SEPTEMBER

PRICE 75 CENTS

electronics

A McGRAW-HILL PUBLICATION

EARTH'S FIELD COMPENSATOR

UTC for Military Components

UTC was the largest supplier of transformer components in World War II. Present UTC production is on a similar basis. Illustrated below are a few of the thousand military types in UTC 1950 production.

United Transformer Co.

150 VARICK STREET • NEW YORK 13, N. Y.

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

electronics

A McGRAW-HILL PUBLICATION

SEPTEMBER • 1951

EARTH'S FIELD COMPENSATOR .... **COVER**
Wooden structure supports current-carrying coils that reduce earth's magnetic field when making precise electron-optical adjustments at the Sylvania Research Laboratories, Bayside, N. Y. Photo by Larry Ankersen. (See p 138)

SITING MICROWAVE ANTENNAS BY HELICOPTER, by B. I. McCaffrey **82**
Two helicopters are used to determine optimum tower heights for line-of-sight communications systems

CRISPENING CIRCUIT FOR COLOR TV **85**
Increasing rapidity of response of video circuit results in improvement in apparent resolution

HOW TO PRODUCE GOOD INSTRUCTION MANUALS, by Eugene Anthony **88**
Qualifications and detailed duties of the Mr. X who is to head the technical manual crew and do the heavy writing

CRAWLER DETECTS GUN-BARREL CRACKS, by R. D. Kodis and R. Shaw **92**
Rotating pickup pulled through magnetized barrel feeds recorder to give unfolded flaw map of inside surface

DOT ARRESTING IMPROVES TV PICTURE QUALITY, by Kurt Schlesinger **96**
Selective circuit removes dot structure from large homogenous areas

REMOTE PICKUP BROADCAST RECEIVER, by Adelbert A. Kelley **102**
Crystal-controlled receiver for 26-mc relay of on-the-spot coverage

MINIATURE RADAR TRANSPONDER BEACON, by R. S. Butts **104**
Mounted in a pilotless plane, beacon extends the range of a radar using passive reflection

IMPROVING PROGRAM LIMITER PERFORMANCE, by Donald W. Howe, Jr **108**
Delay limiter helps prevent a-m interference with adjacent-channel stations

MULTIPLEXING KLYSTRONS, by William L. Firestone **112**
Limitations of many techniques and how a satisfactory system was developed

STRAIN-TESTING RAILROAD BRIDGES, by Albert D. Lewis **117**
Twelve cathode-ray tubes are viewed by 35-mm moving film cameras

WIDE-RANGE ELECTRONIC CHRONOSCOPE, by R. G. Roush **120**
Pulse lengths from 10 microseconds to 1 minute are directly shown on high-speed clock dial driven by charging circuit

UTILITY VIDEO AMPLIFIER, by E. C. Kluender **125**
Use of feedback provides simple amplifier with many applications on program lines

AUDIO AMPLIFIER DAMPING, by R. M. Mitchell **128**
Meaning and measurement of the damping factor described as a function of feedback

NETWORK DESIGN CHARTS (Reference Sheet), by T. U. Foley **132**
Universal T, pi and L network charts cover all normally encountered phase shifts and transformation ratios

BUSINESS BRIEFS 76
CROSSTALK 81
TUBES AT WORK 136
ELECTRON ART 140
NEW PRODUCTS 144
NEWS OF THE INDUSTRY 148
NEW BOOKS 152
BACKTALK 154
INDEX TO ADVERTISERS ......(Last Page)

September, 1951 — ELECTRONICS — Vol. 24, No. 9

Member ABC and ABP

Published monthly with an additional issue in June by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. **Publication Office, 99-129 North Broadway, Albany 1, N. Y.**

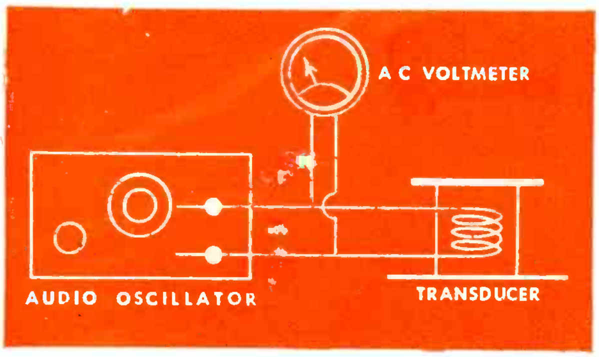
Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 W. 42nd St., New York 18, N. Y. Curtis W. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Senior Vice-President, Publications Division; Ralph B. Smith, Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation.

Subscriptions: Address correspondence to Electronics—Subscription service, 99-129 N. Broadway, Albany 1, N. Y., or 330 W. 42nd St., New York 18, N. Y. Allow ten days for change of address. Please indicate position and company connection on all subscription orders.

Single copies 75¢ for United States and possessions, and Canada; $1.50 for Latin America; $2.00 for all other foreign countries. Buyers' Guide $2.00. Subscription rates—United States and possessions, $6.00 a year; $9.00 for two years; $12.00 for three years. Canada, $10.00 a year; $16.00 for two years; $20.00 for three years. Pan American countries, $15.00 a year; $25.00 for two years; $30.00 for three years. All other countries $20.00 a year; $30.00 for two years; $40.00 for three years. Entered as second class matter August 29, 1936, at the Post Office at Albany, N. Y., under act of Mar. 3, 1879. Printed in U. S. A. BRANCH OFFICES: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, W.C. 2; Washington, D. C. 4; Philadelphia 3; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; Atlanta 3, Ga.; 1111 Wilshire Blvd., Los Angeles 17; 738-9 Oliver Building, Pittsburgh 22. ELECTRONICS is indexed regularly in The Engineering Index.

marion methods

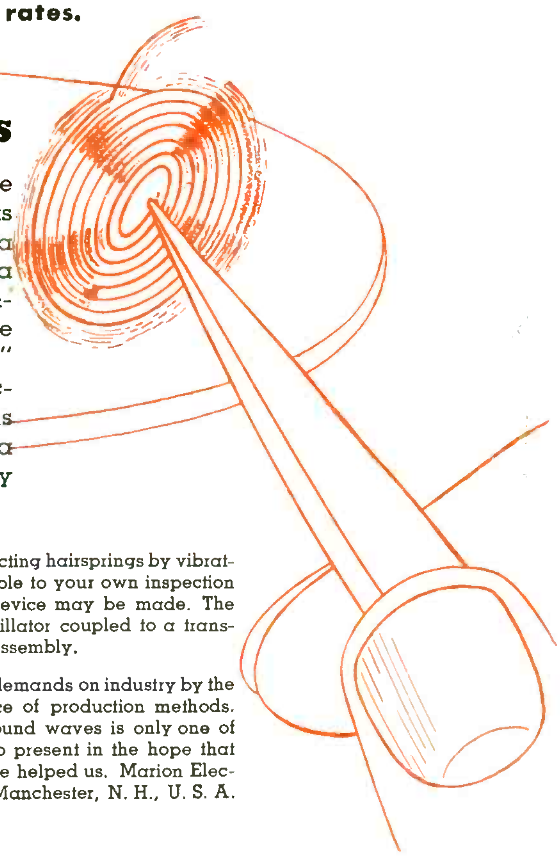
MEASURE HAIRSPRING *TORQUE* WITH SOUND WAVES



Marion's Hairspring inspection method permits *100% inspection and control of hairspring characteristics* at high production rates.

Help yourself to marion methods

THE MARION METHOD of hairspring inspection takes advantage of the relationship between the torque of the hairspring and its natural resonant frequency. Initial calibration is made with a standard torsiometer and frequency is adjusted to resonate a hairspring of known torque. Hairsprings of correct torque specifications resonate when held in tweezers placed against the vibrating surface. Amplitude adjustment permits "Go-No-Go" Inspection to ± 1% of specified torque. With this method, inspection rates of 500 to 600 springs per hour may be achieved. This technique affords production torque control to close limits on a 100% basis, rather than the normal spot checking provided by standard torsiometers.



NOT FOR SALE — Marion's Method of inspecting hairsprings by vibrating them at audible frequencies may be adaptable to your own inspection problems. The illustrations show how such a device may be made. The one pictured uses a Hewlett-Packard audio oscillator coupled to a transducer which may be a modified P. M. speaker assembly.

OTHER MARION METHODS — Current demands on industry by the mobilization program accentuate the importance of production methods. Hairspring torque measurement by means of sound waves is only one of a number of methods which Marion proposes to present in the hope that some of them can help you as much as they have helped us. Marion Electrical Instrument Company, 401 Canal Street, Manchester, N. H., U. S. A.

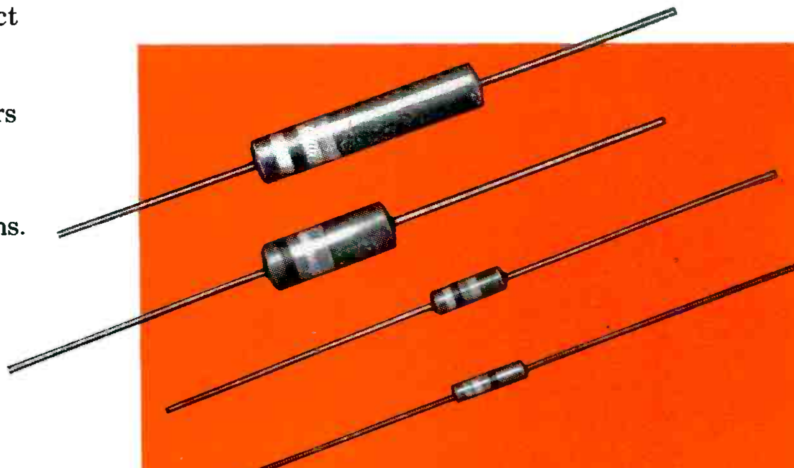
MANUFACTURERS OF MARION RUGGEDIZED PANEL INSTRUMENTS

marion meters

Quality control *for resistors too!*

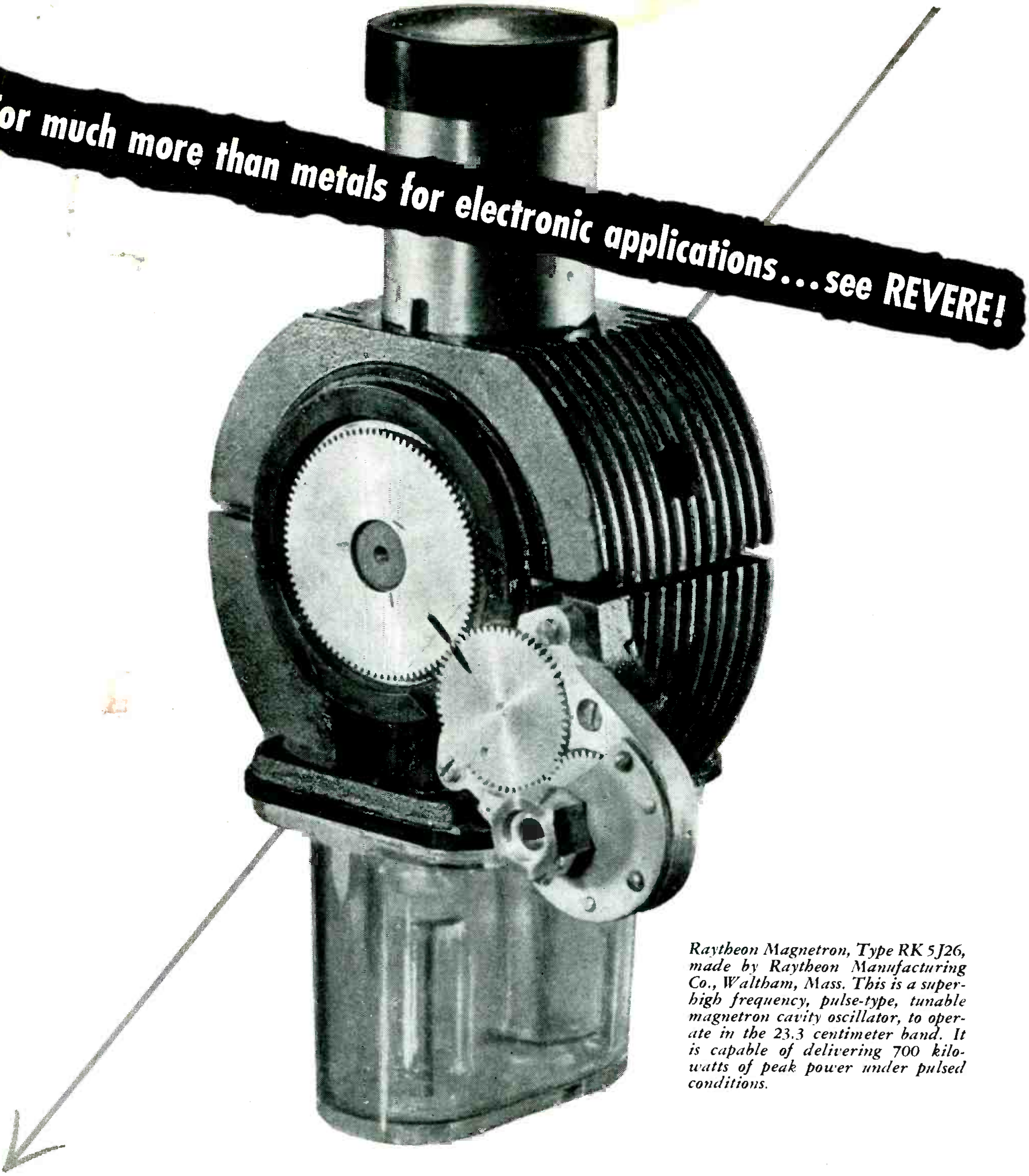
You can test a Quality Control Program in several ways . . . Does it begin *outside* your plant—with rigid specification of materials? Does it include detailed, continuous production-line inspections? Are these supplemented by laboratory and field-testing of your parts and products? And finally—do you reject on the basis of minor flaws? *IRC answers "YES" to all these yardsticks!* But the real proof of our Quality Control Program is the multitude of customers who specify IRC resistors—year after year.

Typical products of quality control, IRC Advanced BT Resistors meet and surpass JAN-R-11 Specifications. In standard RTMA ranges, Advanced BT's are designed to operate with moderate temperature rise and provide efficient power dissipation. Reason is the combination of IRC's filament-type resistance elements with exclusive construction features. Resistance material is permanently cured and bonded to special glass. Leads extend into filament for rapid heat dissipation. Molded bakelite seals element against moisture and prevents grounding. Advanced BT's are available in ⅓, ½, 1 and 2 watt ratings. Send for full details in 12-page technical data Bulletin B-1.



Meet and beat JAN-R-11 Specifications.
⅓, ½, 1 and 2 watts—available in ±5%, ±10% and ±20% tolerance.
Low noise level and temperature coefficient.

For much more than metals for electronic applications...see REVERE!



Raytheon Magnetron, Type RK 5J26, made by Raytheon Manufacturing Co., Waltham, Mass. This is a super-high frequency, pulse-type, tunable magnetron cavity oscillator, to operate in the 23.3 centimeter band. It is capable of delivering 700 kilowatts of peak power under pulsed conditions.

● This Raytheon Magnetron is just one of a number using Revere Metals—and Revere know-how. Revere and Raytheon work closely together, consulting on such matters as the properties of copper and brass, brazing methods, machining, suitability of metals for glass-to-metal seals, and so on. In other words, Revere goes much beyond merely supplying metals. Through the Revere Technical Advisory Service our knowledge and skill are available. They have proved invaluable to many companies. And by the way, do not forget that this collaboration is freely given. If you purchase from distributors and would like to avail yourself of our assistance, simply ask your Revere Distributor. He will be glad to put you in touch with us, without obligation.

REVERE 150th YEAR OF SERVICE TO AMERICA

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

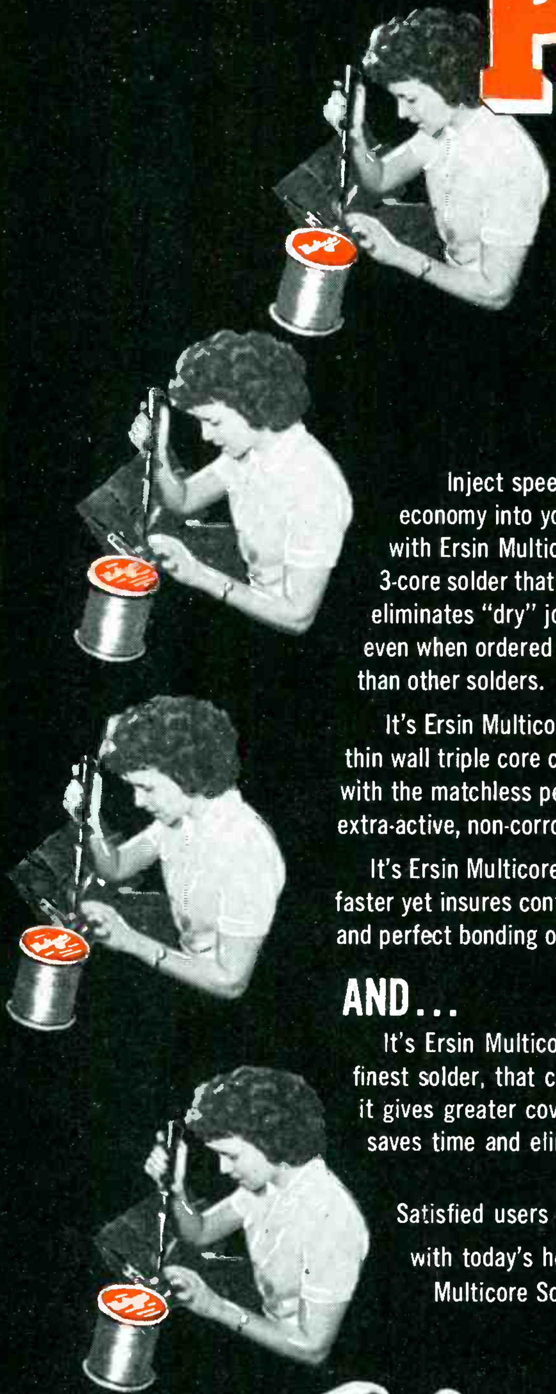
230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

Production Booster!



Inject speed, dependability and economy into your busy assembly line with Ersin Multicore — the original 3-core solder that achieves top production, eliminates "dry" joints and rejects, even when ordered with lower tin content than other solders.

It's Ersin Multicore that combines thin wall triple core construction with the matchless performance of extra-active, non-corrosive Ersin Flux.

It's Ersin Multicore that wets metals faster yet insures continuity of flux and perfect bonding on difficult metals.

AND...

It's Ersin Multicore, the world's finest solder, that costs less because it gives greater coverage per pound, saves time and eliminates rejects.

Satisfied users will tell you ... with today's heavy schedules specify Ersin Multicore Solder to do the job faster and better!

Made of virgin metals only:
Tin: 99.75% pure
Lead: 99.97% pure
Ersin Multicore meets ALL requirements of Federal Specification QQ-S-571-b.

ERSIN Multicore

the only 3 core solder made with non-corrosive, extra-active ERSIN FLUX!

New Edition! FREE— Valuable booklet "Modern Solders" and testing samples available on request.

Address U. S. A. and Canadian inquiries to
MULTICORE SALES CORP.
164 Duane Street • New York 13, N. Y.

Inquiries regarding other territories to
MULTICORE SOLDERS LTD.
Mellier House, Albemarle Street • London, W. 1, England

Plasticon M Capacitors

(Du Pont Polyester Film)

MANUFACTURERS
Glassmike Capacitors
Plasticon Capacitors
HiVolt Power Supplies
Pulse Forming Networks

All Phones: **AMbassador 2-3727**

Condenser Products Company

7517 North Clark Street • Chicago 26, Illinois

Special Purpose

TUBES AND DEVICES

Only a few companies in the country have facilities equal to ours for handling development and mass-production of special-purpose infra-red, photo-electric and advanced thermionic devices.

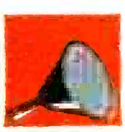
Our research and production specialists have done outstanding development work on such specialized equipment as thyratrons, tri-color display tubes, projection type P.P.I. presentation tubes, etc.

We have facilities for large-volume metal-to-glass sealing, high-vacuum pumping and sealing, annealing, automatic washing, handling of gases, etc.

Our 125,000 square feet of sprinklered floor space has more than a mile of flexible conveyors, large air conditioned areas and pipe line distribution of hydrogen, oxygen, purified water, city water and fuel gas. Quality control facilities and standards equal those of pharmaceutical or jeweled-movement manufacturers.

An ample supply of labor of better than average quality is accustomed to working to tenths-of-thousandths tolerances. We invite inquiries on projects requiring far more than ordinary ability.

THE RAULAND CORPORATION



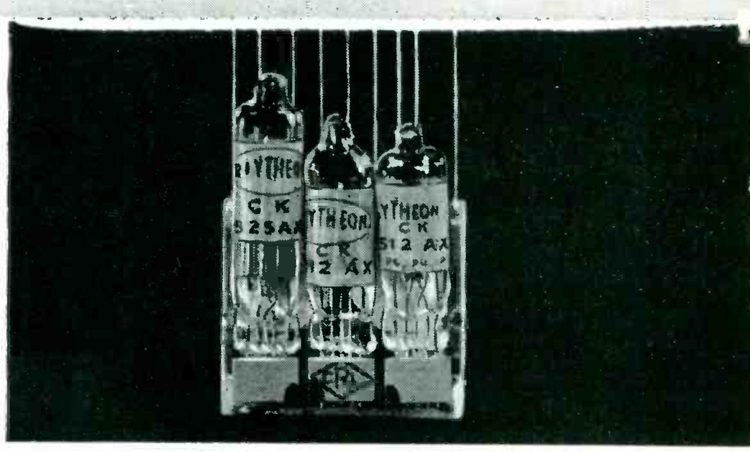
Perfection Through Research

4245 N. KNOX AVENUE · CHICAGO 41, ILLINOIS

Centralab Components

PRINTED ELECTRONIC CIRCUITS

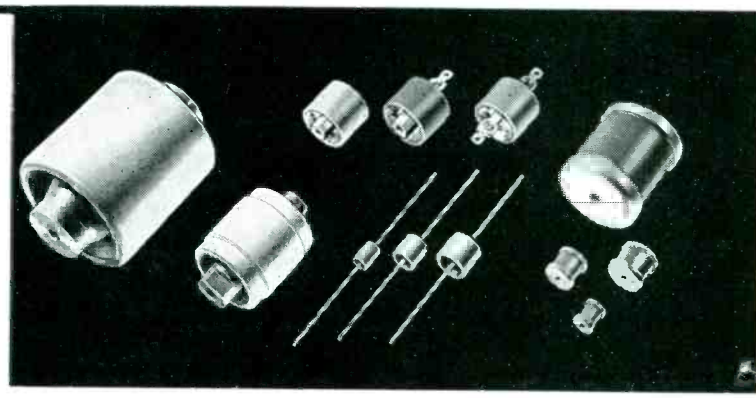
— *Are complete or partial circuits* (including all integral circuit connections) consisting of pure metallic silver and resistance materials fired to CRL's famous Steatite or Ceramic-X and brought out to convenient, permanently anchored external leads. They provide compact miniature units of widely diversified circuits — from single resistor plates to complete speech amplifiers. No other modern electronic development offers such tremendous time and cost saving advantages in low-power applications.



Ampec is a full 3-stage, 3-tube speech amplifier. Gives you truly highly efficient reliable performance. Size: $1\frac{1}{4}''$ x $1\frac{1}{8}''$ x .340″ over tube sockets! Widely used in hearing aids, mike preamps and other amplifier applications where small size and outstanding performance counts. Bulletin No. 973 in coupon below.

CERAMIC CAPACITORS

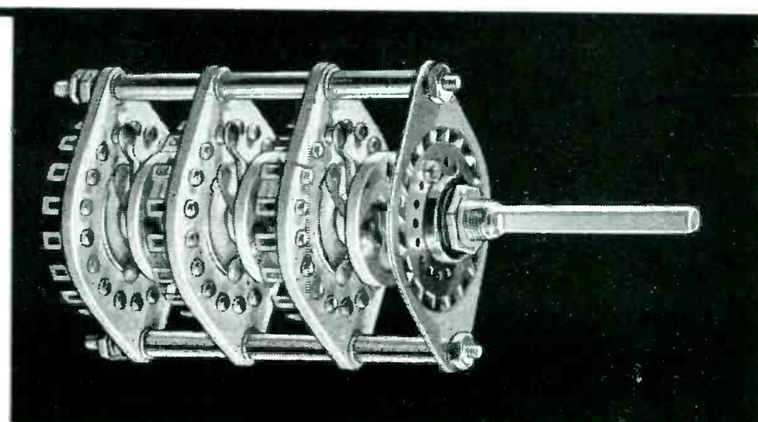
Centralab ceramic capacitors give you permanence never before achieved with old-fashioned paper or mica condensers. Ceramics are impervious to moisture, and have unmatched ability to withstand any temperatures normally encountered in electrical apparatus. Ceramics make possible tremendous space saving; many Centralab ceramic capacitors are ⅕th the size of ordinary capacitors. You can rely on Centralab ceramic capacitors for close tolerance, high accuracy, low power factors, and excellent temperature compensating qualities.



High voltage ceramic capacitors. Capacitance: 5 to 500 mmf., 5 KV to 40 KV D.C. working. Ideal for portable or mobile equipment. Primarily designed for high voltage, high frequency gear. For complete information, check Bulletin No. 42-102 in coupon below.

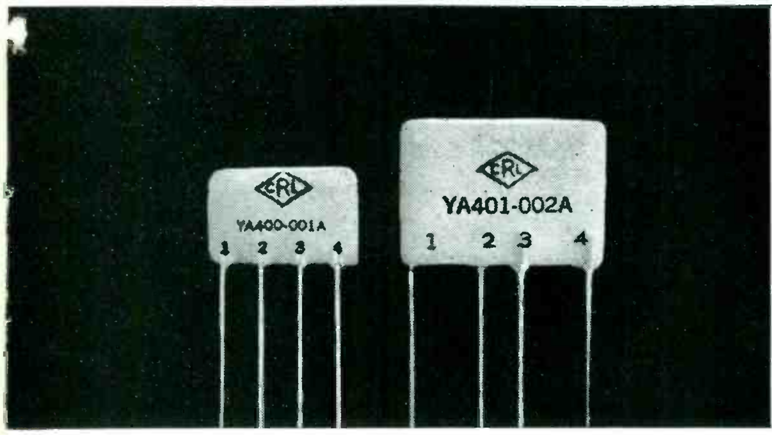
SWITCHES AND CONTROLS

Look to Centralab for standard and special purpose switches — single or multi-section (phenolic or steatite) — single or multi-pole — rotary, slide or lever action — shorting or non-shorting contacts . . . for AM-FM-TV as well as for medium duty power applications. In controls — it's Centralab all the way . . . Centralab introduced composition controls to the electronic industry 25 years ago! New Model 2 Radiohms are America's most modern controls for TV-AM-FM. Centralab Model 1 Radiohm is the outstanding truly miniature unit—the standard of the hearing aid industry.

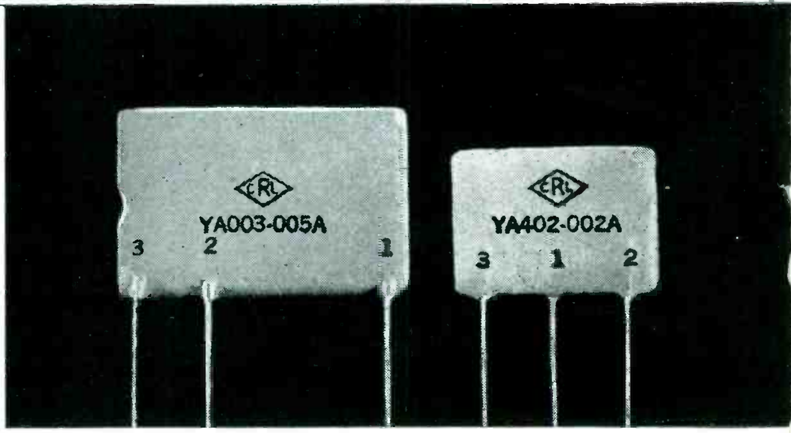


Medium Duty Power Switch for R.F. or $7\frac{1}{2}$ amp. 110-115 V. application. 1, 2 or 3 poles . . . 18 contact sections . . . up to 20 sections per shaft. Contacts, collector rings coin silver mounted on Grade L5 Steatite. Cat. No. 722

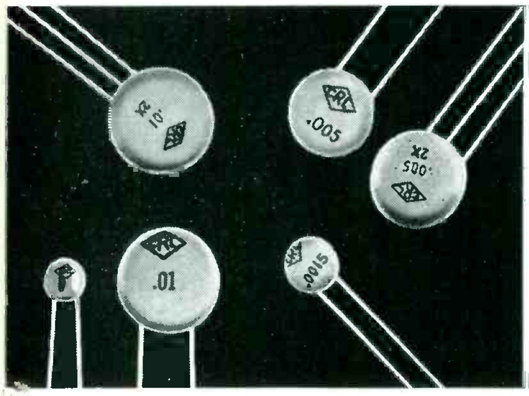
save time...space...weight



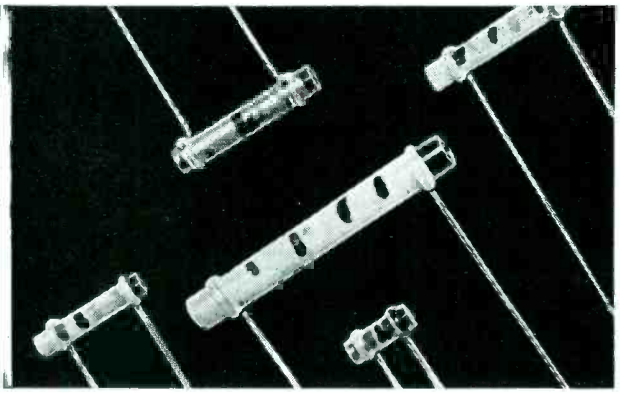
Centralab Triode Couplates save space and weight. They actually replace 5 components normally used in audio circuits. Triode Couplates are complete assemblies of 3 capacitors and 2 resistors bonded to a dielectric ceramic plate. Available in a variety of resistor and capacitor values. Bulletin No. 42-6 in coupon below.



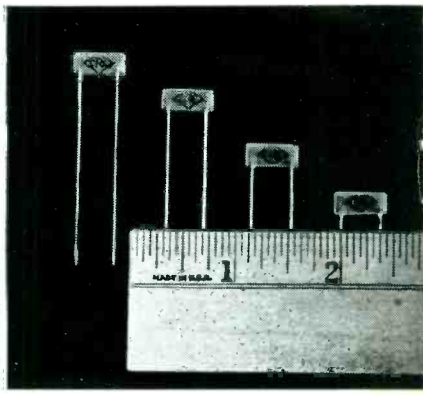
Centralab Vertical Integrators give you big savings in assembly costs, particularly in TV vertical integrator networks. One type consists of 4 resistors and 4 capacitors brought out to 3 leads . . . reducing the formerly required 16 soldered connection to only 3! There's a big saving in the number of parts handled, too! Bulletin No. 42-22.



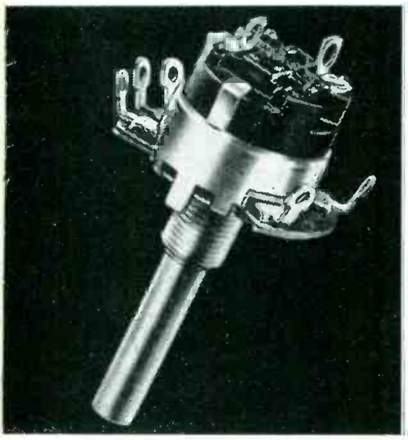
Ceramic Disc Hi-Kap Capacitors hold thickness to a minimum. Make possible very high capacity in extremely small size. Use in HF bypass and coupling. Bulletin No. 42-4R.



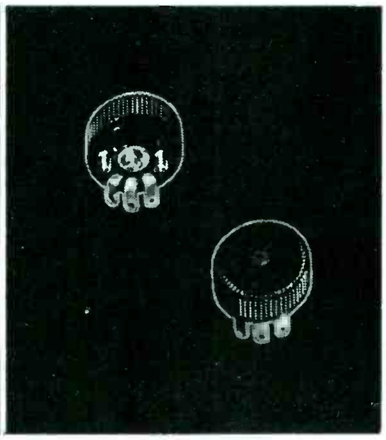
Tubular Ceramic Capacitors — Type TCZ show no capacitance change over wide range of temperature. Type TCN have special ceramic body to vary capacitance according to temperature. Bulletin No. 42-18.



Min-Kaps are very tiny capacitors used where space is at an extreme premium. Ask for Bulletin No. 42-24.



New high quality Model 2 Radiohms are designed for lower noise level, longer life. Bulletin No. 42-85.



Model "1" *Radiohm* control — 1/10 watt — plain or switch type. No larger than a dime. For miniature use. Bulletin No. 42-19.

Centralab ®

Division of GLOBE-UNION INC. • Milwaukee

TEAR OUT COUPON
for the Bulletins you want

CENTRALAB
Division of Globe-Union Inc.
914 East Keefe Avenue, Milwaukee, Wisconsin

Yes — I would like to have the CRL bulletins, checked below, for my technical library!

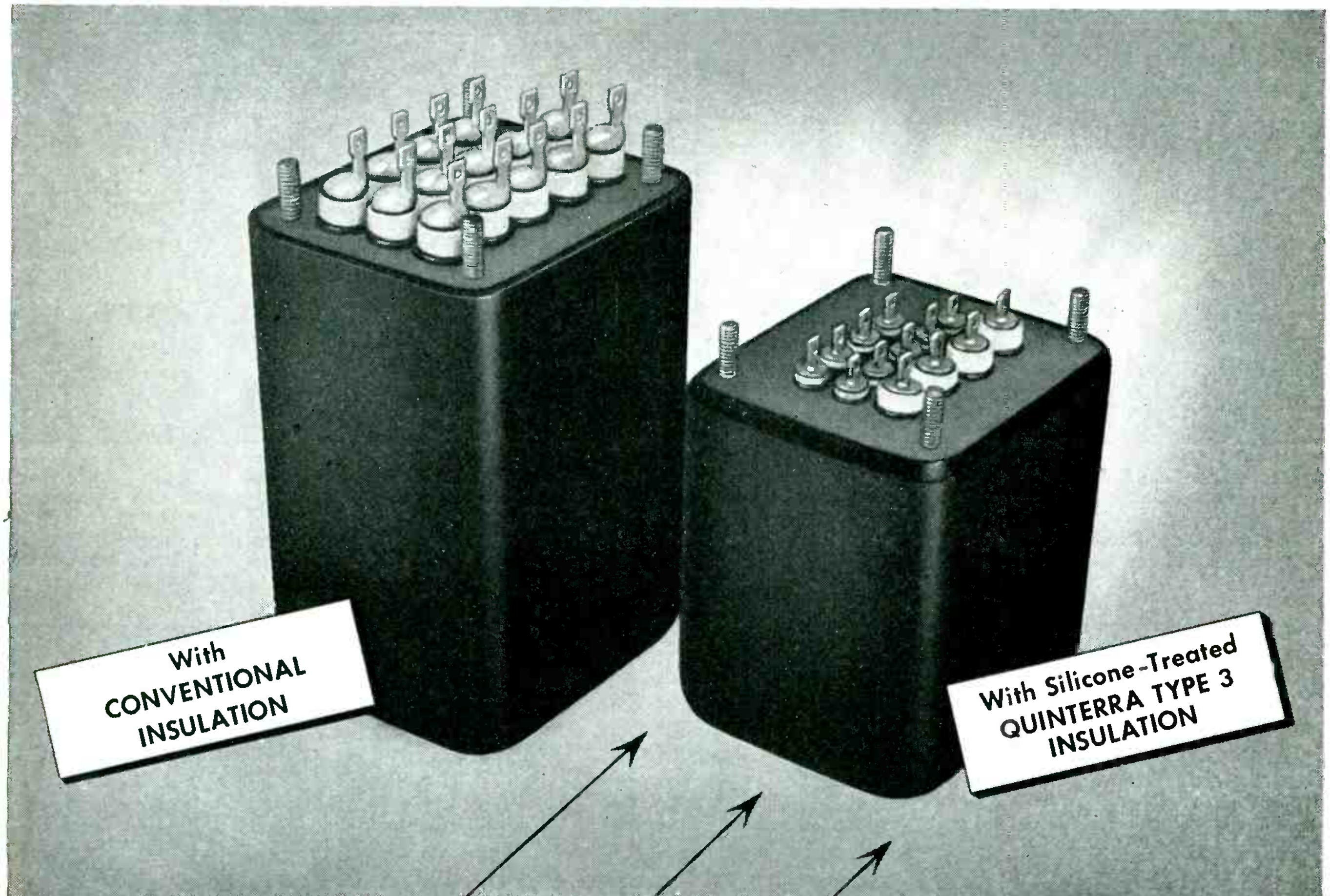
☐ EP-15	☐ 973	☐ 42-18	☐ 42-24	☐ 42-130	☐ 42-157
☐ EP-16	☐ 42-4R	☐ 42-19	☐ 42-85	☐ 42-149	☐ 42-158
☐ 722	☐ 42-6	☐ 42-22	☐ 42-102	☐ 42-156	

Name...

Address...

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

Now available... Johns-Manville



Above comparison shows the savings in space and materials made possible by the use of silicone-treated Quinterra.

Photograph courtesy of *Chicago Transformer Division*, Essex Wire Corporation.

Saves on Size

Saves on Weight

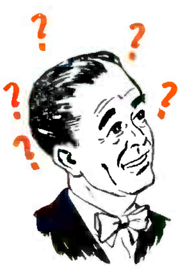
Raises Overload Limits

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

Glass Code	Type	Principal Use	Viscosity Data: Strain Point °C	Viscosity Data: Annealing Point °C	Viscosity Data: Softening Point °C	Viscosity Data: Working Point °C	Thermal Expansion Coeff.—/° C	Density (Sp. Gr.)	Refractive Index Sod. D Line (.5893 Microns)	Log₁₀ of Volume Resistivity 250°C	Log₁₀ of Volume Resistivity 350°C	Dielectric Properties at 1 Mc and 20° C: Power Factor	Dielectric Properties at 1 Mc and 20° C: Dielectric Const.	Dielectric Properties at 1 Mc and 20° C: Loss Factor
0010	Potash Soda Lead	Lamp Tubing	397	428	626	970	91×10^{-7}	2.85	1.539	8.9	7.0	.16%	6.6	1.1%
0080	Soda Lime	Lamp Bulbs	478	510	696	1000	92×10^{-7}	2.47	1.512	6.4	5.1	.9	7.2	6.5
0120	Potash Soda Lead	Lamp Tubing	400	433	630	975	89×10^{-7}	3.05	1.560	10.1	8.0	.16	6.6	1.1
0280	Hard Lime	General	515	547	726	—	82×10^{-7}	2.50	1.517	—	—	—	—	—
1710	Hard Lime	Cooking Utensils	672	712	915	1200	42×10^{-7}	2.53	1.534	11.4	9.4	.37	6.3	2.3
1990	Potash Lead	Iron Sealing	334	359	496	—	127×10^{-7}	3.47	[illegible]	[illegible]	7.7	.04	8.3	.33
3320	Borosilicate	Tungsten Sealing	497	535	780	—	[illegible]	[illegible]	[illegible]	[illegible]	7.1	.32	5.0	1.6
6750	Opal	Lighting Ware	445	475	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—
6810	Opal	Lighting Ware	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—
7040	Borosilicate	Kova	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.18	4.8	.86
7050	Borosilicate	Series	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.33	4.9	1.6
7052	Borosilicate	Kovar	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.26	5.1	1.3
7070	Borosilicate	Low Loss	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.06	4.0	.24
7251	Borosilicate	Electrical	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—
7720	Borosilicate	Electrical	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	27	4.7	1.3
7740	Borosilicate	General	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6	4.6	2.1
7750	Borosilicate	Series Sealin	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9.5	7.7	.20	4.6	.92
7760	Borosilicate	Electrical	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.23	1.473	9.4	7.7	.18	4.5	.79
7900	96% Silica	High Temp.	[illegible]	[illegible]	[illegible]	—	8×10^{-7}	2.18	1.458	9.7	8.1	.05	3.8	.19
7900	96% Silica (Multiform)	High Temp.	820	910	1500	—	8×10^{-7}	2.18	1.458	9.7	8.1	.05	3.8	.19
7910	96% Silica	Ultraviolet Transmission	820	910	1500	—	8×10^{-7}	2.18	1.458	11.2	9.2	.024	3.8	.091
7911	96% Silica	Ultraviolet Transmission	820	910	1500	—	8×10^{-7}	2.18	1.458	11.7	9.6	.019	3.8	.072
8830	Borosilicate	X-Ray	475	510	715	—	48×10^{-7}	2.25	—	7.8	6.3	—	—	—
8871	Lead Potash	Electrical Capacitors	357	384	527	—	103×10^{-7}	3.84	—	11.1	8.8	.05	8.4	.42
8160	Lead Potash	Dumet Sealing	399	433	627	—	91×10^{-7}	2.98	1.553	10.6	8.4	.09	7.1	.64
9010	Lead Free	Television	411	442	650	—	88×10^{-7}	2.59	1.506	8.9	7.0	.22	6.5	1.43
9700	————	Ultraviolet Transmission	517	558	804	1195	37×10^{-7}	2.26	1.478	8.0	6.5	—	—	—
9741	————	Ultraviolet Transmission	407	442	705	—	39×10^{-7}	2.16	—	9.4	7.6	—	—	—

HAVE YOU OVERLOOKED SOME OF THE PROPERTIES OF GLASS?



