A	29.50	860	4.95	9006	.35
		4J41	199.00	HF300	27.50	721A	3.95				

Minimum Order $25.00

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Quartz Crystal Blanks
Holders FT241, FT243
Step-down Transformers 110V/220V

TSK1-SE
TVN3EV Bridge
RF4
APA10
TS10
TS12
TS15
TS16
APA38
TS33
TS34
TS34A
TS35
TS36
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CY94
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352-7039	640VCT @ 250MA, 6.3V/.9A, 6.3V/6A, 5V/6A	$5.49
702724	9800/8600V @ 32MA	8.95
12033	4540V/250MA	17.50
KS9584	5000V/290MA, 5V/10A	22.50
52J652	13,500V/3.5MA	14.65
KS9607	734V CT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3V/0.9A, 6.3V/2.5A, 6.3V/.06A, 5V/6A	6.95
352-7070	2X2.5V/2.5A (2KV TEST) 6.3V/2.25A, 1200/1000/750V @ .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, 6.3V/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
KS 9445	592VCT/118MA, 6.3V/8.1A, 5V/2A	5.39
KS 9685	6.4V/7.5A, 6.4V/3.8A, 6.4V/2.5A ALL CT	4.79
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/.027A	4.95
95-G-45	2000V/.002A, 465V/.6A, 44V/10A, 6.3V/23.5A, 6.3V/1.8A, 5V/9A, 2X2.5V/1.75A	17.95
TRANSTAT	IN; 115V, 400 CY. OUT; 75-120V, 6.0 Amps	12.95

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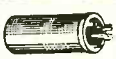
LELAND ELECTRIC TYPE B. Carbon Pile 21-30VDC reg. output 18V at 5 Amps.

WEBSTER ELECTRIC—35x025.

LELAND ELECTRIC TYPE C Spec VR9000-2C. Input volts 22-30. Output volts 19V at 5 Amps.

ELECTROLYTIC CAPACITORS



TWIST PRONG

Cap. Mfd	WVDC	Price
8	450	.16
30	300	.18
40	450	.38
50	400	.36
60	300	.21
80	150	.29
80	500	.43
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
40-40-20-2	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
16-16/25	450/50	.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	28.95
15K VDC	
.0016	7.95
16K VDC	
.015	9.50
20K VDC	
.25	17.50
25K VDC	
1	85.00
.5	65.00

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Gas Phototube having SI Response, particularly sensitive to Red and Near infrared Radiation. Can be used with incandescent light source. Send for data.

Price .... 75¢

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps input

CTJ5-2-600VCT/.2A, 5V/6A				$5.95
CT-15A	550VCT	.085A	6.3V/.6A, 6.3V/1.8A	2.35
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			22.50
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-721	550VCT	.100 A	6.3/1, 2.5VCT/2	2.95
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	.085 A	5V/3A, 6.3V/6A	4.25
CT-610	1250	.002 A	2.5V/2.1A, 2.5V/1.75A	4.95
CT-137	350VCT	.026 A	5V/3A	2.75
CT-866	330V	.065 A	6.3V/1.2, 6.3V/600 MA	1.75
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

Filament Transformers—115V/50-60 cps input

Item	Rating	Each
FT-674	8.1V/1.5A	$1.10
FT-157	4V/16A, 2.5V/1.75A	2.95
FT-101	6V/.25A	.79
FT-924	5.25V/21A, 2x7.75V/6.5A	14.95
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	8.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT-55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V/3A	8.95
FT-986	16V @ 4.5A or 12V @ 4.5A	3.75
FT-38A	6.3/2.5A, 2x2.5V/7A	4.19
FT-A27	2.5V/2.5A, 7V/7A, TAP 2.5V/2.5A, 16KV TEST	18.95
FT-608	6.3V/3A/750V Test	1.79
FT-873	4.5V/.5A, 7V/7A	2.19
FT-899	2x5V @ 5A, 29KV Test	24.50

Plate Trans.—115V, 60 cps

Item	Rating	Price
PT-446	185V3.5A	$4.59
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	145.00
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
STC-047	200V	700V/80 MA, 110V/80 MA, 24V/80 MA, 6.3V/.3A, 6.3V/1A, 5V/3A, 5V/5A, 2.5V/5A	6.95
SCT-607	220V	350-0-350V/.075A, 40VCT/1.A, 15/10/15V@100 MA	4.79

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24V, 7A—AM1510M-7 .... $1.95
40V, 10A, 1 POLE $1.95

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3-15 uuf, 8-85 uuf, 3-35 uuf, 5-50 uuf, 3-10 uuf, 3-7 uuf .... .32 each

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MT-5/ARR-2/FT-338/FT-156/FT-487/FT-185/FT-265A/MT-62/ARC-5/FT-225/FT-162/MT-170A/FT-449/MT-171A/MT-167/U.

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SUPERSONIC CRYSTALS, Rochelle salt ...... $.50 Ea.
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GIBSON GIRL, Emerg. Xmtr, 500 kc $42.95
BC 306 ANTENNA TUNING UNIT. NEW $6.95
R9/APN-4, New, With Tubes $75.00
ID6/APN-4, New, With Tubes and Crystal $75.00
A-62 Phantom Antenna $8.50
2 Meter Choke, 1000 MA, 20-144 .... 8/$1.00
Supersonic Crystal Head, M-1, 22-27KC HI-2 .. $27.45
Underwater Microphone, Model JR, Z=50ω $24.50
Dynamic Mike & Headset Combo. B-19. New $3.75
HS-30 Inserts, M-300 .... $3.50 per M
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SCR 274 Test Set, I-104 .... $12.25
Carbon Pile Reg., 18V-5V #35X025 ....
ART-13 Driver Trans. 6V6 to P-P 811's $1.29
DM 34 Dynamotor, 14V In. 220V, 80 MA out..
Sens. Relay: 3.5MA, 13K ohms, 2PST, 2A $1.29
Klixon Breaker: Thermal, 35A .... .69
T-30 Carbon Mikes. New .... .89
Tel. Tape, 3/8" x 8½" Rolls .... .23 ea, 5/$1.00
Tel. Tape, 4" Rolls .... .12 ea, 10/$1.00

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
AT 731 H.F. Plate (1500 ohm C.T.) to V.C. (16/4 ohms) 20-15KC $3.29
AT50! 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
AT415 Plate (18,000 ohms C.T.) to line (125 ohms) 175 w.—500-600 CY $1.95
AT858 Plate (10,000 ohms C.T.) to line (125 ohms) 125130 ohms) HI-FI—50 W $6.95
AT070 Mike-or-Line (250 ohms) to grid (250,000 ohms C.T.) $1.20
AT-694 HI-FI Output: 3 Watts. 8500 Ohms P-P to V.C (15 Ohms) 15-15KC PM 1 db $1.49
AT4-A1: Mike (35 ohms Carbon) to Line 600 ohm/200 ohm $1.19
AT 649: Line (500 ohms) to Grid (75K ohms) .... .89¢
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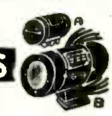
AT 631: Mike-or-Line (200 ohms) To Single or P-P Grids (50K Ohms) .... .59¢
AT 718 Line (300 ohms) to Line (600/30 Ohm) Response 50-20KC P.M. 1 db .... .49¢

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-E: Input: 25 28 vdc, 92 amp. Output: 115 v. 350-500 cy 1500 volt-amperes. Dim. 17"x6½"x10". New $44.50
PE-218-H: Same as above except size: 16½"x6"x10". New $44.50

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D167176	1.50
D168687	1.50
D167208E, D171858	1.50
308A, 3A, 27-B	1.50

MAGNETRONS

Tube	
2J27	2J62
2J31	3J31
2J21 A	5J30
2J22	718DY
2J26	720BY
2J32	725-A
2J38 Pkg.	730-A
2J39 Pkg.	QK 62
2J49	QK 61
2J61	QK 60

700 A, B, C, D
706 AY, BY, DY EY, FY, GY

RADAR • RADIO • TEST GEAR

AN/APS-2	Airborne S Band Radar
AN/APS-3	Airborne 3CM Radar
AN/APS-4	3CM Airborne Radar
RU/GF	Complete Airborne Xmtr-Rcvr $99.50
TS69/AP	Freq. Meter, 341-1000MC $72.50
TS36	Power Meter, 3CM
TS 127/U	Wavemeter, 300-700MC $72.50
TS268/AP	Xtl. Test Set $50
TS65/AP	Slotted Line, 500MC
TS15/AP	Flux Meter
TS47/APR	Test Osc. 50-3000MC $325.00
TS102	Range Callibrator
TS10/APN	Altmeter Test Set
SQ	10CM Portable Radar 115V, 60Cy.
SO-1	10CM SEA Radar, 115VDC
SN	10CM Portable Radar, 115V, 60Cy.
PP-4/APQ-2	DC Power Supply from 400 Cy $65.00
MK10	10CM Gun Laying Radar
MKIV	800MC Gun Laying Radar
SO-8	10 CM Radar, 115VDC
CPN-8	10CM NAV. Beacon, Ground Station
SG	10CM Heavy Duty Ship Radar
SO-7	10CM Radar, Truck Portable 115VAC
AN/APN-4	Loran Set, Airborne
AN/APN-3	Shoran, Xmtr. only
SE	10 cm Surface Search Radar
RA/38	H.V.P. Power Supply

SEND YOUR REQUIREMENTS

PULSE EQUIPMENT

MIT. MOD. 3 HARD TUBE PULSER. Output Pulse Power 144 KW (12 KV at 12 Amp.) Duty Ratio. .001 max. Pulse duration: 5, 1.0, 2.0 microsec. Input voltage: 115v 400 to 2400 cps. Uses: 1-715B. 4-829-B, 3-72's, 1-73. New $110.00

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

APS-1C MODULATOR DECK. Complete, less tubes $75.00

PULSE NETWORKS

15A—1-400-50: 15 KV. "A" CKT. 1 microsec 400 PPS, 50 ohms imp $37.50

G.E. #6E3-5-2000-50P2T, 6KV "E" circuit, 3 sections .5 microsecond, 2000 PPS. 50 ohms impedance $6.50

G.E. #3E (3-84-810) (8-2.24-405) 50P4T; 3KV "E" CKT Dual Unit: Unit 1, 3 sections, 84 Microsec. 810 PPS, 50 ohms imp.: Unit 2, 8 Sections, 2.24 microsec. 405 PPS, 50 ohms imp. $6.50

7.5E3-1-200-67P, 7.5 KV, "E" Circuit, 1 microsec 200 PPS, 67 ohms impedance, 3 sections $7.50

7.5E4-16-60, 67P, 7.5 KV, "E" Circuit, 4 sections 16 microsec, 60 PPS, 67 ohms impedance $15.00

7.5E3-3-200-67P, 7.5 KV, "E" Circuit, 3 microsec, 200 PPS, 67 ohms imp. 3 sections $12.50

MULTI SECTION PULSE NETWORK: ALL RATINGS 8KV

Z = 50 ohms "E" Circuit

Pulse Length Microsec	PRR	Sections
.25	1600	2
.50	800	2
2.6	400	4
5.20	200	4 + 4

Physical Size: 2" x 10 3/4" x 5 3/8" $47.50

PULSE TRANSFORMERS

U-10198. PRI: 4.5KV, 97A PK. SEC: 18KV 26A. PRR—350-500 Cy. DURATION 1.3 usec. $42.50

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.-KS 9800 Input transformer Winding ratio between terminals 3-5 and 1-2 is 1.1:1, and between terminals 6-7 and 1-2 is 2:1. Frequency range: 380-520 c.p.s., Permalloy core $6.00

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 100KW 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 UX 7361 5 microsec, 60-400 cy $5.00

PHILCO #352-7250, 352-7251, 352-7287 UTAH #9262, 9332, 9278, 9341.

RAYTHEON: UX8693, UX7428, UX7350.

WEST. ELECT: D-161310, D-166638, D-166173, D-169114, D-161929, KS9948.

MICROWAVE TEST EQUIPMENT

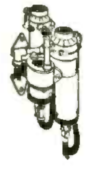
X BAND POWER METER

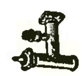
Consists of thermistor mount and bridge, microammeter, rough attenuator, X-Band Waveguide thruout. For power measurements anywhere in the 9000 MC band. $225.00

BROADBAND TEST OSCILLATOR

Freq. coverage 50-3000 MC. By direct calibration and interpolation anti-backlash gear drive: compact, portable. Operates from any 115V source or battery source. New, with all tubes $325.00

S BAND – 3" x 1½" WAVEGUIDE





REACTION WAVEMETER 3000-3700 MC, Mic. Head. Comp. with Cal. Chart. Mfg. G.E. $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 plate $45.00

SIGNAL GENERATOR, using 417A klystron, 2700-3300 mc. Output approx. 50 mw. 115 vac power supply. With tubes, new $425.00

REGULATED POWER SUPPLY for GL 446 type lighthouse tubes (2C40, etc.) 115 vac. 60 cycles. Panel Mounting. Less tubes $32.50

RT-39/APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr-TR cavity, compl. recvr. & 30 MC IF strip using 6AK5 (2C40, 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

TS 268 CRYSTAL CHECKER $50.00

F 29/SPR-2 FILTERS, type "N" input and output $12.50

WAVEGUIDE TO 7/8" RIGID COAX "DOORKNOB" ADAPTER CHOKE FLANGE. SILVER PLATED BROAD BAND $32.50

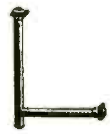
AN/APR5A 10 cm antenna equipment consisting of two 10 cm waveguide sections, each polarized, 45 degrees per set $75.00

AS14A/AP-10 CM Pic: up Dipole with "N" Cables $4.50

S BAND SIGNAL GENERATOR, complete with calibrated attenuator, W. E. coax. wavemeter, McNally Klystron Cavity. Regulated power supply operates from 115 V.A.C., 50-1200 Cycles. Manufactured by W. E. $650.00

OAJ ECHO BOX, 10 CM, TUNABLE $22.50

7/8" RIGID COAX—3/8" I. C.



RIGHT ANGLE BEND, with flexible coax output pickup loop $8.00

SHORT RIGHT ANGLE BEND, with pressurizing nipple $3.00

RIGID COAX to flex coax connector $3.50

STUB-SUPPORTED RIGID COAX, gold plated 5' lengths. Per length $5.00

RT. ANGLES for above $2.50

RT. ANGLE BEND 15 L. OA $3.50

FLEXIBLE SECTION, 15" L. Male to female $4.25

FLEX COAX SECT. Approx. 30 ft. $16.50

7/8" RIGID COAX. BULKHEAD FEED-THRU $14.00

X BAND – 1" x ½" WAVEGUIDE






1" x ½" 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

2J42 Magnetron Pulse Modulator. 14kw max. rating 7kw min. Plate voltage pulsed 5.5kv 6.5 Amp. .001 duty cycles. 2.5 usec pulse length max. filament 6.3V .5 Amp. Includes magnetron mtg. and blower. Requires 3C45 and 2-3B24. New $75.00

TS 268 Crystal Checker $50.00

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-Beacon Mount. P/O APS 10 Radar for mounting two 723A/B klystron with crystal mts. matching slugs, shields $42.50

Dual Oscillator, Mount. (Back to back) with crystal mount, tunable termination attenuating slugs $18.50

Directional Coupler. UG-40/U Take off 20 db $17.50

2K25/723 AB Receiver local oscillator Klystron Mount, complete with crystal mount. Iris coupling and choke coupling to TR $22.50

TR-ATR Duplexer section for above $8.50

CU 105/APS 31 Direction Coupler 25 db $25.00

723AB Mixer—Beacon dual Osc. Mnt. w/xtal holder $12.00

Waveguide Section 12" long choke to cover 45 deg. twist & 2½" radius, 90 deg. bend $4.50

Twist 90 deg. 5" choke to cover w/press nipple $6.50

Waveguide Sections 2½ ft. long silver plated with choke flange $5.75

Rotary Joint choke to choke with deck mounting $17.50

3 cm. mitred elbow "E" or "H" plane 2½" radius $12.00

90 degree elbows, "E" or "H" plane $12.50

90 degree twist 6" long $8.00

45 degree twist $8.00

40KW X BAND Radar, complete as described and illustrated in July 1951 PROC IRE

APS-4 Under Belly Assembly, less tubes $375.00

1¼" x 5/8" WAVEGUIDE

Mitred Elbow H Plane UG51-UG52 $12.00

CG 98B/APQ 13 12" Flex. Sect. 1¼" x 5/8" OD $10.00

X Band Wave GD. 1¼" x 5/8" O.D. 1/16" wall aluminum. per ft., 75c

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" Adaptor, Broadband $22.50

K BAND – ½" x ¼" WAVEGUIDE


APS-34 Rotating Joint $49.50

Right Angle Bend E or H Plane, specify combination of couplings desired $12.00

45° Bend E or H Plane, choke to cover $12.00

Mitered Elbow, cover to cover $4.00

TR-ATR-Section, Choke to cover $4.00

Flexible Section 1" choke to choke $5.00

"S" Curve Choke to cover $4.50

Adapter, round to square cover $5.00

Feedback to Parabola Horn with pressurized window $27.50

90° Twist $10.00

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SUPERIOR VALUES FROM
AMERICA'S LARGEST ELECTRICAL CONVERSION HOUSE

400 CYCLE HIGH FREQUENCY MG UNITS

LOUIS-ALLIS 3 UNIT MG SET. Consists of 5 HP motor operative at 220/440-3-60 directly coupled to alternator with output of 115 volts, 1 ph., 400 cyc. and with exciter unit all mounted on steel base. Price $565.00

AMERICAN 400 CYCLE SETS. A precision built motor generator set ideal for laboratory test work. Consists of 10 H.P. motor directly connected to alternator with output of 5 KVA, 120/208 Volts, three phase, 400 cycles. With electronic exciter—voltage regulator. Frequ. variation ±5%; Voltage variation ±1%; Total harmonic cont. 1.2%. PRICE $1850.00

WINCHARGER PU-7/AP: Input 28 VDC. 160 Amps. Output: 115 VAC. single ph. 2500 V.A. 400 C.P.S. Frequency and voltage regulation built-in. Price.... $87.00

ONAN 400 CYCLE MG SET. Motor: 220V. 3ϕ, 60 cy. V belted to self-excited alternator with output of 4 KVA, 115 Volts, single ph. 400 CPS. Mounted on base with voltage regulator connected. Components all brand new .... PRICE, $712.00

PE118 Units: Operate at 26 VDC, 100 Amp. Output: 115 VAC, 1ϕ. 400 CPS. 1500 VA. with filter system built-in .... PRICE, $29.50

BOGUE THREE PHASE MG SETS. Consists of Motor 10 H.P. operative at 220/440-3-60 Self-exc. alternator with output of 120/208V. 3ϕ, 400 cyc. 5 KVA. Brand New .... PRICE, $1850.00
With Voltage Regulator.......... PRICE, $1950.00

5 KVA BRITISH MG SETS. Motor: 7½ HP. 220-3-60 V belted to self exc. alternator with output of 115 Volts. 1ϕ, 400 cycles.......... PRICE, $975.00

WINCHARGER PU-16/AP INVERTER. Type MG750. Input: 28 volts, 60 amp. Output: 115 volts, 6.5 amp., 400 cyc., 1 ph. Brand new. Price.......... $69.50

PE109 INVERTERS. Input 13.5VDC 29A; Output 115V 400 cy. 1.53A 8000 RPM.......... $59.95

BTH 400 CYCLE M-G SETS. Consists of an alternator of 6 KVA with output of 115 volts, 1ϕ. 400 CPS. V belted drive to 10 HP. motor operative at 220/440-3-60. Excitation provided by dry disk rectifier. Complete with field rheostat. SPECIAL PRICE.......... $985.00

LOUIS ALLIS FREQUENCY CHANGER SETS. Pri: 25 H.P. 220/440-3-60; Sec. 15/10.8 K.W. 3300/2200 RPM. 306/220 Volts 35/35 Amps. 2 ph. 500/360 C.P.S. Brand new. PRICE.......... $1250.00

We can supply these units for 400 cycle output and with transformers to supply 3 phase, wye output. Write for further information.

