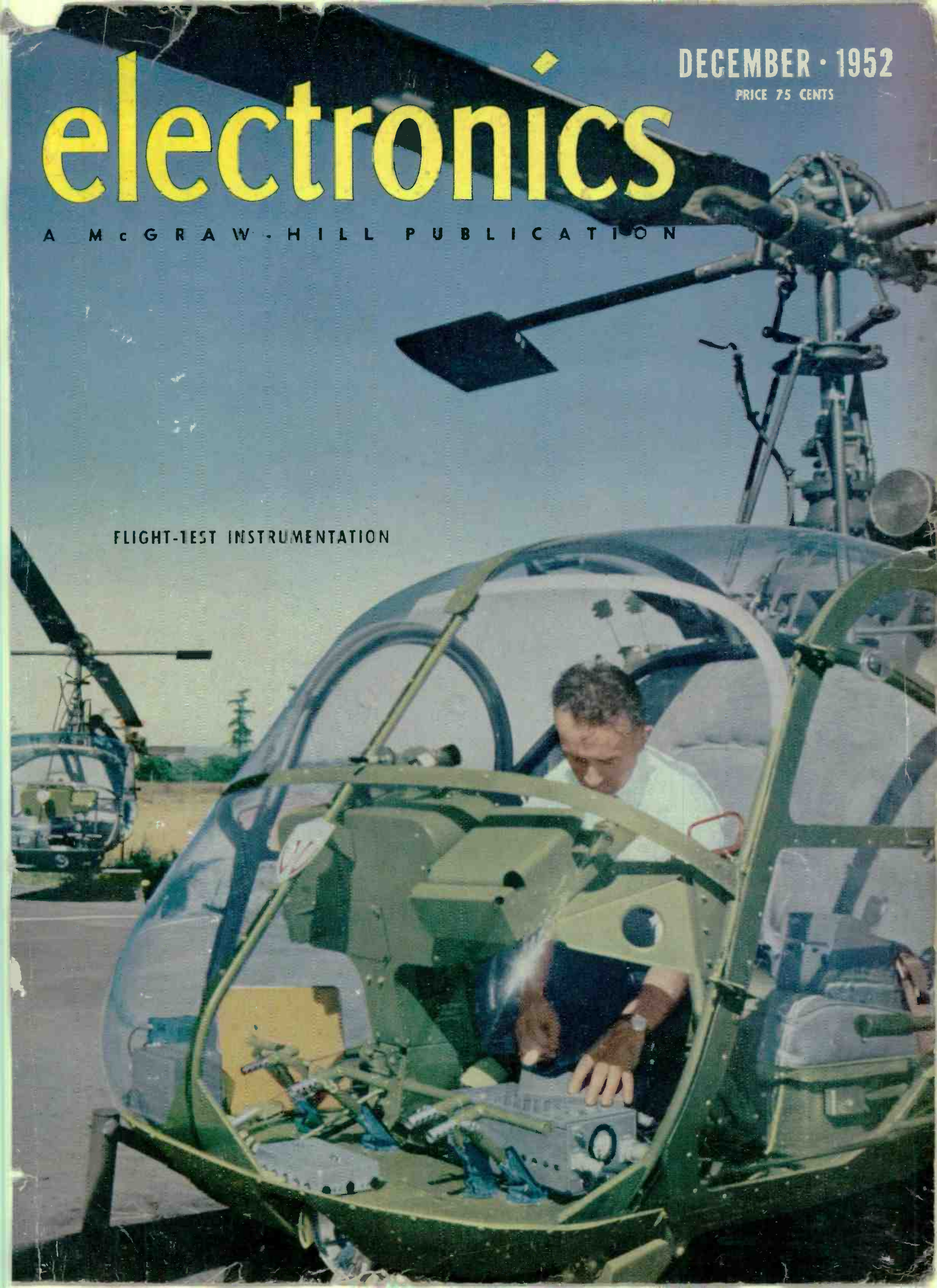
DECEMBER · 1952
PRICE 75 CENTS

electronics

A McGRAW-HILL PUBLICATION

FLIGHT-TEST INSTRUMENTATION

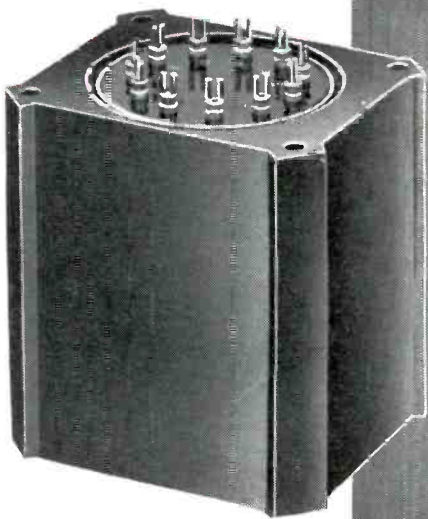


UTC

Linear Standard Units...

THE ULTIMATE IN QUALITY...

UTC Linear Standard Audio Transformers represent the closest approach to the ideal component from the standpoint of uniform frequency response, low wave form distortion, high efficiency, thorough shielding and utmost dependability.

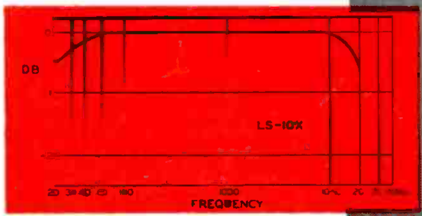


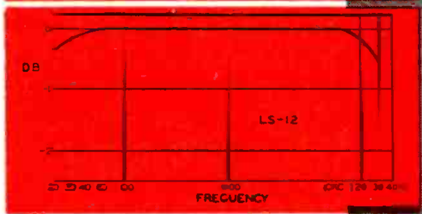
UTC Linear Standard Transformers feature . . .

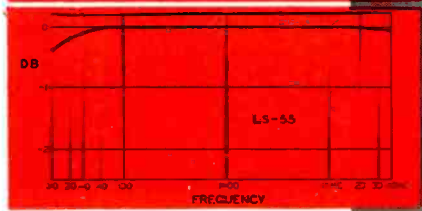
- **True Hum Balancing Coil Structure** . . . maximum neutralization of stray fields.
- **Balanced Variable Impedance Line** . . . permits highest fidelity on every top of a universal unit . . . no line reflections or transverse coupling.
- **Reversible Mounting** . . . permits above chassis or sub-chassis wiring.
- **Alloy Shields** . . . maximum shielding from inductive pickup.
- **Hiperm-Alloy** . . . a stable, high permeability nickel-iron core material.
- **Semi-Toroidal Multiple Coil Structure** . . . minimum distributed capacity and leakage reactance.
- **Precision Winding** . . . accuracy of winding .1%, perfect balance of inductance and capacity; exact impedance reflection.
- **High Fidelity** . . . UTC Linear Standard Transformers are the *only* audio units with a *guaranteed* uniform response of ± 1 DB from 20-20,000 cycles.

TYPICAL LS LOW LEVEL TRANSFORMERS

Type No.	Application	Primary Impedance	Secondary Impedance	±1 db from	Max. Level	Relative hum-pickup reduction	Max. Unbalanced DC in prim'y	List Price
LS-10	Low impedance mike, pickup, or multiple line to grid	50, 125, 200, 250, 333, 500/600 ohms	60,000 ohms in two sections	20-20,000	+15 DB	—74 DB	5 MA	$25.00
LS-10X	As Above	As above	50,000 ohms	20-20,000	+14 DB	—92 DB	5 MA	35.00
LS-12	Low impedance mike, pickup, or multiple line to push pull grids	50, 125, 200, 250, 333, 500/600 ohms	120,000 ohms overall, in two sections	20-20,000	+15 DB	—74 DB	5 MA	28.00
LS-12X	As above	As above	80,000 ohms overall, in two sections	20-20,000	+14 DB	—92 DB	5 MA	35.00
LS-26	Bridging line to single or push pull grids	5,000 ohms	60,000 ohms in two sections	15-20,000	+20 DB	—74 DB	0 MA	30.00
LS-19	Single plate to push pull grids like 2A3, 6L6, 300A. Split secondary	15,000 ohms	95,000 ohms; 1.25:1 each side	20-20,000	+17 DB	—50 DB	0 MA	26.00
LS-21	Single plate to push pull grids. Split primary and secondary	15,000 ohms	135,000 ohms; turn ratio 3:1 overall	20-20,000	+14 DB	—74 DB	0 MA	26.00
LS-22	Push pull plates to push pull grids. Split primary and secondary	30,000 ohms plate to plate	80,000 ohms; turn ratio 1.6:1 overall	20-20,000	+26 DB	—50 DB	.25 MA	32.00
LS-30	Mixing, low impedance mike, pickup, or multiple line to multiple line	50, 125, 200, 250, 333, 500/600 ohms	50, 125, 200, 250, 333, 500/600 ohms	20-20,000	+17 DB	—74 DB	5 MA	26.00
LS-30X	As above	As above	As above	20-20,000	+15 DB	—92 DB	3 MA	32.00
LS-27	Single plate to multiple line	15,000 ohms	50, 125, 200, 250, 333, 500/600 ohms	30-12,000 cycles	+20 DB	—74 DB	8 MA	26.00
LS-50	Single plate to multiple line	15,000 ohms	50, 125, 200, 250, 333, 500/600 ohms	20-20,000	+17 DB	—74 DB	0 MA	26.00
LS-51	Push pull low level plates to multiple line	30,000 ohms plate to plate	50, 125, 200, 250, 333, 500/600 ohms	20-20,000	+20 DB	—74 DB	1 MA	28.00
LS-141	Three sets of balanced windings for hybrid service, centertapped	500/600 ohms	500/600 ohms	30-12,000	+10 DB	—74 DB	0 MA	30.00







TYPICAL LS OUTPUT TRANSFORMERS

Type No.	Primary will match following typical tubes	Primary Impedance	Secondary Impedance	±1 db from	Max. Level	List Price
LS-52	Push pull 245, 250, 6V6, 42 or 2A5 A prime	8,000 ohms	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25-20,000	15 watts	$35.00
LS-55	Push pull 2A3's, 6A5G's, 300A's, 275A's, 6A3's, 6L6's	5,000 ohms plate to plate and 3,000 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25-20,000	20 watts	35.00
LS-57	Same as above	5,000 ohms plate to plate and 3,000 ohms plate to plate	30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25-20,000	20 watts	25.00
LS-58	Push pull parallel 2A3's, 6A5G's, 300A's, 6A3's	2,500 ohms plate to plate and 1,500 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25-20,000	40 watts	50.00
LS-6L1	Push pull 6L6's self bias	9,000 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25-20,000	30 watts	50.00

Write for our Catalog PS-520

United Transformer Co.

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

electronics

DECEMBER • 1952

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December, 1952 ELECTRONICS Vol. 25, No. 12
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marion

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

SPEEDS UP PRODUCTION
REDUCES COSTS
IMPROVES QUALITY

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

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

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

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

SPECIFICATIONS

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

Power: 775 watts at full power output, 100 watts standby.
The entire unit is rigidly assembled and mounted to prevent arc-over and failure of components. It easily meets latest F.C.C. requirements on radiation.

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

marion meters

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MANUFACTURERS OF RUGGEDIZED, HERMETICALLY SEALED AND STANDARD PANEL INSTRUMENTS

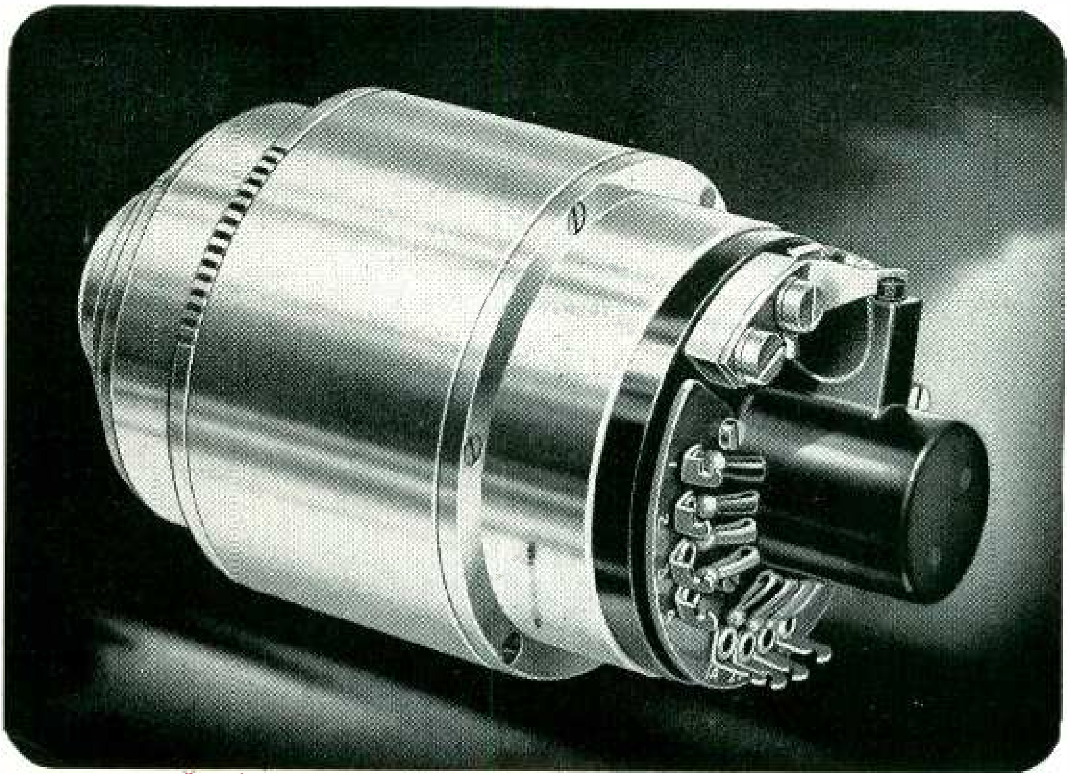
MUIRHEAD

MAGSLIP RESOLVER No. 2

Given R & θ find h & x

$h = R \sin\theta$

$x = R \cos\theta$



Change of axes

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

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

Given N, E ~~determine~~ R & θ

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

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

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

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

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 co-ordinates.

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

Please mail Bulletin B-690 fully describing
MUIRHEAD MAGSLIP RESOLVERS.

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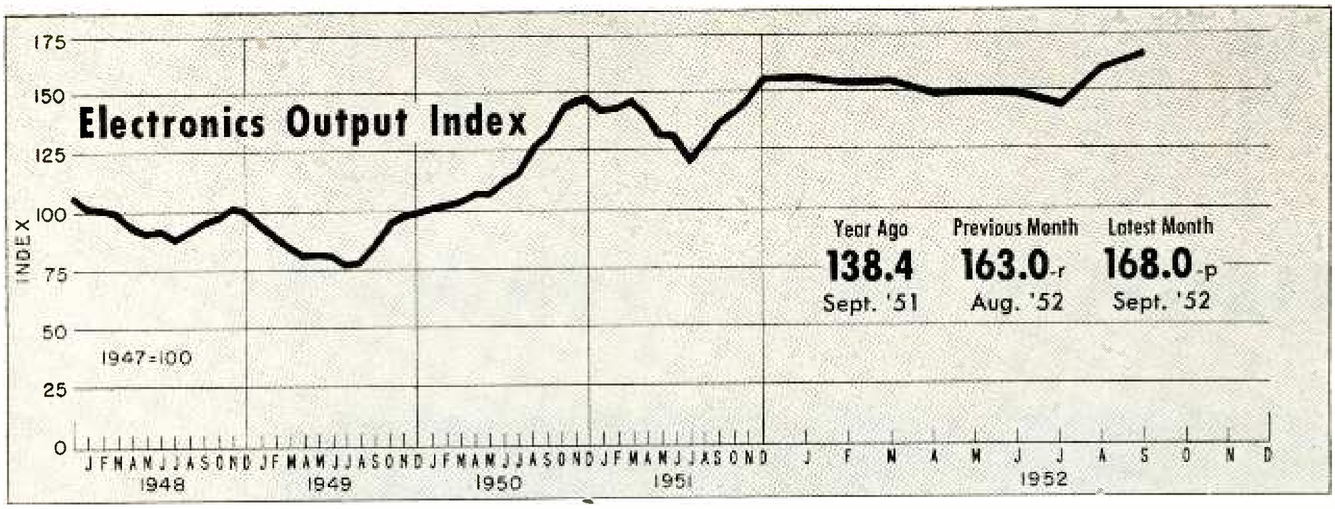
Precision Electrical Instrument Makers



FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RTMA)	Year Ago	Previous Month	Latest Month
	Sept. '51	Aug. '52	Sept. '52
Television sets	337,341	397,769	755,665-p
Home sets	603,055	235,728	324,786-p
Clock Radios	----	108,753	183,496-p
Portable sets	103,355	105,006	126,666-p
Auto sets	393,836	94,315	230,706-p

RECEIVER SALES

(Source: RTMA)		June, July & Aug. '52	Sept. '52
Television sets, units	----	700,490	875,290
Radio sets (except auto)		1,139,467	892,761

RECEIVING TUBE SALES

(Source: RTMA)	Sept. '51	Aug. '52	Sept. '52
Receiv. tubes, total units	27,946,193	30,141,536	34,196,286
Receiving tubes, new sets	16,176,604	19,583,879	23,826,403
Rec. tubes, replacement	7,363,721	7,463,893	7,435,333
Receiving tubes, gov't.	1,568,880	1,706,868	2,032,539
Receiving tubes, export.	2,836,988	1,386,896	902,006
Picture tubes, to mfrs.	294,951	394,605	640,793

BROADCAST STATIONS

(Source: FCC)	Oct. '51	Sept. '52	Oct. '52
TV Stations on Air	108	111	114
TV Stns CPs—not on air	0	51	77
TV Stns—Applications	453	855	840
AM Stations on Air	2,307	2,364	2,368
AM Stns CPs—not on air	98	119	138
AM Stns—Applications	289	276	255
FM Stations on Air	642	624	624
FM Stns CPs—not on air	10	18	17
FM Stns—Applications	9	10	8

NETWORK BILLINGS

(Source: Pub. Info. Bureau)	Sept. '51	Aug. '52	Sept. '52
AM/FM—ABC	$2,165,971	$2,281,852	$2,533,785
AM/FM—CBS	$4,645,527	$3,991,490	$4,847,138
AM/FM—MBS	$1,324,061	$1,325,059	$1,607,107
AM/FM—NBC	$3,713,235	$3,338,843	$3,898,867
TV—ABC	$1,622,482	$1,166,169	$1,203,917
TV—CBS	$4,159,213	$5,105,929	$5,835,622
TV—DuMont	$738,578	$845,780	$809,475
TV—NBC	$5,405,243	$5,618,643	$6,581,618

TV AUDIENCE

(Source: NBC Research Dept.)	Year Ago	Previous Month	Latest Month
	Oct. '51	Sept. '52	Oct. '52
Sets in Use—total	14,003,500	18,711,800	19,124,900
Sets in Use—netw k conn.	13,254,400	18,682,800	19,095,500
Sets in Use—New York	2,550,000	3,100,000	3,135,000
Sets in Use—Los Angeles	1,025,000	1,240,000	1,255,000
Sets in Use—Chicago	995,000	1,235,000	1,255,000

COMMUNICATION AUTHORIZATIONS

(Source: FCC)	Sept. '51	Aug. '52	Sept. '52
Aeronautical	32,221	34,070	34,462
Marine	32,870	36,789	37,437
Police, fire, etc.	9,735	11,486	11,615
Industrial	10,591	14,440	14,761
Land Transportation	4,458	5,204	5,250
Amateur	95,131	114,882	116,629
Citizens Radio	651	1,742	1,767
Disaster	9	80	80
Experimental	439	382	282
Common carrier	822	984	1,026

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	Aug. '51	July '52	Aug. '52
Prod. workers, electronic	238,500	265,300-r	280,900-p
Av. wkly. earnings, elect.	$60.34	$62.80-r	$66.05-p
Av. wkly. earnings, radio	$57.26	$60.60-r	$63.47-p
Av. weekly hours, elect.	40.2	39.3-r	40.9-p
Av. weekly hours, radio.	39.9	39.3	41.0-p

STOCK PRICE AVERAGES

(Source: Standard and Poor's)	Oct. '51	Sept. '52	Oct. '52
Radio—TV & Electronics	259.0	304.3	310.9
Radio Broadcasters	244.7	288.3	288.1

INDUSTRIAL EQUIPMENT ORDERS

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

INDUSTRIAL TUBE SALES

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

p—provisional; r—revised; e—estimated

INDUSTRY REPORT

Voters Take Top Hooperating

Nation and world gather at radio and television sets as election ballots are tallied

ELECTION NIGHT saw the nation's radio, television and wire facilities teamed to provide the timeliest and most comprehensive coverage ever accorded a national election. Twelve million of the 18,700,000 television sets in use were tuned to election returns broadcast by 109 stations in 66 cities.

▶ **Network**—Miles of intercity tv relay circuits pressed into use totaled 30,000, including 2,800 miles added especially for election coverage. The additional circuits linked Chicago and New York, Chicago and Omaha, Los Angeles and Denver, San Francisco and Oakland and furnished pick-ups at the election headquarters of the presidential and vice-presidential candidates. Election returns were also featured over more than 2,000 standard broadcast stations.

▶ **Overseas**—The Voice of America broadcast continuously election night; its 75 short-wave transmitters bringing election news in 46 languages to an estimated 100-million listeners abroad.

In many areas, medium-wave stations, including the vast Armed Forces Radio Service network, relayed VOA broadcasts to local listeners. In South America VOA rebroadcasts were carried by more than 200 local stations.

▶ **Korea**—Our fighting men in Korea and at military installations throughout the Pacific Ocean area and Alaska received election news through the facilities of the Armed Forces Radio Service, whose six west-coast short-wave stations beamed the returns to two-dozen or more medium-wave stations overseas.

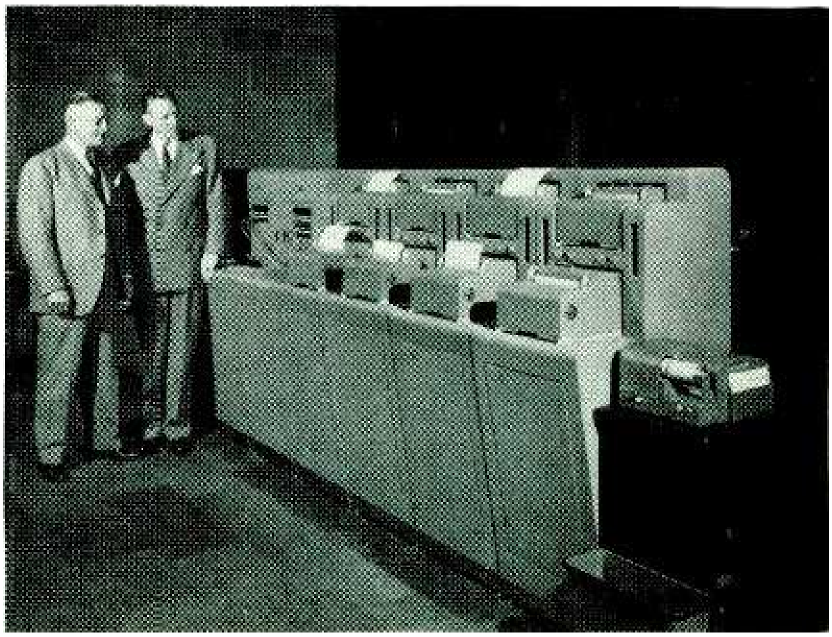
More Electronics Materials Shortages?

NPA sees less steel and aluminum for first quarter of 1953. Copper supplies also uncertain

CONTROLLED MATERIALS such as steel, aluminum and copper will be in tight supply at least through the first quarter of 1953, according to NPA's electronics division. Donald Parris, Deputy Director of the division, warns that not enough raw materials are in prospect for expanded civilian demand plus anticipated military requirements.

As a result, first quarter production of tv receivers may be limited below demand and structural steel for tv towers may be scarce. By the start of the second quarter however, supplies of sheet and strip steel, aluminum and copper are expected to be in balance with demand.

▶ **Steel**—Steps are being taken to distribute available steel equitably. No change in allotments for civilian use is contemplated in the remainder of 1952 nor is



New York Banks Use Facsimile

Fifteen New York City banks and the Federal Reserve Bank of New York are now using Western Union's Intrafax facsimile system for authorizing transfer of funds from the Reserve Bank to other banks throughout the country. The facsimile reproduction of a banker's signature, on the equipment shown, is sufficient authorization for transfer of millions of dollars there likely to be a change in the present rule providing for priority treatment of carry-over orders.

Although military orders have a steel production set-aside for preferential deliveries, effort is being made not to overload mills with them at the expense of nonmilitary customers. Quantities of certain types of steel "emergency rations" for both small and large users are being increased. Loudspeaker manufacturers, however, have notified NPA that allotments of steel for the first quarter of 1953 are inadequate since that is the period when demand for their product is highest.

▶ **Aluminum**—Aluminum supply will be tight through the first quarter of 1953 unless mining areas get heavy rainfalls needed for mining processes soon, according to DPA. Droughts in the Pacific Northwest and in the Tennessee Valley have set back production. Estimates of supply for the first quarter of 1953 have been scaled down from 810 million pounds to 775 million.

Beginning in the second quarter, however, aluminum supplies are expected to improve substantially as a result of new plants and increased water supplies.

▶ **Copper**—NPA's copper division sees uncertainties in supplies, despite substantial buying of foreign copper in recent months resulting from pricing arrangements approved in May. Supplies of foreign raw copper increased substantially during the third quarter of 1952, but refined copper from domestic ores and scrap declined. Receipts of copper and copper-base alloy scrap by mills and foundries also dropped.

The current copper supply situation is roughly in balance with authorized demand for both fourth quarter and first quarter of 1953, but NPA sees the probability that a deficit may occur as demand conditions change.

Engineer Import Speeded

McCarran Act gives priority to immigrants possessing skills urgently needed in this country

BY AFFORDING preference to foreign engineers who desire to enter the U. S., the McCarran Immigration Act may aid the electronics industry, still short of such personnel.

Past efforts of firms to import engineers from Europe, where the reserve of engineers appears to exceed ours (see 'Wanted: More Electronic Engineers', ELECTRONICS, p 5, July 1952), have been hindered by immigration laws requiring specialists to add their names to long, heterogeneous lists.

The new immigration law voids existing quota lists and sets aside the top 50 percent of each country's quota of immigrants for individuals whose presence the Attorney General finds is urgently needed because of their high education, technical training and highly specialized experience.

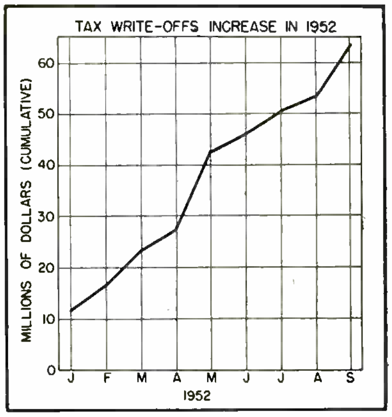
Organizations or firms must petition the Attorney General through their District Director of the Immigration and Naturalization Service on behalf of aliens they wish to import.

▶ **Clearance**—Some aliens can be cleared to handle classified material and some defense plants now have cleared aliens engaged in such work. However, a completed alien-personnel questionnaire must be submitted to the plant's contracting officers with the usual requests for security clearance. Clearance is granted or withheld by the contracting officers on the basis of thorough background investigations by the intelligence branches of the armed services concerned.

A cleared alien may be afforded the same access to classified information as a citizen having like clearance.

How Electronics Plants Expanded For Defense

Tax-aided investments top $63 million. Over 200 companies enlarged production facilities



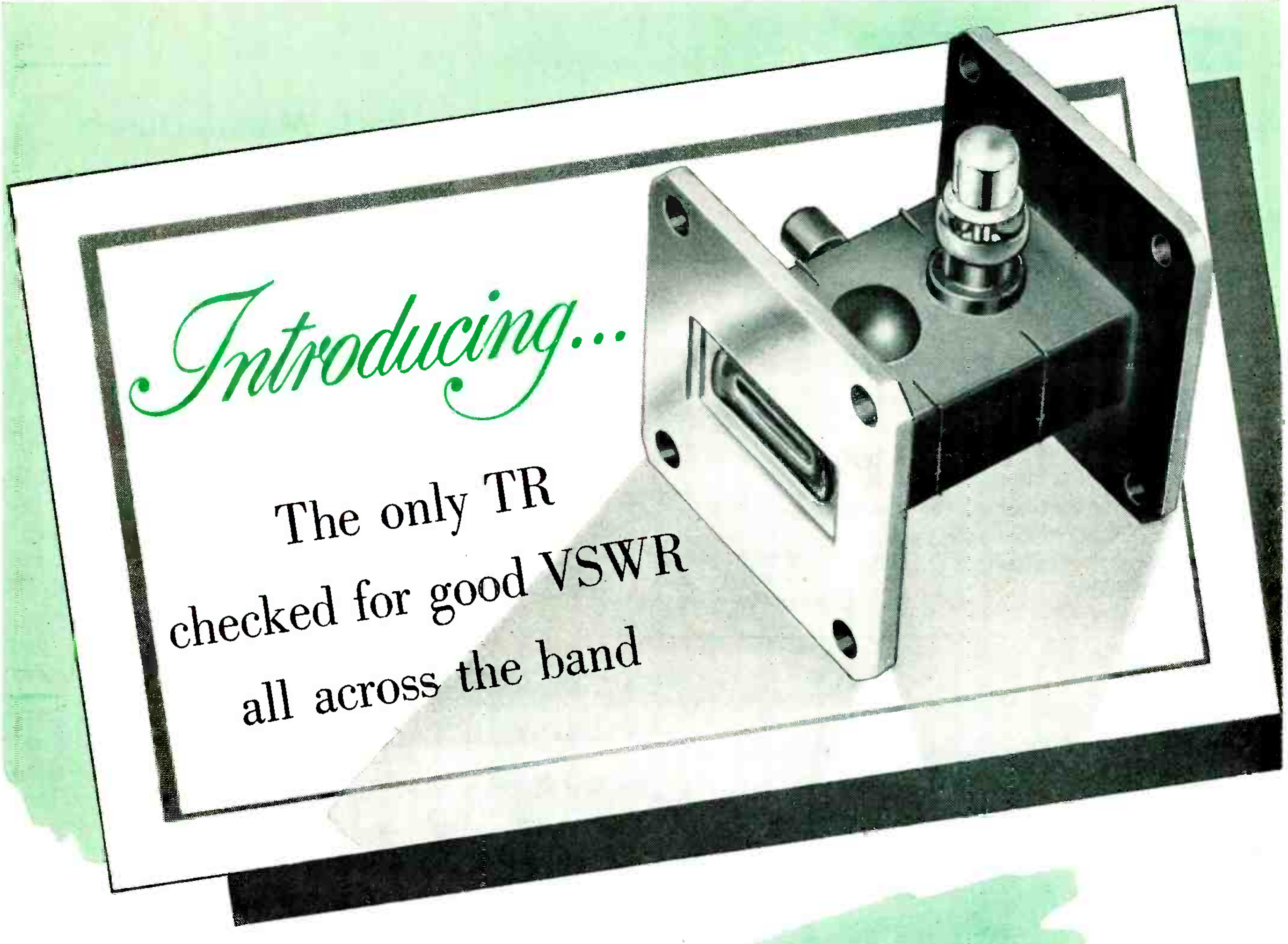
INDEX of the growth of electronics plants this year is seen in an analysis of the Certificates of Necessity issued by the Defense Production Administration during the first nine months. As is shown in the chart, the total amount of these certificates . . . which represents the estimated cost of added productive capacity for U. S. mobilization goals . . . reached $63.8 million. The grand total in electronics tax write-offs approved by DPA since the tax-aid program began in 1950 thus neared $300 million.

▶ **Expansion Plans**—More than 200 electronics and related manufacturers were involved in the $63.8 million expansion. Individual company investments ranged from as little as $2,523 by Treitel-Grotz Co. for the production of electronic parts to a high of $6.1 million by RCA for electronic equipment and tubes.

More than half of this year's total tax-aided investment is divided among 7 electronic manufacturers: RCA $6.1 million, Westinghouse $5.9 million, GE $5.2 million, Raytheon $4.6 million, Sylvania $3.9 million, Western Electric $3.4 million and Zenith $3.4 million.

▶ **Products**—Most of the authorized expansions were for the pro-

(Continued on page 8)



You probably know that the 1B63A is the accepted wide band TR tube for X band use.

But, did you know that every *Sylvania* 1B63A is checked for good VSWR (below 1.4) *not just at the band edges – but all across the band?*

This is one more reason why it will pay you to insist on Sylvania tubes.

Incidentally, do you have our latest TR and ATR catalog in your file? If you don't, better mail the coupon for your copy NOW!

SYLVANIA

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

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Please send me the new Sylvania catalog of TR and ATR Microwave Gas Switching Tubes.

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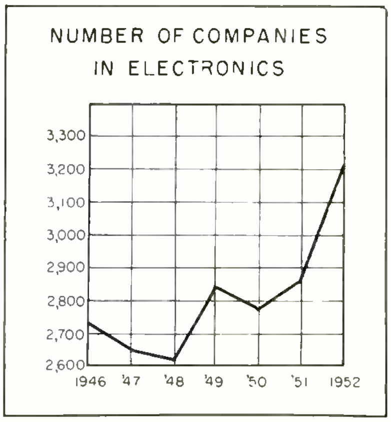
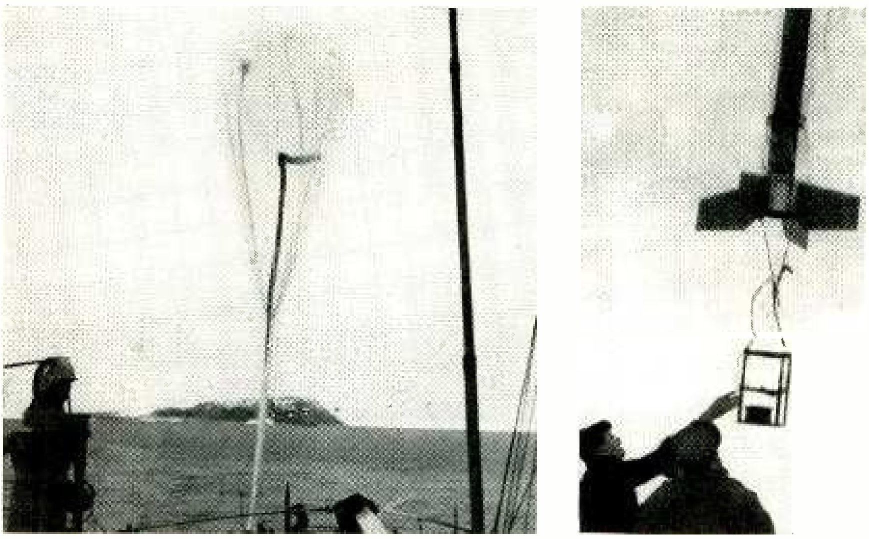
*City*__________ *Zone*____ *State*______ duction of "electronic equipment." However, a large portion was earmarked for electronic tube production facilities. A $5.7 million expansion was arranged by Westinghouse for the production of electronic tube glass envelopes. Other investments for tube production facilities now awaiting DPA approval total $7.5 million.

An average of about 65 percent of this year's $63.8 million electronics expansion has been approved for 5-year depreciation. On individual investments the portions have ranged from 25 percent to 85 percent, depending on DPA determinations.



The total dropped in the first two post-war years. Then the rearmament program, added to new civilian needs, produced a new high in number of companies in the field



BALLOON 'SKYHOOK' helps rocket attain 40-mile altitude, as . . .

Navy Studies Arctic Cosmic Rays

Rocket-borne Geiger counter radios data to icebreaker by fm/fm telemetering link

COSMIC-RAY ACTIVITY over the earth's magnetic pole was the subject of high-altitude research recently carried out by a Navy research team aboard the Coast Guard icebreaker Eastwind.

Small (8-in. diameter) 'Deacon' rockets carried Geiger-Mueller counters and ionization chambers to altitudes greater than 40 miles. Data was reported to the ship by a one-watt transmitter operating on 75 mc. An fm/fm system of radio telemetering was used.

To attain the necessary altitude with small, relatively inexpensive rockets, plastic balloons like the one shown above carried the rockets out of the earth's atmosphere.

Beyond the earth's atmosphere, the rockets were fired by timing devices carried in their tail.

Instruments aboard the rocket were expendable, but in other experiments the balloons carried nuclear emulsion plates to be let down by parachute. During these tests, Navy patrol bombers from the Thule (Greenland) airbase tracked the balloons and located impact spots where the equipment landed.

Parts Manufacturers Fight OPS Price Lids

Parts price ceilings still in effect as RTMA continues protests to the government

REVERBERATIONS caused by OPS action recontrolling radio, television and phonograph component parts prices in October are still circling the electronic industry. RTMA, which led the fight for the parts industry against the ceilings, has protested vigorously to OPS and recently asked the Economic Stabilization Agency to rescind the order. Action by the higher agency has yet to be taken, as of this writing.

▶ **Five Reasons**—RTMA listed five reasons why it believes the OPS action was unjustified and contrary to the Government's economic stabilization policy:

Congress has directed OPS to decontrol commodities as rapidly as possible when such action does not impair the defense effort or create inflationary pressures. OPS in an earlier order stated that radio-television components, as well as receivers, clearly qualify for price-control suspension under the Defense Production Act as amended.

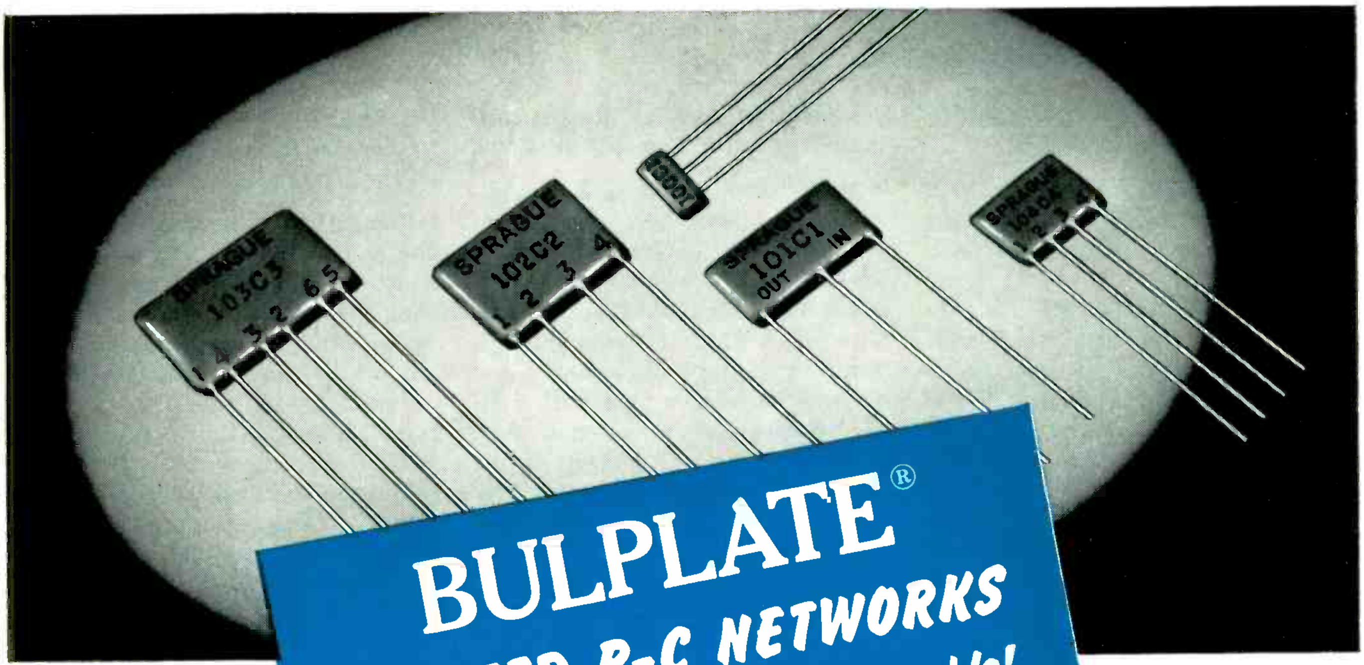
OPS did not follow the customary practice of consulting industry representatives before issuing the order, and the act was one of bad faith with manufacturers who had agreed to supply monthly data to OPS for use in a "trigger" index on price movements.

RTMA counsel doubts that the OPS action is legal because the earlier OPS order suspending controls declared that suspension would be terminated if the price index reached 97 percent of the January 1951 level.

The OPS action was not based on fact, so its findings cannot be substantiated.

While industry, through RTMA, was granted a hearing on the recontrol order after it was issued, the decision of OPS to sustain the order was made by OPS officials be-

(Continued on page 10)



BULPLATE®

PRINTED R-C NETWORKS

Can save you money, time, trouble!

Printed circuits like those shown here offer important advantages in radio and TV production—fewer parts to purchase, inspect, handle, and stock; fewer soldering operations and quicker assembly with minimal wiring errors; faster and easier inspection; greater compactness; and lighter weight. And usually they cost less than the individual capacitors and resistors they replace!

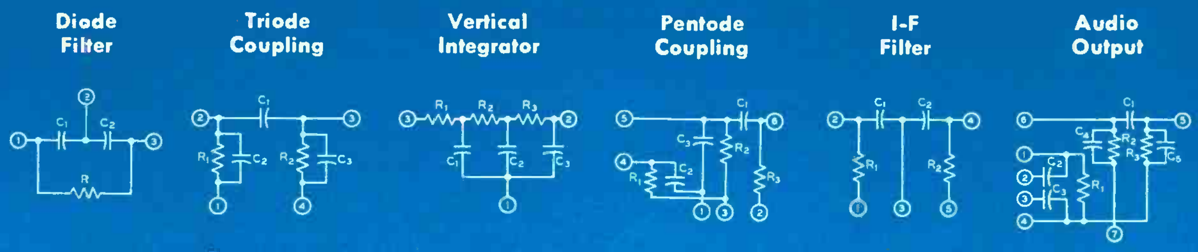
BULPLATE Printed Circuits are a logical outgrowth of Sprague-Herlec BULPLATE Multiple Ceramic Capacitors, first to use the active dielectric as a supporting medium for printed wiring. The printed resistor elements of these plates have proved to be highly stable, another important Sprague contribution.

Thousands of BULPLATES are now in use in radio, television, and military electronics. Are you overlooking a winning bet for your production?

And remember—if you have a special problem on a network which must perform a certain circuit function, Sprague will design it for you.

Write today for Engineering Bulletin 650 to Sprague Electric Company, 35 Marshall Street, North Adams, Mass.

TYPICAL RADIO AND TV BULPLATE CIRCUITS



SPRAGUE

WORLD'S LARGEST CAPACITOR MANUFACTURER

Export Division, Cable SPREXDIV, North Adams, Mass.

fore whom industry was not permitted to state its case.

▶ **OPS View**—Reasons for the OPS action were stated by the agency when it issued the order in October:

Prices of parts affected the charges for an "important" consumer service, the repair of radios and tv sets. This service is now at or near ceiling, and suspension of controls on parts made price controls "ineffective" for the service.

The parts in question are used in many other items which are still controlled. The agency said it could not "practicably" administer suspension of controls on parts used in radios while keeping ceilings on the same parts used in other end products.

Financial Roundup

ACTIVITY on the electronics industry's financial front during October was not as heavy as during the previous month. A total of 7 companies released earnings statements, 2 firms offered stock and 4 manufacturers made stock filings.

▶ **Profits**—For the first nine months of 1952 the net profit picture of seven electronics companies was as follows:

Company	*1952*	*1951*
Bendix Aviation	$10,338,784*	$9,059,345*
G. E.	94,750,000	85,936,000
Minneapolis-Honeywell	5,155,526	7,357,166
RCA	17,847,110	18,356,841
Sylvania	5,031,701	6,169,504
TelAutograph	154,686	125,411
Weston	739,862	452,274

* For nine months ending June 30.

▶ **Stock Offerings**—Electronic Micro-Ledger Accounting publicly offered "as a speculation" an issue of 299,900 shares of common stock (par 10 cents) at $1 per share. Net proceeds will be used for building and installing equipment and for further development and administration expenses.

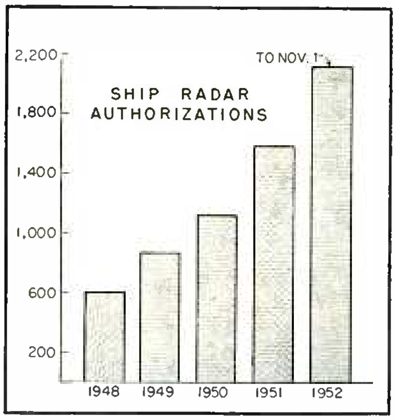
Jefferson Electric made a public offering of a new issue of 100,000 shares of $5 par common stock at $10 per share. The proceeds will be used for expenditures for plant and equipment under the company's expansion program. The cost of additional facilities is estimated at approximately $830,000.

▶ **Stock Filings**—Reeves Soundcraft filed with SEC for 10,245 shares of common stock (par value 5 cents) to be offered at market value estimated at about $2.62½. Proceeds will go to Bernard Goodwin, the selling stockholder.

Trad Television filed with SEC for 50,000 shares of common stock (par 1 cent) to be offered at the market value (around 35 cents per share) but the offer was later withdrawn.

Video Products filed with SEC for 75,000 shares of common stock (par 50 cents) to be offered at $2.50 per share without underwriting. The proceeds will be used for working capital.

Wilcox-Gay filed with SEC for $200,000 of common stock (par $1) to be issued at the market value (1.12½ per share on Oct. 14) to employees under the company's Employees Stock Purchase Plan. There will be no proceeds to the company.



American Ship Radar Tops 2,000

AUTHORIZATIONS for use of ship radar equipment by American-flag merchant vessels had reached 2,144 by November, according to Federal Communications Commission. This represents an equipment investment of better than $27 million since the average set in use cost between $11 thousand and $12.5 thousand. In addition, the mast, cable, incidentals and installation costs borne by the ship owner came to between $1,500 and $4,000 per job.

Increase in use since 1947 shows in the bar chart.

▶ **Competitive Business**—Despite the fact that every new river towboat is said to come from the yard complete with radar, there are too many manufacturers in the field for any one of them to make a killing.

Individual figures are hard to come by, but among the leaders are RCA, Raytheon and Sperry. Others with type approval by FCC include Canadian Arsenal, Ltd. (said to be doing a big Canadian business); Canadian Marconi Co.; Decca Navigator, Ltd.; Electric Service Co.; Harbor Electronics Co.; and Westinghouse. Decca, best known for its hyperbolic navigation system, is a newcomer with a low-power set as low as $5,835. Since August, it has sold four American flag ships.

Television Stations Meet Starting Dates

KDUB-TV is fourth post-freeze station in operation. More to debut this month

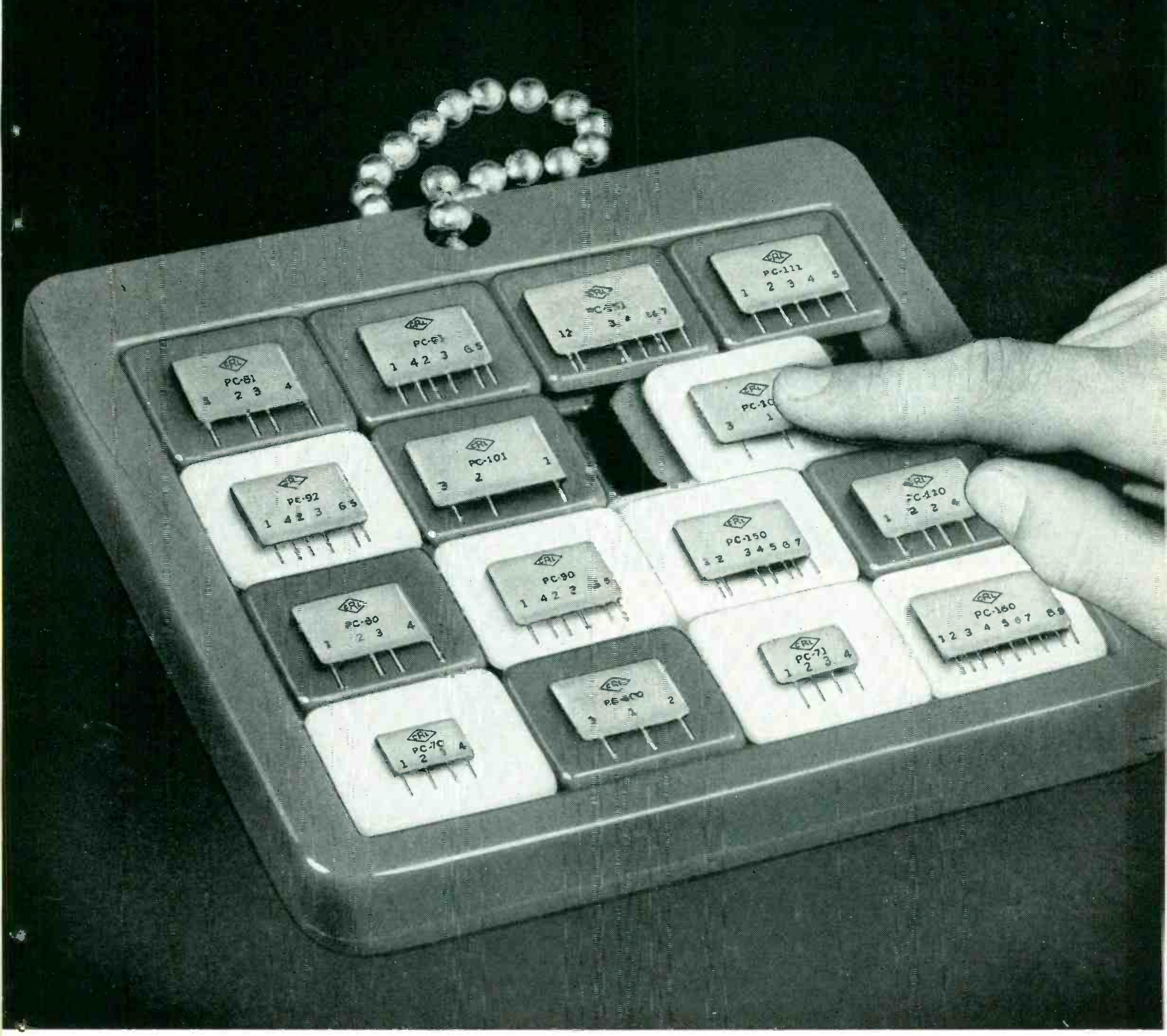
LUBBOCK, Texas became the third new market for television receiver manufacturers to open this year when KDUB-TV, the nation's fourth new tv station, took to the air on November 5 from its interim location atop Lubbock National Bank Building.

The station reports that with its present overall antenna height of 202 feet, signals are reaching as far as Big Spring and Stamford, Texas, which are 110 and 125 miles away respectively. The picture signal into Big Spring was estimated at 200 microvolts. There are about 5,000 sets in the area, with sales going at a rate of approximately 600 a week. Saturation for the market is estimated at 125,000 sets.

▶ **More Markets**—With Lubbock now on the air, tv manufacturers are eyeing their timetables for the next new market. Austin, Texas;

(Continued on page 14)

Let's get our circuits straight



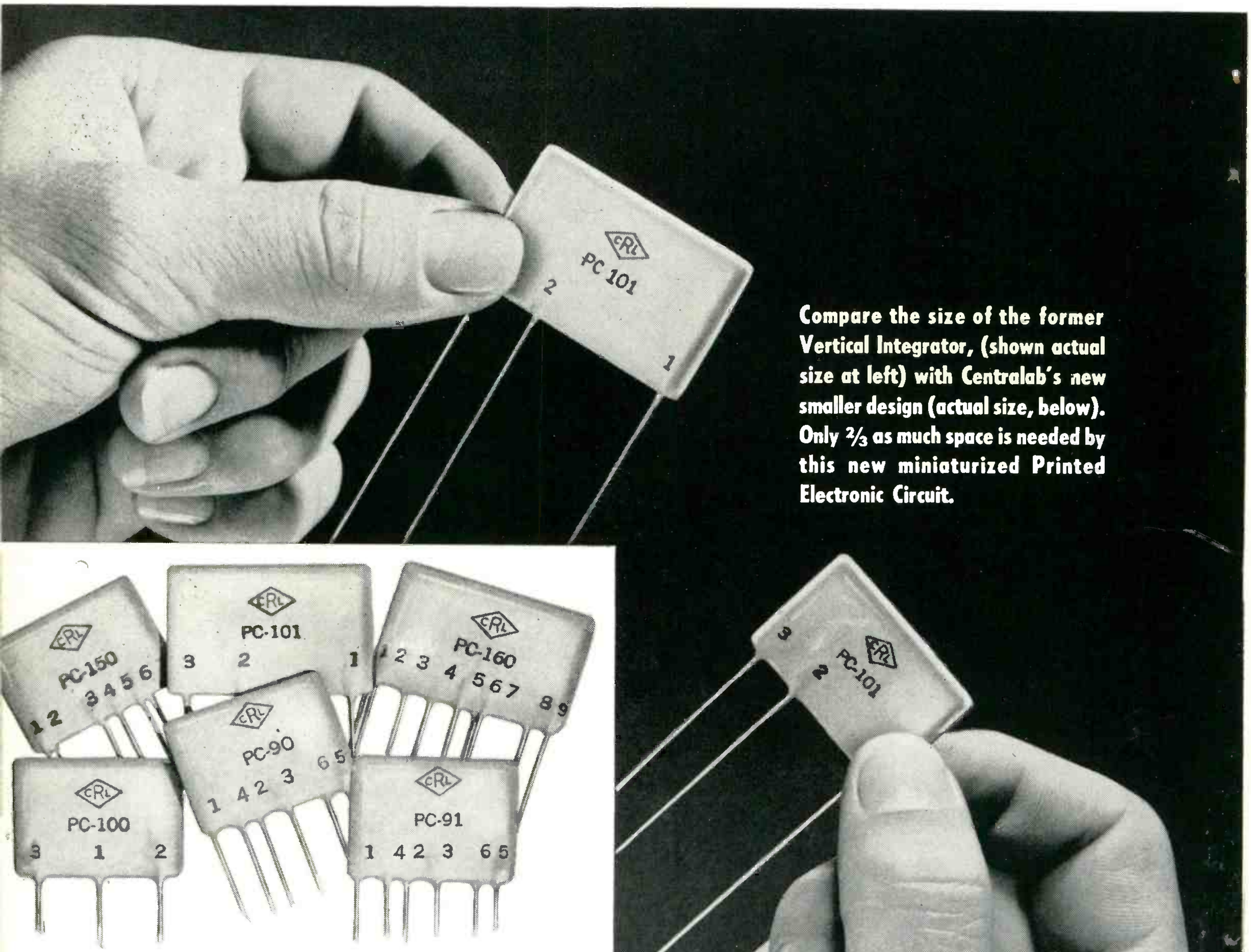
PRINTED CIRCUITS ARE NOT PRINTED ELECTRONIC CIRCUITS

PRINTED ELECTRONIC CIRCUITS are complete or partial circuits in truly miniature sizes — furnished *complete* with conductors, resistors, capacitors and brought out to convenient, permanently anchored mechanical leads. Centralab, the originators of Printed *Electronic* Circuits, makes the world's most complete line — from single resistor plates to complete speech amplifiers.

A PRINTED CIRCUIT is a conductive pattern of an electric circuit, *but* provides conductors only. Don't be misled. A Printed Circuit is *not* a Printed *Electronic* Circuit. There is a place for both in electronic design. Many times they can be used together in the same circuit. But *don't* expect Printed Circuits to do the job that can be provided only by Printed *Electronic* Circuits.

For more information on how Centralab Printed *Electronic* Circuits can offer you big savings . . . turn the page . . .

CENTRALAB now offers smaller sizes in PRINTED



Don't overlook the savings achieved by new, reduced prices on this "bargain group" of PEC's. Check coupon for bulletins. Pentodes (Bulletin 42-128), Vertical Integrators (Bulletin 42-126), Audets (Bulletin 42-129), Pendets (Bulletin 42-149).

Now — Centralab gives you even more versatility . . . still greater savings in electronic design. Yes, the prices of several Printed *Electronic* Circuits have been reduced. What's more, these components have been miniaturized to still smaller sizes. We've achieved maximum compactness plus top performance . . . at a new low price.

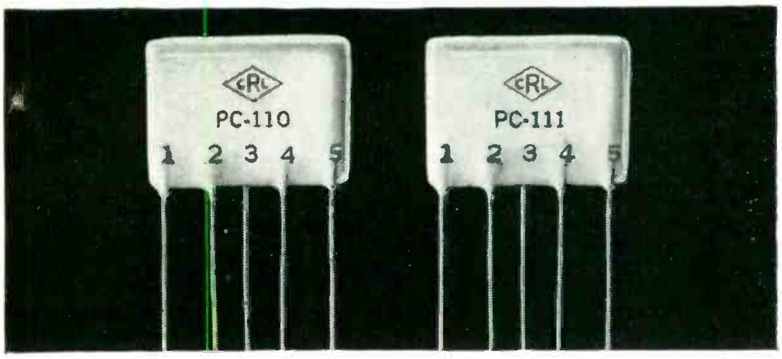
If your designs specify the capacities fulfilled by Pentodes, Vertical Integrators, Audets, or Pendets — look forward to savings ranging from 0.1 to 7 cents per unit.

Actually, these miniature components have always saved you money in time and labor. Now, for the first time, their *first cost is less* than that of the components they replace.

Add up these savings — lower first cost . . . less production time and labor . . . reduced purchasing and inventory requirements. No wonder volume users find they can save thousands of dollars with Centralab Printed *Electronic* Circuits.

even greater savings, ELECTRONIC CIRCUITS

Save time and money . . . space and weight with these PEC's



FILPLATES (2 resistors and 2 capacitors) for bypass and filter application in TV, FM and AM, where filter networks of comparable component values and layout are needed. 28% less soldered connections. Save vital low wattage resistor stocks. Technical Bulletin 42-131.

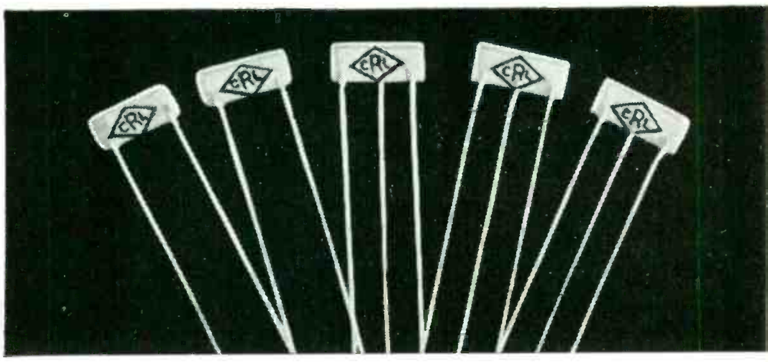
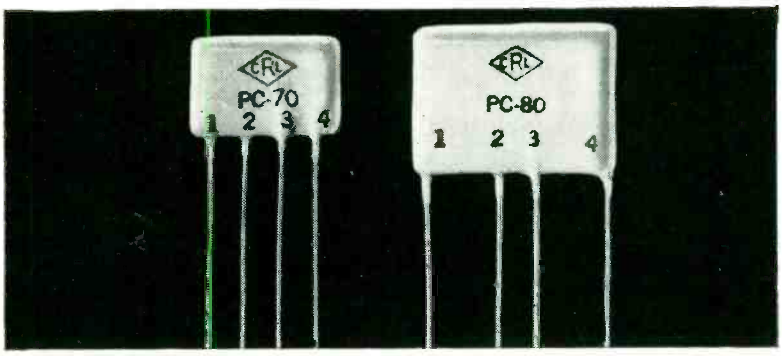


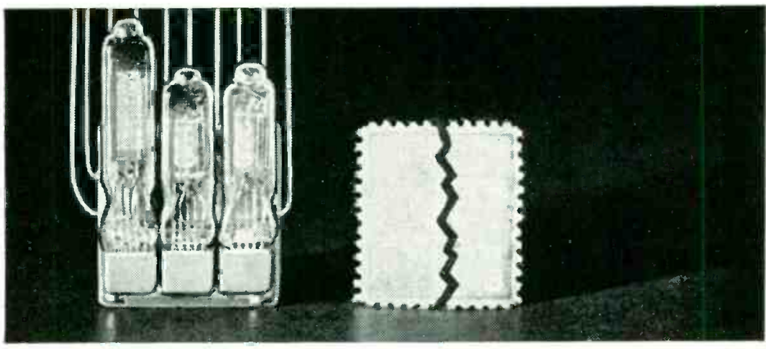
PLATE CAPACITORS AND RESISTOR-CAPACITORS. Excellent for miniature use. Actual size photograph. Because of size, they readily fit all types of miniature and portable electronic equipment — overcome crowded conditions in TV, AM, FM and record player chassis. Technical Bulletin 42-132.

60% Less Soldered Connections with Centralab Triode Couplates



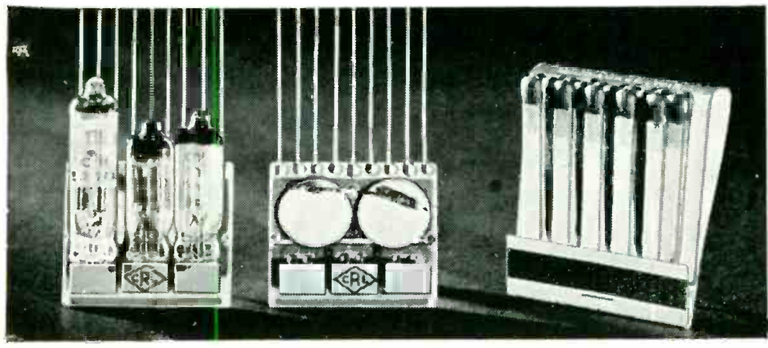
CENTRALAB TRIODE COUPLATES replace 5 components normally used in audio circuits. Triode Couplates are complete assemblies of 3 capacitors and 2 resistors bonded to a dielectric ceramic plate. Available in a variety of resistor and capacitor values. Technical Bulletin 42-127.

New Model 3 AMPEC — A Sub Miniature 3-Stage Speech Amplifier



CENTRALAB'S CONSTANT RESEARCH produced this amazing development in Printed *Electronic* Circuits.. The remarkably small dimensions of this new amplifier unit are approximately $1\frac{1}{32}$" x $\frac{15}{16}$" x $\frac{11}{32}$". Check coupon for Technical Bulletin 42-130.

Standard Model 2 AMPEC Miniature 3-Stage Speech Amplifier



AMPEC — A full 3-stage speech amplifier. Provides highly efficient performance. Size $1\frac{1}{4}$" x $1\frac{1}{8}$" x $\frac{3}{8}$" over tube sockets! Used in hearing aids, mike preamps and other applications where small size and outstanding performance count. Technical Bulletin 42-117.

Centralab

A Division of GLOBE-UNION INC., Milwaukee 1, Wis.

Centralab, A Div. of Globe-Union Inc.
914 East Keefe Avenue, Milwaukee 1, Wisconsin

Please send me the Technical Bulletins on Printed Electronic Circuits as checked below:

☐ 42-128 ☐ 42-129 ☐ 42-131 ☐ 42-127 ☐ 42-117
☐ 42-126 ☐ 42-149 ☐ 42-132 ☐ 42-130

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

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

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

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

York, Pa.; Roanoke, Va. and Spokane, Wash., are given top priority but the industry also is watching the 'sleepers' like Jackson, Miss., and Mobile, Ala.

Estimates by set manufacturers of the number of additional new markets they expect this year vary from a low of 6 to a high of 12. The industry's outlook for new markets in 1953 varies even more. Estimates range from as few as 25 to a top of 65.

► **Old Markets**—Even though there are 18.7 million sets now in use, the industry could 'get along' without new markets. From 60 to 75 percent of all sales represent natural replacement as owners of 7, 10, 12, 14 and 16-inch sets trade in for the 20-inch and larger screens. And there is a market developing for second sets as owners keep the old smaller set for the bedroom, child's room or recreation room and buy one for the parlor. Dealers estimate second-set sales comprise from 5 percent to 10 percent of the total.

Radio Call Box for Patrolmen

Police call boxes are made independent of wireline failure by using in each a Motorola Handie-Talkie radiophone which operates from a-c when in the box, and from batteries when taken out to the scene of an emergency. Selective signaling equipment at base stations permits turning on a red lamp atop any desired box to attract a patrolman's attention

Electronics Invades Medical Labs

Survey shows $290,000 worth of instruments in one lab, made chiefly by electronic firms

MANUFACTURERS of electronic equipment are invading an instrument market hitherto dominated by firms specializing in medical equipment. This conclusion is derived from an instrument-by-instrument survey of each laboratory in the Sloan-Kettering Institute in New York City, devoted entirely to cancer research.

Total numbers of instruments of each type and estimated total values are tabulated here.

2	Amplifiers, a-c linear	$1,050
1	Amplifier, audio	100
4	Amplifiers, d-c	4,500
3	Capacitance bridges	800
6	Capacitor decades	600
1	Capacitor, precision air	700
15	Cathode-ray oscilloscopes	5,300
2	Colorimeters, photoelectric	1,400
1	Conductivity meter	300
1	Counter, automatic gamma	3,000
2	Counters, beta	1,200
3	Counters, end-window	500
1	Counting-rate calculator	500
2	Densitometers, photoelectric	1,200
1	Electrocardiograph	700
1	Electroencephalograph	2,400
3	Electrometers	600
2	Electrometers, vibrating-reed	3,000
1	Electronic switch	400
1	Electron microscope	20,000
1	Electrophoresis equipment	6,000
1	Electroscope, quartz-fiber	75
1	Energy-absorption apparatus	1,800
1	Exposure timer, automatic	700
1	Facsimile-type optical density analyzer	10,000
22	Flow counters	6,400
1	Fluxmeter	225
10	Fraction collectors	4,400
1	Frequency meter	700
8	Galvanometers, mirror	1,550
9	G-M housing and tubes	5,750
2	G-M quenching circuits	200
15	G-M tubes	750
1	Interpolation oscillator	850
1	Ionization chamber	1,200
7	Ionization gages	500
1	Isodosimeter	4,000
3	Kilovoltmeters, electrostatic	750
4	Mass spectrometers	29,000
3	Monitors, lab. radioactivity	1,200
2	Monitors, portable radioactivity	675
3	Multimeters	200
1	Oscillator, audio	200
8	pH meters	4,800
3	Photometers	1,200
2	Photometers, flame	2,400
1	Photomultiplier unit	125
1	Pipette dispenser, automatic	200
1	Polarimeter, photoelectric	1,000
6	Potentiometers, precision	2,400
4	Power supplies, high-voltage regulated	1,900
6	Power supplies, plate voltage	1,100
3	Power supplies, regulated	500
11	Preamplifiers	275
6	Preamplifiers, electrometer-tube	450
3	Pulse generators	4,200
1	Radar set (war surplus)	100
13	Recorders, electronic self-balancing	7,875
5	Recorders, single-pen strip chart	1,500
1	Recording camera, oscilloscope	375
1	Reflectometer	150
10	Resistor decades	1,150
4	Sample changers, automatic	2,500
34	Scalers	22,200
6	Scaler shutoffs, automatic	300
7	Scintillation detectors	3,400
6	Spectrometers, recording infrared	42,000
1	Spectrophotometer, recording ultraviolet	8,000
10	Spectrophotometers	4,850
7	Spectrophotometers, quartz	12,600
1	Stimulator, electrical	500
1	Time-delay generator	1,600
8	Timers, electronic	900
2	Tube testers	300
	Tubes, components and individual meters in stock	5,000
1	Ultracentrifuge	15,000
1	Ultrasonic generator	1,500
1	Vacuum-tube bridge	400
7	Vacuum-tube voltmeters	1,200
1	X-ray unit, soft type	10,000
	Total	$289,825

► **Hospital Needs**—Even more impressive is the tabulation of electronic equipment for Memorial Center, of which SKI is a part. Even a partial listing for the hospital and clinics in this group totals over $700,000, with the bulk of this being made by electronic firms. These figures do not include installation costs, often more than the instruments themselves because of need for special room constructions with lead shielding and elaborate safety precautions. Following is the partial listing with price estimates:

38	X-ray machines	$438,500
1	Betatron	110,000
1	X-ray machine test set	20,000
1	X-ray dosage calibration unit	26,000
	X-ray tubes, power supplies, meters	50,000
	Other meters, recorders	130,000
34	Ionization chambers	7,000
20	Radiation survey meters	5,000
70	Ionization chambers, pocket	2,000
6	Radiation meters, capacitor type	6,000
6	Ionization-measuring instruments	6,000
4	Oscilloscopes, cathode-ray	1,000
20	Voltage regulators	4,000
	Standard test instruments	6,300
	Total	$811,800

Computers Sweat Out Election Results

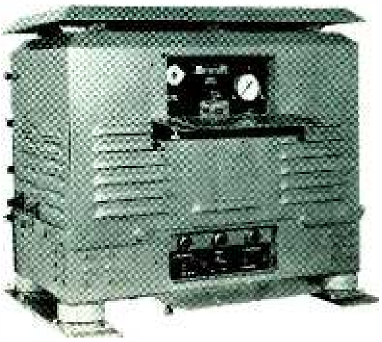
Nonpartisan electronic machines vie with human experts to predict outcome

THREE radio and television networks used electronic calculators on November 4 to analyze election returns. In the opinion of many

(Continued on page 16)

SHOCK AND VIBRATION NEWS

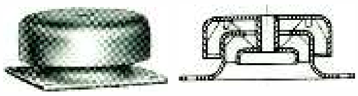
Builder Claims Smooth Performance and Quiet Operation thru the use of Barrymounts in Dehydrator



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

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

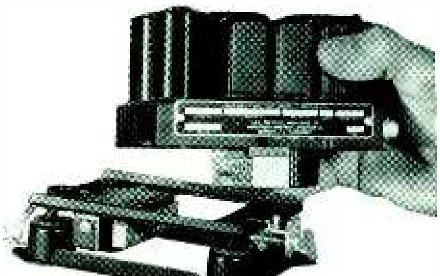
The maker of AUTO-DRYAIRE®, Communication Products Company, Inc. of Marlboro, N. J., states: "We have used Barry Isolators for several years. The excellent service they have rendered in our equipment is the primary reason for their continued use."



Type 2000 Barrymount

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

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



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

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

Check these useful features of miniaturized Barrymounts.

Light weight — only 5/16 ounce each.

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

Resonant frequency — 9 cps

Transmissibility at resonance — 3

Wide load range — 0.1-3 pounds

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

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

FREE CATALOGS

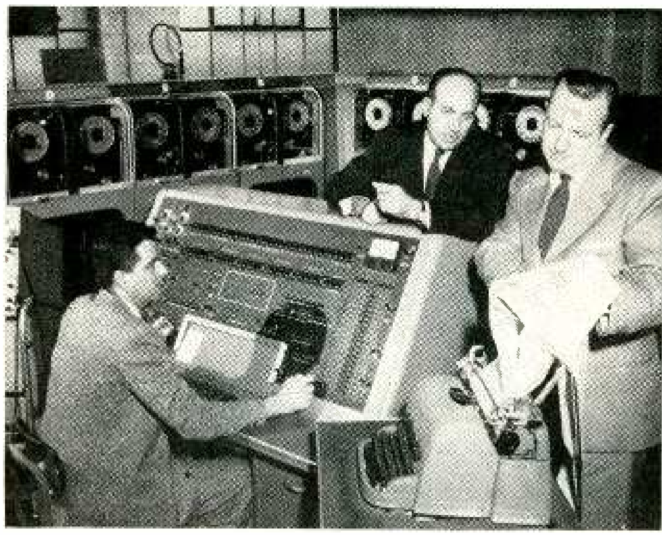
- 523-A — Air-damped Barrymounts for aircraft service; also mounting bases and instrument mountings.
- 509-A — ALL-METL Barrymounts and mounting bases for unusual airborne applications.
- 504-B — Shock mounts and vibration isolators for marine, mobile, and industrial uses.
- 607 — How to cut maintenance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

THE BARRY CORP.

707 PLEASANT ST., WATERTOWN 72, MASSACHUSETTS

SALES REPRESENTATIVES IN

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



Univac (left) and Monrobot (right) also ran on November 4 in race to predict outcome of election on basis of preliminary returns and past elections

viewers and listeners, the results were considerably less spectacular than they were led to expect by advance publicity.

Technically speaking, the calculators did what they were expected to do, but difficulty arose in selecting appropriate past election data for setting up the problems and interpreting results.

▶ **Trio**—The American Broadcasting Company used an IBM calculator, while CBS enlisted the services of Remington Rand's Univac and NBC the Monrobot calculator. As early as 10:30, Univac had decided that Eisenhower was to win in a landslide, and shortly thereafter, Monrobot listed odds in Ike's favor at 6 to 5, and later 3 to 1, as returns became more conclusive. The IBM calculator was used to calculate percentages as returns were filed.

Aside from the thousands of tubes used in these and other calculating machines election night, and the even greater number in the various studio and transmitting facilities across the country, it is estimated that 500 million tubes in television and radio receivers in this country helped to bring results to the public. Receivers and transmitters in use in Europe, South America and Asia swelled the total to a new high for one broadcast.

Canadian TV Takes First Steps

Montreal and Toronto stations now in operation, microwave relay network planned

PRIMED by a $4,500,000 government loan, the Canadian Broadcasting Corporation now has television stations operating in both Montreal and Toronto. Each station has two studios, film reproducing and recording facilities, a mobile unit, a 5-kw picture transmitter and a 3-kw sound transmitter. Plans are under way to build another station in Ottawa.

▶ **Microwave**—A television network linking Toronto and Montreal by way of Ottawa is being built by Bell Telephone of Canada. The 374-mile microwave chain is scheduled for May-1953 completion. A microwave link between Buffalo and Toronto is already operating.

Plans call for a network extending eastward to Quebec City and westward to Windsor, Ontario.

UHF Tubes Promised

ENGINEERS meeting at the recent IRE Broadcast Transmission Systems Symposium groused gently to each other: "How can anybody build a real uhf tv transmitter without tubes?" They were later heartened by three papers presented at the session in Philadelphia.

One engineer described attempts to exploit the conventional space-charge-grid high-vacuum type of tube to its ultimate capability. Probably such a tube can be made to produce appreciable power up to some 3,000 mc. Several different models involve the use of ceramic materials and new ceramic-to-metal sealing techniques.

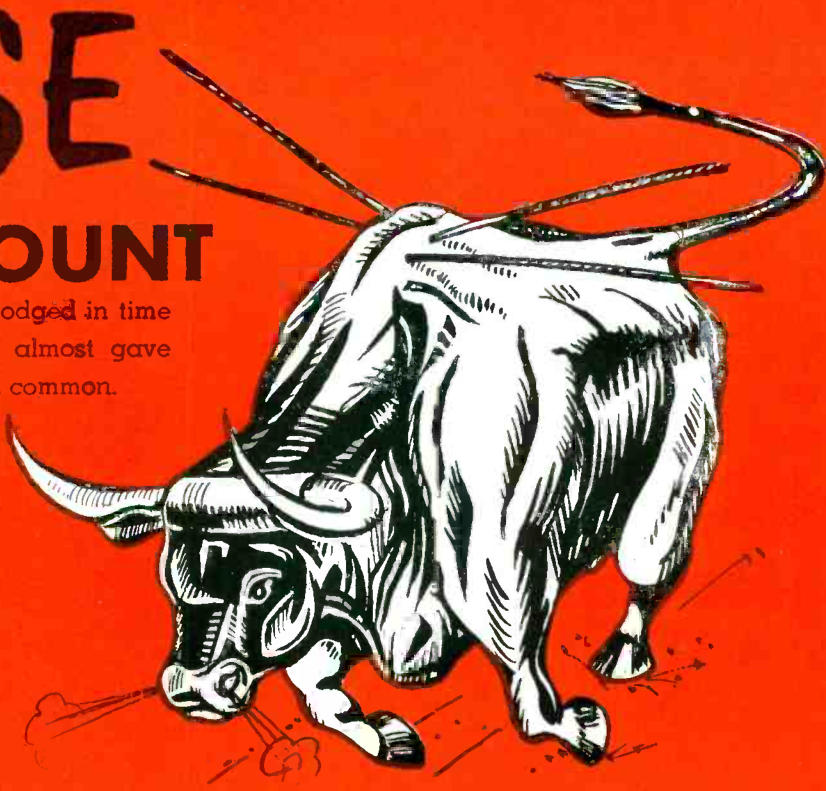
▶ **Big Bottles**—Particularly interesting to tv broadcasters who think in terms of kilowatts at uhf were talks by General Electric and Eimac engineers. A 12-kw television transmitter using the Varian klystron is promised soon to WHUM-TV. Negotiations are going on to make Varian tubes

(Continued on page 18)

CLOSE

DOESN'T COUNT

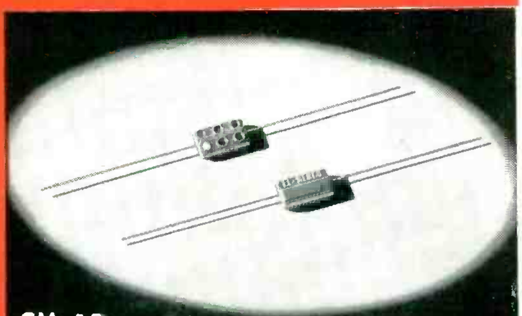
A tired bull fighter that almost dodged in time . . . a defective capacitor that almost gave good service . . . have much in common.



In bull fighting as in building high quality capacitors, being close to proper performance . . . close to dependability . . . isn't good enough.

To make sure that El-Menco Silvered-Mica Capacitors maintain higher standards in every electronic application, they are built with precision by expert craftsmen using the finest materials . . . and each unit is factory-tested at more than double its working voltage.

Sizes for every specified military capacity and voltage.



CM-15

For larger capacity values, which require extreme temperature and time stabilization, there are no substitutes for El-Menco Capacitors.

Write on business letterhead for catalog and samples.

JOBBERS AND DISTRIBUTORS: For information write to Arco Electronics, Inc., 103 Lafayette St., New York, N. Y.—Sole Agent for Jobbers and Distributors in U. S. and Canada.

MOLDED MICA # El-Menco **MICA TRIMMER**

CAPACITORS

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

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

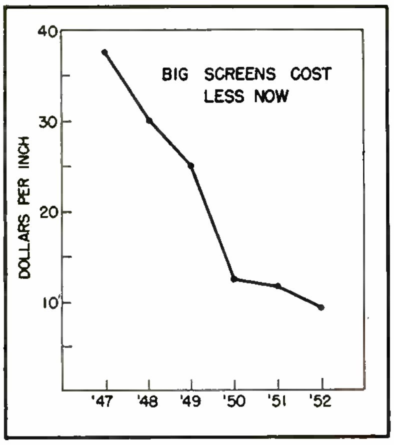
(GE-manufactured) available on a rental basis to broadcasters.

Eimac, already selling klystrons to DuMont, says it has now furnished samples to other transmitter manufacturers. Its tube has the advantage of tunable cavities and thus requires only three models for various segments of the uhf band. High-power klystrons have been conversation pieces for some time. Eimac's usually conservative engineers now say that they are looking towards a 50-kw tube.

Television Picture Prices Hit New Low

Cost per screen inch has dropped sharply since 1947 as tv's face has changed

DESPITE recent tv receiver price increases due to rising labor and material costs, television's cost today in terms of picture size is lower than ever before. As is shown in the chart, this has been true in every year since 1947. Today the average price per screen inch is less than $10 while in 1947 it was about $40. A 7-inch screen cost $300 then but today 20 and 21-inch sets are available for $200, giving three times the screen size for 1/3 less cost.



▶ **Size Cycle**—Predominant picture sizes of the tv industry's top sellers have increased an average of about 2 inches every year since the war. Biggest jump was made in 1950, when the 16-inch set became predominant over 1949's 12-inch receivers. In 1951 the 17-inch picture was the volume seller and this year the 20 and 21-inch screen may take the lead.

▶ **Shape**—Television screens have changed in shape as well as in size in the last five years. Until 1949 almost all screens were round. But then the television industry and the public became screen-shape conscious and the rectangular picture tube came on the market. By 1950 rectangular 16-inch screens represented 34 percent of television picture tube production. In 1951 the percentage more than doubled. Today it is estimated that 98 percent of all 18-inch and larger tubes produced are rectangular.

▶ **Future Screens**—A survey of leading television receiver manufacturers reveals that the predominant tv picture for 1953 will probably be the 21-inch size. In actual percentages, leading set manufacturers expect television sales by screen size to range as follows: 17 inch, 25 to 40 percent; 21 inch, 60 to 70 percent; 24 inch, 0 to 1 percent; 27 inch, 4 to 10 percent.

Electronics Equipment Goes Airfreight

Airlines report growing volume of shipments by manufacturers and distributors

PICTURE of the growing use of air freight by the electronics industry for equipment shipments is seen in reports of representative airlines on this segment of their business.

American Airlines says that its electronics shipments have increased 20 percent in recent months. In the New York area alone, Slick Airways reports that their electronic shipments have increased 10 percent this year. Capital Airlines estimates that electronic shipments now comprise between 8 percent and 10 percent of their total airfreight shipments, while in 1947 the percentage was between 2 and 5 percent. Reports by other airlines such as TWA and Eastern also bear out the upward trend.

▶ **Trend**—Although temporary upsurges in electronic airfreight shipments have happened before, airfreight companies are inclined to believe that present increases are permanent and will grow larger.

American Airlines has just completed a survey of electronic and equipment manufacturers, parts manufacturers and parts distributors that tends to substantiate this belief. American found that use of airfreight for finished equipment was not until recently a regular practice in the industry. It has been used chiefly when unforeseen short supplies of parts developed.

▶ **Parts**—According to American, parts manufacturers find that packaging problems and costs are reduced and that shipping damages are less. Warehousing costs have also been cut because inventories can be held to a minimum. In fact, the airline reports that some tube and parts manufacturers have decided to avoid building warehousing to handle distant growing markets whenever airfreight can be substituted.

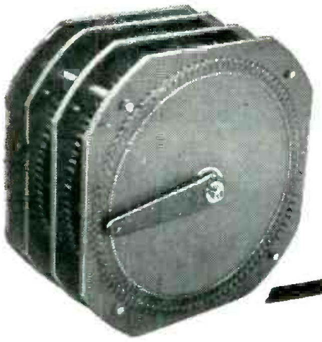
Many parts jobbers have come to consider airfreight a regular part of their business, especially in connection with their industrial electronics sales activities. Since that business calls for a wide variety of parts, for which demand cannot be predicted, airfreight is the answer for an increasing number of jobbers.

Outerspace Radio Ready And Waiting

ROCKETS to the moon may be years away but communications equipment capable of establishing contact is available now.

According to George O. Smith,

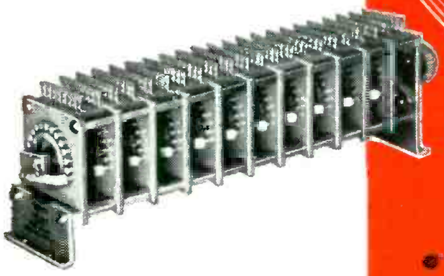
(Continued on page 20)

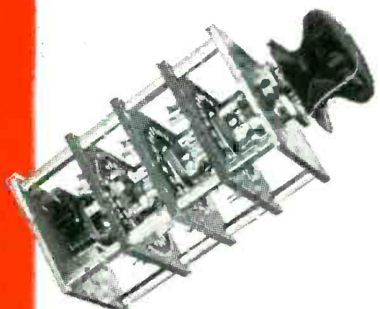


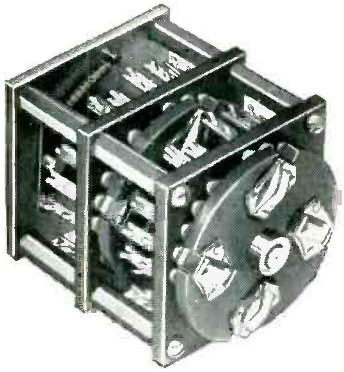
Quick Switches

are a

DAVEN SPECIALTY







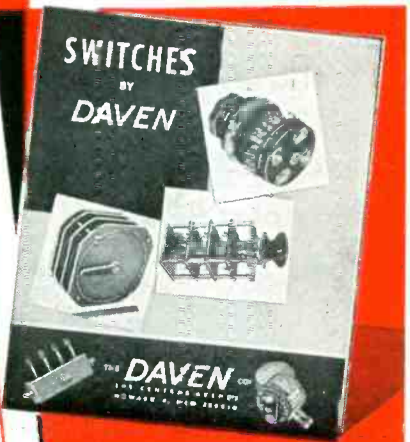
And the "specialty of the house" is double-barreled . . . first, choose from hundreds of standard units to satisfy your needs—for quick switch delivery . . . second, Daven can effect quick 'switches' or changes from standard units to special switches, by using components at hand. Standard parts can be adapted for *your* switch. That too makes for speed, dependability, economy. Write for more detailed data.

Here's Why Daven Switches Excel

- Low and uniform contact resistance.
- Minimum thermal noise.
- High resistance to leakage.
- Trouble-free operation and long life.
- Roller-type positive detent action.
- Depth of unit not increased by addition of detent.

Standard Daven Switches may be the answer to many of your problems. Therefore, check this list below for many of the popular types that are readily available.

Type	Operation	Maximum No. of Positions (per pole)	Maximum Poles per Deck	Deck
GTA	Make before break	24	1	1 3/8"
C1A	Make before break	31	1	1 3/4"
C2B	Break before make	15	1	1 3/4"
D1A	Make before break	47	1	2 1/4"
D7A	Make before break	14	4	2 1/4"
D8B	Break before make	7	4	2 1/4"
D9A	Make before break	9	5	2 1/4"
E3A	Make before break	47	2	2 3/4"
E8B	Make before break	12	4	2 3/4"
E11A	Make before break	15	6	2 3/4"
F1A	Make before break	60	1	3"



It's Free!

Your copy of Daven's complete, new bulletin on switches. Write for it today.

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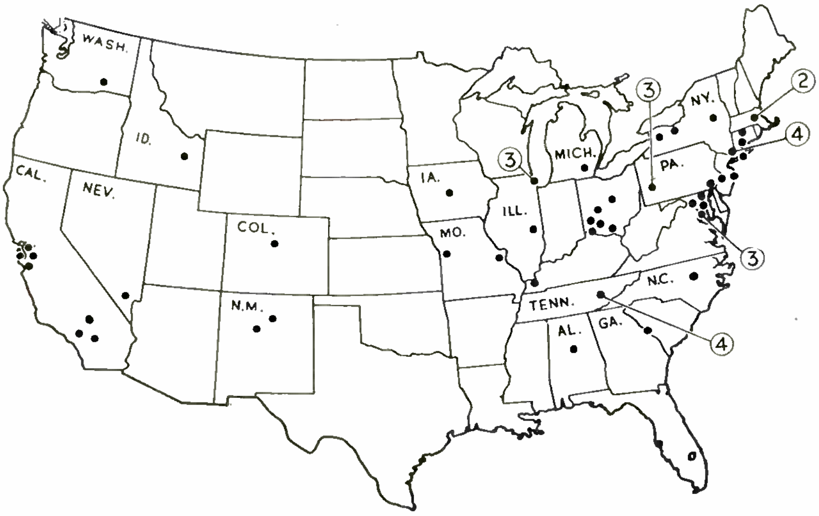
speaking before the recent Symposium on Space Travel in New York, X-Band radar equipment could be converted to communications use. Using a radiated power formula, he pointed out that the minimum required power output to provide communication between earth and moon is 0.291 watts. That is approximately equivalent to the power that is used in an ordinary 3-cell flashlight.

Markets In Atomic Energy Program For Electronic Instrumentation



Numerals show number of plants in cities having more than one

ALABAMA
- BIRMINGHAM: Southern Research Institute

CALIFORNIA
- BERKELEY: Radiation Laboratory
- DOWNEY: North American Aviation Co.
- LOS ANGELES: UCLA Atomic Energy Project
- PASADENA: California Institute of Technology
- RICHMOND: California Research Corp.
- SAN FRANCISCO: U. S. Radiological Defense Lab.
- STANFORD: Stanford Research Institute

COLORADO
- ROCKY FLATS: Dow Chemical Co.

CONNECTICUT
- HARTFORD: Pratt Whitney Aircraft Propulsion Project
- NEW HAVEN: Yale University

DISTRICT OF COLUMBIA
- WASHINGTON: Army Medical Center, National Bureau of Standards, Naval Research Laboratory

GEORGIA
- AUGUSTA: Savannah River Operations

IDAHO
- IDAHO FALLS: National Reactor Testing Station

ILLINOIS
- CHICAGO: Argonne National Laboratory, AEC Chicago Operations Office, University of Chicago
- URBANA: University of Illinois

IOWA
- AMES: Ames Laboratory

KENTUCKY
- PADUCAH: AEC Paducah Operations

MARYLAND
- BALTIMORE: Johns Hopkins University
- BELTSVILLE: U. S. Department of Agriculture
- BETHESDA: National Inst's of Health

MASSACHUSETTS
- CAMBRIDGE: Harvard University, Massachusetts Institute of Technology

MICHIGAN
- ANN ARBOR: University of Michigan

MISSOURI
- KANSAS CITY: Bendix Aviation Corp.
- ST. LOUIS: Washington University

NEVADA
- LAS VEGAS: Nevada Weapons Test Area

NEW JERSEY
- BELMAR: Signal Corps, Engineering Labs.

NEW MEXICO
- ALBUQUERQUE: Sandia Laboratory
- LOS ALAMOS: Los Alamos Scientific Lab.

NEW YORK
- NEW YORK CITY: AEC New York Operations Office, Columbia University, Memorial Hospital, Vitro Corp. of America
- ROCHESTER: Rochester Atomic Energy Project
- SCHENECTADY: Knolls Atomic Power Lab.
- UPTON, L. I., Brookhaven National Lab.

NORTH CAROLINA
- RALEIGH: North Carolina State College

OHIO
- CINCINNATI: U. S. Public Health Service
- COLUMBUS: Batelle Memorial Institute
- FERNALD: Feed Materials and Production Plant operated by National Lead Co.
- LOCKLAND: GE Aircraft Nuclear Propulsion Project
- MIAMISBURG: Mound Laboratory
- PORTSMOUTH: AEC Portsmouth O. Operations

PENNSYLVANIA
- PHILADELPHIA: University of Pennsylvania
- PITTSBURGH: Carnegie Institute of Technology, University of Pittsburgh, Westinghouse Atomic Power Division
- SWARTHMORE: Bartol Research Foundation

TENNESSEE
- OAK RIDGE: Oak Ridge Institute of Nuclear Studies, Oak Ridge National Laboratory, Uranium Gaseous Diffusion Plants operated by Carbide and Carbon Chem. Corp., University of Tennessee AEC Agriculture Research Program

WASHINGTON
- RICHLAND: Hanford Works

Radio Fall Meeting Stresses Color TV

Development work on transistors continues at high level but production is slow

INCREASED INDUSTRY activity in color-television design was evidenced at the recent Radio Fall Meeting in Syracuse, N. Y. Approximately 700 registered at the annual meeting had the opportunity to hear engineers from eight different television manufacturing companies report on present-day design trends.

Just when the FCC might be petitioned to reconsider its color-television system decision remains a moot point. Most optimistic guess is shortly after the beginning of 1953. More conservative viewers say not for at least another year.

▶ **Transistor Situation**—Manufacturers are hard at work improving basic design of the transistor. New materials and methods are being investigated for enclosing the germanium working part of the device to protect it adequately from dirt and humidity and to provide sufficient cooling. According to John S. Saby of General Electric, there is no reason why transistors cannot have indefinite

(Continued on page 22)

meets every production requirement

SPEED
UNIFORMITY
PRECISION
LOW COST

Terminate leads or harnesses by the fastest, most precise method known to today's industry! Speeds are reported up to 4,000 per hour, depending on terminal type, wire size, wire length, etc. All the operator need do is insert the wire — the AMP-O-LECTRIC* machine will do the rest. And with speed, precision and uniformity go hand in hand. You can reduce rejects, improve your wiring, cut costs, and eliminate the wire preparation bottle-neck all at the same time. Over 900 million terminations can't be wrong! Write for a demonstration in your plant.

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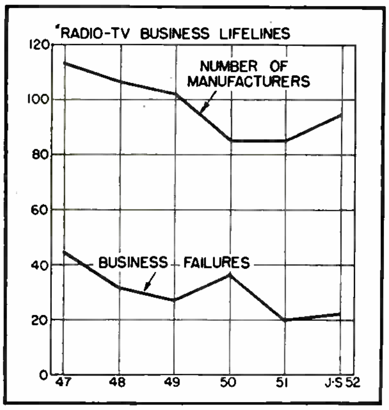
life—if the proper packaging materials and processes are found.

Most commercial applications of transistors are still pretty much in the future. The junction transistor is most in demand and few companies have yet begun production on it. Until automatic production machinery reduces transistor cost, transistor devices cannot compete in most applications with their vacuum-tube counterparts. Where use of the transistor provides outstanding benefits to offset initial high cost, applications will come about sooner.

Radio-TV Firms Increase

Number of manufacturers up by 10 this year, offsetting a slight rise in failures



IMPROVED profit prospects in the radio-tv-phonograph field have increased the number of new companies in the industry this year. There are now 95 such manufacturers, the highest number since 1950. Business failures in the field, according to Dun & Bradstreet, also increased this year but only by 4 over last year's total of 20.

▶ **War**—Biggest upheaval in the status of radio-tv manufacturers occurred in 1950, when the Korean War began. The number of companies dropped by 17 to a total of 85 while failures climbed to 37, an increase of 10 over the year before. In 1951, a sharp decline in tv sales had its effect on the industry's make-up. Although failures decreased, the total number of companies in the field remained almost constant. Few new companies wanted to share in that slump.

▶ **Size**—Total yearly liabilities incurred by failing radio-tv firms have also fluctuated widely. In 1947 they totalled \$6.8 million; 1948, \$9.9 million; 1949, \$4.0 million; 1950, \$2.2 million; 1951, \$3.2 million; Jan.-Sept., 1952, \$6.5 million. A comparison of these amounts with the corresponding number of failures gives some indication of the size of the companies involved. Comparison for this year seems to indicate that the television sales upswing came a little too late for some sizeable manufacturers.

Ferrite Rings Replace Tubes

Pinhead-size ferrite 'doughnuts' store digital data at fraction of cost

A NEW ferrite material having the square-loop magnetic characteristics of the finest grain-oriented steels shows promise of revolutionizing the digital computer business. Major computer laboratories in this country and Europe have tried out the new cores experimentally as magnetic memories, and are now developing associated read-in and read-out circuitry for commercial machines.

Already under discussion is a billion-bit computer. This would have the information-storing capacity of a billion ordinary tube stages yet fit into a 27-foot-square room. Tubes for the same job would need several hundred rooms of that size and would create terrific heat-dissipating problems. Ferrite cores radiate no heat.

▶ **How They Work**—Ferrite memories are strung on a criss-cross of enameled wires in such a way that there is a ferrite ring at each three-wire intersection. Current pulses are sent into an appropriate pair of wires to magnetize a core with one polarity for storage of a 0 and the other polarity for storage of a 1. For read-out, the current pulses are sent through the same pair of wires and the presence or absence of induced voltage pulses in the third wire is interpreted by associated equipment as a 0 or 1.

The cores need be only large enough so the wires can go through their holes, hence hundreds can go in the space required for one tube.

▶ **Originator**—The new ferrite (known as Ferramic MF-1118) was developed by the research staff of General Ceramics and Steatite Corp. under the direction of E. Albers-Shoenberg.

The only known applications so far for the unique square-loop characteristics of the material are in storage and switching circuits of digital computers—but this alone can be enough to require doubling or tripling of the present ferrite core production facilities in this country.

Industrial X-Ray Business Expands

Sales continue to swell this year's volume as uses in industry increase

X-RAY equipment still finds its biggest market in the medical field but manufacturers are optimistic about prospects in the industrial field.

Sales of industrial x-ray have steadily improved since 1950 and this year's volume seems destined to top all previous marks. In 1950, domestic sales reached a total of \$440,000 according to NEMA. They jumped to \$2.4 million in 1951. Sales for the first six months of 1952 reached \$1.6 million, compared

(Continued on page 24)

Midget-sized industrial x-ray unit, developed by GE, goes inside boilers to inspect welds. Equipment is part of two-wheel trailer unit that carries power supply and all apparatus

to $480,000 for the same period in 1951.

▶ **Biggest Use**—Accounting for a major part of the sales rise are companies in the foundry, pressure-vessel, food and chemical fields.

Use of industrial x-ray has increased in foundries for the inspection of castings and forgings. Development of higher energy x-ray equipment now permits internal inspection of metals as thick as 16 inches.

X-ray inspection of pressure vessels has also increased. With high-voltage units, big tanks can be completely inspected in a matter of minutes, saving hours of production time.

In the food field x-ray is now widely used for processing control.

▶ **Success**—Basic reason for the growing use of industrial x-ray equipment is the fact that it has lowered production costs substantially in many cases. X-ray manufacturers point out the fact that many companies have made savings as high as 30 percent of total production costs through the use of the equipment. In terms of dollars, industrial x-ray equipment enabled one foundry to save $35,000 a month in parts salvage alone. With such a record already established, the continued expansion of industrial x-ray markets seems assured.

UHF-TV Waveguide Saves Precious Power

HARD-TO-GET power is conserved in long transmitter-to-antenna runs on higher uhf-tv channels through use of 15 and 7.5-inch waveguide. Main drawback of the 'oversized pipe' is wind resistance, which precludes its use in some cases.

At present, several manufacturers are producing, or planning to produce, RTMA types WR1500 and WR1150, and several leaders in the uhf-tv transmitting field are running tests to determine the relative merits of pipe vs other means. Already in active production are Products Development Co. and the Andrew Corp.

Preliminary test data shows waveguide to have advantage over coax on higher channels, which might be expected, since coax attenuation rises with frequency while that of waveguide decreases with frequency. In some cases studied, the use of waveguide more than doubles system efficiency, thereby halving transmitter requirement for a given erp.

Canada Fights TV Interference

Sweep-circuit radiation is primary headache. Better initial design asked for

BECAUSE EACH Canadian household having a broadcast receiver is assessed a license fee of $2.50, the general public tends to hold government administrative agencies responsible for correcting interference problems. The Department of Transport in Canada has handled such situations when they arise, through their staff of engineers, even though the licensee fee is used for the support of the Canadian Broadcasting Corp.

The most troublesome type of interference, to date, has been sweep-circuit radiation from tv receivers interfering with reception.

Manufacturers and distributors have cooperated in many cases by making necessary changes in a tv set at no expense to the owner. However, once the number of sets increases appreciably, the Department of Transport, the manufacturers and the distributors will no longer be able to handle the situation in this manner.

▶ **Plea**—W. B. Smith of the Department of Transport, in an address at the Radio Fall Meeting in Syracuse, N. Y., urged manufacturers to design their tv sets initially to eliminate as much radiation as possible. Smith pointed out that Canada's Radio Act of 1938 gives the Department the authority to close down any radio or tv set causing interference.

Portables, U-Build-Its Spark Audio Show

Inexpensive equipment opens new market in business and pleasure recording

A NUMBER of new items displayed at the Audio Fair reflect a growing trend in the sound equipment industry; relatively inexpensive, utilitarian pieces of equipment took a prominent place alongside their more spectacular predecessors.

Several manufacturers displayed ultra-portable wire and tape recorders. Such intriguing names as Minifon, Cub Corder, Candid Magnemite and Voyager have been assigned to the self-powered midgets. Although fidelity is not of primary importance in these machines, their ability to reproduce music as a convenient byproduct is quite impressive.

▶ **Down to $29.50**—High cost of living and labor were reflected at the Fair in the popularity of inexpensive enclosures and packaged kits for audio enthusiasts to whom time is less precious than money. One speaker-cabinet combination was demonstrated that sells com-

(Continued on page 26)

plete for less than thirty dollars and provides good response.

Comparative newcomers to audio shows were two-headed pickup arms for playing double-groove binaural records and a fool-proof cabinet that prevents damage to records and recorder due to mishandling. Called Phonogard, the latter uses a sliding transparent canopy to prevent the operator from touching the tone arm. A knob on the front of the box permits remote positioning of the needle on the record for spotting.

Registration figures at the Fair show that 13,000 visited the Hotel New Yorker exhibits during the four-day session.

MEETINGS

NOV. 30-DEC. 5: ASME Annual Meeting, Hotels Statler & McAlpin, New York, N. Y.

DEC. 8-10: Signal Corps Symposium on "Technical Progress in Communication Wires and Cables, Berkeley-Carteret, Asbury Park, N. J.

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

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

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

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

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

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

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

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

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

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

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

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

MAY 12-13: National Conference on Airborne Electronics, Dayton, Ohio.

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

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

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

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

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

FCC Ruling Favors Bell in TV Case

Bell need not link its video channels with Western Union's network

BELL SYSTEM remained sole common carrier in the intercity video-transmission field as the FCC dismissed a two-year-old move to require interconnection between Bell's intercity video-transmission channels and Western Union's New York-Philadelphia microwave radio-relay system.

In a 3-2 decision the Commission ruled that there is no need for additional video-transmission facilities between New York and Philadelphia and that Western Union cannot reasonably be considered a competitor to Bell in the video-transmission field.

In their dissent, Commissioners Hyde and Hennock stated that the majority decision grants a monopoly to Bell that will discourage for all time competition in the television relay field.

Western Union officials indicated that the company's interest in furnishing television channels by microwave would not be diminished by the FCC decision in the case.

Business Briefs

▶ **Teleprompter,** the tv cuing device which rolls a script typed in inch-high letters before the user's eyes, is now available through the RCA Service Company for use by public speakers in all fields.

▶ **Estimates** made by members of the RTMA Sales Managers Committee on tv set production for 1953 average 5,775,000 units. Individual guesses ranged from 5,000,000 to 6,000,300.

▶ **Successful** transition of RCA's Bridgeport experimental UHF tv station to commercial status in Portland, Oregon may set a trend. It is reported that DuMont has received 15 or 20 offers from new tv cp holders for its experimental tv stations in New York.

▶ **Belgian** television plans now call for two services, a Flemish transmission on 625 lines and a French transmission on 819 lines. Both services will use positive modulation and a 7 megacycle bandwidth.

Belgian tv sets built under these standards will have to be modified to receive programs from France or the Netherlands, since Dutch transmissions are negatively modulated and the French use a 14 megacycle bandwidth.

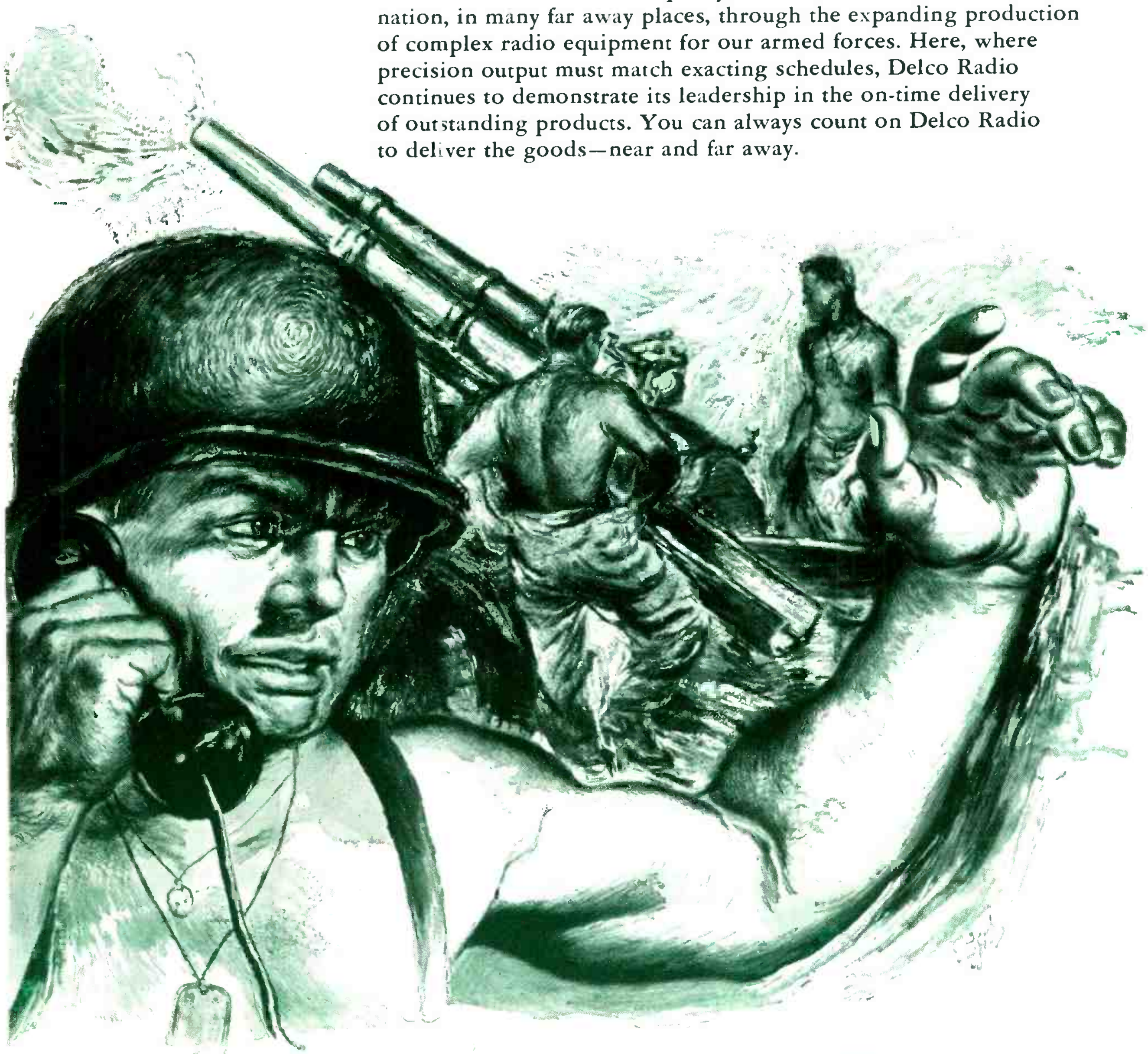
▶ **'Security** sound systems' now being installed in West Coast institutions for the criminally insane allow monitoring of critical areas at a central audio console. A channel identification amplifier responding to louder-than-normal sounds identifies an area of disturbance.

▶ **Registration** of nearly 900 members and guests at the recent 5-day convention of the Society of Motion Picture and Television Engineers convention in Washington, D. C., surpassed attendance records of all previous SMPTE conventions.

Serving at home and far away

DELCO RADIO

As the world's largest producer of radios for automotive use, Delco Radio serves the nation at home with quality manufacturing facilities, a broad engineering and production experience. Today, this same know-how and capacity is also at work in the service of the nation, in many far away places, through the expanding production of complex radio equipment for our armed forces. Here, where precision output must match exacting schedules, Delco Radio continues to demonstrate its leadership in the on-time delivery of outstanding products. You can always count on Delco Radio to deliver the goods—near and far away.



DELCO RADIO

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA

LEADER *IN PRODUCTION*

Delco Radio is the world's largest builder of automobile radios—the leader in production and assembly of component parts.

LEADER *IN ENGINEERING*

Delco Radio developed many of the most important advances in automotive radio . . . has outstanding experience in this field.

LEADER *IN QUALITY*

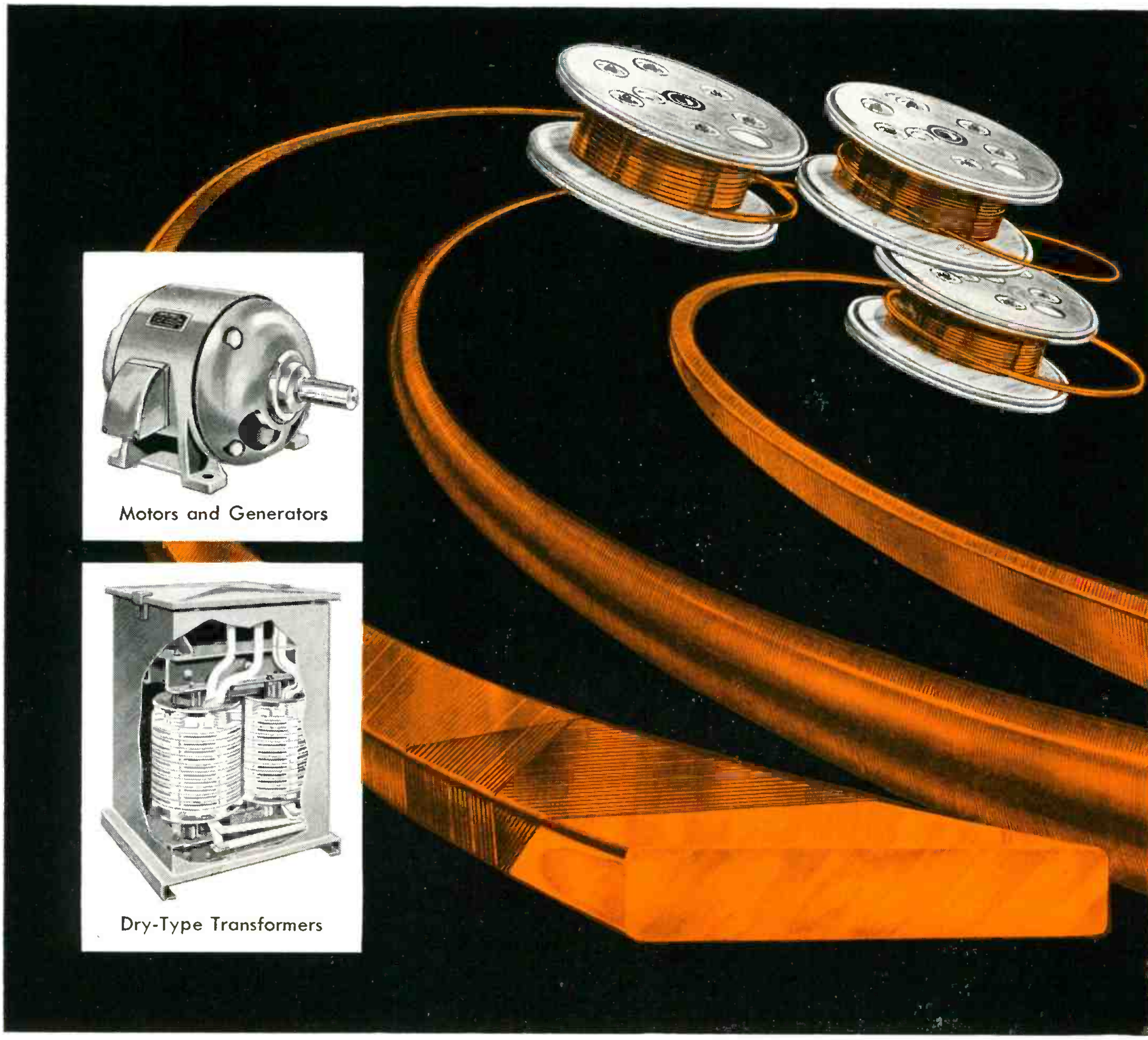
Each step in the manufacturing of Delco Radio products is closely supervised to maintain high, uniform product quality.

LEADER *IN MANUFACTURING*

Completely integrated for efficient production from raw material to finished product, Delco Radio meets any customer need.

Wide Choice of PHELPS DODGE

FOR "HOT WIRE", CLASS B



"It takes the best

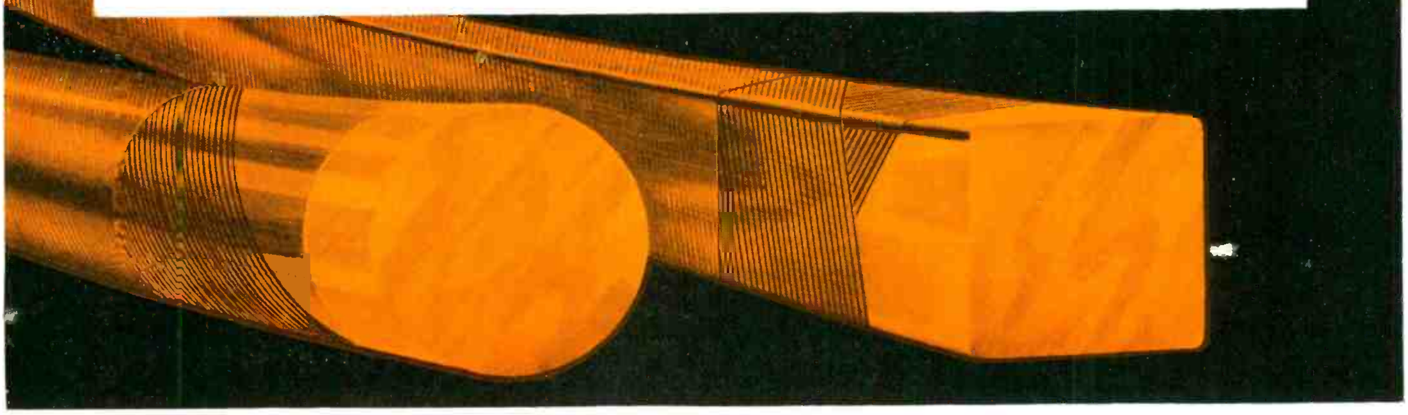
PHELPS DODGE COPPER PRODUCTS
CORPORATION

GLASS-COVERED Magnet Wire
AND CLASS H DESIGNS!

- GOOD THERMAL PROPERTIES IN CLASS B & CLASS H RANGE
- POSITIVE INORGANIC SPACING BETWEEN TURNS
- EXCELLENT MOISTURE AND CHEMICAL RESISTANCE
- DESIGN ECONOMIES AT HIGHER TEMPERATURE

IN PHELPS DODGE magnet wire, spiral wraps of fiberglass provide—between turns—permanent, inorganic spacers which withstand high temperature, extreme overloads. Impregnated against abrasion with organic varnishes, the insulation is Class B. With Silicone varnishes, it's Class H. Glass combined with films, notably Formvar, gives Phelps Dodge magnet wire an excellent balance of overall properties for higher temperature, higher turn voltage applications. Complete information on request.

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



to make the best!"

PHELPS DODGE COPPER PRODUCTS CORPORATION

INCA MANUFACTURING DIVISION

FORT WAYNE, INDIANA

G-E Diffused Junction

NOW RATED

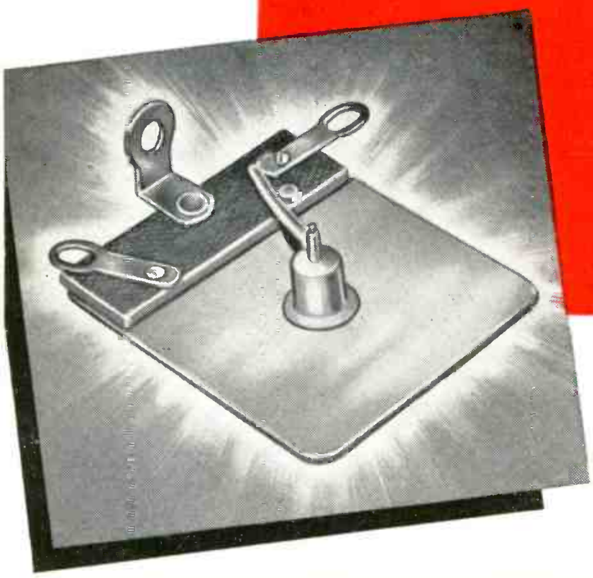
CHECK THESE NEW CHARTS

HERMETICALLY SEALED against deteriorating elements. Glass-to-metal seals throughout.

MINIATURE SIZE to facilitate use in all electronic equipments, yet heat losses are dissipated efficiently.

REDESIGNED to meet all military humidity tests and shock and vibration requirements.

HIGH OUTPUT VOLTAGE and improved back current characteristics.



MODEL 4JA2A4 designed for use in TV power supplies. DC output voltage is 10 to 15 volts higher than with comparable selenium rectifiers in a typical voltage doubler circuit.

Germanium Rectifier

AT 55°C!

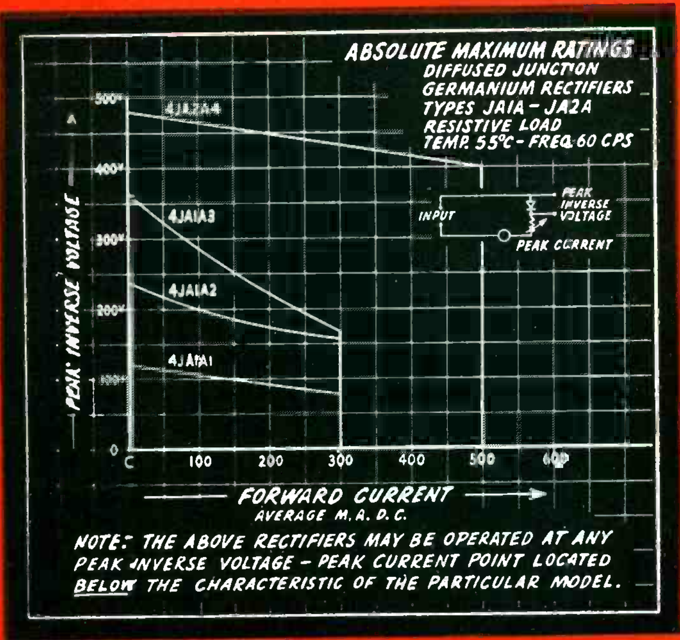
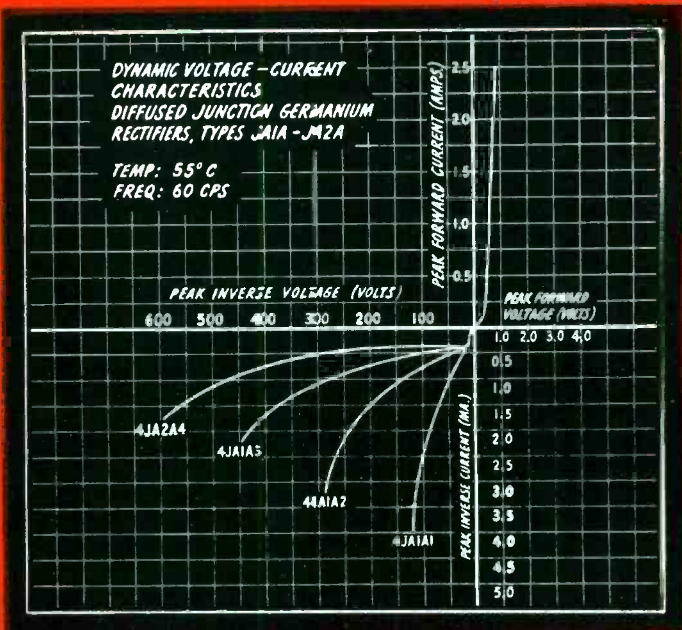


Fig. 1

ABSOLUTE MAXIMUM RATINGS • T-55°C • RESISTIVE LOAD				
DIFFUSED JUNCTION RECTIFIER	4JA1A1	4JA1A2	4JA1A3	4JA2A4
PEAK INVERSE VOLTAGE* (volts)	100	200	300	400
PEAK FORWARD CURRENT (amps)	0.47	0.31	0.25	1.57
D.C. OUTPUT CURRENT* (Ma)	150	100	75	500
D.C. SURGE CURRENT (amps)	25	25	25	25
FULL LOAD VOLTAGE DROP (volts peak)	0.5v	0.5v	0.5v	0.7v
FORWARD RESISTANCE AT FULL LOAD (ohms)	1.1	1.5	1.9	0.5
CONTINUOUS REVERSE WORKING VOLTAGE (volts D.C.)	30	30	30	185
FREQUENCY OF OPERATION (kc)	50	50	50	50
STORAGE TEMPERATURE (°C)	85	85	85	85

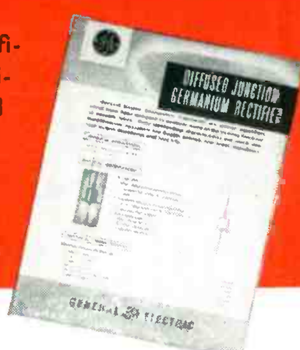
*Typical absolute maximum ratings. For other combinations refer to Fig. 1.



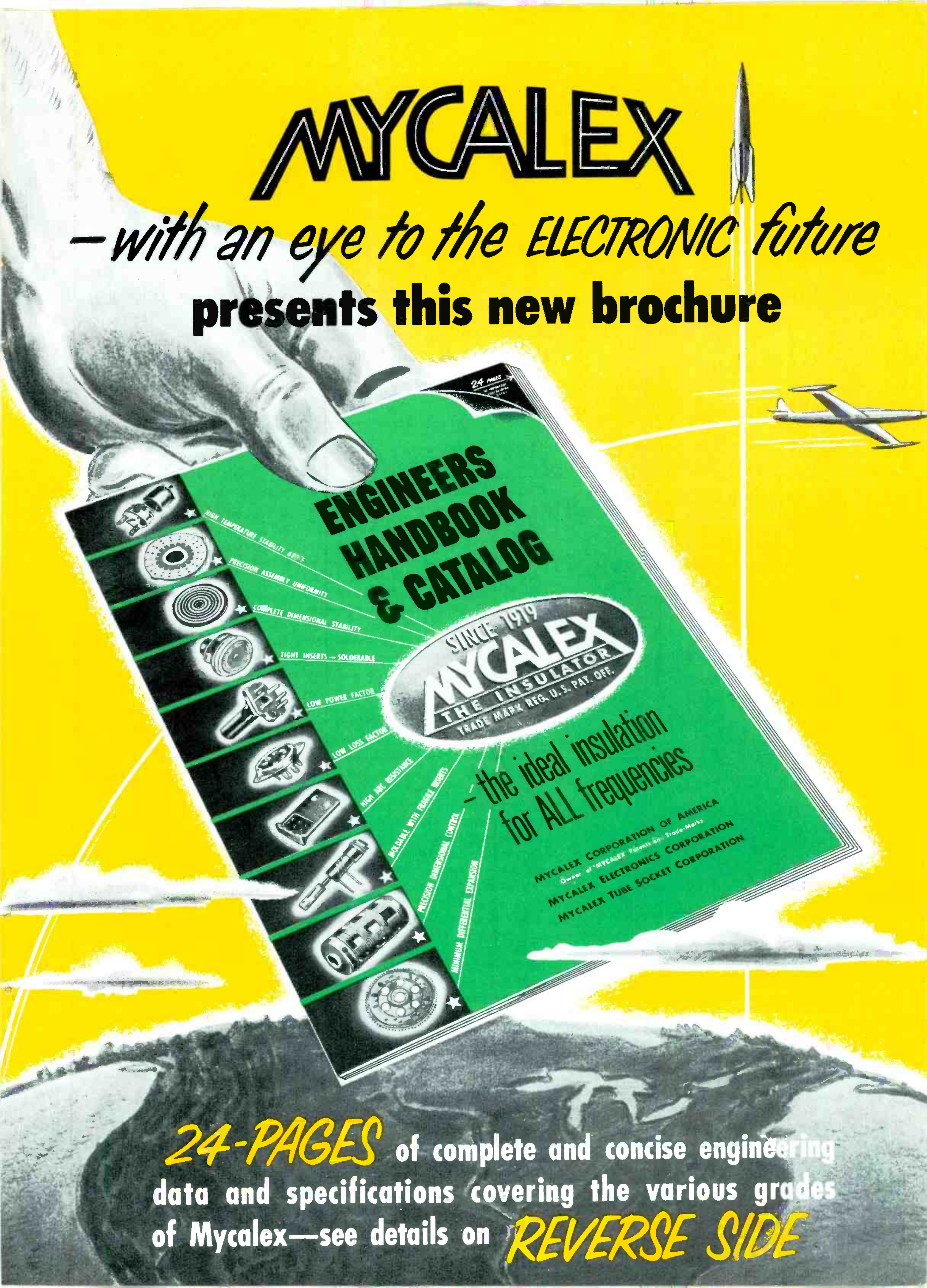
Suggested Application Fields

Originally developed for military use, the new JA1 and JA2 Rectifiers may be adaptable to fields other than radar and military communications. Among them are the following: Computers, magnetic amplifiers, TV receiver power supplies, telephone switchboards. Application information on other uses can be supplied. Write or wire us!

NEW BULLETIN—Complete specifications on the diffused junction rectifiers are contained in this illustrated bulletin. It's yours on request. Write: General Electric Co., Section 4122, Electronics Park, Syracuse, N. Y.



GENERAL ELECTRIC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Typical Operation
Radio Frequency Power Amplifier or Oscillator
Class-C telegraphy or FM telephony,
200-400 mc.

D-C Plate Voltage	1000 volts
D-C Screen Voltage	250 volts
D-C Grid Voltage	—110 volts
D-C Plate Current	150 ma
D-C Screen Current	6 ma
D-C Grid Current	8 ma
Driver Output Power	8 watts
Power Input	160 watts
Useful Power Output	100 watts

Eimac announces the development of the 4X150D radial-beam power tetrode designed for equipment simplification in commercial and military aircraft and vehicular operation. Through a specially constructed heater that has a rating of 26.5 volts at 0.57 amperes, Eimac presents aviation with a tube ideal for 24-28 volt electrical systems. Except for the heater the 4X150D is identical to the universally accepted 4X150A and can be used with the 4X150A air-system socket. The 4X150D is a natural for aircraft and mobile equipment because it combines high power output with small size and a ruggedness that gives it great immunity to damage by thermal or physical shock. Employed as an amplifier, oscillator or frequency multiplier into UHF regions, the 4X150D has a rated plate dissipation of 150 watts.

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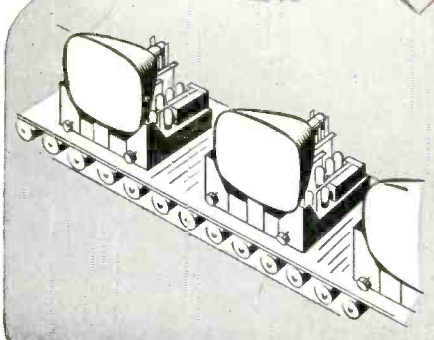
Eimac TUBES

However you compute

IRC BT RESISTORS ARE FIRST

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



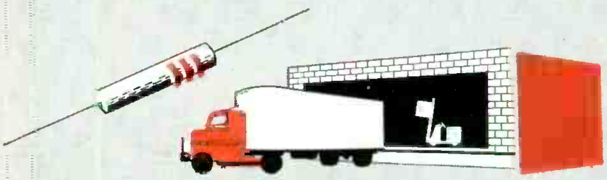
IF QUANTITY PRODUCTION INDICATES LEADERSHIP— *remember* more IRC BT resistors are used in radio and TV sets than any other brand. During the last five years IRC supplied 40% of the resistors used in radio and TV set production.

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

leadership

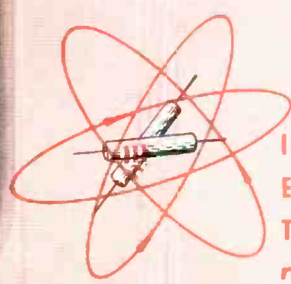
IF GLOBAL ACCEPTANCE REFLECTS LEADERSHIP—

remember IRC filament type BT resistors are favored in every major market of the world. Licensee plants in Canada, England, Denmark, Italy and Australia produce IRC BT's for international electronics.



IF DEPENDABLE DELIVERY REPRESENTS LEADERSHIP—

remember IRC's long record of strike-free labor relations protects your assembly lines. Dependable delivery of Advanced Type BT resistors is further assured by IRC's financial ability to maintain large stocks of wanted ranges and to draw from foreign licensees when demand warrants it.



IF RESEARCH AND ENGINEERING TESTIFY TO LEADERSHIP—

remember IRC BT resistors are produced by the largest resistor manufacturer in the world. The finest accumulation of resistance know-how has been pooled in the perfection of these filament type resistors.

Smallest insulated resistor available anywhere

IRC

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This coupon brings you full data on IRC BT Resistors

INTERNATIONAL RESISTANCE COMPANY

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Please send me full data on IRC Advanced Type BT Resistors:—

☐ Also name and address of nearest IRC Distributor who can furnish speedy delivery of BT resistors in small quantities.

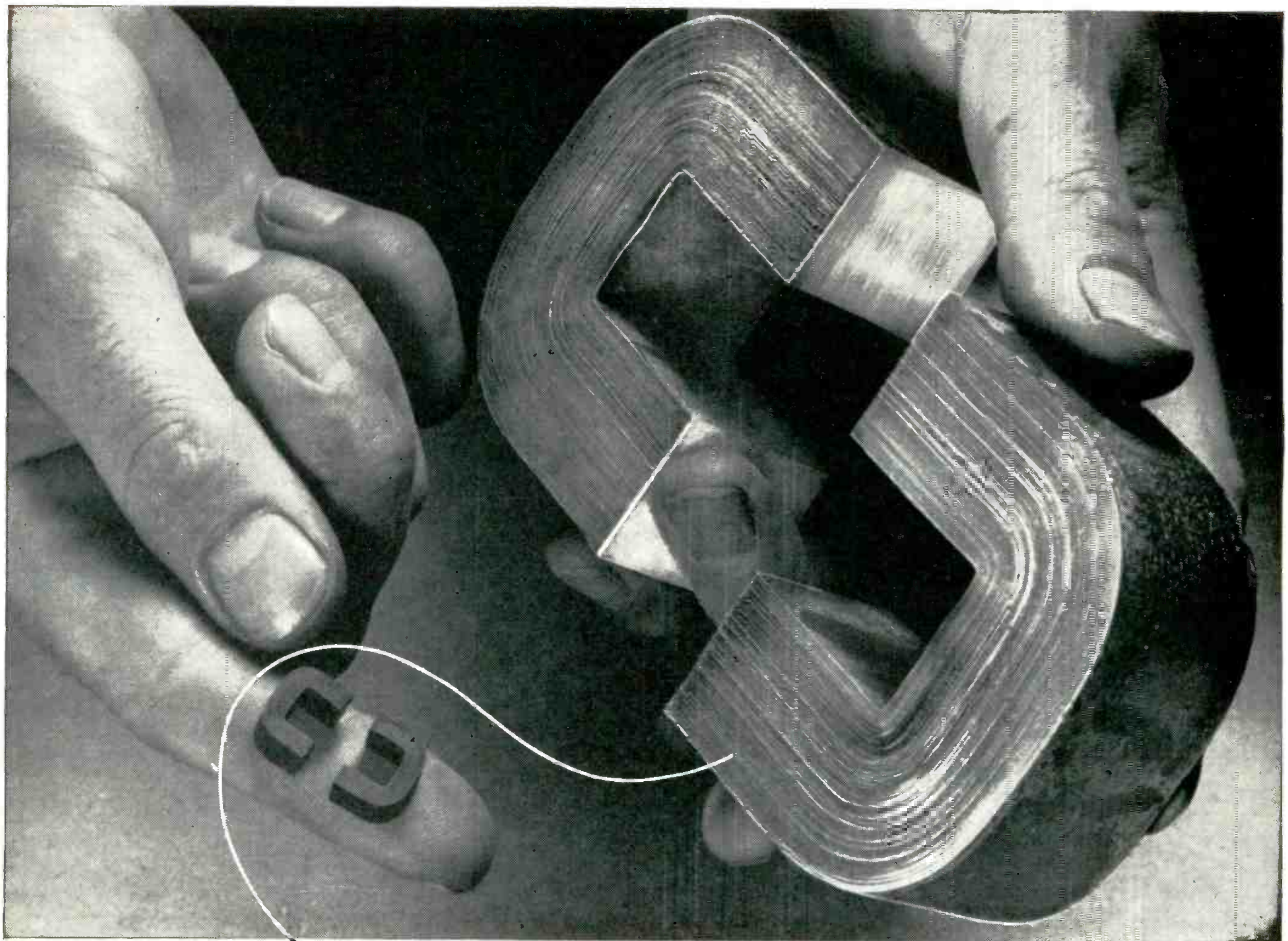
NAME ____________________

TITLE ____________________

COMPANY ____________________

ADDRESS ____________________

CITY ____________________ ZONE ______ STATE ______



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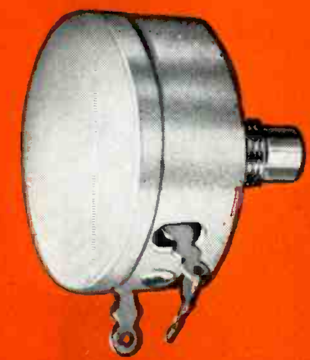
IN CANADA: SANGAMO COMPANY LIMITED, LEASIDE, ONTARIO

TYPE 252, JAN-R-19, Type RA20

2 watt, 1 17/64" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19. Attached Switch can be supplied.

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



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

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

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

Immediate delivery from stock

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

167 types

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

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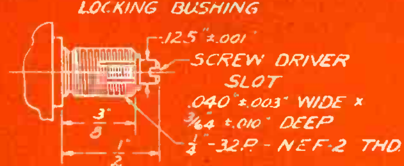
CTS SHAFT TYPE LT-2
LOCKING BUSHING



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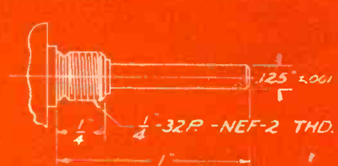
MOUNTING NUT 3/8 HEX × 1/8
LOCK NUT 3/8 HEX × 1/16
LOCK WASHER #1914A

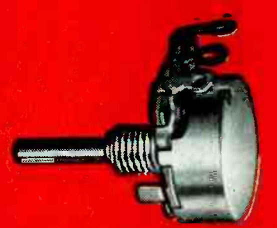
CTS SHAFT TYPE RE



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

TYPE 65

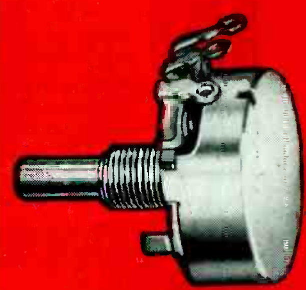
½ watt 70° C, ¾" diameter miniaturized variable composition resistor.



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

TYPE 95, JAN-R-94, Type RV4

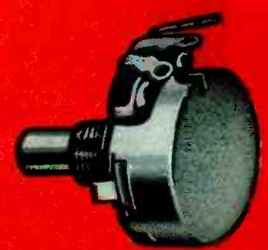
2 watt 70°C, 1⅛" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94. Attached Switch can be supplied.



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

TYPE 45, JAN-R-94, Type RV2

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



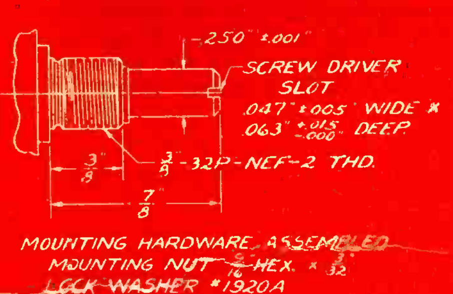
Resistance	RV2, JAN Shaft Type SD CTS Part	JAN-R-94 TYPE	CTS Part Non-JAN Locking Bushing CTS Shaft Type LT-1
100±10%	A5876	RV2ATSD101A	A5922
250±10%	A5877	RV2ATSD251A	A5923
500±10%	A5878	RV2ATSD501A	A5924
1000±10%	A5879	RV2ATSD102A	A5925
2500±10%	A5880	RV2ATSD252A	A5926
5000±10%	A5881	RV2ATSD502A	A5927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

TYPE 35, JAN-R-94, Type RV3

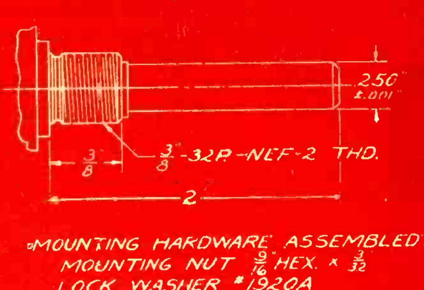
½ watt, 1⅛" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94. Attached Switch can be supplied.

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

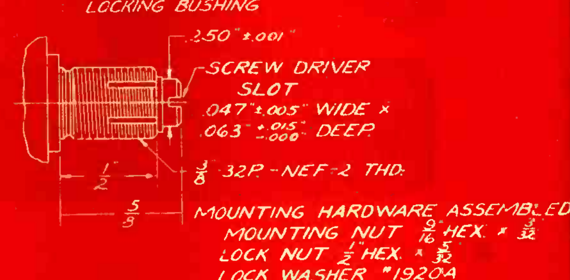
JAN SHAFT TYPE SD



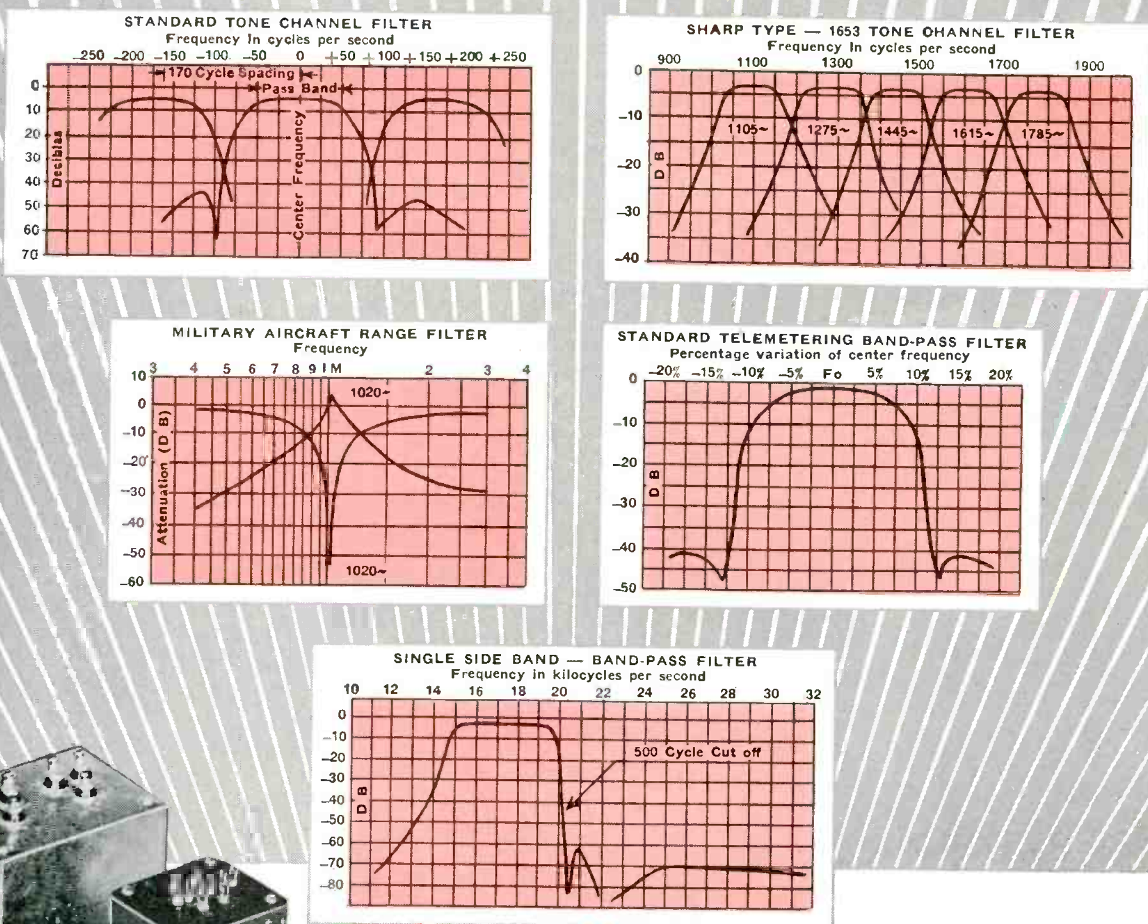
JAN SHAFT TYPE RJ

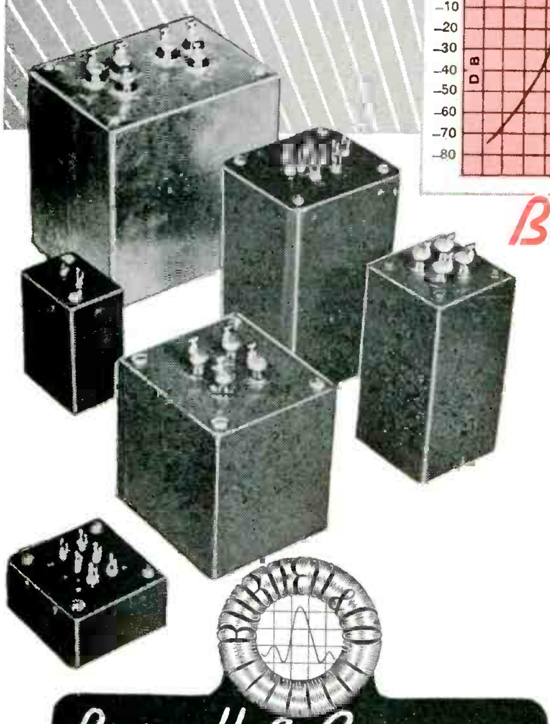


CTS SHAFT TYPE LT-1
LOCKING BUSHING



EXPERTS *in Filters for the Military*





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His filter requirements have become increasingly complicated by other critical factors such as phase shift, linearity, transient response, extreme accuracy through wide temperature ranges etc.

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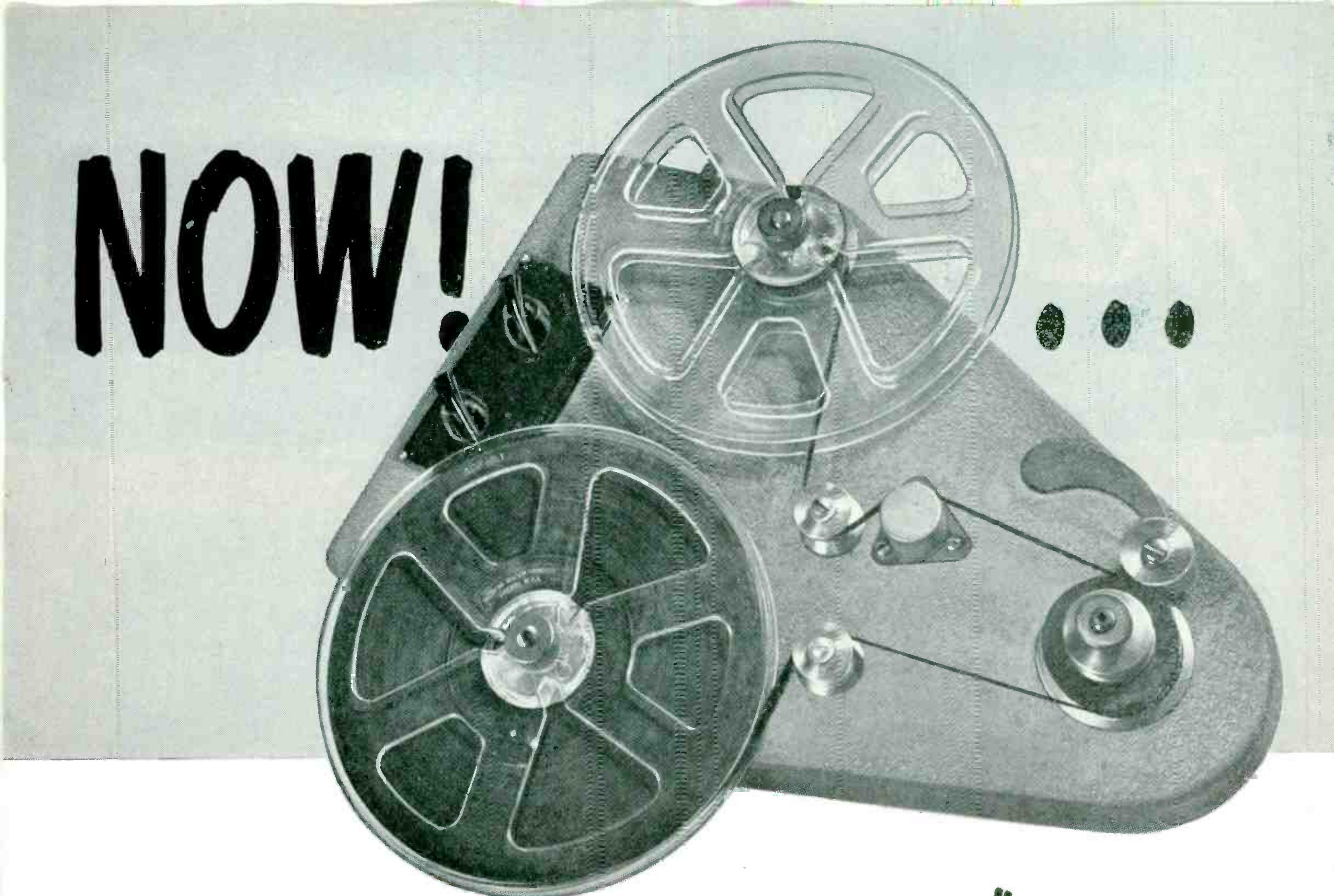

perfect TAPE REPRODUCTION on a 16" TURNTABLE

Whether you're in a 250-watt local station in California . . . a 5,000-watt network outlet in Ohio . . . or a TV station in a large metropolitan center . . . you should *own* a PRESTO TL-10.