Glass has proved an important material for electronic equipment—in tube envelopes, special tubing, sealing beads, insulation and a host of other uses. In almost every application the special electrical and physical characteristics are vital to top notch performance—characteristics such as well controlled dielectric strength, proper loss and power factor, desired transparency and corrosion resistance.

Take a fresh look at your present and projected equipment. Glass may help improve performance or lower costs. Then bring your idea to Corning and let our engineers help choose a glass for you. We have hundreds of glasses with widely varying characteristics, the research and pilot plant facilities to develop your idea and a broad variety of production facilities to produce it. For a quick look at some properties of glasses by Corning write for Bulletin B-83 to Dept. E-9, Corning Glass Works, Corning, New York.

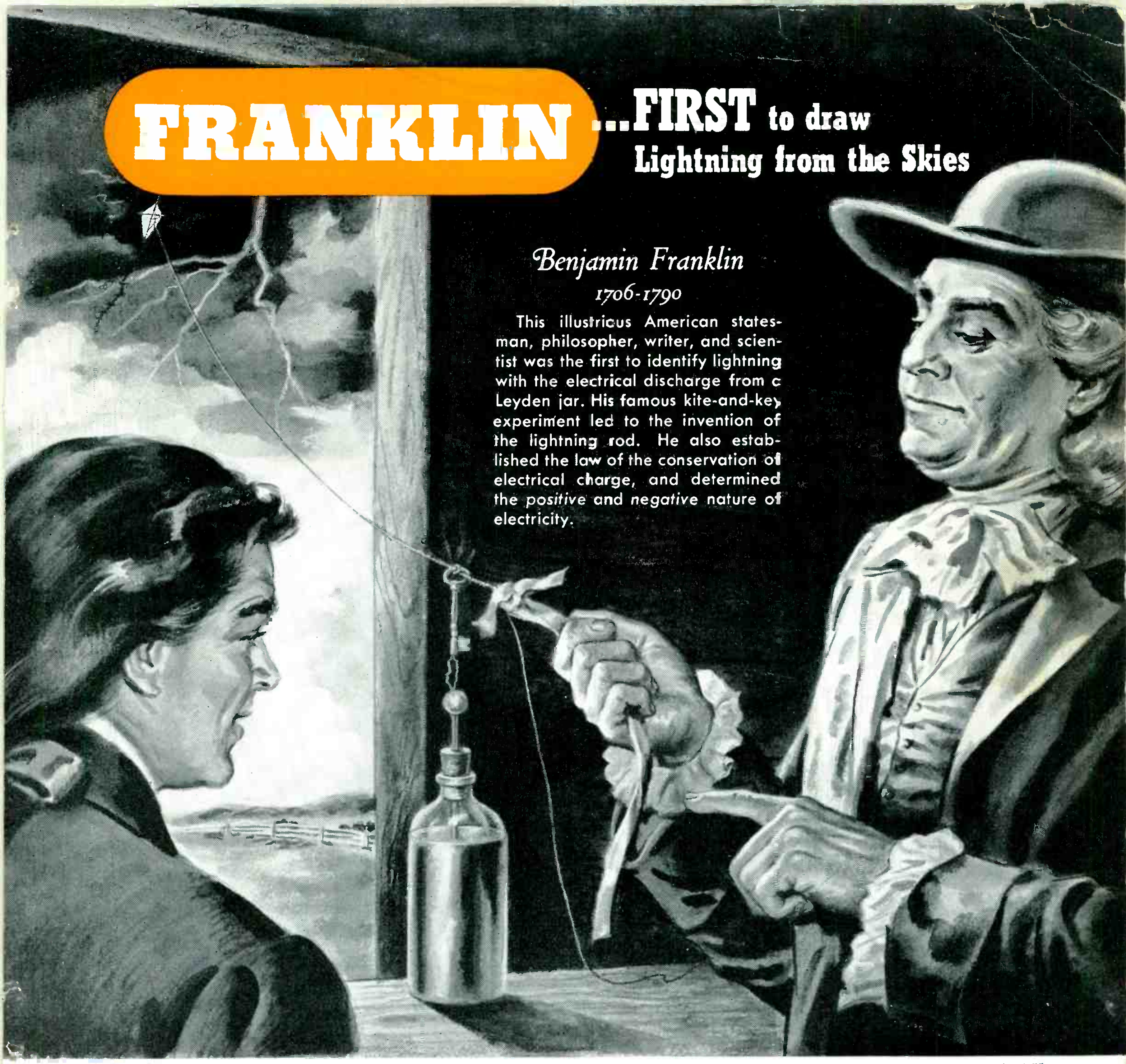
PYREX T.M. REG. U.S. PAT. OFF.

CORNING GLASS WORKS, CORNING, N. Y.

Corning means research in Glass

ELECTRONIC SALES DEPARTMENT — ELECTRICAL PRODUCTS DIVISION

1851 • 100 YEARS OF MAKING GLASS BETTER AND MORE USEFUL • 1951



From an original drawing made for OHMITE.

OHMITE® ...FIRST in Resistors

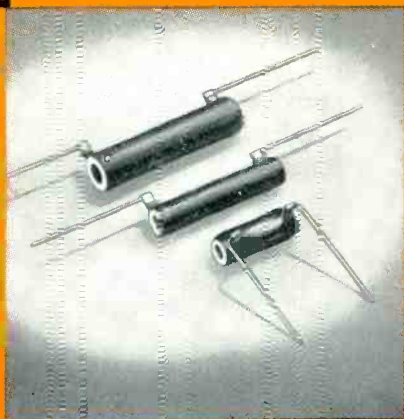
...today

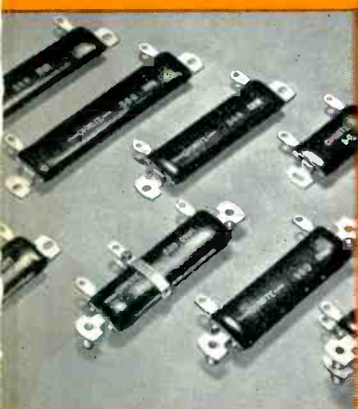
Be Right with

OHMITE

RHEOSTATS
RESISTORS
TAP SWITCHES

Ohmite offers the most complete line of wire-wound resistors on the market today. These Ohmite resistors have become world renowned for their dependability . . . their ability to give unfailing, long-life performance under adverse operating conditions. For *extra* dependability, specify Ohmite resistors—overwhelmingly the first choice of industry today.





OHMITE

HERE ARE SAMPLE KITS

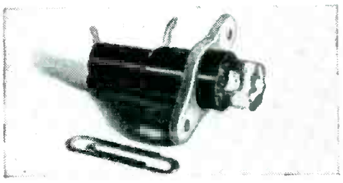
OF NEW ALDEN COMPONENTS WHICH SHOW HOW YOU CAN REALIZE TREMENDOUS SAVINGS IN MAN-HOURS AND CRITICAL MATERIAL

You can use any Alden component and know that you will get the best functional design, requiring the least number of parts, operations and critical material. . . . Your production will be faster and your equipment better with Alden completely "thought-through" engineered components.

BRILLIANT INDICATOR LIGHT

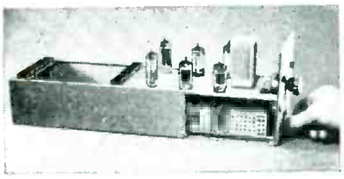
Here is the Alden Pan-i-Lite, a tiny brilliant indicator, that gives a clear, sharp indication. Bulb is instantaneously replaceable. Unscrew lens and you remove bulb—from front of panel. No digging into or disassembling of equipment. Completely thought-through design takes absolute minimum of space (⅜" diameter x ¾" length). (Kit #1—Kit contains 1 demonstrator Pan-i-Lite.)

COMPACT INDICATING FUSEHOLDER



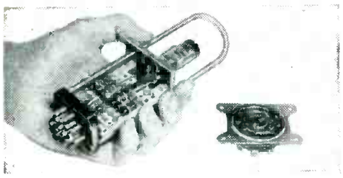
Here is a rugged, well-made indicator fuseholder that saves valuable time in spotting blown fuse . . . Neon bulb, molded as an integral part of lens, glows when fuse blows — instantly spotting trouble. Fuseholder fits ideally into standard assembly techniques — rivets, eyelets or screws to mounting panel. (Kit #2—Kit contains 2 demonstrator Indicator Fuseholders.)

EFFICIENT BASIC PLUG-IN CHASSIS



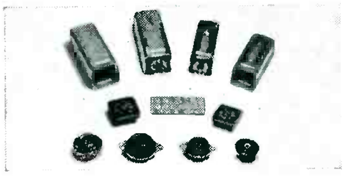
The Alden Basic Chassis gives a brand new approach to equipment construction. Without spending hours of engineering time and without stocking numerous parts, you can have plug-in unit construction. Alden chassis can be standard to provide the means for the most efficient circuitry layout, construction, and maintenance. Chassis is open sided, front panel is detachable, back connectors allow direct wiring, locking devices are easily operable — everything is clean-cut and easily accessible. (Kit #3—Kit contains 1 demonstrator Basic Chassis.)

UNIVERSAL 20-PIN PLUG-IN PACKAGES



The Alden "20" Packages can be the answer to the majority of your circuit unitizing requirements. These packages give you extreme flexibility for component mounting, simplicity of circuitry layout, and speed of assembly. Recognizing that unitization needs more than regular components "adapted", we developed these packages designed specifically for plug-in unit construction. The packages are being used as standard in many labs and manufacturing companies to take care of 90% of their requirements. (Kit #4—Kit contains 1 open and 1 shielded package and 2 mounting sockets.)

MINIATURE 7 AND 9 PIN PLUG-IN KITS

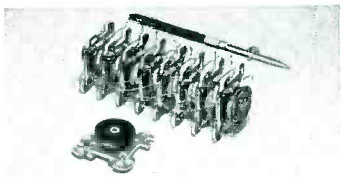


The ideal components for making miniature and subminiature circuits easily replaceable plug-in units. The Alden 7 and 9 pin kits are designed specifically for plug-in construction. The Alden terminal mounting system — for laying out and wiring circuits in the open — speeds production over complicated, involved methods . . . units can be assembled using standard production assembly techniques. (Kit #5—Kit contains 1 each 7 and 9 pin miniature sockets, 1 each 7 and 9 pin miniature base, 1 each 7 and 9 pin housing, 1 each 7 and 9 pin terminal card with 8 staked terminals.)

SAFE HIGH VOLTAGE DISCONNECT

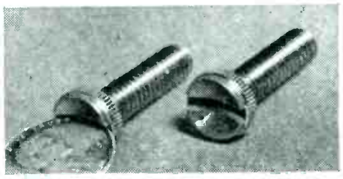
By a special handling and molding technique whereby lead and body is molded as one homogeneous unit of low-loss Polyethylene, this new high voltage disconnect gives complete protection to operator and provides a seal around contact against dust and moisture. The new Alden technique completely bonds wire, contact and insulation into one unit and gives wide freedom to selection of insulating material for disconnects, tube caps, special connectors, etc. (Kit #6—Kit contains 2 high voltage disconnects, 2 low-loss insulated tube caps—demonstrating new molding technique.)

REVOLUTIONARY COMPUTER COMPONENT



Here is the Static Magnetic Memory, a revolutionary device for pulse handling and storing that could well change the whole picture of computer design. Developed by the Harvard Computation Laboratory, these magnetic binaries have unique characteristics that make possible information pick up and recording independent of mechanical movement, a variable information handling rate up to 30,000 pulses per second and permanent information storage without necessity of maintaining power. (Kit #7—Kit contains 2 SMM units, completely interwired as a binary unit.)

PRODUCTION CAP CAPTIVE AND TARGET SCREWS



For the greatest convenience and accessibility to putting together and taking apart equipment, replace conventional type screws with Alden target and cap captive designs. Slot takes coin so no special tools necessary in field. Arced notch and concave head makes beautiful target for assembly with production tools. Cap captive can readily be made captive so it's ideal for holding detachable units. (Kit #8—Kit contains 13 screws and 4 weld pilot nuts.)

MAIL THIS COUPON

ALDEN PRODUCTS COMPANY

DEPT. E., 117 N. MAIN STREET, BROCKTON 64, MASS.

Please send the following Kits

KIT #1	☐	Brilliant Indicator Light (Pan-i-Lite)	$2.00
KIT #2	☐	Compact Indicating Fuseholder	4.50
KIT #3	☐	Efficient Basic Plug-in Chassis	40.00
KIT #4	☐	Universal Alden "20" Plug-in Packages	10.00
KIT #5	☐	Miniature 7 and 9 Pin Plug-in Kits	2.75
KIT #6	☐	Safe High Voltage Disconnect	1.25
KIT #7	☐	Revolutionary Computer Component (SMM)	10.00
KIT #8	☐	Production Cap Captive and Target Screws	3.00

Prices shown are for sample kits only. For production quantities send your requirements and we will quote.

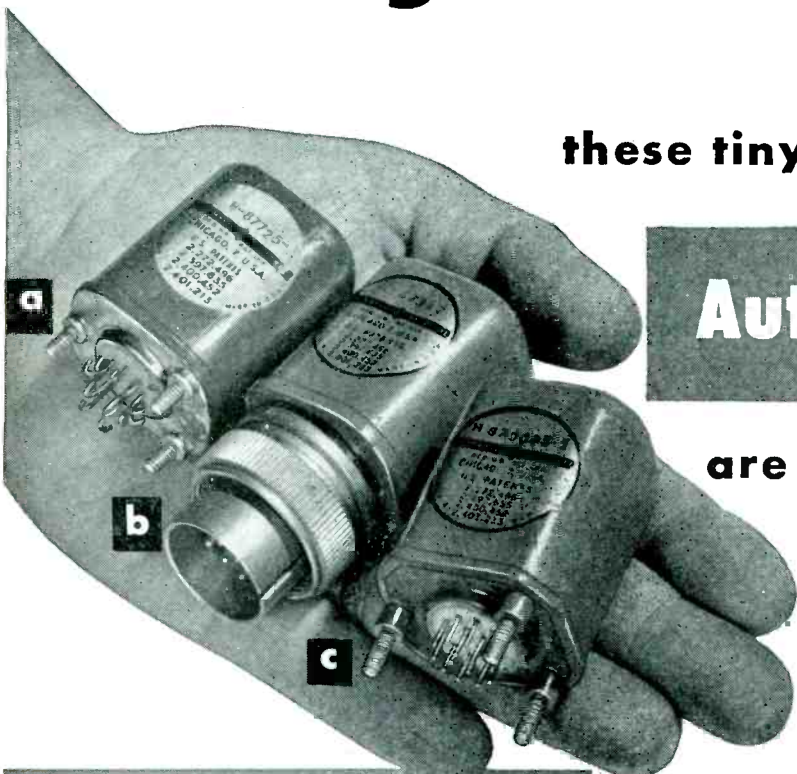
NAME ____________ Title ____________

COMPANY ____________

STREET ____________

CITY ____________ Zone ____ STATE ____________

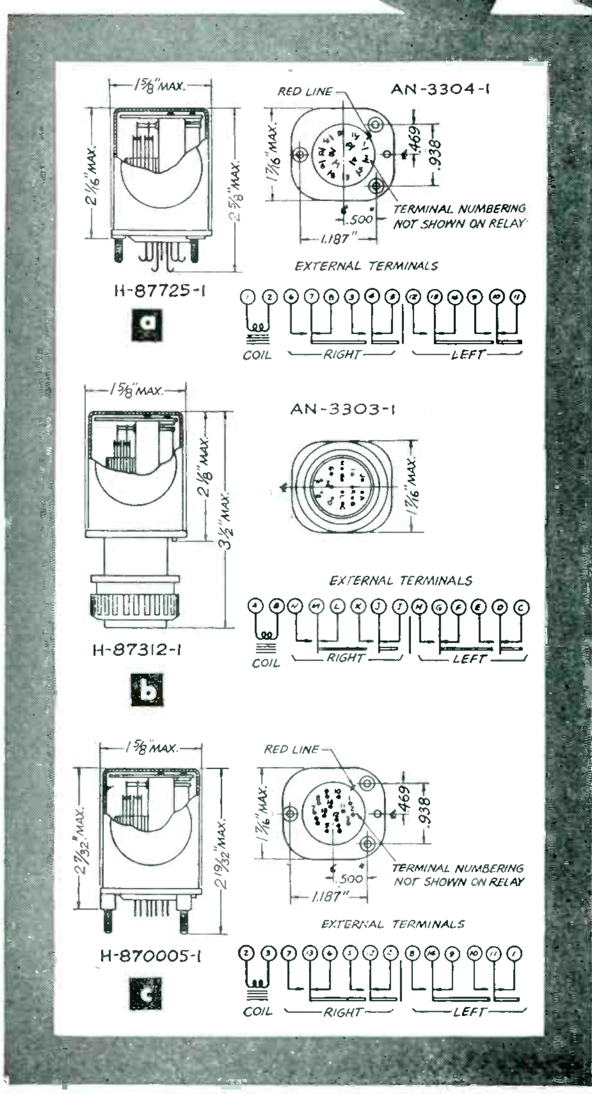
Nothing can touch them!



these tiny Class "S" Relays from

Automatic Electric

are HERMETICALLY SEALED



To give your product high performance standards, use relays that meet *aviation's* highest standards. These Automatic Electric Class "S" Relays meet them all!

small, light-weight—mount in any position in a restricted space...save valuable room, hold down weight.

resist shock and vibration—contact operation is dependable at vibration up to 10.5 G's.

protected from harmful conditions—operate in "ideal" atmosphere of dry nitrogen, sealed against dust, corrosion, atmospheric pressure changes and tampering.

versatile in application—as shown at left, Class "S" Relays are available with solder-or socket-type terminals...and with the contact arrangements *you* specify.

Other telephone-type relays can also be supplied, with or without hermetically sealed enclosures. Write for circulars. Address: AUTOMATIC ELECTRIC SALES CORPORATION, 1033 West Van Buren St., Chicago 7, Ill. In Canada: Automatic Electric (Canada) Ltd., Toronto. *Offices in principal cities.*

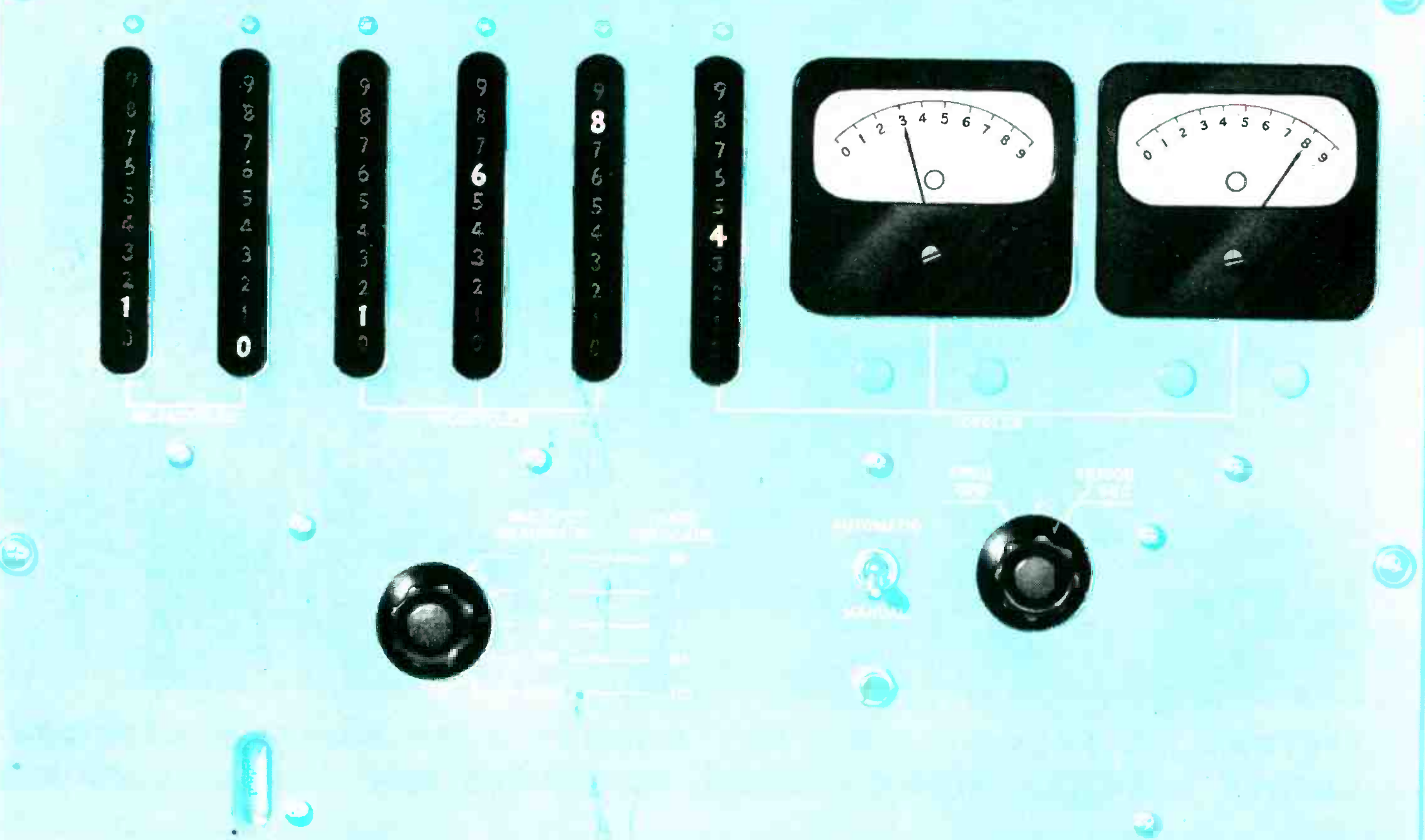
RELAYS SWITCHES

AUTOMATIC ELECTRIC

CHICAGO

With this one *NEW* instrument read frequency directly, automatically, without calculation—*in 1 second or less!*

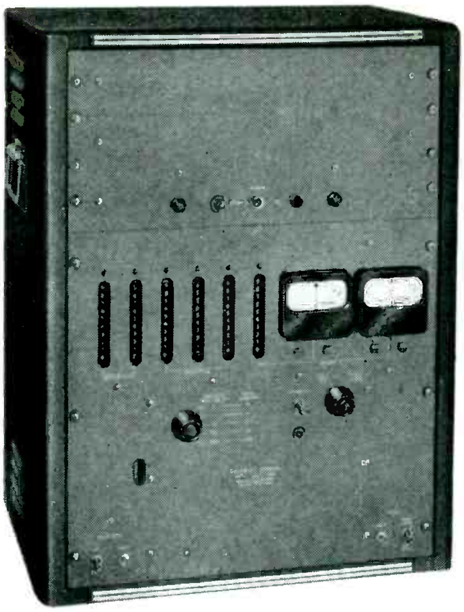
Any frequency to 10,000,000 cps displayed here the split-second unknown is connected! No other equipment needed, no interpolation. (Frequency counted below, 10,168,438 cps.)



A daily work-saver for laboratory or production line!
Here are just a few time-saving uses!

- Measure exact frequency of transmitters and crystal oscillators
- Calibrate sub-audio, audio and supersonic test oscillators
- Measure rpm electronically up to 600,000,000 rpm
- Establish frequencies for filter characteristic determination
- Monitor frequency drift with precise accuracy
- Make rapid checks of crystal frequency
- Read total random events per unit time
- Use as precision frequency standard

HEWLETT-PACKARD *hp* INSTRUMENTS



REVOLUTIONARY NEW
-hp- 524A FREQUENCY COUNTER

- **No figures to add, no calculations!**
- **No complex equipment set-up!**
- **Easily used by non-technical personnel!**
- **Production-line speed, instantaneous readings!**
- **Laboratory accuracy, 1/1,000,000 ±1 count!**
- **Broad coverage, .01 to 10,000,000 cps!**

-hp- 524A Frequency Counter sets new standards for accurate, high-speed frequency measurement in the laboratory or on the production line. It counts frequency instantly, automatically, without effort on your part. It performs all functions of a frequency standard, interpolating system, and detector. For frequency determination it eliminates expensive, hard-to-maintain harmonic amplifiers, transfer oscillators, multi-vibrators, and oscilloscopes.

BRIEF SPECIFICATIONS

-hp- 524A Frequency Counter

COUNTING RATE: 10 mc maximum.

PRESENTATION: 8 places, direct reading.

COUNT PERIOD: 0.001, 0.01, 0.1, 1, 10 secs.

LOW FREQUENCIES: Permits low frequencies to operate as time base. Duration of one cycle is displayed in microseconds.

ACCURACY: ± 1 count ± 2/1,000,000 per week. (Higher accuracy external standard may be employed.)

PERIOD MEASUREMENT: Within 0.3% up to 300 cps: within 1 μsec between 300 cps and 10 kc.

EXTERNAL 100 KC TIMING CIRCUIT: For higher accuracy. Requires 1 v across 50,000 ohms shunted by 30 μμfd.

INPUT VOLTAGE: 1 v peak minimum.

INPUT IMPEDANCE: Approx. 100,000 ohms, 30 μμfd shunt.

CONNECTORS: Standard BNC type.

POWER SOURCE: 115 v, 50/60 cps, 400 watts.

SIZE: Approx. 28" high, 21¾" wide, 14" deep. Weight 115 lbs. Shipping weight 175 lbs.

PRICE: $2,000.00 f.o.b. factory.

Data Subject to Change Without Notice

Two Types of Measurement

1. Direct Counting for High Frequencies • The equipment counts and displays—*directly*—unknown frequencies over exact time intervals of 10, 1, 0.1, 0.01, and 0.001 seconds. Counting and display periods are equal and automatically cycled. The count is displayed repetitively; or, by merely pressing the "manual" button, can be "held" any length of time.

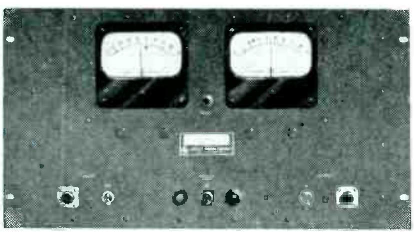
2. Period Measurement for Low Frequencies • The equipment measures the duration of one low frequency cycle in microseconds. A 10 cps sample is taken to determine this period. Periods may be displayed repetitively or "held" as in frequency counting.

Circuit Description

-hp- 524A operates on pulse counting techniques. The unknown is applied through a wide-band squaring amplifier to a fast gate controlled by a time base generator. When the gate is open, unknown is applied to counting circuits. When gate is closed, counting circuits remember and display the counted frequency in cps, or the period in microseconds. Time base circuits are controlled by a highly stable crystal oscillator with instantaneous stability of 1/1,000,000; accuracy of 2/1,000,000 per week.

New *-hp-* 520A High-Speed Scaler

This new *-hp-* equipment is an aperiodic 10 mc scaler offering precise accuracy and high-speed operation for easy measurement of "fast" circuits and nuclear parameters. This equipment is built into *-hp-* 524A Frequency Counter, and is also available as a separate instrument.



-hp- 520A Scaler will count period pulses from 0 cps to 10 mc. Double-pulse resolving time is 0.1 μsec. Triple-pulse resolving time is 0.2 μsec. Scaler delivers 1 output pulse per 100 received, and displays residual count on two panel meters. Instrument may be used with conventional 10^5 pps scalers to increase count capacity. $600.00 f.o.b. factory.

See your -hp- field engineer or write direct for complete details.

HEWLETT-PACKARD COMPANY

2322A PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.
Export: Frazar & Hansen, Ltd., San Francisco, Los Angeles, New York

THE COMPLETE COVERAGE LINE

Our new crazeless gray enamel puts

BLUE RIBBON RESISTORS

STILL FARTHER AHEAD!

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."*

Although its basic design is the same, recent improvements assure you the finest flat resistor made.

Our new 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

Subsidiary of

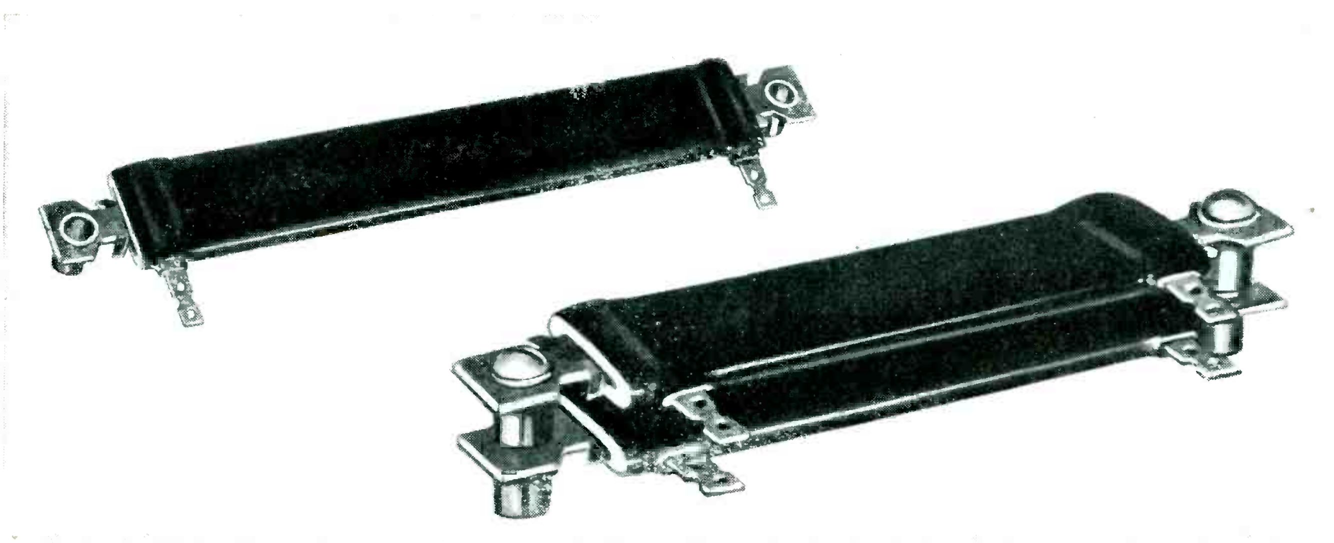
THE NATIONAL LOCK WASHER COMPANY

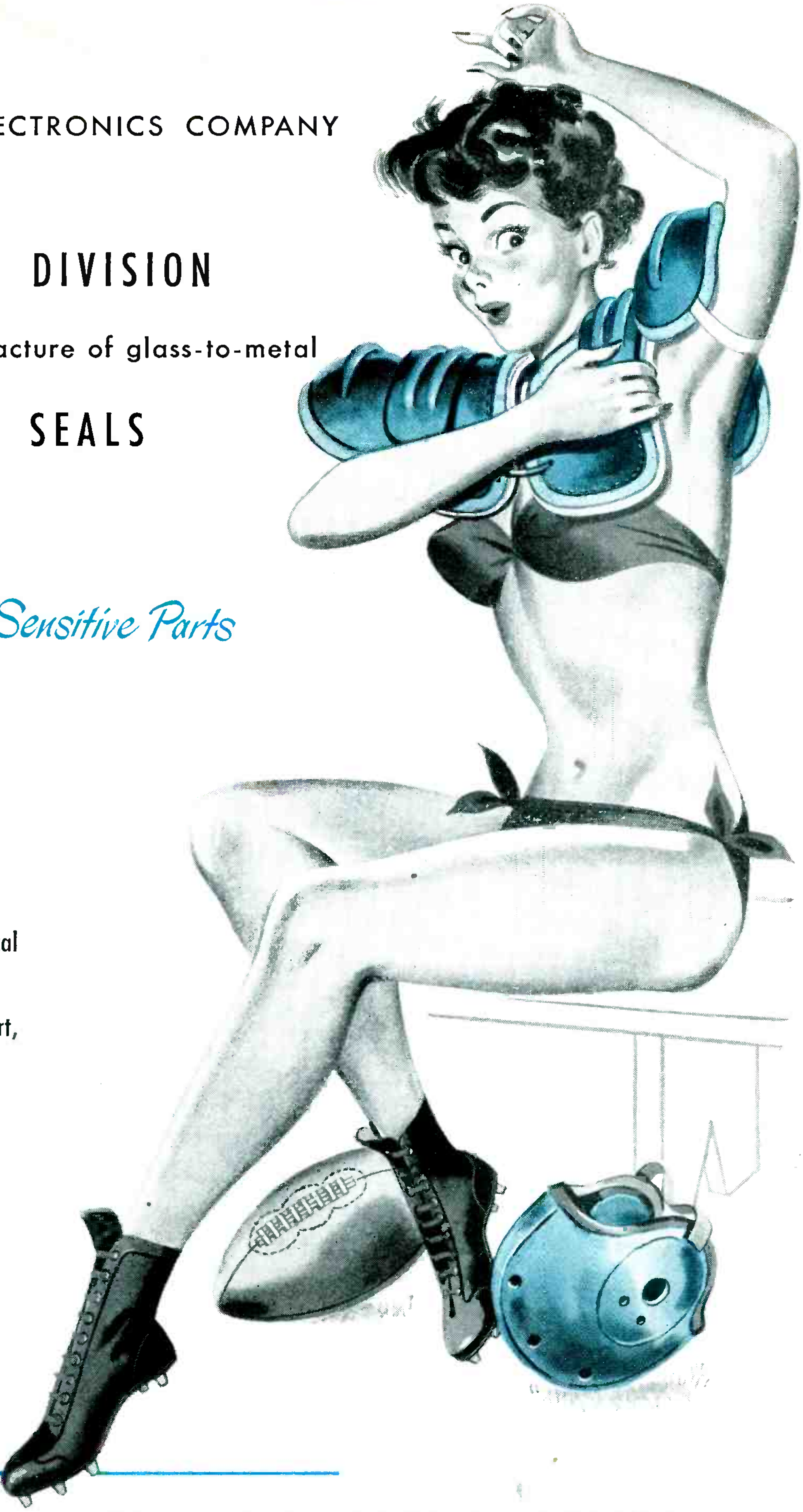
Established 1886

NEWARK 5, N. J. U.S.A.

the mark *of quality*

For more than a quarter of a century





for MILITARY

A COMPLETE LINE OF

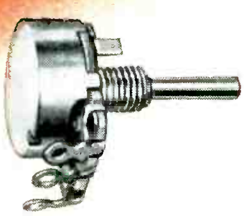
Never Before!

DELIVERS TOP PERFORMANCE IN AN UNPRECEDENTED TEMPERATURE RANGE FROM THE BITTEREST COLD IN ARCTIC REGIONS OR EXTREME ALTITUDES TO FIERY HOT TROPICAL BATTLEFIELDS . . . AND IN AN UNPARALLELED HUMIDITY RANGE FROM COMPLETE ARIDITY TO THE SATURATION POINT.

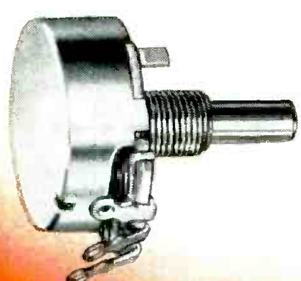
Highly recommended for use in jet and other planes, guided missiles, tanks, ships and submarines, portable or mobile equipment and all other military communications.

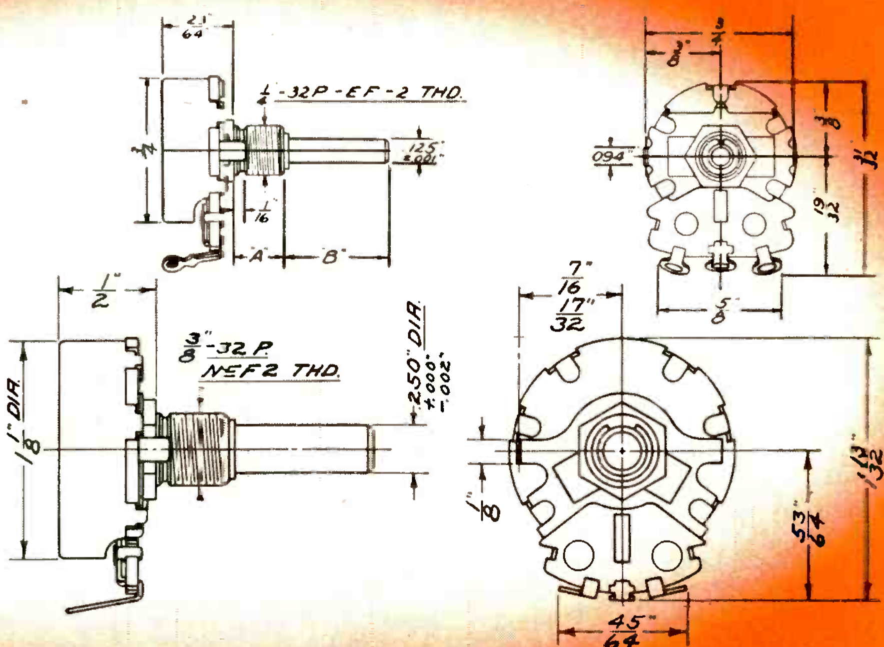
Manufactured from specially developed materials, this absolutely unique variable resistor is available in *miniaturized* size (Type 65) or in conventional size (Type 95) in resistance ranges from 250 ohms to 10 megohms.

TYPE 65
MINIATURIZED



TYPE 95





EXCEPTIONALLY GOOD DELIVERY CYCLE

. . . on military orders due to enormous mass production facilities . . . Please give complete details on your requirements when writing or phoning for further information.

Specialists in

CHICAGO TELEPHONE SUPPLY
Corporation
ELKHART • INDIANA

REPRESENTATIVES
S. J. Hutchinson, Jr.
401 North Broad Street
Philadelphia 8, Pennsylvania
Phone: Walnut 2-5369

W. S. Harmon Company
1638 So. La Cienega Blvd.
Los Angeles 35, California
Phone: Bardshaw 2-3321

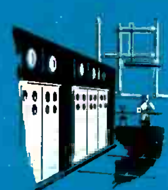
IN CANADA
C. C. Meredith & Co.
Streetsville, Ontario

SOUTH AMERICA
Jose Luis Pontet
Buenos Aires, Argentina
Montevideo, Uruguay
Rio de Janeiro, Brazil
Sao Paulo, Brazil

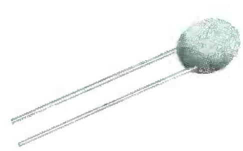
OTHER EXPORT
Sylvan Ginsbury
8 West 40th Street
New York 18, N. Y.