50 K.V.A. 400≈ MG SETS

We have been fortunate in acquiring a quantity of **KATO 400 Cycle Alternators** that we have made up into motor generator sets and are thus enabled to offer these at a very attractive price. These sets consist of a 75 H.P. Motor operative at 220/440 Volts, 3 Phase, 60 Cycles, 1750 R.P.M. which are coupled directly to a self-excited alternator with output of 50 KVA, 120/208 Volts, 400 CPS, 3 Phase. These motor-generator sets are BRAND NEW and complete with compensator for motor starting and field rheostat for voltage output control. Voltage regulator can be supplied at $100.00, additional to price as quoted. We will be pleased to supply complete specifications relative to frequency and voltage variation and harmonic content.
SPECIALLY PRICED! $7450

THREE PHASE 400 CYCLE SETS. Consist of motor operative at 220/440-3-60 V belted to self excited alternator made by Holtzer-Cabot with output of 500 VA. 115 VAC, 3ϕ. 400 cycles.......... PRICE, $295.00

G. E. INVERTER UNITS, Model 5AT121JJ2B; Input: 24 VDC. 55 amp. 8000 RPM. Output: 115 Volts, 3 phase, 400 CPS, 750 VA. and secondary output of 26 Volts. single phase, 400 CPS. 250 VA. With automatic voltage and frequency regulation, built in. Rebuilt and warranted equal to new. Similar to Model 153F. SPECIAL PRICE $97.50

400 CYCLE COMBINATION 1 AND 3 PHASE MOTOR GENERATOR. Consisting of 20 HP Synchronous 220/440V. Motor V belted to two self excited alternators. Generator I: Bogue 5 KVA 120/208 Volts, 3 Phase, 400 CPS with voltage regulator. Generator II: Onan 4 KVA, 115 Volts, single ph. 400 CPS with voltage regulator. Motor and both alternators and two voltage regulators are mounted on welded channel iron base complete with motor starting compensator. SPECIAL PRICE $3175.00

G. E. 400 CYC. MG SET. Motor operative at 220/440 Volts. 3 ph. 60 cyc. direct connected to self excited alternator with output of 120/208 Volts, 3 ph. 400 CPS. 11.0 KVA. complete with voltage regulator and magnetic controller for motor starting. SPECIAL PRICE $2750.00

WE CAN SUPPLY MOTOR-GENERATOR SETS TO ANY FREQUENCY SPECIFICATIONS AND FOR ANY APPLICATION CONSULT OUR ENGINEERING DEPARTMENT

WESTINGHOUSE 20 KVA 400 CYCLE SET. This uit consists of a synchronous motor of 30 H.P. 1200 RPM operative at 220-3-60 direct connected to self-excited alternator with output of 115 Volts, 3 phase, 400 CPS. (Can be reconnected for 120/208 output) Complete with compensator for motor starting.
SPECIAL PRICE $3750.0

HOLTZER-CABOT MG218. Compact 2 bearing units for low current 400 cycle output. Operative at 115 VDC, 2.3 amp. Output: 110 Volts, 1.0 amp. 1 ph. 400 CPS. Brand New. PRICE.......... $79

GENERAL ELECTRIC MG SET. Motor: 7.5 HP, 220/440 Volts, 3 Ph. 60 Cyc. direct connected to Alternator: 5 KVA, .8 P.F. 120/208 Volts, 3 Ph. 400 CPS. Complete with direct connected exciter and voltage regulator all mounted on common base. PRICE... $1650.00

BENDIX-ECLIPSE 800 CYCLE AERO UNIT. Input: 24-28 VDC, 75 amps. Output. 115 V. 10.5 Amp. 800 C.P.S. Complete filter system mounted thereon. Price $22.50

INVERTER UNIT PE206A. Input: 27.5 VDC. 28 amp. Output: 80 Volts, single ph. 800 CPS. 500 VA. Price $19.00

H.F. MOTOR GENERATOR. G.E. Model 5LY126A4. Motor: 115 VDC direct connected to Generator 24-32 VDC. 78 amps., and to alternator 120 VAC. 720 cycles, 1 ph. KW-2¼.......... PRICE, $245.00

BENDIX POWER MG SET. Consists of G.E. 2 HP. Rep-Ind. Motor, 115 volts, single phase, 60 cy. directly connected to Bendix alternator with output of 120 volts, 700 cyc., 600 watts and DC output of 14.5 volts, DC. 22 amp. Brand new. Price.......... $225.00

ESCO DUAL FREQUENCY UNITS. Motor operates at 120 VDC, 10 amperes. Delivers 70 Volts at 120 Cycles or 200 Volts at 720 Cycles. Price.......... $95.00

CONTINENTAL DC/AC SET. Motor: 1.5 HP. 230 VDC, 3440 RPM. Output: 120 VAC. 6.6 amps., .8 KW 800 cyc., 1 ph., also output of 14 VDC, 4 amps., Model CG21637. Compact 2-bear. units. Completely rebuilt. Price $89.00

ONAN 800 CYCLE MG UNIT. Employing 5 H.P. Motor operative at 220/440 Volts, 3ϕ. 60 Cy. V belted to self-exc. generator with output of 1.5 KVA. 115 Volts. single ph. 800 CPS. and secondary output of 500 Watts 28.5 VDC 17.5 amperes. PRICE.......... $289.00

BRITISH MADE 500 CYCLE MG SETS. Motor: 230 Volts, 3 PH—50 Cycles. Alternator: 5 K.W. 180 Volts, 27.8 Amp. 500 Cycles, Excitation—110 VDC. When used at 60 Cycle current, Output is 600 cycles, 220 Volts. Price $353.00

BURKE ALTERNATOR. 62.5 KVA. 220 Volts, 3 Ph. 180 Cycles, 1800 RPM, separately exc. at 125 VDC. 80% P.F. Type ACR-7. Complete with auxiliary exciter MG set and field rheostat. Ball bearings. Will deliver 400 cycles at 4000 RPM. Rebuilt. Price.......... $1375.00

BRITISH DC/AC MG SETS. Input: 230 VDC. Output: 180 VAC, 1ϕ, 500 Cyc. 5 KVA..NEW. PRICE, $265.00

G.E. MG SET MODEL 5LY56AB5A. Motor: 1.1 HP. 250 VDC, 4 amp. Generator: 600 watts, 125 VAC. 4.8 amp., 500 cyc., 1 ph. Price.......... $89.50

NORMAND ELEC. CO. (BRITISH MFG.) MG UNIT. Motor: 220 VDC. 8.8 amp. 2 HP. 4200 RPM. directly connected to H. F. alternator with output of cyc. 1200 watts. Exc. 24 VDC. Price.......... $70.00

ESCO MG UNIT. Operative at 120 VDC, 25 Amp., 4 HP. Delivers 115 VAC, 1 ph., 1050 cyc., 2 KW. An exceptionally fine machine for laboratory use. Can be used with field rheostat for frequencies up to 2000 cycles. Price $175.00

ELECTRIC SPECIALTY FREQUENCY CHANGERS. Type BFS52/BFRS354 Input: 230 Volts, 3 Ph. 60 cy. 3600 RPM. Output: 250 Volts, 20 Amps. single ph. 180 Cyc. 5000 V.A. 3000 Watts. Brand New. Compact ball bearing units for operation of Hi-cycle equipment. SPECIAL PRICE $160.00

WESTINGHOUSE 180 CYCLE ALTERNATORS. 750 V.A. Output: 110 Volts, 3 Phase, 180 C.P.S. 3000 R.P.M. Separately excited at 110 VDC. Price..$44.00
Also available with built-in exciter. Price...... $78.00

GENERAL ELECTRIC HIGH FREQUENCY UNIT. Operating at 440-3-60 .75 amp. Output: 70 Volts, 3 ph. 148 cyc. 220 Watts, 1.8 amperes. An ideal unit for experimental work or for operation of equipment. SPECIAL PRICE $34.50

HIGH FREQ. UNIT. Motor: 24 VDC 50 amp. Alternator: 17 VAC. 1300-1600 cyc. sep. exc. at 24 VDC. 1.25 BHP. 4000 RPM. Made in Canada by Electric Tamper & Equ.......... PRICE, $49.00

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RLX DUAL GENERATORS. Flange mounted. Output: 500 Watts, 1300-2600 Cycles, also 12-14 VDC. 750 Watts. Price $25.50

ELECTRIC SPECIALTY HIGH FREQUENCY CONVERTER UNIT. Primary: 32 VDC, 16 amperes, 3000 R.P.M. Ball Bearings. Secondary: 350 volts, 1500 cycles. .75 amps. 275 V.A. Single Ph. Built-in frequency control. Specially Priced at.......... $30.00

GENERAL ELECTRIC HF MG SETS. Motor 120 VDC Generator: 115 VAC, 1ϕ, 1050 cy. 2 KVA. 2 Bear. BB unit. Price $220.00

WESTINGHOUSE HIGH FREQUENCY UNITS. Input: 115 Volts, D.C. 2.7 Amps. Output: 14.4 Volts. 139 Amp. 450-2550 Cycles. Frequency variation is obtained with built-in controller on end of unit. Price.... $48.50

ALLIS-CHALMERS MG UNIT. .94 KVA. input 24 VDC, 63 amperes. Output 120/60/1, 7.82 amperes, 3600 RPM. New. Price.......... $149.90

WESTINGHOUSE TRANSFORMERS. 550/220/440 Core and Coil type. 200 VA..$12.75; 500 VA..$18.85; 750 VA..$23.75; 1 KVA..$29.85.

CORNELL DUBILIER VIBRATOR TYPE INVERTER UNITS. Input: 105-125 VDC; Output: 115 VAC. 1ϕ. 60 cyc. 65 watts, with built-in relay which automatically starts unit with connected load. SPECIAL PRICE $9.90

BACH-SIMPSON ELECTRONIC INVERTER. DC Input: 115 Volts, Output: 115 Volts, 1ϕ, 60 cyc. 24.5 watts, modified square wave, with built-in relay which automatically turns on inverter with connected load. Contains 8 50L6 GT Tubes. Brand New.
SPECIAL PRICE $12.95

MASTER GENERATORS. 12 Volts, D.C. 41.6 amp. 500 watts. Sep. exc. at 125 VDC. PRICE....... $33.00

BURKE MOTOR GENERATOR DC/AC SETS. 2 Bearing, ball bearings. Motor: 115 VDC 74 amp. 9.4 H.P. Generator: 120 VAC. 48 amp. 3 ph. 60 cyc. 10 KVA. Complete with magnetic controller and field rheostat. SPECIAL PRICE.......... $325.00

ALLIS CHALMERS DC/AC MG SETS. Brand new. 5 KVA: 115 VDC/115 VAC 1ϕ. 60 cyc. complete with controller, field rheostat and spare parts.
SPECIAL PRICE $397.50

HAMMETT RECTIFIERS. Input: 208/230 Volts, 3 Ph. 60 Cyc. Output: 28 Volts, 130 Amps. Equipped with 3ϕ step-down transformer, dry disc rectifiers, cooling fan and motor. DC Voltmeter and Ammeter, overload thermo and 8 point switch for output voltage control. SPECIAL PRICE $293.00

ACME AIR-COOLED TRANSFORMER. Primary: 500 volts. Secondary: 14,840 volts with C.T., 3 phase, 60 CPS, 18.2 KVA, brand new. Price.......... $390.00

GARDNER DRY TRANSFORMER. 3.42 KVA, 230/115 to 5.7 volts, 600 amperes. Price.......... $48.75

BOGUE ELECTRIC AC/DC MG SET. Consists of 7.5 HP motor in center directly connected to 2 12 volt 160 amp. generators. Will deliver 24 volts at 160 amp. or 12 volts at 320 amp. Condition like new.
Price $375.00

BRITISH DC/AC MG UNITS. Operate at 100/110 VDC, 4 amps., 3000 RPM. Output: 230 VAC, .87 amp., 50 cyc. Wt: 132 lbs. Brand new. Price.......... $42.50
With field rheostat for 60 cyc. output. Price.... $50.00

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IF IT'S FROM ONE FREQUENCY TO ANOTHER; FROM DC TO AC OR AC TO DC, IF IT'S FROM ONE VOLTAGE TO ANOTHER, THEN CALL ON US.

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TRANSMITTERS

3 KW GE FM BROADCAST STATION (Formerly WGYN), COMPLETE. 88-108 mc. Includes FM Exciter-Driver in one cabinet, 3 KW Amplifier with Power Supply in second cabinet, 2 RCA type 70-C1 Transcription turntables include Gray Recorder arms and heads, 1—RCA MI-11301A Power Supply. I RCA Type 76-B2 Studio Console, plus all tubes for all equipment. All in good operating condition.
PRICE (not crated) **$5,000.00**

WILCOX, 96-200-A, 2 KW TRANSMITTER, with **Wilcox 36A RECTIFIER.** 125 to 525 KC, complete RF cabinet (96-200A) and Rectifier cabinet which is designed for modulation also (modulator not in stock). New Condition. **PRICE, both units, less tubes, $1,750.00**

TBK-10, 500 watt. 2-18.1 MC, CW Telegraph Transmitter designed for ship installation. Almost NEW condition, complete with tubes, less MG set and accessories.
PRICE **$300.00**

LINK FM TRANSMITTER-RECEIVER. 70-100 mc. 500 watts output. Model 1498 DC. Wall style cabinet containing transmitter, receiver and 14 V. D.C. or 110V. A.C. power supply, hand-set. Dim.: 34" x 21" x 11". NEW condition. Complete with tubes, crystals, special telescopic antenna, instruction book.
PRICE **$500.00**

MODEL ATD AIRCRAFT RADIO TRANSMITTER EQUIPMENT. This is a Navy Model, 4-channel (motor driven band switching), covering the range of 540 KC to 9050 KC. Output 50 watts phone, but operate A-1, A-2 as well as A-3. Operates from 24-28 volt DC Dynamotor. Each set includes: Dynamotor, Remote Control, Channel Selector Control, Plug Connectors, Operating Tubes, Spare Chest with Spare Tubes and Parts, and Instruction Books. All BRAND NEW, in Original Cases; each with 4 Tuning Units to cover the aforementioned range of frequency.
PRICE, EACH **$160.00**

RCA ET-4332-B and MI-8167 TRANSMITTERS. 250 watt output phone. 350 watts CW. Range 2.0 to 20.0 mc. Crystal or M.O. control. Operation 230/1/50/60 cycles AC. With separate speech amplifier, tubes. LIKE NEW condition.
PRICE, EACH **$675.00**

TDQ TRANSMITTERS, VHF. 45 watts output AM, 110 to 156 mc; 115/230 V. AC. 60 cycles, with tubes, cables. EXCELLENT condition.
PRICE, EACH **$650.00**

BC-797-A TRANSMITTERS, 110-126 mc, 50 watts output phone, AM. for 110 V. 60 cycle operation.
PRICE, EACH **$600.00**

SCR-522 VHF AIRBORNE TRANSMITTER RECEIVERS, With Tubes, LIKE NEW condition.
PRICE, EACH, less accessories **$75.00**

MODEL GP-7 AIRCRAFT TRANSMITTING EQPT., 40 watts output A1, A2, and A3. Range 350 to 9050 Kcs covered by 6 plug-in tuning coil units. Eqpt. includes: External Loading (Ant.) Coil, Operator's Control Box, Pilot's Control Box. Cable Connectors. All NEW material, export packed.
Price, Per Set **$75.00**

RMCA MODEL 8010 I.F. SHIP MAIN RADIO TRANSMITTER, 325 to 500 KC. GOOD Condition. Less MG.
PRICE, EACH **$550.00**

TDE-2 TRANSMITTER, 230 V. DC Operation. EXCELLENT condition. With mg. set.
PRICE, EACH **$675.00**

RMCA, 8021 RADIO TELEPHONE SHIP RADIO, 25 watts phone, 6 channel transmitter and receiver, 32 and 110 V. DC Operation. LIKE NEW condition.
PRICE, EACH **$275.00**

RMCA, 8003 EMERGENCY TRANSMITTER, 500 KC, 50 watts output with 12/115 V. DC motor generator set, and battery charging unit. EXCELLENT condition. Complete with tubes.
PRICE, EACH **$275.00**

MACKAY TRANSMITTER #136-A, Freq. 5.5 to 22 mc.; 40 watts, 115 DC with Motor Generator.
PRICE, EACH **$100.00**

SUPREME SHIP-TO-SHORE TRANSMITTER-RECEIVER, 110 watt output, 10 channel, 2-3 mcs., crystal controlled, for 110 V. AC, 60 cycles. Condition LIKE NEW. Complete with tubes and microphone.
PRICE **$500.00**

NEW GE 1 KW, 3 KW, and 10 KW-RF AMPLIFIERS!!