This unique unit immediately converts any 16" turntable into a tape reproducer of maximum accuracy. Mounted on a simple hinge arrangement, the TL-10 lowers on the turntable and is ready for instant use. Just as simply, it can be swung upward, out of the way, to free the table for disc playback. Tape speed can be selected by merely changing the capstan.

No more traffic problems with tape when regular recorders are tied up. No more fear of motor failures—the TL-10 has no motor. No need to buy an additional tape machine. The TL-10 will solve all your tape playback problems at a low cost.

Ask your PRESTO distributor for a demonstration today—or order your TL-10 direct. A limited quantity is on hand for immediate delivery.

here's what it does:

- Reproduces tape without tying up a regular recorder.
- Attaches to any standard 16" turntable.
- Speed: 7½"/sec. and 15"/sec. with response to 15,000 cps.
- Easy to operate and maintain.
- Has the fidelity of high-priced machine at a fraction of the cost.

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PARAMUS, NEW JERSEY

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dependable performance

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- **Advanced production methods** assure high stability, long life.

Standard fixed resistors: 5-200 watts

Adjustable resistors: 10-200 watts

Oval resistors: 30-75 watts

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Special resistors: built to specifications

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

I-T-E PRECISION RESISTORS

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

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

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

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

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

I-T-E DEFLECTION YOKES

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

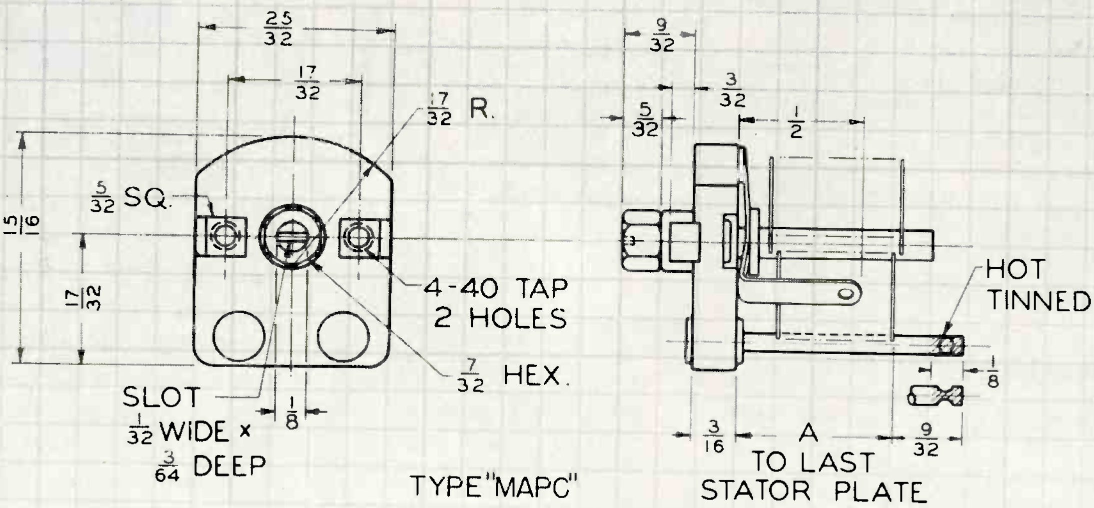
FOR DETAILS— get in touch with your nearest I-T-E representative. Or, send for your copies of the I-T-E *Power Resistor Catalog* and the new *Precision Resistor Bulletin 100A* today.

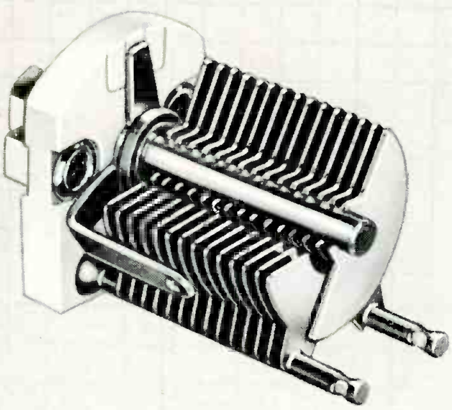
PRODUCTS

DIVISION

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

J.C. Hammarlund has the capacitor to fit your need
Jack





A Complete Line To Assist You!

This trimmer capacitor, the "MAPC", exemplifies Hammarlund's continuing efforts to meet the demand for smaller dependable components. A scaled-down version of the popular "APC", originated by Hammarlund more than 20 years ago, it has everything reduced except the quality and performance characteristics.

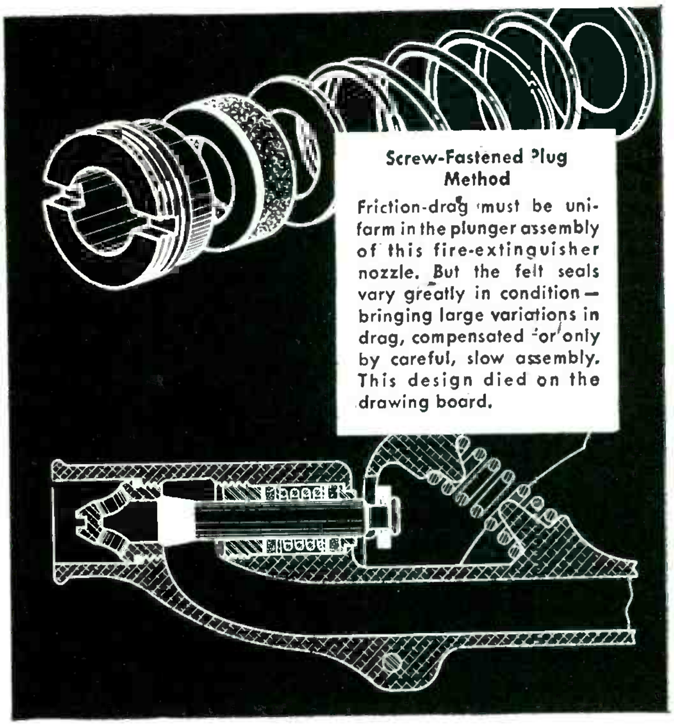
The Hammarlund *complete-line* of variable capacitors, carried by carefully chosen distributors from coast-to-coast, makes it possible for you to pre-select a capacitor that meets all your requirements of construction and operation.

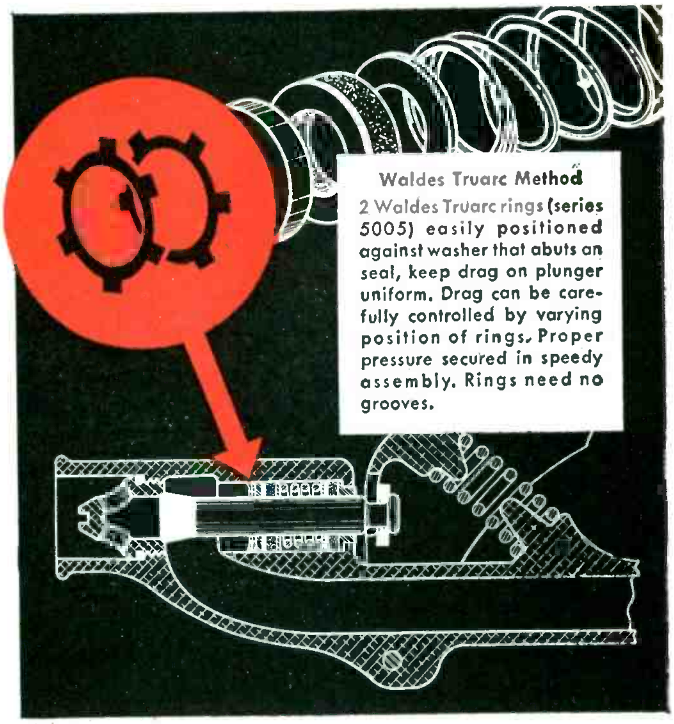
Write today for the 1952 Capacitor Catalog

HAMMARLUND

HAMMARLUND MANUFACTURING COMPANY, INC.
460 WEST 34th STREET • NEW YORK 1, N. Y.

2 Truarc self-locking rings replace threaded plugs. Save 6¢ per unit, speed assembly by 140%.





Ansul Chemical Company's new watertight precision nozzle for their dry chemical fire extinguisher replaces conventional stainless steel plug with two Waldes Truarc Self-Locking Retaining Rings and washer. Rings hold entire nozzle packing securely in place — keep friction drag of plunger uniform. Adjustable in final assembly, Truarc rings speed production from 25 to 60 units per hour. They save 6¢ per unit in overall costs, 1/8" in length.

Redesign with Waldes Truarc Rings and you, too, will save on assembly, time, improve product performance, facilitate easier servicing of whatever you make.

Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better job of holding parts together. They're precision-engineered . . . quick and easy to assemble and disassemble. They give a never-failing grip. Find out what Truarc Rings can do for you. Send your blueprints to Waldes Truarc engineers for individual attention, without obligation.

WALDES TRUARC RINGS MADE THESE SAVINGS POSSIBLE—

Discarded Design: Parts:	Cost Per Unit	Truarc Design: Parts:	Cost Per Unit
threaded stainless steel plug	$0.0675	2 rings	$0.0146
Direct Labor	$0.0350	1 washer	$0.0280
	$0.1025		$0.0426

Total savings per unit with Truarc Rings $.0599

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

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

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2.382.947; 2.382.948; 2.416.852; 2.420.921; 2.428.341; 2.439.785; 2.441.846; 2.455.165; 2.483.380; 2.483.383; 2.487.802; 2.487.803; 2.491.306; 2.509.081 AND OTHER PATENTS PENDING.

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

Please send me the new Waldes Truarc Retaining Ring catalog. E-124

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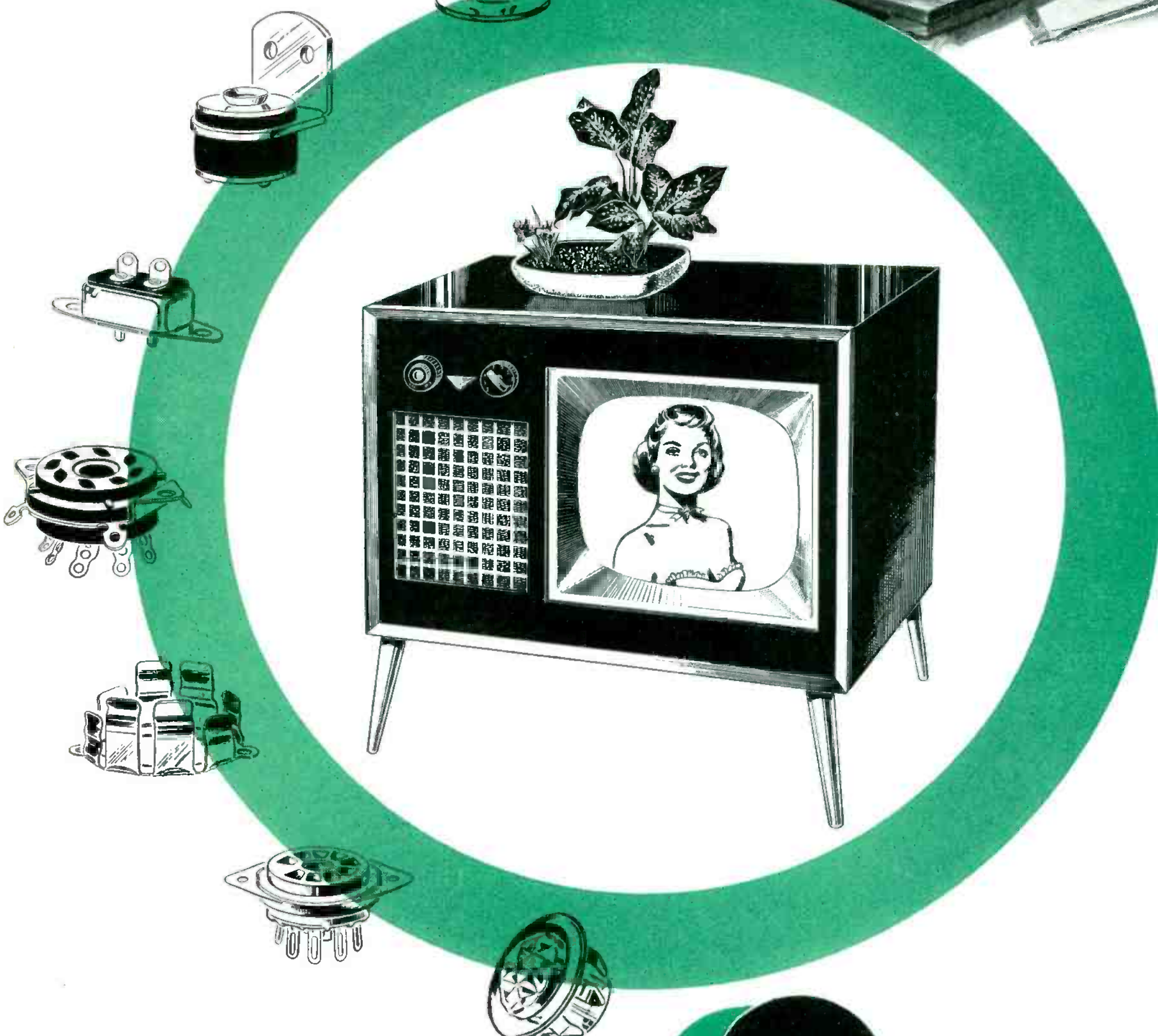
It's a long way from crystal and cat whisker to UHF and TV . . . and design changes never stop. That's why it pays to have your fastening methods checked by trained specialists . . . constantly.

United-Carr offers you ★ Complete engineering and design service ★ Complete facilities for volume production of specialized fasteners and allied devices. ★ Wide experience with the top manufacturers of electronic equipment, automobiles, aircraft, appliances, furniture. ★ The varied technical knowledge of all our divisions and subsidiary companies combined . . . to help you cut costs, speed assembly, improve product performance.

Call your nearest United-Carr field engineer *before* your new product designs crystallize. It is in this all-important *planning* stage that you can make the most effective use of our special services.



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DOT FASTENERS

TAILOR-MADE IN VOLUME QUANTITIES

Bomac
HYDROGEN THYRATRONS*

Bomac Hydrogen Thyratrons are designed primarily for use as a switch tube in line type modulators for pulsing magnetrons in radar equipment.

Although the Hydrogen Thyratron is used extensively in radar modulators, it has also found many applications in laboratory, production and test equipment where precise triggering at high power levels is required.

For full data on ratings and operating characteristics, write for Thyratron Data Sheets.

Bomac produces a complete line of gas switching tubes. This includes TR, ATR, PRE TR and attenuator tubes for all frequency bands.

*Not shown are the E36A and HT415. Availability will be announced at a later date.

We invite your inquiries regarding
- ENGINEERING
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Catalog on request. Write (on your company letterhead) Dept. C, BOMAC Laboratories Inc. Beverly, Mass.

IMPEDANCE

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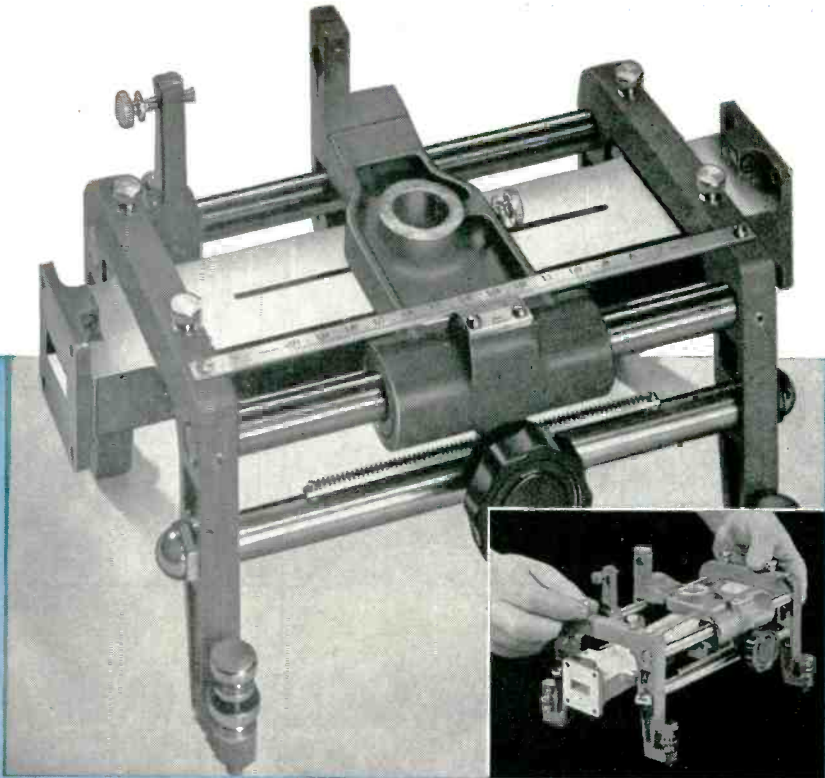

–hp– 809B UNIVERSAL PROBE CARRIAGE with –hp– 810A WAVEGUIDE SLOTTED SECTIONS

Now—a single probe carriage operates with up to 5 different slotted sections—waveguide or coaxial! This means important savings in time; lower investment in instrumentation. The new *-hp-* 809B Universal Probe Carriage mounts slotted sections covering frequencies from 3,000 to 12,400 mc (see table on opposite page)—and you can *interchange sections in 30 seconds* or less!

-hp- 809B Carriage is accurately calibrated in mm. for readings as low as 0.1 mm. Dial gauge may be readily mounted if more accurate readings are needed. Carriage travels on a new 3-point ball-bearing suspension system, and operates in conjunction with *-hp-* 442B Broad-Band Probe and *-hp-* 440A Coaxial Detector combination; or with *-hp-* 444A Untuned Probe. The extremely broad usefulness of this new Universal Carriage means far greater flexibility and lower cost for complete microwave instrumentation.

CONTINUOUS microwave coverage, 10 mc to 12,400 mc. High mechanical stability. Simple operation. Broad applicability. Precision accuracy. Compact size!

New *–hp–* microwave equipment gives you *complete coverage* for VHF, UHF and SHF impedance measurements. Instrumentation includes VHF Bridges as well as the slotted coaxial and waveguide sections which are fundamental tools in impedance measurements. These instruments can be used to measure load or antenna impedance, system flatness, connector reflection, percentage of reflected power, standing wave magnitude or phase, characteristics of coaxial transmission lines or rf waveguide systems, characteristics of rf chokes, resistors, condensers.

For complete details see your *–hp–* sales representative or write direct.

HEWLETT-PACKARD COMPANY

2160A Page Mill Road • Palo Alto, California

Sales representatives in principal areas.
Export: Frazar & Hansen, Ltd.
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–hp– 417A VHF DETECTOR

For use with *-hp-* 803A VHF Bridge. A super-regenerative (AM) receiver covering all frequencies 10 to 500 mc in 5 bands. Offers approx. 5 μv sensitivity over entire band; quick, easy operation, direct-reading frequency control. Thoroughly shielded, suitable for general laboratory use including approximate frequency checks, measurements of noise, interference, etc. $200.00 f.o.b. factory.

–hp– 415A STANDING WAVE INDICATOR

Designed for use with all waveguide or coaxial slotted sections, to give direct reading of standing wave ratio in VSWR or db. Consists of high gain amplifier with low noise level, operating at fixed frequencies between 300 and 2,000 cps. (Normal frequency 1,000 cps., plug-ins for other frequencies available). Input circuits for use with crystal detector or bolometer. $200.00 f.o.b. factory.

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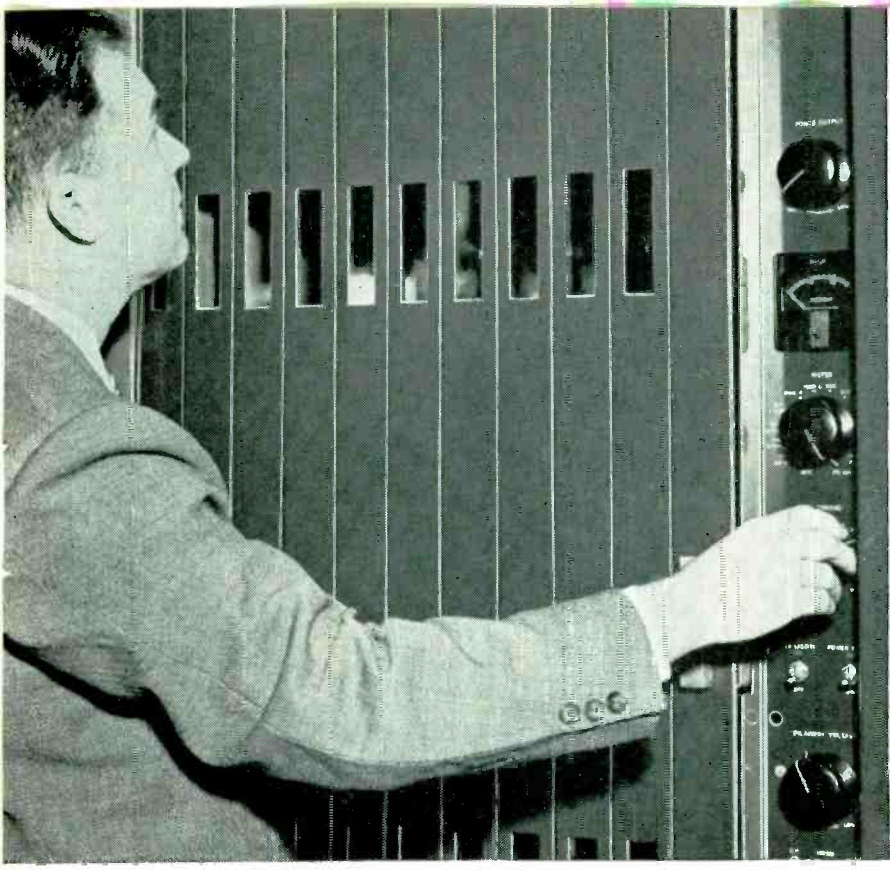
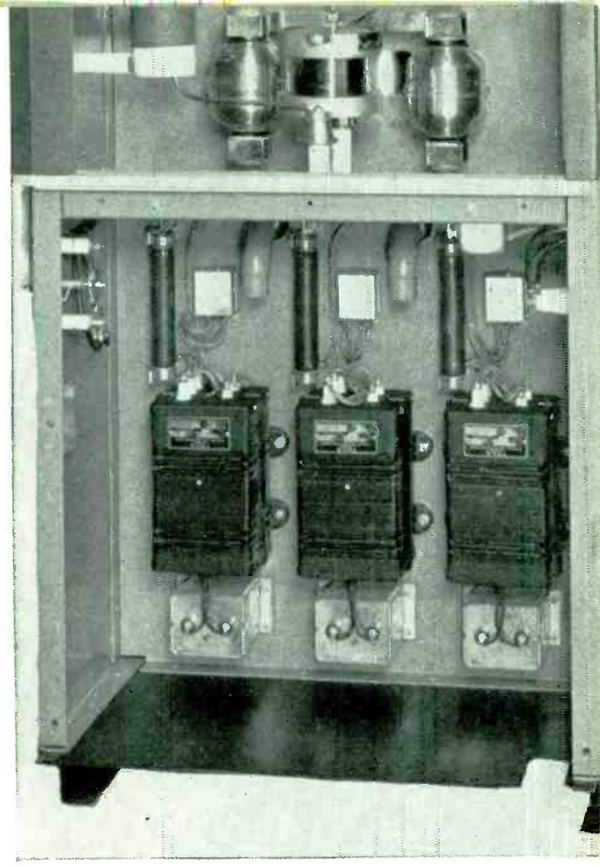


TUNING AN RCA TRANSMITTER. This AM broadcast transmitter is the ultimate in engineering. It's easy and simple to operate . . . compact . . . high in fidelity . . . easy to install and maintain . . . economical to operate. All tube filament voltages of RCA BTA-5G and 10G transmitters are regulated by Sola Constant Voltage Transformers for longer tube life.



REAR-VIEW OF POWER AMPLIFIER. This is the lower section showing three Sola Constant Voltage Transformers installed in a BTA-10G unit. Sola regulators are relatively compact compared to other equipment for comparable ac voltage regulation.

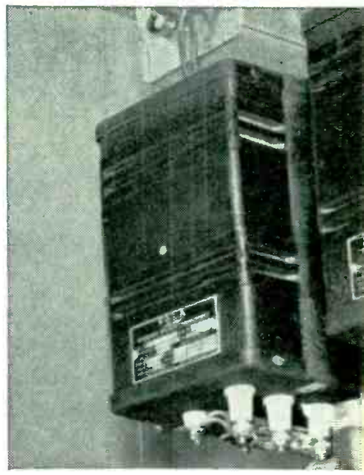
RCA INCREASES TUBE LIFE BY REGULATING FILAMENT VOLTAGE

RCA transmitters are built for 1) *operating ease*, 2) economy and 3) *reliability*. Sola Constant Voltage Transformers are used by RCA in their AM Broadcast Transmitters Types BTA-5G and 10G to help provide these three important advantages.

Sola Constant Voltage Transformers are static-magnetic regulators. In this particular application, they were used as the source of regulated voltage for all tube filaments. They provide secondary voltages regulated within ±3% regardless of primary voltage (transient or continuous) variations as great as 30%.

1. *They provide operating ease because:* regulation is completely automatic, continuous . . . no manual adjustments required... no moving or renewable parts.
2. *They provide economy because:* conventional unregulated power transformer and voltage regulating circuit are eliminated . . . tubes last longer with regulated filament voltage.
3. *They provide reliability because:* regulating response time is 1.5 cycles or less . . . self protecting against short circuits on output and load circuits . . . current-limiting characteristic protects load equipment against faulty currents.

That's how Sola Constant Voltage Transformers helped maintain RCA's high performance standards. They can solve your voltage regulation problems too. When your equipment is protected by a Sola built-in stabilizer you know that you automatically have provided the proper operating voltage level regardless of line voltage conditions.



STATIC-MAGNETIC REGULATION. Standard Sola stabilizers are available in capacities from 15va to 10kva, and with a variety of common power line and filament voltages. Special designs can be produced for quantity orders.

Send for the twenty-four page catalog which gives electrical and mechanical specifications for Sola Constant Voltage Transformers. Write on your letterhead for Bulletin DCV-142.

Applications unlimited for

SOLA *Constant Voltage* **TRANSFORMERS**

Transformers for: Constant Voltage • Fluorescent Lighting • Cold Cathode Lighting • Mercury Vapor Lighting • Luminous Tube Signs
Oil Burner Ignition • X-Ray • Power • Controls • Signal Systems • etc. • **SOLA ELECTRIC CO., 4633 W. 16th Street, Chicago 50, Illinois**
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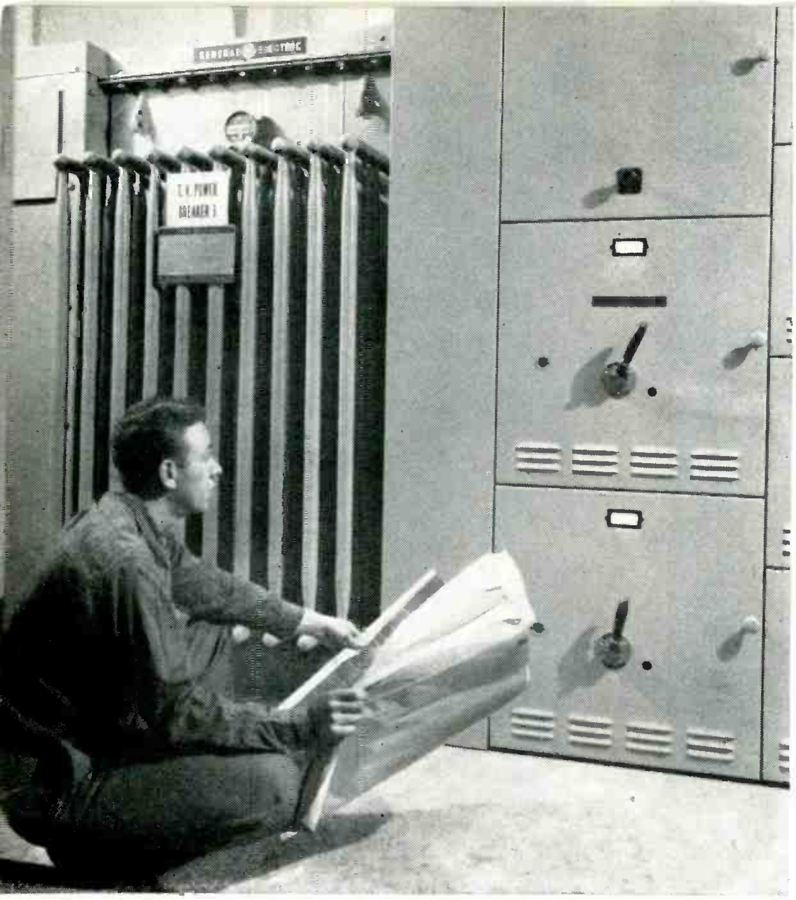
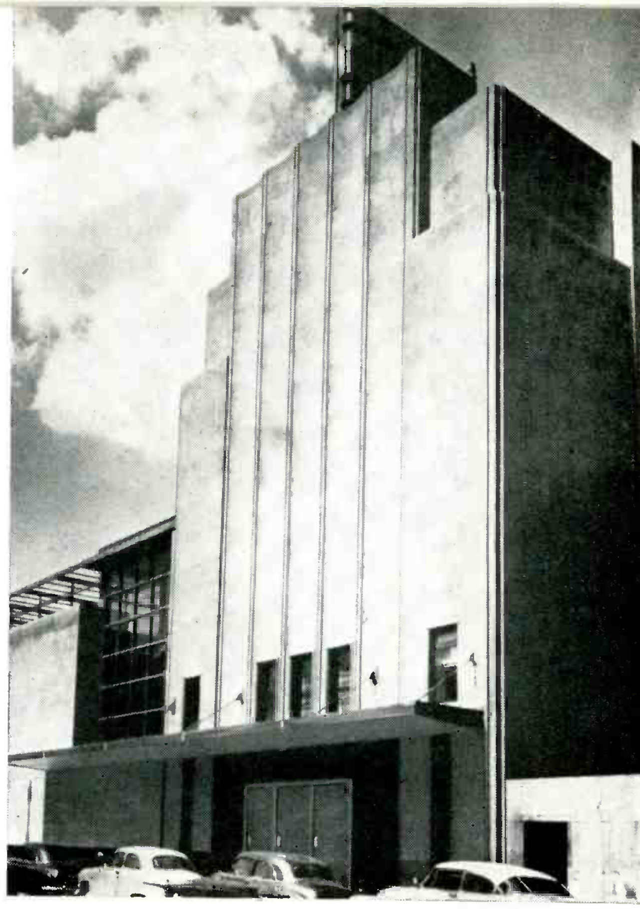


TELEVISION POWER BREAKER. The 500-kva G-E unit substations at WWJ-TV have voltage ratings of 4800-208Y/120, are equipped with Type AK-1-25 air circuit breakers.



WWJ's NEW BUILDING houses studios of Detroit's pioneer TV station. General Electric load-center system furnishes power for amplifying, lighting—other station requirements.

Detroit's new TV studios rely on

Power continuity assured for all studio requirements at WWJ-TV by secondary-selective distribution system

For the engineers of WWJ-TV—Detroit's pioneer TV station and an affiliate of WWJ, the world's first commercial radio station—a dependable source of continuous power rates first consideration in planning the new television studios. Total or even partial power shutdown cannot be tolerated.

At its new studios, WWJ-TV needs reliable power for lighting and amplifying . . . for its monitor panels and relaying equipment . . . for all station auxiliaries such as fans and blowers. To assure reliable power continuity for these many exacting requirements, Giffels & Vallet, Inc., L. Rossetti, associated engineers and architects, and Jack A. Frost, electrical contractor, installed a G-E secondary-selective load-center system consisting of two 500-kva unit substations.

With this distribution system, the station gains, too, in savings basic to load-center power. For example, a G-E engineered load-center system maintains consistent voltage for top operating efficiency, keeps voltage drop down to a minimum, provides less costly feeder breakers, and reduces cable costs.

Air circuit breakers, with ratings properly coordinated with transformer capacities, give adequate interrupting capacity and isolate troubles in feeders. Oil fuse cutouts are interlocked to prevent opening with load on transformers.

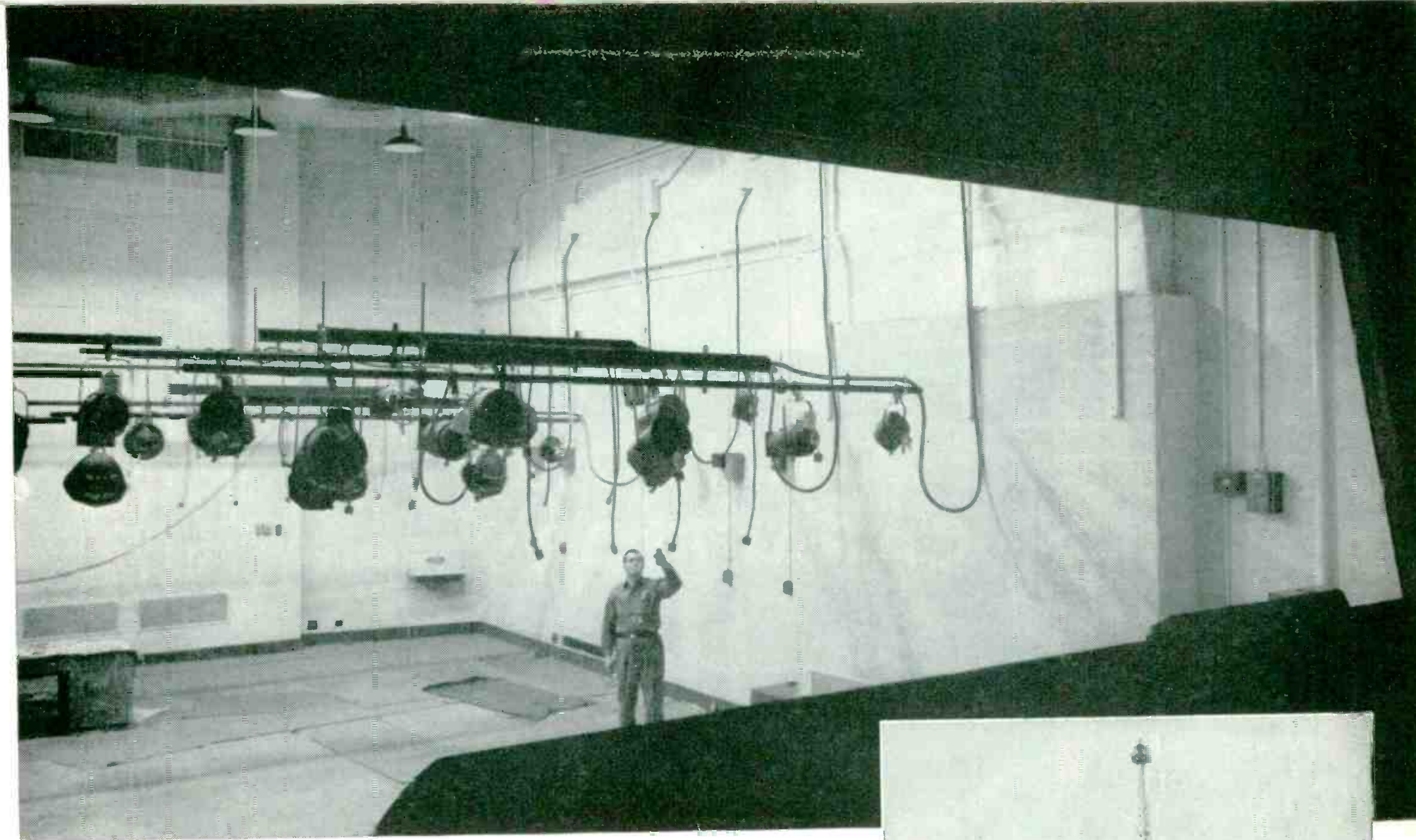
Flexible layout permits easy, quick maintenance without interruption of power. System flexibility itself provides for addition of new loads, making it far less costly for the station to expand in the future. Grounded, metal-enclosed G-E load-center units, with non-inflammable Pyranol* transformers assure maximum protection for operating personnel.

For further information on G-E engineered load centers, call your local G-E sales representative, or write for GEA-3592, General Electric Company, Schenectady 5, N. Y.

321-87

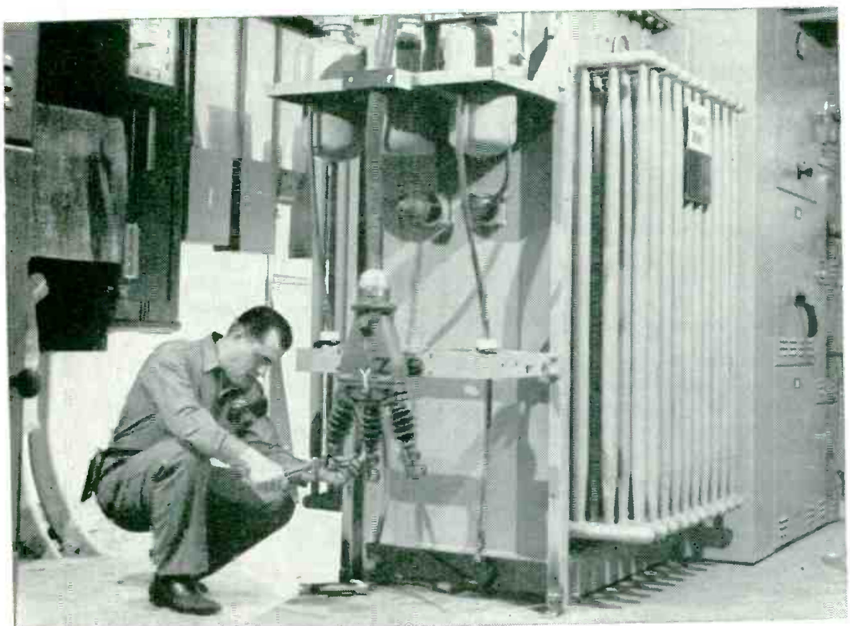
*Reg. Trademark of General Electric Co.

GENERAL ELECTRIC



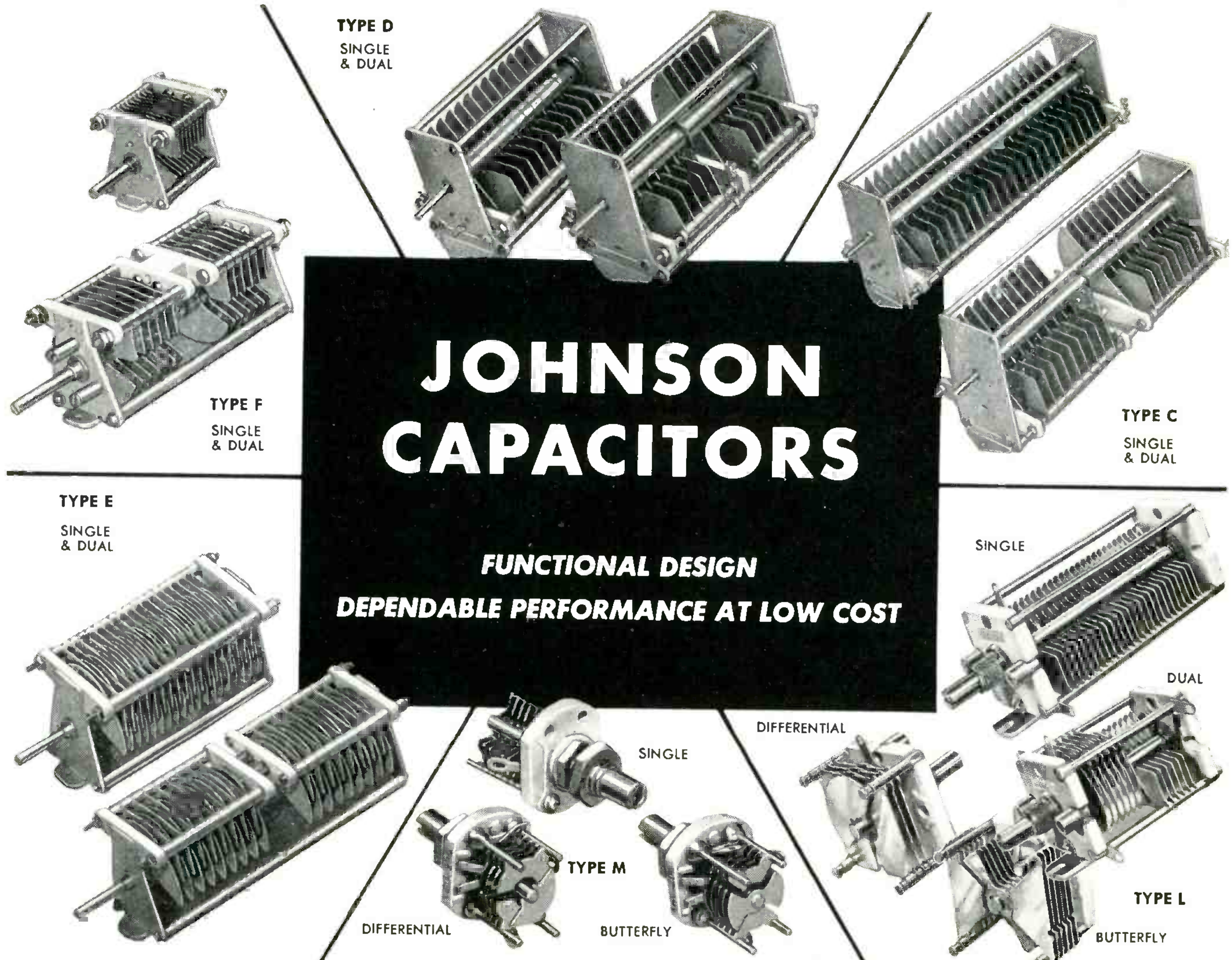
LIGHTS FOR TV PRODUCTION. Studio construction shot from WWJ-TV's control booth shows battery of lights necessary for televising. Lighting throughout the new station is fed from G-E engineered load centers.

G-E load-center system



CUTOUTS FOR PROTECTION. Engineer wires pothead of incoming high-voltage cable to cutouts on transformer of TV lighting breaker. Oil cutouts are interlocked, cannot be opened or closed with load on transformer.

PENOBSCOT BUILDING—Detroit's highest—houses all of WWJ-TV's transmitter equipment. TV antenna tops highest central portion. Here are transmitted programs originating in new studios powered by G-E load centers.



Engineered to meet virtually every electronic need, JOHNSON Variable Capacitors are sturdy and thoroughly reliable. Their functional design permits high standards of workmanship, yet at low final cost. Production quantities available in a wide range of standard types and sizes.

TYPE L—Full soldered construction and rugged design make JOHNSON Type L high frequency capacitors the perfect choice for any application requiring extreme stability and rigidity. Tie rods are soldered directly to ceramic end frames, plates and metal parts are brass, plated with corrosion-resistant Bright Alloy. Dual, butterfly, and differential types ranging from 11 to 200 mmfds. available with .030" spacing. Type L air variables can be manufactured with .020", .060" and .080" spacing in production quantities on special order. Short, low inductance leads are made possible by dual stator contacts and a silver plated beryllium copper rotor contact which may be brought out at any one of four different angles. Panel space required is 1⅜" square.

TYPE M—Miniatures—The answer to many a design problem, encountered in building compact electronic equipment. Available in three types: single section, differential, and butterfly, JOHNSON Miniature Air Variables are ideal for portable, mobile, and airborne equipment in the VHF frequency range. Manufactured to extremely close tolerances, these miniatures feature: split sleeve bearings, Steatite insulation, beryllium copper rotor contacts, and a 3/16" slotted shaft for knob or screw driver adjustment—all metal parts nickel plated. Stock models range from 1.5 to 19 mmfd., mounting area required: ¾"x⅝".

TYPE E and F—JOHNSON Types E and F variable capacitors are extremely compact, designed for use in medium and low power transmitters. Capacity range from 250 to 500 mmfd. Single and dual section models available for both types in 45 standard sizes. Highest possible capacity/volume ratio, aluminum plates .032" thick, heavy aluminum end frames with ¼" aluminum tie rods. Dense molded Steatite insulators combine minimum loss with strength. Rotor contacts are cadmium plated phosphor bronze. Panel space required: Type E, 2⅝" square; Type F, 2"x2-1/16".

TYPE C and D—For higher voltage applications, Type C and D capacitors are available in 45 standard single and dual models, ranging from 12 to 496 mmfd., 3,500 to 11,000 volts peak. Steatite high frequency insulators, sturdy aluminum end frames, equipped with ¼" cadmium plated shafts. Mounting brackets provided for normal or inverted mounting, panel space required: Type C, 5½" wide x 5⅜" high; Type D, 4¼" wide x 4" high.

The complete line of JOHNSON Air Variables is listed in the new General Products Catalog, No. 973. Write for your free copy today!

E. F. JOHNSON COMPANY

CAPACITORS, INDUCTORS, SOCKETS, INSULATORS, PLUGS, JACKS, DIALS, AND PILOT LIGHTS

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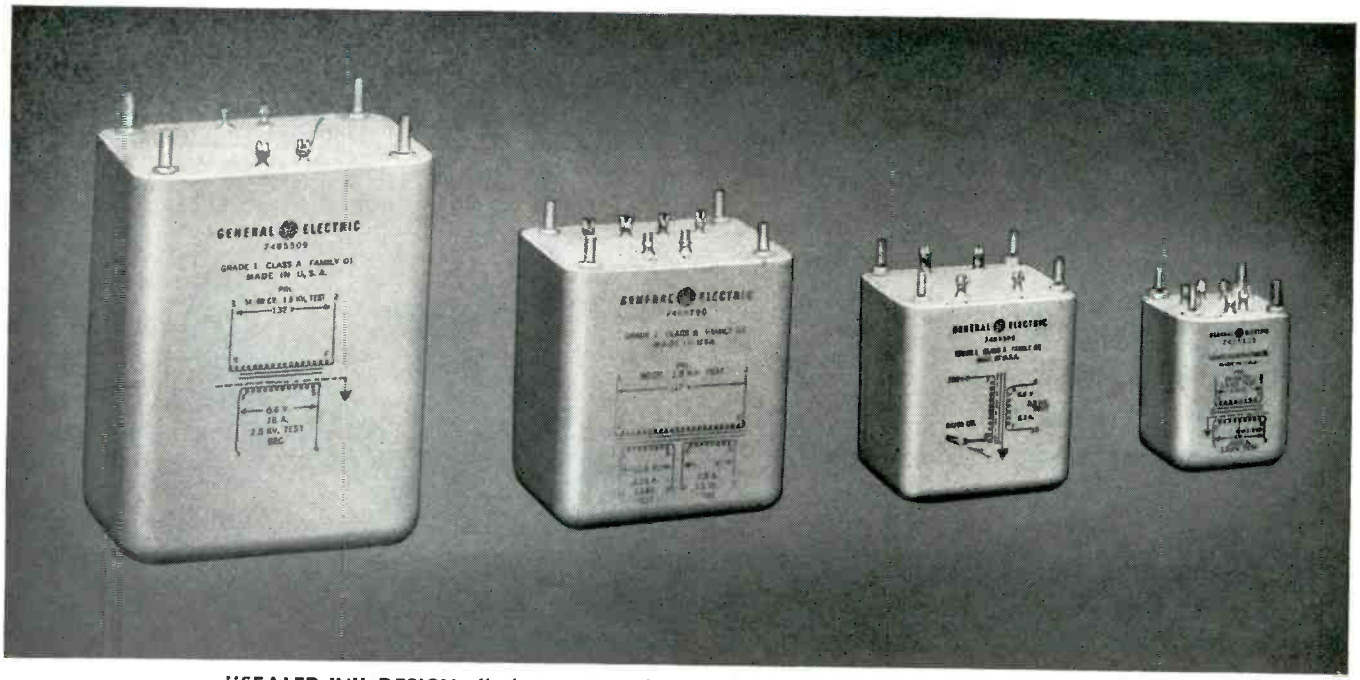
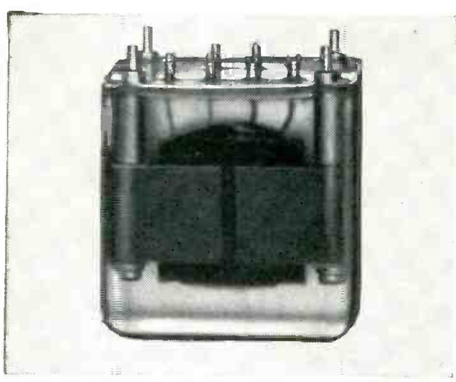
DESIGNER'S



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

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



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

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

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

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

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

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

GENERAL ELECTRIC

DIGEST

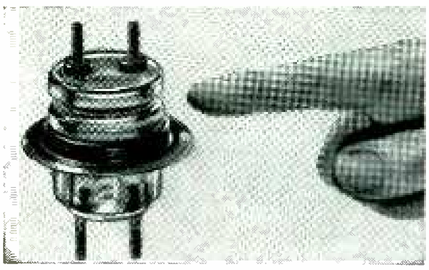
TIMELY HIGHLIGHTS ON G-E COMPONENTS

Permafil d-c capacitors have 80% less weight, bulk

They operate in ambients up to 125C for 10,000 hours without derating

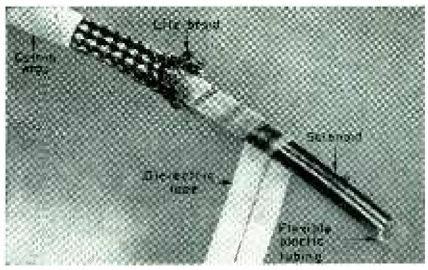
High *or* low temperatures have little effect on the electrical stability of G-E permafil capacitors. Their paper dielectric is impregnated with a solid plastic compound—they can't leak. Insulation resistance is high, and change in capacitance with temperature is slight. With proper derating, these units can be used at temperatures as high as 150C.

Permafil capacitors average about 1/5 the size and weight of liquid-filled capacitors properly derated to operate at 125C. Because of their small size and excellent electrical characteristics they are ideal for most high-ambient blocking, by-pass, filtering, coupling and timing applications. They are available in ratings of 0.05 to 1.0 muf, 400 volts d-c. All are housed in hermetically sealed metal containers, with G-E all-silicone bushings. Check coupon for Bulletin GEC-811.



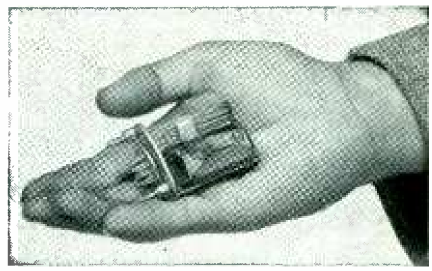
Bushings for hermetic sealing

More and more designers are specifying G-E glass bushings—the type used on capacitors, rectifiers, and instrument transformers. For use where permanent hermetic sealing of electric apparatus is desired, these bushings are easily attached by soldering, brazing, or welding to form a permanent, vacuum-tight seal. Bulletin GEA-5093.



Immediate shipment on delay line

G-E delay line, ideal for delaying signals in electronic circuits, is now available for immediate shipment. Nominal 1000-ohm line delays signals ½ microsecond per ft. Light weight and flexible, it is used widely in military and industrial electronics. Can be obtained in bulk to be cut to desired lengths. Bulletin GEC-459.



New relay doubles tip pressure

This new *hermetically sealed* relay has a larger magnet delivering double average tip pressure yet doesn't exceed Air Force-Navy size and weight specs. Sealed in a standard-size enclosure against dirt, salt, moisture, and pressure changes, it withstands 50g shocks and instantaneous voltage surges up to 1500 volts. Bulletin GEA-5729.

EQUIPMENT FOR ELECTRONICS MANUFACTURERS

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Amplistats
Terminal boards
Push buttons
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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 A 667-23
Schenectady 5, New York

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✓ for reference only

X for planning an immediate project

☐ GEA-5093 Glass Bushings
☐ GEA-5729 Hermetically Sealed Relays
☐ GEC-459 Delay Lines
☐ GEC-811 Permafil Capacitors

Name..........

Company..........

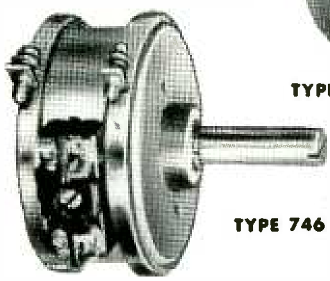
City.......... State..........

Potentiometer accuracy improved!

Fairchild Precision Potentiometers now offer greater accuracy and longer life than ever before

TYPE 736

TYPES 747 and 748



TYPE 746

Experience with Fairchild Precision Potentiometers in hundreds of applications shows that these units far exceed their original guaranteed tolerances. As a result, accuracies of ±1% in non-linear types and as high as ±0.05% in linear types can be guaranteed. Service life as high as 10,000,000 cycles, under certain conditions, also can be provided. High resolution, low torque, and low noise level are other performance features worth noting.

Fairchild Precision Potentiometers perform mathematical computations in electrical computing systems for machine-tool controls, process controls, telemetering, guided missiles, flight control, fire control, and analog computers of all types. They are available in non-linear and linear types and in ganged combinations of either or both with windings to meet your requirements.

If you want *accuracy* in your control systems, ask about Fairchild Precision Potentiometers.

SPECIFICATIONS OF FAIRCHILD PRECISION POTENTIOMETERS (Nominal Values)

	TYPE 736	TYPE 746	TYPE 747	TYPE 748
Resistance Range, ohms				
Linear (standard), min.	680 ±3% a	680 ±3% a	3,000 ±5% a	5,000 ±5% a
max.	115,000 ±3% a	115,000 ±3% a	100,000 ±5% a	150,000 ±5% a
Linear (special), min.	85 ±3% a	85 ±3% a	50 ±5% a	80 ±5% a
max.	145,000 ±3% a	145,00 ±3% a	115,000 ±5% a	200,000 ±5% a
Non-Linear	b	b	—	—
Electrical Function Angle, deg.	320 nominal	320 nominal	351.3 ±0.5	354.5 ±0.5
Electrical Contact Angle, deg., max.	340	340	351.3 (+4, −0)	354.5 (+4, −0)
Mechanical Rotation	Continuous	Continuous	Continuous	Continuous
Functional Tolerance (guaranteed), per cent				
Linear, Some Non-Linear	±0.50 c	±0.50 c	±0.15 d	+0.10 e
Other Non-Linear	±1.00	±1.00	—	—
Mechanical Accuracy				
Concentricity (shaft to pilot bushing), in., FIR max.	0.0025	0.0010	0.0025	0.0025
Radial Shaft Play, in., max.	0.0015	0.0009	0.0015	0.0015
Shaft, dia., in.	Centerless ground stainless steel to 0.2500 (+0.0000, −0.0005 in.)	Centerless ground stainless steel to 0.2497 (+0.0000, −0.0002 in.)	Centerless ground stainless steel to 0.2500 (+0.0000, −0.0005 in.)	Centerless ground stainless steel to 0.2500 (+0.0000, −0.0005 in.)
Pilot Bushing, dia., in.	Machined to 0.5000 (+0.0000, −0.0005 in.)	Machined to 0.5000 (+0.0000, −0.0005 in.)	Machined to 0.7500 (+0.0000, −0.0005 in.)	Machined to 0.7500 (+0.0000, −0.0005 in.)
Torque, oz.—in. per cup	2.0	1.5	1.0	1.0
Wattage (rated at 40 C ambient temperature)	2.5	2.5	4	5
Terminal Voltage, max.	400	400	400	400
Voltage Breakdown at Sea Level (60 cycle) RMS	900	900	900	900
Taps, number per cup	9 f	1 fg	12 h	16 h
accuracy of location, deg.	±1	±1	±1	±0.5
width, deg., max.	1.00 i	1.00 i	0.75 i	0.60 i
Ganging on Single Shaft, max.	5	20	10	10
Operating Ambient Temperature Range, deg. C	−55 to +71	−55 to +71	−55 to +71	−55 to +71
Service Life, cycles, max.	5,000,000 j	5,000,000 j	10,000,000 j	10,000,000 j
Dimensions, in.				
Diameter	1.899	1.750	2.093	3.093
Length (one cup), max.	0.795	0.800 ±0.009	1.156	1.156
Added Length Per Unit Ganged	0.609	0.580 ±0.002	0.594	0.594

a *Tolerance on both linearity and over-all resistance may vary or be improved depending on resistance value required.*
b *Maximum resistance range depends on requirements. Tolerance on over-all resistance of non-linear windings is ±5%.*
c *Linearity up to ±0.30% on the higher resolution windings by special order.*
d *Linearity up to ±0.10% on the higher resolution windings by special order.*
e *Linearity up to ±0.05% on the higher resolution windings by special order.*
f *By adding dummy cup section, 19 taps can be provided.*
g *Two taps can be provided by slight design modification using terminal board clamp screw modified for wiper terminal.*
h *Depending on spacing requirements and without moving bridge or wiper terminal.*
i *Varies with resolution.*
j *Life will be guaranteed depending on specific potentiometer required.*

SAMPLE POTENTIOMETERS IN A HURRY! Send your potentiometer problems to the Fairchild Potentiometer Sample Laboratory and we'll show you how to solve them. Sample units can be designed and built at nominal cost in 4 to 6 weeks after receipt of approved specifications. For full details write to *Potentiometer Division, Fairchild Camera and Instrument Corporation, Park Avenue, Hicksville, Long Island, New York, Department* 140-30A.

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How PROSPEROUS Is The USA?

Just how prosperous *are* the people of the United States?

The sole purpose of this message is to help clear up the confusion and controversy that surrounds this important question.

To find out how much prosperity, or material well-being, the people of the United States now enjoy, it is necessary to get answers to these questions:

1. As compared with other times, what is the total amount of goods and services that we have available for our enjoyment?

2. How great, on the average, is the share of each American in this prosperity?

3. How does our prosperity compare with that of other nations?

National Product at Peak

The government statisticians who do the bookkeeping for the nation produce a figure called the Gross National Product. It is supposed to be the total obtained when you multiply the amounts of everything we produce by the prices of everything produced. This year the GNP, as it is commonly tagged, will add up to something like $345 billion.

Since this will be the highest total that GNP has ever attained, some people will acclaim it as evidence that we now are enjoying the greatest prosperity on record.

The GNP, however, is not an accurate yardstick of prosperity. It may go up because of price inflation alone without any increase at all in the output of goods and services. Also the GNP includes very large amounts of goods and services, such as those for the military, which are in fact a result of misfortune rather than of a condition that might properly be called prosperity. Moreover, there is no deduction from the GNP to make allowance for the equipment that is worn out in producing it.

Little Recent Progress

When we make adjustments such as these — to find out how much of our production really is available for the use and enjoyment of the civilian population — the *adjusted* national product since the beginning of World War II comes out about as follows. The effects of price inflation have been removed from these figures.

YEAR	ADJUSTED NATIONAL PRODUCT	
	Billions 1951 Dollars	Index (1946 = 100)
1940	$176.2	76
1946	232.5	100
1947	240.7	104
1948	244.3	105
1949	239.7	103
1950	260.9	112
1951	267.9	115
1952	264.3	114

From this table the fact stands out that progress in raising our level of prosperity has been halting. What progress we have made came in a few dramatic increases before or after a military build-up. Aside from those, the progress has been fairly slow. This year, 1952, it has been particularly discouraging.

Again, when account is taken of the number of people who must share in the goods and services that are available, our progress is even less marked. This is shown by the following table which gives the share of the average American in the national product. This, as the table indicates, is arrived at simply by dividing the total of available goods and services by the population on hand to share in them.

YEAR	POPULATION Millions	ADJUSTED NATIONAL PRODUCT Billions 1951 Dollars	ADJUSTED NATIONAL PRODUCT Per Person
1940	132.0	$176.2	$1,335
1946	141.3	232.5	1,645
1947	144.0	240.7	1,672
1948	146.6	244.3	1,666
1949	149.2	239.7	1,607
1950	150.6	260.9	1,732
1951	154.4	267.9	1,735
1952	156.9	264.3	1,685

Here it is clear that we have made little or no headway since the end of World War II.

U.S. Compared to Other Nations

Although we are making slow progress in increasing our prosperity, as measured during recent years by the amount of goods per person, we still are by long odds the most prosperous people on earth. This can be seen from the following table. It offers a rough measure of how the adjusted output of goods and services per person in the United States compared in 1951 with that in a number of other countries:

COUNTRY	PER PERSON
United States	$1,735
Canada	1,231
United Kingdom	614
France	510

To figure more closely "How Prosperous is the U.S.A.?" we must answer a number of other questions. One of the most important will be the subject of a later editorial in this series. It is "Who Gets What?" How have various income classes and occupational groups shared the total available goods?

Another question that has a basic bearing on the quality and durability of our prosperity is "How fast are we using up irreplaceable natural resources, such as oil, iron ore, and copper, to sustain it?" Any attempt to deal with this very complicated question must also be deferred.

A Problem for the Future

In the meantime, however, key facts about our prosperity are that:

1. Most of the increase in the nation's total production in recent years has been to meet military requirements rather than to improve the American standard of living.

2. The increase in the supply of goods and services actually available for the average American has been slow and halting.

3. We Americans are still extremely well provided with the good material things of life, as compared with peoples in other lands.

These three facts bring to mind a whole series of policy questions. What can be done to speed up progress in improving our prosperity? What—to repeat the question discussed in the previous editorial in this series—can be done to make our prosperity less precarious?

Here, however, the purpose is not to prescribe. It is simply to indicate as accurately as it can be done in a brief article the actual state of the nation's prosperity.

In doing this much, it can properly be remarked that the record presents to the American economy both a problem and an opportunity of surpassing importance. It is that of building a prosperity that will be both more progressive and more secure than any we have known in recent years. In the light of what clearly remains to be done, we shall make a grave mistake if we use up any of our energy in congratulating ourselves on the relatively meager progress here recorded.

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Here is a multi-turn slide wire potentiometer that fulfills a long-felt need among users of precision potentiometers.

Designed specifically for applications requiring high resolution such as servo-control, computers, etc., it is available with angular shaft displacements up to 3600° Due to the unique slide wire arrangement which allows the brush to traverse the length of a single resistance wire as the shaft is rotated, resolution (zero increment) is unlimited. The "Spiralpot" is small, with a low noise level, exceptional linearity, low torque and long operating life.

The electrical output is exactly proportional to angular shaft position.

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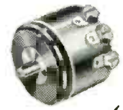
Straight-line motion along axis. Linear or functional output. 200 to 60,000 ohms. 5 sizes, 1" diameter from 2.33" to 6.54" long. Stroke 1/5" to 5"



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Linear and functional outputs. .078" dia. shaft—miniature ball bearings. 7/8" diameter x 7/8" long, .01 oz.-in. torque. 500 to 100,000 ohms.

SPECIFICATIONS:

POSITIVE MECHANICAL STOPS — withstands 500 oz.-in. torque.

SHAFT ROTATION: Up to 3600° plus 20° overtravel.

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ACCELERATION: Will meet specifications during 50G steady state acceleration along any axis.

VIBRATION: Withstands 10G sinusoidal vibration from 10 to 100 cps in all axes, and 10G in selected axes up to 200 cps.

OPERATINGTEMPERATURE: From −55° to +71° C.

STARTING TORQUE: Less than 2 oz.-in.

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LIFE: Over one million revolutions.

POWER: 2 watts at +71° C.

WEIGHT: 4 oz.

RESOLUTION: Unlimited (zero increment).

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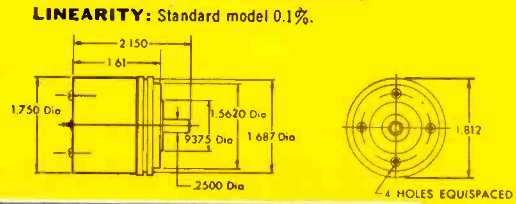

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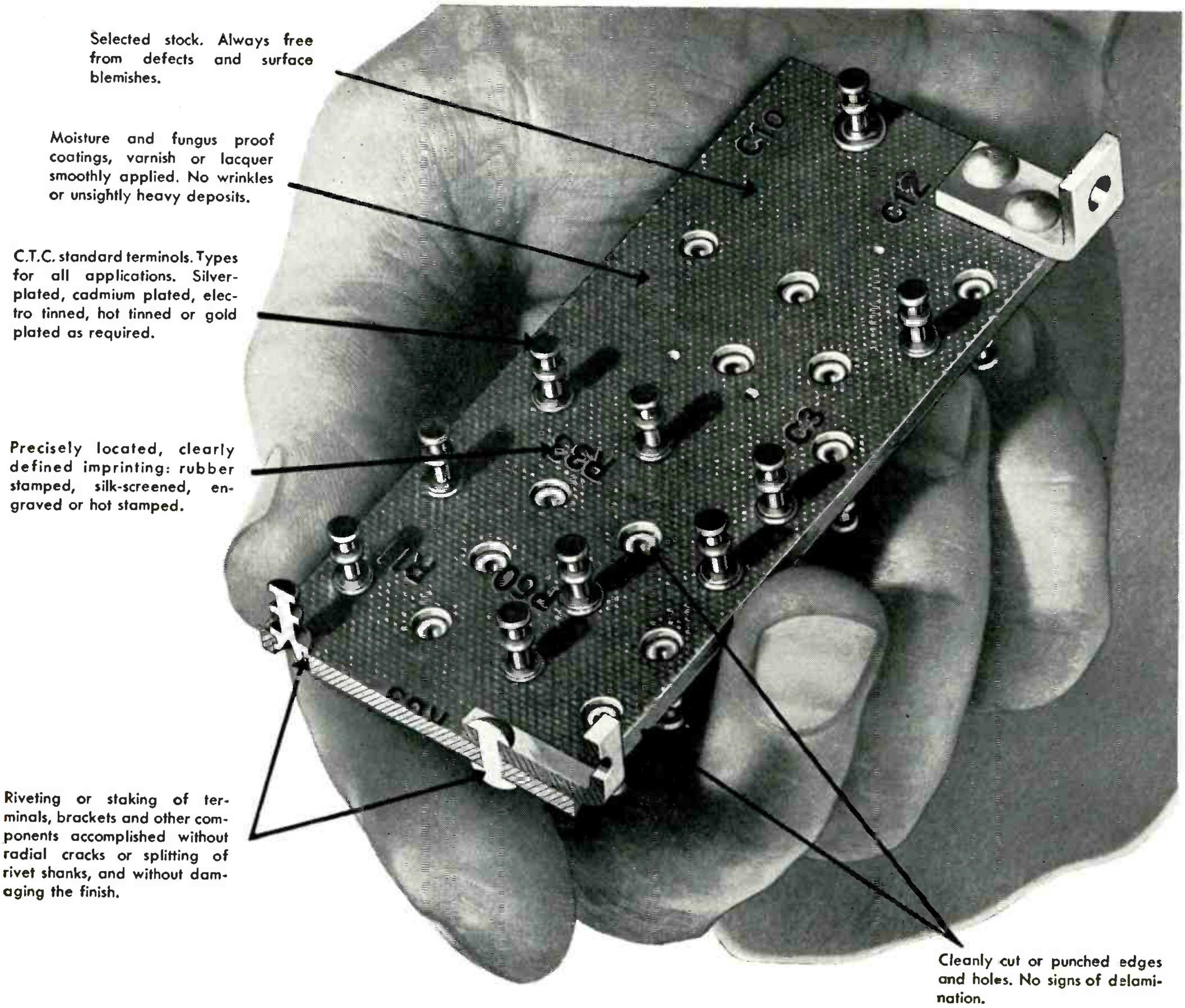

Little details on terminal boards ...*make the big difference in quality*

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

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

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

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

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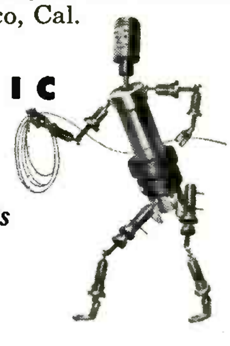

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This forty-foot transmitter cubicle, which will house a 100-KW General Electric transmitter, is but one of the many we have built for "The Voice of America" broadcasting program. The three-inch terminal box represents the other extreme.

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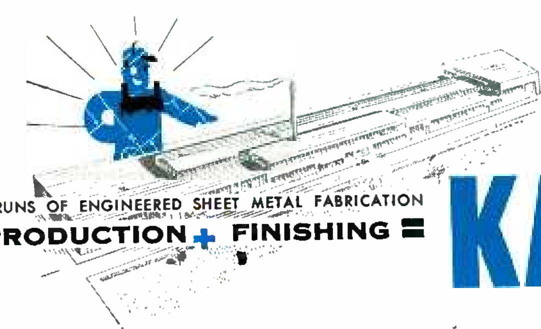

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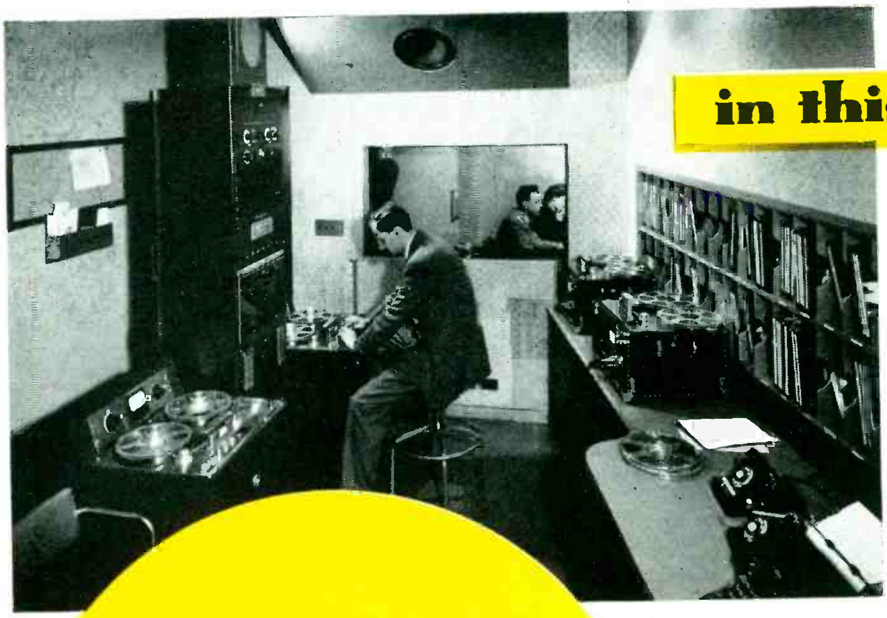

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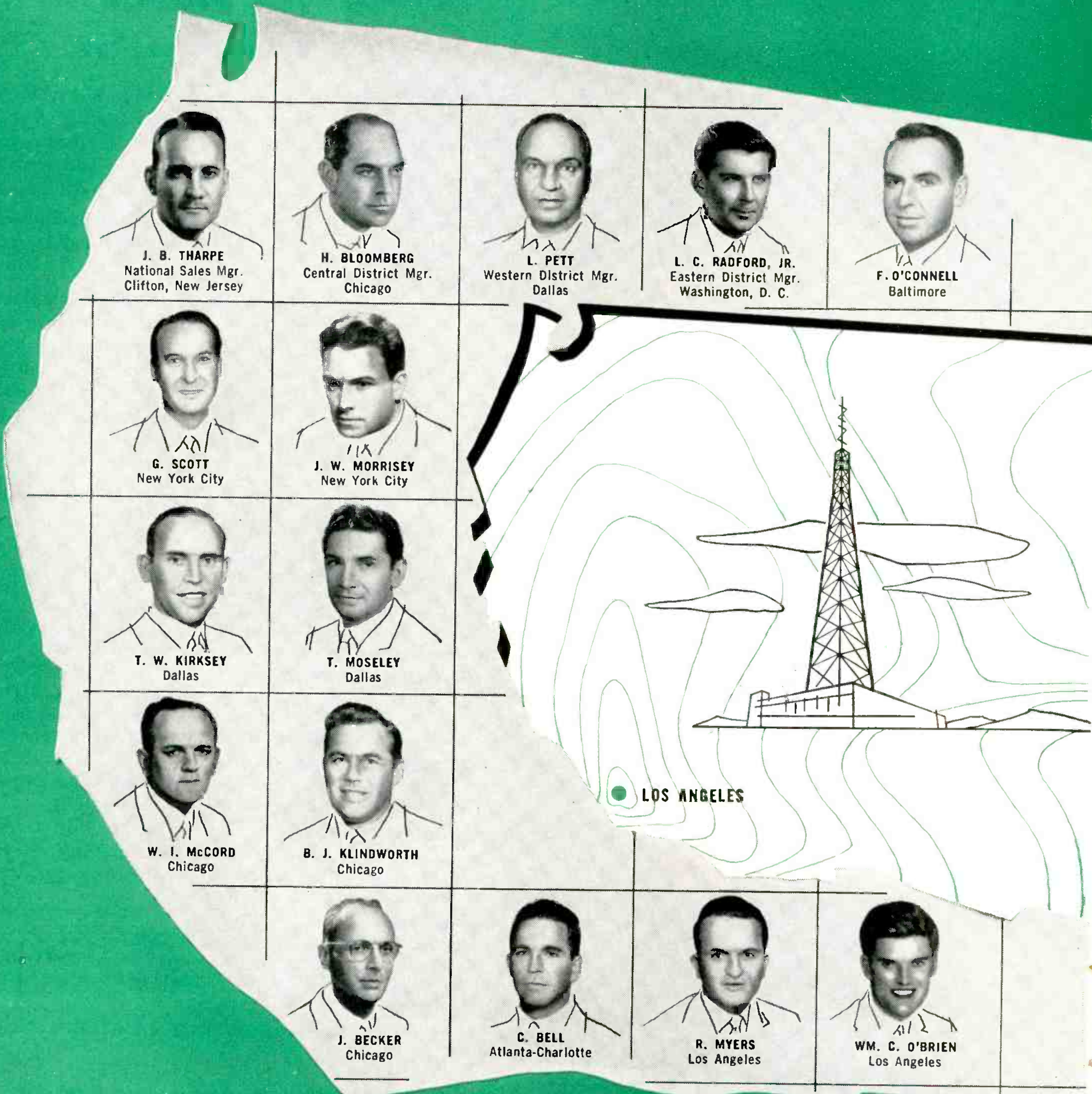

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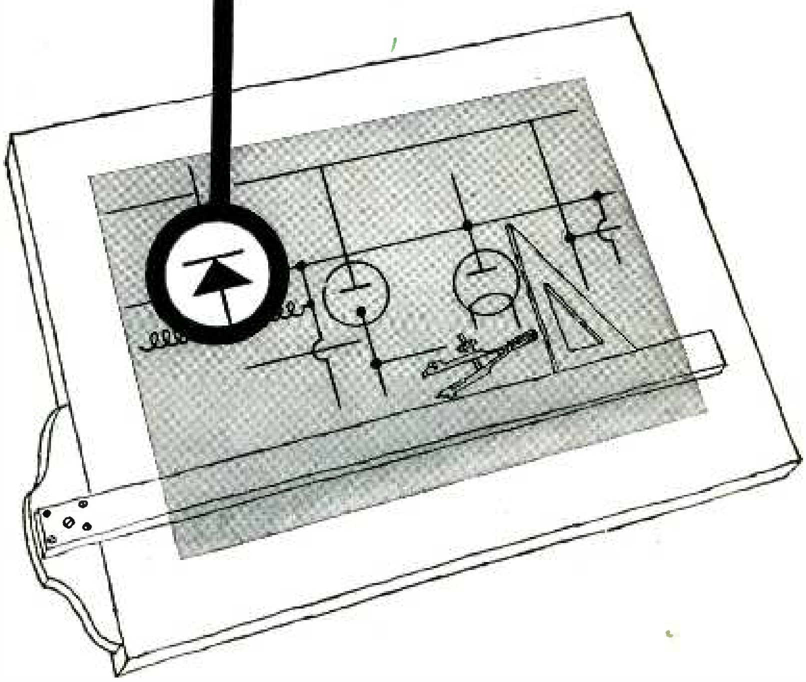
Bradley will do the engineering for you on rectifier specifications



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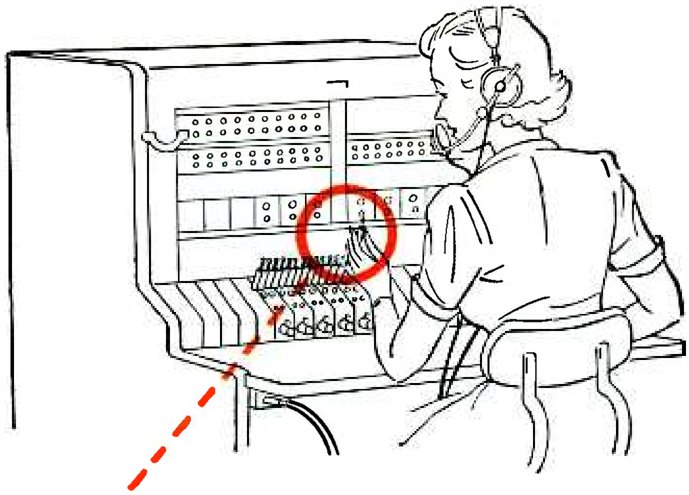
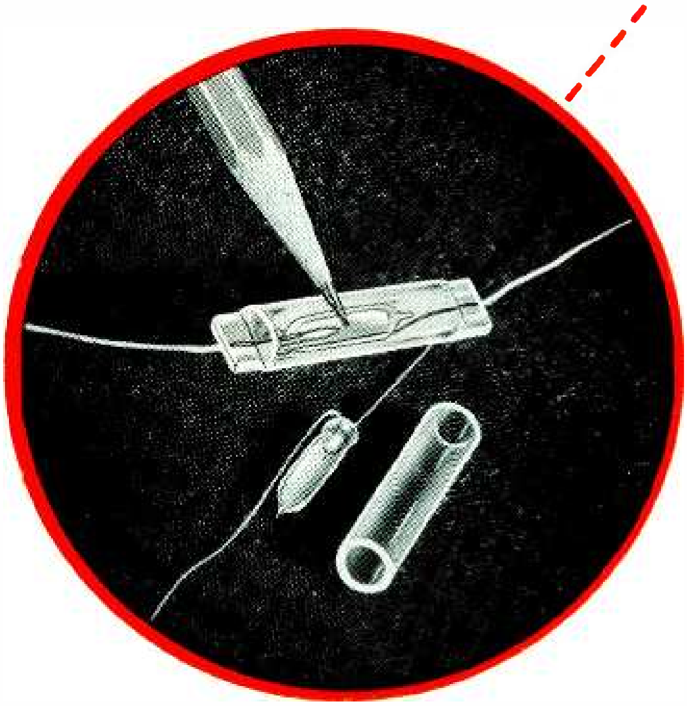


Du Pont NYLON protects thermistors against breakage



Du Pont nylon extruded by Anchor Plastics Co., Inc., New York, N. Y., for Western Electric Company, Inc.

...prevents short circuits

...saves on assembly costs

Developing a protective covering for the tiny thermistors used in the incoming trunk units of this switchboard presented several problems. The covering had to prevent breakage of the glass-enclosed thermistor, have no metal parts, and provide protection against short circuits.

One manufacturer found the solution in Du Pont nylon plastic. To form this covering, nylon is extruded into transparent tubing about the diameter of an ordinary pencil, cut to proper length, and slipped over the thermistor. Then the ends are pressed flat under pressure and heat. The nylon tubing protects the thermistor against breakage, provides excellent insulation, and prevents the glass bulb from being strained when connecting leads are flexed. And its heat-resistance assures long-lasting service.

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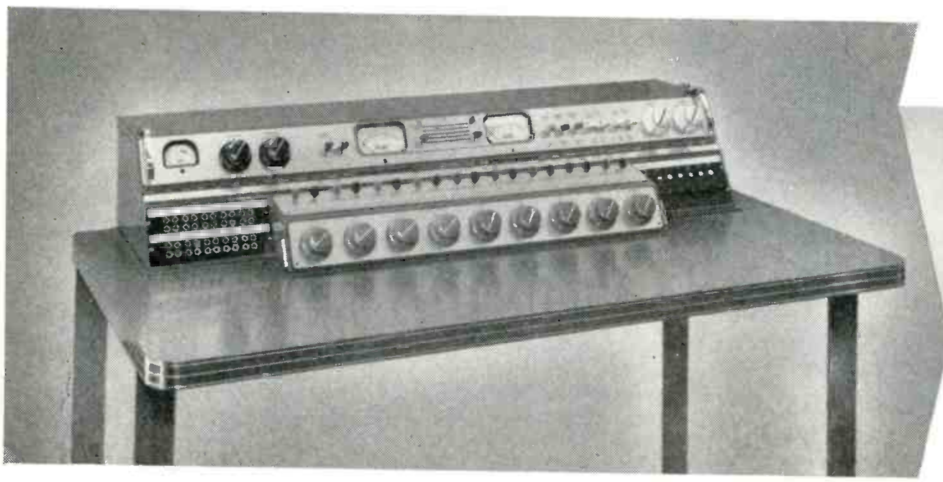

250A Console. This beautiful master console represents a new quality standard for speech input equipment. Like all Altec consoles and mixers, its frequency response, noise level and low distortion more than meet the most stringent broadcast requirements. It is compact and *completely* self-contained, without external power supplies or junction boxes. All amplifiers and power supplies are precision-engineered miniature plug-in units.

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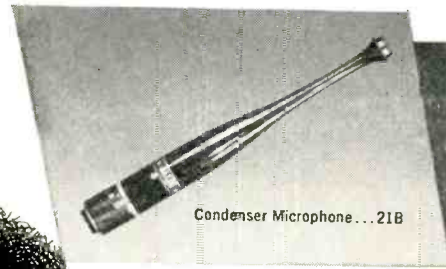

Condenser Microphone . . . 21B

Directional Microphone . . . 639

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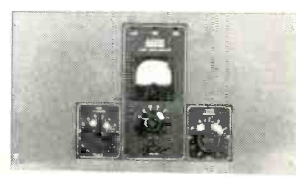
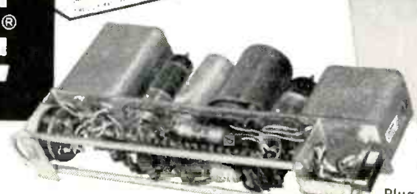
Console . . . 230B

Portable Mixer . . . 220A



Limiter Amplifier . . . A-332C

30-22,000 cycle Monitor Speaker . . . 601A

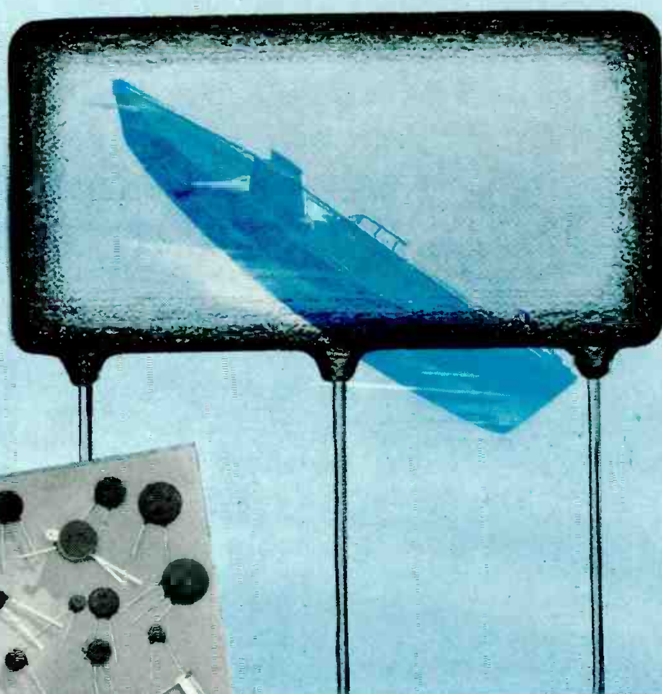


Plug-in Preamplifier . . . A-428A

Hi-Q SERVES NATIONAL DEFENSE

Whenever Electronics Lend Ears to the Fleet

● Among the countless contributions which electronic engineers are making to our armed services, high importance must be placed on long-range eyes and ears for the fleet... ...not only in increasing the deadliness of its own undersea craft, but equally in protecting its surface vessels from enemy submarines. And throughout the field of electronics, high importance is likewise placed on the dependable long life and rigid adherance to specifications found in **Hi-Q** components. Among the countless ceramic units carrying the **Hi-Q** trademark, you'll find disc capacitors of by-pass and temperature compensating types ...tubulars, plates and plate assemblies ...new high voltage capacitors in many styles...trimmers, wire-wound resistors and chokes. You'll find, too, that **Hi-Q** engineers are your best source for specially designed components to meet your specialized, individual needs.



Hi-Q PLATES AND PLATE ASSEMBLIES

Hi-Q Plate Capacitors can be produced in single and multiple units in an unlimited range of capacities up to guaranteed minimum values of 33,000 mmf per square inch. The number of capacities on a multiple unit is limited only by the K of the material and the physical size. In **Hi-Q** Plate Assemblies (printed circuits) the number of combinations of condensors and resistors which can be incorporated on a single unit is virtually endless...again, limited only by the K of the material and physical size.

Hi-Q® DIVISION

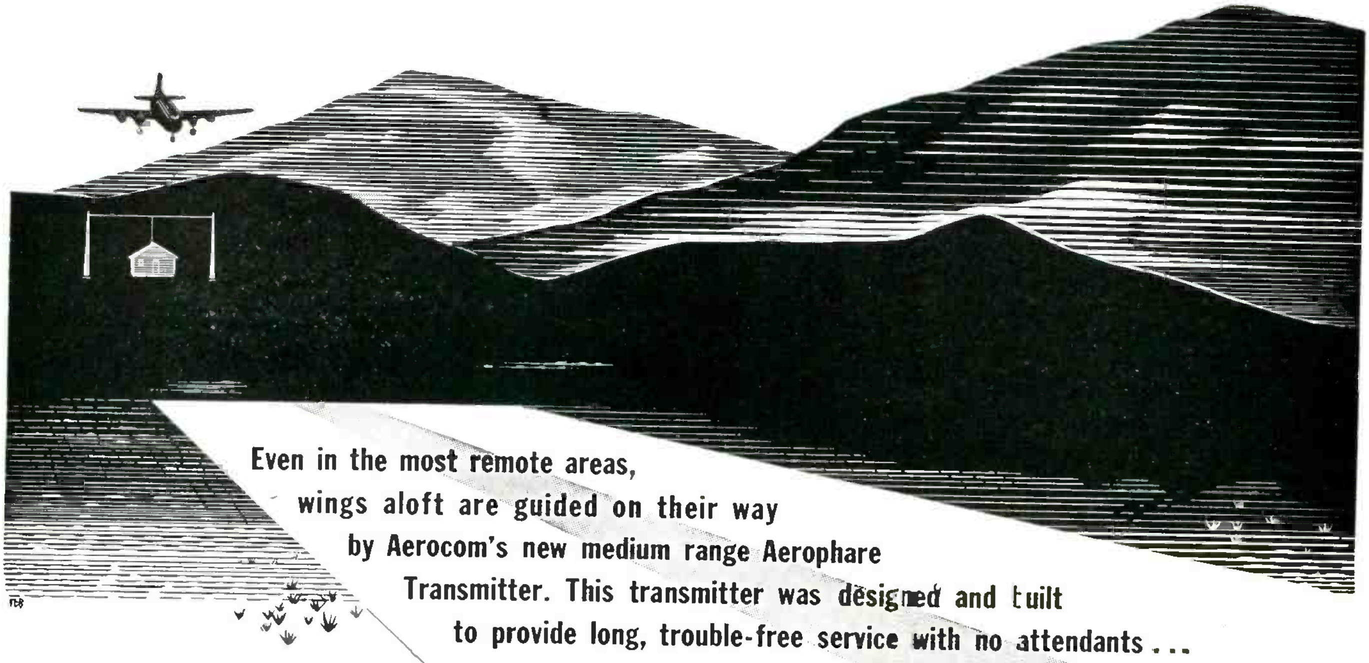
AEROVOX CORPORATION
OLEAN, N. Y.

AEROVOX CORPORATION
NEW BEDFORD MASS.

WILKOR DIVISION
CLEVELAND, OHIO

Export: 41 E. 42nd St., New York 17, N. Y. • Cable: AEROCAP, N. Y. • In Canada: AEROVOX CANADA LTD., Hamilton, Ont. JOBBER ADDRESS: 740 Belleville Ave., New Bedford, Mass.

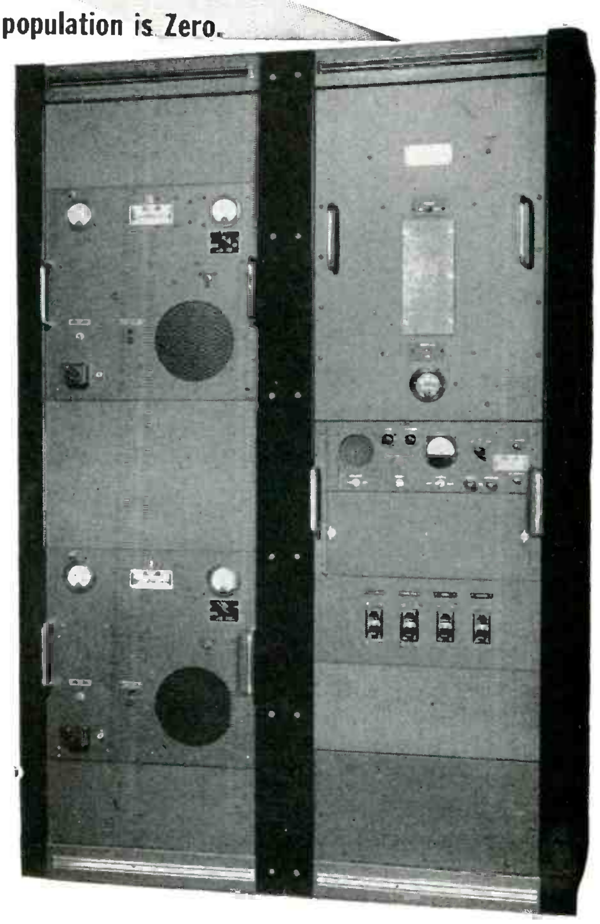
POPULATION-0



Even in the most remote areas,
wings aloft are guided on their way
by Aerocom's new medium range Aerophare
Transmitter. This transmitter was designed and built
to provide long, trouble-free service with no attendants . . .
even where the total population is Zero.

AEROCOM'S

Dual Automatic Package-Type Radio Beacon



for completely unattended service. This aerophare (illustrated) consists of two 100 watt (or 50 watt) transmitters with keyer, automatic transfer and antenna tuner. (Power needed 110 or 220 volt — 50/60 cycles, 520 V.A. for 50 watt, 630 V.A. for 100 watt.)

Frequency range 200 — 415 kcs.: self-contained P.A. coil and "plug-in" crystal oscillator coil cover entire range. (Self-excited oscillator coils covering 200-290 and 290-415 kcs. are available.) High level plate modulation of final amplifier is used, giving 40% tone modulation in 100 watt transmitter and 60% in 50 watt model. Microphone P-T switch interrupts tone, permitting voice operation.

This unit can be operated in air temperature range 0°C to + 45°C using 866A rectifiers, or from — 35°C to + 45°C using 3B25 rectifiers; humidity up to 95%.

The "stand-by" transmitter is selected when main transmitter suffers loss (or low level) of carrier power or modulation. Audible indication in monitoring receiver tells which transmitter is in operation.

Unit is ruggedly constructed and conservatively rated, providing low operating and maintenance costs.

AER -O- COM
Reg. U. S. Pat. Off.

3090 DOUGLAS ROAD MIAMI 33, FLA.


Use "dag"
Colloidal Graphite...
the Ideal CRT Wall Coating
"Dag" Exterior Wall Coating, developed by Acheson Colloids specifically for use on CRT glass envelopes, resists scratching and the loosening action of water. It requires no baking . . . is easy to apply . . . economical to use.
The smooth, uniform conductive black film obtained with "dag" Exterior Wall Coating adheres tenaciously to all CRT walls regardless of the glass to which it is applied.
Apply this specially processed electric-furnace graphite by spraying. The coating dries so rapidly that tubes can be handled in 2 or 3 minutes. Maximum adhesion is obtained by drying at room temperature for 24 hours or by infra-red drying for ½ hr. at 100° C.
The new and complete booklet "Dag" Colloidal Graphite for Electronic and Electrical Applications gives full data on "dag" Exterior Wall Coating and other "dag" dispersions. Write TODAY for Bulletin No. 433-5M.
dag
DISPERSIONS®
Acheson Colloids Company, Port Huron, Mich.
. . . also ACHESON COLLOIDS LIMITED, LONDON, ENGLAND
Units of Acheson Industries, Inc.

KOVAR* Glass Sealing Alloy

Western Electric
15 YEARS

17 YEARS

SPERRY
12 YEARS

RCA
17 YEARS

VARIAN associates
4 YEARS

The Most DEPENDABLE Proved by Experience

RAYTHEON
17 YEARS

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12 YEARS

Bomac
5 YEARS

MACHLETT
14 YEARS

WESTINGHOUSE
17 YEARS

6 YEARS

GE
17 YEARS

FEDERAL TELEPHONE & RADIO FTR
10 YEARS

Supplied by Stupakoff

in the form of: SHEET, ROD, WIRE, FOIL, TUBING, EYELETS, LEADS and FABRICATED SHAPES

The ideal alloy for glass sealing, Kovar matches the expansivity of certain hard glasses over the entire working temperature range. It resists mercury attack, has ample mechanical strength and seals readily with simple oxidation procedure. It is available as sheet, strip, foil, rod, tube, wire—or fabricated into cups, eyelets, leads and other shapes. The prominent users of KOVAR and the length of time they have employed this metal are convincing proof of satisfaction.

*Westinghouse Trade Mark No. 337,962

STUPAKOFF *Products for Electrical and Electronic Applications*

ASSEMBLIES—Metallized ceramic induction coils and shafts; metallized plates for fixed rigid assemblies; ceramic trimmer condensers.

CERAMICS—Precision-made ceramic products for electrical and electronic applications, all voltages, frequencies and temperatures.

RESISTOR CERAMICS—Used for temperature indicating or measuring equipment, for infra-red light source and for heating elements. Complete with terminals, in the form of rods, tubes, discs, bars, rings, etc.

CERAMIC DIELECTRICS—For by-pass, lead-through, blocking, stand-off and trimmer applications. Temperature compensating Ceramic Dielectrics and high K materials. Tubes, discs and special shapes, plain or silvered.

PRINTED CIRCUITS—Amplifiers, couplings, filters, integrators.

STUPAKOFF

STUPALITH—Will withstand extreme thermal shock. May be made to have zero, low-positive or negative expansivities. Safely used at temperatures up to 2400° F.

SEALS, KOVAR-GLASS—Terminals, Lead-ins; Stand-offs—for hermetically sealing and mechanical construction in radio, television, electronic and electrical apparatus. Single or multiple terminal units, in a wide variety of sizes and ratings.

KOVAR METAL—The ideal alloy for sealing to hard glass. Used for making hermetic attachments. Available as rod, wire, sheet, foil—or as cups, eyelets and other shapes.

STUPAKOFF CERAMIC & MFG. CO., Latrobe, Pennsylvania

Basic Foundation Components, Plug-in, Connecting & Fastening Devices for the Electronic Control Industry

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

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

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

Giving you equipment that is easy to operate and maintain

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

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

Suggestion to your Lab or Research Dept.

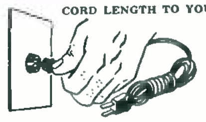
Numerous labs have seen the advantage of using Alden's components to build the particular pet circuits needed for the experimental or test circuits that they use over and over. It may be an assortment of unitized, plug-in power supplies, amplifiers, oscillators, modulators, connecting circuits, etc.,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

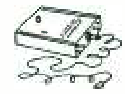
WORKING WITH "ALDEN'S HANDBOOK", THE DESIGN ENGINEER AUTOMATICALLY CREATES *PRACTICAL PRODUCTION DESIGN*, as follows —

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

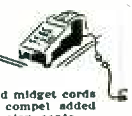
   SEE "ALDEN HANDBOOK" PAGES 4A & B FOR COMPLETE DETAILS

CORD LENGTH TO YOUR SPECS.





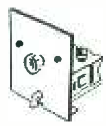
Avoid floorful of over-length cords.



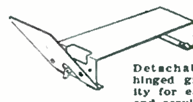
Avoid midget cords that compel added extension cords.

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

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



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

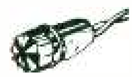


Detachable front panel hinged giving accessibility for ease of assembly and servicing.

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

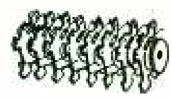
   SEE "ALDEN HANDBOOK" PAGES ES-5A & B; DL-5A & B; TE-3A & B; CG — all pages

Fuses that indicate when blown.



Indicator lamps always easily replaced so always functioning.

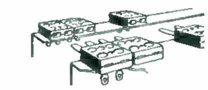
Insulated test point jacks for plate voltages up to 6,000V.



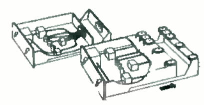
Plug-in Memory or Pulse Circuits.

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

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



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

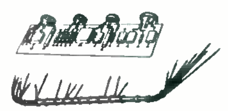


Back Connectors permit direct efficient wiring — avoid conventional rat's nest wiring.

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

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

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

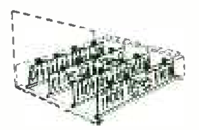


Terminal Panel Board with all components mounted in one plane, and Alden Unit Cable for interconnecting all panel elements with leads.

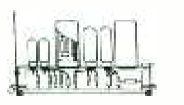
Layering of circuits using Alden Terminal Panels to segregate each main function and associate elements in one plane—for ease of assembly and check.

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

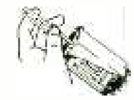
   SEE "ALDEN HANDBOOK" PAGES PI-1A thru H FOR COMPLETE DETAILS



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



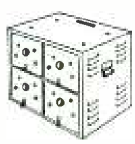
How Alden Terminal Panel groups main functions and how plug-in units have parallel functions for largest amount circuitry per cubic space.



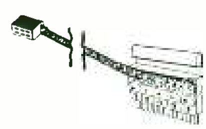
Alden "20" Packages house plug-in Units give independent shielding and heat dispersion.

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

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



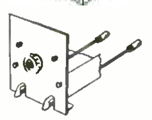
Separate chassis may be stacked in Alden Uni-Rack Cabinet. Cabinet can be interconnected within by Alden unit plug-in cables.



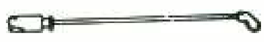
Alden Unit Cable — with variety of plug-in connectors. Carries wiring from chassis to chassis or rack to rack.

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

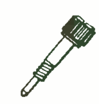
   SEE "ALDEN HANDBOOK" PAGE PI-11 FOR COMPLETE DETAILS



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



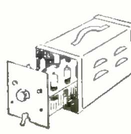
Alden Target Screw
The Toolless Screw



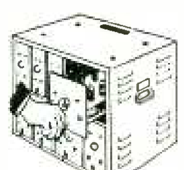
The Captive Screw, never lost.

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

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



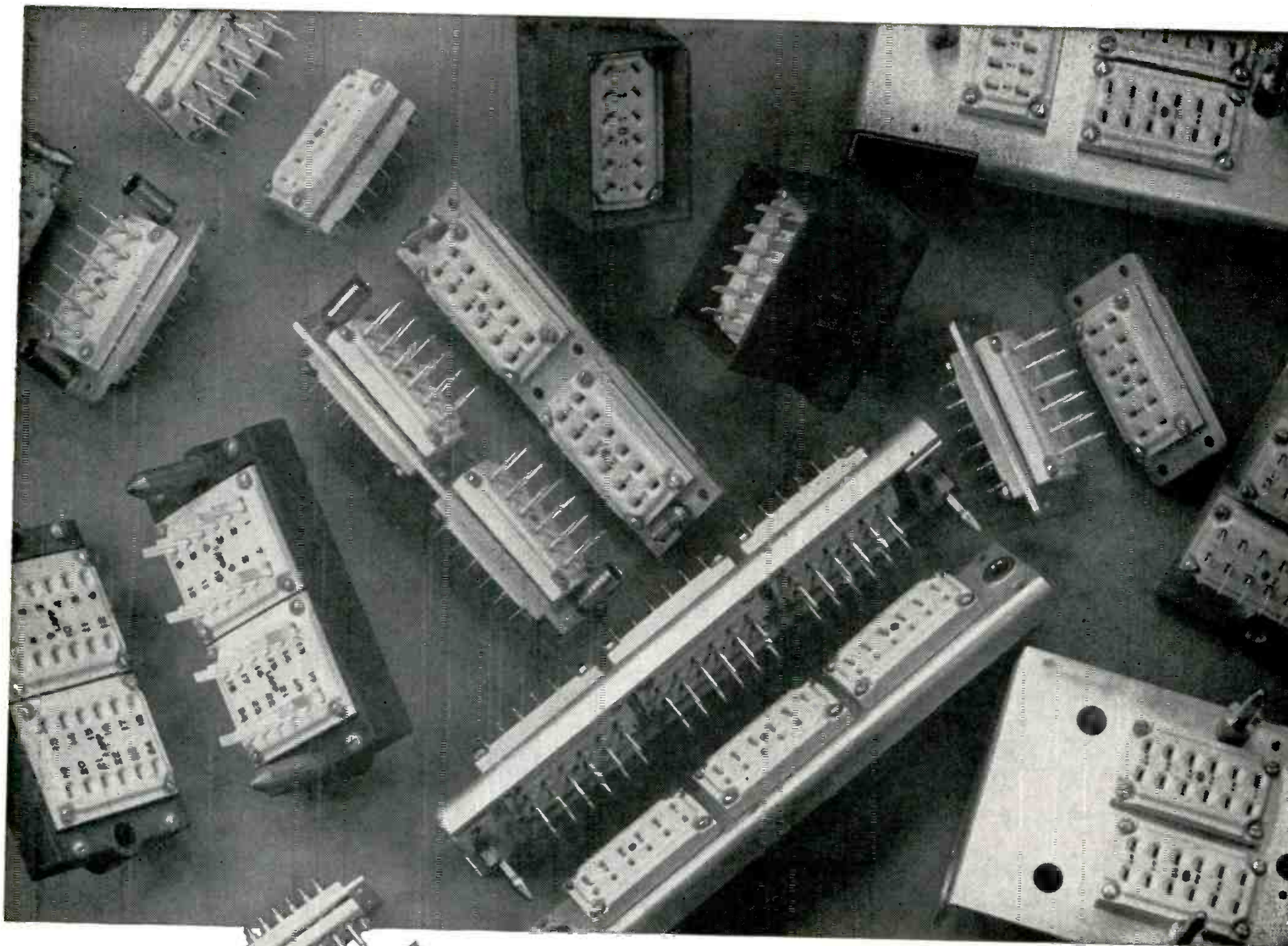
Chassis in carrying or serviceman's case or case to house spare.



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

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

ALDEN PRODUCTS COMPANY 127 North Main Street, Brockton, Massachusetts



Another NEW Shunt Diode by

UNITED

High peak power capabilities of type X-80 in relation to its physical size have been accomplished through an unusually forceful combination of design features.

1. Exclusive UNITED bonded *thoria tungsten core filament* for high electron emissivity.

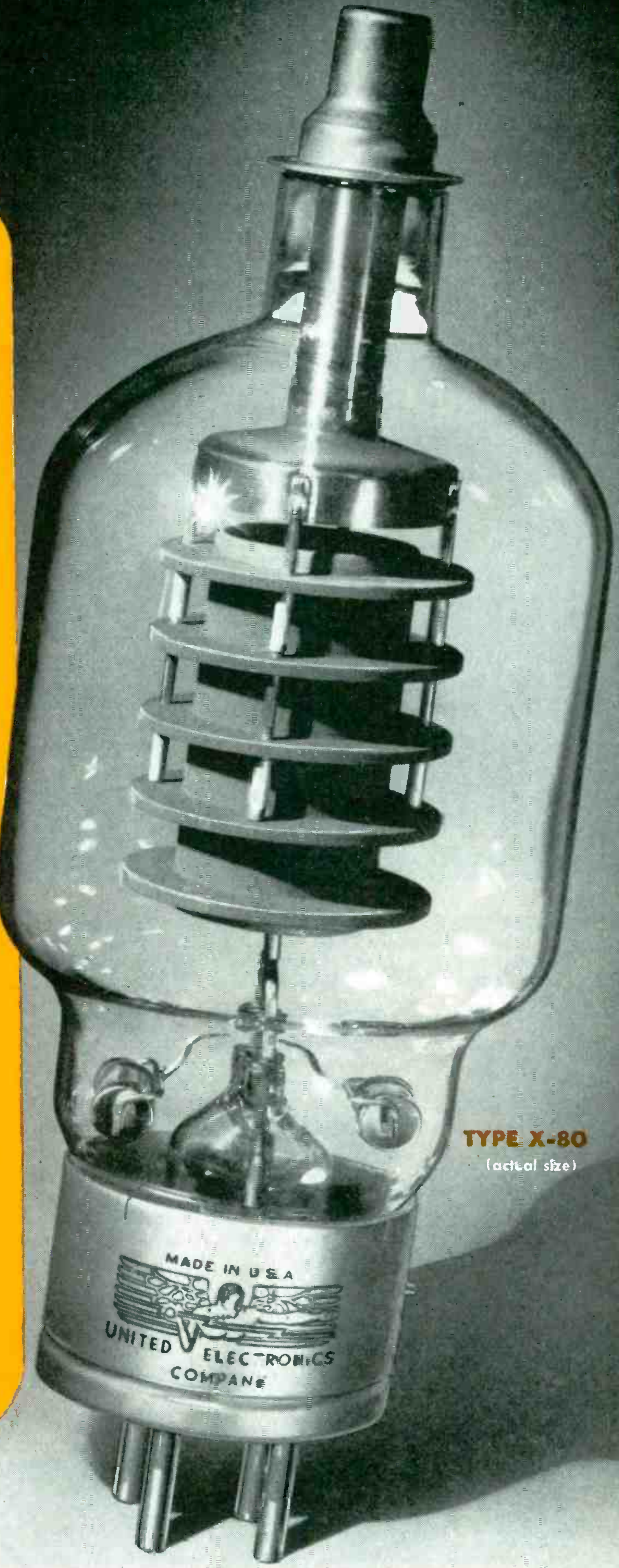
2. Exclusive UNITED *graphite anode* for maximum thermal dissipation.

3. Exclusive UNITED *isolated getter traps* for retention of hard vacuum and high voltage internal insulation.

Type X-80 will serve importantly as a high current clipper tube in radar equipment employing the large hydrogen thyratrons, as well as in power supply rectifier applications.

Write for detailed specifications.

40 Kilovolts Inverse Peak	80 Amperes Peak Plate Current as shunt diode
800 mAdc (average) as a rectifier	Filament Ratings 11 Volts Nominal 15.5 Amperes



TYPE X-80
(actual size)

UNITED ELECTRONICS, 42 Spring Street, Newark 2, N. J.
(TRANSMITTING TUBES EXCLUSIVELY Since 1934)

LABORATORIES: Experimental and development work requires extremely close voltage control for accurate and dependable results.

MANUFACTURING: To achieve maximum rated performance of electrically powered equipment, the input nameplate voltage must be maintained.

TESTING: Constant voltage must be maintained when testing or inspecting your product to obtain a valid check.

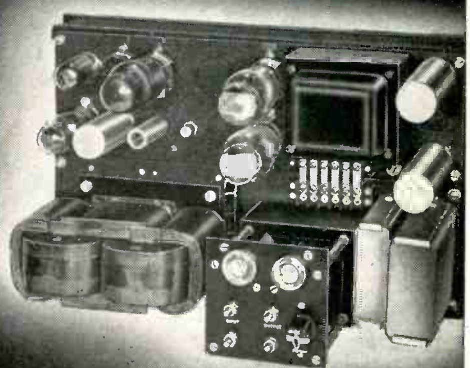
MAINTENANCE: By maintaining constant voltage to lamp loads and electrically operated equipment, productive life is increased and maintenance costs reduced.

ELECTRICAL OPERATIONS IN *Your Plant* REQUIRE

STABILINE

Automatic VOLTAGE REGULATORS

TYPE EM4115



TYPE IE5101R

THERE IS NO BETTER WAY TO MAINTAIN CONSTANT OUTPUT VOLTAGE *Automatically*

TYPE IE

INSTANTANEOUS ELECTRONIC

Completely electronic automatic voltage regulators with no moving parts. Offer instantaneous correction . . . excellent stabilization and regulation. Waveform distortion does not exceed 3%. Particularly adapted for use in laboratories . . . test lines and for all other applications where the most exacting voltage regulation is necessary.

TYPE EM

ELECTRO MECHANICAL

Consists basically of a very sensitive detector controlling a motor-driven POWERSTAT variable transformer and auxiliary transformer. Correction is not instantaneous but is faster than most automatic voltage regulators. Features zero waveform distortion and high efficiency. Ideally suited for controlling large industrial loads.

FOR YOUR ELECTRICAL OPERATIONS . . .

. . . there is a STABILINE Automatic Voltage Regulator right for the job . . . to maintain constant voltage regardless of line or load changes. Send today for complete information.

WRITE TO — 212 THURE AVENUE, BRISTOL, CONNECTICUT
ASK FOR — SECO BULLETIN S351

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

- **STABILINE AUTOMATIC VOLTAGE REGULATORS**
- **POWERSTAT VARIABLE TRANSFORMERS**
- **VARICELL D-C POWER SUPPLIES**
- **VOLTBOX A-C POWER SUPPLIES**
- **SUPERIOR 5-WAY BINDING POSTS**
- **POWERSTAT LIGHT DIMMING EQUIPMENT**

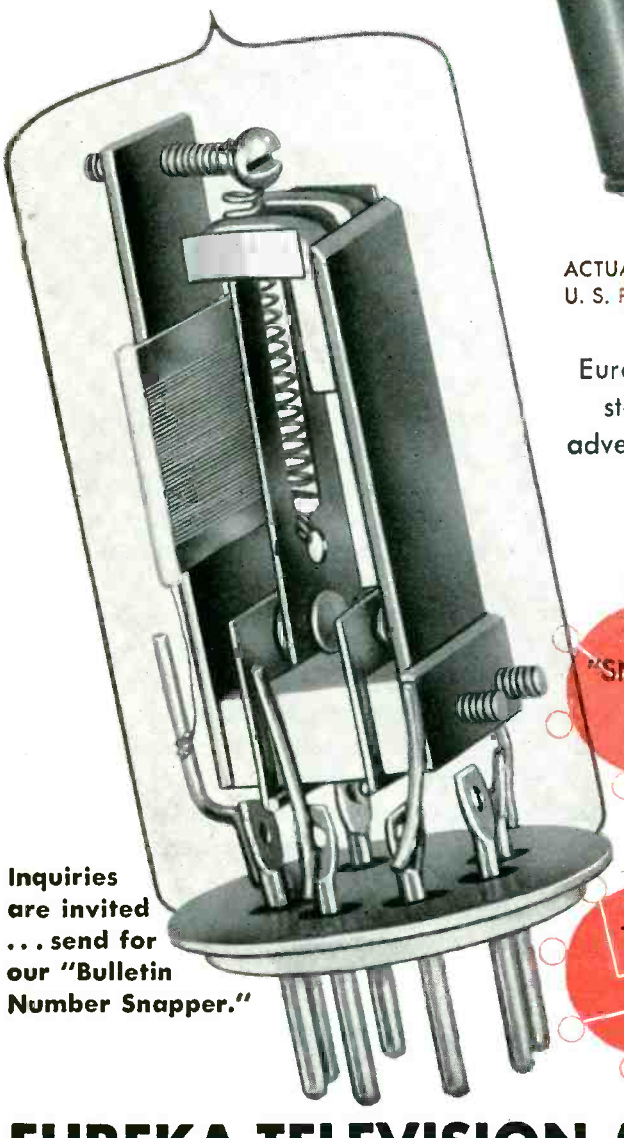
TYPE "SNAPPER"

THERMAL TIME DELAY RELAY

FEATURES . . .

Snap action. Small size. Light weight. Low operating temperature. Operates in any position. High contact rating. Gas filled. Consistent timing. Mechanical structure insures durability and long life.

ACTUAL SIZE
U. S. PATENTS APPLIED FOR



Inquiries are invited . . . send for our "Bulletin Number Snapper."

Eureka's "SNAPPER" incorporates the most radical forward step in the history of THERMAL TIME DELAY RELAYS with the advent of "POSITIVE SNAP ACTION". . . With this action the ELIMINATION OF CHATTERING is accomplished . . . The various uses for a THERMAL TIME DELAY RELAY have been increased manifold with the incorporation of a "SINGLE POLE DOUBLE THROW" feature. Due to its versatility, the "SNAPPER" relay can be manufactured to suit required needs.

VOLTAGE: 6.3, 26.5 and 115 volts (A.C. or D.C.) or as required. AMBIENT TEMPERATURE RANGE: – 60°C. to + 80°C. ENVELOPE: Miniature, or octal metal; glass upon request. All have identical operating characteristics.
TIME DELAY PERIODS: Preset from 5 seconds and up.
VACUUM: Evacuated, inert gas filled producing an arc quenching atmosphere.
HEIGHT: 1¾" max. seated.

EUREKA TELEVISION AND TUBE CORPORATION

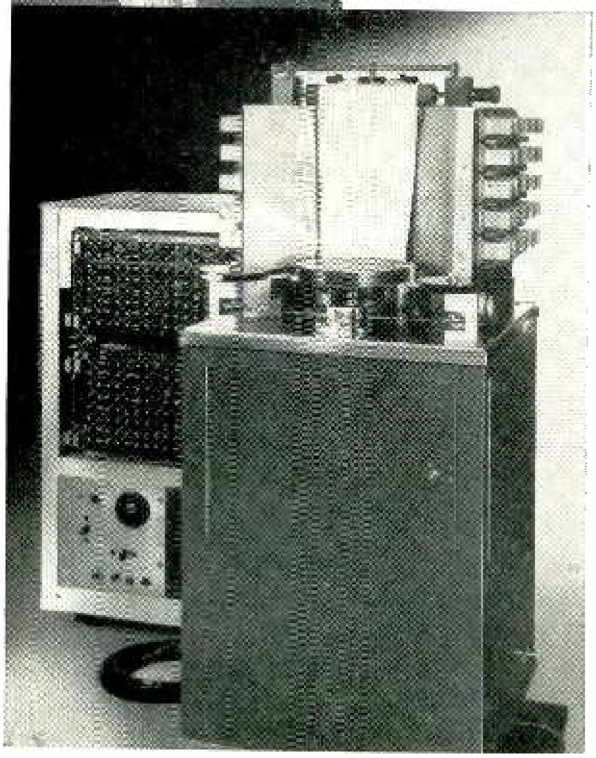
Manufacturers of Cathode-Ray Tubes and Electronic Products

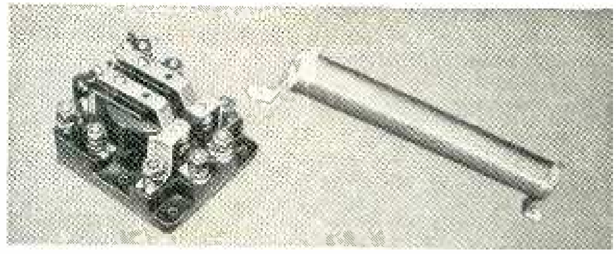
69 Fifth Avenue, Hawthorne, New Jersey • Telephone Hawthorne 7-3907

Potter Instrument Company, Inc.

"The 'Flying Typewriter' and all electronic counters require electric components that are rugged and reliable"

**says Jack Leight, Sales Engineer,
Ward Leonard Electric Company, Mount Vernon, New York**





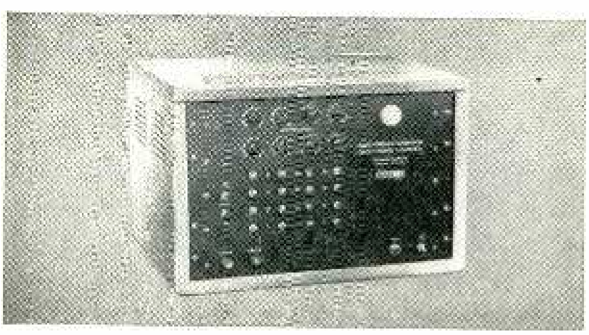
The "Flying Typewriter" is a revolutionary new high-speed electronic printer for data handling, communications, and computing. Developed by the Potter Instrument Company, Inc., Great Neck, New York, it is capable of printing 24,000 characters a minute "on the fly" from a continuously revolving type wheel.

Coupled to an electronic storage or memory unit, the machine first interprets, then prints in familiar typed lines, information taken in coded form from magnetic tape and punched cards or transmitted over narrow channel radio link, telephone and telegraph lines. The entire alphabet, numerals, punctuation and other special symbols are used in printing 300 lines per minute.

Such speed and accuracy in a machine require reliable, rugged electric components. That is why the Potter Instrument Company uses Ward Leonard VITROHM resistors and relays in the electronic counters for the "Flying Typewriter" as well as in many other types of high-speed electronic counters.

The trouble-free operation of Ward Leonard controls also eliminates many costly and time-consuming repairs.

Ward Leonard is always ready to put its staff of application engineers to work with you.



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Special alloy resistance wire is being wound on Vitrohm cores by Caroline Jervisa, for 17 years an employee of the company.

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VITROHM resistors stay on the job under the most adverse operating conditions such as those to which they are subjected in electronic counters where less carefully made resistors would break down.

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All Ward Leonard controls are made to exacting specifications, are guaranteed to give dependable service.

Consult Ward Leonard on their complete line of resistors, relays, rheostats, and other electric controls to meet your special needs.

O.D. and concentricity of finished ceramic cores is checked by Minna M. Henderson, who has had 12 years experience with Ward Leonard.

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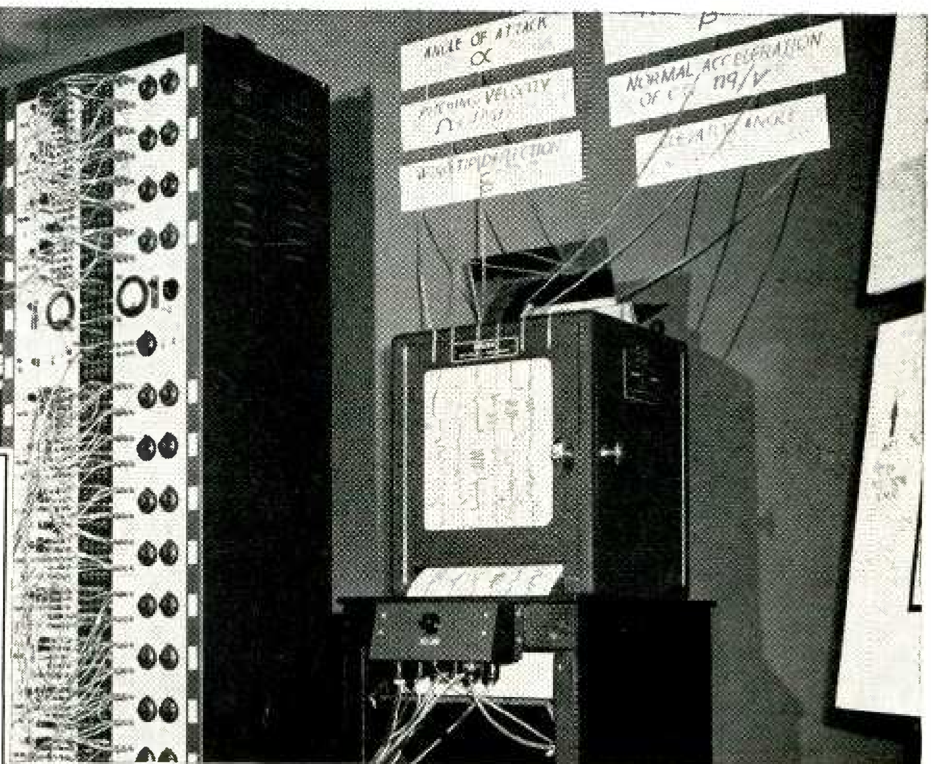

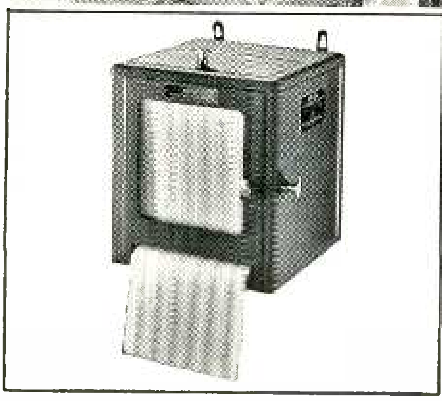

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CABLE BY PHELPS DODGE

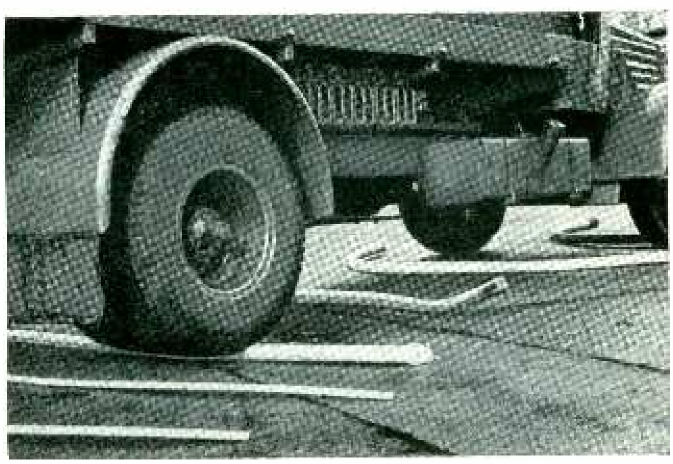
in semi-flexible 1000-ft. lengths without joints!

Reflections Reduced to Absolute Minimum in AM, FM, TV and Microwave Applications

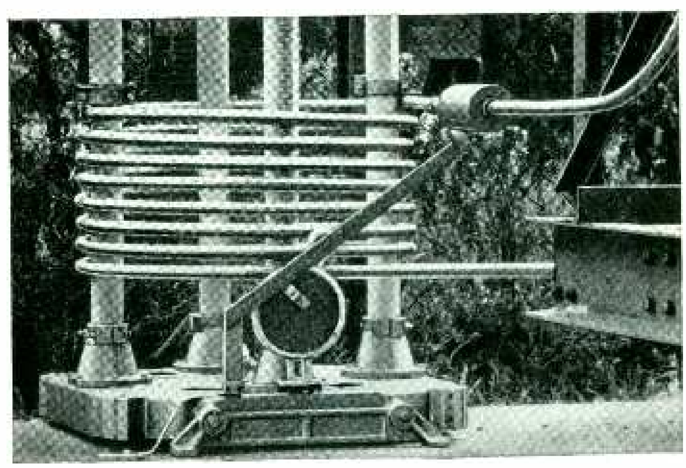
Phelps Dodge Copper Products Corporation's new semi-flexible, aluminum sheathed Styroflex cable is specially designed to meet the need for a high-power, efficient low-loss coaxial cable in the AM, FM, TV and microwave fields. The cable reduces reflections—which cause ghost images in television and distortions in communications—to an absolute minimum.

It was developed by Felten & Guilleaume Carlswerk, of Cologne, Germany, which has made a great many successful installations of the cable throughout Europe. Phelps Dodge is currently making the cable for sale in the United States in standard American sizes and impedances under a working agreement with the Cologne firm. The cable is manufactured in continuous 1000-foot lengths, without joints, and shipped on reels.

Outstanding feature of the cable is the use of insulating Styroflex film to form a helix. This helix, built up of hundreds of precision-wound Styroflex tapes, firmly supports and centers the inner conductor coaxially in an aluminum sheath at all times, assuring retention of excellent electrical properties. Essential flexibility of the Styroflex tape is obtained by special manufacturing techniques.



In test of strength and ruggedness of Styroflex coaxial cable, heavy truck drives over several samples without damaging them.



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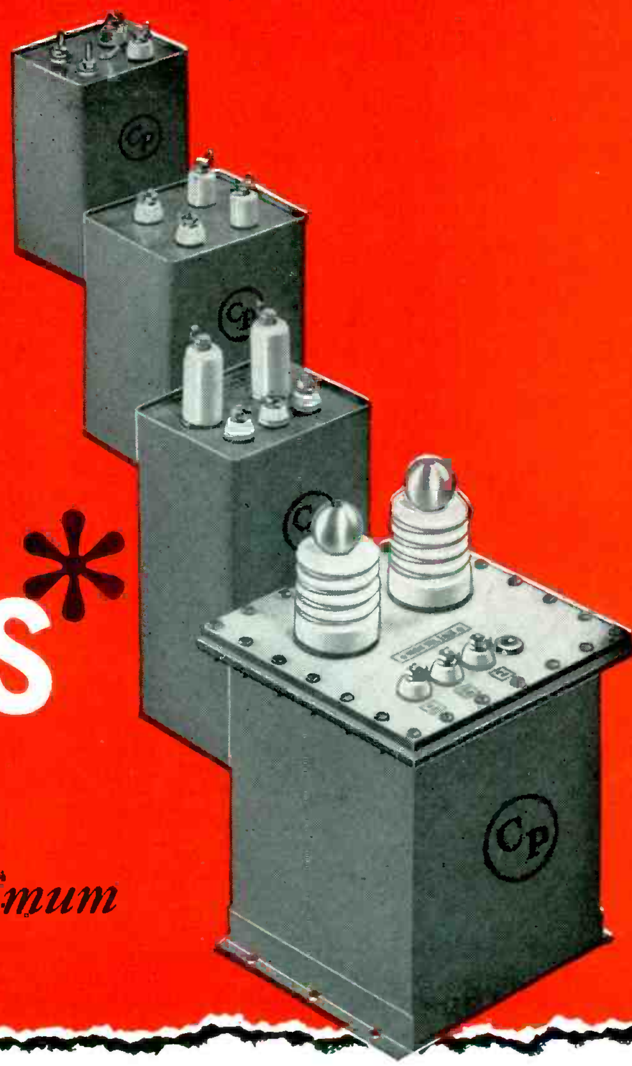

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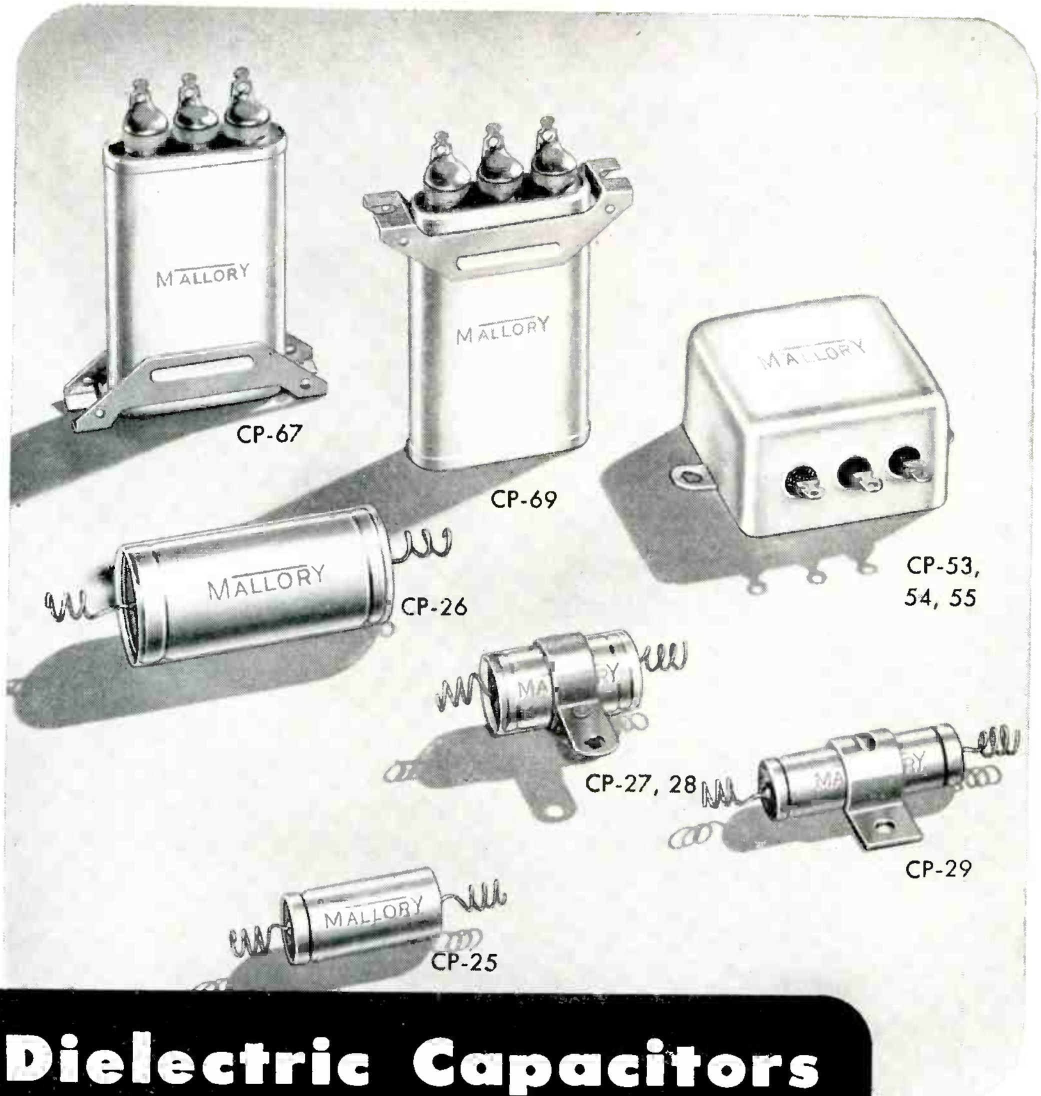

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JAN-C-25 types

For use in military electronic equipment, Mallory paper dielectric capacitors conform to Characteristic E of Specification JAN-C-25. The following types are included in the Mallory line.

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

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

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CROSS TALK

►**MAD-MONEY** . . . Best estimate of probable national-security expenditure this winter and next spring looks like this:

	Annual Rate
4th quarter, 1952	$54 billion
1st quarter, 1953	$55–$56 billion
2nd quarter, 1953	$56–$57 billion

Assuming that perhaps 5 percent of the total expenditure goes for electronic equipment, it is apparent that no great change in the level of our industry's business with government is in the immediate offing.

Procurement of staple items such as clothing, small arms and trucks is well along and may decline. Procurement of electronic items is not so far along and may increase. But it probably will not increase sharply because the military continues to be cautious about stockpiling items so readily rendered obsolete by important new technical advances.

►**S.R.O.** . . . Standing room only, and very little of that, awaited latecomers at recent National Electronic Conference sessions on transistors and electronic equipment reliability, indicating continued interest in the new and the needed. Old-guard subjects that once drew crowds in the multi-ring-circus type technical meeting took a back seat.

The Chicago shindig is not an isolated example. Last March at the New York IRE meeting the transistor session had to be repeated in its entirety to accommodate overflow crowds, and in this instance, too, meetings devoted at least partially to equipment reliability were well attended.

►**TEAMWORK** . . . In English as well as in American movie studios electronic cameras are being teamed experimentally with optical cameras. The electronic camera views the scene to be photographed and film is made by aiming a conventional camera at the display screen of a cathode-ray-tube monitor.

One advantage of the scheme is the ease with which various cameras on a set can be electronically faded together, reducing the need for film splicing. Another is the extreme flexibility with respect to sensitivity and latitude of which the electronic camera is potentially capable. Still another is the simplicity with which electronic cameras can be remotely controlled.

Already films satisfactory for television broadcast have been made by the process. Further refinements, particularly with respect to line structure, will eventually produce films suitable for conventional projection in theaters. It may be that this is the first long stride toward elimination of film entirely. Development of suitable tape-recording systems would be the next step, bringing all-electronic movies, with all that this implies with respect to distribution as well as production.

►**TROUBLE** . . . Causes of radar failure were recently recorded aboard a cruising American naval vessel. Arranged in order of "down-time" hours, they turned out to be (1) mechanical, (2) electrical and (3) "electronic." Fewest failures, in other words, were classified as electronic in the narrow sense of the word.

Gears never intended for service at sea gummed up. Motors unsuitable for this type of service had corroded. Such failures could have been avoided if the manufacturer, quite skilled in electronic circuitry, had been equally experienced mechanically and electrically.

It is becoming more and more evident, as time passes, that the mechanical engineer in particular plays a very important part indeed in the field of electronic equipment design.

►**ARITHMETIC** . . . Each editorial page of ELECTRONICS is equal in content to two average pages of a modern technical book. This issue contains some 125 pages of such material, or the equivalent of a 250-page book. This you get for about half the price of an old-fashioned shave and haircut, assuming a two-year subscription. We think it's quite a buy.

Navy VLF Transmitter

Stentorian voice from Jim Creek will reach submarines cruising below surface and insure reliable arctic communications despite frequent magnetic storms. Either c-w or fsk teleprinter operation is available. Dual power amplifiers use push-pull 5831 triodes. Catenary antennas are suspended between mountain peaks

NEXT SPRING the Navy will commission the world's most powerful radio transmitter. Developing more than 1,000,000-watts in the very-low-frequency band, the transmitter will provide both c-w and teleprinter communications throughout the entire Pacific area. Following precedents set at Haiku, Oahu, T. H. and Trinidad, B. W. I., antenna spans will be suspended between mountaintops to eliminate the need for high towers. These antenna spans or catenaries will vary from 8,700 to 5,640 feet in length and from the midpoint of each span, a 900-foot downlead will be suspended.

The transmitter site, Jim Creek Valley, near Arlington, Washington, is a natural for this type of antenna system. It is flanked on the north by 3,200-ft Wheeler Mountain and on the south by 3,000-ft Blue Mountain. The valley floor averages about 700 feet above sea level. The station is 55 miles northnortheast of Seattle, 20 miles inland from Puget Sound.

Transmitter

The 1,000-kw transmitter is contained within an enclosure 80 ft wide and 50 ft deep. The transmitter is actually a dual 500-kw transmitter arranged in the shape of the letter U. Between the wings of the U are the operator's desk, control console, master oscillator/monitor and tone-keying equipment. On each side are the main rectifiers followed by the exciters and 500-kw power amplifiers. The base of the U contains the control panel and meters for the switch gear, water temperature and flow, pressure pumps and other auxiliary equipment.

The transmitter tunes from 14.5 to 35 kc and has been designed around the RCA type 5831 triode. Each of the two power amplifiers employs three 5831's, two in the push-pull circuit with the third available as a spare. The tubes are cylindrical, with disk electrode connections and are about 10 inches in diameter and 20 inches high. The anode, grid supports and cathode beam former are water cooled. The

Navy vlf transmitter in Jim Creek Valley will deliver 1,000 kw to catenary antennas suspended between twin 3,000-ft peaks. Open towers (foreground) will carry antenna-feed bus

Will Radiate 1,000 KW

By T. D. HOBART

Electronics Transmitter Plant Design Section
Shore Electronics Division
Bureau of Ships, Department of the Navy
Washington 25, D. C.

Mammoth variometer of litzendraht cable is tuning element of power-amplifier tank circuit

6-volt filament structure of thoriated tungsten will require approximately 13 kw heating power. Each tube will require about 1,200 to 1,500 watts grid drive for 285 kw output at 80 percent plate efficiency. Plate voltage is 11.5 kv. The four operating tubes in both power amplifiers will deliver 1,000 kw to the antenna system exclusive of helix losses.

The transmitter is situated on the second floor of the transmitter building. Power transformers, switchgear, pumps, distilled-water tanks, heat exchangers, shops and telephone-cable terminals are located directly below on the ground floor. Immediately to the rear of the transmitter and machinery spaces are two integral helix houses, each 75 feet square and 60 feet high.

Circuit Details

The transmitter begins with a crystal controlled and monitored oscillator, capable of on/off keying or frequency shift keying ±25 cps. The oscillator output is in the order of 5 watts. By coaxial cable either of two such oscillators may excite either of the exciters that follow. Only one oscillator is in use at a given time on a single frequency. The block diagram, Fig. 1, gives the complete tube lineup.

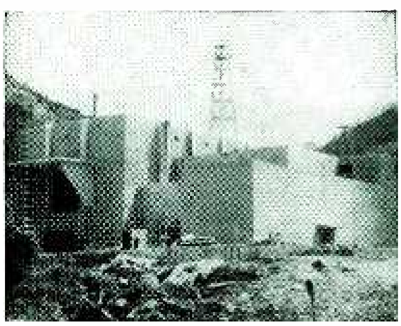
The exciters are a cascade series of R-C coupled amplifiers terminating in a cathode follower driving a pair of air-cooled 892R's. No tuning is required over the frequency range. Inverse feedback from the exciter output to input stabilizes exciter gain and power output so that either one or both of the power amplifiers may be driven by either of the exciters.

The power amplifiers are push-pull circuits, with mica tank capacitors, litzendraht-cable variometer tank inductances and inductive antenna couplers. Normally the left power amplifier will drive the left half of the antenna and the right side is similarly connected. Provision is made however, so that either power amplifier may be connected to either half of the antenna or to its own water-cooled dummy load for test purposes.

Antenna System

An automatic tuning device is incorporated in each power amplifier and antenna half to maintain antenna resonance. The device receives samples of grid-drive and antenna current in each half of the antenna and compares the phases of the sample voltages. Departure from the phase relationships at antenna resonance will cause thyratrons to conduct so as to control rotation of the antenna-tuning variometers in a direction to restore resonance.

The antenna, as shown in Fig. 2, consists of ten catenary spans arranged in a zig-zag plan and suspended from 200-ft support towers erected on the crests of the twin mountain ridges. There are six support towers on each mountain



Transmitter building contains dual 500-kw rigs and auxiliary equipment. Structure is copper shielded against intense electromagnetic field

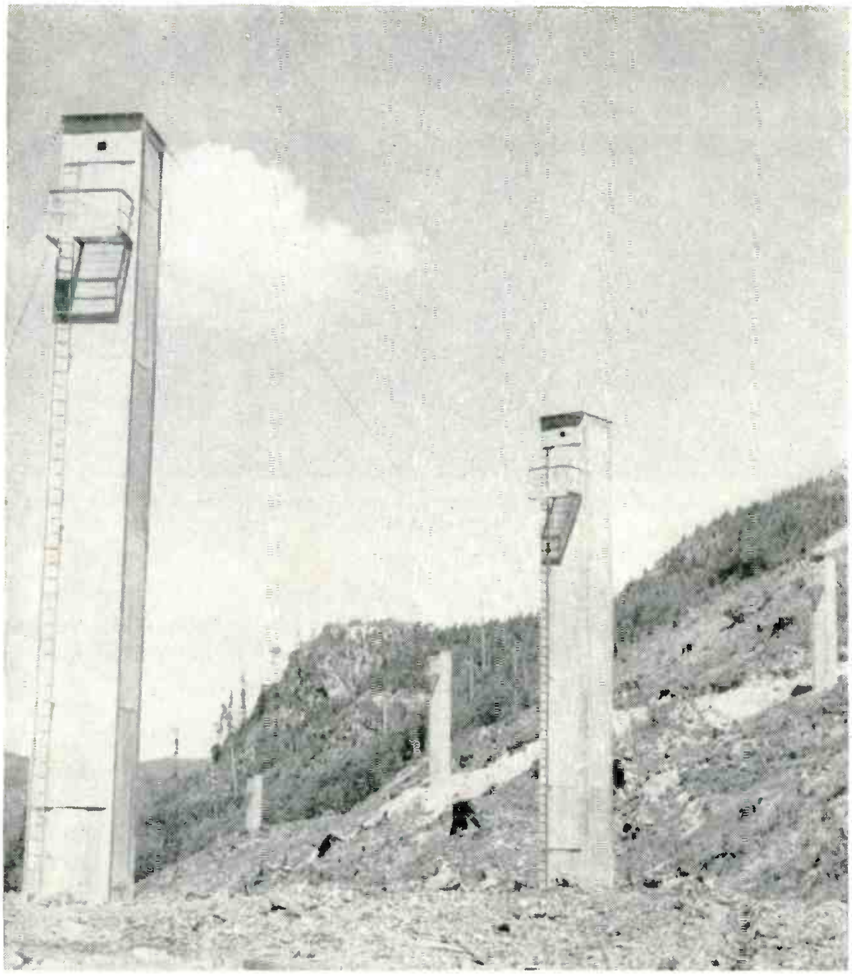
WHY NAVY RADIO CLINGS TO VLF

Very-low-frequency waves behave as though they were propagated in the space between two concentric reflecting spherical shells representing the earth and the lower edge of the ionosphere[1].

Their propagation is characterized by very small ground-wave attenuation, particularly at the lowest frequencies, very slight sky-wave penetration of the ionosphere, and relatively small energy absorption in the ionosphere, which also decreases with frequency. Losses increase during magnetic storms but the effect of these storms is less pronounced as frequency is decreased.

With its 1,000-kw vlf transmitter, the Navy expects to radiate a strong signal into the extreme reaches of the Pacific Ocean and to maintain constant contact with ships in the far north, despite frequent magnetic storms that cause radio blackouts of high-frequency signals.

Very-low-frequency waves also penetrate the ground and sea for a considerable distance. Patrolling submarines, including those of the atomic-powered variety, will never need break surface to receive their orders from Big Jim



Enclosed towers on north slope of valley contain concrete counterweight and pulley system to hold antenna system in tension despite varying ambient temperature. Counterweights are attached to steel tail cables that connect to the antenna downlead through large porcelain insulators

ridge. All catenary spans are spaced 400 feet apart at their midpoints except the fifth and sixth spans, which are spaced 1,000 feet apart, dividing the antenna into east and west halves.

The active radiating element of each span is made of 1.01-in. cable spun from 37 strands of No. 7 extra-high-strength copperweld wire. The radiators are connected to the support towers by plough-steel tail cables. Each radiator is insulated from each of its two tail cables by eight 6-ft-long, 6-in. diameter porcelain insulators. These are arranged in two series groups of four parallel clusters each.

A downlead of 0.92-in. hollow copper tubing is suspended from the center of each catenary span. Each downlead terminates in two spans that go to towers located on opposite slopes of the valley. The downleads are held in tension by concrete counterweight-and-pulley systems located within the enclosed towers on the north mountain slope.

Each half of the transmitter drives five antenna spans and from each helix house, antenna-feed buses run up and down the south slope of the valley supported on 125-ft bus towers and connect to the downlead through feeder spans. Distance from bus tower to catenary midpoint ranges between 1,000 and 1,200 feet.

Total antenna current is expected

Elaborate ground system is made up of copper conductors. Ground wires take to the air when crossing creek as shown at left. Close-up at right is creek diversion wall and shows one-inch copper conductors brazed to form ground screen to be just over 2,100 amperes. Antenna insulator voltage will be in the order of 240 kv.

The tapering nature of the valley causes spans to vary in length. Of the ten catenary spans, the longest is 8,700 feet, the shortest 5,640 feet, the west antenna half averages 8,500 feet, the east half 6,500 feet. The antenna is designed as standing rigging to withstand ½-inch radial ice in a 65-mile-per-hour gale. To accommodate the ice and wind loadings at a proper safety factor, sags in the catenary spans vary from 495 feet for the shortest span to 1,063 feet for the longest. The area between the twelve, 200-ft support towers encompasses 725 acres of which 435 acres are covered by active radiating elements of the antenna.

The intense electromagnetic field around the transmitter necessitates an elaborate grounding system for the entire structure, including copper shielding and a ground screen around the building. The photograph shows aerial ground wires crossing the creek southeast of the transmitter. The detail photograph shows the ground system at the creek diversion wall. One-inch conductors are brazed by the Cadweld process.

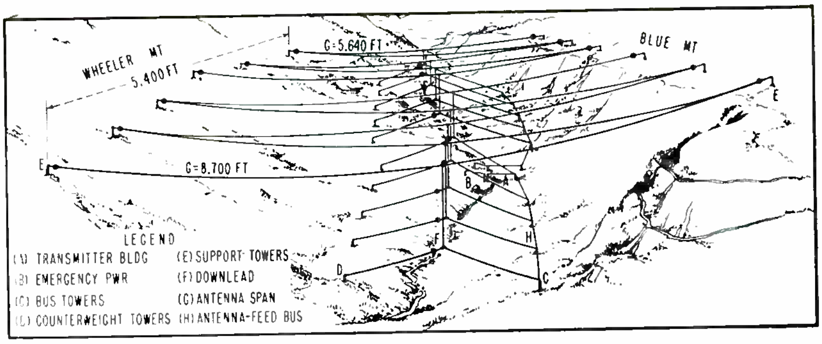


FIG. 2—Antenna system consists of ten catenary spans arranged in zig-zag fashion. Downlead from center of each catenary terminates in two spans. Antenna feed bus runs along south slope of valley. Towers on north slope contain counterweights that keep antenna system in tension

Supporting Facilities

Approximately 7,000 acres have been acquired for the transmitter site. Besides the antenna field and areas for shops and other facilities, the site includes the watershed of Jim Creek and Twin Lakes to supply water for cooling and fire-fighting purposes.

Prime electric power, about 2,500 kw, is to be supplied from the Bonneville Power Administration system over a 12-mile, 110 kv spur line to a transformer station within the radio-station reservation. The substation will transform incoming high voltage to 4,160 volts, 3 phase, and lower voltages for transmitter and other station use. A diesel-electric plant provides an emergency power source.