APPLICATIONS
VARIABLE RESISTORS (COMPOSITION and WIRE WOUND)
MEETS ALL JAN-R-19 SPECIFICATIONS
JAN Type RA 20A
2 Watt (CTS Type 252)
JAN Type RA 20B
2 Watt (CTS Type GC-252)
JAN Type RA 25A or 30A
3 or 4 Watt (CTS Type 25)
JAN Type RA 25B or 30B
3 or 4 Watt (CTS Type GC 25)
JAN-R-94, Type RV-3A
CTS Type 35, 1⅛" Diameter
Composition
JAN-R-94, Type RV-2B
CTS Type GC 45 with Switch
JAN-R-94, Type RV-2A
CTS Type 45, 15/16" Diameter
Composition
JAN-R-94, Type RV-3B
CTS Type GC 35 with Switch
Type 85 NEW High Voltage
Electro-Static Focusing
Type JJ-033 Microphone Jack
Type JJ-034 Phone Jack
Type G-C-35-45 Concentric
Shaft Tandem
ILLUSTRATIONS ARE ACTUAL SIZE
Precision Mass Production of Variable Resistors
FOUNDED 1896
BURTON BROWNE ADVERTISING

100% C-D
– even the ceramic body!



TINY MIKE
High-Voltage Ceramic Capacitors



TINY MIKE
Miniature Disc Ceramic Capacitors

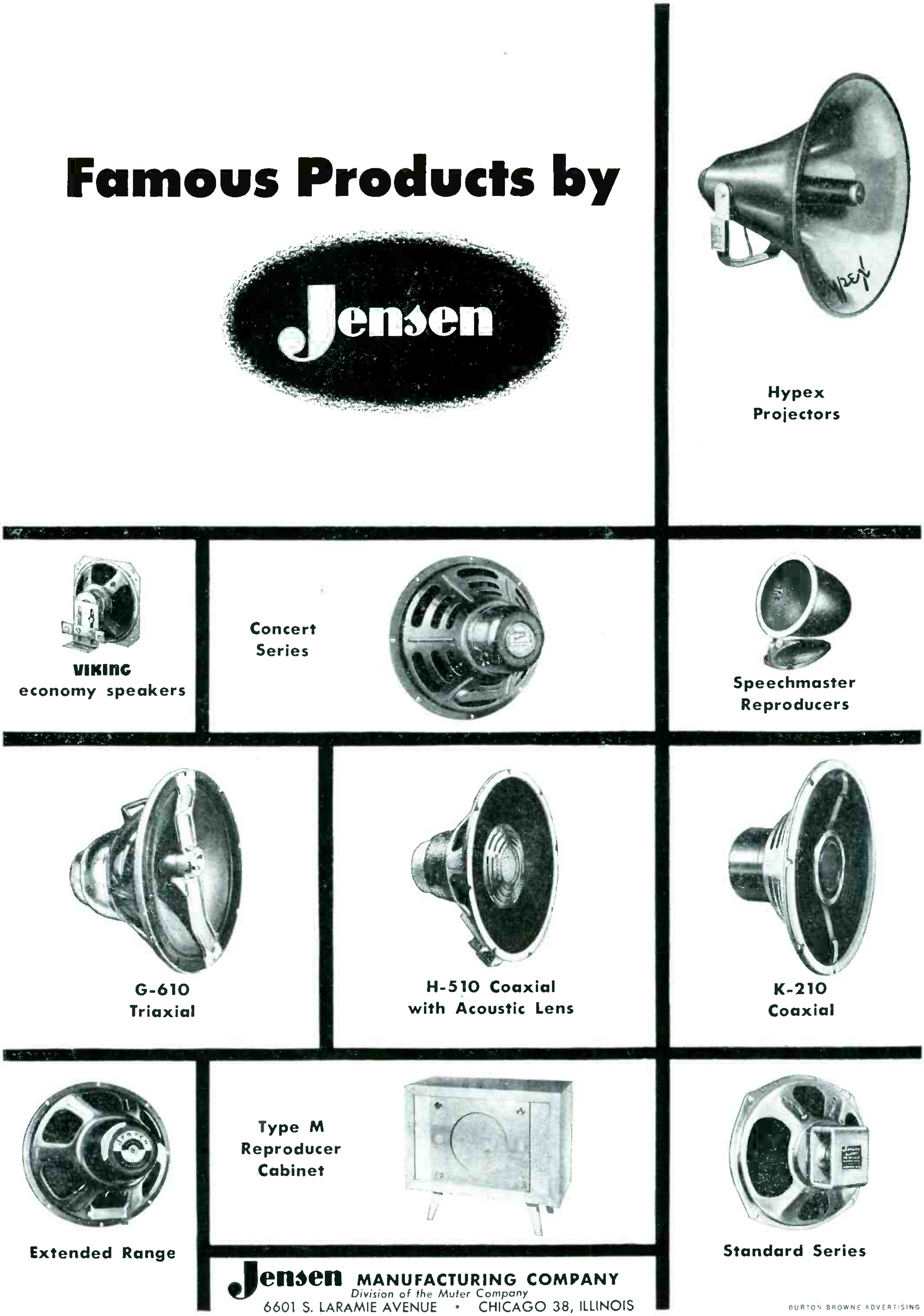
Tiny Mike is an original Cornell-Dubilier engineering job, inside and out! Even the ceramic body is made by C-D, in the newest and most modern ceramic body plant in the world. Fired in electric kilns, and electronically controlled at every stage, these are the most uniform and dependable ceramics ever to be mass-produced. Write today for Engineering Bulletins. Dept. K-91, Cornell-Dubilier Electric Corp., South Plainfield, N. J.

CORNELL-DUBILIER CAPACITORS 1910-1951 ® SUBSIDIARY

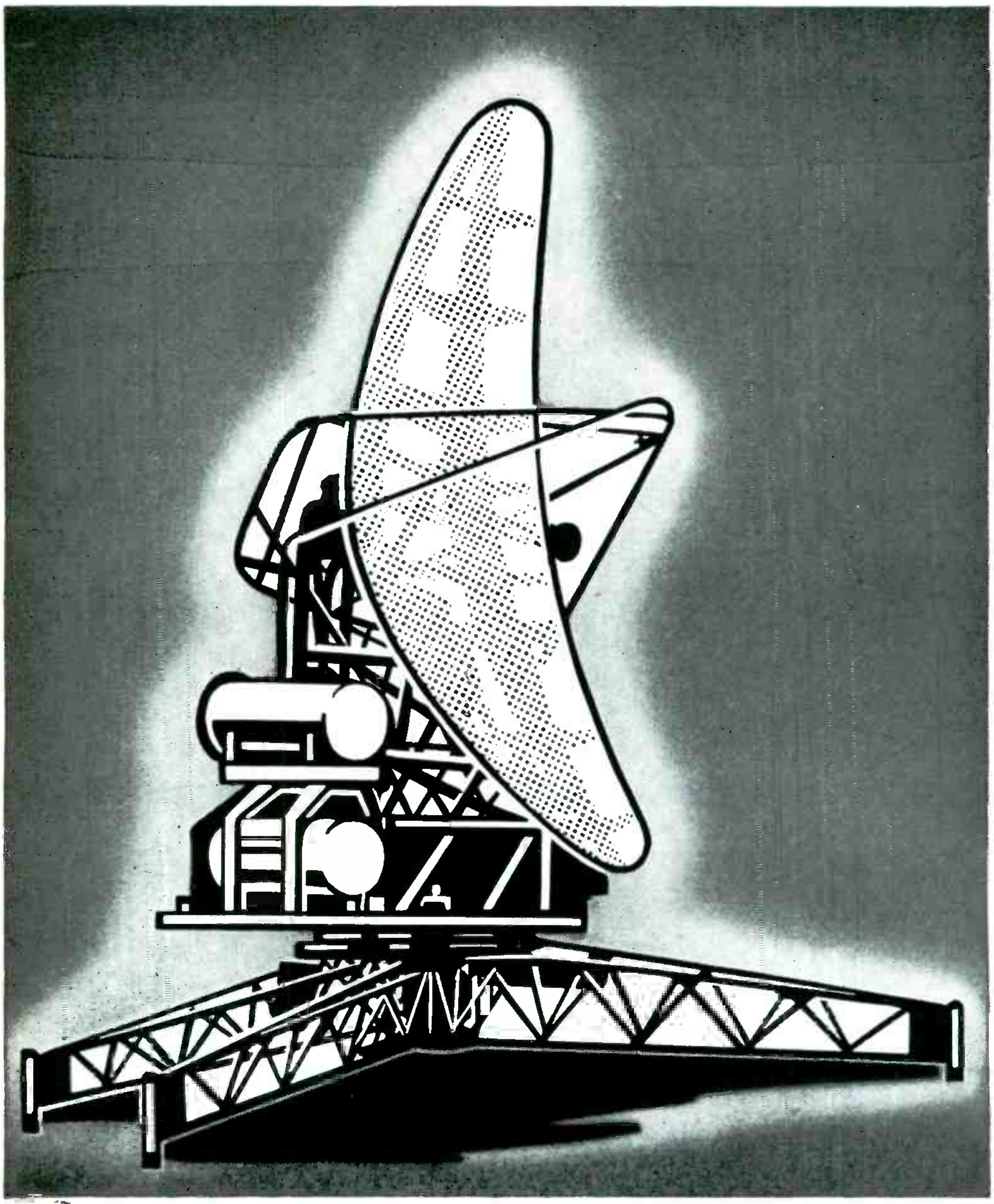
CONSISTENTLY DEPENDABLE

CORNELL-DUBILIER
CAPACITORS

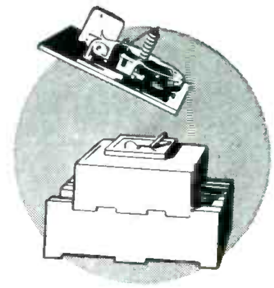
PLANTS IN SOUTH PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER, AND CAMBRIDGE, MASS.; PROVIDENCE, R. I.; INDIANAPOLIS, IND.; FUQUAY SPRINGS, N. C.; AND SUBSIDIARY, THE RADIART CORP., CLEVELAND, OHIO


Famous Products by
Jensen
Hypex Projectors
VIKING economy speakers
Concert Series
Speechmaster Reproducers
G-610 Triaxial
H-510 Coaxial with Acoustic Lens
K-210 Coaxial
Extended Range
Type M Reproducer Cabinet
Standard Series
Jensen MANUFACTURING COMPANY
Division of the Muter Company
6601 S. LARAMIE AVENUE • CHICAGO 38, ILLINOIS
BURTON BROWNE ADVERTISING

CARBOLOY Alnico

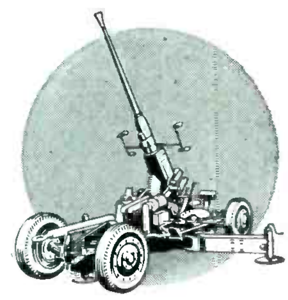


RADAR EQUIPMENT

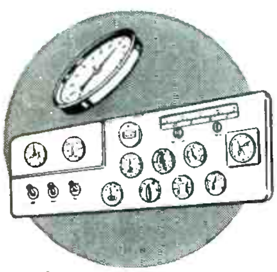


CONTROL EQUIPMENT

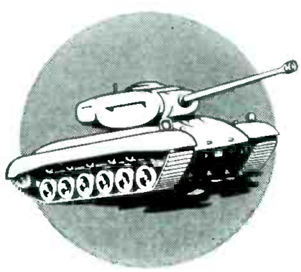
MILITARY COMMUNICATIONS EQUIPMENT



ANTI-AIRCRAFT GUNS

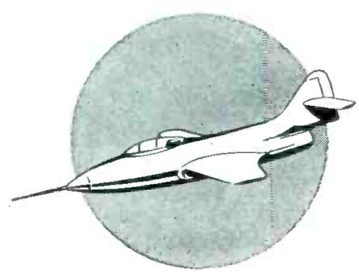


METERS AND INSTRUMENTS



TANKS

TELEPHONES

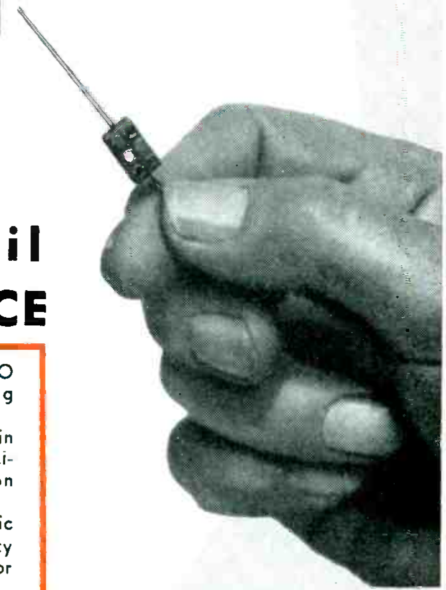


PLANES

ARCO Electronics Inc.

ELMENCO CAPACITORS

MINIATURE
MICA CAPACITORS



SMALLER than your fingernail
BUT SKY HIGH in PERFORMANCE

Known the world over for their reliability under all operating conditions, EL-MENCO CAPACITORS are chosen by manufacturers who want successful performance and long life from their products.
EL-MENCO fixed mica dielectric capacitors are compact, precision made manufactured in accordance with American military standards to meet Army and Navy JAN-C-5 Specifications. All impregnated and JAN, RMA and RCM color coded. Standard specification limits are shown below.
Moulded in low loss bakelite, tested at double the working voltage. Tests for dielectric strength, insulation resistance, temperature co-efficient and capacitance drift, humidity and life tests according to JAN and RCM STANDARDS. All units are wax dipped for salt water immersion seal.

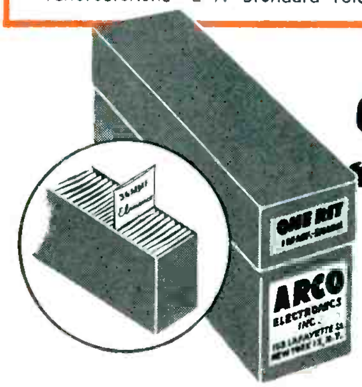
TYPE CM-15

TYPE DESIGNATION	CAP. MMF.	DC WKG. VOLTAGE	TYPE DESIGNATION	CAP. MMF.	DC WKG. VOLTAGE
CM-15-C-010-M	1	500	CM-15-E-750-J	75	500
CM-15-C-020-M	2	500	CM-15-E-820-J	82	500
CM-15-C-030-M	3	500	CM-15-E-910-J	91	500
CM-15-C-050-K	5	500	CM-15-E-101-J	100	500
CM-15-C-100-J	10	500	CM-15-E-111-J	110	500
CM-15-C-120-J	12	500	CM-15-E-121-J	120	500
CM-15-C-150-J	15	500	CM-15-E-131-J	130	500
CM-15-C-180-J	18	500	CM-15-E-151-J	150	500
CM-15-C-200-J	20	500	CM-15-E-161-J	160	500
CM-15-C-220-J	22	500	CM-15-E-181-J	180	500
CM-15-E-240-J	24	500	CM-15-E-201-J	200	500
CM-15-E-270-J	27	500	CM-15-E-221-J	220	500
CM-15-E-300-J	30	500	CM-15-E-241-J	240	500
CM-15-E-330-J	33	500	CM-15-E-251-J	250	500
CM-15-E-360-J	36	500	CM-15-E-271-J	270	500
CM-15-E-390-J	39	500	CM-15-E-301-J	300	500
CM-15-E-430-J	43	500	CM-15-E-331-J	330	500
CM-15-E-470-J	47	500	CM-15-E-361-J	360	500
CM-15-E-500-J	50	500	CM-15-E-391-J	390	500
CM-15-E-510-J	51	500	CM-15-E-431-J	430	500
CM-15-E-560-J	56	500	CM-15-E-471-J	470	300
CM-15-E-620-J	62	500	CM-15-E-501-J	500	300
CM-15-E-680-J	68	500	CM-15-E-511-J	510	300

All the above are silver mica only. Temperature Co-efficient: 50 Parts per Million per degree C. (Characteristic "E"). Standard Tolerance: ±5%. Closest Tolerance: ±.5 mmfd.

Actual Size
9/32" x ½" x 3/16".
For Television, Radio and other Electronic Applications.
2 - 420 mmf. cap. at 500v DCA.
2 - 535 mmf. cap. at 300v DCA.
Temperature Co-efficient ±50 parts per million per degree C for most capacity values. 6-dot color coded.

HANDY KIT for EXPERIMENTAL WORK



Special!

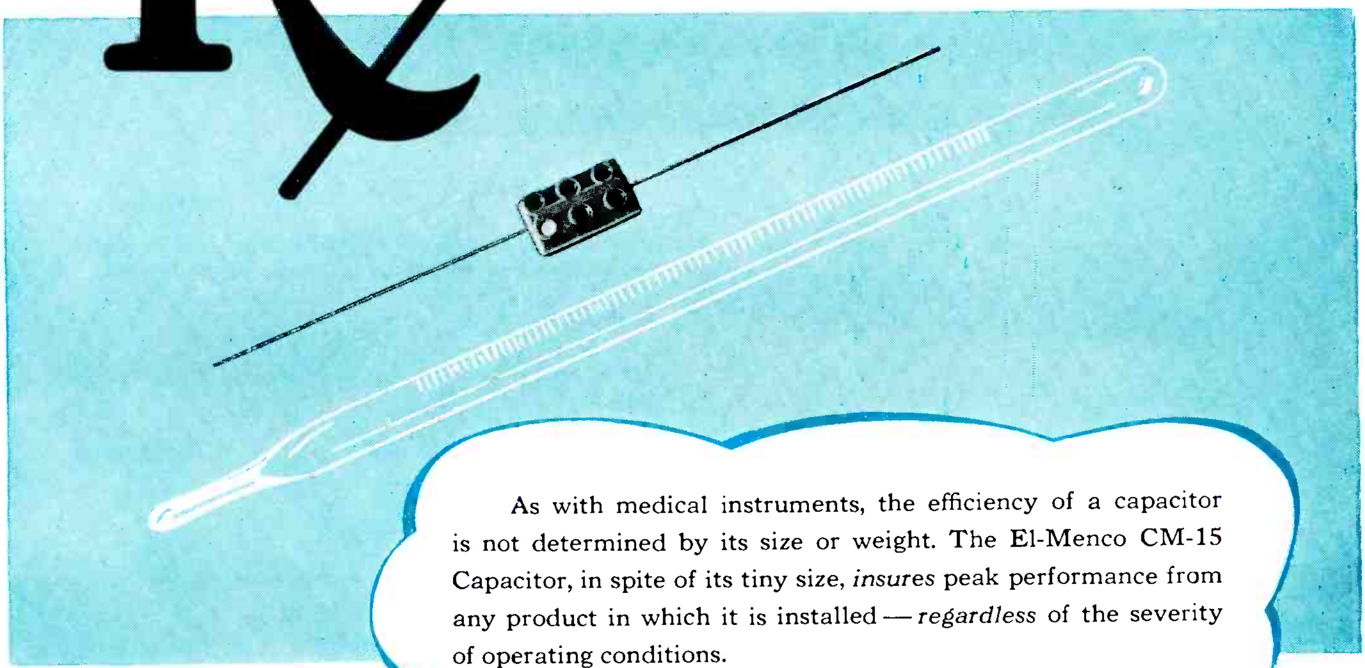
DON'T GET CAUGHT SHORT . . Always Have The Correct Capacity On Hand!

THESE MINIATURES FIT INTO THE SMALLEST AREA CAPACITOR SIZE (9/32" x ½" x 3/16").

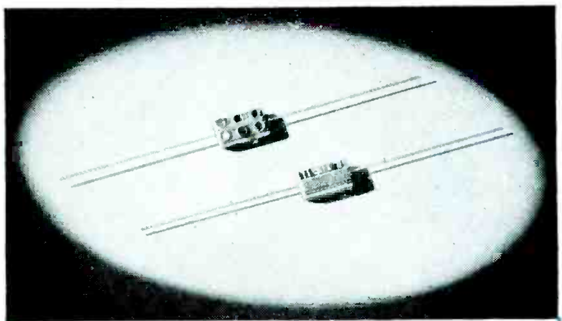
This Handy Kit consists of 46 most commonly used Capacitors . . . five of each capacity packed in moisture-proof transparent cellophane envelope, properly identified for permanent use.

ARCO ELECTRONICS INC. 103 LAFAYETTE ST., N. Y. 13, N. Y.

R̸ FOR PERFORMANCE



As with medical instruments, the efficiency of a capacitor is not determined by its size or weight. The El-Menco CM-15 Capacitor, in spite of its tiny size, *insures* peak performance from any product in which it is installed — *regardless* of the severity of operating conditions.



CM-15 MINIATURE CAPACITOR

Actual Size 9/32" x 1/2" x 3/16"
For Television, Radio and other Electronic Applications.
2 mmf.-420 mmf. cap. at 500v DCw.
2 mmf.-525 mmf. cap. at 300v DCw.
Temp. Co-efficient ± 50 parts per million per degree C for most capacity values.
6-dot color coded.

EL-MENCO CM-15 CAPACITOR

Pretested at *double* its working voltage, this tiny capacitor must prove its ruggedness *before* leaving the factory. It is tested for dielectric strength, insulating resistance and capacity value.

WHEN *YOU* WANT PEAK PERFORMANCE IN YOUR PRODUCT YOUR *BEST* ASSURANCE IS EL-MENCO CAPACITORS.

THE ELECTRO MOTIVE MFG. CO., Inc.
Willimantic, Connecticut

MANUFACTURERS ARE INVITED TO SEND FOR SAMPLES

MOLDED MICA El-Menco MICA TRIMMER
CAPACITORS

FOREIGN RADIO AND ELECTRONIC MANUFACTURERS COMMUNICATE DIRECT WITH OUR EXPORT DEPT. AT WILLIMANTIC, CONN. FOR INFORMATION.

ARCO ELECTRONICS, INC. 103 Lafayette St., New York, N. Y.—Sole Agent for Jobbers and Distributors in U.S. and Canada

VHF
UHF

IMPEDANCE MEASUREMENTS

SPEED AND CONVENIENCE

FTL-42A IMPEDOMETER

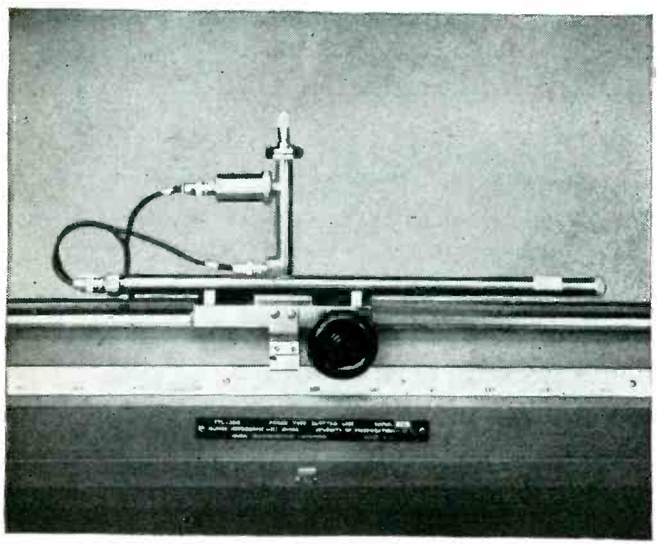
Rapid, accurate measurement of impedance, reflection coefficient and standing wave ratio. Small size, convenient for field use.

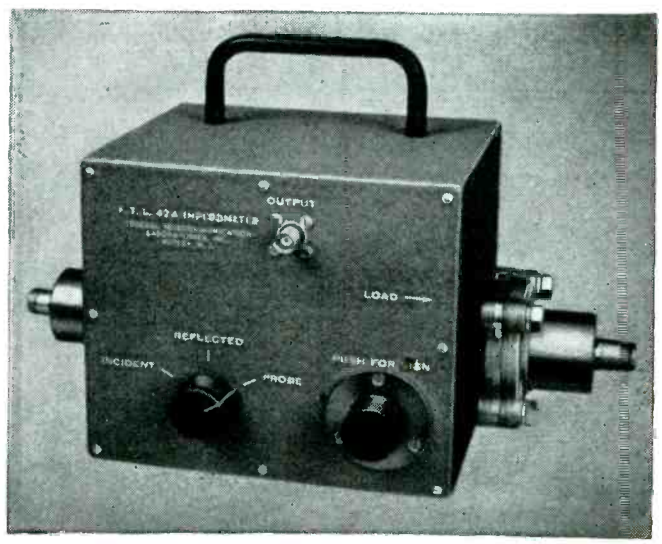
50 to 500 Mc.

Can be inserted in various sizes of solid coaxial line or flexible cables.

Make three readings; plot diagram and read off impedance to ± 5%.

$400.00.





FTL-30A SLOTTED LINE

Precise impedance measurements in the range of 60 to 1000 megacycles per second. Accuracy ± 2%.

1000 to 2000 Mc range covered with slightly reduced accuracy.

Coaxial line 250 centimeters long having a surge impedance of 51.0 ohms ± 0.5 ohms.

$2,495.00.

PRECISION

Write for FTL-30A and FTL-42A brochures.

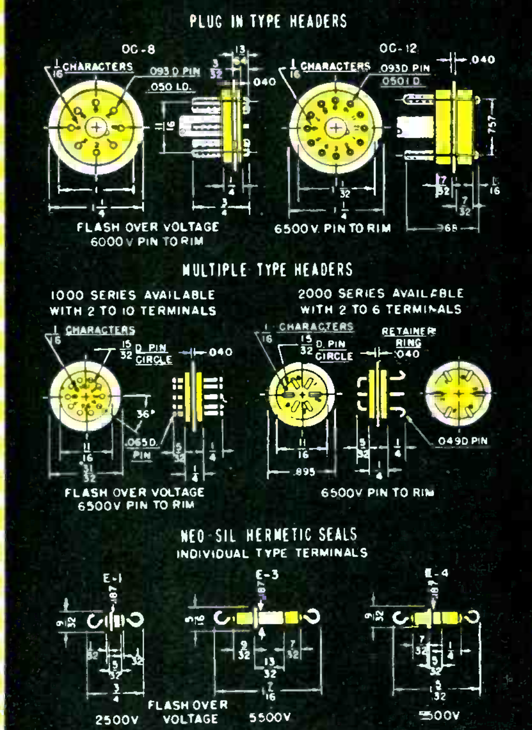
Federal Telecommunication Laboratories, Inc.

500 Washington Avenue
Nutley 10, New Jersey

INTERNATIONAL TELEPHONE AND TELEGRAPH — FTL

NEO-SIL CORPORATION

Master Pieces of Hermetic Sealing



TEST DATA

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

Volume Resistivity at 800 Volts d-c

Room Temperature 25°C	R.H. 30 percent
Megohm-inches	*ohm-centimeters*
1.4×10^6	3.5×10^{12}

Dielectric Constant and Dissipation Factor

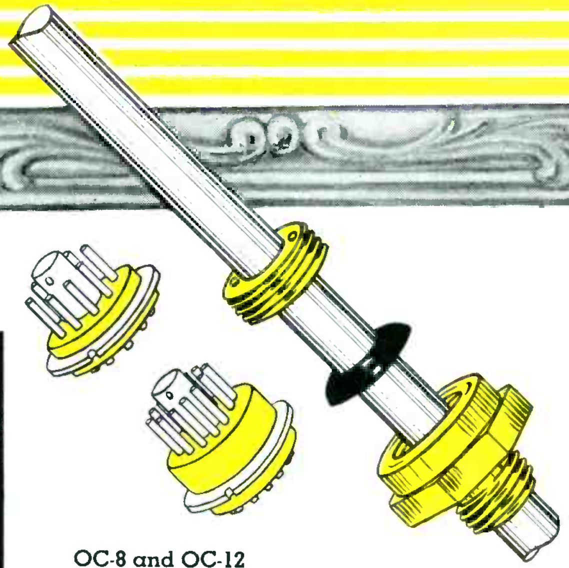
Dielectric Constant	*Dissipation Factor*	*Loss Factor*
	@ 60 cycles per second	
9.22	.058	5.32
	@ 1 megacycle per second	
6.17	.0455	.28
	@ 50 megacycles per second	
5.35	0.20	1.1

Dielectric Strength at 60 cycles
Volts per mil — 370

Durometer Average — 80 ± 5

Temperature — Rated as a Class A material conservatively + 160° to —70° centigrade.

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



OC-8 and OC-12

"8 and 12 Pin Octal Type Plug In Headers, molded with NEO-SIL, are applicable for use on MIL requirements. They will withstand thermal shocks, vibrations, mechanical strains and excessive pressures with no impairment to the seal or other functional characteristics. For use with standard Octal Type Sockets."

¼" SHAFT WATERSEAL BUSHING

"Rotary Waterseal Panel Assemblies, with GRAF-SIL Packing Glands, have an excellent five year customer history on gas filled pressurized components. They are available for ¼" shafts and for potentiometers and switch bushings."

"NEO-SIL's proven Hermetic sealing components will eliminate rejects resulting from breakage, strains, cracks, etc. Each NEO-SIL component is pressure checked at 25 psi — to meet military requirements and as applied to our units, NEO-SIL rubber will resist abusive temperature cycling, salt water, most acids and alkalies, and withstand high pressures and vacuums."

"In addition to the items illustrated above, NEO-SIL offers many other components, such as Hermetically Sealed Fuse Holders, Hermetic Sealing Terminals, Multiple Pin Headers, Hermetically Sealed Cables, Hermetically Sealed Line Cords With Plugs for European use, Meter Gaskets, Panel Gaskets, Adapters (U. S. to Continental), Coil Forms, Crystal Contacts and other molded bakelite and NEO-SIL rubber units."

"Hermetically Sealed Fuse Holders are available for 3-AG and 4-AG fuses. These units are completely sealed from moisture with or without the cap or fuse inserted and are applicable for use on vacuum or gas filled units."

Your special problems are solicited.

NEO-SIL CORPORATION

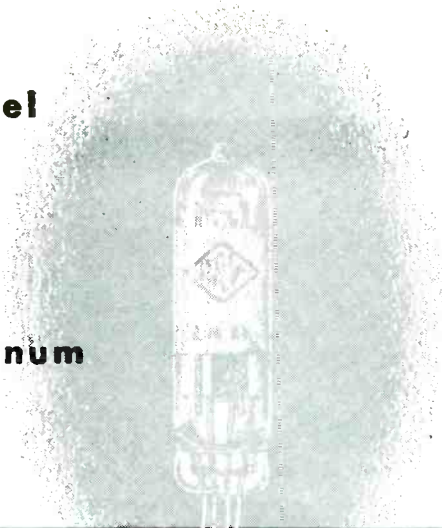
26 CORNELISON AVE., JERSEY CITY 4, N. J.

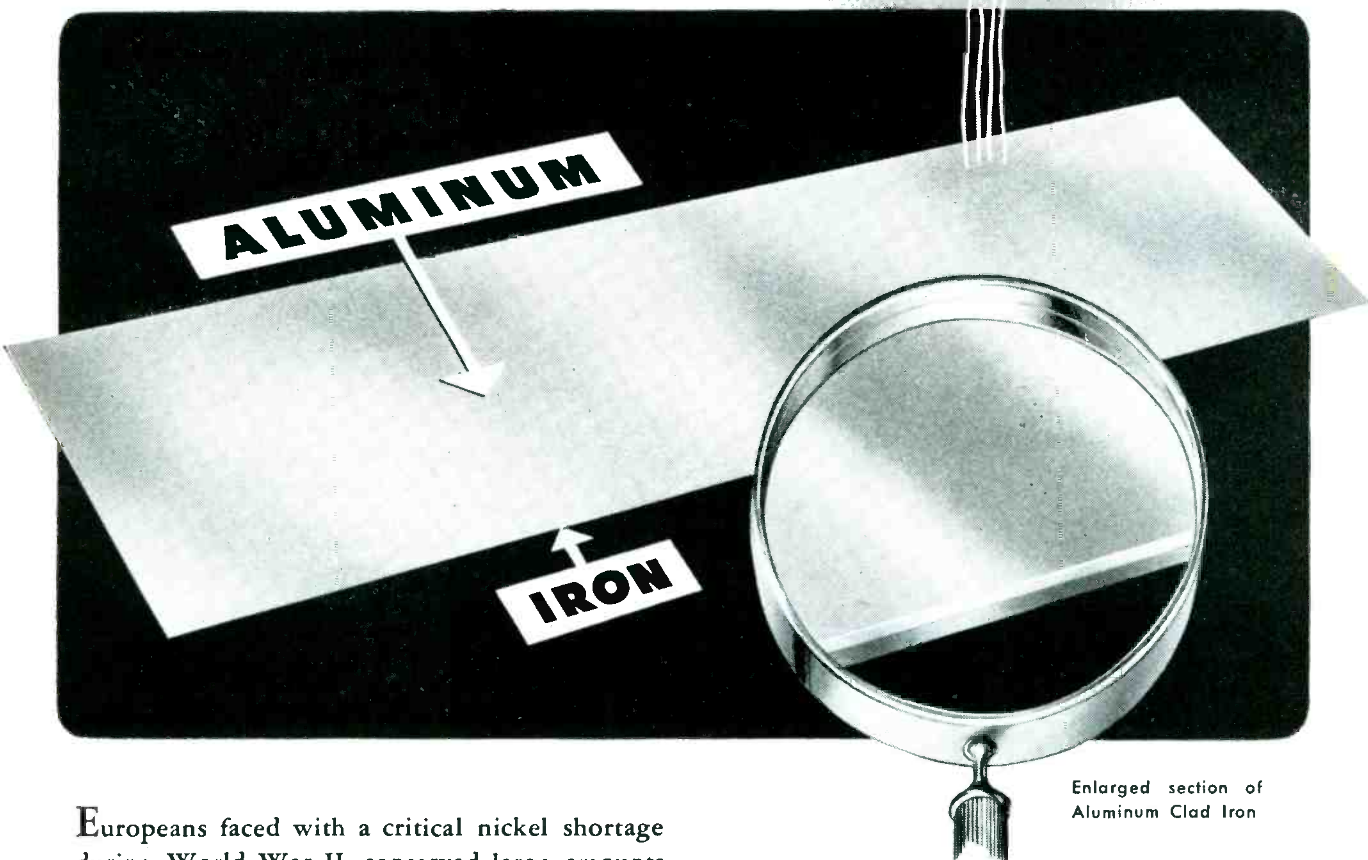
PROBLEM

How to Conserve or Replace Nickel in Radio Tube Parts?

GENERAL PLATE

Provided the Solution with Aluminum Clad Iron . . . *A Composite Metal.*





Enlarged section of Aluminum Clad Iron

Europeans faced with a critical nickel shortage during World War II, conserved large amounts of nickel by using an aluminum clad iron as a radio tube anode material.

With today's increasing nickel shortages, radio tube manufacturers are faced with a similar problem. General Plate has provided a solution by developing techniques which enable it to provide aluminum clad iron material for use in radio tube applications.

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

General Plate Products include . . . Precious metals clad to base metals, Base metals clad to base metals, Silver Solders, Composite contacts, buttons and rivets, Platinum fabrication and refining, Age-hardenable #720 Manganese Alloy. Write for information.

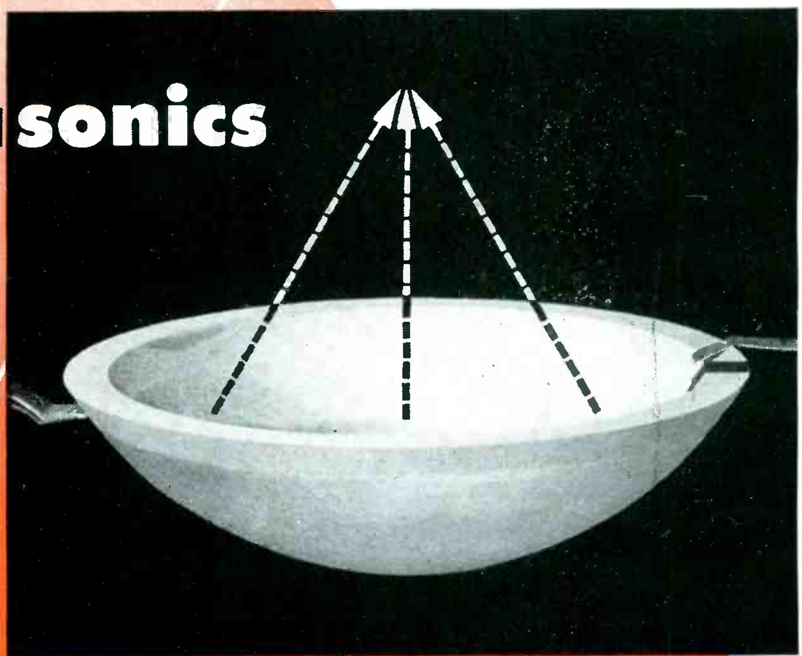
Have You a Composite Metal Problem? General Plate can solve it for you

GENERAL PLATE

Division of Metals & Controls Corporation

39 FOREST STREET, ATTLEBORO, MASS.

focused ultrasonics



FOR EXPLORING YOUR COMPANY'S FUTURE PRODUCTS

● Pioneers in ultrasonics, our company is now busy on specialized assignments, both for the Armed Forces and for important American business concerns. Ultrasonics is a new science with a great future, foreshadowed in many industrial processes.

Exploration in the ultrasonics field has shown that directed and controlled sound waves at high frequency may lead to the fast emulsification of heretofore incompatible elements, the inspection of goods, and improvement of pharmaceuticals. Here at Brush is a reservoir of knowledge of piezoelectricity. Here at Brush is the Hypersonic* equipment for carrying out experiments. We can supply laboratory and pilot plant equipment . . . consisting of electronic generator and transducer for direct focusing of ultrasonic energy.

Your inquiry, directed to HYPERSONIC DIVISION, will receive our careful attention.