G.E. Transmitting Equipment of recent design, NOT WAR SURPLUS, all NEW and export cased—at tremendous reduction from original price! Available, *in quantity:* Type BF-1-A, 1 KW Power Amplifier and Power Supply; BF-2-A, 3 KW Power Amplifier with separate matching Rectifier-Power Supply; BF-3-A, 10 KW Power Amplifier with separate matching Rectifier-Power Supply. This equipment is designed for 88-108 MC FM broadcasting application, beautifully engineered and constructed. (250 Watt FM Exciter or Driver NOT AVAILABLE). Conversion to lower frequencies (2 to 24 mc, or other frequencies) can be accomplished at very low cost. Our factory will be glad to quote on conversion to specified frequencies. All units designed for 208/230 volts, 50/60 cycles operation; 3 KW and 10 KW units require 3-phase. All incorporate internal blower systems for forced air-cooling, and use latest G.E. hi-efficiency tubes. Quantities sufficient to interest manufacturers—to convert for other applications. Ideal for FM Broadcasters, communication companies, Schools, Labs! Available as separate units, or complete. Write for more complete specifications and prices.

TRANS-RECEIVERS

TCS COLLINS SHIP TRANSMITTER-RECEIVERS. Each with cables, remote control box and loading coil, radio-telephone and radio-telegraph at 20 and 40 Watts, 1.5 to 12.0 mc. Following power supplies available: 12 V. DC. 24 V. DC. 230 V DC. 110 V. AC.
Complete with all accessories EXCELLENT, like NEW condition. **WRITE FOR PRICE.**

SCR-624 VHF (100-156 mc) TRANSMITTING-RECEIVING EQPT. Same as SCR-522, but with 110 V. AC Power Supply, all contained in Chests CH-172-A and CH-173-A, with Antenna Masts MA-7-A for each set. 4-channels, crystal control both X'mttr and receiver. 6 watts output Amp. modulated. NEW material. **WRITE FOR PRICE.**

SCR-284 EQUIPMENT, consisting of BC-654 Transmitter-Receiver, PE-103 Generator Power Supply, GN-45 Hand Generator with cranks and legs, and PE-104 Receiver-Vibrator Power Supply, plus other minor accessories. All equipment in EXCELLENT Condition, with complete tubes. **WRITE FOR PRICE.**

SCR-511 POGO STICK WALKIE-TALKIE. This is a low-powered portable AM Radio Telephone Transmitter-Receiver, covering a frequency range of from 3 to 6 mc. Pre-Tuned Plug-in Tuning Units (BC-746) which contain appropriate Transmitter and Receiver. Crystals and matching coils are employed to provide quick changeover to any frequency in the 3 to 6 mc. band. The Transmitter-Receiver (BC-745) is mounted on a 30" metal stake, which can be driven into the ground to support the unit. A telescopic antenna is provided at the top, along with a convenient "press to transmit" switch. Each set consists of: BC-745 Transmitter-Receiver, complete with Tubes; 13 Plug-in Tuning Units BC-746, with crystals and coils to provide coverage over the 3 to 6 mc. range; PE-157 Vibrator Power Supply, which incorporates the dynamic Loudspeaker (for reception), Vibrator, Dry Disc Rectifier, and space for a 2 volt non-spillable acid type storage battery (not supplied). Equipment is NEW and UNUSED. A T-17 Microphone and 2-Volt Storage Battery (Plastic case type readily available) are all that are required for each set to put into operation. **PRICE EACH** **$125.00**

SCR-509/510/609/610 EQUIPMENT. Consisting of BC-659 or BC-620 (for 509/510) transmitter-receivers, and PE-117 or PE120 Power Supplies. Freq. of 509/510 is 20.0 to 27.9 mc; 609/610 is 27.0 to 38.9 mc. Transmitter-Receivers are FM, two-channel, crystal controlled. Excellent Condition units, all tested. **Write for Quantity Prices.**

TEST EQPT.

BC-221, I-222-A Signal Generator, 100-150 MC. with crystal calibrator for 115 V, 60 cycles AC.
TU-56, TU-57, BC-1236-A, and 78E Sig. Generators, TS-143, I-148, TS-143/CPM—1 Synchroscope. Others.

RADAR

SCR-545-A, Complete in Trailer Trucks, with or without 25KVA Gas-Engine Generator Unit and Motor Cab.
Hundreds of radar components, plumbing, magnets, tubes, transformers, etc.

ASB-5 AIRCRAFT RADAR, consists of Ant. Switching Unit, Rectifier Power Unit, Power Control Unit, Radar Receiver, Radar Transmitter, and Indicator. With all plug connectors and tubes, and Operating Manual. New material, export packed. **WRITE FOR PRICES.**

AUDIO SOUND

BEACHMASTER AMPLIFIERS, 250 Watt Portable Sound System. Operates from 110 volt, 1-phase, 60 cycles AC. Tripod, Bracket. Complete Tubes and Cables included. All Equipment in NEW and EXCELLENT condition.
PRICE, EACH **$485.00**

WESTERN ELECTRIC MODEL HLAS, 500 Watt SOUND AMPLIFIER SYSTEM, consisting of 40 Watt Pre-Amplifier, 500 Watt Power Amplifier with built-in Power Supply, Expander-Compressor Circuit, 12-Speaker Horn Racks, and Motor Generator which operates from a 48 Volt DC source to supply 1.5 KVA, 115 Volts, 60 Cycles, 3-phase AC. Included are all Tubes and Cables. Most of this Equipment is NEW to Like-New Condition.
PER SET WITH MG **$985.00**
PRICE, LESS MG **$895.00**

HLAS 6-UNIT SPEAKER HORN RACKS. Each speaker Unit will handle 50-60 Watts of Audio Sound Power. Extremely large Alnico-Slugs (approximately 6 pounds) used in speaker. Two of these Speakers make up a 12-Speaker Rack for above 500 Watt HLAS system. NEW, UNUSED Condition.
PRICE PER 6 UNIT HORN **$135.00**

W.E. SPEAKER UNITS, D-173246, (25-30 W) Dynamic PM, cone type, Beachmaster replacement.
PRICE, EACH **$14.95**

W. E. SPEAKER UNITS, D-173232A (50 to 60 W) Dynamic PM, Cone Type, Western Elec. 500 W. HLAS replacement.
PRICE, EACH **$20.95**

RCA 12 V. DC PUBLIC ADDRESS SYSTEM, 25 watts peak power output, SPEAKER not included. NEW equipment.
PRICE, EACH, complete with sound-powered mike **$54.75**
PRICE, EACH, less microphone **$44.75**
PRICE, EACH, Modified for 110 V. AC, less mike **$49.50**

RECEIVERS

RBM, RBS, BC-1068 VHF, SCR-206 Direction Finders with Loops. Others.
CRV-46136, 100 to 1500 KC, part of DP-13 Radio Equipt.
RT-3/ARN-1 Radio Receivers. New, **Model ZB-3, Aircraft Homing Adapters,** with plugs and accessories. New Eqpt.

MISCELLANEOUS

GENERAL ELECTRIC VOLTAGE REGULATOR (POWER SUPPLY), Model 3GVD-14B-3, delivers up to 750 volts at 100 MA, with voltage divider network to provide lower voltages all regulated. Incorporates switch for "regulating", "non-regulating", and "stand-by". Uses following tubes (not supplied): 1—807, 1—6SJ7, 2—6H6, 1—VR-105, 1—VR-150, 1—6AG7, and 1—5R4GY. Chassis dimensions 11" x 16" x 3" with chassis cover 9" high. Ideal for laboratories, Frequency Shift Equipment, Stable Oscillator construction, etc. All NEW Units.
PRICE, EACH **$24.50**

MP-22A MAST BASE, W/insulator, spring loaded for swiveling and quick return. NEW Units.
PRICE, EACH **$3.95**

RADIOSONDE AN/AMQ-1, Meteorological Balloon transmitter with self-contained instruments. New Units, with slide-rule temperature evaluators and spare (sealed) humidity elements. Large quantity available. Receiving and Recording supplementary eqpt. also available. Type AN/FMQ-1. **WRITE FOR PRICE.**

"SNOOPERSCOPE" TUBES, British Infra-Red Image Converter Tubes, with matching Bausch & Lomb front-end Lens.
TUBE .... **$5.00 ea. LENS** .... **$10.00.**

T-9-APQ-2 Radio Transmitters. Noise modulated Jamming Transmitter, using Electron Multiplier Photocell. For Jamming certain types radar eqpt. New unused transmitters only, with Electron-Multiplier tube. Less other tubes, **EACH** **$32.50**

SB-23/GTA-2 & SB-11/GY Switchboards & Power Supply, for operation from 110V, 60 Cycles AC (with storage batteries). Each in individual metal cabinet. NEW.
Price, Each Set **$300.00**

Immediate Delivery from Stock — All Prices F.O.B. N.Y.C. — All Material Offered Subject to Prior Sale

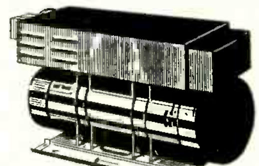
Cable: Telemarine, N. Y.
Tel. LOngacre 4-4490-1

TELEMARINE COMMUNICATIONS CO.

540 W. 27th St.
N. Y. 1, N. Y.

SURPLUS EQUIPMENT

INVERTERS



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.

16486 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.

10563 LELAND ELECTRIC

Output: 115 VAC; 400 cycle; 3-phase; 115 VA; 75 PF. **Input:** 28.5 VDC; 12 amp. . . . . **$80.00 ea.**

12116-2-A PIONEER

Output: 115 VAC; 400 cyc; single phase; 45 amp. **Input:** 24 VDC 5 amp . . . **$90.00 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.**

94-32270-A LELAND ELECTRIC

OUTPUT: 115 Volts, 190 V.A., Single Phase; 400 cyc.; .90 PF, and 26 Volts, 60 V.A., 400 cyc., .40 PF. **INPUT:** 27.5 Volts DC, 18 amps; Cont. Duty, Voltage and frequency regulated **$95.00**

5 RPM GEAR HEAD MOTOR

Mfg. RAE., Type 7519, 115 Volts AD, DC. Fractional HP, Overall dimension: 5½" . . . . **$12.95 ea.**
Lots of 10 . . . . . . **$11.95 ea.**

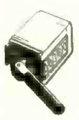
METERS

AMMETER: DC; 2" 100-0-100, complete with external shunt . . . . **$5.95 ea.**
AC Volt, Westinghouse, Type NA-35—3-inch round. F.S.-10 MA . . . . **$6.95 ea.**

MICROPOSITIONER

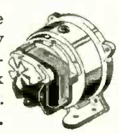
Barber Colman AYLZ 2133-I Polarized D.C. Relay: Double Coil Differential sensitive; Alnico P.M. Polarized field. 24V contacts; .5 amps; 28 V. Used for remote positioning, synchronizing, control, etc . . . . **$12.50 ea.**

VEEDER ROOT COUNTER MODEL S-1



5-figure (0-99,999) non-reset type. Adds ten for each complete revolution of shaft in one direction. Substracts ten for each revolution in opposite direction. Black figures on metal background. Size: ¾" high x ¾" wide x 1-5/16" long. Dovetail mounting — Lever arm removable . . . . **$1.95 ea.**
10 for **$17.50**

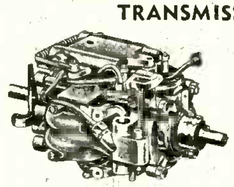
6 RPM GEAR BOX MOTOR



110 Volt, 60 cyc., Single Phase; Ratio—544:1; Mfg. by Merkle-Korff Gear Co., Overall dimensions approx. 3½" x 3½". . . . . **$9.95 ea.**
Lots of 10 . . . . **$9.95 ea.**

WESTINGHOUSE HYDRAULIC TRANSMISSION

BRAND NEW



Ideal as hydraulic torque converters. Contains hydraulic pump and hydraulic motor; 10 ball bearings; has reversible controls. High quality precision workmanship . . . made to exacting specifications for use on 2-ton 40 mm anti-aircraft guns. Overall dimensions: 12" long x 5½" wide x 6½" high. Shipping weight: 20 lbs. Government cost more than $300. **BRAND NEW** . . . . **$29.95 ea.**

POWER TRANSFORMER

Primary 125 volts tapped at 105 and 115 volts, 50 to 425 cycles. Secondaries: 5.1 v. at 3.0 amps. 325-0-325 v. at 0.175 amp., 5.4 v. at 8 amp., 6.4 v. at 10.3 amp., 2.5 v. at 3.0 amp., 4500 v. at .005 amp., 2.5 v. and 4500 volt windings insulated for 6000 volts. All other windings insulated for 1500 volts. Cost government more than $42.00—a real bargain at **$4.95**

G. E. ALTERNATOR

208 Volts, 400 Cycle, 3 Phase Mod. 2CM97B1
55.5 Amps., PF .75, Speed 8000 KW 15, Cont. Duty, Limited Quantity . . $320.00

SERVO MOTOR 10047-2-A: 2 Phase; 400 Cycle; with 40-1 Reduction Gear
$10.00 ea.

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 12606-1-A: Same as 12604-3-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.**

BLOWER ASSEMBLY

115 Volt, 400 Cycle. Westinghouse Type FL, 17CFM, complete with capacitor. New . . . . **$12.50 ea.**

ALNICO FIELD MOTORS

(Approx. size overall . . . 3¾" x 1¼" diameter)
Delco-Type 5069230: 27.5 volts; DC; 145RPM **$19.95 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.**

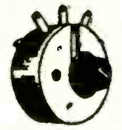
400 CYCLE MOTORS

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.
PIONEER, CK-2, 400 cycle 2-phase.
$20.00 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**

SYNCHROS

IF Special Repeater (115V-400 Cycle)
$15.00 ea.
2JIF3 Generator (115V-400 cyc) . . . **$10.00 ea.**
5CT Control Transformer; 90-50 Volt; 60 Cyc. . . . . **$50.00 ea.**
5F Motor (115/90 volt—60 cyc.) . . . **$60.00 ea.**
5G Generator (115/90 volt—60 cyc.)
$50.00 ea.
5SDG Differential Generator (90/90 volts —400 cyc.) . . . . **$30.00 ea.**
5DG Differential Generator (90/90 volts 60 cycle) . . . . **$50.00 ea.**
TRANSMITTER, BENDIX C-78248: 115 Volt. 60 Cycle . . . . **$25.00 ea.**
REPEATER, BENDIX C-78410: 115 Volt, 60 Cycle . . . . **$37.50 ea.**

POWER RHEOSTATS



Standard Brands: 5 Ohms; 100 Watt; 4.48 amps 100 Ohms; 100 Watt; 1.0 amp.
Boxed, Brand New with Knob $2.50 each — or — $25.00 per Doz.

420 CYCLE GENERATOR

General Electric #5AB324A7; 115 Volts, single phase, 7.5 KVA, 3480 rpm, equipped with triple V-belt pulley. Cycle and voltage may be varied by varying speed. New price **$525.00**

SMALL DC MOTORS

(Approx. size . . . . 4" long x 1¼" dia.)
General Electric-Type 5AB10AJ37; 27 volts, DC; .5 amps, 8 oz inches torque; 250 RPM; shunt wound; 4 leads; reversible . . **$12.50 ea.**
G. E. Type 5BA10FJ215, 24 volts DC, .77 amp. 30 lbs. in. torque, 4 RPM . . . . **$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.

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.**

PIONEER GYRO FLUX GATE AMPLIFIER

Type 12076-1-A, complete with tubes
$27.50 ea.

G.E. MOTOR GENERATOR

Model 5LY77AB1, Input: 115 volts D.C.; 1½ H.P. motor; 13 amp; 3600 RPM; shunt contact regulated. Output: 115 Volts A.C. 60 cycles; KVA .06; shunt self excited.
$129.00 ea.