There will be supporting machine, electrical, carpenter, paint, sheet metal and automotive servicing shops and store houses, as well as living and recreation facilities for a 46-man staff.

REFERENCE

(1) F. E. Terman, "Radio Engineers' Handbook", p 733, McGraw-Hill Book Co., Inc., New York, 1943.

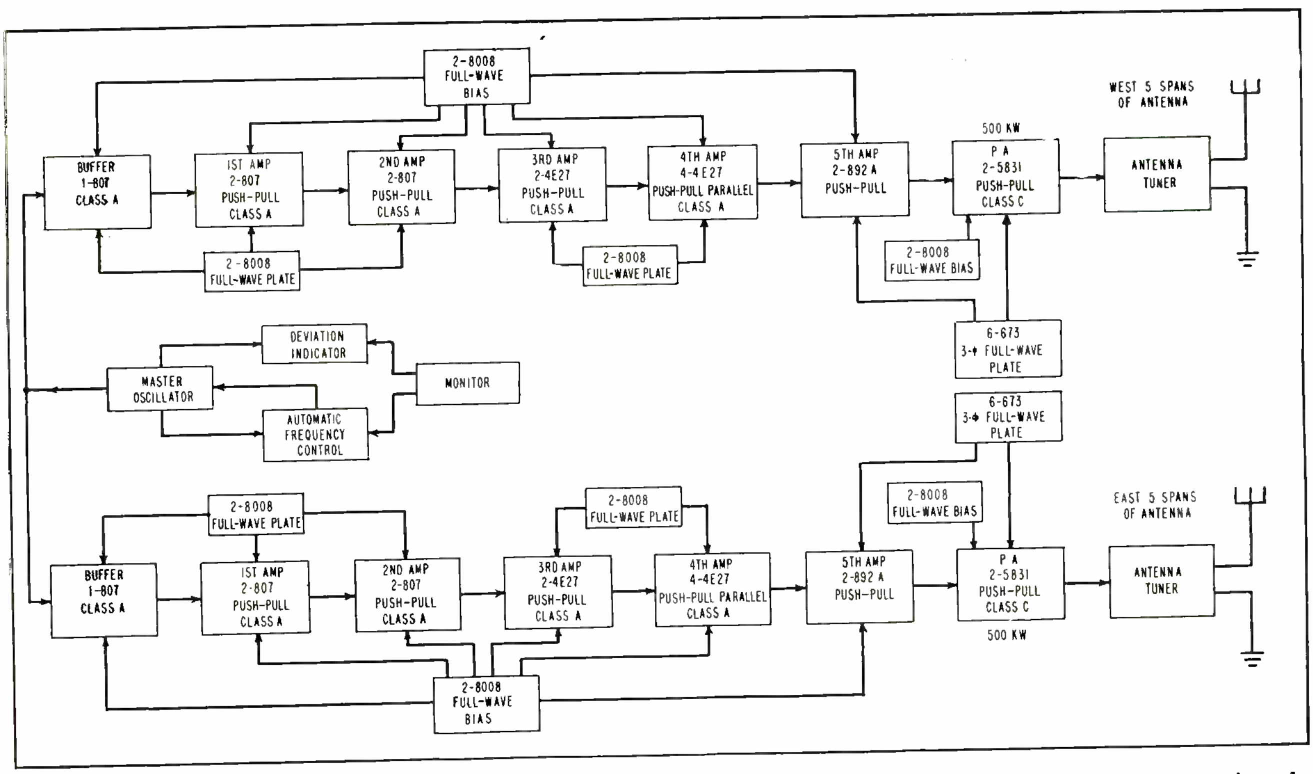
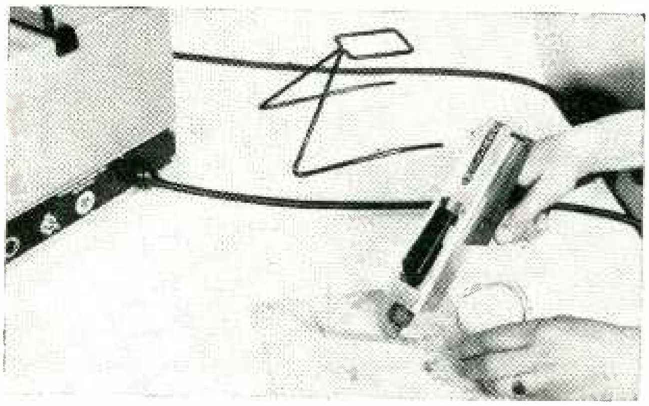
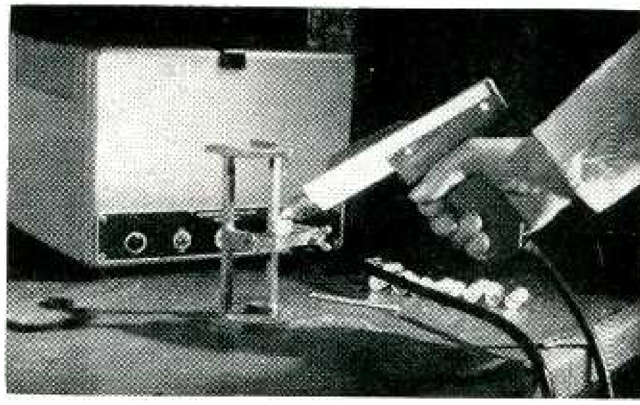


FIG. 1—Block diagram shows tube lineup of dual 500-kw transmitters. Crystal-controlled oscillator excites push-pull drivers through R-C coupled amplifier. Grid drive to 5831 push-pull finals is 1,500 watts

Ultrasonic Tinning



Tinning aluminum strip with ultrasonic tool



Tinning aluminum-foil ends of paper capacitors

THE LIGHT METALS such as aluminum form inert surface oxides that cannot be removed except by strong reagents. Aluminum oxidizes very rapidly and a cleaned surface reacts with oxygen almost instantaneously on exposure to air under normal conditions. It is thus necessary that any method devised for surface cleaning should insure that wetting by the solder occurs at the same time.

Active fluxes such as dilute hydrofluoric acid may be used, but it is impossible to completely free a joint made by this means from acid residue. There is also considerable danger of after-corrosion due to included flux.

One standard procedure is to puddle molten solder onto the surface of the metal to be tinned and then scratch-brush the metal below the molten solder, abrading the oxide from the surface. As solder covers the metal it cannot reoxidize and a wetting action will take place.

Scratch brushing can never completely remove the oxide and at best it cannot provide anything more than a series of keys through the oxide layer, on which will float a film of solder. Unless the surface is reasonably flat and uniform it is very difficult to use a scratch brush. Despite these limitations, there are some applications where it can be used successfully. The jointing of cable sheaths has been carried out by this means for some time.[1]

When a liquid is subjected to rapidly oscillating pressure of increasing amplitude, vapor-filled cavities within the liquid will expand and contract until a point is reached where a violent collapse will occur, producing extremely high localized pressures. If the implosion takes place adjacent to a surface immersed in the liquid, small particles will be eroded away.

Cavitation Abrasion

The passage of a high-intensity sound wave through a liquid is accompanied by cavitation. In practice, ultrasonic frequencies are used. Recent research work has shown that cavitation intensities increase at the lower-frequency end of the ultrasonic spectrum.[2] As the frequency is increased, the sudden collapse of the bubble is changed into a more gradual oscillation. The choice of frequency is also governed by the nuisance value of the sound wave; 20 kc is inaudible to most humans but will induce active cavitation. It has been known for some time that this effect can be applied to the tinning of metals.[3] The soldering action with an ultrasonically vibrated iron is shown in Fig. 1. The displacement of oxide by solder, leaving the oxide and other foreign matter on the surface of the solidified solder, is peculiar to aluminum and its alloys.

German reports as early as 1936 mention the application of ultrasonics to the tinning of light metals such as aluminum. Since this date a number of papers have been published covering ultrasonic equipment designed specifically for this purpose.[4,5,6]

The choice of suitable transducers for the suggested frequency range is limited. Magnetostriction units provide convenient sources of power and enable robust assemblies to be built suitable for most industrial applications. The magnetostriction effect is too well known to need description but in this particular application the choice of materials merits some thought.

Ultrasonic Soldering Iron

Nickel has been generally used for magnetostriction transducers, but suffers from some disadvantages when applied to soft soldering. Probably the most important factor is that the Curie point is low and as the temperature of operation approaches this critical value, the magnetostriction effect will decrease. Nickel also has a low resistance to mechanical fatigue and the design of high-output transducers for operation over long periods presents many problems.

Cobalt-iron alloys have a high resistance to fatigue and a Curie point in the region of 900 C. The change in length on carefully heat-treated samples is nearly as great as nickel and the over-all efficiency of energy conversion is high.

Techniques for Aluminum

Ultrasonic drivers on soldering irons and solder pots produce cavitation action that removes oxide film from aluminum, giving simultaneous cleaning and tinning without flux. Oscillator system is self-driven at natural resonant frequency of load through use of pickup coil on magnetostriction driver, eliminating need for tuning

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The ultrasonic soldering iron to be described utilizes a longitudinally excited magnetostriction element operated at a half-wavelength resonance. This means that there is a node of vibration at the physical center and an antinode at either end. This allows a center mounting to be used without imposing mechanical damping. The transducer is made up of a pack of cobalt alloy laminations insulated from each other in transformer style. This type of construction is superior to the more conventional nickel tubes as eddy-current losses are kept to a minimum. No physical fatigue has been noted, mainly due to the avoidance of highly stressed parts of the structure.

A soldering iron bit is attached to one end of the transducer. The dimension from the tip of the bit to the transducer provides a half-wavelength coupling bar. Hard soldering is employed for jointing. The bit is positioned by a metal diaphragm at the nodal point of the coupling bar. Excitation of the transducer is produced by a high-impedance coil wound on one limb of the U-shaped element, the magnetic circuit being completed by a magnetic alloy block.

In earlier models, the transducer was driven from a power amplifier fed by a local oscillator. This method has many drawbacks, the most outstanding being the necessity for continuous readjustment of the oscillator frequency. Acoustic output from a transducer is a maximum when the system is run at its natural resonant frequency. When used for soldering, the transducer will be subjected to wide extremes of temperature and external loading, causing a considerable variation of the fundamental frequency.

A system was therefore developed to make the unit self-driving. This was done by positioning a small variable-reluctance pickup, provided with permanent-magnet polarization, at the rear end of the transducer as in Fig. 2. The face of one limb completes the magnetic circuit of the pickup pole piece and the gap is adjusted accurately. Changes in the dimension of this gap produced by shortening of the

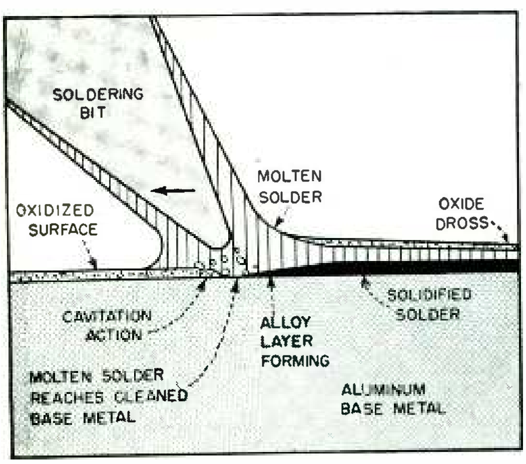

FIG. 1—Ultrasonic tinning action

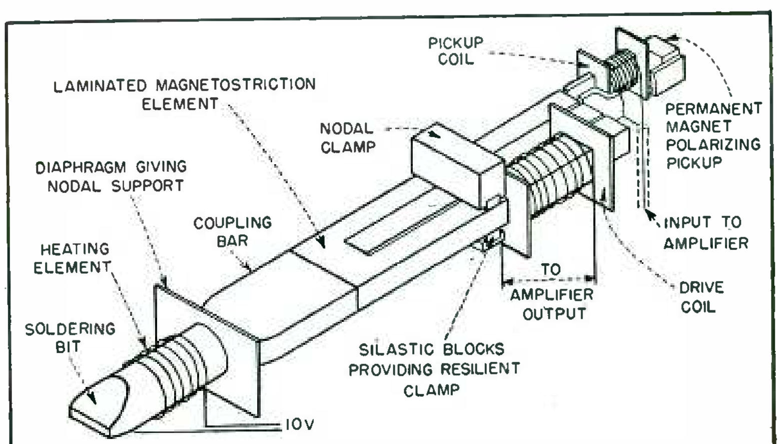

FIG. 2—Construction of magnetostriction driver for soldering iron

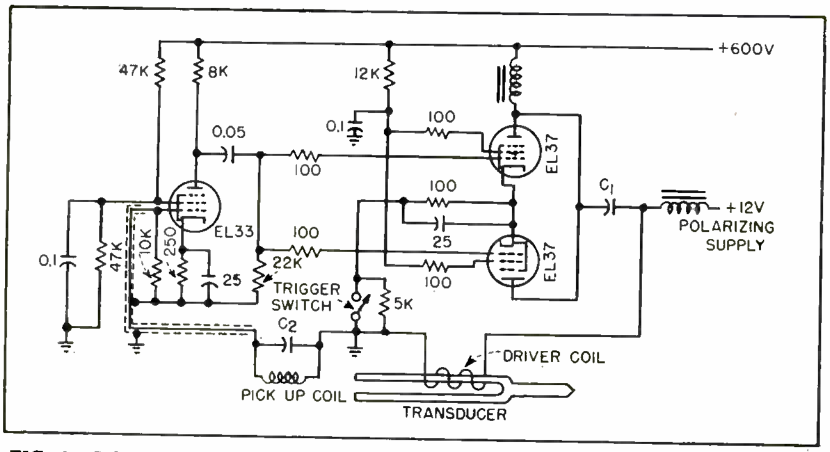

FIG. 3—Self-driving oscillator circuit and push-pull power amplifier for ultrasonic tools

transducer under magnetostriction influence will produce an induced voltage in the pickup coil. This voltage is applied to the driver stage of a class-C amplifier whose parallel-pentode output supplies the high-impedance transducer-energizing coil, as shown in Fig. 3.

Generator Circuit

The reactive component of the transducer load is tuned out by C_1. Matching of the load impedance to the output can then be effected by adjustment of the number of turns of wire on the transducer drive coil. This coil consists of 600 turns of No. 33 SWG copper wire, layer-wound on an insulated bobbin.

In such a system, stable running conditions might be reached at fractions or multiples of the natural resonant frequency. The pickup is therefore tuned by C_2 to the natural frequency of the transducer assembly. The induced voltage will decrease at any frequency outside this, and thus decrease power supplied to the driving coil.

In any resonant circuit of this type, noise composed of many differing frequencies will be present on initially energizing the circuit. The component of the noise which has the mechanical resonance frequency of the transducer will be fed back through the amplifier in phase to build up a larger swing. Other component frequencies will not be suitably phased to be reinforced and will therefore not increase in amplitude. The transducer will thus drop into its natural resonant frequency.

The magnetostriction element is contained in a light-weight pistol-grip assembly. The soldering bit is electrically heated by a low-voltage resistance winding, and power for the driver coil is controlled by means of a trigger switch. Cooling fins are fitted to the coupling bar to prevent overheating by the heat conducted from the bit.

In a modification of this system, the solder bit has been replaced by an electrically heated bath containing the solder. This type of tinning bath can be operated from the same power unit used for the iron.[7]

Soft Solders for Aluminum

Most normal soft solders will wet aluminum and its alloys, but the choice of solder depends on other factors. Most soft solders possess electrochemical potentials differing widely from those of aluminum. In the presence of moisture, electrolytic action can cause rapid corrosion of the solder or the base metal.

It is generally recommended that an electrochemical potential difference of not more than 0.25 volt should be allowed between dissimilar metals in joints exposed to outdoor conditions. This can be achieved by the use of tin-zinc solders. A large measure of protection can be obtained by painting or protecting the exposed surfaces of joints from moisture. An 80–20 tin-zinc ratio has suitable corrosion resistance properties and high tensile strength.

Applications

Although aluminum has a higher specific resistance than copper and thus greater volume for equivalent characteristics, there is a saving of 30 percent in weight and at least 50 percent in cost. The saving in weight is of major importance in the aircraft industry.

One of the main obstacles in the past to wider use of aluminum has been its inability to be easily soldered for electrical connections. Results with simple clamped joints were generally unsatisfactory, due mainly to the entrapped oxide layer and the plastic characteristics of the metal under pressure. Now, however, a stranded aluminum cable can be fitted with an aluminum lug. The cable and lug are initially dip-tinned in an ultrasonic solder bath. The lug is then fitted and reheating completes the joint.

Once a wetting of the metal has been achieved and the alloy layer built up, soldering can be carried out by conventional means for subsequent operations. Unless the alloy layer is completely removed by mechanical means, the joint can be made or broken many times without deterioration of joint strength.

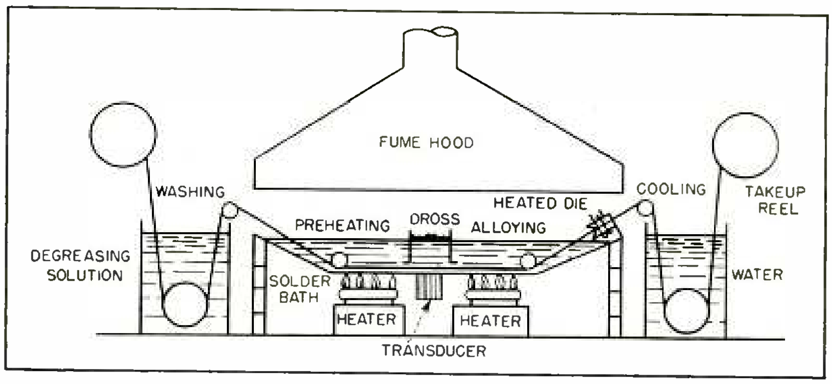

FIG. 4—Proposed plant layout for continuous tinning of aluminum wire, using ultrasonic transducer under molten solder bath

When using tin-zinc solder with aluminum and its alloys, shear strengths of lap joints are between one and three tons per square inch of jointed area. This is somewhat better than can be achieved with conventional soldering on copper.

Although soft soldering cannot compare with welding for ultimate strength, there are many structures that can be fabricated by soft soldering. Antennas for uhf television and for radar can be built up of aluminum; by using ultrasonic soldering the structure can be electrically bonded to insure low contact resistance at high frequencies, and the assembly can be easily erected or repaired when necessary.

Chassis

For aluminum chassis, connections are usually made by riveted or screwed connector tags. These are not satisfactory over a period of time due to the cold flow of most light alloys under pressure. The increase in joint resistance is very marked when high-frequency circuits are used. By soldering the connecting tag to an initially tinned area on the chassis, a sound mechanical joint with constant electrical properties can be achieved. Disorganization of an assembly line due to changeover of soldering irons can be avoided by pretinning the chassis at the required points before it goes on the production line.

Where extreme structural strength is not required, an aluminum chassis can be soft-soldered at the corners with an ultrasonic iron. Even brackets and components can be fastened the same way.

Aluminum-foil paper capacitors have in the past used a pressure joint between the end of the foil and the connecting lead. This is satisfactory for many applications, but for stringent mechanical conditions there is a tendency for poor electrical connections to develop. With an ultrasonic soldering iron or bath the ends of the foil can be completely tinned, permitting a positive soldered connection which can be carried out on a production basis by means of a conveyor.[8]

For hermetic sealing of aluminum cans, the can is tinned to the required depth by dipping into an ultrasonic solder bath. A pretinned lid can then be soldered in position after the components have been inserted and potting compound has been poured in.

In the manufacture of loudspeakers, the aluminum leads of the voice coil are pretinned in a small ultrasonic solder bath. A soft-soldered joint can then be made which in all respects is similar to that obtained with copper wire.

Light alloy castings having flaws or blow holes that would mar the finished appearance can be salvaged with an ultrasonic iron. The casting is preheated and solder is puddled into the hole. The tip of the iron is inserted and tinning of the inside hole results. The solder can then be built up to conform with the contours of the casting.[9]

The use of flux is sometimes a disadvantage when normally solderable metals such as brass and copper require tinning. As one example, telephone relay contact tags must be tinned under very clean conditions. If flux is used, insulators and adjacent parts must be cleaned after tinning. Ultrasonic tinning is effective here. The ultrasonic solder bath can be used with little alteration to existing production techniques.

Work is at present proceeding on a plant for the continuous tinning of aluminum wire. Figure 4 shows a proposed layout for such a process. The magnetostriction transducer is positioned at the bottom of a conventional solder trough. The wire is preheated by previous passage through the molten solder. After tinning, it is passed through a die to consolidate the layer and remove excess solder. The thickness of tin depends largely on the velocity of the wire but owing to the cold diffusion rate of aluminum in tin, it is necessary to have a considerably thicker layer than normal tinned copper wire.

The advantages in the use of tinned aluminum wire are numerous. There is a considerable saving in cost over copper. Stranded cables can be made up and handled as normal copper cables, and soldered to lugs without initial tinning. The saving in weight in large components such as transformers and chokes is also considerable.

Production-line setup for tinning aluminum voice-coil leads for loudspeakers with ultrasonic tinning bath. Solder pot is at top, replacing pointed tip of soldering iron. Ultrasonic generator (about 20 kc) is in cabinet at left

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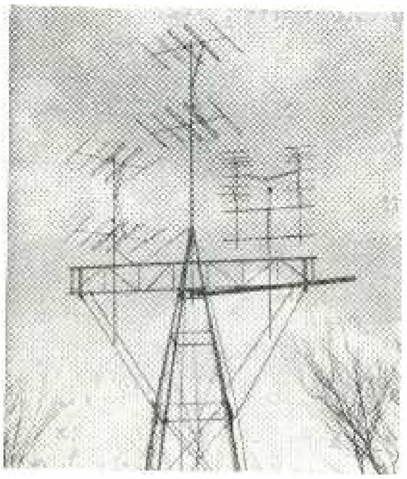

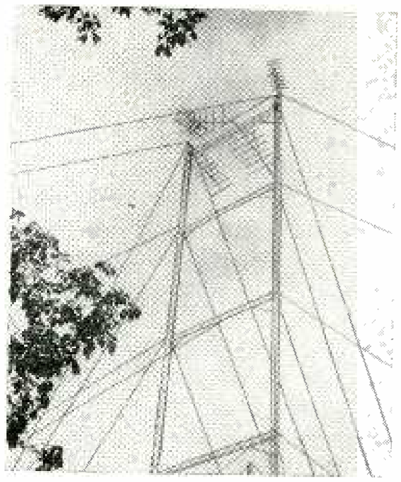

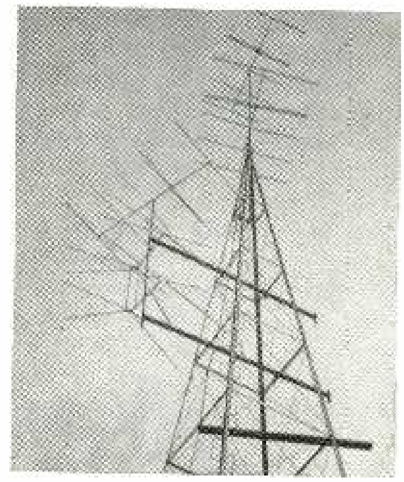

Arrays of high-gain receiving antennas mounted on high towers pick up television signals from distant stations. A separate antenna is used for each television channel. Signals received combined and sent down the tower cable to amplifiers that are installed at the base of the tower

Community Antennas

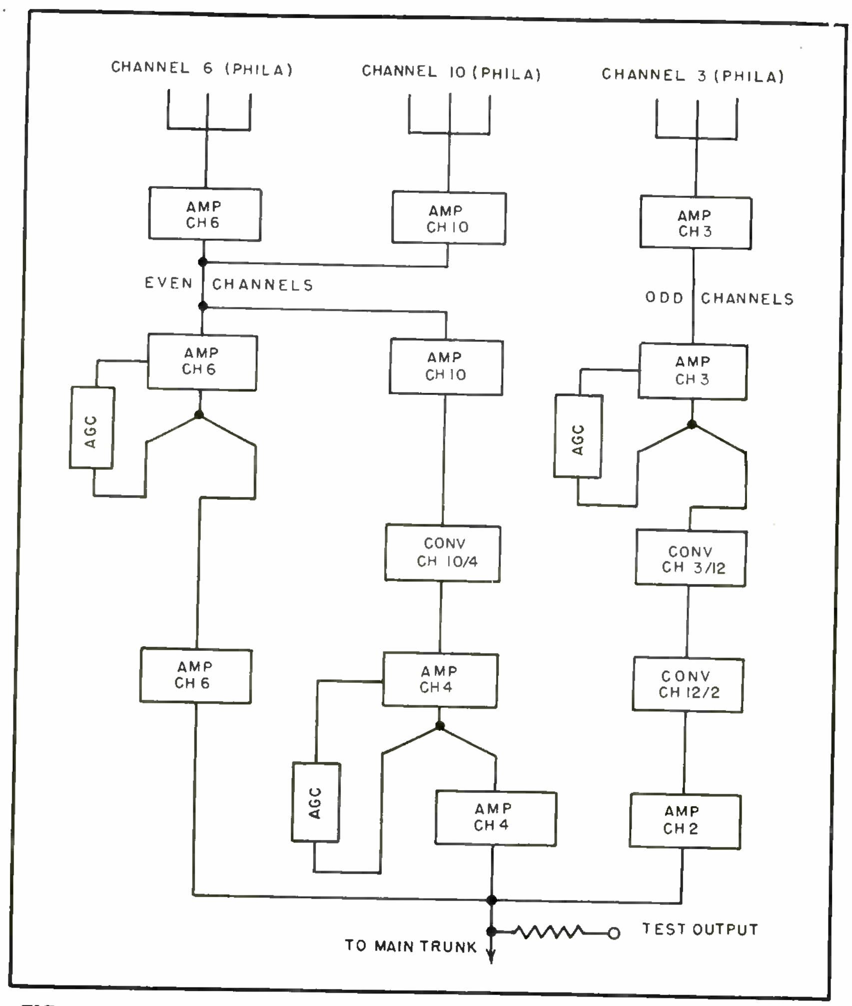

FIG. 1—Master antenna and tower amplifiers constitute the heart of community tv system

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HIGH-GAIN vhf tv receiving antennas are becoming familiar landmarks in television fringe areas where master community antenna systems are bringing satisfactory pictures to their subscribers.

Nearly 150 systems now operating or in some phase of planning or construction will ultimately serve over 1,000,000 viewers. The outlook is bright for even greater expansion. The present FCC tv channel allocation plan, when fully implemented, will leave more than 200 communities without television service, either vhf or uhf. Many set owners in communities served by only one local station will also welcome a community master antenna system capable of pulling in signals from network stations.

Community tv was born in the mountainous regions of Pennsylvania[1] and today more than a third of all systems serve the Keystone State's teacup-like communities. Mountain-ringed Pottsville, 75 air miles from Philadelphia, is served by the largest community tv system,

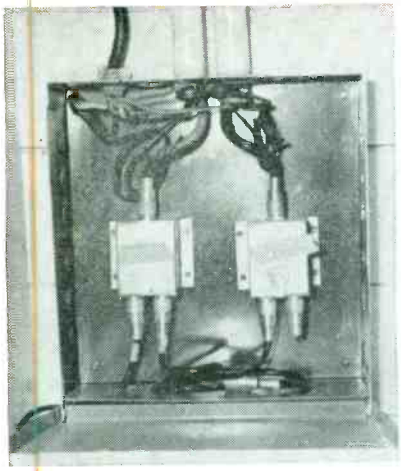

FIG. 2—Distribution transformers feed incoming signals from antennas to separate channel amplifiers

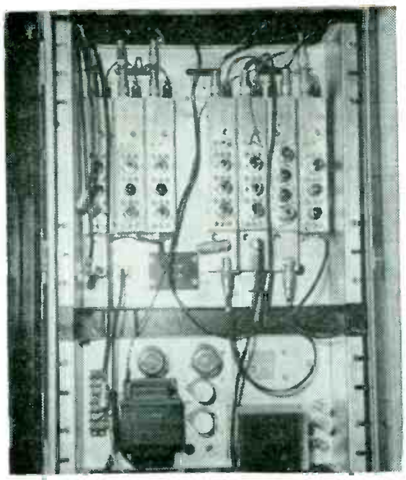

FIG. 3—Input amplifiers, one for each channel (right), and output amplifiers (left) boost signal for transmission

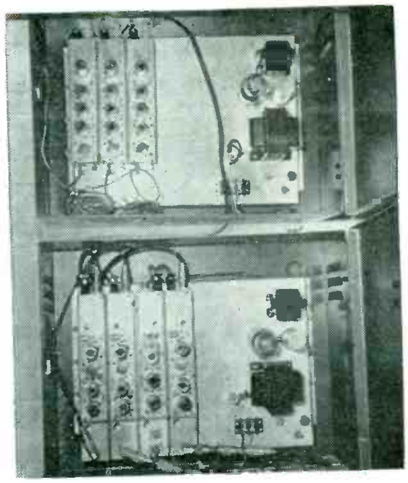

FIG. 4—The agc circuits, top, compensate for signal fluctuations. Converters, bottom, change signals to low band

Bring TV to Fringe Areas

Systems using master high-gain antennas and amplifiers may garner 1,000,000 new viewers. Installations in use now total 150 and are multiplying rapidly. Outlook is bright for continued expansion even when FCC tv allocation plan is completely implemented

Transvideo, with 1,500 subscribers in Pottsville and 150 in nearby Minersville. Transvideo's system shows how master-antenna operators tackle the problems of community tv: signal capture, amplification, transmission and distribution.

Signal Capture

Single-channel, twin-bay, 10-element Yagi antennas are mounted on the bridge between 150-ft twin towers erected on the summit of 1,600-ft Sharp Mountain. Here useful signals can be received from Philadelphia's channels 3, 6 and 10, Lancaster's (Pa.) channel 4 and New York's channel 11. At present, only the Philadelphia channels are normally distributed to subscribers.

The block diagram, Fig. 1, shows the tower amplification system used at Pottsville. Incoming signals from the single-channel antennas are amplified by preamplifiers located high on the tower. Signals from odd and even channels, respectively, are combined and brought down the tower by two coaxial cables. Mixing is accomplished in distribution transformers.

At the foot of the tower, the signals on the odd and even signal cables are separated and applied to appropriate tuned-channel amplifiers. Another pair of distribution transformers is used to divide the signal (Fig. 2).

Input amplifiers for channels 3, 6 and 10 are shown at the right in Fig. 3. Experimentally, an additional input amplifier is provided for channel 4, Lancaster.

Portions of the amplified output from the channel-3 and channel-6 amplifiers are fed back through control circuits to supply agc voltage to compensate for signal strength fluctuations at the antenna. Two control-voltage sources are located on the top chassis, Fig. 4.

High-Band Reception

Only three low-band channels are distributed in systems like the one in Pottsville. Either channels 2, 4 and 5 or channels 2, 4 and 6 may be distributed. Low-band channels are selected because transmission-line losses increase sharply with frequency. The particular channel combinations are chosen to provide a guard band between adjacent channels to prevent interchannel crosstalk.

Channel 10 must be converted to channel 4 for distribution. A 3-tube converter is used. After conversion, the signal is applied to a channel-4 input amplifier, part of whose output is utilized for agc.

Channel 3 must be converted to channel 2 before being distributed. This conversion cannot be accomplished directly. Double conversion is performed, taking the signal first from channel 3 to channel 12 and then from channel 12 to channel 2. The three converters are located on the bottom chassis, Fig. 4, along with the channel-4 (ex-channel-10) input amplifier.

The signals are finally applied to the output amplifiers shown at the left of Fig. 3. These amplifiers have no agc circuit but are otherwise identical with the input ampli-

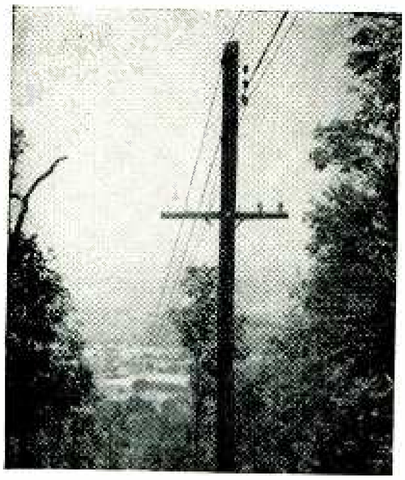

FIG. 5—Main trunk cable carries signal from tower amplifier to town at foot of mountain. Cable is carried on utility poles

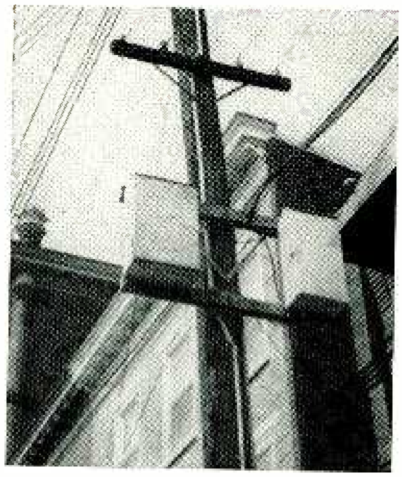

FIG. 6—Line amplifier, left, maintains signal level on trunk while distribution unit, right, feeds several subtrunks or feeders

FIG. 7—Subscribers' lead-ins tap off feeder line using isolating impedances. Lead-ins are commonly RG-59/U coaxial cable

fiers. After amplification, the signals are supplied to another distribution transformer and sent down Sharp Mountain on an RG-11/U transmission line. Figure 5 shows the transmission line carried on the same utility poles that bring power lines to the receiving site.

Line amplifiers are installed at regular intervals along trunk lines. The line amplifier consists of an input and an output amplifier for each of the three channels. The amplifier chassis are the same as those used in the tower amplifier. However, agc is not invariably applied to the input amplifier as is the case of tower amplifiers but only where necessary to equalize the different attenuation of signals differing in frequency. The line amplifiers are contained in the box shown at the left in figure 6.

The box at the right contains a voltage-regulating transformer, safety switches and an eight-way distribution transformer that provides feeder lines for neighborhood signal distribution.

Figure 7 shows five lead-ins to subscribers' homes tapped off a neighborhood feeder line. For economy, home lead-ins are commonly RG-59/U coaxial cable. An isolating impedance is inserted at each tap-off. Depending upon the antenna system in use, this impedance may be either capacitive or resistive. In either case, the impedance decreases in value as the end of the feeder is approached, equalizing signal power supplied to the subscribers on the feeder.

In some systems, an impedance-matching device is used at the subscriber's set to match the 75-ohm line impedance with the 300-ohm set impedance for optimum power transfer to the set and minimum radiation from the lead-in.

Table I—Characteristics of Amplifiers Used in Community Master Television Antenna Systems

Maker and Type	Single Channel or Broad Band	Tube Lineup
Blonder-Tongue Labs.		
Mixer Amplifier	Single Channel	1–6AB4, 1–6CB6
Commercial Antensifier	Broad Band	2–6J6, 2–6BQ7
Jerrold Electronics		
Preamplifier	Single Channel	cascode 6AK5 feeding 6J6, 4–6AK5
Reamplifier	" "	5–6AK5
Philco Corp.		
Preamplifier (Hi & Lo Band)	" "	1–6BQ7, 1–6CB6, 1–6AK5
Mixer Amp (Hi Band)	" "	1–6BQ7, 4–6AK5
Mixer Amp (Lo Band)	" "	1–6BQ7, 1–6CB6, 1–6AK5
Line Amp (Hi Band)	" "	5–6AK5
Line Amp (Lo Band)	" "	2–6CB6, 1–6AK5
RCA		
Tower Amplifier	" "	
Input Strips (Ch 7–13)		3–6AK5, 1–6AN5
Input Strips (Ch 2–6)		3–6AK5
Output Strips (Ch 2–6 only)		3–6AK5
Line Amplifier (2 Strips)	" "	3–6AK5 each strip
Spencer-Kennedy Labs.		
Chain Amplifier	Broad Band	12–6AK5
Technical Appliance Corp.		
Power Amplifier	Single Channel	3–6AK5, 1–6J4
Voltage Amplifier	" "	3–6AK5
Transvision Inc.		
High Channel Amp	" "	5–6AK5, 1–6AN5
Low Channel Amp	" "	4–6AK5, 1–6AN5
National Antenna Corp.		
High Channel Amp	" "	4–6AK5, 1–6AN5
Low Channel Amp	" "	3–6AK5, 1–6AN5

Antenna Array

All-important in design of a community antenna system is location of the antenna site. In general, the best way to select the site is to set up a TV receiver at each proposed location and select the site at which the best picture is received. Tests should be long enough to average out propagation anomalies.

Receiving antennas commonly used in community tv include 10-element Yagis, five-element Yagis, either twin or single fed, and rhombics. Antennas are often paralleled in bays. Systems may then include several bays for each channel.

In some installations, wave traps are inserted at the antenna. These are of the bridged-T type designed for maximum Q and are used to eliminate interference such as arises from harmonics of f-m stations, amateur stations or from adjacent-channel tv stations. The filters are designed with a bandpass characteristic 60 db down at the undesired frequency and less than 1 db down at the desired frequency.

Community systems in flat country like Indiana and Texas often use towers up to 500 feet high to pull in signals from distant stations. In mountainous regions, where a natural barrier rather than distance inhibits tv reception, towers 100 to 200 feet high are erected, usually on a nearby mountain summit. Twin towers with the antenna array mounted on a connecting bridge are gaining increasing favor.

Tower Amplifiers

The first amplification stage of a community system establishes the system signal-to-noise-ratio and subsequent amplification can never improve upon the signal received at the foot of the tower.

Preamplifiers having one or more stages are often located high on the tower. An alternative scheme is to use low-loss, radiation-proof coaxial cable from the antenna and to locate the preamplifier at the base of the tower.

Automatic gain control is first introduced in the tower amplifier. A portion of the amplified output is fed back to the input amplifier grids through an amplifier and diode combination. A good agc system should compensate for gain increases up to 30 db.

Three types of amplification are used in community tv. The broad-band system uses amplifiers having a bandwidth from 40 to 225 mc. The single-channel system uses a separate amplifier tuned to each channel received at the antenna. This may include any vhf channel from 2 to 13. The single-channel converter system provides three channels which may be either channels 2, 4 and 5 or 2, 4 and 6.

Representative of broad-band systems is the Spencer-Kennedy amplifier shown in Fig. 8A. The amplifier consists of two stages each having six 6AK5's with their grids connected at equal time intervals along an artificial delay line and plates connected at corresponding intervals along another line. The lines consist of lumped inductances and the input and output capacitances of the tubes.

The input wave travels down the grid delay line, exciting each tube's grid in turn. A corresponding wave is set up in the plate line. This wave travels down the plate line, reaching the plate of each amplifier tube in time to reenforce the amplified signal coming through the tube. This amplification continues through the stage and the output of the plate line is coupled to the input of the second-stage grid line.

The second stage is identical with the first except that the output of the plate delay line is matched to the external load. The amplifier has a nominal gain of 21 db and a response characteristic flat within plus or minus 1.5 db over its passband.

A typical broad-band response curve is shown in Fig. 8B. Irregularities in an amplifier's response curve are accentuated when several such amplifiers are cascaded. However, broad-band amplifiers have a lower cost per unit and are often used in smaller community installations as well as to extend single-channel systems.

Single-Channel Amplifiers

Single-channel amplifiers, tuned to any vhf channel, are available for community tv use. These amplifiers provide more gain than the

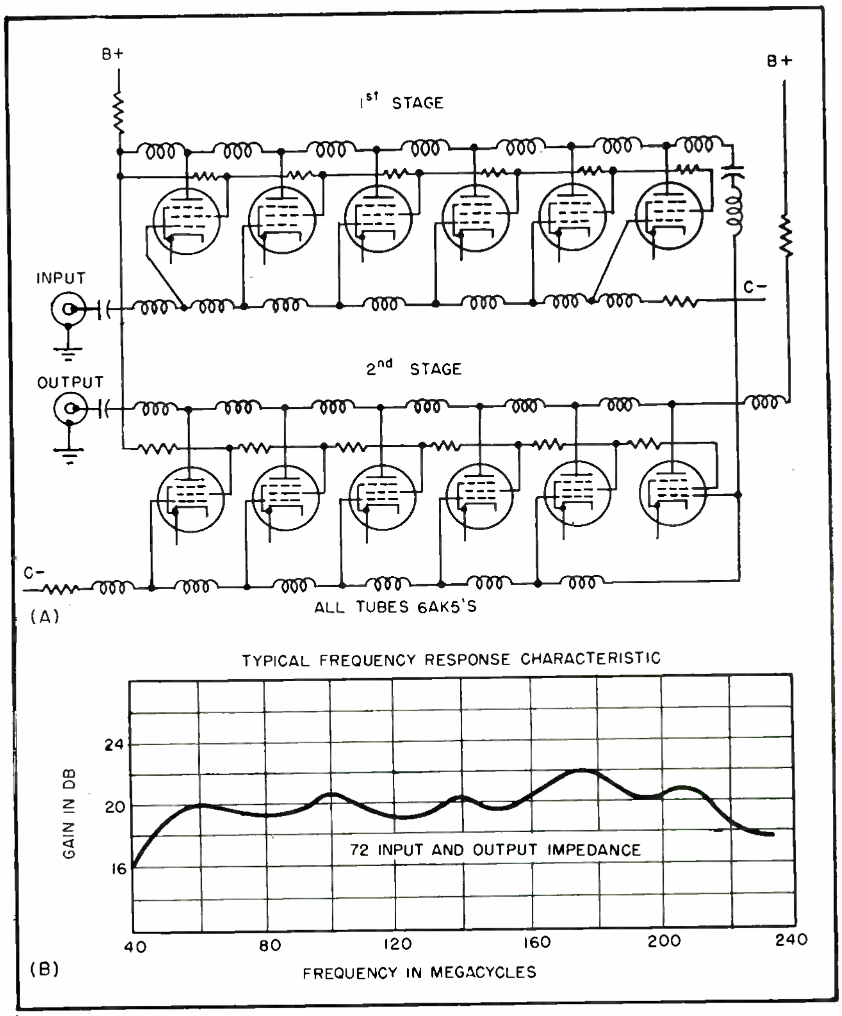

FIG. 8—Broad-band amplifier (A) using twin delay lines amplifies signals from 40 to 225 mc with response characteristic shown (B)

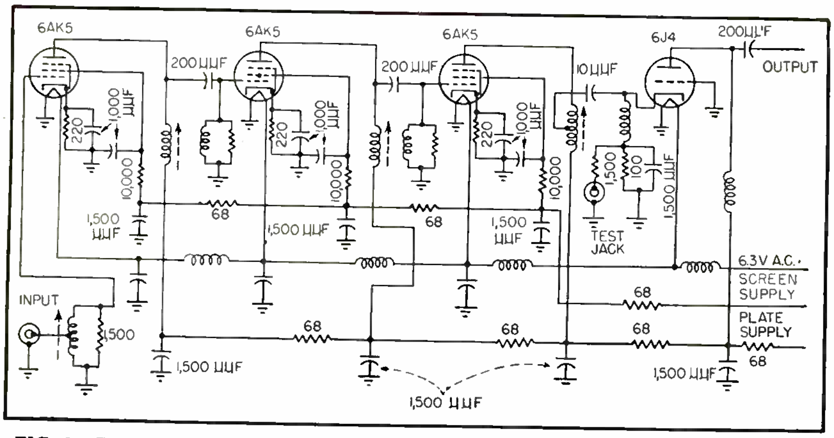

FIG. 9—Four-stage tuned amplifier is suitable for either line or tower amplifier use

wide-band type and readily cascade. However, high-band gain is often as much as 10 db below low-band gain. Moreover, transmission-line attenuation is much greater at high-band frequencies. When both high- and low-band channels are distributed in a community tv system, amplifiers must be inserted in the line more frequently than would be necessary if only the low-band channels were transmitted. This increases power consumption and meter rental charges that are incurred each time power is drawn from utility lines. For these reasons, most community master antenna systems use single-channel amplification of low-band channels only.

A typical amplifier used in a single-channel, converter-type system has a gain on the order of 50 to 60 db, a response characteristic flat within ½ db over its six-mc passband and 30 to 40-db rejection at the nearest interfering channel.

The circuit of a representative single-channel amplifier, the Taco amplifier, is shown in Fig. 9. It uses three 6AK5's in cascade feeding the 6J4 output stage. A complete line amplifier consists of three such strips mounted on a master power chassis containing the 5U4 rectifier. Stagger tuning is used to achieve a six-mc bandwidth. Its rated gain is 56 db as a low-band amplifier and 46 db when used in tower amplifiers for high-band service.

Signal Converters

Converters are used either to convert high-band signals to low band or to interpose a signal between two low-band channels. High-to-low, low-to-high and low-to-low converters are available.

Most converters have crystal-controlled local oscillators and frequency multipliers. Vacuum-tube and crystal mixers are both in use. The vacuum-tube mixer provides 6 to 18 db gain depending upon the frequency conversion required. The crystal introduces about 3 db loss but is often used for economy. Converters having r-f amplifier stages are available.

Signal Distribution

The main trunk cable is split into several subtrunks to serve all parts of the community and the subtrunks are, in turn, split into several feeders. Conservative design practice is to serve subscribers only from feeders. Each time the signal is amplified it must be split between three tuned channel amplifiers and recombined after amplification. Several unique signal-splitting and signal-mixing devices are used.

Figure 10 shows the circuit of an electronic distribution unit that feeds six lines from the main trunk. The unit utilizes six 6AK5's connected as plate-loaded pentodes bridging the trunk. Similar line-bridging amplifiers are used in many agc circuits.

In some systems, subtrunks and feeders are fed at the output of the line amplifiers. Here the channel amplifier outputs pass through series-tuned circuits to a common bus. Usually two outputs are available although up to six outputs can be had when cathode followers are used to provide isolation.

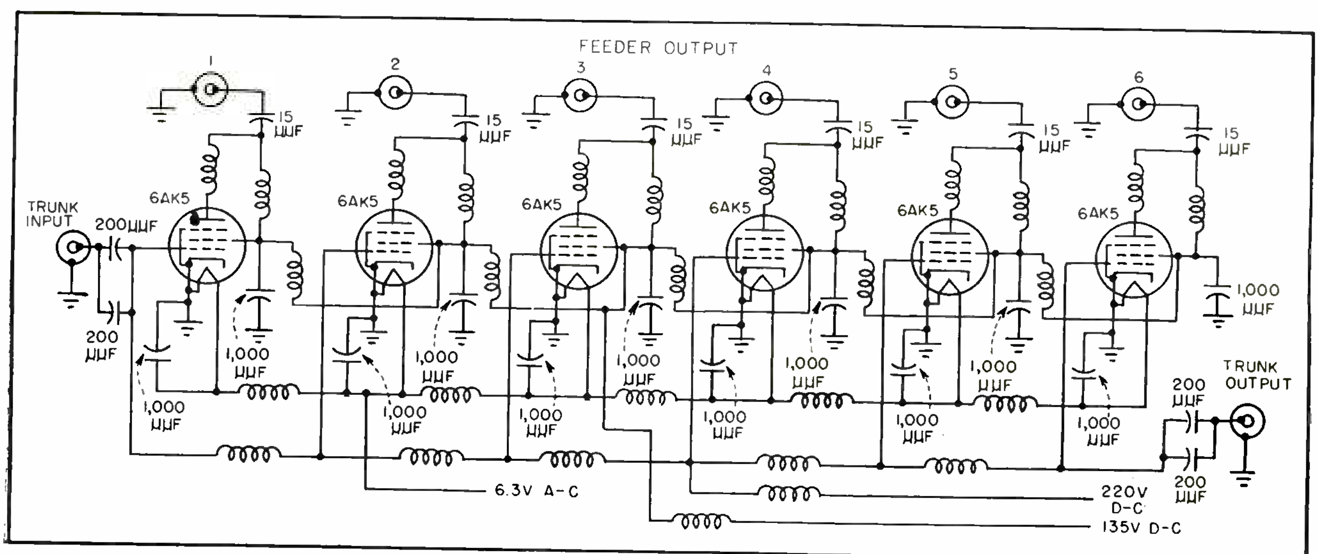

FIG. 10—Distribution unit uses six line-bridging, plate-loaded pentodes to feed six subtrunks or feeders from trunk line

A mixing circuit particularly useful when amplifiers are inserted in trunk lines is shown in Fig. 11A. A single output is provided without loss of power in a resistor terminating an unused outlet. At each channel-amplifier output, the signal looks, in the undesired direction, through a half-wave resonant line, at the high impedance presented by a series antiresonant circuit. This circuit is the output of a different channel's tuned amplifier.

Nonpowered Splitting

Figure 11B shows a versatile distribution system using elevator coils. The coils, similar to those sometimes used at the subscriber's set to match the set's 300-ohm input-impedance to that of the 75-ohm line, effectively present a 300-ohm impedance at one end and 75-ohms at the other. The trunk is terminated in the parallel combination of the 150-ohm resistor and two 300-ohm elevator coil input impedances. Each of the four output lines is correctly matched.

This type of distribution system is used to combine antenna outputs, split the signal at amplifier inputs, combine the signal at amplifier outputs, and divide the signal between various subtrunks and feeders. The basic unit is used with similar units to provide 8, 12 and 16-outlet distribution boxes.

The directional coupler shown in Fig. 11C also consists of a number of transmission-line matching transformers whose inputs are paralleled and whose outputs feed individual loads. Directional coupling results from connection of a resistor from each output terminal to each of the others. A spurious signal fed back through one outlet passes simultaneously through one resistor and two quarter-wave lines before reaching another outlet. Due to the phase shift in the lines, current entering the second outlet through the cables exactly cancels that fed through the resistor. The cables preceding the directional coupler are stagger-tuned for broad banding.

Tap Offs

Subscriber tap offs represent a big cost variable in community tv system design. A few cents saved or lost on every tap off quickly mounts up. Although it is important to eliminate standing waves on trunks, subtrunks and feeders through proper impedance match and correct termination, the impedance of the lead-in is not generally matched to that of the subscriber's set. For further economy, RG-59/U is used for lead-ins.

The lead-in is isolated from the feeder line either by a series resistor or series capacitor. To equalize the signal furnished subscribers, each isolating resistor decreases in value as the end of the feeder is approached. Values from 3,900 to 120 ohms are often used. In capacitor isolation systems, the isolating capacitor's value increases from 3.3 to five micromicrofarads.

In the 54 to 88-mc region, transmission line loss in RG-11/U runs between 1.5 and 3 db per 100 feet. For RG-59/U losses run between 3 and 6 db per 100 feet. Loss in the lead-in isolating impedance runs about 15 db while mismatch at the subscriber's set results in a 3-db loss. Systems are usually planned to put a minimum signal of 200 millivolts into the subscriber's set.

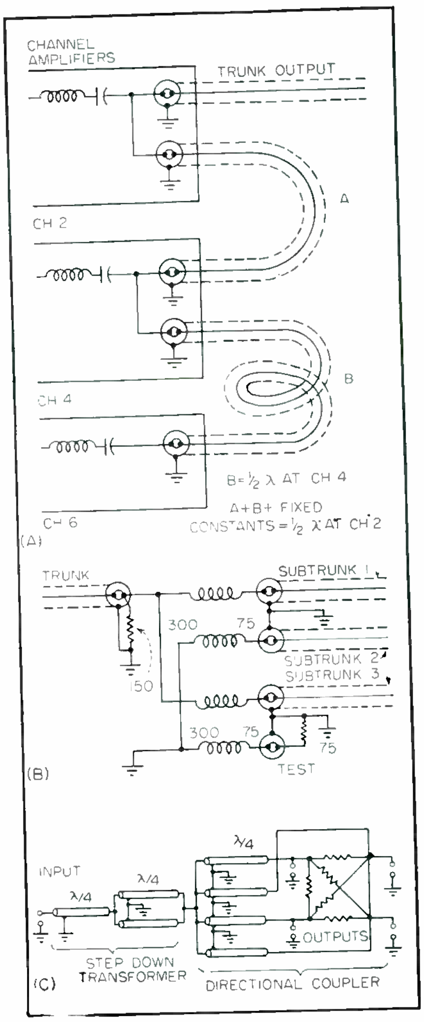

FIG. 11—Community tv systems use several ingenious signal-splitting devices

Economics

A prospective community master tv antenna operator should consider possible early obsolescence of his proposed system as the FCC television station allocation plan is implemented. He must then balance expected revenue against capital outlay. Basic installation cost is roughly $3,000 per mile plus the apportioned cost of connecting each subscriber. This cost runs about $35 each for the first 500 subscribers, $20 each for the next 500 and $15 each thereafter.

Subscriber's installation charge is generally $135, with a monthly service charge of $3.75. This cost is borne gracefully in fringe areas where televiewers frequently pay upwards to $250 for the tower, antenna, rotor and booster required for television DX-ing plus recurrent repair costs arising from windstorm and ice damage.

Coaxial distribution cable is commonly clamped or served to steel messenger cable and strung on utility poles. Quarter-inch cable is used to carry RG-11/U and ⅛-in. cable is used with RG-59/U. Yearly pole rent is about two dollars per pole. A five-dollar monthly meter rental is charged wherever power is drawn from the lines. Power companies, forseeing increased power sales to televiewers, have been notably cooperative in providing right of way. Customarily, power companies grant right of way on a first-come first-served basis but require 40-in. separation between different lines on a single pole. The telephone company usually grants permission for the use of its poles to only one other utility.

Presently, community television is not regulated by the FCC although its Common Carrier Bureau is following its development with apparent interest.

Reference

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Radioactive Thickness Gage

Thickness gage as installed in a paper mill. Paper passes through space between large chamber shown on top and smaller chamber partially visible beneath

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RADIOACTIVE ISOTOPES emit beta and gamma radiation continuously. These rays are measured by a new detector, to gage sheet thickness in the production of paper.

A source of radiation is placed on one side of a sheet material, and a detector is on the opposite side of the sheet. Some of the rays emitted by the isotope are absorbed by the sheet. The amount of absorption is used to measure sheet thickness accurately.

The device consists of a measuring head and a control console. The head is made up of an ionization chamber and a radioactive source mounted on either end of a U-shaped tube with a gap of approximately two inches through which the sheet passes. On one arm of the tube is a sealed box containing a three-stage d-c amplifier using 100-percent negative feedback, a second ionization chamber and sources used for balancing.

Balancing the two chambers is accomplished as follows: The center conductors of the two chambers are connected together and taken to the input grid of the amplifier. Outer conductors are taken to +150v and −150v d-c so that ionization current from one chamber can be balanced out by an equal and opposite current from the second chamber. Current from the detector chamber depends on the weight of the sheet passing through the gap. The balancing current is varied by increasing or decreasing the air gap between the balance chamber and its source.

The second source is mounted on a vernier mechanism with a calibrated dial so that for any weight of sheet passing through the gap, the balance point is indicated by the dial setting. This type of balanced input circuit has two advantages. First, source decay is compensated for automatically as both sources decay at the same rate. Second, since there is zero current flowing in the input resistor normally, changes of value due to temperature variations will cause no drift in the instrument.

Amplifier Circuit

The d-c amplifier, shown in Fig. 1, consists of a 5803 triode feeding into two stages of amplification usinging 5693 pentodes. By using one-percent tolerances for the resistors, it has been found possible to set up the amplifier by adjusting a tapped resistor in the filament lead of the 5803.

Both the input grid and output plate are at ground potential. The feed-back loop is made by returning the input resistor directly to the output plate. Error signals are indicated by a 500-0-500 microammeter connected as a voltmeter between the output plate and ground. Power required by the amplifier is supplied from the console unit.

In the control console are located the power supplies, sensitivity controls, safety relay and the recorder-controller. The d-c supply is a full-wave 300-v unit regulated by two VR-150 tubes with the common connection grounded. Underrated selenium rectifiers are used to provide long trouble-free life.

The sensitivity control consists of a selector switch and series resistors to give various voltmeter ranges. The safety relay shunts both the recorder and the meter in the head to prevent damage should an overload signal be applied. The recorder is connected in series with the meter in the head and may be either a milliammeter or millivoltmeter type.

In this installation, a recorder-controller with zero-center scale is used. Microswitches, cam-operated

Controls Paper Weight

Paper-mill installation of thickness gage and associated recording and controlling equipment keeps paper weight constant within one percent. Device is applicable for measuring thickness of sheet material of any kind

by the pen drive motor, are set to operate on an error signal of approximately one percent of the paper weight being produced. The switches operate a reversing electric motor which moves the stock gate through a gear reducer. The motor is allowed to put on or take off an amount of stock to produce a change of one percent in the paper weight. The motor then waits for the change to be recorded before making further corrections.

Wet-End Measurement

The usual method for automatic control of basis weight is to make measurements at the dry end of the paper machine. Wet-end measurements have the advantage of higher sensitivity because the sheet is about five times as heavy and there is a shorter time between the measuring point and correction point. This latter factor is particularly important on slow-speed machines and leads to closer control.

Since a heavy point at the dry end of the paper corresponds to a heavy point at the wet end, it also corresponds to a high moisture point. If the paper is one pound overweight at the dry end, for instance, the sheet will be approximately five pounds overweight at the wet end. Of these five pounds, four pounds is additional water.

Assuming that the true weight is running through close to the capacity of the drying machines, then the drying section cannot cope with the extra four pounds of water and the sheet comes through wet.

Figure 2A shows a trace made at the wet end of a paper machine. The pattern is abnormal in that it shows variations of 10 lb in a 120-lb sheet. Rapid fluctuations are caused by wet streaks moving in and out of the head. The slow oscillation may be caused by either variations in speed, water or suction. In this case it was caused by suction.

Figure 2B is a typical trace made with the gage on manual control and the thickness gage used as an indicator. It shows the rapid fluctuations caused by streaks passing through the chamber and the slow trends caused by stock changes. Both are of the same order of magnitude, about five lb on a 120-lb sheet.

Figure 2C shows the type of trace made with the gage automatically controlling the basis weight by varying the position of the stock gate. Rapid fluctuations still remain but the trends due to stock changes have disappeared and the weight is held to about two lb.

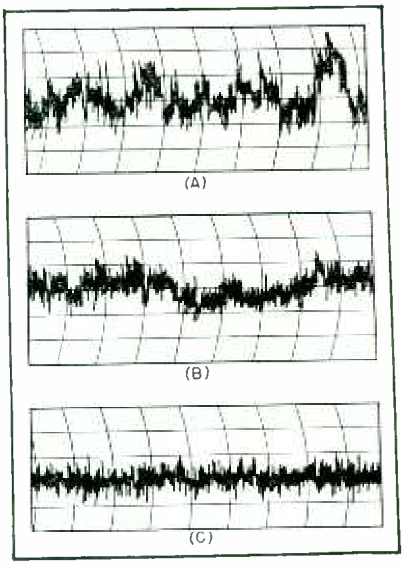


FIG. 2—Sample traces made at wet end of paper. Each subdivision on graphs corresponds to five pounds dry weight

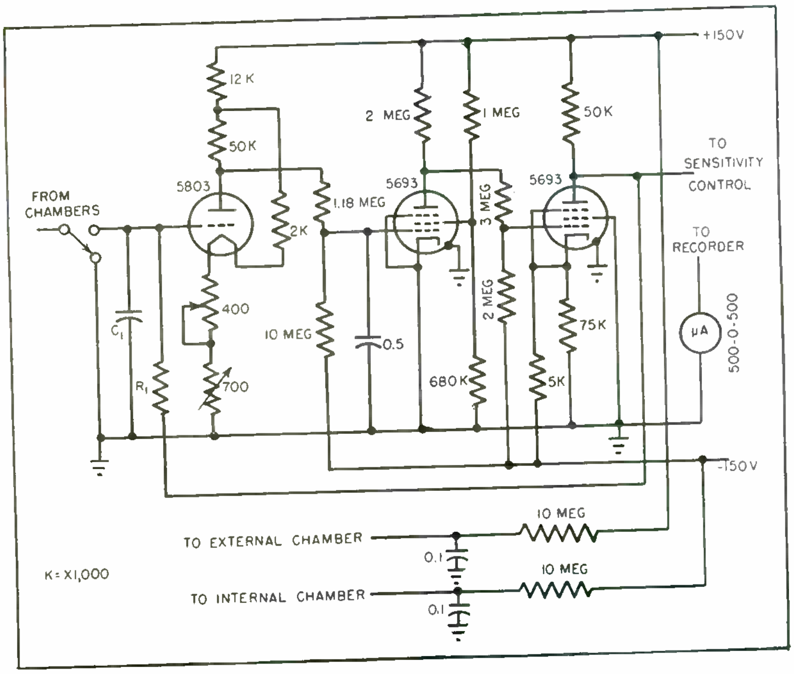
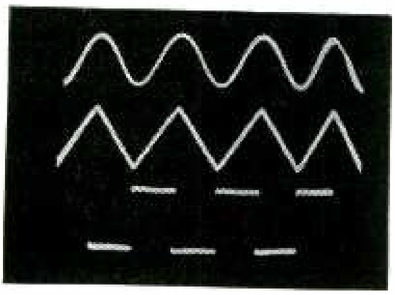


FIG. 1—Simplified schematic of the amplifier portion of the Betameter

A Low-Frequency



Square, triangular and sine-wave functions are available. Square-wave rise time is about 10 microseconds regardless of frequency. Sine-wave distortion is less than one percent

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STABILITY, low distortion and absence of amplitude transients when frequency is changed characterize the low-frequency function generator shown in the photographs. Square-wave, sine-wave and triangular-wave voltages are available in the frequency range from 0.01 to 1,000 cps as well as a trigger pulse synchronized with the output waveform. The square-wave rise time is about 10 microseconds regardless of frequency. Sine wave distortion is less than one percent.

Applications

The instrument is useful in the design and test of servomechanisms, in developing electronic instrumentation in the geophysical field, in biological studies and in vibration testing. It consists of a relaxation oscillator that produces both square and triangular waves of good quality and constant amplitude throughout the frequency range, and a shaper or synthesizer having a nonlinear characteristic independent of frequency and capable of distorting the triangular wave in such a way that a sine wave is closely approximated.

Inherently a constant amplitude device, the instrument eliminates the avc problem encountered in extending the range of an R-C oscillator to unusually low frequencies.[1,2]

Since the generator does not use a mechanically-driven potentiometer, frictional wear is not a problem and a wide frequency range may be obtained.

The general scheme of the function generator is indicated in Fig. 1. The bistable circuit includes a flip-flop capable of producing a square wave at *A* provided it is triggered at the proper time. This square wave is fed to the linear integrator, which converts it to a triangular wave at *B*.

The triangular wave is in turn fed back to the bistable circuit which, in addition to the flip-flop, contains two voltage comparators. The comparators trigger the flip-flop whenever the fed-back triangular wave becomes equal to either of the two switching reference levels shown in the waveform diagram (Fig. 1). The triangular waveform is the switching signal for the bistable circuit and its magnitude is limited to the voltage difference between the switching reference levels.

Frequency of oscillation is determined by the slope of the triangular wave and the difference in potential between reference levels. A type of relaxation oscillator results from loop coupling the bistable unit and linear integrator in this manner. This arrangement is well suited for the generation of low-frequency triangular waves of constant amplitude.

The triangular wave is converted to a sine wave by a method of synthesis or approximation. Referring again to Fig. 1, the sine wave is formed by the network between *B* and *D*. Resistance R_1 between *B* and *C* is fixed, but the resistance from *C* to *D* varies as a function of the instantaneous potential at *C*. This nonlinear characteristic is obtained by the biased diode and resistor network, which is so proportioned that at certain predetermined levels the diodes begin to conduct, changing the resistance from *C* to *D*. Thus the slope of the wave is changed in several discreet steps and a sine wave is approximated.

Bistable Circuit

Figure 2 is a schematic diagram of the bistable circuit. Tubes V_1 and V_2 are connected in a basic Eccles-Jordan trigger circuit. If negative pulses are applied to V_1 and V_2 grids in alternating se-

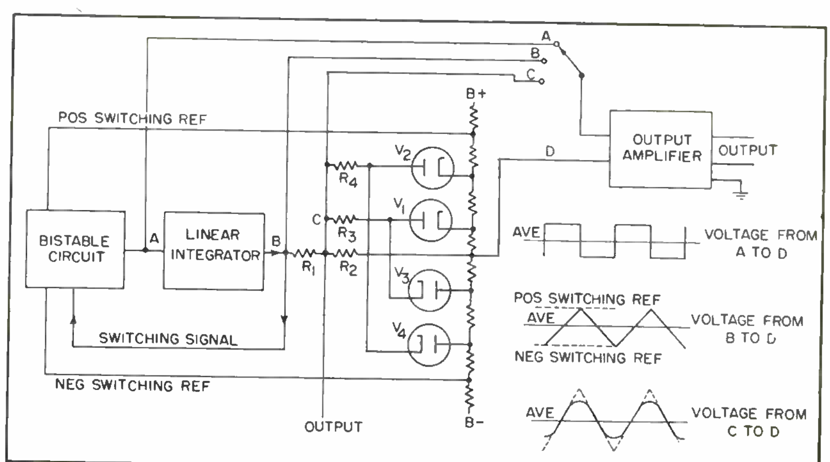


FIG. 1—Block diagram of low-frequency function generator. Waveforms at the right show function outputs. Diagram shows how these are derived from various parts of the generator

Function Generator

Relaxation oscillator produces square, triangular, and sine waves of good quality and constant amplitude in frequency range from 0.01 to 1,000 cps. Generator is useful in servomechanism design, geophysical and biological research, and vibration testing

quence, a square wave will be generated. The two multiar voltage comparators[3], each consisting of a comparator diode and blocking oscillator, are arranged to produce a fast trigger for the flip-flop. The flip-flop tubes, V_1 and V_2 are arranged to serve as the blocking oscillator for their respective comparators.

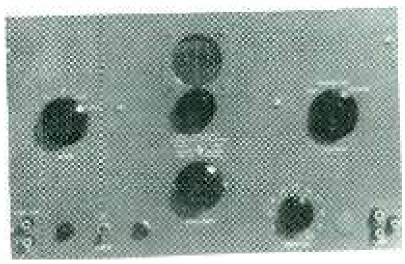
Multiar Circuit

The multiar circuit employs a regenerative loop to produce a pulse when the plate potential of the diode is made positive relative to its cathode. One multiar is composed of V_1, V_3 and T_1; the other of V_2, V_4 and T_2. Considering the first, regeneration from grid to cathode of V_1 can only occur if V_1 and V_3 are both conducting. In this event, the combination operates on the principle of a blocking oscillator.

Assuming V_1 conducting but V_3 cut off, no regeneration occurs because V_3 looks like an open circuit and there is no inductive coupling from grid to cathode of V_1. The plate and cathode of V_3 are respectively coupled to two external voltages, the cathode of V_3 to a positive reference voltage and the plate to the output of the integrator. The output voltage of the integrator is less than, but approaching positive reference voltage while V_1 is conducting.

When the integrator output voltage becomes equal to the reference voltage, V_3 conducts. This results in a low impedance through V_3 completing the regenerative grid-cathode loop of V_1. At this time the system V_1, V_3 and T_1 becomes an oscillator and, as the grid of V_1 goes negative, the necessary trigger is applied to the flip-flop composed of V_1 and V_2.

As soon as V_2 conducts, the multiar composed of V_1 and V_3 is inoperative because V_1 is cut off. The output of the integrator now falls toward the negative reference voltage. Since V_2 is conducting, the regenerative loop from its grid to cathode is completed when the integrator output falls to the level of the negative reference voltage and V_4 conducts. The multiar composed of V_2, V_4 and T_2 now oscillates, supplying a negative impulse to the grid of V_2. The flip-flop then returns to the stable state in which V_1 conducts.



Low-frequency function generator provides single-ended pulse output and optional single or double-ended function output

Frequency Control

Since the slope of the triangular output of the integrator is directly related to its square-wave input, frequency may be varied by controlling the magnitude of the square-wave input using R_4. For good stability, however, the magnitude of the square wave applied to the potentiometer must be controlled accurately. Tubes V_5 to V_8 provide a stiff push-pull clamp for the flip-flop output. Resistor R_3 is adjusted so that full variation of R_4 gives the proper range of integrator input to cover the frequency ratio desired for one band.

The voltage across R_4 is the difference between the switching references. By selecting the switching references from this point a direct relationship between the magnitude of triangle excursion and the magnitude of the clamped square wave is obtained. This results in good frequency stability in spite of possible variations in B+ or drop across V_5 and V_6. The R-C filters in the positive and negative reference lines keep the multiar pulses out of the reference voltage-divider strip and the resistors in the diode plate circuits prevent the multiar oscillation from being shunted to B−.

Miller Integrator

A Miller or amplified-time-constant integrator[4] converts the square wave to a triangular wave of the proper slope, magnitude and linearity over the desired frequency range. An equivalent circuit for the Miller integrator is shown in Fig. 3*A*. If a capacitor, C_1, is connected from the input grid of an amplifier of gain G to its output, there is an apparent capacitance, $(G+1)C_1$ from input to ground. Thus the necessary long time constant for low-frequency integration becomes the term $RC(G+1)$ and if the amplifier gain is high, the RC product can be small. The voltage, E_2, in the figure can be made as linear as desired by making G large without using excessive values of R and C. Since E_2 is also the input to the amplifier that furnishes the amplified time constant, it is reproduced at the output as $-GE_2$. The minus sign indicates a 180-deg phase shift.

The direct-coupled amplifier shown in Fig. 3*B* is used to provide high gain at the lowest frequency. An amplifier of this type exhibits high gain to the difference in potential between the two input grids. It has negligible gain to potential variations common to both grids and to other common mode variations such as B+ and filament voltage drift. The left-hand grid of V_1 has a steady d-c bias and the waveform is applied only to the right-hand grid. Capacitor C_1 is connected from this grid to the plate of the second tube that has 180-deg phase shift. Left grid bias is variable over a limited range to adjust the average level of the integrated output to its proper value with respect to the positive and negative switching reference levels.

The cathode follower prevents loading of the integrating amplifier. The actual gain expression for the Miller integrator[4] determines the product $RC(G+1)$ for any desired degree of linearity of integration. In this case, five megohms and one microfarad require a gain of about 250 for good integration at the lowest operating frequency. The larger capacitors are of polystyrene to insure low leakage and low dielectric absorption. The parameter that controls frequency range is the term $RC(G+1)$. This is adjusted by reducing the C by factors of ten for successively higher ranges.

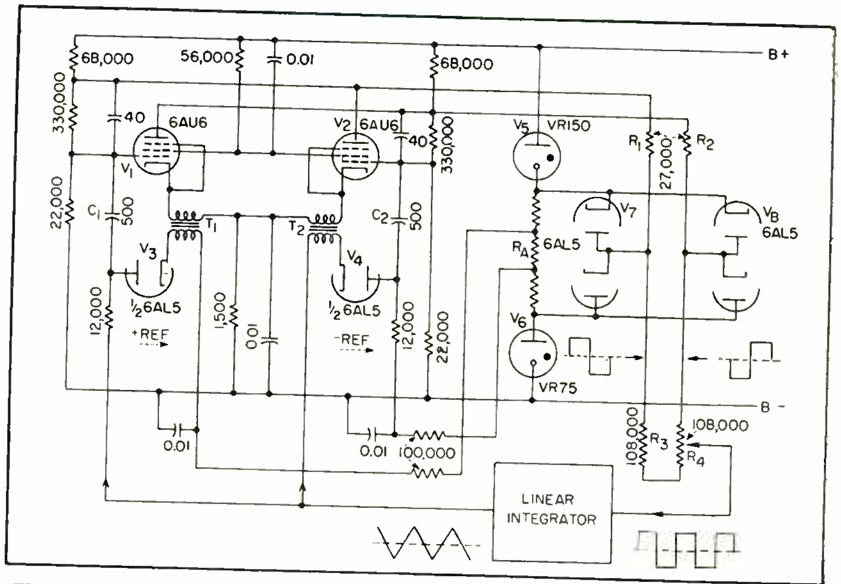


FIG. 2—Basic function generator is a bistable relaxation oscillator working on the Eccles-Jordan principle. Amplitude of square wave fed to integrator determines output frequency

Sine-Wave Shaper

Figure 1 illustrates how a sine wave is synthesized from the triangular wave. Point B is the output of the integrator cathode follower. Point D is at a potential midway between the positive and negative switching references and remains virtually constant at this potential due to the heavy bleeder from B+ to B−. The waveform from B to D is, therefore, triangular.

The voltage at C increases from the average level D toward the positive switching reference. At first, the slope at C is determined by the slope of the triangular wave at B and the divider, R_1 and R_2. When the level at C becomes equal to the potential of the cathode of V_1 there will be current flow through R_3 shunting R_2 and the slope at C will be reduced accordingly. When the potential at C reaches the level of the cathode of V_2 another shunt path is added and the slope at B is further reduced. By this method the sine function from 0 to 90 deg is approximated. When the triangle starts to fall, the diodes cease conducting in turn causing the voltage at B to complete the approximation of the positive half cycle. During the negative half cycle the diodes having their plates biased and

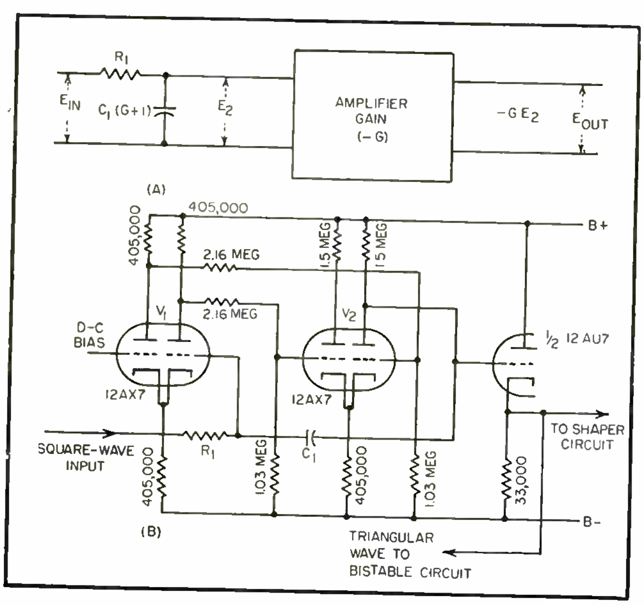


FIG. 3—Integrator that transforms square waves to triangles operates on Miller amplified-time-constant principle

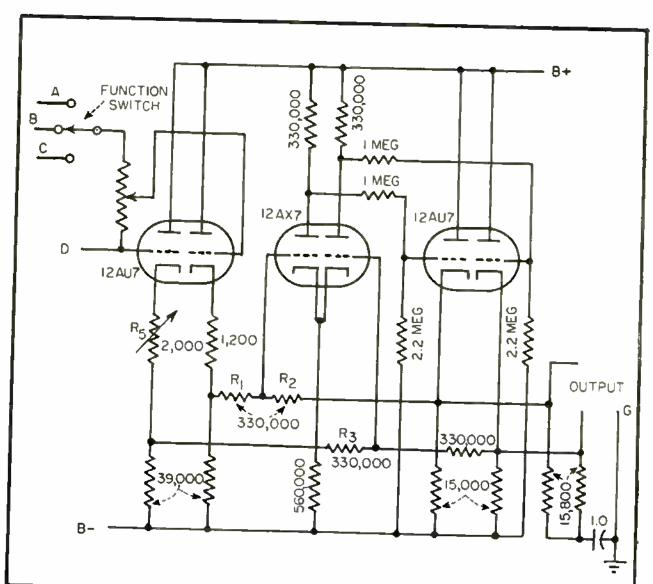
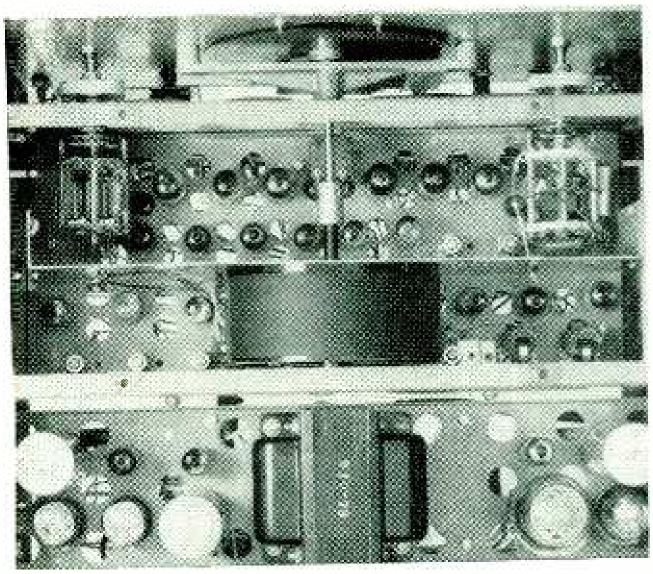
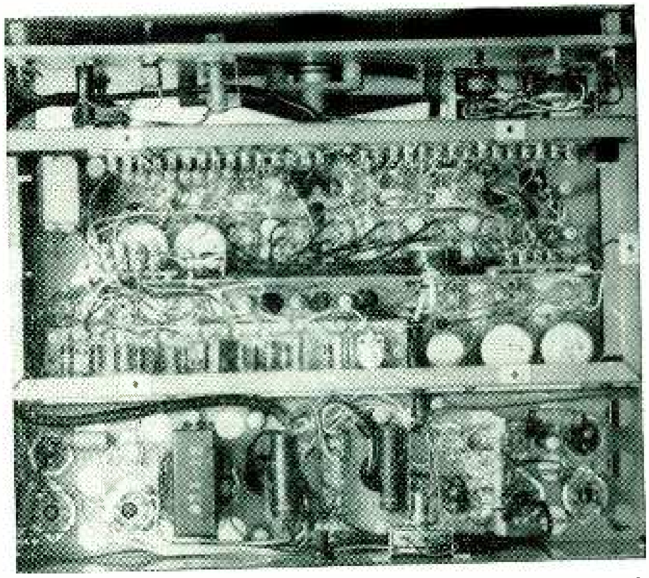


FIG. 4—Output amplifier is direct coupled for best frequency response. Single or double-ended output is available



Top view of instrument chassis with dust cover and internal shield removed. Internal chassis contains all circuits except power supply. Large wire-wound potentiometer, center, is main frequency control



Bottom view of function generator with bottom plate and internal shield removed. Internal chassis is insulated from ground and prevents current transients from returning to B— via output amplifier

cathodes connected to the signal side perform the same shaping function.

This method of sine synthesis is not a function of frequency and is independent of the period of the triangle wave. The rms distortion in the approximation falls off rapidly as the number of diodes is increased. Although four dual diodes give satisfactory performance, six are used to reduce the sharpness of successive breaks. With this degree of approximation, rms distortion may be reduced below one quarter of one percent.

Output Amplifier

The output amplifier is shown schematically in Fig. 4. The amplifier has an input system that responds to the difference between the selected waveform and point *D* (Fig. 1). The first stage is a pair of cathode followers. One reproduces the waveform at *D* and acts as a buffer for that point while the other operates on the selected function in the same manner.

Points *A* through *D* have the same d-c level so that adjustment of the volume control varies only signal magnitude. Resistor R_5 is adjusted for zero d-c component across the output terminals. This adjustment is made at the input to provide d-c stability of the same order of magnitude as signal stability. The second stage is the actual amplifier. The difference signal appearing across the amplitude control appears at both plates of this stage with nearly equal amplitudes and 180-deg phase difference.

The two out-of-phase signals drive the cathode followers comprising the last stage. The proper waveform, therefore, appears between the two cathode-follower outputs. With this arrangement each cathode follower handles about half of the desired output swing. Because all waveforms selected at the input are approximately equal in magnitude and nearly as large as desired, the gain of the second stage is traded by means of heavy feedback for increased stability, low distortion, and low internal impedance.

Feedback is double ended and is furnished by R_1 to R_4. The amplifier contributes negligible distortion to the waveform under rated conditions, 30 volts peak-to-peak into a 2,500-ohm load. Internal impedance is reduced by the feedback to less than 100 ohms, and the amplifier has a flat response extending above the oscillator frequency.

The chassis is left floating with respect to B— so that a choice of output connections can be had. For single-ended operation, the ground terminal is connected directly to one output terminal. For double-ended output, the two terminals are operated independently of ground and a difference of up to 400 volts d-c between output and ground is permissible. This system appears to be the equivalent of a balanced transformer output. As the photographs show, considerable shielding of transformers and portions of the circuit is necessary.

An output trigger pulse synchronized with the l-f oscillations is derived from the bistable circuit and made available as a separate single-ended output. The pulse occurs either on one crest of the sine or triangle wave or on one of the square-wave breaks. The actual sync-pulse relationship to output phase can be changed 180 deg by reversing connections at the signal output terminals.

The relaxation oscillator follows an original design by N. B. Schrock of Hewlett-Packard. The diode-shaping technique was suggested by O. J. M. Smith of the University of California.

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Stable Oscillator for

Multiple silver-plated leads in triode oscillator allow maximum external circuit for tuning. Conservative design provides operation at 930 mc, assuming new standard i-f at 40 mc. Circuit configurations suggested will hold drift to 500 kc for intercarrier receivers

EXPERIENCE obtained during the development of the type 6F4 acorn uhf oscillator triode was beneficial to the design of the type 6AF4 to be described. An identical internal mount structure was adopted for the 6AF4 because previous experience with the acorn tube showed it capable of oscillating at frequencies up to 1,500 megacycles. A major factor contributing to uhf oscillation is the small physical size of the parts by which a reduction in interelectrode capacitance is achieved. The cross-sectional view of the 6AF4 in Fig. 1 shows the comparative dimensions of the tube mount.

Because of the limited space within a flat cathode of this length, a special heater design was required to provide necessary power. The heater is a tightly wound coil formed in the shape of a hairpin. It operates at 6.3 volts and draws a current of 225 milliamperes.

The cathode has a rectangular cross-section and is made of seamless nickel tubing having a low silicon content that guards against the formation of a high-impedance interface layer between the base metal and the cathode coating during oscillator operation. The use of a low-silicon-content cathode also helps to control excessive reduction of the cathode coating and thus minimizes loading effects from barium evaporation.

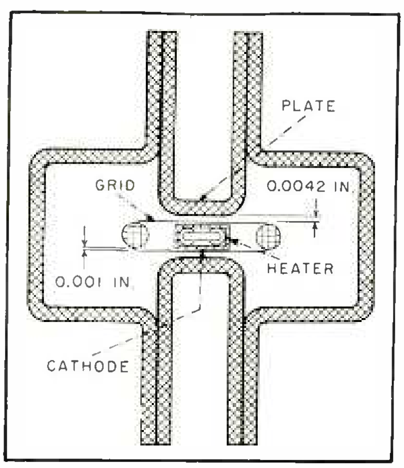

FIG. 1—Cross section of the 6AF4 tube show comparative dimensions of the mount

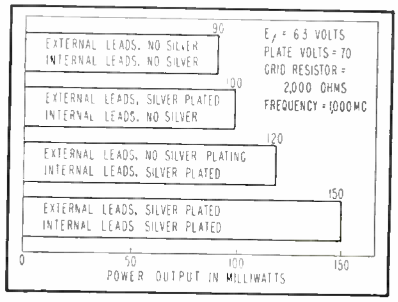

FIG. 2—Skin effect is minimized by silver plating external and internal leads

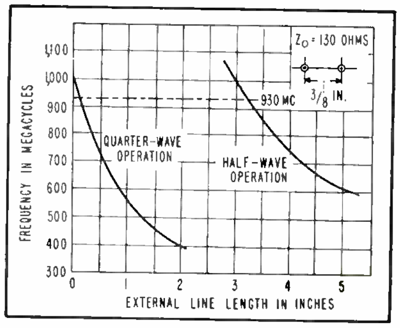

FIG. 3—Frequency versus transmission-line length for open and shorted lines

Cathode lead inductance is minimized through the use of a comparatively wide tab for connection to the stem lead. The operating temperature of the cathode is approximately 1,080 deg Kelvin. This relatively high operating temperature minimizes end-cooling effects and permits satisfactory tube operation when heater voltage drops owing to line-voltage fluctuations.

The grid is a flat oval of extremely fine gold-plated moly-tungsten alloy wire wound at a relatively fine pitch on chrome-copper side rods. The dimensions of both the grid and cathode are held to close tolerances to maintain spacing.

The plate is made of carbonized nickel and is approximately 1/4 inch long. Grid-to-plate spacing is in the order of 0.004 inch. To minimize grid-to-plate capacitance, the plate area presented to the grid is just sufficient to cover the active area of the cathode. Radiator fins are utilized to increase the dissipation capabilities of the plate.

Mica spacers are designed to minimize microphonics by holding the mount and all individual elements securely in place. Serrated edges of the mica maintain contact with the walls of the glass envelope and prevent movement of the mount. Relative motion of parts is minimized by controlling the size of mica holes to close tolerances to insure a tight fit.

Lead inductance and resistance are effectively reduced in the 6AF4 as a result of the short lead lengths and the double connections to grid and plate. Short lead lengths are made possible by the low mount height and the use of straight con-

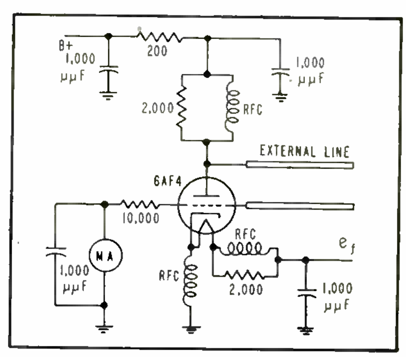

FIG. 4—Basic series circuit for obtaining oscillations from new triode tube

UHF TV Receivers

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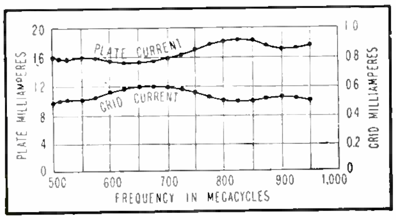


FIG. 5—Continuous tuning of oscillator with 100 volts on the plate

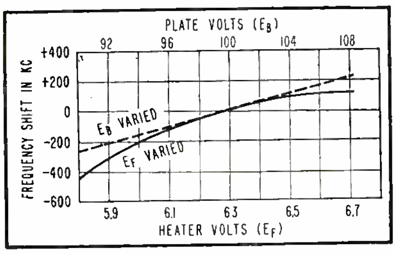


FIG. 6—Typical stability curves show variation from 930 mc with variable voltages

nections to the elements. Double connections to the grid and plate admittedly cause some increase in interelectrode capacitance. However, since the capacitance between the grid and plate electrodes comprises more than half the total grid-to-plate capacitance, the overall effect of a multiplicity of leads is to increase the resonant frequency of the tube by virtue of the decreased lead inductance.

Maximum Frequency

The position of mount height above the stem has a noticeable effect on the frequency of oscillation in a given circuit. In a half-wave circuit, an oscillator frequency of 990 megacycles was obtained using tubes made with the bottom mica mounted 7.5 millimeters above the stem. Experimental tubes made with a 6.5 millimeter mount height oscillated in the same circuit at 1,005 megacycles. The resonant frequency was increased to 1,025 megacycles when the mount assembly was placed on its side. In this position, the mount rests on top of the stem fillets so that lead inductance and resistance are at a minimum. However, no reduction was effected in microphonics or in frequency drift with this design. Moreover, sealing-in of the mount within the bulb becomes a critical process if oxidation of the grid and precathode breakdown are to be prevented. For these reasons, the horizontal construction was discarded in favor of the 6.5-millimeter structure.

Increased power output at uhf is obtained by silver-plating both internal and external leads to minimize losses from skin effect. Figure 2 shows the effect of silver-plating leads on the power output of an oscillator operating at approximately 1,000 megacycles per second. The operating conditions of the oscillator were, heater voltages 6.3 volts, plate voltage 70 volts, and grid resistor 2,000 ohms. Average power output ranged from 90 milliwatts from tubes having unplated leads to 150 milliwatts from tubes having silver-plated internal and external leads.

Basing Arrangement

Arrangement of the plate and grid leads permits either series or parallel operation. For the latter, the tube would act as the termination of a pair of parallel lines. Here, the tube and socket capacitances are lumped at one end of the line causing considerable foreshortening of the lines. In series operation some gain can be obtained in the length of the resonant lines by terminat-

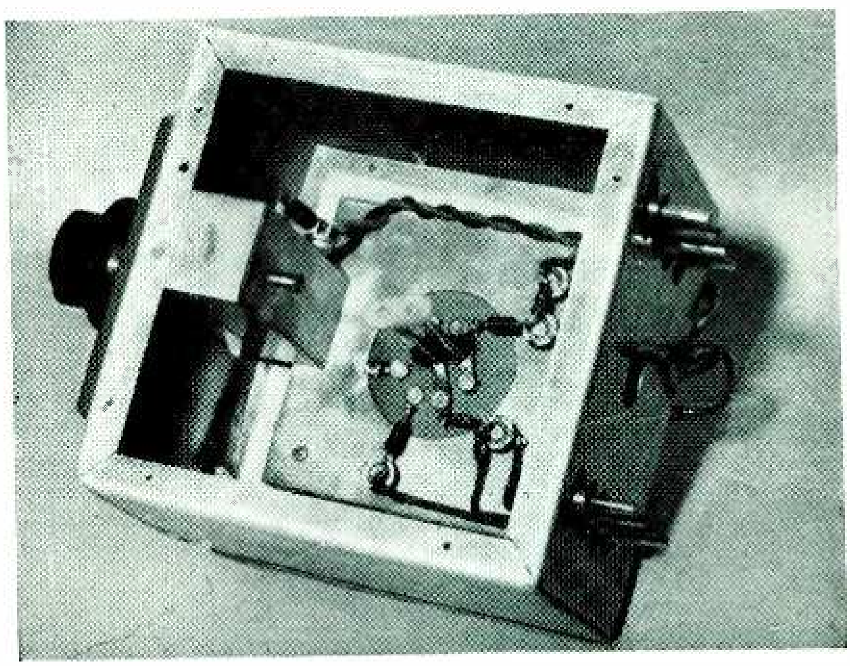


FIG. 7—Test oscillator used for measuring generated frequency and developed grid current at 1,000 mc. Tunable wavemeter is shown at left

ing each pair of grid and plate leads with a line. Thus, part of the grid-plate capacitance can be distributed between each pair of lines.

Circuit Considerations

In assembling the performance data for the 6AF4, it was conservatively assumed that the oscillator frequency will be above the signal frequency, and that the intermediate frequency will be 41.25 to 45.75 megacycles. At the upper limit of 890 megacycles for the signal, the required oscillator frequency is approximately 930 megacycles. Figure 3 shows a plot of frequency as a function of transmission-line length for both a quarter-wave shorted and half-wave open line.

It is difficult to generate this frequency using the tube with a closed external transmission line because of the short line lengths involved and the complication of a suitable tuning arrangement. However, the required frequency range can be satisfactorily obtained using half-wave operation. When half-wave operation is used and the oscillator is tuned to the high end of the range, the voltage node is at an inaccessible point inside the tube and the external length of open line is less than a quarter-wave length.

As the frequency of the oscillator is decreased by some tuning arrangement, the node moves outside the tube and assumes a position on the external transmission line. It is this half-wave type of circuit operation that was used to investigate the characteristics of the tube in the laboratory. This mode of tuning is sometimes considered equivalent to series tuning.

Typical Oscillator Circuit

The basic oscillator circuit for the type 6AF4 tube is shown in Fig. 4. Feedback to obtain a driving voltage between grid and cathode involves interelectrode capacitances within the tube, and, therefore, requires suitable external circuits including capacitance to ground of the plate and grid lines and suitable choice of heater and cathode chokes. It is recommended that the heater be kept at cathode potential to minimize the effects of variations in heater-to-cathode capacitance be-

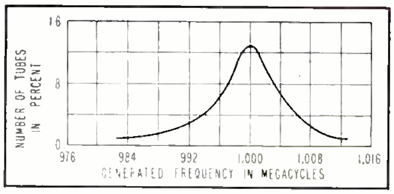


FIG. 8—Gaussian distribution curve shows design center of tube batch at 1,000 mc

tween tubes. The proper value of cathode choke will depend upon the capacitance to ground and the lead lengths of the particular circuit layout involved.

Practical values vary from 5 turns of No. 26 wire space wound on a half-watt resistor for a circuit with low capacitance and short leads, to a single flat copper strap where the distance from the cathode terminal to ground exceeds three-quarters of an inch. In any case, the cathode choke should be optimized for best operation, taking care that no frequency discontinuity results from the choice. Failure to oscillate well at a particular frequency may be caused by an improper value of cathode lead inductance and can be remedied by experimenting with the design of the choke and the value of its shunting resistor.

Extreme care must be taken to avoid all parasitic resonances, some of which are difficult to eliminate. Spurious resonances are usually associated with the cathode-lead inductance, external leads between grid or plate and cathode, or other leads and chokes in the oscillator enclosure. The enclosure itself can cause difficulty and may require special consideration. An erratic jump or discontinuity in the frequency can be attributed to parasitic oscillations, the complete elimination of which constitutes a major problem in the design of uhf tuners. The 6AF4 tube has no internal antiresonant regions within the required frequency range and will perform properly in a suitable circuit arrangement. Performance of the tube over the complete frequency range is shown in Fig. 5, which is a plot of oscillator grid and plate current as a function of frequency. The data were obtained in a continuously tunable oscillator developed in the laboratory.

Frequency Stability

Of all the requirements, that of stability is one of the most important. Slight frequency shifts can necessitate frequent retuning of the receiver. If intercarrier sound is employed in the receiver, it is believed that a maximum warm-up drift of 500 kilocycles is tolerable, which is 0.05 percent of the top required frequency of 930 megacycles. If intercarrier sound is not used, then the drift tolerance must be reduced to the order of 50 kilocycles, a ten-fold improvement in the drift performance. In addition, microphonics become a serious problem that would otherwise be inconsequential if an intercarrier sound system were used. For these reasons, separate channel i-f amplifiers are impractical and are not recommended for this application.

Those contemplating the design of uhf converters using the 6AF4 may also be faced with the 50-kilocycle drift tolerance; however, the required top frequency of operation will be only 800 megacycles and may be lower. This factor will allow the use of additional capacitance loading to decrease the effects of tube-capacitance variations.

Frequency deviations not resulting from temperature instability

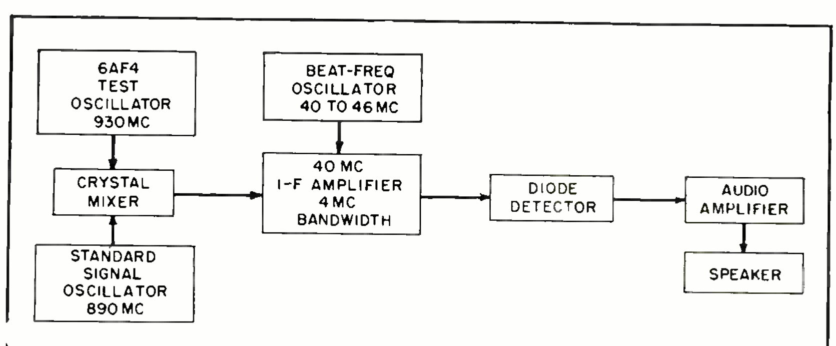


FIG. 9—Drift measurement on a test oscillator tube fixed tuned at 930 mc is checked by zero-beating with precision oscillator at 40-mc i-f

are often the result of changes both in the applied voltages or in the circuit elements. Anode voltage changes affect the transconductance of the tube and the electron transit time. The heater voltage may affect the space charge within the tube, depending upon cathode activation, and also affects the input capacitance. Figure 6 shows typical stability curves for plate and heater voltage variations of the 6AF4 operating near its resonant frequency.

An inspection of the curves shows that the frequency shift is nearly 25 kilocycles per volt for anode voltage, while the shift due to heater voltage is approximately 50 kilocycles for a change of 0.1 volt. Changes in line voltage, therefore, result in the effects becoming cumulative, variations of ten percent causing a frequency shift greater than the 500-kilocycle requirement for an intercarrier sound system. However, because line voltage changes of ten percent generally do not occur instantaneously, the situation is more tolerable than may be first assumed.

It is evident that if a receiver of high quality is to be built, regulation of both plate and heater voltage for the oscillator is required. Regulation of the anode supply voltage alone is very beneficial, although not a completely satisfactory solution.

Mounting Considerations

Stability of the external circuit elements can best be achieved by using construction materials which are relatively independent of temperature, vibration, and aging. It is recommended that mica-filled rubber or ceramic sockets be used. Materials with low temperature coefficients should be used for the resonant circuit construction. Unnecessary insulation material and mechanical supports should be omitted wherever possible without causing microphonism. It is desirable to shock-mount the complete tuner assembly so far as possible from the loudspeaker to minimize any microphonics.

The seating position of the tube in its socket can vary the generated frequency by as much as ten megacycles. It is therefore recommended that the tube be clamped securely in its socket by use of a conventional miniature shield and external clamp arrangement. Alignment of the oscillator should be made after the assembly is clamped. Such an assembly will also help suppress microphonics.

Product Control Test

Special test methods and equipment were developed to control the product, frequency drift of the tube and variation in generated frequency being of particular interest. Figure 7 shows a test oscillator used for measuring generated frequency and developed oscillator grid current. Operating frequency is centered at 1,000 megacycles using a half-wave, unloaded transmission line. Incorporated in the oscillator box is a tunable wavemeter.

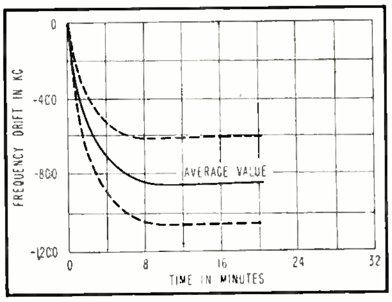


FIG. 10—Frequency drift curve shows that receivers can be built to compensate adequately for intercarrier sound system

Limits can be placed on the generated frequency test that will facilitate the control of the lead inductance and interelectrode capacitances. A distribution curve for generated frequency in the test oscillator is shown in Fig. 8. The designer will find that if a transmission line with a characteristic impedance of 100 ohms or greater is used, a trimmer capacitance with values up to 0.25 micromicrofarad placed at the end of the line will be sufficient to compensate for tube variations.

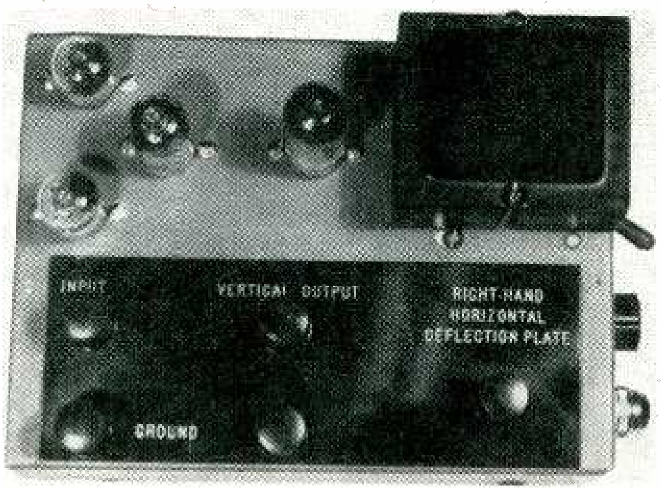
Measuring Frequency Drift

An accurate evaluation of the warm-up drift characteristics of the tubes required the design of a frequency-drift test set. To avoid any additional variables introduced by switching, the test oscillator is operated at a fixed frequency of 930 megacycles. The oscillator is electrically similar to that which would be used in the application, but is simpler mechanically. A block diagram of the drift set is shown in Fig. 9. The tube under test operates as the local oscillator of a tuner using a crystal mixer and a 40-megacycle intermediate frequency. A second 890-megacycle variable oscillator serves as the signal source for the receiver. The output of the crystal mixer is fed to a 40-megacycle i-f amplifier with a 4-megacycle bandwidth. A diode detector followed by an audio amplifier supplies an audio signal to the speaker.

An i-f beat-frequency oscillator covering a frequency range from 40 to 46 megacycles is used to determine the frequency variation of the oscillator under test. All the oscillators except that under test are enclosed in metal boxes, and all the equipment is supplied with well-regulated plate and heater voltages. Equipment, except the test oscillator, is made to reach thermal equilibrium by allowing it to operate for a minimum of one hour. After the equipment has stabilized, the tube under test is inserted in the oscillator and the voltages are applied immediately. Zero beat is obtained as quickly as possible; the initial reading is taken at 30 seconds.

Measurements are taken at regular intervals thereafter until frequency stabilization is reached. Usually, stability occurs within ten minutes from the time the first reading is taken. Typical drift curves for the 6AF4 operating at 930 megacycles are given in Fig. 10. The average total frequency drift of the tubes has been established at approximately 900 kilocycles in the negative direction. This value represents a drift of 0.1 percent of the operating frequency. Expected normal maximum and minimum variations in tubes are indicated by the dotted curves. If the drift characteristics of the tube can be accurately predicted, methods of compensation can be employed to achieve the desired requirements for an intercarrier sound receiver.

Switch Provides



Typical small unit for use with an oscilloscope

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PRESENCE and magnitude of a nonvarying component of a signal are often worthwhile factors to know. The following devices allow any oscilloscope to display this information without requiring any special connections or alterations of any kind.

The principle can best be introduced by considering a crude expedient for obtaining the type of data mentioned. Suppose one wants to know the approximate size of the d-c component of a signal under observation. If the input terminals of the oscilloscope are momentarily shorted, the pattern will give a vertical jump whose magnitude can be estimated and which is proportional to the signal's d-c component.

The following devices are special fast electronic switches or shorting bars that alternately (automatically on every other sweep) trace the signal under test and then short the input terminals to trace the zero-voltage axis. They are activated by the oscilloscope's own sweep circuit and thus require few components.

When in operation the oscilloscope will display a graph of voltage as a function of time as well as a straight line showing the axis from which this voltage is actually measured. One might ask how the capacitance-coupled amplifiers can even carry any information about a d-c component that may exist. This action occurs because the capacitors pass the changes in voltage as the signal is turned on and off. They pass a-c whose amplitude (besides the varying component) is proportional to the magnitude of the d-c component.

The system works equally well for net positive or negative voltages and, if no d-c is present, it will present the signal with a straight line through its average value. If a battery is connected to the input, one sees two straight lines separated by an amount proportional to the voltage. This is similar to a breaker or chopper amplifier and the signal being passed by the vertical amplifiers is a square wave automatically synchronized at the proper points.

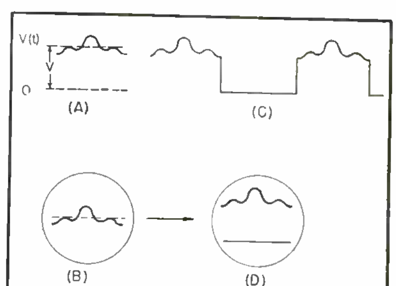


FIG. 1—A waveform and its appearance with an ordinary oscilloscope (A) and (B). The waveform if periodically shorted out (C) and its displayed appearance when the short is added or removed before each new sweep (D)

At *A* in Fig. 1 is shown a voltage varying with time and having a d-c component making its average value *V*. If applied to most oscilloscopes, the pattern would appear as at *B*, with the d-c removed and the average value of the varying component at the center. After passing through the electronic switch, the voltage is alternately turned on and off and so the actual voltage presented to the oscilloscope is that shown at *C*. It will be displayed as shown at *D*.

This combination pattern will automatically center itself in the most desirable possible manner so that the center of the total signal will be at the center of the screen and the test voltage and the zero axis will be at top and bottom, equally spaced from the center.

Bistable Multivibrator

A circuit for accomplishing this action is shown in Fig. 2. The sawtooth sweep voltage from the oscilloscope is differentiated to give a negative pulse at the end of each sweep. This pulse changes the state of a trigger pair before each new sweep. The trigger pair (bistable multivibrator) turns a diode network or switch on and then off on alternate sweeps.

If the control tubes are biased into conduction they short any signal to ground, while if they are biased off they leave the oscilloscope input terminals open-circuited. If the tubes are held in conduction by an external current, their incremental resistance goes to zero. It should be pointed out that one could use series switching by interchanging the series cathode resistor and the switch tubes. This requires a lower input impedance.

By the use of cross-connect capacitors as large as shown, the

D-C Reference Display

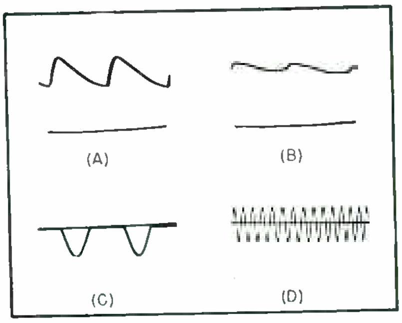
By use of fast-operating switching circuits, any oscilloscope may be used to display the magnitude of the nonvarying component of a signal. The zero-signal axis is always obvious no matter where the gain and centering adjustments are set

switching of the trigger pair is made independent of the input pulse size (sweep amplitude). The trigger pair and its power supply are floating freely with respect to ground. This allows direct coupling of the push-pull signal into the diodes. For short sweeps, the power supply can bias the diodes on and capacitance can couple the off signal to the diodes. In general it is easier to couple power into the isolated system through the power transformer at a 60-cycle rate.

Variation

Figure 3 shows another circuit that performs this same operation. It is made as different as possible from that of Fig. 2 to illustrate other possibilities. Here two triodes are placed back-to-back, one to short positive signals and the other negative ones. The triodes are normally maintained in the conducting state by connecting their grids, through a resistor, to *B*+. The trigger pair periodically biases these tubes off to remove the clamping action and allow a signal to pass. Once again, the trigger-pair voltage swing must be greater than the largest expected input signal if the switch tubes are to stay under control throughout the input cycle.

Though it is only required that the grids of the switch tubes be driven negative, there is loading by them near zero volts so a cathode follower is placed between the trigger pair and these tubes. If connected as shown, it can handle the full voltage swing. Rather than use cathode-resistor bias as before, the trigger pair has its cathode grounded and employs separate positive and negative power supplies. A simple selenium-rectifier full-wave doubler supplies voltage with a readily available midtap, as will a full-wave quadrupler if a larger voltage swing is desired. Line-voltage fluctuations have no effect (for voltages from say 100 to 300 volts) if corresponding components in the multivibrator are approximately matched.



Sketches of some typical patterns. A poorly filtered half-wave power supply (A), one filtered better (B), an unfiltered negative half-wave supply (C) and a sine wave with no steady component (D)

Application Changes

The circuits shown were to be used with an oscilloscope with a high input impedance. These circuits may be followed by a cathode follower so that there would be no capacitive loading nor attenuation to cause difficulty when the input resistor is made large. For studying fast waveforms, a smaller input resistor can be used with germanium diodes for the switch elements. In some cases these units may be preceded by an attenuator so that a switch tube is never driven out of the condition determined by the trigger pair to cause distortion.

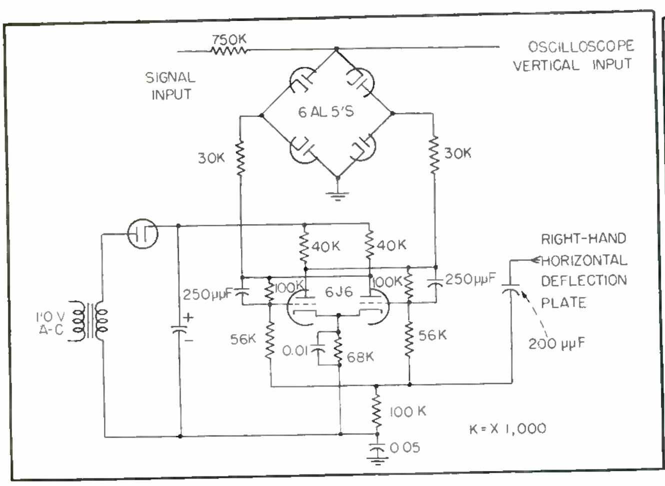


FIG. 2—Diode circuit controlled by a bistable multivibrator

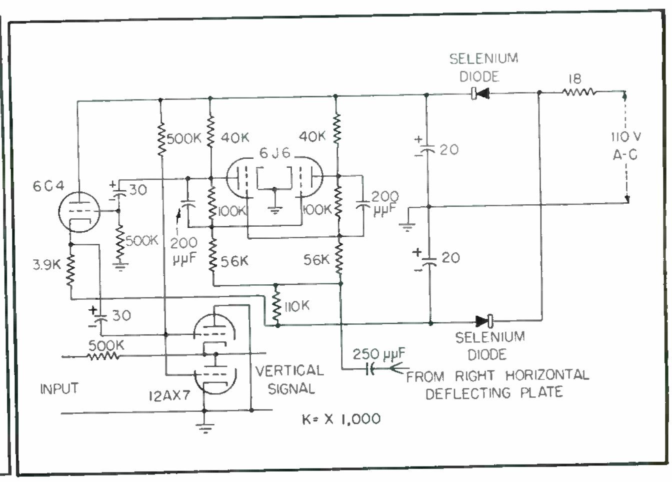


FIG. 3—Triode switching circuit with back-to-back connection

Double-Counter F-M and

Drift due to effects of aging, temperature, humidity and voltage are cancelled to maintain constant center frequency in a new circuit. It is useful in high-quality f-m receivers, for afc in f-m transmitters or as basis of wide-range frequency-deviation meter

NEED exists for a frequency-discriminating circuit having a high degree of stability (as to temperature, vibration and aging effects) and large bandwidth at medium intermediate frequencies, accompanied by good linearity. A further objective is automatic frequency control of wide operating and capture range and high degree of long-term stability. Basically, principles of a well-known pulse counter demodulator are applied in this circuit, which consists of two such counters connected in a special manner to be described. For this reason it is referred to as the double-counter demodulator circuit.

Circuit Description

The double counter consists of two counters with outputs connected in series preceded by limiters and frequency conversion circuits, as shown in Fig. 1. The i-f or signal frequency f_s is fed directly to the input of the two mixers. There the signal mixes with the respective crystal oscillators. The oscillators may also be tunable for special applications.

The two crystal-oscillator frequencies f_1 and f_2 are equally spaced on both sides of the input frequency f_s, f_1 being below and f_2 above it. The two resulting signals f_s-f_1 and f_2-f_s are fed into two separate squaring amplifiers. These amplifiers provide the necessary square wave, which after differentiation operates the counter circuits. The counter design is conventional with

Table I—Experimental Demodulators

Characteristics	Circuit A	Circuit B
Center frequency	4.0 mc	4.5 mc
Crystal frequencies		
f_1	3.92 mc	4.0 mc
f_2	4.08 mc	5.0 mc
Peak separation	0.16 mc	1.0 mc

one counter indicating the rate of positive pulses and the other that of the negative pulses. The individual counter unidirectional outputs are combined by connecting their integrating circuits to a common point.

The principle of operation is shown in Fig. 2. At the center frequency $f_s = (f_1 + f_2)/2$ the voltage outputs of the two counters cancel out and the d-c output voltage is zero. As the frequency is changed from the center frequency the absolute value of the d-c voltage increases, with either a negative or a positive polarity depending on the direction in which the frequency is changed until the frequency of one of the crystal oscillators is reached.

As the frequency is changed further the output voltage remains approximately constant, but only if the bandwidths of the individual counters with their associated amplifiers and limiters are adequate. This is true if the bandwidth is greater than the frequency separation of the two extremes of the observed resultant curve. The effects of smaller bandwidths are illustrated in Fig. 3.

Assuming that both counters are identical and that the components have the same characteristics, any drift due to aging, changes in temperature, humidity and/or voltage cancels out in the output and the center frequency does not shift.

For given counter-circuit elements the slope of the output versus frequency curve near the center frequency is independent of the peak separation. Peak separation is here defined as equal to the frequency difference of the two crystal oscillators. The term peak separation was chosen as a convenient analogy to the conventional type of f-m discriminator. Figure 2 illustrates this property.

If relatively high R_dC_d time constant of Fig. 1 is used to provide high slope near the center frequency, when only moderate distortionless deviations are required a wide peak separation will in such design obtain an afc action over a comparatively large range.

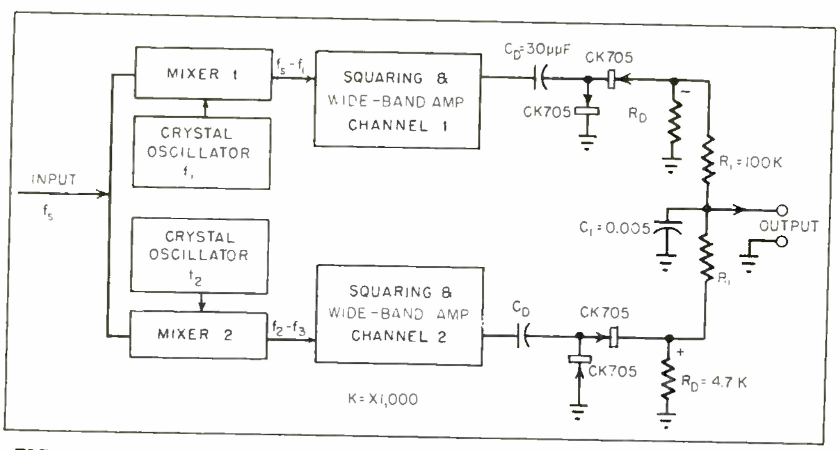


FIG. 1—Block diagram of the double-counter discriminator. Differentiating components are C_D and R_D; C_I and R_I are integrating components

AFC Discriminator

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Large peak separation is possible depending only on the bandpass of the squaring amplifiers and independent of the preceding i-f or signal frequency. The part of the curve between the peaks is linear, thus introducing little distortion when used for demodulating f-m signals.

One of the disadvantages of the single counter circuit, an image usually within 1 mc of the desired frequency, is not present in the double counter since this circuit, by itself, does not introduce any additional images. The resultant frequency versus output voltage function is single valued for the double counter and double valued for a conventional counter.

Further Advantages

A considerable advantage of this circuit over the single counter, when used for automatic frequency control, is that the d-c output voltage is zero at the center frequency, thus obviating provision of a separate source of a well-stabilized d-c reference voltage.

Since there are no tuned circuits in the double counter, no alignment or adjustment is required either at the factory or in the field. The circuit can be conveniently used for afc and f-m demodulation simultaneously.

This circuit combines the convenience of the discriminator-curve shape peculiar to the Foster-Seeley discriminator with the high-slope linearity and absence of tuned circuit elements encountered in conventional counter-type demodulators. The advantage of cancellation of component effects is unique in this circuit.

Two experimental double counter f-m demodulators were built with characteristics shown in Table I. The response curves are shown in Fig. 4. The circuits were identical in both cases, with only the crystal oscillator frequencies being different. The bandwidth of the squaring and amplifying circuits was approximately 1 mc. The following tests were made using the 4.5-mc double counter.

Voltage Stability

The B-plus voltage for the entire circuit (counters and amplifiers) was changed 20 percent. The center-frequency shift under these conditions was 4 kc or 890 parts per million with respect to the input frequency. Distortion at ±250-kc deviation was measured, using a 1,000-cycle modulating frequency. A Boonton 202B signal generator with a Univerter providing 4.5-mc carrier frequency was used.

The 4.5-mc signal was then amplified to about 2 volts in an SKL model 202P wide-band amplifier. No attempts were made at minimizing distortion and the circuit was tested in its original form. Second-harmonic distortion was 1 per cent and third 1.25 per cent at these deviations.

It is believed that considerable improvement is possible at the expense of some elaboration as tests with other counters indicate. The distortion in the signal generator-Univerter-wide band amplifier link alone could not be measured with available test equipment.

From these figures it is seen that in the experiment described the ratio of peak separation to undistorted frequency swing is of the order of 2. This value compares favorably with the Foster-Seeley discriminator. The maximum value of the ratio could not be accurately established because of limitations of available test equipment.

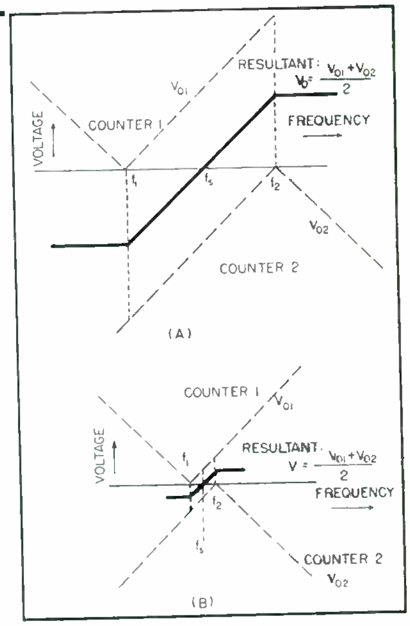

FIG. 2—Demodulator curves: (A) shows wide peak separation and (B) is for narrow peak separation

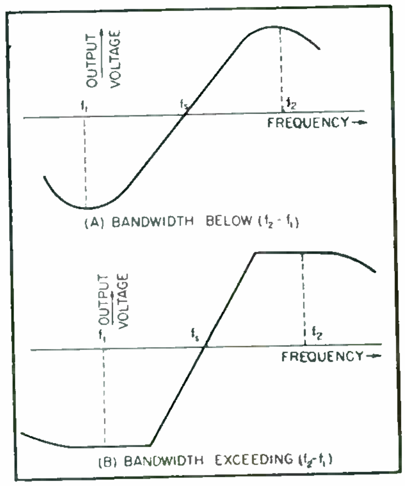

FIG. 3—Effect of amplifier bandwidth on the shape of resultant curve

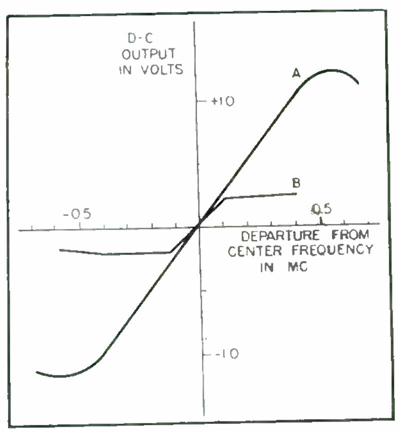

FIG. 4—Characteristics of two experimental models whose characteristics are given in Table I

How to Apply

Improperly-applied vibration isolators may amplify, rather than reduce, mechanical motion imparted to electronic equipment aboard aircraft, ships and other vehicles. Data provides guide for use of isolators to minimize vibration-caused malfunctions

INSTRUMENTS for aircraft, ships and other vehicles have multiplied rapidly in the last decade, and more precision electronic devices are constantly being used. Vibration is a potential source of trouble to all of these instruments.

Motion is the most noticeable effect of vibration. In the presence of mechanical vibration, reading and adjustment become difficult and unnecessarily tiring to the operator. Accompanying motion is acceleration force which, if great enough, can damage equipment or cause malfunction.

Vibration control techniques have been devised to provide dynamic protection. However, an incorrectly applied vibration isolator can amplify vibration and cause more damage than would ordinarily result from rigid mounting. It is the aim of this paper to guide the designer in selection of vibration isolators, presenting enough information to determine approximate preliminary design data with a minimum of calculations.

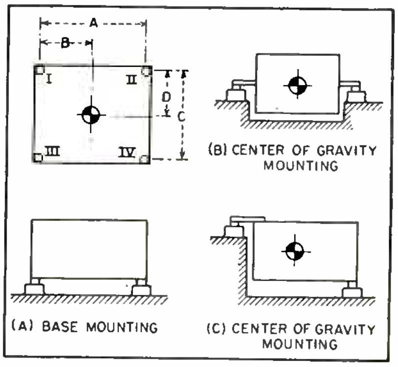

FIG. 1—Typical methods of placing vibration isolators

The equipment to be isolated is assumed to be a rectangular object mounted on four elastic elements as shown in Fig. 1.

Preliminary Data

Before considering application of vibration isolators to a specific installation, the following information should be considered:

(1) Exciting frequencies and excursions (or acceleration forces) of supporting structure at these frequencies.

(2) Critical frequencies of equipment and excursions (or acceleration forces) equipment can tolerate at these frequencies.

(3) Dimensions, weight and location (in all three planes) of center of gravity of equipment.

(4) Space allowed for placing isolators and for motion of equipment.

(5) Required stability. Will installation be subjected to transient shock loads? Can equipment tolerate angular motion?

(6) Environment—ambient temperatures, possible corrosive atmospheres (such as presence of sunlight, solvents or ozone).

(7) Stiffness of supporting structure.

(8) Requirements of applicable military specifications. Some com-

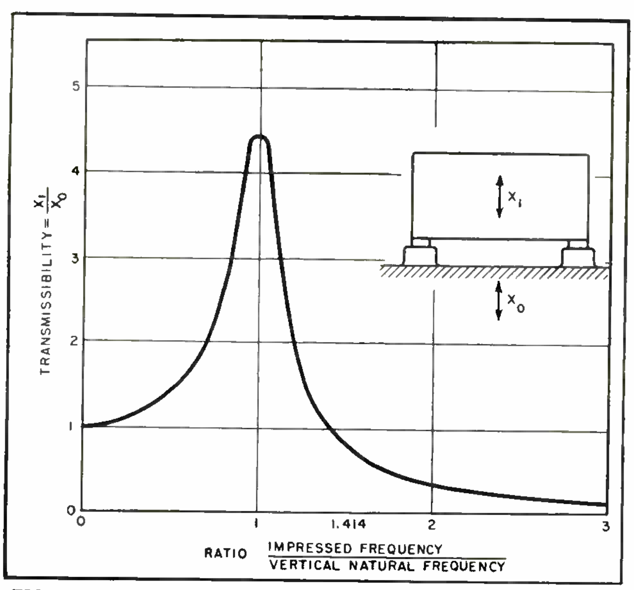

FIG. 2—Typical vibration test curve of a system excited in the vertical direction

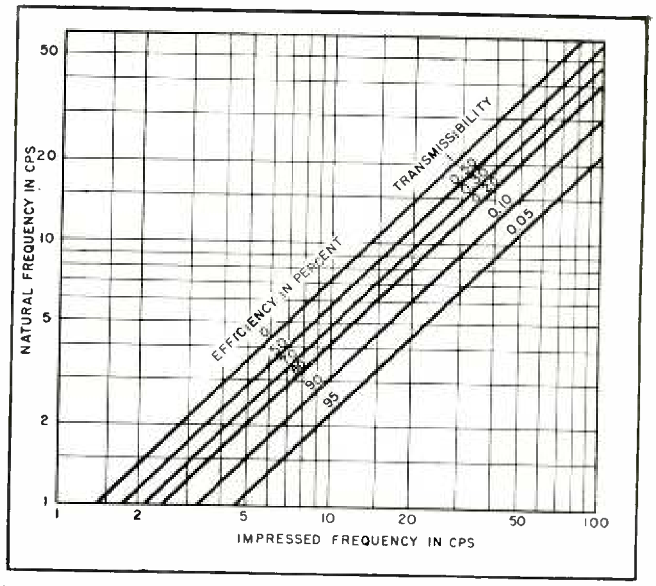

FIG. 3—Chart for determining transmissibility (or vibration efficiency) of an ideal, undamped, linear system

Vibration Isolators

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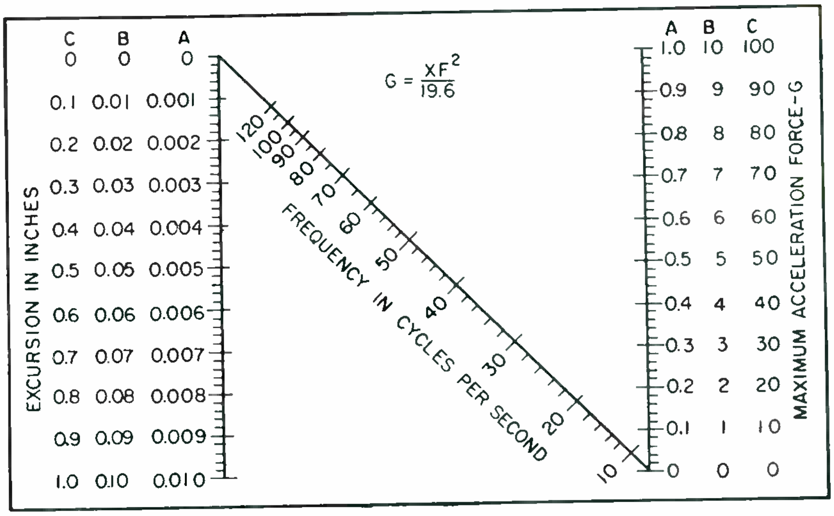

FIG. 4—Nomograph for maximum acceleration force of simple harmonic motion

mon specifications are: JAN-C-172A, AN-E-19, MIL-E-5272 and BuShips 40T9.

Most vibration isolator manufacturers will recommend a suitable installation if provided with this information.

Vertical Natural Frequency

Figure 2 is an actual test curve of a spring-supported equipment vibrated in the vertical direction through a frequency range, thus considering only the vertical natural frequency of the system. When the system is excited at its natural frequency, the system will be in resonance and exciting forces will be amplified rather than reduced. Therefore, it is very desirable to adjust the natural frequency so that it will be excited as little as possible in service and will not coincide with any critical frequencies of the equipment.

Theoretically, the natural frequency of the system must be less than 0.707 times the exciting frequency if the equipment is to be isolated. In practice it is customary to have the natural frequency a maximum of 40 percent of the exciting frequency or the equipment critical frequency. To prevent the supporting structure from disturbing the performance of the system, its natural frequency should be at least three times the natural frequency of the equipment.

Figure 3 shows a family of curves for transmissibility as a function of natural frequency and exciting frequency. These curves are used to determine a natural frequency for the system to obtain desired transmissibility at the exciting frequency. Efficiency is equal to (1 – *transmissibility*) times 100 percent.

Typical natural frequencies of systems in current use are listed below:

Application	*Natural Frequency*
Reciprocating engine aircraft	7 to 11 cps
Jet powered aircraft	12 to 20 cps
Ships, trains and motor vehicles	25 cps

Glossary of Vibration Terms

***Excursion*—Total motion along any given axis; often called double amplitude; measured in inches.**

***Amplitude*—One-half the excursion; measured in inches.**

***Critical Damping*—Damping required to allow a spring-supported mass to return to its equilibrium position without oscillating after having been displaced.**

***Transmissibility*—Excursion of the equipment divided by excursion of supporting structure; sometimes called magnification factor; symbol TR.**

***Vibration Efficiency*—(1 — *TR*) x 100 percent; sometimes called vibration absorption.**

***Natural Frequency*—Frequency of free vibration of a spring-supported mass when displaced from its equilibrium position and released; expressed in cycles per second or cycles per minute.**

***Critical Frequency* — Natural frequencies of component parts or frequencies that interfere with equipment operation.**

Figure 4 is a nomograph for acceleration force as a function of frequency and excursion. Using this chart it is possible to determine the forces that the equipment will experience by connecting the frequency and excursion scales with a straight edge and reading maximum acceleration force.

Knowing the desired vertical natural frequency, Fig. 5 may be used to determine the vertical characteristics of springs. If the equipment center of gravity is centered between four springs, each spring will carry ¼ the weight of the equipment, and four identical springs may be used.

If the center of gravity is not centered between the springs, the equations in Table 1 may be used to determine the load on each spring. It is also necessary to adjust the spring rate k (slope of the load-deflection curve of the spring) so that each spring will have the same static deflection and natural frequency when carrying its normal load. Figure 5 is still applicable.

Horizontal Natural Frequency

The horizontal natural frequency should also be less than 40 percent of the exciting frequency or equipment critical frequency.

Figures 3, 4, and 5 still apply,

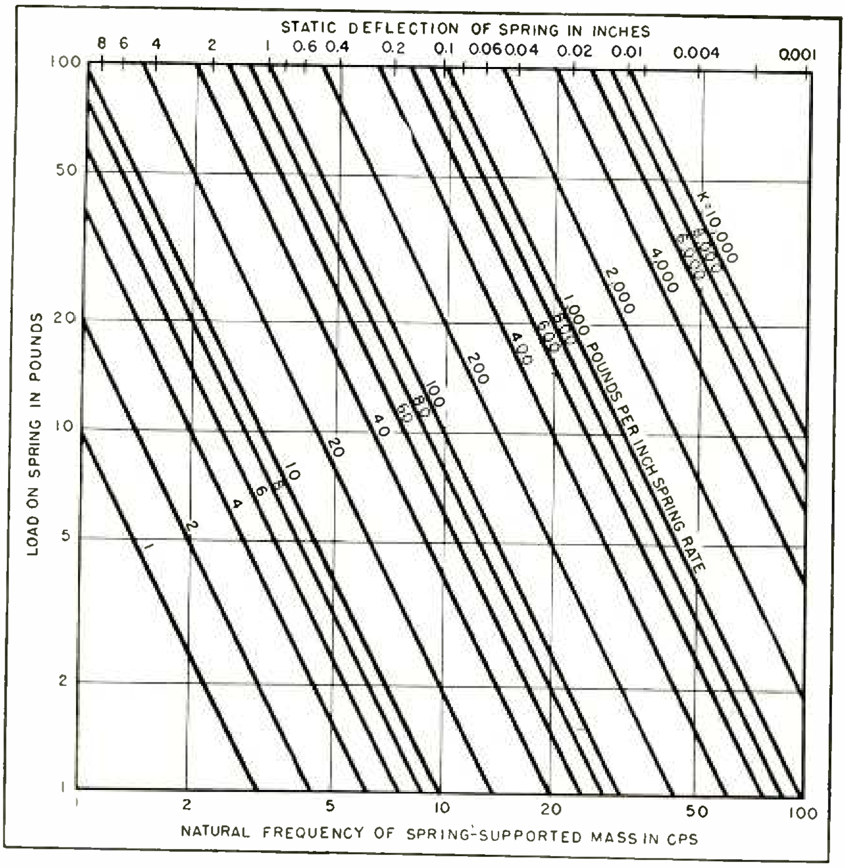

FIG. 5—Spring rate, static deflection and natural frequency for a linear-spring-supported mass

but Fig. 2 no longer applies since it refers only to vertical excitation. Figure 6, a test curve of the same system vibrated horizontally, is used instead.

Now two natural frequencies are involved. These include a lower mode wherein the equipment rocks about a point well below the springs and a higher mode wherein the equipment oscillates about a point in the vicinity of its center of gravity. Two other natural frequencies will occur if the equipment is rotated 90 degrees in the horizontal plane with respect to the exciting force.

Figure 7 can be used to determine the approximate frequencies of these modes as a function of spring rates and equipment dimensions. These curves assume that the equipment is solid, of uniform mass and that the springs are attached at the extreme corners.

Figure 2 would also have shown more than one natural frequency if each of the four springs had not had the same natural frequency so that the equipment translated with little rotation.

The equipment may be made merely to translate under horizontal excitation by fastening the springs in the plane of the center of gravity (figures 1B and 1C) instead of the bottom corners. In this case, Fig. 7 may be applied by letting H/W equal zero. The first mode will be one of translation and the second mode can be excited only by torsional excitation.

Damping

Damping is very advantageous while the system is in resonance because it reduces transmissibility. Some disadvantage appears at high frequencies where damping increases transmissibility. Some materials have the inherent characteristic of providing damping that varies with deflection, thus providing high damping at resonance and less damping at higher frequencies and lower excursions.

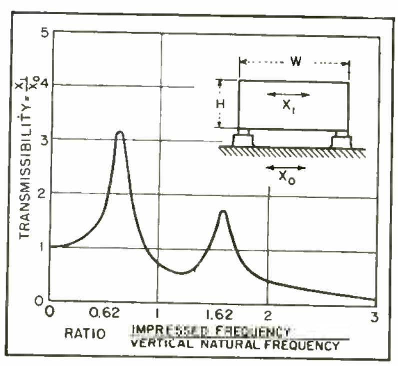

FIG. 6—Typical vibration test curve of a system excited in the horizontal direction

Figure 8 shows maximum transmissibility at resonance as a function of damping. Knowing the impressed excursion at the natural frequency, this curve may be applied to determine the excursion of the equipment. Or, the maximum allowable excursion may be determined by dividing the total clearance by the impressed excursion. Applying this figure to the curve will determine the necessary damping coefficient.

In general, it is desirable to have a minimum of 10 percent of critical damping unless the natural frequency of the system is never excited or is excited for only a few milliseconds. Damping greater than 25 percent of critical can be obtained only by using elaborate dashpots or friction devices.

Some commonly used resilient materials are listed in Table II. The figures are approximate and a manufacturer should be consulted for specific information.

Sample Problems

Problem 1—A gyroscope shaft has a natural frequency of 20 cycles per second. Tests of a rigidly mounted unit have shown that an excursion greater than 0.020 inch at this frequency will damage the bearings. The structure excursion is 0.060 inch. The unit is 3 inches in diameter, 5 inches long, weighs 4 pounds, and the center of gravity is centered. Angular motion must be held to a minimum and ½-inch clearance is available all around the installed unit.

Solution: Minimum transmissibility required at 20 cps = 0.020/0.060 = 0.33. Maximum allowable natural frequency (Fig. 3) = 10 cps. Desirable natural frequency = 8 cps. Maximum allowable transmissibility at resonance, allowing ⅛-inch thick snubbers for overload protection is

$$\frac{1/4 - 1/8}{1/2\ (0.060)} = 4.2$$

Table I—Equations for Support Loads with Uncentered Center of Gravity

Load on Spring I	$= W \frac{(A-B)}{A} \times \frac{(C-D)}{C}$ lb
Load on Spring II	$= W \frac{(B)}{A} \times \frac{(C-D)}{C}$ lb
Load on Spring III	$= W \frac{(A-B)}{A} \times \frac{D}{C}$ lb
Load on Spring IV	$= W \frac{(B)}{A} \times \frac{(D)}{C}$ lb

Notation shown in Fig. 1A.
W = total weight of equipment.

Minimum allowable damping (Fig. 8) = 12 percent of critical. Load per spring = 4 lb/4 = 1 pound. Spring rate (Fig. 5) = 6.5 pounds per inch. Static deflection of linear spring (Fig. 5) = 0.154 inch.

Because a minimum of rotation is desired, center of gravity mounting (Fig. 1A and 1B) should be used. The lateral spring rate should then equal the vertical spring rate (Fig. 7).

The gyro may be mounted on four springs, each having a spring rate of 6.5 pounds per inch, vertically and laterally, and a minimum of 12 percent of critical damping, placed equidistant from the center of gravity. The static deflection of the gyro will be 0.154 inch and the translational natural frequencies 8 cycles per second.

Problem 2—A radio is to be mounted in an airplane. It is 10 in. wide, 16 in. long, and 10 in. high, weighs 36 pounds and the center of gravity is centered. The lowest critical frequency of the radio is 30 cycles per second.

Vibration isolators are available with a vertical natural frequency of 9 cps under a 9-lb load. Their lateral spring rate is one half their vertical spring rate. Will these mounts provide isolation for the radio at its critical frequency?

Solution: Load per mount = 36 lb/4 = 9 lb. Vertical natural frequency = 9 cps. Longitudinal natural frequencies:

$$\frac{H}{W} = \frac{10}{16} = 0.63$$

1st mode = 0.65 × 9 = 6 cps (Fig. 7) 2nd mode = 1.65 × 9 = 15 cps. Lateral natural frequencies:

$$\frac{H}{W} = \frac{10}{10} = 1$$

1st mode = 0.55 × 9 = 5 cps (Fig. 7)
2nd mode = 1.55 × 9 = 14 cps
Highest natural frequency = 15 cps

The highest transmissibility at 30 cps, therefore, is 0.35. These mounts will probably provide adequate vibration isolation.

Spring Rates

Thus far, it has been assumed that springs were linear, having a load-deflection curve typified by the curve in Fig. 9. This has the disadvantage of having poor stability and overload characteristics —a transient shock can cause the spring to move to its bottom-most position after which the transmitted force increases very rapidly, subjecting the equipment to high accelerations.

Many vibration isolators are nonlinear, the typical load-deflection curve being like the top curve in Fig. 9. Both of these springs have the same initial slope and both have the same amount of travel, but notice the increased area under the nonlinear curve. This area is proportional to the amount of energy a spring can store, hence a much greater amount of energy is required to obtain solid contact in the nonlinear spring than is required in the linear spring.

The increasing stiffness of the nonlinear spring also serves to hold the natural frequency approximately constant if the static load is increased. Nonlinear vibration isolators are often designed to carry loads up to 100 percent greater than the lowest rated load with little change in natural frequency and only small additional deflection.

Figure 5 must be used with discretion when it is applied to a nonlinear spring. The spring rate k must be taken as the dynamic value and will no longer have a direct relationship with the static deflection as shown in Fig. 5. Instead the static deflection should be increased so that the spring rate (or slope of the load-deflection curve) will be the dynamic value when the normal load is placed upon the spring.

Two phenomena are caused by nonlinearity, particularly the abrupt nonlinearity introduced by snubber contact. These are jump and harmonics and are illustrated in Fig. 10.

Jump is a violent continuation of resonant amplitudes when the

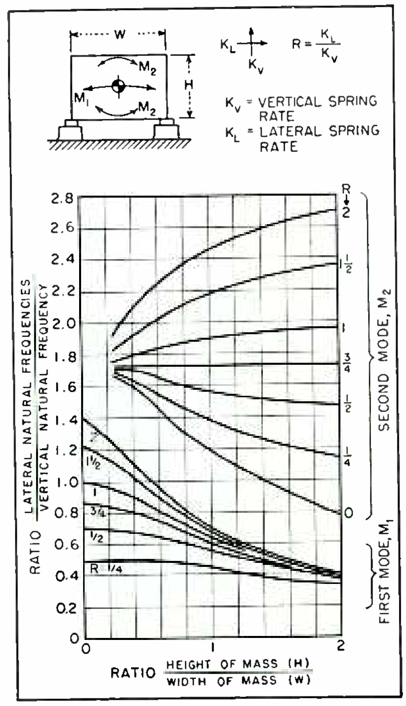

FIG. 7—Horizontal natural frequencies of a uniformly-distributed mass mounted upon linear, undamped springs acting at the edge of the mass

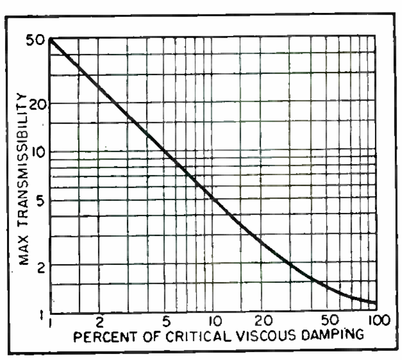

FIG. 8—Maximum transmissibility at resonance with a damped system

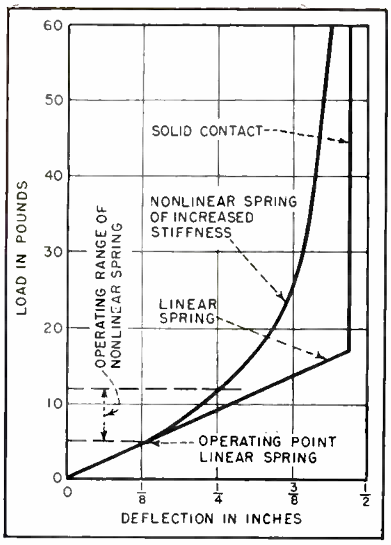

FIG. 9—Typical load-deflection curves

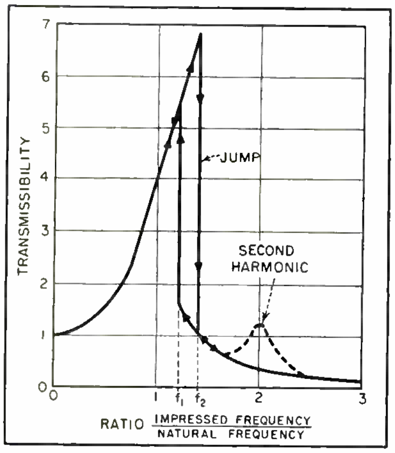

FIG. 10—Vibration phenomena that may exist in a nonlinear system

impressed frequency is increased through the natural frequency, ceasing abruptly at some high frequency f_2. Decreasing the impressed frequency from f_2 results in an abrupt increase in amplitude at an intermediate frequency f_1, whence the amplitudes are the same as with increasing frequency. Jump causes large acceleration forces and can be very damaging to equipment. It can be eliminated by allowing greater operating clearances, reducing the transmissibility at resonance or eliminating the abrupt change in spring rate.

Harmonics are a mild repetition of resonance, occurring at higher multiples of the natural frequency. The equipment moves at the natural frequency of the system. Transmissibility of the harmonic cannot exceed the transmissibility of resonance. Therefore, the harmonic cannot impose any greater acceleration forces upon the equipment than does the actual resonance. Harmonics are shown on a test curve as dotted resonance peaks at the frequency at which they occur.

Installing Isolators

When the correct vibration isolators have been selected, they must be properly installed to prevent malfunction.

Each isolator should be placed so that its center stud is concentric with the outer housing when the equipment is in place to utilize all of the operating clearance. If the installation is to be made in the field, correct spacing can be maintained by using isolators mounted on a single plate or in the form of an integral mounting base. The number of screws required for fastening the isolators is considerably reduced by this procedure.

Tubing and electrical leads must exert as little force and spring rate as possible. Extremely stiff leads and tubing will short out any vibration isolator designed for a lightweight equipment. If limp leads and tubing cannot be used, the stiffness of leads and tubing should be considered in the design of the isolators, and they should have a bend of large radius between equipment and supporting structure to reduce and control their stiffness.

If a belt drive is connected to the equipment, there is a force exerted that may impair the performance of the vibration isolators by forcing the equipment against the snubbers. This force may be opposed by an equal spring force acting in the opposite direction. The spring used should have a deflection of several inches to exert the required force; its low spring rate will then affect the vibration performance of the system as little as possible.

In general, it is not advisable to mount upon vibration isolators any object protruding from an aircraft skin. Slipstream buffeting will render the isolators ineffective and severe damage may result to the equipment.

Pressure-sealed blisters and domes in aircraft cannot generally be mounted upon vibration isolators. The difference between ambient pressure and air pressure inside the cabin at high altitudes will force the blister outward until the isolators are pressed firmly against their snubbers, rendering them ineffective.

Summary

A well designed vibration isolator installation should have the following features:

(1) Center of gravity of the instrument in the plane of the isolators and centered or as closely as possible.

(2) Isolators spread as far apart as possible and correctly spaced.

(3) Adequate clearance to prevent contact with adjacent structure.

(4) Natural frequency of the supporting structure at least three times the natural frequency of the system.

(5) Electrical leads and tubing as limp as possible and bent to a specified radius before being secured to the adjacent structure.

(6) Compliance with all applicable military specifications.

Table II—Commonly-Used Resilient Materials

Material	Damping	Thickness Required	Remarks
Steel springs	½ %	Function of design	Many types available
Rubber	2 to 5 %	1½″	Can be used in shear Many varieties available
Knitted Stainless Steel Wire	15 to 20 %	1″	Wide environmental tolerance
Felt		4″	Great thickness required for low natural frequency
Cork	6 %	4″	Same as felt

Carrier Amplifier Has Zero Drift

Aircraft flight testing with recording oscillographs is speeded up using an amplifier equipped to maintain zero level in carrier-bridge circuits. Automatic zeroing circuit can be switched in to compensate for slow drifts whenever dynamic response of phenomena measured exceeds 0.2 cps

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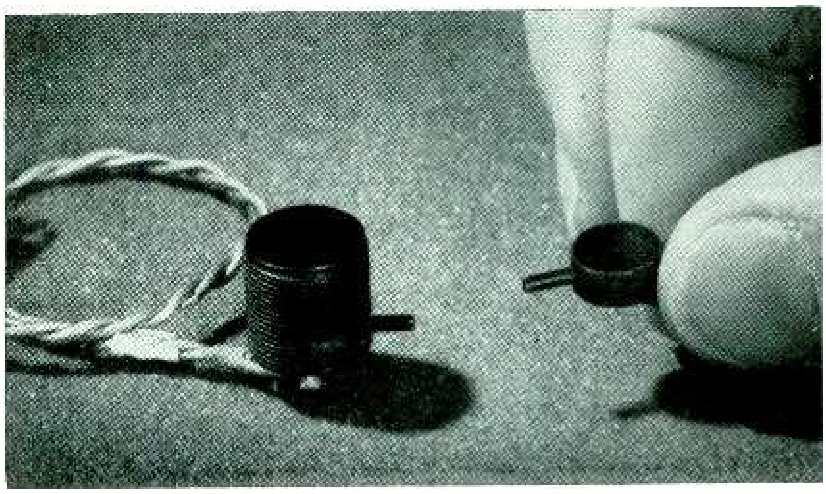
DRIFTING of oscillograph data traces is essentially eliminated by use of a new technique employed in a carrier amplifier designed for stress and strain and other parameters whose measurements are based on resistive strain-gage types of transducers.

In the past, one of the most exasperating problems has been the drift of these traces. During a long, elaborate and expensive test run, sections of some of the data have been completely lost when traces are driven off the edge of the recording paper. Although characteristics of the new equipment can be changed as desired, most applications are satisfactorily met with circuit constants chosen to permit dynamic response down to $\frac{1}{5}$ cps but which eliminate automatically from the recordings as drift any lower frequencies.

Applications

A characteristic problem in flight research is that instrumentation must be set up and aligned on the ground with no possibility of further in-flight adjustment. Drift of oscillograph record traces due to changes in static pressure, temperature and load at various altitudes or flight conditions produces off-scale drift and loss of important dynamic test data. Automatic zero-drift compensation allows multichannel transducer systems to be operated in flight for dynamic studies with the reference position of each data trace remaining unaffected by static disturbances at the bridge circuit.