*Trade-Mark

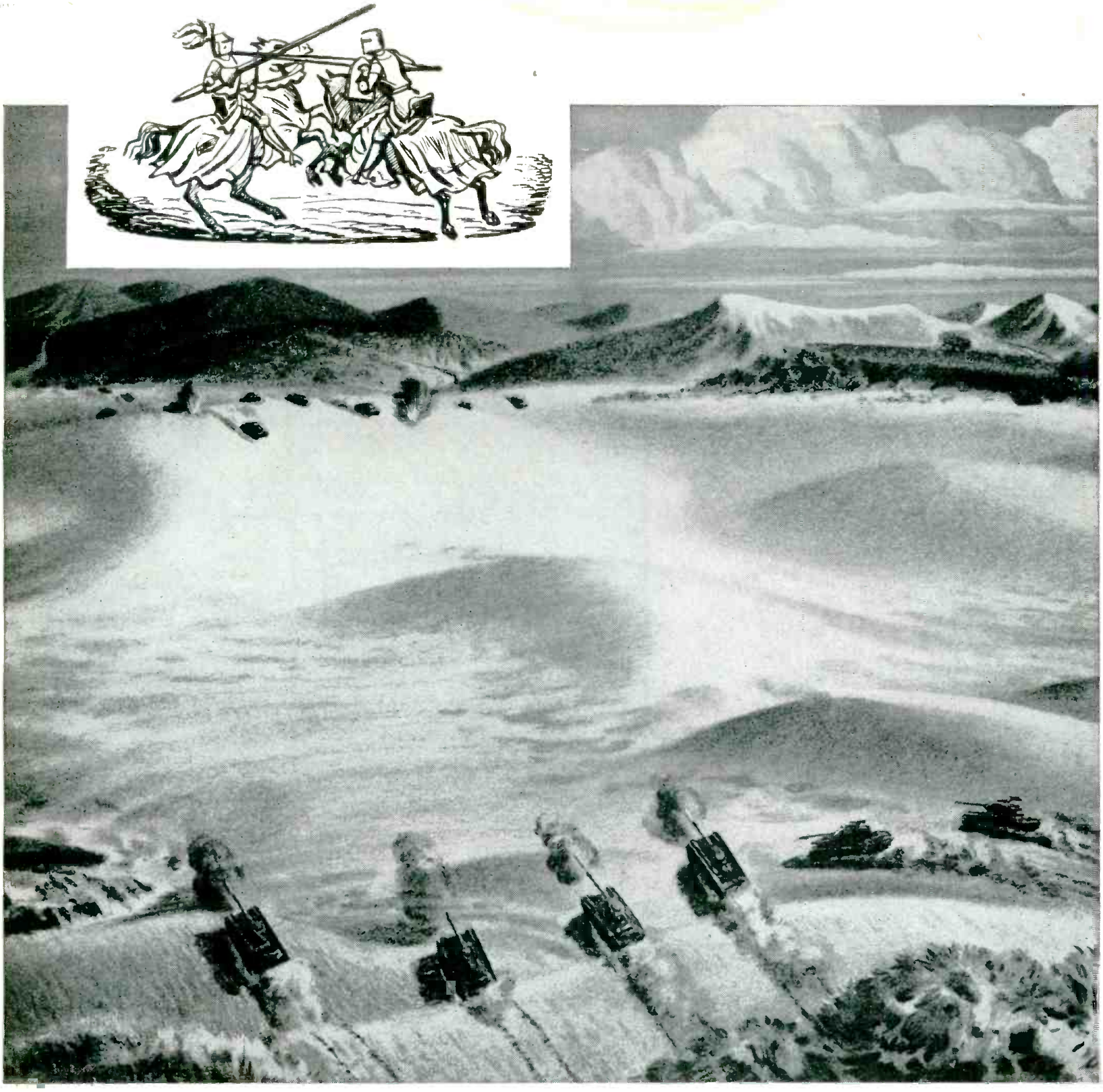
Manufacturers of

ACOUSTICAL EQUIPMENT — MAGNETIC RECORDING DEVICES
RESEARCH AND INDUSTRIAL INSTRUMENTS
PIEZOELECTRIC CRYSTALS — ULTRASONIC EQUIPMENT

"OUR BUSINESS IS THE FUTURE"

THE BRUSH DEVELOPMENT COMPANY

3405 Perkins Avenue, Cleveland 14, Ohio

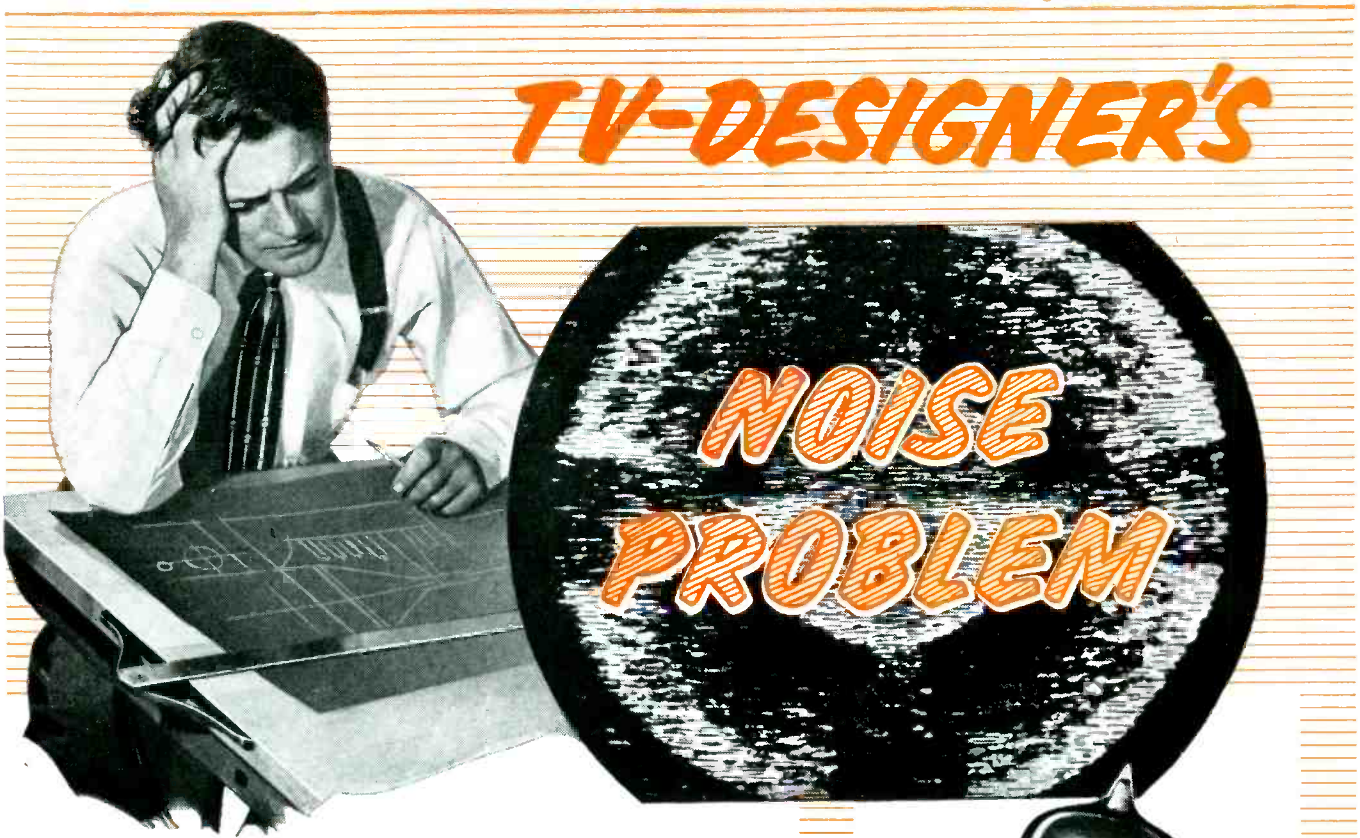


Hitting modern targets poses ever-new problems

Increasing emphasis on speed and mobility in modern warfare intensifies the problem of destroying the target. It takes it out of the reach of the manual ability and into the realm of electronics. Working closely with our Armed Forces since 1918 in pioneering and developing equipment to meet these problems, Arma is in the forefront in supplying such precision instruments for our nation's defense.

ARMA CORPORATION
254 36th Street, Brooklyn 32, N.Y.
SUBSIDIARY OF AMERICAN BOSCH CORPORATION

QUALITY ARMA INSTRUMENT PRECISION



"Snow in fringe-area reception: how can I reduce it . . . economically?"

Here's a brand-new, up-to-the-minute way to cut noise nuisance at a budget figure. It's G. E.'s great new 6BK7—a miniature designed by General Electric to solve the very problem *you* face, Mr. Designer!

This new tuner tube is low in two important ways—noise level and cost. At a real bargain price the 6BK7 improves picture quality in marginal TV areas, making friends for your set right where sales are growing fastest.

Intended primarily for cascode service in v-h-f, the 6BK7 also may be used as a low-noise first-intermediate-frequency amplifier in u-h-f. Design features include: (1) a special shield between the triode sections, (2) high transconductance to improve gain and reduce noise level.

You'll take pride in the more widely usable TV set you can design around this pace-setting G-E tube. Telegraph or write for Engineering Bulletin ET-B32, just off the press! Or, if you wish, a G-E tube engineer will be glad to call on you. *Electronics Department, Section 6, General Electric Company, Schenectady 5, New York.*

6BK7
High-Gm Twin Triode

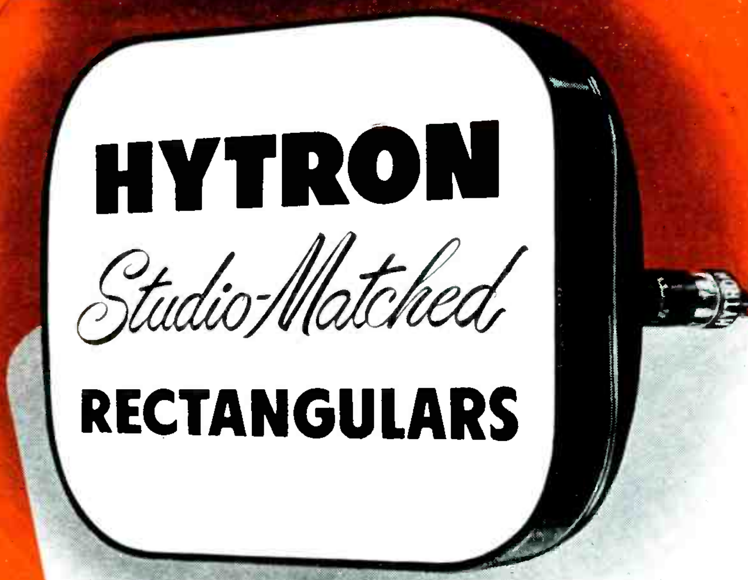
Typical operating conditions, each section

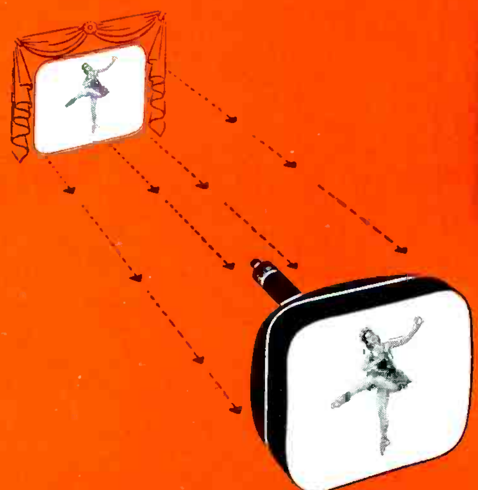
Plate supply voltage	150 v
Cathode bias resistor	56 ohms
Amplification factor	40
Plate resistance	4,700 ohms
Transconductance	8,500 micromhos
Plate current	18 ma
Noise factor, as a cascode amplifier at 216 mc	7 db

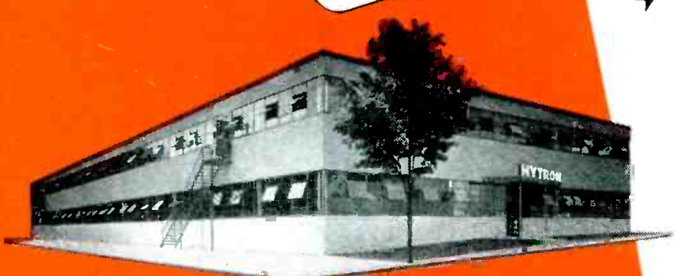
GENERAL ELECTRIC

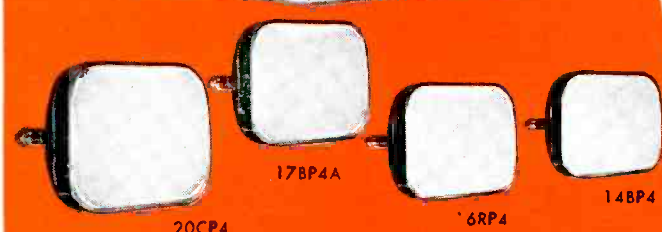
181-K4

WHAT YOU GAIN WHEN YOU BUY...









LEADING TV SET MANUFACTURERS PICK HYTRON RECTANGULARS:

ADMIRAL • AIR KING • BENDIX • CROSLEY • EMERSON
HALLICRAFTERS • HOFFMAN • MOTOROLA • NATIONAL
OLYMPIC • SENTINEL • SETCHELL-CARLSON • SPARTON
STROMBERG-CARLSON • TRAV-LER • WESTINGHOUSE
AND OTHERS

1. **You get THE ORIGINAL.** The *studio-matched* rectangular tube is Hytron's baby. Its logically designed screen matches the 4 by 3 aspect ratio of the studio picture. Quite naturally, Hytron's new rectangular is fast becoming the most popular picture tube.

2. **You get UNIFORMITY.** Hytron's new picture-tube plant is the most modern in the world. It was designed especially to mass-produce Hytron *studio-matched* rectangulars of uniform dependability.

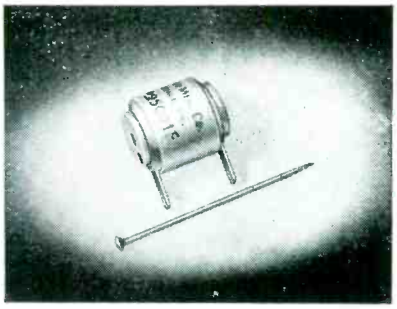
3. **You get A COMPLETE LINE.** Hytron offers you 14-, 16-, 17-, and 20-inch *studio-matched* rectangulars. All the popular rectangulars (and the popular types of round tubes too).

4. **You get THE QUALITY LEADERS DEMAND.** Nine out of ten leading TV set makers choose Hytron. More and more leading service-dealers pick Hytron. Because their own experience proves Hytron *studio-matched* rectangulars give "amazingly clearer, sharper, more brilliant pictures." Demand this same performance for yourself. Demand original Hytron *studio-matched* rectangulars.

MANUFACTURERS OF RECEIVING TUBES SINCE 1921
HYTRON
RADIO AND ELECTRONICS CO.
A DIVISION OF COLUMBIA BROADCASTING SYSTEM INC.

MAIN OFFICE: SALEM, MASSACHUSETTS

Something New

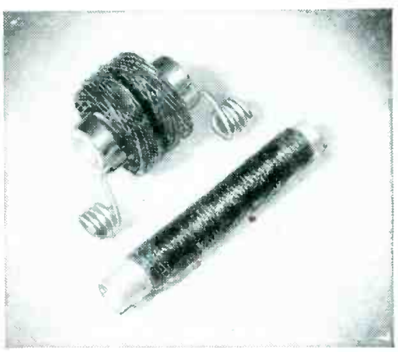


NEW MINIATURE HERMETICALLY-SEALED PRECISION RESISTORS IN LUG TYPES

Miniature hermetically-sealed resistors with solder lug terminals and designed to meet the requirements of JAN-R-93, characteristic A, style RB11, have been announced by the Shallcross Manufacturing Company, Collingdale, Pa.

Known as Shallcross Akra-ohm type 1180, the resistors are only 19/32" long x ½" diameter and are rated 0.25 watt at 250 volts. Resistance values up to 0.1, 0.3 or 0.4 megohms may be obtained depending on the alloy wire used for the windings. Windings are non-inductive. The resistors are hermetically-sealed in Steatite by a patented Shallcross process which provides positive immunity against the effects of humidity, fungus and salt water immersion.

This and other Shallcross hermetically-sealed resistor types in accordance with JAN styles RB12A and RB14A, as well as twelve other JAN characteristic B styles, are described in the new Shallcross resistor bulletin R-3b which is available on request.



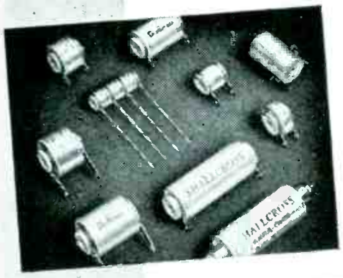
SPECIAL COILS AND CHOKES INTRODUCED BY SHALLCROSS

A new line of coils and chokes adaptable to "tailor-made" specifications has been introduced by the Shallcross Manufacturing Company, Collingdale, Pa. Types include high Q radio-frequency chokes, progressively-wound slug-tuned broadcast coils and oscillator coils, all of them having out-of-the-ordinary characteristics which cannot be matched by standard coil types.

Shallcross r-f chokes may be made up as two separate coils having a specified coupling coefficient. High-permeability iron cores are sometimes used to provide greater inductance in a small unit.

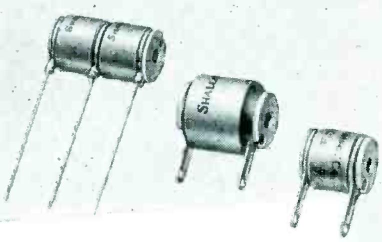
(Advertisement)

SHALLCROSS MATCHES YOUR Precision Resistor Requirements!



. . . for real dependability on STANDARD INDUSTRIAL USES

. . . over 40 economical standard types and sizes, each available in numerous mechanical and electrical adaptations. Write for Shallcross Data Bulletin R3A.



. . . for JAN EQUIPMENT

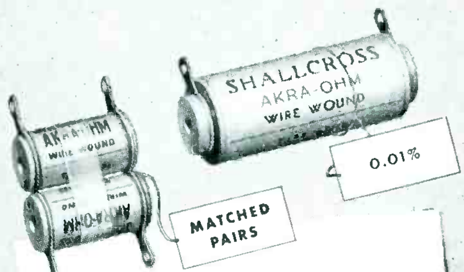
Shallcross is in constant touch with the latest military precision resistor requirements. The present line includes 13 types designed for JAN characteristic "B" and 4 types for characteristic "A".

. . . for MINIATURIZATION PROGRAMS

For years, Shallcross has led the way in the production of truly dependable close-tolerance, high-stability resistors in miniature sizes. Standard and hermetically sealed types are available.

. . . for SPECIAL ASSEMBLIES

Shallcross regularly produces hundreds of special precision resistor types including precision power resistors, resistors with axial or radial leads and multi-unit strip resistors (illustrated) with either inductive or non-inductive windings.



. . . for HIGH-STABILITY APPLICATIONS

Many Shallcross Akra-Ohm resistors are available with guaranteed tolerance to 0.01% and stability to 0.003%. Matched pairs and sets are supplied to close tolerances.

SHALLCROSS

SHALLCROSS MANUFACTURING COMPANY
COLLINGDALE, PA.

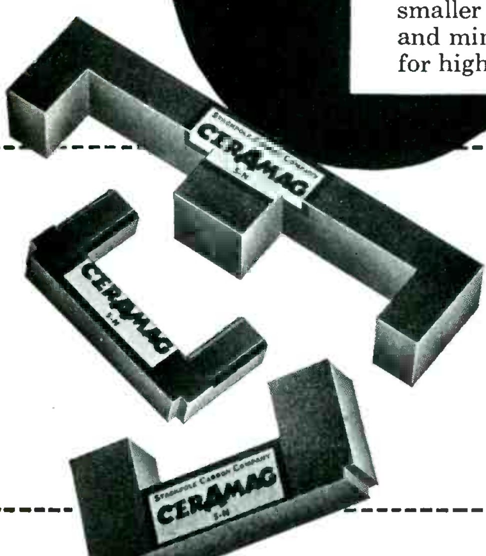
SEGMENTED DEFLECTION YOKE CORES

This popular 4-segment design is highly efficient. It is easy to handle in TV production work and assures a minimum of breakage. 2-segment types are also available.

STACKPOLE

Ceramag® ...THE CERAMIC CORES THAT SET THE QUALITY STANDARDS

The tremendous advance in the use of metallic oxide (non-metallic) cores has been due in large part to Stackpole powder molding experience which paved the way to fully dependable units in production quantities. Stackpole Ceramag Cores assure lower losses with higher operating efficiency, lower operating temperatures, lighter weight, smaller sizes, maximum permeability, less corona effect and minimum cost. Ceramag cores are made in two grades for high and low flux densities.

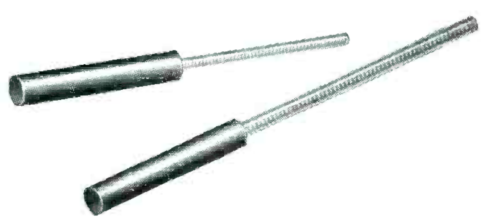


"U" and "E" CORES FOR FLYBACK TRANSFORMERS

Permeability of these Stackpole Ceramag Cores is of the order of 10 to 1 by comparison with conventional iron cores. They are materially smaller, have higher resistance and operate much cooler due to the absence of eddy current losses. Many special types are regularly produced.

TELEVISION IMAGE W-I-D-T-H CONTROL TYPES

These Stackpole Ceramag Cores assure remarkably higher standards of efficiency for TV horizontal image deflection circuits. In areas where there is a low line voltage, they give ratios of from 1 to 8 or more compared with 1-5 for previous high permeability types.



Electronic Components Division

STACKPOLE CARBON COMPANY, St. Marys, Pa.

BROWN INSTRUMENTS ACCELERATE RESEARCH

New Brown (*40X*) Amplifier...

combines high gain and sensitivity with good stability

Electrical Characteristics

- EQUIPMENT INPUT IMPEDANCE—3000 ohms.
- STABILITY (after warm-up)—within 1.0 μv.
- DEAD ZONE (with 7650-3 motor)—0.1 μv.
- OVERALL VOLTAGE GAIN—40 x 10^6.
- 60 CYCLE OUTPUT CURRENT—0-12 MA.
- 60 CYCLE OUTPUT VOLTAGE—0-154.

Specially designed to reduce thermal potentials and stray pickup, the new Brown *40X* servo amplifier incorporates an extra stage of amplification to provide increased sensitivity . . . permitting motor drive from signals as low as 0.5 microvolts.

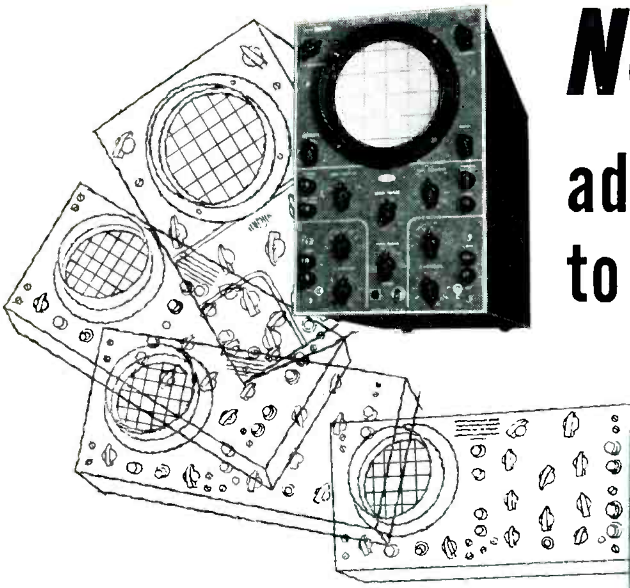
Pictured above is the amplifier showing the rectifier which provides d-c filament voltage for the first amplifier tubes. It can be used as the basic link in a closed servo loop (where great sensitivity is required) . . . to translate electrical signals into directional motion . . . to provide corrective action in conjunction with minute error signals . . . for null detection . . . or for remote positioning.

For detailed information, write for a copy of Data Sheet No. 10.20-4.

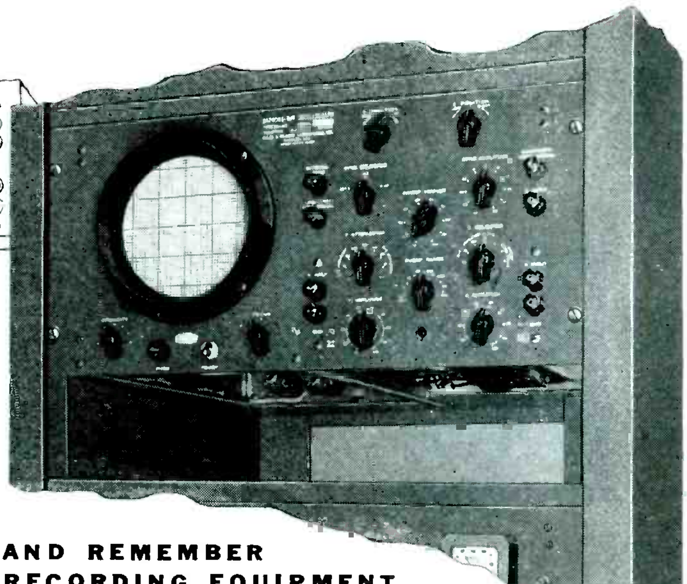
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4428 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS **Honeywell**

Brown Instruments



Now...
add 304-H performance to your relay racks!



The DU MONT Type 304-HR (rack mountable Type 304-H) $395.00

The circuit designs which have made the Type 304-H the most widely used general-purpose cathode-ray oscillograph have been repackaged to bring you the added convenience of rack mounting!

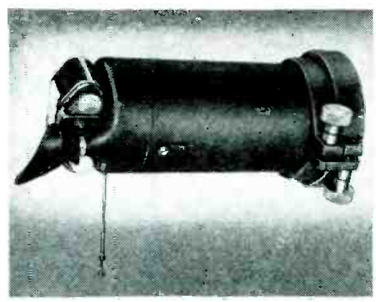
STANDARDIZE ON THESE WELL-KNOWN FEATURES OF THE TYPE 304-H....

- High light output — *Type 5CP-A Cathode-ray Tube operated at 3000 volts accelerating potential.*
- High Sensitivity — *0.028 volt peak-to-peak per inch through Y-axis amplifier.*
- Both A-C and D-C Amplification — *Y axis frequency response from 0 to 100,000 cps, down 10%, down 50% at 300,000 cps.*
- Stabilized Synchronization — *sync-limiting circuit eliminates the effects of over-synchronization.*
- Linear Sweeps — *Driven and Recurrent Sweeps variable continuously from 2 to 30,000 cps. — slower sweeps available by adding capacitance between front-panel terminals.*
- Sweep Expansion — *up to six times full-screen expansion of driven or recurrent sweeps, with complete positioning.*
- Provision for Intensity Modulation — *15 volts peak will blank the beam at normal intensity.*

....PLUS THESE MECHANICAL FEATURES IN THE TYPE 304-HR

• Standard 19″ relay-rack panel • Width — 19″ • Height — 8¾″ • Depth — 19½″ • Panel-control symmetry similar to that of the Type 304-H • Dust cover supplied.

AND REMEMBER RECORDING EQUIPMENT....



THE TYPE·296·$149.50
- Simplified operation.
- High quality, coated f/2.8 lens.
- Economical use of film.
- Fits standard 5-inch cathode-ray oscillographs.
- Records writing rates up to 20 inches/microsecond.

....FOR THRIFTY SINGLE-FRAME RECORDING

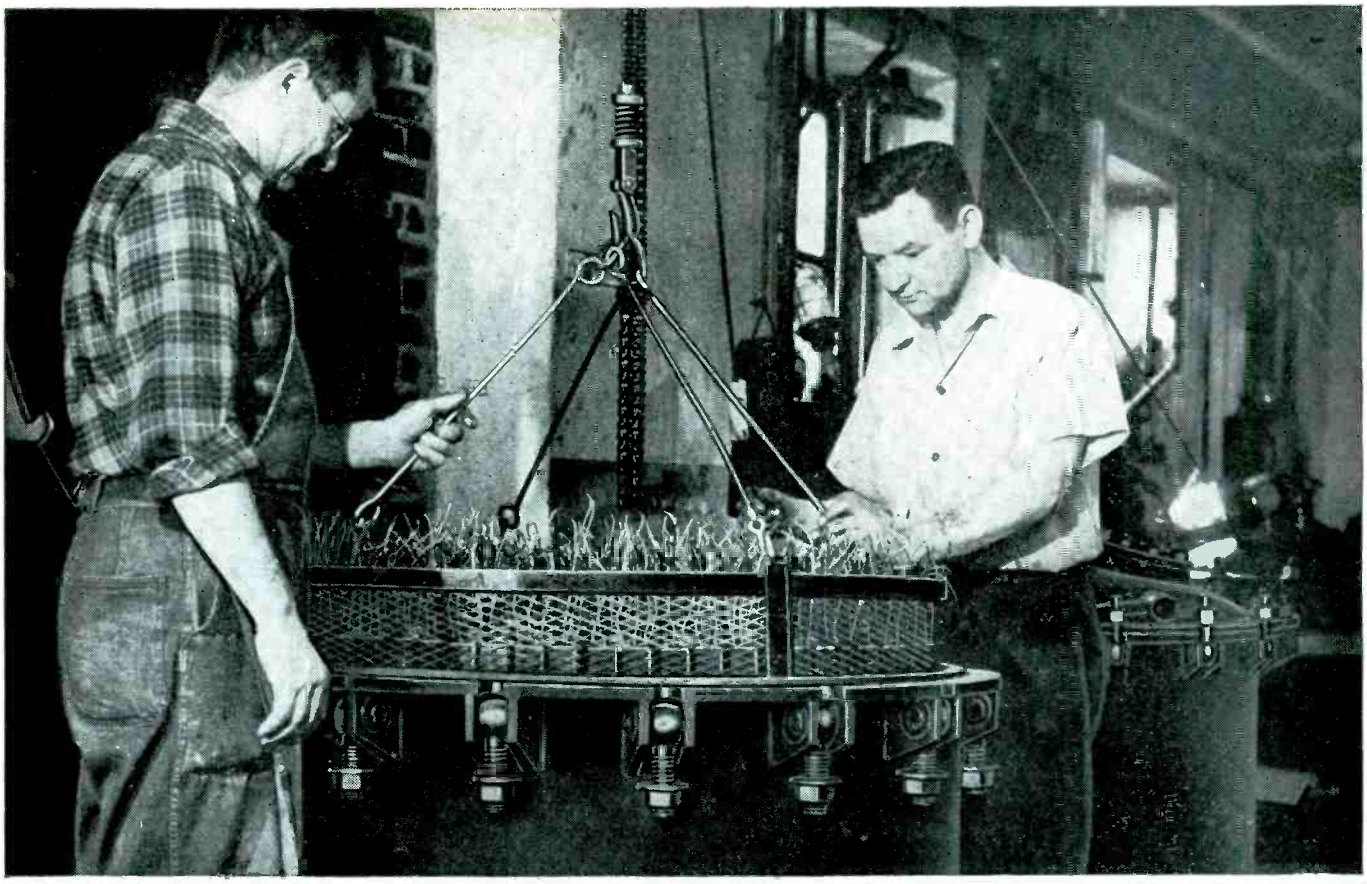
THE TYPE 297 $355.00
- Coated f/1.9 lens.
- Available with f/2.8 lens ($285.00).
- Simultaneous Binocular viewing and recording.
- Built-in illuminated data card.
- Fits standard 5-inch cathode-ray oscillographs — without additional supports.

....FOR IMPROVED FINISHED-PRINT RECORDING

DUMONT

for Oscillography

INSTRUMENT DIVISION • ALLEN B. DU MONT LABORATORIES, INC.
1000 MAIN AVENUE, CLIFTON, N. J.



New York Transformer Co. Insulates with IRVINGTON No. 100 Varnish

"FOR EXCEPTIONAL LIFE IN SEVERE SERVICE"

For specialty transformers that meet unusual and exacting requirements, the electronic industry turns to New York Transformer Co., Inc., Alpha, N. J. And for insulation that gives outstanding performance under the toughest conditions, NYT has turned—for more than 10 years—to Irvington No. 100 Clear Baking Varnish, for use on *all* its power transformers and chokes.

Here are two *major* reasons why NYT counts on Irvington No. 100:

MOISTURE RESISTANCE. 24-hour water immersion reduces dry dielectric strength of 2250 vpm *by only 2.2%.*

HEAT RESISTANCE. Irvington No. 100 withstands ASTM heat endurance test at 105° to 110°C *for over 1000 hours.*

You too can give your products service advantages like these—and save time and money, *because . . .*

Irvington No. 100 cures fast and thoroughly, even in deep windings. Its clarity allows quick identification of color coding or numbering—saves time on the assembly line, reduces risk of rejects.

Get the full story today—Technical Data Sheet is yours for the asking.

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

Send this convenient coupon now

Irvington

VARNISH & INSULATOR COMPANY

Irvington 11, New Jersey

Plants: El Monte, California — Hamilton, Ontario, Canada

EL-9/51

Irvington Varnish & Insulator Company
6E Argyle Terrace, Irvington 11, N. J.

Gentlemen:

Please send me your Technical Data Sheet on Irvington No. 100 Clear Baking Varnish.

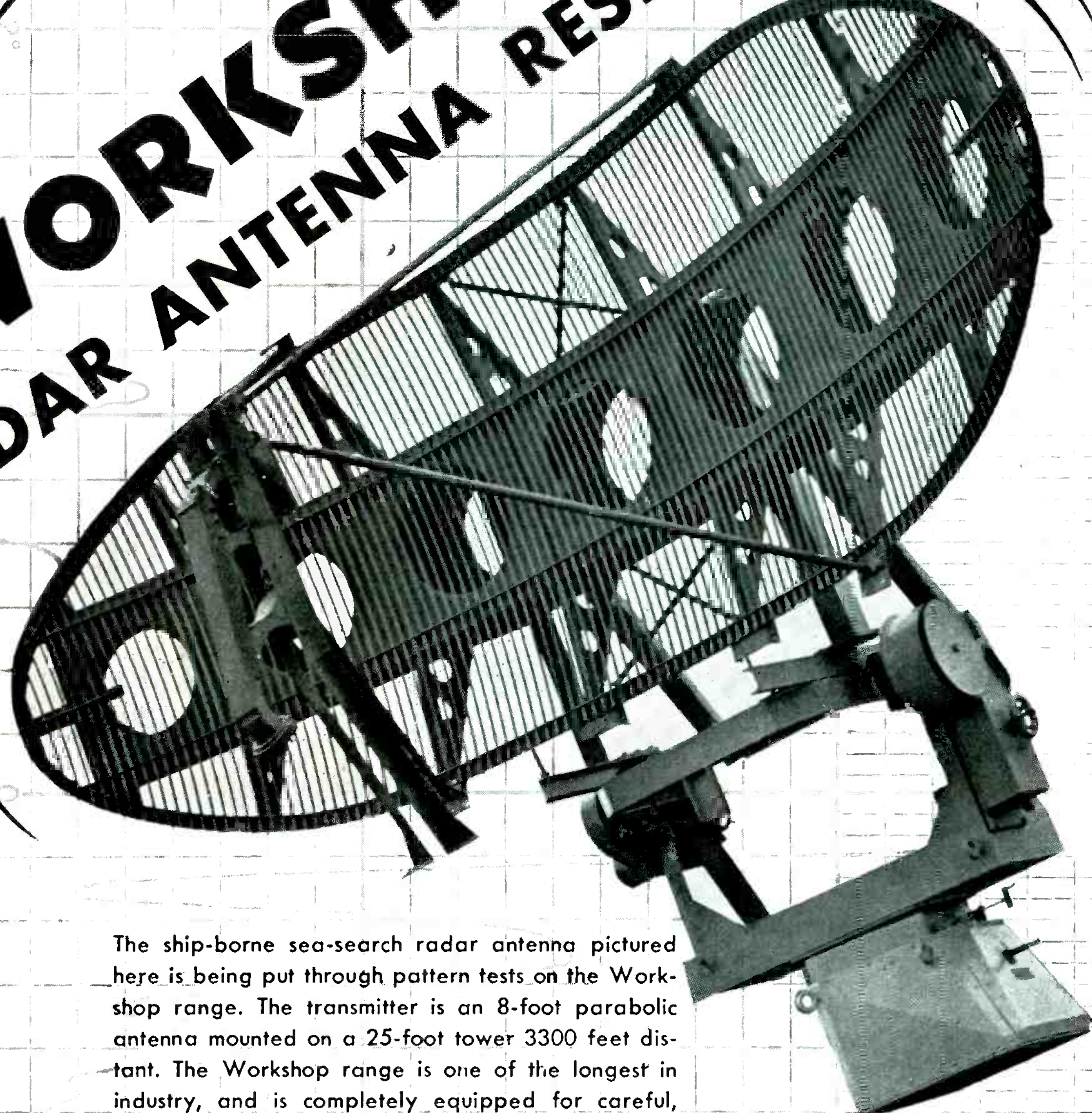
Name...Title...................

Company..

Street..

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

WORKSHOP
RADAR ANTENNA RESEARCH



The ship-borne sea-search radar antenna pictured here is being put through pattern tests on the Workshop range. The transmitter is an 8-foot parabolic antenna mounted on a 25-foot tower 3300 feet distant. The Workshop range is one of the longest in industry, and is completely equipped for careful, accurate pattern measurements. This range is typical of Workshop's outstanding facilities for research, development and production. These facilities are constantly at work for government and industry in the solution of difficult antenna problems.

The WORKSHOP ASSOCIATES

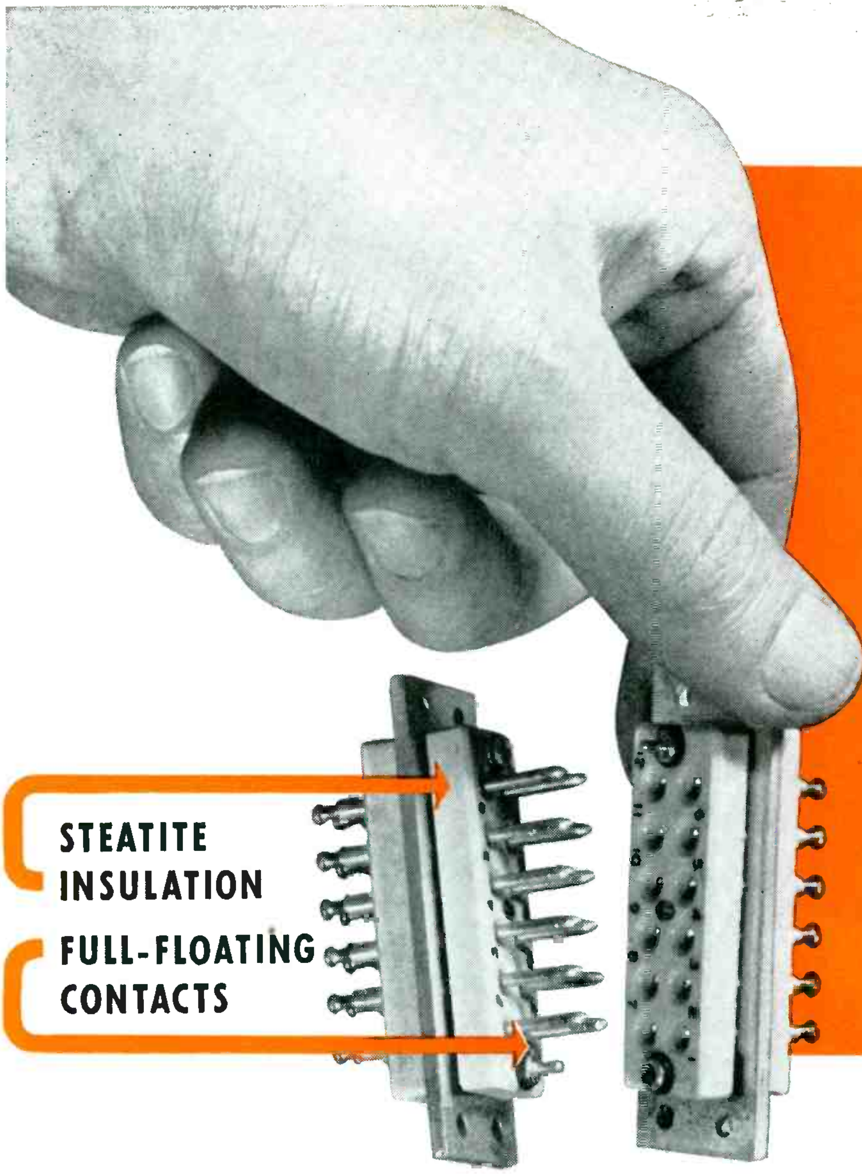
DIVISION OF THE GABRIEL COMPANY

Specialists in High-Frequency Antennas

135 Crescent Road, Needham Heights 94, Massachusetts

Lapp

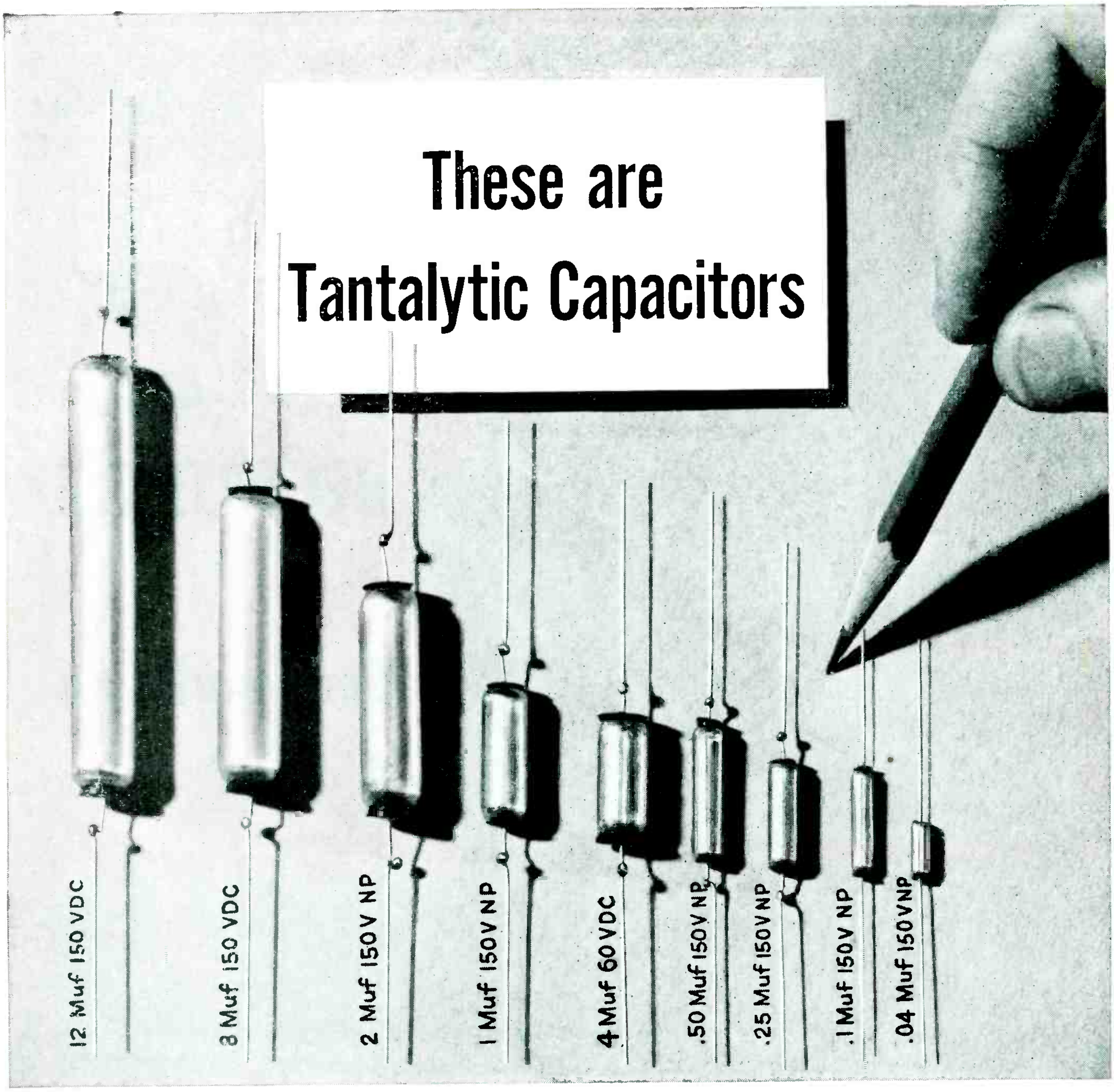
PLUG-AND-RECEPTACLE for Sectionalizing Circuits



SIMULTANEOUS contact of any number of leads can be made or broken by use of Lapp Plug-and-Receptacle units, for panel-rack assembly or other sectionalized circuits. Insulation is Steatite, the low-loss ceramic which is non-carbonizing, even when humidity, moisture or contamination sets up a leakage path. The unit shown above provides twelve contacts, rated for operation at 2.5Kv peak terminal-to-terminal, 1.5Kv peak terminal-to-ground, 25 amps at 60 cps. All contacts are silver-plated; terminals are tinned for soldering. Polarizing guide pins assure positive alignment. Write for specifications of this and other available units, or engineering recommendations for special units for your product.