SYNCHRONOUS SELSYNS

110 volt, 60 cycle, brass cased, approx. 4" dia. x 6" long. Mfg. by Deihl and Bendix.
Quantities Available
REPEATERS . . . . **$15.00 ea.**
TRANSMITTERS . . . . **$15.00 ea.**

SINE-COSINE GENERATORS

(Resolvers)

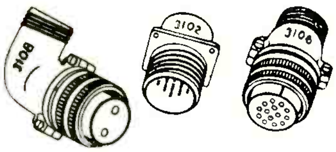
Diehl Type FJE-43-9 (Single Phase Rotor). Two stator windings 90° apart, provides two outputs equal to the sine and cosine of the angular rotor displacement. Input voltage 115 volts, 400 cycle . . . . **$25.00 ea.**
Diehl Type FPE-43-1 same as FJE-43-9 except it supplies maximum stator voltage of 220 volts with 115 volts applied to rotor . . . . **$25.00 ea.**

ALL EQUIPMENT FULLY GUARANTEED

Please enlose full amount with order
All prices net FOB Pasadena, Calif.
Prices subject to change without notice

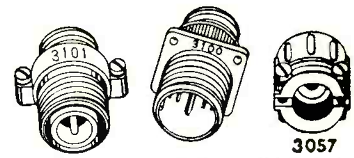
C and H Sales Company

BOX 356-X EAST PASADENA STATION • PASADENA 8, CALIFORNIA



AN CONNECTORS

DISCOUNT: 50%



Insert	Shell and 1947 List Price 3100	3101	3102	3106	3108
8S-1S	$1.59	1.63	1.19	1.59	2.61
8S-1P	1.53	1.59	1.19	1.59	2.67
10S-2S	1.48	1.53	1.08	1.39	2.47
10S-2P	1.43	1.48	1.08	1.48	2.52
10SL-3S				1.73	2.67
10SL-3P	1.73	1.77	1.43		
10SL-4S				1.53	2.76
10SL-4P	1.59	1.63	1.19		
10S-656S	1.48	1.53	1.08	1.59	2.81
10S-656P	1.43	1.43	1.04	1.53	2.72
12S-3S	1.63	1.73	1.19	1.97	2.72
12S-3P	1.68	1.68	1.24	1.97	2.87
12S-4S	1.39	1.53	1.04	1.59	2.72
12S-4P	1.39	1.53	1.04	1.59	2.72
12-5S	1.59	1.92	1.39	1.97	3.01
12-5P	1.53	1.73	1.24	1.92	2.81
12S-6S	2.37	2.37	1.84	2.67	3.73
14S-1S	1.77	2.03	1.33	2.37	3.16
14S-1P	1.77	2.03	1.33	2.32	3.16
14S-2S	1.88	1.97	1.43	2.41	3.25
14S-2P	2.08	2.17	1.63	2.37	3.50
14-3S	2.03	2.08	1.43	2.17	4.15
14-3P	2.08	2.12	1.43	2.57	3.95
14S-4S	1.70	1.70	1.43	2.27	3.16
14S-4P	1.39	1.48	1.08	1.97	2.81
14S-5S	2.12	2.32	1.57	2.47	3.71
14S-5P	2.12	2.37	1.59	2.81	3.71
14S-6S	2.57	2.47	2.17	3.07	4.20
14S-6P	2.61	2.61	2.08	2.96	4.09
14S-7S	2.23	2.23	1.63	2.76	3.76
14S-7P	1.97	1.97	1.43	2.27	3.16
14S-9S	2.08	2.08	1.53	2.37	3.56
14S-9P	1.97	1.92	1.43	2.23	3.36
14S-11S	2.17	2.17	1.63	2.52	3.65
14S-11P	2.37	2.37	1.83	2.72	3.85
16S-1S	2.61	2.87	2.23	3.21	3.85
16S-1P	2.87	2.87	1.88	3.21	4.40
16-2S	2.27	2.32	1.68	2.72	3.56
16-2P	2.08	2.12	1.48	2.47	3.56
16S-3S	1.83	1.92	1.24	2.23	3.41
16S-3P	1.83	1.92	1.24	2.23	3.41
16S-4S	1.92	2.03	1.39	2.37	2.92
16S-4P	1.92	2.03	1.39	2.32	3.56
16S-5S	2.17	2.37	1.73	2.76	3.56
16S-5P	2.17	2.23	1.59	2.57	3.76
16S-6S	2.17	2.37	1.53	2.67	3.91
16S-6P	2.12	2.17	1.53	2.52	3.71
16-7S	2.67	2.72	2.08	2.61	4.15
16S-8S	2.37	2.72	2.08	3.07	3.65
16S-8P	2.61	2.47	1.92	2.87	3.71
16-9S	2.72	2.87	2.12	3.25	4.29
16-9P	2.57	2.67	2.03	3.01	4.05
16-10S	2.61	2.76	2.12	3.11	4.09
16-10P	2.27	2.37	1.73	2.72	3.85
16-11S	2.37	2.52	1.83	2.47	3.91
16-11P	2.27	2.37	1.59	2.72	3.80
16-12S	2.67	2.72	2.08	3.07	4.15
16-12P	2.37	2.47	1.77	2.76	3.85
16-13S	2.96	3.02	2.19	3.02	4.74
16-13P	4.21	4.32	3.50	4.69	5.92
18S-1S	3.65	3.80	2.87	3.91	5.19
18-1P	4.00	4.15	3.16	4.49	5.72
18-2S	3.51	3.16	2.08	3.71	4.69
18-2P	2.61	2.72	1.63	3.80	4.25
18-3S	2.76	2.52	1.63	3.65	4.44
18-3P	2.72	2.47	1.48	2.96	4.25
18-4S	2.87	2.92	1.83	3.11	3.95
18-4P	3.07	2.96	2.03	3.16	4.55
18-5S	2.76	2.76	1.83	3.16	4.44
18-5P	2.96	2.67	1.68	2.96	4.44
18-6S	2.87	2.92	1.83	3.31	4.40
18-6P	2.72	2.81	1.73	2.96	4.25
18-7S	3.36	3.11	2.03	3.60	4.64
18-7P	2.87	2.68	2.08	3.16	4.55
18-8S	3.71	4.00	2.96	4.00	4.99
18-8P	3.60	3.65	2.61	3.71	4.93
18-9S	4.00	3.56	3.41	4.89	4.40
18-9P	4.09	4.20	2.92	4.35	5.19
18-10S	4.00	3.71	2.37	4.84	5.24
18-10P	3.56	3.25	2.17	3.41	4.75
18-11S	3.60	3.36	2.47	4.35	5.39
18-11P	3.21	2.96	2.32	3.95	4.93
18-12S	3.11	3.24	2.52	3.36	4.64
18-12P	3.71	3.16	2.23	3.36	4.99
18-13S	4.64	4.40	3.41	5.43	6.03
18-13P	3.45	3.16	2.23	3.95	4.84
18-15S	4.98	4.56	3.26	5.33	6.99
18-15P	7.94	7.58	6.34	8.90	9.36
18-16S	3.07	2.67	1.73	3.25	4.35
18-16P	2.87	2.61	1.68	3.11	4.25
18-17S	4.00	3.71	2.61	4.49	5.28
18-17P	4.09	4.09	3.01	4.35	5.59
18-18S	2.91	3.71	2.61	4.89	5.19
18-18P	4.09	4.09	3.01	4.35	5.59
18-19S	15.90	15.25	13.50	15.75	16.30
18-20S	2.96	3.11	2.08	3.21	4.49
18-20P	3.31	2.92	2.12	3.76	4.99
18-22S	3.51	3.16	2.08	3.71	4.69
18-22P	2.61	2.72	1.63	3.80	4.25
18-30S	2.96	3.11	2.08	3.21	4.49
18-30P	3.31	2.92	2.12	3.76	4.99
18-31S	2.96	3.11	2.08	3.21	4.49

Insert	Shell and 1947 List Price 3100	3101	3102	3106	3108
18-31P	3.31	2.92	2.12	3.76	4.99
20-1S	4.44	4.69	3.60	4.75	4.84
20-1P	5.63	6.32	3.91	5.92	5.97
20-2S	3.25	3.36	1.92	4.05	4.25
20-2P	3.11	3.31	1.83	3.45	4.20
20-3S	3.71	3.76	2.23	4.25	4.69
20-3P	3.41	3.56	1.97	3.80	4.84
20-4S	3.36	3.36	2.08	3.76	4.93
20-4P	3.16	3.20	1.92	3.71	4.84
20-5S	3.07	3.16	1.68	3.45	4.40
20-5P	2.87	2.92	1.43	3.56	4.20
20-6S	3.25	3.45	2.08	3.60	4.40
20-6P	3.25	3.31	1.83	3.60	4.20
20-7S	3.51	4.15	2.87	3.80	5.09
20-7P	4.35	4.69	3.25	4.64	5.59
20-8S	4.40	4.44	3.01	5.33	5.33
20-8P	4.20	4.29	2.81	4.89	5.09
20-9S	4.29	4.40	2.92	4.79	5.28
20-9P	4.15	4.20	2.76	4.64	5.09
20-10S	3.36	3.36	2.08	3.76	4.93
20-10P	3.16	3.20	1.92	3.71	4.84
20-11S	4.66	4.76	4.02	5.49	7.77
20-11P	3.57	3.66	2.93	4.39	6.72
20-12S	3.56	3.60	2.17	4.44	4.49
20-12P	3.36	3.45	2.03	3.80	4.35
20-13S	3.65	4.75	2.27	4.84	4.59
20-13P	3.11	3.76	2.27	3.45	4.59
20-14S	4.40	4.44	3.11	5.59	5.39
20-14P	3.91	4.44	2.92	4.15	5.28
20-15S	4.55	4.69	3.21	5.19	5.53
20-15P	3.95	4.09	2.61	4.89	4.93
20-16S	4.55	4.79	3.31	4.89	5.63
20-16P	4.44	4.49	3.11	4.89	5.43
20-17S	4.44	4.55	3.11	5.63	5.43
20-17P	4.20	4.29	2.81	4.59	5.19
20-18S	4.84	4.93	3.41	5.83	5.83
20-18P	4.25	4.29	2.81	5.43	5.24
20-19S	4.20	4.25	2.81	5.39	5.19
20-19P	3.91	4.15	2.72	4.21	5.04
20-20S	4.25	4.29	2.81	4.40	5.24
20-20P	3.80	3.91	2.41	4.40	4.79
20-21S	4.59	4.75	3.25	4.93	5.63
20-22S	4.44	4.55	3.11	5.43	5.43
20-22P	4.25	4.35	2.87	4.55	5.24
20-23S	3.71	3.80	2.32	4.64	4.69
20-23P	3.36	3.45	2.03	3.80	4.35
20-24S	3.91	4.00	2.57	5.04	4.89
20-24P	3.71	3.80	2.32	4.35	4.69
20-25S	4.44	5.04	3.60	4.75	5.92
20-25P	5.63	6.03	4.59	5.92	6.92
20-26S	3.85	3.91	2.47	5.04	4.84
20-26P	3.45	3.71	2.23	3.80	4.55
20-27S	4.05	4.50	3.15	4.00	5.25
20-27P	3.40	3.85	2.55	3.45	4.60
20-28S	4.44	5.04	3.69	4.75	5.63
20-28P	5.63	5.97	[illegible]	5.92	6.57
20-29S	7.07	6.63	5.93	7.82	9.41
20-29P	4.52	4.07	3.37	5.30	6.85
22-1S	3.71	3.71	2.03	4.25	5.04
22-1P	3.41	3.45	1.88	4.00	4.79
22-2S	4.29	4.35	2.87	5.24	5.63
22-2P	3.95	4.00	2.57	4.40	5.33
22-3S	3.71	3.76	2.32	4.79	5.04
22-3P	3.36	3.36	1.97	3.95	4.75
22-4S	4.00	4.09	2.52	4.55	4.89
22-4P	3.71	3.91	2.37	4.09	5.04
22-5S	3.95	3.95	2.57	4.15	5.33
22-5P	3.71	3.71	2.27	3.91	5.09
22-6S	3.80	3.85	2.37	5.04	5.19
22-6P	3.56	3.56	2.12	4.29	3.56
22-7S	3.85	3.85	2.47	4.75	5.24
22-7P	3.41	3.41	2.03	4.00	4.79
22-8S	3.71	3.91	2.52	4.15	5.24
22-8P	2.96	3.11	1.68	3.41	4.44
22-9S	3.71	3.76	2.27	4.93	5.04
22-9P	3.21	3.25	1.92	4.00	4.15
22-10S	3.16	3.76	2.17	3.56	4.84
22-10P	3.41	3.45	2.03	3.91	4.79
22-11S	3.45	3.56	2.12	4.09	4.84
22-11P	2.87	3.36	1.97	3.25	4.49
22-12S	4.20	4.29	2.76	4.79	5.53
22-12P	3.85	3.91	2.47	4.59	5.24
22-13S	4.29	4.29	2.87	5.33	5.63
22-13P	3.60	4.00	2.57	4.05	5.28
22-14S	5.19	5.97	4.64	5.59	6.81
22-14P	5.88	5.83	4.44	7.06	7.21
22-15S	5.19	5.24	3.76	6.37	6.52
22-15P	3.95	4.09	2.67	4.35	5.39
22-16S	4.93	4.99	3.51	6.08	6.32
22-16P	4.35	4.40	3.01	5.59	5.73
22-17S	4.25	4.79	3.31	4.64	5.88
22-17P	4.44	4.49	3.07	5.09	5.83
22-18S	4.09	4.35	2.87	4.55	5.63
22-18P	3.91	3.91	2.52	5.09	5.28
22-19S	4.49	5.24	4.00	4.89	6.17
22-19P	4.89	4.93	3.45	6.07	6.27
22-20S	3.85	4.44	3.07	4.25	5.48
22-20P	4.09	4.15	2.67	4.55	5.19
22-21S	4.55	4.79	5.56	5.04	6.32
22-22S	4.35	4.40	2.92	5.24	5.68
22-22P	4.20	4.20	2.76	4.79	5.48

Insert	Shell and 1947 List Price 3100	3101	3102	3106	3108
22-23S	4.99	5.04	3.60	6.17	5.83
22-23P	4.40	4.40	3.01	5.33	5.77
22-24S	4.15	4.09	2.72	4.20	5.48
22-24P	3.65	3.71	2.23	3.95	4.99
22-25S	4.15	4.20	2.72	5.24	5.48
22-25P	3.80	3.80	2.37	4.40	5.19
22-26S	4.49	4.49	3.11	4.79	5.83
22-27S	4.89	5.09	3.71	5.33	6.43
22-27P	4.29	4.84	3.31	4.75	5.92
22-28S	4.55	4.55	3.16	5.77	5.92
22-28P	3.80	3.85	2.37	4.98	5.19
22-29P	4.49	4.49	3.11	5.43	5.83
22-33S	3.95	4.20	3.11	4.40	5.77
22-33P	4.20	4.25	2.81	5.13	5.53
22-36S	7.07	7.56	6.67	8.04	8.48
22-36P	13.00	13.48	12.59	13.96	14.41
24-1S	4.44	4.35	2.67	5.28	5.59
24-1P	3.71	4.00	2.57	4.55	5.48
24-2S	4.89	4.79	3.07	5.63	5.97
24-2P	4.09	4.29	2.57	4.49	5.48
24-3S	4.29	4.69	3.01	5.04	5.88
24-3P	3.80	3.80	2.61	4.49	5.53
24-4S	4.64	4.79	3.07	5.63	5.97
24-4P	4.05	4.25	2.57	4.84	5.48
24-5S	4.69	5.43	4.40	5.39	6.57
24-5P	5.19	5.63	3.91	5.13	6.86
24-6S	5.09	4.99	3.31	5.88	6.17
24-6P	4.35	4.35	2.67	5.04	5.59
24-7S	5.48	6.37	4.69	6.23	7.45
24-7P	5.28	6.03	3.76	6.03	7.21
24-9S	4.93	5.24	4.00	5.77	6.96
24-9P	3.85	4.09	2.47	4.64	5.39
24-10	5.53	5.48	3.76	6.37	6.86
24-10P	5.43	5.39	3.65	6.27	6.57
24-11S	6.03	5.92	4.25	6.81	7.16
24-11P	4.89	5.28	3.56	5.68	6.47
24-12S	5.04	5.83	4.75	5.77	7.01
24-12P	4.64	4.79	3.07	5.43	5.97
24-14S	4.99	4.93	3.21	5.83	6.12
24-14P	4.00	4.25	2.72	4.79	5.63
24-15S	4.69	5.43	4.40	5.39	6.67
24-15P	5.77	5.63	3.95	6.57	6.92
24-16S	5.28	5.19	3.45	4.69	5.92
24-16P	4.20	4.55	2.81	4.20	5.04
24-17S	5.73	5.63	3.16	5.68	6.86
24-17P	3.80	4.05	2.52	4.59	5.43
24-18P	3.45	3.71	2.17	4.25	5.13
24-19S	5.59	5.53	3.80	5.48	6.72
24-19P	4.55	5.04	3.31	5.33	6.27
24-20S	5.63	5.63	3.80	5.92	6.47
24-20P	6.12	6.08	4.44	6.61	7.06
24-21S	4.84	4.84	3.65	5.68	5.73
24-21P	4.59	4.55	3.11	5.04	6.37
24-22S	5.95	6.00	5.63	6.10	9.47
24-22P	8.60	8.65	7.45	8.80	10.63
24-23S	5.96	5.93	4.22	6.81	7.07
24-24S	4.69	5.43	4.40	5.39	6.67
24-24P	6.23	5.63	3.95	6.57	6.92
24-27S	4.44	4.41	2.70	5.26	5.56
24-27P	4.41	4.37	2.67	5.22	5.52
24-28S	7.30	7.25	5.63	8.09	8.25
24-28P	9.28	9.18	7.56	9.48	10.22
24-691S	5.28	5.19	3.45	4.69	5.92
24-691P	4.20	4.55	2.81	4.20	5.04
24-835S	9.09	9.04	7.25	9.88	10.22
24-835P	5.04	4.98	3.25	5.88	6.17
28-1S	5.77	6.61	4.25	6.57	7.45
28-1P	5.13	5.83	3.56	5.68	6.76
28-2S	5.59	6.43	4.09	6.17	7.65
28-2P	5.24	5.88	3.56	5.88	7.10
28-3S	5.53	5.73	3.41	6.57	6.96
28-3P	4.35	4.64	2.52	5.39	6.03
28-4S	5.09	5.83	3.56	5.88	6.72
24-4P	4.59	5.24	2.92	5.33	6.23
28-5S	5.88	5.88	3.60	6.81	7.16
28-5P	4.89	5.13	2.92	5.88	6.52
28-6S	6.03	6.03	3.76	6.96	7.36
28-6P	4.75	5.04	3.07	5.43	6.57
28-7S	5.33	5.33	3.01	6.17	6.57
28-7P	4.25	4.49	2.57	5.24	6.12
28-8S	5.48	6.32	4.00	6.37	7.60
28-8P	5.13	5.88	3.65	6.08	7.21
28-9S	6.32	7.25	5.43	7.21	8.64
28-9P	5.39	5.97	3.71	6.27	7.21
28-10S	6.47	6.47	4.20	7.41	7.76
28-10P	5.97	6.08	3.80	6.96	7.36
28-11S	7.41	8.09	5.83	6.76	9.33
28-11P	7.01	7.21	4.93	7.06	8.49
28-12S	6.52	7.50	5.92	7.45	8.84
28-12P	7.10	7.76	5.48	7.56	9.04
28-13S	6.52	7.50	5.92	7.45	8.84
28-13P	7.80	7.80	5.48	8.69	9.09
28-14S	5.04	5.28	4.35	6.03	7.60
28-14P	5.77	5.77	3.45	6.67	7.06
28-15S	8.54	8.78	7.16	9.53	10.76
28-15P	9.28	9.28	7.01	10.22	10.61
28-16S	5.77	6.61	5.13	6.67	8.05
28-16P	6.86	6.86	6.23	7.76	8.09
28-17S	5.09	5.88	4.44	5.97	7.41
28-17P	5.43	6.17	3.91	6.17	6.17
28-18S	6.12	6.37	4.55	7.10	8.14