The problem of static zero drift becomes especially acute in ultra-high-gain measurements with transducers. Temperature effects, which might only be second order or insignificant at normal gain, produce off-scale drift problems. Gain typical of the amplifier circuit is 30 microvolts input for 1-milliampere output into 40 ohms. Automatic drift compensation facilitates complete balancing and centering of the test data without extensive precau-



Flush-mounting transducers used for dynamic pressure measurements, particularly on aircraft

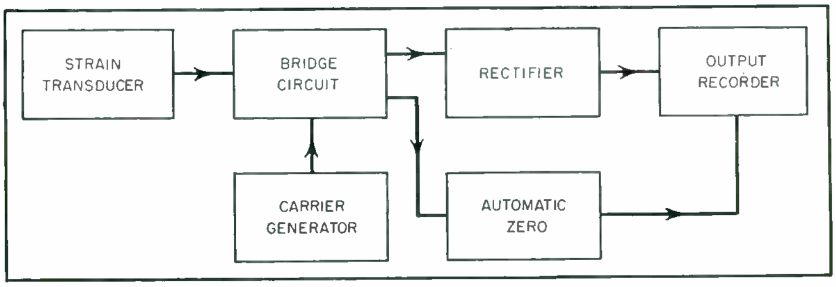


FIG. 1—Single channel of improved instrumentation carrier amplifier using zero-drift compensation

tions and set-up of the bridge circuit itself.

Tare Compensation

Resistance-gage bridge weighing systems often encounter the problem of tare change due to static changes on the structural support. Such tare changes may arise from leakage of weighed substance on the scale platform, bridge-temperature disturbances or hysteresis effects in response of the system. Automatic static drift compensation allows long unattended operation of dynamic weighing systems without the tare-change problem.

For dynamic stress analysis, strain gages are mounted to the test structure while at rest. Test conditions under operation subject the strain pickups to both static and dynamic loading. Automatic zero-drift compensation eliminates the problem of having to rebalance or adjust every bridge circuit to bring the dynamic information back on the record scale every time operation conditions are changed. A high sensitivity may be set for analysis of dynamic components of strain to the exclusion of static components.

Dynamic studies involving extensive multichannel transducer instrumentation in research laboratories are faciliated by the circuit feature since non-temperature-compensated transducers may be used, bridge balance checks and adjustments during test runs are eliminated, and economy in time of test personnel is achieved. It is often necessary that equipment be set up, balanced, and left unattended for several hours in the field, during which time isolated transients are to be recorded. Expense in setting up many of these transient tests dictates the utmost in reliability of equipment, and off-scale data drift causing a loss of the transient to be measured can be serious. Automatic compensation insures an on-scale recording of the transient after long-time unattended standing of the instrumentation.

General Arrangement

The block diagram, Fig. 1 shows the typical arrangement of a carrier channel with power supply arranged for connection to an array of resistive strain gage pressure transducers of a type illustrated. These transducers are designed particularly for application to aircraft surfaces in flight or wind-tunnel investigations of localized pressure variations. The transducer is a hollow cylinder with a taut diaphragm at one end and a strain gage mounted on the inner surface of the diaphragm.

Because of the small diameter, this type of cell conforms reasonably closely to airfoils and other curved structural surfaces. Loca-

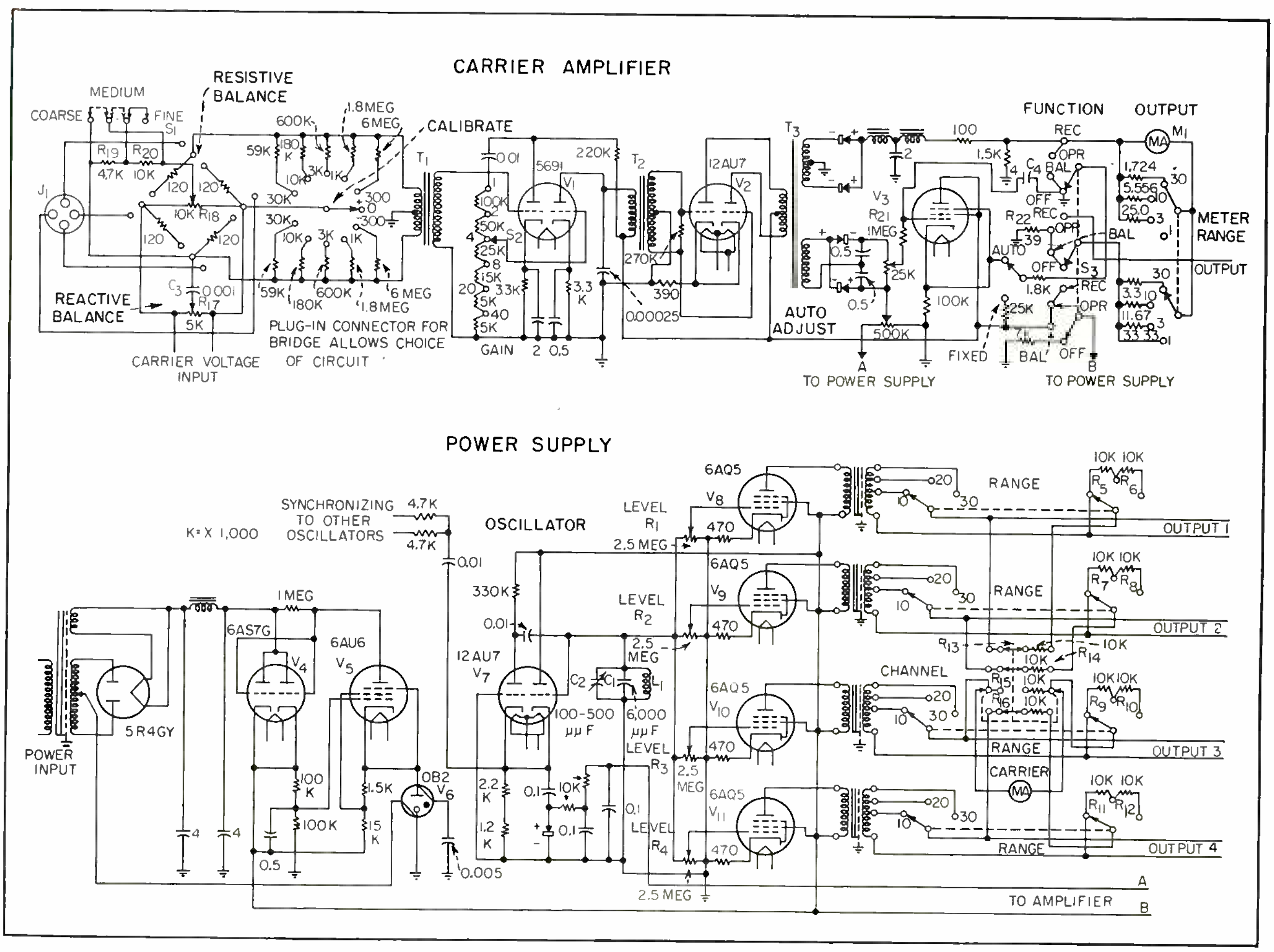


FIG. 2—Complete circuit diagram of typical power-supply and carrier oscillator suitable for four channels and one channel of carrier amplifier employing automatic zeroing through tube V_3

tion of the strain gage directly on the surface acted upon by the dynamic pressures produces a phase- and amplitude-true signal that is fed through the bridge circuit shown, to the carrier amplifier.

After the bridge circuit has been balanced for both resistive and reactive components, a reference voltage is applied to the output and the bridge off-balanced resistively. The equipment is then put into operation and measurements are recorded about this off-balance position which provides for sensing of positive and negative signals.

Power Supply Circuit

The complete circuit of the carrier amplifier is shown in Fig. 2. Stabilized plate and filament voltages for four amplifier channels are derived from the electronically regulated power supply stabilized by the circuit including V_4, V_5 and V_6. The filament transformer is a constant-voltage type. Changes in line voltage cause a corresponding change in plate voltage of V_5 whose cathode voltage and bias are kept constant by the action of voltage-reference tube V_6. Change in output voltage of the power supply is amplified by V_5 and applied to the grid of V_4, controlling the voltage drop through V_4 and counteracting the change in power-supply output.

The power-supply unit also contains the 2,500-cps carrier oscillator V_7, which is tuned by L_1, C_1 and C_2. This carrier voltage is applied through separate potentiometers R_1, R_2, R_3 and R_4 to amplifier tubes V_8, V_9, V_{10} and V_{11}—each of the four channels thus being independently controllable and containing an output transformer with taps to permit impedance matching to bridge circuits of 120, 300, and 1,000 ohms. Resistors R_5 through R_{12} are carrier-level meter-shunt resistors. Resistors R_{13} through R_{16} are substitution resistors to assure constant loading of those three carrier channels not being metered.

In physical arrangement, two carrier channels are customarily included in a single unit and the power supply is arranged to operate two amplifier units or four channels. In many cases more than four channels are in use and several power supplies are in operation. To prevent beating between channels, interconnections cause the various oscillator units to lock-in and oscillate at a common frequency.

Amplifier Circuit

Although two channels of amplification are included in a single unit, the schematic of Fig. 2 shows one channel as typical. Carrier voltage is supplied to the bridge circuit from the power unit. Reactive balance is effected by C_3 and R_{17} while resistive balance is provided by potentiometer R_{18}. Switch S_1, R_{19} and R_{20} provides for coarse, medium or fine adjustment.

Cardinal points of the bridge are led to connector J_1 so that any leg of the bridge can be connected to the external transducers. Shunt resistances and the calibrate switch are provided to cause a known bridge unbalance for equipment calibration during operation.

Bridge output is transformer coupled through T_1 to the voltage amplifier consisting of the two cascaded sections of dual triode V_1. Overall amplification is determined by the step-type gain control S_2. Power amplification is accomplished by transformer coupling through T_2 to the grids of dual triode V_2. Output of this stage is fed through T_3 to the output network of the amplifier where different modes of operation are selected through control S_3. When this control is in the off position all amplifier circuits are inactive except the tube filaments which are heated. Switching to balance position (BAL) activates the amplifier circuits and carrier voltage passes through the upper secondary windings of transformer T_3, is rectified, filtered, and then metered at M_1.

Output from the lower secondary winding of T_3 supplies the automatic-zero compensation circuit which is inoperative when the AUTO-FIXED switch is in the fixed position. This position of the switch is used during the process of balancing the transducer bridge both resistively and reactively as described above and for conventional static-dynamic measurements. When the bridge is balanced, no carrier enters the amplifier or reaches transformer T_3 and therefore meter M_1 reads zero.

After the balancing operation, switch S_3 is turned to the operate position (OPR) and a stabilized direct current from the power supply is injected in series with meter M_1 producing a reading of approximately 7 ma off the zero-center position. The meter reading is again brought back to zero by operation of the resistive balance control and the resulting bridge unbalance gives positive and negative sensing. The lower network out of transformer T_3 is still inactive and the amplifier in this operating condition can be used to make static measurements with no interference from the drift-compensating circuit.

When the AUTO-FIX switch is placed in auto position, the zero-drift circuit is activated. Output from the lower secondary winding of T_3 feeds a voltage-doubler rectifier circuit which supplies bias to V_3, the value being dependent upon carrier level. Cathode current of V_3, which is directly proportional to this grid bias, is introduced in series with M_1 to offset the effect of slow changes in carrier level due to drift. Components R_{21} and C_4 form a time-constant network with approximately five-second characteristic that prevents compensation for dynamic changes in carrier.

Opposition of the upper circuit from T_3 (which will pass both a-c and d-c effects to meter M_1) and the lower circuit (which will send a-c to ground and pass a d-c component) results in a system that automatically cancels d-c (or static changes) and passes only dynamic changes.

An external meter or recording galvanometer is connected to the amplifier output. Function control S_3 feeds the amplifier output to the recorder terminals and disconnects from those terminals substitution load resistor R_{22}. In this operating condition the situation described above applies to the external meter or recorder and in the case of the latter the result of the compensating action is to maintain recording traces in their original position on the paper and thus avoid loss of recording data.

One-Channel Converter

Production-model frequency converter uses printed inductors and germanium-diode mixer. Wide-range grounded-plate oscillator covers entire uhf television band. Intermediate frequency can be any desired low-band vhf channel

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SELECTIVITY for rejection of image and other undesired responses is provided by two tuned input circuits in the converter to be described. The circuit, which includes a local oscillator, crystal-diode mixer and low-pass output filter, is shown schematically in Fig. 1.

The unit is designed to convert television signals on any given uhf channel to corresponding signals on a selected channel in the lower vhf band. Powered from the tv receiver, the uhf converter is disabled by a switch during vhf reception. Two or more one-channel converters can be used with a single vhf receiver. The photographs illustrate chassis layout and installation.

Local Oscillator

At ultrahigh frequencies, the plate of the oscillator (Fig. 1) has a low impedance to ground while the cathode and heaters have high impedances to ground. Oscillator frequency is determined primarily by the series resonant circuit between the grid and ground, which consists of a short length of coiled bus wire and a conventional trimmer capacitor. This type of circuit tunes over a relatively narrow frequency range, slightly more than half the uhf television band. The inductance can, however, be changed by a shorting bus wire, to make the circuit tune over the other half of the band.

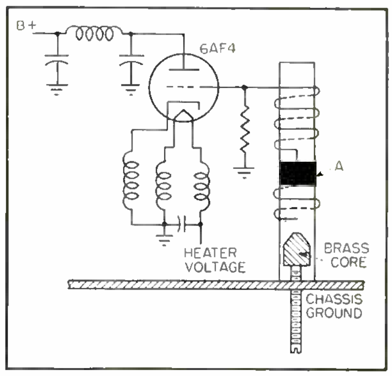


FIG. 2—Slug-tuned printed inductor and capacitance to ground tune local oscillator over wide range

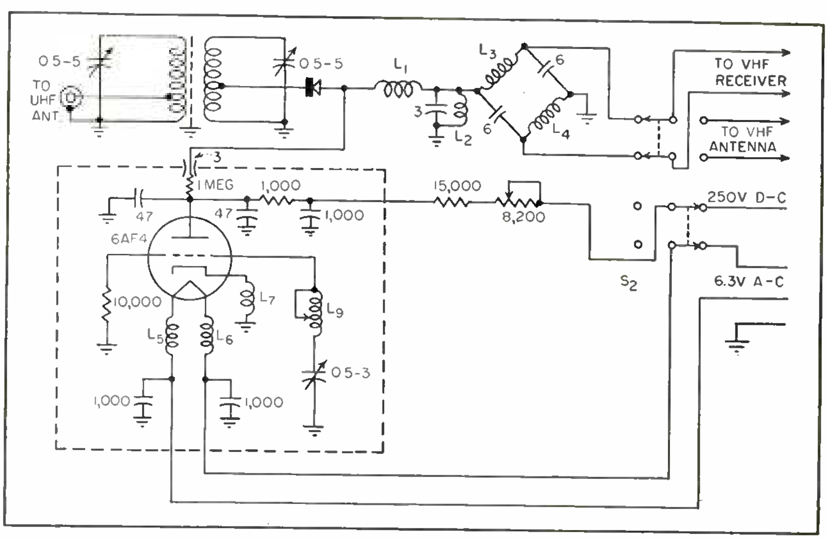
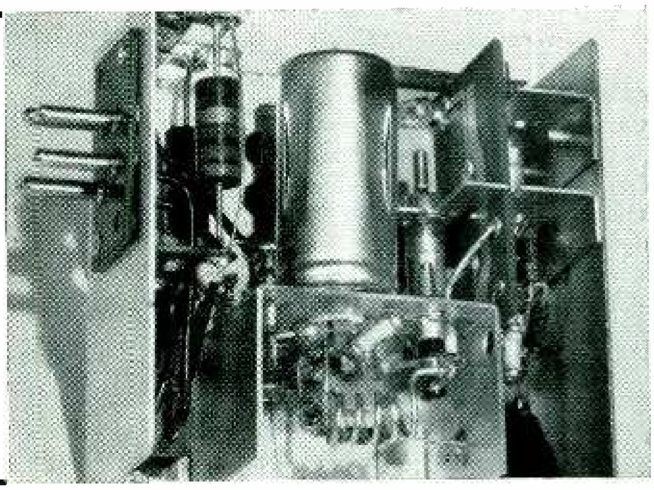


FIG. 1—Converter consists of two tuned input circuits, grounded-plate oscillator, crystal mixer, low-pass output filter and lattice network

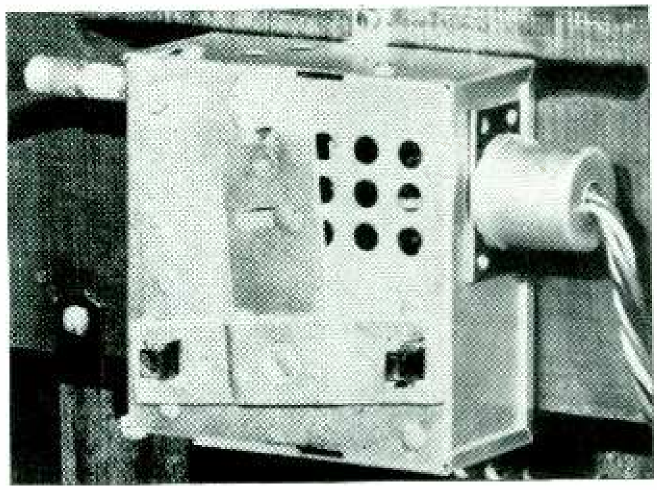
Wide-Range Tuned Circuit

The wide-range tuned circuit shown in Fig. 2 can be used with the grounded-plate oscillator to cover the entire uhf television band. The inductance is printed on an insulating tube having low loss, low dielectric constant and low coefficient of thermal expansion, such as high-quality glass. One end of

for UHF Television



Chassis layout of one-channel uhf-tv frequency converter



Converter attaches to rear of vhf television receiver

the inductance connects to the grid of the oscillator tube while the other end is open-circuited. The capacitance between the inductance and ground is varied by the displacement of a brass core. This corresponds to the conventional trimmer capacitor. Additional tuning range is obtained because of the large capacitance between the core and the portion of the inductance marked *A* (Fig. 2).

Oscillator Stability

Field tests of prealigned converters in conjunction with vhf receivers having intercarrier sound systems have proved oscillator stability to be satisfactory as evidenced by reception of both sound and picture carriers less than 20 seconds after cold start.

The oscillator couples to the crystal mixer through the one-ohm resistor between the oscillator plate and mixer. The resistor is essentially equivalent to a capacitor of about 0.5 $\mu\mu$f at the oscillator frequencies.

However this resistor, when located near the oscillator tank circuit, also picks up energy inductively from the oscillator. The combined inductive and capacitive coupling between the oscillator and mixer makes crystal excitation more uniform throughout the entire uhf television band. Maximum variation of crystal rectified current, shown in Fig. 3, is about 4 to 1. At an i-f of about 70 mc, the optimum rectified current for efficient mixer operation ranges from 0.7 to 2.0 millamperes.

Input Tuned Circuits

Two series-tuned circuits are used for preselection. They employ printed inductances as shown in the photograph and conventional trimmer capacitors. Capacitive and inductive coupling between the printed inductances produce a fairly good bandpass characteristic at all signal frequencies. Wired versions of this unit have produced equally satisfactory results.

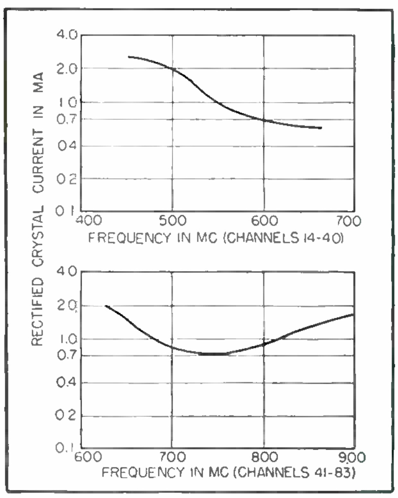


FIG. 3—Variation of crystal-mixer excitation with frequency. Optimum current range is from 0.7 to 2.0 ma for 70-mc i-f

Input Selectivity

Undesired responses are caused by one or more interfering signals, either dependent upon or independent of the oscillator frequency. Second, third and possibly fourth harmonics formed in the mixer may cause interference in the presence of a single interfering signal, but only the second harmonic is of importance if such interference is caused by two or more interfering signals.

The relative magnitudes of undesired responses at a desired-signal frequency of 550 mc are illustrated in Fig. 4, where the response of the desired signal is taken as unity or 0 db. The ratio of the magnitude of any undesired response to that of the desired response is the rejection of the undesired response.

Relative magnitudes of the undesired responses at signal frequencies of 700 mc and 850 mc are similarly illustrated in Fig. 4. With the exception of image responses, all other undesired responses are more than 55 db below the response of the desired signal.

According to FCC channel allocation, image-frequency interference by other uhf signals is unlikely if either a 41-47 mc or 76-88 mc i-f is used. Transmissions in the 420-450 mc amateur band may, however, be sources of image-frequency interference.

Tuner Noise Figure

The noise figure of a tuner is not always an exact measure of the amount of noise a viewer sees in a weak-signal area.

Several factors, video drive to the kinescope, resonant effects in the video amplifier, a-m compression at the picture detector and i-f sensitivity hence operating level of the picture detector, are all contributing factors of the amount and the appearance of noise on a tv screen.

Field observations reveal that for a given input signal strength, the noise visible on the screen of a television receiver having a given noise figure may not always be more objectionable than that of another television receiver having a somewhat lower noise figure. However, with properly designed i-f and video systems, the noise figure of the r-f system may be considered as a fair figure of merit for fringe area reception.

Printed Circuits

The input printed-circuit inductance is tapped for connection to the uhf transmission line. The tap is adjusted for matching the tuned-circuit impedance with the characteristic impedance of the line. A secondary tap is adjusted to match the secondary tuned-circuit impedance with the signal frequency impedance of the crystal diode. Under these conditions, the noise figure of the converter is primarily governed by the noise figure of the television receiver and the conversion loss of the crystal mixer.

The loss in the selective circuit, the excess temperature noise of the crystal diode and the loss in the low-pass filter and lattice network are also contributing factors to the overall converter noise figure. Measured converter noise figures of fifty production units range from 17 to 21 db when it is used in conjunction with a vhf receiver having a noise figure of 6 db.

The low-pass filter network which is required for reduction of oscillator radiation and the isolation between the vhf and uhf oscillators contributes a loss of approximately 4 db.

The average noise figure of present commercial tuners of the crystal-diode type usually runs around 14 db, if the crystal mixer is followed by a low-noise i-f amplifier in place of the low-pass filter network in this frequency converter.

An alternative approach is the use of an r-f amplifier preceding the mixer. Several types of uhf amplifier and mixer tubes have been developed. Conventional tube types such as the 6AN4 and the 6AJ4 would offer an average noise figure of about 12 db at 500 mc and about 16 db at 900 mc. An improvement of approximately 2 db can be realized by using two r-f amplifier stages in cascade. This improvement is due to increased gain of the r-f amplifier that minimizes the effect of mixer noise on the overall noise figure of the tuner. Curves showing the average noise figures of uhf tuners of various designs are given in Fig. 5. It is noted that the 416A narrows the gap between the noise figure of the present tuners and the noise figure of future tuners.

300-Ohm Balanced Input

Normally, the converter has a 75-ohm unbalanced input impedance. However, provision is also made for balanced 300-ohm operation that may permit use of the vhf antenna in strong signal areas. Balanced 300-ohm operation is made possible through a high-pass filter and a 300-to 75-ohm balun, shown in Fig. 6. This arrangement will

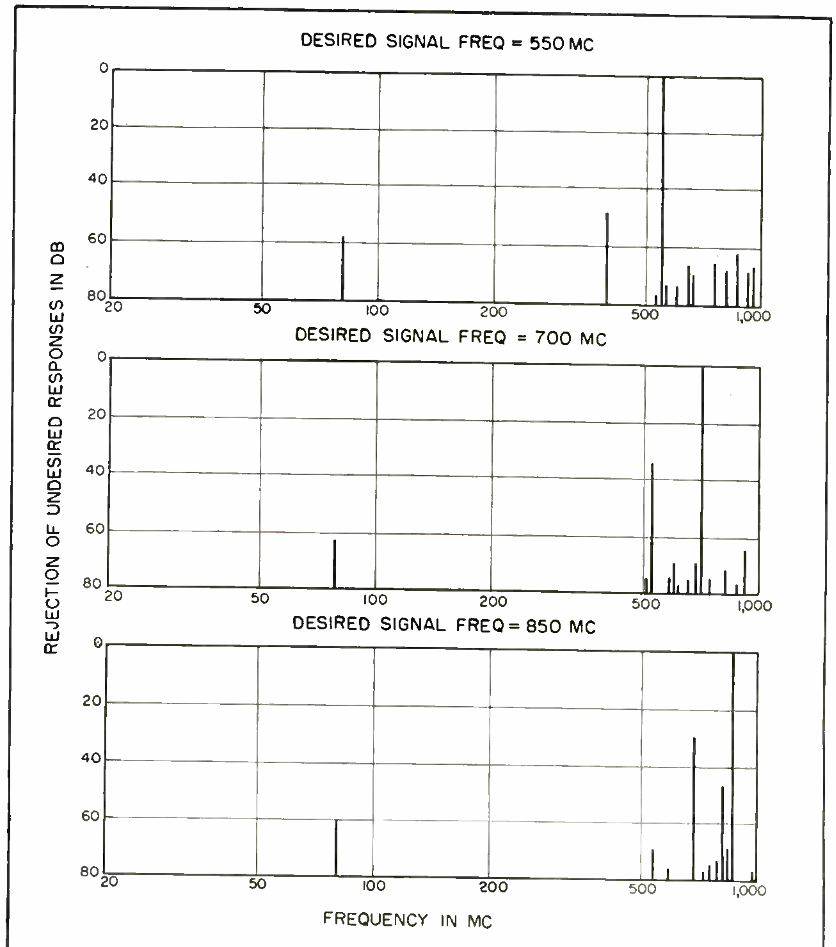
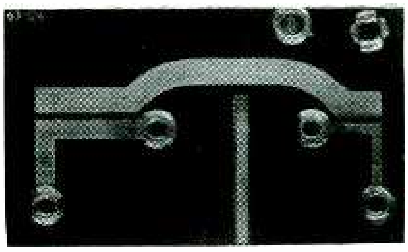


FIG. 4—All spurious responses, except that of image frequency, are more than 55 db down from desired signal



Input circuit printed inductors give good bandpass characteristics

not substantially affect vhf reception, because when the converter is in the vhf position, the high-pass filter presents a high impedance to the vhf antenna terminals.

The high-pass filter and the balun introduce an insertion loss of about 3 db. From the practical point of view, this added loss may not be objectionable as this arrangement is intended for use only in strong signal areas.

Crystal-Diode Mixer

Selection of a crystal diode for use as a uhf mixer is a compromise between cost and performance. Several types of crystal diodes may be used as mixers for frequencies up to 890 mc. The CK-710 germanium-crystal diode is small in physical size and acceptable in performance although its r-f and i-f impedances and conversion loss seem to vary over wider limits than do those of the 1N82 silicon-crystal diode.

Under optimum operating conditions, the impedance across the output terminals of the mixer must be zero at signal frequencies and must match the impedance of the crystal diode at the intermediate frequency. Furthermore, the impedance across the input terminals of the crystal mixer must be zero at the intermediate frequency and must match the impedance of the crystal diode at the signal frequencies. Although these conditions can never be completely fulfilled in practical application, the mixer circuit should be designed to approach these conditions. The mixer circuit shown in Fig. 1 is a fairly good approximation for optimum mixer operation.

Crystal Resonance Effects

Figure 7A is a complete schematic of the mixer circuit. The equivalent circuit, Fig. 7B, shows the crystal diode replaced by a capacitor C_1 and a resistance R_1. This equivalent circuit, however, is only true at a particular frequency and under a given operating condition.

During development of the converter, it was noticed that r-f selectivity fell off and the converter noise figure degraded substantially at about 650 mc. These troubles occurred at different frequencies when wiring changes were made in the mixer circuit. By circuit transformation, the equivalent mixer circuit of Fig. 7B becomes a simpler equivalent circuit, Fig. 7C which in turn leads to Fig. 7D and finally to Fig. 7E.

Resonant Effect

If the circuit constants in the mixer circuit are such that these transformations take place at a frequency within the uhf television band, a resonant effect arises in the mixer circuit and couples a load resistance R_4 into the secondary selective circuit. Selectivity is thereby broadened because of the lower operating Q of the tuned circuit, and the noise figure is degraded somewhat because of power dissipation in the coupled load resistance and also mismatch between the tuned circuit and the crystal-diode mixer.

In the final design of this converter, mixer circuit constants are such that the resonant effect takes place at a frequency above the uhf television band.

Tuner Output Circuit

Choice of the vhf channel to be used as converter i-f influences converter performance in many ways. A high i-f increases the overall noise figure slightly, but reduces oscillator radiation, improves rejection of undesired responses and lowers the operating frequency of the uhf oscillator. There are other performance characteristics affected by the converter i-f but of relatively lesser importance. Channel 5 or 6 has been considered as a good compromise for use as converter i-f.

Low Pass Filter

A π-configuration low-pass filter with cutoff frequency at about 140 mc follows the crystal mixer. Advantage is taken of the fact that the output impedance of the crystal diode in Fig. 1 is in the order of 200 to 300 ohms with normal crystal excitation and the low-pass filter is designed to match the crystal impedance. The input shunt

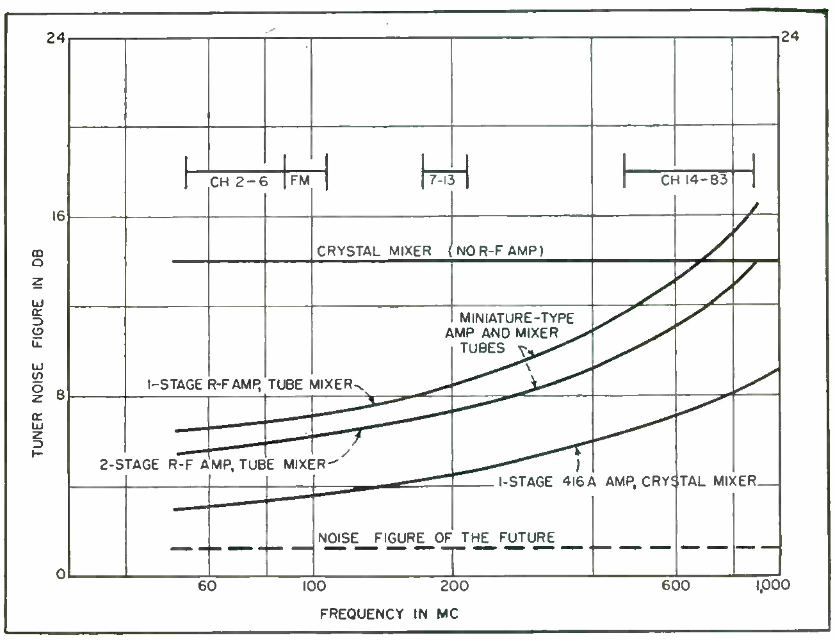


FIG. 5—Noise figures for various converters show effect of using one or more r-f stages before mixer

arm, 3.0-$\mu\mu$f capacitance, of the filter is connected across the mixer output terminals with a lead length that makes it approximately series resonant at the middle of the uhf band to present a low r-f impedance. The reactance of the lead length at the intermediate frequency is small, thus fairly good i-f matching is maintained between the crystal mixer and low-pass filter.

Lattice Network

The low-pass filter is followed by a lattice network to convert a single-ended 300-ohm impedance to a balanced 300-ohm impedance. The network uses two identical coils and two identical capacitors. The values of inductance and capacitance are so chosen that $\sqrt{X_L X_C} = 300$ ohms where X_L is the inductive reactance and X_C is the capacitive reactance, and $|X_L| = |X_C|$ at the center frequency of the pass band. In the first arm of the lattice network, the voltage developed across the inductive reactance forms half the output voltage, while in the second arm, the voltage developed across the capacitive reactance forms the other half of the output voltage. Since these two voltages are equal in magnitude but 180 degrees out of phase with each other at the center frequency of the pass band, a balanced output is obtained.

Standing-Wave Ratio

The degree of balance depends upon the i-f pass band. If channel 4 corresponds to the center frequency of the pass band, then any channel from 2 to 6 inclusive may be used for uhf reception without introducing excessive insertion loss by the lattice network. With normal crystal excitation, the standing-wave ratio is about 2.0 on channels 2 and 6, and 1.2 on channels 3 and 5. The lattice network may be replaced with an unbalanced primary and balanced secondary transformer.

Converter Isolation

The low-pass filter and the lattice network also serve to minimize oscillator radiation from converter output leads and to reduce interaction between the uhf oscillator and vhf oscillators. Interaction between the fundamental or harmonic components of the uhf oscillator and the harmonic components of the vhf oscillator causes disturbance in uhf reception. In addition, the harmonic components of the vhf oscillator appearing across the uhf mixer may also take the place of the uhf oscillator to heterodyne with an undesired signal and produce interference.

Oscillator Interaction

The vhf oscillator energy at its fundamental or harmonic frequencies may appear at the uhf mixer either by radiation from the vhf receiver chassis, picked up by the converter transmission line or antenna or by direct coupling through the circuits between the vhf oscillator and uhf mixer.

In general, the interaction observed in a uhf converter having first i-f amplifier stage or stages is chiefly due to radiation from the vhf receiver chassis, while that observed in a uhf converter without an i-f amplifier is primarily the result of circuit coupling. The magnitude of such interaction, however, is difficult to measure as the accuracy of such measurement is limited by operating conditions of the vhf oscillator, positions of the vhf receiver and surrounding objects relative to the frequency converter, lengths and relative positions of transmission lines being used and the desired signal frequency and the converter output channel.

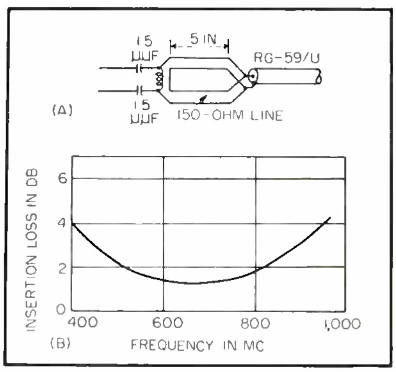


FIG. 6—High-pass filter and 300 to 75-ohm balun permit use of vhf antenna in strong-signal areas

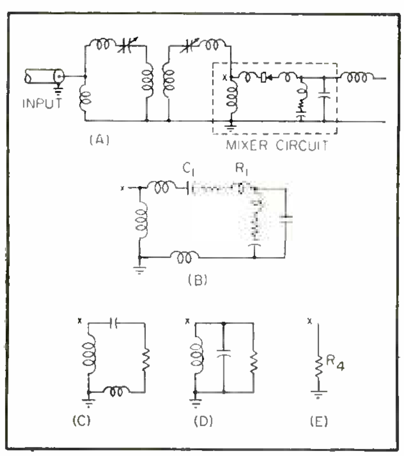


FIG. 7—Transformation of mixer circuit illustrates loss of selectivity due to resonant effects

Installation

Under typical installation conditions, maximum interaction between the very-high-frequency oscillator and the oscillator in the ultrahigh-frequency converter takes place on channel 72 when channel 6 is used as the converter i-f. The approximate magnitude of this interference is equivalent to an interfering signal of 200 microvolts across the converter input terminals at 820.5 mc.

The converter draws an average current of 0.225 ampere at 6.3 volts and 12 milliamperes at 250 volts, which must be supplied by the vhf receiver. However, the power to the converter is turned off automatically when the receiver is on vhf operation; consequently, two or more single-channel frequency converters may be used in conjunction with the same vhf receiver without requiring more power than is necessary to supply one unit.

Acknowledgment

The author wishes to acknowledge the valuable work contributed by H. M. Wasson and S. Lynn in the development of the one-channel uhf converter.

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STABILIZED Time-Division MULTIPLIER

Used in solution of problems involving differential analyzers, the multiplier has high speed and detects its own errors. The stabilized switch it contains can be employed with other circuits to provide function generation, interpolation, quadrant switching and digital-analog conversion in either direction

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In the development of precision analog computing equipment, it has become evident that the two most important requirements for computing circuit elements are a stabilized d-c amplifier and a high-speed precision switch. Goldberg[1] developed a circuit stabilizing one d-c amplifier. Ingerson[2] succeeded in stabilizing a large number of d-c amplifiers with a single pulse amplifier. The first requirement would seem to have been satisfied.

The second requirement, a high-speed precision switch, has been sought by many people. Several electronic switches have already been described in the literature. Most of these switches provide the necessary speed but, to the author's knowledge, few provide the accuracy and drift-free operation required for precise computing. In 1951 the authors[3] described a simple but adequate voltage switch, which they had used in an unstabilized time-division multiplier. Goldberg[4] recently reported his earlier development of a precision current switch; it meets all operational requirements but is restricted to unidirectional currents.

The authors have developed a stabilized time-division multiplier, which they believe is simpler and more reliable than their previous unstabilized one. Stabilization, by reducing drift, provides increased accuracy and repeatability; by eliminating the need for manual balancing and alignments, it affords greater operating convenience, particularly when many multipliers are used in a single installation.

The stabilized multiplier, in its present form, uses 18 vacuum tubes, none of which requires selection. In the current stage of development, its accuracy is 0.1 percent. Changes in calibration and drift from day to day are negligible; accuracy and repeatability

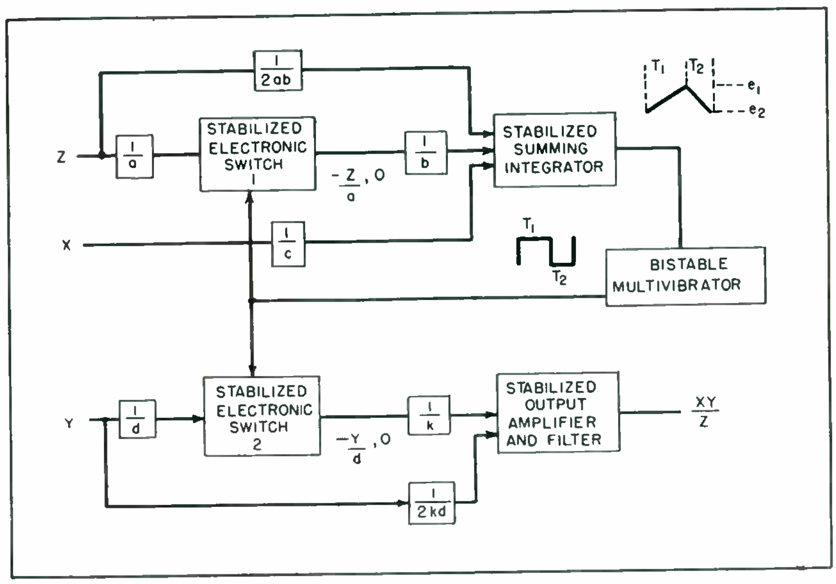

FIG. 2—Arrangement of stages in stabilized electronic multiplier

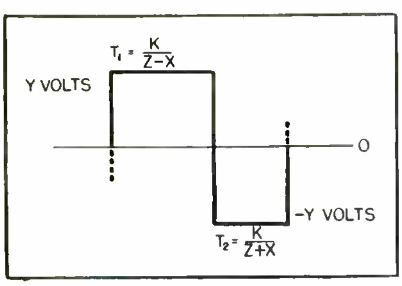

FIG. 1—Basic time division waveform

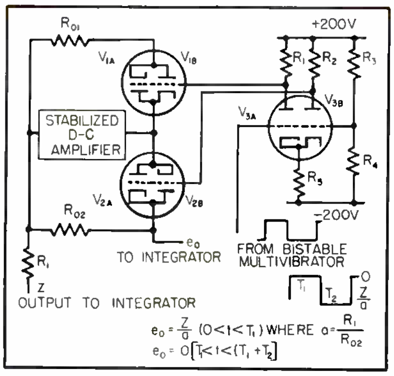

FIG. 3—Stabilized electronic switch used in the time-division multiplier showing input from bistable multivibrator

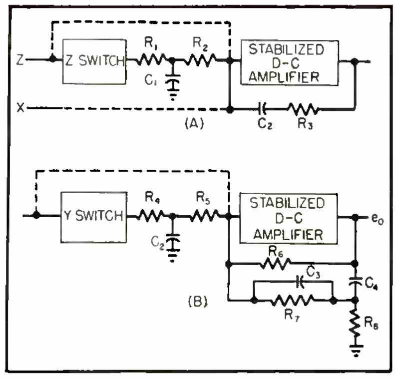

FIG. 4—The *Z* switch and integrator showing filter and (A) *Y* switch and output amplifier showing filter (B)

are maintained even with changes in vacuum tubes. The frequency response, measured at its output, is flat to about 200 cycles per second.

An important feature of the multiplier is its ability to recognize and to signal overdriven inputs, an overloaded output, or a component malfunction. The complete failure of any tube or resistor, except for a few wire-wound resistors, is immediately made known to the operator by visible or audible means.

Time-Division Multiplication

The basic method of time-division multiplication is not new. The algebraic product of two voltages is formed by averaging several cycles of a quasirectangular waveform; the duration and amplitude of alternate portions of the wave form are functions of the input variables as shown in Fig. 1. The amplitude of the first portion of each cycle is Y, and its duration is $T_1 = K/(Z - X)$ second; the amplitude of the second portion is $-Y$ for $T_2 = K/(Z + X)$ second; the average value is $Y(T_1 - T_2)/(T_1 + T_2) = XY/Z$.

This basic waveform does not actually appear anywhere in the stabilized multiplier. However, the same effect can be produced in several ways, one being described below.

Stabilized Multiplication

A block diagram of the stabilized time-division multiplier is shown in Fig. 2. Timing of the waveform is dependent on input variables X and Z; it is controlled by switch 1, the integrator, and the bistable multivibrator, which changes from one of its stable states to the other whenever the output level of the integrator reaches e_1 or e_2, actuating switches 1 and 2 in unison. When the output of the integrator reaches e_2, switch 1 is closed and the input to the integrator is

$$\frac{X}{c} + \frac{Z}{2ab} - \frac{Z}{ab} = \frac{X}{c} - \frac{Z}{2ab} \qquad (1)$$

where a, b, and c are constants. Since the output of the integrator must reverse direction, one requirement in the choice of constants is that

$$\frac{Z_{min}}{2ab} > \frac{X_{max}}{c} \qquad (2)$$

The output of the integrator then increases linearly with time from e_2 to e_1; the required transition time T_1 is established by

$$K\int_0^{T_1} -\left(\frac{Z}{2ab} + \frac{X}{c}\right) dt = e_1 - e_2 \qquad (3)$$

where K is the gain of the integrator.

From Eq. 3 it follows that, since X and Z may be assumed constant over the interval

$$T_1 = \frac{e_1 - e_2}{K\left(\frac{Z}{2ab} - \frac{X}{c}\right)} \qquad (4)$$

Similarly, when e_1 is reached, switch 1 is opened and the integrator output decreases linearly with time from e_1 to e_2, establishing the time T_2 by

$$K\int_0^{T_2} \left(\frac{Z}{2ab} + \frac{X}{c}\right) dt = e_1 - e_2 \qquad (5)$$

Therefore

$$T_2 = \frac{e_1 - e_2}{K\left(\frac{Z}{2ab} + \frac{X}{c}\right)} \qquad (6)$$

The output of switch 2 is $-Y/d$ during the interval T_1 and zero during T_2; thus, the average input to the output amplifier and filter is

$$\left(\frac{Y}{2kd}\right) - \left[\frac{\left(\frac{Y}{kd}\right) T_1}{T_1 + T_2}\right] = \frac{Y}{kd}\left[\frac{1}{2} - \frac{T_1}{T_1 + T_2}\right] = \left(\frac{ab}{kcd}\right)\frac{XY}{Z} \qquad (7)$$

The scale factor of the output amplifier is selected so that the output voltage is XY/Z.

The frequency, or repetition rate, of the quasirectangular wave is

$$f = \frac{1}{T_1 + T_2} = \frac{Kab}{e_1 - e_2}\left[\frac{\left(\frac{Z}{2ab}\right)^2 - \left(\frac{X}{c}\right)^2}{Z}\right] \qquad (8)$$

With $Z = +100$ volts, this frequency varies from 15 kc for $X = 0$ to 10 kc for $X = \pm 100$ volts. It decreases rapidly as the value of Z decreases. Consequently, as in other time-division multipliers, there is a limit imposed on the minimum value of Z that may be used in problems requiring good filtering of the carrier frequency. In problems requiring both a wide range in Z and good filtering, a circuit employing a multiplier with two Y sections may be used.

Precision Switch

Switch 1 is shown in more detail in Fig. 3; it consists essentially of a stabilized d-c amplifier with two alternately switched feedback impedances. During the positive portion of the input from the multivibrator, V_{3A} conducts, disconnecting R_{01}. Simultaneously, V_{3B} is cut off, and conduction through V_2 closes the feedback path through R_{02}. Similarly, during the alter-

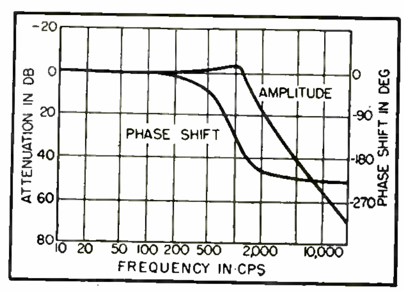

FIG. 5—Frequency characteristics of multiplier output filter

nate period, the feedback path is maintained through R_{01}. The output voltage is taken from the junction of V_2 and R_{02}; when V_2 is on and V_1 off, the output voltage is precisely equal to $(R_{02}/R_1)Z$. When V_1 is on and V_2 is off, the output voltage is zero since the junction of R_1, R_{01}, and R_{02} is maintained at ground potential by the d-c amplifier.

Stray Capacitance

When this type of switch is used to supply the resistive input of a d-c feedback amplifier, the chief sources of error result from the stray capacitances of V_1, V_2, and V_3, and to the winding inductances of the wire-wound resistors, R_{01} and R_{02}. The effect of stray capacitance is minimized by the use of low values of resistance for R_{01}, R_{02}, R_1, R_2, and R_5. Small shunting capacitors compensate for winding inductances.

To achieve adequate filtering of the output without inducing excessive phase shift at low frequencies, it is necessary to supply a resistance-capacitor filter from the output of switch 2. Although the output impedance of the closed switch is quite low, the impedance of the open switch, compared with that of the resistance-capacitor filter, cannot be made negligibly small. As a result, the transadmittance of the input network is not constant but is a function of β, which equals $[T_1/(T_1 + T_2)]$.

This partial filter, the output amplifier, and the remainder of the output filter are shown in Fig. 4B. The error caused by the finite output impedance can be completely compensated by an identical resistance-capacitor network between the output of switch 1 and the integrator.

Output Filtering

It is difficult to design the output filter for a time-division multiplier because the intended use of the device is not always known. If the output is to be integrated, little or no filtering is required. On the other hand, if the output is to be connected to some other nonlinear circuit, considerable filtering may be required to prevent an undesirable d-c offset. This is particularly true if one multiplier supplies another operating at or near the same repetition rate.

Since too little filtering may cause gross errors, a small amount of phase shift at signal frequencies must be tolerated in the general design and a compromise between carrier attenuation and signal phase shift must be made. The three-section filter has a transfer function.

$$G(p) = \frac{(0.1\tau p + 1)}{(\tau p + 1)(\tau^2 p^2 + 0.5\tau p + 1)} \quad (9)$$

where

$$\tau = 10^{-3} \text{ second} \quad (10)$$

The amplitude and phase-shift curves, in Fig. 5, for this filter show that the attenuation is 57 decibels at 10,000 cycles per second, that the phase shift is 16 degrees at 200 cycles per second, and that the response is essentially flat to 200 cycles per second.

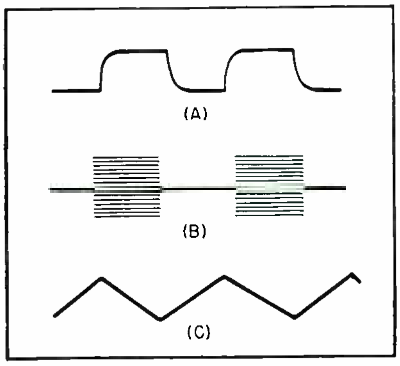

FIG. 6—Output of *Y* switch with constant voltage (A) with variable voltage applied (B) and output of error integrator (C)

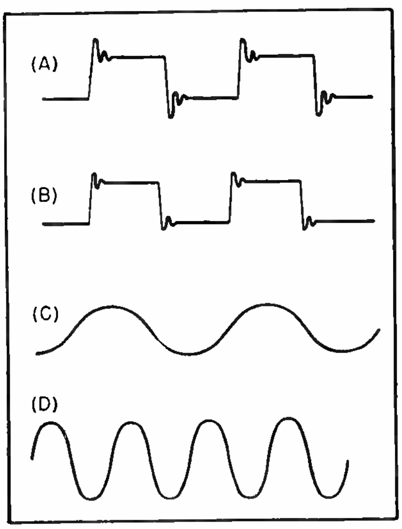

FIG. 7—Step-function response in *X* channel (A) in *Y* channel (B). Input to multiplier, *A* sin π *t* (C) and multiplier output (D)

The operation of the complete multiplier, including the switches and the sweep generator, is stabilized against drift merely by stabilizing the four d-c amplifiers. The method is Ingerson's and consists of periodically sampling the error voltage at the summing point of each amplifier (approximately three times a second), of amplifying the error voltage by an a-c amplifier, synchronously rectifying the amplified error voltage, and applying it to a low-pass filter connected to the d-c amplifier in such a manner as to reduce the original error voltage.

Drift Stabilization

This method reduces effective amplifier drift by a ratio of about 500 to 1. The output pulses of the a-c amplifier, which are proportional to the error voltage at the summing point of the d-c amplifiers, are used to indicate excessive summing-point error (approximately 0.005 volt) resulting from an overloading or a malfunction of the multiplier.

A few of the basic waveforms derived from a stabilized multiplier are shown in Fig. 6. The output of the Y switch when both X and Y are constant is shown at (A); the repetition rate is about 15 kc. In (B) the effect on the amplitude of varying Y is shown, and (C) illustrates the operation of the integrator.

Figure 7 gives a rough measure of the multiplier performance: (A) shows the output of the multiplier when Y is constant and X is a 100-cycle-per second square wave; in (B) the X and Y inputs have been interchanged; (C) shows the result of squaring the quantity $A \sin 200\pi t$.

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Bandwidth Nomograph for Pulse Filter Network

Gives minimum bandwidth required for adequate transmission of a periodic rectangular pulse, based on spectral distribution of pulse energy, for any selected efficiency of ideal and R-C filters. Law of diminishing returns applies to bandwidth increases

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WHEN A PULSE or other signal is applied to a filter with limited bandwidth, the output is a distorted version of the input because some of the frequency components of the signal are attenuated or eliminated. The importance of these components can be measured by the energy which they represent, so it is commonly stated that "such distortion is minimized by the selection of a frequency band sufficiently wide to include nearly all of the total energy of the frequency components."[1]

This observation appears freqently in the literature and the principle is well understood. Quantitative application of this idea, however, appears to have been limited to simple cases involving periodic signals or to elegant attacks on the problem of optimizing performance in the presence of noise.

Periodic Inputs

For a periodic input, the various harmonic components can be found by Fourier analysis; the Fourier series for a number of common periodic waves are readily available in the literature[2]. The power represented by any harmonic can be found by squaring its magnitude, and the combined power of several components is found by addition. In the case of a square wave, for example, the magnitudes vary inversely with n, the order of the harmonic, where $n = 1, 3, 5, \ldots$. From this information, one readily determines that the fundamental component of the square wave accounts for 81.1 percent of the total power and that higher harmonics contribute as shown in the following table:

Highest Harmonic Included	Percent Power
1	81.1
3	90.1
5	93.5
7	95.0
9	96.1
11	96.7
13	97.2

Single-Pulse Inputs

For periodic inputs, such as a rectangular pulse, the frequency components are not distinct but form a continuous spectrum. The relative magnitudes are again determined by Fourier analysis, using the Fourier integral.

The actual signal energy in any portion of the frequency spectrum is found by squaring amplitudes and integrating with

(Continued on p 144)

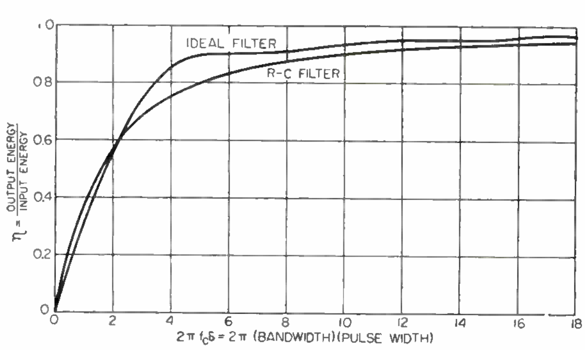

FIG. 1—Transmission efficiency for rectangular pulse input

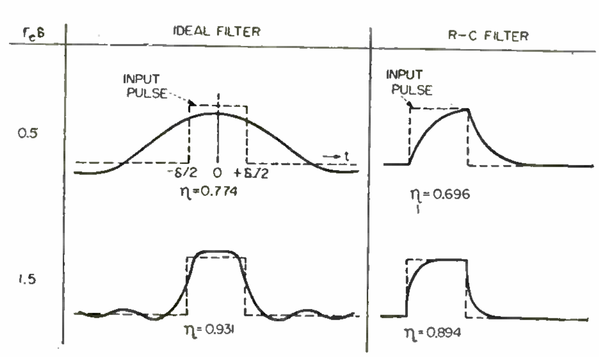

FIG. 2—Responses of filters for rectangular input pulses

Bandwidth Nomograph (continued from p 142)

respect to frequency over the required interval.

If the signal is an isolated rectangular pulse of width δ, the frequency spectrum is[3]

$$g(f) = \frac{\delta}{2\pi}\left[\frac{\sin \pi f \delta}{\pi f \delta}\right] \qquad (1)$$

Squaring and integrating, the fraction of the total energy in the band between zero frequency and an upper limit f_c is found to be

$$\eta = \frac{2}{\pi}\left[\frac{\cos 2\pi f_c\delta - 1}{2\pi f_c \delta} + \mathrm{Si}(2\pi f_c\delta)\right] \qquad (2)$$

where $\mathrm{Si}(2\pi f_c\delta)$ is the sine integral, a function which has been computed and tabulated[4,5].

Strictly speaking, an energy distribution computed in this way describes only the input signal to a network. When the network is the so-called ideal filter, however, whose gain is one for $f<f_c$ and zero for $f>f_c$, the values from Eq. 2 represent the ratio of output to input energy. Interpreted in this way, the energy distribution can be regarded as defining an efficiency of transmission which bears some relation to the fidelity of signal reproduction.

Design of Practical Filters

For practical filters, this same efficiency can be calculated from either frequency or time information, by analytical or graphical methods. For a simple resistance-capacitance low-pass filter whose cutoff frequency is defined as $f_c = 1/2\pi RC$, the ratio of output to input energy is

$$\eta = 1 - \frac{1}{2\pi f_c \delta}\left[\quad - e^{-2\pi f_c\delta}\right] \qquad (3)$$

Values computed from Eq. 2 and 3 are plotted in Fig. 1. The two curves are similar in shape and intersect at $\eta = 0.57$, where f_c is approximately equal to $1/\pi\delta$. The close correspondence between the two curves is due in part to the fortunate choice of the -3 db or half-power point in defining the cutoff frequency of the R-C filter.

The relation between network efficiency and quality of pulse reproduction is suggested in Fig. 2, which shows typical pulse responses for ideal and R-C filters. From these pictures one might conclude that 70–75 percent efficiency is a minimum standard, that 90–95 percent is preferable, and that an even higher figure might be better.

In selecting bandwidth, however, consideration should be given to signal-to-noise ratio. In the absence of detailed information, it is probably good policy to use the minimum bandwidth consistent with adequate signal reproduction. In this connection, Fig. 1 shows clearly a law of diminishing returns in increasing bandwidth. For a given pulse width, an increase in efficiency from 90 to 95 percent requires doubling the bandwidth; a further increase to 99 percent requires a further multiplication of bandwidth by five.

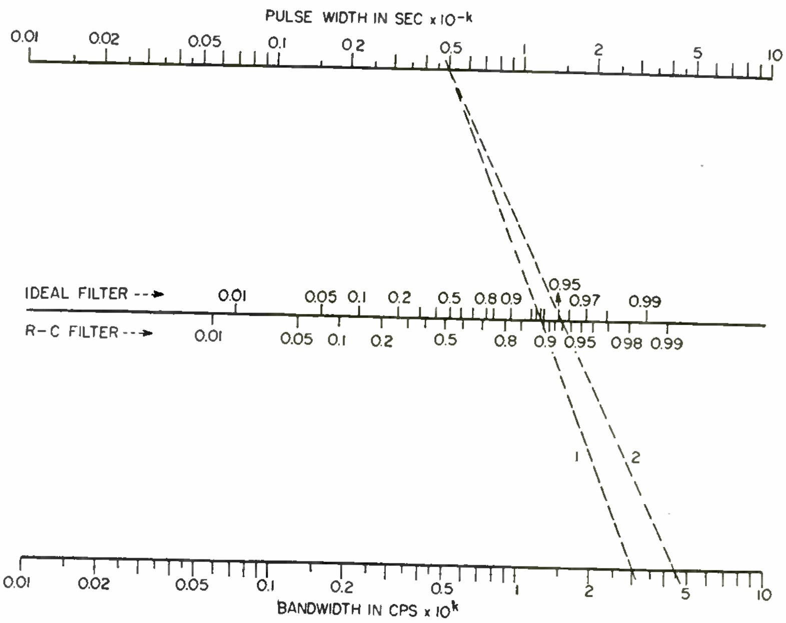

FIG. 3—Nomograph relating efficiency, bandwidth and pulse width. Multiplier k is zero when using seconds for pulse width and cycles per second for bandwidth; any other consistent units may be used, such as $k=3$ for milliseconds and kc or $k=6$ for microseconds and mc

Bandwidth Nomograph

Calculations of network bandwidth are simplified by the use of the nomograph shown in Fig. 3. A straight line drawn between points on the upper and lower scales determines the network efficiency for the given pulse width and bandwidth, for either the ideal filter or R-C filter, depending on which center scale is used. A multiplier is included on the pulse width and bandwidth scales to emphasize that any consistent units may be used, such as seconds and cycles per second, milliseconds and kilocycles or microseconds and megacycles.

Example of Use

As a sample problem, suppose that a 0.5-microsecond pulse is to be transmitted by an ideal filter with an efficiency of 93 percent. Line 1 on the nomograph gives the required bandwidth of three megacycles. According to line 2, somewhat greater bandwidth (4.5 megacycles) is required with an R-C filter.

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(5) "Tables of Sine, Cosine and Exponential Integrals", Vol. I, Federal Works Agency, New York, 1940.

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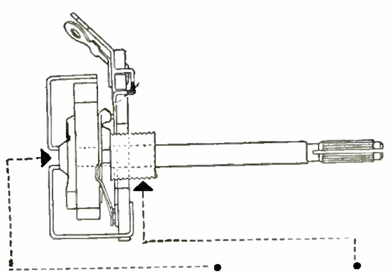

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ELECTRONS AT WORK

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OTHER DEPARTMENTS featured in this issue:

Nonlinear Filtering and Waveshape Multiplexing*

By R. E. Scott, S. Fine and A. MacMullen

Research Laboratory of Electronics
Massachusetts Institute of Technology
Cambridge, Mass.

LINEAR FILTERS have been designed on both a frequency and statistical basis to restrict a band to that needed for the signal components and to keep noise out. When the noise and the signal have components in the same band, pre-emphasis has been used. To accomplish this result, the transmitted signal is distorted to increase its level in the noise band, and both signal and noise are then attenuated at the receiver. The nonlinear filter described in this article accomplishes essentially the same result without the necessity of predistorting the transmitted signal.

When it is desirable to separate several channels of information from a single-channel carrier, as in telemetering, a number of schemes have been used for this purpose. For example, combined amplitude and frequency modulation and pulse-time multiplexing. The method of waveshape multiplexing described here is novel and may have some advantages in particular application instances.

* This work has been supported in part by the Signal Corps, the Air Materiel Command, and the Office of Naval Research.

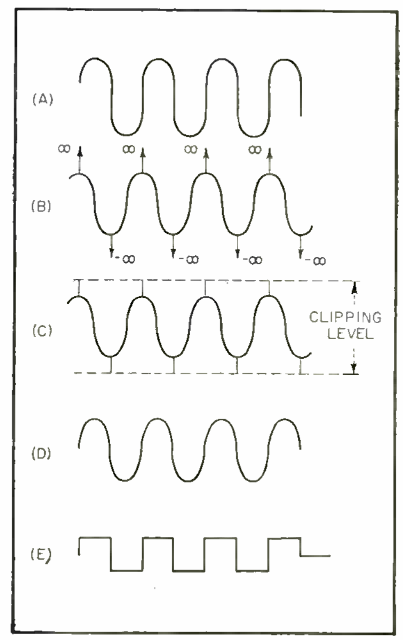
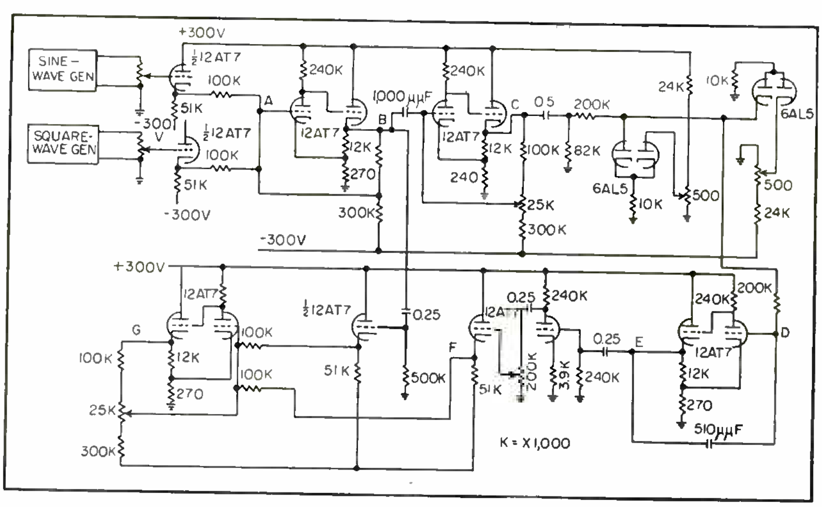


FIG. 1—Waveforms of ideal filter

This discussion will be limited to the separation of sinusoidal signals from random square waves or pulses. The signals can be separated even when they are coherent and possess components in the same frequency band. A linear filter would fail entirely to separate such components.

The method is most obvious when considered in the time domain. Because of the nonlinear operations, analysis in the frequency domain is inadmissible. Stated briefly, the method consists of taking successive derivatives of the signal plus the

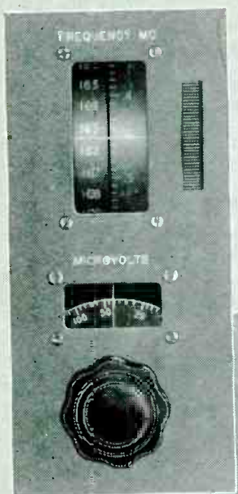


Schematic diagram of experimental unit

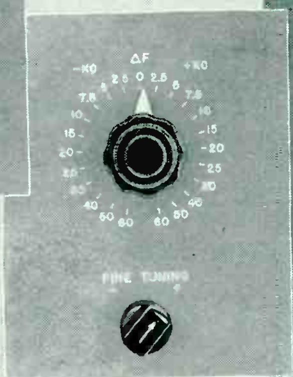
Type 206-A

FM SIGNAL GENERATOR
for Mobile Communications Receivers

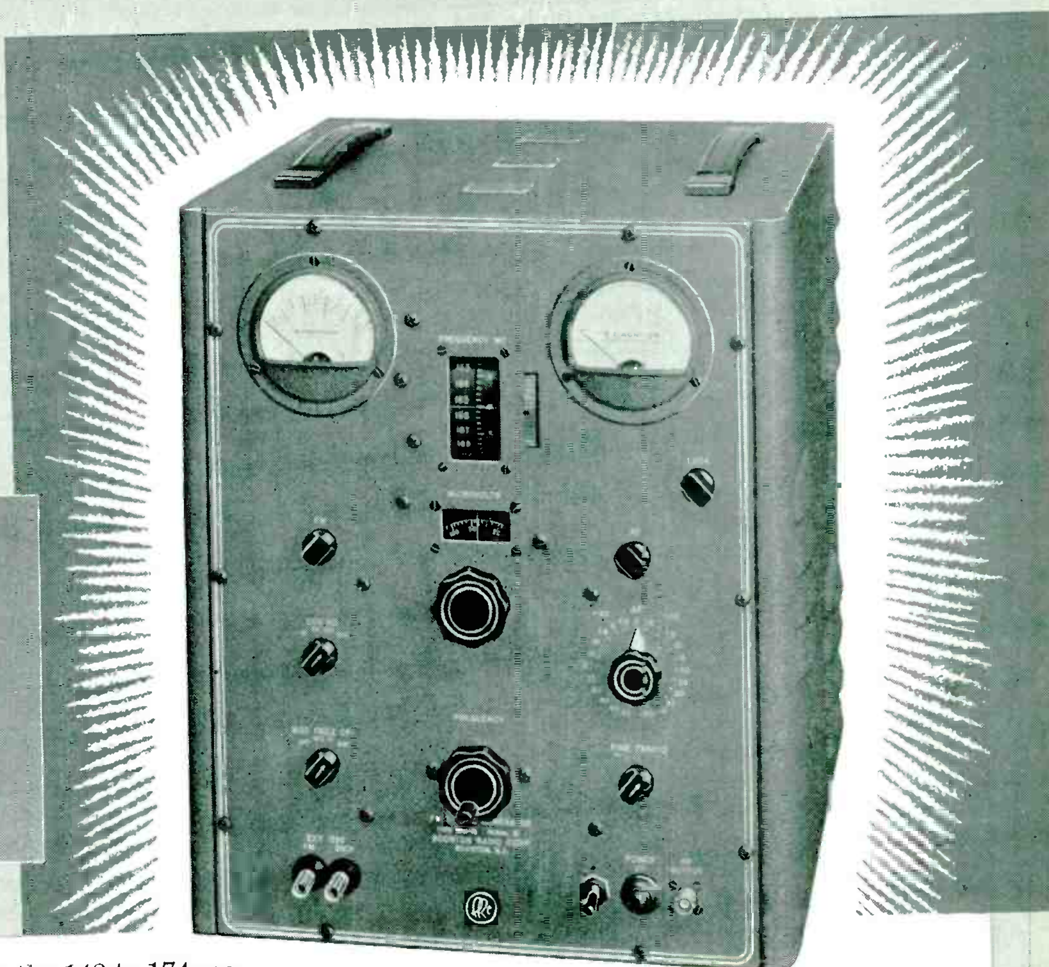
Frequency Range
146 mc to 176 mc



PANEL A



PANEL B



Mobile communications receivers in the 148 to 174 mc range have high sensitivity and rigid selectivity specifications. The receivers must not drift nor suffer detuning from variations in signal level. To be certain that these important requirements are met, laboratories and manufacturers must have a test instrument with capabilities at least an order better than receiver requirements.

The Type 206-A FM Signal Generator meets these needs. Output frequency is adjusted by a mechanism with a fast and vernier drive which is marked in 1.0, 0.1, and 0.01 mc divisions (see panel A). The dial mechanism position can be changed with respect to the tuning condenser shaft by a lock mechanism to calibrate any single point. Tuning in discrete steps for selectivity measurements may be carried out rapidly by a switched electronic tuner (see panel B). Very fine tuning corrections can be made by an additional electronic vernier. Drift of oscillator output with time is very low and variation in output frequency with attenuator setting negligible. A wide range of output levels is available (see panel A). The instrument is characterized by low microphonism and low leakage.

SPECIFICATIONS (Type 206-A)

FREQUENCY RANGE: 146 mc to 176 mc in one range.

FREQUENCY CONTROLS: Main dial marked in 1 mc divisions.
Vernier (mechanical) marked in 0.1 and 0.01 mc divisions.
$\triangle$F Switch: ± 60 kc in small discrete increments.

Fine Tune: Continuous electronic tuning over ± 10 kc range.

FREQUENCY ACCURACY: ± 0.2% after warmup.

FREQUENCY STABILITY: With temperature variations: ± 0.001% per degree centigrade.

With line voltage variation: ± 0.002% for ±10% line variation.

RF OUTPUT VOLTAGE: 0.1 to 200,000 microvolts into a 53 ohm load.

RF ATTENUATOR ACCURACY: Approximately ±10%.

RF OUTPUT IMPEDENCE: 53 ohms resistive looking into panel connector.

FREQUENCY MODULATION: Frequency deviation ranges (continuously variable) 0-10, 0-25, 0-100 and 0-250 kc.

Frequency deviation accuracy: Can be calibrated to ±5% by internal standard.

FM DISTORTION: Less than 2% at 100 kc and less than 10% at 250 kc deviation.

MODULATING SOURCES: Internal AF oscillator at 400 and 1000 cps.
External AF oscillator may be used.

Output from internal AF oscillator available for synchronizing or other purposes.

POWER SUPPLY: Provides electronically regulated filament and B voltages.

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noise, clipping those derivatives which strongly represent the noise and reintegrating to obtain the original wave with the noise greatly attenuated.

Basic concepts of the method are illustrated in Fig. 1. The input wave is the in-phase combination of a square wave and a sine wave shown in Fig. 1A. The problem is to separate the two while preserving the essential qualities of each. Differentiation, a linear operation, produces the waveform of Fig. 1B, which is a sinusoidal wave with superimposed positive and negative impulses. Finite amplitude-limiting of this signal, as shown in Fig. 1C, removes all but an infinitesimal amount of the energy associated with the impulses. Integration of the clipped wave yields the original sinusoid complicated by essentially none of the square-wave component, as in Fig. 1D. The square wave is obtained by subtracting the pure sine wave from the original input, as shown in Fig. 1E. A practical physical system departs from this description in minor details only.

The block diagram of an experimental system operating over a sinusoidal frequency range of 60 to 4,000 cps and over an independent pulse repetition frequency range of 0 to 4,000 pps is shown in Fig. 2. Examples of actual waveforms obtained at the various points of Fig. 2 are given in Fig. 3.

The voltage at point *B* of Fig 2 consists of a sine wave and a square wave as shown in Fig. 3A. Differentiation of this signal produces a waveform shown in Fig. 3B. As

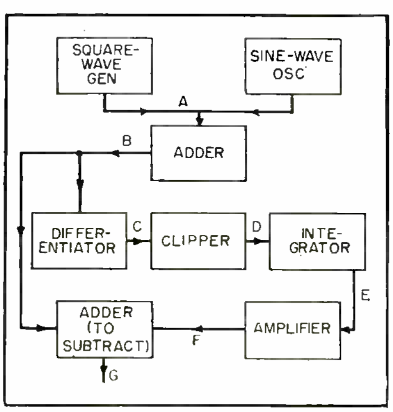

FIG. 2—Block diagram of test system

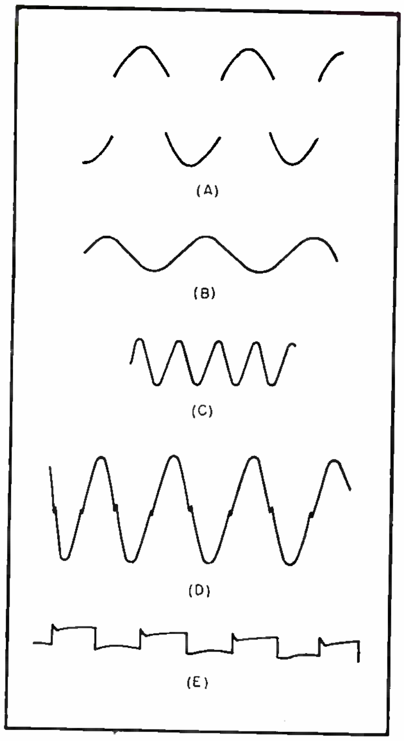

FIG. 3—Waveforms from test system

is evident, a steep pulse approximating an impulse is present. Clipping this differentiated waveform produces a resultant waveform shown in Fig. 3C, in which the major portion of the energy contained in the impulse is removed. Final integration, shown in Fig 3D, results in almost complete removal of the square wave. Amplification and subtraction of the sine wave of Fig. 3D from the input results in the output at *G* of Fig 2, as shown by Fig. 3E.

In the practical device, a certain degree of interaction of the two wave shapes is still present. The amount depends upon the rise time of the input pulse and upon the accuracy with which the electronic devices represent their mathematical counterparts.

By frequency modulation of the sine wave, and pulse-width modulation of the square wave it is possible to transmit the two waveshapes simultaneously and to separate them at the receiving end. Even with fairly crude circuitry the interaction between channels is less than ten percent.

A circuit diagram of the experimental unit is shown at the beginning of this article. The amplifiers use positive feedback within the loop to increase the internal gain of each section to about 100.

Except for the clipping diodes, the elements shown in the block diagram are standard components of an analog computer. The system was set up on a differential analyzer in the laboratory and results similar to those shown were obtained.

The filtering scheme can be extended to include additional derivatives. When the data represent a dynamical system, there are physical limitations on the second and third derivatives and these limitations set the level at which the clipping should occur. Waveshape multiplexing can also be extended to more channels at the expense of using additional derivatives.

Electronics Aids the Dentist

BY DAVID BECKER
Montclair, N. J.

PERIODONTICS, the study of the regions surrounding the teeth, embraces many problems concerning gum diseases and adjacent bone disturbances. One of the major problems is an unbalanced bite. An extreme case of unbalanced bite may occur when there is contact between only one tooth in the upper jaw and one tooth in the lower jaw.

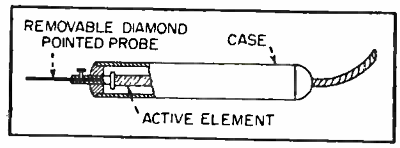

FIG. 1—Mechanical drawing of the probe

This condition may lead directly to loosening of the teeth in their sockets.

The periodontist balances the bite by grinding down elongated teeth, capping shorter ones and by making artificial restorations. Ordinarily, the dentist has at his disposal two methods of analysis during diagnosis and treatment. The first is a wax impression of the mouth and the second is use of carbon paper placed between the upper and lower jaws when the patient bites. Neither of these methods is en-

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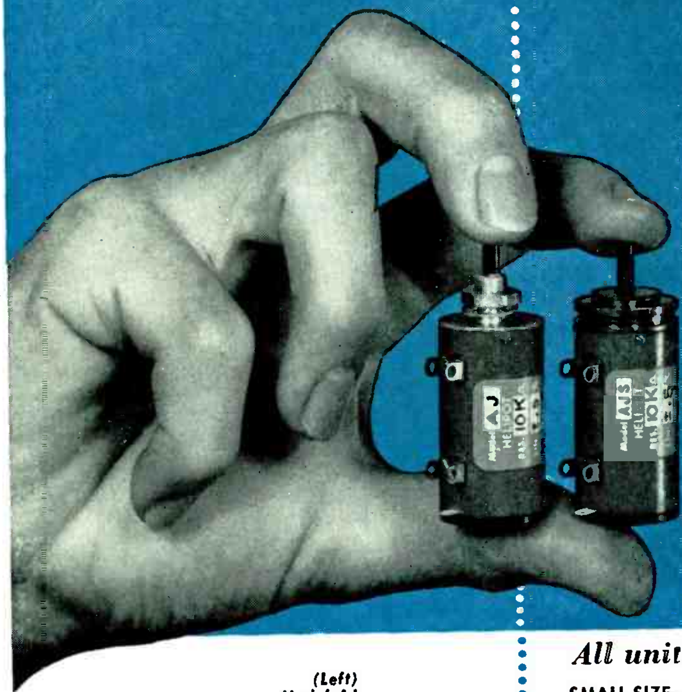

(Left) *Model AJ* *Bushing Mounting*

(Right) *Model AJS* *Servo Mounting*

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All units have these important features . . .

SMALL SIZE—LIGHT WEIGHT: All AJ Models are only ¾" in diameter (small as a penny) 1⅜" long—weigh 1.0 oz. They require a minimum of valuable panel space!

HIGH PRECISION—CIRCUIT SIMPLICITY: On many applications an AJ Series will replace two conventional potentiometers, providing *both* wide range and fine adjustment in one unit. The 18" slide wire gives a resolution of 1/3000 in a 100 ohm unit—1/6500 in a 50,000 ohm unit!

RELIABILITY: The AJ models are rugged and simple—built to close tolerances with careful quality control. Their performance and reliability reflect the usual high standards of Helipot quality.

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For light weight, unusual compactness, high accuracy and resolution, coupled with utmost reliability, investigate the AJ series...

- All types have bearings at *each* end of the shaft to assure precise alignment and linearity at all times.
- Either single or double shaft extensions can be provided to meet individual needs... also, ball or sleeve bearings, special shaft lengths, flats, screwdriver slots, etc.
- By means of a unique Helipot welding technique, tap connections can be made to only ONE turn of the resistance winding, and can be provided at virtually *any* desired point on the resistance element.
- New improved terminals are rigidly anchored in place to prevent twisting and coil failures due to fatigue. These anchor-locked terminals are used both at the taps and at the coil ends.

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Helipot—world's largest manufacturer of precision potentiometers—has built an enviable reputation for its high design and construction standards, and the AJ models meet these standards in every way.

The resistance elements are made of precision-drawn alloys, accurately wound by special machines on a heat-dissipating copper core.

Each coil is individually tested, then permanently anchored in grooves precision-machined into the case. Slider contacts are of long-lived Paliney alloy for low contact resistance and low thermal e.m.f.... and all terminals are silver plated and insulated from ground to pass 1,000 volt breakdown test.

In spite of light weight and compact design, all AJ models are built throughout for long life and rugged service. Potentiometer life varies with each application, of course, depending upon rotation speed, temperature, atmospheric dust, etc. But laboratory tests show that under proper conditions, all of the AJ series have a life expectancy in excess of one *million* cycles each!

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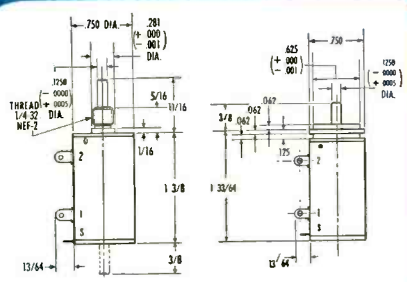

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Number of turns	10
Power rating	2 watts
Coil length	18"
Mechanical rotation	3600° + 12° −0°
Electrical rotation	3600° + 12° −0°
Resistance ranges	100 ohms to 50,000 ohms
Resistance tolerance	± 5.0%
Linearity tolerances:	
All values	± 0.5% (standard)
5000 ohms and above	± 0.1%
Below 5000 ohms	± 0.25%
Starting torque	0.75 oz. In.
Net weight	1.0 oz.

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A patient being tested with the probe in position on a tooth

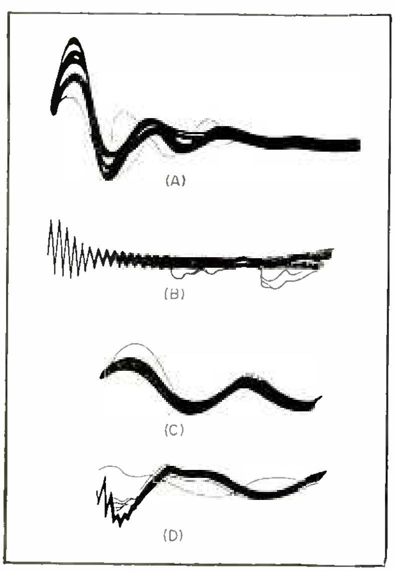
tirely satisfactory.

In the method developed, vibrations picked up on a tooth, as it is contacted by the opposing tooth during a patient's usual biting action, are applied to the vertical deflection plates of a cathode-ray oscilloscope. A suitable transducer in a probe, Fig. 1, is used as the pickup. The oscilloscope gives a visual presentation of the degree and nature of the vibration caused by the two teeth striking together.

Permanent recordings of a patient's condition are made with a 35-mm camera. The complete technique provides an indicator for investigation, diagnosis and treatment. Each tooth is tested individually by placing the point of the probe against the neck of each tooth as the patient closes his jaws. Oscilloscope patterns are first used to check questionable areas.

For diagnosis, the dentist can tell by observing the relative amplitudes of patterns from different teeth which ones need grinding or building up. Mobility of teeth can also be diagnosed by the presence of superimposed oscillations at the beginning of the main pattern. Amplitude of these vibrations indicates the degree of mobility.

Chewing efficiency takes place in the diagnosis by the presence or absence of large pulses in the background. During such a diagnosis, the patient grinds his teeth in a lateral motion.



Sketch of sample oscilloscope patterns. Excessive pressure of upper left molar (A), tooth that can move one mm in any direction (B), tooth with insufficient pressure (C) and lower tooth driving upper tooth towards palate away from probe

Tester For Germanium Diodes

By Nicholas DeWolf and Norris E. Schick

Electronics Division
General Electric Co.
Syracuse, N. Y.

With the rapid increase in the use of germanium diodes as circuit elements in receivers, computers and military equipment, the need for a flexible tester to serve as the counterpart of tube checkers has become more evident.

Such a tester must meet several requirements. Primarily it must check the quality of diodes to the RTMA specifications. It should be usable in the selection of diodes for special applications and for determining, by experiment, the minimum usable quality limits that can be tolerated in a given application. It must make possible the evaluation of the usability of diodes in applications where stability is of prime importance or if the units are operated outside of ratings, it must be possible to detect changes in characteristics.

Specifications for the majority of germanium diodes are based on static point tests of forward and inverse resistance at specific voltages. Figures 1 and 2 demonstrate the nonlinearity of these resistances with changes in voltage level. It is evident that the diodes must be tested at the specified voltage limits if their conformance to specifications is to be evaluated. Forward resistance is generally tested at a one-volt level and inverse resistance at 50 and 10 volts, although other voltages are also required. The manufacturer's specification sheets and a recent article[1] show the necessary ranges.

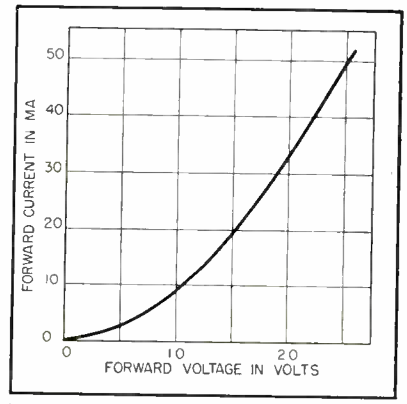
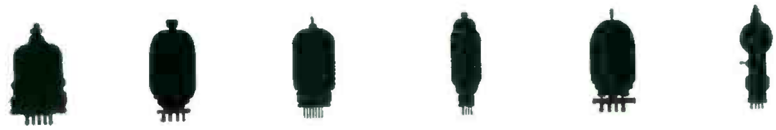


FIG. 1—Typical static forward current-voltage characteristic of a 1N48 diode

There are many dynamic tests that may be more suitable than static testing for specialized applications but these fall into the minority of required diode tests. Rectification efficiency at various frequencies, levels and impedances as well as pulse cutoff and conduction properties are but a few of the special tests that may be applied. Complexity of these tests and the variations in conditions required preclude the possibility of including them in a compact and simple test equipment. These characteristics are best tested by a separate special equipment designed to correlate with the specific application.

In order to cover the large majority of germanium diodes, a survey was made of all manufacturers' static specifications, which included some 75 grades of diodes. It was evident that the major portion of these fell within the following ranges: Forward currents measured from 0.25 to 1 volt ranging from 10 μa to 10 ma. Inverse currents measured from 1 to 100 volts



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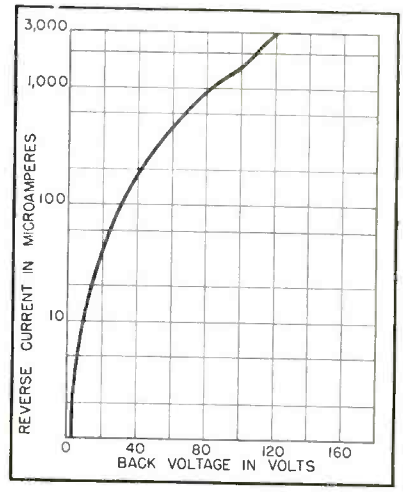


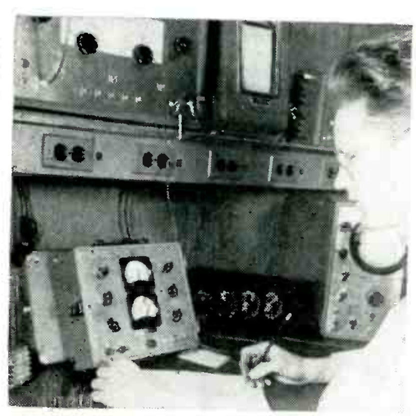
FIG. 2—Typical static reverse current-voltage characteristic of a 1N48 diode

ranging from 5 μa to 1 ma.

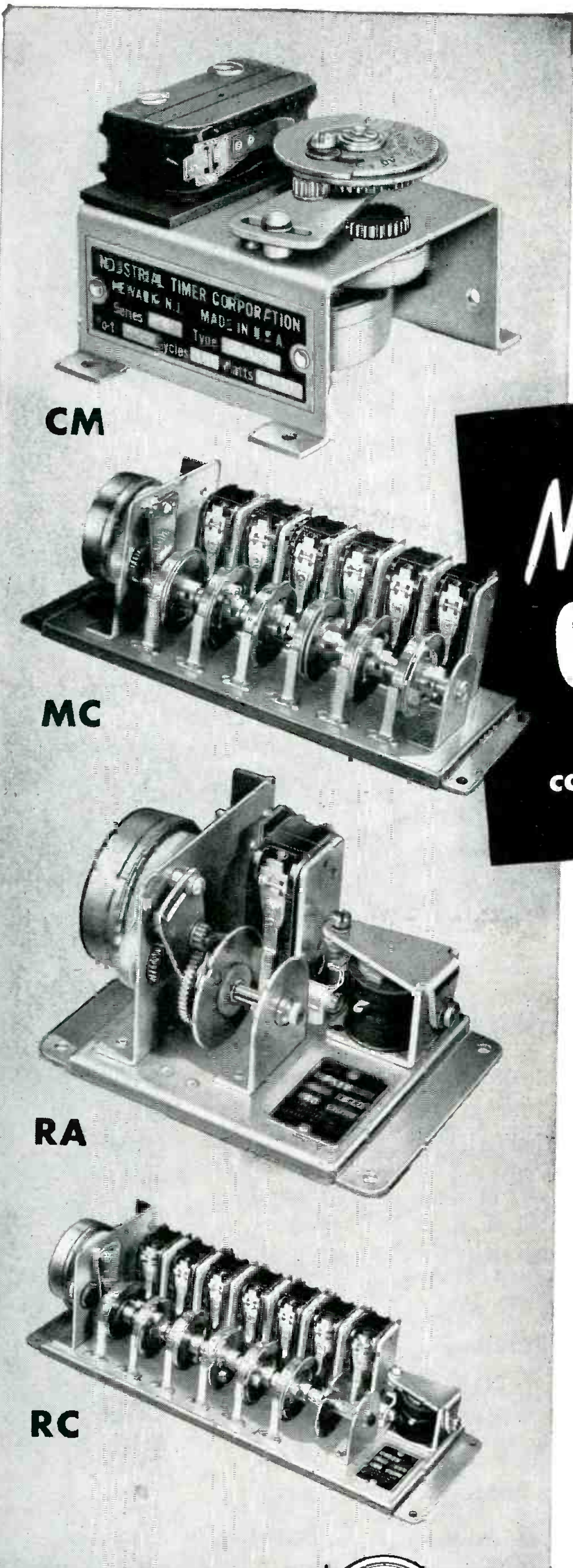
Because of the higher impedance and voltage levels in inverse resistance testing, different problems occur from those in forward resistance testing.

Inverse current can be tested in the conventional circuit illustrated in Fig. 3. The circuit consists of a milliammeter in series with the diode, a voltmeter across the combination and a limiting resistor to prevent instrument damage in the event of a short circuit at the test terminals.

Outside of the normal errors in instruments and resistors, the only error that can occur is that caused by the voltage drop in the milliammeter. Using 3-inch panel instruments, the error will vary from 50 to 300 millivolts depending on the current range and will cause less than a 10-percent error in diode voltage reading for ranges above



Tester being used in a diode-checking operation



These Industrial Timer Corporation timers provide accurate and highly dependable instruments for control of a single operation or multiple operations (simultaneously or in sequence).

OUTSTANDING FEATURES ARE:

(1) the wide range of over-all time cycles obtainable from any one model;

(2) the ease with which over-all time cycles can be changed;

(3) the simplicity with which individual cams can be adjusted for ON and OFF periods, and positioned in specific timing sequence.

New! Synchronous Motor Driven CAM TIMERS

for single cycle and continuous recycling applications

Series CM CAM RECYCLING TIMERS

The Series CM Cam Recycling Timer repeats a definite electrical ON and OFF time cycle continuously. The cam is coupled to the motor by means of a simple gear and rack assembly—and the over-all time cycle can be easily changed by substituting gear racks. (Bulletin 33)

Series MC MULTI-CAM TIMERS

The Series MC Timer is identical to the CM Timer, but operates 2 to 6 circuits. All cams are mounted on a single shaft, which assures a common time cycle for all circuits. Each cam, however, is independently adjustable for a specific timing sequence. (Bulletin 34)

Series RA SINGLE CYCLE CAM TIMERS

The Series RA Timer provides a single time cycle upon being actuated electrically from remote control. A pawl on the cam eliminates necessity for prolonged closing of relay switch when starting. (Bulletin 35)

Series RC SINGLE CYCLE MULTI-CAM TIMERS

The RC is identical to the RA, but operates from 1 to 6 additional circuits. Thus it provides all the features of the Series MC Timer, plus the single cycle control afforded by the RA. (Bulletin 35)

Send us specifications, and we shall make recommendations based on your particular needs. Bulletins sent free on request.

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The round tubing ranges from 1/8" to 6", with wall thicknesses from .0075" to 1/8". The minimum ID of the square and rectangular tubing is 3/8", with 2 1/8" the maximum ID. 1/16" is the maximum wall thickness. All tubing can be supplied in lengths from 2' to 4'. From our own fabricating experience, we know you will find this sturdy material easy to drill, tap, rivet, flute or thread.

Think it over . . . then talk to the man from C-D-F, a skilled plastics engineer. C-D-F has sales offices in principal cities with modern test laboratories at all plants. C-D-F spiral tubing. The man from C-D-F. *Both* are good to know!

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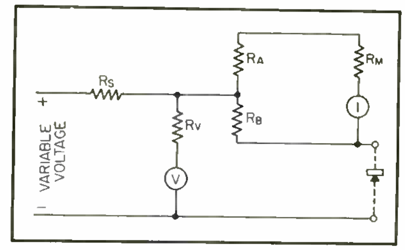

FIG. 3—Inverse-resistance test circuit

3 volts. Fortunately, this error is highest at the higher current ranges which are not normally used on the low voltage ranges.

Voltage drop in the microammeter becomes excessive in forward-resistance testing and the use of the preceding circuit is undesirable.

A novel modified-bridge circuit may be used to advantage to avoid instrument corrections, as illustrated in Fig. 4. This circuit does not involve any errors other than those caused by the meter-movement inaccuracies and resistor tolerances.

Optimum Design

The optimum design is complex and depends to a large extent on the resistance of the meters. In the ranges that a diode checker would be used, it was found that the simplest method considering the necessary range switching, was to make the current instrument's series resistance high compared to the upper bridge arms. If the source resistance is made very low and the voltmeter resistance high, current ranges can be varied by changing the upper bridge arms only. This can be made to keep the internal impedance at the right value automatically. On the low-voltage high-current ranges these

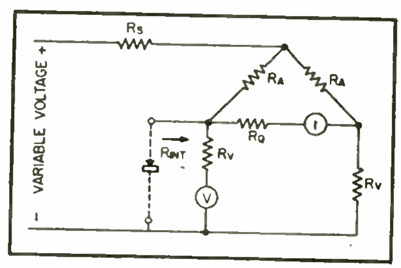

FIG. 4—Forward-resistance test circuit Tester being used in a diode-checking operation

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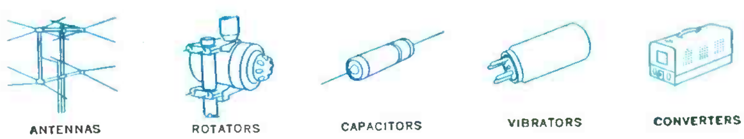

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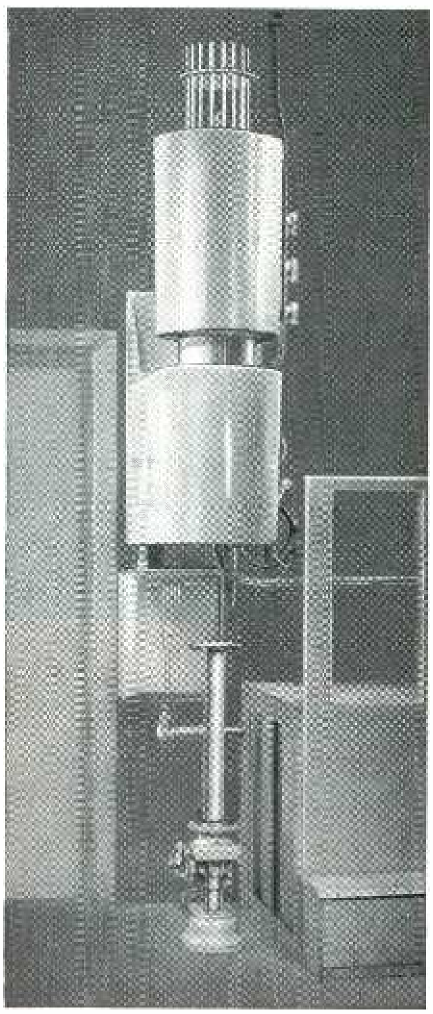
BETTER CONTROL OF COPPER OR ALLOY BRAZING WITH LITTON HYDROGEN FURNACE

Litton Model 4400 Vertical Hydrogen Furnace is designed for easily observed, accurately controlled production-line brazing of assemblies up to 6½″ in diameter and 12″ in length. Brazing is performed in a hydrogen atmosphere and work can be inserted into the open bottom either mechanically or hydraulically. Operating temperature range permits copper brazing as well as all types of gold-copper and silver alloy brazing.



Model 4400 Furnace is divided into two chambers. The upper or brazing chamber is equipped with radiant heating for maximum flexibility. The lower or cooling chamber permits rapid cooling to the freezing point of the metal or alloy. The heating chamber has an inconel inner wall surrounded by 3″ of thermal insulation. Two replaceable pyrex windows permit a clear view of the work during the heating cycle. Tungsten heating rods are spring-loaded to preserve tautness, and may be easily replaced. The cooling chamber is a double-walled cylinder of stainless steel within which water is circulated.

In operation, work is raised into the upper chamber, heated at the desired rate or rates, and immediately lowered into the cooling chamber. Since power is applied only during the heating cycle (normally less than one-third of loading, heating and cooling time), power consumption is minimized.

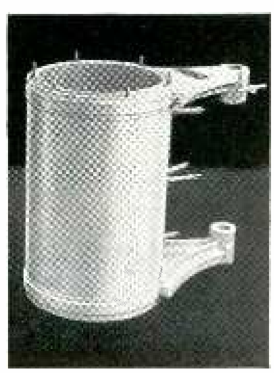
SPECIFICATIONS—MODEL 4400 VERTICAL HYDROGEN FURNACE

Work diameter, max.	6½″
Work length, max.	12″
Temperature, max.	1250°C
Voltage to maintain 1250°C	Approx. 22v
Kva to maintain 1250°C	Approx. 23 kva
Overall height	75″
Overall diameter, heater	17″
Overall diameter, cooler	12″

Heater elements: 15 Tungsten rods, .050″ dia. x 40″ long, connected in parallel.

Time to raise furnace and work to 1000°C: Approx. 17 minutes.

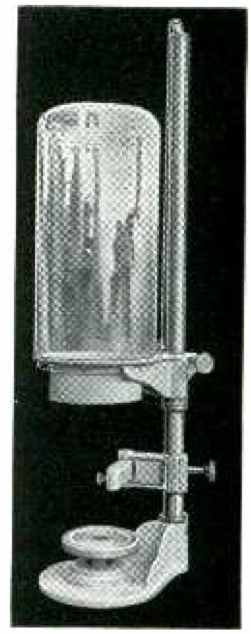
GLASS BAKING OVENS



Litton Glass Baking Ovens are circular and easily mount in any exhaust position. Heating is by Calrod units and ovens are designed for continuous operation at 500° C. Oven models 2, 3 and 4 can be operated in either series or parallel. Ovens range from 5″ to 12¾″ in diameter, and 12″ to 18″ in length. Complete details and prices for all models will be supplied on request.

MODEL 5301 BELL JAR

For smaller brazing problems, Litton table-top Bell Jars offer maximum convenience and speed. Visibility through the all-glass jar simplifies alignment and positioning of the work. Vertical movement of the bell is lightened by a counterweight inside the supporting column. Work stand height is variable, and the heater rod can be adjusted and locked in position.



SPECIFICATIONS—MODEL 5301 BELL JAR

Base	11½″ x 16½″
Column height	56¾″
Heater stand, height	23½″
Heater stand arm (extended length)	10⅝″
Heater stand, vertical travel	12″
Work stand extensions	2″, 4″, 6″, 8″ and 12″
Jar diameter	12″
Height	24″
Travel of jar	28½″

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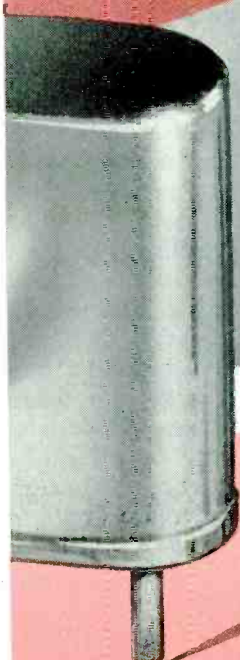

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CARLISLE 2, PENNSYLVANIA

LICENSED UNDER PATENTS OF THE BELL SYSTEM approximations do not hold true but the errors involved are not serious.

REFERENCE

(1) Semiconductor Diodes, ELECTRONICS, p 112, March 1951.

Vibrating-System Decay-Constant Measurement

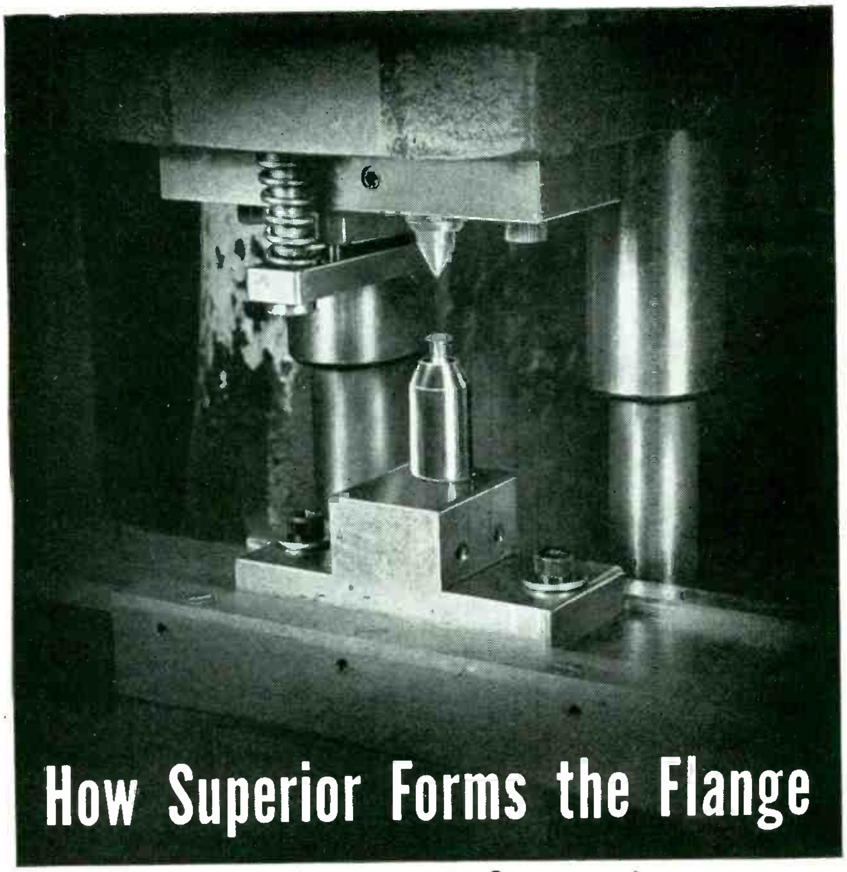
AN INSTRUMENT developed at the National Bureau of Standards, measures the time of decay of mechanical and electrical vibrating systems within the range from five seconds to five milliseconds or less with an accuracy of one-half percent.

The device was developed specifically to study internal losses in quartz as a function of temperature and relaxation effects in the alkali halide and other crystals. The instrument may be used to study mechanically vibrating systems by attaching an electromechanical transducer, such as a quartz plate resonator, to the device to convert the energy from mechanical to electrical. By using auxiliary equipment, further applications are possible for the measurement of the time constant of phosphors, photocells and other phenomenon involving exponential decays.

The method used involves a voltage-amplitude comparison, in which the time for the falling exponential waveform to pass from one known voltage to another is measured. A pair of identical circuits, Fig. 1, amplifies, differentiates and shapes the decaying voltage into pulses that are used to trigger a precision counter chronoscope.

The two circuits are alike except for different reference voltages controlling the time of initiation of the triggering pulses through each circuit. One reference voltage controls the starting pulse, which is passed through the circuit to the chronoscope when the input voltage reaches a selected value. The other reference voltage passes the stopping pulse on to the chronoscope when the input voltage has decayed to the second selected value.

An essentially ripple-free decaying waveform is impressed on one of the cathodes of a 6AL5 twin



How Superior Forms the Flange

to give you better tube performance

● What do you expect when you order a tubular part with a flare or flange at one or both ends?

Certainly you expect that the over-all dimensions of the part will be within certain close tolerances. You expect that the flange or flare will be the only distortion in the tube. You want the flange dimensions and the flare angle to be within the limits established in your specification. You must be assured that the worked areas will be free from cracks, pits and breaks. You probably hope that the working has not set up unrelieved stresses to result in premature failure of the part.

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This isn't a matter for boasting. The ability to deliver flared and flanged parts to meet these basic requirements is just a part of our job, made possible by our long experience and extensive, highly-developed equipment for performing just such operations.

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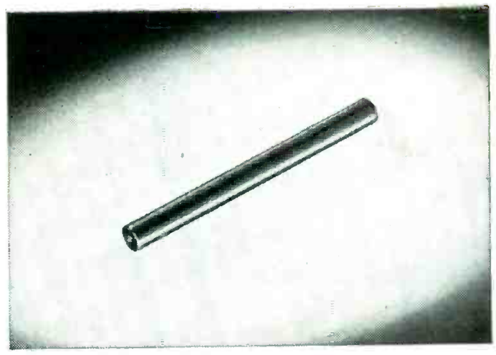
If you are a manufacturer or experimenter in electronics and have need for a tubular part, whether it be a simple cut and tumbled tube, a flared or flanged part, rolled or bent, machined at either or both ends or drilled in one or more places, tell us about it. We can probably help you and we're always glad to do so. Write Superior Tube Company, 2500 Germantown Ave., Norristown, Penna.



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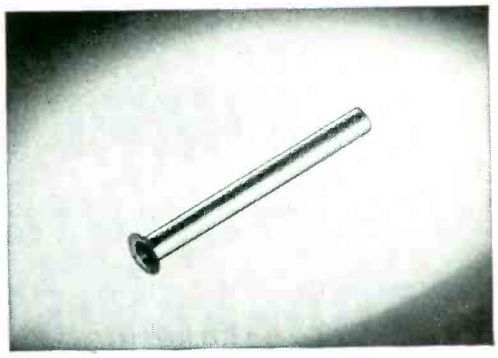

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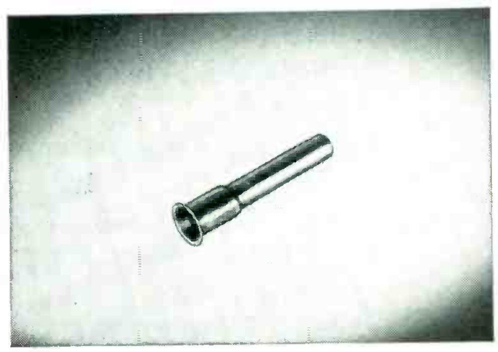

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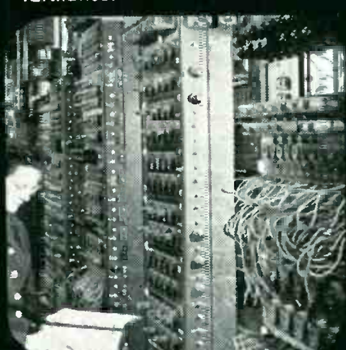

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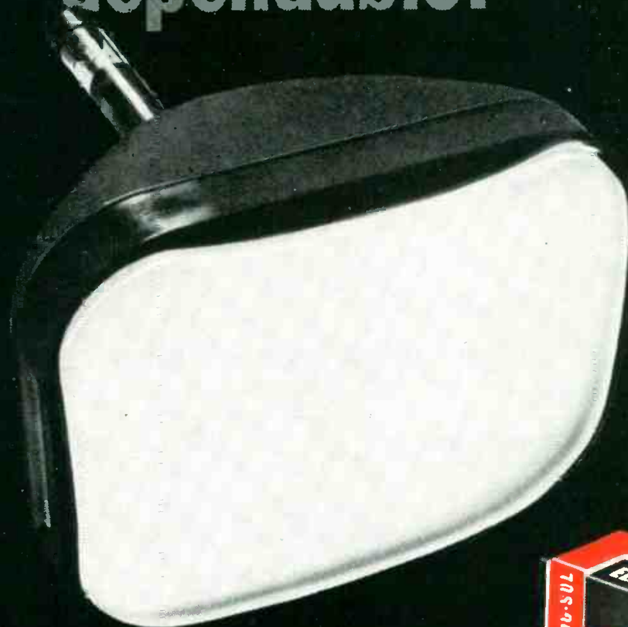

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diode through the primary windings of a pulse transformer. The anode of the tube is held at about 45 volts. As long as the cathode potential, decreasing with the decaying waveform, exceeds that of the anode, no conduction takes place. When the cathode and anode potentials become equal, a small current flows in the diode circuit and a voltage appears across a differentiating circuit in the grid of a 6BA6 high-gain pentode amplifier. This voltage is amplified and its phase is inverted by the pentode.

The amplified pulse is impressed upon the cathode of the diode through a capacitor and the secondary of the pulse transformer. The combination of tube and transformer phase inversion, drives the cathode voltage lower and increases the difference in potential between it and the anode. Heavy conduction in the diode then takes place within a short time after the small initial pulse appears. A sharply rising oscillatory wave is generated within a time limit determined by the reactance in the regenerative circuit of the 6BA6.

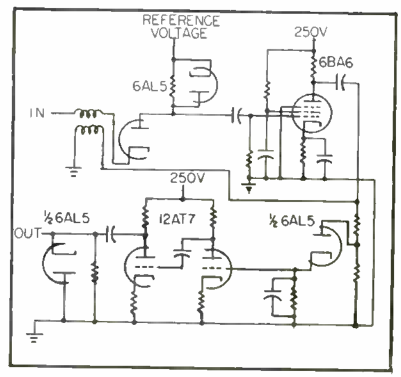
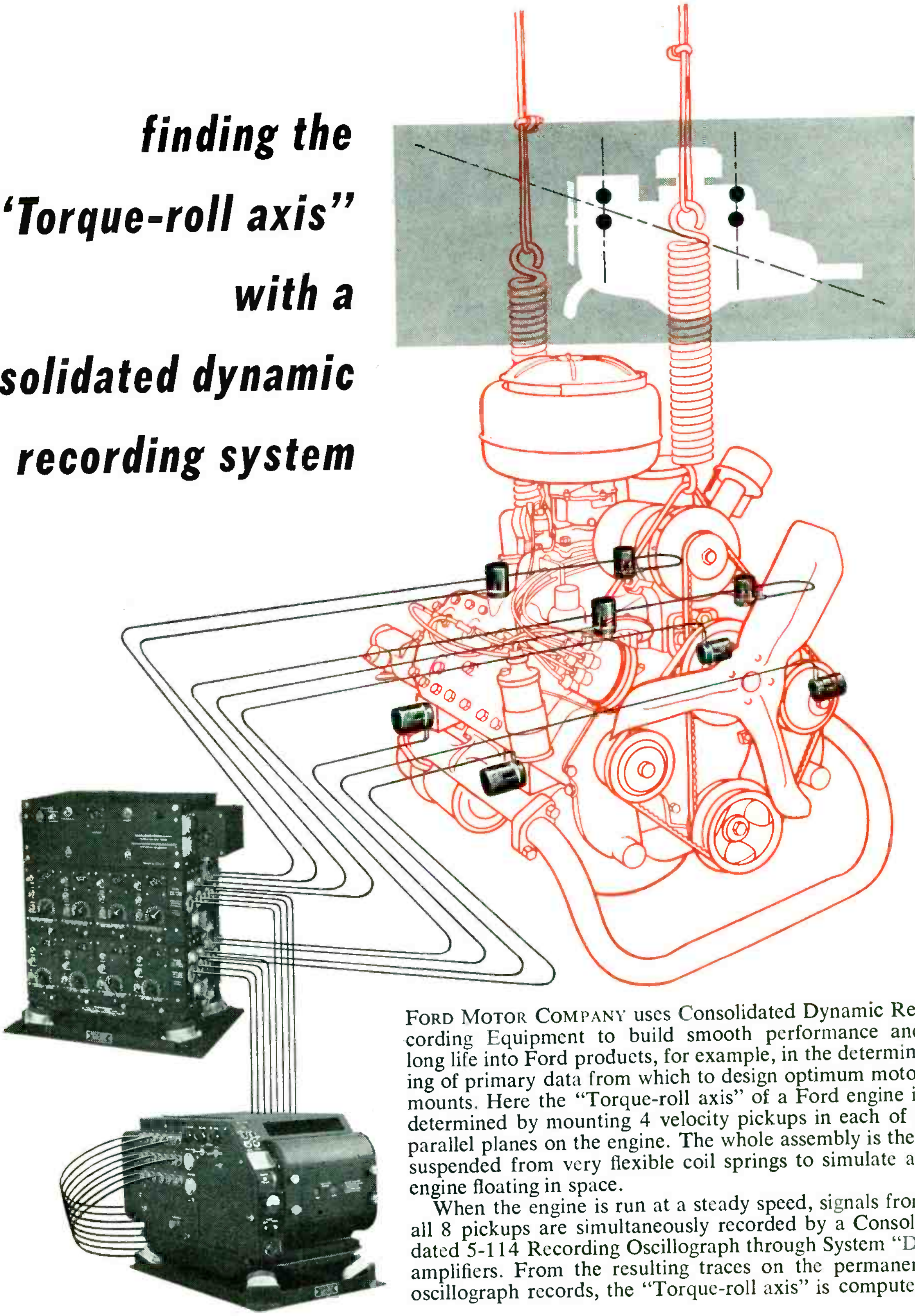


FIG. 1—Schematic diagram of one of the voltage comparison circuits

The impedance level at the anode of the 6BA6 is high and any loading of the circuit adversely influences the speed of response of the complete circuit. The circuits following this type of regenerative voltage comparator convert the waveform into a single pulse at an impedance level suitable for triggering a precision counter chronoscope.

A diode rectifier, one-half of a second 6AL5, of short time con-

finding the "Torque-roll axis" with a Consolidated dynamic recording system



Ford Motor Company uses Consolidated Dynamic Recording Equipment to build smooth performance and long life into Ford products, for example, in the determining of primary data from which to design optimum motor mounts. Here the "Torque-roll axis" of a Ford engine is determined by mounting 4 velocity pickups in each of 2 parallel planes on the engine. The whole assembly is then suspended from very flexible coil springs to simulate an engine floating in space.

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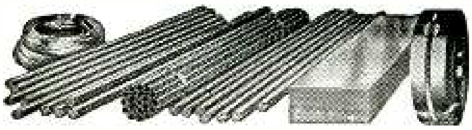

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COPPER ALLOY BULLETIN

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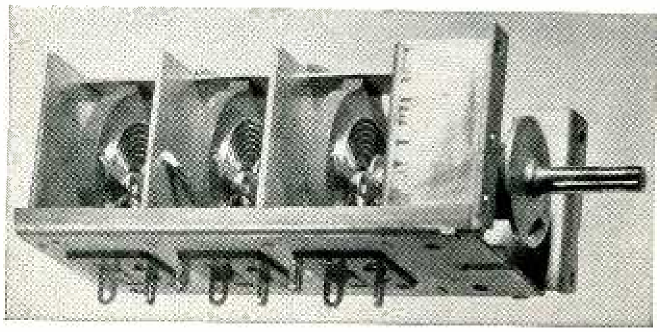


VHF Inductuner, courtesy P. R. Mallory & Co., Inc., Indianapolis, Indiana.

Designers of Electronic Components Prefer Copper Alloys

The complexity of modern radio and television equipment has radically affected the design of component parts. The electronic parts manufacturer, through careful design and choice of materials, is continually seeking methods for reducing the size and cost of his parts and to improve their quality.

VHF Inductuner®

The illustrated, compact, highly efficient Inductuner consists of three small spiral wound coils ganged together. The inductance of each is simultaneously varied by rotating a common insulated shaft. Three silver-plated brass collars are clamped to the shaft. Riveted to each is a silver-plated, movable contact arm with a grooved tip which follows the spiral of the coil, pivoting as the diameter of the coil changes. A stationary contact arm maintains constant pressure against one side of the rotating collar. This contact arm is riveted to a brass input terminal. The other input connection is made through another brass terminal which is soldered directly to the inside end of the coil.

All brass parts are silver-plated to improve conductivity and resistance to corrosion. Being non-magnetic, they do not affect the magnetic field around the coils.

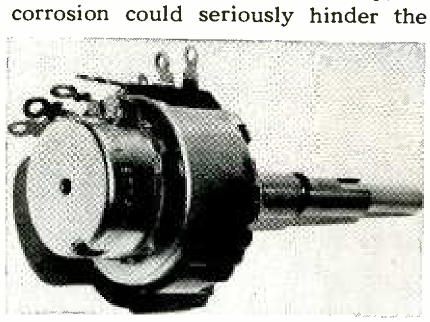
A free-cutting brass bushing, fastened to the frame, serves to guide the shaft and also acts as a spacer, positioning six metal stops. To keep the stops from separating, a brass washer, spring temper, exerts a slight pressure against them.

Brass Shaft Combines Potentiometers

Two separate circuits can be mechanically controlled by using a dual potentiometer for space saving and cost reduction. The front unit is operated by a hollow brass shaft made from free-cutting brass rod (alloy 6). The rear unit is operated by a solid shaft which passes through the hollow brass shaft. Both shafts are contained within a threaded free-cutting brass bushing which is used to fasten the dual potentiometer to the chassis.

The excellent machinability of free-cutting brass rod allows the bushing and hollow shaft to be held to close dimensions minimizing any play between the parts. At the same time, the low coefficient of friction of leaded brass prevents binding.

Within each unit a spring brass, silver-plated contact rides on a resistance strip exerting a uniform pressure as it is rotated. Any variation in conductivity due to variations in pressure, scratching of the resistance strip, or corrosion could seriously hinder the proper operation and life expectancy of the unit.

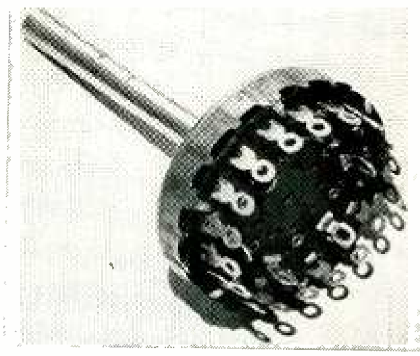


Dual Potentiometer, courtesy P. R. Mallory & Co., Inc.

Compact Rotary Switch

This 6-pole, 3-position rotary switch is compactly designed for maximum efficiency and long life. Mounted on a stationary laminated phenolic disc are 24 contacts made of Cartridge Brass (70% copper, 30% zinc), silver-plated for lower contact resistance.

Six small phosphor bronze, Grade A (95% copper, 5% tin, 0.15% phosphorus), silver-plated, movable spring contacts are located on another laminated phenolic disc which in turn is fastened to the shaft. When the shaft is rotated, the movable contacts bridge across the stationary contacts making and breaking the different circuits.



Rotary Switch, courtesy P. R. Mallory & Co., Inc.

A heavy phosphor bronze spring, fastened to the shaft, is designed to exert a constant pressure against the casing. Indentations on the casing index the shaft rotation to conform to terminal locations. A 3/8-inch threaded bushing made from free-cutting brass rod is used to mount the switch.

Copper-Base Alloys — For Highest Quality

For highly functional, longer-lasting parts, copper-base alloys offer many advantages. The slight difference in cost, if any, is infinitesimal when figured on a unit cost basis. On the other hand, false economy or incorrect choice of materials will greatly reduce the life span and jeopardize the operation of the entire unit. Our laboratory will be glad to work with fabricators to help choose the proper copper-base alloys for specific needs. (9108)

ADLAKE RELAYS AT WORK —One of a series of advertisements on specific ADLAKE installations.

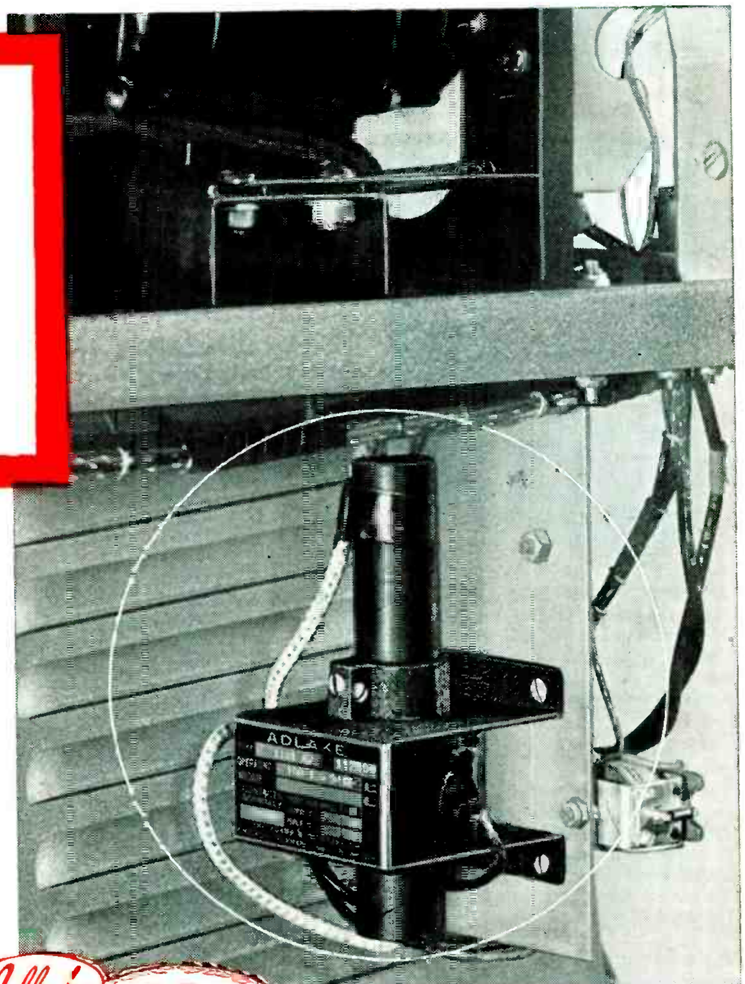
For DUPLICATING DEPENDABILITY

THERMO-FAX uses Adlake MERCURY RELAYS

In Minnesota Mining & Manufacturing Company's *Thermo-Fax* Duplicator, pages are copied by means of infra-red light. The relay which functions in the control circuit and governs the infra-red light must provide reliable, maintenance-free operation . . . and such a requirement calls for ADLAKE Mercury Relays!

The same engineering skill that assures dependability in this installation is available for *your* relay problems. ADLAKE engineers will be happy to work with you on questions of relay design and application. If you don't find the relay you need in the ADLAKE relay catalog, it will be custom-built for you.

Write today for your free copy of the illustrated ADLAKE Relay Catalog—no obligation, of course. Address The Adams & Westlake Company, 1107 N. Michigan, Elkhart, Indiana.



Controls of the *Thermo-Fax* Duplicator, showing the No. 1101 ADLAKE Relay used in this installation.

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Every Adlake Relay Brings You These Advantages:

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stant, is connected to the anode of the pentode amplifier to convert the input oscillations into a step function containing only a slight ripple. This impulse waveform is amplified in a two-section rise-rate triode amplifier that further increases its speed of rise. Another differentiating circuit and an overshoot diode clipper complete the output section.

The decaying waveform is applied simultaneously to a second circuit, similar to the one described. The second circuit differs from the first in that the reference voltage on the anode of the comparison diode prevents the circuit from functioning until the input voltage has decayed to a lower value than in the first circuit, usually $22\frac{1}{2}$ volts. The output pulse of the second circuit is then used to stop the chronoscope. The time difference between the 45-volt triggering and the $22\frac{1}{2}$-volt stopping pulses is a measure of the damping coefficient of the vibrating system.

Low-Cost Variable Phase Shifter

By Sidney Wald
Baltimore, Md.

Precision and linearity in a continuous phase shifter are not always as important as low cost and ready availability of components. This article describes how a circuit using a tapped potentiometer having any convenient range of mechanical rotation may eliminate the usual synchro resolver and yet perform a creditable phase-shifting job.

Referring to Fig. 1, the manual control consists of a linear resistance potentiometer having three

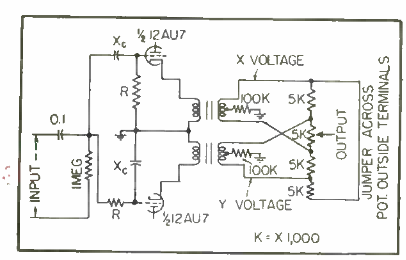
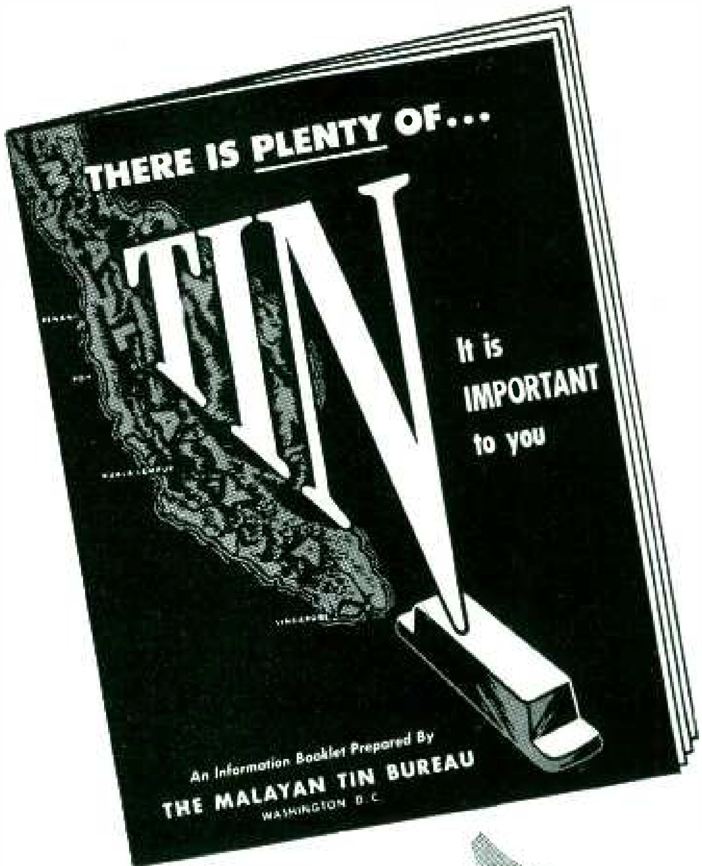


FIG. 1—Schematic diagram of the phase shifter



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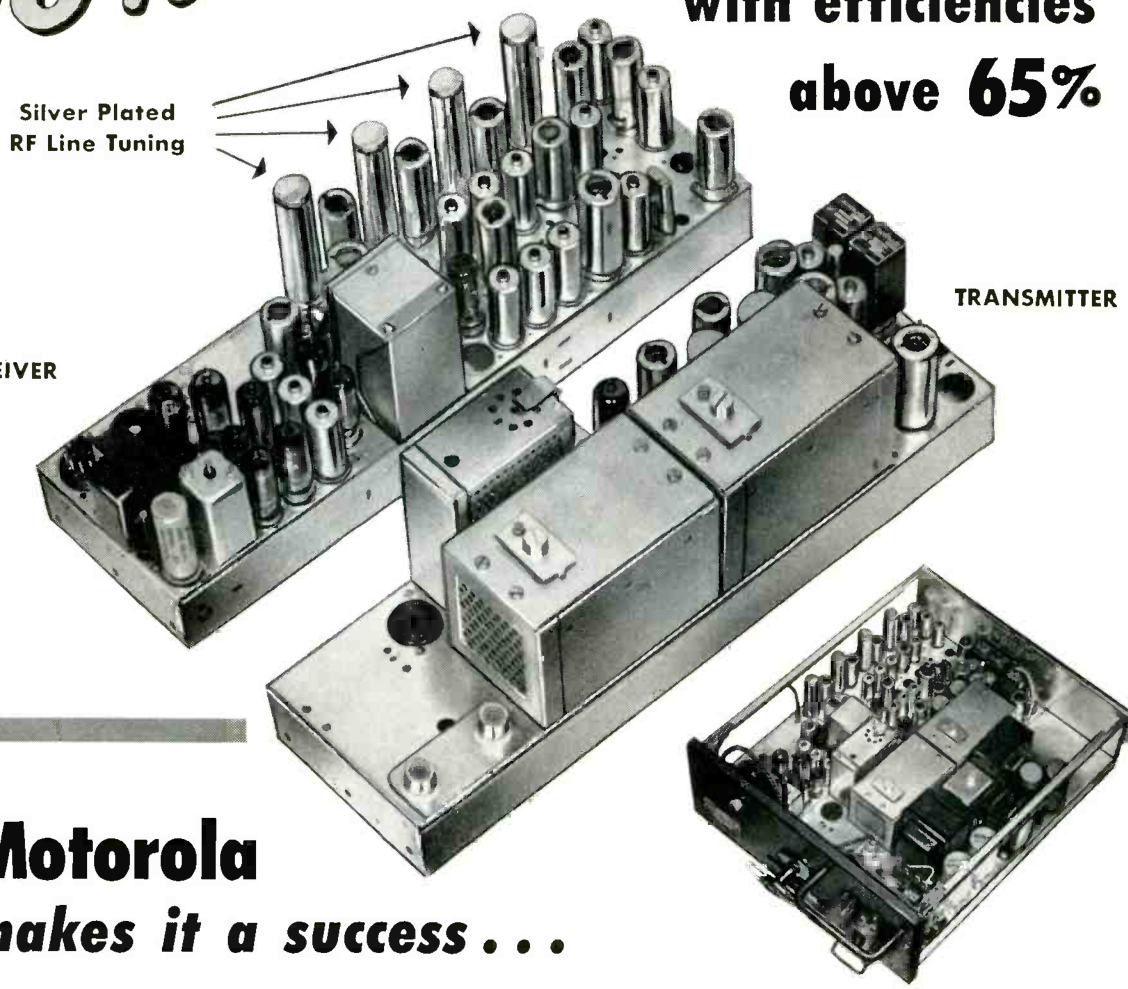

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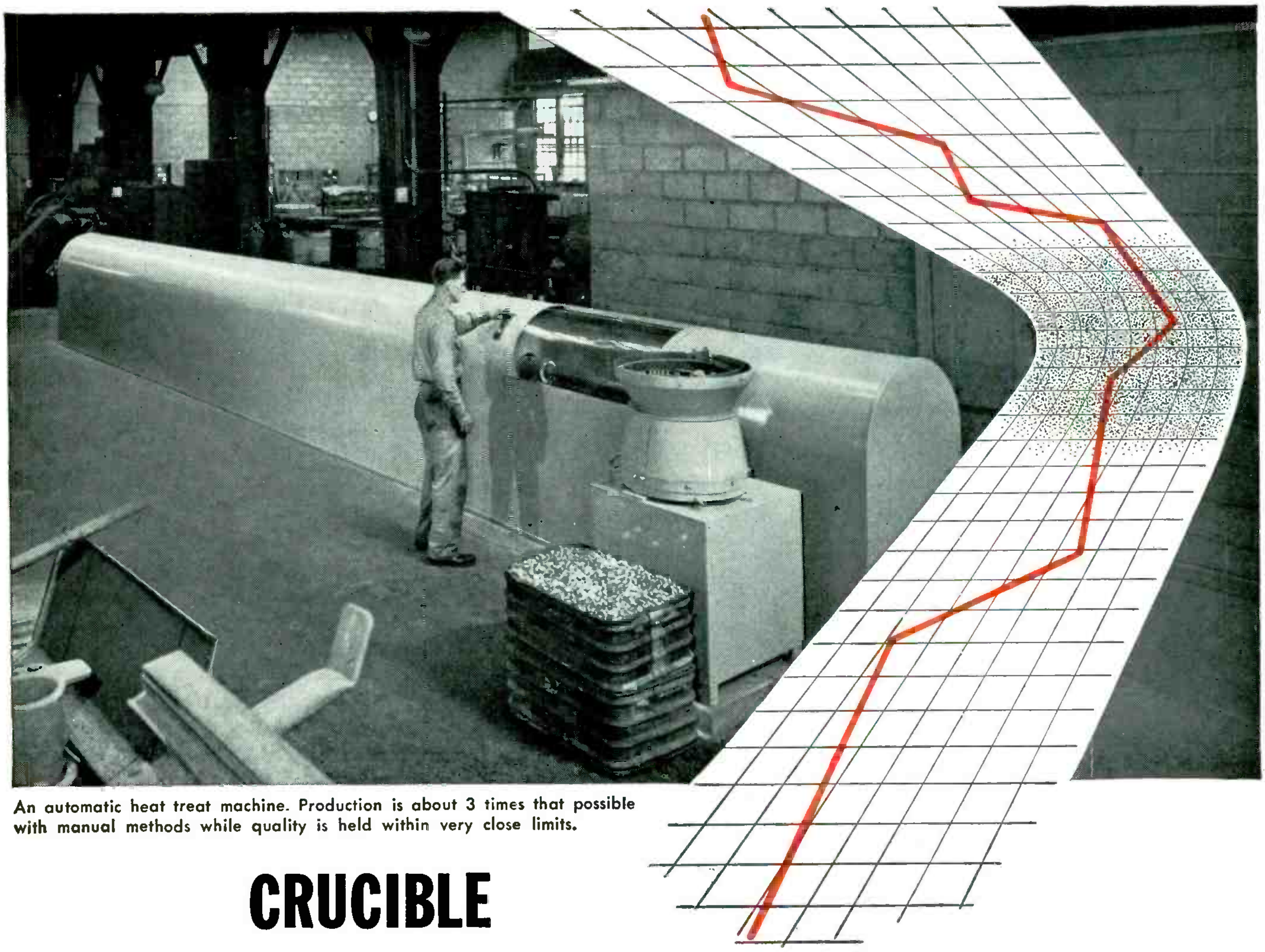

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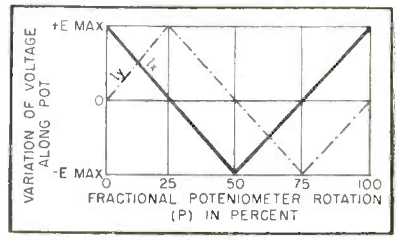

FIG. 2—Component voltage distribution along potentiometer

equally-spaced taps, dividing the resistance element into four equal sections.

The sections are fed in overlapping fashion with fixed 90-deg voltages from a simple R-C phase splitter and cathode follower. The output voltage is the sum of the component quadrature voltages existing at any point along the potentiometer.

Since the variation of voltage along the potentiometer is discontinuous, as shown in Fig. 2, if the circuit is analyzed from 0 to 25 percent rotation (first tap), the balance of operation may be understood by analogy.

If E_{max} is the voltage between ground and any potentiometer tap, and p is the fractional rotation of the rotor, then from 0 to .25 percent rotation, the following equations hold

$$e_x = p\left(\frac{-E_{max}}{0.25}\right) + E_{max} \quad (1)$$

$$e_y = p\,\frac{E_{max}}{0.25} \quad (2)$$

The pick-off voltage at any point on the potentiometer between 0 and 25 percent rotation is the vector sum

$$e_{out} = e_x + j\,e_y \quad (3)$$

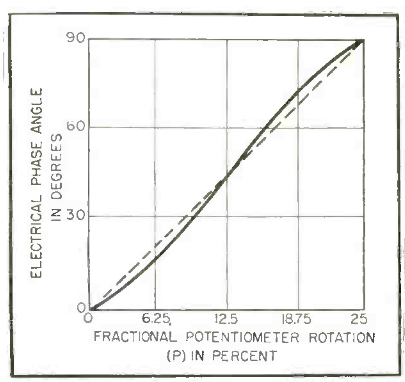

FIG. 3—Variation of output phase angle with potentiometer rotation. Curve repeats for every 25-percent rotation

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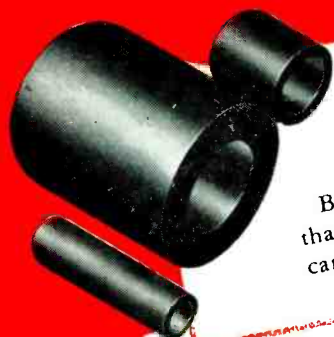

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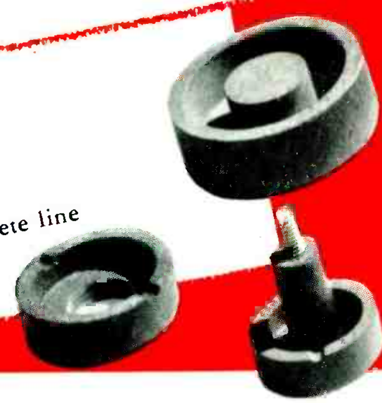

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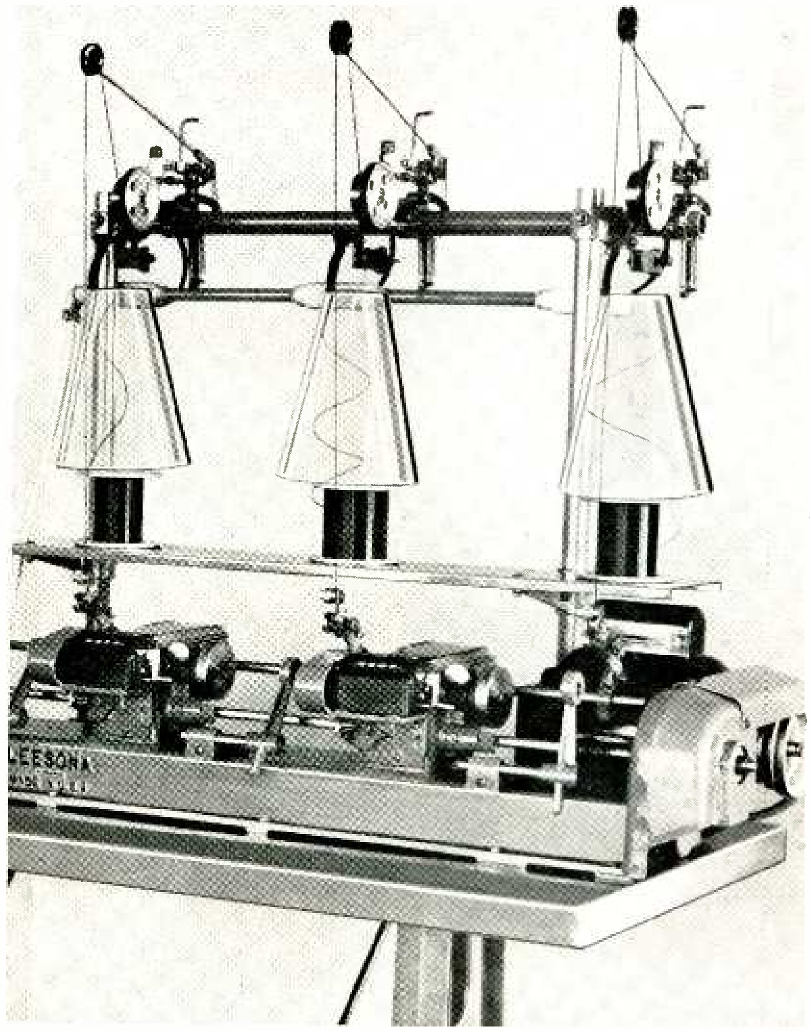

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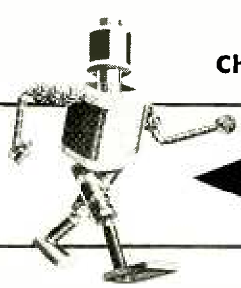

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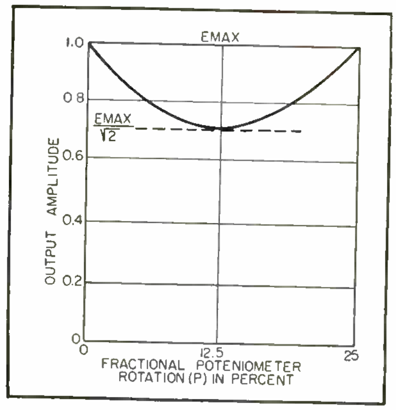

FIG. 4—Variation of output voltage amplitude with potentiometer rotation.

$$e_{out} = p\left(\frac{-E_{max}}{0.25}\right) + E_{max} + j\,p\,\frac{E_{max}}{0.25} \quad (4)$$

The phase angle of the output voltage is given by

$$\phi = \text{arc tan}\,\frac{e_y}{e_x} = \frac{p\,\dfrac{E_{max}}{0.25}}{-p\,\dfrac{E_{max}}{0.25} + E_{max}} \quad (5)$$

which can be simplified to

$$\phi = \text{arc cot}\,\frac{0.25}{p} - 1 \quad (6)$$

The variation of ϕ with rotation p is shown in Fig. 3. The amplitude of the output voltage

$$e_o = \sqrt{(e_x)^2 + (e_y)^2}$$

$$= E_{max}\sqrt{\frac{2p^2}{0.0625} - \frac{2p}{0.25} + 1} \quad (8)$$

The variation of e_o amplitude with rotation p is shown in Fig. 4. Figure 5 is a vector representation of the components e_x and e_y as the rotor of the potentiometer moves from zero to full range.

Selection of potentiometer resistance is not critical provided it is large compared to the impedance of the transformer secondaries. The

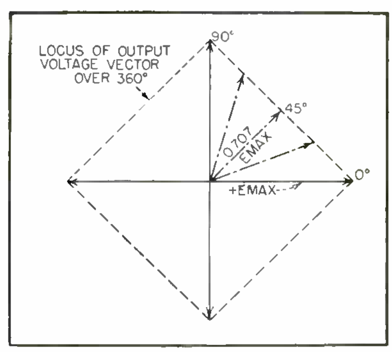

FIG. 5—Vector addition of voltage components

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function of the resistor in the center tap of each transformer secondary is to improve the accuracy of the summation of the component voltages by more completely isolating the secondaries from one another.

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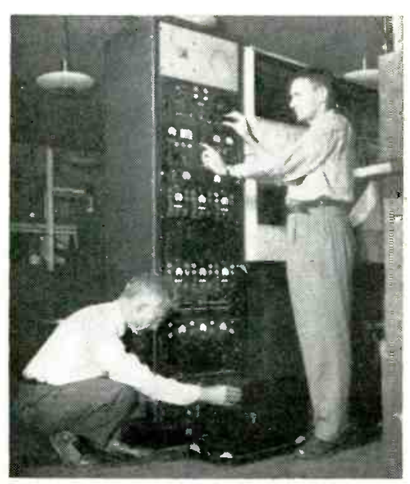
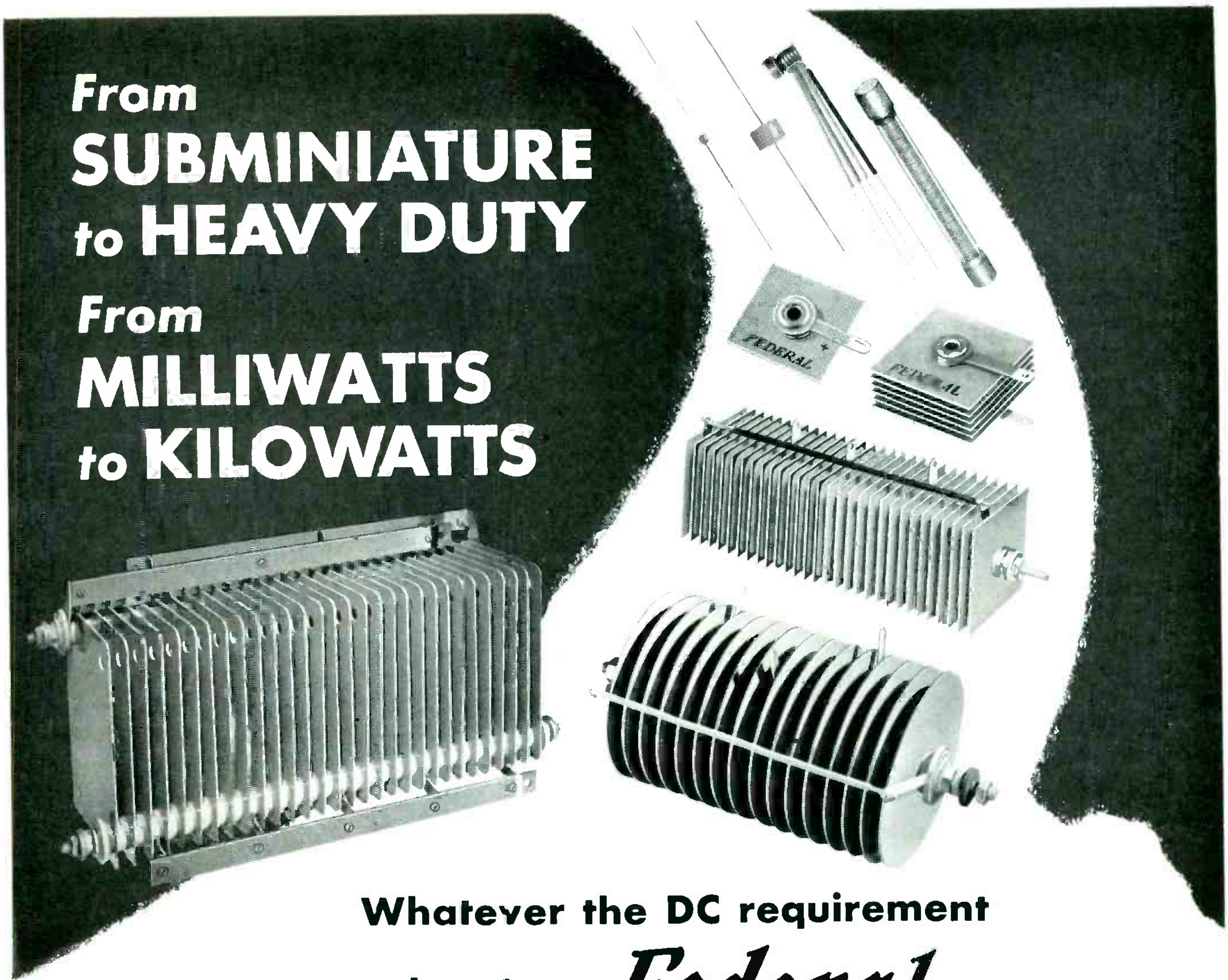
No unusual effects from the flight were experienced by the monkeys and mice although they were subjected to a brief initial acceleration



Final inspection being given to the electronic telemetering equipment used to record various reactions of animals used in the high-altitude rocket ascent



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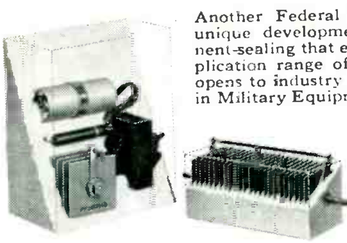

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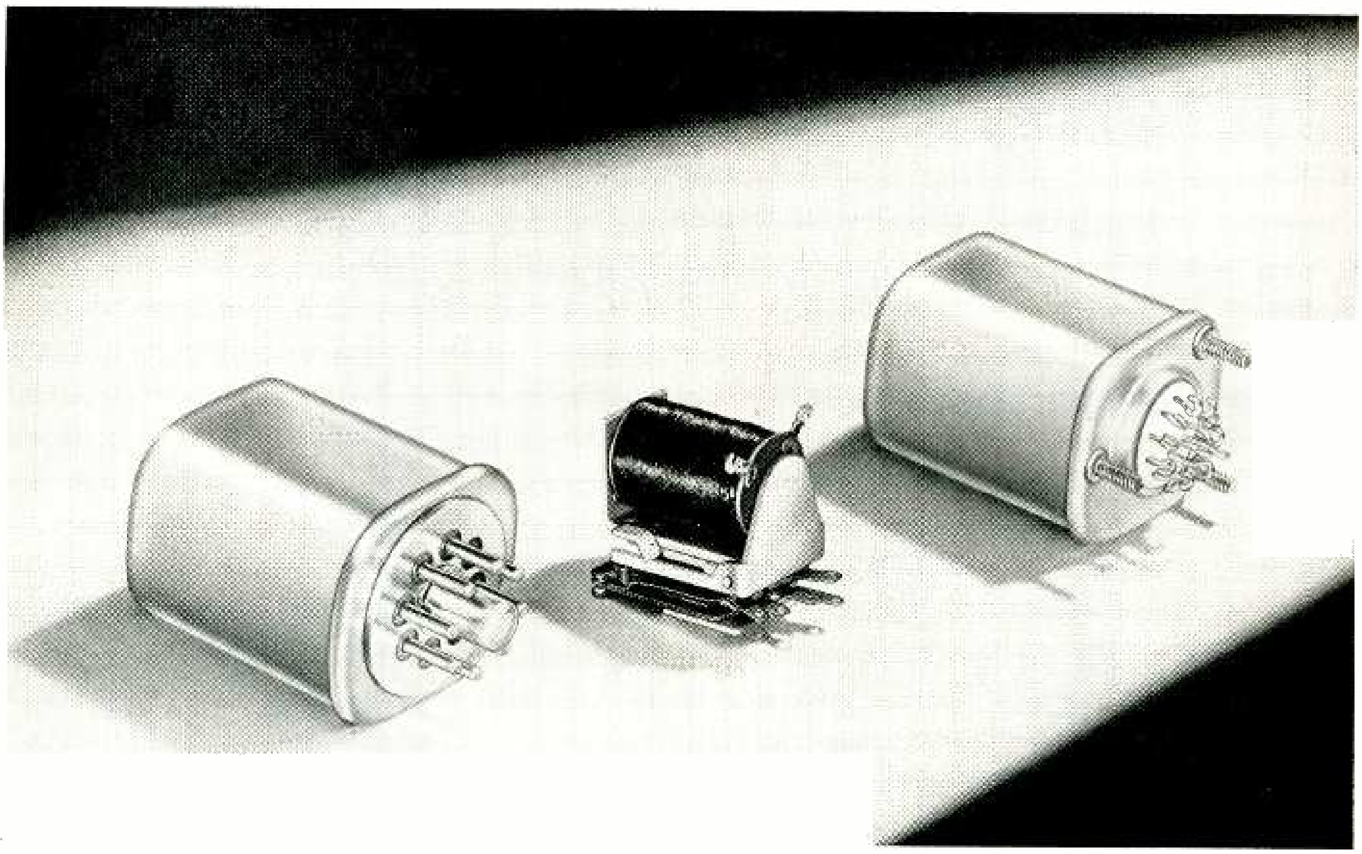
of about 15 g, lasting less than one second, and a longer force of 3 to 4 g, lasting for 45 seconds. During the flight, the monkeys were anesthetized to prevent their disturbing the instrumentation necessary to record the physiological reactions.