Lapp Insulator Company, Inc., LeRoy, New York

Lapp



Here is one of the fastest moving developments in recent years—General Electric's new electrolytic-type capacitors. These Tantalytic capacitors with their small size and large capacitance per unit of volume have excellent low temperature characteristics, long operating life and in many cases can replace bulky hermetically-sealed paper capacitors. Ratings presently available for consideration range from .02 muf up to 12 muf at 150 volts dc. Units pictured are representative of these ratings.

Other features of G-E Tantalytic Capacitors include:

- Extremely long shelf life.
- An operating temperature range from −55°C to +85°C.
- Exceedingly low leakage currents.
- Ability to withstand severe physical shock.
- Completely sealed against contamination.

If you have large-volume applications where a price of 3 to 5 times that of hermetically-sealed paper capacitors is secondary to a combination of small size and superior performance—get in touch with us. Your letter, addressed to Capacitor Sales Division, General Electric Company, Hudson Falls, N. Y., or your nearest Apparatus Sales Office will receive prompt attention.

General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

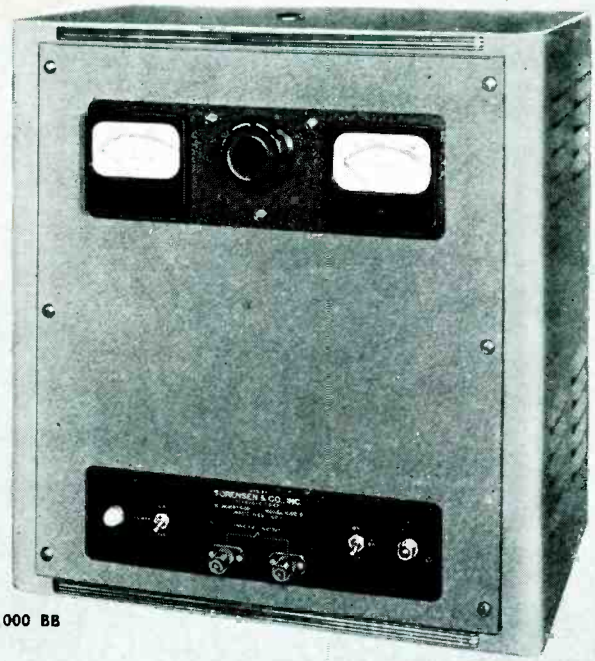
407-306

There's more to these

B-nobatrons

(DC POWER SUPPLYS)

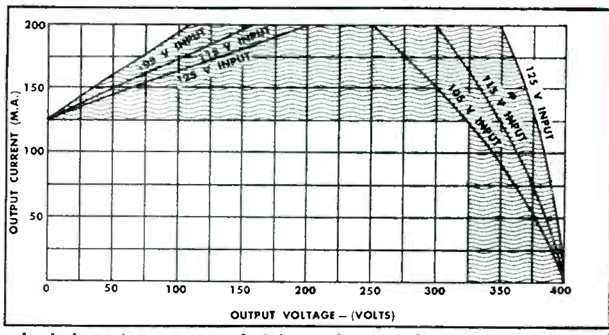
than meets the eye!



MODEL 1000 BB

MODEL 325 BB

OUTPUT VS LOAD, MODEL 325BB



shaded section — area of "plus value" performance

The Sorensen line of B-NOBATRONS is *conservatively rated*. The performance specified for each unit is available under *all line and load conditions* within the range of the instrument.

This leaves room for "plus values" that should not be overlooked! As shown in the graph at left, it is possible under many conditions to obtain current and voltage *considerably in* excess of the ratings. And you get similar premium performance from *all* B-NOBATRONS!

Further, the Sorensen name on any Isotronic* product is your assurance of careful construction, finest materials, dependable and economical operation. Write for full information.

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

DC POWER SUPPLY SPECIFICATIONS

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

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

Specify

SORENSEN

Sorensen & Company, Inc. • 375 Fairfield Ave., Stamford, Connecticut

FOR THE BEST IN REGULATED LOW VOLTAGE DC SUPPLYS, INVESTIGATE SORENSEN'S LINE OF NOBATRONS.

THOMPSON EXPANDS ITS SERVICE INTO ELECTRONICS PRODUCTION

USE Thompson

COAXIAL SWITCHES

Model No. 10829. Single-pole two-throw coaxial switch

Model No. 10567. Single-pole four-throw coaxial switch

TYPICAL PERFORMANCE

Frequency range, 0 to 10,750 Mc./Sec.

V. S. W. R., 1.5 maximum

Insertion loss, .5 decibels or less at 3,000 Mc./Sec.

Cross-talk, 50 decibels minimum at 3,000 Mc./Sec.

Characteristic impedance, 50 ohms normal

Maximum RF voltage, 500 volts, RMS

Power rating, CW Maximum continuous 100 watts at 3,000 Mc./Sec.

● Reliable R-F AND MECHANICAL PERFORMANCE under extreme environmental conditions is guaranteed in types which include single-pole 2-throw, 3-throw, 4-throw and 6-throw; double-pole, double-throw; and Sensing Switches. Remote actuation (28 volts DC or 115 volts AC) is available for all.

The Thompson Products Electronics Division has a competent staff of engineers, electronic and environmental test equipment, model shop facilities and production facilities ready to work for you on your coaxial switch problems.

WRITE *for further technical information and descriptive brochure; your inquiry will bring a prompt reply.*

ELECTRONICS DIVISION, 2196 CLARKWOOD ROAD, CLEVELAND 3, OHIO

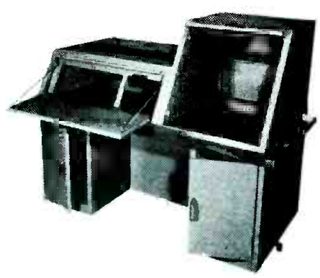
Thompson Products, Inc.

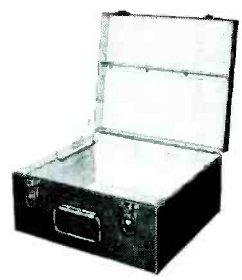
MANUFACTURERS OF PRECISION AIRCRAFT PARTS AND ACCESSORIES

CLEVELAND • DETROIT • LOS ANGELES • ST. CATHARINES, ONTARIO

Right
Down
Your
Alley...

Bowl them over with a product "packaged" in smart styling! Say farewell to misfit, makeshift cabinets that copy-cat the other fellow. You can afford your own exclusive design when we "productioneer" the job for most economical treatment. Housings built for *you alone* permit features that mean less costly final assembly. It makes no difference how simple and thrifty or elaborate you want it—our faultless workmanship will make you proud to put your trade mark on the product. Write for data book.





KARP METAL PRODUCTS CO., INC.

215 63rd STREET, BROOKLYN 20, NEW YORK

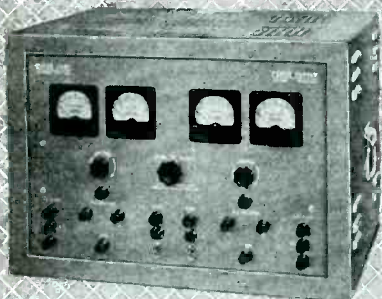
Specialists in Fabricating Sheet Metal for Industry

VOLTAGE REGULATED POWER SUPPLIES

For Industrial and Research Use

MODEL 815

B SUPPLY:
0-600 volts, 200 Ma.
REGULATION:
½% for both line and load variations.
RIPPLE: 5 millivolts.
C SUPPLY:
0-150 volts, 5 Ma.
REGULATION:
10 millivolts for line 105-125 volts.
½% for load at 150 volts.
RIPPLE: 5 millivolts.
FILAMENT SUPPLY: 6.3 volts AC, 10 Amp., CT



MODEL 510

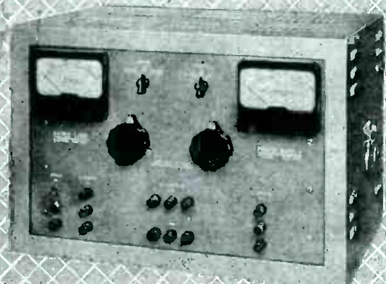
Model 510 features TWO COMPLETELY INDEPENDENT REGULATED POWER SUPPLIES.
OUTPUT DC FOR EACH SUPPLY:
200-500 volts, 200 Ma.
REGULATION:
½% for both line and load variations.
RIPPLE: 5 millivolts.
OUTPUT AC FOR EACH SUPPLY:
6.3 volts, 6 Amp. CT.
The supplies may be connected for series, parallel, or bucking operation.

MODEL 315

B SUPPLY: 0-300 volts, 150 Ma.
REGULATION: ½% for both line and load variations.
RIPPLE: 5 millivolts.
C SUPPLY: 0-150 volts, 5 Ma.
REGULATION: 10 millivolts for line 105-125 volts.
½% for load at 150 volts.
RIPPLE: 5 millivolts.
FILAMENT SUPPLY: 6.3 volts AC, 5 Amp., CT.
Available with Rack Mounting

MODEL 500-R

OUTPUT DC: 0-500 volts, 300 Ma.
REGULATION: ½% for both line and load variations.
RIPPLE: 10 millivolts.
OUTPUT AC: 6.3 volts, 10 Amp., CT.
Model 615 is the Model 500-R plus C supply



MODEL 800

Model 800 features TWO INDEPENDENT REGULATED POWER SUPPLIES.
OUTPUT DC FOR EACH SUPPLY:
0-600 volts, 200 Ma. In parallel 400 Ma.
REGULATION:
½% for both line and load variations.
RIPPLE: 5 millivolts.
OUTPUT AC FOR EACH SUPPLY:
6.3 volts, 10 Amp., CT

MODEL 245

OUTPUT DC: 200-500 volts, 200 Ma.
REGULATION: ½% for both line and load variations.
RIPPLE VOLTAGE: 5 millivolts.
OUTPUT AC: 6.3 volts, 6 Amp., CT.
Available with Rack Mounting

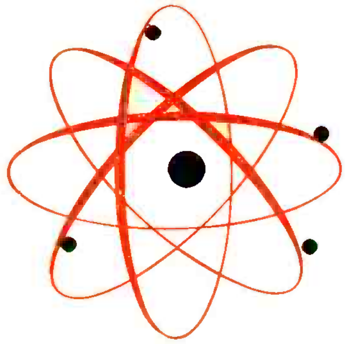
REGULATION 0.1%
KEPCO LABORATORIES manufactures on special order high quality, extremely well regulated Power Supplies. Let us quote on your special requirements.

MANUFACTURERS OF ELECTRONIC EQUIPMENT • RESEARCH • DEVELOPMENT

KEPCO
LABORATORIES, INC.

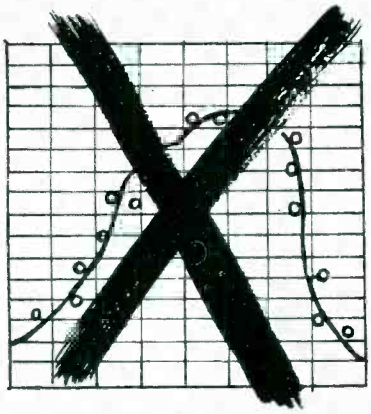
149-14 41st AVENUE • FLUSHING, N. Y.

FOR SPECIFICATIONS ON OUR COMPLETE LINE OF POWER SUPPLIES-WRITE DEPT. Z

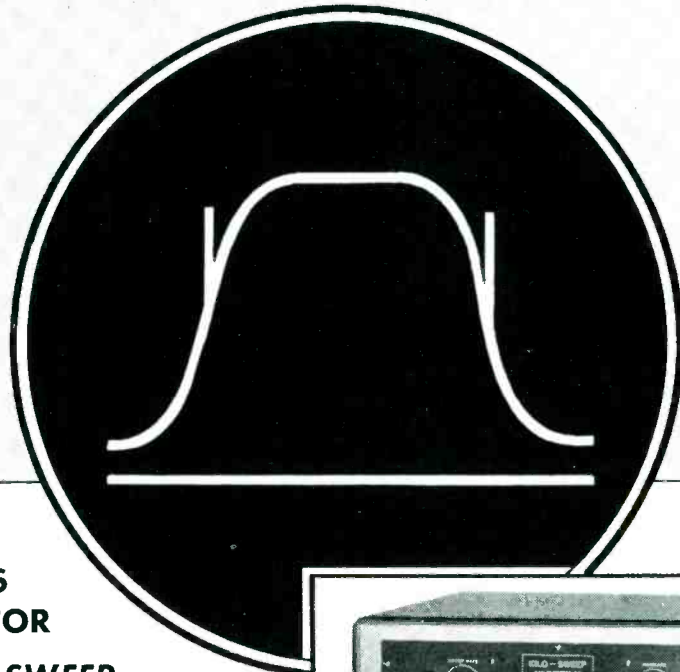


speed up LOW FREQUENCY alignment with the new

KILO-SWEEP



ELIMINATE TEDIOUS POINT-BY-POINT METHODS



GET DIRECT OSCILLISCOPE PRESENTATIONS WITH THIS NEW SWEEPING OSCILLATOR

Use the new KILO-SWEEP

In the 50 KC to 2 MC frequency range. You speed alignment of tuned amplifiers as you obtain truly precise adjustment of both frequency and band width.

FEATURES:

SWEEP METHOD: All Electronic

SWEEP RANGE: 50 KC to 2 MC (Dial Divisions every 0.1 mc)

SWEEP WIDTH: 0 to 100 KC (Dial Divisions every 10 KC)

FREQUENCY MARKS: Pip type crystal positioned at 0.5, 1.0 and 2.0 MC. Other frequencies on special order.

OUTPUT: 0.5 volt into 70 ohms.

ATTENUATORS: Separate controls for RF and mark signals.

BASELINE: Zero reference line.

PRICE: $525 F.O.B. factory. Additional marks $20 each.

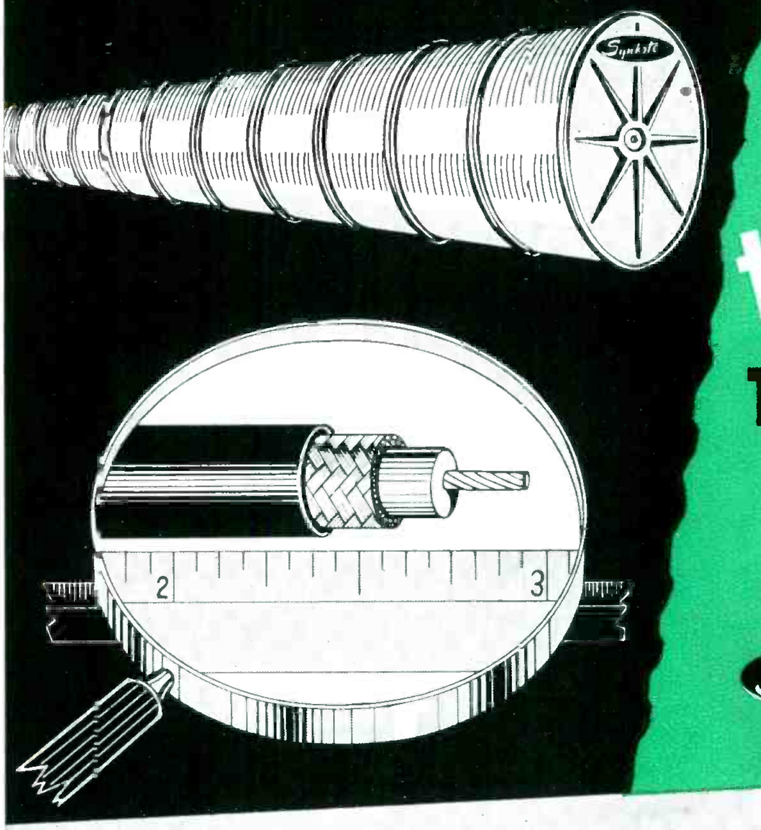
Inquire about the SONA-SWEEP for similar work from 5 KC to 200 KC.

KAY

KAY ELECTRIC COMPANY

23 Maple Avenue — Phone CAldwell 6-4000 — Pine Brook, New Jersey

Export Department: 13 East 40th Street, New York 16, N.Y.



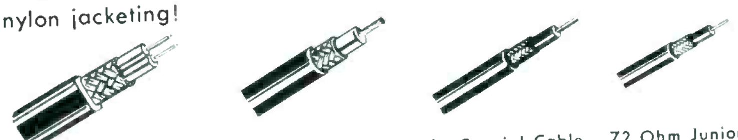
MADE BY t-h-e m-i-l-e

TESTED BY the inch

Synkote® Coaxial Cable

. . . miles of Synkote coaxial cable have been turned out since Plastoid Corporation first pioneered in coaxial construction — and every single inch has been checked again and again for tensile and dielectric strength, chemical stability of insulation, uniformity of dimensions, abrasion resistance of jacketing, uniformity of dimensions.

This inch-by-inch inspection assures you that every length of Synkote coaxial cable will give you *all* the advantages you expect from *all* Synkote wire. Advantages like high dielectric strength and low dielectric leakage. Thermoplastic insulation that's almost completely impervious to water, acids, alkalies, oils, heat and cold. PLUS exceptionclly tough, abrasion-resistant nylon jacketing!



230 Ohm Shielded Lead In | 11/U Coaxial Cable | 59/U Coaxial Cable | 72 Ohm Junior Coaxial Cable

And of course . . . specially engineered designs for special needs!

Other Synkote Products

HOOK UP WIRE
AIRCRAFT CABLE
TV WIRE
MULTI-CONDUCTOR CABLE

Engineering Service

Just tell us your requirements in electronic wiring. We'll be glad to help you select, from the comprehensive Synkote line, the type of insulated conductor that best meets your needs. And we're prepared, on short notice, to engineer new designs to fit your problem—and to produce them in practically any quantity.

Mail coupon for full information

PLASTOID Corporation

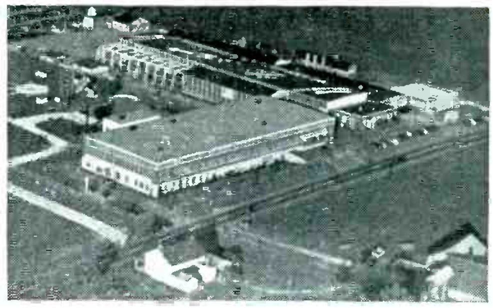
42-61 24th Street, Long Island City 1, N. Y.

PLASTOID CORPORATION Dept. E
42-61 24th Street, Long Island City 1, N. Y.

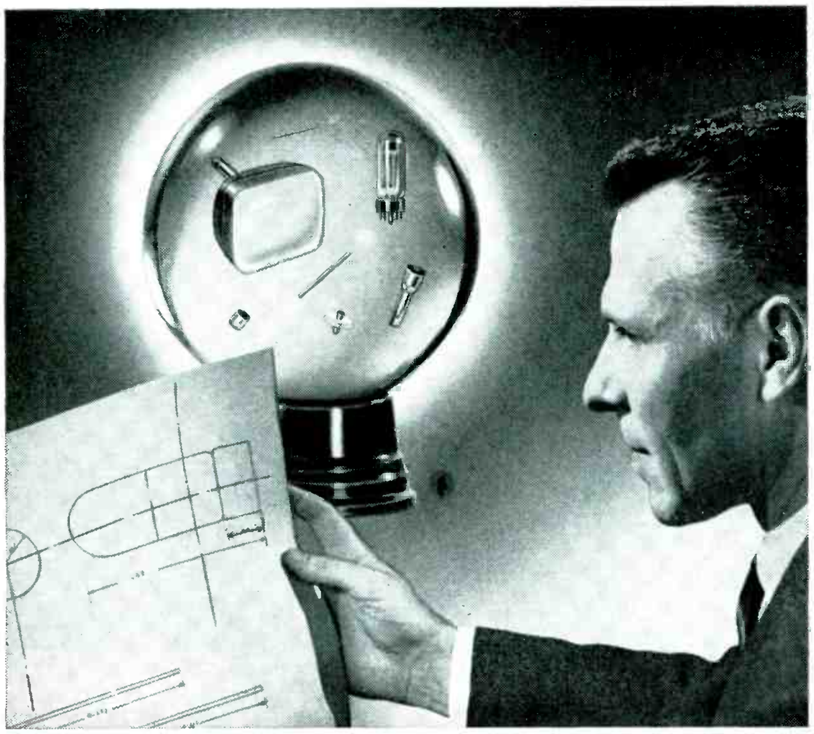
Gentlemen:
Please send me additional information on Synkote Coaxial Cable of the following types.........

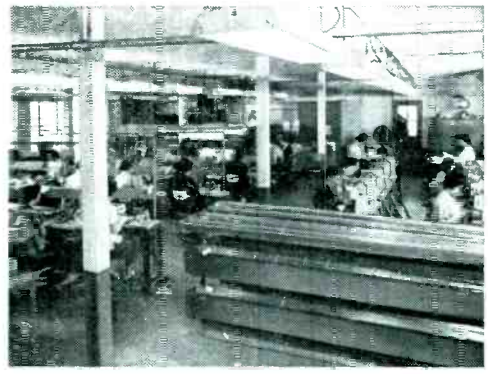
Name.........
Company.........
Address.........
City......... *State*.........

With our hands full today...we've our eye on tomorrow

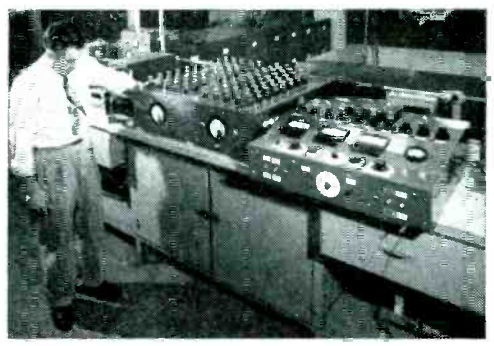


Buildings . . . enclosing more than 4 acres —all devoted to the development, production and testing of fine small tubing.





Men and Machines. . . fabricating, inspecting and finishing parts to meet the most exacting specifications.



Engineering . . . laboratory equipment for all kinds of testing, including emission characteristics of nickel cathode materials.

Here at Superior we produce quantities of quality parts for the Electronics Industry. Our research engineers are constantly at work to improve these products and to develop new parts to do the job better. Production-wise we're working just as constantly to produce more and more of these better products for you.

During the year 1950, we doubled our disc cathode capacity, added over 50% to Seamless cathode capacity. Through the same period we almost doubled the number of machines making Lockseam cathodes . . . more than doubled capacity. 1950 production of Lockseam cathodes increased 280% over 1949. Demand kept pace with the increase.

Plans for the future include the installation of new machines and the improvement of already good processes so that the Electronics Industry's coming needs may be as well met as its past demands.

Then as now, we at Superior will deliver truly superior small tubing products to do tough jobs better. Superior Tube Company, 2500 Germantown Ave., Norristown, Pa.

Which Is The Better For Your Product . . .

SEAMLESS . . . ? The finest tubes that can be made. Standard production is .010″ to .121″ O.D. inclusive, with wall thicknesses of .0015″ to .005″. Cathodes with larger diameters and heavier walls will be produced to customer specification.

Or LOCKSEAM*. . . ? Produced directly from thin nickel alloy strip stock, .010″ to .100″ O.D. in standard length range of 11.5 mm to 42 mm. Round, rectangular or oval, cut to specified lengths, beaded or plain.

Superior

THE BIG NAME IN SMALL TUBING

All analyses .010″ to 5/8″ O.D.
Certain analyses (.035″ max. wall) Up to 1¾″ O.D.

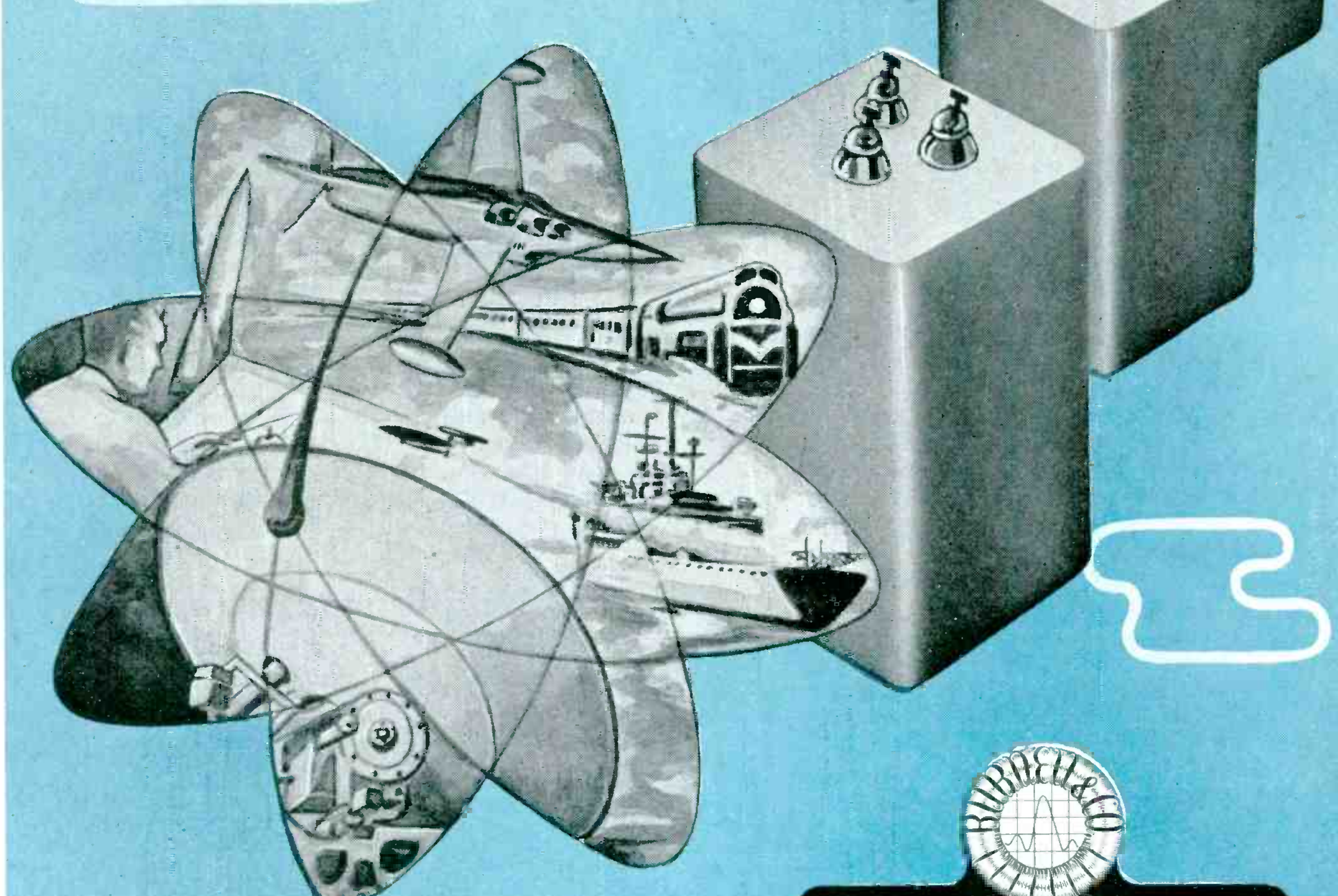
*MFD. UNDER U. S. PATS. ***SUPERIOR TUBE COMPANY • Electronic Products for export through Driver-Harris Company, Harrison, New Jersey • Harrison 6-4800***

Burnell Filters
FOR MILITARY APPLICATIONS

With the increasing number of audio filter applications in electronic military equipment, the importance of stability and durability under extreme service conditions creates many more problems in the design and manufacture of these networks.

A filter, which is not really a component, but an assembly of many components (often quite intricate) is affected by the slightest weakness in any of these parts. As a consequence, it has been our greatest task to either develop or find sources of the highest quality for materials employed in the production of filters. This project has so far been very fruitful although it necessarily resulted in increased material cost, much of which has been offset by the introduction of new and more efficient production and design methods.

All of this adds up to another step forward for Burnell & Company in the production of high quality filter networks for the Nation's military electronic program.



EXCLUSIVE MANUFACTURERS OF COMMUNICATIONS NETWORK COMPONENTS

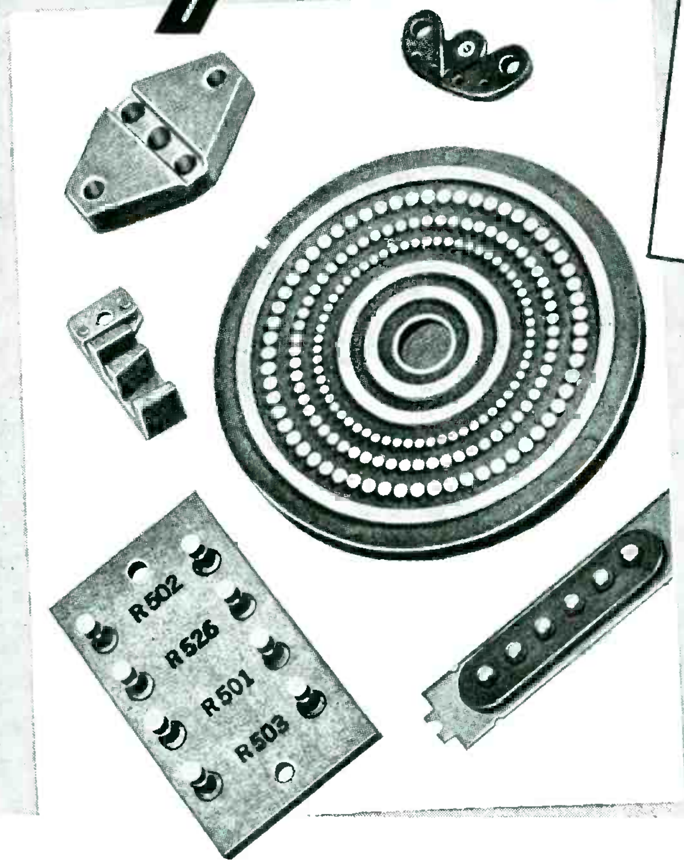
BURNELL & CO

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

For better products at lower cost—

SPECIFY MYCALEX

Glass-Bonded Mica INSULATION



- MOLDS AND MACHINES TO CLOSE TOLERANCES
- MOLDABLE WITH METAL INSERTS
- CAN BE TAPPED, THREADED, SLOTTED
- AVAILABLE IN RODS, SHEETS, SPECIAL SHAPES
- MOLDED IN PRACTICALLY ANY SHAPE OR SIZE
- LOW-LOSS FROM 60 CPS TO 24,000 MCS

MYCALEX glass-bonded mica insulation is the one highly adaptable, versatile insulating material that combines every desirable characteristic required in a modern dielectric. Although far superior to lower cost dielectrics, MYCALEX offers considerable advantages over many materials costing several times as much. MYCALEX is available in various grades, each featuring specific characteristics to meet particular needs. Since proper application of the right grade of MYCALEX has resulted in simultaneous product improvement and lower cost in hundreds of instances, it's good business to check with MYCALEX before specifying sheet, rod, fabricated or molded insulation.

JAN APPROVED

MYCALEX 410 is approved fully as Grade L-4B under National Military Establishment Specification JAN-1-10, "Insulating Materials, Ceramic, Radio, Class L."

MYCALEX 400 is approved fully as Grade L-4A under National Military Establishment Specification JAN-1-10, "Insulating Materials, Ceramic, Radio, Class L."

Write for 20-Page Catalog Today!

A valuable compilation of engineering data and manufacturing information on electrical insulation that you'll surely want for your technical file. Request it today—no obligation.

CHARACTERISTICS

MYCALEX GRADE	400	410	410X
POWER FACTOR, 1 MC	0.0018	0.0015	0.012
DIELECTRIC CONSTANT, 1 MC	7.4	9.2	6.9
LOSS FACTOR, 1 MC	0.013	0.014	0.084
DIELECTRIC STRENGTH, volt/mil	500	400	400
VOLUME RESISTIVITY, ohm/cm	2×10^{15}	1×10^{15}	5×10^{14}
ARC RESISTANCE, seconds	300	250	250
MAX. SAFE OPER. TEMP., °C	370	350	350
WATER ABSORPTION % 24 hrs.	NIL	NIL	NIL

SINCE 1919 MYCALEX THE INSULATOR TRADE MARK REG US PAT OFF

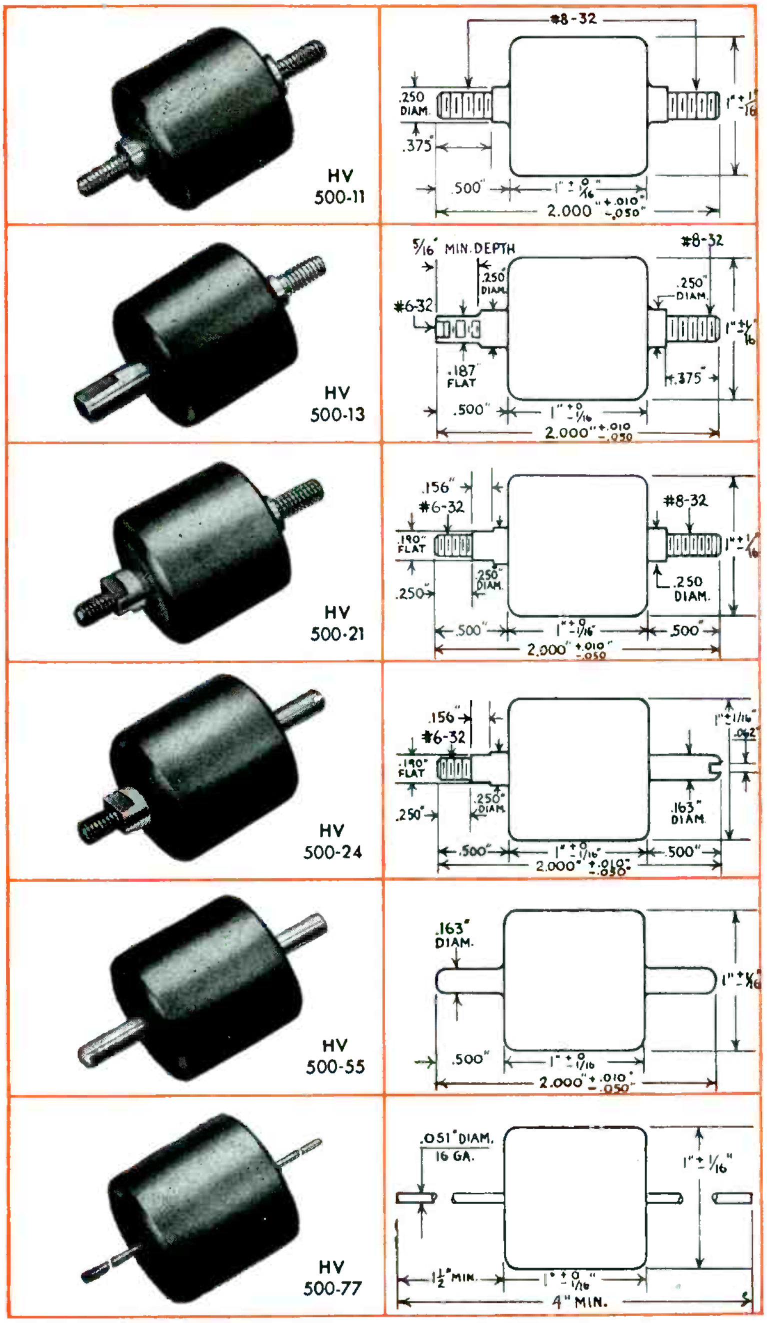
MYCALEX CORPORATION OF AMERICA

Owners of 'MYCALEX' Patents and Trade-Marks

Executive Offices: 30 ROCKEFELLER PLAZA, NEW YORK 20 — Plant & General Offices: CLIFTON, N.J.

Hi-Q*

HIGH VOLTAGE CAPACITORS WITH CHOICE OF TERMINALS



Hi-Q High Voltage Capacitors are sturdy, thoroughly tested units capable of withstanding high voltages and operating at extreme humidity and raised temperatures.

The piercing pressure of the dielectric material is greatly increased by a meticulously exacting jacketing procedure in conjunction with a newly developed plastic with excellent arc resistant properties. Terminals are silvered brass and integrally soldered to the silver electrodes which are fired directly to the ceramic dielectric.

These HV 500 Capacitors provide an excellent working parameter when used in conjunction with high voltage horizontal output transformers.

SPECIFICATIONS

Capacity	500 mmf ± 20%
Power Factor	2% Max
Insulation Resistance	50,000 megohms
Working Voltage	20,000 V. D. C.
Flash Test	27,000 V. D. C.

NOTE: Dash numbers after HV 500 designate types of terminal. For example, HV 500-11 indicates type 1 terminal both ends; HV 500-24 indicates a type 2 and a type 4 terminal. HV 500-66 is not shown, since it is similar to HV 500-11, except that length of thread is only .250", while protrusion is lengthened to .250".