Insert	Shell and 1947 List Price 3100	3101	3102	3106	3108
28-18P	5.59	5.83	3.71	6.57	7.21
28-19S	5.33	6.12	3.85	6.12	7.06
28-19P	4.64	5.39	3.11	5.59	6.61
28-20S	6.32	7.25	4.99	7.10	8.00
28-20P	5.48	6.32	4.00	6.27	7.56
28-21S	10.86	10.86	7.45	11.80	12.14
28-21P	9.58	9.58	7.16	8.89	10.81
28-22S	6.81	6.81	4.49	7.65	8.05
28-22P	6.37	5.97	3.76	6.96	7.25
32-1S	6.67	6.86	4.40	7.90	8.34
32-1P	5.82	6.32	3.91	6.72	7.76
32-3S	7.25	7.41	4.93	7.25	8.89
32-3P	6.57	6.81	4.44	7.45	8.34
32-4S	7.30	7.56	5.92	8.29	9.42
32-4P	6.92	7.01	4.64	8.05	8.54
32-5S	6.32	7.25	4.25	6.67	8.20
32-5P	5.09	5.77	3.36	6.03	7.01
32-6S	10.76	10.86	8.44	11.90	12.40
32-6P	9.33	9.42	7.06	9.62	10.96
32-7S	10.61	10.72	8.29	11.76	12.29
32-7P	9.73	9.82	7.16	9.43	11.41
32-8S	9.73	9.88	7.45	10.86	11.41
32-8P	8.98	9.13	5.83	10.12	10.66
32-9S	8.40	8.64	6.61	9.38	10.46
32-9P	7.45	7.56	5.09	8.54	9.09
32-10S	7.80	8.14	5.73	8.69	9.68
32-10P	6.23	6.72	4.35	7.10	8.09
32-12S	7.76	7.90	5.48	8.89	9.38
32-12P	6.86	7.01	4.55	8.05	8.54
32-13S	10.60	10.80	8.85	11.60	11.80
32-13P	8.45	8.70	6.80	9.05	9.75
32-15S	7.63	7.70	6.07	9.56	9.70
32-15P	7.33	7.41	5.78	9.26	9.41
32-16S	10.76	10.86	8.49	11.90	12.44
32-16P	9.38	9.53	7.10	10.52	11.01
32-17S	12.78	13.30	11.19	13.41	14.63
32-17P	12.48	13.04	10.93	12.82	14.37
32-101S	13.77	15.50	12.74	14.66	15.65
32-101P	11.36	11.50	9.09	12.49	12.89
32-102S	11.56	11.65	9.24	12.44	13.18
32-102P	9.04	9.13	6.67	10.12	10.66
36-1S	8.84	9.28	6.99	9.13	10.96
36-1P	8.20	8.34	5.28	8.64	10.08
36-2S	7.60	8.29	6.12	9.04	9.97
36-2P	7.25	7.56	5.33	8.34	9.28
36-3S	8.44	8.58	6.43	9.77	10.02
36-3P	7.59	7.80	5.53	8.58	9.42
36-5S	7.94	8.09	5.92	9.28	9.77
36-5P	6.96	7.10	4.84	8.29	8.78
36-6S	9.42	9.62	7.60	10.76	11.30
36-6P	8.34	8.58	6.37	9.38	10.17
36-7S	12.89	10.04	10.81	12.34	14.72
36-7P	10.26	11.90	8.64	13.09	13.58
36-8S	10.92	12.40	9.97	11.90	14.42
36-8P	11.50	11.70	8.78	12.89	13.48
36-9S	12.60	12.78	10.52	13.97	14.46
36-9P	9.48	11.01	8.44	12.14	12.49
36-10S	12.56	12.56	10.56	14.67	14.15
36-10P	15.04	15.04	13.04	17.15	16.63
36-13S	8.58	8.74	6.12	9.93	10.42
36-13P	7.60	7.76	5.09	8.89	7.01
36-14S	9.62	9.77	7.16	10.85	11.45
36-14P	6.86	7.01	4.35	8.14	8.64
36-15S	8.89	10.17	8.00	9.88	11.06
36-15P	10.12	10.26	7.65	11.16	11.94
36-19S	11.89	9.04	9.81	11.34	13.72
36-19P	9.26	10.90	7.64	12.09	12.58
36-20S	11.89	9.04	9.81	11.34	13.72
36-20P	9.26	10.90	7.64	12.09	12.58
40-1S	12.29	12.49	9.04	13.73	12.93
40-1P	10.81	11.01	6.57	11.10	11.57
40-2S	10.32	10.57	7.50	10.86	11.80
40-2P	9.73	9.88	6.37	11.70	12.29
40-6P	11.21	9.77	7.65	13.13	13.73
40-7S	10.42	10.66	7.85	10.92	11.90
40-7P	13.93	12.40	10.52	15.80	14.61
40-9S	17.24	17.44	13.68	19.21	19.85
40-9P	14.76	15.01	11.26	16.78	12.38
40-10S	15.26	15.76	11.76	17.28	17.88
40-10P	13.93	14.12	10.37	15.85	16.49
40-11S	13.04	14.66	10.61	16.44	17.04
40-11P	11.86	12.05	8.34	13.82	14.42
44-1S	14.72	16.54	10.86	15.16	16.54
44-1P	15.06	15.30	9.09	15.06	13.73
44-2S	18.37	16.44	10.46	17.18	16.93
44-2P	13.88	14.42	8.44	14.12	15.65
44-3S	15.90	12.34	10.17	15.90	8.64
44-3P	14.52	14.72	8.74	14.52	15.26
44-4S	18.86	18.37	13.13	18.02	18.81
44-4P	16.40	16.60	10.46	16.34	17.82
48-1S	15.94	16.29	9.58	19.85	18.46
48-1P	13.97	14.22	8.20	15.36	16.93
48-2S	15.94	16.29	9.58	19.85	18.46
48-2P	13.97	14.22	8.20	15.36	16.93
48-3S	15.94	16.29	9.58	19.85	18.46
48-3P	13.97	14.22	8.20	15.36	16.93
48-4S	15.94	16.29	9.58	19.85	18.46
48-4P	13.97	14.22	8.20	15.36	16.93
48-5S	34.53	39.14	31.67	39.27	39.84
48-5P	23.45	27.68	21.53	27.96	28.11

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APS-4	Complete Radar	APS-6 Complete
Mark 16	Complete Radar	RT34/APS13
APT1	APT4	MD5/APS3
APT2	T-85/APT-5	MD22/UPN2
APT3	MD4/APS2	MD38/APQ13

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Complete Line!

DuMont 224-A Oscilloscope
1-77 Hickok Tube Checker
1-208 FM Signal Generator
RPC Model 644 Multimeter
Ferris Microvolter Mod. 18-C

1–83G	TS19/APQ5	TS170
1–86A	TS24A/APR2	TS175/UP
1–114	TS27/TSM	TS182/UP
1–183	TS34/AP	TS184A/AP
1–185	TS36/AP	TS204/AP
1–187	TS61/AP	TS250/APN
1–198	TS62/AP	TS251
IE–36	TS89	SL1 Slotted Line Test Set
I–122	TS92	
I-139	TS100/AP	UPM-1 (Complete)
I-212	TS111/CP	
I-222	TS126	WE 1 193
TS3/AP	TS127/U	Range Calibrator 1–146
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Transtat controlled to produce high voltage DC from 110 VAC 60 cycle source. Up to 11,500 VDC @ 50 W. Metered high voltage (0-15KV) and current (0-20 MA). NEW....................$74.50

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SCR 625. For prospecting, mining, etc. NEW $59.50

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ARC-1	APR-5	R89
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APR-4	TA2J-24	733-D

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If the type of tube you are looking for is listed, you have a buy!! All brand new, guaranteed tubes at the lowest prices in the industry. We have them in stock. Immediate delivery.

OA2	.99	2C44	.75	5AP1	3.49	VT90	.75	353A	3.95	713A	.92	838	2.95	1616	.69
OA3/VR75	1.25	3E22	1.95	5C30/C5B	3.75	VT98	75.00	357A	14.95	714AY	5.75	841	.39	1619	.35
OB2	1.05	2J22	7.50	5FP7	3.95	100TH	8.50	371B	.89	715A	5.95	843	.33	1625	.45
OB3/VR90	1.05	2J26	9.95	C5B	3.75	HY114B	.75	388A	1.29	715B	8.50	846	49.95	1626	.45
OC3/VR105	1.10	2J27	9.95	C6A	5.75	VT127	1.75	394A	4.75	717A	1.19	851	39.50	1629	.30
OD3/VR150	.85	2J39	19.50	6AK5	.95	205B	1.49	417A	14.95	721A	1.75	860	6.50	1636	2.95
1B22	2.19	2J40	29.50	6K7G	.45	211	.75	450TH	37.50	722A	1.89	861	21.50	1642	.59
1B26	2.49	2J61	39.50	7BP5	14.95	211 GE	1.75	530	16.95	723AB	17.95	864	.75	1851	1.69
1B27	14.50	2J62	29.95	7C4	.35	217C	6.95	531	6.75	724B	2.49	865	1.25	2051	.95
1B29	4.75	2V3G	.75	7E5	.39	249B	3.25	533	45.00	725A	6.25	866A	1.45	7193	.35
1B36	7.50	2X2	.49	10Y	.39	250TH	18.95	559	2.25	800A	1.75	872A GE	3.95	8011	.75
1B56	24.50	3B7/1291	.30	12A6	.49	250TL	16.95	HY615	.22	801A	.44	874	.69	8012	2.75
EL1C	2.49	3B22	2.49	24G	1.49	257B	9.95	700A	17.50	803	3.25	876	.59	8013A	3.95
1D8G	.59	3C24	1.49	RK34	.49	285A	4.95	701A	4.95	805	3.69	879	.49	8021	1.95
1L4	.59	3C28	4.95	45 Special	.29	286A	6.95	702A	2.49	807	1.59	931A	5.95	8025A	6.95
1R4/1294	.89	3CP1/S1	1.95	FG17	4.50	304TH	7.50	703A	4.75	808	1.75	954	.35	9001	1.50
1T4	.59	3DP1	3.95	CRP72	1.00	304TL	8.75	704A	.89	812	3.25	955	.45	9002	1.25
2C21/1642	.59	3D6/1299	.35	RK72	1.00	307A	3.50	705A	1.95	813	8.50	957	.45	9003	1.75
2C22/7193	.30	3D23	4.75	CRP73	1.00	316A	.49	706AY-DY	39.50	814	3.40	E1148	.33	9004	.49
2C26A	.29	3FP7	1.75	RK73	1.00	328A	7.95	706EY-GY	29.95	829B	14.50	CK1005	.65	9005	1.50
2C34/RK34	.49	3Q4	.59	RK75	3.95	329A	7.25	707A	7.95	830B	2.95	1608	3.95	9006	.29
2C40	9.95	4B28	3.95	REL5	45.00	331A	6.95	708A	3.75						
2C43	16.95	4J42/700A	17.50	FG81A	3.49	350B	3.95	710A/8011	.75						

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CO-127 single #14 AWG braided and tinned copper braid shield

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2 conductor AWG 12	7 conductor AWG 16
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11 conductor shielded AWG 20	10 conductor AWG 16
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DRIA-23 FRIA-4

SINGLE CONDUCTOR AWG 10

shielded cable with terminal lug each end 100′ and 150′ lengths

WIRE

AWG 18 copperweld
AWG 29 tinned copper
Resistance wire AWG 32
AWG 22 with nylon core plastic insulation

LINEAR WIRE WOUND POTENTIOMETERS

10 Ohm	25 Watt	$.90	15000 Ohm	25 Watt	$1.70
15	25	.95	20000	25	2.00
20	25	.95	6	50	1.60
25	25	.95	150 w/switch	50	2.15
50	25	.95	200 w/switch	50	2.15
100	25	.95	10000	50	2.95
200	25	1.20	15	75	2.95
350	25	1.20	.5 Meg 1″ shaft	AB "J"	1.45
500	25	1.20	200,000 1/8 SD	AB "J"	1.40
1000	25	1.30	200 1/8 SD	AB "J"	1.40

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10 CM echo box CABV 14ABA-1 of OBU-3, frequency range 2890 MC — 3170 MCS. Direct reading micrometer head. Ring prediction scale plus 9% to minus 9% Type "N" input. Resonance indicator meter. With accessories, spares and 10 CM directional coupler. Brand New

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2C34	$0.55	803	$3.75	CEQ-72	$1.15
2X2/879	.60	826	.95	CK 70	4.25
3B24	5.00	864	.40	CRP-72	1.15
3C24	1.75	931A	4.45	E1148	.35
7C4/1203A	.75	955	.40	HY-615	.20
10Y	.45	957	.40	RKR-72	1.15
15R	.70	CK1005	.50	RK-73	.60
30 Special	.45	CK1007	.90	5BP4	4.95
39/44	.30	1626	.40	5FP7	1.95
45 Special	.35	1629	.35	1J6G	.70
WE 203A	8.00	2051	1.15	1B3GT	.89
316A	.65	7193	.50	3A4	.65
WL-531	5.50	8011	1.50	5U4G	.57
713A	.95	9006	.40	6K6GT	.65
801A	.40	C5B	8.50	12A6	.65

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.4 HY 4.5 Amp DC 3 ohms 1230 RMS to ground GE69G351. New.
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10 CM ROTATING ANTENNA

24″ Parabola in turret 360° span at 12 RPM DC, motor control and reversing switch New

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Breaks Contact with Increase of Temperature New $1.35

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DPST 115 VAC 60 cycle 15 Amp De-Ion Line Starter Westinghouse $6.95
DPST 115 VAC "AB" #700 $5.95

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24 VDC 3PDT 8 Amp....................$1.50
110 VAC DPST 1 Amp Contacts Struthers Dunn CKA 1970....................$3.65
115 VAC DPST Struthers Dunn CXA 2997 $3.65
220 VDC DPDT Struthers Dunn CK 2122..$4.50
230 V 50 cycle DPDT G.E. 12HGA11A2..$4.00

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Constant Speed Control Governor which automatically brings about the adjustments in propeller blade pitch necessary to maintain constant engine speed. Used on DC-3 Airplanes. Brand New.

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Walkie-Talkies 2.3-4.6 MC
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DAB-3—Direction Finder
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APS-6		SCR-545
APS-13	SO	SCR-750
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SCR-284—the famous mobile and ground station for field use. Large quantity of complete sets available.

MAG—10 cm. portable link radar transmitter receivers, 6-volt operation.