During the rocket flight and the periods of zero gravity, the mouse in a smooth drum, floating free, appeared to have completely lost his senses of direction and orientation and was unable to direct his movements normally. The mouse in the drum containing a small shelf was able to cling to the shelf, orient himself and command his body at will. These reactions, plus several human experiments in jet planes, have indicated that a man, properly secured in an aircraft, can function normally during brief periods of zero gravity and perform any operations necessary in piloting an aircraft.

Effective Cathode Impedance

By W. Chater and N. Golden
Sylvania Electric Products, Inc.
Electronics Division
Bayside, New York

In the opinion of many audio designers the effective cathode impedance for cathode by-passing is shown by the circuit of Fig. 1A and for cathode negative feedback by the circuit of Fig. 1B, where the effective cathode impedance is either R_k or perhaps R_k in parallel with $\frac{1}{g_m}$ of the tube. Calculation illus-



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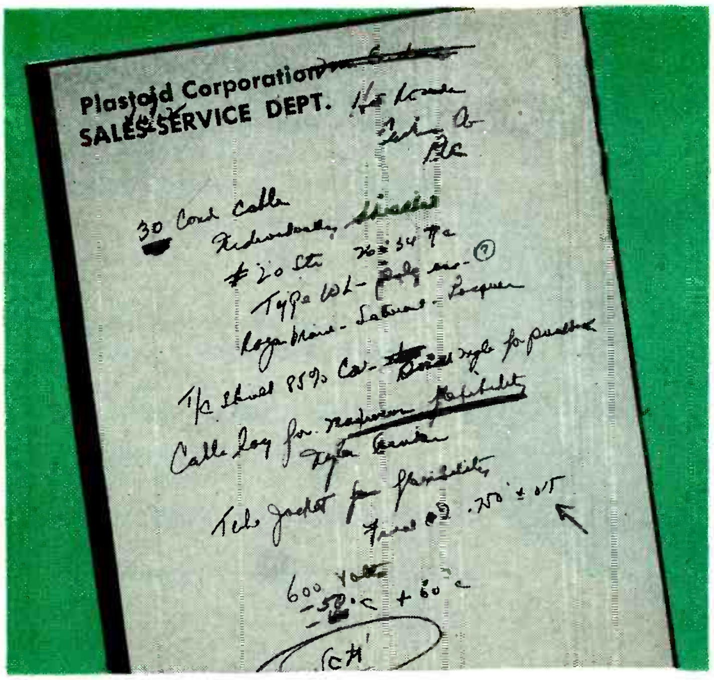

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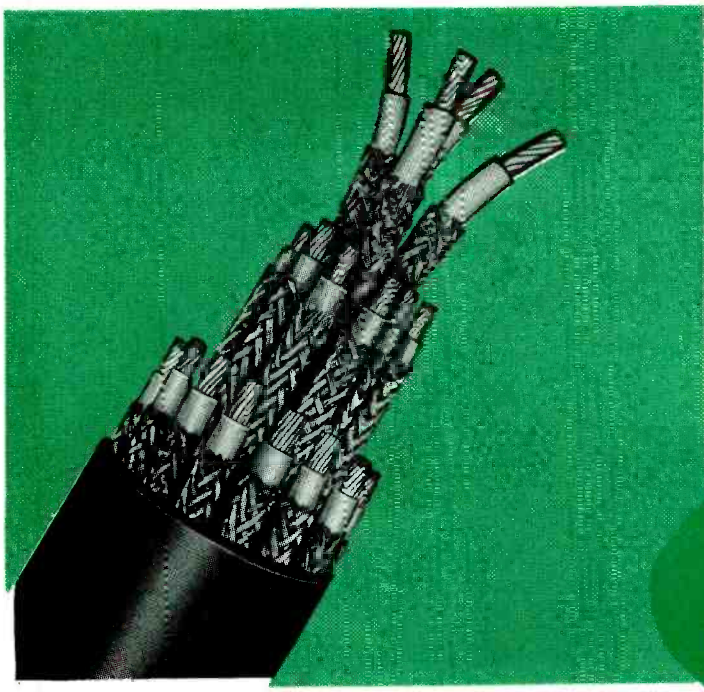

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trates the opportunity for considerable error in both cases.

The actual correct value for the effective cathode resistance is R_k in parallel with a quantity called R_m, defined by

$$R_m = \frac{r_p + R_L}{\mu + 1}$$

For example the ratio of the gain G (with a given bypass capacitor C) to G_o, that would be obtained for a completely bypassed cathode is

$$\left|\frac{G}{G_o}\right| = \sqrt{\frac{(R_{eq}/R_k)^2 + (\omega\, C_k\, R_{eq})^2}{1 + (\omega\, C_k\, R_{eq})^2}}$$

where R_{eq} is the parallel resistance

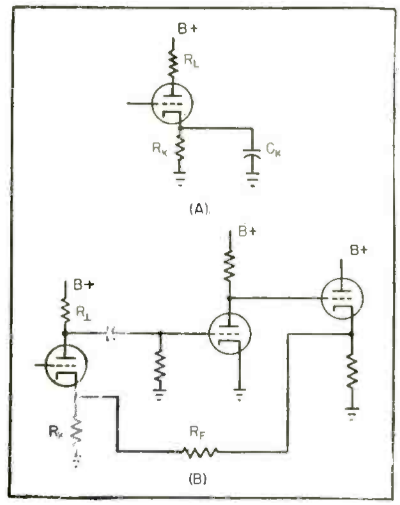

FIG. 1—Two circuits showing effective cathode impedance for cathode bypassing (A) and for negative feedback (B)

of R_m and R_k. For $\left|\frac{G}{G_o}\right| = 1$, it is required that

$$(\omega\, C_k\, R_{eq})^2 > > 1$$

If this holds then

$$(\omega\, C_k\, R_{eq})^2 > > \left(\frac{R_{eq}}{R_k}\right)^2$$

is satisfied automatically.

If typical values for low-μ and high-μ triodes and typical pentodes are put into the equation it appears that the normal practice of setting $\omega\, C_k R_k = 10$ for the lowest frequency of interest is not satisfactory if, for instance, the amplifier is to be flat $\pm\frac{1}{2}$ db down to the lowest frequency of interest.

The problem of calculating R_f, Fig. 1B, to give a certain number of db of feedback requires that the effective cathode impedance R_{eq} is related to the feedback resistor R_f such that $\frac{R_{eq}}{R_f + R_{eq}}$ gives the feedback ratio.

If $R_{eq} = R_k$ is assumed, the feedback may well be 40 percent too low. If $R_{eq} = 1/g_m$ is assumed, the feedback may well be 100 percent too high. Only if $R_{eq} = \frac{R_k R_m}{R_k + R_m}$ is used, does the calculated feedback conform to the experimentally determined feedback. Since R_{eq} should be known particularly accurately, the addition term $\frac{(R_L)}{1 + \mu}$ in R_m should be taken account of in the way suggested for good results.

Cadmium-Sulfide Crystal Rectifiers

POINT-CONTACT crystal rectifiers can be made from cadmium-sulfide as reported in a paper by Gene Strull of Northwestern University at the 1952 National Electronics Conference in Chicago, Ill.

Research was done with crystals intended primarily for use as x-ray detectors. Known properties of germanium and silicon rectifiers were used as guides. Investigations were made concerning crystal orientation, mounting method and impurity activators.

Long hexagonal cadmium-sulfide crystals were tested for rectification in the circuit of Fig 1. Single crystals or groups of crystals were used. All crystals were attached to appropriate holders by means of a commercial solution of colloidal graphite in alcohol.

It was found that crystals mounted with any orientation acted as rectifiers. Crystals exhibiting rectifying action were mounted in such a manner that there was a difference in size between the two contacts. The point-contact type of mounting, rather than a large-area contact, was necessary for rectification.

Crystals with added impurities of

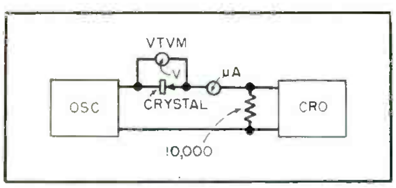

FIG. 1—Circuit used to test cadmium-sulfide crystals for rectification

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copper, silver, aluminum, indium or gallium were tested as well as pure cadmium sulfide. No difference in rectification ability was noted from one crystal type to the next. The polarity of the rectified wave was always the same, regardless of which impurity the crystal contained. All crystals were *n*-type semiconductors.

Pure cadmium-sulfide crystals had the same properties as crystals with impurities probably because of an excess amount of metallic cadmium inherently present. The excess cadmium would cause the crystal to be an *n*-type semiconductor, which accounts for the fact that all crystal types acted as *n*-type semiconductors.

Voltage tests made on the rectifiers indicated that they rectify from about 0.1 to 40 volts, with optimum rectification occurring at seven volts. With six volts applied in the forward direction and an illumination level of 30 lumens per square foot, the resistance of a typical crystal is about 100,000 ohms.

Cadmium-Sulfide Transistors

An attempt was made to construct a cadmium-sulfide transistor, but amplification was not obtained with any of the various types of connection tried. However, control was noted for each type of connection.

The main difficulty seemed to be making contact to the crystal. The output wave was a true representation of the input wave which would seem to indicate that a cadmium-sulfide transistor is possible.

Vacuum-Tube Circuits Without Plate Supplies

BY PHILIP B. CLARK
Syracuse, New York

WHILE TESTING several multivibrator circuits, it was discovered that one of them would not stop operating when the plate supply potentiometer was turned to zero. Since it was found that other circuits also operated under the same conditions, an investigation was made of the phenomenon.

Apparently, energy is trans-

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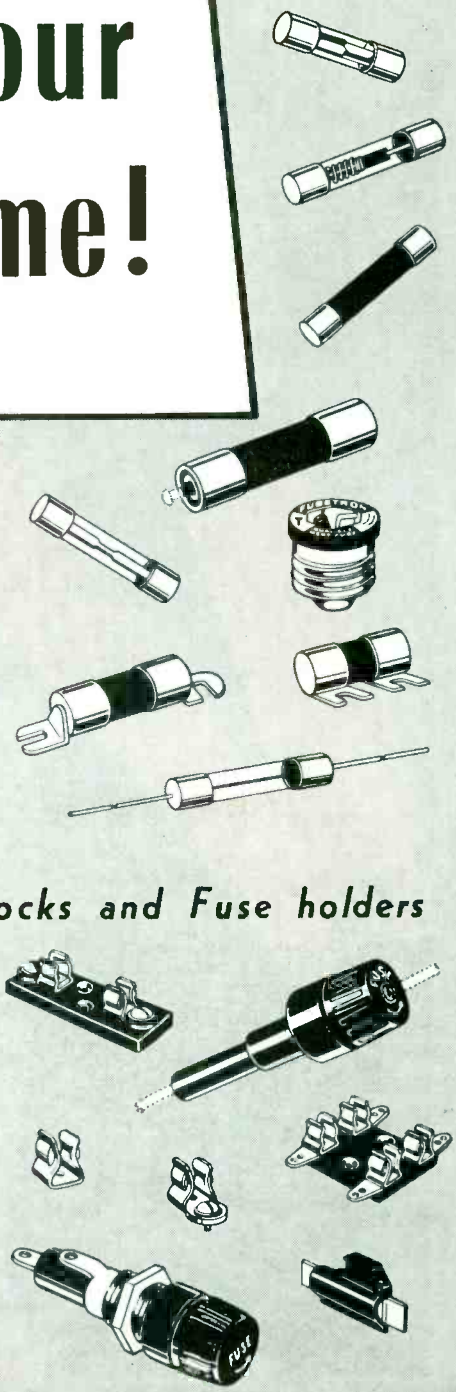

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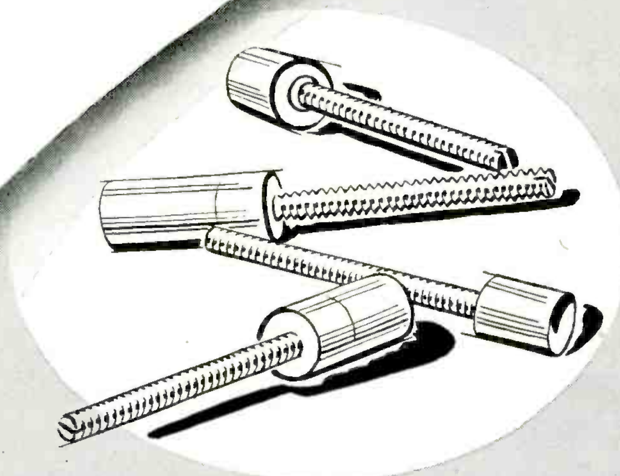

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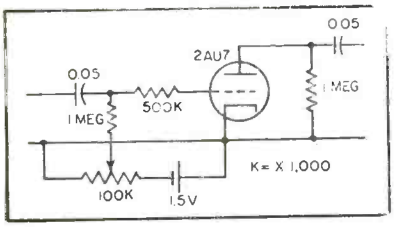


FIG. 1—Limiting circuit with zero plate supply

ferred from the heater circuit of the tube to the remaining portion of the circuit. A potential will be generated by two sources; thermal emf due to dissimilar metals in the circuit and tube and contact potential. Contact potential may be defined as the open-circuit potential measured between the cathode and the other elements of a heated vacuum tube. Voltages produced by thermal effects are of the order of 0.1 volt or less and are minor compared to the contact potential which may be as high as four volts in certain tubes.

Several circuits have been constructed using a 12AU7. One of the first applications to suggest itself was to use the tube in a limiting circuit, as shown in Fig. 1. Although the plate circuit will provide both positive and negative limiting, the positive portion of the wave is also limited by grid conduction.

If the signal is small enough to remain on the linear portion of the curve, the signal will be reproduced in the plate circuit with very little distortion. Proper biasing of the grid is essential for this type of operation. An excellent square wave will result if a six-volt sine wave is fed into the grid circuit. Alteration of the circuit values will produce clamping in the grid circuit, if desired, for special waveforms. Output is 0.75 volt.

Not greatly divorced from the

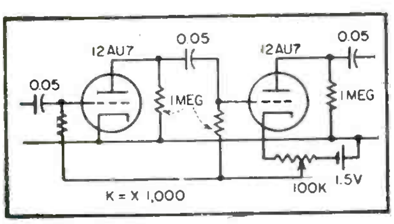


FIG. 2—Schematic diagram of a low-gain amplifier

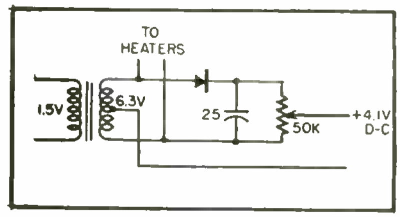


FIG. 3—Grid bias circuit incorporating a selenium rectifier

limiter is a low gain amplifier, Fig. 2, operating with very small input signal levels. Such a unit resembles a standard amplifier except for the lack of a plate supply.

Due to the high plate-load resistors, the frequency response of the amplifier is limited to the audio range. In Fig. 1 and 2, a battery shunted with a potentiometer is used to supply the proper grid bias. A more practical system utilizes the heater voltage in a divider circuit if the tube is heated by d-c. If a-c is used, a suitable single-plate selenium rectifier, Fig. 3, with a low voltage filter capacitor will work very effectively.

In the operation of a multivibrator circuit, Fig. 4, the grid is operated with a one-megohm resistor to ground. Since the grid current is appreciable when the grid potential is zero, the grid will automatically bias itself negative to approximately —0.5 volt. Under conditions involving a one-megohm load resistor, the plate voltage swings over a range of 0.75 volt which is sufficient to drive the other tube into the cutoff region. Since this is the basic requirement for multivibrator operation, no external plate supply is required.

If the plate load resistance is made too small, the total plate swing will not be enough to drive the grid of the second tube into cutoff and the multivibrator will cease operation. Decreasing the

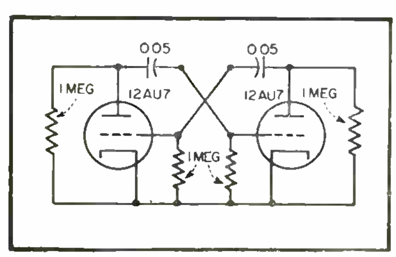
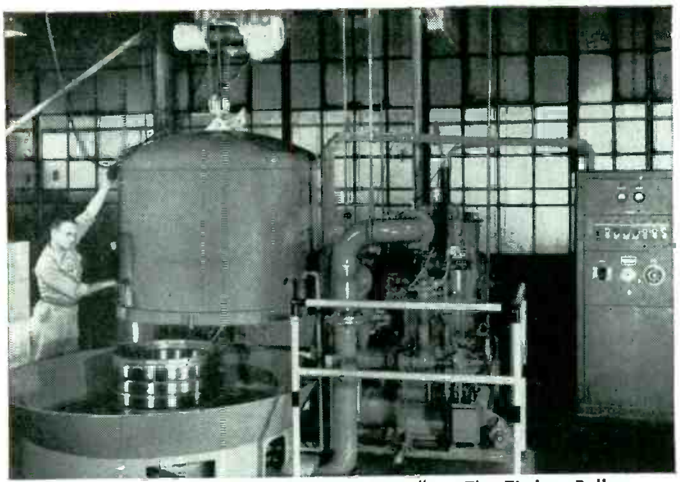
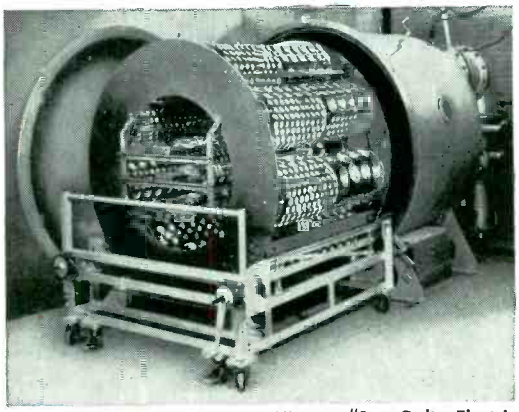


FIG. 4—Schematic diagram of a multivibrator



Kinney Vacuum Pump Case History #1 — The Timken Roller Bearing Co. uses this vacuum drier to eliminate corrosion by removing moisture from bearings.

Kinney Vacuum Pump Case History #4 — The Rauland Corporation aluminizes television picture tubes on this high speed vacuum production machine.



Kinney Vacuum Pump History #2 — Delta Electric Co. increases reflective power of lamp reflectors with this National Research Corporation vacuum coating unit.

Kinney Vacuum Pump Case History #3 — Parts are spin-tested at speeds up to 100,000 rpm in this vacuum spin pit developed by Warren Bro-hers Manufacturing Division.

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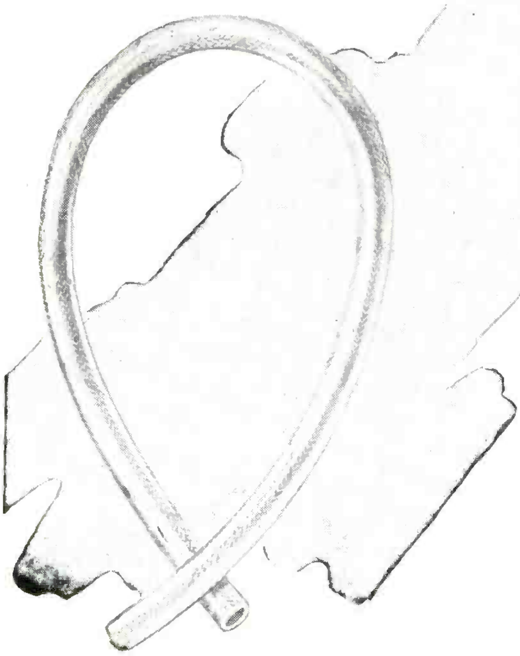

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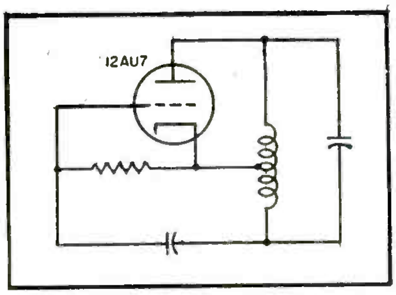

FIG. 5—Oscillator circuit which will operate either as a Hartley oscillator or a blocking oscillator

grid resistor decreases the negative bias on the grid which will also stop the operation. If a vacuum phototube is connected in parallel with one grid resistor, the audio frequency output of the multivibrator will vary as a function of the light intensity falling on the phototube.

An oscillator circuit, basically of the Hartley type with the exception of d-c blocking capacitors and a plate supply, is shown in Fig. 5. The circuit functions in the normal way and the output is an excellent sine wave. Alteration of the time constant of the grid circuit turns the oscillator into a blocking oscillator. Operation of the circuit in this manner gives output waveforms which compare very favorably with those shown in textbooks. It is not known what frequency limitation exists for this circuit. Elimination of the high plate circuit resistance opens applications in the radio-frequency range for this circuit.

Huge G-M Counter Monitors Background Count

By Russell M. Ball
Chief Engineer
Nuclear Instrument and Chemical Corp.
Chicago, Ill.

WITH INCREASING use of radioactive materials in industry and laboratories, instruments or methods are needed to prevent one series of experiments or measurements from interfering with another in the same general vicinity.

Precautions are particularly necessary when large sources of penetrating gamma radiation are being used intermittently. At this company, the problem was particularly annoying. The test section contin-

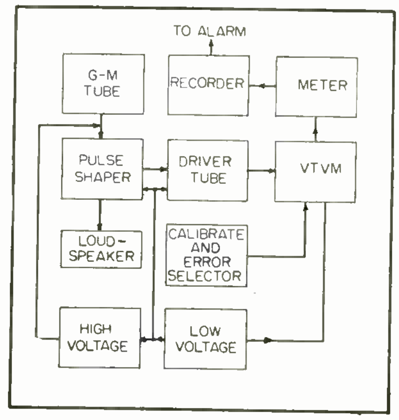

FIG. 1—Block diagram of the G-M counter monitoring system

uously replaced and removed sources from shields simultaneously to calibrate manufactured instruments. Measurements of efficiency were made on sensitive detectors in the development section and weak samples were assayed in the chemistry department. The ultimate solution was to monitor radiation continuously and have warning lights automatically flashed when background went above preset levels.

Since most troublesome radiation was from the gamma rays emitted by cobalt and radium, a simple G-M tube detector was chosen as being sufficient. The number of background counts from this tube is a direct function of its total volume. The greater the count rate, the higher the accuracy which may be obtained for a given time period. Because it was desired to have the indicator respond quickly and accurately to changes in background, this meant obtaining the largest detector practical.

The G-M tube is 24 in. long and 2 in. in diameter and is filled with a mixture of self-quenching organic gas. The high voltage for the detector and the conversion of count rate to meter deflection is done with the system shown in block-diagram form in Fig. 1.

The instrument, as shown, is capable of operating an Esterline-Angus recorder and an alarm circuit. Initially, only the recorder was used to determine what fluctuations in background were normal throughout the day. As expected, these variations were large and unshielded sources could be detected throughout the plant.

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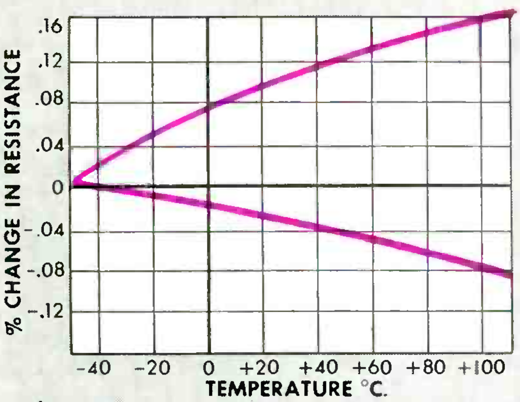

1. Analysis — Ni 74.75%, Cr 20.00%, Al 2.75%, Cu 2.50% **2.** Excellent corrosion resistance. **3.** Resistivity — 800 ohms per circular mil foot (134 microhm cm.) **4.** Temperature coefficient of electrical resistance — Plus or minus .00002 ohms per ohm per degree centigrade between minus 50°C. and plus 105°C. **5.** Thermal E.M.F. vs. Copper — .0025 mv. per degree between —50 and 105°C. (max.) **6.** Non-magnetic. **7.** High tensile strength in fine sizes — 150,000 to 200,000 p.s.i. **8.** It may be readily welded or brazed and soft soldered with special care. **9.** Available in: (a) Bare wire sizes .0009 and larger. (b) Enameled, Formex, Cotton, Silk, Nylon and glass insulated wire in sizes .0015 to .0113.

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ceptable levels were set, the level alarm was installed with indicators wired to all sections concerned. The alarm circuit was originally designed to require a manual reset when the alarm level was exceeded. As this would be an unnecessary nuisance, the circuit was modified to the one shown in Fig. 2. The essential change is the addition of the thermal-delay switch.

If the level exceeds the limit set, even for only an instant, the warning lights turn on for a period of about 15 seconds (the warmup time of the thermal-delay relay). If, at the end of this time, the radiation level has not fallen to normal, the

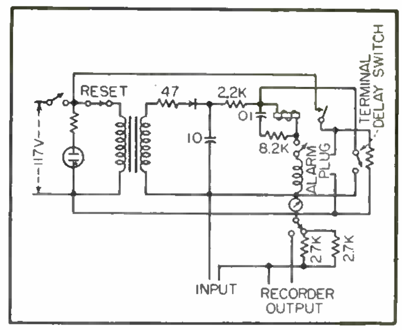

FIG. 2—Modified alarm circuit incorporation a thermal-delay relay and switch

thermal relay makes and breaks intermittently and randomly. Random flashing of the light continues until the radiation level has fallen to normal.

After a period of time in use, it was found that certain groups were affected by only extremely high background and only needed warnings when levels became quite high. However, this required only an additional alarm circuit with the alarm contacts set at the appropriate level and with an additional set of alarm lights installed.

In this system, the recorder may be removed with only the loss of a continuous record of the background. Fortunately, the alarm contacts provide 110 volts when closed and all manner of bells or other signal devices may be operated.

The device uses standard instruments and has been shown to be very reliable in continuous operation. It should prove valuable to

laboratories and industries where variations in radiation background interference is troublesome.

Mobile Radio Aids Hawaiian Sugar Industry

MOBILE radio telephone systems are proving valuable time and money savers on 13 plantations of Hawaii's $175,000,000 cane sugar industry.

Because of the large areas involved and the extensive mechanization of the plantations, adequate communications prior to the use of the systems were impossible. With the installation of mobile radio systems in their cars, key personnel are able to keep in constant touch with all phases of operations.

Most units installed on Hawaii's plantations are manufactured by General Electric and Motorola.

Units first installed operated in the 150 to 172-mc band at 20 watts. Due to the rough terrain of the islands, many dead spots were found and coverage was increased considerably by utilizing the 40 to 50-mc band at 30 watts.

Fixed stations use remote-controlled transmitters running 50 or 60 watts. Antennas are usually installed on top of the sugar mills which are about 60 to 70 feet high. Antennas are of the half-wave coaxial type.

Remote control units enable the central station to be controlled from several locations. The master remote control unit is sometimes located at the truck dispatcher's office, the hub of transportation operations. A secondary remote control unit is located in the factory superintendent's office. From both locations, dispatchers can contact or receive calls from mobile units in supervisors' cars.

Frequencies used are authorized by the FCC for industrial users. At these vhf frequencies, danger of atmospheric disturbances and dead spots due to the reflection or refraction of the radio waves is minimized.

Before installing the mobile-radio systems, engineers make extensive surveys to tailor the system to par-

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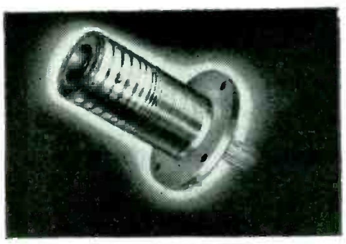

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Operator shown sending a dispatch to mobile units

ticular needs and topography of the plantations. Field surveys are conducted to obtain field-strength measurements and other engineering data to determine the optimum locations for the central station, remote receivers and antenna. Field surveys also substantiate computations obtained by analyzing topographical maps of the area and taking into consideration equipment characteristics and performance. This assures that all equipment will be placed and used to its best advantage.

One plantation, whose installations cover about 40 miles, has six remote-control units so a person can talk from any of the six points to mobile units. These remote-control units are seven or eight miles from the main transmitter. The remote dispatch controls are connected to the main station by single twisted pairs of telephone lines.

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EXTENSION of microwave gas-absorption investigations to a low range of frequencies is made possible through the development of a coaxial absorption cell by the National Bureau of Standards.

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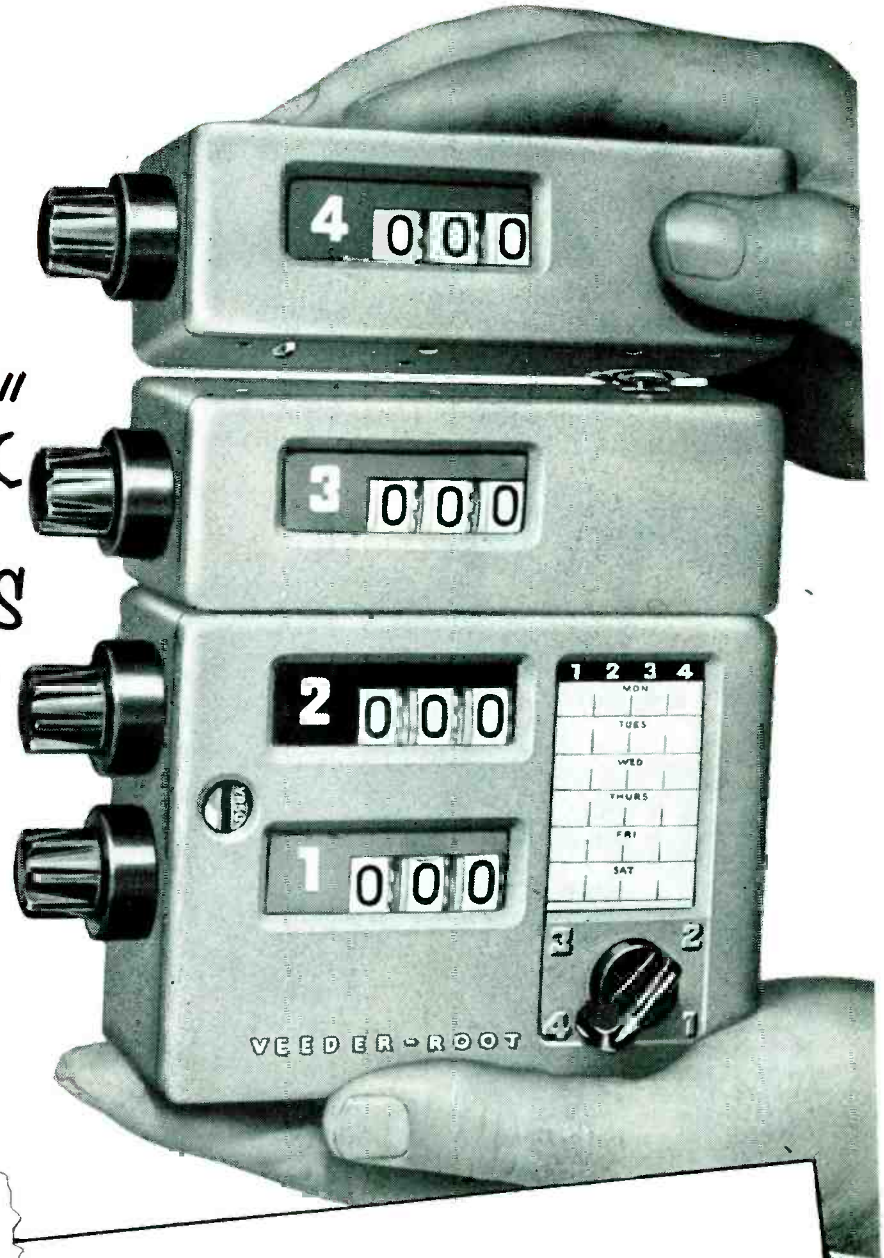

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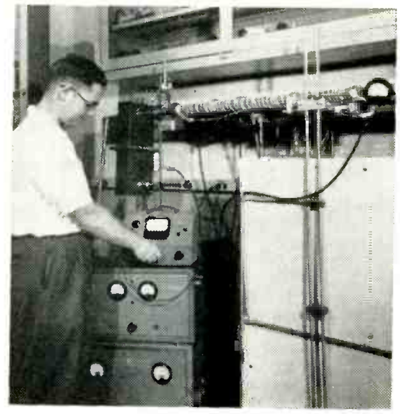

Operator shown adjusting the gain of the detector amplifier

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A transverse field is set up by the applied Stark voltage and alters the absorption frequencies of the enclosed gas molecules. When the microwave energy alone is impressed on the cell, the slight absorption which occurs as the frequency is varied through the resonant frequency of the gas is difficult to observe. Presence of the Stark field, applied and removed at some predetermined rate, causes a corresponding alternation in the gas absorption and is more easily detected.

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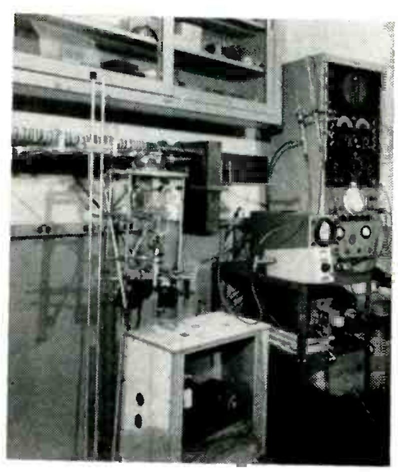

Input end of the microwave spectrograph absorption cell

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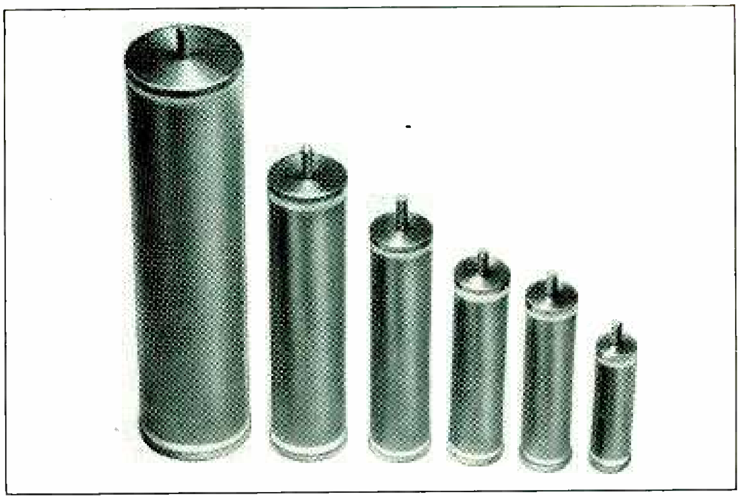

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rods form the center conductor. Each brass rod is 15 inches long and the rods are connected end-to-end by threaded joints. One rod has a sliding joint that telescopes to accommodate longitudinal expansion during heating or cooling. Ends of the cell are vacuum-sealed by Teflon disks at the centers and rims of the tube. An exhaust manifold for adjusting gas pressure is attached to the cell through four $\frac{1}{4}$-in. holes in the side of the brass tube.

Signal voltages are coupled to the cell through coaxial-to-waveguide-to-coaxial transformers placed at both ends. The transformers are made from L-band waveguide sections and are scaled down from broadband, S-band commercial waveguides. One transformer is modified to permit insertion of the Stark voltages.

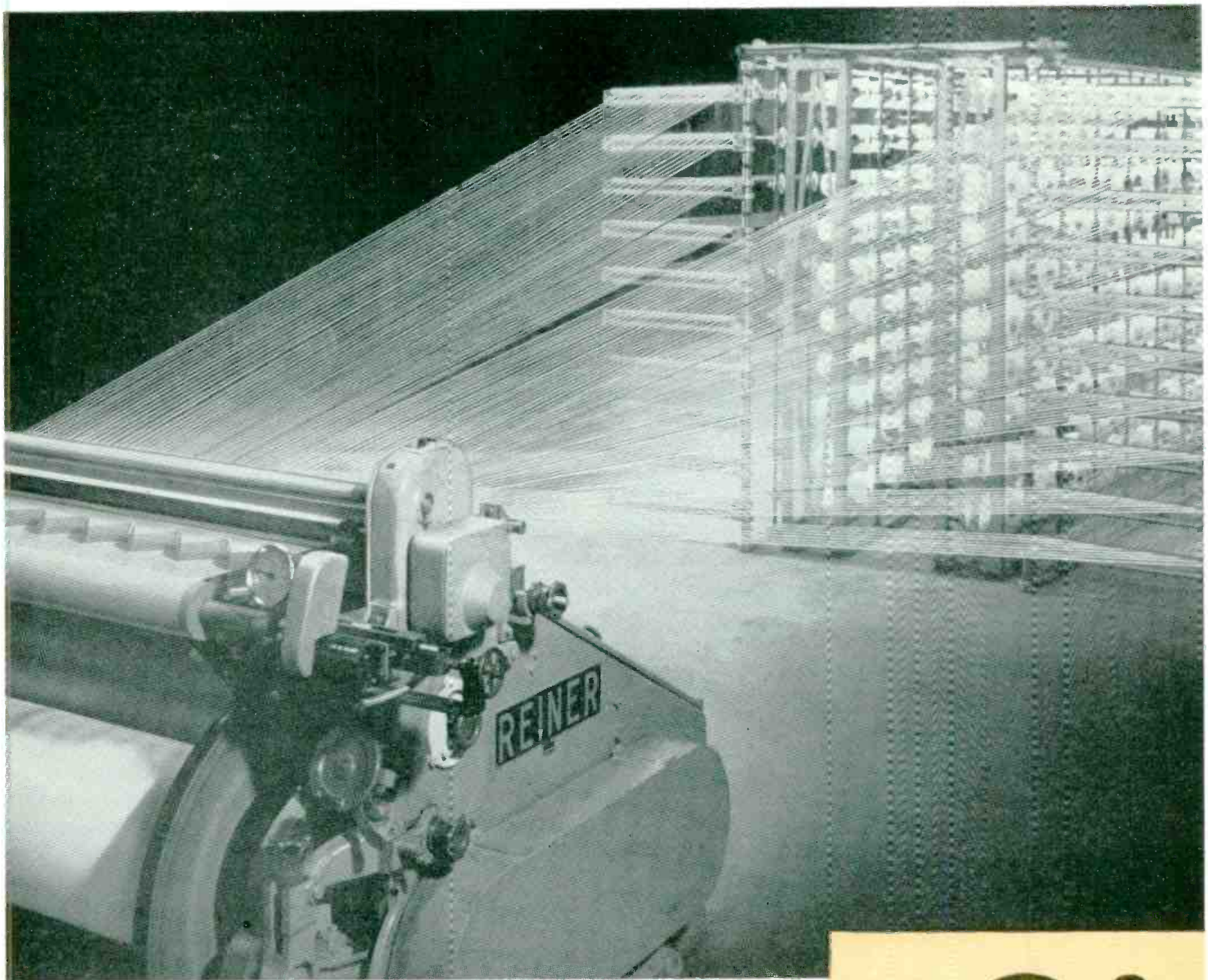
Source of r-f energy for the spectrograph in which the cell is used is a conventional klystron oscillator. At the absorption frequency of a particular gas, the frequency of the oscillator is varied by a motor-driven control either of the sweep voltage, over a small frequency range, or of a cavity plunger for wide-range tuning. This permits observations of the gas absorption to be recorded on a strip chart as a function of frequency.

Automatic Calibration of Speed Recorders

SPEED REGULATION over long periods of time is of vital importance in many industrial processes, but especially in the manufacture of synthetic yarns, such as Nylon, where pumps and feed wheels must be synchronized accurately over periods as long as several months at a time.

The system described records machine speed accurately, and once every 45 minutes it takes time out to check itself for possible inaccuracies due to tube aging and other gradual effects.

To record machine speed, a pulse signal the frequency of which is proportional to speed is developed and applied to a frequency converter that produces a d-c voltage proportional to frequency. This voltage is applied to the automatic



(Photo: Courtesy of Robert Reiner, Inc.)

Miles of Nylon filament with a problem in every inch . . . for SYNTHANE

You are looking at thousands of miles of the hair-fine filaments that go into nylon fabric.

Many equipment and processing problems must be worked out before these filaments emerge as blouses, curtains or couch covers. Synthane solves many of these problems. For example, to process nylon yarn, treatment with a corrosive size is necessary. Machine components made of Synthane laminated plastics stoutly resist corrosion.

The "elastic memory" of nylon causes the fit that endears nylon hosiery to women, but it also crushes ordinary bobbins on which the yarn is wound. Synthane laminated plastic bobbins successfully resist crushing.

Nylon filaments are glamorous. They are also so fine they must be handled gently. Synthane laminated plastic parts can be machined to snag-free super smoothness.

The properties that make Synthane laminated plastics essential to textile people may interest you. For information and ideas about how Synthane may be helpful to you, send for the Synthane Catalog. Synthane Corporation, 6 River Rd., Oaks, Pennsylvania.

Bobbins, pims and redraw caps made from Synthane laminated plastics. Synthane is also used for hosiery examining forms, measuring rolls, piping, gears, verge plates and many other textile parts.

Synthane—one of industry's unseen essentials

SYNTHANE

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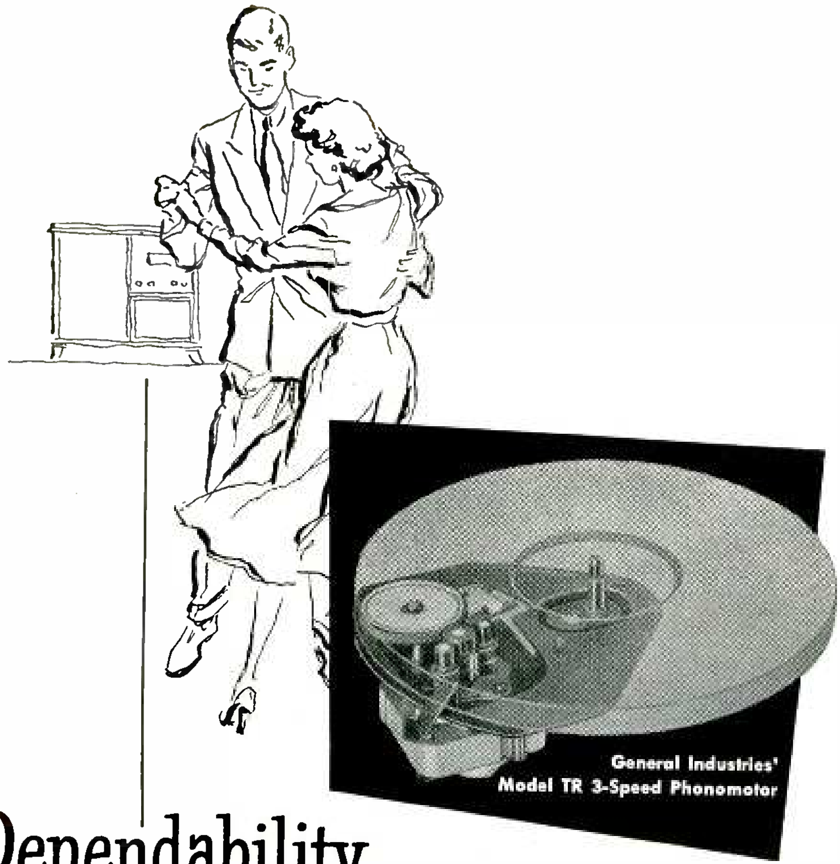
LAMINATED PLASTICS



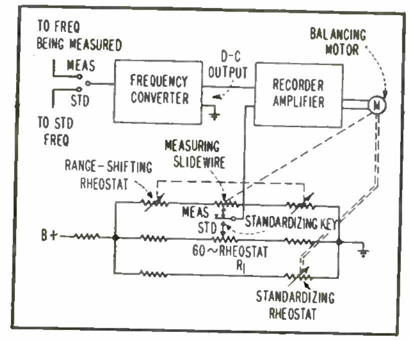


FIG. 1—Automatic frequency recorder calibrator schematic.

calibration equipment as indicated in Fig. 1. Slide-wire potentiometer R_1 is initially adjusted so that the voltage at the slider (with respect to ground) is exactly equal to that appearing across the output terminals of the frequency converter when exactly 60 cps is applied to its input.

When calibration is desired the input to the frequency converter is connected to a standard 60-cps source, while the standardization key is depressed. Any change that has occurred since previous calibration is automatically balanced out as the balancing motor turns the standardizing rheostat.

The system described will be accurate to within 0.01 cps despite a change in 10-cps signal voltage from 10 to 150 volts. Power supply voltage changes from 105 to 130 volts cause an error of 0.02 cps. This article is based on a paper entitled, "An Automatically Calibrated Frequency Recorder" presented by W. E. Phillips at the 1952 National Electronics Conference in Chicago.

High-Frequency Calibration of Magnetic Materials

LOSS FACTOR and r-f permeability of magnetic materials in the frequency range from 50 kc to 30 mc can be determined by a new system devised by the National Bureau of Standards.

A coaxial line of variable length constructed to dimensions of high accuracy is the primary calibrating standard. Characteristics of magnetic materials, such as ferrites and powdered irons, are determined in

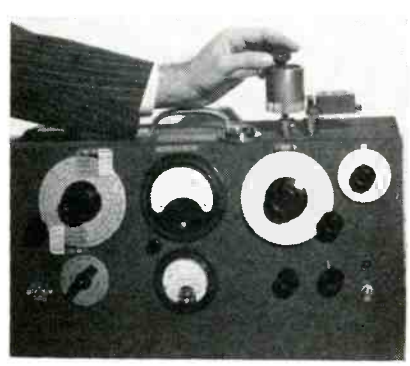
terms of the variation of the length of the line.

The method of measurement depends on the change in inductance of an accurately-machined coaxial line when a sample of magnetic material is inserted. The line is calibrated in 19 one-in. stops and includes a micrometer system that permits the measurement of variations to within 0.0005 in. along the 20-in. range. The line is made from nonmagnetic materials to reduce the possibility of extraneous magnetic fields affecting the measurement.

In a typical investigation, a sample of magnetic material is ground into the shape of a coaxial disk that completely fills a section of the space between the conductors of the coaxial line. All tolerances are ± 0.0002 in. in the grinding process.

The output terminal of the coaxial line is connected to the unknown terminal of an r-f bridge suitable for measuring inductance in the frequency range at which the material will be used. The bridge is balanced with no sample in the line and with the coaxial segment extended to almost its fullest length. Then, the disk of magnetic material is placed on the center conductor of the line. A metal cap holding the disk in place short-circuits the end of the coaxial line. Resulting bridge unbalance is adjusted to the original conditions by a combined manipulation of the resistance reading arm on the bridge and a reduction in the length of the line.

Variation in length is directly proportional to the permeability of the magnetic material relative to



Toroid magnetic material being inserted into the coaxial line of the r-f permeameter

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LFE Model 401 Oscilloscope . . .
A high gain, wide band, versatile, general purpose instrument

Advances in electronics have placed greater demands on the time, frequency, and amplitude measuring capabilities of laboratory oscilloscopes. LABORATORY FOR ELECTRONICS, INC., recognizing the ever-increasing requirements of the rapidly expanding electronics industry, and using specifications set forth by electronic engineers, has developed the Model 401 oscilloscope to provide the features and conveniences required in a medium price, general purpose instrument.

SPECIFICATIONS

Y-Axis

Deflection Sensitivity—15 millivolts peak-to-peak/cm
Frequency Response—DC to 10Mc
Transient Response—Rise Time—0.035 microseconds
Signal Delay—0.25 microseconds
Input line terminations—52, 72, or 93 ohms, or no termination, for either AC or DC input
Calibrating Voltage—60 cycle square wave.
Input Imp.—1 megohm, 30 mmf.

X-Axis

Sweep Range—0.01 sec/cm to 0.1 microseconds/cm
Delay Sweep Range—5-5000 microseconds in three ranges—continuously adjustable
Triggers—Internal or External, + and −, or 60 cycles, or delayed trigger outputs are available at suitable binding posts.
Built-in trigger generator for triggering external circuits and sweeps.

General

Low capacity probe
Functionally colored control knobs conveniently grouped
Folding stand for better viewing
Adjustable scale lighting
Facilities for mounting oscilloscope cameras
Dimensions—12½" wide, 15" high, 19" deep
Weight—55 lbs.
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air and constitutes a primary method of measurement. Difference in resistance readings is a measure of the loss factor of the material and is limited only by the inherent accuracy of the bridge instrument.

R-F Permeameter

The secondary standard is called an r-f permeameter and is a modification of an instrument[1] for the measurement of permeability alone at low audio and power frequencies. Principle of operation depends on the change in input impedance reflected into the primary of a transformer by load variations in the secondary. The transformer of the permeameter is composed of a reference toroid and a length of coaxial line. Changes in the secondary are produced by the insertion of a toroid of magnetic material into the coaxial line.

A toroidal ring is slipped over the center conductor and rests on the bottom cover of the coaxial line. A number of windings, suited to the conditions of the experiment, are wound on the toroid. The material of the toroid has a low dielectric constant and a high Q at the frequency to be used during the test. One end of the winding is connected to the type-N cable plug and the other end to the coaxial line to unbalance the system electrically. In this position, the toroid acts as a reference for the measurement by becoming the primary of a transformer, the secondary of which is the metallic portion of the coaxial line.

The type-N cable plug is connected to an r-f bridge or a Q meter. The bridge is first balanced with the secondary of the transformer unloaded. The magnetic material to be tested, formed into a toroid and without windings, is then placed on the shelf in the line and the impedance bridge is rebalanced. Variation in input impedance, as read on the bridge, is the quantity from which the permeability and loss factor of the test ferrite or powdered iron are computed.

REFERENCE

(1) G. A. Kelsall, Permeameter for Alternating Current Measurements at Small Magnetizing Forces, *J.P.S.A. and R.S.J.*, p 329, Feb. 1924.

Production Techniques

Edited by JOHN MARKUS

OTHER DEPARTMENTS featured in this issue:

Automatic Core-Dipper Applies Strippable Plastic Coatings

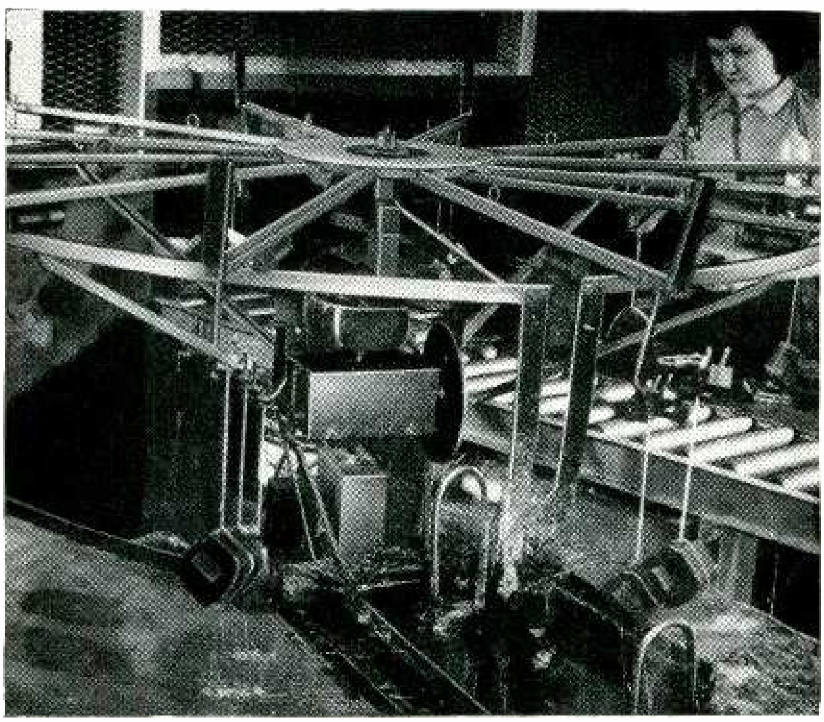
STRIPPABLE plastic coatings are applied to finished Hipersil cores by means of a merry-go-round machine that automatically provides a quick dip to obtain the required amount of plastic material. The dipping operation is motorized but rotation of the turntable itself is manual.

After dipping, the core travels over a drain that catches surplus fluid, then out over the work floor for drying until it reaches the unloading position. Here the operator removes coated cores and puts on new ones.

Hand grips are provided on the spokes of the turntable to rotate the entire machine to the next position. This rotation brings each arm in turn over the dipping tank. Here the arm starts an electric motor which acts through a gear box to rotate a large cam that lowers and raises the arm to achieve the desired dipping of the core. The arm drops down into a U-shaped slot provided for the purpose in the circular rim of the machine.

The plastic material in which the cores are dipped has a low melting point and low set-up point. Because of the high degree of plasticizing, it will not adhere to the core, and can be readily stripped off by the user. The coating serves to protect as well as package the cores until they are ready for insertion in the finished coils of transformers or magnetic amplifiers.

A wire basket having U-shaped pipes as handles is kept in the tank to catch cores that drop off. This eliminates having to fish for cores in the opaque, viscous liquid.



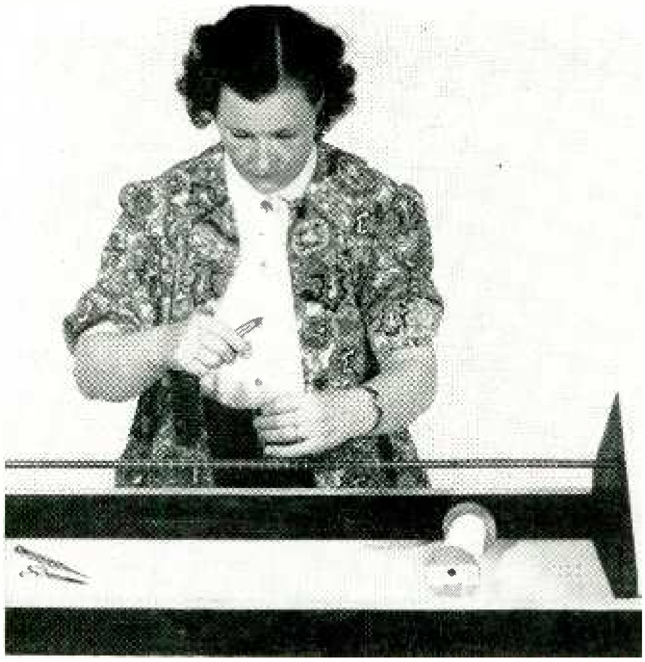
Combination manual and motorized turntable developed by Westinghouse for dipping cores in strippable plastic. Each arm has pegs on which up to five cores can be hung, depending on their size

Training Cable-Lacers

AS PART of its program for training new workers, the Electronics Division of American Machine and Foundry Co., Boston, uses specially designed practice fixtures to build up skill in the use of lacing cord.

The first step in the lacing portion of the program is learning to tie knots correctly with lacing cord on a practice rod supported by the peaked ends of a long wood tool-holding box. The edges of the box are covered with white masking tape to improve their appearance and encourage neatness on the part of the trainee.

A shuttle-like tool known as the Flexso Needle, made by Linen Thread Co., Inc. New York, is used as a lacing needle. The cord is



Board used for practicing the forming and soldering of cables

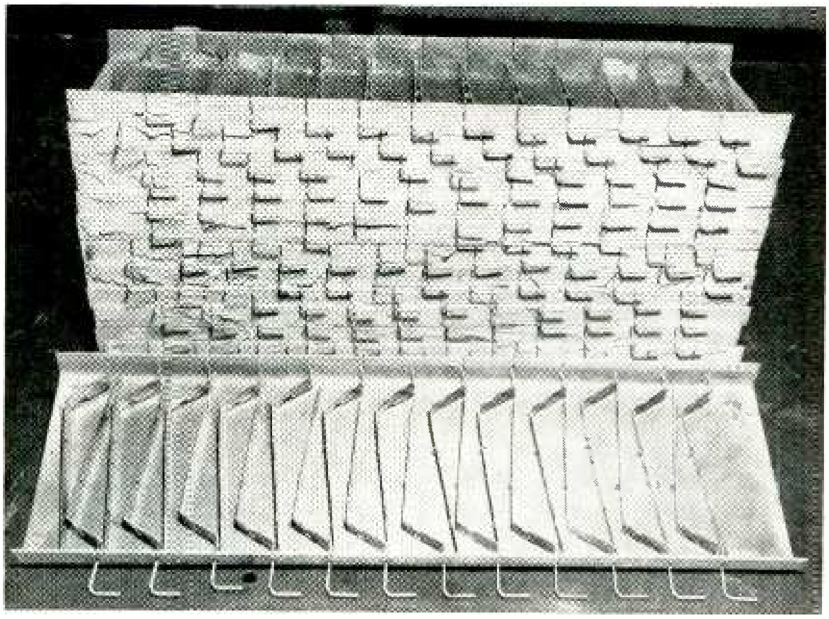
Practice setup used by trainee in learning to tie knots

wound on the needle and the practice rod is laced with a predetermined length of cord. Total practice time depends on the individual, and rarely exceeds one week.

After mastering lacing knots, the trainee learns to identify color-coded wires. Next comes work on a special cabling board designed for practice in modeling and forming a small section of cable. The operator lays in the wires in a predetermined sequence and laces them. The same practice board also serves later for practice in soldering the leads of the cable to terminal strips and cable sockets used in military electronic equipment.

Slotted Trays Serve as Pointer-Spraying Masks

SHALLOW U-shaped metal trays serve also as masks for spraying fluorescent paint on dial pointers of auto radios in Sylvania's Buffalo plant. Each tray holds 24 pointer assemblies, arranged so that portions to be sprayed project outward through slots in the sides of the tray. Pointers are arranged alternately so that twelve project from each side, thus obtaining maximum use of tray space.



Method of loading and stacking masking trays for spraying ends of pointers without getting paint on supporting arms

After loading, trays are stacked as high as desired and moved to a rotating turntable in the spray booth. After pointers on one side are sprayed, the entire stack is rotated 180 degrees for spraying the other side.

After about every 10 sprays, the trays are stripped clean of oversprayed paint by soaking in caustic solution.

Rack for Harnesses

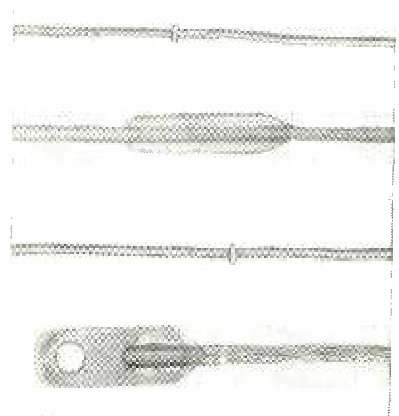
COMPLETED wiring harnesses for electronic calculators and business machines are stored and transported on a rack made for the purpose in the Poughkeepsie, N. Y. plant of International Business Machines Corp. Pipes and pipe fittings form the framework, and solid iron rods serve as cross-pieces over which the harnesses are looped. Casters at the four corners facilitate movement. A wood box set

Rack-type truck for wiring harnesses

on the pipe frame keeps ends of long cables from dragging on the floor and permits use of the truck for other purposes as well. Older methods simply piled the cables one atop another, and sorting and breakage consumed a great deal of time and expense.

Cold Pressure Welding for Aluminum Wire

BUTT-WELDING of aluminum wire becomes as simple as inserting the two wire ends into a small device and squeezing plier-like handles, with a new process known as Kold-welding. The weld is made in a matter of seconds without heat, flame or current and without acids, fluxes or chemicals. The operation involves cleaning the mating surfaces and pressing them together



Example of butt weld between wires, lap weld between wires, another butt weld and lap weld of stranded wire to terminal lug. All are aluminum

MOLONEY *HiperCore* ELECTRONIC CORES

Over 200 manufacturers of electronic products for ultimate use by the U. S. Government are now using Moloney HiperCore Cores for Electronic Transformers.

More than 1000 standard sizes are available in quantity to such manufacturers in thicknesses from 1 mil to 12 mil and in widths from ¼″. HiperCore Electronic Cores are of wound core construction using oriented-grain, cold-rolled silicon steel which results in greater flux carrying capacity and lower losses than other type cores of comparable sizes. These smaller, lighter cores perform better and permit increased production by savings in assembly time.

Rigid control of core production permits these cores to test well within industry tolerances. Table at right shows typical test requirements. Special tests for specific operating conditions are made when desired.

Write today for further information.

ME-52-27

STANDARD TESTS

All 12 mil cores are tested for core loss (true watts) and exciting volt-amperes (apparent watts) at 60 cycles. 4 mil cores are tested at 400 cycles. Following table gives maximum test values. Average values are approximately 20% less than maximum.

	12 Mil—60 Cycle @ 15000 gauss	4 Mil—400 Cycle @ 10000 gauss
Core Loss (TW)	0.95 x lbs.	4.4 x lbs.
Exciting Volt-Amps (AW)	1.75 x lbs. + 6.25A*	5.0 x lbs. + 16.6A*
* A = Gross Area of core face in Sq. In.		

All 2 mil cores are tested for pulse permeability by using a 2 microsecond pulse width at 400 P. P. S. and maximum flux density of 10000 gauss. The minimum permeability will be 500.

All 1 mil cores are tested for pulse permeability by using a 0.25 microsecond pulse width at 4000 P. P. S. and maximum flux density of 3000 gauss. The minimum permeability will be 175.

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GREATER RELIABILITY
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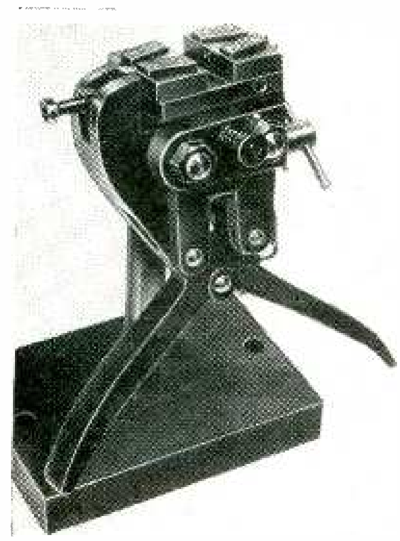
SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA in such a way that the aluminum oxide film is pushed out of the way and there is an actual intermolecular flow of the pure aluminum. The result is a small, compact bond that can actually have a greater tensile strength than the wire itself. When tested to tensile failure, the wire ultimately parts at some point remote from the weld because the process work-hardens the metal in the vicinity of the weld.

The small flash of metal produced at the bond of a butt weld may be removed, leaving the joint at the same gage as the wire itself.



Hand tool for butt-welding wires up to 0.07 inch diameter. The wire ends are inserted through holes on either side near the top. The knob at the right is then turned to give the wires the correct position and shear their ends in preparation for the weld. The handles are now squeezed and released, completing the weld. The joined wire is lifted out through the top of the tool

The process can also be used for joining flat sheets of aluminum, as in the fabrication of aluminum housings for airborne electronic equipment. The bond is again made solely by pressure, but with a different type of tool that fits into practically any power-operated press. This and other tools are soon to be available from Utica Drop Forge & Tool Corp. under arrangements with Koldweld Corp., sole U. S. licensee under patents of General Electric Co., Ltd. of England.

Another application of the process is fusing a small disc of copper

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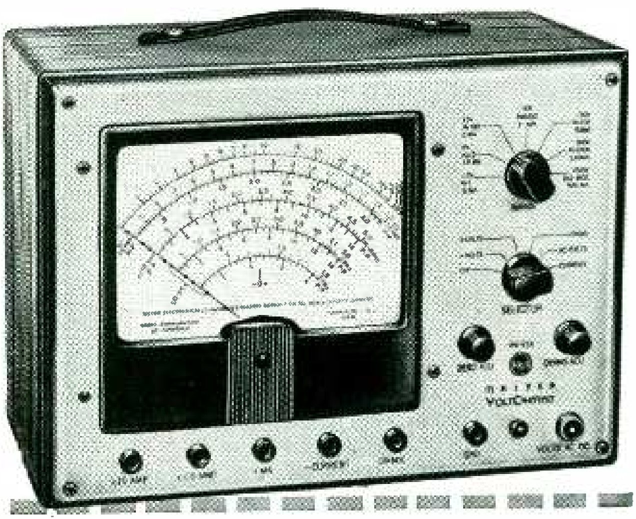
RCA WV-97A Senior VoltOhmyst®

Especially useful as a television signal tracer—made possible by its high-impedance, full-wave signal rectifier for direct reading of peak-to-peak voltage up to 4200 volts. Measures ac in the presence of dc . . . dc in the presence of ac. Frequency response flat from 30 cps to 3 Mc.

- Electronic ohmmeter measures resistance from 0.2 to one billion ohms.
- Directly measures complex waves from 0.2 volt to 2000 volts peak-to-peak.
- Measures rms values of sine waves from 0.1 volt to 1500 volts.
- Measures dc voltages from 0.02 volt to 1500 volts with constant input resistance of 11 megohms—1-megohm resistor in dc probe.
- Over-all accuracy on dc, ± 3% of full scale.
- 7 non-skip ranges for resistance and ac and dc voltage measurements.
- Negative-feedback circuit provides over-all stability—all-steel case shields bridge circuits from external fields.

$67.50 complete with matched probes and cables.



RCA WV-87A Master VoltOhmyst

Combines all the outstanding features of the Junior and Senior **VoltOhmyst** plus more ranges, more functions, and an easy-to-read 7½" meter. Measures . . .

- Peak-to-peak values of unsymmetrical complex waves from 0.2 to 2000 volts.
- Peak-to-peak values of symmetrical complex waves from 0.2 to 4200 volts.
- RMS values of sine waves from 0.1 volt to 1500 volts.
- DC voltage from 0.02 volt to 1500 volts.
- Resistance from 0.2 ohm to 1000 megohms.
- Small direct currents from 10 microamperes to 500 milliamperes.
- Large direct currents from 500 ma up to 15 amperes.

$112.50 complete with matched probes and cables.

RCA WV-77A Junior VoltOhmyst

Unquestionably the greatest value in all-electronic volt-ohmmeters. The WV-77A is factory-calibrated against the finest laboratory standards. Equipped with five ranges for measuring dc voltage, ac voltage, and resistance. Measures dc from 50 millivolts to 1200 volts; ac from 100 millivolts to 1200 volts rms; and resistance from 0.2 ohm to 1 billion ohms.

- DC input resistance, 11 megohms on all dc ranges.
- Response flat from 30 cps to 3 Mc on 3-, 12-, and 60-volt ranges.
- Sturdy 200-microampere meter movement electronically protected against burn-out on all functions.
- Degenerative bridge circuit provides freedom from effects of line-voltage changes.
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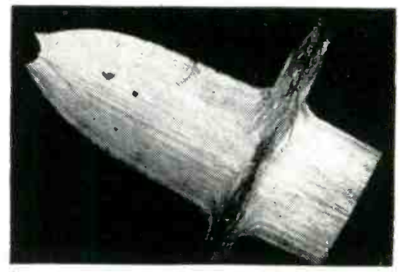

Enlargement of cross-section of butt weld in aluminum wire after pulling to tensile failure. Wire broke well away from weld

to an aluminum chassis with a single blow of a punch press. The copper can then be tinned and soldered conventionally for anchoring of ground wires. Silver contacts can similarly be cold-welded to copper or aluminum strips. The resulting bond is claimed to be immune to loosening either by vibration of relay operation or by the extreme heat cycles of arcing.

Other tools, developed in England but not yet available in the United States, permit welding together extremely thin nonferrous metal sheets (under 0.01 inch), to permit continuous runs of machines without retreading. The method has also proved inexpensive and satisfactory for sealing electrical and electronic units in airtight moisture-proof thin-walled aluminum containers. The mating sheets need not be of the same thickness; paper-thin aluminum foil can be welded to heavy sheets or even to aluminum castings.

Dissimilar nonferrous metals can also be joined by pressure if the wires are lapped and fused by pressure from opposite sides. Similar conductor metals can also be joined by the lapping technique; this has the advantage that the flashing is in one plane and can be trimmed off more readily. Stranded wire can be lap-welded just as easily as solid wire. Either solid or stranded wire can be welded directly to soldering lugs, as in the example shown.

Air Blast Cleans Parts

BEFORE inserting the heater assembly in a cathode sleeve for a pencil triode, the operator blows off all dust particles with an air blast. The heater assembly is held in front of a copper tube coming up over the

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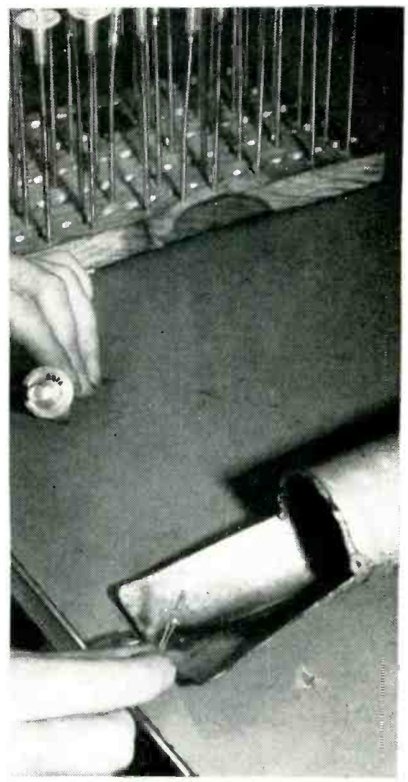


Holding heater assembly in air blast prior to insertion in cathode sleeve of type 5876 pencil triode. Air blast comes out of flattened copper tubing that is bent over edge of bench. Holes in board at rear are drilled in several diameters, so one board can be used for storing and transporting different sizes of assemblies

front edge of the bench. The tube is bent in such a way that the blast is directed into a metal cylinder on the bench. Use of the cylinder eliminates blowing things around each time the air blast is turned on by a foot-operated valve.

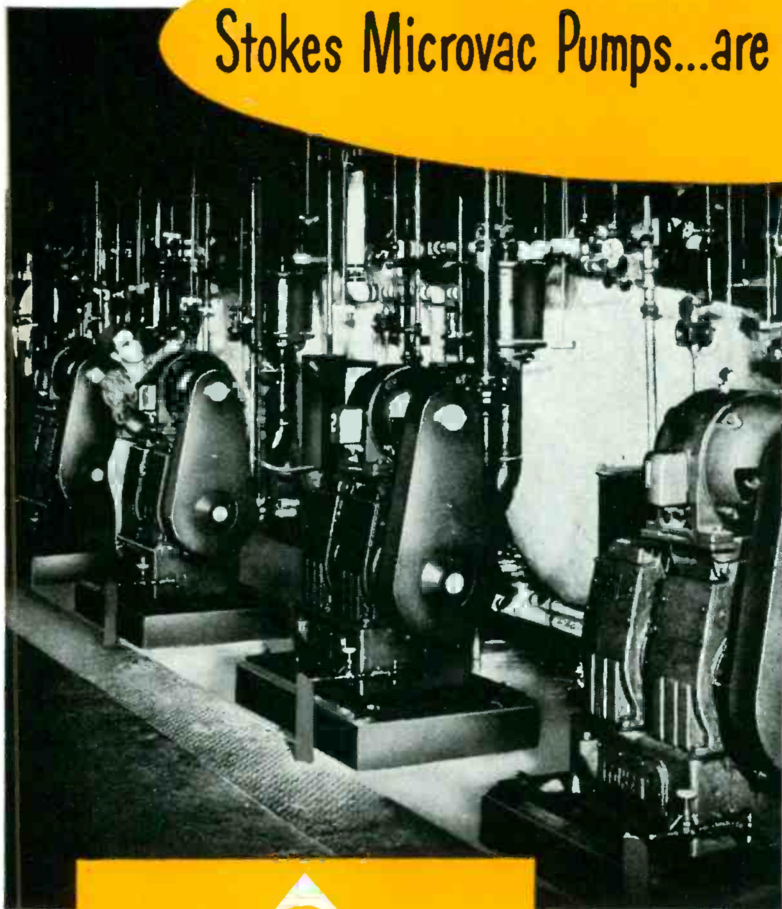
To help insure cleanliness in tube manufacture, similar air blast setups are provided at many other working positions in the RCA tube plant at Harrison, N. J.

Quick-Change Engraving Dial

ENGRAVING of chassis and panel lettering for electronic equipment is speeded up through use of a new master copy dial that provides 41 quickly changeable characters. The dial locks at each character position by means of a spring-held ratchet, yet may be easily spun to a new position by turning the center knurled knob.

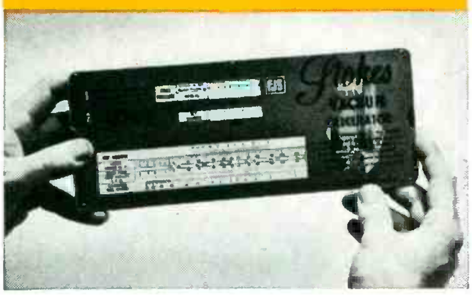
As made by H. P. Preis Engraving Machine Co., Hillside, N. J., the dial fits the copy table of any en-

Stokes Microvac Pumps...are basic to Vacuum Processing



Typical installation of Stokes Vacuum Pumps.

Send for new Vacuum Calculator for rapid slide-rule calculations. Includes standard ABCD log scale. Also send for Catalog 700, "Stokes Microvac Pumps for High Vacuum" with copious reference material.



High volumetric and mechanical efficiency make these famous pumps economical and reliable units in any vacuum system.

Capacities of Stokes Microvac Pumps run from 15 to 500 cfm . . . pressures to 10 microns absolute. Power consumption is low and the top-mounted motor contributes to compact design requiring minimum floor space.

Lubrication of the four moving parts (including the exhaust valve of corrosion-resistant Teflon) is fully automatic. There are no stuffing-boxes or grease-fittings, and no packing.

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Stokes is the only manufacturer of equipment for complete vacuum systems, including Microvac mechanical pumps, oil diffusion pumps, McLeod Gages and Vacuum 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 purposes for which vacuum deserves exploration.

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Pharmaceutical Equipment,

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High Vacuum Pumps and Gages,

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Master copy dial for faster engraving of panels

graving machine. The only adjustment needed is positioning one letter or character correctly for engraving. Other characters then lock in the correct position as the dial is rotated. Units are available with various sizes and styles of characters.

Neoprene Grommets Improve Tool Handles

TO IMPROVE the balance and feel of tweezers, operators in the military radio department of RCA's Camden, N. J. plant slipped several neoprene grommets over the butt end. The soft non-slip grommets are positioned to rest on the back of the hand against the forefinger, as shown.

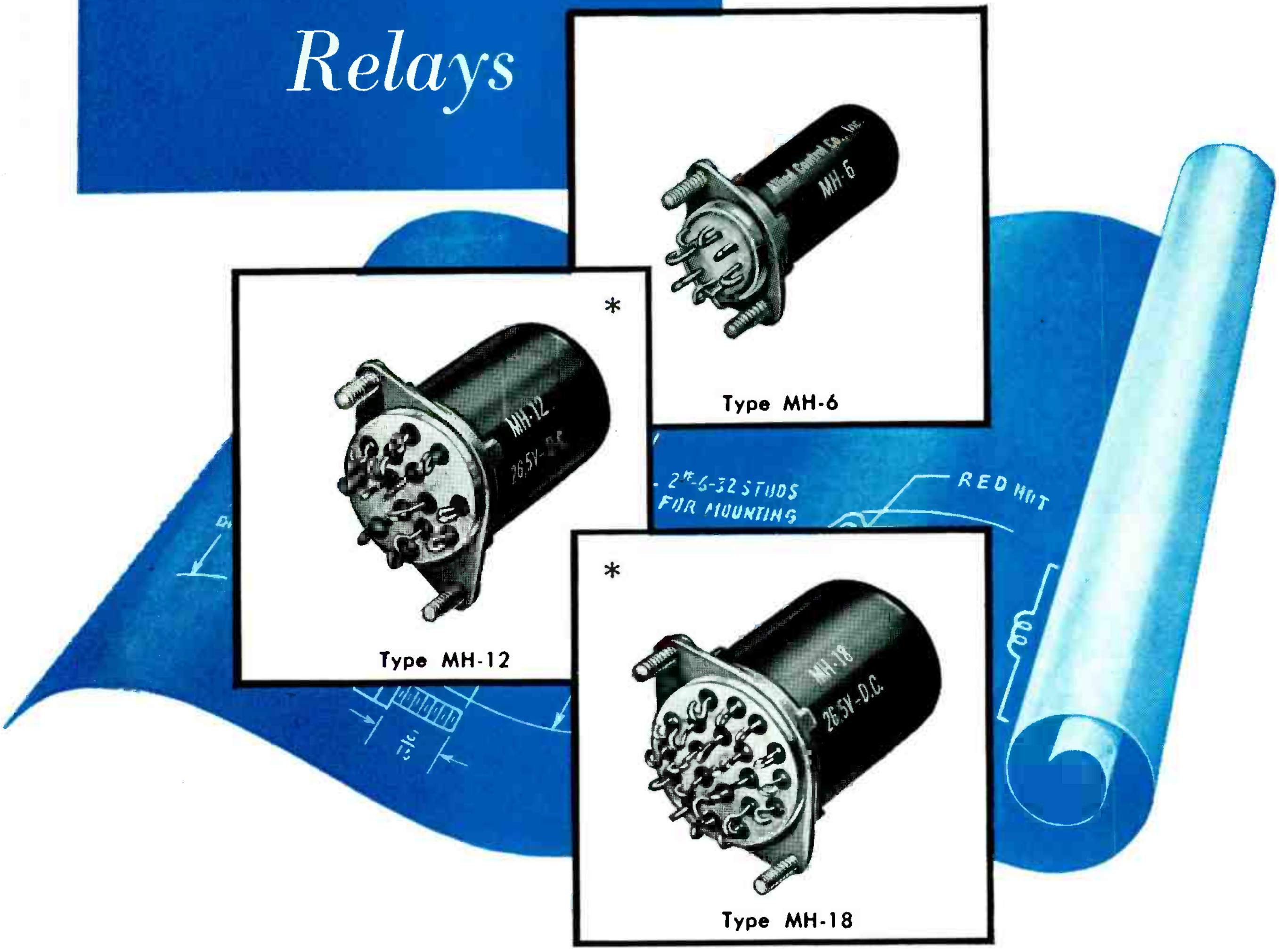
To improve the grip and feel of small plastic-handle socket wrenches and screwdrivers, operators in the new Poughkeepsie, N. Y. plant of

Grommets improve feel of tweezers used to inspect plug-in i-f stage for AN/PRC-10 portable transceiver made by RCA

ALLIED'S NEW 50 G *Sub-Miniature Relays*

*

Approved by U.S.A.F. Spec. MIL-R-5757A



Type MH-6

* Type MH-12

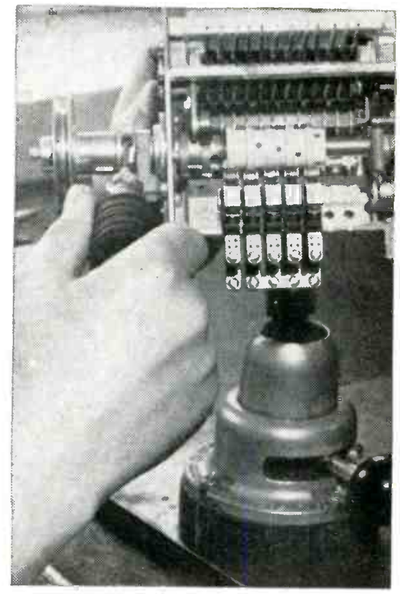
* Type MH-18

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

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

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

AL 149



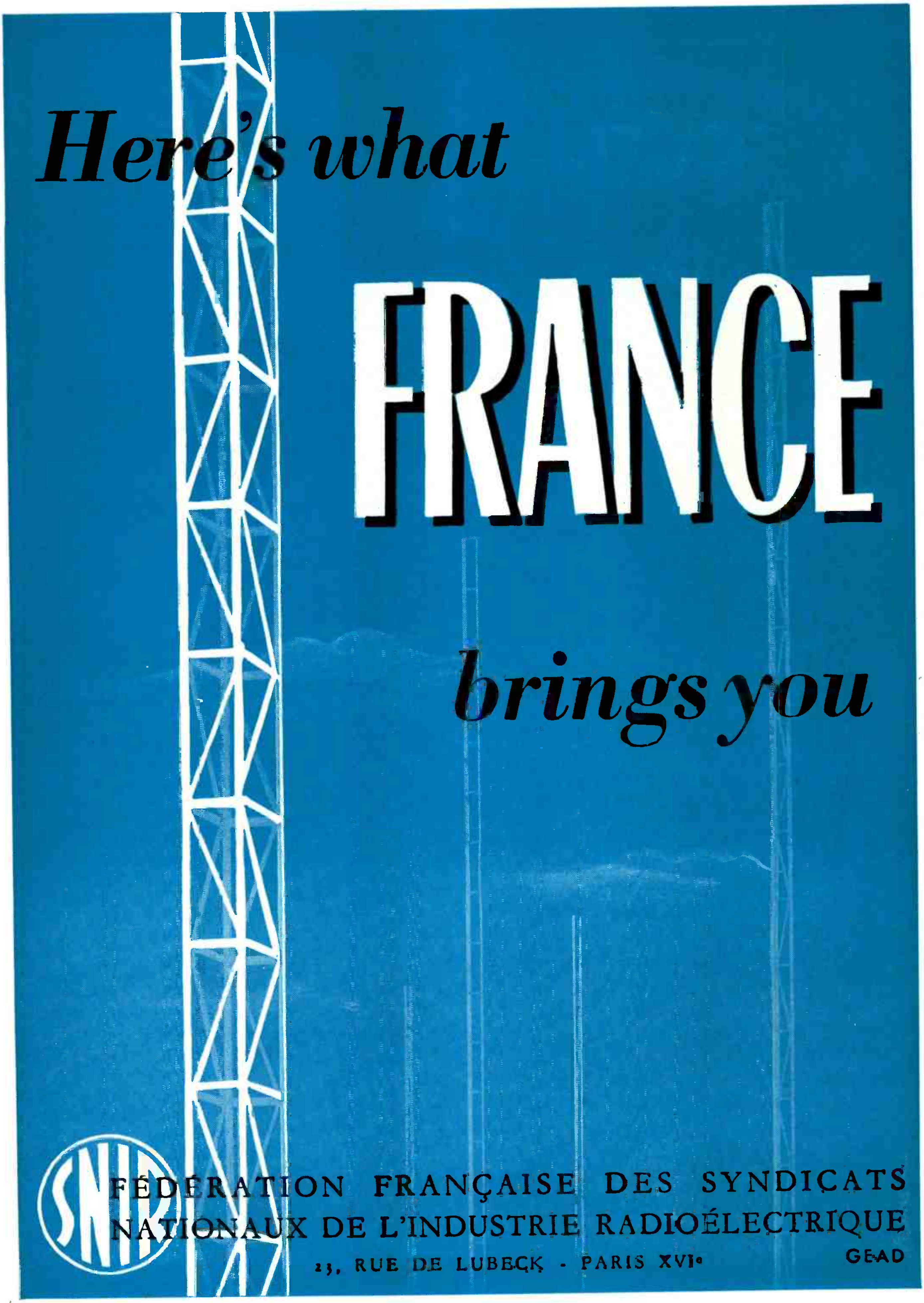
Grommets on plastic handle of socket wrench speed up assembly of punch drive unit for IBM electronic key punch

International Business Machines Corp. use four or more large neoprene grommets on the handles. The grommets improve the feel and balance of these small tools, minimizing slippage and thereby reducing rejects.

Accelerated Etching Processes for Printed Circuits

FOUR METHODS for accelerating the etching operation in connection with the production of conductive patterns have been evaluated and compared by Stanford Research Institute for the Wright Air Development Center. Results, abstracted below, are presented in the SRI technical report on the project, entitled "Development and Application of Automatic Assembly Techniques for Miniaturized Electronic Equipment."

(1) Spray Etching. An apparatus was constructed for etching a circuit pattern on metal using a metal-plastic laminate base material. As shown in Fig. 1, the laboratory equipment consisted of a glass tub partially filled with $FeCl_3$ 42° Bé solution at room temperature, and racks for holding the specimens to be etched. A specially designed glass spray gun was used to aspirate the etchant against the surface of the metal. Copper-plastic laminate base plates 3 in. × 3 in., having a copper foil 0.0027 in. thick,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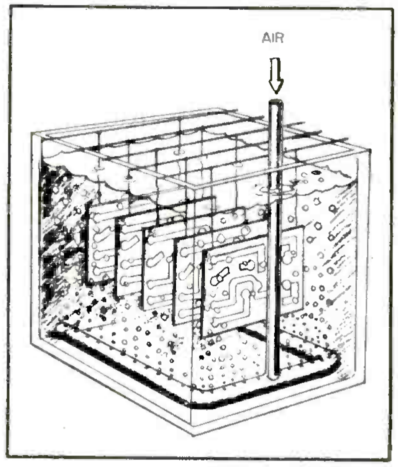

FIG. 1—Spray etching equipment

were used for tests. They were inserted in the rack and sprayed until the circuit pattern was formed. The time required to remove all the excess metal from the plates varied between 10 and 15 minutes. The quality of the etched circuit was quite satisfactory.

(2) Air Agitation Etching. Another method of etching the above type of base plate was to place the plates in a rack and submerge them in the etchant at room temperature. The fluid was agitated by bubbling air through the fluid from the bottom of the tank, as shown in Fig. 2. The oxygen in the air also served to oxidize the ferric chloride, thus making available for etching all the chlorine present in the chloride. The time required for removing all the excess metal from the base plate varied between 40 and 50 minutes. The quality of the finished circuit was satisfactory.

(3) Mechanical Agitation Etching. A third method of etching involves submerging the plates in a rack in the solution and agitating with a motor stirrer. This method produced satisfactory plates but the time required varied between 60 and 70 minutes.

(4) Rocker Agitation Etching. A fourth method was to rock the entire etchant bath, with the base plates fastened in a rack as in Fig. 3. This method also produced satisfactory plates, but required the longest time, between 75 and 80 minutes. A fresh batch of etchant was used for each experiment so as to insure reproducible results.

The objective of this laboratory work was to simulate production

etching equipment. The spray provided the fastest means of removing metal to produce a printed circuit on a base plate. A decrease in etching time also decreased the amount of undercutting of the lines, insuring maximum bond of the circuitry to the base plate.

Present production-line spraying equipment and plant layout (with modifications because of the etchant) can be readily adapted to spray etching. It is felt that the spray etching process is unique and will prove to be an economical production method.

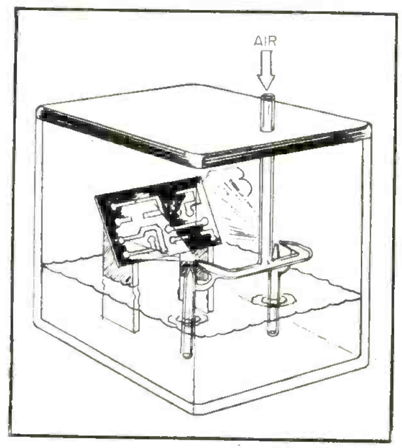

FIG. 2—Etching equipment using air agitation

Since a considerable amount of copper is removed during the etching operation, the problem of maintaining etching strength of the ferric chloride solution becomes important in mechanized production. The first attempt toward a solution was to plate out the copper on graphite electrodes as fast as the copper went into solution. It was discovered that the copper plated out was in a nonadherent spongy condition. When the carbon electrode was lifted out of the bath the copper fell back into the bath and dissolved. Further work is necessary to develop a continuous copper recovery process.

Production Problems

Unusual problems encountered in the development of etching processes are presented below, along with solutions that proved successful for various firms. These can be

tried one after another when one of these problems is encountered, though usually only one of the solutions is needed to solve the problem.

Undercutting of Metal Foil. (1) Increase width of lines so that close tolerances are not required; (2) control etching time more closely; (3) control concentration of etchant more carefully; (4) reduce thickness of metal foil to minimum, making it possible to reduce etching time; (5) inspect plates frequently during etching.

Poor Line Definition. (1) This is no problem in the photo etching process if good drawings and negatives are made and the etching properly performed; (2) use printing press process; (3) use automatic printing machine to give correct exposure.

Breakdown of Resist. (1) Prevented by proper heat treatment;

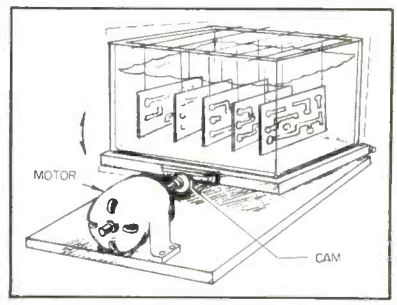

FIG. 3—Etching equipment using rocker agitation

(2) etchant was diluted and kept in circulation and tank was not heated; (3) photographic coatings properly applied prevented this.

Poor Adherance. (1) Make surface of base material dull and smooth; (2) to prevent breakdown of bond between copper foil and base plate during soldering, use small pencil-type soldering iron and 60-40 (low-melting-point) solder; (3) if toluene used to remove resist after etching tends to loosen bond between foil and base plate, use carbon tetrachloride instead.

Open Spots in Coil Windings. (1) Remedied by closer control of process and operators.

Flashovers and Poor Connections in Dip Soldering. (1) Flux recommended by Squire Labs eliminated flashovers; (2) good connections

are assured by closer control of process and careful cleaning of parts.

Plastic Tarpaulins

NEW PLASTIC tarpaulins having only one-tenth the weight of conventional fabric tarps and costing only one-third as much are now available for protecting production areas during painting and other maintenance work. A high degree of transparency permits quick locating of covered material without having to lift all tarps. The polyethylene

Use of new plastic tarp to cover production equipment while removing paint from overhead steel beam preparatory to painting

plastic used will not absorb paints or liquids, is easily washed and dried, and is tear-resistant.

In electronic plants, the new tarp material is ideal for covering assembly-line benches at night to keep out dust during sweeping and cleaning operations. The material is made by the Plastics Division, Canton Containers, Inc., Canton, Ohio.

Small-Parts Rack

WOOD racks constructed as a single curved unit which surrounds the working area on a bench are used in RCA's Camden plant to keep ten different types of small parts within easy reach of the operator.

The sloping bottoms of the com-


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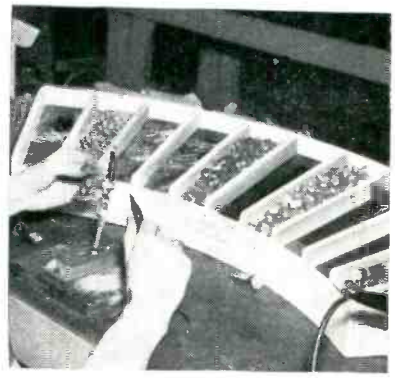


Type of rack used to keep small parts safely separated but within easy reach of operator. Wood, sheet metal and Pressdwood are combined here to simplify construction in company shop

partments are raised about three inches above the surface of the bench and slanted toward the operator, so that each part is in the optimum position in space for being picked up by the fingers of the operator as she assembles the components of a plug-in i-f stage for military radio equipment.

Terminal-Pin Twister

ASSEMBLY of solder terminals on the phenolic base plate for an i-f transformer is speeded up and

New air-operated fixture used in Crosley Division's Cincinnati plant to twist terminals of i-f transformer base after assembly

Method of using foot-operated air valve to actuate terminal twister

fatigue is reduced by a Crosley-developed air-operated fixture that twists all terminals at once when a foot-operated air valve is actuated. The setup leaves both hands of the operator free to perform the manual work of loading and unloading the terminals and plate on the fixture.

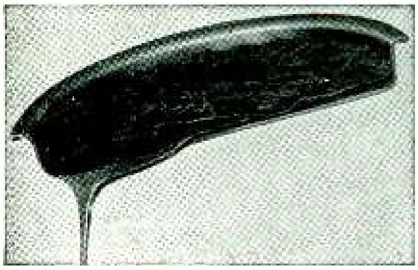
The former method of twisting

Manually-operated terminal twister. Parts bins used here are made from ½-inch plywood

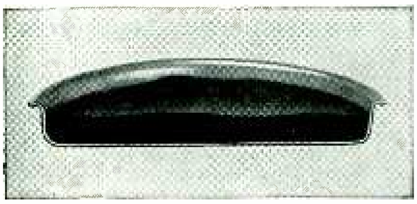
IRVINGTON INSULATING VARNISH DIGEST

Comparative Tests Show Superiority Of Internal Curing

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



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



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

Air Drying Varnishes Have Many Applications

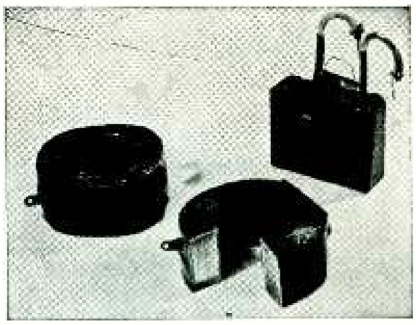
Air drying varnishes produced by Irvington Varnish & Insulator Company find wide use both as a final coat on windings already impregnated with other types of Irvington varnish and as a means of protecting other types of electrical apparatus and improving appearance.

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

"Deep-Cure" Insulating Varnishes Give Outstanding Performance

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

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



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

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

Chemical Stability

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

Production Procedures

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

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

Finishing Enamels Protect Windings Against Oil, Dust

Insulated windings can be protected from the harmful effects of oil, moisture, chemicals, water and grease by means of a quick-drying coat of a finishing enamel. Formulated specifically for use as a finishing coat, Irvington Enamels are easily applied by brush and dry rapidly to a tough adherent film.

Two major types are: No. 32 red, designed to give the fastest drying time consistent with good protection under most service conditions; and No. 30 red, for especially severe service conditions..

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

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

terminals, also illustrated, involves pulling a lever at one side of the fixture while holding the phenolic plate in position with the other hand. Twisting of six terminals at once requires considerable pull, and varying speeds of pull as the operator tires can result in occasional rejects. Use of an air cylinder to actuate this lever gives constant rate of twist and hence a more uniform product. The control valve is a Logan valve, made by Logansport Machine Co., Logansport, Ind.

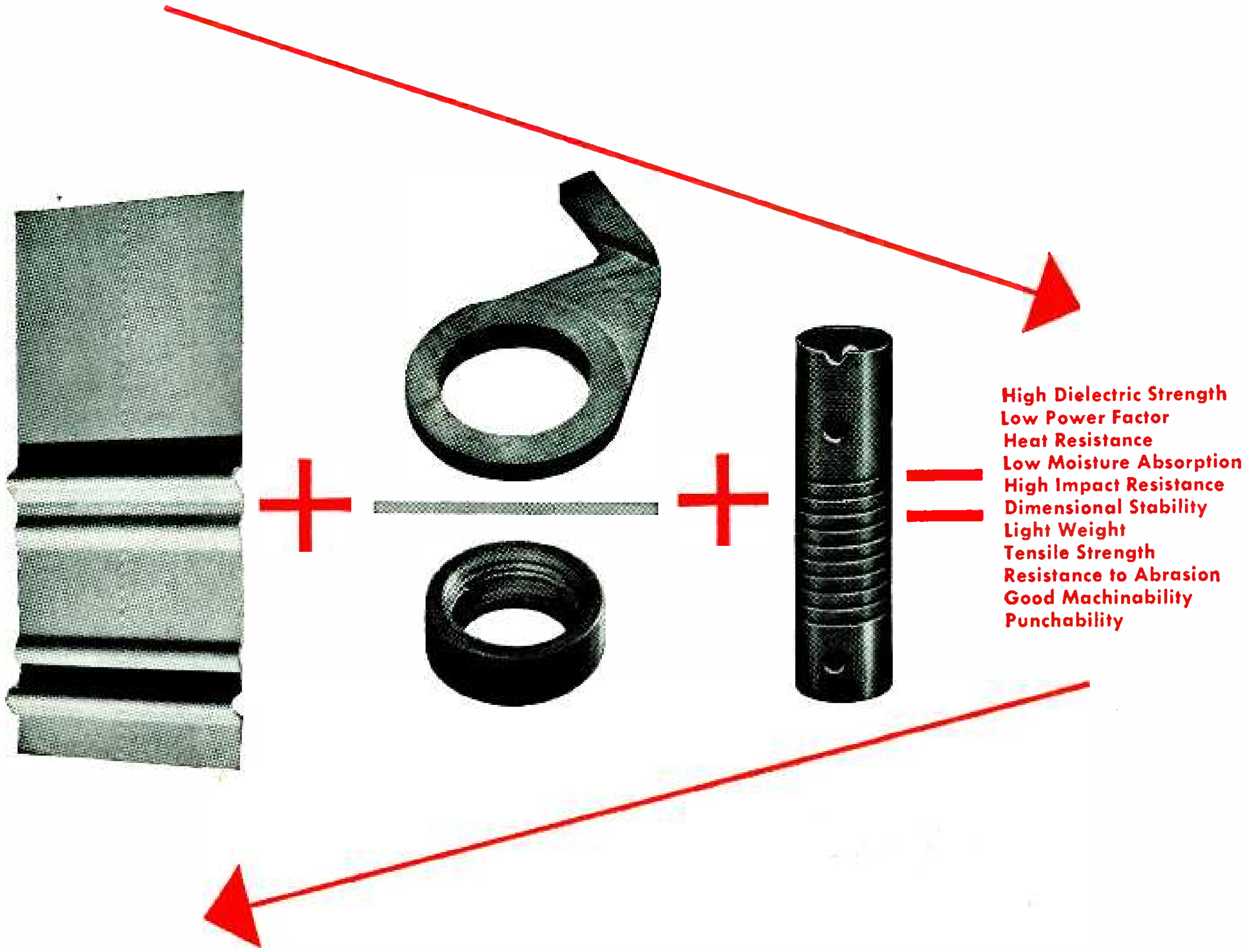
Testing Miniature Motors

By CURTISS R. SCHAFER
The Liquidometer Corp.
Long Island City, N. Y.

THE TEST unit shown measures the impedance, the minimum voltage required for rotation and the phasing of the miniature 2-phase 400-cycle induction motors used in the indicators for capacitance-type aircraft fuel gages. These motors, through a speed-reduction gear train, drive a rebalancing potentiometer and pointer which indicates weight or gallonage on an appropriate dial scale. While not strictly electronic devices, these miniature motors are widely used in electronic aircraft instrumentation.

A simple four-terminal fixture is used for holding the motor and its leads. The operator merely connects the motor leads, rotates the knob in the center of the panel until both voltmeters read alike and notes the dial reading, presses the

Miniature 400-cps motor is placed in fixture at left for quick check of performance



the right combination of properties can be "custom-built" with Lamicoid®

LAMICOID (a thermosetting plastic laminate) is remarkably versatile and adaptable. Almost any characteristic, in any combination, can be built into LAMICOID by the use of fillers such as glass, nylon, fabric, paper, etc., with a variety of synthetic resins.

This versatility and adaptability has been proved in such products as tube socket supports, coil forms, dials, name-plates, antenna parts, motor and transformer parts, and switch gear and relay parts. In thousands of cases, LAMICOID is providing the practical solution to material shortages . . . and bringing about savings and product improvement, too.

Take advantage of LAMICOID's "custom-built" personality. Investigate the advantages it offers *your* product. LAMICOID can be supplied in standard sheets, rods and tubes or fabricated into parts to your specifications. Our 58 years of experience in developing and producing electrical insulating materials is at your service. Send your blueprints and specifications today for a prompt quotation.

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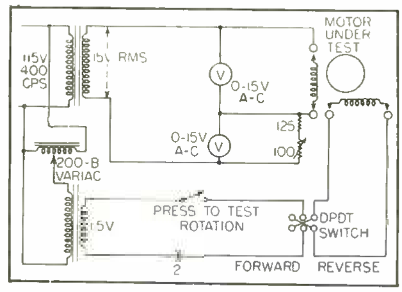


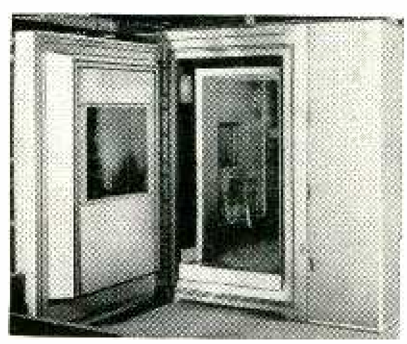
Motor test circuit, as used for Kollsman type CA motors and others

button under the right-hand voltmeter and notes the direction of rotation of the shaft, then throws the dpdt switch from forward to reverse and observes whether or not the shaft rotates in the opposite direction. The two voltmeters are matched so that they both read alike, and are of the 2,000-ohms-per-volt rectifier type. The motor impedance is measured by the equivalent series resistance method.

Walk-In Test Room

EVALUATION of electronic equipment under controlled atmospheric conditions is expedited by installation of a combination temperature-humidity-altitude test room in the Electronics Division plant of Westinghouse in Baltimore. With this, altitudes up to 80,000 feet are quickly simulated for high-altitude tests of rocket and guided missile control equipment. Simultaneously, temperature and humidity can be varied over the entire expected operating range.

The installation, constructed by Bowser Technical Refrigeration Division, Terryville, Conn., uses reflective metal insulation consisting of eleven layers of 34 gage alumi-



Walk-in test room capable of taking electronic equipment through all atmospheric changes encountered in the flight of a rocket or guided missile

Our Blue Ribbon Resistor—designed in 1939—was the *first* flat or strip resistor in the field. And now, though there are others of similar type, the Hardwick, Hindle Blue Ribbon still holds first place—and *is still winning "blue ribbons,"* and such comments as quoted above.

Although its basic design is the same, recent improvements assure you "the finest flat resistor made."

Our crazeless gray enamel completely eliminates the disastrous crazing which results in failure of the resistive element due to moisture penetration from humidity, salt and other severe atmospheric conditions—thus giving greater dielectric strength.

The aluminum thru-bar, in contact with the internal surface of the ceramic core, distributes the heat more uniformly along its entire length—than conventional tubular resistors.

The studs—corrosion and rust resistant—are peened to serve as mounting supports and also to permit the stacking of two or more units when space need be saved. And our unique method of fastening the tube to the thru-bar prevents loosening under vibration.

As compared to the conventional tubular resistor Blue Ribbons give you:

1. Higher wattage rating per unit space requirement.

2. Reduction in space behind the panel or mounting surface.

3. Sturdy but simple mounting, either single or stacked.

4. Lighter weight.

5. Lower induction.

Our Blue Ribbons are designed for and manufactured in accordance with JAN-R-26A specifications.

Send for our catalogue, showing these and other Hardwick, Hindle resistors of distinction.

HARDWICK, HINDLE, INC.

Rheostats and Resistors

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The mark of quality

For more than a quarter of a century

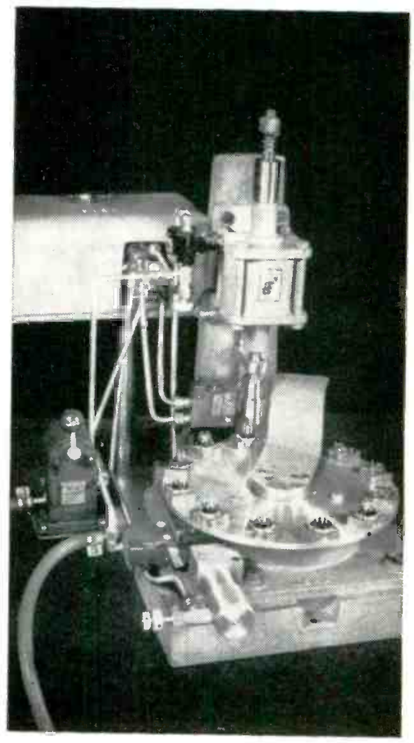
num alloy sheets separated by ⅝ inch thick cypress wood spacers. The interior finish of the room is stainless steel. Layers of insulation are individually vented, thereby allowing for full evacuation of the walls during altitude simulation and permitting drainage of any condensed moisture which might collect in the walls.

Humidity is controlled by passing the air over a temperature-controlled water bath in which are immersion heaters and cooling coils.

A window in the door and two windows in the walls permit watching tests from the outside. The entire system is operable from a remote control panel.

Crimping Saddles on Plastic Tube Sockets

A TWELVE-POSITION air-powered rotary work feeder permits a production rate of up to 2,000 per hour in the operation of crimping the metal saddle to a plastic tube socket. The metal and plastic parts are put together by hand and placed in the empty nests of the feeder. Upon arriving at the work station, an auxiliary valve on the indexing table admits air to the double-acting air cylinder which presses the



Air-power setup for crimping saddles onto sockets

"We get CONSISTENTLY EXCELLENT RESULTS with D-H ALLOYS"

... says Resistance Products Company, of Harrisburg, Pennsylvania

This company produces precision wire-wound resistors of utmost stability for electronic equipment used by the Armed Forces and for makers and users of test instruments, meters, and scientific apparatus of various types. The vital accuracy of much important equipment, therefore, is very dependent upon the quality of the resistors coming off the production lines of Resistance Products Company.

In view of this, Driver-Harris is particularly gratified to have Resistance Products state: "Reflecting our experience with Driver-Harris alloys is our large use of Karma wire. Currently, we are employing Karma for numerous critical applications where utmost stability, together with high resistivity and low temperature coefficient of resistance, is requisite. *Consistently excellent results* are being obtained. We have, in fact, used Karma with outstanding success ever since its introduction several years ago. It is our belief the development of this alloy constitutes a major forward step."

Karma* is ready to serve you, too; as are world-famous Nichrome* and Nichrome V, and over 80 other alloys developed by Driver-Harris for the electrical and electronic industries. We feel confident that, like Resistance Products Company, you'll realize exceptional advantages by putting one or more D-H alloys to work for you. Let us have your specifications. We'll gladly make recommendations based on your specific needs and have our engineering department help you obtain best results.

KARMA* and world-famous Nichrome* are manufactured only by

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HARRISON, NEW JERSEY

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

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

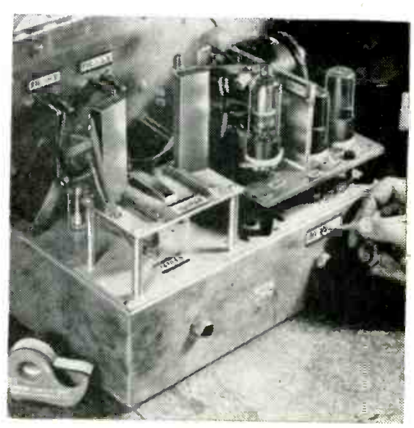
*T.M. Reg. U. S. Pat. Off.

MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD die head upon the assembled parts and crimps the metal around the shoulders of the plastic member. At this point a limit valve is tripped by an arm attached to the ram of the cylinder, reversing the pneumatic timer. This makes the ram retract and indexes the rotary table in readiness for the next cycle. The completed piece is ejected by air blast and deflected into the desired receiving bin by a metal plate mounted on the center of the rotary table.

To obtain the correct interlock among the various units involved, a speed control valve and quick-exhaust valve are attached to the double-acting air cylinder. With these, the production rate is limited only by loading time. The basic air-actuated units used in this setup are made by Mead Specialties Co., Chicago, Ill.

Write-On Plastic Tape

ADHESIVE plastic tape on which notations can be written with an ordinary lead pencil are used in Stromberg-Carlson's Rochester plant to identify tubes, terminals and components on test sets and experimental breadboard units. The new Labelon tape (made by Labelon Tape Co., Rochester, N. Y.) is pressure-sensitive, sticking without moistening to any dry and comparatively smooth surface. The writing is not on the surface of the tape; it appears beneath a transparent plastic outer layer which protects it against smudging. The tape is available in four standard colors as an



Writing on pressure-sensitive label with pencil. Same lettering effect is obtained with any pointed instrument

TOM POLGLASE of Anaconda receives 1st award from General Chairman A. S. Roberts at Chicago Industrial Packaging and Materials Handling Exposition.

PRIZE-WINNING
MOLDED SHIPPER

No problem plagues magnet-wire users more than damage to wire shipped in easily-broken wood boxes. Difficult to detect, even the slightest injury can conceivably impair the performance of finished windings.

Now a special fibre-molded case* protects wire spools from rough, tough handling in transit, stockroom and shop. Developed and used by Anaconda, this new container won top honors at the recent 7th Annual Exposition of the Society of Industrial Packaging and Materials Handling Engineers.

Made in identical halves, it has met severe tests . . . tests under which the best conventional wooden boxes burst. After one hundred 30-inch drops, the new case *still retained its wire spools in perfect shape.*

This molded shipper is ⅔ lighter, handles easier, stores in less space, nests compactly when empty. From factory to your workbench it safeguards the exceptional quality built into all ANACONDA Magnet Wire—Formvar, Enamel, Vitrotex† and the others. Ask for full details. Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

53356

the right magnet wire for the job

ANACONDA®

**patent applied for* †reg. U.S. Pat Off.

OLD AND NEW. Here the new molded fibre containers carry the same wire weight as 24 wooden boxes.

◄**TRAY-LIKE FIBRE CASE** is sturdy, handy, has no sharp corners, nail or sliver hazards. Top nests in bottom half . . . takes ⅓ the space of wooden empties.

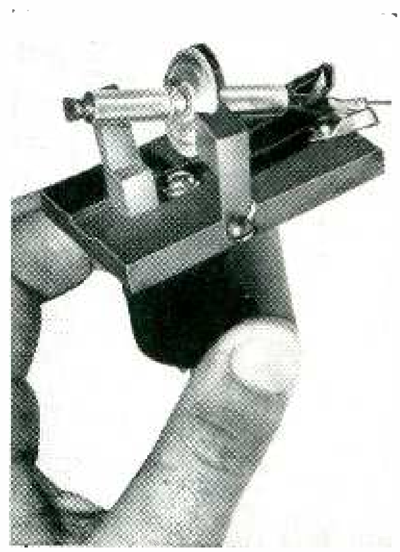
Method of using tape to determine life of fluorescent tubes

aid to coding, in a variety of widths fitting standard dispensers.

Other uses include identification of fuses, switches, wall outlets, plant wiring, stockroom bins and other items requiring either temporary or permanent labels. Life of fluorescent lamps can be easily determined by applying a dated label to the reflector when a new one is installed. Life of tubes in electronic equipment can be determined in the same way. Temperatures up to 160 F do not affect the tape.

Adapters for Pencil Triodes

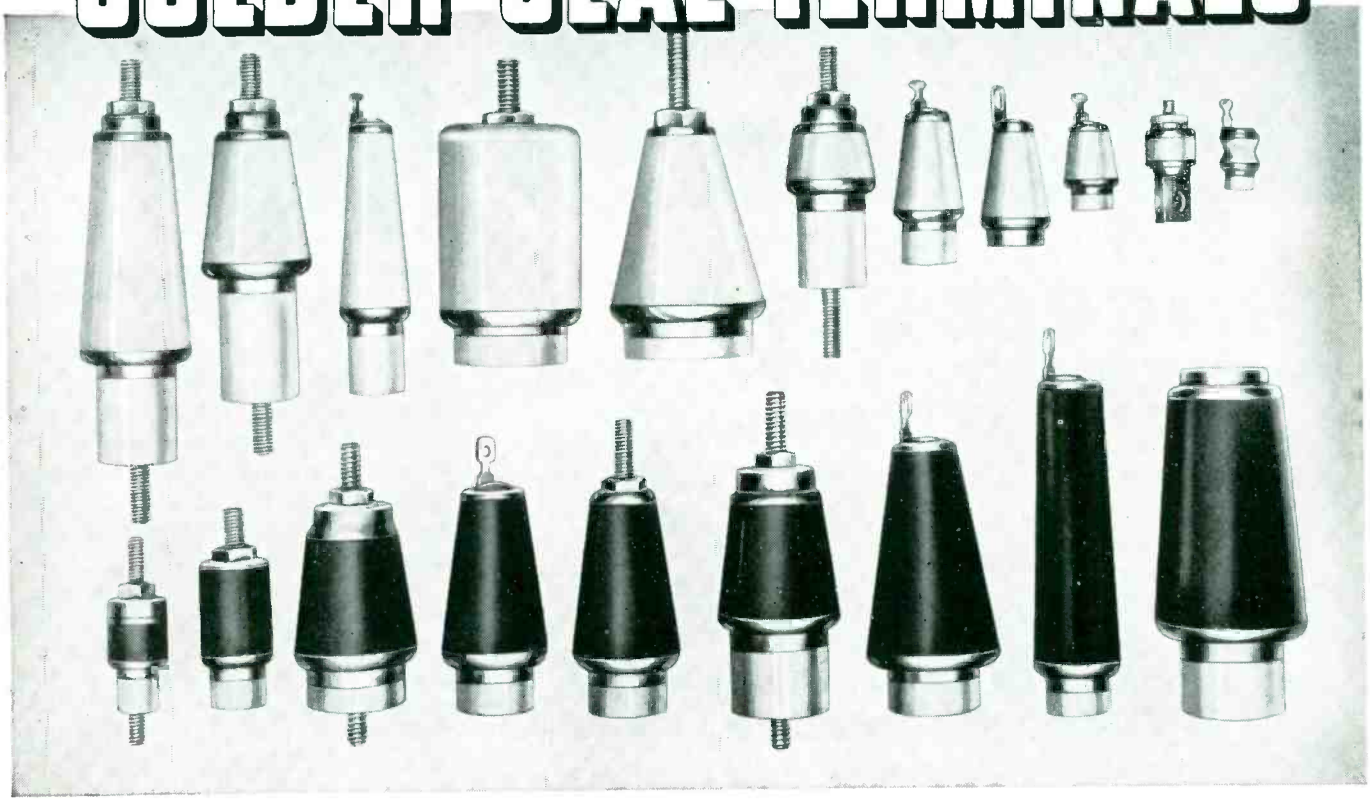
AN ADAPTER that permits plugging a pencil triode into a standard octal socket for aging and testing speeds production of these tubes in RCA's Harrison, N. J. plant. The two filament leads go into spring-clip terminals at one end of the flat plastic support which is mounted on an octal tube base. Anode and cathode



Pencil triode adapter using V-shaped block as grid contact. Vacuum-tight metal pinch seal shows clearly at left end of tube here

Solve your hermetic seal problems with this expanded line of rugged GENERAL CERAMICS SOLDER-SEAL TERMINALS

- EASE OF ASSEMBLY
- SUPERIOR STRENGTH
- NON-DETERIORATION
- PERMANENT SEALING
- RESISTANCE TO HEAT
- EXTREMELY LOW-LOSS



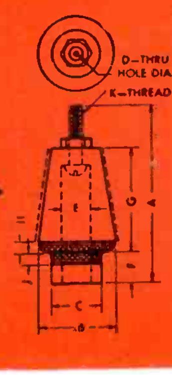
General Ceramics Solder-Seal Terminals are available in a range of sizes and shapes capable of meeting practically any requirement. Solder-Seal Terminals are easily soft-soldered to closures and effect a permanent, positive hermetic seal that is virtually immune to mechanical or thermal shock. There are no rubber or plastic gaskets to age or deteriorate. For complete information call, wire or write today.

STANDARD SOLDER LUG TYPES

PART NO.	A	B	C	D	E	F	G	H	J
D-3342	1 1/32	.490	3/8	.095	3/16	3/16	1/2	1/16	3/32
D-3346	1 19/32	5/8	.490	.095	1/4	3/8	7/8	3/32	1/8
D-3350	2 9/32	15/16	11/16	.130	3/8	3/8	1 15/32	1/8	1/8
D-3349	3 3/16	3/4	9/16	.130	1/4	5/16	2 7/16	1/8	1/8

STANDARD THREADED STUD TYPES

PART NO.	A	B	C	D	E	F	G	H	J	K
D-3856	1 7/32	.490	3/8	1/16	1/4	3/16	1/2	1/16	3/32	6/32
D-3857	1 51/64	5/8	.490	1/16	1/4	3/8	7/8	3/32	1/8	6/32
D-3962	2 15/32	15/16	11/16	.055	3/8	3/8	1 15/32	1/8	1/8	8/32
D-3638	2 15/32	15/16	11/16	1/16	3/8	3/8	1 15/32	1/8	1/8	10/32



GENERAL CERAMICS AND STEATITE CORPORATION
STEATITE INSULATORS

General CERAMICS and STEATITE CORP.
Telephone: Perth Amboy 4-5100
GENERAL OFFICES and PLANT: KEASBEY, NEW JERSEY

MAKERS OF STEATITE, TITANATES, ZIRCON PORCELAIN, FERRAMICS, LIGHT DUTY REFRACTORIES, CHEMICAL STONEWARE, IMPERVIOUS GRAPHITE

Pencil triode adapter using fuse clips for anode and cathode sleeve contacts

sleeves at opposite ends of the triode make contact with vertical metal posts, and the central grid disk contacts a spring-mounted V-shaped metal block when the tube is pushed into the adapter. Leads go from these five terminals to five pins of the octal base.

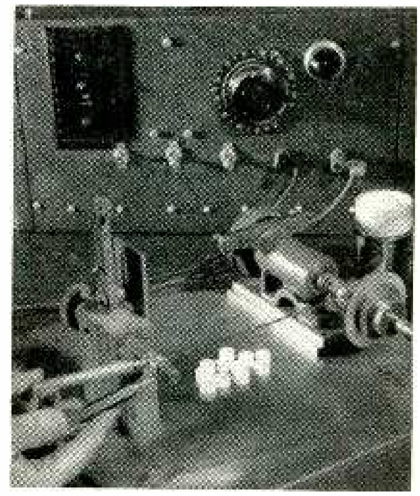
In another form of this adapter, the anode and cathode sleeves push into fuse clips, and the grid disk presses against a flat contact blade mounted in a groove.

Welding Hiperthin Cores

CORES for bimagnetic elements used in computer devices comprise only a few turns of ⅛, ¼, ½, or 1-mil material wound on a ceramic spool from ⅛-inch strips of Hiperthin or Orthonik material. A winding fixture developed for this purpose by Westinghouse has an overhead arm on which are mounted two small welding points and a knife edge. After a core is wound, this arm is brought down and the capacitor-discharge spot welder is tripped by a foot switch to weld the last turn in place. The strip is then cut off against the knife edge to finish the core.

Welding current is accurately controlled by a Variac that is adjusted each time the thickness of material is changed, to insure that just the outer lamination is welded to the one underneath.

Spool diameters range from ⅛ inch to 1¼ inch, and the number of



Setup for winding five-turn core of ¼-mil Orthonik on small ceramic spool. Test leads connected to welder in background are used to anchor last turn on core by spot welding. For small cores, winding mandrel is turned by hand with knurled knob at left. Motor drive is available for large cores. Welding points on vertical arm over winding fixture are used in place of test prods for welding larger cores

turns ranges from two turns on the smallest core up to 80 turns of magnetic material on the largest.

The magnetic material is obtained in 2¼-inch-wide rolls. These are cut to the required narrow ⅛-inch strip with a motor-driven slitter using razor blades as slitting knives. The wide strip is drawn across these knives with extreme accuracy to obtain narrow strips that are straight and have no burrs on the cut edges.

Gas Heaters Dry Lacquer on Wire

PRODUCTION of hookup wire for electronic equipment was boosted 50 percent by replacing electric heating elements with gas-fired unit heaters in the plant of Holyoke Wire and Cable Corp. This change eliminated the production bottleneck in the lacquer drying towers, which served to dry the flame-resistant lacquer that is applied over the glass or textile covering on the wire.

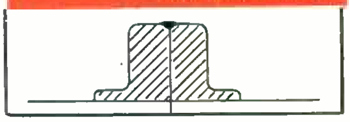
The electric heaters provided an air temperature slightly above 100 F, which was satisfactory for drying the lacquer only if it did not pass too quickly up and down the 25-foot drying tower. The National

IDEAS *in the making*

Araldite Bonding and Casting Resins developed by Ciba Research are simplifying manufacturing methods, improving product efficiency, and opening new fields of product development. You will want to know more about them.*

DURABLE . . . HIGH TEMPERATURE RESISTANT METAL-TO-GLASS BOND ON CONTACT LEADS ON DUAL-BEAM CATHODE RAY TUBE

The ARALDITE RESIN bonds the metal caps protecting the contacts that protrude from the frustro-conical section or neck wall of the tube.
(Photo courtesy Allen B. Du Mont Laboratories, Inc.)



The exceptional bonding properties of ARALDITE RESINS whereby durable bonds are achieved between many different types of materials under severe service conditions where other bonding materials prove inadequate, are demonstrated in this important application by the Allen B. Du Mont Laboratories, Inc. The ARALDITE RESIN used, "has proven very satisfactory in its bonding strength and in its resistance to softening under conditions of high humidity at elevated temperatures."

FILTER ASSEMBLIES FOR PUMP UNITS THAT ARE HIGHLY RESISTANT TO ALL TYPES OF CHEMICAL SOLUTIONS

The filter cylinders shown in the inset are ARALDITE RESINS cast in specially designed molds to provide permanent units within complete filter equipment capable of pumping as much as 2280 gallons per hour of highly corrosive solutions . . . a primarily important factor in the use of Sethco Filter Pump Units such as the model shown here for durably efficient installations in process equipment.

SEND THIS COUPON . . . or write us on your company letterhead . . . for complete technical data on the physical properties and recommended procedures for the successful use of Araldite Resins for your own fabricating needs.

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BONDING ☐ *Check here*

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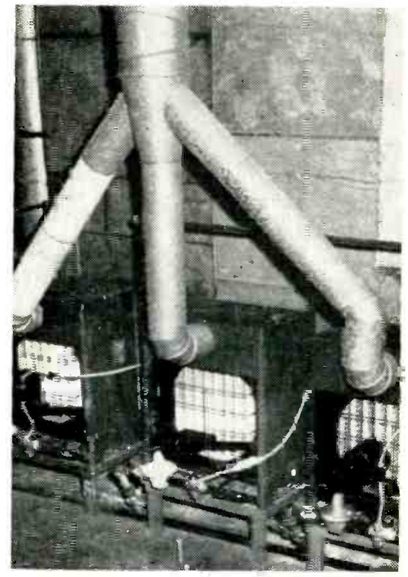


Installation of gas-fired heaters near base of lacquer-drying tower for hookup wire. Fans were removed from the heaters since a large exhaust fan was already installed for dispelling explosive lacquer fumes from the tower

Radiator Co. Series C gas-fired heaters with 172,000 Btu hourly output boosted this temperature to over 130 F, permitting the lacquering room to stay well ahead of the braiding room in production.

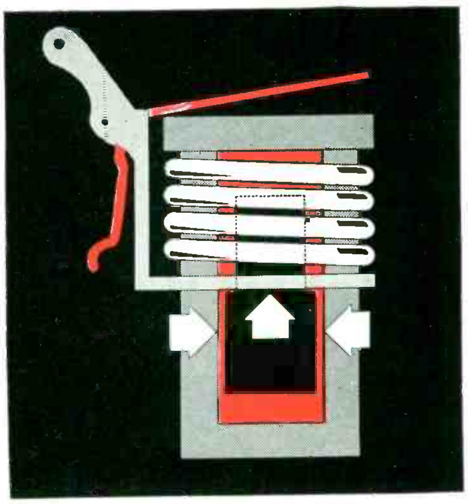
Hinged Soldering Fixture

AT ONE work position on the uhf adapter assembly line in Crosley's Cincinnati plant, a hinged wood fix-

Hinged fixture for holding uhf television tuner. Since soldering to a chassis cools the soldering iron quickly, two irons are provided for alternate use. Air wrench for driving screws into other end of chassis hangs within convenient reach of operator

Laboratory demonstration shows 30 amperes continuously flowing through 30 ampere Heinemann Circuit Breaker held over hot plate.

the one circuit breaker principle ...THAT IGNORES HEAT!



The FULLY MAGNETIC Principle

One magnetic coil is the entire actuation of HEINEMANN Circuit Breakers. Thermal warp elements are eliminated. On short circuits, the coil instantly trips the breaker. On small overloads, a time delay is introduced while the movable core is drawn toward the pole piece, increasing the magnetic flux. Moreover, the time delay is proportioned to the overload . . . being shorter for large overloads . . . and longer for small ones.

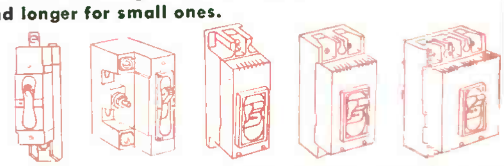
HEAT . . . the downfall of most circuit protection equipment . . . will not alter the performance of Heinemann Circuit Breakers. You never need to use false ratings to compensate for operating temperatures or room temperature. With Heinemann, current is the only consideration . . . and current (not heat) trips the breaker. There is never nuisance tripping, yet Heinemann provides the fastest circuit interruption available for short circuits and proportioned response for overloads.

Performance and dependability to this extent explains why most equipment manufacturers use Heinemann Circuit Breakers in their products.

Send for complete literature. HEINEMANN ELECTRIC COMPANY, 97 Plum Street, Trenton 2, N.J.

don't use heat...USE POWER

HEINEMANN Circuit breakers



HEINEMANN Circuit Breakers . . One, two and three pole . . 10 milliamps to 100 amperes ture permits flipping the chassis over on end quickly for insertion of shield mounting screws. When the fixture is down on the bench, the other end is exposed to the operator for soldering the end shield to the chassis.

Grid-Winding Machines for Pencil Triodes

TINY grid cylinders consisting of 0.8-mil wire spiralling around 18 spaced 1.5 or 2-mil-diameter longitudinal support wires are automatically wound and silver-brazed at high speed in a special grid-winding machine developed by the Harrison, N. J. tube plant of RCA.

The 18 spools of nickel-plated copper wire for the vertical supports surround the circular base of the winder. Each wire passes through internal drive rolls and straightening rolls that bring the wire up through 18 slots in a metal cone that surrounds the mandrel rod. As the 18 wires slowly rise with the mandrel, close up against it, the 0.8-mil silver-plated nickel alloy grid wire is wound around them. This is done by rotating the

Machine for winding tiny grids used in pencil triodes

HIGH VOLTAGE **VACUUM** HIGH CURRENT **CAPACITORS**

by

Dolinko & Wilkens, Inc.

ADVANCED DESIGN

HIGHER PERMISSIBLE TEMPERATURES

- PYREX GLASS—for maximum strength, *higher permissible operating temperatures*, better vacuum "bake," bell-shaped bulb for maximum external voltage breakdown.

7.5 KV RATING
1⅝" O.D. 4$\frac{13}{16}$" L.

16 KV RATING
1⅞" O.D. 4$\frac{13}{16}$" L.
Except VC100-16;
2½" O.D., 4$\frac{13}{16}$" L.

NO R.F. PICK-UP

- ALL OFHC COPPER—non-magnetic, *no r.f. pick-up, low* coefficient of expansion, high thermal and electrical conductivity, high "Q".

FOR HARD OPERATION UNDER LOAD

- INTERNAL STRUCTURE—large copper-to-glass seals, specially processed cylinders, maximum spacing, high-temperature braze of low vapor pressure *for "hard" operation under load.*

20 KV RATING
2⅝" O.D. 4½" L.
Except VC250-20:
2⅞" O.D., 6½" L.

32 KV RATING
2⅞" O.D. 6½" L.

HEAVY DUTY APPLICATION

- COMPACT AND RUGGED — suited especially for *heavy duty application* in transmitters, communications services, aviation radio, induction and dielectric heating, industrial oscillators, diathermy and amateur radio.

STANDARD TYPES

NOTE: Type designations are self explanatory; first digit group specifies capacitance in mmfds., second digit group gives peak kilovolt rating, e.g., VC50-16 is 50 mmfds. rated at 16 kilovolts.

Type	Max. Amps RMS at 27.3 mc.	Type	Max. Amps RMS at 27.3 mc.	Type	Max. Amps RMS at 27.3 mc.
VC6-32	45	VC6-20	30	VC6-16	25
VC12-32	45	VC12-20	30	VC12-16	25
VC25-32	45	VC25-20	30	VC25-16	25
VC50-32	65	VC50-20	60	VC50-16	45
VC75-32	65	VC75-20	60	VC75-16	45
VC100-32	65	VC100-20	60	VC100-16	45
VC150-32	65	VC250-20	65		
VC200-32	65			VC100-7.5	35
VC250-32	65				

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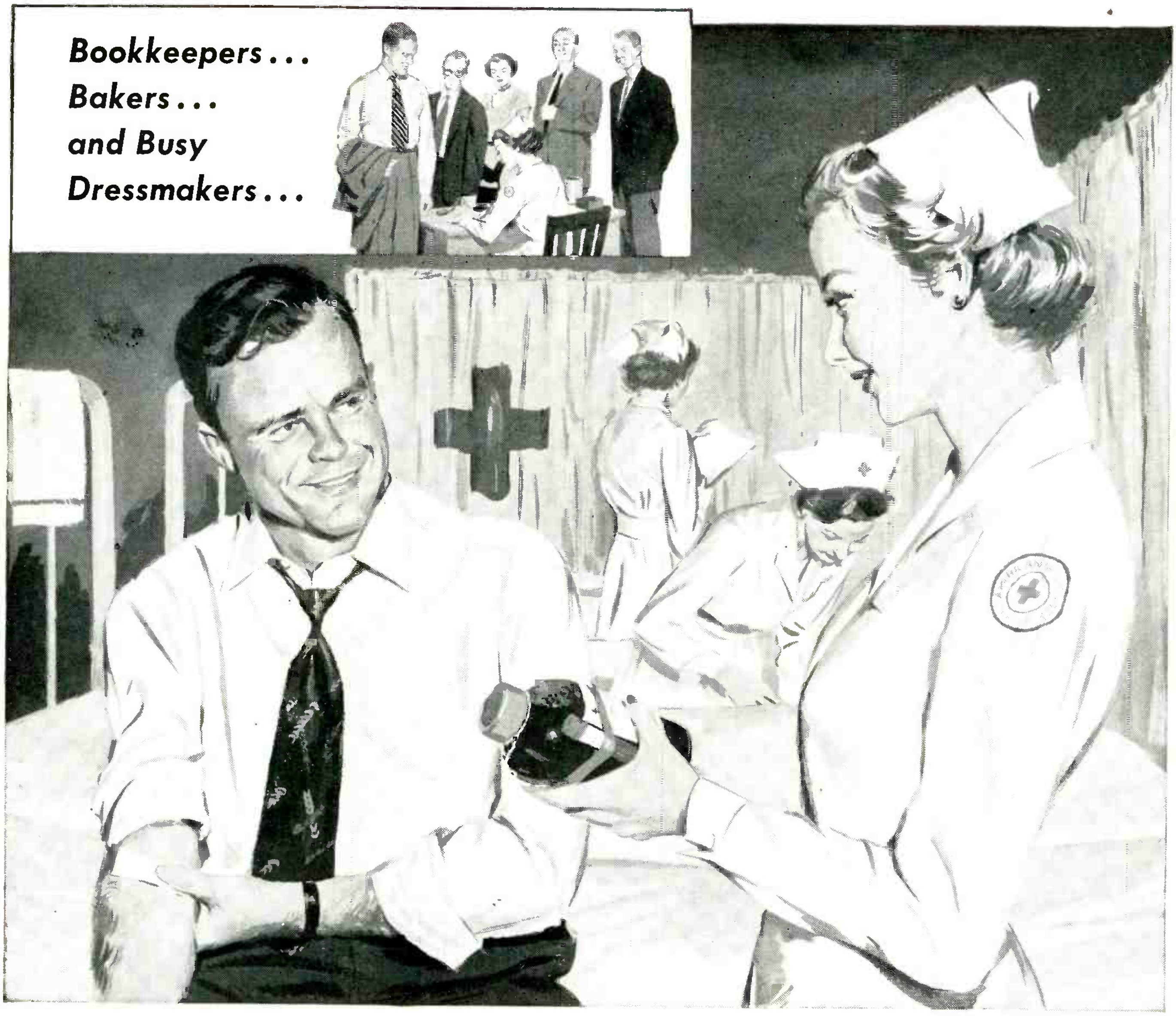


Americans Are Rolling Up Their Sleeves!

YES, ALL KINDS OF PEOPLE ARE GIVING BLOOD SO THAT OUR WOUNDED MAY LIVE!

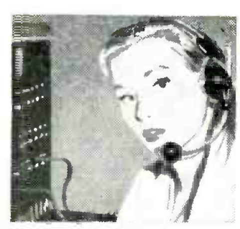
● Today, the blood of a Boston bookkeeper may be flowing through the veins of a wounded kid from a Kansas farm . . . the blood of a pretty Southern housewife may have saved the life of a grizzled leatherneck. For, blood is blood, a God-given miracle for which there is no substitute . . . and when a man's life hangs in the balance and blood is needed, there is nothing else to take its place!

Right now the need for blood is urgent. In hospitals—at home and overseas—many men require four and six transfusions during delicate operations. And the blood *must be there*—when it's needed. So give the most precious gift of all—*your* blood!

Be assured that giving blood is neither difficult nor distressing. And what a thrill there is in knowing that you've performed a really unselfish act! So call your local American Red Cross today and make an appointment. And tell your friends and neighbors about your experience. Let them share the wonderful feeling Americans get when they roll up their sleeves—and give blood.

But—

WHAT HAPPENED TO THAT PINT OF BLOOD YOU WERE GOING TO GIVE?



Call Your American Red Cross Today!

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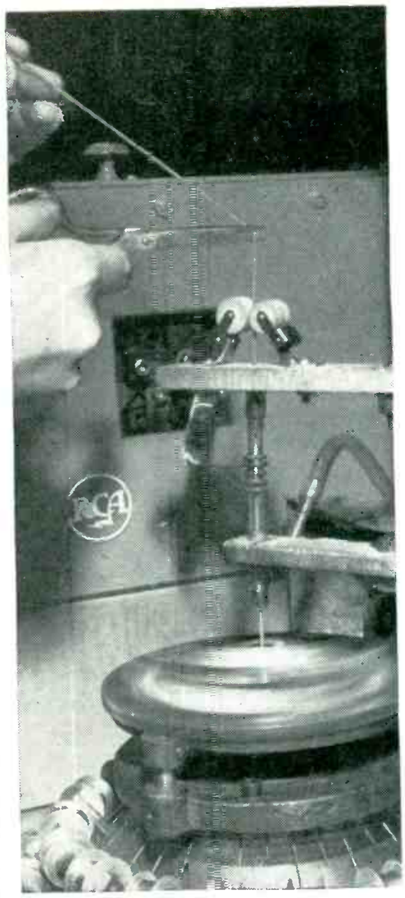


Grid-winding machine in action, with operator cutting the fine grid wire after breaking off a section of wound mandrel at a previously notched point

reel of plated grid wire. Grid spool rotation speed, controlled by gears, determines the spacing between grid turns.

The completed grid structure rises into a quartz tube in which is an atmosphere of hydrogen. The work coil of an induction heating generator surrounds this tube, to heat the silver-plated windings and supports and fuse them together at each crossover. The hydrogen prevents oxidation of the silver during the brazing operation.

An extra set of 18 spools of support wire of a different size is mounted on the machine. With these, different types of grids can be wound merely by changing the reel of grid wire, which for pencil triodes is used in three different sizes.

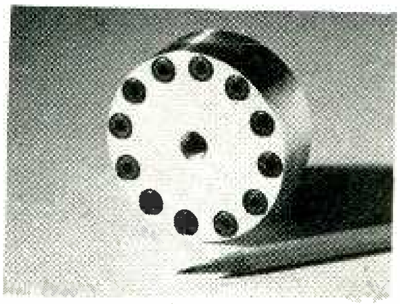
The completed grid cylinder on its mandrel is removed as each mandrel length leaves the machine. The cylinder is then placed in another machine which cuts it into separate grids prior to removing them from the mandrel.

NEW PRODUCTS

Edited by WILLIAM P. O'BRIEN

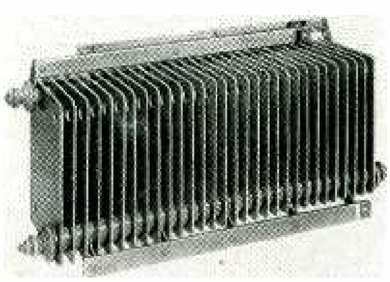
Testing Devices For Laboratory and Industry Are Described . . . Variety of New Components Included . . . Thirty-Eight Recent Manufacturers' Catalogs Reviewed (p 340)

OTHER DEPARTMENTS
featured in this issue:



Pressure-Gage Aid

TRANS-SONICS, INC., Bedford Airport, Bedford, Mass. The type 40 Isolator safely confines highly corrosive fluids and transmits their pressure with negligible pressure drop. Most standard pressure gages can, in conjunction with the Isolator, be used to measure pressures of materials that might otherwise react violently and destroy the pressure gage. The unit operates at line pressures up to 1,000 psi and will withstand full line pressure on either side in case of failure. It provides for large volumetric displacement as may result from enclosed liquid thermal expansion. A four-page folder now available contains technical notes and a dimensional outline drawing.

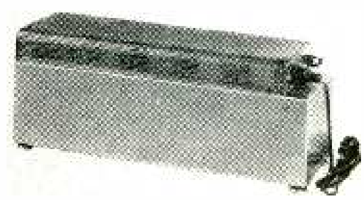


Selenium Rectifier Cell

FEDERAL TELEPHONE AND RADIO CORP., Clifton, N. J., has developed a new selenium rectifier cell rated 36 v rms, designed especially for applications where size and weight are primary considerations. Because the individual cells are so rated, a rectifier stack made up of these cells will not only withstand a higher reverse voltage, but will require fewer cells for the same voltage output. As a result, losses are proportionately less, and the efficiency of the stack is considerably increased. The unit is particularly well adapted for use in aircraft and in many types of military equipment. Its compactness and lighter weight also make it ideal for use in battery chargers and power supplies. Other features include rugged construction, long life and a high operating temperature, which results in less derating.

C-R Tube Booster

STANDARD TRANSFORMER CORP., 3580 Elston Ave., Chicago 18, Ill., is in production on the P-8192 c-r tube booster, a compact, self-contained device designed to add months to the useful life of a tv picture tube. It can be used with all electromagnetic picture tubes, regardless of size, where dimming is due to low cathode emission. Easy to install, the booster measures only 3½ in. high and 1½ in. in diameter. Of autoformer construction, it has 18-in. leads between the booster and the connector plug, allowing the booster to be placed anywhere in the set, and is supplied with bracket and screws for chassis or cabinet mounting. To install, it is only necessary to remove the tube connector and attach it to the booster, then attach the connector plug of the booster to the tube.



Regulated D-C Power Supply

ACME ELECTRONICS, INC., 300 North Lake Ave., Pasadena 4, Calif. Model S-715 regulated d-c power supply, designed to give a minimum of 20,000 hours of service without failure, uses no vacuum tubes in any of its circuits. Selenium rectifiers are used, and regulation is accomplished by a special magnetic amplifier circuit. Output power is rated at 300 v d-c with less than 0.1-percent ripple. Regulation is ± 1.0 percent from 0 to 200 ma output current, and for input voltages from 105 to 125 v. Nominal power frequency is 60 cps but rated regulation is maintained for frequency

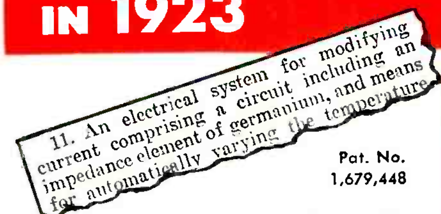
RAYTHEON

and TRANSISTORS

A *Thirty-Year Record* OF

Germanium Product Research, Development and Manufacture

IN 1923


11. An electrical system for modifying current comprising a circuit including an impedance element of germanium, and means for automatically varying the temperature

Pat. No. 1,679,448

Raytheon's Dr. C. G. Smith applies for patent on a germanium current amplifier.

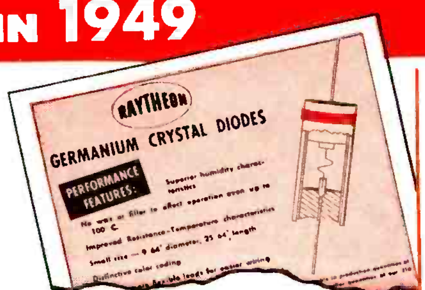
IN 1929

Raytheon designed and produced this Germanium *Photo Transistor.*

IN 1948

the Raytheon CK-703 *Point Contact Transistor* is perfected and put in production, now superseded by the improved type, CK716, currently available.

IN 1949



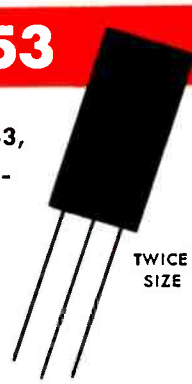
Raytheon inaugurates large scale production of *Germanium Diodes.*

IN 1950

TWICE SIZE

Raytheon develops the CK710 *Germanium Diode Mixer* to replace silicon diodes. UHF television receiver circuits now use the CK710.

IN 1953



TWICE SIZE

by early 1953, Raytheon Junction Transistors and New Point Contact Transistors will be available in sample quantities.

RAYTHEON®

Excellence in Electronics

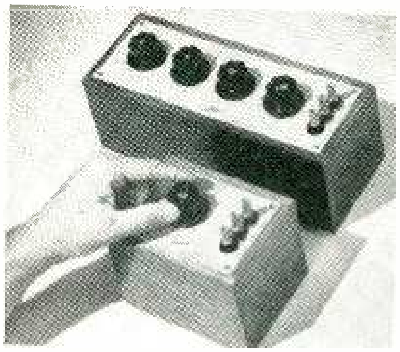
RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division — for application information call

Newton, Mass. Bigelow 4-7500 ● Chicago, Ill. NAtional 2-2770 ● New York, N. Y. WHitehall 3-4980 ● Los Angeles, Calif. Richmond 7-5524

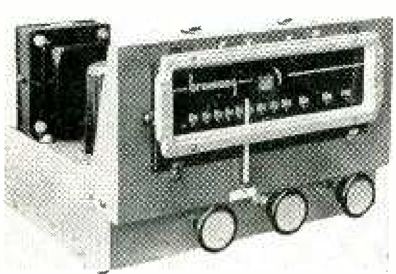
RAYTHEON MAKES ALL THESE:

RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES variations of ±10 percent. Modifications can be made for use on other power frequencies and for other voltage and power requirements.