JOBBERS—ADDRESS: 740 Belleville Ave., New Bedford, Mass.

Hi-Q*

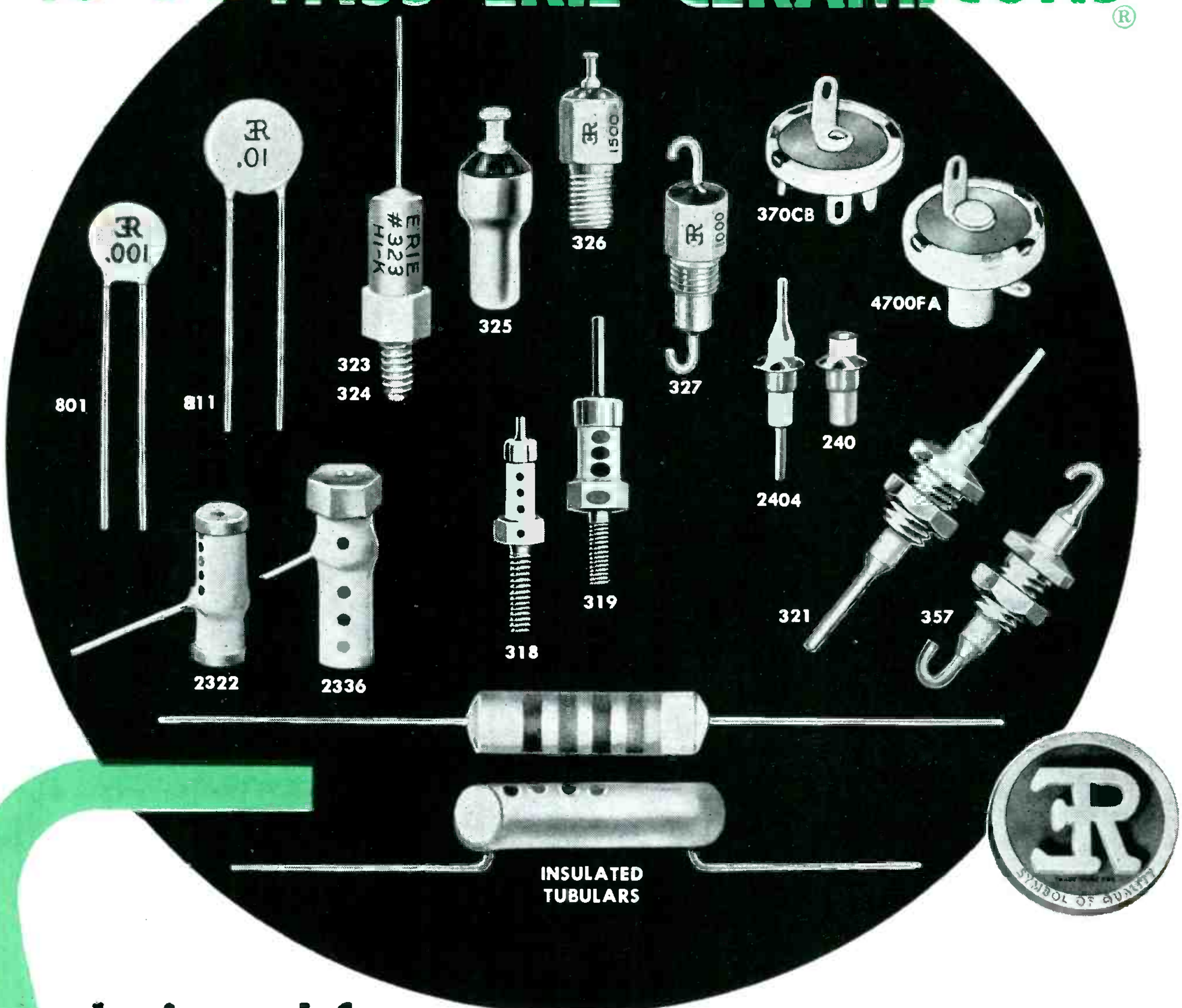
** Trade Mark Registered, U. S. Patent Office*

Electrical Reactance Corp.
OLEAN, N. Y.

SALES OFFICES: New York, Philadelphia, Detroit, Chicago, Los Angeles

PLANTS: Olean, N. Y., Franklinville, N. Y. Jessup, Pa., Myrtle Beach, S. C.

18 BY-PASS ERIE CERAMICONS®



designed for
MINIATURIZATION, RUGGEDIZATION

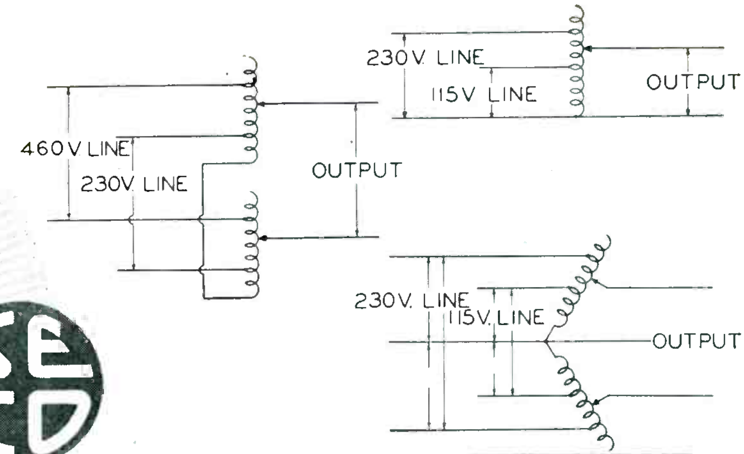
Erie Ceramicons fulfill all the requisites for efficient by-passing—compact design, low inductance, and conservative 500 volt D. C. rating. Erie Resistor offers the most complete line of ceramic by-pass units available. Each design has been thoroughly proven in domestic and military equipment.

Sixteen popular styles in ceramic capacitors are shown above. Feed-Thru's are supplied in values up to 2000 mmf, Stand-Off units up to 5000 mmf, Tubular and Disc units up to .01 mfd. Also shown above are two Silver Button Micas representing the 370 series for values up to 1000 mmf and the 4700 series for values up to 6000 mmf. Write for samples to meet your specific requirements.

Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND . . . TORONTO, CANADA

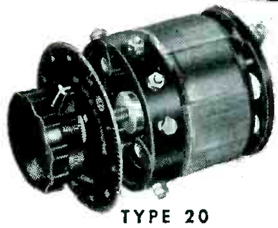


A TYPE FOR EACH APPLICATION

A COMPLETE LINE of standard manually-operated and motor-driven POWERSTAT variable transformers are available for 115, 230 and 460 volts, 50/60 cycles, single and three phase service in ratings from 405 VA to 100 KVA in air-cooled, oil-cooled and explosion-proof models. Non-catalogued assemblies are offered for 25, 400/800 cycles and higher frequency operation and for requirements involving J.A.N. specifications.

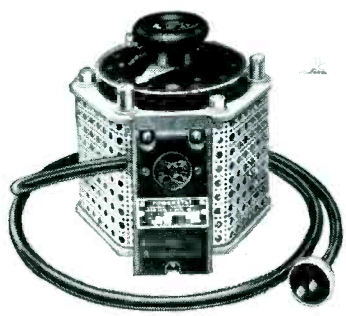
SUPERIOR PERFORMANCE is inherent in every POWERSTAT variable transformer. Each unit possesses excellent regulation, high efficiency, conservative rating, zero waveform distortion, rugged mechanical construction, smooth control and simplified mounting.

ONE SOURCE, The Superior Electric Company can provide the answer to your variable a-c voltage problem. Superior offers more combinations of connections and ratings for variable a-c voltage control than any other manufacturer. Look to Superior first.

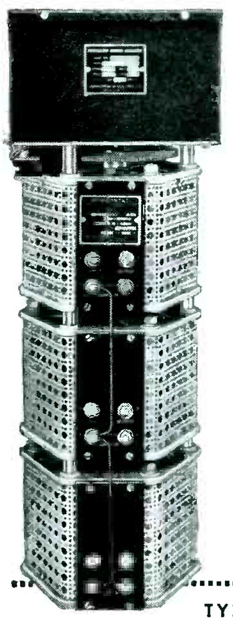


TYPE 20

TYPE 116



TYPE 2PF1126



TYPE MZ1126-3Y

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

GET THE FACTS

16-page POWERSTAT Bulletin P550, complete with application and design information, ratings, diagrams and dimensions.

409 CHURCH STREET, BRISTOL, CONNECTICUT

SEND ME Bulletin P550 on POWERSTAT Variable Transformers.

NAME ____________________

TITLE ____________________

COMPANY ____________________

CO. ADDRESS ____________________

CITY __________ ZONE ______ STATE ______

MANUFACTURERS OF

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

RAYTHEON announces . . .

a complete line of

STANDARD CONTROL KNOBS

6 TYPES — 5 SIZES — MATTE OR MIRROR FINISH

Designed and Styled For High Grade Electrical and Electronic Equipment

Save time, save money, meet your own or government standards by choosing from this complete line of functionally sound, attractively styled, injection molded control knobs. Now available in a completely integrated family of 54 items—in a choice of *six* basic types and *five* widely used sizes. Made of tough, durable "Tenite II" (cellulose acetate butyrate) with anodized aluminum inserts and dual setscrews. All types and sizes available with gleaming *mirror finish* . . . or with non-reflecting *matte finish* for military applications.

Write for complete information—Address Dept. 6460-KA.

RAYTHEON®

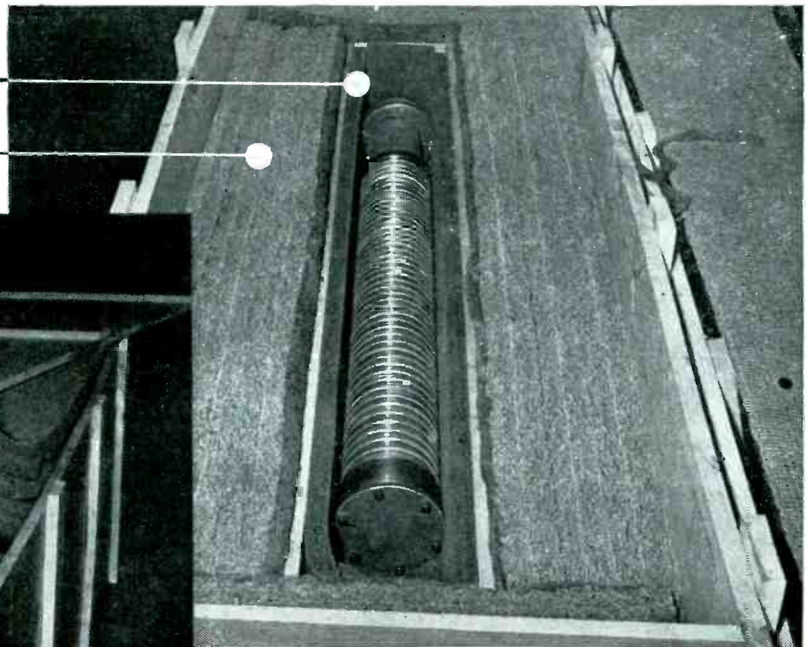
Excellence in Electronics

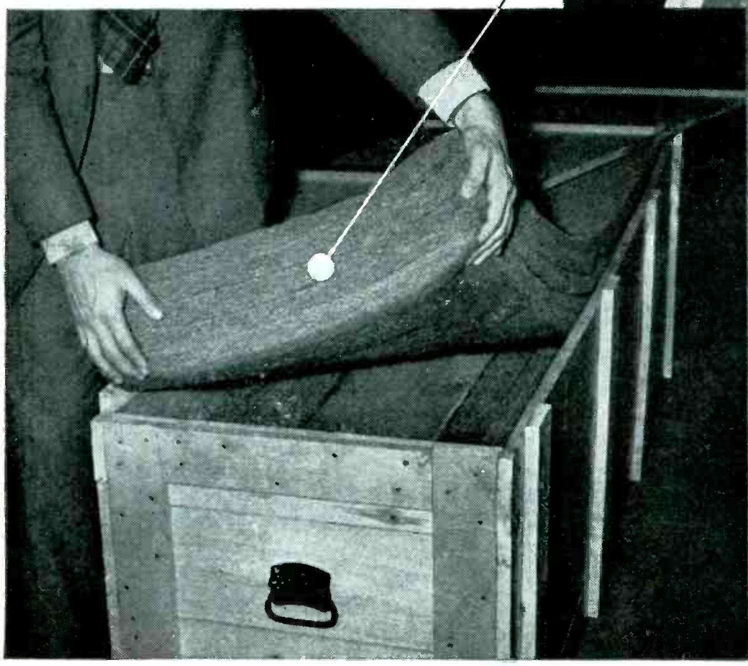
RAYTHEON MANUFACTURING COMPANY

EQUIPMENT SALES DIVISION • WALTHAM 54, MASS.

How to **PACK** a delicate product for **SHIPMENT ANYWHERE**

•**SPONGEX cellular rubber**
•**TEXLITE® rubberized hair**





This fragile high-voltage tube is cushion packaged for safe arrival

Photographs courtesy of High Voltage Engineering Corporation.

The last nail in place and this high-voltage tube is ready for shipment anywhere. On arrival, it will do the job it was built to do. It's packaged to take the bangs.

After analyzing its needs, this fragile tube was packed in two outstanding cushioning materials—Spongex cellular rubber, and Texlite rubberized hair.

If breakage in transit is eating into profits, consult with our Packaging Division. They are equipped to analyze and prescribe the requirements of your product for safe arrival anywhere—whether shipped by land, sea or air.

For better package cushioning use

SPONGEX® PRODUCTS

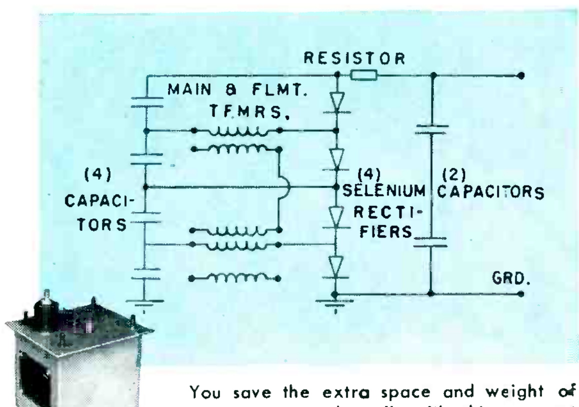
Spongex products available for protective packaging

- **TEXLITE** rubberized hair and/or wool
- **SPONGEX** cellular rubber
- **TEXFOAM** latex foam rubber

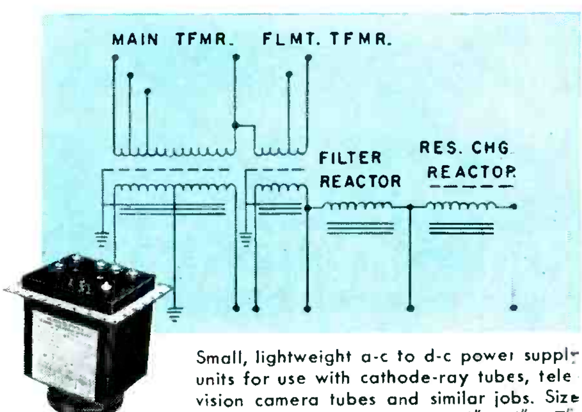
THE SPONGE RUBBER PRODUCTS COMPANY 469 DERBY PLACE, SHELTON, CONNECTICUT

Buy your radar components "packaged"

to save space, weight and installation costs



You save the extra space and weight of unnecessary tank walls with this compact rectifier transformer assembly. Ideal for radar applications.



Small, lightweight a-c to d-c power supply units for use with cathode-ray tubes, television camera tubes and similar jobs. Size of 7-kv unit illustrated—only 6" x 6" x 7"; weight 8 lb.

Filament and plate transformers plus charging and filter reactors—in fact, any combination of electrically adjacent units except pulse transformers*—can be packaged corona-free in one hermetically sealed, oil-filled container. You'll save space. You'll usually save weight. You'll make major savings in installation costs because of simplified mounting and fewer connections. You'll secure the high reliability typical of oil-filled units . . . and terminals and leads are under oil to eliminate corona.

If packaged components have an application in your work, we'd like to hear from you. These "packages" are always tailored to individual jobs, so no catalog is available. However, proposition forms will be supplied which list the information we need to prepare a quotation. For prompt attention, address General Electric Co., Sec. 43-328A, 100 Woodlawn Avenue, Pittsfield, Massachusetts or your nearest Apparatus Sales office.

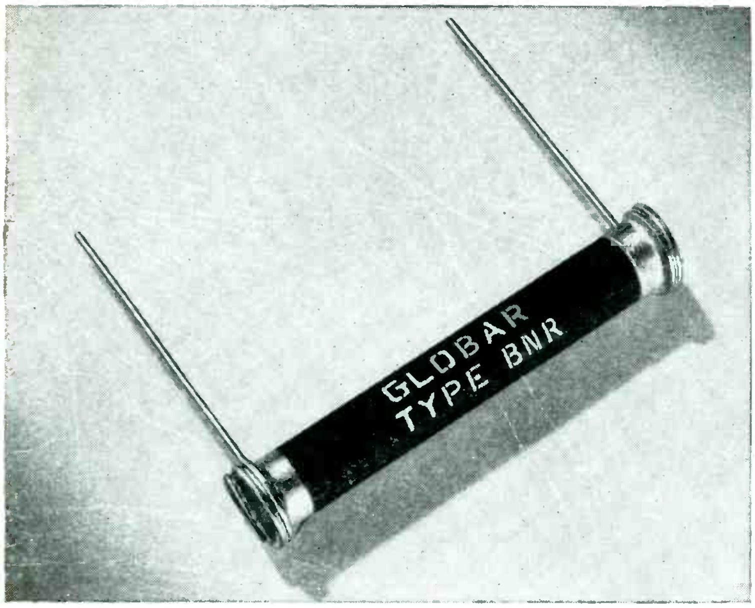
General Electric Company, Schenectady 5, New York.

**Inclusion of pulse transformer not usually practical because of effect on capacitance.*

GENERAL ELECTRIC

401-65

Minimize Effects of Varying Supply Voltage the Simple Way



GLOBAR
TYPE BNR
VOLTAGE SENSITIVE
RESISTORS

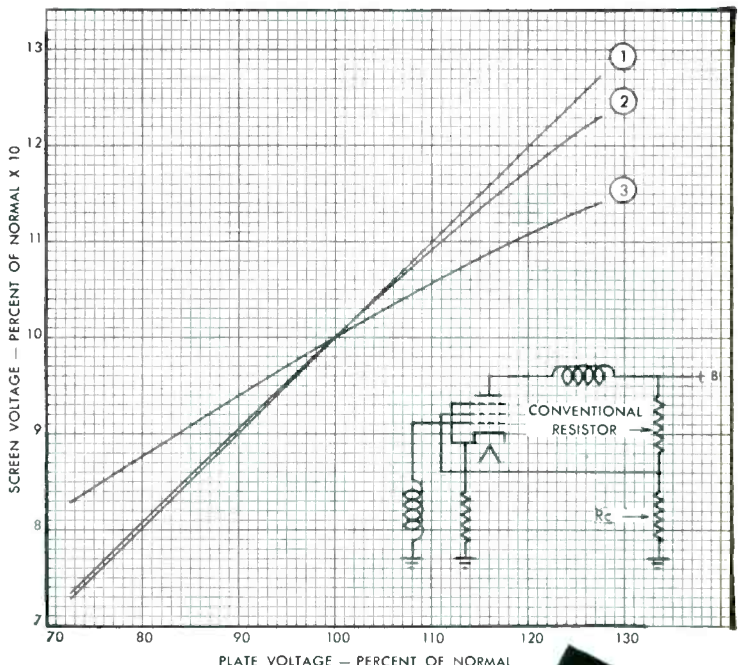
Performance of Various Voltage Reducers for Pentode Screen Supply

1 Divider with conventional composition Resistor at R_c.

2 Plain series dropping Resistor (R_c omitted).

3 Divider with GLOBAR type BNR at R_c.

● Variation in supply voltage which impairs pentode amplifier performance is especially serious in cathode ray tube applications where the effect on sweep amplifier output is visible. This is where the voltage sensitive characteristics of GLOBAR type BNR resistors prove extremely valuable. Employed in a voltage divider as shown here, they help to stabilize gain of amplifiers against supply voltage variations. Often, they reduce screen voltage variations by as much as *one half.*



WRITE for a copy of Bulletin GR-2 which contains useful engineering data on GLOBAR type BNR resistors. Dept. E 87-69, GLOBAR Division, The Carborundum Company, Niagara Falls, New York.

GLOBAR Ceramic Resistors
BY CARBORUNDUM
TRADE MARK

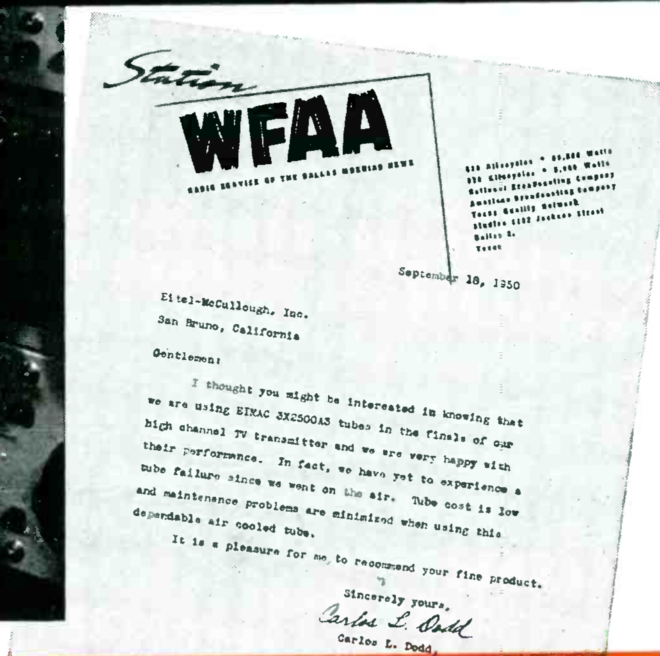
"Carborundum" and "Globar" are registered trademarks which indicate manufacture by The Carborundum Company, Niagara Falls, N. Y.

87-69

CARLOS L. DODD
CHIEF ENGINEER WFAA-TV, DALLAS, TEXAS
TRANSMITTER—DUMONT 5 KW. CHANNEL 8.

From WFAA-TV,

More Proven Performance of the Eimac 3X2500A3



Station
WFAA
RADIO SERVICE OF THE DALLAS MORNING NEWS

September 18, 1950

Eitel-McCullough, Inc.
San Bruno, California

Gentlemen:

I thought you might be interested in knowing that we are using EIMAC 3X2500A3 tubes in the finals of our high channel TV transmitter and we are very happy with their performance. In fact, we have yet to experience a tube failure since we went on the air. Tube cost is low and maintenance problems are minimized when using this dependable air cooled tube.

It is a pleasure for me to recommend your fine product.

Sincerely yours,
Carlos L. Dodd
Carlos L. Dodd

The Eimac 3X2500A3 is one of the outstanding vacuum tube developments made during recent years. Consistent performance, long life, and low cost account for its filling the key socket positions in many important recently designed equipments.

The 3X2500A3 is a compact, air-cooled triode. Its coaxial construction results in minimum lead inductance, excellent circuit isolation, and convenience of use with coaxial plate and filament tank circuits. For AM service it is FCC rated for 5000 watts per tube as a high-level modulated amplifier. It has comparatively low plate-resistance, high transconductance, and will provide effective performance over a wide range of plate voltages at frequencies extending well into the VHF.

Reports from many engineers, like Mr. Dodd of WFAA-TV, confirm the outstanding transmitter performance, simplified maintenance, and low tube replacement cost made possible through the use of the Eimac 3X2500A3. Consider this unequalled triode for your applications . . . complete data are free for the asking.

ALMOST A YEAR AGO...

this ad first appeared. Today WFAA and Eimac are still proud of their 3X2500A3 performance. A few weeks ago the first tube was removed from service (7000 hrs.). The other three are still providing top-notch performance.

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA

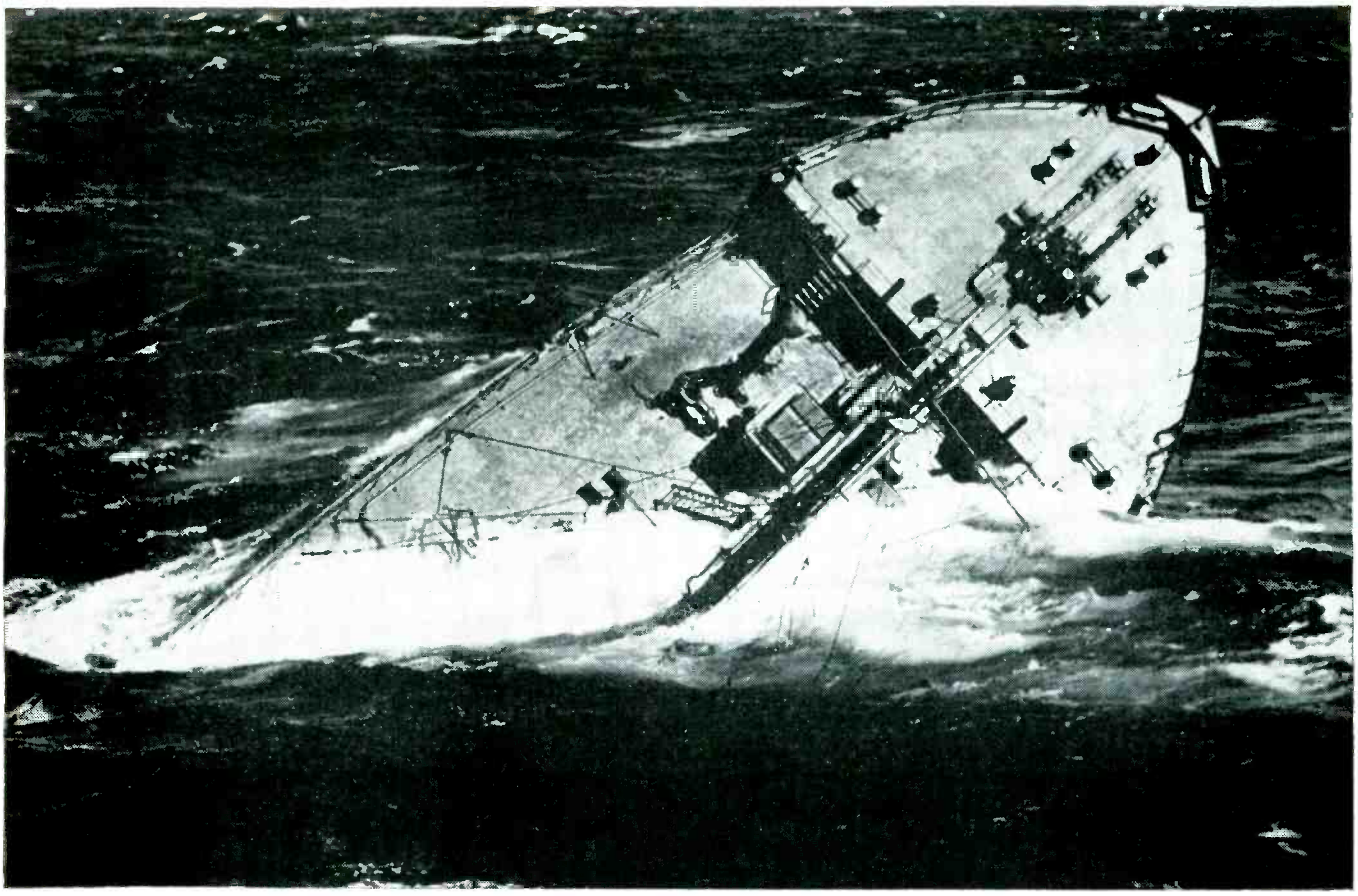
*COMPLETE DATA AVAILABLE FREE

Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

Follow the Leaders to Eimac Tubes — The Power for R-F

the 3X2500A3 is another Eimac contribution to electronic progress.

269



not so easy

now . . .

The all-out war against the submarine is an electronic war; and, thanks to significant progress, it's not so easy now for undersea prowlers to maraud the sea lanes.

Techniques in combating the deadly submarine have been made more effective by the design and development of greatly improved underwater detection equipment. We at Edo are proud of the important role we have played and are playing in this never-ending task to provide our Navy with the best devices possible to search for and locate enemy submarines.

In fact, the Edo Corporation has become a leader in the design, development, and manufacture of many new sonar equipments of far greater range, accuracy, and dependability than previously thought possible.

WHO IS EDO?

Twenty-five years of research, development, and manufacturing experience are behind Edo's work in the electronic field. Founded in 1925, the company first built seaplane floats, later expanded to the design and manufacture of marine aircraft, and built various aircraft components in great quantity during World War II. Now with this intimate knowledge of marine and aviation, has been combined top engineering and manufacturing talent in the field of electronics for the design and production of various types of underwater detection equipment.

For a complete picture of Edo's first quarter of a century send for your copy of Edo's 25th anniversary brochure by writing to the Edo Corporation, Dept. M-9, College Point, N.Y.

Edo

EDO CORPORATION · COLLEGE POINT, N. Y.

CONTROLS AND RESISTORS AT A GLANCE

CLAROSTAT

YOURS FOR THE ASKING

This new Clarostat chart shows you at a glance the correct resistor or control for your particular application. Photograph, detailed drawing, brief specifications and type designation, for each item. You'll find a reproduction of this chart in the 1951 Electronic Buyer's Guide. If you want one for your wall or desk, write us on your business letterhead.

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

AMP

SOLDERLESS WIRING DEVICES
for the electronics industry

SPECIAL SOLDERLESS PINS, PLUGS, CONTACTS, AND CONNECTORS

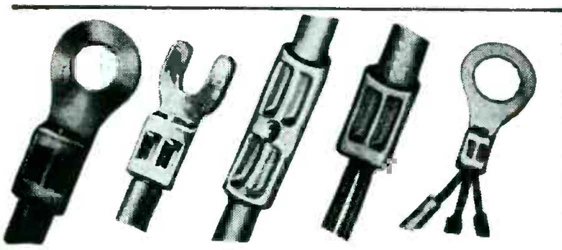
Eliminate unnecessary parts, speed production, and reduce costs by designing with AMP'S special connectors in mind. We stock many unusual items, and can make new ones for your particular needs. These terminals are all applied to wire at high speed (from 2,000 to 4,000 per hour) by special AMP Automatic Machines. (see below)

PRE-INSULATED DIAMOND GRIP
Trade-Mark
SOLDERLESS TERMINALS

No extra insulation sleeving necessary. One operation installs completely insulated, vibration-proof connection.

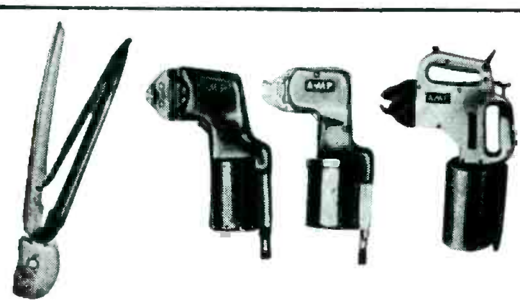
Plastic insulation of high dielectric properties is bonded to full-length copper sleeve—cannot slip or be removed. Min. breakdown voltage: 2500 volts D.C. in air at sea level. Will withstand high pressure crimp, temperatures at 350° F. for 10 hours without damage. Wire is supported to prevent fraying of wire insulation and torsional stress. Color-coded in wire size ranges from #22 to #10. Available in a variety of tongue shapes and connector styles.

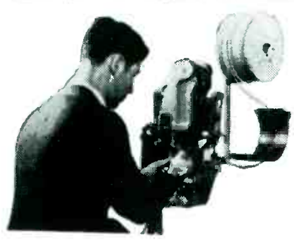
U. S. Patents #2,410,321; 2,379,567; 2,405,111; 2,468,169; other U. S. Patents Pending.

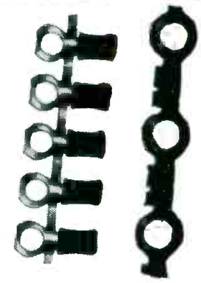


SOLISTRAND SOLDERLESS TERMINALS
Trade-Mark U. S. Patents Pending

Unique crimp makes this non-insulated terminal equally valuable for solid, stranded, square, or irregular shaped wire. Brazed seam. One piece construction of high conductivity pure copper, electro-tinned for corrosion resistance. Available in a wide variety of tongue shapes and connector styles from #22 to #4/0.





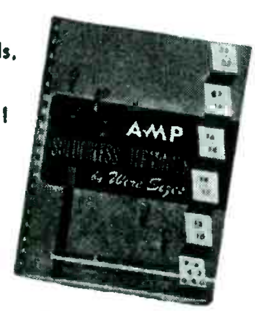


TOOLING

Whatever your production requirements, there is an AMP tool for the purpose. Strong, positive-action hand tools; light weight, compact pneumatic tools; bench presses; dies; hydraulic tools; and Automatic Machines. Terminals feed into AMP Automatic Machines in strip form to yield crimping rates up to 4,000 complete terminations per hour.

WRITE FOR COMPLETE "WIRE SIZE" CATALOG

98 page catalog lists
all AMP tools and terminals,
BY WIRE SIZE RANGES.
Send for your copy today!



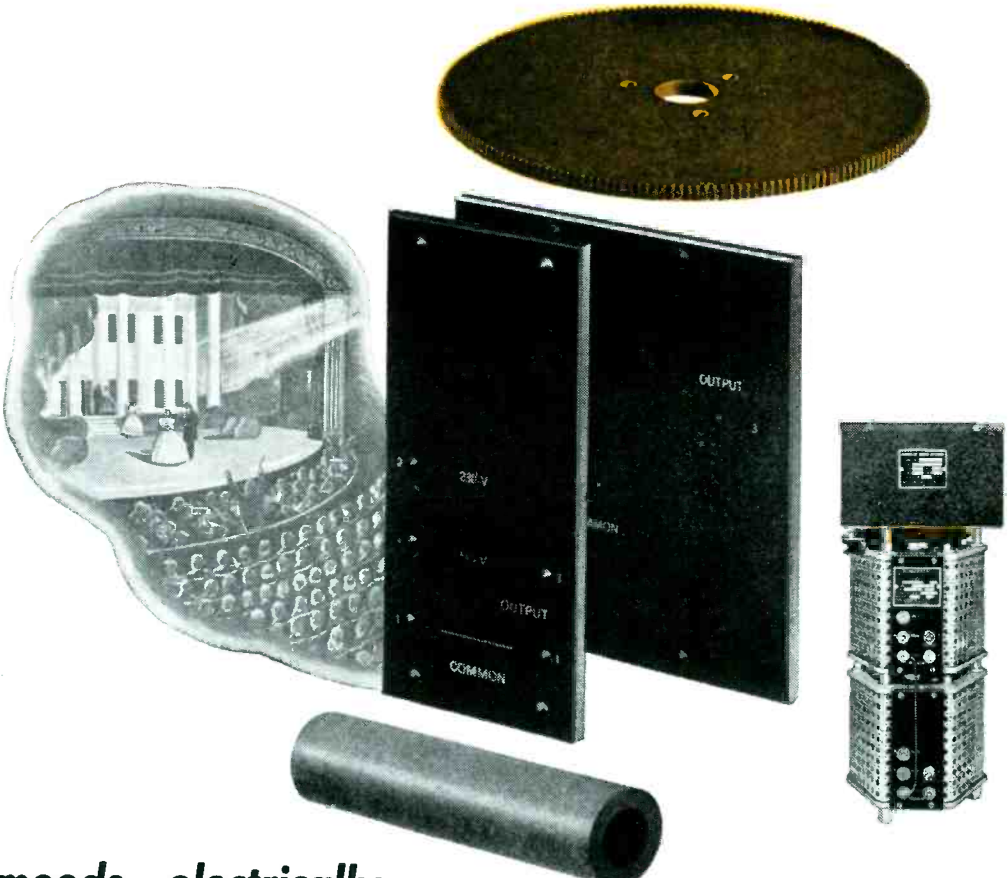
AMP

AIRCRAFT-MARINE PRODUCTS INC.

ELECTRONICS DIVISION

2100 Paxton Street, Harrisburg 10, Pa.

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



How to manage moods—electrically

The parts enlarged in the illustration above are a drive gear, a shaft, and panels used in the many types of Superior Electric Company *Powerstats*.

These parts have one characteristic in common. They are all made from Synthane, a laminated plastic.

Superior selected Synthane for its *combination* of properties. Synthane is dielectrically and mechanically strong, easy to machine, and is attractive in appearance. The panels are easily printed at a saving over engraving cost; the gear is silent.

A *Powerstat* is a manager of moods. Installed in the lighting systems of theatres, salons, banks, and other places of business and recreation, a *Powerstat* controls the intensity and blending of light to help create any mood from the spectacular to the subdued, from reverence to revelry.

Synthane is made in many grades, each particularly desirable for some electrical, chemical or mechanical purpose. Yet each grade possesses a *combination* of other valuable characteristics. Light weight, mechanical strength, resistance to moisture, corrosion and abrasion, high dielectric strength, low power factor, dimensional stability under a variety of conditions, and ease of fabrication are just a few of them.

Should these properties of Synthane suggest a possible application to you, write for more information. Synthane Corporation, 6 River Road, Oaks, Pennsylvania.

PLASTICS WHERE PLASTICS BELONG

SYNTHANE

S

Manufacturers of laminated plastics

ELECTRONICS

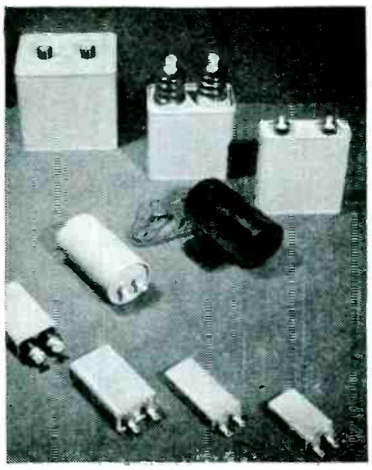
Designers

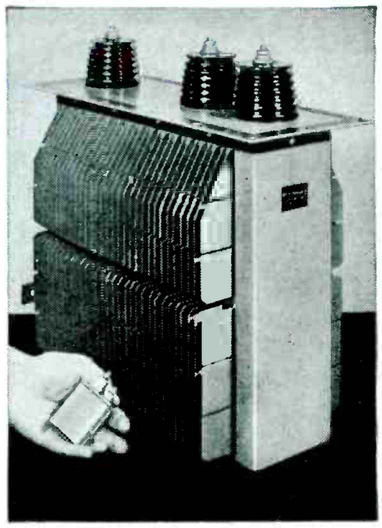
CAPACITORS, CAPACITOR NETWORKS
... Built to meet your needs

Here are a few of many G-E capacitors available to meet the needs of the industry's designers

A-C — D-C DUAL-RATED CAPACITORS

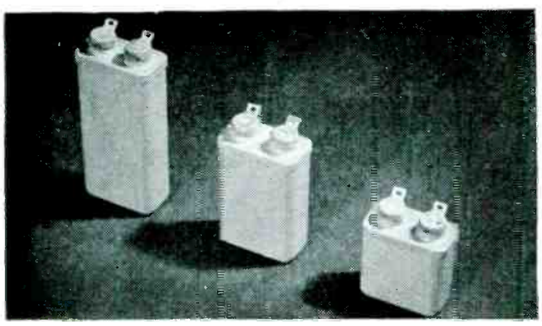
Because they can be used for both a-c and d-c applications, these Pyranol*-filled capacitors *simplify your design problems and reduce your inventories.* Dual-rated units are available in ratings from 236 through 660 volts a-c and 400 through 1500 volts d-c. Other Pyranol-filled units: 0.01 to 75 muf, ±10%—236 to 600 volts a-c and 400 to 100,000 volts d-c. More data available in Bulletin GEC-809.