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TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
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OC3	$1.60	2J39	49.50	4J29	175.00	304TH	15.00	715B	17.50	892R	250.00
OD3	1.50	2J42	150.00	4J30	write	304TL	15.00	720	write	2x2/879	1.75
C1A	6.00	2J49	100.00	4J31	175.00	307A	5.00	721A	3.75	954	1.00
C1B	7.00	2J50	75.00	4J33	190.00	339A	35.00	723A/B	25.00	955	1.00
C6A	write	2J61	75.00	4J52	350.00	371B	2.50	724B	6.50	956	1.00
C6F	12.50	2J62	75.00	5J23	write	388A	2.75	725A	write	1616	2.75
C6J	write	2K22	write	5J26	350.00	446A	2.00	730A	45.00	1619	.75
1B22	3.95	2K25	35.00	5J29	write	446B	4.00	803	7.00	1624	2.00
1B23	10.00	2K26	150.00	6C21	29.50	450TH	45.00	807	1.65	1625	.65
1B24	write	2K29	35.00	10Y	1.25	450TL	45.00	813	9.00	1626	.75
2B22	4.95	2K36	write	100TH	9.00	464A	9.50	829A	12.00	1629	.65
2B26	3.75	2K41	150.00	204A	60.00	705A	3.50	832A	10.00	1636	3.00
2C40	18.00	2K45	100.00	211	1.00	706A-GY	45.00	833A	42.50	1642	3.50
2C43	25.00	2K54	150.00	250TH	30.00	707B	25.00	836	4.75	2050	2.00
2D21	1.70	2K55	100.00					837	2.75	8012	4.25
2E22	3.75	3B24	6.50					843	write	8020	3.50
2J21	17.50	3B27	10.00					849	50.00	8025	7.00
2J22	17.50	3B28	10.00					851	80.00	9001	1.65
2J26	27.50	3C31	5.75					860	5.00	9002	1.50
2J27	27.50	3E29	15.00					861	40.00	9003	1.75
2J31	27.50	4C27	25.00					865	1.40	9004	1.75
2J32	65.00	4C28	35.00					872A	3.85	9005	1.90
2J33	100.00	4E27	17.50					874	1.50	9006	.50
2J34	write	4J25	175.00					889R	195.00		
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DM-32	DY-10	PE-86	BD-69
DM-33	DY-12	PE-94	MS-41
DM-36	DY-22	PE-98	

And other numbers.

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TUBES—Magnatron, Receiving & Transmitting
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G.E. 7000 ohm 6 ma. 3PNO compact type......$2.45
G.E. CR2791, 10,000 ohm 9 ma, 3PDT..........$4.95
GM LABS. 200 ohm (dual) 6-12-24 volt 4PDT..$3.75
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TYPES	CM-45	CM-50	CM-55	CM-56	CM-70	ETC.	
600VDCW	.00005	.0001	.00025	.0005			$.25
600VDCW	.002	.003	.0035	.004			$.30
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Dummy Load, S Band, 1½"x3" guide dissipates 1000 watts average power in still air, VSWR less than 1.15 between 2.5 to 3.7 KMC, choke flange, weight 13 pounds.

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S Band Spectrum Analyzer 2700-3400 Mc., similar to above.

Amplifier Strip AM-CCA/SPR-2, contains I. F. amplifier, detector, video amplifier, pulse stretcher and audio amplifier and Rectifier Power Unit PP-155A/SPR-2, band width 10 megacycles, center frequency 30 megacycles, sensitivity 50 microvolts for 10 milliwatts output. Power supply 80/115 V ac, 60-2600 cps, 1.3 amps. Send for schematic.

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Microline MK SX-12 Klystron Supply and Panel.

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Power Supply, input 220V 3 ph 60 cycles

output:	3500 volts 2 amps DC	11v 31a ac
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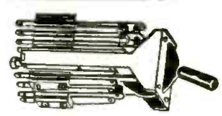

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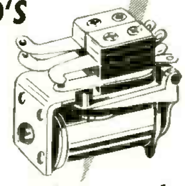

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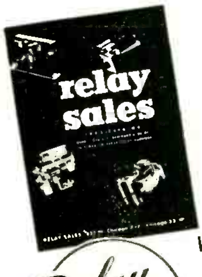

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*TS-12	*TS-117/GP	TS-323	BC-949/A
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TS-33/AP	*TS-155A/AP	I-122	BE-67
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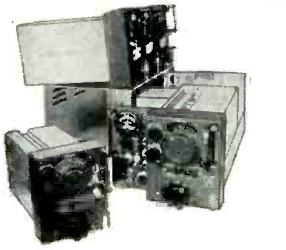

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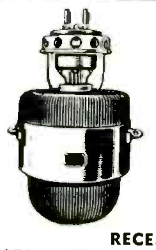

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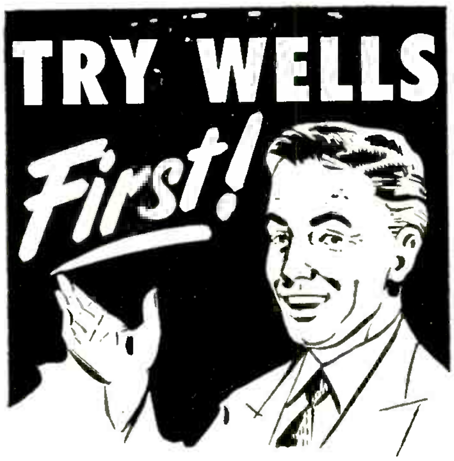

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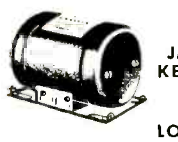


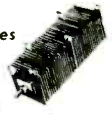

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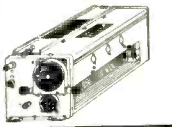


RADIO RECEIVER

BC-AR-429. Western Electric. Uses four—39/44's, one—37, and one—38 tubes. Comes complete with six new tubes and tuning cable. Size 6x7x15". Wt. 11½ lbs. Price brand New....$7.95

3,750 WATT RECTIFIER TUBE

Continental Electric Co.—Type CE202. Half-wave mercury vapor. Rated up to 250 VDC at 15 amp. Filament 2.5 volt—20 amps. Mogul base. Price NEW $9.95

2.28 KVA PLATE TRANSFORMER

United Transformer Co.—117 VAC-60 cy primary. Secondary 4800 volts CT at 0.475 amp DC. HIPOT: Pri-1500 VRMS, Sec-7000 VRMS. Hermetically sealed. Size 10 x 10 x 11". Wt. 94 lbs. Finish has a few scratches but otherwise perfect. Price brand NEW $29.50

ELAPSED TIME METER

General Electric. Sym. M305. Indicates 1-99,999 hours. 115 VAC, 60 cycles. 3" round bakelite case. Square flush face.
Price NEW $11.50

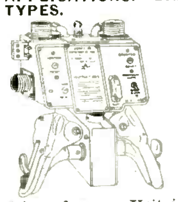
SPECIALS

DC MOTOR—Emerson Electric. Type D44F0447-0447. 1 H.P. 5400 RPM. 12 volts. 100 amps. Double end shaft ⅝" dia. by 1-3/16" length on each end. 4½x4½x9". Wt. 17 lbs. Price NEW $8.50

AMPLIDYNE MOTOR GENERATOR.. Emerson Electric. #5AM31NJ18A. Input 27 VDC—44 amps. Output 60 VDC—8.8 amps. 530 watts, 8300 RPM. 6x8x12". Wt. 34 lbs. Price NEW....$7.95

WHITE-ROGER SERVO MOTORS—24 VDC. Torque 150 in., lbs. Reversible. Control box on top has limit switches, relays, and selenium rectifiers (to block AC out of motor). 5x5x4". Can be supplied in Models 6904—5 RPM. 6904—3½ RPM. or 6905—2½ RPM. Price each NEW..........$8.95

SEE APRIL AD ON PAGE 380 FOR OTHER GEAR HEAD MOTORS. OUR CUSTOMERS HAVE USED THESE TO MAKE COIL-WINDERS. MIXERS. HOISTS. WINCHES. DUMB WAITERS. GARAGE DOOR-OPENERS, RETRACTABLE STAIRS, BUFFERS. AND FOR MANY OTHER APPLICATIONS. LIMITED STOCK ON SOME TYPES.



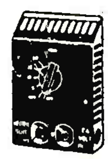
HAND CONTROL

Emerson Electric. #250-CE15. For Martin Power Gun Turret which this unit completely controls. Handle assembly moves in two planes, operating built-in elevation and azimuth field rheostats. Six switchettes, built into molded plastic handles, control signals and firing of guns. Unit is filled with other switches, circuit breakers, resistors, gears, AN connectors and cables, etc. Size 12x11½x6½". Wt. 10 lbs. Acquisition Cost over $200.00. Price NEW in original boxes $8.95

NOTE. OTHER GUN TURRET EQUIPMENT IN STOCK INCLUDING JUNCTION BOXES, CONTOUR FOLLOWERS, ELEVATION-AZIMUTH AMPLIDYNE UNITS, SWITCH BOXES, AND INTERRUPTERS.

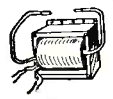
GUN FIRE INTERRUPTER

Mfg. by Fox Industries for **Emerson Electric.** Mod. 150-CH-3. Disassembles into two independent gear boxes. Back half is worm type with a 30 to 1 ratio and has a 7/16" take-off shaft 4½" long. Front half is a pinion-rack gear combination. Rack has a 6" travel. Ball and sleeve bearings. Size 5x6x13". Wt. 6½ lbs. Acquisition cost $158.00. Our price NEW in original boxes ONLY $5.95



RHEOSTAT

Ideal for regulating voltage on motors, generators, soldering irons, etc. Rated 100 watts, double windings, and dual female 25 amp. 125 volt receptacles. Supplied in either 2.0 or 5.75 ohm models. (Specify) 7x5¼x1¾". Wt. 2½ lbs. Price NEW ONLY $1.95



OPEN TYPE TRANSFORMERS—60 CY.

#0692. Input 115/230 V. Output 18 V at 100 amps. Secondary leads 18" long. 7¾x5x6". Wt. 40 lbs. Price NEW $16.50

#4320. Input 115 V. Output 25 V at 9 amp. 3¼x4x4". Wt. 6¼ lbs. Price NEW..........$3.75

#306. Input 115 V. Output 11 V at 5 amp. 2¾x3½x2¾". Wt. 3 lbs. Price NEW.......$2.95

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4736 Olive St. St. Louis 8, Mo.

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We have developed the new Directron Universal Selenium Rectifier, which for the first time permits a single stack to work as a half-wave rectifier, full-wave center-tap, or bridge rectifier merely by proper connections to the contacts. These rectifiers are a must for labs and occasional users of Selenium Rectifiers. Full hook-up and technical information. Order in the following sizes.

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12 Amps. (Up to 20 volts Input).............. 14.25

SELENIUM RECTIFIERS

FULL-WAVE BRIDGE TYPES

Current (Continuous)	18/14 Volts	36/28 Volts	54/42 Volts	130/100 Volts
1 Amp.	.....	$2.10	.....	$8.95
2 Amps.	$2.20	3.60	$6.50	10.50
2½ Amps.	.....	.....	.....	13.00
4 Amps.	3.75	6.75	8.75	.....
5 Amps.	5.00	8.00	13.00	32.00
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	.....	.....

We now stock over 100,000 plates and can manufacture standard as well as special types of selenium rectifiers, rect. supplies, and XFMRS. Low prices . . . Write.

• New, Selenium Rectifier Transformers

PRI: 115 V., 60 cycles in. Sec: 9, 12, 18, 24, and 36 volts
4 Amps ...$ 8.75
12 Amps ... 16.75
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"Made to our specs. for continuous, heavy duty use"

- 115V. PRI.—36V. 50 amp second XFMR..$39.95
- 115V. PRI.—5V. @ 190 Amp. SEC........$59.95
- 115/230 V. 60 cy. PRI. SEC.: 1.5, 30.5, 33.5, and 36.5 V @ 4 AMPS.

Herm. sealed—Special $7.95

EMAC 32 KV.
VACUUM CAPACITORS. BOXED
6MMF. ....$8.50 — 12 MMF. $10.95
50 MMF. $13.50

- Weston Meters. 0-100 micro amps. 2¼" Diam. New Boxed. VERY Special at only........$5.95
- Bliley-Type SMC—100 Kc, Crystal Standards. New $8.50

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We guarantee all tubes. We endeavor to give you low, low prices, consistent with quality merchandise and service.

Here is only a partial listing of our large stocks of Nationally Advertised Brands.

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1B22	2.25	6AC7	.98	715-A	6.00
1B23	8.00	6AG5	.69	715-B	9.00
1B24	12.50	6AG7	1.50	715-C	22.95
1B27	15.00	6AK5	.75	717-A	.98
1B36(SYL.)	4.50	6AN5	2.75	725-A	6.95
1L21(G.E.)	4.00	6AQ6	.90	807 or 807A	1.65
1N21	.79	6BH6	.75	808	2.25
1N21-B	3.25	6BK7	1.40	814(G.E.)	2.75
1N23	1.35	6C4	.60	829-B	12.00
1N23-A	2.45	6F6	.95	832-A	8.50
1N23-B	3.65	6J5	.55	837	1.25
1N26	7.95	6J6	.69	861	22.00
1N34	.64	6J7	.95	866-A	1.55
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1N44/400B	1.21	6L7	.98	884	1.70
1N45/400C	1.39	6S7	.98	892-R	175.00
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1P24	1.60	7C25	125.00	954	.29
2E24	3.95	7C30	85.00	CK1027	2.50
2E26	3.19	872-A(G.E.)	3.50	1613	.90
2E30	2.19	12A6	.65	1616	.74
2J30	49.50	12AU7	.69	1624	1.40
2J32	35.00	12SF5	.70	1625	.39
2J34	27.50	12SR7	.75	1629	.29
2J49	35.00	15-E	1.30	2050	1.47
2K45	95.00	35-T(ION)	4.00	2051	1.19
3B29	13.50	211	.75	5516	5.98
3BP1	6.75	242-C	4.00	5608-A	2.95
3BP11	10.00	274-A(WE)	3.50	5654	2.25
3C23	9.75	274-B(WE)	2.25	5814	2.25
3D6/1299	.50	275-A(WE)	4.50	5910	.75
3DP1-A	5.95	304-TH	8.50	9001	1.00
3S4	.90	304-TL	8.50	9002	.98
4-125A	29.00	311-A(WE)	6.50	9003	1.50
4J32	99.50	359-B(WE)	2.50	9004(RCA)	.39
4J33	99.50	373-A(WE)	5.00	9006	.39
4X150A	39.50	374-A(WE)	1.50	C6L/5528	15.00
5BP1	3.95	387-A(WE)	2.50	F-123-A	5.95
5CP1	3.95	400-A(WE)	2.50	F660	37.50
5D21(WE)	9.95	403-B/5591	5.00	FG-172	15.50
5FP7	1.75	407-A(WE)	5.00	KU-676	25.00
5LP7	15.95	408-A(WE)	2.75	RKR-72	.75
5U4-G	.59	527	12.00		
5V4-G	1.05	559	1.00		

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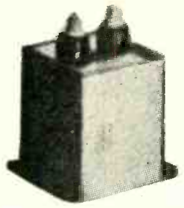

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Round 1 MFD. 1000 VDC screw Type 1 Lug 2¾" High ....50¢ ea.

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TYPE J150 ohm 50 Watt #5381.......$1.89 each
TYPE K 100 Watt 25 Ohm...............$2.96
TYPE H 25 Watt 15 Ohm................$1.67

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815	2.80	9002	1.35
829B	14.50	9003	1.70
830B	3.95	9006	0.40
832	6.95	ELIC	2.75
832A	9.00	6L6G	1.58
1B24SYL	13.95	2J49	105.00
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Voltmeter Westinghouse Type NX35 0-500 V DC 3½" rd. FS-IMA...........................$12.35
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Meter 0-15 MA-DC Westinghouse RX-37 4" square $11.85
COUNTER Veeder Root Ratchet 5 Number Type 1144 ....$1.19

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UG 9/U ....95 EACH

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HAYDON SYNCHRONOUS MOTOR

110 V.A.C.
½ R.P.M.
3.6 Watts
$2.47 each

Haydon, 2.2 watt 1-120 RPM..............$1.68
complete with coin arrangement for 25¢ pc..$2.49
minimum order 5 pcs. on synchronous motor.

MICA TRANSMITTING CAPACITORS Type G3 .0001 Mfd 25KV.......................$48.00 ea.
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Type TA-1000-2 7500/3900 Ohm........$5.25 ea.

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Three term. bot. mntg. channel type. Dims. 3¾"x3½"x2". 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 where ruggedness and quality are paramount. Carton or 24 weight 42 lbs. $.79 ea.

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Three term. dual 3 mfd. oil cond. complete with brackets, measuring 4¼"x1¾"x1". Ideal for audio crossover networks.

16 mfd.—600 V...........$1.75
Dual 8 mfd oil filled cond. hermetically sealed and packed. Tobe type PT-SC-11 measuring 3¾"x2⅝"x2⅝". Stud mntg. centers 2". Plugs into standard four prong socket. *Quantity discount.*

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7 mfd.—600 V............$1.25
4 mfd.—600 V............$1.10

6 mfd.—600 V...........$1.55
JAN approved CP70BIFF605K
Complete with brackets

8 mfd.—1000 V. JAN.......$3.25
4 mfd.—600 V. JAN........$1.35
.5 mfd.—400 V............$ .19
.5-.1 mfd.—2000 V.........$ .69

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2J22	304	832
6AC7	304TL	VR75
6AG5	807	VR90
6L6M	813	VR105
6X5	829	VR150

Complete line of C.R. Tubes

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Complete with PE-103, PE-104, BC-654 plus all accessories. Like new.

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5—100 W. Transmitters; voltage input 6, 12, 24, 32, 48, 110 VDC and 110 VAC. 60-day warranty with each set. Here are some samples:
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BC-221	TS-10	TS-124
I-36	TS-16	TS-127
I-130A	TS-34A	TS-170
I-222	TS-46AP	TS-215/AP
LM	TS-47APR	

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BC-312 RECEIVER
COMPLETE COMMAND EQUIPMENT: ARC-5 & 274-N
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Halicrafter BC-610 Transmitter. 400 W.
BC-640 & BC-639. Complete.
BC-460 Collins Auto-Tune Xmtr. 200 W.
BD-71 & BD-72 Switchboard. SCR-193

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AN3106-10S-2S. PL-68, PL-259A, 83-1H, S8, JK 33A. **CONDENSERS: BATHTUB, MICA, AIR, OIL, HV, CER. JPOTS, RELAYS, MIKES, 3AG&MDL** fuses, **SWITCHES SPARES** for: **AN/TRC-1, MK11** Radar, **AN/TPN-2** 2% .002 Silver Mica CM30; many other items.