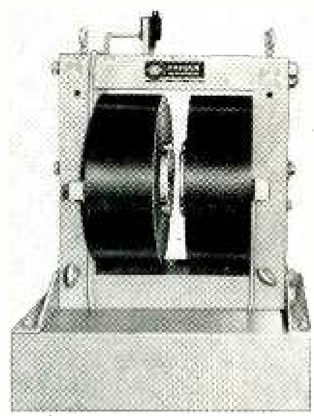
Decade Inductors

LENKURT ELECTRIC CO., 1113 County Road, San Carlos, Calif. Decade inductors are now available with inductance values guaranteed to within one percent. Four individual units cover the ranges from 1 to 10 mh, 10 to 100 mh, 100 mh to 1 h and 1 to 10 h. All four units are also available as a single unit to cover the complete range from 1 mh to 10 h. Design and construction details make these decades ideal for laboratory use. Moisture-resistant impregnated inductors are wound on molybdenum permalloy toroidal cores for high Q and low external pickup. Each decade has complete electrostatic shielding. Full rotary switches for selecting inductance values have low contact resistance, laminated self-wiping contacts and positive detents.



F-M Tuner

BROWNING LABORATORIES, INC., 750 Main St., Winchester, Mass. Model RV-31 f-m tuner features an all triode r-f section and follows the Armstrong receiving method with dual cascade limiters for most effective noise quieting. Input signals of 3 μv will produce 20 db of quieting. The afc locks the local oscillator into correct tuning and may be switched off if desired. A selector switch permits f-m, phono, tv or recorder playback to be fed through the tuner volume control to the main amplifier. Full 15 kc audio output is fed through a cathode follower output stage at very low distortion; less than 0.25 percent at 25 kc modulation swings. Long cable runs are possible at the low impedance output without affecting high-frequency response.



Research Magnet

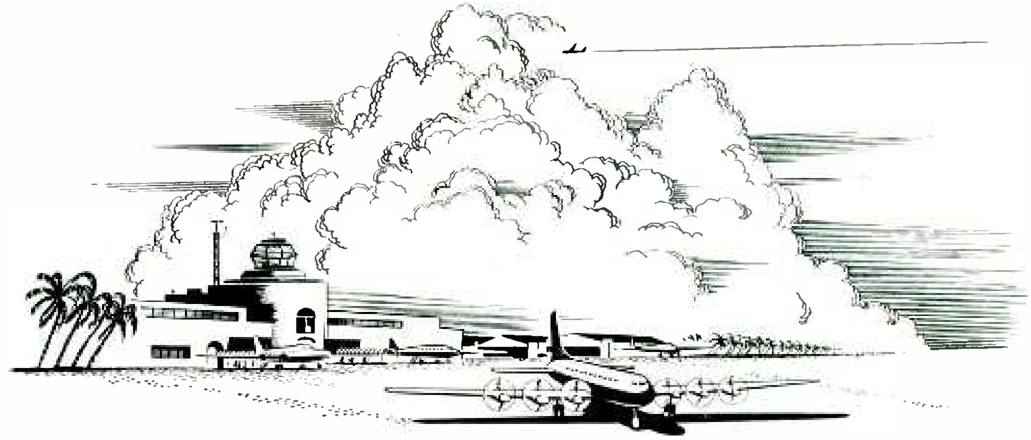
VARIAN ASSOCIATES, 905 Varian St., San Carlos, Calif. Magnetic fields as high as 40,000 gauss, or lower fields with extremely high uniformity are provided by the model V-4012 research magnet. Applications include nuclear and paramagnetic-resonance work, Zeeman studies, and other research projects where relatively high volumes of high-homogeneity magnetic field are required. Under the standard arrangement with pole caps of 12-in. diameter and air gap of 1¾ in. a magnetic field is produced which is uniform to one part in 50,000 throughout a cu in. volume of air gap. Maximum air gap of 5¼ in. is possible. For high-field studies tapered pole caps are substituted for the conventional flat ones. Having dimensions 41¼×36×52½ in. high, the magnet weighs approximately 5,600 lb.

High-Gain D-C Amplifier

GEORGE A. PHILBRICK RESEARCHES, INC., 230 Congress St., Boston 10, Mass. Model K2-W is a general-purpose high-gain d-c amplifier of modular construction, offering stability and fidelity for operational service in feedback computing systems of every speed. A low output impedance is automatically maintained whether or not feedback is applied. The inputs are high-impedance and differential, permitting gains of either sign up to 15,000. The power requirements are unusually low; 5 ma at ± 300 v d-c, and heater power for a pair of 12AX7 double triodes.

Twin Diode

RADIO CORP. OF AMERICA, Harrison, N. J. The 5726 is a high-perveance, miniature twin diode especially useful as a detector in circuits utilizing wide-band amplifiers. Constructed to give dependable performance under shock and vibration, it is particularly suited for use in mobile and aircraft equipment. The two, sturdy, coiled heaters used in the tube are internally connected in series to provide fail-safe operation in applications which require that burnout of either heater will make the heaters of both units simultaneously inoperative. These heaters employ pure tungsten



Dependable Insulation "upstairs and down"

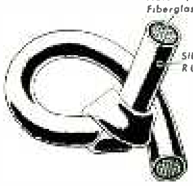
BH "1151"

Fiberglas Silicone Rubber Tubing . . . Sleeving

Often in a matter of minutes a plane wings from a steaming tropic air-strip to the sub-arctic temperatures of the stratosphere. Fungus breeding, wet heat one minute . . . intense, stiffening cold the next . . . and the electrical system must "take it".

That's why BH "1151" was developed. Here at last is electrical tubing and sleeving of braided Fiberglas coated with Silicone Rubber that is *inherently* flexible — no plasticizers or solvents to "sweat out" — and chemically incapable of supporting fungus growth.

BH "1151" is the new Class H insulation that is completely flexible when manufactured and *keeps* that flexibility.



BH "1151" withstands bending, required in normal assembly, without loss of dielectric strength — will not craze or crack. Remains unchanged through continuous operation at temperatures from –90°F. to 400°F.

The flexibility of BH "1151" speeds installation and offers new design freedom while assuring product protection.

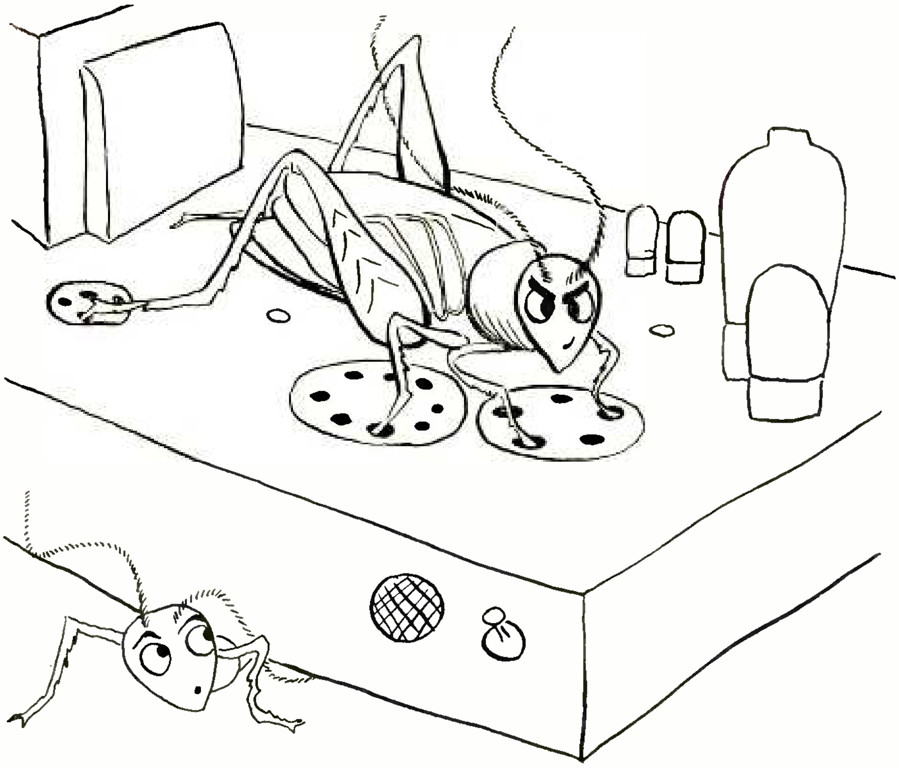
Bring your product up to date — insulate it with BH "1151" Tubing and Sleeving. Write for samples and data sheets today.

Address Dept. E-12

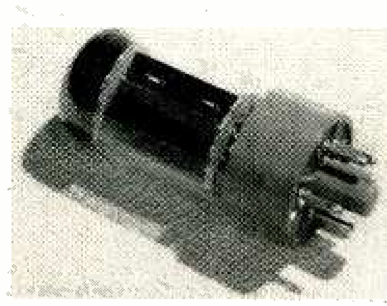
BENTLEY, HARRIS MANUFACTURING CO.
CONSHOHOCKEN, PA.

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.

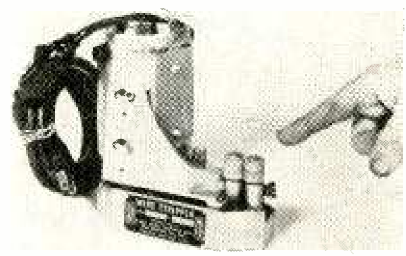


to provide long life under conditions of frequent on-off switching.



High-Vacuum Rectifier

General Electric Co., Schenectady, N. Y., has developed the GL-6087 full-wave, high-vacuum rectifier designed for use in aircraft power supply units of moderate current requirements. Through use of a unipotential cathode that is internally connected to the filament, excessive surge voltages across the filter input capacitors during the warm-up period are avoided. Maximum ratings as a rectifier include a peak inverse plate voltage of 1,400 v at altitudes up to 60,000 ft and a steady-state peak plate current of 375 ma per plate. In typical operation it has a d-c output current of 125 ma. Measured with applied d-c at 125 ma per plate, the tube voltage drop is 50 v.

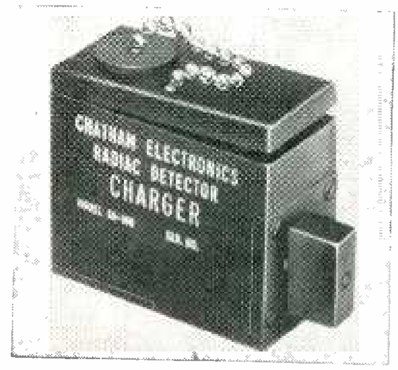


Small Wire Stripper

The Eraser Co., Inc., Rush Wire Stripper Division, 104 S. State St., Syracuse 2, N. Y., has developed a new miniature wire stripper, known as the type R Midget. Specially designed for removing film insulations from wire ranging from AWG50 to AWG40 inclusive, the midget stripper may be used in conjunction with the coil winding machine, mounted on a fixed or swinging bracket or track. It can

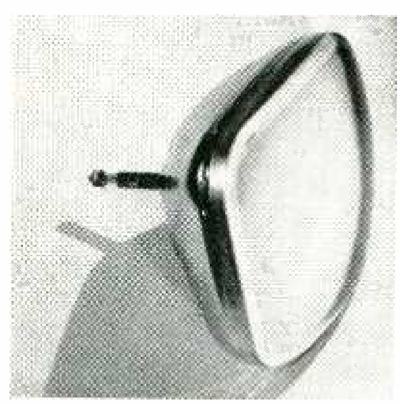

FREED Instruments & Transformers
Famous For
QUALITY • DEPENDABILITY • ACCURACY
FREED
1020-B MEGOHMMETER
A precision electronic megohmmeter which for years has given satisfactory service in hundreds of laboratories and on production lines.
• EASY TO READ
Direct reading on a 4" scale.
Protected against overload.
• RAPID & SAFE TO USE
Test voltage removed from terminals and capacitive components discharged to ground in all positions of multiplier switch.
• ACCURATE
Within 3% up to 100,000 megohms, 5% from 100,000 to 2,000,000 megohms.
SPECIFICATIONS
Range: 1 megohm to 2,000,000 megohms in six overlapping ranges selected by a multiplier switch.
Voltages on Unknown: The voltage applied to the unknown terminals is 500 volts d-c and is independent (less than 1%) of the value of the unknown.
Stability: Line voltage variations from 105-125 volts will cause less than 2% variation in the meter reading.
Power Supply: 105-125 volts A.C. 50-60 cycles 30 watts.
Dimensions: 9½ x 10½ x 8 inches.
Net Weight: 18 pounds.
MEGOHMMETER
TYPE 1020-B
ZERO
PRESS
500V.
GND.
GUARD
MEGOHMS
10 MEG
1 MEG
CALIBRATION
ZERO ADJ.
100 MEG
1K MEG
10K MEG
100K MEG
High Fidelity Transformers
Slug Tuned Components
Hermetically Sealed Components to meet MIL-T-27 Specs
Commercial Components
Sub-miniature hermetically sealed Toroidal Inductors
Freedseal Treatment ANE-19 Specs
Miniature Inductors
Pulse Modulators
FREED TRANSFORMER CO., INC.
1722B WEIRFIELD ST. (RIDGEWOOD) BROOKLYN 27, N. Y.

be used in any position, horizontal or vertical. The stripper uses ⅜-in. diameter Fybrglass wheels that develop sufficient frictional heat to melt the insulation and then wipe away the residue. This permits complete removal of the insulation without scoring or breaking the wire. The design is such that the leads can be stripped up close to the coils.



Radiac Detector Charger

CHATHAM ELECTRONICS CORP., 475 Washington St., Newark 2, N. J. Model No. XA-100 radiac detector charger offers a compact, easy to use, portable means of charging pen-type fiber dosimeters. The charger is completely self-contained and does not require tubes or batteries. Polarity is dependent upon the direction of rotation; hence if a dosimeter is overcharged it may be zeroed by changing direction of turning. The charger is capable of delivering a current of 10^{-8} amperes at an output voltage up to 3,000 v, positive or negative polarity.



Rectangular TV Picture Tube

GENERAL ELECTRIC CO., Schenectady 5, N. Y., has developed type

INTERNATIONAL RECTIFIER CORPORATION

EL SEGUNDO CALIFORNIA

HERMETICALLY SEALED

Diameter.........3/16" to 1-1/4"
Length.............9/16" to 10"
Current: half-wave..1.5 ma to 60 ma
Voltage: DC output......20 volts to 4,000 volts

PHENOLIC CARTRIDGE

Diameter...............⅛" to 1"
Length................½" to 12"
Current: half-wave..1.5 ma to 60 ma
Voltage: DC output....20 volts to 10,000 volts

SELENIUM DIODES

Diameter.........0.100" to 0.300"
Length...........0.210" to 0.250"
Output Voltage..........20V to 80V
Output Current...250 ua to 1.5 ma
Temperature Range -50°C to 100°C

Selenium Rectifiers

A recent month's production included Rectifiers to supply 40 microamperes, 1,000 volts, and Rectifiers with a capacity of 140,000 amperes, 14 volts.

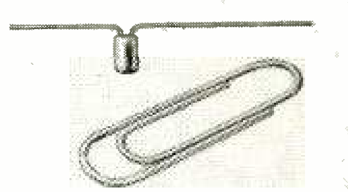
POWER STACK
30 Kw DC Power
Considered to be the largest single selenium rectifier stack produced.

Owned and managed by Engineers who are specialists in the design and manufacture of Selenium Rectifiers. Submit your problems for analysis and we will be glad to offer our recommendations.

INTERNATIONAL RECTIFIER CORPORATION

General Offices: 1521 E. Grand Ave., El Segundo, Calif. • Phone: El Segundo 1890
Chicago Branch Office: 205 West Wacker Drive • Phone: Franklin 2-3889

27EP4, a 27-in. rectangular tv picture tube. It is a magnetic-focus, magnetic-deflection, all-glass tube that features an aluminized backing on the screen, which reflects light emitted from the back surface of the screen, providing a picture that is up to 100 percent brighter than a nonaluminized 27-in. tube at the same voltage. Length of the tube from front to back is less than 23 in. The space saving is made possible by use of a 90-deg diagonal deflecting angle. Recommended operating conditions are: anode voltage, 16,000 v; grid No. 2 voltage, 300 v; grid No. 1 voltage, −33 to −77 v; and ion-trap field intensity, 38 gausses.



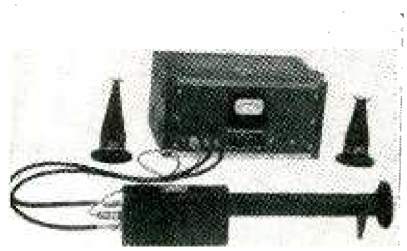
Selenium Diodes

INTERNATIONAL RECTIFIER CORP., 1521 E. Grand Ave., El Segundo, Calif. Two new selenium diodes, types 1S1 and 5U1, have been developed for addition to the line of subminiature diodes now in production. Type 1S1 is rated for a maximum input of 26 v rms at 100-μa output, while the type 5U1 is rated for 130 v maximum at 1.5 ma. These new diodes augment the line of eight types currently being produced for operation in an ambient temperature range of 50 to 100 C. The units are completely encapsulated within a thermosetting plastic to protect them against adverse environmental conditions. These selenium diodes are being extensively used to provide bias for tubes in diversified military and commercial electronic equipment. Measurements are as follows: type 1S1—0.10 in. wide × 0.21 in. long; type 5U1—0.30 in. wide × 0.25 in. long.

Pattern Generator

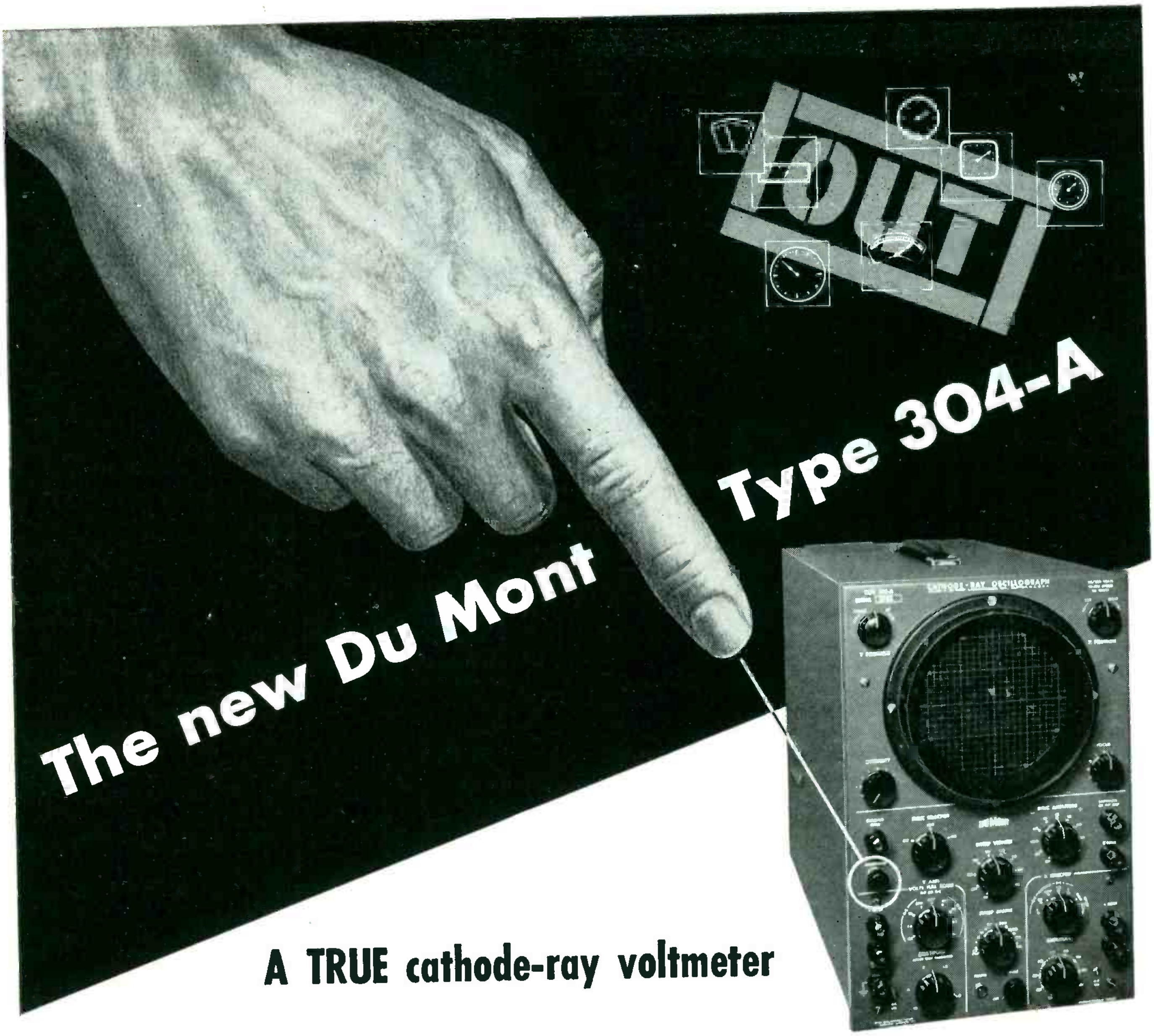
UNITED TECHNICAL LABORATORIES, Morristown, N. J. A new pattern

generator that has been designed particularly for testing tv receivers and tv picture tubes has been announced. The instrument may be connected to several tv chassis points for adjustment data or used as a test pattern source to modulate tv signal generators. The unit acts either through a receiver's video system so that horizontal or vertical lines are produced on the picture tube screen, or tests the overall response when used to modulate a tv signal generator. These lines are used to correct linearity and centering of tv images. Model CB-101 pattern generator may also be connected directly to tv picture tube pins so that tube operation may be checked without removal of the receiver chassis from its cabinet. Special leads and connectors are supplied for connecting the instrument to the video amplifier or picture tube pins.



Calorimetric Wattmeter

G. W. ASSOCIATES, P. O. Box 2263, El Segundo, Calif. Model KM-3/90-B calorimetric wattmeter is designed to measure accurately the average power dissipated by a signal source in the frequency range of 2,600 mc to 90,000 mc. It has a maximum average power rating of 400 watts. The termination is capable of peak powers in excess of 500 kw. Input power must be supplied from a 115-v 60-cycle a-c source. Power consumption under full load is 15 watts. The instrument consists of a combined power supply and control unit housed in one cabinet, and the calorimetric termination in a separate unit. The termination directly matches type RG-48/U waveguide, and may be matched with all other standard sizes by means of adapters. These adapters are designed to operate



AT THE PUSH OF A BUTTON...

Once you zero-set a new Du Mont Type 304-A it is almost automatic to measure potentials of the waveforms on the screen of the cathode-ray tube. And you'll be surprised to find out how much more you know about your circuit; how much easier circuit development and production testing become when amplitude calibration is in front of you every time you examine a waveform.

The new Du Mont Type 304-A will make your job easier, will greatly simplify measurements that formerly were difficult or inconvenient to make. The Type 304-A is not just another oscillograph; it is a true cathode-ray voltmeter, made possible by a precision calibrator and the tight-tolerance, flat-face Type 5ADP- Cathode-ray Tube. Only through the combined facilities, unique in the industry, of the Du Mont Cathode-ray Tube and Instrument Divisions could the Type 304-A Cathode-ray Oscillograph have evolved.

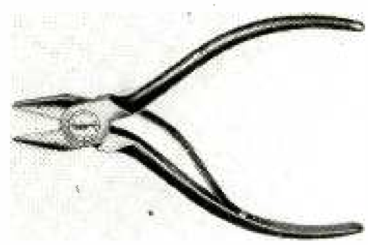
SPECIFICATIONS:

- Tight-tolerance, flat-face Type 5ADP- Cathode-ray Tube
- Vertical and horizontal amplifiers flat to d.c., 10% down at 100 KC
- Direct voltage measurement — Range, 0.1 to 1000 volts full scale, read directly from oscillograph scale; 5% overall accuracy
- High sensitivity — At full gain, 0.025 volts/inch
- Undistorted vertical and horizontal deflection more than 4 inches
- Expansion equivalent of 20 inches vertically and 30 inches horizontally with full positioning
- Driven and recurrent sweeps with sync limiting — Range, 2 to 30,000 cps; provision for extra-low frequency sweeps by externally connected capacitor; maximum writing rate, 1 inch/μsec
- Illuminated, numbered scale and suitable filter provided; scale illumination variable from zero to more than adequate for viewing and photography
- Improved stability of vertical amplifier

Price **$333.00**

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

over the whole bandwidth allocated to each waveguide.



Trimming Plier

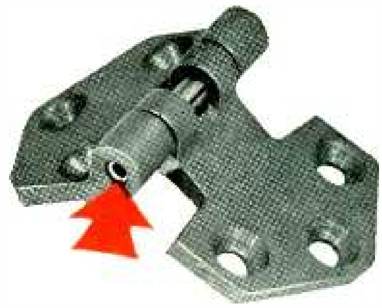
MATHIAS KLEIN & SONS, 3200 Belmont Ave., Chicago 18, Ill., now offers a new lightweight oblique cutting plier, without the customary top bevel. With this new design, the entire length of the cutting knives works flush against the cutting surface, permitting a close, clean trim. The plier is especially useful for cutting small wires or trimming plastic. The extremely narrow head also makes it ideal for cutting in confined places. A replaceable tempered steel spring keeps the plier in open position for immediate use without the necessity of opening by finger. It is also available without the leaf spring if preferred. The plier may be had in 5-in. size only.

Axial Lead Resistor

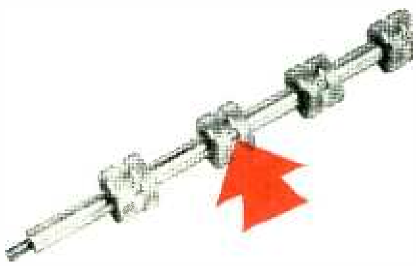
BOND ELECTRONICS CORP., Springfield, N. J., is in production of a newly designed true axial lead resistor with completely noncorrosive joints without the use of solders or fluxes. The new resistors are completely protected from chassis or mounting surface, due to the true axial termination, affording greater dielectric path. They are guaranteed to exceed the requirements for JAN R-B-51, are made to all standard tolerances and are wound in a wide range of alloys to meet re-

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.

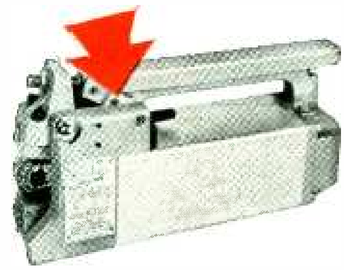


REPLACING A HEADED PIN . . . In this hinge pin application, Rollpin is simply and inexpensively driven in place, greatly reducing assembly costs. Constant spring tension holds Rollpin firmly in place . . . eliminates loosening of hinge due to wear.



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

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.

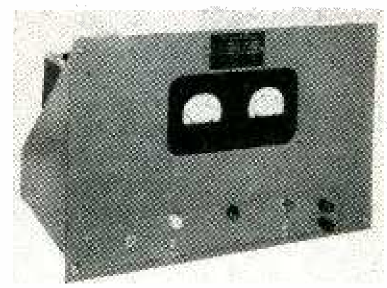
Dept. R6-1221 Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

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_____

quirements of varying resistance values.

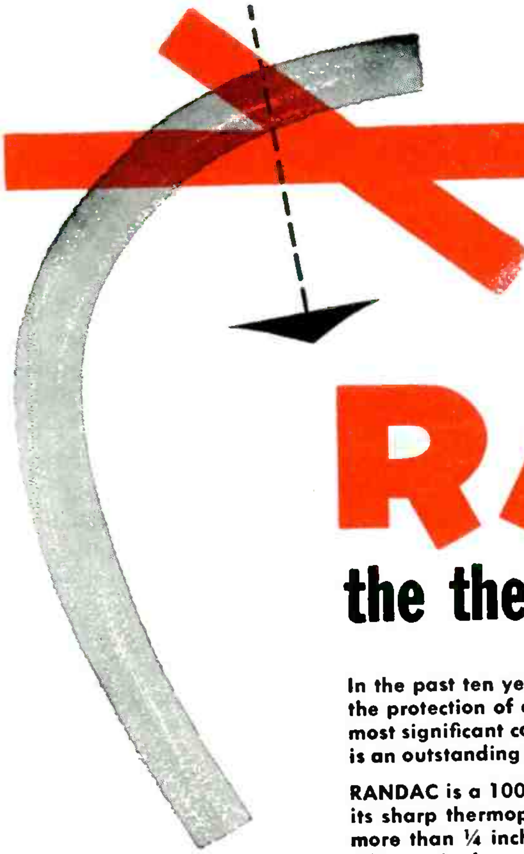


Nobatron

SORENSEN & CO., INC., 375 Fairfield Ave., Stamford, Conn. Model E-300-1 Nobatron is a B supply designed specifically for a test position requiring 300 v d-c, regulated, at the relatively high current of 1 ampere. Input is 105-125 v at 50-60 cycles; output is adjustable from 297 to 303 v d-c at 0-1 ampere; regulation accuracy is ±1.0 percent for line and load changes from zero to full load; and ripple is 10 mv.

Crystal Test Set

MICROWAVE ASSOCIATES INC., 22 Cummington St., Boston 15, Mass. The T104A crystal test is a portable, completely self-contained equipment for the field testing and selection of 1N23B matched crystal pairs for X-band balanced mixer applications in the frequency range of 8,500 to 9,500 mc. Provision is made for testing pairs for crystal current balance, i-f impedance balance and leakage power (an indication of r-f impedance balance)—the



MITCHELL-RAND

announces its most significant compound development of the decade

RANDAC

the thermosetting encapsulating plastic

In the past ten years Mitchell-Rand has developed a great many electrical insulating compounds for the protection of electronic and electrical components. However, in RANDAC Mitchell-Rand makes its most significant contribution to the electrical and electronic industries . . . the development of RANDAC is an outstanding achievement!

RANDAC is a 100% solid resin for encapsulating and sealing electrical and electronic components . . . its sharp thermoplastic melting point permits "hot melt" dip-coating in thicknesses from 25 mils to more than ¼ inch without danger of resin flow or damage and without the use of a cast or mold. After a single cure the RANDAC becomes tough and infusible contributing everlasting protection to the equipment it encases.

RECOMMENDED APPPLICATIONS *for* RANDAC

1. Coating and encapsulating for purpose of moisture resistance, mechanical shock resistance, and electrical insulation on: Transformers, Resistors, Rectifiers, Capacitors, Transistors, Printed circuitry, Electronic assemblies.
2. Corona control by void filling and coating high voltage transformers, parts, and assemblies.
3. Sealing parts such as capacitors resistors, and rectifiers, into metal, ceramic, and plastic cases.
4. Cast embedment of electronic parts and assemblies.

RANDAC features

RESISTANCE TO THERMAL SHOCK
Transformers coated with RANDAC have withstood thermal shock tests from room temperature to −65 C.

HIGH TEMPERATURE STABILITY
Maximum unit operating temperatures of above 150 C are indicated for RANDAC encapsulated units.

ELECTRICAL PROPERTIES
RANDAC exhibits a high dielectric strength and is well suited for corona suppressing applications.

LOW MOISTURE ABSORPTION

ADHESION
RANDAC shows excellent adhesion to most metals, ceramics, and plastics.

LOW SHRINKAGE AFTER GEL

RANDAC HERMETICALLY SEALS AND ENCASES ELECTRONIC AND ELECTRICAL PARTS IN THICKNESSES FROM 25 MILS TO MORE THAN ¼ INCH WITHOUT THE USE OF CASTS OR MOLDS OR THE NECESSITY TO EMPLOY MULTIPLE DIP AND CURE CYCLES.

A working sample of RANDAC will be sent on letterhead request.

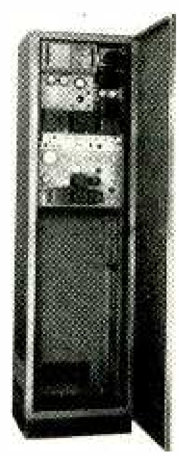
MITCHELL-RAND · SINCE 1889 · Electrical Insulation Headquarters

MITCHELL-RAND INSULATION COMPANY, INC.
51 MURRAY STREET · Cortlandt 7-9264 · NEW YORK 7, N. Y.

A PARTIAL LIST OF M-R PRODUCTS: FIBERGLAS VARNISHED TUBING, TAPE AND CLOTH • INSULATING PAPERS AND TWINES • CABLE FILLING AND POTHEAD COMPOUNDS • FRICTION TAPE AND SPLICE • TRANSFORMER COMPOUNDS • FIBERGLAS SATURATED SLEEVING • ASBESTOS SLEEVING AND TAPE • VARNISHED CAMBRIC CLOTH AND TAPE • MICA PLATE, TAPE, PAPER, CLOTH, TUBING • FIBERGLAS BRAIDED SLEEVING • COTTON TAPES, WEBBINGS AND SLEEVINGS • IMPREGNATED VARNISH TUBING • INSULATING VARNISHES OF ALL TYPES • EXTRUDED PLASTIC TUBING three characteristics for which test limits have been defined in the proposed JAN specification for 1N23B matched pairs. The equipment is entirely self-calibrating.

Electrical Coil Protection

DOUGLAS-RANDALL, INC., 102 High St., Westerly, R. I. Protection against damage from continued exposure of electrical coils to temperatures up to 300 F is now obtainable at low cost with the process used by the company in the manufacture of electrical coils. The new process, which does not involve the use of silicones, provides protection in the intermediate temperature range at a cost only slightly above that of unprotected coils. Thus the manufacturer who needs 300-deg protection can avoid the considerable cost increases resulting from the use of other processes that necessarily go to 500 F. Both random-wound and interleaved coils, wound on either round or rectangular bobbins, can be furnished with 300-F protection.



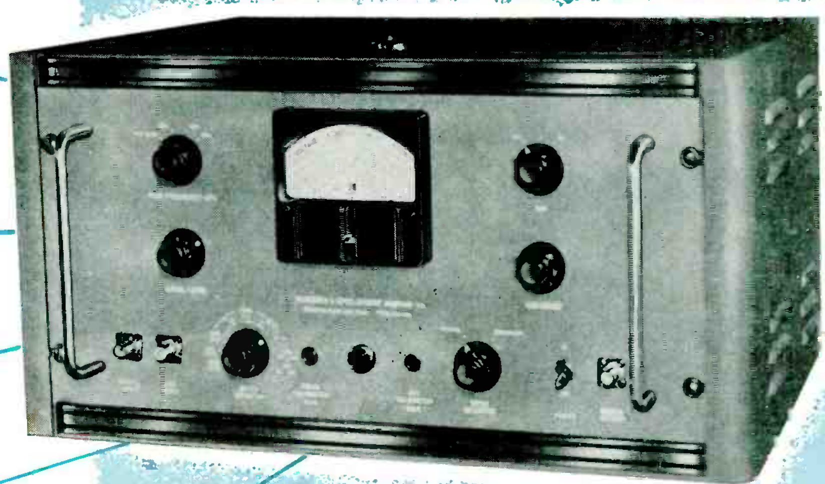
Microwave Radio System

RADIO CORP. OF AMERICA, Camden, N. J., announces a short-haul microwave radio system for communication, utility, pipeline and vhf operations. Type CW-5B microwave relay equipment operates in the 940 to 960-mc frequency range and may be used for point-to-point communications over distances up to 300 miles. The equipment serves terminal and automatic relay stations, providing for simultaneous operation of five voice channels and one service chan-

ARE VSWR MEASUREMENTS YOUR PROBLEM?

-then the PRD **type 275**

voltage standing wave ratio amplifier is your solution



- A.G.C. maintains output constant within ± ¼ db for a ± 3 db variation in the r-f source.
- Wide VSWR ranges of 1:1.3, 1:3, 3:10, 10:30, and 30:100.
- High sensitivity—1.0 microvolts input for full scale deflection.
- Input circuit — Provides for either crystal or bolometer operation.
- Low input noise level of 0.03 microvolts.

Type 275 Amplifier is a high gain linear audio amplifier designed to accurately indicate voltage standing wave ratios. The application of expansion circuit techniques provides a full scale deflection of 1:1.3. This means greater accuracy for low VSWR measurements. The unit may be operated as either a broadband amplifier over the range of 300 to 3000 c.p.s. or as a narrow band amplifier at 500, 1000, and 1300 c.p.s. The square law meter, calibrated to read directly in db, and the high voltage gain of 140 db make this amplifier particularly suitable for microwave attenuation measurements with a bolometer r-f detector. Inquiries invited—address Dept. E-12. Are you on our list to regularly receive "PRD Reports"?

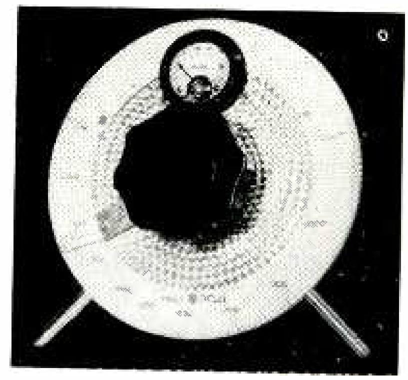
Polytechnic RESEARCH & DEVELOPMENT COMPANY · Inc

PRD

55 JOHNSON ST., BROOKLYN 1, NEW YORK

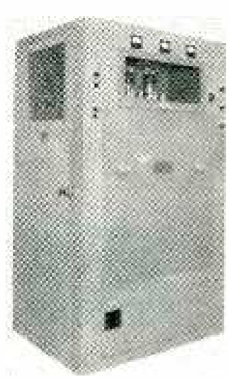
WESTERN SALES OFFICE: 741 NO. SEWARD ST., HOLLYWOOD 38, CALIF.

nel. From 9 to 18 telemetering, remote control, or supervisory circuits may be substituted for each voice channel.



Frequency Meter

MARCONI INSTRUMENTS LTD., 23 Beaver St., New York 4, N. Y., is manufacturing a series of absorption-type frequency meters covering the spectrum from 125 to 4,000 mc. Fundamentally this apparatus consists of a tuned concentric line controlled by a variable capacitor with a 9-in. scale dial calibrated directly in frequency. Visual indication is provided by a 250-μa ammeter. A type-N fitting equipped with probe antenna permits the measurement of transmitter frequency either through radiation or directly coupled via coaxial connector. Capable of measuring either a pulse or sine wave, the instrument provides accuracies up to 0.1 percent. Size of the unit is 6½ in. × 6½ in. × 4½ in. over projections.



High-Power Audio Amplifier

WESTINGHOUSE ELECTRIC CORP., P.O. Box 2099, Pittsburgh 30, Pa. Type FG 5/10 variable-frequency audio

Announcing

A NEW SPOT-RATING SERVICE ON G-E THYRATRONS!

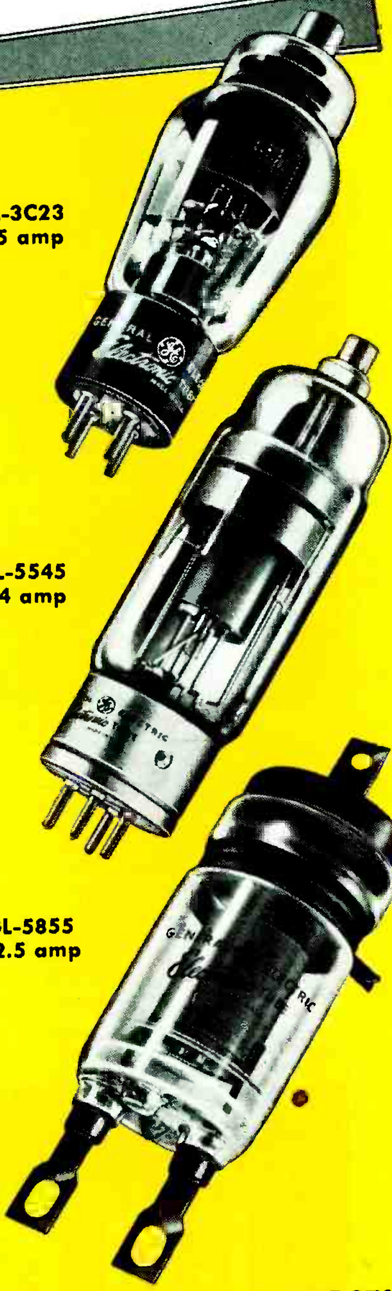
Equipment designers can now call on General Electric to investigate and approve applications of thyratrons which are not covered by published ratings

- **PUBLISHED RATINGS ARE MAXIMUM LIMITS FOR A SPECIFIC SET OF CONDITIONS.** The published ratings of a G-E thyratron apply to a set of pre-established conditions. In actual practice, your new circuit may call for a control tube with higher average current capacity than, say, the GL-3C23's 1.5 amp—yet peak voltage requirement may be less than the tube's rated 1,250 v. At your lower voltage, Type GL-3C23 may well carry the additional current! General Electric always is glad to suggest such possibilities.

- **START WITH WIDEST CHOICE OF TYPES!** When you buy an overcoat, a camera, or an outboard motor, you are best served at the store that offers a large selection of types and sizes. The same holds true with electronic tubes. G.E. builds more thyratrons than any other manufacturer—34 types in all. You are more apt to find the exact control tube you need!

- **THYRATRON IS A G-E "FIRST"!** General Electric pioneered the thyratron, which means longer experience with the tube, greater know-how—more opportunity to cross check design against performance in all types of applications.

- **DISCUSS YOUR PROBLEM WITH G.E.!** A staff of experienced tube engineers will be glad to analyze your control-tube needs. You may wish to describe these by letter, or ask a G-E engineer to call. There are *more* G-E thyratrons . . . they will *do more* for you! General Electric's new spot-rating service pinpoints both advantages to your benefit! *Tube Department, General Electric Company, Schenectady 5, N. Y.*



GL-3C23
1.5 amp

GL-5545
6.4 amp

GL-5855
12.5 amp

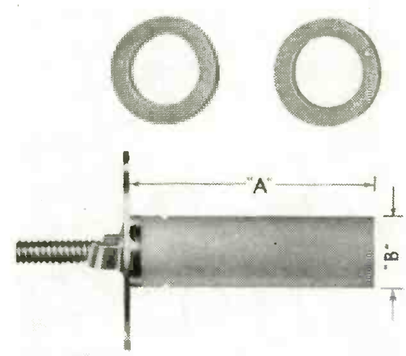
CHECK G.E.'S 34 TYPES *FIRST!*

What are your thyratron needs? G. E. offers you the widest choice in the industry—34 types. They range, in average current, from 0.1 amp up to 12.5 amp; in peak inverse voltage, from 200 v up to 15,000 v. Chances are, the ratings of one or more of these G-E tubes will closely approximate your requirements.

GENERAL ELECTRIC

163-1A4

amplifier is capable of delivering either 5 or 10 kw output power. This power amplifier will take a signal of about 10 mw from any conventional 30 to 10,000 cps source and build it up to 5 or 10 kw with uniform response ($\pm$1.5 db). It is useful in laboratories where a variable frequency power supply is required or in conjunction with high power pulsing equipment, and also in many industrial processes.



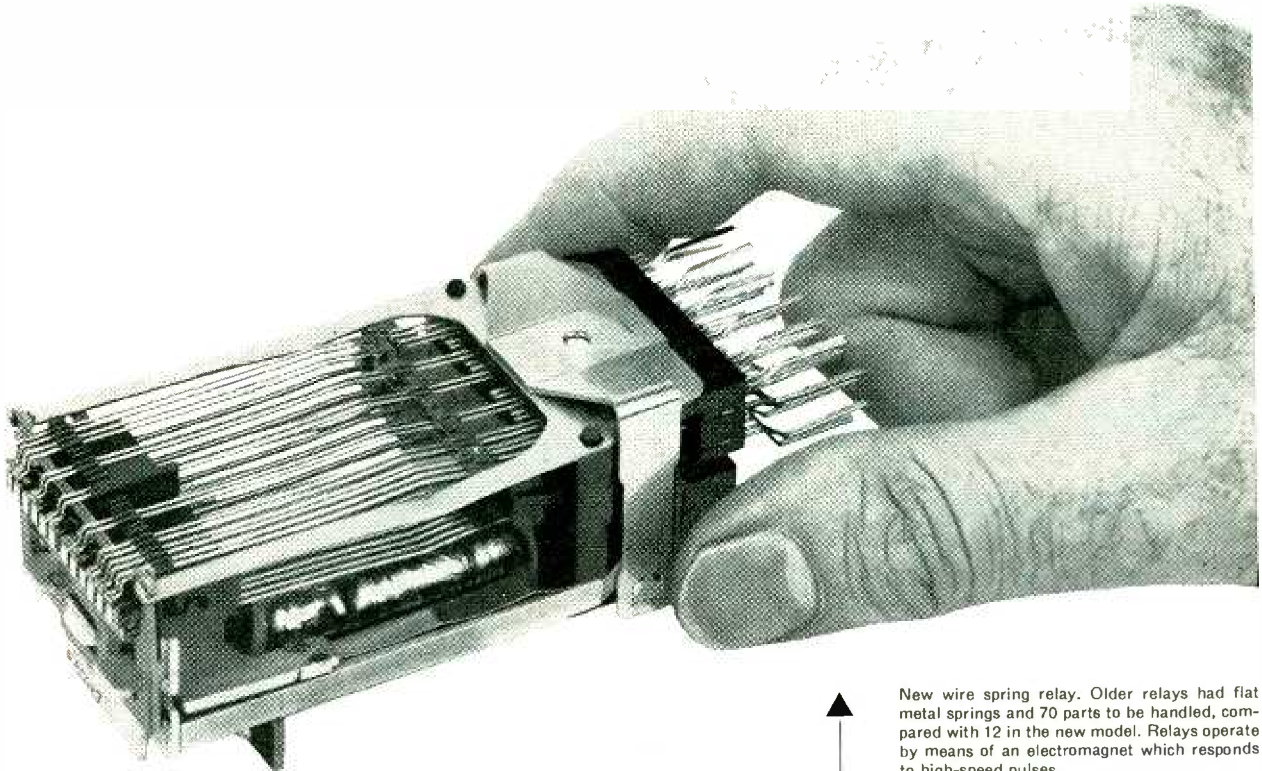
Coil Forms

NATIONAL Co., 61 Sherman St., Malden, Mass., has announced production of a new line of small permeability-tuned ceramic coil forms. Designed primarily for high-frequency applications, these coil forms conform to government specifications. The form itself is made of grade L4 ceramic (JAN-1-10). The base is silver-plated brass while the core is brass or iron. Nylon rings are provided to separate coils if more than one is wound on the same form. Small holes in these rings can be used to secure leads.

Microwave Signal Sources

KAY ELECTRIC Co., Pine Brook, N. J., has announced a new series

It splits seconds even faster

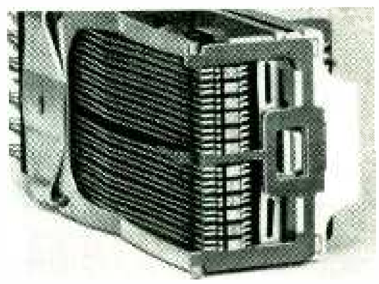


New wire spring relay. Older relays had flat metal springs and 70 parts to be handled, compared with 12 in the new model. Relays operate by means of an electromagnet which responds to high-speed pulses.

In a split second, relays, which are high-speed switches, set up dial telephone connections. Then they are off to direct the next call. Yet even this speed is too slow for Bell Laboratories scientists in quest of still faster switching.

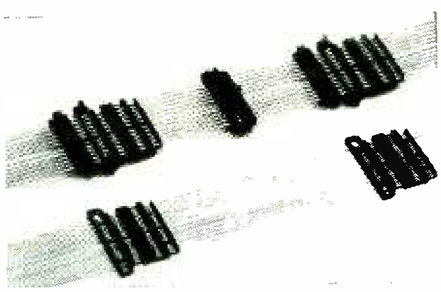
Scientists and engineers devised a new relay — the wire spring relay — and worked out the production problem with Western Electric, manufacturing unit of the Bell System. This is twice as fast, uses less power and costs less to make and maintain.

With speedier relays, switching can be done with less equipment . . . and calls go through faster. The wire spring relay is a practical example of how Bell Telephone Laboratories and Western Electric pool their skills to improve telephone service while keeping its cost down.



New relays must be able to operate one billion times—equal to once-a-second for 30 years. Employing a sound recorder as a precision vibrator, Bell scientists learned to evaluate the effect of sideways motion on relay life. Such rubbing motion is limited to one-thousandth of an inch in the new relays.

Dynamic Fluxmeter, developed by Bell Laboratories, indicates flux build-up in intervals of 25 millionths of a second. Precise information like this was essential to higher speed operation.



Relay springs as they come from Western Electric molding machine, before being cut apart for use. Molding technique saves time and money . . . makes possible the maintenance of precise adjustment.

Bell Telephone Laboratories

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS of signal sources for microwaves from 1,245 mc to 9,660 mc. These instruments, known as Centilators, may be used for the following purposes: (1) checking scale models of antennas in the lower frequency bands; (2) as an experimental transmitter for point-to-point communication; (3) for general laboratory use; (4) for educational institutions and other instructional purposes; (5) for microwave receiver sensitivity checks; and (6) for frequency response and band-pass characteristic measurements or microwave receivers and systems. Each Centilator consists of a reflex klystron oscillator, an output transmission line system with an attenuator and a crystal detector, a sawtooth generator that provides signal for sweeping the klystron frequency, and a regulated power supply.

Regulated Power Supply

Universal Electronics Co., 2012 South Sepulveda Blvd., Los Angeles 25, Calif. The new model 300A regulated power supply furnishes continuously variable voltage from 0 to 500 v d-c at 0 to 300 ma. Bias voltage supplied can be varied from 0 to −150 v at 2 ma maximum. Also furnished from the unit are two independent outputs of low a-c voltage that may be used separately or combined to give either 6.3 v at 6 amperes or 12.6 v at 3 amperes. In addition to high-gain amplification, filament, line and load compensation circuits are featured to secure the supply's strict regulation of less than 0.2-v variation of the high voltage from no load to full load, 0 to 500 v, or for line fluctuations from 105 to 125 v. Hum voltage is unusually low at 2 mv rms for any voltage or load within ratings. In-

ternal impedance is less than 1 ohm for d-c and less than 0.25 ohm from 20 cycles to 50 kc.

Field Strength Meter

INDUSTRIAL TELEVISION, INC., 369 Lexington Ave., Clifton, N. J. The IT-105R field strength meter is designed to fill the growing need for field strength measurements of both uhf and vhf tv signals. A speaker is included and supplemental equipment in the form of a battery pack is provided. Channels 2 through 82 are covered, 72 or 300 ohm input, and signal strength from 0 to 50,000 μv is read on a 4½-in. rectangular meter.

Pulse Generator

CARLSON & NICHOLSON, INC., 497 Maynard Drive, Buffalo 21, N. Y. Model 7 pulse generator is designed for laboratory use. It generates video pulses from approximately 0.2 μsec to 2,000 μsec. This range is divided into four scales. These scales are continuously adjustable with a smooth vernier drive, which operates a pulse-length control element. This element is a two bearing, ceramic insulated, variable capacitor, thus insuring stability of calibration. Both positive and negative pulses are available, simultaneously, from coaxial connectors

"What would you have done?" asks Mr. George Fehlman

Executive Vice-President, Belnap & Thompson, Inc., Chicago—merchandise prize incentive programs

"Recently, we had to deliver prize material to client sales meetings, scheduled all over the country for the same day.

"We were forbidden to ship early—and we *must* not be late! What would you have done?

"We called Air Express.

"Within 24 hours, almost 1,000 shipments were dispatched. All arrived on schedule. Not a single call or wire inquiring about a shipment was received!

"We've become accustomed to that kind of service from Air Express. What's more—on practically every shipment we make, the Air Express rate is *lowest* in the field. These rate differences often save several hundred dollars in one day's shipping!

"Our business has grown from $4\frac{1}{2}$ million yearly sales 5 years ago, to more than $9 million this year. We give credit for an important 'assist' to Air Express!"

AIR EXPRESS

GETS THERE FIRST

Division of Railway Express Agency
1952 — our 25th year of service

on the front panel. The pulse generator is designed to operate from a 117-v 60-cycle source.

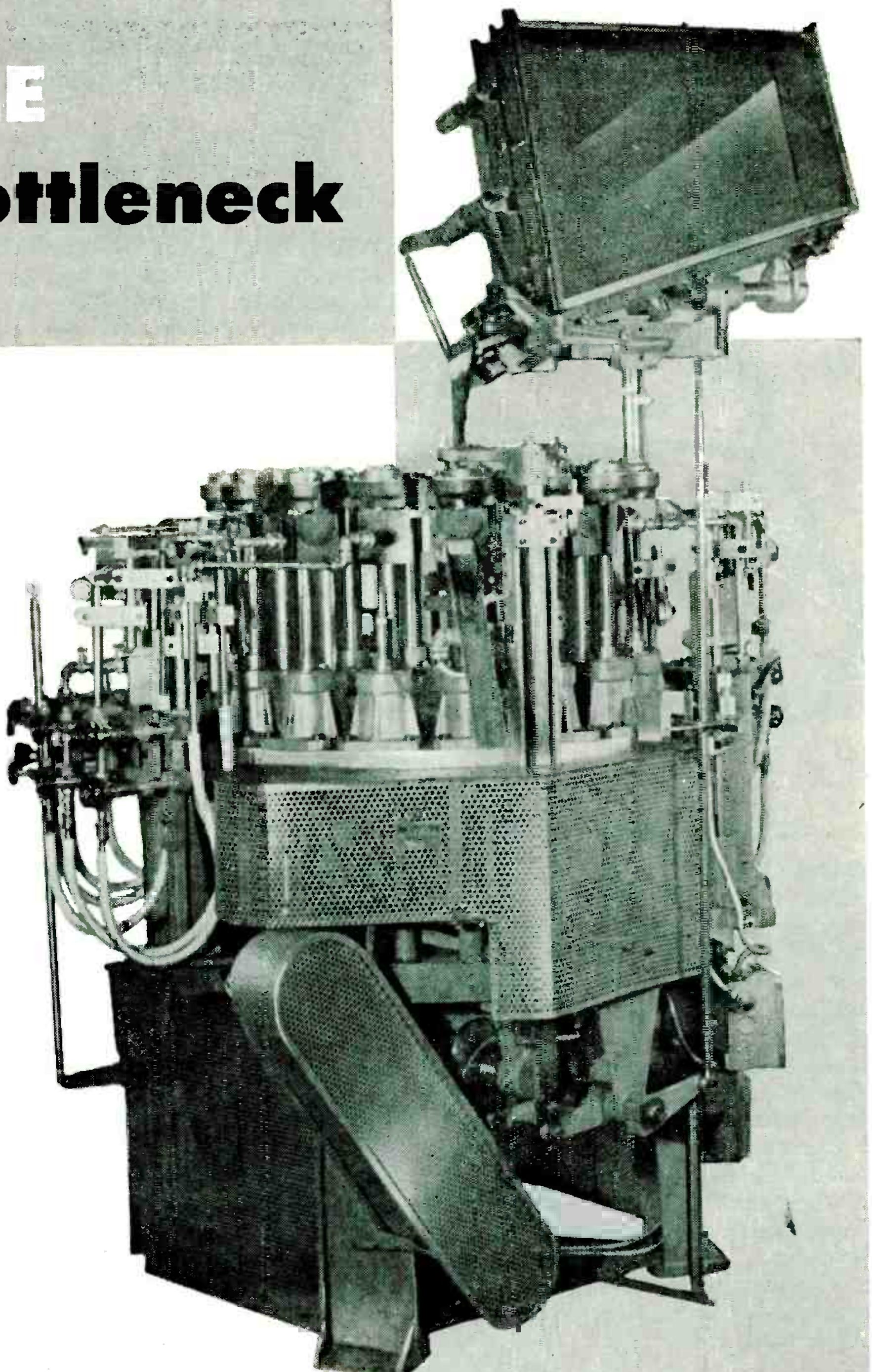
Electronic Recorder

MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Windrim Ave., Philadelphia 44, Pa., has designed a strip chart recorder for simplifying measurement and recording a large number of variables. The instrument features adjustments to vary span, suppression, damping and amplifier sensitivity. It will be produced in single and multipoint models. The highly flexible multipurpose test device can measure and record varied spans as well as the magnitude of various electromotive forces developed by strain gages, thermocouples, tachometers and miscellaneous laboratory equipment that provides a d-c signal output. The recorder has been successfully used for rocket testing and other aircraft applications.

Laboratory-Type Meter

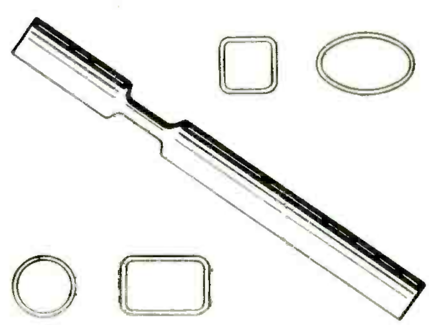
PHAOSTRON CO., 151 Pasadena Ave., South Pasadena, Calif., is in production on a new laboratory-type instrument, ruggedized for field service and available as a d-c voltmeter, a-c voltmeter and d-c milliammeter. Each instrument features 5 full-scale ranges, a range and scale changer that automatically changes meter electrical characteristics to correspond to the selected scale, a mirror scale for laboratory precision and 3-way binding posts. These instruments are available singly and in sets of four, and make possible simultaneous measurement of 2 or more circuit characteristics. They provide

how KAHLE broke a bottleneck



A manufacturer of sub-miniature tubes used in guided missles and proximity fuses came to Kahle recently with this problem: by using hand and semi-automatic methods to produce his bulbs, the reject rate ran very high. This caused a bottleneck, since production of the tube's internal elements was always far ahead of the bulb supply. Kahle's solution was to design and build the fully automatic bulb making machine, Model 1991, shown here. This machine — capable of making flat, oval, oblong, square and round bulbs — offered the perfect combination of production and precision by producing tubulated bulbs with precise internal dimensions at a rate of 1300 units per hour.

This is but one of hundreds of problems solved by Kahle. In every case, Kahle's experience and ability have resulted in the design, development and production of a machine engineered to produce results as specified. Working closely with your organization, Kahle's experienced staff of electronic and equipment engineers will, at your request, recommend a solution to your own specialized production problems. Learn how Kahle's more than 40 years of practical experience can benefit you . . . write Kahle now.



Kahle ENGINEERING COMPANY

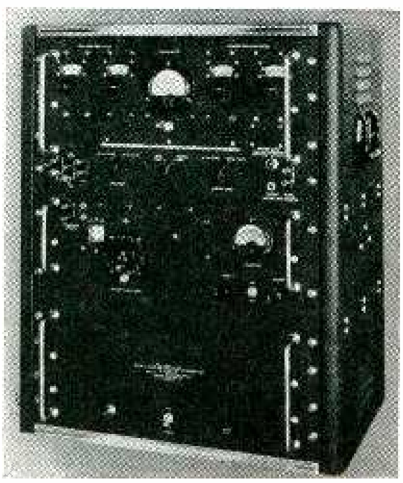
1310 SEVENTH STREET

NORTH BERGEN, N. J.

an accurate and sensitive means for electrical measurement in the laboratory, on the production line and for field use.

UHF Antennas

TECHNICAL APPLIANCE CORP., Sherburne, N. Y., announces two new uhf antennas. The Bow-Tie is a stacked four-element antenna for maximum gain. The four elements are factory preassembled to a 4-ft mast section complete with Q-bars and stand-off insulators and fits an additional 4-ft section of mast which is included to provide clearance above the roof. A companion model for full-channel coverage is the Bow-Low consisting of a Bow-Tie antenna in conjunction with an all-channel antenna designed to be mounted on an 8-ft mast. Tubular twin-lead transmission line is recommended for use with these antennas.



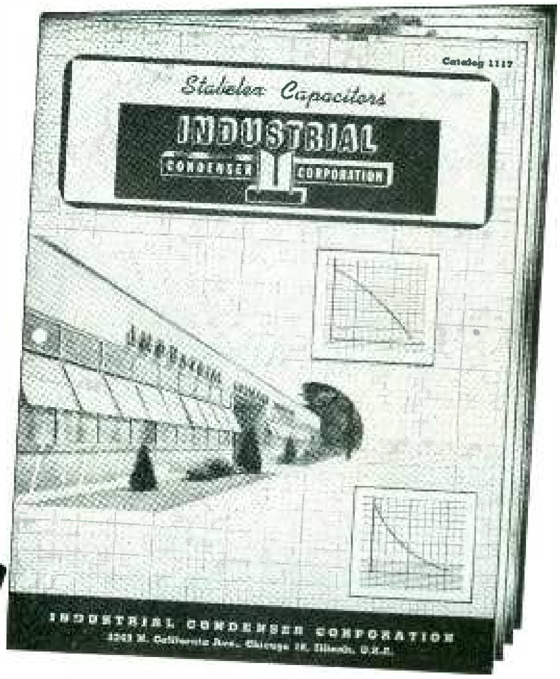
Noise and Distortion Analyzer

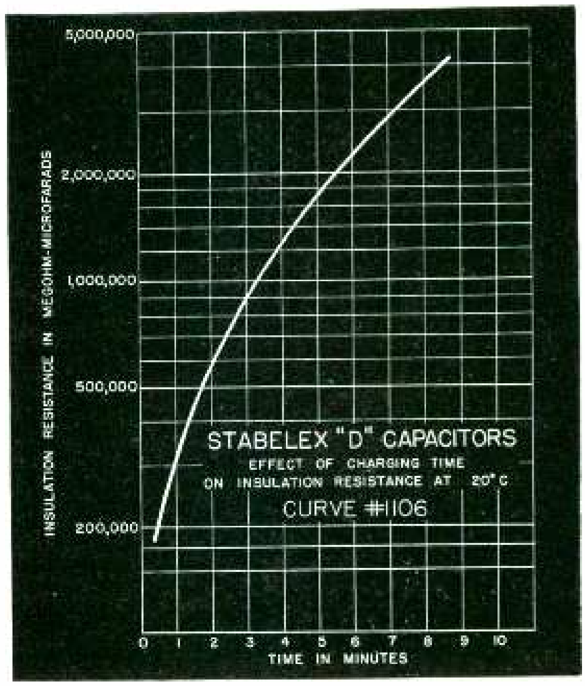
EMPIRE DEVICES, INC., 38-25 Bell Blvd., Bayside, N. Y. Model ND-110 noise and distortion analyzer is a harmonic wave analyzer capable of measuring the mean power of complex signals (broad band) and the distribution of this power within the ultrasonic frequency spectrum (narrow band). Frequency range is 4 to 110 kc. Broad-band sensitivity is —80 dbm to +20 dbm, with accuracy of ±1 db; narrow-band sensitivity, —110 dbm to +20 dbm, with accuracy of ±2 db. The instrument has an essentially flat pass band of 3,200 cycles (±1,600

Sensational Advancements In Science & Industry

Created the Need for THE NEW *Stabelex* "D" CAPACITORS

YOUR FREE INDUSTRIAL CONDENSER CORPORATION Stabelex "D" Capacitor Catalog may prove to be the most important new single piece of literature for you this year!





Curve # 1106 shows the effect of charging time on insulation resistance at 20° C.

Performance curves illustrating various characteristics of the Stabelex "D" Capacitor will appear in this magazine each month.

OUTSTANDING FEATURES

INSULATION RESISTANCE AT 20° C. AFTER THREE MINUTES CHARGE—900,000 megohm microfarads

INSULATION RESISTANCE AT 75° C.—78,000 megohm microfarads

INSULATION RESISTANCE AT −75° C.—In excess of 5 million megohm microfarads

CHANGE IN CAPACITANCE FROM 25° C. TO −80° C; +0.76%

SELF TIME CONSTANT OF 10 MFD CAPACITOR—4800 hours

Q AT 50 KILOCYCLES—10,000

POWER FACTOR AT 1 KC—0.00025

SEND FOR CATALOG 1117 TODAY

After a long period of research, Industrial Condenser Corporation now offers to industry for the first time the first of their family of Stabelex capacitors, Stabelex "D", which has been produced for special applications for some time.

Complete information performance curves, characteristics, and suggested applications of the various types now available will be found in this catalog.

INDUSTRIAL CONDENSER CORPORATION

3244 N. California Avenue
Chicago 18, Illinois, U.S.A.

Please send me my FREE copy of your new Catalog 1117 on Stabelex "D" Capacitors.

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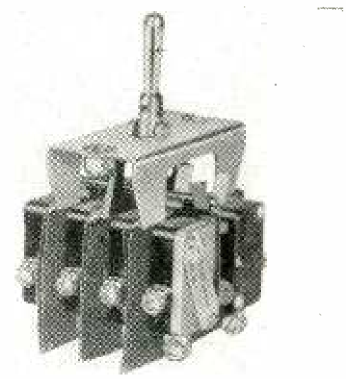
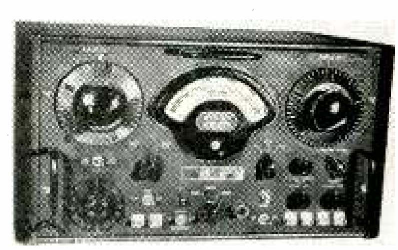
Mfrs. of OIL, WAX, ELECTROLYTIC, PLASTIC CAPACITORS and RADIO INTERFERENCE FILTERS cycles from center frequency). Response is down a minimum of 85 db for all frequencies that are removed from the center frequency by at least ±2,400 cycles.



Switch Assemblies

MICRO SWITCH, Division of Minneapolis-Honeywell Regular Co., Freeport, Ill., is in production of precision toggle switch assemblies of a new type for multiple circuit control. Built primarily to meet the exacting vibration resistant requirements of aircraft, the assemblies will find wide use in any electrical equipment where manual or mechanical multiple circuit control is required. The assemblies are available with from one to 10 double-throw switching elements, all operated by a single lever. The lever may be detented in the center, and either or both extreme positions, or may be self returning to the center. Each switching element is Underwriters' Laboratories listed at 10 amperes up to 250 v a-c, and will handle 30 v d-c inductive loads at 10 amperes at sea level and 6 amperes at 50,000-ft altitudes.



Range Calibrator

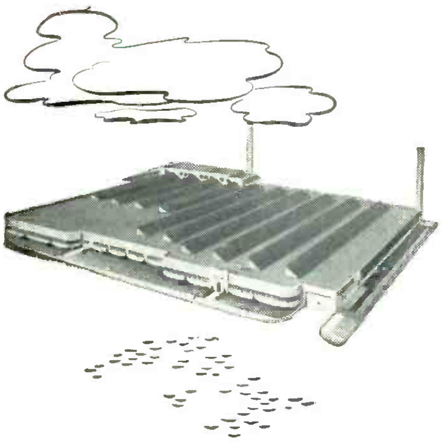
MISSOURI RESEARCH LABORATORIES, INC., 2109 Locust St., St. Louis,

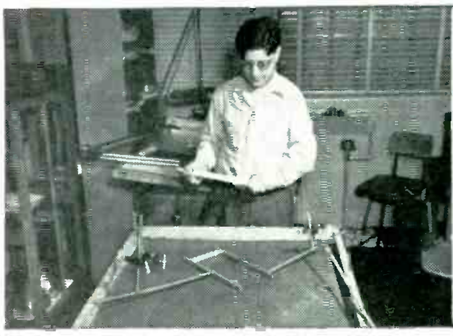
What Rauland means by "Perfection Through Research"

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

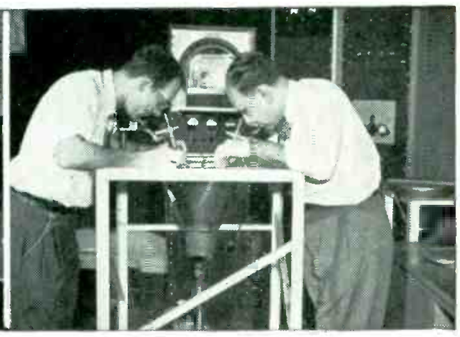
The result has been to give you more picture tube advancements since the war than any other manufacturer . . . first chance at the latest developments for companies using Rauland tubes as original equipment . . . and a real selling edge at the retail level because of the extra satisfaction which Rauland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

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

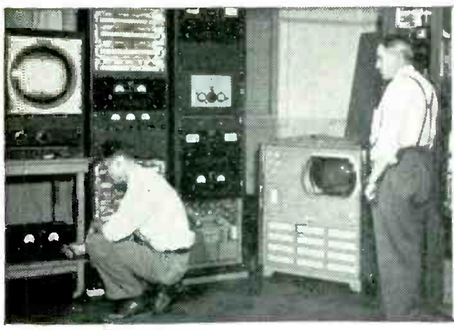




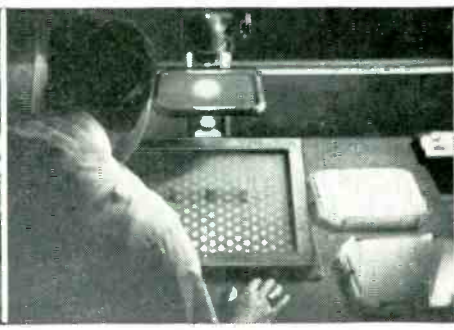
Rubber model for studying electron optical designing—basis for Rauland's exclusive Indicator Ion Trap.



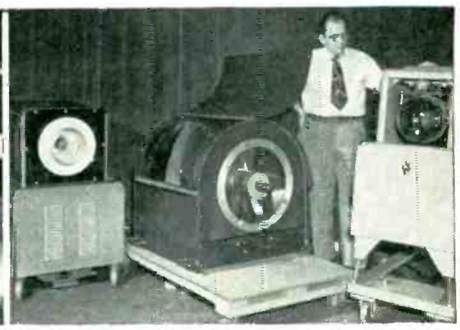
Alignment of the screen and parallax mask of tri-color tube containing approximately a million fluorescent dots.



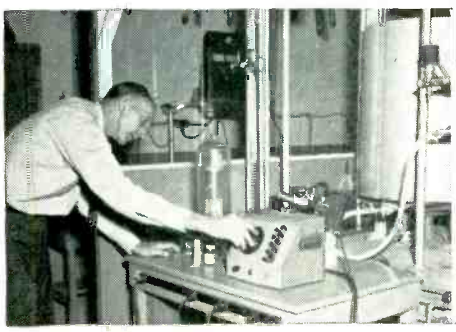
All-electronic tri-color tube in electronic receiver system (left) in comparison with mechanical system (right).



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



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



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

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

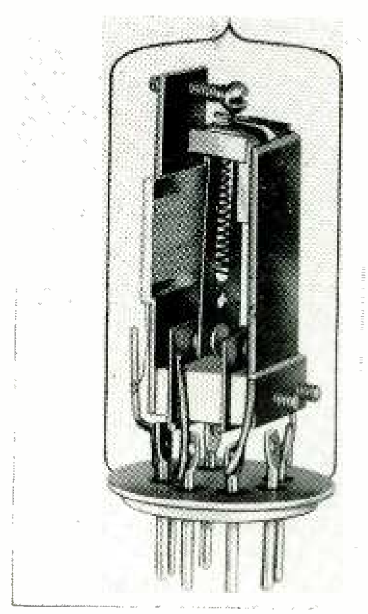
A physicist using a Rauland-developed radiation meter in checking X-ray radiations from cathode ray apparatus.

THE RAULAND CORPORATION

Perfection Through Research

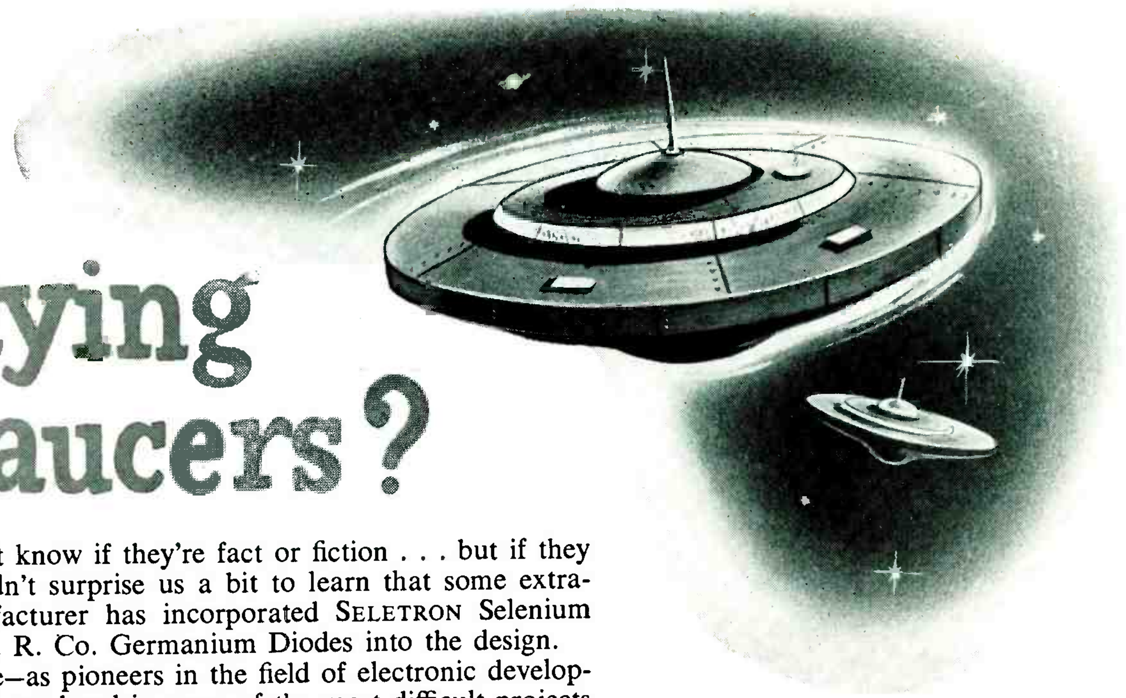
4245 N. KNOX AVENUE • CHICAGO 41, ILLINOIS

Mo., announces a model 312 range, range-rate calibrator that may be used in the laboratory or production line to provide a simulated target for accurately and rapidly checking the range and range-rate of radar gun-laying or ranging systems. Operating from an external or internal trigger, this instrument will check or calibrate range with an accuracy of 0.25 percent from 0 to 50,000 yards (in steps of 0 to 500, 0 to 5,000 and 0 to 50,000) and range-rate either in or out from 0 to 1,500 knots with an accuracy of 0.5 percent. The instrument has a variable stabilized prf from 100 to 10,000 pps and has variable outputs for both positive or negative trigger and target pulses. Although the model 312 was designed for 60-cycle operation, 400-cycle models are available and the company can supply any combination of range and range-rate on request.



Thermal Time Delay Relay

EUREKA TELEVISION AND TUBE CORP., Hawthorne, N. J. The "Snapper" type spdt relay has these features: snap action; small size; light weight; low operating temperature; operation in any position; high contact rating; gas filled; consistent timing; and mechanical structure that insures durability and long life. Voltage is 6.3, 26.5 and 115 v or as required (a-c or d-c); power —3 watts maximum; contacts—6



Flying Saucers?

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

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

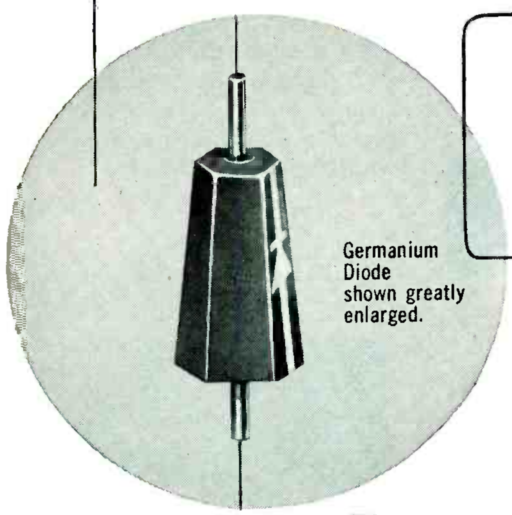
Seletron

RR GERMANIUM DIODES

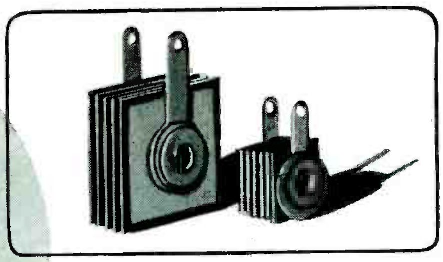
Radio Receptor's new Germanium Diodes feature polarity at a glance combined with simplicity of construction and sound design principles. The tapered shape speeds assembly because operators can see at a glance the correct direction of assembly. Users are enthusiastic over the quality of the product which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

SELENIUM RECTIFIERS

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



Germanium Diode shown greatly enlarged.



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

Germanium Transistors available in limited quantities.

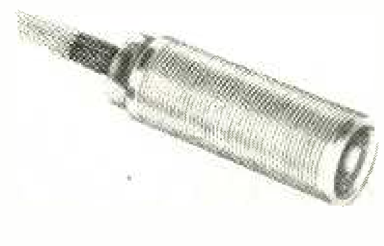
Seletron and Germanium Division

RADIO RECEPTOR COMPANY, INC.

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

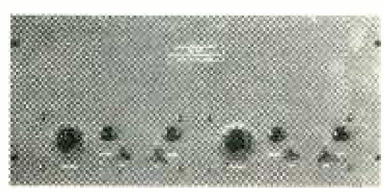
SALES DEPT: 251 West 19th Street, New York 11, N. Y. • FACTORY: 84 North 9th Street, Brooklyn 11, N. Y.

amperes; ambient temperature range—−60 C to +80 C. Weight of the 7 or 9-pin type is 6 oz; the 8-pin type, 1.33 oz. It withstands vibration of 30 g at frequencies of 5 to 55 cps. Impact of 50 g does not damage the relay. Height of each relay is 1¾ in. maximum seated.



Slip Ring Assembly

Electro Tec Corp., South Hackensack, N. J., announces development of an extremely short slip ring assembly providing 46 independent circuits. Its high accuracy and miniature size will assist engineers in the design of miniaturized, lightweight test units. The new assembly eliminates one of the major restrictions previously imposed on complex electromechanical apparatus where large angular motions are encountered. Individual rings are 0.023 in. wide and barriers between rings, 0.020 in. in width. Each ring is located within 0.002 in. of its nominal dimension over the 1.935 in. of active length. Gold finish is provided to maintain a constant low voltage drop between the wire brushes and the rings.



Carrier-Controlled Relay

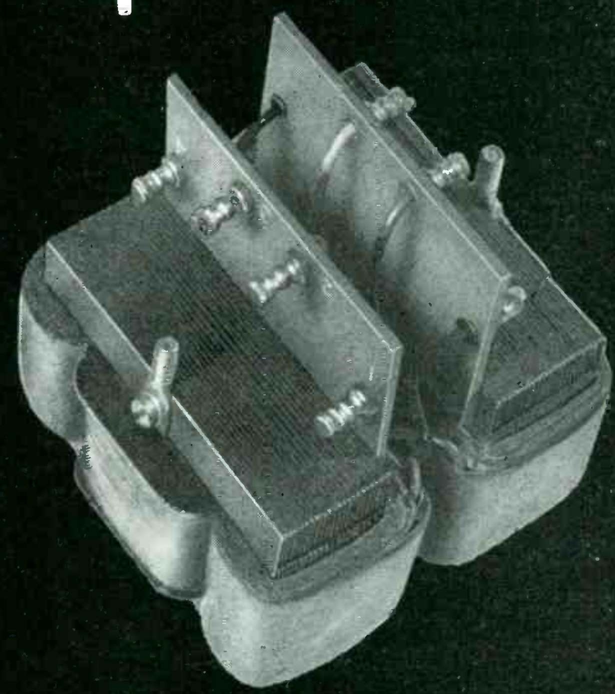
Haller, Raymond and Brown, Inc., State College, Pa., has de-

veloped a carrier-controlled relay that accepts a portion of the i-f signal voltage from a radio receiver and develops a control signal that is coincident with the reception of a radio-frequency carrier. Although primarily intended for controlling the tape motion of a magnetic tape recorder, it may be used for any of a number of functions. Two sets of double-throw switching circuits are available, and more can easily be provided. The unit contains its own power supply, which is stabilized against line-voltage fluctuations. A threshold adjustment permits compensation for variations in r-f noise level, and a panel control permit the control circuit to be bypassed. When used in conjunction with a communications receiver such as the Hammarlund Super Pro, a carrier level 3 db above the noise level is sufficient to actuate the control circuit.

Frequency Measuring Device

C. G. CONN LTD., Elkhart, Ind. The 6T-4 Stroboconn measures all types of repetitive frequencies, constant or variable. A frequency signal presented to the instrument instantaneously becomes a continuous, visual pattern for the duration of the signal. Accuracy of the unit is 0.05 percent. The 6T-4's range covers from 32.703 to 4,186 cps. Widely used in industry and laboratories where a high degree of accuracy is necessary, the Stroboconn checks and measures rotational speeds and natural frequencies, calibrates precision oscillators and tachometers, compares ratios between frequencies without regard

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 hermetically 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

for the actual frequencies involved, and performs many other frequency measuring and testing operations.

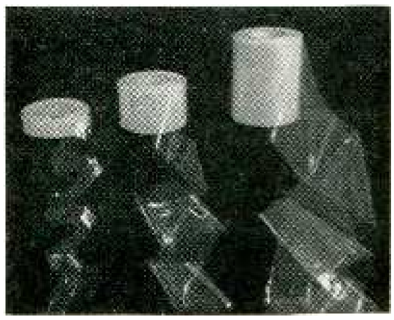
Power Tetrode

EITEL-MCCULLOUGH, INC., San Bruno, Calif., has developed the 4X150D, a radial beam-power tetrode designed for use in commercial and military aircraft and other vehicular operation. The new tube has a heater rating of 26.5 v at 0.57 ampere which makes it ideal for use in 28-v electrical systems. Size (2½ in. in length) and shape of the tube are identical to the Eimac 4X150A. It is used as an oscillator, amplifier or frequency multiplier into uhf and has a plate dissipation rating of 150 w in class-C telegraphy or f-m telephony service.

Orientation Heads

F & M SALES Co., 1054 Cahuenga Blvd., Hollywood, Calif. Series 600

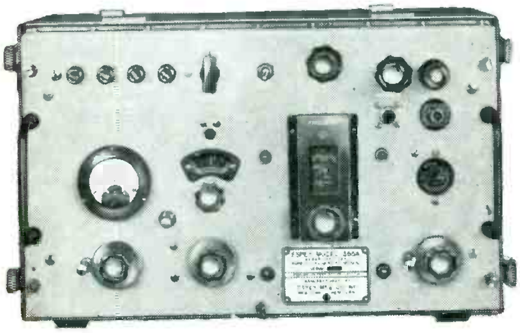
orientation heads are an improved line of Mastercraft combination slide tables for controlled processing of quartz crystal wafers. Improved handling of mother quartz coming to the saw is made possible through use of interchangeable work-holding plates on which the quartz is cemented and placed in exact register with reference to the abrasive saw. The work-holding table carrying the work-plate can be tipped in any direction for correct position of the quartz with respect to the X axis. The orientation head to which the work-table is pivoted may be rotated through 360 deg by means of cut worm and worm-gear, with orientation controlled within 1 minute of arc in either direction without backlash. Movement of both longitudinal and transverse slides is by means of lead screws furnished with micrometer dials reading to 0.001 in.



Teflon Film

DILECTRIX Co., 211-48 Jamaica Ave., Queens Village 8, N. Y., has announced thin Teflon polytetrafluorocthylene film in 400-ft spools for use in high temperature electrical components. This new chemically inert plastic film is available in thicknesses of 0.00025 in., 0.0005 in., 0.001 in. and 0.002 in. and widths up to 5 in. Dielectric strengths (short time) as high as 3,000 v per mil have been reported for the ½ mil film. This value does not change appreciably with temperature. Dissipation factor of the film in the frequency range of 60 to 10^8 cps is <0.0002 and dielectric constant over the same range is 2.0 to 2.2. Continuous operating temperatures of 200 C have produced no deleterious effects in the properties of Teflon film. Suggested uses include transformer winding,

Hard-to-get X-BAND SIGNAL GENERATOR Now Available



Model 385A
(Equivalent to TS-147 C/UP TEST SET)

ESPEY Model 385A (Equivalent to Test Set TS 147 C/UP) is a Portable Microwave Signal Generator designed for testing and adjusting beacon equipment and radar systems which operate within the frequency range of 8500 MC to 9600 MC.

COMPACT — SELF CONTAINED — WEIGHS ONLY 40 LBS. COMPLETE WITH ACCESSORIES AND COMBINATION CASE.

GENERAL SPECIFICATIONS:

FREQUENCY RANGE: 8500 MC to 9600 MC. Selection is accomplished by a tuneable klystron which is set to an accurate absorbtion wavemeter.

FREQUENCY ACCURACY: ± 2 MC.

OUTPUT POWER RANGE: −42 dbm to −83 dbm.

INPUT POWER RANGE: + 7 dbm to + 30 dbm.

ATTENUATOR ACCURACY: ± 1 db with calibration chart provided.

INPUT AND OUTPUT COUPLING: Type N female fitting (UG 23B/U).

MODULATION AVAILABLE ON OUTPUT: FM signal internally generated.

MODULATION OF INPUT SIGNAL ACCEPTED: CW or any other wave shape including pulse. Minimum pulse width accepted is .5 microseconds. Meter will read average power of input signal.

FM MODULATION: Carrier can be modulated through klystron mode at any frequency in range. (Minimum mode is 30 MCS). The sweep rate is continuously adjustable from 0 to 6 MCS. per microsecond.

EXTERNAL SYNC. PULSE REQUIRED: Amplitude of video input 10-50 volts positive polarity pulse .5 to 20 microseconds wide. Unit may also be synchronized from RF input pulse provided peak RF input power is at least 5 watts.

POWER SOURCE: 115 ± 10 volts A.C. 50 to 1600 cycles, single phase.

POWER CONSUMPTION: 125 watts.

SIZE: Width 11 inches.
Length 18¾ inches.
Height 12¼ inches.

WEIGHT: 40 lbs. including accessories.

ACCESSORIES AND SPARES PROVIDED:

ACCESSORIES: 1 R.F. Cord assembly. Consists of 8 ft. of RG-9A/U cable fitted with two UG-21B/U connectors. Calibrated to an accuracy of ± 0.3 db.
1 Trigger cord assembly. Consists of six ft. of RG-11/U cable fitted with two type 49195 connectors.
1 Power cord assembly. Consists of six ft. of rubber covered two-conductor cord with male plug and female receptacle.
1 Pick-up antenna.
1 coaxial cable fitting (right angle).

SPARES, OPERATING:
1 thermistor mount.
5 fuses, 2 amp.
9 wave guide flange joint gaskets.
3 panel lamps, 3.0 volt.
2 IN 23 B rectifier crystals.

THE ACCESSORIES AND SPARE PARTS ARE CONTAINED IN THE REMOVABLE PROTECTIVE COVER.

RADIO INTERFERENCE and FIELD INTENSITY MEASURING EQUIPMENT

Radio test sets AN/URM-6 (Espey Model 386) and AN/PRM-1 (Espey Model 383) can be used for radio interference surveys to determine the source of radiated or conducted interference from equipment such as gasoline engine generators, motors or electronic equipment. Field intensity measurement surveys may be made with these test sets for adjusting directive antennas or for exploring radiation patterns, where the field intensity may vary over a wide range of values. Can also be used as sensitive radio frequency microvoltmeters for any radio frequency measurements within their respective ranges.

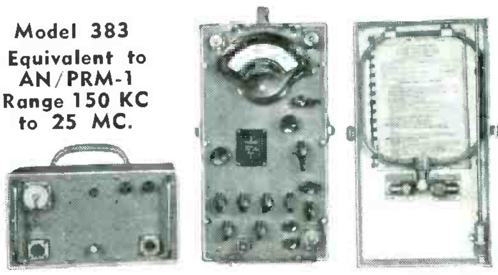
These instruments manufactured in accordance with JAN specifications wherever applicable.

Prices and deliveries on request.
Write Dept. E-12

Model 386
Equivalent to AN/URM-6
Range 14 KC to 250 KC.

Supplied complete with following:
Radio interference, field intensity meter—Power supply—2 Antennas—R. F. cable assembly—2 Power Cable assemblies—6 Special purpose cable assemblies—C h a r t—Clipboard—R. F. Probe—3 Impedance matching networks—Cord—Ammeter—Milliameter, recorder—2 Tripods—Shoulder strap—Instruction books—4 Portable carrying cases to house equipment and tripod case—Weight approximately 300 lbs.

Model 383
Equivalent to AN/PRM-1
Range 150 KC to 25 MC.



Supplied complete with following:
Radio interference, field intensity meter—3 Antennas—3 Adapter connectors—R. F. probe—3 Impedance matching networks—4 Special purpose cable assemblies—Power cable assembly—Cord—Ammeter—Power supply—Chart set—Instruction books—Shoulder strap—2 Portable carrying cases to house equipment—Weight approximately 150 lbs—Can be operated on batteries if desired.

ESPEY

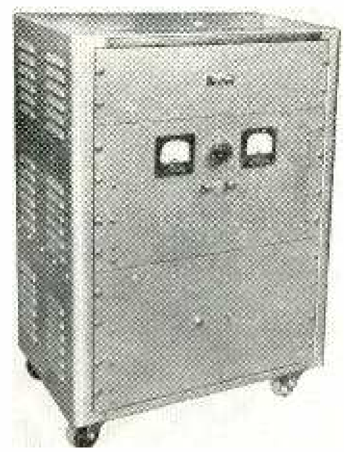
ESTABLISHED 1928

TEL. TRAFALGAR 9-7000

MANUFACTURING COMPANY, INC.

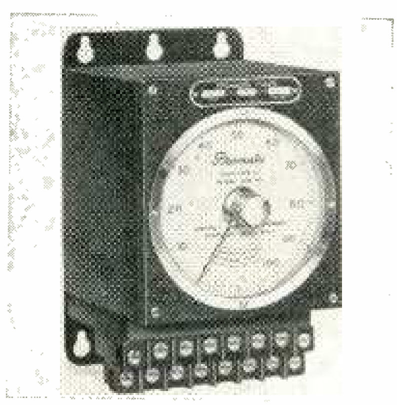
528 EAST 72nd STREET, NEW YORK 21, N. Y.

cable and wire wrapping, high temperature capacitors, thin electrical gaskets and miniaturization applications.



H-F Regulated Power Supply

American Electroneering Corp., 5029 W. Jefferson Blvd., Los Angeles 16, Calif. Model AEC-1030 regulated power supply was designed to produce a regulated 115-v a-c output at frequencies other than 60 cycle. Frequency range is 3,600 to 4,000 cycles. Frequency calibration and stability is better than 2.0 percent under normal temperature conditions. Regulation from 0 to 3-ampere load is ±5.0 percent. The set operates from 115-v a-c, 50 or 60-cycle line.



Electronic Timer

General Control Co., Boston 34, Mass. A new Promatic electronic timer is capable of controlling timed operations between 60 milliseconds and 60 seconds. The discharge of a resistor-capacitor network through a sensitive gas-tetrode relay tube

Phaostron

CARB-OHM

A DEPOSITED CARBON RESISTOR

HERMETICALLY SEALED

1% PRECISION RESISTOR

AVAILABLE FROM ⅓ to 2 WATTS

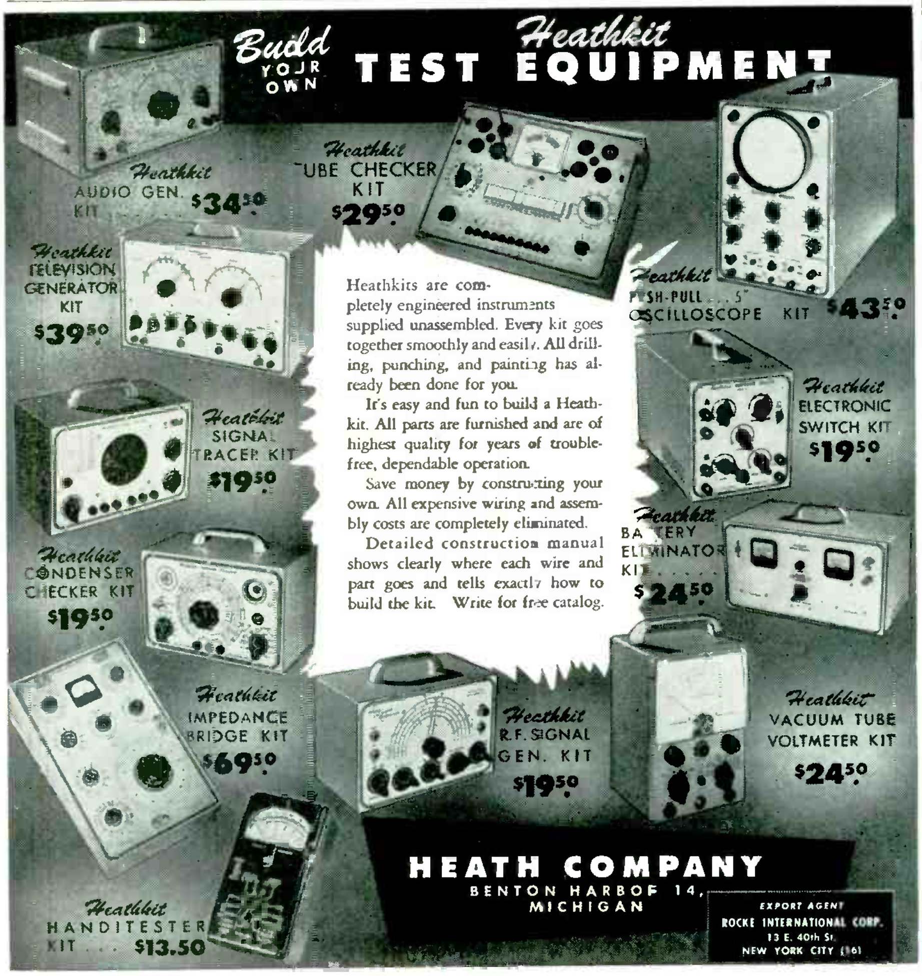
"Here is a resistor that will withstand ambient temperatures of 105°C for at least 1000 hours with full rated loads.

"Certified inspection after 1000 hours found these resistors remained within 1% of their original resistance."

Technical information available upon application

ENVIRONMENT FREE ELECTRICAL EQUIPMENT by *Phaostron*

PHAOSTRON COMPANY, 151 PASADENA AVE., SOUTH PASADENA, CALIF.



Heathkits are completely engineered instruments supplied unassembled. Every kit goes together smoothly and easily. All drilling, punching, and painting has already been done for you.

It's easy and fun to build a Heathkit. All parts are furnished and are of highest quality for years of trouble-free, dependable operation.

Save money by constructing your own. All expensive wiring and assembly costs are completely eliminated.

Detailed construction manual shows clearly where each wire and part goes and tells exactly how to build the kit. Write for free catalog.

HEATH COMPANY
BENTON HARBOR 14, MICHIGAN

EXPORT AGENT
ROCKE INTERNATIONAL CORP.
13 E. 40th St.
NEW YORK CITY (16)

GOSLIN Creative Talent and Radar Skill

...Created the transformers for the APS-42...a proven storm and terrain warning type *radar*. An early pioneer in the field of airborne *radar* and its many complex problems, GOSLIN specializes in airborne *radar* transformers.

Working closely with the nation's outstanding producers of *radar*, GOSLIN introduced miniaturization reforms that rocked the very foundations of the transformer industry. The results? New transformers combining small size and light weight together with *guaranteed terminal performance* and dependability.

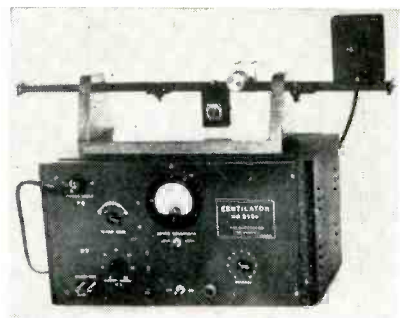
Today, GOSLIN transformers are installed in leading civilian and military aircraft *radar* equipment for greater safety and protection under any and all conditions. Production facilities are geared for *immediate delivery*.

Custom-engineered for every airborne *radar* application, GOSLIN hermetically sealed and open framed airborne units meet or surpass all civilian and military specifications. Complete facilities available for all JAN tests.

Write for new, descriptive Brochure containing detailed information on GOSLIN Transformers and facilities.

GOSLIN
ELECTRIC & MANUFACTURING CO.
A DIVISION OF THE GOSLIN CORPORATION
Designers and Manufacturers of Electro-Magnetic Components
2921 WEST OLIVE ST., BURBANK, CALIFORNIA

provides the basis for each timing period, the duration of which may be manually set by a potentiometer. Steps within the overall timing range are adequately covered by plug-in capacitors. The time period is set manually by means of the indicator and dial. Control contacts are dpdt, rated at 10 amperes, 12 v a-c, noninductive. Operation is from 115 v a-c or 220 v a-c, 60 cycles.

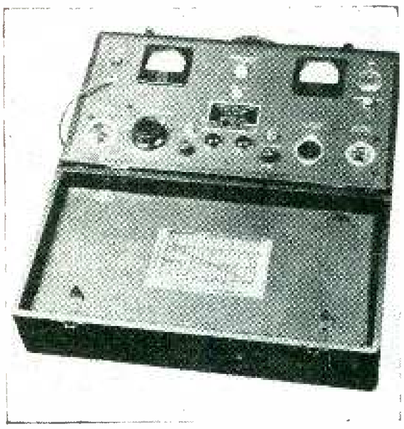


Microwave Signal Sources

POLARAD ELECTRONICS CORP., 100 Metropolitan Ave., Brooklyn 11, N. Y., announces an improved series of microwave signal sources covering the frequency range of 634 to 10,750 mc in five units. These employ a reflex klystron as a source of microwave energy. Frequency can be read directly to 10-percent accuracy. A single dial controls cavity frequency and reflector voltage. Modulation inputs for the signal sources is available on the front panel. High stability and durability are essential features of these signal sources.

Laboratory Scaler

TRACERLAB INC., 130 High St., Boston 10, Mass. Intended primarily for laboratories wishing to inaugurate a program with a minimum of cost, the SC-19 utility scaler incorporates an electronic scale of 256, a wide-range preset count selection and a h-v power supply for Geiger tubes. The instrument uses eight electronic scales-of-two giving a scaling factor of up to 256, followed by a mechanical register. A scale selector switch allows the choice of four scaling factors of 32, 64, 128 and 256. Predetermined counts ranging from 320 to 256,000 may be selected by means of a preset count switch which will stop the register at 10, 100 or 1,000. The scaler has a resolving time of about 10 μsec and a maximum counting rate of 1,000 cpm on the register.



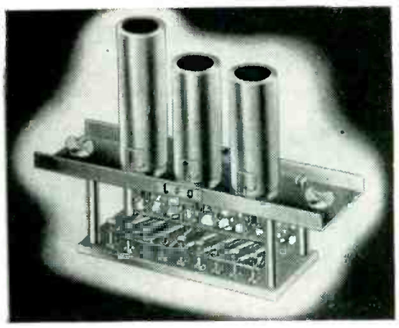
Insulation Tester

TRANSITRON, INC., 154 Spring St., New York 12, N. Y., is in production on an insulation tester with continuously variable output from 0 to 15 kv d-c. The instrument will perform accurate resistance measurements and nondestructive breakdown tests on all types of materials. Tests may be made on motor windings, ignition systems, wiring harnesses, insulators and connectors. Point of breakdown is clearly visible. In addition, the unit can be used as a laboratory high-voltage power supply. Panel meters provide direct indication of the applied voltage and the leakage current through the test specimen with an accuracy of 2 percent.

High-Nickel Alloy Strip

AMERICAN SILVER CO., 36-07 Prince St., Flushing 54, N. Y., has avail-

able ultrathin and extremely precise high-nickel alloy strip for use in the manufacture of electrical, electronic and communications equipment. High-nickel alloys (including temperature compensation, low expansion, higher permeability, glass sealing and electrical resistor alloys) are regularly custom-rolled in strip up to 8-in. wide and down to 0.0005 in. thin—to tolerances as close as ±0.0001 in. Nickel-iron, nickel-chrome, nickel-cobalt-iron and nickel-molybdenum-iron alloys, rolled to precision tolerances and ultrathin gages, are available in quantities of 1 lb to thousands. Typical uses for high-nickel alloy strip include: permanent magnet assemblies, variable capacitors, vacuum-tube assemblies, high-precision instrument transformers, locator parts, transformer bushings and magnetic shields.



Miniaturized Plug-In Amplifier

THE L&O RESEARCH AND DEVELOPMENT CORP., 315 S. 15th St., Philadelphia 2, Pa., has developed a miniaturized plug-in a-c feedback amplifier. This amplifier employs two pentode voltage amplifiers and a beam-power output stage. Power output is approximately 3 watts. The unit has a wide application in audio and servomechanism fields and is ideal for driving two-phase servo motors in systems where space is limited and ease of maintenance a necessity. The feedback resistor is connected to terminals on the receptacle so that any desired gain can be achieved with a single basic amplifier that features a high open-loop gain, sturdy and unique mechanical construction and employs JAN components. The amplifiers are supplied with mating

Eliminate Redesign

by using
TRIAD
"HS" and "HSM" Transformers

The Triad "HS" and "HSM" Series of hermetically sealed transformers are particularly applicable to military and commercial uses, where long life and top performance are prime factors. Because they are designed to meet MIL-T-27 specifications, their use in prototypes will eliminate redesign at the production stage.

Such features as "Climatite" Treatment, Wide Frequency Range, Reduced Field Pickup, Small Size, Low Distortion, Low Temperature Rise, Sturdy Terminals and Attractive Grey Finish, make these transformers the obvious choice for all high quality electronic equipment.

Offered as a complete line in matching construction, Triad "HS" and "HSM" Series Transformers are available at all Triad jobbers.

Write for Catalog TR-52G

TRIAD TRANSFORMER MFG CO
4055 Redwood Avenue
Venice, California

High Sensitivity . . Logarithmic
AC VOLTMETER
50 MICRO VOLTS TO 500 VOLTS

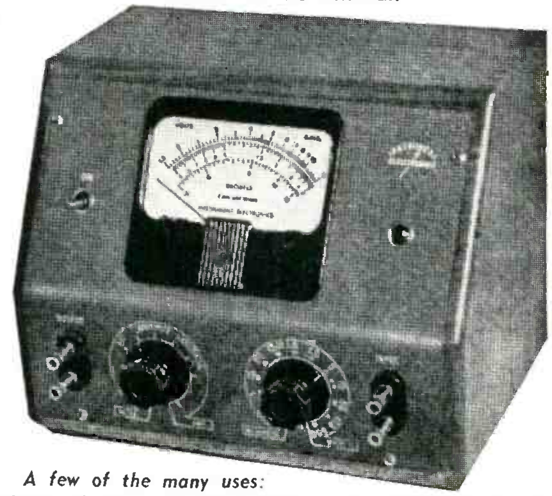
SELF-CONTAINED
ALL AC OPERATED UNIT

An extremely sensitive amplifier type instrument that serves simultaneously as a voltmeter and high gain amplifier.

- Accuracy ±2% from 15 cycles to 30 kc.
- Input impedance 1 megohm plus 15 uuf. shunt capacity.
- Amplifier Gain 25000

Also MODEL 45
WIDE BAND
VOLTMETER
.0005 to 500 Volts!
5 Cycles 1600 kc

MODEL 47 VOLTMETER



A few of the many uses:

- Output indicator for microphones of all types.
- Low level phonograph pickups.
- Acceleration and other vibration measuring pickups.
- Sound level measurements.
- Gain and frequency measurements for all types of audio equipment.
- Densitometric measurements in photography and film production.
- Light flux measurements in conjunction with photo cells.

Write for Complete Information

Instrument Electronics Corp. 90 MAIN STREET PORT WASHINGTON, N. Y.

MIL-B-233A
JOINT ARMY-NAVY
SPECIFICATIONS

SPARE AND REPAIR
PARTS BOXES

Manufactured to meet material, workmanship and finish requirements of Army-Navy specifications.

Accessories: Internal framing, partitions, trays and wood chucks as required.

Complete Facilities under one roof for quality mass production, including Heliarc welding, baking and finishing. Whistler and Wiedermann equipment for short runs. Tool and die engineering and designing. Completely conveyerized finishing facilities. Large assortment of stock and special dies for radio and television and electronic field.

Write for Catalog and Price List.

ART-LLOYD
Metal Products Corp.
2973 Cropsey Ave., Brooklyn 14, N. Y. • CO 6-5100
PRECISION SHEET METAL PRODUCTS, MASS PRODUCTION SPECIALISTS

receptacles. Models of the miniaturized amplifier are available employing voltage or current feedback.

Precision Pulser

Radiation Counter Laboratories, Inc., 5122 West Grove St., Skokie, Ill. Mark 15 Model 47 precision pulser is a generator of pulses with extremely short rise-time and a precise control of pulse amplitude. It is of particular value in testing linear amplifiers and pulse circuits where a low-level signal is required. Pulse rise time is less than 10^{-8} seconds, fall time is 350 μsec. The instrument has ranges of 1 mv, 3 mv, 10 mv, 30 mv and 100 mv pulse amplitude with 10-turn linear potentiometer control over these ranges. The pulse height is standardized against a standard cell in the instrument. Repetition rate is 3,600 pps.

Recording Oscillograph

Photron Instrument Co., 6516 Detroit Ave., Cleveland 2, Ohio. Model F6A is a portable six-channel recording oscillograph. Chart drive is continuously variable from zero to five in. of chart per second with higher chart speeds available. Speed of the chart is controlled by means of a small knob on top of the instrument. The drive mechanism is con-

structed so either six-channel, two-channel or single-channel chart paper may be used affording economical chart consumption. Chart paper may be easily replaced without removing the cover. A hinged door on top of the instrument case provides access to ink wells, pens and zero adjustment levers. A Plexiglas door provides access to chart paper so notations may be made while the instrument is in operation.

Transmitting Tube

General Electric Co., Syracuse, N. Y. Type GL-6017 ceramic-and-metal envelope power transmitting tube is designed for use in the vhf range. It is a forced-air-cooled tube rated at 660 watts power output as r-f amplifier in class B tv transmission service and 1,100 watts in class C telegraphy service. This three-electrode tube is designed particularly for grounded-grid operation. In tv applications it is particularly useful for operation in the 9-to-13 channel range (174 to 216 mc) but is rated for full output to 400 mc. Maximum ratings for the tube as an r-f power amplifier in class B to service are: d-c plate current, 0.7 ampere; plate input, 2,000 w; and plate dissipation, 1,000 w.

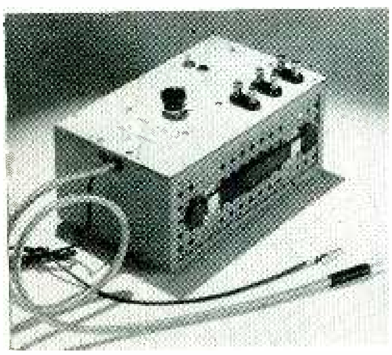
Filament Transformer

The Electronic Rectifier Co., Rochester, N. Y., is manufacturing a new 2-kw filament transformer that is housed in a sheet steel cabinet $9\frac{1}{8}$ in. $\times$ 7 in. $\times$ $16\frac{1}{4}$ in. The unit is sturdily built to insure long life and really hard use, and is adjustable from 5 v, 200 amperes to

40 v, 50 amperes. It is designed particularly for high-vacuum coating.

Local-Distance Switch

RADIO MERCHANDISE SALES, INC., 1165 Southern Blvd., New York 59, N. Y. Because of the increase in power recently granted tv stations, and because of the increased sensitivity of the newer tv receiver models, a conflict arises between these two factors in strong signal areas. To answer this situation, RMS has introduced a local-distance switch that eliminates the overload that causes either a buzz in the sound or darkening of the tv picture. The switch, model LDS, is inserted into the antenna circuit. When overload occurs the switch is moved to local position. This reduces the gain of the receiver, and in turn eliminates the overload.



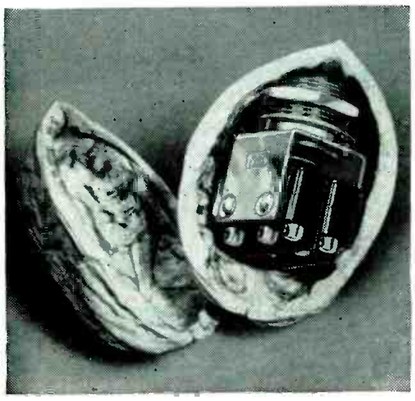
Instrument Amplifier

KEITHLEY INSTRUMENTS, 3868 Carnegie Ave., Cleveland 15, Ohio. Several refinements are announced in the model 102 Phantom Repeater, an instrument amplifier with an extremely high input impedance. Improvements include reductions in input capacitance and in power consumption. The instru-

ment's input impedance is now greater than 200 megohms shunted by 6.0 $\mu\mu$f, and output impedance is within 350 ohms in series with 8 μf. Features include gains of 1.0, 10 and 100; frequency response of 5 cps to over 150,000 cps. Use of the instrument increases the accuracy of many measurements. Examples include connecting a voltmeter or oscilloscope through the Phantom Repeater to a high-impedance test circuit.

Thermistor

VICTORY ENGINEERING CORP., Springfield Road, Union, N. J. Type 71A2 thermistor has several unusual features. The resistance element is completely sealed in a glass rod with leads extending out opposite ends thus overcoming leakage resistance effects. The temperature coefficient has the extremely high value of —7 percent per deg C at 0 C. Its resistance at 0 C is 60 megohms and drops to 3 megohms at 50 C.



Weatherproof Switch

MICRO SWITCH, a division of Minneappolis-Honeywell Regulator Co., Freeport, Ill., has announced a new compact, weather and oilproof pushbutton electric switch. Weighing only 1 oz, the dpdt assembly will fit inside a walnut shell. The panel-mounted pushbutton is sealed against the entrance of oil, water and dirt by synthetic sponge rubber. The small movement required to operate subminiature snap-acting switches is provided by resilience of the seal. No sliding joints are required. Underwriters' Laboratories

list both single and double-pole switch assemblies for 5 amperes 250-v a-c, and either type will control 30-v d-c inductive loads of 2 amperes at sea level, and 1½ amperes at 50,000-ft elevation.

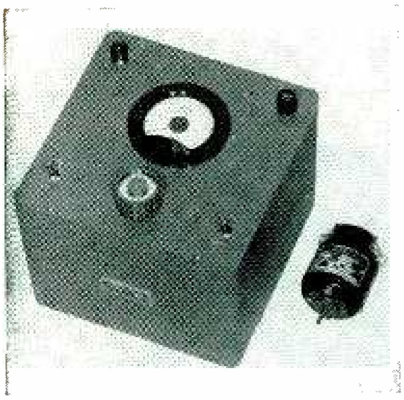
Controllable Inductors

C. G. S. LABORATORIES, INC., 391 Ludlow St., Stamford, Conn., has announced the H3M3H9L Increductor controllable inductors. Maximum inductance of the unit at zero control current is 30 mh which can be reduced to 1/400th of this value with 100 ma peak control current. The corresponding frequency variation is 20 times the starting frequency. The approximate range of starting frequencies for zero current is between 10 kc and 100 kc. The inductor features a linear relationship between frequency shift and control current extending over at least a 5-to-1 change of frequency.

Audio Oscillators

HEWLETT-PACKARD CO., 395 Page Mill Road, Palo Alto, Calif., has

announced two new wide-range R-C oscillators of compact size and simple operation. Models 200AB and 200 CD have high stability and accurate, quickly resettable tuning circuits. Operation is simplified and only three front panel controls are used. Model 200AB, for general audio tests, offers a frequency range of 20 cps to 40 kc and a full watt output. Model 200 CD, for wide-range measurements at lower power levels, provides constant voltage output from 5 cps to 600 kc. Both instruments are adjusted and calibrated to meet exact frequency and performance specifications. An output amplifier provides complete isolation of the load, and changes in output load do not change oscillator performance. Frequency stability is better than ±2.0 percent including warmup, and hum voltage is less than 0.1-percent rated output.



Motor Control

INDUSTRIAL CONTROL Co., Wyandanch, L. I., N. Y. The 302-A is a wide-range speed and torque generator. It consists of a special motor and control box operating from the 117-v, 60-cps line. The motor speed can be varied from 100 to 10,000 rpm, with a maximum output torque of 1.0 oz-in. Matching gear boxes are available for any reduction ratio. Motor speed can be controlled remotely, either by a varying d-c voltage or a shaft position. The speed is read directly on a front panel meter and provisions are made to measure the torque delivered to the load. The unit finds application in automatic control systems, light machine tools, industrial process control, coil-wind-

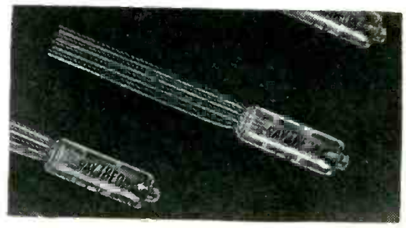
ing equipment, servo directors, variable-speed turntables and textile looms.

Soldering Iron

AMERICAN ELECTRICAL HEATER CO., 6110 Cass Ave., Detroit 2, Mich., has announced the No. 3128-A Angle-type electric soldering iron for light-duty soldering. Weighing only 10 ounces, the new iron's angle shape permits easy application to work that is difficult to reach with straight irons. It has a ¼-in. plug-type tip, an input of 60 watts, and is available in standard voltages and for 32 volts. A separate heat-insulating stand is supplied with each iron.

Printed-Circuit Rotary Switch

THE DAVEN CO., 191 Central Ave., Newark 4, N. J., has applied the printed circuit technique to special rotary switches for pulse work and telemetering. Where previously odd-shaped segments and very irregular timing intervals were difficult to obtain, this new method has now made them practicable on a rotary switch for either high or low speed applications. With this new technique, almost any number of contacts can be spaced around the periphery of a contact panel at irregular intervals, depending on the timing required. Either shorting or non-shorting switch action can be obtained. More accurate dimensions of contacts and spacing between contacts can be maintained than with previous methods of fabrication.



Subminiature Triode

RAYTHEON MFG. CO., 55 Chapel St., Newton 58, Mass., announces a new low-microphonic subminiature triode designated CK6247 (formerly known as CK628). It has a maximum noise output of 2.5 mv a-c across 10,000 ohms in the plate circuit when the tube is subjected to vibrational acceleration of 15 g at 40 cps. The normal amplification factor rating is 60, and the mutual conductance rating 2,500 μmhos with maximum allowable plate voltage of 275 v.

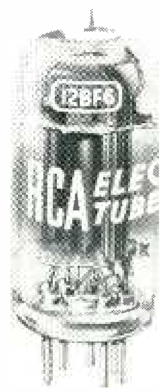
Attenuation Networks

THE DAVEN CO., 191 Central Ave., Newark 4, N. J., announces availability of its new series 690, T or balanced-H attenuation networks. These networks are designed for use in general laboratory and production testing where ruggedness, flexibility and reliability are of prime importance. The series 690 has a frequency range from 0 to 50,000 cycles. These networks consist of plug-in impedance adjusting networks combined in compact assemblies with either two or three

attenuation controls, depending upon the loss per step desired. The plug-in impedance matching networks may be obtained in a wide range of impedance and loss, with special impedances and losses available to meet requirements. Level of operation is + 20 db (0.6 w) maximum input, with accuracy of resistor units calibrated at ± 1.0 percent.

Fixed Coaxial Pads

TELEWAVE LABORATORIES, INC., 100 Metropolitan Ave., Brooklyn 11, N. Y., has announced a series of fixed coaxial pads for application in circuits operating at frequencies from 0 to 10,000 mc. Available are 6, 10 and 20-db pads. These coax pads are of conventional pi and T construction, utilizing metallized film resistors. Their small size and rugged characteristics render them highly useful in microwave circuits.



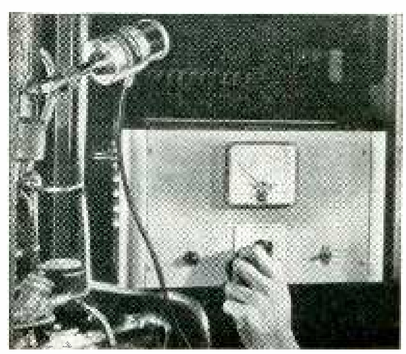
Multiunit Tube

RADIO CORP. OF AMERICA, Harrison, N. J. The 12BF6 is a multiunit miniature tube of the heater-cathode type containing two diodes and a medium-mu triode in one envelope. It is intended primarily for use as a combined detector, amplifier and avc tube in automobile radio receivers operating from a 12-volt storage battery. The characteristics of the triode unit are such that it can be impedance-coupled or transformer-coupled to the output stage. In either case the triode unit can supply more than ample output with low distortion to

drive a pair of 12V6-GT's operating at maximum plate voltage in the output stage of automobile receivers.

Magnetic Modulator

LEAR, INC., 11916 W. Pico Blvd., Los Angeles 64, Calif. The F5A magnetic modulator, recently released for general industrial use, is especially designed for accurate and stable conversion of low-level d-c signals into proportional a-c signals more suitable for electronic amplification. It utilizes signals derived from thermocouples, strain gages, certain computing devices and a multitude of other industrial instruments. The unit offers low distortion, almost unlimited life and extreme linearity with stability; is shockproof, hermetically sealed and magnetically shielded; has fast response, operates over a wide frequency range and is virtually unaffected by humidity and temperature changes.



Vacuum Gage

DISTILLATION PRODUCTS INDUSTRIES, division of the Eastman Kodak Co., Ridge Road West, Rochester 3, N. Y. Type PHG-09 gage covers a

U. G. CONNECTORS

Our Coaxial Cable Connectors Meet All Government Specifications

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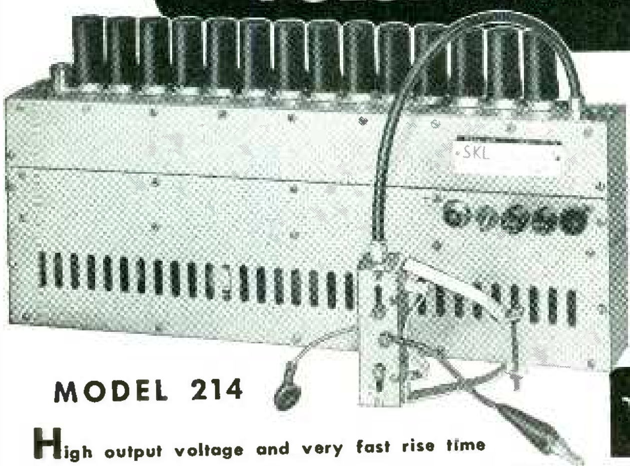
100 MC BANDWIDTH PULSE AMPLIFIER



MODEL 214

High output voltage and very fast rise time with no overshoot characterize the performance of the SKL Model 214 Chain Pulse Amplifier. The specially designed terminating cable provides a resistive output of 500 ohms and a capacitive output for connection to a cathode ray tube grid or deflection plates. Capable of deflecting a 5XP tube more than 1", the Model 214 finds extensive use in radar, oscillography, television testing, and nuclear physics.

Write today for further information.

FEATURES

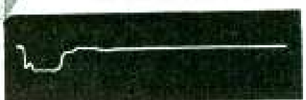
MAX. OUTPUT VOLTAGE
125 volts

RISE TIME
.006 usec.

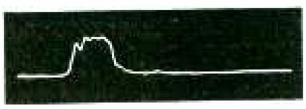
GAIN
30 db

INPUT IMPEDANCE
180 ohms

BANDWIDTH
40 KC to 100 MC



0.06μ sec complex pulse applied directly to oscilloscope plates. Rise time approx. 0.001μ sec.



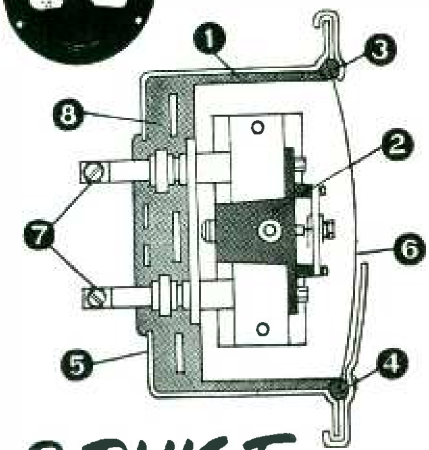
Pulse through Model 202P Wide Band Chain Amplifier and Model 214 Chain Pulse Amplifier (50 db gain). Note reproduction of fine detail.

SKL SPENCER-KENNEDY LABORATORIES, INC.
186 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.

Available NOW!

RUGGEDIZED METERS

...TO MEET SIG. C. SPEC.
MIL-M-10304



8 PLUS Features

EXTRA "RUGGEDIZED" FEATURES

1. Meter movement shock-mounted and housed in rubber-lined case.
2. Meter movement supported by die-cast frame for greater strength and increased accuracy.
3. Observation window rubber grommeted and sealed to rubber lining of case—providing hermetical seal of high dielectric materials.
4. Non-rigid mounting of observation window with rubber grommet increases resistance to shock.
5. Each meter designed and built by SUN to highest quality and precision standards.

EXTRA INSTALLATION ADVANTAGES

6. Slight convexity of observation window reduces chance of accidental breakage during installation or shipment.
7. Terminals side-tapped and provided with tined binding screws to facilitate wiring with or without wire lugs or by pressure, soldering or both.
8. Breakage or damage in wiring is reduced through non-rigid mounting of terminals and use of flexible interior conductors.

Building rugged electric meters is not new to SUN . . . For over 20 years, the automotive industry has depended on SUN as one of the largest "D'Arsonval-type" meter manufacturers—to produce rugged, tough meters that will stand up under the abuse and rough handling of portable field instruments used in automotive repair work. SUN "Ruggedized" Meters not only meet Specification MIL-M-10304 (Sig. C)—but also embody many *plus* features that make installation easier, faster and help prevent assembly or shipping damage. Complete data bulletin on SUN "Ruggedized" Meters available on request.

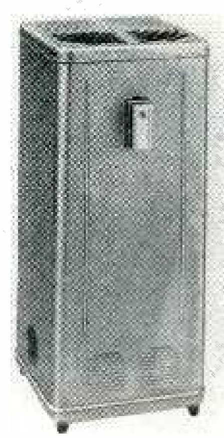
SUN "Ruggedized" Meters are available as D-C Volt Meters, Ammeters, Milli-ammeters and Micro-ammeters and also may be ordered as rectifier type A-C instruments. 6060-0

SUN ELECTRIC CORPORATION
6383 Avondale Avenue, Chicago 31, Illinois

range of 8 million to 1 on a single meter from a single pickup. It can be used to read vacuums from 0.50 mm to 10^{-7} mm Hg. The all-metal pickup tube which handles this range works on the glow discharge principle. In the tube, permanent magnets provide a field which lengthens the electron paths into tight spirals that give high ionization per electron, with a cascade effect. Having no filament to burn out, the new tube can be operated at full atmosphere without damage. In addition, the circuit is insensitive to fluctuations in line voltage.

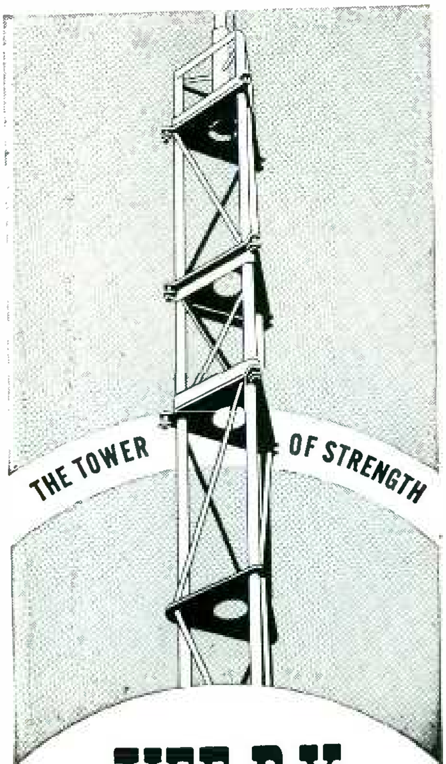
Low-Loss UHF Cable

COLUMBIA WIRE & SUPPLY CO., 2850 W. Irving Park Road, Chicago, Ill., announces a new low-loss cable developed by Anaconda and designed for uhf television reception. The cable is of semisolid construction and features 22-gage copperweld conductors, suspended polyethylene tubes within a heavy virgin polyethylene jacket of special design.



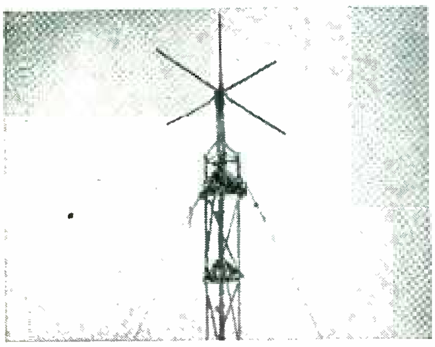
Dehumidifier

THE WALTON LABORATORIES, Irvington, N. J. The Aqua-Sorber dehumidifier includes an automatic control that saves on power consumption and is activated by the moisture content of the atmosphere. Thus it operates only when necessary rather than at timed intervals. Other features include maximum air flow, easy removal of the water container and a hose connection readily accessible for



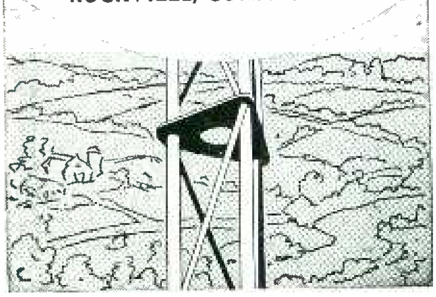
VEE-D-X
Sectional Tower

MOST ECONOMICAL FOR
MICROWAVE · FM · TV
COMMUNICATIONS · RADAR



Actual photograph of VEE-D-X Sectional Tower installation showing 152 MC ground-plane antenna suited for ground-to-plane, ship-to-shore, and mobile communications.

THE LaPOINTE-PLASCOMOLD CORP.
ROCKVILLE, CONNECTICUT



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1000 OHMS TO 9 MEGOHMS

Used extensively in commercial equipment including radio, telephone, telegraph, sound pictures, television, etc. Also in a variety of U. S. Navy equipment.

HIGH VALUE RANGE
10 to 10,000,000 MEGOHMS

This unusual range of high value resistors was developed to meet the needs of scientific and industrial control, measuring and laboratory equipment — and of high voltage applications.

SEND FOR BULLETIN 4906

It gives details of both the Standard and High Value resistors, including construction, characteristics, dimensions, etc. Copy with Price List mailed on request.

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NEW YORK 16, N. Y.

Western District Office • Times Building, Long Beach, California

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Panel Meters	Tachometers	Shunts (Electrical)
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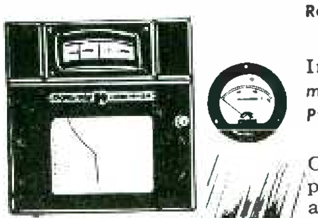
and Laboratory Standard Instruments

In addition, we manufacture and stock *Special Test Equipment • Electric Heating Units • Current Transformers • Pyrometers • Thermocouples • Rectifiers.*



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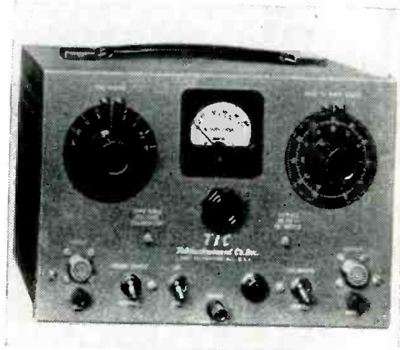
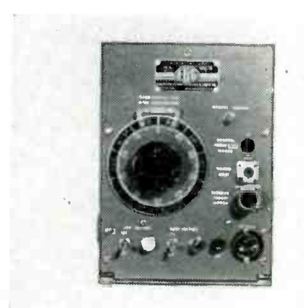
permanent automatic water removal through drain piping. The unit is equipped with 1/5 horsepower motor that provides 56-percent greater power than the conventional $\frac{1}{8}$ horsepower motor.



Voltage Calibrator

TEL-INSTRUMENT CO., INC., 50 Paterson Ave., East Rutherford, N. J., has available the type 2004 voltage calibrator that is designed to make any oscilloscope an accurate visual voltmeter. It measures the peak to peak voltage magnitude of a complex or sinusoidal waveform from 10 mv to 100 v within ± 2 percent. A direct-reading front panel meter indicates the location of the a-c axis with respect to the negative voltage peak with an accuracy of ± 3 percent. It provides an externally available square wave for checking and recompensating the scope probe attenuator and eliminates repeated disconnection of calibrator leads by use of front panel switches.



Double-Flash Light Source

EDGERTON, GERMESHAUSEN & GRIER, INC., 160 Brookline Ave., Boston 15, Mass. Type 2307 double-flash unit is used to take two superimposed

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KELLOGG CODE 101-A 20 cycle INVERTER

Reliable - Fast Starting - Efficient

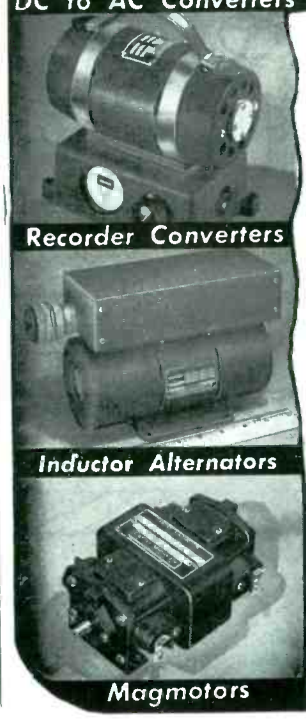
This new 20 Cycle Inverter was designed and developed in Kellogg Laboratories for military use. Now, in addition to military application, it is available for commercial purposes. Check your requirements against the features, exclusive with Kellogg, that are listed below.

- A miniaturized, hermetically sealed inverter designed to provide a 20 cps output from a DC source.
- Suitable for a variety of applications where a source of 20 cps ringing signals is required.
- Incorporates a special noise suppression filter.
- Operates over a wide range of DC input voltages from 80 to 140 volts.
- Reaches full output in less than 0.25 sec.

Output voltage (p. to p.) . . . = DC input voltage
Output frequency: . . . . .20 cps ± 1.5 cps
Contact rating: . . . . .30 VA. .25 amps. max.
Contact dwell: . . . . .74% min.
Operating Temp.: . . . .—40°C to 85°C
Overall size (approx.): . . . . .3-11/32 L x 2-1/32 W x 2-7/8 H
Mounts: . . . . .4 No. 4-40 x 1/4 studs
Mtg. Dimensions: . . . . .1-23/32 x 2-29/32
Dielectric strength. . . . .200 V. DC each terminal to case

For more information write Dept. 26-L

KELLOGG SWITCHBOARD AND SUPPLY CO. IT&T ASSOCIATE . . . . . . Sales Offices: 79 W. Monroe St., Chicago 3, Ill. An Associate of International Telephone and Telegraph Corporation



DEPENDABLE . . . COMPACT . . . EFFICIENT

Carter *Rotary Power*

Carter DC to AC Converters, Dynamotors, Genemotors, Magmotors, and Inductor Alternators (inverters) are made in a wide variety of types and capacities adaptable to communications, laboratory, and industrial applications, of many kinds. Widely used in aircraft, marine, and mobile radio, geophysical instruments, laboratory work, ignition, timing and many other uses.

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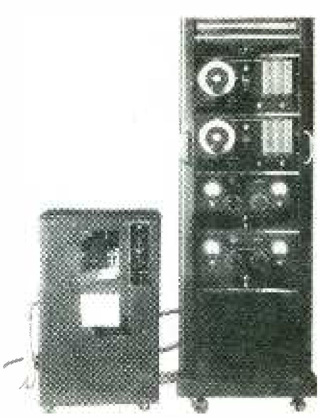
photographs as closely timed intervals for measuring velocities. Submicrosecond (⅓ µsec) exposures by silhouette cover an 8-in. square field. An electronic delay circuit, accurate to 0.5 µsec, varies the interval between flashes up to 100 µsec. Synchronized photoelectrically or by a pulse, the shadow method makes shock waves visible in photographs, for simple determination of average velocities. Two circuits energize one light source to give equally-bright pulses of light from the same position in space. With the field lens, a suitable exposure is made on Super XX film.

Molded Capacitors

INTERNATIONAL RESISTANCE CO., 401 N. Broad St., Philadelphia 8, Pa. Type CAS molded capacitor is identical in size to the type BTS resistor (13/32 in. long × ⅛ in. diameter). It is specially designed to obtain small values of capacitance with exceptionally high Q for its range, and is currently being manufactured in standard values from 0.22 µµf to 2.2 µµf, ±20 percent standard tolerance. The new unit, molded in thermosetting material, is suitably protected for all applications requiring an insulated capacitor, particularly where exacting small-value capacitances are required as in trimming applications, and meets JAN-C-20A in temperature coefficient and humidity.



Radiation Counter

NORTH AMERICAN PHILIPS CO., INC., 750 South Fulton Ave., Mt. Vernon, N. Y., has announced a

REXOLITE
1422
(FORMERLY G. E. TEXTOLITE 1422)

THE *Better* PLASTIC
U. H. F. INSULATION
BECAUSE OF:—

- outstanding electrical properties
- superior machinability
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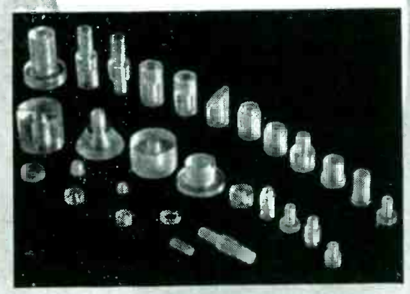
- and extremely low initial cost



Rexolite 1422 has been specifically designed and developed to meet the growing need for a lightweight — low cost U. H. F. insulating material.

Rexolite 1422 is available for immediate delivery as centerless ground rod in any diameter up to 1". Also cast in larger diameter rods and sheets.

Meets JAN-P-77 and MIL-P-77A specifications.

The unusual chemical inertness and physical properties of Rexolite 1422 allow its use where other materials fail.

For use in: connectors, coaxial connectors, waveguide, antennas, leads and spacers, spreaders and air wound coil supports, coil forms.

Write today for technical bulletins and samples. Our engineering staff is always at your disposal.

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from .450" to 25" I.P.
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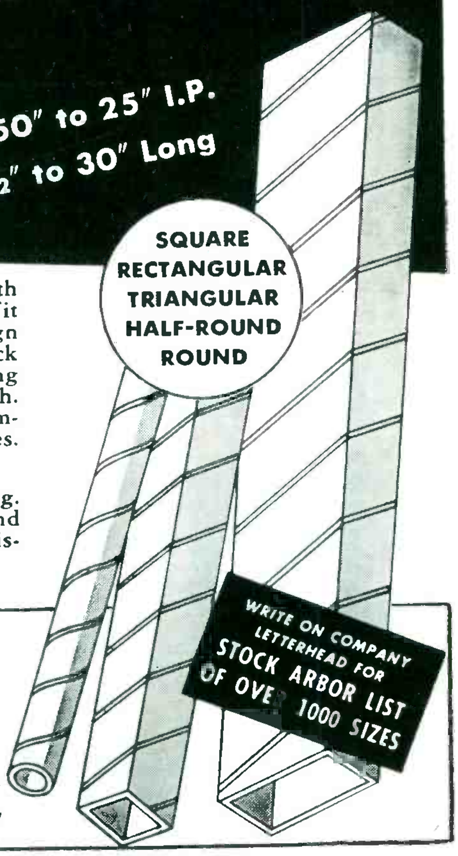

It pays to check your requirements with PARAMOUNT . . . because you benefit from PARAMOUNT'S coil-proved design and construction—vast range of stock arbors—wide experience in engineering special tubes! Hi-Dielectric. Hi-Strength. Kraft, Fish Paper, Red Rope, or any combination wound on automatic machines. Tolerances ± .002".

ALSO: *Shellac-Bound* Kraft paper tubing. Heated shellac forms an adhesive bond between the laminations. Absolutely moisture resistant.

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Paramount
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Mfrs. of Paper Tubing for the Electrical Industry

IN-RES-CO
TYPES CX & BX
WIRE WOUND
RESISTORS

FEATHERWEIGHT!
—another IN-RES-CO solution for CIRCUIT DESIGNERS

SEALED IN MOLDED BAKELITE PLUS LIGHTWEIGHT

The dependable resistive elements that combine positive sealing with the important advantage of lightweight. Molded Bakelite core reduces weight by one-half compared to ceramics. Positive seal effectively protects the winding against harmful climatic conditions. Additional IN-RES-CO features include long life stability, hard soldered connections to terminals and extra-sturdy, vibration proof terminal leads. Both CX and BX Resistors include space-saving terminal supported axial terminals of tinned wire.

IN-RES-CO
TYPE CX
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RESISTOR

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TYPE BX
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RESISTOR

ASK FOR THE NEW RESISTOR HANDBOOK – Contains complete data on resistors for every purpose and their recommended applications. Please make request on company letterhead

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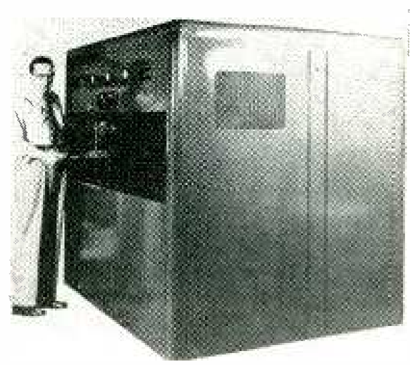
APPLICATION-DESIGNED RESISTORS FOR ELECTRONICS AND INSTRUMENTATION new scaler-printer designed for radiation counting as applied in nuclear work, packaging and other applications. The instrument indicates in printed numerals up to 999 and provides for multiplying this figure by 2, 4, 8, 16, 32 and 64. It will resolve pulses separated by 5 μsec and performs reliably for indefinite periods of time. An interval timer having a range up to 55 seconds allows count accumulation for a predetermined interval, reproducible to within 0.13 second. The instrument counts electronically, stores the counts in a memory circuit, and after completion of the counting interval channels the memorized count into a mechanical printer where part movements are minimized to assure long life.



Induction Heating Units

LINDBERG ENGINEERING CO., 2450 W. Hubbard St., Chicago 12, Ill. Model LI-50A-1 high-frequency induction heating unit provides more than 50 kw at 400,000 cps on a 100-percent duty cycle. The new units are recommended for heating and fabricating operations that call for production brazing, soldering, hardening, forging or shrink fitting. Input is 230, 460, 550 v, 3 phase, 60 cycle. Dimensions of the unit are 96 in. wide, 68 in. deep and 80 in. high. Weight is 5,400 lb without accessories.

Literature

Ceramic Disk Capacitors. Aerovox Corp., New Bedford, Mass., has

available its 1952-53 catalog that includes expanded listings of ceramic disk capacitors. The expanded listings now range from 0.00001 to 0.01 μf for single-section units; from 0.001 to 0.004 μf for two-section units; and 0.0015 and 0.002 for three-section units. The high-Q disk capacitors discussed come in seven sizes for bypassing, blocking and coupling applications. They are also available for temperature compensating where high Q and stability of capacitance are essential.

D-C Bridge and Amplifier. Allegany Instrument Co., Inc., 1000 Oldtown Rd., Cumberland, Md. Model 2001 d-c bridge and amplifier is technically described and illustrated in a single-page bulletin. Chief features and specifications are given. The instrument described is designed for use with d-c bridge circuits and thermocouples and utilizes electronic inversion of d-c potentials by means of a 50-kc inverter.

Locknuts. Standard Pressed Steel Co., Jenkintown, Pa. Thin locknuts, one-third lower in height, that meet or exceed in many instances minimum Army-Navy tensile requirements for regular-height locknuts are described in a new 26-page catalog. Sizes, fits, part numbers, dimensions, tensile values, materials, packing quantities and weights are listed in the catalog for all Flexlocs in both thin and regular design and for aircraft and commercial use. The book is well illustrated and stoutly covered for shop use. The Flexlocs described are made of various materials that can be used in temperatures from subzero to 750 deg.

Process Industries Instruments. Ess Instrument Co., 96 South Washington Ave., Bergenfield, N. J., has available bulletin 522 describing the wide range of application of "electric eyes" to process industries. The bulletin, by means of problem and solution, covers some usual and unusual installations that have been made for instant and accurate monitoring of process flows. It points up techniques used

for either gases or liquids and describes standard and special instruments.

Insulating Wire & Cable Splices. Bishop Mfg. Corp., 10 Canfield Rd., Cedar Grove, N. J. A four-page two-color folder entitled "Insulating Wire and Cable Splices with Bi-Seal Self-Bonding Insulating Tape" was recently issued. It covers the characteristics, properties and applications of Bi-Seal, a unique self-bonding tape available for wire and cable splicing. The folder is well-illustrated and gives complete specifications.

Servo Motor. Kinetix Instrument Co., Inc., 902 Broadway, New York 10, N. Y. A recent catalog sheet deals with the type K-101600 servo motor. Purpose of the unit described is to provide driving means for control-type synchros, through amplifier, for continuous synchro null positioning—for plate-to-plate control—for servomechanism systems requiring two-phase a-c motors with low inerita and high torque rating. Average electrical and mechanical characteristics are given.

Microwave Equipment. DeMornay-Bonardi, Inc., Los Angeles, Calif., announces a unique catalog combining the additional features of a textbook and manual. The volume consists of 134 pages of technical information on microwave engineering. The 11 opening pages include charts, graphs and drawings that enable the engineer to fully understand the principles behind the company's microwave equipment. On the 21 succeeding pages, eleven phases of microwave test equipment measurements and calibration procedures are illustrated with easy-to-read, well-labeled drawings. The balance of the catalog is devoted to over 320 pieces of equipment now being manufactured.

Radio Telemetering. Applied Science Corp. of Princeton, P.O. Box 44, Princeton, N. J., has published a four-page brochure presenting airborne and ground station equipment and accessories for radio

smaller than a suitcase

AMERICAN ELECTRIC

400 Cycle

MOTOR ALTERNATOR

WEIGHT: Approx 125 lbs.
SIZE: 22" x 12" x 12"

Designed for production and laboratory high frequency power supply requirements. STRONG—SIMPLE—INDESTRUCTIBLE CONSTRUCTION—No delicate moving parts, brushes or springs to wear out or maintain.

Replaces single large, hard-to-get H-F power supply serving multiple purposes . . . *A bank of these compact, flexible units costs far less, provides individual portable power sources for each project, avoids downtime hazards of single unit!*

Meets power supply requirements for AN-E-19 equipment.

OUTPUT: Up to 1000 Watts single phase 115V or up to 1800 Watts three phase 115/200V. Input: 60 cycle AC.

Total harmonic content under 5%; ± 1% voltage regulation.

WRITE FOR DETAILS!

Larger capacities available.

AMERICAN ELECTRIC MOTORS

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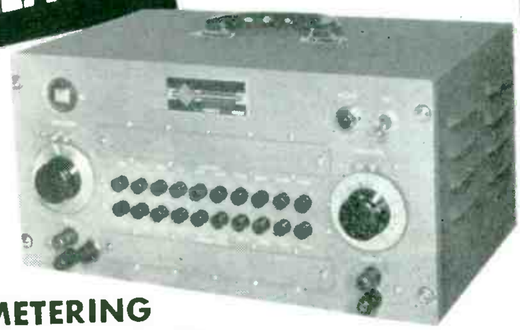
Los Angeles 22,
California

PUSH-BUTTON AUDIO OSCILLATOR

MODEL TO-100



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telemetering. The folder features large illustrated charts showing building block accessories in complete PW or PDM systems for airborne equipment. Another chart features custom-engineered ground station and laboratory equipment for the reception, recording, calibration, linearization, plotting and tabulation of data from airborne systems. Also featured are complete installations of ASCOP fully automatic data treating devices for reading and processing telemetering data.

Laboratory Equipment. The Daven Co., 191 Central Ave., Newark 4, N. J., has prepared a thorough and complete pamphlet on laboratory equipment. Units such as attenuation networks, decade resistance boxes and individual resistance units, volume-level indicators, transmission-measuring sets, noise and distortion meters, output power meters, are completely detailed with pictures, descriptive copy, technical data and diagrams as to types, specifications and impedances.

Screen Rooms. Ace Engineering & Machine Co., Inc., 3644 N. Lawrence St., Philadelphia 40, Pa. Up-to-the-minute data on screen rooms and their uses in meeting JAN-I-225, 16E4 (Ships), MIL-I-6181 as well as civilian specifications for radio interference suppression are included in Shielded Enclosure Engineering Bulletin No. 3. An analysis is made of the factors influencing the measurements of attenuation versus frequency and the bulletin likewise outlines the many civilian and military applications where effective shielding of r-f interference is essential. Details of modern screen room construction are fully illustrated and described.

Gearmotors. Star-Kimble Motor Division of Miehle Printing Press and Mfg. Co., 200 Bloomfield Ave., Bloomfield, N. J. A new line of gearmotors, comprising motor and speed reducer compactly mounted in a single housing, and with speed ratios ranging from 2.5 to 1 to 97 to 1, is described in bulletin B-601. The speed reducers presented include planetary, offset and right-angle worm-wheel types. The

motors discussed are available in ratings from ½ to 75 hp, in a-c squirrel-cage and wound-rotor, d-c shunt, series and compound types. Illustrations and design and performance features are included.