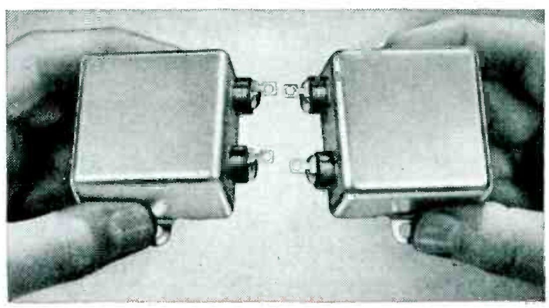


CAPACITOR PULSE NETWORKS

For use where normal (exponential) capacitor discharge shape is not suitable and where definite energy content and duration is required. Used in guided missiles, aircraft, and land and sea radar. They'll give reliable performance whether required service life is 10,000 hours or 60 seconds—over a temperature range of −55 C to +125 C. Unit consists of capacitor and coil sections sealed in single container. See Bulletin GEA-4996.



PERMAFIL CAPACITORS—These high-temperature capacitors can be operated continuously at 125 C without derating. Capacitance at 25 C will not change more than −10% at −55 C or +3% at +125 C. Designed to meet performance requirements of JAN-C-25 characteristic "E" capacitors. For more detailed information, ask for Bulletin GEC-811.

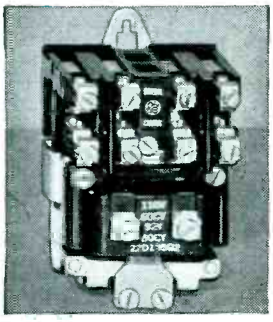


LOW-VOLTAGE, HIGH-CAPACITY UNITS—Cut space requirements in half. Yes, the *new* G-E 8-muf, 100-volt d-c capacitor on the left, above, is identical in size and weight to the old 4-muf unit on the right. The new design meets all "F" requirements of JAN-C-25 for 100-volt units. Available in 3-, 8-, and 10-muf capacities in Case Styles 53; and 4-muf capacity in Case Style 61. Other ratings can be built in mass-production quantities. For prompt attention, write, stating quantities involved, to *Capacitor Sales Division, General Electric Co., Hudson Falls, N. Y.*

GENERAL ELECTRIC

Digest

TIMELY HIGHLIGHTS ON G-E COMPONENTS



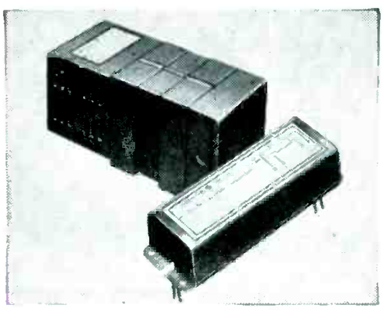
G-E RELAYS HAVE MANY ELECTRONIC EQUIPMENT APPLICATIONS

Because they're available in so many forms—with up to eight poles, and in any combination of normally open and normally closed contacts—these CR2810-A11 relays have many electronic-circuit applications. Tips can easily be changed from normally open to normally closed, without additional parts, to accommodate circuit modifications. They're rated to carry 10 amps a-c. Construction features are shown in Bulletin GEA-5154.

CURRENT-LIMITED HIGH-POTENTIAL TESTER—FOR GREATER SAFETY IN INSULATION TESTING

To minimize most of the hazards of high-potential testing, this G-E insulation tester limits output current to 5 milliamperes maximum, considerably below the "let go" level. As a result, you can use this hi-pot tester without the usual interlocks, cages, or safety barriers. Testing is non-destructive—flashovers cannot burn insulation or damage equipment. Weighing only 22 lbs., the unit can easily be carried between test locations. Range: 0 to 3500 volts RMS. Send for Bulletin GEC-700.

KEEP A STEADY 115 VOLTS WITH THESE STABILIZERS



Though line voltage may fluctuate anywhere between 95 to 130, a G-E voltage stabilizer will keep input to sensitive equipment at a steady 115 volts. By means of a special transformer circuit these units maintain this output within +1% for fixed, unity-power-factor loads. Fast response restores normal voltage within three cycles. Certain units—15, 25, and 50 va—are small enough (2 inches high by 9 inches long) to mount on radio or electronic instrument chassis. Other standard ratings to 5000 va are available for larger installation. Write for Bulletin GEA-3634.

EQUIPMENT FOR ELECTRONIC MANUFACTURERS

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

Components

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

Development and Production Equipment

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

*Reg. Trade-Mark of General Electric Co.

General Electric Company, Section A667-17
Schenectady 5, N. Y.

Please send me the following bulletins:

Indicate
(√) for reference only
(x) for planning and immediate project

( ) GEA-3634 Voltage stabilizers
( ) GEA-4996 Capacitor networks
( ) GEA-5154 CR2810-A11 Relays
( ) GEC-700 High-potential tester
( ) GEC-809 Dual-rated capacitors
( ) GEC-811 Permafil capacitors

Name ____________________

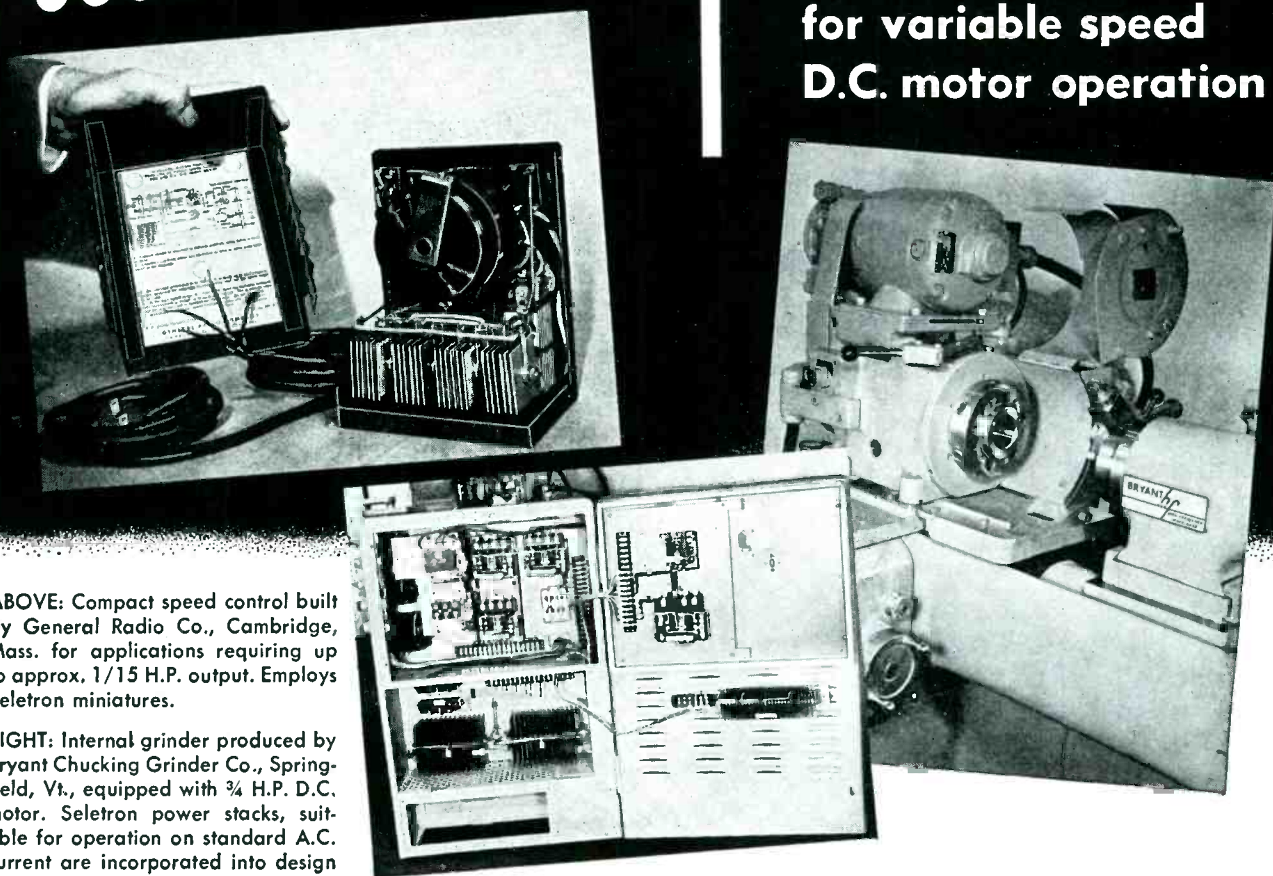
Company ____________________

Address ____________________

City ____________________ State ____________________

YOU ARE IN GOOD COMPANY...

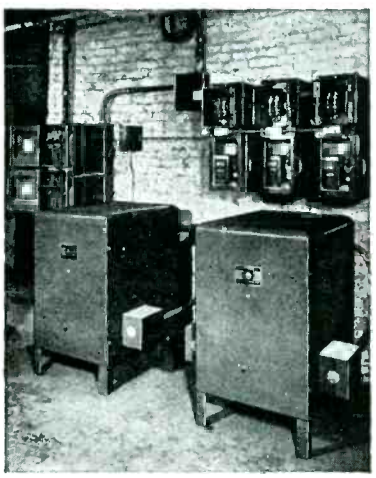
when SELETRON selenium rectifiers are "at the controls" for variable speed D.C. motor operation



ABOVE: Compact speed control built by General Radio Co., Cambridge, Mass. for applications requiring up to approx. 1/15 H.P. output. Employs Seletron miniatures.

RIGHT: Internal grinder produced by Bryant Chucking Grinder Co., Springfield, Vt., equipped with ¾ H.P. D.C. motor. Seletron power stacks, suitable for operation on standard A.C. current are incorporated into design of machine.

Seletron makes them ALL . . . *Large, Medium and Small!*



ABOVE: Elevator rectification — 3 bank power supply and regenerative braking equipment employing Seletron, built for Clinton Realty Co., Chicago, by Ther Electric & Machine Works.

There is a dependable SELETRON selenium rectifier for economical conversion of alternating current to D.C. for *all* requirements. SELETRON rectifiers have proved their efficiency and adaptability through the years in a wide range of industrial applications and electronic circuits.

Let SELETRON engineers help solve *your* rectification problems as they have for so many other ranking companies. Write now! Make sure to request a copy of our comprehensive bulletin No. 104-D-9.

Seletron

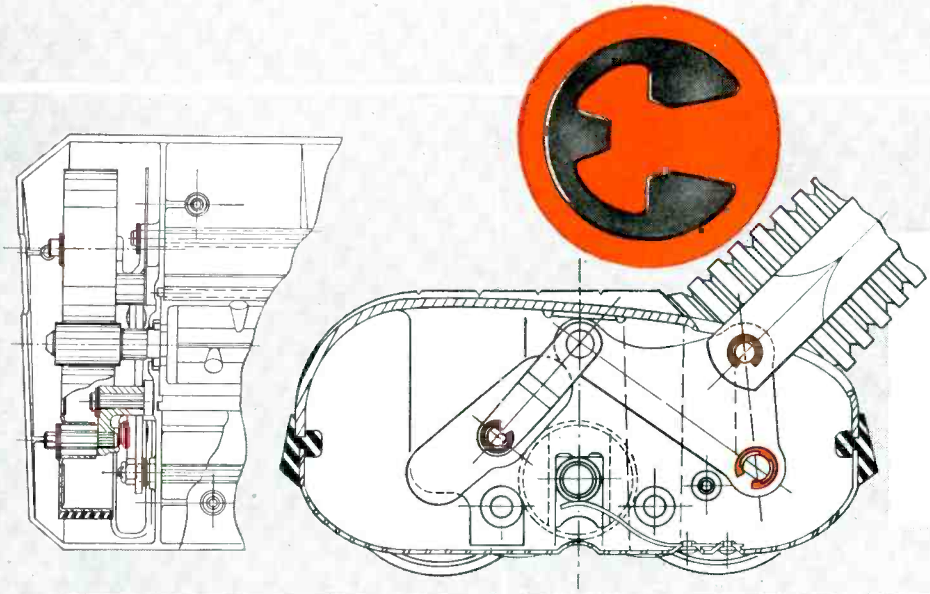
SELETRON DIVISION

RADIO RECEPTOR COMPANY, INC.

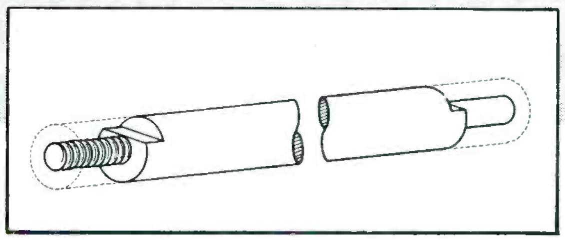
RR *Since 1922 in Radio and Electronics* RR

Sales Dept: 251 West 19th St., New York 11, N.Y. Factory: 84 North 9th St., Brooklyn 11, N.Y.

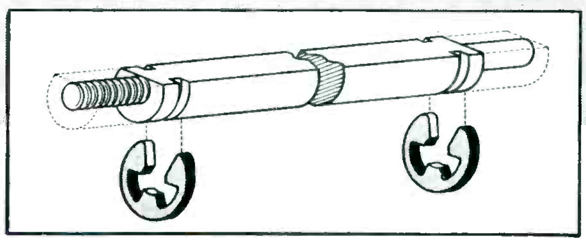
12 TRUARC RINGS SAVE 25% MATERIAL ...50% LABOR COSTS...50% ASSEMBLY TIME



With Waldes Truarc Retaining Rings, assembly in hard-to-reach places is easier, since there are no washers and bulky lock nuts. Smaller shafts can be used. Unit is smaller, lighter, more efficient!



CONVENTIONAL WAY: 2 round rods were required, milled down to D-shape. Difficulty of keeping flat surfaces in same plane caused rejects. Two separate threading operations to accommodate lock nuts.



TRUARC WAY: Truarc Rings allowed Lewyt Corporation to use two stock D-shape rods. No milling of shoulders. Simple screw machine operation cuts grooves for Truarc E-Rings, threads one end. Greater accuracy, fewer rejects.

Using 12 Waldes Truarc E Retaining Rings in their new "101" Vacuum Cleaner nozzle brought the Lewyt Corporation, Brooklyn, N. Y. tremendous material and labor savings . . . eliminated 2 milling and 12 threading operations . . . made possible the use of stock extruded D-shaped rods . . . simplified maintenance. And with Waldes Truarc Rings unit is 15% lighter . . . 10% smaller overall!

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

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

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

SEND FOR NEW BULLETINS

WALDES TRUARC RETAINING RINGS

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

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,948; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING.

Waldes Kohinoor, Inc., 47-16 Austel Place E093
Long Island City 1, N. Y.

Please send Bulletins 6, 7 and 8—giving engineering specifications for all types of Waldes Truarc Rings.

Name__________

Title__________

Company__________

Business Address__________

City______ Zone______ State______

678

BUSINESS BRIEFS

By W. W. MacDONALD

First Station License issued by the FCC for the new Disaster Communications Service went to KMAA2, covering the use of one fixed station, ten portable and four mobile units based on Police Department headquarters in Santa Cruz, California. Second license was issued to KOAA2, covering one fixed station, 19 portable and 28 mobile units to be used for Maricopa County civil defense under the direction of Paul A. Hodges of Phoenix, Arizona.

DCS uses the band 1,750 to 1,800 kc, covered by Part 20 of the Commission's rules and regulations. The service was established March 21, 1951 to provide radio communications during disaster or emergency periods such as floods, hurricanes, earthquakes and armed attack. Both government and nongovernment applicants, including amateurs, are eligible for licenses if the proposed service is part of a recognized local or regional disaster communications plan.

Four Companies active in the field have sold about 200 industrial television installations in the past two years with, according to our best estimate, some of the installations utilizing several cameras.

Industrial television equipment in use is probably worth somewhere in the neighborhood of one million dollars.

Britain is at present exporting radio, television and other electronic equipment at the rate of nearly 18 million pounds sterling per year. British radar, for example, is being installed on about one commercial ship per day.

Educational Institutions interested in using television to further their various ends and aims would, for the most part, prefer to cooperate with commercially owned stations rather than to operate their own. This, at any rate, is the opinion of Allen B. DuMont Labs following a survey covering 158 colleges and public-school systems in 46 states.

Some 41 percent said they intended to apply for noncommercial television station licenses if and when these became available on the ultra high frequencies. The others said they would use commercial facilities.

Atomic Energy Projects in the U. S. employ 90,500 people at this writing. Of these, 5,500 work for the government and the remaining 85,000 for prime contractors and subcontractors, according to Gordon Dean, chairman of the AEC.

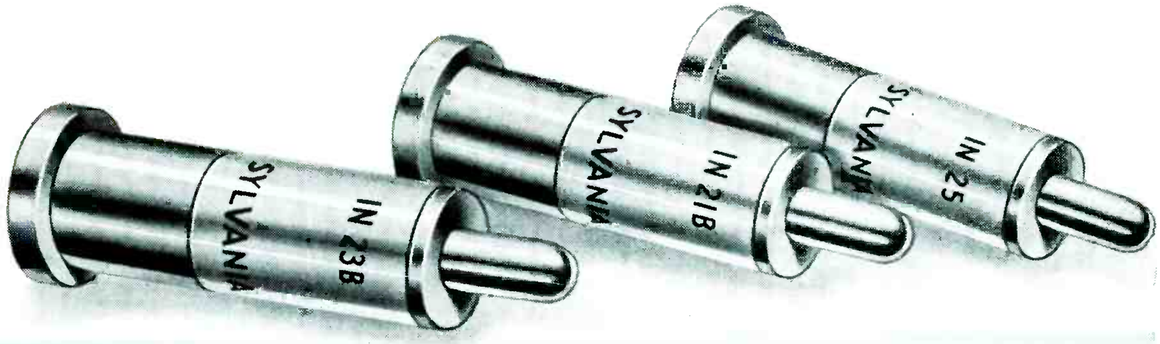
Conservation of Materials (p 84, April) is further advanced by the development of electronic-equipment transformer types using 25 percent less copper and silicon steel than conventional types. Nylon insulation on the wire and asbestos material between layers permits safe operation 25-degrees centigrade above normal, and is ok with Underwriters.

Philco, Chicago Transformer, Essex Wire and du Pont cooperated in the design.

We've Often Wondered how trouble-free large-scale electronic computers are. Here are some facts about the National Bureau of Standards' 800-tube SEAC:

The computer was scheduled to work 24 hours a day, 7 days a week during October, November and December 1950. In general, of each week's 168 hours 16 were reserved for preventive maintenance and 76 hours were allocated to engineering development and testing of new computer equipment. The remaining 76 hours were devoted to solution of problems.

For the entire three months, 76 percent of the total time assigned to problem solution was "good" time. Week by week during the



SYLVANIA PLUGS THE 16,000 MC GAP

with the new 1N78 Silicon Crystal Mixer

Sylvania adds another to the world's widest Silicon Crystal Mixer line – the 1N78 for 16,000 mc, one of the newest SHF bands. This new diode is the latest product of Sylvania's continuing exploration into frequency conversion in microwave regions.

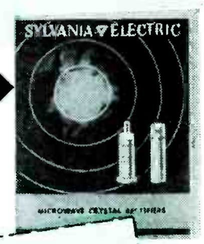
Better and better performance at existing frequency bands and new designs for tomorrow's frequencies are both to be expected of Sylvania's advanced research and long experience in Silicon Diode technology.

Sylvania also makes Silicon Crystal Video Detectors for use as microwave detectors in receivers of non-heterodyne type. Other Sylvania products engineered for radar and SHF receivers include magnetrons, TR tubes, ATR tubes and hydrogen thyratrons.

Sylvania Silicon Mixer Diodes

Type	Construction	Design Frequency (Approx.)
1N25	Cartridge	1000 mc.
1N21B	Cartridge	3000 mc.
1N23B	Cartridge	10,000 mc.
1N78	Coaxial	16,000 mc.
1N26	Coaxial	24,000 mc.
1N53	Coaxial Miniature	Above 30,000 mc.

Write for this 16-page book, "Microwave Crystal Rectifiers," including the new 1N78 characteristics and ratings.



Sylvania Electric Products Inc.
Dept. E-1009, Emporium, Pa.
Please send me the "Microwave Crystal Rectifiers" booklet, including data on the 1N78.

*Name*________________
*Company*________________
*Street*________________
*City*________ *Zone*____ *State*______

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC. 1901-1951 50th ANNIVERSARY FIVE DECADES OF PROGRESS

ELECTRONIC DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS period the reliability trend moved irregularly upward, with the figure reaching a high of 96 percent for the last week.

TV Head-End Tuners sold to set manufacturers in 1950 were valued at $66,000,000, according to our best estimate.

Jet Airplanes flying over Dayton, Ohio, emit a high-pitched whining sound, some of which appears to be up in the ultrasonic region. The sound opens the doors of some local garages equipped with electronic actuators operated by ultrasonic whistles in cars.

Marconi Wireless, of England, appears to have something in its 500-watt broadcast transmitters designed for unattended operation at sites remote from studios. When a fault develops they turn themselves off. Still more important, if several units are used in parallel, units that go sour are turned off but the others continue to function, providing continuous service at reduced power.

Orders for ten 2-kw models (four paralleled 500-watters) have been received from Italy. Sweden has ordered seven 2-kw combinations.

Certificates of Necessity permitting five-year amortization of the cost of new facilities, for tax purposes, where such new facilities are used in whole or in part for the performance of contracts important to the mobilization program, have been issued to many firms in our field.

Here is a list of the ones about which we have heard to date:

Company	Product	Eligible	Certified
Advance Electric	relays	$87,010	75%
Aermotive Equip.	control panels, testers	5,000	85
American Lava	resistor cores	712,140	80
Arma	computers	173,718	80
Blaw-Knox	radio-radar towers	50,900	95
Chatham Electronics	tubes	23,276	80
C. P. Clare	relays	545,000	75
Collins	radar	903,266	80
Driver-Harris	wire	759,051	70
Allen B. DuMont	electronic equipment	27,625	75
Electronic Assoc.	electronic inst.	8,709	85
Electrons, Inc	tubes	35,000	85
General Electric	electronic equip.	15,693,000	75
General Insulated	wire	17,085	75
E. I. Gutham	coils	57,825	75
Haydu	tubes	76,694	80
Hogan Labs.	electronic research	14,205	85
Hudson Wire	wire	368,700	80
Hytron	tubes	3,333,000	75
Landsdale Tube	tubes	4,088,390	75
Lavoie	electronic equipment	47,780	85

Lewyt.........: ..	communications equip.	2,894,783	75
Machlett..........	tubes	1555,000	80
Minneapolis-Honeywell	aircraft controls	2,316,618	75
Nat'l. Elec. Machine	electronic equipment	158,364	80
New York Trans....	transformers	50,000	75
Okonite-Callender...	wire	80,140	75
Polytechnic Research	testing	108,842	85
Progress...........	welding equip.....	14,214	100
Radio Receptor.....	electronic equipment	455,000	70
Raytheon..........	tubes	2,727,720	70–80
Reflectone....... ..	training devices	7,882	90
Resistance Products	resistors	25,110	80
Rex...............	wire insulation	400,000	75
Rome Cable........	cable	799,100	75
Sangamo...........	mica capacitors	348,307	75
P. J Schweitzer....	paper, insulation	457,168	50
J. P. Seeburg.......	radio-radar	127,239	85
Steel Products......	antenna system	1,714,052	75
Stewart-Warner....	electronic equip.	1,075,000	75
Sylvania...........	tubes	7,018,707	70–85
Technicraft........	electronic components	76,006	75
Titeflex............	radio-ignition	289,065	80
Transicoil..........	servo motors	137,285	90
Tung-Sol...........	tubes	60,600	90
U. S. Rubber.......	wire	108,864	75
U. S. Testing.......	testing	11,829	75
Varian............	tubes	2,445,933	80
Western Elec. Inst..	course indicators	556,193	80
Westinghouse......	tubes	12,010,000	75
Weston............	course indicator	1,500,000	80
Wickes............	electronic equip.	230,977	75

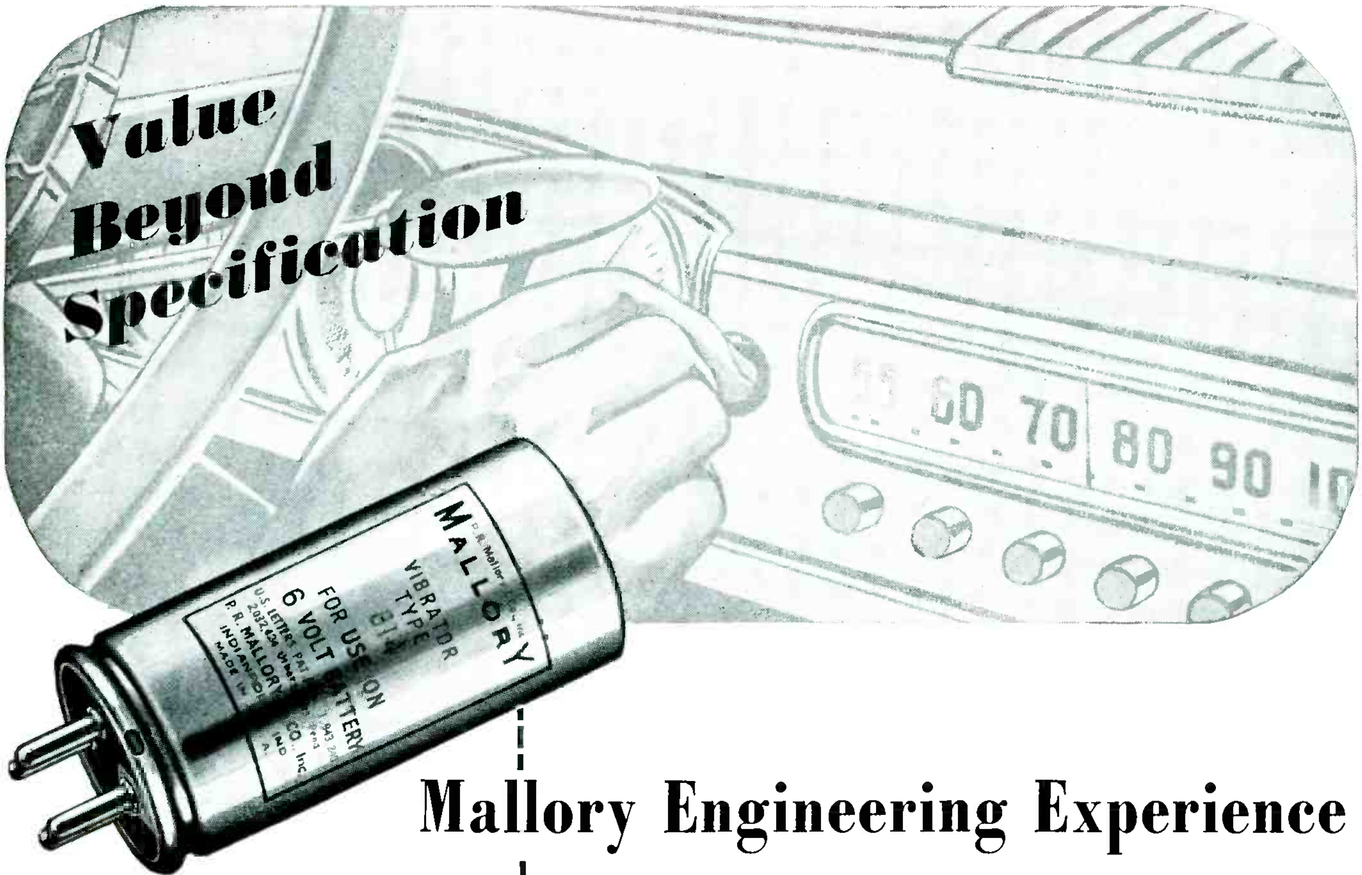
An Equation appearing in a recent issue of the *Journal of the Acoustical Society of America* would be 18 ¾-inches long if run on one line. It appears to be the general expression for "eigenfunctions."

We thought we had trouble!

Advertising Eagle-Eye Dept., Editorial Div.: *A condenser may be a capacitor to us but it is still a condenser to at least six copywriters. . . . . . Wildlife currently popular with illustrators includes the bear, the duck, the elephant and the penguin. . . . . The word spalling is not a mistake in spelling but means "chip or splinter". . . . . Bakelite's customers (not us!) still occasionally spell it with a lowercase "b". . . . . An asterisk placed up near an ad's headline should, we respectfully submit, always come home to roost somewhere farther along in the copy. . . . .A manufacturer in our field is located on Pratt Oval.*

Dutch Government has declined to grant a subsidy for television broadcasting in the Netherlands, apparently owing to the country's need to conserve cash at this time. Indefinitely postponed, therefore, is the plan of Philips Incandescent Lamp Works to convert its experimental tv programs into a commercial service.

Intriguing Names Department: Better Monkey Grip Company, Dallas, Texas.—*from one of our own field-staff reports.*



Mallory Engineering Experience

Solves Design Problem . . .
Saves Customer Money

MALLORY VIBRATORS

Mallory Vibrators are based on exclusive design and manufacturing methods that assure long, trouble-free service. Send the details of your application. Get Mallory's recommendation on the Vibrator or Vibrapack* power supply best suited to your needs.

Mallory contributes more than a fine product to the solution of a customer's problem. With the product comes the intelligent application of experienced engineering knowledge that cuts costs and eliminates delays.

For example, a large electrical manufacturer, designing a new automobile radio, was unable to match certain elements in the circuit. This company turned to Mallory for advice. The problem was solved quickly . . . with a redesigned transformer, a timing condenser and a Mallory Vibrator. Tests showed excellent results, and a great saving to the customer in engineering time.

That's value beyond specification!

Mallory electronic know-how is at your disposal. What Mallory has done for others can be done for you.

Vibrators and Vibrapack* Power Supplies

P. R. MALLORY & CO., Inc.

MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

SERVING INDUSTRY WITH

Electromechanical Products
Resistors *Switches*
TV Tuners *Vibrators*

Electrochemical Products
Capacitors *Rectifiers*
Mercury Dry Batteries

Metallurgical Products
Contacts *Special Metals*
Welding Materials

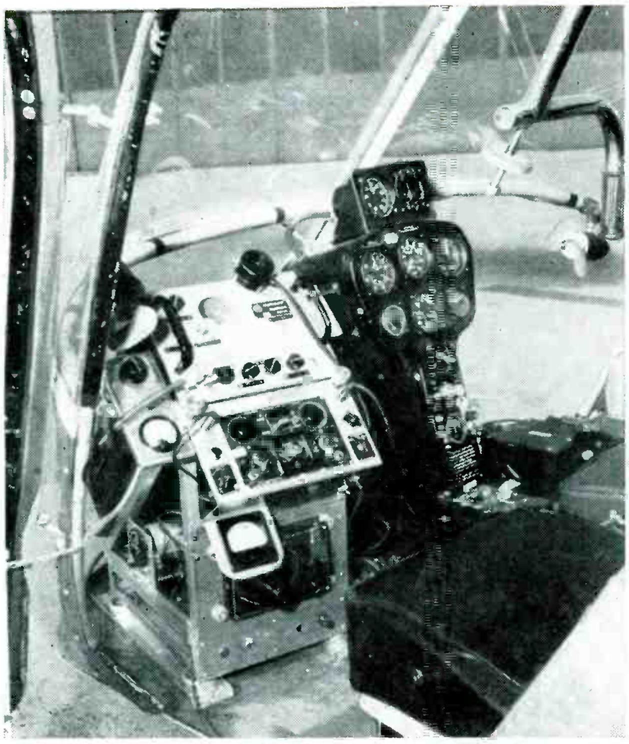
**Reg. U.S. Pat. Off.*

CROSS TALK

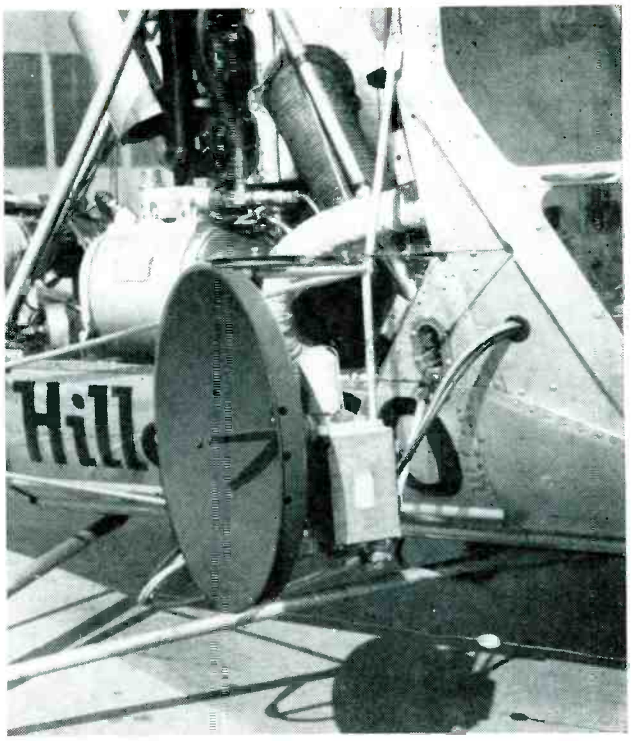
▶ **CHESS** . . . The ability of the new digital computer at the University of Manchester to play chess has been investigated at some length, and progress has been made in programming the machine for this purpose. Matters have gone so far, in fact, that a "transatlantic challenge chess match" between Manchester and Princeton University is in prospect, as soon as the new computer in Princeton is ready. If this hoped-for event comes off, we hope the moves are sent from one side of the ocean to the other in the clear, so ordinary mortals can kibitz. Should Princeton or Manchester make an obvious misplay, there will be a very great satisfaction in the detection thereof. The Manchester machine has 3,500 tubes, 12 c-r storage tubes, 100,000 soldered joints, 6 miles of wire and a power consumption of 27 kilowatts. It can also be beaten, regularly, by any human chess player in the master class, many of whom live largely on corn flakes, corresponding to not more than 100 watts, with no soldered connections whatever.

▶ **CREATIVITY** . . . At what age does a research worker perform his most creative work? This almost unanswerable question has an important bearing on the administration of development and research programs, the wellspring of our business. Everyone has heard the complaint of the executive engineer, who, enmeshed in paper work, longs for the old days when he was active in the lab. Since the engineer-turned-administrator seems to be getting younger every day, it is a fair question whether a lot of technical creativity is being poured down the drain by ill-considered promotions out of the lab and into the office. Shorty Engstrom, who as head of research at RCA's Princeton Laboratories knows whereof he speaks, told the Second Annual Conference on Industrial Research that the most revolutionary creative thoughts come to few research workers during their first decade of work. Rather, "the best original and creative work comes before the close of the *second* decade..." If this situation is true throughout our industry, it is certain that the answers to many of our most urgent research problems have been lost, traded in on a two-car garage. And, just as certainly, the trouble is the too-great disparity between the pay-scales for straight research work and administrative work. A little more birdseed for the goose might do wonders in the production of golden eggs.

▶ **FOG** . . . Returning to these shores last month aboard the *S. S. America*, we had the interesting experience of traveling three days through heavy fog, all at full speed ahead. When the mast head could be seen through the murk, there was the radar antenna writhing about, making it all possible. The Coast Guard tells us that the master of a vessel, if he wishes to be held blameless in a collision, must maintain such speed as to be able to stop within one half the distance of clear visibility ahead. This rule is much honored in the breach in mid-Atlantic; but even at that, without radar we would almost certainly have been a day late entering port. The *America* carries 1,095 passengers and the food is very good, worth at least seven dollars a day at wholesale prices, or a saving to the U. S. Lines of some $7,665 per day in food alone, thanks to radar. Not to mention certain intangibles, like being scared out of your wits, in among the fishing dories. As it was, we entered the berth just 10 minutes late, just like the airplanes. And nicely rested, thank you!



Operator's position shows modified radar receiver and radio-telephone set used for communication between planes



Close-up view of receiving antenna installation. Klystron at right rotates with antenna; only 30-mc i-f is piped to receiver

Siting Microwave Antennas

Two machines, one with transmitter and one with receiver, hover over proposed locations for microwave relay stations and determine optimum heights for antennas. System is also suggested for relaying secret military messages under combat conditions

By B. I. McCAFFREY

Project Engineer
PSC Applied Research
Toronto, Canada

THE ABILITY of helicopters to hover has led to their use in determining optimum locations for microwave relay antennas. In the system illustrated in the photographs, two helicopters are used, each hovering over the desired location at various heights. One machine carries a microwave transmitter which radiates horizontally towards the second in a 30-degree beam. The other carries receiving equipment whose antenna beamwidth is 8 degrees. The received signal is observed visually on a small cathode-ray tube and aurally in headphones. The visual indication permits determination of relative field strength and estimation of Fresnel patterns. The aural signal enables the pilot to maintain proper heading.

Communication between the participating helicopters is provided by a separate radio-telephone system. Quite often ground relay stations are used with the communications circuit to ensure consistent communication during tests.

Airborne Antennas

In helicopter flying, maximum efficiency while hovering is accomplished by heading the aircraft into the wind. In order to take advantage of this characteristic, it is necessary to provide 360-degree rotation of the antennas. The ability to rotate the antennas poses somewhat of a problem in aerodynamics and balancing, but this is solved by having two antennas available on each helicopter. Each antenna provides slightly greater than 180 degrees of rotation. The choice of radiator depends on the wind direction at the time of operation. The installation on the receiving helicopter is illustrated in the photographs.

Tentative sites having been chosen, it is often possible to supply a photograph of each location. Upon these, lines may be drawn between recognizable features to assist the pilot in choosing his heading. In the absence of photographs, maps or compass headings may be used. The pilot climbs to an altitude which will ensure adequate clearance, adjusts for a predetermined bearing, and by radio contact makes final settings to pick up the microwave signal. Both helicopters then

Airborne helicopter, showing location of receiving parabola on side. A similar antenna on the other side of the plane permits 360-degree azimuth coverage

By Helicopter

proceed to descend slowly until a grazing point is reached.

If a good profile is available one grazing point reading is sufficient, for only a check is needed. Lacking an elevation profile it is necessary to shift helicopter positions a number of times and by intersection to determine the location and relative height of the highest obstruction.

Experiments have shown that the signal-cutoff point is quite definite just as the beam falls below the grazing point. To take readings over any site takes only a few minutes.

Determining Height

The height of the helicopter at any instant may be read on a survey-type portable barometric altimeter. The aircraft is lowered to the ground, where the altimeter is set at zero. Thereafter heights may be read directly. Accuracy can be ±5 feet if a good instrument is used.

Where the area is covered by trees, the tree heights must be determined. Again this can be done photographically, or the operator can land in a convenient clearing and trek back to make measurements from the ground. A plumb line might also be dropped, but this should be of a light material (fishline) in case it should foul the rotors.

Choice of Frequency

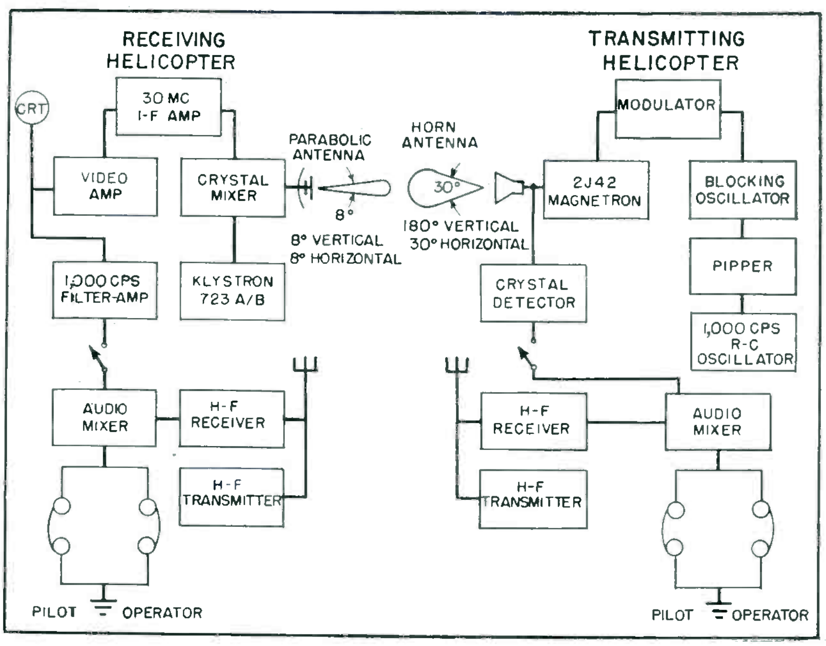
At first thought it might seem wise to use the frequency of the proposed link when making tests. Experience with the system has proved, however, that this is not necessary. In practice, a frequency of 9,375 mc (3.2 cm) is used. This choice was determined by several factors.