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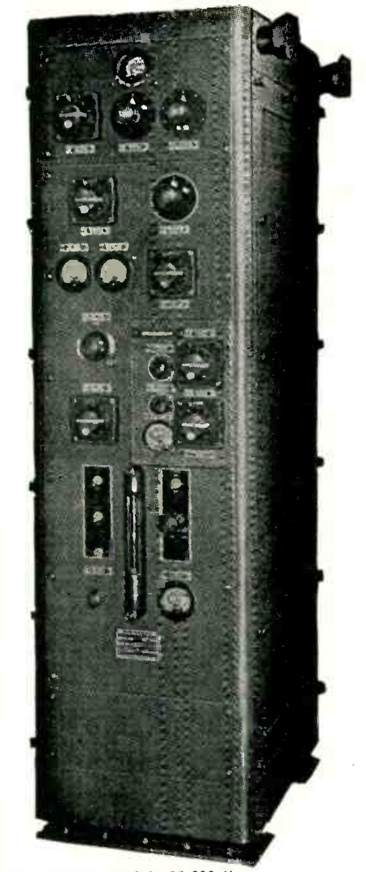

Freq. Range: 2000 to 20,000 Kcs.
Output: 350 Watts C.W. 250 Watts Radiotelephone
Input: 190 to 250 Volts AC 50/60 cps.
Size: 60" high, 17" wide, 27" deep.
Tubes: 807s, 813s, 805s, 866s.

Crystal Oscillator unit built-in, fully shielded and stable. All self contained including antenna network. Master Oscillator unit (available) fits in place of Xtal unit. Speech amplifier is only external unit and has 110/220 v. AC input, four stages, high gain. Total net weight, 625 lbs.

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0.116	150	600	1830	3333	10500	36000	200000
0.42	160	612	1850	3384	10600	37000	201000
0.425	165	620	1865	3500	10900	38140	205000
0.607	170	625	1892	3509	10936	38500	210000
0.7	175	633	1894	3600	11000	39000	215000
1.03	179	640	1895	3700	11400	39500	220000
1.3	180	641	1896	3730	11500	40000	225000
1.75	182	645	1897	3760	11690	41400	229000
2.5	182.4	649	1898	3900	12000	42000	230000
3	200	650	1899	4000	12500	43000	235500
3.83	209.4	657	1900	4030	12800	45000	238000
4	210	665	1901	4200		47000	240000
4.35	216	670	1902	4220	13100	47500	245000
5	220	673	1903	4280	13500	48000	250000
5.025	220.4	675	1904	4300	13550	48660	265000
6.25	225	680	1905	4314	13600	49000	268000
6.5	230	681	1906	4440	14000	50000	270000
7	235	684	1907	4444	14250	51000	275000
7.8	240	689	1908	4500	14400	52000	294000
7.9	245	697	1909		14500	55000	300000
8	245.4	699	1910	4720	14550	56000	307500
10.3	250	700	1911	5750	14600	57065	311000
11.2	260	711	1912	4850	15000	58333	314000
	270	733	1913	4885	16000	60000	316000
13.5	271	740	1914	4900	16500	61430	325000
14.2	275	750	1915	5000	16800	62000	330000
	280	800	1916	5100	17000	64000	333500
14.5	286	806	1917	5210	17500	65000	350000
15	289	820	1918	5235	17977	66600	353500
16	299	850	1919	5270	18000	66650	375000
17	300	854	1922	5300	18300	67500	380000
19.5	310	899	1924	5500	18380	68000	390000
19.2	311	900	1926	5600	18500	70000	400000
20	320	910	1960	5730	18800	72000	402000
22	325	917	1980	5770	19000	73500	420000
23	330	946	2000	5910	19500	75000	422000
24	340	978	2045	6000	20000	80000	425000
25	350	1000	2080	6100	20441	82000	430000
27	360	1030	2095	6125	20500	84000	450000
28	366.6	1056	2141	6140	21000	85000	458000
30	370	1059	2142	6200	21500	85750	470000
31.5	375	1067	2145	6300	22000	88000	472000
37	380	1100	2150	645[illegible]	22500	90000	478000
48	389	1110	2160	6500	22990	91000	500000
	390	1150	2180	6800	23000	93000	510000
50	400	1155	2187	6840	23150	93300	520000
51.78	410	1162	2195	6990	23325	95000	521000
55	414.3	1200	2200	7000	23400	100000	525000
56.7	418.8	1225	2250	7320	23500	110000	543000
60	425	1250	2300	7500	24000	115000	550000
63	426.9	1260	2400	7700	24600	116667	560000
68	427		2450	7717	25000	120000	570000
74	430	1350	2463	7900	25200	130000	575000
75	440	1355	2485	7930	25400	135000	600000
80	450	1400	2490	7950	25833	140000	620000
81.4	452	1488	2500	8000	26000	141000	650000
88	460	1495	2525	8094	26500	145000	654000
	470	1500	2600	8200	26600	147000	660000
95	475	1510	2625	8250	27000	150000	680000
100	478	1518	2635	8500	27500	155000	690000
101	480	1600	2700	8700	28000	160000	700000
103.2	487	1640	2750	8770	28430	165000	750000
105	500	1646	2850	9000	28500	166750	761300
105.7	510	1650	2860	9100	29000	167000	800000
107	520	1670	2870	9445	29500	169200	813000
110	525	1680	2900	9500	29990	175000	820000
120	540	1710	3000	9710	30000	180000	850000
121.2	550	1712	3100	9800	31000	180600	860000
125	560	1740	3163	9900	31500	185000	900000
130	575	1770	3259	9902	32000	186600	910000
135	580	1800	3290	10000	33000	190000	930000
147.5	588	1818	3300	10430	35000	198000	950000

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1.1	1.5	2.	2.8	3.9	5.5	7.62	11.55
1.2	1.57	2.11	2.855	4.	6.	7.74	12.
1.25	1.579	2.2	3.	4.23	6.5	8.	12.83
1.3	1.65	2.25	3.3	4.25	6.6	8.02	13.
1.35	1.75	2.5	3.5	4.5	6.7	8.5	13.85
1.39	1.8	2.7	3.673	5.	7.	9.05	30
						9.5	51.

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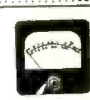

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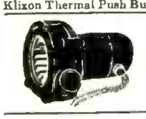

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Any Type—Any Quantity

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MFD.	VOLTAGE	TYPE	PRICE
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.01	4000 AC	26F789	2.95
.02	1000 DC	27F285	1.25
.02	400 DC	23F274	.39
.02	10 KVDC	24714	9.50
.045	16 KVDC	D-4495	9.95
.05	600 DC	S. T.	.29
.05	1000 DC	23F328	.49
.05-.05	600 DC	S. T.	.49
.05-.05	600 DC	22F797	.69
.06	25 KVDC	26F585	17.50
.1	400 DC	481379	.45
.1	500 DC	K7876543	.49
.1	600 DC	22F415	.59
.1	1000 DC	27F287	.65
.1	1500 DC	P70B1EH104K	.69
.1	3500 DC	K5204513	2.95
.1	7500 DC	25F405	3.95
.1	10 KVDC	23F430	9.95
.1	12 KVDC	26F68	9.95
.1-.1	230 AC	Z11860	.49
.1-.1	600 DC	22F805	.85
.1-.1	600 DC	27F291	.85
.1-.1-.1	400 DC	NCP9183	.79
.1-.1-.1	400 DC	CA-255	.79
.1-.1-.1	600 DC	6111G	.85
.1-.1-.1	600 DC	37J425	.85
.15	440 AC	5213288	.70
.15	4000 DC	400015	2.95
.15-.15	6000 DC	26F435	5.25
.15	8000 DC	Ldg. Mfgr.	6.95
.19	2500 DC	28F201	2.35
.2	440 AC	Ldg. Mfg.	.69
.2	1000 DC	23F316	.72
.2	10 KVDC	26F433	10.95
.2-.2-.2	4000 DC	10345	4.95
.25	250 AC	26F822	.69
.25	330 AC	9CE1A147	.72
.25	400 DC	DA4025	.49
.25	460 AC	26F876	.79
.25	600 DC	22F611	.69
.25	1000 DC	62B1FG254K	.89
.25	1000 DC	27F255	.85
.25	1000 DC	26F467	.85
.25	1000 AC	481129	1.45
.25	2000 DC	TJU200025	1.45
.25	3000 DC	5511P	3.45
.25	3500 DC	25F637	4.95
.25	4000 DC	26F767	5.95
.25	6000 DC	25F659	7.95
.25-.25	400 DC	22F640	.79
.25-.25	600 DC	6022G	.79
.25-.25	600 DC	51B4FF254L	.99
.25-.25	600 DC	K7102019P1	.79
.3	2000 DC	25F932	1.45
.3-.3	1000 AC	21F560	1.95
.31	2000 AC	21F480	2.50
.36-.36	800 AC	25F888	1.65
.366-.127-.055	330 AC	25F683	.95
.375	250 AC	26F937	.79
.38-.38	800 AC	21F707	1.65
.4	500 AC	21F720	.79
.4-.4	800 AC	21F588	1.70
.4	1400 AC	25F934	1.70
.42	800 AC	21F331	.85
.44-.44	880 AC	21F484	1.70
.45	120 DC	Ldg. Mfg.	.65
.45-.45	800 AC	21F569	1.95
.46	1750 AC	21F573	1.95
.5	200 DC	Ldg. Mfg.	.62
.5	330 AC	25F572	.79
.5	400 DC	C59589	.69
.5	400 DC	Ldg. Mfg.	.69
.5	600 DC	22F612	.79
.5	600 DC	Ldg. Mfg.	.79
.5	600 DC	Ldg. Mfg.	.79
.5	600 DC	65B144504K	.95
.5	1000 DC	23F331	.89
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.5-.1	400 DC	481769	.70
.5-.5	300 DC	23F280	.82
.5-.5	400 DC	Top Term.	.89
.5-.5	600 DC	23F498	.92
.5-.5	600 DC	23F487	.92
.5-.5	3000 DC	25F526	4.95
.5-.5-.5	600 DC	22F437	1.25
.58	1000 AC	21F476	1.65
.6	200 AC	28F120	.95
.6-.6-.6	100 AC	22F7142	1.25
.635	1300 AC	21F386	1.65
.656	900 AC	25F891	1.65
.666	800 AC	21F333	1.35
.67	120 AC	26F663	.95
.7	1300 AC	21F485	1.50
.7-.7	800 AC	21F381	1.95
.7-.7	800 AC	21F718	1.95
.75	330 AC	9CE1A148	.95
.75	400 DC	28F168	.89
.8	120 AC	21F603	.89
.86	660 AC	21F336	.95
1.0	100 DC	54B1EB105K	1.25
1.0	500 DC	23F303	.95
1.0	500 DC	9CD6A4	.95
1.0	440 AC	9CE1A320	1.05
1.0	600 DC	62B1BF105K	1.15
1.0	600 DC	Bathtub	.89
1.0	600 DC	Ldg. Mfg.	1.05
1.0	1000 DC	Ldg. Mfg.	1.15
1.0	1150 AC	21F641	1.75

MFD.	VOLTAGE	TYPE	PRICE
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1.0	2000 DC	23F70	2.95
1.0	4000 DC	40010	8.95
1.0-1.0	600 DC	Bathtub	1.25
1.0-1.0	600 DC	23F569	1.65
1-1-3-5	150 DC	Ldg. Mfg.	.95
1.05	800 AC	21F592	1.25
1.1	200 AC	25F450	1.25
1.1	440 AC	26F853	1.30
1.1	720 AC	21F477	1.65
1.25	125 AC	26F594	1.45
1.25	125 AC	28F192	1.45
1.25	660 AC	21F713	1.65
1.26	440 AC	21F338	1.45
1.26-.25	1000 AC	21F850	.95
1.26-3.0	1000 AC	21F714	.95
1.35	125 AC	28F238	1.49
1.45	750 AC	Ldg. Mfg.	1.55
1.45-2.8	850 AC	Ldg. Mfg.	1.55
1.5	330 AC	25F483	1.55
1.5	660 AC	21F651	1.75
1.58-0.3	800 AC	21F671	.95
1.66	850 AC	21F697	1.75
1.75	150 AC	28F159	1.55
1.75	330 AC	21F174	1.75
1.75	660 AC	21F631	1.95
2.0	120 AC	1A931	1.45
2.0	220 AC	21F169	1.65
2.0	330 AC	Ldg. Mfg.	1.70
2.0	400 DC	Bathtub	1.45
2.0	600 DC	Ldg. Mfg.	1.70
2.0	600 DC	22F999	1.70
2.0	250 AC	25F150	1.68
2.0	660 AC	25F993	1.85
2.0	800 AC	21F835	1.90
2.0	1000 DC	Ldg. Mfg.	2.95
2.0	1500 DC	Ldg Mfg.	3.95
2.0	2000 DC	20020	5.50
2.0	2500 DC	Ldg. Mfg.	6.45
2.0	3000 DC	Ldg. Mfg.	7.95
2.0	4000 DC	22F985	14.95
2.0	5000 DC	23F50	15.95
2.0	6000 DC	60020	27.50
2.0-.5-.3	200 DC	355	.95
2.2	750 AC	21F563	1.75
2.25	330 AC	21F479	1.85
2.25	600 DC	Ldg. Mfg.	1.85
2.25	1600 AC	21F667	4.50
2.5	330 AC	Ldg. Mfg.	2.35
2.6	440 AC	21F744	2.35
2.6-0.4	440 AC	21F676	1.75
2.7	230 AC	Ldg. Mfg.	2.45
2.75	330 AC	25F983	2.50
2.75	385 AC	49F16	2.60
3.0	330 AC	Ldg. Mfg.	2.75
3.0	600 DC	F6030	2.25
3.0	1000 DC	Ldg. Mfg.	2.75
3.0-.05	600 DC	22F632	1.65
3.25	330 AC	25F378	3.15
3.26	230 AC	21F696	2.75
3.5	330 AC	21F587	3.45
3.5	660 AC	25F971	3.95
3.7	230 AC	49F9	3.45
3.7	230 AC	21F705	3.45
3.75	330 AC	Ldg. Mfg.	3.50
3.75	1000 DC	6037	3.75
3.9	230 DC	Ldg. Mfg.	3.50
4.0	100 DC	23F548	1.95
4.0	330 AC	Ldg. Mfg.	3.65
4.0	400 DC	Oil Filled	2.50
4.0	500 DC	Oil Filled	2.65
4.0	600 DC	26F106	2.75
4.0	600 DC	70B1FF405V.	3.45
4.0	600 DC	481249	2.75
4.0	660 AC	21F665	3.95
4.0	1000 DC	Oil Filled	3.75
4.0	2000 DC	22F195	15.95
4.0	4000 DC	70E1EM405K	27.50
4.0-4.0	1000 DC	4223	4.50
4.5	230 AC	21F703	3.95
4.5	330 AC	21F691	4.25
4.65	230 AC	21F365	3.95
5.0	220 AC	21F134	4.35
5.0	330 AC	9CE1A306	4.35
5.5	230 AC	21F702	4.40
5.75	330 AC	26F100	4.50
5.0	440 AC	21F420	4.75
6.0	330 AC	3060	4.85
6.0	600 DC	5060	4.85
6.5	330 AC	Ldg. Mfg.	4.95
7.0	230 AC	21F300	4.95
7.5	330 AC	9CE1A309	4.95
8.0	660 AC	6080	5.25
8.0	1000 DC	Oil Filled	4.95
9.5	330 AC	26F273	4.95
10.0	50 AC	26F412	2.75
10.0	330 AC	Oil Filled	5.95
10.0	440 AC	25F501	5.95
10.0	600 DC	Ldg. Mfg.	5.95
10.0	1000 DC	10100G	7.95
10.0	1500 DC	23F152	8.95
10.0	1500 DC	70B1FH106K	8.95
12.0	750 AC	25F268	8.95
12.0	1000 AC	25F234	8.95
14.5	275 AC	25F500	7.50
15.0	330 AC	Ldg. Mfg.	9.50
20.0	220 AC	21F299	9.50
25.0	25 DC	Bathtub	.95
25.0	50 DC	Bathtub	1.45
30.0	90 AC	Ldg.Mfg.	2.65
30.0	400 DC	26F702	9.95
42.0	600 DC	25F673	17.50
46.2	330 AC	26F413	24.50
50.0	330 AC	KS8545	27.50
50-50-50	90 AC	MK4 MOD2.	29.95
60.0	3000 DC	18F269	75.00

HIGH VOLTAGE CAPACITORS

MFD.	VOLTAGE	TYPE	PRICE
.06	25 KVDC	26F585	17.50
.02	10 KVDC	24714	9.50
.045	16 KVDC	D4495	9.95
.1	6000 DC	19F210	27.50
.1	10 KVDC	23F430	9.95
.1	12 KVDC	26F68	9.95
.2	10 KVDC	26F433	10.95
.25	15 KVDC	15020	19.50
.25	20 KVDC	20020	27.50
.25	20 KVDC	14F64	29.95
.25-.25	6000 DC	A7548	14.50
.275-.275	7500 DC	Inerteen	16.50
.5	20 KVDC	20005	45.00
.5	25 KVDC	14F103	57.50