Tube Data. Penta Laboratories, Inc., 216 N. Milpas St., Santa Barbara, Calif., announce the availability of new data sheets on the following tube types: PL-4D21, a power tetrode having a plate dissipation rating of 125 w, which is interchangeable with type 4-125A; PL-5C22, a hydrogen thyratron capable of providing a pulse power output as great as 1 megawatt at 1.0-percent duty; and type PL-R1, a spdt switch enclosed in an evacuated glass envelope with a peak voltage rating between open contacts of 21,000 v.

Radio-TV-Electronics Dictionary. Radio Corp. of America, 30 Rockefeller Plaza, New York 20, N. Y., has published a 50-page dictionary of common and uncommon terms in radio, television and electronics. Over 750 terms are defined and diagrams, symbols and illustrations are included. One page of the glossary gives a list of abbreviations of technical terms with their meanings.

Synchro Resolver. Kinetix Instrument Co., Inc., 902 Broadway, New York 10, N. Y., has published a catalog sheet on its 400-cycle two-phase high-accuracy synchro resolver. The purpose of the device illustrated and described is to produce output voltages equal to the product of the input voltage and the sine or cosine of the mechanical angle of the rotor from a defined zero. Average electrical characteristics outlined include input to rotor and input to stator.

General Catalog. Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill., has released its 1953 general catalog containing 236 pages and listing 18,000 items. Special emphasis has been placed on equipment for industrial maintenance, research and production requirements. There are detailed listings of standard and special-

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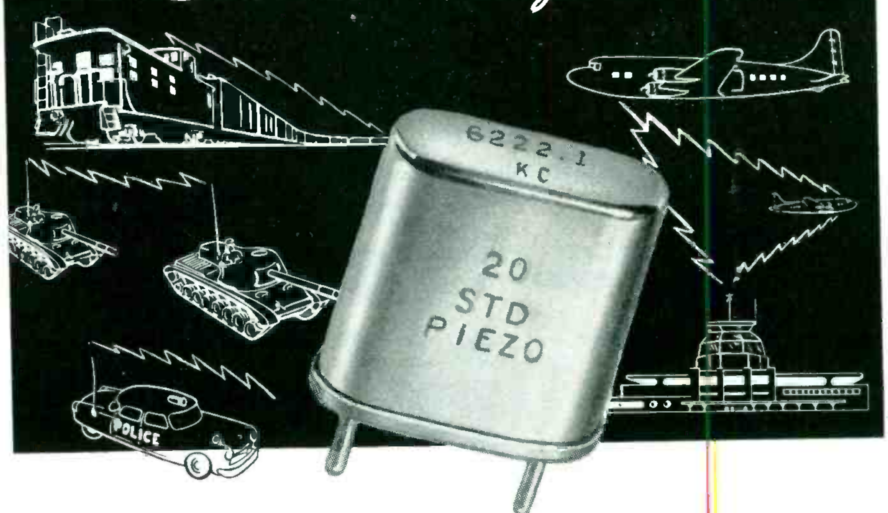

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X-Ray Analysis. North American Philips Co., Inc., 750 So. Fulton Ave., Mount Vernon, N. Y. A new 8-page booklet titled "Facts and Figures on Three Powerful X-Ray Tools for Non-Destructive Analysis" is now available. Diagrams are used to show the principles of operation for the three instruments, data are given on recommended fields of application and results to be obtained are explained. In addition, the booklet clearly illustrates how the simplest film diffraction unit consisting of the basic x-ray generator plus a camera can be converted to spectrometer and spectrograph use through the addition of these components.

Industrial X-Ray Machine. Triplett & Barton, Inc., 831 North Lake St., Burbank, Calif. A recent 8-page brochure deals with the model 49-1 lightweight, portable, 260 kvp industrial x-ray machine. It gives an illustrated description of the power and cooling assembly, the master control and the self-contained high-voltage transformer and tube head. Two pages of technical specifications are included. A single-page insert contains general specifications on trailer mounting for the unit.

Instruments Catalog. Kay Electric Co., 14 Maple Ave., Pine Brook, N. J. The 64-page catalog designated as 52-3 covers a wide line of electronic instruments assembled in generic groups. It illustrates and describes high-frequency equipment; speech, subaudio and audio-frequency analysis equipment; industrial instruments; production and service test equipment; and accessories and components. Order-for lacings that stay put!

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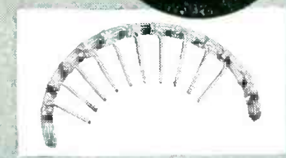

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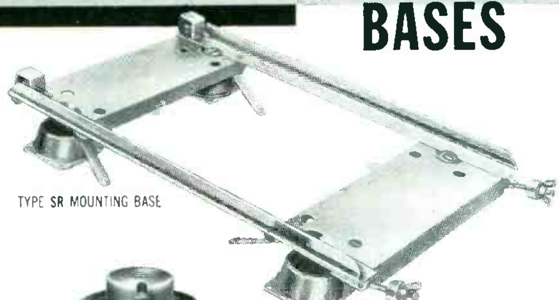

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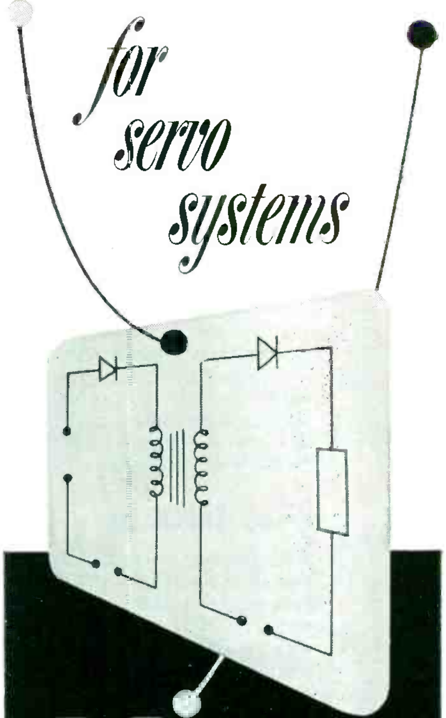

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ing information, as well as a price list and index are included.

TV Transmitters. Standard Electronics Corp., 285 Emmett St., Newark 5, N. J. Bulletin TTS-61 contains the technical details of the complete range of tv transmitting equipment manufactured by the company. It presents the electrical and mechanical specifications on the 500-watt visual—250-watt aural basic unit with Add-A-Unit design amplifiers that provide complete transmitters of 5, 10 and 20-kw output. The bulletin points out that the Add-A-Unit design offers versatility and flexibility in adapting the transmitter to any station layout, with lower installation, operating and maintenance costs. Also included are facts concerning tv accessory equipment now available.

Portable Oscilloscope. Beam Instruments Corp., 350 Fifth Ave., New York 1, N. Y. Availability of an attractive two-color leaflet describing the physical and electrical characteristics of the new Cossor 1039 portable oscilloscope has been announced. Designed for use by the mobile engineer and radio and tv service technician for both field and bench applications, the oscilloscope described weighs only 9¼ lb, and measures 5½ in. × 4½ in. × 11½ in., and features a high-frequency amplifier in two ranges—25 cycles to 3.5 mc.

Magnetic Materials. The International Nickel Co., Inc., 67 Wall St., New York 5, N. Y. A recent 12-page reprint gives a review of magnetic materials covering a range of 20 high-permeability materials and 22 permanent magnet alloys. Typical properties are given in table form and comparative information is discussed in the text and illustrated by 15 charts. Applications drawn primarily from the communications field illustrate practical usage of the various alloys.

Metallized-Paper Capacitors. Aerovox Corp., New Bedford, Mass., has issued a bulletin, Form No. HTMP252, dealing with high-temperature metallized-paper ca-

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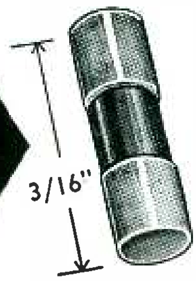

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Tolerance: 5% or 10%
Wattage: 1/4 watt continuous duty at 25°C
Size: 1/16 inch diam. x 3/16 inch long
Terminals: Tinned sections 1/16 inch long
Film Length: Type R-063 — 1/16 inch
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Temperature Coefficient: approx. 0.0019 ohms/ohm/°C.
Power Sensitivity: Approx. 10 ohms/watt

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pacitors. The bulletin lists the standard numbers of the modified plastic tubular type P92ZN, the "bathtubs" type P30ZN, and the metal-cased tubulars with vitified ceramic terminal and seals type P123ZNG. Drawings and dimensions are included. There is also basic information on performance characteristics such as temperature range, insulation resistance, power factor, humidity resistance, cold test, drip test and life test, including relevant curves.

Electrometer. Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Wayne and Windrim Aves., Philadelphia 44, Pa. Data sheet 10.014a deals with the improved Brown electrometer for minute current measurements. The data sheet describes the application and operation of this vibrating-reed type instrument. It delineates various important electrical characteristics and features of the equipment and discusses the theory of operation, stability and reliability of response, zero checking and other important details concerning this recording instrument which has proved to be a useful tool in nuclear radiation studies.

Solderless Terminals. Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa., recently published a dramatically illustrated brochure entitled "The Harrisburg Story". The 20-page booklet describes the origin, growth, business philosophy and engineering principles of this manufacturer of solderless wiring devices and fixed capacitors. It also points out that the company is primarily concerned with the engineering and production of completely installed wire terminations, not simply solderless terminals.

Fuse Guides. Littelfuse, Inc., 1865 Miner St., Des Plaines, Ill., recently issued the latest tv fuse guide for faster and easier radio-receiver fuse replacement. It lists the brand name, model numbers and corresponding fuse requirements on all makes and models, starting with the first sets made and ending with those now on the market. Also of interest is the company's automo-

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tive fuse guide, which includes car radio fuses for all makes of cars beginning with 1940 and including all the 1952 models.

Test Chamber Controls. Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Wayne and Windrim Aves., Philadelphia 44, Pa. Data sheet 11.0-5a describes the application and operation of instrumentation as used with test chambers produced by Tenney Engineering, Inc., Newark, N. J. This 4-page data sheet discusses the various temperature, pressure and humidity control problems involved in various types of test chambers as designed for various uses. Several different control systems are schematically illustrated. Illustrations of typical Tenney test chambers are also included.

Universal Impedance Bridges. Brown Electro-Measurement Corp., 4635 S. E. Hawthorne Blvd., Portland 15, Ore., has published a four-page folder on its line of universal impedance bridges and bridge-null amplifiers designed for the precise measurement of resistance, capacitance and inductance. Chief features and complete technical specifications are outlined.

Crystal Catalog. James Knights Co., Sandwich, Ill., has issued a complete new catalog of crystals. It lists 45 different crystals for use in communications equipment, laboratory instruments, medical and industrial equipment. Crystal applications range from two-way radio communication for airlines to unusual examples like this whaling application: A crystal controlled transmitter, affixed to harpoons for directing vessels to the spent whale. Other applications include use in the pasteurizing of beer, measuring earth temperatures at extreme depths electronically and use in celestial timers in observatories. Development engineers and others will find the new catalog of interest.

Transformer Applications. United Transformer Co., 150 Varick St., New York 13, N. Y., has released a catalog listing over 600 stock items covering the entire scope of electronic transformer applications. It

is fully indexed, giving complete technical descriptions of all items. In addition, a center insert gives circuit details for high-fidelity amplifier equipment. A large group of hermetic sealed units for military applications is also listed. Also included are—a commercial grade line for industrial users; a special series for amateur radio operators; and a replacement series for radio equipment and the experimenter. A number of pages is devoted to high Q filter coils and complete audio filters.

Amplifiers and Communications Equipment. Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif., is distributing a 16-page catalog that illustrates and describes laboratory-type a-f amplifiers, broadcast and tv program equipment, tape and disk-recording apparatus, high-fidelity sound systems and magnetic film recording equipment. Product items are amply illustrated. There are characteristic charts, a specifications list for each product, block drawings and circuit layouts. Accessories in the catalog include cord racks, shelf brackets, standard panels, relay racks, mounting frames and power supplies.

Copper-Oxide Rectifier Stacks. General Electric Co., Schenectady 5, N. Y. A new 8-page two-color booklet describes the basic characteristics and applications of copper-oxide rectifier stacks. Designated as GEA-5699A, the booklet is complete with charts, graphs and tables, illustrating the characteristics, manufacture, circuit design and application of copper-oxide rectifiers.

Electronic Components. Centralab, A Division of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc. The industrial and distributor catalog No. 28 covers 470 new items. It covers the company's five product divisions: variable resistors, ceramic capacitors, rotary and lever switches, printed electronic circuits and steatite insulators. A few of the items included are: a new line of miniature ceramic rotary switches; disk capacitors with molded insulation—all values; ex-

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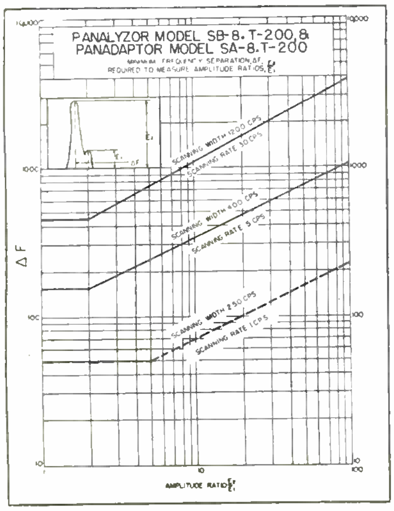

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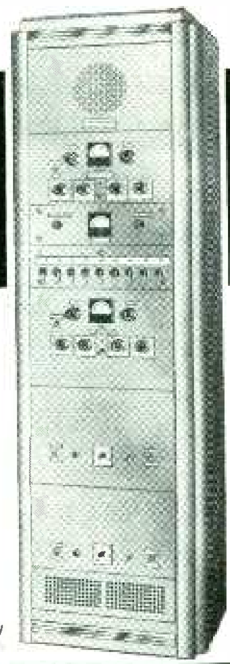

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Unit Measuring Systems. Minneapolis-Honeywell Regulator Co., Brown Instruments Division, Wayne and Windrim Aves., Philadelphia 44, Pa., describes a system for automatic recording and control of pH in a new four-page data sheet. Instrumentation data sheet No. 10.7-1 includes discussion of measuring system components adjustments for operation, as well as variations in recording and control systems for electric or pneumatic modes of control and single or multipoint recording.

Capacitor Catalog. Sprague Electric Co., 35 Marshall St., North Adams, Mass., has released a comprehensive catalog on its transmitter-type mica-dielectric capacitors that conform with specification JAN-C-5. Designated catalog 31, this new reference for engineers and purchasing agents consists of 32 easy-to-follow pages of helpful illustrations, engineering drawings and technical characteristics of each unit.

Microwave Instruments and Accessories. Waveline Inc., Caldwell, N. J., has issued an 82 page catalog dealing with its complete line of test equipment for the microwave frequencies. For ease of ordering it lists the units for each microwave frequency band under a common series of numbers. Thus, for example, all units of X band, 8,200 to 12,400 mc ($1 \times 1\frac{1}{2}$ o.d. waveguide) are listed under the 600 series. K band units (RG-53/U, $\frac{1}{2} \times \frac{1}{4}$ o.d.) are listed under the 800 series. Therefore, the first digit indicates the wave guide size and the second two indicate the particular component. Illustrations, technical descriptions and specifications are included.

Magnetic Alloys. Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa., has issued booklet TD-52-100, an 8-page "what is it," "where to use it" treatise on mag-

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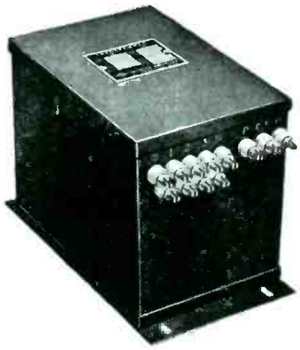
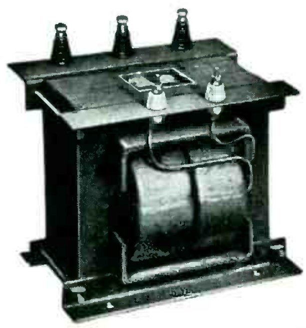


Over 28 years' experience in the manufacture of special transformers to meet individual requirements. Built in quality proved by years of actual use.

From 10 VA to 300 KVA Dry-Type only. Both Open and Encased. 1, 2, and 3 Phase. 15 to 400 cycles.



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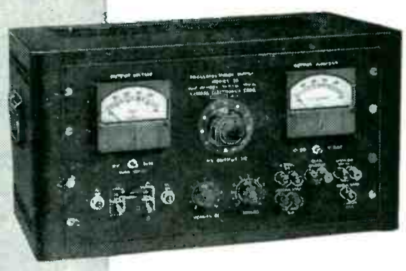

BENCH MODEL 50

• STABLE • DEPENDABLE • MODERATELY PRICED •

- **INPUT:** 105-125 VAC, 50-60c
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- **OUTPUT #2:** 0-50 VDC, 0-200 VDC Bias Output.
- **OUTPUT #3:** 6.3 VAC at 5A unregulated
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- **RIPPLE OUTPUT:** Less than 8 millivolts rms

ALSO AVAILABLE STANDARD RACK MOUNTING
MODEL 50-R PANEL SIZE 10½" x 19" DEPTH 14¼"

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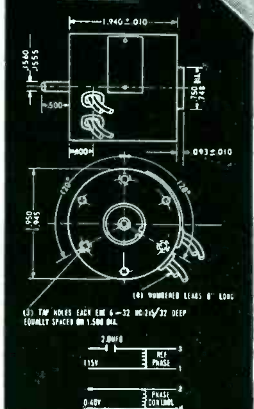
TYPE A09C-1

MOTORS--- PRECISION ENGINEERED



This two phase Servo Motor, totally enclosed has our newly developed low inertia lamination, rotor inertia .059 oz. in. delivers 3 oz. in. of stall torque with an input of 8 watts per phase.

The motor is ideally suited for plate circuit operation, and similar types can be supplied wound 2 or 4 pole with a wide range of torque and impedances.

SPECIFICATIONS
Conform to the Standards of the Gov't specifications.
Continuous duty

WEIGHT	12 oz.	VOLTS	115
R P M	1500 Average	CYCLES	60

AIR MARINE MOTORS INC.
2183 JACKSON AVENUE SEAFORD, L. I., N. Y.
WAntagh 2-7309

netic alloys. The various alloys that are covered include Hipernik, Hipernik V, Conpernik and Hiperco. The first three materials mentioned are iron-nickel alloys while the last is iron-cobalt alloy. These materials provide a wide range of magnetic properties needed for many special requirements. Physical and magnetic property tables together with the availability of each alloy are included. These are accompanied by a discussion of individual alloy heat treatment techniques. The inclusion of fifteen core loss and magnetization curves makes the booklet especially valuable when matching the correct alloy with a specific application.

Lightweight Amplifier-Bridge Simmonds Aerocessories, Inc., 105 White Plains Road, Tarrytown, N. Y., is offering a new 4-page folder that contains complete design data on a new lightweight amplifier-bridge for the Pacitron fuel gage system. Circuit diagrams, photos and tables giving installation information are included in the new folder for the convenience of aircraft engineers in specifying the gage for measuring fuel and oil quantities. Compensated and uncompensated units are covered as well as bracket and rack mounted types. Descriptive material also includes such subjects as: weight reduction, compactness, aspect ratio, internal shock mounts, high temperature operation, power consumption, vacuum tubes, replacement of components, test connectors and accuracy. Data in the new folder covers the latest improvements in fuel gage systems for aircraft.

Products Catalog, Raytheon Mfg. Co., Waltham 54, Mass. The company's products are shown in a profusely illustrated, three-color catalog recently published. A brief history of the company and a photo layout of its various plants are followed by detailed descriptions of the products of each of the organization's four divisions: Receiving Tube, Power Tube, Equipment and Television and Radio. A page is devoted to an outline of the concern's research activities.

PLANTS AND PEOPLE

Edited by WILLIAM P. O'BRIEN

Research Outfit Changes Headquarters

WALTER KIDDE NUCLEAR LABORATORIES, a privately-financed research organization devoted primarily to the development of atomic power for commercial and industrial purposes, recently established new laboratory facilities at 975 Stewart Ave., outside of Garden City, L. I., N. Y., to serve as headquarters for the firm's operations. Research operations have begun there, although the installation of certain specialized equipment needed to carry on nuclear research and development projects will continue for several months. A minimum staff of 100 will be required when the building is in full operation within the next 6 to 12 months.

The Laboratories were organized to carry out three fundamental objectives. The first is the development of commercial atomic power, with particular emphasis on original research and development in the field of low-cost nuclear reactors. The second is cooperation with government agencies and their contractors and subcontractors in the development and design of atomic facilities. The third objective is collaboration with private industrial organizations, laboratories and others interested in the application of the nuclear sciences to specific problems.

Sylvania Dedicates Woburn Plant

A NEW, multi-million dollar electronics plant was recently dedicated by Sylvania Electric Products Inc. in Woburn, Mass. The 50,000-sq ft plant, which employs approximately 850 persons, is headquarters of the administrative, sales, engineering and manufacturing staffs of the company's Electronics Division, and is the site of the principal manufacturing operations. Its output of electron tubes and devices are used in such fields as radar, navigation, communication, flight and gun-fire control, and includes microwave tubes, semiconductor devices, including transistors, and special-purpose tubes.

Admiral Adds Space

CONSTRUCTION of a 46,000-sq ft, one-story brick addition to the Admiral Corp. tv plant at Bloomington, Ill., was recently announced. The new plant will contain tv installation lines, storage for cabinets, tubes and other components and warehouse space for finished products. The new facility will also feature an overhead conveyor line on which every tv chassis will receive a thorough aging test before installation in the cabinet.

The plant addition is expected to be ready for occupancy by Jan. 1.

SMPTE Election Results

NEW OFFICERS of the Society of Motion Picture and Television Engineers, who begin two-year terms on January 1, are as follows: Herbert Barnett of General Precision Equipment Corp., president; John G. Frayne of Westrex Corp., executive vice-president; Norwood L. Simmons of Eastman Kodak Co., editorial vice-president; John W. Servies of National Theatre Supply Co., convention vice-president; Edward S. Seeley of Altec Services Corp., secretary.

Named to the board of governors were: Gordon A. Chambers of Eastman Kodak; Charles L. Townsend of NBC-TV; Frank E. Carlson of GE; Malcolm G. Townsley of Bell & Howell; William A. Mueller

Herbert Barnett (right), assistant to the president of the General Precision Equipment Corp., and newly elected president of the SMPTE, is congratulated by Peter Mole, head of Mole-Richardson Co., Hollywood, who has been president of the society for the past two years. Mr. Barnett will assume office for a two-year term beginning Jan. 1, 1953

OTHER DEPARTMENTS featured in this issue:

TO-DAY'S GREATEST SUCCESS . . .

THE AUTO-CHANGER OF TO-MORROW

The "Monarch" auto changer

A masterpiece in design and technical excellence—a three-speed automatic record changer designed to play 12", 10" and the increasingly popular 7" records *intermixed in any order*. The "Monarch" combines ease and simplicity of operation with the high standard of reproduction and performance demanded by the most discriminating listener.

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- ★ Pick-up automatically returned to rest position and motor switched off after last record.
- ★ New reversible dual stylus crystal pick-up has extended frequency range to 10,000 c.p.s. Self compensated for the L.P. lower frequencies with the Turnover frequency at the correct point.
- ★ Remarkably compact design makes it an ideal unit for the radiogram/TV combination console.
- ★ Simplicity of design guarantees long life and trouble-free operation.
- ★ Beautiful styling and finish that will harmonize with any cabinet design.
- ★ Operates on 100/125–200/250 volts, 50 cycles A.C. Models also available for 60 cycles A.C.

The "Regent"

. . . a beautifully styled three-speed gramophone. Complete with ingenious automatic stop and light-weight high-fidelity turnover type crystal pick-up fitted with two permanent sapphire styli.

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BSR

Birmingham Sound Reproducers Ltd., Old Hill, Staffs. England. Grams: 'Electronic Old Hill, Cradley Heath.'

Warner Bros; and LeRoy M. Dearing of Technicolor Corp.

Avco Expands

THE MANUFACTURING facilities of the tube division of Sarkes Tarizan, Inc., at Batavia, Ill., were recently purchased by Avco Mfg. Co. These facilities consist of two plants containing 80,000 sq ft to fill out needs for Avco's tv and radio operations.

Hyman Named to Consultant Post

A. Hyman, new JFD consultant

FORMERLY supervisory electronic engineer for the Civil Aeronautics Administration in New York, Abraham Hyman has joined the JFD Mfg. Co., Inc., Brooklyn, N. Y., as electronic consultant.

In his new capacity Mr. Hyman will work on antennas and electronic products. His work with the CAA had been concentrated in vhf and uhf systems. In 1945 he was with Federal Telecommunication as a development engineer. There he worked on microwave and vhf/adf equipment.

Leinicke Promoted

EMPLOYED as a design engineer with Dalmo Victor Co., San Carlos, Calif., since 1947, Robert F. Leinicke has been elevated to chief project engineer. In his new position he is responsible for engineering supervision and administration of all projects of both production and development types.

Columbia U. Sets Up New Lab

A NEW acoustics laboratory where sound that man cannot hear, as well as audible noise, will be investigated, has been established in the Engineering Center at Columbia University, New York City. When completed, the laboratory will provide facilities for research and instruction in electroacoustics, ultrasonics, psychoacoustics, speech, noise control and musical acoustics.

Director of the Laboratory is Cyril M. Harris, associate professor of electrical engineering, international authority on acoustics and former consultant to the Office of Naval Research in London. Lecturer at Delft Technical University in the Netherlands, Dr. Harris was research scientist with the Bell Telephone Laboratories, Murray

RTMA BOARD OF DIRECTORS FOR 1952-53

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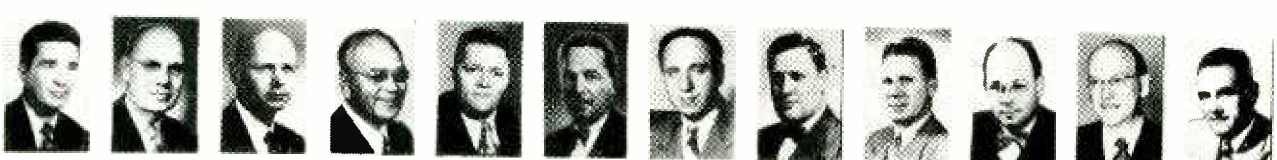

Sidney Harman; B. W. Cooper; Frank W. Godsey, Jr.; Harlan B. Foulke; E. K. Foster; G. Richard Fryling; Sam Norris; D. S. W. Kelly; Matt Little; Harry A. Ehle; W. S. Parsons; H. C. Mattes

These "Firsts" Helped Westinghouse Customers

1920 **Westinghouse Makes First Dry Battery WD-11 Tube**

1921 **Westinghouse Testing New Indirectly-Heated Tube**

1926 **WESTINGHOUSE INVENTS NEW KU-610 THYRATRON**

1928 **Announce New Photo-Tube and Long-Life Cathode Ray Tube**

1929 **Westinghouse Patents KOVAR for Metal-to-Glass Tube Sealing**

1931 **Westinghouse Unveils First High Power UHF Tube**

1932 **Westinghouse Tells of New Ignitron Tube**

1941 **WL-530 in Radar at Pearl Harbor**

USERS OF WESTINGHOUSE TUBES GET FIRST BENEFITS FROM MANY NEW TUBE DEVELOPMENTS

These are only a few of the "firsts" that Westinghouse created in the electronic tube industry. In each case, designers using Westinghouse Tubes gained advantages by having first chance to use these innovations.

Today, Westinghouse still pioneers in electronic tubes and tube making. For instance, Westinghouse 40 KV and 20 KV rectifying tubes are under 9 ounces, only 2¾" high. Designers seeking the ultimate in space and weight savings will find them in these new WL-6102 and WL-6103 tubes.

Radical new developments in other power tubes and receiving and television picture tubes are now being engineered at the *NEW* Westinghouse Electronic Tube Division at Elmira and Bath, New York.

NEW SERVICE, NEW DISTRIBUTION

Westinghouse plans for Electronic Tube Division expansion are in operation. New service facilities, new warehousing policies, and new distributors are opening rapidly.

New merchandising methods will aid distributors in serving industrial users—many of these business-building programs are totally new in the tube industry. Here, as elsewhere, Westinghouse plans to provide industry leadership in service.

It pays in profits to deal with Westinghouse and with Westinghouse distributors. For full information on how Westinghouse can help you with problems of design, service, or supply, call your nearest Westinghouse representative, or write to Department A-112.

RELIATRON™ TUBES

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

ELECTRONIC TUBE DIVISION

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

ET-95003

Hill, N. J., for five years.

The major part of the laboratory's work will be devoted to basic research in ultrasonics and psychoacoustics.

IT&T Names New Executive

APPOINTMENT of Gordon C. Knight as assistant to the president of International Telephone and Telegraph Corp. has been announced.

Active in management and industrial relations since 1941, he comes to IT&T from its subsidiary, the Capehart-Farnsworth Corp., where he has served successively as assistant to the president, division manager of research and development, and operations manager of the commercial products division.

G. C. Knight, assistant to president at IT&T

Swanson Joins ERA

ENGINEERING RESEARCH ASSOCIATES, Inc., St. Paul, Minn., announces the appointment of Carl E. Swanson to the position of senior scientist. In this post he will supervise the firm's St. Paul Division special projects activities. Projects under his direction will include work on automatic industrial process control systems, magnetic recording techniques and systems, development of communications equipment and other research activities.

Mr. Swanson's professional experience includes the positions of aeronautical research consultant at Minneapolis-Honeywell and re-

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As temperature measuring elements and liquid level sensors, these temperature responsive resistors are the best you can buy. In standard or special types, their high-precision manufacture makes them precisely right for your job when it comes to resistance values, size, temperature coefficient, mountings and quality. Ask us about applications.

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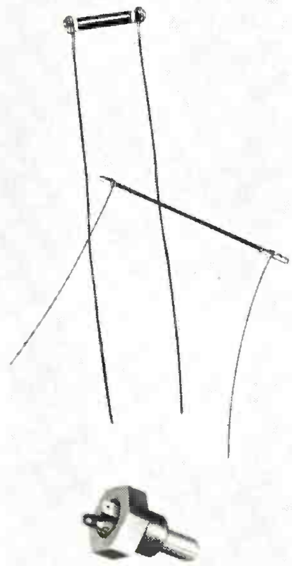

Used in this typical application for sensing the temperature of hydraulic oil.

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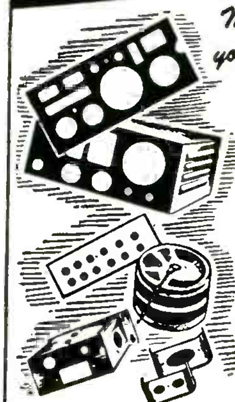

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The answer to all electric counting requirements

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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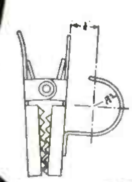
Sturdily constructed for maximum life. Finished in semi-gloss black enamel. Ribbed, firm-gripping clamping pads made of hard neoprene. Mounting plate enables clip to be attached to hard surface, such as a switch case. Hard drawn steel spring wire insures optimum spring action.



WITH MOUNTING HOOK FOR USE ON CORDSETS . . . This model utilizes a steel mounting hook which can be hooked directly on a cordset molded for this purpose.

DATA SHEETS ON REQUEST.

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C. E. Swanson, senior scientist

search director, superintendent of communications, and manager of engineering for Northwest Airlines. His experience also includes ten years on the teaching staff of the University of Minnesota.

Veteran Inventor Joins RCA

THE NOTED engineer and inventor in radio, television and electronics, Dr. E. F. W. Alexanderson, has joined the Radio Corp. of America as a consultant. This new association returns him to the corporation which he served as chief engineer from 1920 to 1924.

Although credited with more than 300 inventions, Dr. Alexanderson is best known for his invention of the high-frequency alternator that bears his name. This machine, which he developed in 1909, was an important step in making international radio communications successful.

Rucker Adds to Staff

APPOINTMENT of R. R. Harrison as assistant chief engineer and Bruce MacDonald as a senior project engineer has been announced by H. A. Price, chief engineer, The Rucker Co., Oakland, Calif.

Prior to his appointment Harrison served as senior design engineer in charge of design and construction of the Convair Guided Missile Division's Centrifuge Laboratory at Pomona, Calif.

MacDonald had served as project

engineer in the Guided Missiles Branch, Wright Air Development Center, Dayton, Ohio.

Acme Picks New Executives

DIRECTORS of Acme Electric Corp., Cuba, N. Y., have advanced Charles H. Bunch from the presidency to chairman of the board, and also have elected James A. Comstock as president.

Mr. Bunch, who helped found the company in 1917, has held the office of president since 1942. Prior to becoming president he held various other offices in turn from engineer, treasurer, to sales director.

C. H. Bunch, recently named chairman of the board

Mr. Comstock joined the company in 1930 as chief engineer, after resigning his position as transformer engineer with Modern Electric Co., Toledo, Ohio. While associated with Acme he has held respectively

J. A. Comstock, newly elected company president

the offices of chief engineer; purchasing agent; manager of specialty transformer and radio transformer sales; general manager of the Clyde, N. Y., plant; and since 1946, executive vice-president.

Acme Electric Corp. manufactures transformers for electronic and power applications.

Hoffman Advances Briggs

HOWARD BRIGGS, formerly assistant vice-president in charge of the Hoffman government contract office in Washington, D. C., has been appointed assistant to the president of Hoffman Laboratories, Inc., Los Angeles, Calif.

Prior to joining Hoffman in 1950, Briggs was vice-president in charge of sales for the Howard Radio Co. in Chicago, a position he held 15 years.

Howard Briggs

As assistant to the president of Hoffman Laboratories, Inc., he will manage the military production phase of the corporation and will coordinate procurement, sales, manufacturing and other related departments.

RTMA Headquarters Staff Increased

WITH the view of expanding RTMA's government relations activities, executive vice-president James D. Secrest has announced the appointment of Charles Maechling, Jr., as the Association's government relations officer.

In his new post, Mr. Maechling will be staff assistant to the RTMA

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No.	BASE KEYWAY	T-Slots	TABLE DIA.	BASE DIA.	HEIGHT	WEIGHT	PRICE
83	5/8"	5/8"	8"	6 1/4"	5"	28 lb.	$54.50
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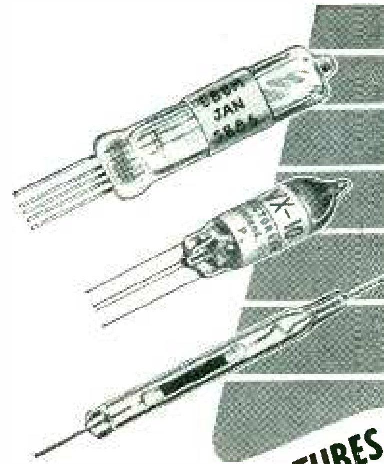

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An electrometer tube is a special purpose vacuum tube designed to present a minimum load to the signal voltage or current applied to the input. It has extremely small grid currents, high inter-electrode resistance and stable D.C. characteristics.

Originally developed for laboratory use, the electrometer tube has come of age with the development of atomic energy. It now finds many new applications in other fields, e.g., electrostatic voltmeters, computors, photometers, p.h. meters, etc.

5886

Electrometer Pentode—For use with high gain amplifiers having feedback to degenerate the input signal. When triode connected, it is interchangeable with the 5803 for many applications. $Ic = 2 \times 10^{-13}$.

5800

Electrometer Tetrode—The ultimate in low grid currents. G_2 is the control element. G_1 is an accelerator grid which may also serve as the plate in the inverted triode connection. $Ic = 3 \times 10^{-15}$.

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Electrometer Triode—For single tube circuits it is a compromise to produce higher transconductance at the expense of slightly higher grid currents. It is also used as an inverted trianode. $Ic = 5 \times 10^{-14}$.

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Electrometer Diode—Used as a clipper wherever high insulation is important. As an electrometer, it requires a high gain feedback amplifier circuit. $R = 10^{14}$ Ohms.

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Resistors—"Calibrated Insulators" for electrometer input circuits. $R = 10^6$ to 10^{14} Ohms.

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COMPONENTS DIVISION

Victoreen Instrument

3800 PERKINS • CLEVELAND 14, O.

Government Relations Section headed by Ben Edelman of Western Electric Co. This active RTMA section was established early this year to deal with problems of electronic manufacturers handling government contracts.

Mr. Maechling comes to RTMA from the Office of the General Counsel of the Department of the Air Force where he dealt with government contract law and procurement matters.

TelePrompTer Corp. Elects V-P

ELECTION of Hubert J. Schlafly, Jr. as vice-president in charge of engineering of TelePrompTer Corp. was recently announced. The corporation, located in New York City, manufacturers and leases an electronically synchronized and controlled prompting device widely used in tv, motion pictures and by public speakers.

H. J. Schlafly Jr.

Mr. Schlafly went to TelePrompTer Corp. from 20th Century Fox Film Corp. where he was director of television research. Prior to that he spent several years with GE at Schenectady, N. Y., in its Electronics Laboratories.

Raytheon Breaks Ground for New Lab

AN ELECTRONICS laboratory, to cost nearly $2,000,000, is now under construction in Bedford, Mass., by Raytheon Mfg. Co. The building, being constructed by Raytheon for

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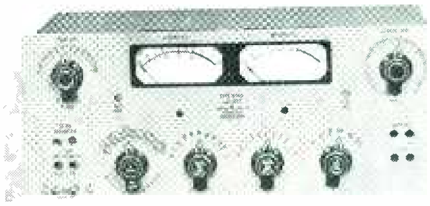

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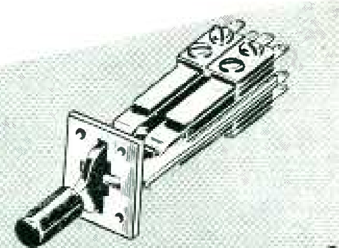

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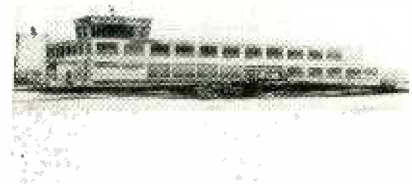


Architect's sketch of the Roytheon Mfg. Co. development lab under construction at the Hanscom Airfield, Bedford, Mass.

the Navy, will be used by the company as a research and development center. Approximately 700 persons will be employed in the project.

When completed, the structure is expected to be one of the most advanced laboratories ever built for the development of electronics equipment used in conjunction with aircraft. It will have 21 specially designed test bays for operating and testing radar equipment.

New England Plant Moves

EMERSON AND CUMING, INC., engineers and manufacturers of plastics for electronics, have announced the establishment of their plant, laboratory and office facilities at 869 Washington St., Canton, Mass. The company was formerly located in Boston, Mass.

Hammarlund Leases More Space

THE HAMMARLUND MFG. CO., whose main offices and factory are located at 460 W. 34th St., New York City, has leased an additional 12,000 sq ft of space at 541 W. 34th St.

The new area will be used for subassembly manufacturing on the SP-600 general-purpose communications receiver, for spare parts packing and shipping, and for stocking standard capacitors. Up to 125 persons can be employed in the new space.

Brush Development Ups Novak

THE appointment of Albert J. W. Novak as assistant general sales manager has been announced by The Brush Development Co., Cleveland, Ohio, manufacturers of indus-

A. J. W. Novak, recently promoted at Brush

trial and research instruments, and acoustic and magnetic recording equipments and components.

Mr. Novak has been with Brush in various engineering and sales capacities since 1946. Most recently he was manager of the Instrument Department, Sales Division. In 1941 he was an industrial engineer with RCA Mfg. Co., Camden, N. J. From 1942 to 1946 he served with the U.S. Navy in industrial engineering and electronics positions.

Clarostat Announces Midwest Plant

THE OPENING of an additional plant in the midwest has been announced by Clarostat Mfg. Co., Inc., Dover, N. H., manufacturers of resistors, controls and resistance devices.

Already in operation, the new plant in the Chicago area provides more floor space than was available in the company's original plant building in Brooklyn, N. Y. Meanwhile the company will not diminish its operation in Dover, N. H.

Audio Engineers Elect Officers

THE FOLLOWING new officers were elected by the membership of the Audio Engineering Society at its recent Fourth Annual Convention in New York City:

President—F. Sumner Hall of F. Sumner Hall, Inc.; executive vice-president—Jerry B. Minter of Measurements Corp.; central vice-

president—Walter S. Pritchard of Ohio Bell Telephone Co.; western vice-president—Richard L. Burgess of Allied Recording Mfg. Co.; secretary—C. J. LeBel of Audio Instruments Co., Inc.; treasurer—Ralph A. Schlegel of WOR Recording Studios; governors—Price E. Fish of Columbia Broadcasting System; Jay H. Quinn of Fairchild Recording Products Corp.; C. H. Sawyer of Bell Telephone Laboratories; John D. Colvin of Commercial Radio Sound Corp., C. G. McProud of Radio Magazines, Inc.; and W. O. Summerlin.

Gabriel Labs Appoint Research Director

JOHN RUZE was recently named director of research of The Gabriel Laboratories, division of The Gabriel Co., Needham Heights, Mass. The Laboratories provide research and development facilities to other Gabriel divisions.

J. Ruze, director of research at Gabriel Labs

Before joining Gabriel, Dr. Ruze was assistant chief of the antenna laboratory at the Air Force Cambridge Research Laboratories. During the war he headed the antenna design section at the Signal Corps Engineering Labs.

Daystrom Buys Crestwood

PURCHASE of the Crestwood Recorder Corp., Chicago, Ill., manufacturers of magnetic tape recorders, was recently announced by James F. Brehm, president of the

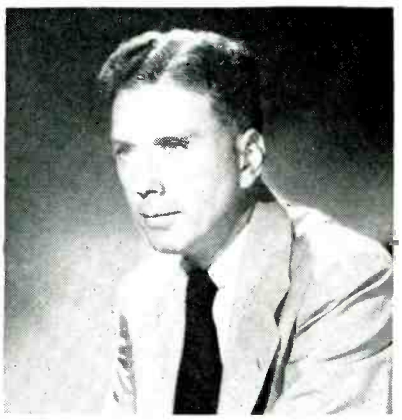
Daystrom Electric Corp.

H. H. Hanlon, president of Crestwood, will continue as sales manager and will direct national distribution.

Daystrom Electric Corp. is a subsidiary of Daystrom, Inc., Elizabeth, N. J. Since World War II the company has been a leading manufacturer of wire, film and tape recorders for all branches of the military services.

National Appoints Kirkpatrick

WILLIAM A. READY, president of the National Co., Inc., manufacturers of communication radio receivers, electronic equipment and components, has announced the appointment of Donald N. Kirkpatrick as chief engineer.



D. Kirkpatrick, chief engineer of the National Co.

He was most recently employed as chief engineer by the Boonton Radio Corp., Boonton, N. J., manufacturers of test instruments.

As chief engineer at National Co., he will be responsible for all engineering activities, including the development of new products.

Welge Takes New Post

P. R. MALLORY & Co., Inc., Indianapolis, Ind., announces the appointment of Victor Welge as associate director of engineering. Mr. Welge came to Mallory from Consolidated Vultee Aircraft Corp., San Diego, Calif., where he headed the staff of the firm's electronics and missile section.

In his new position he will be

concerned with electric, electronic and mechanical engineering problems in Mallory's Central Engineering department and will assist Central Engineering management in all administrative duties concerning engineering activities in the firm's ten manufacturing divisions.

He was at one time engaged in designing p-a and broadcasting-studio equipment for Remler Radio Co., San Francisco. Later he joined the staff of Associated Broadcasters Inc., San Francisco, where he served as transmitter engineer for commercial station KFSO and aided in the design and installation of the directional antennas for KWID, a noncommercial 100,000-watt short-wave station transmitting to foreign countries. He served as chairman of the San Diego section of the IRE until he moved to Indianapolis.

Speakman Appointed by Fairchild

Edwin A. Speakman has been appointed general manager of the Fairchild Guided Missiles Division, Wyandanch, N. Y. He has been vice-chairman of the Research and Development Board, Department of Defense, for the past two years.

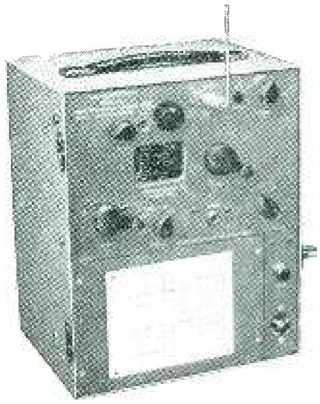
Mr. Speakman was appointed to the Naval Research Laboratory in Washington, D. C. in 1939, where he was made assistant superintendent of the Radio Division and headed the Countermeasures Branch of the laboratory. During this period he initiated developments for Naval radar equipment for which he received the Navy's Meritorious Civilian Service Award in 1946. In 1949 he joined the Research and Development Board as executive director of the Committee on Electronics.

Lenkurt's Sales Engineering Augmented

Edwin J. Rudisuhle has joined the sales engineering department of the Lenkurt Electric Co., San Carlos, Calif., manufacturers of multichannel telephone and radio equipment. He will be concerned primarily with

Do You Want to Measure Or Generate Any Frequency

From 20 — 640 M. C.*
Within 10 Parts Per Million?



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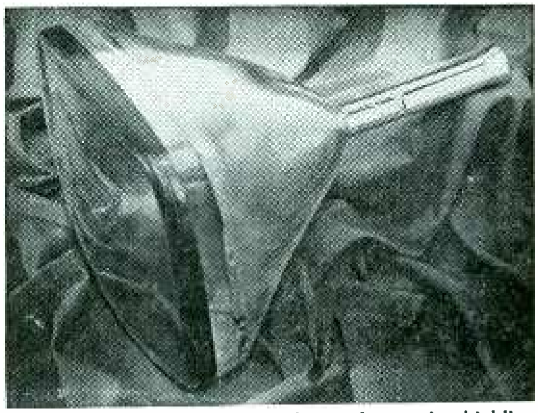

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E. J. Rudisuhle, now with Lenkurt's sales engineering staff

the application of carrier channelizing equipment to vhf and microwave radio links.

Before joining Lenkurt, Mr. Rudisuhle was with the CAA as chief, Electronics Establishment Branch, Ninth Region. In this capacity he was in charge of radio engineering in the Pacific area and supervised the engineering and installation of a number of multichannel radio links. His previous experience in the communications field includes several years with the FCC as both field and laboratory engineer.

Gordon Occupies New Plant

THE Claud S. Gordon Co., of Chicago, Ill., has opened its new manufacturing plant on a 6½-acre site at Richmond, Ill. Modern, new machinery has been installed for the manufacture of their line of thermocouples, pyrometer accessories, specialty instruments and metallurgical testing machines. The new facilities include also a modern, complete insulating mill for applying insulation to all types of thermocouple wire and extension lead wire to meet standard and special order requirements. The home office and the headquarters for the engineering and service departments remains in Chicago.

Electronic Firm Sale

UNDERWOOD CORP. has announced that it is acquiring the Electronic Computer Corp. of Brooklyn, N. Y., which will become the electronic computer division of Underwood.

NEW BOOKS

Antennas: Theory and Practice

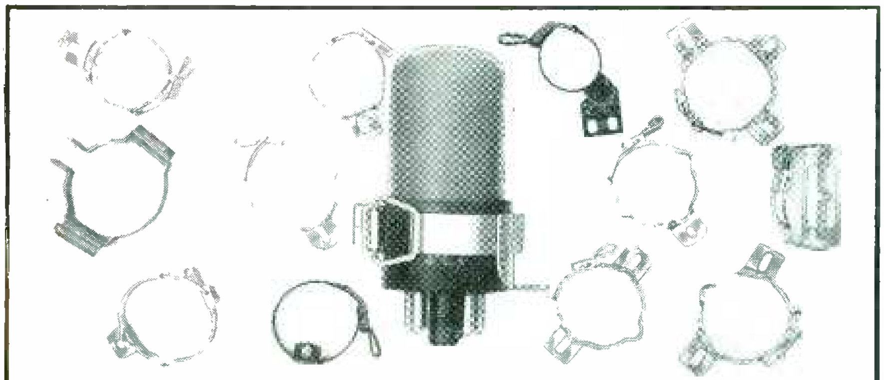
By S. A. Schelkunoff and H. T. Friis. *John Wiley & Sons*, 639 *pages*, $10.00, 1952.

Dr. Schelkunoff, the senior author of this recent book on antennas, is well known to those who have been concerned with waveguide and antenna problems. His contributions to electro-magnetic theory have been numerous and his development and popularization of the impedance concept has done much to simplify the treatment of field problems so that difficult boundary value problems can be reduced to relatively simple network or circuit problems which are familiar to the average engineer.

Dr. Friis, the co-author of the book, has been active in the early development of radio and is known for his work on short-wave transmission phenomena. Dr. Friis also appears to possess the ability to state difficult concepts in simple terms. His collaboration with Dr. Schelkunoff has resulted in a book which is of interest to the practical-minded engineer and to those who are theoretically inclined.

The book opens with a long chapter on the physical principles of radiation. This chapter, with its excellent illustrations and physical derivation of the radiation process, will give the neophyte an intuitive grasp of antenna theory. The next three chapters are concerned with Maxwell's equations, plane waves and spherical waves. In these chapters, the field relationships are developed from basic principles. Chapters 5 and 6 treat the directive properties of arrays and current distributions and contain most of the standard derivations. Chapter 7 gives a brief treatment of the effect of ground on radiation patterns. Chapter 8 is a rather extensive discussion of currents on linear antennas. Chapter 9 treats the relationship between antenna and network theory. The next two chapters contain a discussion of small antennas and of antennas which are self-resonant.

Chapter 12 is a discussion of various topics relating to the theory



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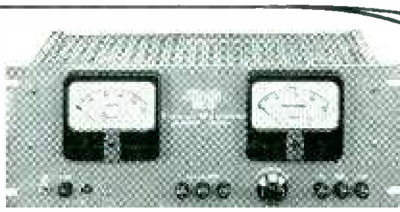

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of linear antennas. Chapter 13 treats the impedance of dipole antennas and contains an extensive discussion of a subject to which Dr. Schelkunoff has made many contributions. Chapter 14 is on rhombic antennas while Chapter 15 is on linear antenna systems. These chapters are of a practical nature and treat some of the design features of antennas which are useful at communication frequencies. The last four chapters, which constitute about one-eighth of the book, are on horns, slot antennas, reflectors and lenses.

The book closes with a series of appendices which contain data useful in antenna design. A rather complete author and subject index is provided. At the end of each chapter, there is a short representative list of references which is quite up to date. An excellent collection of problems and answers is appended to many of the chapters, thus increasing the value of the book as a textbook.

On the whole, this book is one of the best theoretical treatments of linear antennas on an intermediate level which has appeared to date. In this field, the book is fairly complete and contains much of the results which have appeared in the periodical literature as well as some interesting results which are presented for the first time in this book. However, several topics in the field of linear antennas have been treated very briefly or have been omitted altogether. For instance, there is only a very brief discussion of sleeve antennas which are so useful in broadband applications. There is no mention of helical antennas which find many applications where circular polarization is desired. The problem of mutual impedance between antennas of large diameter has not been treated. This last problem is important in practice since antennas are very frequently used in arrays. However, the rigorous computation of mutual impedance for large-diameter dipoles is extremely laborious and, for actual applications, is usually determined by measurement.

The subject of antenna measurements has not been treated although the title of the book would have led one to expect some discussion of this important topic. The subject of microwave antennas has been treated much too briefly in view of the present-day importance of such antennas. Perhaps the authors felt that the excellent book on microwave antennas by Silver left little to be improved on. In all fairness, however, the reviewer should point out that the antenna field has so grown in scope in the past decade that it would take a number of authors and four or five volumes to cover the field with any pretense at completeness.

Despite the minor criticisms above, the reviewer wholeheartedly recommends this book to those engineers who have any interest in the theory or practice of antennas. The book is a gold mine of information and those who care to do a little digging will find ample reward.—HENRY JASIK, *Consulting Engineer, Westbury, New York*

Theory of Superconductivity

BY MAX VON LAUE. *Academic Press, Inc., New York*, 1952, 140 *pages*, $4.00.

THE BOOK is an English translation of a book published in German in 1947. The author has been interested in certain aspects of the theory of superconductivity for many years, and in this book he presents a discussion of some of the topics in which he has been particularly interested. Specifically, what is presented is a treatment of the London theory of superconductor electrodynamics together with a number of applications of the theory to problems involving superconductors of especially simple geometrical form. The London equations are presented in the generalized tensor form due to von Laue. However, the problems treated in the book are problems which can be treated using the original London theory. The problems concern, for the most part, superconducting spheres, cylinders and slabs in magnetic fields of simple shape. In each case the superconducting material is assumed to have cubic symmetry so that no "tensor" effects occur.

The viewpoint of the book is extremely narrow, since the author deliberately excludes all phases of the subject which cannot be considered closed to research. A superconducting material is characterized as a continuous medium bounded by mathematically sharp surfaces within which certain equations—the London equations or some analogue — completely describe the electrodynamic properties. If two different superconductors, or a superconductor and non-superconductor, are put in contact, the surface of contact is conceived to be really sharp; the electrodynamic equations are imagined to change discontinuously across the surface, but otherwise, the surface is not thought of as having any particular properties. Only a few problems can be adequately treated within such a theory and they are just the problems whose solutions constitute the content of the book.

The book has little or nothing to say concerning much of the phenomenology of superconductors. Such matters as the effect of strain or lattice imperfections on the superconducting properties are excluded explicitly. The variation of properties from one metal to another, and from metal to alloy is not discussed. No attention is given to the meaning of the distribution of superconductors in the periodic table beyond noting that no ferromagnetic has been observed to become superconducting. The theory of the intermediate state is omitted except for a demonstration that the London electrodynamics permits a deduction of the correct condition for the appearance of the intermediate state. In short, the discussion is limited to a treatment of single crystal pure superconductors which are wholly in the superconducting state.

Although the book is well written and, at the time of its German edition, could meet a definite need, the reviewer sees no pressing reason for re-issuing the book at this time. As an introductory book for one wholly unacquainted with the subject, it is not superior to older books, and contains a minimum of information concerning the phenomena themselves. As a book for a research scientist working in the field, it contains nothing new and little that is relevant to current research; it would be useful mainly

to one who needed the detailed solutions of the particular problems which are treated. As a book for one interested in an instrumentation application of superconductors, it does not seem valuable. In his prefatory remarks the author expresses the hope that his presentation will stimulate experiments to determine whether his particular generalization of the London theory is necessary and valid. What the nature of such experiments might be is not described in the book. Indeed the whole plan of the book militates against its functioning as a stimulus to research, for by restricting his attention to matters about which there can be little question, the author has all but severed connection with research interest.

The translation is excellent and the typography very elegant.—DR. EDWARD N. ADAMS II, *Assistant Professor of Physics, Department of Physics, The University of Chicago.*

Radio Interference Suppression

BY G. L. STEPHENS. *Second Edition. Iliffe & Sons, Ltd. London. 1952. 132 pages, 10 shillings six pence; available in U. S. from The British Book Centre, Inc., 122 E. 55th St., New York 22, N. Y., $2.50.*

A PRACTICAL guide to the universal problem of man-made interference to radio communication, written from the English standpoint but useful to any practical workman who not only wants to find a source of noise but to get rid of it.

The first chapters are taken up with a discussion of the origins of interference, the principles of its suppression but the bulk of the book is concerned with practical applications. Remedies for noise from motors and generators, hair driers, "lifts", neon signs, fluorescent lamps, r-f heating equipment, oil-fired heating systems, automobiles etc., etc., are covered. Unfortunately the racket produced by television receivers is treated from the viewpoint of another TV looker and not from the situation of other services which may be annoyed by unsteady, raspy noise so prevalent between 3 and 4 mc and caused by TV sets.—K. H.

BACKTALK

Super Dog Whistle

DEAR SIRS:

AS A horticultural experimenter I am interested in a unit that would generate a supersonic wave such as an electrically operated super dog whistle that might have some influence within an area of six or eight feet.

Could you give any lead?

HARRY S. WELBY
Taft, California

(Editor's Note: We referred Mr. Welby to several manufacturers of ultrasonic whistles, but we couldn't refrain from asking him a few questions about the intended application of such equipment to the seemingly unrelated science of horticulture. His answer appears below.)

Save the Fruit Trees

DEAR SIRS:

APPRECIATING your letter of the 12th, (see above) my interest was in a cure for Nematode on roots of fruit trees. It's a hairlike worm within a gall on roots. It seemed possible the very ultra waves that could be built up could be used to the discomfort of such a pest if the device were installed in a pit among the roots.

Poisons and chemicals are now being injected under pressure but one would hesitate to use such a method where fruit is involved. For ornamentals that might work. So if ultrasonic waves were somewhat inhibitive to worms within an area of 5, 10, or 20 feet perhaps such treatment once a year might help.

HARRY S. WELBY
Taft, California

Interchanged

DEAR SIRS:

THIS IS TO CALL your attention to the following printing errors that occurred in the figures of my article entitled, "Frame Synchronization for Color Television" which appeared on page 146 of the October 1952 issue of ELECTRONICS magazine.

Figures 2 and 3 were interchanged, although the captions appear in the proper places. Also, the waveforms appearing in the upper left-hand corner of Fig. 8 are upside down and backwards.

Incidentally, rare as these errors are in ELECTRONICS, they might be circumvented by permitting the authors of articles to review the figures as well as the text before the final printing.

DONALD RICHMAN
Hazeltine Corp.
Little Neck, New York

(Editor's Note: Unfortunately, our tight publishing schedule precludes the sending of copies of drawings to authors for approval except in very special cases.)

Electronic Witch

DEAR SIRS:

THERE IS another field, besides Medicine, where electronic instruments are urgently needed. This is *irrigation*. All the fruit growers in southern California and many other places are water-hungry.

The chief engineer (a college graduate) of a certain irrigation district actually hired a professional "water-witch" or "dowser" to locate water with a divining rod! Three good wells were brought in without a failure. But when the engineer worked according to his own theories he got a dry hole.

Why not make *electronic instruments* to do the following:

(1) For the first experiment watch the recording needle of a brain-wave machine attached to a dowser (water witch) who thinks he is walking over underground water. Perhaps doctors and engineers would learn something new and surprising about the human nervous system, no matter what the result.

(2) Consider the high dielectric constant of the water and the earth a charged sphere.

(3) Study all kinds of sand and rocks. Dowsers claim that running water is different from still water. Perhaps some grains of sand (quartz) act like small piezoelectric generators. The varying pressure caused by the ripples in running water will then generate small voltages.

(4) Consider "streaming potentials." When water is forced

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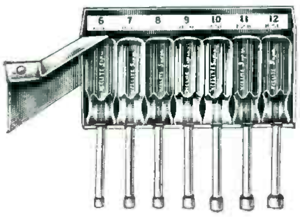

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Featuring: Very low output impedance at high power levels; 1/2% regulation; 5 MV ripple. Continuous duty components; short delivery.

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through a layer of sand or clay, the water acquires one charge and the clay or sand the opposite charge.

(5) It is said that the tips of weeds and the sharp points of leaves discharge electricity into the air. If this is true, perhaps this is in some way related to underground water.

(6) In designing some kind of instrument perhaps *electrets* are an important item to consider.

In all these experiments "give the electronics boys complete freedom" as you say in ELECTRONICS. Above all don't be frightened by "scientists". If they hear the word divining rod they will call you a "witch stick wielding medicine-man" and so on.

NAME WITHELD BY REQUEST

Underwriting

DEAR SIRS:

WITH REFERENCE to the item entitled "Handicap" appearing in the *Crosstalk* department of the October 1952 issue of ELECTRONICS, I find that our Mr. G. E. Schall wrote to a member of your staff on August 18 outlining the general procedure that is followed for underwriting foreign-made equipment.

The item in question includes two misstatements of fact that in the interest of accuracy should be corrected in an early issue of ELECTRONICS. The safety requirements of Underwriters' Laboratories, Inc. are applied equally to both domestic and foreign manufacturer's equipment. More specifically the construction and test requirements are the same regardless of the point of manufacture. Rubber-insulated wires are accepted without special tests and have been widely used for that reason. Thermoplastic wire is required to meet tests applied to each production lot whether of domestic or foreign manufacture.

In recent weeks an English wire manufacturer has obtained Label Service on thermoplastic wires which should be of interest to European equipment manufacturers.

K. S. GEIGES
Chief Electrical Engineer
Underwriters' Laboratories, Inc.
New York, New York

PROFESSIONAL SERVICES

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FOR THE FIELD OF ELECTRONICS

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Of Electronics published Monthly at Albany, New York for October 1, 1952.

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(Continued on the opposite page)

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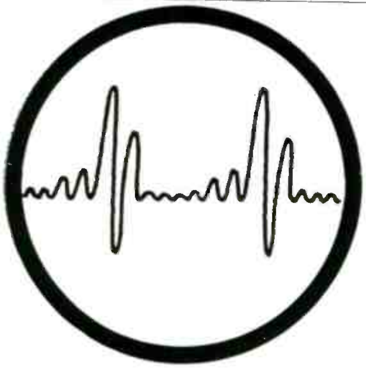

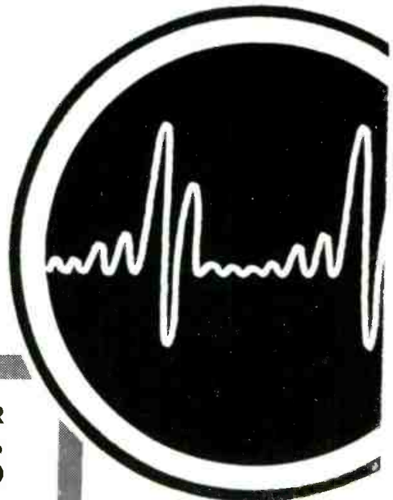

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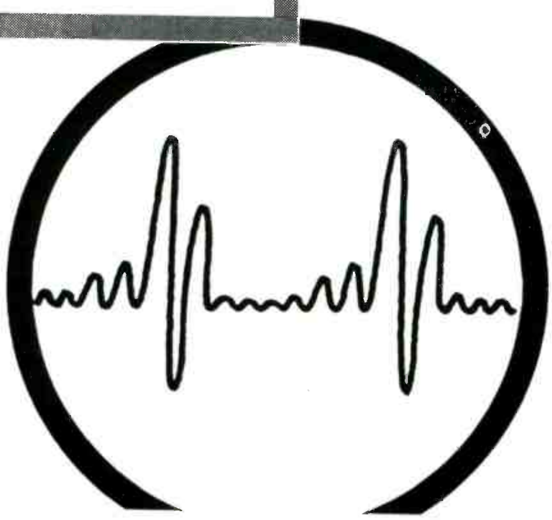

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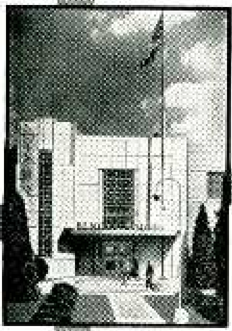

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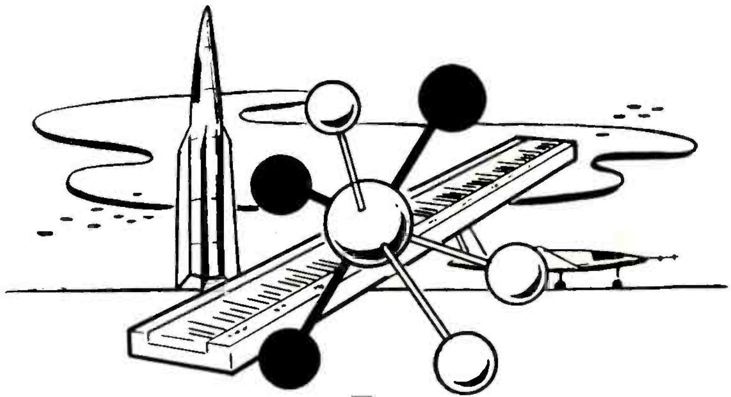

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2	600 R'd	.69	.1-.5	2000	.95	1-1	7500	22.50	.25	50KV	95.00
2-2	600 R'd	1.65	.25	2000	1.50	.075-.075	8KV	6.50	7.5	220VAC	1.95
3	600	.95	.3	2000	1.30	.5	10	16.50	1-3	330VAC	1.95
4	600	1.65	1	2000	1.95	1	10KV	29.50	10	330VAC	3.95
4	600 R'd	1.65	3	2000	3.75	.1	12KV	8.95	12.75	330VAC	4.10
5	600	1.75	12	2000	8.95	1	15KV	45.00	15	330VAC	4.50
6	600	1.85	1	2500	2.75	.045	16KV	4.70	5	440VAC	3.10
8	600 R'd	1.85	1-1	2500	3.85	.05	16KV	4.95	2.9	660VAC	3.50
8-8	600	1.95	32	2500	15.80	.075	16KV	8.95	7	660VAC	4.25
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4 x 3	600	2.50	1	3000	3.40	1	20KV	54.00			
10	600	3.25	2	3000	4.50						
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3.5-.5	1000	1.85	.1	5000	1.60						
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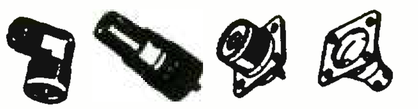

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RG-8/U	100.00	RG-19/U	1250.00	RG-35/U	900.00	RG-59/U	60.00
RG-9/U	250.00	RG-20/U	1450.00	RG-54A/U	97.00	RG-62/U	75.00
RG-9A/U	275.00	RG-21/U	220.00	RG-55/U	110.00	RG-77/U	100.00
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2 ϕ LOW INERTIA SERVO MOTORS

KOLLSMAN—45 Volt 60 cycle 4 watts 1500 RPM—new $22.50
PIONEER—10047-2-A 26 volt 400 cycle with 40:1 reduction gear $10.50
PIONEER—OK-13 115 volt 400 cycle—includes damping signal generator (autosyn) $47.50

HIGH VOLTAGE TRANSFORMERS

G.E.—Pri. 115V 60 cy. Sec. 6250V 80 MA—12.5 KV insulation $18.50
G.E.—Pri. 115V 60 cy. Sec. 6250/3850/2600V 56 MA 12.5 KV Insulation $18.50

ANTENNAS

AT-4/ARN-1 .... $8.25
AT-38A/APT (70 to 400MC) 13.70
AT-49/APR-4 (300 to 3300MC) 13.70
AN-65A (P/O SCR-521) 1.50
AN-66A (P/O SCR-521) 1.75
AIA-3CM conical scan 125.00
ASB Yagi—5 element 450 to 560MC 9.00
ASB Yagi—Double stacked 6 element 14.70
ASA Yagi—Double stacked 370 to 430MC 29.40

RELAYS

Sigma type 4AH—2000Ω 4 ma DC coil—SPDT contacts—hermetically sealed 5 pin plug-in base $3.30
Sigma type 4R—8000Ω 1 ma DC coil—SPDT contacts—enclosed type 5 pin plug-in base $4.25
Stevens Arnold type 171 Millisec relay—900 ohm coil SPST NO contacts $5.50
Cutler Hammer and Square D type B-7A contactor—24 VDC coil—SPST NO 200 Amp contacts...$4.75
Price Bros. type 161-M—220 VAC contactor—SPST No double bk 30A contacts $3.25
G.E. CR5181-1A6—115 V 60 cy. AC contactor—4PST 30 Amp contacts plus two auxiliary SPDT contacts $14.50
RBM—115 V 60 cy. AC coil—DPDT 3 amp Contacts $3.20

METERS

1 MA DC 3½" R Dejur Mod 310 (0-4KV scale) .$5.75
500 Microamps. DC—2½" round—Sun 4.30
1ma. DC Fan type—4" scale (rem. from equipt). 3.95
500 ma. DC 2½" R.—General Electric 2.95
2 amp. RF 2½" Sq.—Simpson 3-15
5 amp. AC 4" R.—JBT 4.11
30 V DC 2½" R.—General Electric 3.95
3 amp. RF 3½" R.—Weston 6.00

CRYSTAL DIODES

1N21	$1.19	1N27	$1.79	1N41	$11.25
1N21A	1.69	1N31	8.10	1N42	18.75
1N21B	3.50	1N34	.66	1N43	1.55
1N22	1.09	1N34A	.95	1N45	.94
1N23	1.95	1N38	1.70	1N52	1.05
1N23A	3.25	1N39	6.25	1N55	3.15
1N23B	4.25	1N40	10.60	1N60	.55

TYPE "J" POTENTIOMETERS

Resis.	Shaft	Resis.	Shaft	Resis.	Shaft
60	SS	5K	1/4"	50K	3/8"
60	9/16"	5K	3/8"	50K	1/2"
100	SS	5K	1/2"	100K	SS
200	SS	10K	SS	150K	1/2"
250	1/8"	10K	3/8"	200K	3/8"
500	SS	10K	1/2"	250K	SS
500	5/16"	15K	SS	250K	3/4"
500	1/2"	15K	1/2"	250K	3/8"
500	5/8"	20K	SS	500K	SS
650	1/2"	25K	SS	500K	1/4"
1K	SS	25K	1/4"	500K	7/16"
2K	3/8"	30K	1 1/8"	1 Meg	SS
2500	SS	40K	SS	2.5 Meg	SS
4K	SS	50K	SS	5 Meg	SS
5K	SS	50K	1/4"		

$1.25 *each*

DUAL "J" POTS.—$2.95 ea.

50 SS	330 SS	2500 SS	2.5 meg SS
100 SS	500 SS	10K SS	5 meg SS
250 SS	1K SS	1 meg SS	1K/25K ⅜"

TRIPLE "JJJ" POTS.—$3.95 ea.

100K/100K/100K ⅜" 20K/150K/15K ⅜"

SOUND POWERED TELEPHONES

U. S. NAVY TYPE M HEAD AND CHEST SETS
U.S.I. A-260 W.E. D-173013
A.E. GL832BAO
ANY TYPE—$14.88 EACH
TS-10 Type Handsets $9.25

GENERATORS AND INVERTERS

Eclipse-Pioneer type 716-3A (Navy Model NEA-3A) Output-AC 115V 10.4A 800 to 1400cy. 1ϕ; DC 30 Volts 60 Amps. Brand new $38.50
Eclipse-Pioneer type 1235-1A. Output-30 Volts DC 15 Amps. Brand New-Original Packing....$15.50
PE-218 Inverters-28 VDC to 115 VAC 400 cy 1500 VA. (New) $49.50
Pioneer Type 800-1B Inverter-28VDC to 120V 800 cy 7 amp AC (used) $22.65
G. E. Inverter-28 VDC to 120 VAC 800 cy 750 VA 1ϕ $39.50
ATR Inverter 6VDC to 110 VAC 60 cy 75W....$22.95
PU-7/AP Inverter-28 VDC to 115 VAC 400 cy 2500 VA (used) $75.00
Eclipse-Pioneer type 12121-1A Inverter—Voltage and frequency regulated—24VDC 18 Amp input—AC output 115V 3ϕ 400 cy 250VA 0.7 PF — (New) $225.00

TEST EQUIPMENT

- Gen. Radio 475B Frequency Monitor $200.00
- Gen. Radio 681A Freq. Deviation Meter....$87.50
- 1-72K Signal Generator $48.50
- C-D Quietone Filter Type IF-16 110/220 V AC/DC 20 Amps *$9.00
- TS-143/CPN Oscilloscope *$95.00
- Dumont 175A Oscilloscope *$225.00
- Gen. Radio 757-P1 Power Supply *$27.00
- A. W. Barber Labs. VM-25 VTVM *$86.00
- TS-10A/APN Delay Line Test Set $45.00
- TS-19/APO-5 Calibrator $75.00
- CW1-60AAG 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
- 1-138A Signal Generator—10 cm *$185.00
- BC-221 Frequency meter *$125.00
- CW—60ABM Frequency Meter—10 CM....$97.50
- Weston Model 1 D.C. Milliameter 150/1500 MA with leather case $75.00

All items New Except Where noted * (Exc. Used Condition.)

MISCELLANEOUS EQUIPMENT

AN/APA-23 Recorder $147.50
1-82F Selsyn Indicator 6.95
SCR-515 compl. w/dynamotor control box.... 69.50
Amperex 1B98 Gamma Counter 9.87
Powerstat 1226—115/230V Input—0-270V out. @ 9 amp. 37.00
FIMAC-35T Ionization Gauge 5.95
B-7/ABS-2 Receiver 49.50
FI-8 1020 cycle filter 2.95
BM-29 remote control unit 8.95
BM-14 remote control unit 8.95
BTA-1B 12/24 V dynamotor 40.00
BC-1206-CM2 Receiver 12.95
ASR-4 Radar equip. Complete 69.75
RCA AVR-15 Beacon Recvr 18.50
Navy DP-14 Direction Finder complete 385.00
CU-24/ART-13 Antenna Loading Cond 4.95
T-85/APT-5 300-1600 MC Transmitter 175.00
Sola #30807 Constant Volt. Transf. 250 VA. 49.00
PP-104/APT-5 Rectifier Unit for above 42.50
BC-1016 Tape Recorder 350.00
AN/APA-30 .... 375.00
BC-910A Oscilloscope 147.50
BC-1068 Receiver 57.50
ATI and ATK TV Block Equip .... Quote
BC-348 Receiver .... Quote
BTA-1B Transceiver .... Quote
T-47/ABT-13 Transmitter .... Quote
Sperti IS21 vacuum relay switch (P/O AN/ART-13) 9.50

PULSE TRANSFORMERS

UTAH 9262 9278 9280 UTAH 9318 9340 9350

G.E. K541318	Westinghouse 187AW2F
G.E. 68G-627	Westinghouse 232-AW2
G.E. 68G828	Westinghouse 232-BW-2
G.E. 68G929G1	AN/APN-4 Block Osc.
G.E. 80G13	Philco 352-7149
G.E. K-2468B	Philco 352-7150
G.E. K-2469A	Philco 352-7071
G.E. K-2744B	Philco 352-7178
AN/APN-9 (901756-501)	Raytheon UX-7350
AN/APN-9 (901756-502)	Raytheon UX-10066
AN/APN-9 (352-7250)	W.E. D-161310
AN/APN-9 (352-7251)	W.E. D-163247
Westinghouse 132-AW	W.E. D-163325
Westinghouse 139DW2F	W.E. D-164661
Westinghouse 166AW2F	W.E. KS-9563
Westinghouse 176AW2F	

SPARE PARTS FOR ARMY AND NAVY RADIO, RADAR & SONAR EQUIPMENT

AN/APS-2	AN/APN-4	AN/ARC-5	QCB
AN/APS-3	AN/APN-9	SF	QCJ
AN/APS-4	AN/ARC-1	SL	QCL
AN/APS-15	AN/ARC-3	SO	WEA
etc.	etc.	etc.	etc.

QUOTATIONS UPON REQUEST

SPRAGUE PULSE NETWORKS

7.5 E3-1-200-67P, 7.5 KV, "E" Circuit 1 Microsec. 200 PPS 67 ohms imped, 3 sections $4.30
7.5 E3-3-200-67P, 7.5 KV, "E" Circuit 3 Microsec. 200 PPS, 67 ohms imped, 3 sections $6.75
7.5 E4-16-60-67P, 7.5 KV, "E" Circuit 4 sections. 16 microsec, 60 PPS, 67 ohms imped $8.25
15 E4-.91-400-50P, 15 KV, "E" Circuit .91 microsec. 400 PPS, 50 ohms imped, 4 sections $37.50
15-A-1-400-50P, 15 KV, "A" Circuit, 1 microsec. 400 PPS, 50 ohms imped $32.50

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST. PHILA. 6, PA.
Telephones - MARKET 7-6771-2-3

"CABLE ADDRESS—LECTRONIC PHILADELPHIA"

Reliance Specials

GEAR ASSORTMENT

100 small assorted gears. Most are stainless steel or brass. Experimenter's dream! ....Only $6.50

HAYDON TIMING MOTOR

1 R.P.M., 115 V., 60 Cycle..........$1.95

TIMING MOTOR

8 RPM 115V 60 cyc
E. Ingraham Co.
$1.79

400 CYCLE INVERTERS

Leeland Electric Co.

#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¢ each
T 115 Similar to T 114 with tap brought out..... }

AC LINE CORDS 6 ft. long with molded plug......16¢

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	3/4	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

NEEDLE BEARINGS

TORRINGTON B108 ½" wide ⅝" 13/6".......30c

Brand New Meters—Guaranteed

0-10 ma. D.C. 3½"..$3.95 0-80 Amp. D.C. 2½"..$2.50
0-1 Ma D.C. 3½" DeJur..(Scale Reads 0-4 KV)..$5.75

SELENIUM RECTIFIERS

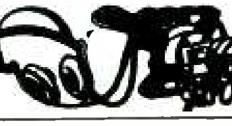
Full Wave 200 MA 115V...........................$1.79
Half Wave 100 MA 115V........................... .91

SOUND POWER HANDSET

BRAND NEW

Includes 5 ft. cord.—Uses no batteries or external power source.
$18.50 pr

Sound Powered Chest Set RCA— With 24 Ft. Cord
Per Pair
USED $17.60
NEW $26.40



POSTAGE STAMP MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd
10	40	70	125	240	400	680	.0016	.004
20	47	75	135	250	430	800	.002	.0044
22	50	80	150	270	470	820	.0027	.005
23	51	82	160	300	500	910	.0033	.006
24	56	90	175	330	510	.001	.0036	.0065
25	60	100	180	360	580	.0012		.0068
33	62	110	200	370	600	.0013		.0082
39		120	220	390	650	.0015		.01

Price Schedules

10 mmf to 820 mmf............................ 5¢
.001 mmf to .0016............................ 8¢
.002 mfd to .0082 mfd........................ 15¢
.01 mfd...................................... 28¢

SILVER MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
10	50	100	170	360	510	.001	.0024	.0047
18	51	110	180	370	525	.0011	.0025	.005
22	56	115	208	390	560	.0013	.0027	.0051
23	60	120	225	400	570	.0015	.0028	.0056
24	62	125	240	410	680	.0016	.003	.006
25	66	130	250	430	700	.0018	.0033	.0068
27	68	135	255	470	800	.0022	.0039	.004
30	75	150	260	488	900	.0023	.004	
40	82	155	270	500				

Price Schedule

10 mmf to 700 mfd............................ 10¢
.0011 mfd to .002 mfd........................ 20¢
.0022 mfd to .0082 mfd....................... 50¢

PULSE TRANSFORMERS

UTAH—9262 9278 9280 9340
WESTERN ELECTRIC—D166173 D161310
KS8696, KS9800, KS9862, KS13161
GENERAL ELECTRIC—80-G-5
JEFFERSON ELECTRIC—C-12A-1318
DINION COIL—TR1048 TR1049
also 352-7250-2A; 352-7251-2A; T-1229621-60

COAXIAL CABLE CONNECTORS

15¢ UG175/U	$1.20 83-1F	30¢ 83-1AP	75¢ 83-1J	40¢ SO-239	12¢ HOOD

83-1AC	$0.42	UG-23/U	$1.20	UG-175/U	$0.15
83-1AP	.30	UG-23B/U	1.90	UG-176/U	.15
83-1F	1.20	UG-23C/U	1.90	UG-185/U	1.20
83-1H	.12	UG-24/U	1.30	UG-224/U	1.35
83-1HP	.25	UG-25/U	1.35	UG-255/U	2.45
83-1J	.75	UG-27/U	1.30	UG-260/U	1.20
83-1R	.40	UG-27B/U	3.45	UG-261/U	1.20
83-1RTY	.65	UG-28A/U	3.75	UG-262/U	1.20
83-1SP	.45	UG-30/U	2.30	UG-274/U	2.75
83-1SPN	.50	UG-57B/U	2.30	UG-290/U	1.20
83-1T	1.30	UG-58/U	.80	UG-291/U	1.25
83-2AP	1.95	UG-58A/U	1.15	UG-306/U	2.95
83-2J	2.10	UG-59A/U	2.25	UG-499/U	1.25
83-2R	1.70	UG-83/U	1.95	UG-625/U	1.35
83-22AP	1.40	UG-85/U	1.75	CW-123A/U	.50
83-22R	.68	UG-87/U	1.60	M-358	1.30
83-22SP	.90	UG-88/U	1.10	M-359	.30
83-168	.15	UG-89/U	1.35	PL-258	.75
83-185	.15	UG-102/U	.90	PL-259	.45
UG-13/U	1.70	UG-103/U	.68	PL-259A	.50
UG-21/U	.95	UG-104/U	1.40	PL-274	1.20
UG-21B/U	1.35	UG-106/U	.12	SO-239	.40
UG-22/U	1.30	UG-146/U	2.55		
UG-22A/U	1.60	UG-167/U	5.70		

NEW COAXIAL CABLES

	Price per 1000 Ft.		Price per 1000 Ft.
RG 5/U*......	$140.00	RG 22/U*.....	$150.00
RG 6/U.......	180.00	RG 22A/U....	285.00
RG 7*........	85.00	RG 24........	675.00
RG 8*/U......	100.00	RG 26/U......	475.00
RG 9*/U......	250.00	RG 29*.......	50.00
RG 9A/U......	275.00	RG 34/U......	300.00
RG 10........	240.00	RG 35........	900.00
RG 11*/U.....	100.00	RG 41*/U.....	295.00
RG 11A/U*....	150.00	RG 54A/U.....	97.00
RG 12........	240.00	RG 55*.......	110.00
RG 13*/U.....	216.00	RG 57*/U.....	325.00
RG 17........	650.00	RG 58*.......	60.00
RG 18/U......	900.00	RG 58A/U*....	65.00
RG 19........	1250.00	RG 59*.......	55.00
RG 20/U......	1450.00	RG 62*.......	75.00
RG 21........	220.00	RG 77*.......	100.00

Add 25% for orders less than 500 feet.
* No minimum order—others 250′ minimum.

UNIVERSAL JOINT ALUMINUM

¼" hole x ½" O.D.
1⅛" long **85¢**

SPAGHETTI SLEEVING—assortment—99 feet.....$1.00

TYPE "J" POTENTIOMETERS

100 S.S.*	1,500 1/4S.S.	15K 1/4	200K S.S.*
150 S.S.	2,000 1/4	25K S.S.	250K 5/8
300 S.S.*	2,500 S.S.	70K S.S.	250K S.S.*
400 S.S.	3,000 3/8	80K S.S.	500K S.S.*
500 S.S.	4,000 3/8	100K 7/16	1Meg S.S.
1,000 3/8	5,000 3/4*	100K S.S.*	
1,000 S.S.	10K 5/8	200K 5/8	

*Split Locking Bushing **$1.25 EACH**

TYPE "JJ" POTENTIOMETERS

Ohms	Shaft	Ohms	Shaft	Ohms	Shaft
1000	S.S.	30K-10K	3/8"†	1 Meg.	1/2"
10K	5/16"	3K-90K	1/4"	1 Meg.	S.S.
15K	S.S.			1 Meg.	S.S.

SD—Screw Driver
*—Split Locking Bushing
†—With Switch

PRICE—$2.00 EACH

JONES BARRIER STRIPS

2—140Y	$0.17	3—141W	$0.27	9—141Y	$0.71
3—140¾W	.21	4—141	.24	3—142	.24
6—140	.28	5—141	.29	2—150	.43
10—140W	.59	5—141¾W	.41	3—150	.60
10—140¾W	.59	7—141¾W	.56		
3—141¾W	.27	8—141¾W	.64		

TIME DELAY RELAY

Raytheon CPX 24166
1 Min. Delay. 115 V., 60 Cycle

2½ second recycling time spring return • Microswitch contact, 10A • Holds ON as long as power is applied • Fully Cased •
ONLY $6.50

AN CONNECTORS
IMMEDIATE SERVICE
PHONE! WIRE! WRITE! YOUR NEEDS

PRECISION RESISTORS—¼ WATT—30¢

2	10.48	12.32	14.98	62.54	147.5	705
2.5	10.84	13.02	15.8	79.81	220.4	2,193
3.5	11.25	13.52	16.37	105.8	301.8	3,500
5	11.74	13.89		123.8	366.6	
6.68				125	414.3	59,148

PRECISION RESISTORS—½ WATT—35¢

.25	11.1	75	400	6,500	16,000	36,000
.334	13.15	87	723.1	7,000	16,700	37,000
.444	13.3	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		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	61	260	4,451	15,000	32,888	100,000
3.25	65	270	5,714	15,750	33,000	180,000
5.26	66.6	290	5,900	15,755	33,300	
5.89	69	298.3		15,810	35,888	

PRECISION RESISTORS—1 WATT—45¢

.1	2.55	15	60	425	7,000	55,000
.11	2.58	18	80	1,530	8,250	56,000
.2	2.6	28	125	2,215	9,000	65,000
.31	2.66	30	250	2,250	10,000	68,000
.861		38	270	2,550	12,000	70,000
1.01	3.39	45.5	312	3,300	50,000	84,000
1.166	5.21	54.25	420	5,221		95,000

PRECISION RESISTORS—1 WATTS—60¢

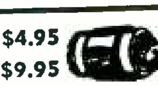
100,000	149,500	270,000	348,000	590,000
105,000	150,000	296,000	399,000	600,000
120,000	240,000	310,000	413,000	645,000
128,000	260,000	320,000	520,000	650,000
130,000			522,000	700,000
132,000				800,000

MEGOHM 1 WATT 1%—$1.50; 5%—60¢

PRECISION RESISTORS—2 WATT—75¢

4,385 5,000 6,000 10,000 19,917

DIFFERENTIAL Used $4.95 New $9.95

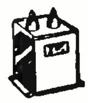


115 V., 60 Cycle #C78249

3⅜" dia. x 5⅜" long
Used between two C78248's as a dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted)..........$5.50
Mounting Brackets—Bakelite for selsyns, and differentials shown above..............35¢ pair

OIL FILLED CONDENSERS

MFD	V.D.C.	Price	MFD	V.D.C.	Price
5.2	50	$0.35	.25	3,000	$2.25
6	400	.85	1	3,600	3.95
3 x 3	400	1.00	3 x .2	4,000	2.50
4	500	.85	2	4,000	6.95
4-4	500	1.30	3	4,000	7.95
8	500	1.35	.01	5,000	.95
1	600	.45	.01-.03	6,000	1.40
.5-.5	600	.40	.03-.03	6,000	1.50
2	600	.80	1	6,000	9.95
4	600	1.63	.02-.02	7,000	1.55
8	600	2.05	.02-.03	7,000	1.60
10	600	2.95	.1	7,000	1.95
4 x 3	600	1.75	.1-.1	7,000	2.25
8-8	600	1.79	.1	7,500	2.25
1	800	.60	.3-.3	7,500	4.50
1	1,000	.75	.075-.075	8,000	1.85
2	1,000	.95	.15-.15	8,000	2.95
3	1,000	1.70	.25	20,000	19.95
6	1,000	2.75			
8	1,000	3.25			
1	1,500	1.45			
.02	2,000	.65			
.1-.1	2,000	1.30			
.1-.5	2,000	1.65			
3	2,000	3.75			
8	2,000	7.95			



1 mfd 6,000 V.D.C. G.E.
$9.95

OIL FILLED A.C. CONDENSERS

MFD	V.A.C.	Price	MFD	V.A.C.	Price
.2	750	$0.69	15	440	$6.25
8	660	7.50	4.4	375	2.15
6	660	5.95	25	330	7.50
5	660	5.45	20	330	6.75
	660	4.95	4	330	2.25
3	660	4.45	3	330	1.45
2.9	660	4.35	1.75	330	.85
2	660	3.95	20	220	4.95
1	660	2.95	7.5	220	2.00

1N34 Crystal Diode ....79¢

300 Twin Lead.............02½ per ft. $18.95 per M

Dynamotor DM 33A ....$3.75 ea.

Chokes: 30 Hy. 80MA @...$1.29; 6HY. 80 MA @...79¢

Power Tap Switch—OHMITE (#312-5 Taps) non-shorting 25A 150 V. A.C.......................$3.95

Timer—Industrial Timer Corp. 15 min. on 15 min. off continuous 115 V. A.C. Fully cased Plugs into octal socket $5.50

BC 221 FREQUENCY METER....................$80.00

Mike Connector Amphenol 80-81 Interchangeable with Amphenol 80-M cad plated.......................25¢

2J1G1 SELSYNS $8.95

400 CYCLE BRAND NEW

Minimum Orders $3 All orders f.o.b. PHILA., PA.

RELIANCE MERCHANDIZING CO.

Arch St. Cor. Croskey Phila. 3, Pa. Telephone Rittenhouse 6-4927

PE 218 LELAND ELECTRIC

Output: 115 VAC; Single Phase; PF 90; 380/500 cycle 1500 VA. **Input:** 25-28 VDC; 92 amps; 8000 RPM; Exc. Volts 27.5. **BRAND NEW** .... **$39.95 ea.**

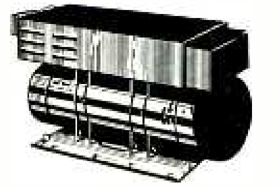
MG 153 HOLTZER-CABOT

Input: 24 V, DC, 52 amps; **Output:** 115 volts—400 cycles, 3-phase, 750 VA, and 26 Volt—400 cycle, 250 VA. Voltage and frequency regulated .... **$95.00 ea.**

PIONEER 12130-3-B

Output: 125.5 VAC; 1.15 amps, 400 cycle single phase, 141 VA. **Input:** 20-30 VDC, 18-12 amps. Voltage and frequency regulated .... **$89.50 ea.**

INVERTERS



10563 LELAND ELECTRIC

Output: 115 VAC; 400 cycles; 3-phase; 115 VA; 75 PF. **Input:** 28.5 VDC; 12 amp. .... **$80.00 ea.**

E-1616-2 EICOR, INC.

100 V.A.; 3 Phase; 115 Volts; 400 Cycle .95 P.F. **Input:** 27.5 Volts, 9.2 Amps; Continuous duty .... **$79.50 ea.**

12116-2-A PIONEER

Output: 115 VAC; 400 cyc; single phase; 45 amp. **Input:** 24 VDC 5 amp..**$90.00 ea.**

10285 LELAND ELECTRIC

Output: 115 Volts AC. 750 V.A., 3 phase, 400 cycle, .90 PF. and 26 volts, 50 amps, single phase, 400 cycle, .40 PF. **Input:** 27.5 VDC, 60 amps, cont. duty, 6000 RPM. Voltage and Frequency regulated.**$195.00**

10486 LELAND ELECTRIC

Output: 115 VAC; 400 Cycle; 3-Phase; 175 VA; .80 PF. **Input:** 27.5 D.C.; 12.5 Amp; Cont. Duty.............. **$90.00 ea.**

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" 100-100, complete with external shunt............. **$5.95 ea.**
AC Volt, Westinghouse, Type NA-35—3-inch round. F.S.-10 MA.......... **$6.95 ea.**
AMP METERS; D.C., 0-300 amps, 3" round type complete with external shunt.**$6.95 ea.**
ELAPSED TIME METER, Aero Instrument Co.—Model 1001. Records operating time of AC electrical and electronic equipment. Registers up to 9,999.9 hours in 1/10th hour increment . . . then automatically resets. Diameter 3½" with glass covered face. 120 VAC; 60 cycle. NEW.**$14.95**

MICROPOSITIONER

Barber Colman AYLZ 2133-1 Polarized D.C. Relay: Double Coil Differential sensitive, Alnico P. M. Polarized field. 24V contacts; .5 amps; 28 V. Used for remote positioning, synchronizing, control, etc....... **$12.50 ea.**

BLACK & DECKER MOTOR AN 94-32159-A; Volts 24; 1 amp; series wound; 12,000 RPM; 1/75 H.P.; Cont. duty; overall size 5-⅜" x 3" dia...**$9.95 ea.**

SYNCHROS

IF Special Repeater (115V-400 Cycle) **$15.00 ea.**
2J1F3 Generator (115-400 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.**
TRANSMITTER, BENDIX C-78248; 115 Volt. 60 Cycle .... **$25.00 ea.**
REPEATER, BENDIX C-78410; 115 Volt, 60 Cycle .... **$37.50 ea.**
REPEATER, AC synchronous 115 V., 60 cycle, C-78863 .... **$15.00 ea.**
7G Synchro Generator (115/90 volt; 60 cycle) **$75.00**
6G Synchro Generator (115/90 volt; 60 cycle) **$60.00**
6DG Synchro Differential Generator (90/90 volt; 60 cycle) **$60.00**
2J5F1 Selsyn Control Transformer: 105-55 Volts; 60 Cycle.................. **$50.00**
2JD5J2 Selsyn Motor: 115-90 Volts; 60 cycle **$50.00**
2JD5HA1 Selsyn Generator: 115-105 Volts; 60 cycle **$50.00**
2J1F1 GENERATOR; 115—57.5 Volt; 400 cycle .... **$12.50 ea.**
2J1H1 DIFFERENTIAL GENERATOR; 57.5—57.5 Volt; 400 cycle........... **$12.50 ea.**
2J1G1 CONTROL TRANSFORMER; 57.5—57.5 Volt; 400 cycle............... **$7.50 ea.**

SYNCHRONOUS SELSYNS

110 volt, 60 cycle, brass cased, approx. 4" dia. x 6" long. Mfg. by Diehl and Bendix.

Quantities Available.

REPEATERS **$20.00**
TRANSMITTERS **$20.00**

POWER UNIT PU-6/TPS-1

Gasoline driven 2-cycle engine. Dual voltage generator; 120 VAC; 1400 watt; 400 cycle; 28 VDC; 14.3 amp.
BRAND NEW **$295.00**

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.**

400 CYCLE MOTORS

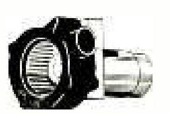
AIRESEARCH: 115V; 40 CPS; Single phase; 6500 RPM; 1.4 amp; Torque 4.6 in. oz.; HP .03..................... **$10.00 ea.**
EASTERN AIR DEVICES TYPE JM6B: 200 VAC; 1 amp; 3 phase; 400 cycles, 6000 RPM........................ **$12.50 ea.**
EASTERN AIR DEVICES, TYPE J31B: 115 V. 400-1200 Cycle, Single Phase **$12.50 ea.**
AIRESEARCH: AC Induction, 200 V; 3 Phase, 400 Cycle, 2 H.P., 11,000 RPM; 8 amps........................... **$79.50 ea.**
AIRESEARCH: AC Induction, 200 V; 3 Phase, 400 Cycle, .12 H.P., 6500 RPM; 1.5 amps **$25.00**
Electric Motor: PNT—1400—A1—1A Serial No. 207, 208 V., 400 cycles, 3 phase, Kearfott Co., Inc. .... **$17.50 ea.**

SERVO MOTOR 10047-2-A; 2 Phase; 400 Cycle; with 40-1 Reduction Gear $10.00 ea.

BLOWER ASSEMBLY

115 Volt, 400 Cycle. Westinghouse Type FL, 17CFM. complete with capacitor. New .... **$12.50 ea.**

BLOWER

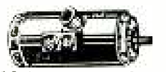


Eastern Air Devices, Type J31B: 115 volt; 400-1200 cycle; single phase; variable frequency; continuous duty; L & R #2 blower; approx. 22 cu. ft./min. **$15.00**

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.

GENERATORS



Eclipse-Pioneer: 716-3A (Navy Model NEA-3A) OUTPUT: 115 VAC; 10.4 amps; 800 cycle; single phase; 28.6 VDC; 60 amps @ 2400 rpm; spline drive; self exciting; wt. 60#.
BRAND NEW in original box..... **$39.95 ea.**

SMALL DC MOTORS

(Approx. size....4" long x 1¼" dial.)
General Electric Type 5AB10AJ37; 27 volts, DC; .5 amps. 8 oz inches torque; 250 RPM; shunt wound; 4 leads; reversible..**$12.50 ea.**
General Electric. Mod. 5BA10FJ33; 12 oz. inches torque, 12 V DC, 56 RPM, 1.02 amp. **$15.00 ea.**
General Electric-Type 5BA10AJ52C; 27 volts, DC; .5 amps, 8 oz inches torque; 145 RPM; shunt wound; 4 leads; reversible **$12.50 ea.**
General Electric Type 5BA10AJ18D; (27 volts DC; 1 oz. foot 110 r.p.m.; 0.7 amp. **$19.95**

ALNICO FIELD MOTORS

(Approx. size overall) . . . 3¾" x 1¼" diameter)
Delco-Type 5069230: 27.5 volts; DC; 145RPM **$19.95 ea.**
PM Motor, Delco Type #5069370: 27.5 volt; DC Alnico Field; 10,000 r.p.m.; dimensions 1" x 1" x 2" long; shaft extension ½", diameter 0.125" **$12.50**
PM Motor, Diehl Mfg. SS FD6-21: 27.5 volt; DC Alnico Field; 10,000 r.p.m.; dimensions 1" x 1" x 2" long; shaft extension ½" diameter 0.125" **$12.50**

AC CONTROL MOTOR

Diehl Mfg. Co., FPE-25-7, 20 Volts, 2 ph 1600 RPM, .85 amps................ **$15.00**
Diehl Mfg. Co., FPE-25-11: 75 to 115 volts; 11 amps, 60 cycle, 2 phase 2 pole. Low inertia motor, 5 watts output......... **$25.00**
AC CONTROL MOTOR, DIEHL FPE 49-2: 115 Volt; 60 Cycle; .32 Amp; 2 Phase; OUTPUT; 11 Watts; 2 Pole........... **$69.50 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.**

SINE-COSINE GENERATORS

(Resolvers)

Diehl Type FJE43-9 (Single Phase Rotor), Two stator windings 90° apart, provides two outputs equal to the sine and cosine of the angular rotor displacement. Input voltage 115 volts, 400 cycle.......... **$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.**
Arma Resolver Type 213044: equal in size to size 5 synchro; 55-60 cycle; single phase primary, 2 phase secondary............ **$79.50**

SYNCHRONOUS MOTOR

Reuland Electric; 3 phase; 220/440 volt; 1/3rd HP; 60 cycle; 1800 r.p.m.; frame #203; cont. duty; 40° C rise. Star connected; ball bearing; mounted in 1 HP frame **$49.50**

Immediate Delivery

ALL EQUIPMENT FULLY GUARANTEED

All prices net FOB Pasedena, Calif.

C and H Sales Company

BOX 356-X EAST PASADENA STATION • PASADENA 8, CALIFORNIA

COMMUNICATIONS EQUIPMENT CO.

24 VOLT TRANSFORMERS

For operating surplus gear, toy trains, gadgets, etc. Operates from 115V, 60 cy., supplies 24 VAC at 1.2 Amp., herm. sealed and cased .... A Great Buy at Only **$1.49**

RECTIFIER TRANSFORMERS

Pri: 115V. 60 Cy. Sec: 28V/3.1A. 26V/8.4A 7.3V/14A	$12.95
Pri. 210/215/220/225/230/235/240V, 60 Cy., 1 Phase Sec: 11/10/7.5/5VCT @ 35A	$19.50
Pri: 115V 60 Cy. Sec: 20 V @ 10A	3.95
Pri: 115V 60 Cy. Sec: 8.1V @ 1.5A	1.39
Pri: 115V 60 Cy. Sec: 18.5V @ 3.5A	2.79

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps Input

CT75B	600-0-600V/.6A, 2X5VCT/6.2A, 6.3VCT/3A, 6.3V/.3A			$12.95
CTJ5-2-	600VCT/.2A, 5V/6A			5.95
CT-15A	550VCT .085A 6.3V/.6A, 6.3V/1.8A			2.85
CT-164	4200V.002A/12KV Test, 5VCT/3A/12KV Test, 6.3V/0.6A/5400V Test			12.95
CT-341	1050 10 MA,—625V @ 5 MA, 26V @ 4.5A 2x2.5V/3A, 6.3V @ 3A			16.95
CR 825	360VCT	.340A	6.3VCT/3.6, 6.3VCT/3A	3.95
CT-626	1500V	.160A	2.5/12, 30/.100	9.95
CT-071	110V	.200A	33/.200, 5V/10, 2.5/10	4.95
CT-367	580VCT	.050 A	5VCT/3A	2.25
CT-99A	2x110VCT	.010 A	6.3/1A, 2.5VCT/7A	3.25
CT-403	350VCT	.026 A	5V/3A	2.75
CT-931	585VCT	.086 A	5V/3A, 6.3V/6A	4.25
CT-456	390VCT	30 MA	6.3V/1.3A, 5V/3A	3.45
CT-160	800VCT	100 MA	6.3V/1.2A, 5V/3A	4.95
CT-931	585VCT	86 MA	5V/3A, 6.3V/6A	4.95
CT-442	525VCT	75 MA	5V/2A, 10VCT/2A, 50V/200 MA	3.85
CT-720	550-0-550V/250 MA, 6.3V/1.8A			8.95
CT-43A	600-0-600V/.08A. 2.5VCT/6A, 6.3VCT/1A			6.49
CT7-501	650VCT/200 MA, 6.3V/8A, 6.3V/5A			6.49
CT-444	230-0-230V/.085A, 5V/3A, 6V/2.5A			3.49

Filament Transformers—115V50-60 cps input

Item	Rating	Each
FT-674	8.1V/1.5A	$1.10
FT-157	4V/16A, 2.5V/1.75A	2.95
FT-101	6V/.25A	.79
FT-924	5.25V/21A, 2x7.75V/6.5A	14.95
FT-824 7,	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	8.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT-55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V/3A	8.95
FT-986	16V @ 4.5A or 12V @ 4.5A	3.75
FT-38A	6.3/2.5A, 2x2.5V/7A	4.19
FT-A27	2.5V/2.5A, 7V/7A, TAP 2.5V/2.5A, 16KV TEST	18.95
FT-608	6.3V/3A/750V Test	1.79
FT-873	4.5V/.5A, 7V/7A	2.19
FT-899	2x5V A 5A, 29KV Test	24.50

Plate Trans.—115V, 60 cps

Item	Rating	Price
PT-699	300/150V/.05A, 300/150V/.05A	$2.79
PT-302	120-0-120V/350 MA	4.69
PT-108	17,600V/144 MA	120.00
PT-671	62V/3.5A	7.95

Special Fil. Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STF-370	220/440	3x2.5V/5A, 3KV Test 2.5V/15A	$6.95
STF-11A	220V	2x40V/.05A, 2x5V/6A 12.6V/1A	4.49
STF-608	220V	24V/0.6A, 5V/3A, 6.3V/1A, 6.3V/1A	3.45
STF-968	230V	2.5V/6.5A	3.50
STF-631	230V	2x5V/27A, 2x5V/9A	17.59

Special Plate Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STP-613	230V	230/.05A, 230V/.05A	$1.79
STP-409	220/440V	136VCT 3.5A	5.69
STP-815	240/440. 3ph	1310V .67A, 6KV Test	27.50
STP-129	230V	3850V 3.12KVA	42.59
STP-823	137V	222VCT/.3A	2.35
STP-08B	50V	2x750V/.001A	1.79
STP-622	210/220/230	5000V/1A	59.75
STP-945	210/220/230	550-0-550V/.3A	5.95

Special Comb. Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STC-16A	220V	260V/.03A, 100V/1A, 6.3V/4.2A	$4.69
STC-609	220V	220V/3A	6.95

AUDIO TRANSFORMERS

AT201 50L6 output (4000 ohms) to V.C. (3 ohms)	$.40
AT SUB Subouncer, Multimatch, 200 ohms to 15 K ohm C.T. and 100 K ohm Grids	$.69
AT731 H.F. Plate (1500 ohm C.T.) to V.C. (16/4 ohms) 20-15KC	$3.29
AT501 HI-Fi Special:PRI:3000 ohms P-P/Sec:4/16/12/50/200 ohms 60-10,000 CY.—1 db 50W	$3.49
AT152 HI-FI Driver Pri: 10,000 ohms Sec: 40,000 ohms PP Grids 50-15 KC/1 db	$1.49
AT062 Output to H.S. or line PRI: 14,200 ohms SEC: 8000 600 ohms	$1.10
AT449 HI-FI Driver (5000 ohms) to P.P. output grids (4,000 ohms) 100-10,000 CY. 10 W 6V6 to PP 805'S	$2.39
AT666 Intercon Input: Spkr (-4-8 ohms) to grid (250-000 ohms	$0.69

This Month's Special

SA4A/APA-1 Motor Driven Coaxial Ant. Switch DPDT, Continuous Operation from 24VDC. Completely Enclosed	$24.50
MP-22 MAST BASE Mobile Antenna Mount	4.59
SA1A/APN-1 Altitude Limit Switch for APN-1 Altimeter	7.95
ALTITUDE INDICATOR for APN-1	12.50
C-387-D Final P.A. Coil for BC610 2-3.5 MC, Variable Link	4.89
RA-74 Power Supply for Super Pro	69.50
J-17/ARC-5 Junction Box for ARC-5	7.95
J-22/ARC-5 Junction Box	3.49
SUPERSONIC CRYSTALS, Rochelle salt	.50 ea.
MOTOR, 24 vdc. 3 HP 3800 rpm, New	75.00
TV LEAD-IN WIRE, 300 ohms, HI-Q, Lo-Loss	$17.50/M FT Roll
BC 306 ANTENNA TUNING UNIT, NEW	6.95
R9/APN-4, New, With Tubes	75.00
ID6/APN-4, New, With Tubes and Crystal	75.00
A-62 Phantom Antenna	8.50
2 Meter Choke, 1000 MA, 20-144 ....8/	1.00
Supersonic Crystal Head, M-1, 22-27KC HI-2	27.45

G.E. RELAYS

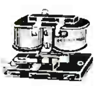
CR2792B116A3

SPST—50 Amp Contacts. Operates from 22-30 VDC. Coil Res. 200 Ohms. Completely enclosed in transparent plastic case, which may be removed for adjustments... **$1.59**

GE#CR2791B116W3

Same as above, except additional terminal brought out from contact arm **$1.74**

GE#CR2791-F100D3

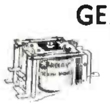


Differential: DPST, Norm. open. Dual coil. 1500 ohms per coil—25 Ma. Operating Current. Contacts: 20 Amp. **$2.25**

GE#CR2791F100G3

Same as above, except has extra 1A contact. Rated 5 Amp **$2.35**

GE#CR2791D101F3



All Ceramic Insulation, DPDT. Coil—12VDC, 100 Ohms DCR. Contacts designed for fast operation. Rated at 5 Amps. **$1.25**

GE#CR2791B106J3

3PDT. 5 Amp contacts. Coil rated 22-30VDC. 150 Ohms DCR. Contacts are designed for fast operation, and enclosed by clear plastic cover **$1.35**

GE#CR2791B106C3

SPDT. Dual Contacts will handle 20 Amps. Coil: 18-28VDC 125 Ohms DCR **$1.25**

THESE RELAYS AVAILABLE IN MFRS. QUANTITIES

DYNAMOTORS

Type	Input Volts	Input Amps	Output Volts	Output Amps	Radio Set
PE86	28	1.25	250	.060	RC 36
DM416	14	6.2	330	.170	RU 19
DM33A	28	7	540	.250	BC 456
PE101C	13/26	12.6	400	.135	SCR 515
		6.3	800	.020	
BD AR 93	28	3.25	375	.150	
23350	27	1.75	285	.075	APN-1
ZA0515	12/24	4/2	500	.050	
B-19 pack	12	9.4	275	.110	MARK 11
			500	.050	
D-104	12		225	.100	
			440	.200	
DA-3A	28	10	300	.060	SCR 522
			150	.010	
			14.5	.5	
5053	28	1.4	250	.060	APN-1
PE73CM	28	19	1000	.350	BC 375
CW21AAX	13	12.6	400	.135	
	26	6.3	800	.020	
			9	1.12	
PE94	28	10	300	.200	SCR 522
			150	.101	
			14.5	.5	

INVERTERS

PE-218-H: Input: 25 28 vdc, 92 amp. Output: 115 v. 350 500 cy 1500 volt-amperes. New	$44.50
PE-206: Input: 28 vdc, 38 amps. Output: 80 v 800-cy. 500 volt-amps. Dim: 13"x5⅜"x10⅜". Bew	$22.50
LELAND No. 10536: IN: 28 VDC, 12A. OUT: 115V, 115VA, 400 CY 3 PHASE. EXC. COND	$70.00

ELECTROLYTIC CAPACITORS

TWIST PRONG

Cap. Mfd	WVDC	Price
8	450	$0.16
30	300	.18
40	450	.38
50	400	.36
60	300	.21
80	150	.29
8-8	450	.24
30-20	25	.16
20-20	150	.23
80-80	300	.21
90-10	350	.21
80-10	450	.49
150-50-25	150	.49
80-10-10-10	300	.21
40-40-20-20	150	.28
30-15-15-15	300	.28
80-10-10-10	350	.32
40/10	450/350	.55
40/20	150/25	.21
40/50	400/300	.28
80/50	450/50	.65
250/1000	10/6	.30
8-8-10	450/25	.26
10-10/10	150/25	.23
10-10/20	450/25	.26
10-15/20	350/25	.18
15-15/10	450/350	.23
80-40/150	400/50	.45
120-60/20	150/25	.45
30-30-15/30	300/50	.39
40-40-20/20	350/15	.28
60-40-20/50	300/25	.28
60-40-20/200	150/10	.39
80-40-30/20	150/25	.36
80-40-30/100]	150/25	.36
8/8/8	475/100/100	.23
10/50/100	350/100/50	.23
10/50/100	450/100/50	.27
20/20/10/20	350/300/300/25	.35

UPRIGHT OIL CAP.

MFD	Each
220VAC/600VDC	
6.2	$1.29
15	3.49
330VAC/1000VDC	
15	3.79
1000VDC	
.5	.69
.5-.5	1.19
1	1.49
4-1.5	2.19
1.5	1.39
1500 WVDC	
1	1.59
1.5	1.59
2	1.79
2000 WVDC	
1	1.79
2500 WVDC	
.5	2.98
4000 WVDC	
.15	6.95
4800 WVDC	
.1-.1	4.79
6000 WVDC	
.1	3.69
.15-.15	3.89
1.5	10.98
7000 WVDC	
.1-.1	3.79
1	9.95
8000 WVDC	
.075-.075	3.79
10K VOC	
.1	8.95
15K VDC	
.0016	7.95
16K VDC	
.015	9.50
20K VDC	
.25	17.50
25K VDC	
1	85.00
.5	65.00

SELENIUM RECTIFIERS

F. W. BRIDGE

UP TO 18 VAC IN—UP TO 14 VOC OUT	
2A	$2.50
4A	4.00
6A	6.00
10A	7.50
12A	9.00
24A	18.00
UP TO 36 VAC IN—UP TO 28 VDC OUT	
1A	$3.00
2A	4.00
5A	10.00
10A	14.50
12A	18.00
24A	36.00
UP TO 54 VAC IN—UP TO 42 VDC OUT	
2A	$6.50
4A	8.50
UP TO 120 VAC IN—UP TO 100 VDC OUT	
2A	$11.00
10A	48.00
12A	60.00

NON-POLAR CAPACITORS

A.C. ELECTROLYTICS

CAP.	VAC.	PRICE
13-15	220-	$1.20
20-24	110-	1.00
26-30	220-	1.35
43-65	110-	1.25
43-48	110-	1.25
50-75	110-	1.25
53-60	220-	1.50
61-69	320-	1.60
64-72	110-	1.25
72-87	110-	1.25
75-84	110-	1.25
88-106	110-	1.50
107-129	110-	1.65
130-157	110-	1.75
130-150	70-	1.50
130-180	110-	1.85
158-191	110-	1.85
161-180	110-	1.75
189-210	110-	1.95
200-220	110-	1.95
270-300	110-	2.10
324-360	110-	2.40
378-420	175-	3.00
432-480	110-	2.75
485-540	110-	2.85

FILTER CHOKES

Stock	Description	Price
CH-366	20H/.3A	$6.95
CH-322	.35H/350 MA—10 Ohms DCR	2.75
CH-141	Dual 7H/75 MA, 11H/60 MA 5KV DC Test	4.69
CH-119	8.5H/125 MA	2.79
CH-69-1	Dual; 120H/17 MA	2.35
CH-8-28	2 x .5H/380 MA/25 Ohms	1.79
CH-776	1.28H/130 MA/75 ohms	2.25
CH-344	1.5H/145 MA/1200V Test	2.35
CH-43A	10HY/15 MA—850 ohms DCR	1.75
CH-917	10H, 450 MA, 10KV TEST	12.95
CH-366	20H/300 MA	6.95
CH-999	15HY/15 MA—400 ohms OCR	1.95
CH-511	6H/80 MA—310 ohms DCR	2.45
CH3-501	2x5H/400 MA	2.79
CH-188M	5HY 200 MA	1.79
CH 303	300H/.02A, 2500V Test	1.69
CH 932	SWING 9-60H/.4-.05A, 10KV	7.95

UNIVERSAL SUPPLY KIT

Delivers 230V @ 40MA DC. From 110/220VAC. 60 Cy. Kit consists of 1-tTX Transformer, 1-5 Hy @ 40MA Choke, 2-8MFD @ 450V Filter Cond. 1-6x5 Tube. A great buy at only **$3.95**

INTERPHONE AMPLIFIER

Easily converted to an ideal Inter-Communications set for office, home or factory. Original. New w/conversion diagram **$4.75**

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COMMUNICATIONS EQUIPMENT CO.

PULSE TRANSFORMERS

D-166173: Video, Ratio = 50:900 Ohms 10KC—2MC $12.50
G.E.K.-2745 .... $39.50
G.E.K.-2744-A. 11.5 KV High voltage, 3.2 KV Low voltage @ 200 KW oper. (270 KW max.) 1 microsec. or 1/microsec. @ 600 PPS....... $39.50
W.E. D169271 Hi Volt input pulse Transformer..$27.50
G.E. K2450A. Will receive 13KV, 4 micro-second pulse on pri. secondary delivers 14KV. Peak power out 100 KW G. E. $34.50
G. E. K2748A. Pulse Input line to magnetron....$36.00
Ray UX 7896—Pulse Output Pri. 5v. sec. 41v $7.50
Ray UX 8442—Pulse inversion—40v + 40v......$7.50
Ray UX 7361 .... $5.00
PHILCO 352-7250, 352-7251, 352-7287
UTAH 9332, 9278, 9341.
RAYTHEON: UX8693, UX5986 .... $5 ea.
W.E.: D-166310, D-16638, KS 9800, KS9948

PULSE EQUIPMENT

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

DELAY LINES

D-168184: 0.5 microsec. up to 2000 PPS 1800 ohm term $4.00
D-170499: 25 .50/.75 microsec. 8 KV 50 ohms imp. $16.50
D-165997: 1¼ microsec. $7.50
RCA 255686-502, 2.2μ sec. 1400 ohms....... $2.00

PULSE NETWORKS

G.E. #6E3-5-2000-50P2T. 6KV "E" circuit, 3 sections .5 microsecond. 2000 PPS 50 ohms impedance $6.50
15A—1-400-50: 15 KV, "A" CKT. 1 microsec. 400 PPS. 50 ohms imp. $37.50
G.E. #3E (3-84-810) (8-2-24-405) 50P4T; 3KV "E" CKT Dual Unit: Unit 1, 3 sections, 0.84 Microsec. 810 PPS. 50 ohms imp.: Unit 2, 8 Sections, 2.24 microsec. 405 PPS. 50 ohms imp. $6.50
7-5E3-1-200-67P. 7.5 KV "E" Circuit, 1 microsec. 200 PPS. 67 ohms impedance 3 sections....... $7.50
7-5E4-16-60, 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
#755: 10KV, 2.2usec., 375 PPS. 50 ohms imp...$27.50
#754: 10KV, 0.85usec., 750 PPS. 50 ohms imp...$27.50

400 CYCLE TRANSFORMERS

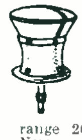
(All Primaries 115V. 400 Cycles)

Stock	Ratings	Price
352-7039	640VCT @ 250MA, 6.3V/.9A, 6.3V/6A, 5V/6A	$5.49
702724	9800/8600 @ 32MA	8.95
12033	4540V/250MA	17.50
KS9584	5000V/290MA, 5V/10A	22.50
52J652	13,500V/3.5MA	14.65
KS9607	734VCT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3V/0.9A, 6.3V/2.5A 6.3/.06A, 5V/CA	6.95
352-7070	2X2.5V/2.5A (2KV TEST) 6.3V/2.25A, 1200/1000/75 OV @ .005A	7.45
352-7196	1140V/1.25MA, 2.5V/1.75A, 2.5V/1.75A —5KV Test	3.95
352-71 6	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/.06A, 6.3VCT/21A	4.25
KS 8984	27V/4.3A. 6.3/2.9A. 1.25V/.02A	2.95
52C080	526VCT/50MA, 6.3VCT/2A, 5VCT/2A	3.75
32332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
68G631	1150-0-1150V	2.75
80G198	6VCT/.00006 KVA	1.75
302433A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.5A, 2.5V/3.5A	4.85
KS 9445	592VCT/118MA, 6.3V/8.1A, 5V/2A.	5.39
KS 9685	6.4/7.5A, 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/.092A, 465V/.6A, 44V/10A, 6.3V/23.5A, 6.3V 1.3A, 5V/9A, 2X2.5V/1.75	17.95
TRANSATIN:	115V, 400 CY. OUT: 75-120V, 6.0 Amps	12.95

TEST EQUIPMENT

● Signal Gen.	RCA 710A, 370-560 MC	350.00
● Signal Gen.	20A Microvolter	175.00
● TS 10A	Altimeter Test Set	32.50
● TS 16/AP	Altimeter Test Set	
● TS 36	Power Meter, 3 CA1	
● TS 47/APR	Test Osc. 50-3000 MC	325.00
● TS 56/AP	Slotted Line, 500 MC	325.00
● TS 127/UP	Wavemeter, 300-700 MC	72.50
● TS 69/AP	Wavemeter, 340-1000 MC	72.50
● TS 70/AP	Pwr. Meter, 200-800 MC	
● TS 110/AP	Echo Box, 2400-2700 MC	

MICROWAVE ANTENNA EQUIPMENT



AT49A/APR — Broadband Conical 300-3300 MC. Type N Feed (AS SHOWN) $12.50
AS-31/APN-7: 10 cm. Polyrod in Lucite Ball. Type N. Fitting Coax Feed.$22.50
Relay System Parabolic reflectors approx. range 2000 to 6000 Mc. Dimensions 4 ½" x 3'. New $100.00
Dipole for above $12.00
TDY "JAM" Radar rotating antenna, 10 cm. 30 deg. beam, 115 V AC drive. New....... $350.00
Parabolic Peel. Radiation pattern approx. 25 deg. in horizontal, 33 deg. in vertical planes....... $35.00
Cone Antenna. AS 125 APR. 1000-3200 mc. Stub supported with type "N" connector....... $14.50

30' SIGNAL CORPS RADIO MASTS

Complete set for erection of a full flat top antenna. Of rugged plymold construction telescoping into 3 ten-foot sections for easy stowage and transportation. A perfect set-up for getting out. Supplied complete: 2 complete masts, hardware, shipping crate. Shipping wt. approx. 300 lbs. Sig. Corps No 2A289-223-A. New .... $49.50 per set
AS14A/AP, 10 CM pick up dipole assy, complete w/length of coax and "N" connectors....... $3.50
AS46A/APG-4 Yagi Antenna, 5 element array..$22.50
30" Parabolic Reflector Spun Aluminum dish....$4.85

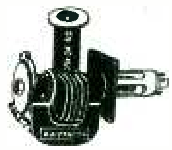
10 CM GUN-SIGHT ANTENNA

Spherical Radome House Drive Motor, Dish, Feed and Gunmount. TOTAL DIAMETER: Approx. 15 inches. DISH: 13" Diam. FEED: Dipole and disk vertex. SCAN: Conical at 2400 RPM. BEAMWIDTH: 25°-30°. Entire unit may be pressurized up to 15 lbs/in., and energy may be fed by any flexible coax. cable. Complete unit with drive-motor and radome $325.00

• AN/APS-2	Airborne S Band Radar
• AN/APS-3	Airborne 3CM Radar
• AN/APS-4	3CM Airborne Radar
• RU/GF	Complete Airborne Xmtr-Revr $99.50
• SO-1	1CCM SEA Radar, 115VDC
• SN	1CCM Portable Radar, 115V, 60 Cy.
• PP-4/APQ-2	DC Power Supply from 400 Cy. $65.00
• MK 10	10CM Gun Laying Radar
• MK IV	800MC Gun Laying Radar
• SO-8	10CM Radar 115V DC
• CPN-8	10CM NAV. Beacon, Ground Sta.
• SG	10CM Heavy Duty Ship Radar
• AN/APN4	Loran Set, Airborne
• AN/APN-3	Shoran, Xmtr. only
• SE	10 cm Surface Search Radar
• RA-30	H.V.P. Power Supply
• AN/APN-7	Airborne Beacon, 10CM.
• BM or BG	IFF Sets, 115VAC

MAGNETRONS

Tube	Tube	Tube
2J27	2J49	720BY
2J31	2J61	725-A
2J21	700	730-A
2J22	706	QK 62
2J26	2J62	QK 61
2J32	3J31	QK 60
2J37	5J30	2J56
2J38	718DY	2J32
2J39		



THERMISTORS VARISTORS

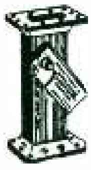
D167018	$1.50	D171812	$1.50
D167332	1.50	D172155	1.50
D167613	1.50	D167176	1.50
D166228	1.50	D168687	1.50
D164699	2.50	D167208E, D171858	1.50
D163903	1.95	308A, 3A, 27-B	1.50
D166792	2.15	D168403	2.15

RADAR TRAINER

Bench set designed for training personnel in use of ABS radars, or any sets using "B" presentation. Simulates convoy, ship, land, sea return with adjustable amplitude, range and azimuth. Brand new, in original cases, complete with all cables and instruction book $325.00

MICROWAVE COMPONENTS

S BAND—3" x 1½" W.G. 10 CM.



DIRECTIONAL COUPLER, Broadband, 20 db. Coupling, Type "N" Takeoff. Complete with all Hardware. Navy = CABV 47AAN-2. As shown. $37.50
WAVEMETER, 2700-3400 MC. Reaction Type with counter Dial — Mfg., W.E. $92.50
REACTION WAVEMETER, Mfg. G.E. 3000-3700 MC. Mic. Head....$125.00
LHTR LIGHTHOUSE ASSEMBLY. Part of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG To Recvr. Uses 2C40, 2C43, 1B27. Tunable APX 2400-2700 MCS. Silver Plated....... $49.50
BEACON LIGHTHOUSE cavity 10 cm. for APN-19 Mfg. Bernard Rice, each $25.00
MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated....... $45.00
RT-39/APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr.-TR cavity, compl. recvr. & 30 MC IF strip using 6AK5 (2040, 2C43 1B27 lineup) w/Tubes.
721A TR BOX complete with tube and tuning plungers $12.50
McNALLY KYLSTRON CAVITIES for 707B or 2K28 .... $4.00
F 29/SPR-2 FILTERS, type "N" input and output Hi-Pass Over 1000 MC....... $12.50
WAVEGUIDE TO ⅞" RIGID COAX "DOORKNOB" ADAPTER CHOKE FLANGE, SILVER PLATED BROAD BAND $32.50
AS14A/AP-10 CM Pick up Dipole with "N" Cables $4.50
OAJ ECHO BOX, 10 CM TUNABLE....... $22.50
HOMEDELL-TO-TYPE "N" Male Adapters, W.E. #D167284 .... $2.75
I. F. AMP STRIP: 30 MC, 120 d.b. gain, 2 MC Bandwith, uses 6AC7's—with video detector. Less tubes $24.50
POLYROD ANTENNA, AS31/APN-7 in Lucite Ball. Type "N" feed $22.50
ANTENNA, AT49A/APR: Broadband Conical, 300-3300 MC Type "N" Feed....... $12.50
"E" or "H" PLANE BENDS, 90 Deg. less flanges $7.50

⅞" RIGID COAX—⅜" I. C.

RIGHT ANGLE BEND, with flexible coax output pick-up loop $8.00
SHORT RIGHT ANGLE BEND, with pressurizing nipple $3.00
RIGID COAX to flex coax connector....... $3.50
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
⅞" RIGID COAX. BULKHEAD FEED THRU....$11.00

X BAND—1" x ½" W.G. 3 CM.

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
Bulkhead Feed-thru Assembly $15.00
Pressure Gauge Section 15 lb. gauge and press nipple $10.00
Pressure Gauge, 15 lbs. $2.50
Dual Oscillator. Mount. (Back to back) with crystal mount, tunable termination attenuating slugs.$18.50
Directional Coupler, UG-40/U Take off 20 db...$17.50
TR-ATR Duplexer section for above....... $8.50
Waveguide Section 12" long choke to cover 45 deg. twist & 2¼" radius, 90 deg. bend....... $4.50
Twist 90 deg. 5" choke to cover w/pres 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. mitered elbow "E" plane....... $12.00
UG 39 Flanges .... $ .85
90 degree elbows, "E" or "H" plane 2½" radius.$12.50
45 degree twist $8.00
APS-4 Under Belly Assembly, less tubes.....$375.00

1¼" x ⅝" WAVEGUIDE

CG 98B/APQ 13 12" Flex. Sect. 1¼" x ⅝" OD..$10.00
X Band Wave GD. 1¼" x ⅝" O.D. 1/16" wall aluminum .... per ft. 75c
Stug 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" W.G. 1.25 CM.

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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FROM A to Z POWELL SERVICE IS BEST

AN Connectors—over 2500 different types in stock. Write for new four page reduced price list. World's best service on AN connectors, Liberal Discount!

BATTERY—BA 210—6V dry cell dated Nov. 1951, orig. cases guar......$.49
BA35—same except 1½V ....$.44

COAXIAL Connectors—stock delivery, C of C, NEW LOW PRICES.

No.	Group	Type	Price
UG 9/U	N	P	$1.11
UG 12/U	N	P	.95
UG 18 B/U	N	P	1.08
UG 19 B/U	N	S	1.59
UG 20 B/U	N	J	1.61
UG 21/U	N	P	.95
UG 21A/U	N	P	1.76
UG 21B/U	N	P	1.19
UG 21C/U	N	P	1.54
UG 21D/U	N	P	1.42
UG 22A/U	N	S	1.97
UG 22B/U	N	S	1.50
UG 22C/U	N	S	1.40
UG 23/U	N	J	1.20
UG 23C/U	N	J	1.58
UG 23D/U	N	J	1.89
UG 24U	N	P	.90
UG 25U	N	S	.90
UG 27U	N	B	1.30
UG 27A/U	N	B	2.25
UG 27B/U	N	B	3.15
UG 27C/U	N	B	3.75
UG 28A/U	N	T	3.75
UG 29/U	N	A	1.40
UG 29B/U	N	A	1.65
UG 30/U	N	A	2.50
UG 57B/U	N	A	1.72
UG 58A/U	N	R	1.12
UG 58/U	N	R	.78
UG 59A/U	HN	P	2.15
UG 59/U	HN	P	1.49
UG 59B/U	HN	P	2.45
UG 60A/U	HN	J	1.51
UG 83/U	UHF-N		1.75
UG 85/U	BN	P	1.70
UG 87/U	BN	R	1.50
UG 88/U	BNC	P	.90
UG 88 B/U	BNC	P	1.09
UG 89/U	BNC	J	1.10
UG 90/U	BNC	S	1.13
UG 91 A/U	N	P	2.11
UG 92 A/U	N	J	2.74
UG 93 A/U	N	S	1.63
UG 94 A/U	N	P	1.68
UG 96 A/U	N	S	1.53
UG 97 A/U	LN	B	3.75
UG 98 A/U	LN	R	3.15
UG 100A/U	LN	P	3.36
UG 101A/U	LN	S	4.00
UG 102/U	Twin	P	.84
UG 103/U	Twin	R	.84
UG 105/U	Twin	A	1.40
UG 106/U	Hood		.15
UG 107B/U	N	T	3.75
UG 108A/U	LN-N		3.25
UG 109A/U	LN	A	3.67
UG 110/U	SKL-N		13.50
UG 115/U	BN	J	1.65
CW 123A/U	BNC	CAP	.45
UG 131/U	SKL-N		7.50
UG 146/U	UHF-N		1.99
UG 160A/U	N	S	2.20
UG 166/U	Pulse	P	32.50
UG 167A/U	N	P	3.48
UG 171/U	UHF-B		2.50
UG 173/U	UHF	U	.29
UG 175/U	UHF	U	.14
UG 176/U	UHF	U	.14
UG 180A/U	Pulse	P	5.95
UG 181A/U	Pulse	J	5.65
UG 182A/U	Pulse	P	5.65
UG 185/U	BNC	R	.99
MX 195/U	Hood		.89
UG 201/U	BNC-N		2.25
J 201	SKL	T	4.50
UG 203/U	UHF	P	.75
UG 206/U	BN	R	1.45
UG 212A/U	HN	B	3.25
UG 213A/U	LN-N		3.99
UG 215/U	LC	A	3.85
UG 224/U	UHF	A	1.15
SO 239	UHF	R	.40
UG 242/U	BN	T	4.27
UG 245/U	BN	P	2.25
UG 252/U	HN	A	5.25
UG 254A/U	BNC	R	2.66
UG 255/U	UHF-BNC		1.98
PL 258	UHF	A	.73
PL 259	UHF	P	.47
PL 259A	UHF	P	.58
UG 260/U	BNC	P	.89
UG 261/U	BNC	J	1.10
UG 262/U	BNC	S	1.06
UG 271/U	LC-N		7.55
UG 273/U	UHF-BNC		1.49
PL 274	UHF	A	1.10
UG 274/U	BNC	T	2.31
PL 275	Twin	A	2.10
UG 275/U	SKL	P	5.50
UG 276/U	SKL	B	9.00
UG 290/U	BNC	R	.90
UG 291/U	BNC	S	1.05
UG 296/U	UHF	R	3.75
UG 306/U	BNC	B	2.75
UG 309/U	BNC-HN		3.29
UG 333/U	HN	J	4.90
UG 335/U	BNC-N		3.95
UG 342/U	BN	B	2.95
UG 349/U	BNC-N		2.70
UG 352A/U	LC	R	6.40
M 358	UHF	T	1.50
M 359	UHF	B	.30
UG 413/U	HN	T	42.00
UG 414/U	BNC	A	1.95
UG 421/U	Twin	P	2.86
UG 422/U	Twin	R	2.86
UG 423/U	Twin	S	5.40
UG 483/U	N	J	3.49
UG 495/U	HN	P	6.40
UG 496/U	HN	R	2.95
UG 535/U	BNC	R	1.98
UG 536/U	N	P	1.54
UG 564/U	N-C		2.40
UG 565/U	C-N		2.61
UG 566/U	C	T	9.65
UG 567/U	C	B	5.02
UG 568/U	C	R	1.60
UG 569/U	C	R	1.95
UG 570/U	C	S	1.85
UG 571/U	C	S	3.11
UG 573/U	C	P	2.72
UG 625/U	BNC	R	1.05
UG 631/U	C	S	3.85
MX913/U	CAP		.49
1PC2250	plug-in		.39
1PC2350	socket		.39
1PC9175	cable ter		.39
1PC27000	BNC	HV	2.49
1PC28000	BNC	HV	2.49
MC-10		P	.30
MC-20		R	.46
MC-210		R	.53
MC-250		P	.53

Type Letter Definition
A–Adapter Straight R–Panel Receptacle
B–Adapter Angle S–Cable Panel Jack
J–Cable Jack T–Adapter Tee
P–Cable Plug U–Bushing

DIFFERENTIAL, Gear 643268, 1 13/16" OD x 1 ¾" shaft w two ball bearings, our #658 ....$3.95
DIFFERENTIAL, Dual, 206832, probably part of a gun director unit, add four pieces of information and give sum. Only 1¼" O. D. by 3 ⅜" long. Cost about $200. New in overseas pack. ONLY $5.50

EZY-MOUNT—Breadboard chassis in stock with individual mounts for various components, Kit EM666....$19.95

FILTER, Line—D170738, 60 db att. 150 KC to 30 MC—Permalloy torridal coils herm sealed, tiny, rated 10 AMP. $2.95

GEAR DRIVE—5:1—Crowe 296 tiny planetary, ¼" to ¼" — reg. $6.00. Sale $2.90

HEADER—8 different color seals, Fusite, 267535, 1"x1"x5/16, for herm. sealed relays transformers, etc.....$.22 Many others in stock, write for list.

INSULATORS—Pillar, ceramic glazed, tapped both ends.

Dia.	High	Tap	Price
1/4"	1/2"	6–32	$ .05
1/2"	1/2"	6–32	.05
3/8"	1 2"	6–32	.05
cone	9 16	6–32	.09
3/8"	5/8"	8–32	.05
3 8"	5 8"	6–32	.05
3/8"	1"	6–32	.07
1/2"	1 1/2"	8–32	.08

Mfd.	Volt	Type	Dia.	Leng.	Qu.	Price
.1	400	G191P10494TA	5/8	1 1/4	92	1.59
.15	100	G91P15491T	13/32	29/32	190	.98
.15	200	G191P15492TA	7/16	1 3/8	252	1.19
.18	200	G191P18492TA	5/8	1 3/16	450	.98
.18	400	G191P18494TA	5/8	1 21/32	100	1.44
.22	100	G191P22491	13/32	1 3/8	42	1.49
.22	400	191P22404	13/32	1 3/8	173	1.49
.24	100	G191P24451TA	7/16	1 7/16	384	1.19
.27	100	G191P27491	9/16	1 5/32	20	1.59
.27	200	G191P27492TA	5/8	1 3/8	303	1.19
.33	100	G191P33491TA	5/8	1 3/16	4	1.95
.33	200	G191P33492TA	5/8	1 7/16	427	1.19
.39	200	G191P39492TA	5/8	1 11/16	398	1.19
.39	400	G191P39494TA	13/16	2 3/16	99	1.59
.47	100	G191P47491	9/16	1 3/8	114	1.75
.56	200	G191P56492TA	3/4	1 11/16	294	1.80
.68	200	G91P68492	9/16	1 28/32	24	2.10
.82	400	G191P82494TA	1 1/16	2 3/16	101	2.10
1.0	400	G191P10594TA	1 1/16	2 1/8	78	2.35
1.0	200	*767-236	9/16	1 15/16	200	2.20
1.0	400	*767-78	3/4	2 3/32	504	1.80

* Not Vitamin "Q" but similar.

POTENTIOMETERS, 25 Watt, these excellent wirewound controls are made by the leading manufacturers and are in original cartons. Priced ridiculously low, only 20% of list. Satisfaction guaranteed! Substantial stock, up to 7000 pieces of a size.

Ohms	Bush	Shaft	Cat #	Price
2	5/8s	1, 8-d	O-H	$1.04
3–3	1/2	1/2	I	1.04
15	3/8	1"	C	1.04
15	3/8	1 1/8	D-245	1.04
15	1/2	1 1/4	I	1.04
20	1/2	1/2 F	D-245	1.04
25	3/8	1	D-245	1.04
30	3/8	1	C	1.04
50	3/8	1 1/8	D-245	1.04
50	5/8	1/8-d	O-H	1.04
75	1/2	7/16	O-H	1.04
100	3/8	1	D-245	1.04
350	3/8	1 1/8	O-H	1.04
500	3/8	11/16	D-245	1.04
5K	1/2	1/8sd	I	1.24
5K	3/8	7/8f	D-245	1.24
20K	1/2	1/8sd	D-245	1.40

VDC	VAC	AMP	Cat. #	Price
10	13	2	D10	$3.05
10	13	4	D11	3.95
10	13	6	D12	4.50
10	13	12	D14	5.60
10	13	15	D15	8.90
10	13	22.5	D16	10.10
20	26	2	D17	5.55
20	26	4	D18	7.45
20	26	6	D19	8.00
20	26	12	D21	10.25
20	26	22.5	D23	18.20
40	52	2	D24	10.10
40	52	6	D26	14.65
40	52	12	D28	19.05
40	52	22.5	D30	34.30
60	78	2	D31	13.50
100	130	.5	D38	9.85
120	156	2	D47	23.95
120	156	4	D48	36.00

10VDC—full wave, others full wave bridge

RECTIFIERS—low current bridge

VDC	VAC	MA	Cat #	Price
20	26	10	A200	$ .70
20	26	50	A201	1.05
100	130	10	A204	2.00
300	390	10	A210	6.00

RECTIFIERS—high voltage half wave.

VDC	Peak Inverse	MA	Cat. #	Price
130	370	5	A221	$.80
130	370	25	A222	.80
260	740	5	A224	1.50
260	740	25	A225	1.60
650	1850	5	A227	3.60
650	1850	25	A228	4.20
975	2760	5	A230	5.10
1300	3700	5	A232	10.90
1300	3700	5	A233	6.60
1300	3700	25	A234	8.20
1625	4600	5	A236	8.10
1625	4600	25	A237	10.20
1950	5515	5	A239	9.60
2275	6430	5	A242	11.10
2275	6430	25	A243	14.00

RECTIFIERS—small 130 VAC

35 Ma.	$ .54	250 Ma.	$1.42
65 Ma.	.66	300 Ma.	1.60
100 Ma.	.92	450 Ma.	2.13

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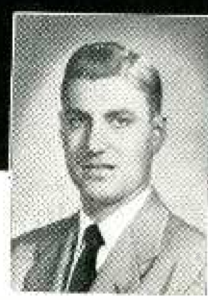
LOcust 7-5285**



JOINT—Universal Aluminum ¼" bore 1 ⅛" overall length..............$.85

KNOBS National and Eby in stock include new Eby 867 bar..........$[illegible]

LAMP—Black Light—4 W-T5 ⅝" dia x 5 ⅜"—New ....$ [illegible]
NE-51 09
NE-2 09
AR-1 Argon 2½W std. base...... .25

MOTOR 1 RPM Synchron......$3.50
60 RPM Telechron—6 Watt...$4.30

NETWORK — DELAY, 1400 ohm, alum. can 1 ⅜ x 1 ⅜ x 3 ⅜", 2.1 micro second #661 ....$.95
NON-LINEAR Coil-RET-D164820 tiny saturable reactor used in BC 604 Useful as harmonic generator, in DC amplifiers etc. Permally tape core only .0004 inches thick. Cost twice this..........$2.90

OIL FILLED Subminiature Vitamin Q Condensers.

POTENTIOMETERS—50 & 100 watt.

Ohms	Watt	Cat. #	Price
12	50	WL	$1.41
500	50	D	1.41
500	100	O-K	2.19
800	50	O-J	1.48

QUARTZ Crystal—915KC 1%...$.19

RELAY—telephone style, 3600 ohm 5 milliampere, 2 micro switch, DPDT 10 A contacts. A 28000 Bargain..$6.45
RESISTORS—Deposited carbon ½ watt, very high short & long term stability, low noise, radial leads: 2.2K, 10K, 47K, 100K, 470K, 1Meg, 2.2Meg........$.15
RESISTORS—Composition BTS ½ W, 10% All RMA values, many other types. BTS ....3¢ ea., 100 for $2.50

SELENIUM Rectifiers Stock delivery of Sarkes high quality units.

Mfd.	Volt	Type	Dia.	Leng.	Qu.	Price
.0033	600	*774-606A	9/32	13/16	218	$.74
.0082	400	G191P82294TA	11/32	15/16	73	.89
.01	100	G191P10391	1/4	3/4	59	1.35
.01	200	G91P10392	1/4	3/4	76	1.44
.01	400	G88P10394	1/4	3/4	113	1.49
.01	600	G91P10396	5/16	7/8	62	1.49
.01	200	G191P10392TA	11/32	7/8	479	.89
.012	200	G191P12392TA	3/8	28/32	100	1.44
.015	200	G191P15392TA	11/32	28/32	380	1.19
.015	400	G191P15394TA	11/32	29/32	99	1.44
.022	100	G191P22391	11/32	7/8	20	1.65
.027	200	G191P27392TA	11/32	29/32	98	1.44
.033	400	G191P33394TA	7/16	15/16	98	1.44
.033	200	G191P33392TA	3/8	15/16	401	.98
.043	200	G191P43352TA	7/16	15/16	164	1.29
.056	200	G191P56392TA	7/16	15/16	97	1.44
.068	200	G191P68352TA	7/16	15/16	569	.89
.082	400	G91P82394	13/32	1 3/8	31	1.49

TIME DELAY Relay—adjustable from 1-60 seconds, 1/16" spaced one second marks for accurate, easy setting. Contacts SPDT, 1000 W; 115 VAC oper. 2 second spring recycle when deenergized. Fully enclosed in attractive black bakelite 3" round case. Brand new. Reg. price $26.46. Model TD-1M.$11.95 Model TD-15S (15 sec.)........$13.95
TRANSFORMER—400 cycle, hermetically sealed, 117V in; 596 Vct. @ 157MA. 5V @ 2A, 6.3V @ 0.6A, 6.3V @ 4.5A, 6.3V @4.5A out 3 ¾ x 4 ⅜ x 5". Brand New. ONLY..............$4.95
TRANSFORMERS, Pulse — 901756-501 RCA. 15/16 dia. x 1⅝" high, 165 turns on primary. 330 turns secondary, core is ¾" stack of .007 inch "F" laminations. Magnetic Metals Co. Audio 58, used to form 7.3 microsecond pulses......$1.50 901756-502, RCA, same core & can as 501, 100 to 200 turns, used to form 2.2 microsecond pulses $1.50

UL Approved Cord Set, 6 ft., fresh. D709 Brown ....$.23

VIBRATOR Power Supply, PE204A Radiart, 12VDC in, supply plate and screen volts for telephone repeater EE99 plus TY14, 6" x 7" x 5¼" with cable & 18 contact Jones, spare VS-1 6 pin vibrator & schematic in case, orig. overseas pack, two to the case. Checked output, not simultaneously: 190V-OMA, 92V-40MA, 150V 16MA, 130V-42MA, 125V-28MA (ahead of filter) $5.95

WIRE, Non-Strip Rex, CJR red or blue #26-19/38,550 ft. spools. This tiny wire can be soldered without stripping, Ideal for that intricate job. Reg. $16.50 per m., 500 ft........$2.75

XTRA Care taken to make sure all shipments have the right items, are shipped at the right time to the right place with the right packing.

YOU will be pleased with our stock and service on these regular lines too: Akro-Mils, Alpha, Automatic, Cannon, Carling, Chicago Transformer, Crest Labs., Eby, Electro Mfg's., Federal, Grayhill, Greenlee, JCT, Kings, National, Sarkes, Switchcraft, Tuck, USECO, Vector.

ZENITH—Remote Control unit 115 VAC input 4½ RPM output either direction with control cable, switches, etc. Ideal for moving "hot" items in measurements labs. A dozen were used in a psycho lab for remote control of potentiometers. Plenty of torque. New in orig. ctn. Few left! HURRY!..$8.95

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It has to be right! . . . when it's from Semler. Semler is one of the leading suppliers of precision test equipment to the aircraft industry. Semler is a recognized and approved source of supply for many foreign and U.S. Government agencies.

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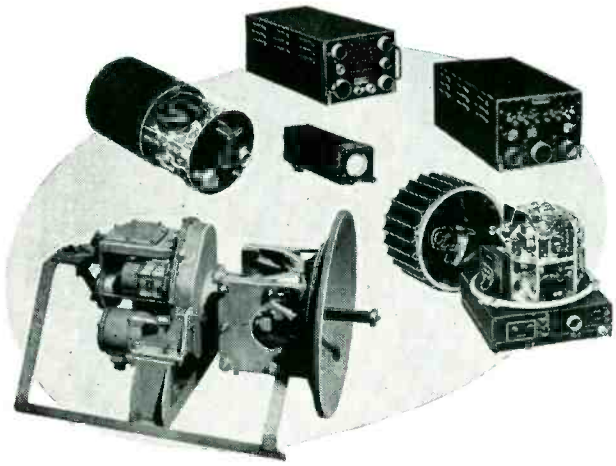
AN/APS-6

AIRBORNE RADAR

This multi-purpose, multi-range set can be used as: 1) Conventional radar; 2) Gun aiming; 3) Beacon; 4) Identification signals; up to 100 miles. Originally designed primarily for night fighters, it is also suitable for fog and low visibility conditions. There are four Radar-scanning ranges (nautical miles); 65-mile; 25-mile; 5-mile; and 1-mile; PLUS a Gun-Aim range of 1,000 yards or less. The instrument has a 120-degree scanning cone, normally. This narrows to a 15-degree cone during the gun-aiming operation only. 65-MILE AND 25-MILE RANGES present a scope showing target range and azimuth deviation from line of flight. Progress towards target moves the target indication down the scope. 5-MILE AND 1-MILE RANGES bring elevation into scope with addition of an elevation-blip which will show in relation to target. AT 1,000 YARDS, GUN AIM ranging brings a gun sighting pattern on scope, with a positive indication when target moves within 250-yards' range.



The AN/APS-6 is illustrated above in the chief assembled components making up the set (NOT shown in proportion). The illustration does not show minor junction boxes, racks, etc., which, however, are included with the unit when shipped.