MFD	VOLTAGE	TYPE	PRICE
.5	25 KVDC	25050	57.50
.5	25 KVDC	Inerteen	57.50
.5-.5	9000 DC	2C21B1	32.50
.65	12.5 KVDC	120065	19.95
.75	25 KVDC	14F88	72.50
1.0	7500 DC	7520	27.50
1.0	10 KVDC	Inerteen	37.50
1.0	15 KVDC	14F63	45.00
1.0	20 KVDC	14F22	69.50
1.0	25 KVDC	A6734	82.50
2.0	6000 DC	60020	27.50
4.5	7500 DC	14F338	69.50
7.0	4000 DC	40244	37.50

ELECTRONIC TUBES

TYPE	PRICE
OA2	1.20
OA3/VR75	1.23
OA4G	1.19
OB2	1.40
OB3/VR90	1.05
OC3/VR105	1.05
OD3/VR150	.90
OZ3/	.85
BG1A	9.50
1B21A	2.75
1B22	2.25
1B23	8.25
1B24/Syl	10.50
1B24/West	9.00
1B26/	2.95
1B27	18.75
1B29	2.45
1B32	2.50
1B35	12.50
1B36	15.75
1B38	28.50
1B40	8.50
1B42	16.00
1B44	Q
1B50	Q
1B51	Q
1B52	Q
1B53	Q
1B54	Q
1B55	Q
1B56	Q
1B57	Q
1B58	Q
1B60	Q
1B62	Q
1N21 xtal	1.25
1N21A xtal	1.75
1N21B xtal	3.75
1N23 xtal	1.45
1N23A xtal	2.95
1N23B xtal	4.75
1N34 xtal	.75
1N34A xtal	.80
1D21/SN4	3.25
1P42	3.95
2AP1	7.50
2B22	2.45
2C21/1642	.69
2C22/7193	.29
2C26A	.49
2C33/RX233A	Q
2C34	.75
2C39	24.50
2C40	14.95
2C43	14.95
2C44	1.15
2C50	Q
2C51	8.50
2C52	Q
2D21	1.35
2E22	1.95
2E24	4.65
2E26	3.75
2E27	3.50
2E30	4.00
2E31	Q
2E32	1.50
2E36	4.20
2E41	Q
2E42	2.75
2G21	2.45
2G22	2.45
2J21A	7.50
2J22	7.50
2J26	17.50
2J27	17.50
2J30	49.50
2J31	25.00
2J32	27.50
2J33	27.50
2J34	27.50
2J37A	12.75
2K25	25.00
2RA3/CE213	2.50
3AP1	9.95
3BP1	5.75
3BP4	8.39
3B24	4.75
3B24W	5.75
3B27	3.75
3B29	Q
3CP1	2.25
3C23	9.95
3C24	1.75
3C31/C1B	2.95
3C33	15.00
3C45	17.50
3DP1	5.00
3DP1A	9.00
3DP1S2	10.00
3D23	Q
3D21A	3.45
3D24	7.10
3E29	12.95
3FP7	1.95
3GP1	4.25
3HP7	3.50

TYPE	PRICE
4-65A	19.95
4-125A	29.50
4-250A	42.50
KC4-3	49.95
4B22/EL5B	10.95
4B24/EL3C	6.95
4B25/6CF	9.95
4B26/2000	7.95
4B28	5.95
4B32	11.00
4C35	32.50
4E27	17.50
4J32	95.00
4J33	95.00
4J37	Q
4J38	Q
4J39	Q
4J41	Q
4X500A	85.00
C5B	3.95
5BP1	6.95
5AP1	4.95
5AP4	4.95
5BP4	4.25
5CP1	3.95
5C22	55.00
5CP7	12.50
5D21	17.50
5FP7	1.95
5GP1	4.95
5J23	11.95
5J30	49.50
5R4GY	1.85
6AN5	4.95
4AR6	3.25
6AS6	2.75
6AS7G	4.35
C6J	7.95
6C21	22.50
6J4	6.95
6K4	Q
7BP7	6.50
9GP7	14.50
10Y	.49
12DP7	12.50
12GP7	12.50
12HP7	12.50
15E	1.25
15R	.79
FG17(GE)	4.95
RK20A	9.95
24G	1.75
FG27A	6.95
RK28A	Q
RK34/2C34	.75
RK48A	9.50
53A	5.95
FG57	14.95
QK59	65.00
QK62	65.00
FG67	49.95
CEQ72	.75
CRP72	.75
RKR72	.85
RKR73	.65
FG81A	3.45
FG97	Q
100TH	7.95
FG104/5561	22.95
FG105	17.95
VU111S	1.10
114B	.85
RX120A	8.95
VT127A	1.95
FG172	24.50
HF125	24.00
HF130	19.00
HF140	15.25
HF150	18.00
HF175	18.00
HF200	25.00
T200	23.00
HF201A	Q
203A	8.25
204A	59.50
211	.89
CE213/2RA3	2.50
217C	8.25
227A	4.25
FG235A/5552	79.50
237A	Q
241B	Q
242C	14.00
245A	19.90
249B	7.50
249C	3.75
HF250	28.00
250R	9.25
250TH	21.50
250TL	18.95
251A	Q
252A	20.95
255B	Q
258B	10.25
266B	Q
270A	99.50
FG271/5551	69.50

TYPE	PRICE
282A	Q
284D	16.50
286A	21.00
287A	13.85
293A	2.95
294A	3.95
HF300	32.00
304TH	13.95
304TL	11.95
307A/RK75	4.25
308A	55.00
309A	Q
313C	Q
316A	.65
323AB	14.95
327A	4.75
331	9.95
S340	2.50
349A	Q
350A	7.95
350B	4.95
355A	23.00
368AS	6.95
371A/B	.89
393A	8.95
394A	4.95
417A	11.95
434A	19.00
446A/2C40	4.95
446B	17.50
450TL	55.00
450TH	55.00
451	14.75
464A	8.95
468	26.00
471A	2.25
GL502A	1.85
527	12.95
530	16.95
531	9.50
532A	2.50
533	Q
559	1.25
562A	Q
575A	13.95
600	7.25
602	9.10
604	7.95
614	7.95
615	6.50
617	10.35
618	11.00
623	10.35
625	26.00
627	32.25
635	11.25
643	12.00
649	6.60
WL651/656	Q
F660	39.95
WL672	29.95
GL673	20.95
701A	5.75
702A	3.25
703A	5.25
704A	.95
705A	2.15
706DY	37.50
706FY	39.50
706GY	39.50
707A	17.95
707B	18.95
708A	4.25
709A	3.25
710A/8011	.95
713A	1.45
714AY	5.95
715A	6.25
715B	9.50
715C	24.50
717A	1.15
718BY	49.50
719A	24.50
721A	2.25
722A	2.95
723A/B	17.95
724A	2.95
724B	3.15
725A	6.75
726A	6.25
726B	29.50
SN729	Q
730A	28.95
801A	.49
802	4.25
803	3.75
803A	9.95
805	3.75
807	1.59
808	2.50
809	1.65
810	9.95
811	2.85
812	2.75
813	8.95
814	2.75
815	2.65

TYPE	PRICE
816	1.05
826	1.50
828	8.95
829	9.95
829A	10.95
829B	12.95
830B	2.75
832	7.95
832A	8.95
833A	39.95
836	4.45
837	1.35
838	2.25
841	.45
843	.39
849	24.50
851	39.95
852	25.00
860	3.25
861	21.95
864	.25
865	.98
866A	1.39
868	Q
869B	32.50
872A	3.95
874	1.15
876	.39
878	1.69
905	3.95
906P1	9.95
908	9.95
918	1.45
919	2.95
922	1.39
927	1.10
926	2.75
930	1.20
931A	4.50
954	.25
955	.35
956	.35
957	.35
958	.35
959	3.95
991	.39
CK1005	.89
CK1006	3.25
CK1089	.95
CK1090	.75
R1111	Q
R1131C	Q
E1148	Q
1206	Q
1603	5.25
1613	.95
1614	2.95
1616	.98
1619	.89
1622	2.45
1624	1.69
1625	.39
1626	.39
1629	.39
1630	.89
1631	1.39
1632	.79
1633	.79
1634	.79
1636	2.95
1638	.79
1641/RK60	2.49
1644	1.25
1642	.69
1851	1.55
1960	.65
1961	5.95
2050	1.75
2051	1.10
HF3000	Q
ZB3200	Q
4120/SS501	Q
R4210	Q
R4410	Q
R4330	Q
5511	82.00
5557	6.70
5559	18.95
X6089	Q
UX6653	Q
7193	.29
8005	6.95
8008	6.95
8011	1.69
8012	3.95
8013	2.95
8013A	5.95
8020	1.95
8025	5.45
9001	1.49
9002	.98
9003	1.65
9004	.75
9005	1.90
9006	.35

TUNGAR BULBS

199698	.5A	2.50	199698	2A	2.75	859483	5A	3.00	99X45	20A	8.00
12X825	2A	2.75	16X897	2A	6.00	189048	6A	2.50	76X13	20A	9.00
206501	2A	2.75	195528	2A	2.00	189049	6A	2.50			

All tubes tested and guaranteed. Standard Brands only.

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F.O.B. Boston, minimum order $5.00.

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Test Sets TS-12, 13, 14, 33, 35, 146, 147, 174, etc. Radio Radar Equip. ARC-1, 3, ART-13, ATC, APS-10, 15, 33, 34, TPQ-2, BC-348, 342, BC-1016 Recorders, etc.

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R·H·S

SPECIALS OF THE MONTH

PANEL METERS

2" SQUARE WESTON—SANGAMO

0-20 Volts D.C.	$2.95	0-5 Ma	$2.95
0-40 Volts D.C.	2.95	0-500 Microamp.	4.95
0-.5 Amp R.F.	2.95		
0-100 Ma (0-300 scale)	2.95		

RADAR—COMMUNICATIONS AND TEST EQUIPMENT

FLUXMETER

Portable Gauss Meter with range of 500-4000 Gauss. Used to test Magnatron and other magnets. Probe has a gap of 1¼". Complete. Brand New $32.50

TS-34/AP SYNCROSCOPE AND OSCILLOSCOPE. Used to test and service airborne and ground radars. Complete in portable carrying case with all probes, cables and accessories. Input 110v 60-2600 cyc. Excellent.

TS-16 Altimeter Test Set. Used to check various altimeters or as an accurate wavemeter. New $29.95

TS-61/AP S-band Echo Box. Using meter provided, it is possible to maximize the XMTR adjustment and determine relative power output. Complete with probe and cable. Very good condition. $140.00

TS-13/AP Xa band signal generator, wave meter, wattmeter. Precision lab microwave. Test set will provide either pulsed or CW output in Xa band. Input 115v 60-800 cyc.

TS-226/AP used to measure peak power output of any xmitter in the range of 200-1000 mcs. Has provision for oscilloscopic signal observation and built in calibration. Part of AN/APM-29.

TS-69/AP freq. meter covering range of 400-1000 mcs. complete with calibration charts, antenna & crank. In metal carrying case. Excellent $72.50

TS-170/ARN-5 XTAL controlled test osc. with the following freq. ranges: 332.6, 333.8, 335.0 depending on XTAL in use. This set is used to align glide path receivers. Batteries and antenna are self contained. Excellent condition.

TS-89/AP Voltage Divider. 1:10 and 1:100 ratios. Wide band for true pulse shape. Output to scope.

TS-10/APN Altimeter Test Set. Good condition. Complete with cables and dummy antenna $35.00

TS-12/AP V.S.W.R. Test Set for X-band. Complete with amplifier, slotted line, termination, adaptors, etc. In 2 carrying cases. Excellent.

TS-45/APM-3 X-band signal generator. 8400-9600 mcs. pulsed & CW output. Used to check APS4 and similar sets.

TS-36/AP X-band Power Meter. Consists of power measuring circuit. Horn antenna, co-ax to wave guide adaptor, connecting cable and probe. Will measure either absolute or relative power. Nominal band of usefulness is approx. 8.5-9.7 KMC.

TS-3/AP S-band Frequency and Power Meter. Portable. Battery operated. Complete with all cables.

TS-33/AP X-band Frequency Meter. 8500-9600 mcs. Contains crystal detector and indicating meter. Output to scope will indicate pulse wave shape.

TS-62/AP X-band Echo Box. 8400-9600 mcs. tuned and untuned input. Will indicate resonance on meter. Complete with pick up antenna and cable.

IE-19 TEST SET. V.H.F. portable equipment covering 100-156 mcs. Used to test SCR-522, ARC-1, ARC-3, etc. Complete with signal generator, field strength meter and accessories. In carrying case. Excellent.

BC-221 PRECISION FREQ. METER. Covers 150kc-20,000kc. Can be supplied with or without modulation. Portable. Complete with calibration book and crystal. Excellent.

S-BAND SIGNAL GENERATOR. Laboratory test set using 707 Klystron in McNally Cavity. Has precision attenuator and wave meter. Complete with cables. Mfg'r. Western Electric. Input 110v 60-2600 cyc. $400.00

OTHER TEST SETS

TS-278/AP	TS-189/U	LM
TS-102/AP	TS-110/AP	IE-36
TS-47/APR	TS-164/AR	TS-59/APN
TS-184/AP	TS-19/APQ-5	TS-23/APN
TS-268/UP	TS-98/AP	TS-18/AP
1-130	TBN-3EV Thermister Bridge	

AN/TPS-3 PORTABLE RADAR

Lightweight Portable Search Radar for detection of aircraft, in the frequency range of 600 MCS. power input: 115v 400 cyc, 1330 watts, 28V DC 400W. Complete installation.

PE-104 VIBRAPACK for SCR-284. Overseas packed in original cartons with spare vibrator. Large quantity available. New.

SO-13 S-BAND MARINE RADAR

Compact Sea Search Radar for small vessels. P.P.I. indication is provided. Complete in original cases with complete sets of spares. Excellent condition.

We maintain a completely equipped reconditioning shop and development laboratory. All equipment is reconditioned and checked out to original specs. Our laboratory facilities, technical and production know-how and thirty thousand feet of space is available for electronic subcontracts.

AN/APS-15A RADAR

High resolution X-band Navigation and Blind Bombing Radar. Can be used for high or low altitude blind bombing, precision navigation and to home on X-band ground beacons. Can also be used for ground installations. Available with or without the flux gate gyro stabilizing system. Presentation is a 5" P.P.I. a 3" A scope and a 5" remote P.P.I. Power input is 28v and 110v 400 cyc. The following units are supplied: transreceiver RT-15A, indicator R-78A, antenna AS-18, control C-33, amplifier AM-19/APA-14, range unit CP-11, computer CP-10, remote P.P.I. 1D-30/APS-2, junction box J-15 and J-14, all plugs and connectors. With the flux gate system AM-21 and CN-4 are supplied in addition. Weight is approx. 375 lbs. installed. Electrical characteristics are as follows: freq. X-band. power output approx. 40 KW, range 5, 30, 50 and 100 mile search and beacon. Precision ranging and bombing on 5 to 30 miles. Antenna beam width 4°. Precision expanded beacon range from 10-200 miles. Supplied from stock, reconditioned and checked out.

SCR-555 DIRECTION FINDER

Freq. range 18—65 mcs. Complete installations available including the quonset hut. Bearing indication is aural-null or left-right bearing on a meter type indicator. Power input is 12v. Weight of complete installation, approx. 2500 lbs.

AN/UPN 1 & 2 PORTABLE RADAR BEACONS

S-band beacons that can be interrogated by any S-band radar in a 45 mile range and will answer with a coded reply which can be changed as desired. The UPN-1 is battery operated. The UPN-2 is 110v 60-2600 cyc. Weight is approx. 65 lbs. complete.

APR-1 MICROWAVE RECEIVER

We can supply from stock AN/APR-1 receivers and 3 tuning units to cover the freq. range of 38-1000 mcs. These receivers are almost identical to the APR-4 equipment and the tuning units are directly interchangeable. These sets have outputs for a panadaptor and pulse analyzer which can be supplied on request.

AN/TPS-1 SEARCH RADAR. This is a pack portable ground search radar for the detection of aircraft up to 100 miles. Range and azimuth data is displayed on a 7" P.P.I. and a 5" "A" scope. This set was called the G.I.'s radar because of its ruggedness, dependability and ease of servicing. Complete tech data is as follows:

Range Max. 100 Mi. Min. .25	P.R.R. 200 Per Sec.
Azimuth Mech. 360° Automatic 360° Accuracy ±3° Scanning Manual Automatic	Pulse Width 2 Micro Sec. Beam Width 3° Horiz. 13° Vert.
Presentation 7" P.P.I. 5" A Scope	
I.F.F. not provided but has provision for. Frequency 1074-1086 Mcs.	Power Input 1100 W at 115V 400 Cyc. and 180 W at 27V D.C.
Power output 150 K.W.	Weight: 1,518 Lbs.

AN/APS-3 Airborne X-band Search and Homing radar. Complete. Contains RF head, modulator, synchronizer, control boxes, plugs, antenna, etc. 115v 400 cyc.

SQ 10 CM PORTABLE RADAR. This set is a very compact search radar. Complete installation available. New in carrying cases. Tech. data as follows:

power input: 90-130v cy cyc.; pulse rate: 800 cyc.: range: 3, 15, 45 miles; pulse width: 1 microsec.; 300 yds. min. range, all ranges; I.F.F. synch. output available; accuracy ±5°; power output 1 KW; beam width: 8° horiz. 15° vert.; presentation: A, B, P.P.1.

AN/ARC-1 TRANS/REC.

Provides Radio-Telephone Communication between Aircraft or Aircraft and Ground. Complete with Shock Mount and Control Box. Input: 28V DC. Excellent condition. Available in either 10 or 20 Crystal Controlled Channels 100-156 MCS. checked out.

SCR-269/G Automatic Radio Compass. Freq. range 200-1750KC. Complete with BC-433-G receiver, BC-434, LP-21, 1-81, 1-82, BK22, etc. Very good condition $129.95

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