PRECISION TEST EQUIPMENT

In Stock Now

TS3/AP	TS80/U
TS10B/APN	TS89/AP
TS12/AP	TS100/AP
TS13/AP	TS101/AP
TS15/AP	TS110/AP
TS16/APN	TS111/CP
TS19/APQ5	TS118/AP
TS23/APN	TS125/AP
TS24/ARR2	TS126/AP
TS26/TSM	TS131/AP
TS27/TSM	TS148/UP
TS32/TRC1	TS155
TS33/AP	TS170/ARN5
TS34A/AP	TS174/U
TS35/AP	TS175/U
TS36/AP	TS184A/AP
TS45/APM3	TS204/AP
TS51/APG4	TS226/AP
TS56A/AP	TS239/UP
TS59/APN1	TS251
TS61/AP	TS268/U
TS67/ARN5	TS323
TS69	TS428
TS78/U	

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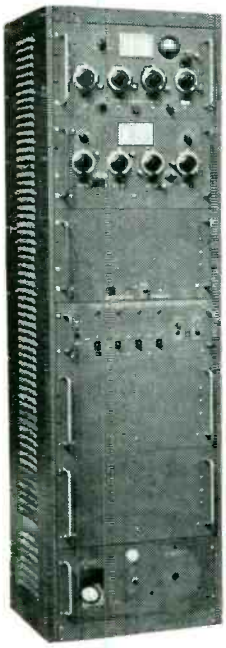

BC640 TRANSMITTER

This is a crystal-controlled complete ground station, including speech amplifier. Suitable for police radio, taxicab, ground-to-plane, etc. Operates 110-125-V., 60-cycle, or 220-250V.-60 cycle; 1 Ph.; 100-158 Mcs; with a push-pull HK24G, 75 W. output at the final amplifier. Also, Class B, AM, Push-pull 811's; auto transformer. Transmitter keys at 30 wpm satisfactorily.

BC639 RECEIVER

Originally designed for use with BC640 above. Same power supply; same range, 100-158 Mcs. 1 RF and 3 IF stages; RA42 power supply; includes signal strength meter. AM receiver also suitable for CW operation.

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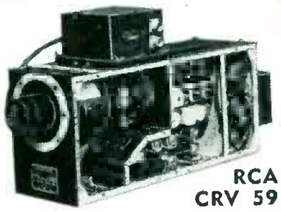
Sembro
Los Angeles

TELEVISION CAMERAS



RCA CRV 59

Vertical scanning 40-60 cps. Horizontal scanning 13,500 - 15,800 cps. 350 line resolution. Uses 1848 Iconoscope. Six stage video amplifier unit with band pass of about 3.5 mcs. Entire unit is self-contained complete with RF transmitter, having a power output of 25 watts, operating on a carrier frequency of 60 to 110 mcs. All controls are readily accessible on the exterior of the set.

A highly efficient unit which was originally used by the U. S. Navy for directing pilotless aircraft. It is now being used by laboratories and universities throughout the country for particular experimental work in the field of television. It is invaluable for training purposes in television schools. Industrial application for the observation of instruments that are inaccessible for size or physical hazard. Currently being used for observation of aircraft in the California Associated Wind Tunnels at the California Institute of Technology. For TV studio use, this camera may be used in the movie pick-up chain. It may also be easily adapted for driving from a master synch generator. Ideal for use in place of a monoscope for alignment purposes.

In Stock Now

IE19	I-122	I-222
IE21	I-130	I-223
IE36	I-139A	BC-221
IE45	I-145	BC-376
IE46	I-148	BC-906
IE57	I-155	BC1066
I-56	I-173	BC1201
I-72	I-176	BC1203
I-95	I-177	BC1277
I-96	I-196A	BC1287
I-100	I-198	BE-67
I-115	I-208	OAP-1

TS21/CRN5	TS102	AN/APR-1
TS34	TS117	AN/APR-4
TS62	TS125	IS-185

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Hewlett- Packard 200D Audio Oscillator

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QUARTZ CRYSTALS

NEW LISTING

Made from the finest Brazilian Quartz. Will provide a high degree of activity and frequency stability. All tested and marked by the manufacturer to a very close tolerance. In the frequencies outlined below the crystals itemized under the heading "From & To" are mostly in progressive frequencies between the limits shown (as for example: "From 3300 to 3377," are as follows: 3300KC, 3301KC, 3302KC—, 3377KC.) are of limited quantities in each frequency. Those listed singly are in quantities of 50 or more.

FT243

Prong centers ½", Prong dia. 3/32"

Price $1.15 ea. (25 for $25.00)

FROM	TO
1915	1995
2030	2065
2175	2155
2300	
2320	2390
2420	2490
2604	
2605	
3105	KC
3652	3689
3729	3799
3805	3823
	4100
4104	4150
4244	4290
4305	4397
4400	4480
4600	4690
4800	4898
4913	4941
5100	5195
5300	
5320	5897.5
5500	
5630	
5633.3	
5655.5	
5677.7	
5700	
5706.6	5775
5722.2	
5744.4	
5800	5892
5900	5975
5955	
6000	6075
6000.6	
6150	
6175	

FROM	TO
6100	6173.3
6225	
6250	
6275	
	6292
6300	6375
6400	6498
6500	
6506.6	6675
6700	6775
6800	6875
6815	
6830	
6900	6975
6978.75	
7228	7281
7325	7375
7458.75	
7440	7475
7500	7597
7606	7673.3
7625	
7650	
7675	
7700	
7725	
7728.8	
7750	
7751.25	
7773.75	
7775	7790
7800	
7825	
7850	
7875	
7900	
7925	
7950	
7925	

FROM	TO
7906	7968
8000	
8025	
8050	
8100	8175
9206	8275
8300	8375
8385	
8400	8475
8500	8575
8600	8650
8786.25	
8808.75	
8876.25	
8921.25	
9135.0	
9342	9399
9405	9499
9500	
9516	9589
9608	9638
10075	
12608	12698
12700	12783
12800	12890
12902	12998
13004	13009
13010	13099
13100	13196
13213	13299
13302	13361
13400	13496
13500	13554
13837	13897
13903	13996
14038	14092
14110	14198
16585.55	
17170	

CR 1A/AR or FT241

Prong spacing ½", Prong dia. ⅛"

Price 79¢ ea. 12 for $9.00

FROM (Frequencies IN KC)	TO
2853	
3988	
4188	
4285	
4300	4374
4788	
5020	5090
5100	
5120	5180
5200	5295
5250	
5300	5396
5410	
5470	
5500	
5468	
5470	5780
5810	
5891	
5910	
5923	5960
6011	6080
6130	6195
6203	6275
6270	
6300	6375
6370	
6400	6499
6490	
6500	6590
6600	6685
6744	
6815	6877
6905	6980
7270	
7330	
7460	
7500	
7540	
7541.6	
7560	
7600	

FROM (Frequencies in KC)	TO
7620	
7625	
7650	
7738	
7740	
7750	
7760	
7770	
7775	
7778	
7780	
7790	
7800	
7810	
7825	
7830	
7850	
7851	7880
7900	
7910	
7925	
7930	
7940	
7950	
7970	
7975	
7990	
8002	
	8010
8007	
8012	
	8092
8205	8298
8308	
8300	8370
8407	
8412	
8405	8490
8506	8561
8645	
8630	8650
8985	
11677	

XL5 Dual

3 prongs ½" x 1 19/32" prong dia.

Price $1.95 ea.

2520 & 2698
2731 & 2891
2436 & 2276
3128 & 3153
2605 & 3153

XL5 Single

3 prongs ½" x 1 19/32" prong dia.

Price $1.35 ea.

FROM	TO
2200	2210
2300	2384
2410	2450
2561	
2600	2698
2704	2787
2802	2891
2916	
3117	3171
3154	
3325	3371
3435	
3857	

FT241A

SPECIAL TYPE WE.

Prong spacing 1" CTS.
Prong Size 3/32" dia.

These are in successive steps of .1 MC variation from 20.0 MC to 27.9 MC

Suitable for low frequency purposes (1/54 of Stated Values)

Price $1.15 ea.

UNASSEMBLED CRYSTALS

consists of quartz crystal plates made for FT243 holders. Furnished complete with holders, electrodes, springs and all hardware.

Price .29 ea.

Crystal plates available in the following frequencies:—

7533	7750	7873	8475
7541		7950	8750
7550	7775	8275	
7640	7800	8325	
7650	7825	8450	
7700	7850		

EDLIE ELECTRONICS, Inc.

154 Greenwich Street,
New York, N. Y.
Telephone DIgby 9-3143

WIRE-CABLE TUBES PARTS

CORDAGE

CO-122 3 conductor each #22 AWG neoprene jacket 550' lengths
CO-127 single #14 AWG braided and tinned copper braid shield

MULTI-CONDUCTOR

2 conductor AWG 12	7 conductor AWG 16
7 conductor AWG 14	19 conductor AWG 16
14 conductor AWG 16	6 conductor AWG 20
11 conductor shielded AWG 20	10 conductor AWG 16
2 conductor AWG 18	22 conductor AWG 16

2 conductor shielded AWG 10

AMOUR

DRIA-23 DHFA-100 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

OIL FILLED CONDENSERS

MFD	VDC	Each	Ten	MFD	VDC	Each	Ten
1	600	.85	.80	.5	2000	2.00	1.90
2	600	.95	.95	.25	3000	2.85	2.80
4	600	1.40	1.40	.5	3000	2.95	2.90
5	600	1.65	1.60	.2	5000	4.50	4.25
1-8	600	2.50	2.35	.1	7500	3.95	3.95
.01	1000	.85	.80	1	7500	12.50	12.00
.5	1000	.95	.90	.1	12000	7.95	7.95
2	1000	1.65	1.60	.0008	15000	12.50	11.75
1	1200	1.65	1.60	.2	15000	14.95	14.80
1	1500	1.75	1.65	.045	16000	12.95	12.50

SPECIALS

80-86 Crystal in Holder $2.50
Balloon with Hydrogen Generator $2.50
300 Feet Aerial Wire $2.00

MICROWAVE TEST EQUIPMENT

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.

TUBES

2C34	$.45	803	3.60	CEQ72	.85
2X2/879	.55	826	.65	CK 70	4.15
3B24	4.95	864	.25	CRP 72	.85
3C24	1.60	931A	4.45	E 1148	.30
7C4/1203A	.70	955	.30	HY 615	.20
10Y	.35	957	.35	RKR 72	.85
15R	.65	CK 1005	.45	RK 73	.45
30 Spec.	.40	CK 1007	.90	5BP4	4.25
39/44	.25	1626	.35	5FP7	1.75
45 Spec.	.35	1629	.25	1J6 G	.70
WE 203A	6.75	2051	1.10	1B3 GT	.80
316A	.60	7193	.50	3A4	.60
WL 531	4.95	8011	1.50	5U4G	.57
713A	.90	9006	.30	6K6GT	.60
801A	.25	C5	8.00		

HI VOLTAGE FILTER CHOKES

.4 HY 4.5 Amp DC 3 ohms 1230 RMS to ground. New.
1 HY 3.2 Amp DC 3.5 ohm GE69G459. New.
1.7-3 HY 2 AMP DC 34,000 VDC GE Y346A. New.

NAVY ENTERING TYPE INSULATOR

Porcelain flanged bowl with brass rod, fittings and aluminum shield. Dimensions 4⅜" high, 6-5/16" OD at base. Brand new $4.50.

10 CM ROTATING ANTENNA

24" Parabola in turret 360° span at 12 RPM DC, motor control and reversing switch New.

TIME DELAY SWITCHES

1 Minute 115 VAC 60 cycle Enc. in Waterproof Metal Case New $5.25
3 Micro Switches Contact at 40-41-42 Second Time Delay 110 VAC Motor New $4.50
Thermo Switch 50° to 300° F 115 VAC @ 6A 230 VAC @ 5A
Breaks Contact with increase in Temperature New $1.35

CONTACTORS

DPST 115 VAC 60 cycle 15 Amp De-Ion Line Starter Westinghouse $6.95
DPST 115 VAC "AB" #700 $5.95

RELAYS

12 VDC DPST Allied Control Box 32.....$1.25
24 VDC DPDT Allied Control BJD36.....$1.45
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

ROLLER INDUCTANCE COIL 0-15 MH WITH VERNIER ADJUSTMENT

Coil is wound on ceramic form 3⅛" long. Right angle drive gear with ⅝" shaft. Three position switch for vernier operation New—Meissner—C-625

METERS

Portable 0-25 Amps AC Weston #433 Brand New $37.50
Switch Board Panel 0-100 Amps DC Weston #269 with 100 Amp Shunt Brand New $24.95

EQUIPMENT

Walkie-Talkies 2.3-4.6 MC
MN-26Y Bendix Compass Receiver
BC-733 Glide Path Receiver
DAB-3—Direction Finder
RDF Receiver Equipment 200-550 KC Fixed Tuned

SWITCHES—BATHTUB—OIL FILLED—MICA CONDENSERS—POTENTIOMETERS. SEND FOR CATALOG

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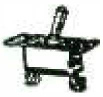

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ANTENNAS
Insulators, Mast Sections
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GENERATORS
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HEADSETS
IF COILS
JACKS
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KEYS, *Telegraph*
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X BAND THERMISTOR Mount 8500 to 9600 MC. VSWR less than 1.4, RG-51 guide $70.00

X BAND VARIABLE ATTENUATOR Guillotine type, 0 to 30DB Attenuation. Dial direct reading within 1DB—$80.00

VSWR AMPLIFIER tunable high gain linear amplifier, for measurement of standing wave ratios in conjunction with slotted lines. Crystal or Bolometer input—$300.00

DELAY LINE, Z-1000 ±10% band pass 0-2 MC., delay time 4 micro-seconds, type YE-4 B.

TUNING UNITS FOR APR-4 RECEIVER

These tuning units are incomplete, new, in operating condition but lack the front panel, tuning motor and tuning shaft and side panels $100.00

TN 18 300-1000 MC — TN 19 1000-2200 MC — TN 54 2200-4000 MC

BUTTERFLY TUNERS

110-330 megacycles oscillator butterfly $25.00

80-300 megacycles mixer butterfly with socket for 955 (used as diode mixer) $25.00

400-800 megacycles oscillator butterfly with 703 tube mounted on it...... $30.00

X Band Spectrum Analyzer 8500-9600 MC. Calibrated frequency meter, tuned mixer, 4 i.f. stages. 3 Video stages over-all gain 125 db., reg. Power Supply.

S Band Spectrum Analyzer 2700-3900 megacycles—Similar to above.

HIGH POWER DUMMY LOADS

DC-2000 MC, 100 watts dissipation, VSWR less than 1.1, no cooling necessary.

X Band, 1¼" x ⅝" guide, choke or plain flange, dissipates 350 watts average power continuously in still air, VSWR less than 1.15 between 7 and 10 KFC, weight 5¼ pounds.

X Band, ½" x 1" guide, choke flange, dissipates 250 Watts average power continuously in still air, VSWR less than 1.15 between 8.2 x 12.4 KMC, weight 3¼ pounds.

X Band, 1¼" x ⅝" guide, plain flange, dissipates 200 watts average power continuously in still air, VSWR less than 1.15 between 7-10 KMC, weight 3¼ pounds.

X Band, 1¼" x ⅝" guide, plain flange, dissipates 150 watts average power continuously in still air, weight 2 pounds 4 ounces.

S Band 1½" x 3" 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.

S Band Mixer, tunable by means of slider; type N connector for the R.F. and local oscillator input, U.H.F. connector for the I.F. output, variable oscillator injection $30.00

33 MC I.F. STRIP, VIDEO, and AUDIO AMPLIFIER and 110 Volt 60-2600 cps POWER SUPPLY. Bandwidth 10 mc new, part of SPR-2 Receiver. AMPLIFIER STRIP AM-SSA/SPR-2 contains I.F. amplifier, delector, video amplifier, pulse stretcher and audio amplifier and Rectifier Power Unit PP-155A/SPR-2 bandwidth 10 mc, center frequency 30 mc. sensitivity 50 microvolts for 10 milliwatts output. Power supply 80/115 V ac 50-2600 cps 1.3 amps. Send for schematic...... $65.00 less tubes

S Band Signal Generator Cavity With Cut-Off Attenuator, 2300-2950 mc., 2C40 tube, with modulator chassis........... $30.00

High Pass Filter F-29/SPR-2, cuts off at 1000 mc and below; used for receivers above 1000 mc.................. $12.00

TS-89 Voltage Divider for measuring high video pulses, ratios 1:10 and 1:100 transmission flat within 2 db 150 c.p.s. to 5 mc., with cable for attaching to syndroscope $30.00

Variable Waveguide Below Cut-Off Attenuator L 101-A U.H.F. Connectors at each end calibration 30-100 db........ $25.00

S Band Standard Frequency Cavity, adjustable, with crystal holder and 1N27 crystal $50.00

S Band Test Load TPS-55P/BT. 50 ohms $12.00

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RE 9-5960

ANTENNA EQUIPMENT

MAST BASES—INSULATED:

MP-132 BASE—(As illustrated at left) 1" heavy coil spring, 2" insulator. Overall length: 11-½". Weight: 2-¾ lbs. Price $3.95

MAST BASE—Insulated type with heavy coil spring and 5" dia. insulator. Requires 1 inch hole for mtg. Weight: 9 lbs. $5.95

MAST SECTIONS For ABOVE BASES:

Tubular steel, copper coated, painted, in 3 ft. sections, screw-in type. MS-53 can be used to make any length with MS-52-51-50-49 for taper. Any section .... 50¢ Each

Larger Diameter Sections: MS-55-54....$1.25 Each.

AN-104B Antenna—100-156 MC.—Copper......$5.95
AN-104B Antenna—100-156 MC.—Steel...... 3.95
AN-104A Antenna—100-156 MC.—Copper...... 3.00
AN-104A—Antenna—100-156 MC.—Steel 2.00
AN-117 Whip Steel—6 Ft. length........ 1.50
AN-109A Whip Steel, 5 Ft. w-Base........ 1.50
AS-27/ARN-5 Ram's Horn, 10 MC.—USED... 5.95
LP-20A Loop for ADF equip.—Used, tested... 9.95
AT-37/APT Stub—113-115 MC. 6.95
AT-42/APT-3 or APT-1 Stub—113-150 MC.... 6.95
AS-97/ARQ-8 Spike with coaxial load in base.. 4.95
AS-61/ARN-5-Half-Wave Dipole—335 MC..... 3.95
AT-2/APN-2 .... 4.95

SELENIUM RECTIFIER UNITS

HEAVY DUTY—30 VOLT DC OUTPUT:

115/200 V. Three Phase 400 Cycle Input:
TYPE 143 w/Transformer & VR 100 Amp.....$69.50
TYPE 3FS-5 w/Trans., VR, & Blower—200 Amp. $69.50
TYPE-52A-11 Rectifier Only, Cased, 200 Amp.$39.50
TYPE A-1 Rectifier Only, Cased, 300 Amp....$49.50

AERIAL WIRE—Phosphorus Bronze #16 Stranded. 200 lb test. Weatherproof. 150 ft. on Reel. RL-3 with Clip $1.50

TELEPHONE WIRE—3 Cond. copper & steel, 525 ft. $4.75

TRANSFORMERS—110V. 60 Cycle Pri.

Sec. Two 12 V. 4 A. windings—gives 12 V. 8 A. or 24 V. 4 A. $5.95
Sec. 24 Volt ½ Amp. 1.50
Sec. 24 Volt 1 Amp. 1.95
Sec. 24 Volt 6 Amp. 5.95
Sec. 6-24 or 30 Volts 8 Amp........ 5.95

MOUNTINGS AND CLAMPS:

FT-154 for BC-348 Receiver $2.50
FT-470 Mounting & Clamp........ 1.00
MC-476 Maple Ball for above—f/Fairlead........ 1.00
MC-396 Wood Clamp for Fairlead........ .75
M-235 Bobbin & 250 Ft. W-106 Antenna Wire.. 3.50
WT-7 Weight for Trailing Antenna........ 1.50

BLOWERS:

115 Volt 60 cycle BLOWER (pictured), approx. 100 CFM Dis. 2¼" intake; 2" outlet. Quiet running. Motor size: 2½"x3¼". NEW — not Gov't surplus. Order No. E-520 **$7.99**

DUAL BLOWER—Same as RN-520 above, except has blower assembly in each side of motor. Order No. E-800 .... $12.95

COMPACT TYPE—108 CFM. motor built inside squirrel cage. 1-½" Intake: 3-⅜" x 3" Dis. Complete size: 4-¼" W x 9-⅜" H x 8-⅛" D. Order No. E-860 .... $13.50

FLANGE TYPE—140 CFM. 3-½" Intake: 2-½" Dis. Complete size: 8-½" W x 7-¼" H x 6-¾" D. Order No. E-865 .... $12.95

FLANGE TWIN—275 CFM. 4-½" Intake: 3-¼" x 3" Dis. Complete size: 11-¾" W x 8-⅝" H x 8-1/16" D. No. E-134........ $20.95

CORDS—CABLES

C-501 Cord—f/GN-45 Generator $2.50
CD-318 Cord w/PL-68 & SW-141 & JK-48F.. .89
CD-307 Cord—6.5 Ft. w/PL-55 & JK-26...... .89
CD-604 Cord w/C-410 Trans. & PL-54 Plug... .89
CD-365 Cord for LP-21-Loop 1.75
MC-215 Tuning Shaft for 274N........ 2.00

DYNAMOTORS:

DYNAMOTOR and BLOWER: 9 Volts DC input: output 450 Volts 60 MA. 4500 RPM. At 6 Volts DC input; output 260 Volts 65 MA. 3000 RPM......$4.95

Input	Output	Stock No.	Price
14 V. DC	600 V. 300 MA.	BD-86	$9.95
12 V. DC	220 V. 70 MA.	DM-24	6.95
12 V. DC	220 V. 100 MA.	DM-18	4.95
12 or 24 V. DC	440 V. 200 MA. & 220 V. 100 MA.	D-104	14.95
14 V. DC	375 V. 150 MA.	DM-375	8.95
14 V. DC	330 V. 135 MA.	DM-330	7.95
14 V. DC	500 V. 500 MA.	PE-59	14.95
12 or 24 V. DC	275 V. 110 MA.	USA/0516	3.95
12 or 24 V. DC	500 V. 50 MA.	USA/0515	3.95

ALSO—PE-73; PE-86; DM-53; DM-33; 5055; DM-416; PE-101, etc.

AIRCRAFT CONTROL CABLE—3/32" 7 x 14 Strand, Weatherproofed, Galvanized, 920 lb. Test. Ideal for Television Guying and many other uses. Prices: 3-½¢ per Ft. 1000 Ft. or more @ 3¢ per Ft.

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MC-211 Rightangle Adapter for Comm. Sets... .50
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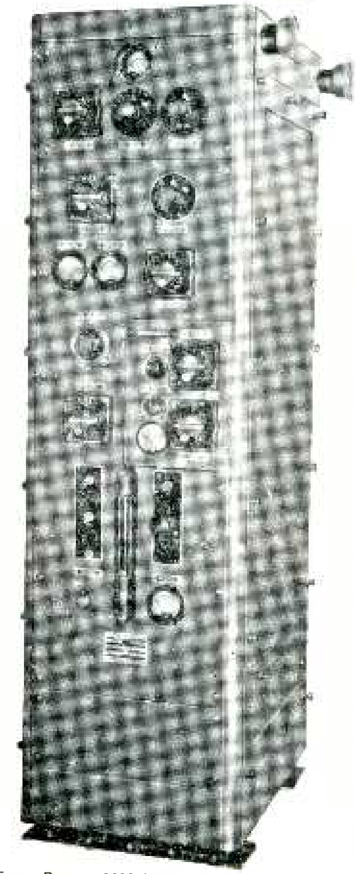

Freq. Range: 2000 to 20,000 Kcs.
Output: 350 Watts C.W. 250 Watts Radio telephone
Input: 190 to 250 Volts AC 50/60 cps.
Size: 60" high, 17" wide, 27" deep.
Tubes: 807s, 813s, 805s, 866s.
Crystal Oscillator unit built-in, fully shielded and stable. All self contained including antenna network. Master 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.

Complete! New! From Stock! Quantities! Prices on Request.

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MFD	BATHTUB COND. 400V	600V	1000V	CHANNEL TYPES 400V	600V	1000V
.05	$.30	$.35	$.40	$.35	$.40	$.50
.10	.35	.40	.45	.40	.45	.50
.25	.40	.45	.50	.50	.60	.65
.50	.45	.50	.60	.60	.65	.70
1.0	.50	.65	.75	.75	.85	—
2.0	.85	1.15	—	—	—	—
2 x .05	.35	.40	.45	.40	.45	.60
2 x .10	.40	.45	.50	.45	.50	.65
2 x .25	.45	.55	.65	.50	.65	.75
2 x .50	.55	.65	.85	.60	.75	—
2 x 1.0	.85	.95	—	—	—	—
3 x .05	.40	.45	.50	.45	.50	.65
3 x .10	.40	.45	.65	.45	.50	—
3 x .25	.50	.65	—	.60	.75	—
3 x .50	.60	.65	—			
				YAB/T	WAB/T	

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OTHER VALUES—VOLTAGES AVAILABLE
JAN-C-25 TYPES AVAILABLE IN QUANTITY

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New Manufacture Hi-Capacity Oil Cond.
For Servo-Control-Network Applications
20-30-40-50-60 MFD/600 VDC, also AC rated
COMPACT UNITS
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CAPACITOR BRACKETS, CP06 & CP07 types IN STOCK
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NOISE SUPPRESSOR TYPE CAPACITORS, CA-442, CA-445
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EI-11, Ei-75, EE-26-27, F-11, F-12, UI-312 etc.
ROSIN CORE SOLDER, new 60-40 grade, 062D @ .75

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Mallory, miniature instrument type, 90V/15ma.. .65
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RELAY SPECIALS

AUTOMATIC ELECTRIC type 13 STEPPER, 8-12 VDC, 3 circuit 25 position, 360 degree rotation.....8-95
ALLIED BJ, 24 volt, DPDT .... .75
ALLIED BL, 42 ohm, 6 volt coil, SPNO .... .65
CLARE # SK5032, 6 volt, DPDT sealed plugin.3.45
C-H MOTOR STARTER, 3 phase 15A cont. 24V coil 4.95
G.E. 6000 ohm/6 ma plate type 3PNO, compact.1.75
G.M. BK-35, SUPER-SENSITIVE, 10,000 ohm/½ ma 4.95
SIGMA 5H, 2-65 ohm coils, 2-24 volt, cased...2.75
SIGMA 41F, 8000 ohm .04 watt sensitive AC-DC.2.75
ROTARY RELAY, 14 volt, 2 position........ 1.95
A.B B5 SOLENOID, 100 ohm 24V coil, SP/50A.1.35
G.E. miniature, 10,000 ohm 1½ ma, SPNO....2.45

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Input 230 volts DC
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6 mfd.—150 V .... $.35
Three term. dual 3 mfd. oil cond. complete with brackets, measuring 4¼"x1¾"x1". Ideal for audio crossover networks.

8 mfd.—600 V $2.25
#23F7—B'kts

1 mfd.—1000 V .... $.69
TJU-10010—Ind. boxed in factory cartons. A real jobber buy.

1-1 mfd.—600 V .... $.85
3 ST. Bathtub. Lots of 100 10% Disc.
Same type but with 2 terms .... $.70

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Top Term. Bathtub cond. Lots of 100 10% disc.

4 mfd.—600 V $1.15
Tobe TRS—604

10 mfd.—600 v ..... $.98
Three term, bat. mfg. channel type. Dims. 3¾" x 2½" x 2". Two 5 mfd. sections rated 400 V at 72 deg "C". 1800 V test. Meets commercial specs. for 600 V. operation up to 40 degs "C". Ideal for filter or power factor application. Repeat sales prove this rugged high quality condenser to be of outstanding value. Carton of 24, weight 42 lbs. Large qua. available **$.89**

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115 V. 1 phase, 100 amps.
KVA. 11.5, Range 0-115 V.
Amertran #29145—Sp'ly Priced

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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#23F299

1 mfd.—25 KV .... Sp'ly Priced
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Condensers of all Types in any quantity. Also other standard components.

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CONDENSERS: BATHTUB, MICA, AIR, OIL, HV, CER.
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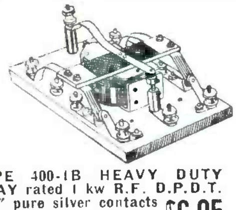

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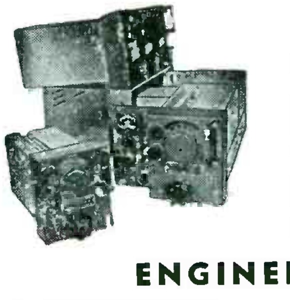

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1B3GT	.57	6S8GT	.63
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1U4	.48	6V6GT	.40
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3S4	.51	12AT7	.61
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6AK5	.86	12AX7	.53
6AL5	.36	12BA6	.38
6AQ5	.41	12BE6	.40
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6AX4GT	.54	25L6GT	.43
6BA6	.38	35B5	.41
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6BE6	.40	35W4	.26
6BG6G	1.21	35Z5GT	.31
6BH6	.50	50B5	.41
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AN/ARN-7 COMPLETE
SCR-269 COMPLETE
TBS 4 & 5, NEW, COMPLETE
AN/ARC-1 VHF EQUIPMENT
BC-348 RECEIVERS
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31 KVA BUDA DIESEL PLANT

3 phase, 110 V, 60 cycles. Spare parts and generator available. Has been run only 40 hours.

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CU-25 ANT. LOAD	DY-11 & 12 Dynam't'r
MT-283 MOUNT	0-16 LFO
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SA-22 ANT. LOAD	C-87 CONTROL BOX

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Absolutely complete, brand new

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BC-1016	R-4/ARR-2 Receivers
APA-6 INDICATOR	BC-640 VHF XMTR
APA-11 INDICATOR	SCR-510
APA-17 RADAR	SCR-522
HS-33 HEAD SETS, NEW	MG-153
MG-149F & H	

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SCR-720	SCR-522
SO-7	AN/ART-13
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SCR-269	

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Altimeter equipment—complete

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110 v. 60 cycle 30RPM $2.60
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Step-Up or Step-Down
4½ lbs. $2.85
230 volts to 115 volts
115 volts to 230 volts
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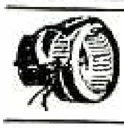

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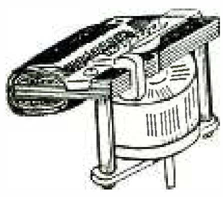
Genuine TELECHRON Motors



2.RPM $2.90
8 RPM 3.90
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One of each $15.00

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1800 RPM SYNCHRONOUS Motor; 115 volts AC, 18 watts 1¼ lbs.; 2"x3"x2" $4.50

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Western Electric CF-1A 4-channel carrier telephone terminals.
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Oil Pressure —Pioneer 6007-4H-14A
Oil Pressure —Pioneer 6007-4H-7-A
Manifold Pressure—Pioneer 6007-ID-7A
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RADIO COMPASS INDICATOR

Fairchild type I-82F

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Manifold Pressure—#4250-1-B1. for PBM-3C & PB4Y.

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Lord 100-P-6 Load rating 6 lbs............ 15.00/C
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Harris 5205 Load rating 10 lbs............ 18.00/C
Harris 5215 Load rating 15 lbs............ 18.00/C

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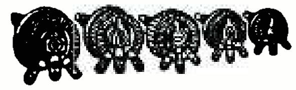

r	W	Ea.	r	W	Ea.	r	W	Ea.
.5	25	1.98	75	25	1.98	500	300	9.49
.5	50	2.81	75	75	3.90	585	150	6.59
.5	150	5.93	80	50	2.53	750	25	2.23
1	50	2.81	80	500	12.46	750	150	5.46
2	50	2.81	100	25	1.98	1000	25	2.53
2	100	4.68	100	50	2.53	1000	50	2.66
2	300	8.42	100	100	4.39	1200	225	7.20
3	100	4.67	125	25	2.23	1200	300	8.40
3	225	6.58	150	50	2.53	1250	50	2.66
4	225	6.60	175	25	2.23	1250	150	6.10
5	25	1.97	185	25	2.23	1500	25	2.53
5	50	2.53	200	25	2.23	1500	50	2.66
5	100	4.68	200	100	4.40	1600	50	2.66
6	25	2.23	200	150	5.04	1800	150	6.19
6	50	2.53	225	50	2.53	2000	25	2.53
6	75	3.90	250	25	2.23	2000	50	2.66
7	25	1.98	250	50	2.53	2250	150	6.24
7.5	75	3.95	300	50	2.53	2500	50	2.66
8	50	2.53	300	75	3.90	2500	100	4.68
10	25	2.23	300	100	4.40	2500	150	6.24
10	50	2.53	300	150	5.04	3000	25	2.66
10	100	4.37	350	25	2.25	3000	100	4.95
12	25	2.23	350	100	4.40	5000	25	2.66
12	50	2.53	370	25	2.23	5000	50	2.90
15	25	1.98	378	150	6.59	7500	50	2.90
15	75	3.90	400	25	2.23	7500	100	5.32
15	100	4.38	400	75	3.90	10000	50	2.99
20	50	2.53	500	25	2.23	10000	100	5.32
22	50	2.53	500	50	2.53	10000	100	5.51
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50	50	2.53	500	150	5.15			

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G-1 Type		G-2 Type		G-3 Type		G-4 Type	
.0001	6kv	.0001	10kv	.001	20kv	.00025	30kv
.00015	5kv	.00015	10kv	.00015	20kv	.0006	35kv
.0002	6kv	.0002	10kv	.0004	20kv	.0025	25kv
.0008	6kv	.00025	12kv	.00045	15kv	.003	20kv
.01	4kv	.0003	10kv	.00047	20kv	.0039	20kv
.032	2kv	.000375	10kv	.0005	20kv	.0075	15kv
.04	1kv	.0004	5kv	.00095	5kv	.01	12kv
.051	1.5kv	.0005	10kv	.001	20kv	.03	8kv
.08	1.5kv	.00057	10kv	.0011	20kv	.056	5kv
.09	1.5kv	.00065	10kv	.00124	15kv		
		.001	10kv	.01	5kv		
				.015	3kv		
				.25	1.6kv		

C-D Type #56

.000155	30kv	.001	30kv
.0004	30kv	.03356	2.5kv
.000533	30kv	.007/15kv—70A/300kc	

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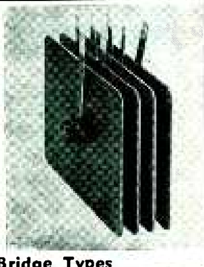

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2½ Amps.	.....	.....	7.50	13.00
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6 Amps.	5.50	9.00	14.00	33.00
10 Amps.	6.75	12.00	20.00	40.00
12 Amps.	8.50	16.00	25.50	50.00
20 Amps.	13.25	24.00	36.00	90.00
24 Amps.	16.00	31.00	39.50	98.00
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1N70	3.15	6X5GT	.52	805	2.50
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1N81	2.58	7C30	85.00	812-A	3.50
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28	Microammeter	special	Weston 366	
77	DC Milliammeter	0–3	Gruen	5–87
124	DC Milliammeter	0–15	Simpson	26
23	DC Milliammeter	0–150	Gen. Elec.	DO-53
50	DC Milliammeter	0–200	Marion	
32	DC Milliammeter	0–200	Simpson	25
281	DC Milliammeter	0–400	Triplett	321-T
147	DC Milliammeter	0–500	Dejur	312
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490	DC Amp	60–0–60	50 M.V.
240	DC Amp	0–120	50 M.V.
270	DC Amp	120–0–120	50 M.V.
1340	DC Amp	0–240	50 M.V.
230	DC Amp	240–0–240	50 M.V.
2800	DC Volt-Amp	0–30v/30a	50 M.V.
330	DC Volt-Amp	0–30v/60a	50 M.V.
50	DC Amp	0–50	50 M.V.
60	DC Amp	50–0–50	self-contained
140	DC Amp	20–0–100	50 M.V.
300	DC Amp	0–150	50 M.V.
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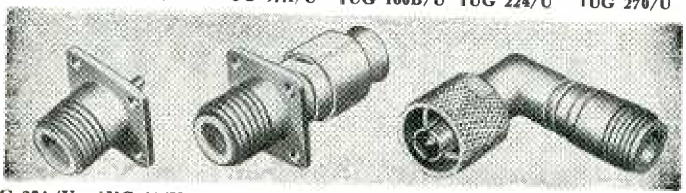
UG 28A/U, UG 29/U, UG 29A/U, UG 29B/U, UG 30/U, UG 32/U, UG 33/U, UG 34/U, UG 35A/U, UG 36/U, UG 37/U, UG 37A/U, UG 38A/U, UG 39/U, UG 40/U, UG 45/U

UG 89/U, UG 90/U, UG 91/U, UG 91A/U, UG 92/U, UG 92A/U, UG 93/U, UG 93A/U, UG 94/U, UG 94A/U, UG 95/U, UG 95A/U, UG 96/U, UG 96A/U, UG 97/U, UG 97A/U

UG 115/U, UG 119U/P, CW 123A/U, UG 131/U, UG 146/U, UG 148A/U, UG 149A/U, UG 154/U, CW 155/U, UG 155/U, UG 156/U, UG 157/U, UG 158/U, UG 159A/U, UG 160A/U, UG 160B/U

UG 203/U, UG 204A/U, UG 206/U, UG 207/U, UG 208/U, UG 212A/U, UG 213A/U, UG 215/U, UG 216/U, UG 217/U, UG 218/U, UG 219/U, UG 220/U, UG 222/U, UG 223/U, UG 224/U

UG 252/U, UG 253/U, UG 254A/U, UG 255/U, UG 256/U, UG 257/U, PL 258, PL 259, PL 259A, UG 259/U, UG 260/U, UG 261/U, UG 262/U, UG 266/U, UG 269/U, UG 270/U



UG 20A/U, UG 20B/U, UG 21/U, UG 21A/U, UG 21B/U, UG 21C/U, UG 22/U, UG 22A/U, UG 22B/U, UG 23/U, UG 23A/U, UG 23B/U, UG 23C/U, UG 27A/U, UG 27B/U, UG 28/U

UG 46/U, UG 57/U, UG 57B/U, UG 58/U, UG 58A/U, UG 59/U, UG 59A/U, UG 60/U, UG 60A/U, UG 61/U, UG 61A/U, UG 83/U, UG 85/U, UG 86/U, UG 87/U, UG 88/U

UG 98/U, UG 98A/U, UG 100/U, UG 100A/U, UG 101/U, UG 101A/U, UG 102/U, UG 106/U, UG 107A/U, UG 107B/U, UG 108/U, UG 108A/U, UG 109/U, UG 109A/U, UG 110/U, UG 114/U

UG 166/U, UG 167/U, UG 167A/U, UG 173/U, UG 174/U, UG 175U, UG 176/U, UG 180A/U, UG 181A/U, UG 182A/U, UG 185/U, UG 188/U, MX 195/U, UG 197/U, UG 201/U, UG 202/U

UG 231/U, UG 233/U, UG 234/U, UG 235/U, UG 236/U, UG 237/U, SO 239, UG 241/U, UG 242/U, UG 243/U, UG 244/U, UG 245/U, UG 246/U, UG 249/U, UG 250/U, UG 251/U

UG 271/U, UG 272/U, UG 273/U, UG 274/U, PL 274, UG 275/U, UG 276/U, UG 279/U, UG 286/U, UG 287/U, UG 290/U, UG 291/U, UG 294/U, UG 299/U, UG 306/U, UG 309/U

UG 333/U, UG 334/U, UG 335/U, UG 347/U, UG 348/U, UG 349/U, UG 352/U, UG 358/U, M 358, M 359A, MT 412, UG 414/U, UG 421/U, UG 422/U, UG 423/U, UG 478/U, UG 479/U, UG 482/U, UG 483/U, UG 484/U, UG 486/U, UG 487/U, UG 491/U, UG 492/U, UG 493/U, UG 494/U, UG 495/U, UG 496/U, UG 499/U, UG 503/U, MX 504, UG 505/U, UG 506/U, UG 507/U, UG 526/U, UG 530/U, UG 531/U, UG 532/U, UG 533/U, UG 535/U, MX 554/U, UG 557/U, MX 564/U, UG 586/U, UG 625/U, MX 913/U

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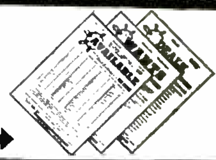

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Electronics, INCORPORATED

All Items Fully Guaranteed

NOW AVAILABLE — a brand new stock of condensers

We own and have in stock all items listed below.

CP 70 STYLE CONDENSERS VDC TYPE

MFD	VDC	TYPE
.00365	15 K	14F162
.0091	15 K	14F222
.0066	20 K	PL1391-978
.075	16 K	572
.045	16 K	D-4495
.51	10 K	LD
.49	10 K	LD
.35	30 K	
.33	8500	26F267
.25	600	CP65B
.25	1000	23F242
.25	3000	CP70E1EL254K
.25	6000	25F659
.25	7500	25F431
.25	10 K	D 9181
.25	15 K	8174
.25	20 K	TK 20002-2
.25	25 K	8118
.25	50 K	14F97
.15	8000	8020
.15	50 K	14F72
.15/.15	5000/8000	Vitamin "Q"
.05	600	OM6005
.05	1000	23F203-G2
.05	3000	23F636
.05	10 K	Y 3605
.02	600	P13356
.5	600	CP70B1EF504-V
.5	1000	TJU10005
.5	2000	XLNJW20-.5
.5	2500	2509
.5	3000	22F242 (CP70)
.5	4000	TJU 40005
.5	5000	26F549
.5	10 K	408936
.5	25 K	14F103
.2	4000	XLMSW40-.2
.2	50 K	14F126
.1	600	28F28
.1	1500	K34J-222-3
.1	1750	CSF48596-AP
.1	2000	23F378
.1	3000	TJU 30001
.1	7500	25F175
.1	12 K	26F628
.1	13 K	2FF313B
.1	15 K	26F359
1	400	CP69B2BE1105MK
1	500	9CE6A4
1	600	TJ 6010
1	1000	TJ 10010-2
1	1200	
1	1500	
1	1750	CSF48596
1	2000	TRS 2001
1	3000	TJU 30010
1	4000	TJU 40010
1	5000	23F49
1	6000	FP
1	6000	TK 60020
1	7500	
1	10 K	14F267
1	13 K	25F313
1	15 K	14F63
1	25 K	A 6734
1	25 K	TJ
1.5	1500	K7106149P1
1.5	2500	8487
2	200	TRS 202
2	600	26F167
2	1000	CP70B1FG205-X
2	1500	TRS 1502
2	2000	23F161
2	2000	CAY 4808-10
2	2500	2509
2	3000	TQ30020
2	4000	23F47
2	5000	23F188
2	32 K	43J861
2 x .875	400	23F279
2 x .05	2000	P720555-69
2 x .5	400	RAL 300
2 x .5	1000	9107
2 x .5	2000	P720555-9

CP 70 STYLE CONDENSERS VDC TYPE

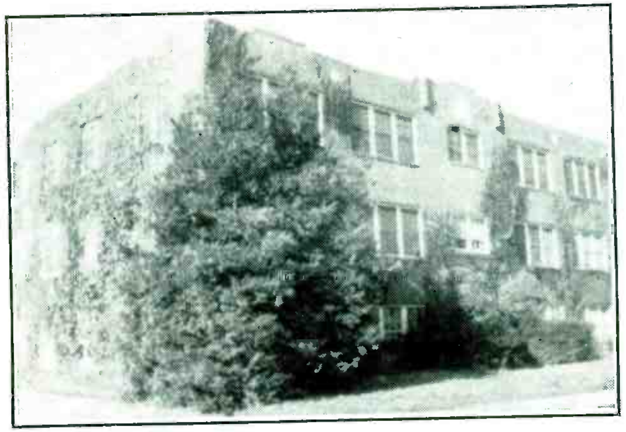
MFD	VDC	TYPE
2 x .5	3000	25F526
2 x .5	9000	PC 2151
2 x .1	600	SPG621DB
2 x .1	7000	25F360
2 x .1	7500/7520	7520
2 1.25	7500	26F360
2 x 3	600	PC2401
2 x 8.5	1000	46D048
3 x .25	600	CP69B5EF254
3 x .05	500	B34584
3 x .5	500	
3 x 8	500	CSF481337-20
4	400	25F664
4	600	TJU 6040
4	1000	8788 (CP70)
4	1500	TRS 1504
4	2000	23F119
4	2500	TRS 2504
4	3000	CP70E1EL504V
4	4000	25F664-G2
4	5000	TJ 50040
4 x 3	600	4883
5	600	CAY 48733
5	1000	XLMW10-5
5	10 K	TK 10050G
6	600	CP70E1FF605K
6	1000	CP70B1EG605K
6	1500	CAY 48731-10
6	2000	XLMS20-6
8	200	TRS 208
8	220	TRS 202
8	600	22F136-G2 (CP70)
8	1000	
8	1500	TJH 15080
8	3000	Vitamin "Q"
10	400	25F471
10	600	26F524
10	1000	26F754

CP 70 STYLE CONDENSERS AC TYPE

MFD	VDC	TYPE
10	2500	23F397
12	600	TJ 6120
12	1000	0115
12	4000 peak	7418
12.5	4000 peak	545-A
15	1000	TJ 10150
15	1500	TJH 15150
25	2800	Vitamin "Q"
25	3000	Vitamin "Q"
30	600	CAY 48732-10
30	2500	Vitamin "Q"
50	100	KLHRAW1-50

40 KILOWATT TRANSFORMER AND CHOKE KIT FOR THE PRESS—WIRELESS PW-40. NEW

MFD	VAC	TYPE
.25	115	Hi Pass
.14	115	26F988
.05	300	PC 1344-3
.6	90	1C
1	150	25F757
1	220	21F319
1	330	67X1X
1	1200	PRF 1201
1.25	1000	26F556
2	330	26F406-G2
3	330	67X3B
3 x .6	90	1C



CP 70 STYLE CONDENSERS AC TYPE

MFD	VAC	TYPE
3 x 30	90	9C
3.75	330	KG 3037
3.5	220	21F319
4	150	CD 4880-5
4	440	67X23
5	440	67X24
6	330	KGM 3060
6	440	35-4-06
6	460	67X38
6	553	PO5
6	660	67X38
7	660	26F306
8	660	21F50-G3
8	1500	22F57
10	220	ALMJW2.5-10
10	330	PRF 3310
10	330	Y 6845
10	660	25F688
12	220	MC 787
12	330	21F130
15	220	ALMJW2.2-15
15	330	25F801
15	660	26F495
16	600	PC 1330
16.5	236	P 7369
28	440	67X23
30	90	26F571-G3
50	330	26F447
500	100	KLHRAW1-50
500	330	KGH3500-3

VACUUM CONDENSERS

MFD	VDC	TYPE
12	20 K	VC-12
50	5 K	8047
50	20 K	VC-50
50	20 K	W-50
100	7.5 K	1L33

TYPE G. MICAS

MFD	Voltage	TYPE
.04	1 KV	G-1
.09	1.5 KV	G-1
.08	1.5 KV	G-1
.0025	2.5 KV	XPY25-225
.0008	3 KV	UC 2509-M
.02	3 KV	G-1
.00095	5 KV	CD 48274
.0015	5 KV	CRV 48416
.006	5 KV	CRV 48415
.01	5 KV	CD 48408
.00025	6 KV	PL-586-59
.0024	6 KV	G-1
.0006	6 KV	G-1
.0004	6 KV	488-26A
.0002	6 KV	1950-207
.006	6 KV	488-26A
.004	6 KV	G-1
.001	6 KV	G-1
.0012	7 KV	CRV-48157
.003	7 KV	UC 3048
.002	8 KV	UC 2371
.00002	10 KV	UC 3292
.000375	10 KV	CRV-48418
.00068	10 KV	MX-61
.00057	10 KV	CD-48879-2
.00025	10 KV	CRV-48155
.00015	10 KV	UC-3123
.0008	10 KV	CRV-48417
.0002	10 KV	48270-B5
.005	10 KV	UC-2617

TYPE G. MICAS (Con't)

MFD	Voltage	Type
.001	10 KV	UC-3296
.02	10 KV	PL-133-52
.0025	12 KV	XPXW
.008	12 KV	G-4
.00532	15 KV	1980-318
.00002	15 KV	MX-60
.0025	15 KV	1970-218
.002	15 KV	G-3
.01	15 KV	1940-225
.00035	20 KV	PL 289-51
.00025	20 KV	G-3
.00015	20 KV	1970-404
.0005	20 KV	PL-280-51S
.0003	20 KV	UC-3112K
.0002	20 KV	G-3
.0001	20 KV	G-3
.002	20 KV	G-3
.0025	25 KV	G-3
.002	30 KV	1940-217
.0005	35 KV	G-4
.001	35 KV	1940-214
.001	75 KV	PL 49-728

STANDARD BATHTUB CONDENSERS

MFD	Voltage	Terminal
.01	600 VDC	Side
.05	600 VDC	Side
.05-.05	1000 VDC	Side
.05-.05-.05	600 VDC	Side
.08	1500 VDC	Top
.1	600 VDC	Side, Top, Bottom
.1	1000 VDC	Side
.1-.1	400 VDC	Side
.1-.1	600 VDC	Side
.1-.1-.1	400 VDC	Side
.1-.1-.1	600 VDC	Side
.2	600 VDC	Side
.2	1000 VDC	Side
.25	400 VDC	Side
.25	600 VDC	Side, Top, Bottom

MFD	Voltage DC	Terminal
.25-.25	400 VDC	Side
.25-.25	600 VDC	Side, Top, Bottom
.25-.25-.25	600 VDC	Side
.3	600 VDC	Top
.5	300 VDC	Top
.5	400 VDC	Side
.5	600 VDC	Side, Bottom
.67	120 VAC	Side
.75	600 VDC	Bottom
1	100 VDC	Side
1	200 VDC	Side
1	300 VDC	Side
1	400 VDC	Bottom
1	600 VDC	Side
1	1000 VDC	Side
1-1	400 VDC	Side
1-1	600 VDC	Bottom
2	25 VDC	Side
2	400 VDC	Side
2	600 VDC	Side
4	50 VDC	Side
4	100 VDC	Side
4	450 VDC	Side
10	150 VDC	Side
20	150 VDC	Side
25	25 VDC	Side
25	50 VDC	Side, Top
30	150 VDC	Bottom
40	25 VDC	Side
50	25 VDC	Side
50	50 VDC	Side

For partial tube listing see our ad in November Electronics, Pg. 479

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Wellesley 5-5210-1

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Tube	Price
OY4	$ .45
OZ4	.59
O1A	.65
1A3	.70
1A5GT	.58
1A7GT	.85
1B1	.45
1B3GT	.82
1B4P	.79
1C6	.69
1D5GP	.69
1E5G	.71
1G4GT	.69
1G6GT	.69
1H5GT	.69
1H6G	.75
1J6GT	.75
1L4	.83
1LA6	.95
1LB4	.98
1LC6	.91
1LH4	.87
1LN5	.75
1N5GT	.75
1N6G	.75
1P5GT	.69
1Q5	.68
1R4	.69
1R5	.65
1S4	.69
1S5	.64
1T4	.65
1T5GT	.68
1U4	.67
1U5	.65
1V	.65
1X2A	.90
1Z2	.75
2A3	1.10
2X2	.59
2X2A	1.55
3A4	.65
3A5	.85
3D6	.45
3Q4	.63
3Q5GT	.79
3S4	.70
5T4	1.35
5U4G	.65
5U4GW	2.35
5V4G	.89
5W4	.79
5Y3GT	.49
5Y4G	.65
5Z3	.75
5Z4	.85
6A3	.95
6A6	.82
6A7	.87
6A8	.85
6A8GT	.95
6AB4	.65
6AB5	.85
6AB7	.98
6AC5	1.05
6AC7	.93
6AD7	1.29
6AE5	.89
6AF4	1.45
6AF6	.85
6AG5	.80
6AG7	1.25
6AH6	1.29
6AJ5	1.95
6AK5	1.30
6AK6	1.09
6AL5	.59
6AL7GT	1.15
6AQ5	.57
6AQ6	.85
6AQ7GT	1.02
6AR6	3.35
6AS5	.75
6AS6	3.30
6AS7	4.50
6AT6	.60
6AU5GT	1.19
6AU6	.63
6AV5	.95
6AV5GT	.95
6AV6	.55
6AX5GT	
6BA6	.63
6BA7	1.25
6BC5	.73
6BE6	.63
6BF5	1.10
6BF6	.72
6BG6G	1.59
6BH6	.90
6BJ6	.85
6BK7	.95
6BL7GT	1.25
6BQ6GT	1.20
6B4G	1.25
6B7	.95
6B8	.75
6B8G	.75
6C4	.55
6C5	.60
6C5GT	.60
6C6	.59
6C8	.85
6CB6	.72
6CD6G	1.85
6D6	.72
6E5	.79
6F5	.62
6F5GT	.62
6F6	.85
6F6GT	.80
6F7	.85
6F6G	.87
6G6G	.95
6H6	.65
6H6GT	.65
6J5	.65
6J5GT	.55
6J6	.90
6J7	.89
6J7GT	.60
6J8G	1.30
6K5GT	1.00
6K6GT	.65
6K7	.79
6K7GT	.79

Tube	Price
6K8	.85
6K8GT	.85
6L5G	.75
6L6	2.25
6L6G	1.45
6L6GA	1.45
6L7	.85
6L7G	.85
6N5	
6N7	.95
6N7GT	.85
6Q7	.79
6Q7GT	.85
6R7G	.85
6S4	.62
6S7	.85
6SA7	.65
6SA7GT	.65
6SB7Y	.90
6SC7	.85
6SC7GT	.85
6SD7GT	.85
6SF5	.75
6SF7	.75
6SG7	.75
6SH7	.75
6SH7GT	.75
6SJ7	.65
6SJ7GT	.70
6SJ7Y	.80
6SK7	.70
6SK7GT	.72
6SL7GT	.75
6SN7GT	.75
6SN7GTA	.80
6SN7GTW	2.25
6SQ7	.60
6SQ7GT	.62
6SR7	.65
6SR7GT	.67
6SS7	.80
6ST7	.98
6SU7GTY	2.70
6SV7	1.05
6T8	1.00
6U4	.75
6U5	.87
6U6GT	.85
6V6	1.30
6V6GT	.67
6W4GT	.65
6W6GT	.75
6X4	.60
6X5	.60
6X5GT	.60
6Y6G	.95
6Z4	.60
6Z5G	.60
7A4	.75
7A5	.75
7A6	.75
7A8	.75
7AF7	1.05
7B4	.75
7B7	.75
7C4	.75
7C5	.75
7C6	.80
7C7	.75
7E7	.75
7EZ5	.75
7F7	.75
7F8	1.65
7H7	.75
7L7	.85
7N7	.85
7S4	.95
7V7	.89
7W7	.95
12A6	.65
12A6GT	.65
12A7	.90
12AL5	.85
12AT6	.55
12AT7	.95
12AU6	.70
12AU7	.85
12AV6	.60
12AW6	1.20
12AX7	.90
12BA6	.69
12BE6	.69
12BH7	.90
12BN6	1.05
12C8	.69
12H6	.69
12J5	.50
12J5GT	.50
12K7GT	.75
12K8	.72
12K8Y	.90
12SA7	.78
12SA7GT	.79
12SC7	.89
12SF5	.75
12SF7	.81
12SG7	.85
12SH7	.68
12SJ7	.65
12SK7	.75
12SK7GT	.75
12SL7	.75
12SL7GT	.92
12SN7GT	.77
12SQ7	.70
12SQ7GT	.72
12Z3	.75
14F7	.85
14H7	.85
14J7	.85
19BG6G	1.83
19T8	1.05
24A	.85
25AV5GT	1.05
25BQ6GT	1.45
25C6G	1.47
25L6GT	.67
25W4GT	.68
25Z5	.65
25Z6GT	.65
27	.30
28D7	2.35
30	.30
31	.50
32	.47
35A5	.68
35B5	.67
35C5	.67
35L6GT	.67

Tube	Price
35W4	.49
35Z3	.69
35Z4	.60
35Z5	.50
36	.64
37	.59
39/44	.25
40	.69
41	.69
42	.65
43	.65
45	.75
50B5	.75
50C5	.75
50L6GT	.65
50Z7G	.75
53	.68
54	1.35
56	.55
70L7	1.35
71A	.55
75	.82
76	.55
77	.55
78	.75
79	.75
80	.60
81	.75
83	1.10
84	.75
85	.69
89	.25
101A	.50
102A	.50
117Z3	.65
300B	3.75

TRANSMITTING

Tube	Price
OA2	$1.10
OA3	1.12
OA4G	1.25
OB2	1.25
OB3	1.15
OC3	1.05
OD3	.95
OZ3	.95
KC1	350.00
VG1A	8.75
1AD4	2.05
1AG5	1.90
1AH4	2.50
ELC1B	8.75
1B21A	3.95
1B22	2.25
1B23	8.75
1B24	9.95
1B26	3.75
1B27	21.25
1B29	2.75
1B32	2.25
1B35	11.00
1B35A	17.50
1B36	16.75
1B37	19.50
1B38	39.95
1B40	9.95
1B41	45.00
1B42	15.00
1B44	37.50
1B50	32.50
1B51	12.00
1B54	37.50
1B56	37.50
1B63A	87.50
1B85	9.00
1B86	9.50
EL1C	7.55
ELC1J	9.00
1C21	2.85
1D2F	5.25
ELC1K	9.45
1L21	15.00
1L22	30.00
1L23	30.00
1L24	48.00
1L25	16.00
1L31	16.00
1L32	15.00
1L33	34.50
1L36	15.00
1L38	25.00
1N21	1.25
1N21A	1.95
1N21B	3.50
1N21C	17.50
1N22	1.65
1N23	1.35
1N23A	2.50
1N23B	3.50
1N25	5.25
1N26	7.75
1N27	4.25
1N34	.65
1N34A	.90
1N35	1.90
1N38	1.50
1N38A	1.70
1N39	4.00
1N40	7.75
1N41	11.00
1N43	1.65
1N44	.95
1N47	6.25
1N48	.70
1N51	.50
1N52	1.70
1N54	.95
1N54A	1.20
1N55	2.50
1N55A	4.00
1N56	.90
1N56A	1.20
1N57	1.10
1N58	1.20
1N58A	1.25
1N60	.60
1N61	2.25
1N63	3.70
1N64	.70
1N66	.90
1N67	2.30
1N68	2.30
1N69	1.10
1N70	3.05
1N71	6.25
1N81	1.80
1N82	1.10
1P21	50.00

Tube	Price
1P22	14.75
1P28	15.50
1P29	2.95
1P37	1.85
1P40	1.85
1P41	2.80
1P42	5.65
1Q26	100.00
1V6	5.65
2AP1	6.50
2AP1A	10.50
2AP5	9.75
2BP1	9.60
2BP11	11.00
2B22	2.45
2C21	1.25
2C22	.49
2C26A	.59
2C33	3.65
2C36	27.50
2C39	24.50
2C39A	33.75
2C40	12.00
2C43	18.00
2C44	1.45
2C46	38.00
2C50	6.50
2C51	6.25
2C52	6.25
2C53	11.50
2D21	1.90
2D21W	3.15
2E22	2.50
2E24	4.50
2E25A	5.75
2E26	3.40
2E27	2.75
2E30	2.00
2E31	2.10
2E32	1.60
2E35	2.15
2E36	2.25
2E41	3.35
2E42	2.65
2F21	105.00
2G21	2.20
2G22	2.20
2H21	100.00
2J21A	7.50
2J22	9.00
2J26	25.00
2J27	23.00
2J30	69.50
2J31	27.50
2J32	37.00
2J33	45.00
2J34	32.00
2J36	120.00
2J37	16.00
2J37A	37.50
2J38	37.50
2J39	37.50
2J40	49.50
2J48	49.50
2J49	75.00
2761	59.50
2J62	59.50
2K22	55.00
2K23	55.00
2K25	27.50
2K26	95.00
2K28	29.95
2K29	29.95
2K33	260.00
2K41	150.00
2K45	135.00
2K56	98.00
2RA3	1.95
2V3G	2.75
2X2	.75
2X2A	1.85
3AP1	12.25
3AP1A	14.00
EL3B	9.50
3B4	2.55
3B22	4.75
3B24	5.50
3B24W	7.50
3B25	6.80
3B26	6.75
3B27	4.25
3B28	7.50
3B29	14.95
3BP1	5.75
3BP1A	16.25
3CP1	4.75
3CP1S1	4.95
EL3C	8.75
3C21	5.75
3C22	98.00
3C23	11.25
3C24	1.95
3C31	3.95
3C33	21.00
3C45	18.50
3D21A	9.00
3D22	14.95
3D23	2.50
3D24	7.10
3E29	14.95
3FP7	3.95
3FP7A	14.00
3GP1	6.95
3HP7	6.95
3JP1	18.00
3JP7	21.00
3KP1	14.50
3KP11	16.50
3RP1	14.50
4-65A	19.50
4X100A	48.00
4-125A	30.00
4X150A	46.00
4-250A	40.00
4-400A	60.00
4X500A	120.00
KC4	50.00
KC4-3	39.95
4B24	8.50
4B26	11.00
4B28	6.25
4B32	11.00
4C35	32.50
4D32	22.00
4E27	22.50
4E27A	35.50
4J31	135.00
4J32	195.00
4J33	195.00

Tube	Price
4J52	195.00
4J38	195.00
C5B	4.25
5AP1	5.95
5AP4	9.95
5BP1	5.25
5BP1A	22.00
5CP1	4.50
5CP1A	22.50
5CP7	12.50
5C22	49.50
5D21	18.35
5FP7	2.50
5FP7A	12.50
5FP14	27.50
5JP1	27.50
5J29	29.95
5J32	125.00
5LP5	14.50
5RP1A	27.50
5R4GY	1.75
5R4WGY	3.25
5UP1	17.00
5UP11	22.50
6AJ5	2.95
6AK5	1.30
6AN5	3.15
6AR6	3.35
6AS6	2.95
6AS7	4.50
EL6B	11.95
6BG7	1.80
6BL6	75.00
6BM6	75.00
C6J	7.95
6C21	49.95
6C24	72.00
6D4	2.70
6J4	6.95
6K4	4.50
7BP1	10.95
7BP7	8.95
7BP12	22.50
7BP14	22.50
7CP1	22.50
10Y	.65
12DP7	17.50
12GP7	17.50
12HP7	17.50
CA13	.70
15E	1.85
15R	1.05
FG17	5.25
RK20A	9.95
PJ22	2.50
24G	1.85
CE25	4.95
RK25	6.25
25T	9.00
26A7GT	26.00
FG-27A	23.00
RK28A	15.00
28D7	2.35
FG32	15.00
FG33	23.00
RK34	85.00
35T	9.00
35TG	9.00
35TIG	9.00
RK39	14.50
TZ40	4.35
RK48A	9.95
EF50	1.30
53A	5.95
FG57	14.95
QK59	65.00
QK62	65.00
FG67	22.50
75TH	14.75
75TL	14.75
CEQ72	.85
RKR73	.75
RK75	4.25
FG81A	9.25
89Y	.95
FG95	27.50
FG97	25.00
FG98A	27.00
ML100	59.95
100-1G	24.50
100TH	11.95
100TL	19.95
FG104	24.95
FG105	24.95
VU111S	1.00
114B	2.35
ZB120	16.75
RX120A	14.50
F124A	26.50
VT127	1.95
VT127A	2.75
HF125	24.50
HF130	18.75
HF140	17.25
HF150	18.8-
FG172	29.95
HF175	19.95
HF200	28.00
HF201A	28.00
GL203A	11.00
203D	3.25
204A	69.95
207	230.00
211	1.45
211C	18.00
211D	15.25
212E	100.00
CE213	2.50
217C	10.95
GL218	225.00
RX233A	3.95
FG235A	72.50
249B	7.95
250TH	21.50
250TL	19.00
FG258A	235.00
264C	3.45
267B	
270A	99.50
FG271	57.50
FG280	59.50
282A	
284D	17.50
285A	8.95
HF300	35.00
304TH	13.50
304TL	11.95
307A	4.95
308A	55.00

Tube	Price
CE309	5.25
310A	6.50
311A	
313C	4.20
316A	3.00
319A	23.25
323B	12.50
327A	4.75
331A	3.50
S340	2.65
349A	1.35
350A	8.00
368AS	7.95
371B	1.39
388A	4.75
393A	12.50
394A	4.50
417A	17.50
446A	3.75
446B	16.75
446D	16.75
450TH	65.00
450TL	65.00
464A	8.95
471A	12.50
GL473	165.00
GL502A	1.80
530	16.95
531	8.25
532A	3.75
549	34.50
559	1.75
575A	19.95
592A	34.50
615	1.75
617	11.00
623	11.00
627	29.95
KU628	32.50
649	6.95
651/656	69.50
F660	37.95
653	9.95
672A	34.50
673	21.00
677	55.00
FG632A	
GL675	
705A	2.35
706DY	59.50
706GY	59.50
707A	18.25
707B	19.25
708A	4.75
709A	3.85
713	1.98
714AY	12.50
715	5.00
715A	5.75
715B	12.50
715C	24.50
717A	1.75
718BY	79.50
719A	42.50
721A	4.50
723AB	18.95
724A	2.75
724B	3.15
725A	9.50
726A	14.50
726B	55.00
726C	100.00
SN729	3.25
730A	28.95
801A	.85
802	4.20
803	14.95
804	16.50
805	4.95
806	17.50
807	1.69
808	6.95
809	3.50
810	13.50
811	2.95
811A	4.25
812	4.75
812A	4.75
813	13.50
814	3.25
815	2.95
816	1.50
826	1.25
828	12.50
829	9.00
829A	11.00
829B	13.95
830B	3.25
832	8.50
832A	9.95
833A	37.50
834	13.50
836	4.65
837	1.65
838	4.95
841	.65
842	3.75
843	1.26
845	13.50
846	225.00
849	59.95
851	75.00
852	27.50
857B	225.00
860	4.95
861	29.95
864	.35
865	2.35
866A	1.60
868	2.50
869B	95.00
872A	4.25
874	1.50
876	.95
878	1.95
884	1.75
885	2.00
888	1.70
889A	225.00
891	225.00
892	225.00
894	.75
905	3.95
913	15.50
917	3.25
918	2.85
919	3.25
920	3.85
921	1.95

The above listing represents only a small portion of our tremendous tube stock. Since we are unable to list our entire inventory, if your requirements are not listed, write and allow us to quote you accordingly.

Prices subject to change without notice. TERMS: Rated firms net 10 days, Non-rated 25% with order balance COD. Prices FOB Boston. Minimum order $10.00 or 10 of a type.

ELECTRO Sales Company Inc. ESCO

110 PEARL ST. BOSTON 10, MASS. Phone: LIBERTY 2-7890

INDEX SEARCHLIGHT

December, 1952

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ADVERTISERS INDEX

TO THE ADVERTISERS

December, 1952

SEARCHLIGHT SECTION
(Classified Advertising)
H. E. Hilty, Mgr.

ELECTRO—FOR ELECTRONIC SURPLUS

OIL FILLED CONDENSERS

MFD.	VOLT.	TYPE	PRICE
.01	1000 DC	24F174	$ .49
.01	4000 AC	26F789	2.95
.02	1000 DC	27F285	1.25
.02	400 DC	23F274	.39
.02	10 KVDC	24714	9.50
.045	16 KVDC	D-4495	9.95
.05	600 DC	S. T.	29
.05	1000 DC	23F328	.49
.05-.05	600 DC	S. T.	.49
.05-.05	600 DC	22F328	.69
.06	25 KVDC	26F585	17.50
.1	400 DC	481379	.45
.1	500 DC	K7876543	.49
.1	600 DC	22F415	.59
.1	1000 DC	27F287	1.05
.1	1500 DC	P70B1EH104K	1.70
.1	3500 DC	K5204513	2.95
.1	7500 DC	25F405	7.50
.1	10KVDC	23F430	9.95
.1	12 KVDC	26F68	9.95
.1-.1	230 AC	Z11860	.49
.1-.1	600 DC	22F805	.85
.1-.1	600 DC	27F291	.85
.1-.1-.1	400 DC	NCP9183	.79
.1-.1-.1	400 DC	CA-255	.79
.1-.1-.1	600 DC	6111G	.85
.1-.1-.1	600 DC	37J425	.85
.15	440 AC	5213288	.70
.15	4000 DC	400015	2.95
.15-.15	6000 DC	26F435	5.25
.15	3000 DC	Ldg. Mfgr.	6.95
.19	2500 DC	28F201	2.35
.2	440 AC	Ldg. Mfg.	.69
.2	1000 DC	23F316	.72
.2	10 KVDC	26F433	10.95
.2-.2-.2	4000 DC	10345	4.95
.25	250 AC	26F822	.69
.25	330 AC	9CE1A147	.72
.25	400 DC	DA4025	.49
.25	460 AC	26F876	.79
.25	600 DC	22F611	.69
.25	1000 DC	62B1FG254K	1.25
.25	1000 DC	27F255	1.25
.25	1000 DC	26F467	1.25
.25	1000 AC	481129	1.45
.25	2000 DC	TJU200025	1.45
.25	3000 DC	5511P	3.45
.25	3500 DC	25F637	4.95
.25	4000 DC	26F767	5.95
.25	6000 DC	25F659	7.95
.25-.25	400 DC	22F640	.79
.25-.25	600 DC	6022G	.79
.25-.25	600 DC	51B4FF254L	.99
.25-.25	600 DC	K7102019P1	.79
.3	2000 DC	25F932	1.45
.3-.3	1000 AC	21F560	1.95
.31	2000 AC	21F480	2.50
.36-.36	800 AC	25F388	1.65
.366-.127-.055	330 AC	25F683	.95
.375	250 AC	26F937	.79
.38-.38	800 AC	21F707	1.65
.4	500 AC	21F720	.79
.4-.4	800 AC	21F588	1.70
.4	1400 AC	25F934	1.70
.42	800 AC	21F331	.85
.44-.44	880 AC	21F484	1.70
.45	120 DC	Ldg. Mfg.	.65
.45-.45	800 AC	21F569	1.95
.46	1750 AC	21F573	1.95
.5	200 DC	Ldg. Mfg.	.62
.5	330 AC	25F572	.79
.5	400 DC	C59589	.69
.5	400 DC	Ldg. Mfg.	.69
.5	600 DC	22F612	.79
.5	600 DC	Ldg. Mfg.	.79
.5	600 DC	Ldg. Mfg.	.79
.5	600 DC	65B144504K	.95

MFD	VOLT.	TYPE	PRICE
.5	1000 DC	23F331	1.45
.5	1000 DC	10050G	1.45
.5	1500 DC	481294	1.65
.5	1500 DC	21F628	1.65
.5	2000 DC	26F698	1.95
.5	3000 DC	30003	3.95
.5	4000 DC	28F128	6.95
.5	5000 DC	50005	8.95
.5-.1	400 DC	481769	.70
.5-.5	300 DC	23F280	.82
.5-.5	400 DC	Top Term.	.79
.5-.5	600 DC	23F498	.92
.5-.5	600 DC	23F487	92
.5-.5	3000 DC	25F526	5.75
.5-.5-.5	600 DC	22F437	1.25
.58	1000 AC	21F476	1.65
.6	200 AC	28F120	.95
.6-.6-.6	100 AC	22F7142	1.25
.635	1300 AC	21F386	1.65
.656	900 AC	25F391	1.65
.666	800 AC	21F333	1.25
.67	120 AC	26F663	.95
.7	1300 AC	21F485	1.50
.7-.7	800 AC	21F381	1.95
.7-.7	300 AC	21F718	1.95
.75	330 AC	9CE1A148	.95
.75	400 DC	28F168	.89
.8	120 AC	21F603	.89
.86	660 AC	21F336	.95
1.0	100 DC	54B1EB105K	1.25
1.0	500 DC	23F303	.95
1.0	500 DC	9CD6A4	.95
1.0	440 AC	9CE1A320	1.05
1.0	600 DC	62B1BF105K	1.15
1.0	600 DC	Bathtub	.89
1.0	600 DC	Ldg. Mfg.	1.05
1.0	1000 DC	Ldg. Mfg.	1.85
1.0	1150 AC	21F641	1.75
1.0	1500 DC	15010	2.25
1.0	2000 DC	23F70	2.95
1.0	4000 DC	40010	8.95
1.0-1.0	600 DC	Bathtub	1.25
1.0-1.0	600 DC	23F569	1.65
1-1-3-5	150 DC	Ldg. Mfg.	.95
1.05	800 AC	21F592	1.25
1.1	200 AC	25F450	1.25
1.1	440 AC	26F853	1.30
1.1	720 AC	21F477	1.65
1.25	125 AC	26F594	1.45
1.25	125 AC	28F192	1.45
1.25	660 AC	21F713	1.65
1.26	440 AC	21F338	1.45
1.26-.25	1000 AC	21F850	.95
1.26-3.0	1000 AC	21F714	.95
1.35	125 AC	28F238	1.49
1.45	750 AC	Ldg. Mfg.	1.55
1.45-2.8	850 AC	Ldg. Mfg.	1.55
1.5	330 AC	25F483	1.55
1.5	660 AC	21F651	1.75
1.58-0.3	800 AC	21F671	.95
1.66	850 AC	21F697	1.75
1.75	150 AC	28F159	1.55
1.75	330 AC	21F174	1.75
1.75	660 AC	21F631	1.95
2.0	120 AC	1A931	1.45
2.0	220 AC	21F169	1.65
2.0	330 AC	Ldg. Mfg.	1.70
2.0	400 DC	Bathtub	1.45
2.0	600 DC	Ldg. Mfg.	1.70
2.0	600 DC	22F999	1.70
2.0	250 AC	25F150	1.68
2.0	660 AC	25F993	1.85
2.0	800 AC	21F835	1.90
2.0	1000 DC	Ldg. Mfg.	2.95
2.0	1500 DC	Ldg. Mfg.	3.95
2.0	2000 DC	20020	4.95
2.0	2500 DC	Ldg. Mfg.	6.45

MFD.	VOLT.	TYPE	PRICE
2.0	3000 DC	Ldg. Mfg.	10.95
2.0	4000 DC	22F985	14.95
2.0	5000 DC	23F50	17.50
2.0	6000 DC	60020	27.50
2.0-.5-.3	200 DC	355	.95
2.2	750 AC	21F563	1.75
2.25	330 AC	21F479	1.85
2.25	600 DC	Ldg. Mfg.	1.85
2.25	1600 AC	21F667	4.50
2.5	330 AC	Ldg. Mfg.	2.35
2.6	440 AC	21F744	2.35
2.6-0.4	440 AC	21F676	1.75
2.7	230 AC	Ldg. Mfg.	2.45
2.75	330 AC	25F983	2.50
2.75	385 AC	49F16	2.60
3.0	330 AC	Ldg. Mfg.	2.75
3.0	600 DC	F6030	2.25
3.0	1000 DC	Ldg. Mfg.	3.45
3.0-.05	600 DC	22F632	1.65
3.25	330 AC	25F378	3.15
3.26	230 AC	21F696	2.75
3.5	330 AC	21F587	3.45
3.5	660 AC	25F971	3.95
3.7	230 AC	49F9	3.45
3.7	230 AC	21F705	3.45
3.75	330 AC	Ldg. Mfg.	3.50
3.75	1000 DC	6037	3.75
3.9	230 DC	Ldg. Mfg.	3.50
4.0	100 DC	23F548	1.95
4.0	330 AC	Ldg. Mfg.	3.65
4.0	400 DC	Oil Filled	2.50
4.0	500 DC	Oil Filled	2.65
4.0	600 DC	26F106	2.75
4.0	600 DC	70B1FF405V	1.45
4.0	600 DC	481249	2.75
4.0	660 AC	21F665	3.95
4.0	1000 DC	Oil Filled	3.75
4.0	2000 DC	22F195	8.75
4.0	4000 DC	70E1EM405K	27.50
4.0-4.0	1000 DC	4223	5.25
4.5	230 AC	21F703	3.95
4.5	330 AC	21F691	4.25
4.65	230 AC	21F365	3.95
5.0	220 AC	21F134	4.35
5.0	330 AC	9CE1A306	4.35
5.5	230 AC	21F702	4.40
5.75	330 AC	26F100	4.50
5.0	440 AC	21F420	4.75
6.0	330 AC	3060	4.85
6.0	600 DC	5060	4.85
6.5	330 AC	Ldg. Mfg.	4.95
7.0	230 AC	21F300	4.95
7.5	330 AC	9CE1A309	4.95
8.0	660 AC	6080	5.25
8.0	1000 DC	Oil Filled	5.25
9.5	330 AC	26F273	4.95
10.0	50 AC	26F412	2.75
10.0	330 AC	Oil Filled	5.95
10.0	440 AC	25F501	5.95
10.0	600 DC	Ldg. Mfg.	5.95
10.0	1000 DC	10100G	7.95
10.0	1500 DC	23F152	8.95
10.0	1500 DC	70B1FH106K	8.95
12.0	750 AC	25F268	8.95
12.0	1000 AC	25F234	8.95
14.5	275 AC	25F500	7.50
15.0	330 AC	Ldg. Mfg.	9.50
20.0	220 AC	21F299	9.50
25.0	25 DC	Bathtub	.95
25.0	50 DC	Bathtub	1.45
30.0	90 AC	Ldg. Mfg.	2.65
30.0	400 DC	26F702	9.95
42.0	600 DC	25F673	17.50
46.2	330 AC	26F413	24.50
50.0	330 AC	KS8545	27.50
50-50-50	90 AC	MK4	29.95
50.0	600 DC	Leading Mfg.	22.50

BATHTUB CONDENSERS

Mfd.	WVDC	Term.	Price
25	25	Top	$0.65
5	50	Bot.	.49
25	50	Side	.69
25	50	Top	.69
1	100	Side	.25
40	100	Side	.79
2x.1	200	Side	.25
.25	200	Side	.29
.5	200	Side	.35
1	200	Top	.39
2x.5	230AC	Side	.49
3x.1	400	Side	.45
.25	400	Top	.35
2x.25	400	Side	.39
.5	400	Bot.	.35
.5	400	Side	.39
.5	400	Top	.39
2	400	Side	.60
3x.01	600	Top	.39
.02	600	Top	.25
.05	600	Side	.20
2x.05	600	Top	.29
.1	600	Top	.35
.1	600	Side	.35
2x.1	600	Side	.39
2x.1	600	Bot.	.39
.2	600	Top	.25
.25	600	Side	.39
2x.25	600	Bot.	.49
2x.25	600	Top	.49
2x.25	600	Side	.49
.5	600	Bot.	.47
.5	600	Side	.47
.5	600	Top	.47
2x.5	600	Bot.	.59
2x.5	600	Side	.59
2x.5	600	Top	.59
1	600		.69
2	600		.95
.1	1000	Top	.39

MINE DETECTOR SCR 625

Detects metallic objects (ferrous or nonferrous) to depth of approx. 6 ft. Find outboard motors on the bottom of lakes, locate underground piping, treasure, metallic fragments in lumber, etc. New, complete with inst. book. **$65.00.** Used but like new, **$45.00.**

HIGH VOLTAGE CAPACITORS

Cat. #	Mfd.	WVDC	Price
18F269	60	3KV	$65.00
QLXP30	120	3KV	87.50
22F985	2	4KV	14.95
PFD40244G	7	4KV	42.50
14F1	4	5KV	42.50
14F2	7	5KV	52.50
19F210	0.1	6KV	37.50
A7548	2x.25	6KV	17.50
TK60020	2	6KV	27.50
1227192	2x.275	7.5KV	27.50
7520	2x1.0	7.5KV	27.50
26F360	2x1.25	7.5KV	29.95
14F338	4.5	7.5KV	79.50
CC21B	2x0.5	9KV	32.50
10020	0.1	10KV	9.95
Inerteen	1.0	10KV	37.50
26F68	0.1	12KV	9.95
TK120065	.65	12.5KV	19.95
15020	.25	15KV	19.50
14F17	1	15KV	49.95
14F63	1	15KV	49.95
14F18	1.5	15KV	62.50
20020	.25	20KV	27.50
14F64	.25	20KV	27.50
37485	.25	20KV	27.50
26F585	.06	25KV	17.50
XSW200	.25	20KV	27.50
20005	0.5	20KV	45.00
14F22	1.0	20KV	72.50
14F139	.01	22KV	15.50
Inerteen	.5	25KV	57.50
25020	.5	25KV	57.50
14F24	.5	25KV	57.50
14F88	.75	25KV	72.50
Interteen	1.0	25KV	82.50
A6734	1.0	25KV	82.50
Inerteen	.25	32.5KV	42.50
14F112	.001	50KV	42.00
14F98	.025/.025	50KV	59.50
14F127	.025	50KV	45.00
14F126	.2	50KV	67.50
14F97	.25	50KV	72.50

SPECIALS OF THE MONTH

BATTERIES, wet cell. 8 volt, 15A. Non-spill. Made up from 4 cells 2 volts ea. **$7.95**

RELAYS, Allen-Bradley. #89309, 24 VDC, SPST, NO, Dbl. Brk. 100A. **$2.50 ea** **$2.00**/C Lots

RELAYS, Allen-Bradley #95545(B6B) 24 VDC, SPST, NO, Dbl. Brk. 200A **$2.50 ea** **$2.00**/C Lots

RELAYS, G.E. Type CR2791B100F3 24 VDC, DPDT, 10A **$1.75 ea, $1.00** /C Lots

WIRE, W11B, 1 Mile Reels. 2 cond. #19 twisted pair on metal reel **$14.95**

TRANSFORMERS, modulation, Thordarson T47420A. Pri: 1500–750 Ohm. D.B. level 250W. Ratio: 1 to 2.33–3.27. Cycles per sec: 90 to 20,000. 13¾"L. 9½H, 7½"W. 100# **$15.00**

HEAVY DUTY COPPER OXIDE RECTIFIERS

Hammett Model 1 SPS-130. Input AC: 208/230V 60 cy 3ph 21A Output DC: 28 volts @ 130A Cont. Duty. Output voltage variable by means of power tap switch Complete with indicating meters on front panel. Self Cooled Schematic available. Brand new Export Packed **$297.50**

GP-7 Radio Xmtr. Complete w/6 Tuning Units & all accessories. Freq. Range: 350–9050 Kcs. Tube Complement: (1) 803, (1) 801, (1) 843, (1) 5Z3, (2) 1616 and a full set of spares. 100W output. Brand New export boxed. Gross Wt. 450 Lbs. **$149.50**

RA38 POWER SUPPLIES

Available from stock. Quotation upon request.

INVERTER

PU-16/AP Inverters. Input 28VDC 60A; Output 115V 400cy 6.5A 8000 RPM 750VA **$89.50**

PU-7/AP Inverters, Input 28VDC 160A; Output 115V 21.6A 400cy 8000 RPM 2500 VA **$89.50**

PE218 Inverters, Input 28VDC 100A; Output 115V 400cy 1500VA **$39.95**

PE109 Inverters, Input 13.5VDC 29A; Output 115V 400cy 1.53A 8000 RPM **$59.95**

G.E. Amplidyne 5 AM 31NJ9A **$29.95**

G.E. Amplidyne 5 AM 31NJ18A **$19.95**

Pioneer 10047-2A Servo Motor, 2ph. 400cy. w/40:1 reduction gear **$14.95**

W. E. Sine Wave Motor Generator, KS-5913LO2, Mtr. 115V 60cy 1ph 1/50hp 1725RPM; Generator 16V 2ph 1725 RPM **$17.95**

Transtat Voltage Regulators, 11.5 KVA 50/60cy. Commutator Range 0–115V. Max Amps: 100. Reconnection Diagram available for 220V 50A operation **$225.00**

TRANSTAT, 0.25KVA. Fixed Winding 115/1/60. Commutator Range 103–126V Max Amps: 2.17 **$8.95**

F.O.B. Boston, minimum order $5.00.

ELECTRO Sales Company Inc. ESCO
110 PEARL ST. BOSTON 10, MASS. Phone: LIBERTY 2-7890

WANTED! WANTED!

Needed for Government Defense Projects—all types of military electronic gear with the prefix TS, BC, SCR, APR, APS, etc. Highest prices paid or will exchange for your needs. No offer too small or too large.

WRITE! WIRE! CALL!

TEST EQUIPMENT

TS-34/AP SYNCRO-SCOPE AND OSCILLO-SCOPE.

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.

TS-3/AP—S-Band Power Frequency Meter
TS-10/AP—APN-1 Test Set
TS-12/AP—X-Band V.S.W.R. Test Set
TS-13/AP—X-Band Signal Generator
TS-14/AP—S-Band Signal Generator
TS-15/AP—Flux Meter
TS-16/AP—APN-1 Test Set
TS-18/AP—Capacity Divider
TS-23/APN—SCR-718 Test Set
TS-33/AP—X-Band Frequency Meter
TS-35/AP—X-Band Test Set
TS-36/AP—X-Band Power Meter
TS-45/APM-3—X-Band Signal Generator
TS-59/APN—APN-1 Test Set
TS-61/AP—S-Band Echo Box
TS-62/AP—X-Band Echo Box
TS-69/AP—300-1000 MC Frequency Meter
TS-89/AP—Pulse Voltage Divider
TS-98/AP—Pulse Voltage Divider
TS-102/AP—Range Calibrator
TS-111/AP—S-Band Wavemeter
TS-118/AP—Power Meter
TS-125/AP—S-Band Power Meter
TS-155/UP—S-Band Signal Generator
TS-164/AP—Frequency Meter
TS-170/ARN-5—I.L.S. Test Set
TS-184/AP—Test Set
2S-226/AP—300-1000 MC Power Meter
TS-268/UP—Crystal Test Set
TS-278/AP—APS-13 Test Set
IE-19—SCR-522 Test Set
IE-36—SCR-522 Test Set
BC-221—Frequency Meter
BC-1277—S-Band Signal Generator
TBN/3EV—Thermistor Bridge
CW/60/ABM—S-Band Frequency Meter

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

RECEIVING TUBES

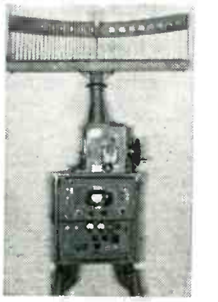
OA2	$0.95	6AK5	$0.88	6ST7	$0.98
OA4G	1.05	6AK6	1.09	6SU7GTY	2.75
OB2	1.05	6AL5	.52	6SV7	.98
OZ4	.59	6AQ5	.57	6V6	1.55
1A3	.70	6AQ6	.85	6V6GT	.65
1A7GT	.80	6AR5	1.25	6W4	.65
1B3/8016	.82	6AT6	.65	6X4	.65
1C5GT	.75	6AU5	1.19	6X5GT	.65
1D8GT	.65	6AU6	.59	6Y6G	.95
1G6GT	.65	6AV6	.55	6Y7G	.75
1L4	.67	6B4G	1.25	7A6	.75
1LA4	.85	6B7	.95	7B7	.75
1LA6	.95	6B8G	.75	7C5	.75
1LB4	.98	6BA6	.65	7C7	.75
1LC5	.75	6BC5	.75	7F7	.75
1LC6	.91	6BE6	.65	7N7	.85
1LN5	.75	6BF6	.72	7Y4	.59
1N5GT	.75	6BG6G	1.89	12A6	.65
1P5GT	.69	6GH6	.95	12A7	.90
1R4	.69	6BJ6	.95	12AH7GT	1.19
1R5	.65	6BQ6	1.25	12AT6	.55
1S4	.69	6C4	.55	12AT7	1.10
1S5	.65	6C5	.60	12AU6	.75
1T4	.65	6C6	.59	12AU7	.88
1U4	.67	6C8G	.85	12BA6	.69
1V	.65	6D6	.72	12C8	.69
1X2	.96	6D8	.85	12H6	.69
2A3	1.10	6E5	.79	12K8	.72
2X2	.50	6F6	.85	12SA7GT	.79
2X2A	1.55	6F7	.85	12SC7	.85
3A4	.65	6H6	.65	12SG7	.85
3A5	.85	6H6GT	.65	12SJ7GT	.65
3B7/1291	.42	6J5	.75	12SK7GT	.80
3D6/1299	.43	6J5GT	.55	12SL7GT	.75
3Q4	.63	6J6	.95	12SN7GT	.85
3Q5GT	.79	6J7	.95	12SQ7GT	.72
3S4	.74	6J7G	.60	12SR7	.72
3V4	.74	6K6GT	.65	14B6	.75
5R4GY	1.65	6K7	.79	14H7	.85
5T4	1.32	6K8GT	1.15	25L6GT	.65
5U4G	.69	6L6	2.25	25Z5	.65
5V4G	.98	6L6G	1.50	25/6GT	.68
5W4	.79	6L6GA	1.50	41	.69
5Y3GT	.45	6L7	.85	43	.68
5Y4G	.67	6N7GT	.85	45	.75
5Z3	.85	6R7	.79	50A5	.89
5Z4G	.95	6SA7GT	.65	50B5	.75
6A3	.95	6SC7	.95	50C5	.67
6A6	.82	6SF7	.75	50L6GT	.65
6A7	.89	6SG7	.75	50Y6	.72
6A8GT	.95	6SH7	.65	53	.68
6AB7	.98	5SJ7	.75	75	.82
6AC5GT	1.0[illegible]	6SK7GT	.72	80	.65
6AC7	.95	6SL7GT	.75	83	.95
6AG5	.75	6SN7GT	.75	83V	.92
6AG7	1.45	6SQ7	.65	84/6Z4	.75
6AH6	1.29	6SR7GT	.68		
6AJ5	1.95	66SS7	.80		

R·H·S

RELIABILITY! HONESTY! SERVICE!

RADAR

APA-10—Panoramic Adaptor
APA-17—Automatic Direction Finder 250-1000 MC
APQ-5—Low Altitude Tracking & Bombing Equip.
APR-1—Radar Search Receiver 40-3400 MC
APR-2—Radar Search Receiver 85-1000 MC
APR-4—Radar Search Receiver 38-4000 MC
APR-5—Radar Search Receiver 1000-3100 MC
APR-6—Radar Search Receiver 3000-6000 MC
APS-2—S-Band Search Radar
APS-3—X-Band Search Radar
APS-4—X-Band Search & Homing Radar
APS-6—X-Band Search & Gun Laying Radar
APS-15A—X-Band Blind Bombing Radar
APR-4—Radar Jamming Xmitter 165-780 MC
APT-5—Radar Jamming Xmitter 350-1400 MC
SO-13—S-Band Marine Radar, Lightweight
SQ—10 CM Portable Radar
TPS-1—Portable Search Radar
TPS-3—L-Band Search Radar
UPN-1 & 2—S-Band Portable Beacon Battery or 110v AC



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.I.

MOBILE POWER PLANT

(GAS DRIVEN)

Output: 220v — 3KW — 60 cyc. One phase. Excellent condition, checked out.

RA-34—Power Supply for BC-375E
RA-62—Power Supply for SCR-522
BC-1016—Ink Tape Recorder
PE-103—Dynamotor Power Supply
PE-104—Vibrator Power Supply
GN-58—Hand Cranked Generator W/Legs & Seat
SCR-578—Gibson Girl (Emergency Xmitter)
CRT-3—Victory Girl Dual Freq. Emergency Xmitter Sound Powered Chest & Headsets MI-2454-B; Type O, Mfg. RCA.
AS-32/APX-1—Antenna
ANICRC-7—V.H.F. Handi-Talkies 112MC Xtal Controlled.
MN/26-Y—Compass Receiver
BC-733D—Receiver with Tubes
C-3—Navy Snooperscope in Carrying Case
BC-1284—Lighthouse Tube Preamplifier
BC-996—Interphone Amplifier
RL-42—Motor Antenna Reel
30 MC—I.F. Strips Using 6AK5
RD-7/APA-23—Recorder for APR
AS-27/ARN-5—Antenna
ARA—Receiver—500-1500 KC
ID/80-APA-17—Indicator
R-28/ARC-5—Receiver—100-156 MC
RM-29—Remote Control
BC-455—Receiver—6-9 MC
BC-454—Receiver—3-6 MC
BC-800—Transmitter/Receiver
BC-950—Transmitter—100-156 MC
RA-300—FM Exciter (Mfg. Tempco)
FL-8—Filter
FL-5—Filter, Less Cables
3C-16-D GSAP—Gun Camera Computers with All Accessories; in Carrying Case
AT-2A/APN-2—Antenna

SPARE PARTS AND COMPONENTS AVAILABLE FOR MANY EQUIPMENTS

ALL EQUIPMENT SOLD IS CAREFULLY RECONDITIONED AND CHECKED OUT TO ORIGINAL SPECIFICATIONS IN OUR OWN SHOPS USING FINEST LAB TYPE TEST EQUIPMENT

THESE COMPLETELY EQUIPPED SHOPS AND OUR EXPERIENCED TECHNICAL STAFF ARE AVAILABLE FOR GOVERNMENT PRIME OR SUBCONTRACT WORK OR PRIVATE COMMERCIAL ORDERS ON ANY TYPE OF COMMUNICATIONS OR RADAR APPARATUS.

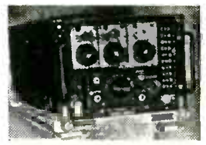
PANEL METERS

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

COMMUNICATIONS

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.

APA-11—Pulse Analyzer
APN-1—Airborne Radio Altimeter
ARC-4—VHF Transceiver 140-150 MC
ARN-5—Glide Path Receiver
ARN-7—Airborne Directional Finder
ARR-2—Homing & Receiving Equipment
ART-13—Collins Autotune Transmitter
BC-223—30-Watt Transmitter 2-5.2 MC
BC-342—Receiver—1.5 to 18 MC 110v AC
BC-348—Receiver—1.5 to 18 MC 28v DC
BC-375E—Radio Transmitter
BC-639—VHF Receiver 100-156 MC
BC-640—VHF Transmitter 100-156 MC
BC-1206—Beacon Receiver 200-400 KC
RC-103—Airborne Localizer Receiver
SCR-269—Radio Compass
SCR-274N—Command Equipment
SCR-284—Field Radio Station
SCR-291—Semi-Portable Direction Finder
SCR-300—Field Transmitter and Receiver
SCR-522—VHF Transmitter and Receiver
SCR-536—Handi-Talkie
SCR-555—Semi-Portable Direction Finder
SCR-694—Portable Field Transceiver
SCR-625—Mine Detector
SCR-718A-AM-C—High Altitude Altimeter
T-50—Radio Telegraph Transmitter
TCS—Marine Telephone Transceiver

XMITTING TUBES

OA3/XR75	$1.04	15R	$0.69	866A	$1.3
OB3/VR90	1.19	28D7	11.95	866JR	1.2
OC3/VR105	1.19	30 Spec	.45	869B	65.00
OD3/VR150	.95	35T	3.25	872A	2.95
1B23	9.75	45 Spec	.32	874	1.19
1B24	9.75	100TH	7.95	878	1.59
1B27	14.95	211	.65	885	1.39
1B29	2.45	250TH	19.95	902A	9.95
1N21B	3.25	250TL	17.95	918	1.18
1N23	1.25	262B	3.95	922	1.25
1N23A	2.39	274B	2.95	923	.95
1N23B	3.69	304TH	8.95	927	1.05
1N34	.76	304TL	8.95	930	.95
1N34A	.97	307A/RK75	3.95	931A	4.45
2AP1	10.95	316A	.65	954	.25
2C40	7.50	328A	8.95	955	.35
2C43	14.95	350A	6.45	956	.35
2C44	1.19	350B	3.95	957	.39
2C46	7.95	368AS	7.50	958	.49
2C51	6.25	371A	.95	959	3.95
2D21	1.35	371B	.69	991/NE16	.35
2E22	1.75	393A	7.95	1603	7.95
2E24	4.65	394A	3.95	1613	.39
2E26	3.15	417A	8.75	1616	.69
2K25/723AB	28.75	434A	27.50	1619	.24
2K28	32.50	446A	1.15	1622	2.45
2K33A	310.00	446B	3.75	1624	1.45
3AP1	9.95	575A	15.75	1625	.35
3B24	5.25	701A	5.75	1626	.25
3B24W	7.95	703A	5.25	1629	.25
3B26	3.59	705A	1.65	1630	.75
3BP1	5.95	707B	13.95	1632	.72
3C22	115.00	714AY	7.95	1638	.45
3C24/24G	1.75	715A	6.39	1851	1.58
3C45	15.95	715B	8.75	2051	1.18
3CP1	1.95	715C	19.95	5670	6.95
3CP1S1	1.95	717A	.98	8008	5.95
3DP1	4.45	721A	2.45	8011	.90
3DP1A	6.95	723A	9.50	8012	2.65
3DP1-S2A	8.95	723A/B	19.95	8013	2.59
3D21A	3.25	724B	3.25	8020	.98
3E29	13.95	725A	6.75	9001	1.50
3FP7	1.65	726A	18.95	9002	.98
3GP1	4.39	730A	29.50	9003	1.65
4-125A	27.50	800	1.75	9004	.35
4-250A	37.50	802	3.95	9005	1.45
4AP10	4.45	803	3.25	9006	.27
4C35	27.50	804	11.75	C1JA	9.95
4E27	14.95	805	3.75	C6A	7.95
5AP1	3.45	806	24.95	C6J	6.39
5AP4	3.45	807	1.59	CK1005	.48
5BP1	4.45	808	2.69	F123A	7.75
5BP4	4.45	810	9.50	F127A	27.50
5CP1	4.59	811	2.85	F128A	89.50
5CP7	11.75	812	2.75	FG17	4.89
5D21	19.95	813	11.75	FG27A	4.95
5FP7	1.85	814	2.69	FG32	8.95
5GP1	4.85	815	2.35	FG57	14.95
5JP1	24.45	816	1.05	FG81A	3.49
5JP2	22.50	826	.69	FG105	17.95
5LP1	22.50	828	9.95	FG172	33.50
5NP1	5.50	829	10.95	GL434A	29.95
6AN5	3.30	829B	12.95	GL502A	1.79
6AS6	2.50	830B	2.75	HF100	8.95
6AS7	4.45	832	6.75	HF300	22.45
6C21	21.00	832A	8.50	HY114B	.69
6J4	6.75	836A	3.49	HY115	.69
7BP7	6.55	837	1.45	ML101	47.50
7DP4	14.50	838	2.25	REL21	1.95
9LP7	4.95	845W	4.25	RK60/1641	2.25
10BP4	17.45	849C	27.50	RK65	26.50
10Y	.39	851	47.50	RK72	.48
12DP7	14.75	860	3.95	VT127A	2.45
15E	1.35	861	22.50	WL616	34.50
		865	.98		

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MICA CAPACITORS

Brand NEW Made to Rigid Gov't Specs.

Fig. B. .001 mf. 10c; .006 mf. 23c; .01 mfd. 35c
Fig. C. Solder Lug Terminals & Mtg Holes

Mfd.	Each	Mfd.	Each
600 WV		600 WV	
.0001	$0.29	.03	1.19
.001	.42	1200 WV	
.002	.45	.002	.66
.004	.53	.004	.68
.005	.55	.005	.71
.006	.59	.01	.78
.008	.63	2500 WV	
.01	.66		
.02	$0.76	.00047	.59

Fig. D. Screw Term & Mtg.

Mfd.	Each	Mfd.	Each
600 WV		1200 WV	
.0001	$0.29	.01	$0.78
.00055	.37	.013	.89
.00085	.42	.03	1.89
.0012	.44	.033	2.39
.003	.49	2500 WV	
.005	.54	.0004	.59
.015	.71	.002	1.09
.02	.78	.0022	1.09
.03	1.19	.0024	1.13
.033	1.29	.0035	1.19
.039	1.98	.0036	1.19
.04	2.09	.0043	1.29
.05	2.39	.005	1.45
1200 WV		.006	1.55
.001	.61	.01	1.89
.002	.66	.015	2.19
.0051	.71	3000 WV	
.0068	.75	.005	1.65

Fig. E. Upright Xmtg Micas

Mfd.	Each	Mfd.	Each
250 VDC		.0001	$1.08
.05	$0.47	.0003	1.15
.2	2.59	.0007	1.19
1500 VDC		.0055	1.39
.04	.89	3000 VDC	
.05	1.08	.0055	1.35
2000 VDC		.008	1.79
.003	1.08	3500 VDC	
.005	1.19	.000033	.78
.006	1.25	5000 VDC	
.01	1.39	.000082	1.65
.015	1.68	.0001	1.79
.02	1.98	.00015	2.29
.03	2.35	.00018	2.39
2500 VDC		.0003	2.75
.0025	1.08	.00043	2.85
.006	1.65	.0006	3.59
3000 VDC		.001	3.89
.00005	.78	.01	4.79

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INPT 6VDC, Output 200V/100ma, or 12/24V Output 500V/50ma P' Magnt. As Illustrated .. 6.95
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DA3A 28V/10.5A out 300VDC/260ma 150VDC/10ma, 14.5vdc/.5A 6.75
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FE97 Plate Supp.. Less Tubes 9.98

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Pliers, 6" Side Cutter 89c
Pliers Linesmans 7" Heavy Duty 79c
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Special 98c

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2J1F3 GE Brand New 115V/400 cy. ea. 9.75
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Bendix Autosyns AY1 & AY5 .... 2 for 4.95
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100 MMF 7.5KV GE 5.98
12 MMF 20KV Jennings 9.98
50 MMF 20KV Jennings 12.98
12 MMF 32KV Eimac 14.98

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831SPN/PL259A Plug $0.65 .... 10 for 5.50
831SP/PL259 Plug $0.50 .... 10 for 4.75
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CORD same as above 8 ft $1.29; 12 ft long. 1.49
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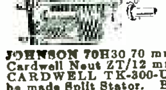

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0.42	275	1250	3384	16800	115000
0.425	280	1260	3500	17000	116667
0.607	286	1300	3509	17500	120000
0.7	289	1350	3600	17977	130000
1.03	299	1355	3700	18000	135000
1.3	300	1400	3730	18300	140000
1.75	310	1488	3760	18380	141000
2.5	311.5	1495	3900	18500	145000
3	320	1500	4000	18800	147000
3.83	325	1510	4030	19000	150000
4	330	1518	4200	19500	155000
4.35	340	1600	4220	20000	160000
5	350	1640	4280	20441	165000
5.025	360	1646	4300	20500	166750
6.25	366.6	1650	4314	21000	167000
6.5	370	1670	4440	21500	169200
7	375	1680	4444	22000	175000
7.8	380	1710	4500	22500	180000
7.9	389	1712	4700	22990	180600
8	390	1740	4720	23000	185000
10.38	400	1770	4750	23150	186600
11.25	410	1800	4850	23325	190000
12	414.3	1818	4885	23400	198000
13.52	418.8	1830	4900	23500	200000
14.2	425	1850	5000	24000	201000
14.25	426.9	1865	5100	24600	205000
14.5	427	1892	5210	25000	210000
15	430	1894	5235	25200	215000
16	440	1895	5270	25400	220000
17	450	1896	5300	25833	225000
19	452	1897	5500	26000	229000
19.2	460	1898	5600	26500	230000
20	470	1899	5730	26800	235500
22	475	1900	5770	27000	238000
23	478	1901	5910	27500	240000
24	480	1902	6000	28000	245000
25	487	1903	6100	28430	250000
26	500	1904	6125	28500	265000
28	510	1905	6140	29000	268000
30	520	1906	6200	29500	270000
31.5	525	1907	6300	29990	275000
37	540	1908	6495	30000	294000
48	550	1909	6500	31000	300000
49	560	1910	6800	31500	307500
50	575	1911	6840	32000	311000
51.78	580	1912	6990	33000	314000
55	588	1913	7000	35000	316000
56.7	600	1914	7320	36000	325000
60	612	1915	7500	37000	330000
63	620	1916	7700	38140	333500
68	625	1917	7717	38500	350000
74	633	1918	7900	39000	353500
75	640	1919	7930	39500	375000
80	641	1922	7950	40000	380000
81.4	645	1924	8000	41400	390000
88	649	1926	8094	42000	400000
89.8	650	1960	8200	43000	402000
95	657	1980	8250	45000	420000
100	665	2000	8500	47000	422000
101	670	2045	8700	47500	425000
103.2	673	2080	8770	48000	430000
105	675	2095	9000	48660	450000
105.7	680	2141	9100	49000	458000
107	681	2142	9445	50000	470000
110	684	2145	9500	51000	472000
120	689	2150	9710	52000	478000
121.2	697	2160	9800	55000	500000
125	699	2180	9900	56000	510000
130	700	2187	9902	57065	520000
135	711	2195	10000	58333	521000
147.5	733	2200	10430	60000	525000
150	740	2250	10500	61430	543000
160	750	2300	10600	62000	550000
165	800	2400	10900	64000	560000
170	806	2450	10936	65000	570000
175	820	2463	11000	66600	575000
179	850	2485	11400	66650	600000
180	854	2490	11500	67500	620000
182	899	2500	11690	68000	650000
182.4	900	2525	12000	70000	654000
200	910	2600	12500	72000	660000
209.4	917	2625	12800	73500	680000
210	946	2635	13000	75000	690000
216	978	2700	13100	80000	700000
220	1000	2750	13500	82000	750000
220.4	1030	2850	13550	84000	761300
225	1056	2860	13600	85000	800000
230	1059	2870	14000	85750	813000
235	1067	2900	14250	88000	820000
240	1100	3000	14400	90000	850000
245	1110	3100	14500	91000	860000
245.4	1150	3163	14550	93000	900000
250	1155	3259	14600	93300	910000
260	1162	3290	15000	95000	930000
270	1200	3300	16000	100000	950000

Any Size Above, Each 35c; Ten for $3.29

MEGOHMS

1.	1.579	2.7	4	6.7	10
1.1	1.65	2.75	4.23	7	11.55
1.2	1.75	2.8	4.25	7.5	12
1.25	1.8	2.855	4.5	7.62	12.83
1.3	1.9	3	5	7.74	13
1.35	2	3.3	5.1	8	13.85
1.39	2.11	3.5	5.5	8.02	30
1.4	2.2	3.673	6	8.5	51
1.5	2.25	3.75	6.5	9.05	
1.57	2.5	3.9	6.6	9.5	

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Vacuum Precision HiVolt Resistors

Megohms — .12/.25/.6/.75/.83/.99/1/1.5/2/3/3.75 ½% Accy .... Ea. $1; .... Ten for $7.50

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10 Amp/130vacdc Csd USN 0.1 to 1000 Mc's $1.29
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2 for $6.00
50 Amp/600vac/250vac. Fltrs both sides of line. SOLAR "Elim-O-Stat" New $9.98
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926B-5, 926B-16, 926B, 929-1, 930-19, 926B-19, 926A-10 .... 5 for $1.00

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BROKEN KEYS OR CRACKED BASE ELECTRICALLY PERFECT & GTD.
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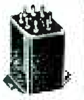

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15000V AS V'DBLR WE. SIG 3H5629/7500V/35MA 19.95

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42.5V/2A SEL RECT TRANS 4.85
INPT 110 & 220 V., OUTPT 12.6 VCT/3.5A, 16.6V/1.25A 6.98

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10BP4 .... $13.98
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Your old pict. tube is worth money, write for trade-in-allowance toward RMA coded and dated tubes with one year guarantee. Ship your defective picture tubes prepaid only.
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(4) 36V BATTERIES W/Acid 3.35
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Acid is Shipped in Bottles. R'Exp only

SHARPENING STONE

INDISPENSABLE for Lab or Workshop. Finest Silicon Carbide No. 124 Carborundum Co. Unsurpassed for Precision Grinding of Crystals Knives, Fine Tools—6" x ⅝". A $2.00 VALUE. —ONLY .... 45c; 3 for $1.00

FUSES & HOLDER

3AG: 1/8, 1/4, 1/2 Amp. 5c; 100 for 3.98
3AG: 1, 1 1/2, 2, 3, 4, 15, 20 Amp. Each 3c; 20 for 50c; 100 for 2.49
3AG: Slo-Blo; 10, 20 Amp. 12 for 1.00
4AB: BUSS 10 Amp. 7c; .. 100 for 5.98
4AG: ¼, ¾ Amp. 7c; ..... 100 for 5.98
4AG: 3, 5, 10, 15 Amp. Ea. 5c; ..... 100 for 3.98
4AG: Slo-Blo: 3, 10, 15, 20 Amp. Ea. 9c; 100/7.98
5AB: BUSS, Littelfuse, 5 Amp. Ea. 4c; 100/3.00
5AG: 35, 80 Amp. Ea. 5c; .... 100 for 3.98
7AG: 0.2 Amp. Littelfuse. Ea. 9c; .. 100 for 7.98
8AG: 1/32, 2/10, 1/2 Amp. Ea. 8c; ... 100 for 6.98
HOLDER 1075 Littelfuse 20c; ...... 10 for 1.75

OIL CAPACITORS

Mfd	Each	Mfd	Each	Mfd	Each
50wvdc		1000wvdc		12500wvdc	
4	$0.40	.45	.59	2	95.00
150wvdc		1	.79	15000wvdc	
1-1-3-5	.69	2	.85	.0016	9.98
250wvdc		5	2.98	25000wvdc	
2x.25	.35	15	4.98	.00025	7.49
300wvdc		1400wvdc		1	95.00
1.2	.39	.25	1.29	AC RATED 220vac/600dc	
400wvdc		.5	1.39		
.1	.49	1500wvdc		2	.69
.5	.59	.5	1.49	4	.89
1	.69	.75	1.69	5	1.29
4	.98	1	1.79	225vac/630dc	
6	1.08	5	3.49		
8	1.19	6	3.98	8.3	.79
10	1.39	2000wvdc		230vac 630dc	
2x.1	.75	.1	1.49		
2x.5	.94	2x.1	1.69	5	1.29
3x.1	.91	1	1.75	330vac 1000dc	
3x.25	.99	2	2.98		
600wvdc		3	3.69	1.25	.63
.034	.30	8	9.49	1.5	.70
.1	.35	2500wvdc		1.75	.98
.25	.39	.25	2.29	2	.33
.5	.42	3000wvdc		2.5	.90
1	.52	.1	2.49	2.8	.95
2	.65	2	4.45	3	1.00
3	1.00	3	6.98	4	1.29
5	2.25	4	7.89	5	1.49
6	2.59	4000wvdc		15	3.98
7	2.89	2	8.98	25	6.49
10	3.10	5000wvdc		405vac/1200dc	
2x.1	.59	.2	4.49		
2x.25	.78	2	10.98	.15	1.29
2x.5	.89	4	19.98	600vac/1800dc	
2x1	1.05	7000wvdc			
2x2	1.25	.002	1.69	16	6.98
2x8	3.25	.0075	1.98	660vac/2000dc	
3x.05	.75	.1	4.98		
3x.22	.85	7500wvdc		5	4.49
3x.25	.98	.03	2.98	6	4.98
700wvdc		.05	3.49	10	6.98
4	1.50	10000wvdc		16	7.98
800wvdc		.03	3.49		
.1	.69	12000wvdc			
		.02	4.98		

2MFD/330VAC/1000WVDC "CD" RDN CAN 3 for $1.00; 10 for $3.00; 100 for $25
9MFD/220VAC/600VDC $1 .... 12 for $10
Quantity Users Write for Special Prices

HIV PHOTOFLASH KIT

Includes V4X4 Flash Lamp Rated 200 Watt Seconds, Flash Lamp Holder & 8" Reflector & Cable. 115V/60Cy Inpt Power Transformer & Multi Section Capacitor Bank. All Resistors, Capacitors, Rectifiers & Sockets.
SPECIAL $24.98

LO-VOLT PHOTOFLASH KIT

Includes DLX15 Flash Lamp Rated 200 Watt Sec. Flash Lamp Holder & 8" Reflector & Cable! Power Transformer & CD Flash Capacitors, (2) 200 Mfd Each W/Output of 100 Watt Sec. Al. Resistors, Capacitors, Rectifiers & Sockets. $29.98
Extra Flash Lamp Holders W/8" Reflector & Cord $3.98; W/Lamp V4X4 or DLX $12.98

TAB "SUN-FLASH" LAMPS

"Tab" No.	Replaces	W-Sec. Max.	Each
U5W	GE-FT105	100	$5.98
U10	GE FT114	100	7.25
No. 1	AMGLO 5804X	100	10.98
23ST	GE FT 210	200	9.98
53GT	GE FT 408	500	13.50
VA	SYLV. 4330	200	9.98
23MT	FT 214	250	9.98
22ST	FT 110	200	9.98
353GTQ	FT 503	5000	49.98
V4X4	X400	200	10.98
DX	SPRGFA100	150	9.00

Write for Complete "THRIFTLITE" Data Boosterpacks. Ext lites, Units for Focal plane shutters & accessories. We Buy Sell & Swap.

TEST CORDS

15 Foot Extension Cord Hvy Duty. Rubber Covered Insulation. As Illust. $1.10
6 Foot Line Cord w/Plug Rubber Covered .. 55c
4 Foot Test Cord, Plug & (2) Alligator Clips Attached .... 49c; 3 for $1.25
4 Foot Instrument Test Leads. High Quality. Red & Black .... 49c; 3 for $1.25

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PH. RECTOR 2-6245

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Klystron Mtg Assy (723 AB) & Coupling to 2 Type "N" Co-Ax Fittings $9.98
Two for $18.00

1 Microsecond Delay Line $2.95; 4 for $10.00

Microwave Lighthouse Assy —P/O RT39 Apg & 15, osc and Tr Cavities, Type N Coupling. Uses 2C43, 2C40, 1B27, Tuner 24-2700 MC Less Tubes $20 @ 2 for $36.00

3cm T-Sect. Waveguide & Atten. Output. Thermal Comp & Pwr Meas Thermistors Xtal Diode Detector Mtg. & C'ling $18.95; 2 for $35.00

Watt Meter Low Power. Used with Bolometer. Bridge Measures Low Level Microwave Power. Balanced Barretter Bridge Direct Reading. Self Calibrating Range. 50 Microwatts to 10 Milliwatts. **SPECIAL** $119.00

X Band Adaptor UG39 to UG40 Choke to Plane **Flange** ....$1.69; 4 for $6.00

PULSE TRANSFORMERS

7.5 KV Pulse. Pri 4KV. 50-1000 ohm imped Permalloy Core. W'Eco $14.98

PULSE SHAPING Xfmr Raytheon UX12819. IMU Sec. 2000 CY $7.95

UTAH 9340 P/O CP-5A/APS15 ....$9.00

Write for Details on Pulse Units

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Primary 7.5KW. W/110V Inpt. Two Secondaries Dlvr 220V at 7.5 Amp Each, or One 440V at 7.5A. Same but 220V Pri. Will Deliver 2X440 at 7.5A Each, or 880V at 7.5A.
"TAB" SPECIAL $124.50

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G. E. CR2811C22AQ. Heavy Duty Electric Starter, Transmitter or Motor Starter Switch. For Single or 2 or 3 Phase Appl. Rated 1 Phase 3HP/110V, 7½ HP/220V 10 HP/600V. Rated 2 or 3 Phase 7½ HP/110V, 15 HP/220V, 25 HP/600V. Control Inpt. 220V/1PH/60-Cy. Contacts rated 45 Amp Enclosed, 50 Amp Open. Delivered U S.A ...**$39.95; 2 for $75.00.**

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PARTS CABINET

50 Draw Hvy Steel 34½"H/18"W/9"L/65 lbs. Draws 3" W/2½" H/8"L $38.00
100 Draws as above. 135 lbs $65.00
27 Draw Hvy Steel 37"H/30¾"W/14¼"L/120 lbs. Draws 3" H/9" W/12" L $38.00
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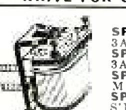

SPST Mini Size 115VAC 3A CTS ....98c; 3 for $2.75
SPDT Mini Size 115VAC 3A CTS ....$1.39; 3 for $3.75;
SPDT 24VDC/5A CTS 98c;
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DPDT & SPNO 12VDC/10A Contacts. **SPECIAL $2.98; 4 for $10.00**
DPDT Clare SK5010, Octal Base, 18-28V 2A Contacts, Nitrogen Sld ....$1.49; 4 for $5.00

866A KIT AND XFORMER

2 Tubes, Sckts, xfmr 115v 60cyc Inpt. outpt. 2.5vct, 10A/11vinsul $6.98

DIODE PROBE TUBE

Unexcelled for **No-Loss VHF** testing. Ultra-sensitive subminiature-envelope. New, w/data VR92 ....**25c; 5 for $1.**

HIGH CURRENT MICA CNDRS CYLINDRICAL SIMILAR TYPE "G"

MFD	KV	AMPS	MC	EACH
.01	10	30	3	49.50
.0025	20	22	3	45.00
.0025	12	20	3	28.95
.001	30	30	3	95.00
.0012	20	16	3	35.00
.002	20	22	3	40.00
.005	10	30	1	32.50
.004	12	20	3	34.00

CIRCUIT BREAKER FUSES

PUSH TO RESET

Amps 3-5-7-10-15-20 Ea. 27c 4 for $1.; 25 for $5.; 100 for $18.
Circuit Breaker Fuse W/2 Mounting Clips 39c; 3 for ...$1.00; 20 for ....$5.98; 100 for ....$25.
Fuse is 3AG Size. Operates up to 24 Volts

Heinmann Magn Bkrs, Amps: 0.22, 2, 3, 5, 7, 9, 12, 15, 20, 30, 35, 40, 80, 180 ....**Each $1.69; 10 for $15.98**
Sq. D & CH Toggle Sw Brkrs, Amps: 5, 10, 15, 20, 25 98c ....**10 for $8.98**
Klixon Thermal Push Button Brkrs Amps: 5, 10, 15, 20, 25, 30 89c;...**10 for $7.98**

MERCURY THERMO REGULATOR

DUAL CKT, 105°F & 32°F. Extremely sensitive & accurate for most exacting requirements—Research, Fire Prev., Freeze, Pt Control, or Max-Min Temp Control. Brand New, Individ. Boxed w-data & ckt. Excellent Safety Device for Thermo Control of Air Cooled Selenium Rectifiers.
SPECIAL Ea. 98c; ....**12 for $10.00**

CIRCULAR SLIDE RULE

Equiv to 12"—Only 2⅛" Radius. LAMINATED—Print Stays On! Mult, Div, Sqs, Cubes & Roots, Log, Decimal Equiv Data, Case 89c
Parallel Rules. Precision Drafting Tool Mfr. BRUNING 6" wide. For Radiomen, Engineers, Students—Unsurpassed for Quick Ckt Diagrams.
SPECIAL ....39c; 3 for $1.00
Ball Pens Red & Blue Gtd ....5 for $1.00
Ball Pens Draftsman Black Gtd ....2 for $1.00

METER SPECIALS

0-30VDC Aircraft Type "AN" as Illustrated ......$1.95; 3 for $5.25
0-150V Weston 3" Sq. $8.95
0-60ADC "AN" ....$3.25; 3 for $9.
0-240ADC "AN" $3.49; 3 for $9.75
—20 +3VU Weston 301 Vol. Level Indicator $16.98

SELENIUM RECTIFIERS

We specialize in Rectifiers and Power supplies to your specifications. Immediate delivery.

Current (cont.)	18/14 Volts	26/18 Volts	36/28 Volts	54/40 Volts	130/100 Volts
1AMP	1.25		2.20	3.60	7.50
2AMP	2.20		3.60	6.50	10.50
4AMP	3.75		6.75	8.75	
5AMP	4.95		7.95	12.95	27.00
10AMP	6.75	9.98	12.00	18.00	40.00
12AMP	8.50		16.00	25.50	50.00
20AMP	13.25	16.20	24.00	36.00	90.00
24AMP	16.00		31.00	39.50	98.00
30AMP	18.50	24.30	36.00		
36AMP	25.50		45.00		

Full Wave Selen Rect & Trans. in Kit Form. All 115V/60cy inputs.
up to 14VDC at 12 amps $18.98
up to 28VDC at 12 amps 28.98
up to 28VDC at 48 amps 117.00
up to *20VDC at 6 amps 12.98

RECTIFIER XFMRS
18.8—19.2—20.4—21.4 Volts/12 Amp....$10.98
31—32—34—36 Volts/12 Amp 2 Kvins....13.98
18—12—9—CT—9—12—18V/4 Amp....8.75
18—12—9—CT—9—12—18V/12 Amp....16.75
36VCT—24V—18V/24 Amp....35.75
18V/2A....2.75; 18V/4A....3.95

BATTERY CHARGER RECTIFIER

10-0-10 Volts (CT) 120 Amp (Fan Cooled). Replace Your Old Inefficient Sulphide Rect. with the New Selenium Types. **SPECIAL**..$13.75
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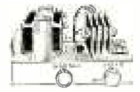
"HO" RAIL PACK



0 to 12VDC/2 Amp Variable DC supply, uncased and completely built —inpt. 115v/60 cy. Usable LAB supply, filament D.C. plating, battery charging, model railroad, includes voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives $10.95
2 for $20.00

TUBES

"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

Tube	Price	Tube	Price	Tube	Price
OA2	$0.95	2E25/HY65	5.15	6A4	1.89
OA3/VR75	1.04	2E26	2.88	6A5G	2.39
OA4G	1.05	2E30	1.95	6A6	.80
OB2	1.37	2E31	1.49	6A7	.85
OB3/VR90	1.09	2E36	2.19	6A8GT	.90
OC3/VR105	1.19	2E41	2.39	6AB4	.79
OD3/VR150	.90	2E43	1.39	6AB5/6N5	1.33
OY4	2.53	2G21	2.39	6AB7/1853	.98
OZ4	.60	2J21	8.75	6AC5GT	1.00
C1A/ELC1A	9.75	2J21A	8.90	6AC6G	.95
O1A	.69	2J22	7.69	6AD7G	1.29
VS-1	12.49	2J30	87.25	6AG5	.79
1A3	1.10	2J31	27.25	6AG7	1.39
1A4P	.79	2J31A	79.95	6AH5G	1.49
1A5GT	.79	2J32	27.45	6AH6	1.22
1A6	1.49	2J33	27.25	6AJ5	1.40
1A7GT	.95	2J34	27.25	6AK5	.74
1AD4	2.95	2J36	120.00	6AK5W	2.98
1AE4	1.80	2J37	12.70	6AK6	1.05
ELC1B/3C31	3.45	2J38	11.75	6AL5	.54
1B3/8016	.81	2J39	44.00	6AL7GT	1.29
1B4P	.89	2J42	250.00	6AN5	2.90
1B5/25S	.99	2J48	24.25	6AQ5	.55
1B7GT	.99	2J49	34.00	6AQ5W	3.98
1B21/471A	2.85	2J50	21.25	6AQ6	.81
1B22	2.20	2J52	249.50	6AQ7GT	1.29
1B23	9.90	2J55	85.00	6AR5	.79
1B24	9.45	2J56	149.00	6AR6	2.98
1B26	2.45	2J61	49.95	6AS5	.79
1B27	12.75	2J62	49.45	6AS6	2.43
1B32/532A	3.90	2K22	49.95	6AS6W	3.20
1B35	10.98	2K23	29.00	6AS7G	4.14
1B37	16.98	2K25	39.95	6AT6	.63
1B38	29.95	2K25/723AB	31.59	6AU5GT	1.10
1B40	4.95	2K28	32.00	6AU6	.59
1B41	49.95	2K33	300.00	6AV5GT	1.29
1B42	18.00	2K35	398.00	6AV6	.49
1B46	1.98	2K41	145.00	6AW6	1.89
1B53	49.95	2K42	145.00	6AX4/6U4	.79
1B56	38.50	2K43	135.00	6AX5GT	.79
1B58	175.00	2K46	360.00	6B4G	1.23
1B60	69.75	2K47	460.00	6B5	1.19
1B63	50.00	2K48	118.00	6B6G	.89
1B63A	75.00	2V3G	.98	6B7	.95
EL1C	2.70	2W3GT	.98	6B8G	.60
1C5GT	.89	2X2	.49	6BA6	.63
1C6	.79	2X2A	1.53	6BA7	1.27
1C7G	.89	3A4	.99	6BC5	.63
1D5GP	.99	3A5	.81	6BC7	1.23
1D7G	.89	3A8GT	1.59	6BD5GT	1.65
1D8GT	.89	3B4	2.69	6BD6	.83
1D21/631P1	3.89	3B5	.98	6BE6	.59
1E5	.99	3B7/1291	.69	6BF5	.98
1E7G	.99	3B22	2.70	6BF6	.65
1F4	.69	3B23/RK22	4.95	6BF7	2.55
1F5G	.79	3B24	5.40	6BG6G	1.39
1F6	.89	3B25	4.50	6BG7	1.98
1F7G	.89	3B26	3.70	6BH6	.63
1G4GT	.89	3B28	7.90	6BJ6	.69
1G5G	.89	3C6/XXB	1.49	6BK7	2.15
1G6GT	.79	3C22	77.00	6BL7GT	1.45
1H4G	.89	3C23	9.90	6BN6	1.49
1H5GT	.72	3C31/C1B	3.45	6BN7	1.69
1H6GT	.79	3C33	14.98	6BQ6GT	1.20
1J5G	1.20	3C34/HK24	5.49	6BQ7	2.15
1J6GT	.79	3C45	15.48	6BY5G	1.45
1L4	.69	3D6/1299	.69	EL6C/6C	16.98
1L6	.98	3D21A	4.98	6C4	.50
1LA4	1.19	3D22	13.95	6C5GT	.55
1LA6	.99	3D23	4.90	6C6	.57
1LB4	1.29	3E29	14.95	6C7	1.26
1LC5	.79	3K22	275.00	6C8G	.80
1LC6	1.39	3K23	405.00	6C21	29.45
1LD5	.99	3K30	300.00	6CB6	.69
1LE3	.99	3LF4	1.29	6CD6G	1.69
1LH4	.89	3Q4	.79	6D4	2.70
1LN5	.79	3Q5GT	1.29	6D6	.89
1N5GT	.72	3S4	.85	6D7G	.89
1P5GT	.79	3V4	.79	6D8G	.85
1P42	5.60	4-125A	29.95	6E5	.79
1Q5GT	.70	4-250A	40.95	6E7	1.39
1Q26	69.00	4-1000A	108.50	6F4	6.20
1R4/1294	1.29	4B23	16.98	6F5	.95
1R5	.79	4B27	4.98	6F6	.79
1S4	1.19	4B32	9.50	6F6GT	.79
1S5	.79	4C25/HK54	5.98	6F7	.85
1S21	7.90	4C33	59.00	6F7G	1.10
1T4	.79	4C35	27.25	6G6G	.90
1T5GT	.99	4C36	15.98	6H6	.60
1U4/5910	.73	4E27/257	14.50	C6J/5C21	6.95
1U5	.79	4J22	148.50	6J4	6.66
1V	.79	4J31	95.00	6J5GT	.47
1V2	.70	4J34	194.00	6J6	.63
1X2	.95	4J42/700	27.00	6J7	.72
1Y2	6.98	4J47	260.00	6J8G	1.19
1Z2	3.98	4J47CY	198.00	6K4	5.15
2A3	1.78	4J52	350.00	6K4A	6.45
2A4G	1.19	4T4/2	5.95	6K5GT	1.09
2A5	.69	4X-150A	45.00	6K6GT	.59
2A6	.69	4X-500F	85.00	6K7	.75
2A7	.69	5AX4GT	.54	6K8	1.08
2AC15	4.98	5AZ4	1.35	6L5G	.75
2AS15	4.98	C5B/5C30	3.95	6L6	2.09
2B7	.89	EL5BHD	16.98	6L6G	1.35
2B22	3.90	5C21/C6J	6.95	6L6GA	1.35
2C21/1642	.67	5C22	49.95	6L6GAY	2.29
2C22/7193	.33	5C30/C5B	3.95	6L7	.80
2C26	.19	5D21	27.45	6N4	2.39
2C26A	.47	5D23/RK65	36.50	6N6G	1.69
2C33/RX233A	3.49	5J29	12.40	6N7GT	.80
2C34/RK34	.69	5R4GY	1.60	6P5GT	.89
2C39	33.98	5R4GYW	1.75	6Q7	.89
2C40	7.29	5T4	2.49	6R7	.77
2C43	26.75	5U4G	.69	6R8	1.39
2C43/464A	9.49	5V4G	1.10	6S4	.98
2C44	1.20	5W4	.89	6S7G	.83
2C50	3.69	5X4G	.79	6S8GT	.92
2C51	6.45	5Y3GT	.43	6SA7GT	.63
2C52	5.98	5Y4G	.79	6SA7GTY	3.37
2D21	1.26	5Z3	.99	6SB7Y	1.19
2E5	$1.19	5Z4	1.49	6SC7	.90
2E22	1.95	C6A	6.75	6SD7GT	.80
2E24	4.69	6A3	.90	6SF5	.77

Tube	Price	Tube	Price	Tube	Price	Tube	Price	Tube	Price
6SF7	.73	12AY7	2.95	35/51	.89	117P7GT	1.39	CK533AX	1.39
6SG7	.72	12AZ7	1.49	35A5	.79	117Z3	.59	CK534AX	.89
6SH7	.61	12BA6	.59	35B5	.79	117Z4GT	1.39	CK536AX	.89
6SJ7	.70	12BA7	.79	35C5	.69	117Z6GT	1.19	CK537AX	4.98
6SK7GT	.69	12BD6	1.23	35L6GT	.79	117Z7GT	1.49	CK538DX	.89
6SL7GT	.69	12BE6	.59	35T	6.95	F123A	7.90	CK539DX	1.98
6SN7GT	.70	12BF6	.85	35TG	5.45	T125	12.49	CK541DX	1.98
6SN7WGT	2.25	12BH7	1.29	35W4	.59	F127A	19.98	CK542DX	.98
6SQ7GT	.63	12BY7	1.35	35Y4	.69	VT127A	3.90	CK543DX	.98
6SR7	.65	12BZ7	1.25	35Z3	.79	CV148	4.98	CK544DX	.98
6SS7	.75	12C8	.65	35Z4GT	.69	150T	14.50	CK546DX	1.98
6ST7	.98	12F5GT	.65	35Z5GT	.59	FG166	49.00	CK547DX	1.98
6SU7GTY	2.69	12H6	.65	REL36/6J4	.49	FG172	29.00	550P1	19.95
6SZ7	1.05	12J5GT	.49	36	.65	182B	1.20	CK571AX/5886	4.98
6T7G	.85	12J7GT	.75	37	.69	FG190	12.80		
6T8	.98	12K7GT	.89	38	.59	HF200	21.00	CK573AX/6029	4.45
6U5/6G5	.99	12K8	.69	RK39	2.89	T200	22.98		
6U6GT	.83	12Q7GT	.55	39/44	.59	201A/CX301A	.98	575A/975	13.75
6U7G	.55	12S8GT	.98	CRC40	.59	203A	5.98	WL579	10.49
6V3	1.89	12SA7GT	.69	T40	4.29	205B/VT2	1.69	WL579B	12.98
6V6	1.39	12SC7	.80	TZ40	3.98	CE206	3.15	601B	.19
6V6GT	.57	12SF5GT	.72	40	1.09	211/VT4C	.45	HY615	.25
6V8	1.99	12SF7GT	.49	HY40Z	3.75	CE215	8.98	616	37.00
6W4GT	.57	12SG7	.83	41	.79	RX215	9.95	KU627	18.00
6W6GT	.89	12SH7	.63	42	.69	WE215A	.18	WL652	65.00
6W7G	.85	12SJ7GT	.59	43	.85	217C	8.75	WL670A	11.98
6X4	.59	12SK7	.72	45	.69	227A	4.98	WL676	39.95
6X5GT	.59	12SL7GT	.65	45S/VT52	.65	231	1.20	WL686	35.00
6Y6G	.89	12SN7GT	.75	45Z3	.69	242C	3.95	701A	5.89
6Y7G	.89	12SQ7GT	.63	45Z5GT	.89	244A	4.15	702A	3.29
6Z7G	.89	12SR7	.63	46	.89	247A	9.95	702B	5.98
6ZY5G	.89	12X3	.90	47	.99	250R	9.90	703A	4.75
7A4/XXL	.73	12Z3	.89	48	1.17	250TH	22.25	704A	.98
7A5	.73	14A4	.87	RK48A	6.85	250TL	17.75	705A/8021	1.98
7A6	.73	14A7/12B7	.75	RK49	7.50	HK254	14.49	707A	7.90
7A7	.69	14AF7/XXD	.83	49	.83	262B	3.98	707B	13.50

Use Your Priority for SPEEDY DELIVERY—Extend Your DO & Contract Nos.

Tube	Price	Tube	Price	Tube	Price	Tube	Price	Tube	Price
7A8	.69	14B6	.65	50	1.19	274B	3.45	710A/8011	.95
7AD7	1.49	14B8	.89	50A5	1.19	276A	9.89	713A	.98
7AF7	.89	15C5	1.07	50B5	.79	300B	11.50	NL714	5.95
7AG7	1.00	14C7	.95	50C5	.69	HF300	24.30	714AY	5.90
7AH7	1.19	14E6	.99	50C6	1.49	T300	26.98	715A	6.00
7B4	.69	14E7	1.09	50L6GT	.69	304TH	8.90	715B	8.40
7B5	.73	14F7	.95	50X6	.89	304TL	8.90	715C	19.80
7B6	.73	14F8	.83	50Y6GT	.79	307A/RK75	4.20	717A	.90
7B7	.73	14H7	.83	50Z7G	.98	310A	6.25	718BY	48.45
7B8	.83	14J7	.83	52	.99	311CH	10.95	718CY	48.45
7C4/1203A	.73	14N7	.87	53	.69	311CT	10.50	719A	28.50
7C5	.69	14Q7	.73	T55	8.79	311T	10.50	721A	2.49
7C6	.69	14R7	.80	55	1.06	313C	2.98	722A/287	2.45
7C7	.69	14S7	.98	56	.85	316A	1.49	723A	11.95
7C23	72.00	14W7	1.09	57	.79	323A	24.25	723A/B	25.00
7C29	69.95	14X7	1.23	58	.79	327A	4.95	724A	3.95
7E5/1201	.65	15E	1.98	RK59	1.45	S340	2.98	724B	3.45
7E6	.53	15R	.89	59	1.78	350A	6.50	725A	8.90
7E7	.73	FG17	3.95	RK60/1641	1.95	350B	4.95	726A	14.25
7F7	.73	18	.98	T60	10.49	353A	4.65	726B	45.00
7F8	1.25	19	.69	RK61	3.05	HK354	24.98	726C	52.00
7G7/1232	.89	19BG6G	1.79	HY69	4.98	355A	14.15	800	1.85
7H7	.73	19T8	1.09	70A7	1.59	368A5	7.49	801A	.45
7J7	.89	19V8	1.62	70L7GT	1.59	371B	.90	803	3.89
7K7	1.10	T20/1623	3.79	71A	.79	380A	.79	804	11.50
7L7	.83	TUF20	5.19	CRP72	1.20	388A	1.49	805	3.90
7N7	.79	TZ20	3.79	CRP73	1.49	393A	8.90	807	1.65
7Q7	.69	20	1.17	73	1.67	394A	4.90	808	2.59
7R7	.83	RK20A	8.95	NR74	.29	FP400	15.98	809	2.43
7S7	.92	RX21	3.75	HY75	4.59	WE417/5842	18.50	810	9.95
7T7	1.03	22	.99	75	.99	WL417A	8.95	811	2.90

Top Dollar Paid for Your Surplus Tubes—Send List and Prices

Tube	Price	Tube	Price	Tube	Price	Tube	Price	Tube	Price
7V7	.79	24	.85	76	.79	GL434A	18.45	811A	3.79
7W7	.95	24A	1.10	77	.69	446A	1.05	812	2.70
7X7/XXFM	.89	24G/3C24	1.90	78	1.05	446B	3.89	813	12.49
7Y4	.49	25A6	1.09	79	.89	450TH	45.00	814	2.75
7Z4	.65	25A7	2.98	80	.69	450TL	52.00	815	2.98
8DC-15	4.98	25AC5GT	1.59	81	1.69	460/HF200	15.95	816/866Jr	1.07
10Y	.35	25AV5GT	1.29	FG81A	3.90	WL468	13.95	826	.95
CV11	5.25	25BQ6GT	1.19	82	1.19	GL471A	2.69	828	11.29
12A	.57	25C6	1.18	82V	1.39	CK501X	1.26	SD828	.98
12A5	1.39	25L6GT	.69	83	1.45	CK501AX	1.26	829	11.45
12A6	.59	25W4GT	.89	83V	1.79	CK502AX	1.79	829B	12.45
12A7	.90	25Y5	.79	84/6Z4	.99	CK505AX	1.79	830B	3.49
12A8GT	.65	25Z5	.79	85	.79	CK506AX	1.79	832	7.65
12AC7	1.19	25Z6GT	.99	89	.75	RH507	9.98	832A	9.65
12AH7GT	1.45	26	.79	VR92	.25	CK509AX	1.26	833A	39.45
12AK5	1.98	27	.69	FG95/5560	24.85	CK512AX	3.15	834	5.95
12AK5W	2.98	FG27A	8.70	FG98	19.95	CK522AX	2.49	836	4.75
12AL5	.75	HV27	10.95	100TH	7.83	CK525AX	3.15	837	1.45
12AT6	.52	RK28A	4.89	102D	2.98	CK526AX	3.95	838	3.98
12AT7	.81	30	.70	102G	2.98	CK527AX	3.49	843	.39
12AU6	.72	31	.59	FG104	37.98	CK528AX	2.39	845	5.95
12AU7	.63	HY31Z	2.75	FG105	17.64	CK529AX	2.98	849	29.45
12AV6	.49	32	.49	VU111	1.45	GL530	22.00	852	19.98
12AV7	.98	FG32/5558	13.85	HY114B	.75	CK531DX	1.98	860	4.90
12AW6	1.79	32L7GT	1.49	HY115/145	.79	531	6.98	861	23.95
12AX4GT	1.20	33	.59	117L/M7GT	1.59	CK532DX	1.98	864	.39
12AX7	.79	34	.69	117N7GT	1.79	WL532	3.98	865	1.29

Tube	Price
866A	1.50
868/CE1C	3.49
869	36.95
872A	3.29
874	1.39
878	1.95
884/6Q5G	1.80
885	1.45
893A	250.00
917	2.59
919	2.75
925	1.69
922	1.85
923	1.00
927/CE25	1.49
930	1.20
931A	5.00
954	.25
955	.39
956	.36
957	.45
958A	.67
967/FG17	3.95
SD969	.98
973	16.95
991	.45
FM1000	1.50
CK1005	.85
CK1006	3.49
CK1007	.89
CK1027	3.35
CK1028	9.98
CK1089	2.98
CK1090	2.98
R1100	5.00
R1130	12.00
E1148	1.35
HY1231Z	5.39
1612	1.90
1613	.89
1616	.74
1619	.25
1620	4.70
1622	2.69
1624	1.90
1625	.33
1626	.33
1629	.29
1630	.97
1631	.74
1632	.77
1633	.73
1634	.73
1635	1.89
1636	3.19
1644	.95
2000T	149.50
2050	1.47
2051	1.15
5516	5.98
5517	3.39
5594	6.65
5608A	5.95
5637	7.15
5638	12.70
5651	3.05
5654	2.79
5656	6.90
5663	1.85
5670	5.30
CK5672	2.29
CK5676	2.29
CK5678	2.45
5684	14.98
5686	3.90
5687	5.75
5692	7.69
5693	7.69
5694	3.65
CK5697	5.98
CK5702	7.45
CK5703	.98
CK5704	4.39
5718	10.15
5719	12.75
5726	4.39
GL5727	4.49
5744/CK619CX	6.49
5749	3.39
5751	5.45
5763	1.70
CK5783	6.69
CK5784	7.40
5812	2.99
5814	5.49
CK5829	4.49
5840	12.75
CK5851	4.98
CK5875	1.98
5881	2.89
X6030	4.49
8002R	99.50
8005	7.25
8008	6.49
8012	2.89
8013	2.75
8013A	6.45
8014A	28.95
8020	1.25
8025A	4.75

Tube	Price
9001	1.55
9002	.95
9003	1.50
9004	.42
9006	.39

C Ray Tubes

Tube	Price
2AP1	9.70
3AP1	9.75
3AP5	18.00
3AP1A	14.25
3BP1	5.75
3BP1A	14.98
3BP5	18.00
3CP1	1.90
3DP1	4.75
3EP1/1806P1	4.85
3FP7	.98
3FP7A	14.98
3GP1	4.20
3GP4	16.50
3GP5	18.00
3GP7	18.00
3HP7	3.40
3HP14	14.98
3JP7	12.50
3JP12	19.95
3JP14	16.95
4AP10	4.40
5AP1	3.45
5BP1	4.25
5BP4	4.25
5CP1	4.50
5CP1A	18.49
5CP5	30.00
5CP7	11.75
5FP7	1.49
5HP1	5.70
5HP4	5.70
5JP2	19.25
5JP4	26.75
5JP5	35.00
5JP7A	39.00
5LP1	22.25
5LP2	27.50
5LP4A	33.00
5LP7	29.95
5MP1	10.50
5RP7A	89.50
7BP1	8.65
7BP7	6.50
7EP4	17.98
7JP4	18.39
9GP7	12.75
9LP7	2.98
12DP7	16.89
12DP7A	49.50
12GP1	49.98
12GP7	14.75
12HP7	14.75
12JP4	27.00
12KP4	27.00
12LP4	21.25
912	89.98
913	9.98

Xtal Diodes

Diode	Price
1N21A	1.55
1N21B	3.00
1N21C	21.50
1N22	1.25
1N23	1.35
1N23A	2.35
1N23B	3.49
1N25	4.98
1N26	8.75
1N27	1.55
1N29	3.50
1N32	23.75
1N34	.64
1N34A	.90
1N35	1.65
1N38	1.43
1N39	4.15
1N40	7.95
1N41	9.98
1N42	17.50
1N43	1.69
1N44	1.21
1N45	1.39
1N46	.69
1N47	5.49
1N48	.59
1N51	.45
1N52	1.85
1N54	.89
1N55	2.35
1N56	.89
1N57	.89
1N58	1.19
1N60	.60
1N61	2.10
1N63/K63	2.49
1N64	.69
1N67	1.95
1N69	1.98
K34	1.39

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Index to electronics Volume XXV

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Items for which the page reference is marked "D" are editorial material published monthly in Backtalk, Electrons at Work, Production Techniques, The Electron Art and Tubes at Work.

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NEW AMPEREX 5894-A

UHF and VHF Twin Tetrode For W-I-D-E Band Operation

RF Amplifier, Modulator, Frequency Doubler, Tripler

Our earlier version, the AMPEREX AX-9903/5894 gained such immediate and universal acceptance with equipment manufacturers, users and engineers that it supplanted the standard 829B tube in almost all instances where its slightly greater height was not a deterring factor.

NOW the new AMPEREX 5894-A does everything that the AX-9903/5894 did . . . does it better . . . and is reduced in height to the size of the 829B.

IMPROVED HF PERFORMANCE The Cathode and Grid structure is supported at the TOP as well as the bottom of the tube. Being thus held in exact vertical alignment with the plates, the two sections of the tube are in closer electrical balance.

PHYSICALLY STRONGER* This new type of construction . . . coupled with the fact that anode seal strength has been increased by replacing the top section of the tube with a powdered glass seal . . . enables the tube to withstand greater shock and vibration.

*With this new construction the maximum force on the ends of the anode pins perpendicular to the pin axis is about 14½ pounds. WITH GREATER FORCE THE PINS BEND WITHOUT FORMING CRACKS IN THE GLASS.

See these new tubes at leading Jobbers everywhere, or write for data sheets.

5894-A CHARACTERISTICS

250 mc. . . . . . . 85 watts output
500 mc. . . . . . . 45 watts output

Filament Voltage	
Series	12.6v.
Parallel	6.3v.

Filament Current	
Series	0.9a.
Parallel	1.8a.

Maximum	
d.c. Plate Voltage	600
d.c. Grid #2 Voltage	250
d.c. Grid #1 Voltage	−175
Plate Dissipation (w.)	2 x 20
c.c. Plate Current (ma.)	2 x 100

Fits 829B Type Socket.

	PER UNIT
Grid to Plate	<0.08 mmfd.
Input	10.5 mmfd.
Output	3.2 mmfd.

MOUNTING POSITION: Base up or down. Horizontal with anode leads in horizontal plane.

Re-tube with AMPEREX

AMPEREX ELECTRONIC CORP.
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RCA metal-shell kinescopes give you 8 plus features at no extra cost

RCA-developed metal-shell kinescopes offer design engineers, manufacturers, and users of TV receivers, many important advantages over all-glass types . . .

1 Reflection-free Faceplates: Frosted surface of faceplate prevents reflections of light sources and bright room objects at any angle to the tube.

2 Superior Faceplate Quality: Metal-shell construction permits the use of high-quality sheet glass *made to RCA specifications*. Its use results in greater freedom from imperfections, such as blisters, chill marks, shear marks, mold marks, and ripples. Faceplates of uniform thickness transmit the picture with uniform brightness levels over the entire viewing area.

3 Less Weight: RCA 21" metal-shell kinescopes weigh only about 18 pounds, a value approximately 12 pounds less than comparable-size glass types. Hence, they are cheaper to ship, easier to handle during assembly and testing operations, and can be mounted with lighter supporting structures.

4 Optically Superior: Relatively thin and flat spherical faceplate of uniform thickness permits wide-angle viewing with minimum picture distortion.

5 High Safety Factor: Inherent mechanical strength of metal-shell construction provides greater factor of safety in handling operations.

6 Utilize Time-Tested Components: 21" metal-shell kinescopes permit the use of proven deflection circuits and available components to produce pictures having good corner focus and negligible pin cushion. No need to experiment with special components; volume production can be achieved with minimum delay.

7 Volume Types: Because of RCA's vast production experience, 21" metal-shell kinescopes offer a greater degree of dependability and uniformity.

8 Availability: Manufacturing facilities in two RCA plants insure continuous high-volume supply.

For technical data or design assistance on RCA kinescopes or other types of tubes, write RCA, Commercial Engineering, Section LR-42, or contact your nearest RCA field office:—

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