It was necessary to produce equipment in as short a time as possible. Microwave equipment for the link had to be installed within 10 months. It was not then in full production, and the quantity for the order had to be determined. Components for 3.2 cm were available on short notice, and the 3.2-cm gear could be smaller and lighter for the same antenna patterns.

Receiving Equipment

The block diagram shows the complete system. The microwave receiving equipment is a typical radar superhet circuit using a parabolic antenna, 723 A/B klystron local oscillator, 1N23A crystal mixer, a 30-mc i-f amplifier and one stage of video.

The receiving antenna is a 16-



Block diagram of complete microwave antenna siting system. Helicopters are equipped with auxiliary two-way radio to facilitate maneuvering inch parabola driven by a double dipole. The radiation pattern has a main lobe of 8 degrees in both horizontal and vertical planes. A small angle is required here, of course, since sharp cutoff of signal must occur when any obstruction appears in the line between aircraft. The close-up photograph of the receiving antenna shows the location of the klystron at the antenna. The simple method of tuning reflex klystrons by variation of reflector voltage makes this possible and obviates the need for waveguide to carry the received energy into the cockpit. The mixer is contained in the box directly below the klystron so that only the 30-mc i-f signals need be carried by cable to the operator's position. A small amount of preamplification is used to improve the signal-to-noise ratio and to provide matching to the output coax.

Tuning is performed at the operator's position by varying the klystron reflector voltage. Only slight adjustments are needed during the first few minutes required for equipment warm-up.

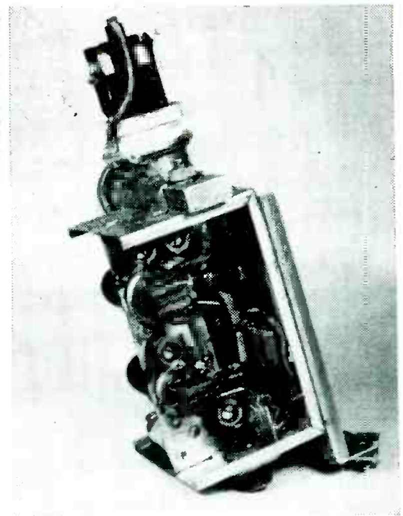
The receiver output pulses are observed on the two-inch crt shown. Since the relative amplitudes of signals are the important detail, no sweep is provided and the pattern appears merely as a bright vertical line. By concentrating the pattern into a single line, the picture is bright and more easily visible. Satisfactory deflection of the trace is realized at the extreme range since the video output runs as high as 100 volts.

Since it is the pilot's duty to decide on the best heading for the aircraft the control for the antenna has been located within his reach. The best azimuth for the antenna is chosen by adjusting for peak signal as heard in his headphones. To obtain sufficient energy to drive headphones from a source of 0.25-microsecond pulses and at the same time eliminate spurious noise, output from the video stage is passed through a 1,000-cycle filter-amplifier.

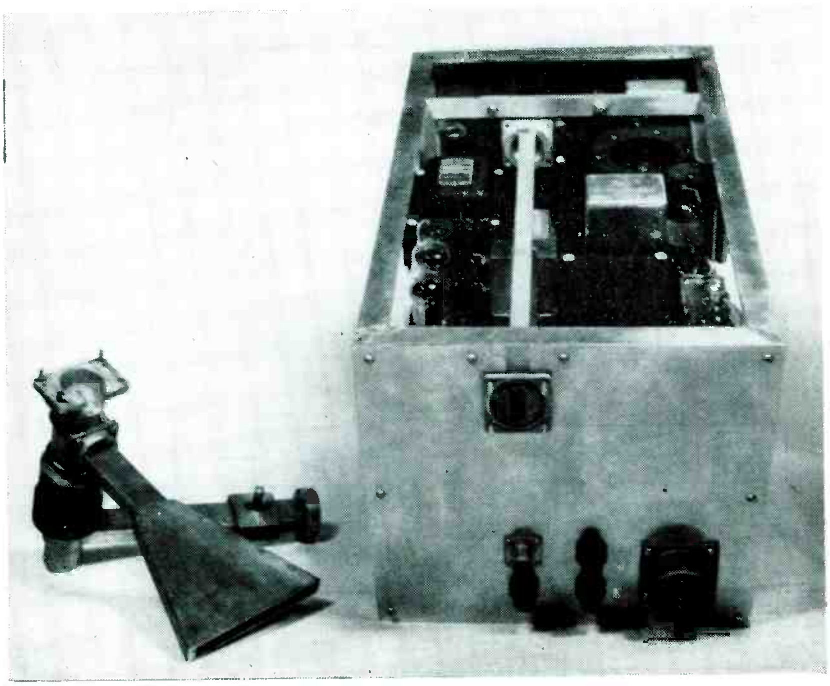
For convenience in operating, the resulting 1,000-cycle sine waves are mixed with the communication signals before reaching the earphones. Both pilot and operator are then familiar at all times with the conditions and a minimum of talking back and forth inside the helicopter is necessary.

Transmitter

The microwave transmitter is a small 2J42 magnetron delivering 7.5 kw peak power to a horn antenna. The radiation pattern of the horn is 30 deg horizontally and 180 deg vertically. It was not considered advisable to restrict the transmitted signal to too tight a beam since some difficulty was expected to be met in the field when aligning receiving and transmitting antenna at extreme range. The pilot of the transmitter helicopter does not have a signal on which to tune for maximum as does the pilot in the receiver ship and must rely on a rough compass bearing to assist him in directing the beam towards the listening operator. On the other hand a reasonably tight beam is required to prevent reflections from off-course surfaces from reaching the receiving site.



Klystron-mixer assembly removed from back of receiving antenna. Crystal mixer is located under knurled cap at top of waveguide near klystron



Microwave horn antenna and transmitter. Transmitter box contains magnetron, modulator and power supply

Military Application

It is interesting to note that the system described here may be adapted to military field communications problems, especially where enemy jamming is a hazard. Whenever messages are to be handled quickly, all the advantages of the telephone for direct communication may be realized by simply arranging via ground stations to have a pair of helicopters proceed aloft. Either f-m, a-m or pulsed-time modulation could be employed to carry confidential conversations reliably between ground units of a swiftly moving army which has no time to set up wire lines. By using very tight beams with the smallest possible side lobes, interception as well as jamming by the enemy would be eliminated.

Test patterns and program images (405 lines, 144 fields) transmitted over CBS monitor circuit, left to right: 10-mc circuit, 4-mc circuit without crispening, and 4-mc with crispening

CRISPENING CIRCUIT for COLOR TV

Designed by CBS engineers for field-sequential color television, the "crispening" technique sharpens the vertical edges of extended objects by combining the video waveform and its derivative, modified in non-linear fashion. Circuit for receivers uses two tubes and two crystal diodes

During the FCC hearings on color television, Dr. Peter C. Goldmark described in general terms a new circuit, known as the "crispening" circuit, which had been designed for use with the field-sequential system of color television. In connection with the inauguration of color television service last June, details of the crispening circuit were released for the information of those interested in the design of color television transmission circuits and receivers.

The new circuit is intended to improve the apparent resolution of a television image by increasing the rapidity of response of the video transmission circuit, that is, by decreasing the time-of-rise of the leading and trailing edges of long pulse waveforms passing through the system. Such leading and trailing edges are produced when the

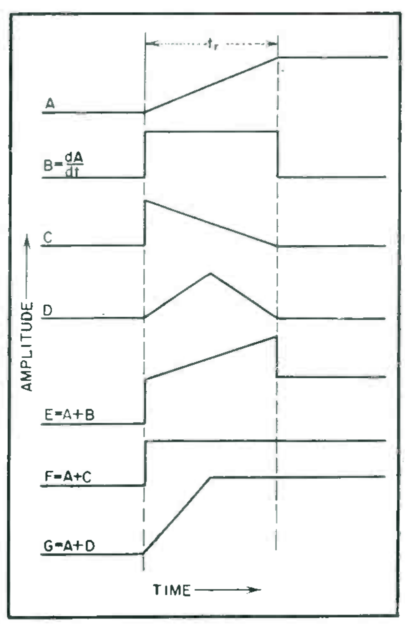


FIG. 1—Curves illustrate the action of the crispening circuit. Curve G shows "crispened" response

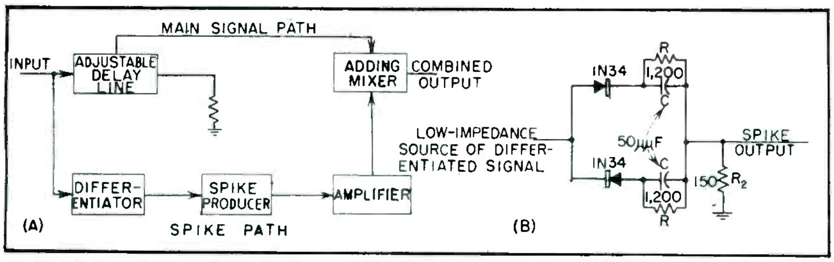


FIG. 2—Block diagram of crispening circuit (A) and details of spike producer (B)

scanning spot at the camera passes across a boundary between a dark and light area, as for example the vertical edge of any extended object. By decreasing the time of rise at the output of the crispening circuit, relative to that at the input, the corresponding edges in the reproduced image may be made to appear more sharply defined.

The usual method of increasing the sharpness of television images is to make the fullest possible use of the available video bandwidth, by the use of peaking circuits in video amplifiers, video preemphasis, and correction of aperture distortion. All of these techniques are used in field-sequential color tv but, because of the comparatively high picture-repetition rate (2.4 times that of the black-and-white system), the resolution available, even when full use is made of the band, is limited.

The crispening circuit is a technique for improving the resolution, by sharpening the edges of extended objects, without increasing the bandwidth. The improvement is roughly equivalent to that which would be obtained by doubling the bandwidth. However, the improvement is confined to the edges of extended objects; no improvement is obtained in resolving small objects, of a size corresponding to the maximum video frequency actually transmitted, and this limitation also applies to adjacent small objects, such as fine vertical lines which appear in test charts and fabrics.

Crispening Principle

The basic principle of the crispening circuit is shown in Fig. 1. Curve *A* shows an idealized step-response video waveform, arising from scanning across the edge of an object. The time of rise, t_r, corresponds to the upper limit of the video band passed by the transmission system between camera and picture tube. If this wave is passed through an ideal differentiating circuit series capacitor and shunt resistor), the wave shown at *B* may be produced. This is the derivative of the original waveform.

The derivative wave may be modified in various ways, such as the single slope right-triangular wave *C* or the isosceles-triangular wave in *D*. If the derivative or one of its modified forms is then added to the original waveform, the resultant waves *E*, *F*, and *G* appear, all of which have leading edges steeper than that of the original. Form *E* does not have the desired shape. Form *F* is theoretically possible, but requires highly complicated circuitry. The combination of *A* and *D* shown as wave *G* represents the practical operation of the crispening circuit. The modified derivative *D* is known as the "spike", and the resultant waveform *G* can be made to have a time of rise approximately half that of the initial wave *A*.

Figure 2 illustrates the circuit which produces the desired result. The input wave is passed along two paths, a main signal path containing an adjustable delay network, and a spike-producing path. The latter consists of a differentiator which produces the waveform of Fig. 1B, and a spike producer which modifies the derivative to the form of Fig. 1D. The spike is then amplified and combined with the delayed main signal in an additive mixing amplifier, producing the result of Fig. 1G.

Details of the spike producer appear in Fig. 2B. The differentiated signal, arising in a low-impedance source, is passed to two germanium crystal diodes which present opposite polarities to the signal. The two polarities are required to permit handling both negative-going and positive-going transitions. The spike appears across resistor R_2, its amplitude and duration depending on this resistance as well as the values *R* and *C* in the diode paths. Since the spike has edges which are sharper than that of the main signal, the amplified signal which follows the spike producer must have

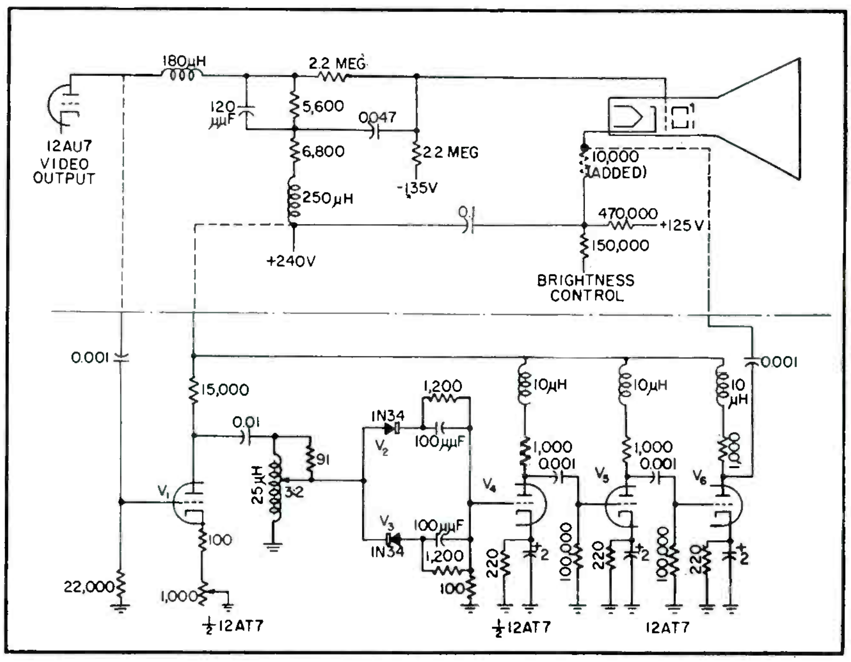


FIG. 3—Crispening circuit designed for use in color-tv receivers. The video waveform is applied to the picture tube grid, the spike to its cathode

a correspondingly wide bandwidth, as must the mixing amplifier in which it is combined with the main signal.

Practical Circuits

The circuit details are not so simple as the foregoing description might indicate, largely because it is necessary to avoid overshoots in the resultant waveform. This can occur if the spike is wider than the original transition. The diodes reduce the effective width of the spike by introducing a nonlinear (approximately square-law) transfer characteristic. But the correct result then occurs only for one amplitude of the spike. Correct spike width over a range of amplitudes can be achieved by feeding the diodes from a low-impedance source and using an R-C load circuit of proper time constant with each diode.

A practical crispening circuit suitable for domestic field-sequential television receivers is shown in Fig. 3. The elements above the centerline are conventional. The crispener, below, consists first of a triode differentiator. The required low-impedance output of this stage is provided by the step-down transformer. This feeds the double-diode spike-producer, like that shown in Fig. 2B. Then follows a three-stage wideband video amplifier (typically, flat within 1 db to 8 mc). The amplified spike is then fed to the cathode of the picture tube, in the proper polarity to combine with the main signal applied to the grid of the picture tube. The control in the cathode of the differentiator serves to control the amplitude of the spike. If the delay in the main signal path does not match that in the spike-producing path, the compensation circuit of the video output stage may be transformed into a filter having the required delay.

A more elaborate circuit, shown in Fig. 4, is intended for use at the end of coaxial cable network circuit, having a nominal upper cutoff of 2.75 mc. It operates between 75-ohm terminations, 1.4 volt peak-to-peak, at input and output (no net gain). The principal differences between this circuit and the receiver-type unit are provision of adjustable delay in the main signal path, and an extra stage (V_5 6AH6) preceding the triode differentiator. This stage, operating in conjunction with three additional germanium diodes and a voltage-regulator tube, serves as a clipper to remove the synchronizing signals from the composite waveform before production of the spikes. The clipping level is set by the control in the cathode of this stage.

Figure 5 shows typical results achieved with the crispening circuit in the form of oscillograms of video signals with and without benefit of the crispening action. At the top are shown negative-going and positive-going unit steps of high amplitude. It will be noted that the crispened waveforms have times of rise or fall about twice as rapid as the initial wave, and that a slightly higher degree of overshoot occurs in the crispened cases. Below is shown a similar case with somewhat smaller amplitude. In this case the overshoot is not prominent. Finally, at the center of Fig. 5 are shown pulse waveforms, the equivalent of positive and negative unit steps in rapid succession. It will be noted that the crispening action is successful even with pulses of this type, provided only that the leading and trailing edges do not follow so closely that the initial waveform has no flat top.

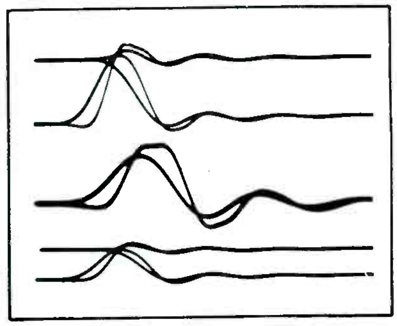


FIG. 5—Oscillograms showing increased steepness of isolated transitions (positive and negative) due to crispening technique

The accompanying photographs of test patterns and images show the comparative effect of a wide-band (10-mc) transmission system and the crispening circuit with 4-mc transmission, both compared with images (in the center in each case) transmitted over a 4-mc path without crispening.

Further details on the theory and practice of this circuit are to appear in a paper by Dr. Goldmark and John M. Hollywood, scheduled to appear in the October or November, 1951 issue of the *Proceedings of the IRE*.—D.G.F.

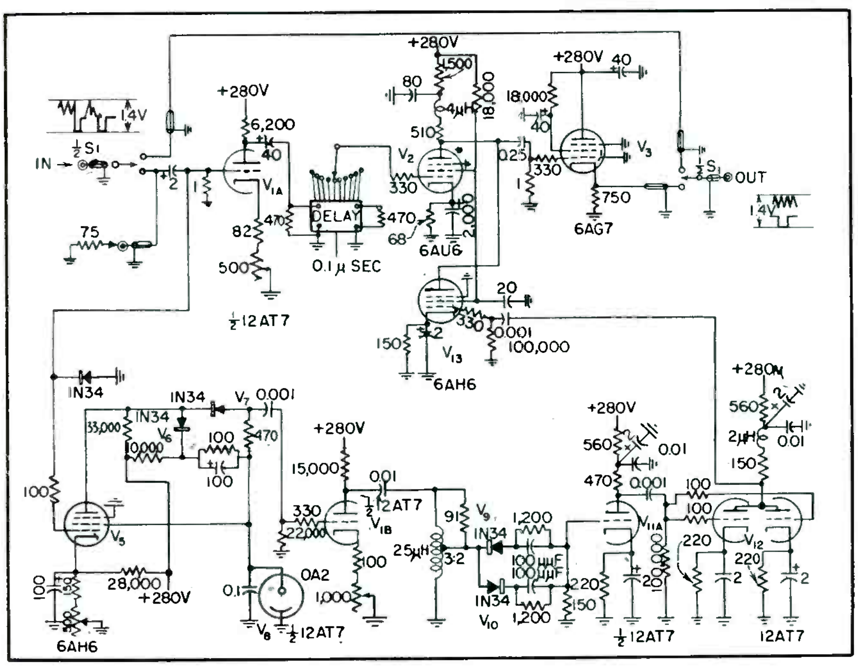


FIG. 4—More elaborate form of circuit intended for coaxial cable circuits and elsewhere in the chain between color camera and transmitter

How to Produce GOOD

Detailed qualifications to serve as a practical guide for finding the Mr. X who will head the technical manual crew, and breakdown of his program for producing a technical manual that goes beyond minimum requirements of military specifications. Project engineers shouldn't do the heavy writing; their knowledge is a handicap

THERE ARE many ways to prepare technical manuals for military electronic equipment. One has only to solicit the opinions of men and organizations that have successfully done such work to realize how many different methods have been used. Some methods are diametrically opposed, others differ in detail; few are similar. The end product has similarly exhibited a wide variance in quality.

The ideas to be presented here constitute an organized production procedure with specific methods, goals and responsibility, and include the elements essential to a good finished product. Producing technical manuals is a matter of grave importance and must not be allowed to follow haphazard methods.

It is assumed that the organization of the technical manual department will resemble that outlined in an earlier article, "How To Set Up An Instruction Manual Department," ELECTRONICS, June 1951, p 100. In that article, a Mr. X was identified as the man charged with the responsibility of producing the manual and of doing the heavy writing. His qualifications and personal duties were touched upon only lightly. Since he is the central force, those factors are most important and will be described in more detail here. The purpose of this second article is to clarify the picture of the type of man needed and how he functions.

Qualifications of Mr. X

In selecting the man to act as manager, supervisor, group leader or engineer in charge of the technical manual crew, bear in mind that he should have only the responsibility of producing manuals.

The technical ability of Mr. X should be on a plane with that of a project engineer. In other words, he should be a man capable of doing engineering and design work on the type of equipment involved. He could, in fact, be obtained from the engineering department. The things to look for are ability to express himself well, a better-than-average ability to absorb technical information, a natural flare for drafting and the reputation for maintaining neat, clear and informative engineering notes.

The man you select should have some writing experience, or at least show a decided interest in writing. The personnel section may be able to devise some form of test to investigate that point, requiring, for example, that he describe on paper how to build some simple object or give a detailed description of some common article. Much can be learned from a test of this sort if it is administered properly.

It is essential that Mr. X be capable of drafting, at least in its simpler forms. He must be able to do layout work, freehand mechanical and electrical sketches and be able to interpret all forms of drawings intelligently. Without these qualities he will be at a loss to do his technical manual job since the illustration of the book is as important as the writing. If he has artistic talent, he is even better qualified because he can do a better job of expressing art requirements, can make suggestions in the form of sketches, and can approve intelligently the art work prepared for the manual.

It is desirable that Mr. X have some technical experience principally in the field of service or repair work. This will place him in a better position to appreciate the kind of technical information needed by men in the field. In lieu of this, active radio amateur experience is excellent. The average amateur makes radio his hobby because of a natural interest, and in the pursuit of that hobby learns to build, repair, test and improvise.

In reviewing the qualifications, they may seem a unique combination not to be expected in more than a very few men. Almost every professional man, however, has talents or interests which extend beyond his profession. A recheck of the requirements will show that a part of them are to be expected in a good engineer; the balance explains why all engineers cannot be technical manual producers.

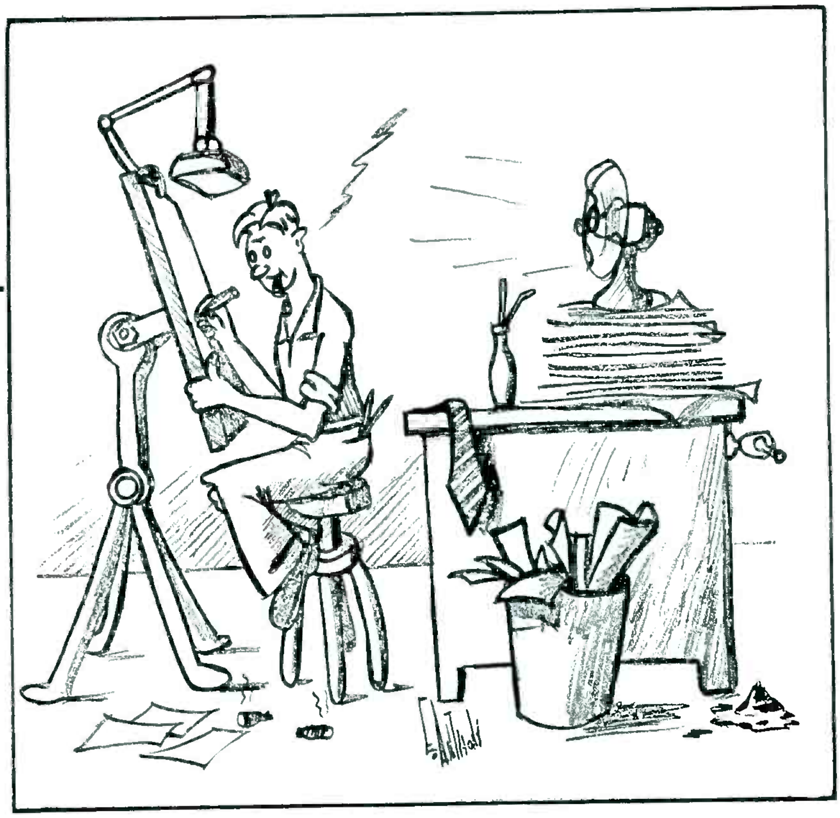
Why Not a Project Engineer?

When Mr. X is assigned to produce a technical manual for a given piece of equipment, it is generally true that his knowledge of it is at best only cursory. Often he knows nothing more than its formal name and model number. This situation is commonly interpreted as undesirable and is used as the justification to assign the writing job to project engineers.

As a matter of fact, the situation is not undesirable, but rather represents a distinct advantage. Mr. X is completely free of experiences connected with the metamorphosis of the equipment and is primarily interested only in its final form. If he has the engineering qualifications mentioned earlier, he can learn every essential fact related to it. *That very process is the one he must duplicate in his manual.* He cannot help but record, mentally

INSTRUCTION MANUALS

By EUGENE ANTHONY
Product Service Manager
General Electric Supply Corp.
New York, N. Y.



The complete over-all schematic diagram of the equipment is the most important part of an instruction manual, and as such deserves the undivided attention of the most skilled manual man. This is a job for Mr. X himself

at least, the individual steps in his investigation which, in logical sequence, provided him with a full understanding of the functions and physical characteristics of the equipment. He knows what phases proved confusing and which idea clicked into place at the right time.

The value of this relationship is pointed up by one of the common shortcomings of text prepared by project engineers. Most often, the facts prove confusing and do not pull together until an advanced stage of the material is reached. Then, many check-back references are needed to fit the pieces together. The reason is, no doubt, that it is rather difficult for a project engineer to assume the position of a person totally ignorant of the equipment. The project engineer already has an intimate knowledge of the equipment, and this is invariably a serious handicap in organizing and writing a clear and logical step-by-step presentation for a manual reader who knows little or nothing about the equipment.

Through his role as producer of the technical manual, Mr. X can retain his "I don't know it until you show me" attitude. Every diagram he inspects benefits from this point of view.

Mr. X's Program

Upon being assigned to a specific piece of equipment, one of Mr. X's first acts will be to determine which instruction book specifications are called for in the contract. If he is not already familiar with them, he will study them carefully to determine what the minimum requirements are. This will probably take a day or two, during which time he may make pencil notes in the specification book and/or separate notes on cards or slips of paper. He will start thinking in terms of which assistants can do what job.

His next step will be to get his assistants into productive motion. It is not within the scope of this article to describe those duties, but they include such items as:

(a) Collecting drawings related to the equipment
(b) Photography up to the finished product
(c) Stock drawings (such as socket voltages and tube layouts)
(d) Preparation of stock tables and procedures
(e) Compiling parts list
(f) Actual service test work (proving-out data)
(g) Preparing waveform drawings
(h) Cabling drawings
(i) Installation drawings

The above will keep several assistants productively and continuously employed in preparing material for the end product. During that time, Mr. X may assist them with suggestions and criticism and direct their work in other ways. He may, for example, set aside one hour per day to check the progress of his assistants.

Having dispatched his assistants, Mr. X can settle down to his heavy work. This can divide into four distinct phases. In presenting these below, a representative type of equipment is assumed in order to make possible a rough estimate of time required for each phase. The actual time required will obviously vary with the equipment under consideration. In the assumed case, for a highly complex electronic system such as a complete loran station, Mr. X might break down his schedule to these phases:

(a) Complete-story drawings — 6 weeks
  (1) Overall schematic — 3 weeks total time producing

pencil sketch for draftsman
  (2) Block diagrams — 3 weeks
- (b) Technical writing—5 weeks
- (c) Coordinating the work of others to final manuscript—10 weeks
- (d) Preparation for printing layout and final details—4 weeks

It might be well to note that, toward the end of this project, and principally during the last 4 to 5 weeks, Mr. X can start laying the groundwork for his next project.

The Over-All Schematic

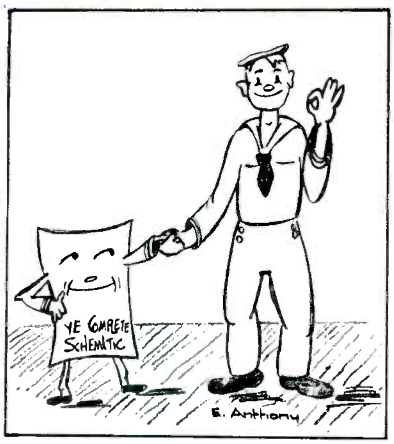
It may seem that excessive time (3 weeks) is assigned to the complete circuit drawing, but that is not true. Undoubtedly, the most important part of the manual is the complete schematic. Any maintenance man would save that one page if he were forced to decide on one. From his point of view, the manual is written around that drawing. A most serious mistake is to treat the schematic as one of many routine drawings. It should be given the weight it actually attains in the eyes of the ultimate manual user.

Mr. X should have a large drawing board in his office to do this work, together with all necessary drafting equipment. He should then proceed to make one single schematic circuit diagram *of the entire equipment*. This requires the combining of all individual drawings originally prepared by the engineers.

It might be well to comment, parenthetically, on the probable reaction to the idea of Mr. X doing this job. Why not a draftsman?

The answer is that the drawing, as explained earlier, is the most important single item in the manual. As such, it should be given the most skilled and responsible attention available. In addition, it serves a second important purpose; the very process of preparing a complete comprehensive drawing is an education in itself. The several weeks spent doing the job provide Mr. X with the groundwork for the future work on the manual.

The first stage in preparing the drawing is the freehand sketching of a single schematic of the entire equipment. The finished drawing is



If forced to choose just one page from a manual, the military maintenance man will invariably take the complete schematic. This diagram generally requires at least two personal redrawings by Mr. X to present the pertinent electrical data as clearly as possible

generally a most disappointing, dirty and confusing job. It may even be in sections which have been taped together in an arrangement that has possibilities.

Having completed this first sketch, most major improvements in layout become evident. The object, of course, is to produce a drawing based on electrical continuity rather than physical location of components. As an example, Fig. 1 illustrates one basic idea in simplifying circuit tracing. In this case the components involved are physically located in three different units and are connected through terminal boards and cables. In rearranging for the over-all schematic, the electrical data is retained relative to terminals, while symbol numbers convey the information relative to their physical location.

As a further example toward simplification, all parallel or series resistors may be shown as single resistors bearing the numbers of the individual resistors and showing total resistance. Thus, a string of three 5,000-ohm resistors bearing symbol numbers R301, R316 and R317 can be shown as a single resistor with the number R301, 16-17 and a value of 15K.

At this point Mr. X has a fair idea of the probable size of the drawing and can decide on an aspect ratio which suits the drawing and conforms with the specification. It is most important to decide now upon that ratio because full utilization of the area will produce the most efficient use of the space, permitting the least crowding.

A second full drawing is made, again freehand, this time relocating components and rerunning leads so as to give a most direct schematic which is easily traced. Cross-overs are avoided where possible; circuits are kept in logical step-by-step order. For clarity, double-section tubes are split apart since this almost always produces a clearer drawing.

The drawing may reach its final sequence in this stage or may be resketched several more times; in any event the object is to come up with a clear free-hand layout, neatly spaced and with ample room for lettered data. This layout is then expanded in content by the identification of all significant feed wires, connectors, tube functions, control and adjuster titles, and similar data. This information is developed through discussion with the project engineers. By this time, Mr. X has a fairly good speaking acquaintance with the circuit. As an example toward helping the maintenance man, all control labelling is made to conform with actual panel engraving. The engineers may have their own pet titles on their drawings; unless these are changed, confusion results and the opportunity is missed to make things clearer.

Once this stage is completed, the rough sketch can be given to a professional draftsman to make a neat mechanical drawing. It should conform to standards provided for drafting by Mr. X. This includes such items as tube circle diameters and the physical sizes of coils, resistors, capacitors and other parts.

Lettering the Schematic

Mr. X will probably choose to inspect progress of the drawing from time to time. It is best to have it completed without lettering. A print is then made and given to Mr. X for checking and lettering. The two are a natural combination. It is best for Mr. X to do the lettering because poor lettering layout can destroy an otherwise good drawing. He can easily letter the drawing freehand, using different colored pencils for different lettering sizes (three sizes will probably be used). By lettering about the same size as the lettering guide specified, Mr. X will establish the appearance of the finished product. He may choose one size of lettering for symbol numbers, for example, and a smaller size for electrical values.

It is, of course, most important to have all electrical values shown for all components. Nothing is more annoying than studying a schematic diagram without knowing the values of components and the type numbers of tubes.

When the drawing is fully checked, the final layout looks good, and all helpful data is shown, it is given to a tracer to be done in ink. Here, line weights, lettering guide sizes, and other detailed specifications must be firmly established before work is undertaken.

Should last-minute changes be made in the equipment which interfere with the clean character of the finished ink drawing, it is wisest to have a photolitho tracing made, obliterating the affected area on the photolitho negative. The result is the equivalent of an ink tracing with certain areas missing. The new information can then be redrawn neatly.

Block Diagrams

Two block diagrams, at least, should be made by Mr. X, whether or not called for in the specifications. The first should be a unit-function diagram with boxes to represent each individual electrical function or tube stage. Like the schematic, this drawing may well be very large and may require many days of layout work followed by careful selection of wording. The boxes are interconnected by flow lines. Where helpful, electrical waveforms should be shown to convey additional useful information.

The first layout will probably be awkward and complex, but can be improved by the patient application of discreet changes until the minimum of cross-overs and fold-backs are obtained with the most logical succession of blocks.

Since this drawing will form a basis of some important text, Mr. X will probably choose to number each block so that references can be made later without difficulty.

A second block diagram, similar to the first, should also be prepared for trouble-shooting work. It forms a basis for signal tracing. This diagram is strictly a stage-by-stage diagram, the prime identification of blocks being the symbol numbers of the tubes. At each point where signals appear, space should be left for an oscillogram. One of Mr. X's assistants will, in the meantime, be collecting drawings of oscillograms with full identification as to test point, amplitude, sweep conditions and other pertinent data.

The oscillograms may be omitted until the final ink stage, with circles being used in their place. In the final tracing, the forms can be added, together with all necessary data relative to them.

Having completed these drawings, Mr. X will be rather well acquainted with the functions of the equipment and will be well prepared to start his manuscript.

Writing

Mr. X can write the descriptive material covering equipment purpose, theory of operation and actual operation. The block diagram will prove most helpful here and will speed things along.

There is little that can be said relative to this phase of the work since it consists principally of day-to-day plugging. The technique used will depend upon Mr. X. He will probably require large numbers of small line illustrations in this portion of the book. There will be many consultations with engineering during this phase of the work.

The applicable specifications will probably state clearly the type of contents for each section or chapter.

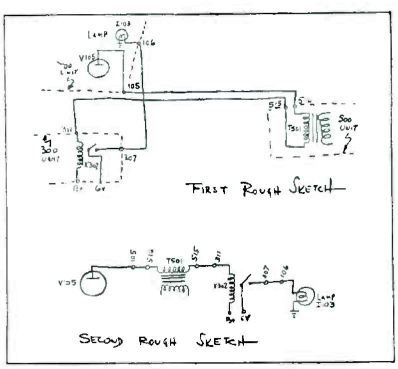


FIG. 1—Example of how a portion of an ordinary schematic is simplified for the complete schematic

There are, however, some helpful suggestions relative to the theory-of-operation section which experience has shown to be worthwhile.

It is generally more than a modest challenge to prepare a workable format for the theory of operation. This stems from the fact that two kinds of information are required and the two sometimes are permitted to become confused.

First, only cursory information is required. This provides information relative to the operation of the equipment from the standpoint of over-all stage functions. A sawtooth generator, for example, is described in terms of synchronizing triggers, developed waveform and application rather than in terms of how the sawtooth is generated.

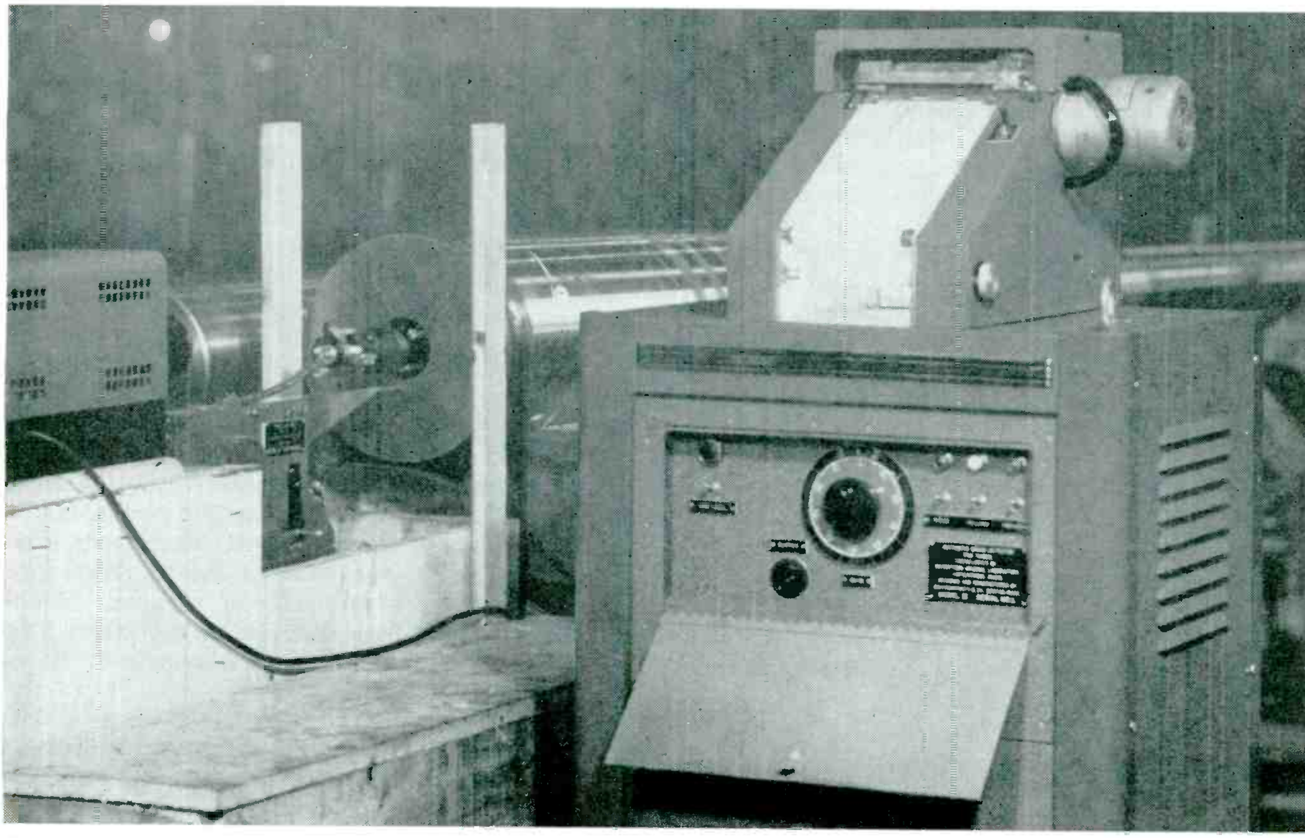
Second, specific circuit data is required without regard, necessarily, to the external purpose. In the above example, the operation of the generator, as a generator, is explained.

To cover both requirements smoothly, the entire equipment can first be described functionally, using only the block diagram as a reference. Then, as a second part of the chapter, the circuits can be described without more than passing reference to their function in the entire equipment. In this way, there is a clean break and a reader can choose the section which satisfies his needs and training. The job of writing is also simplified tremendously.

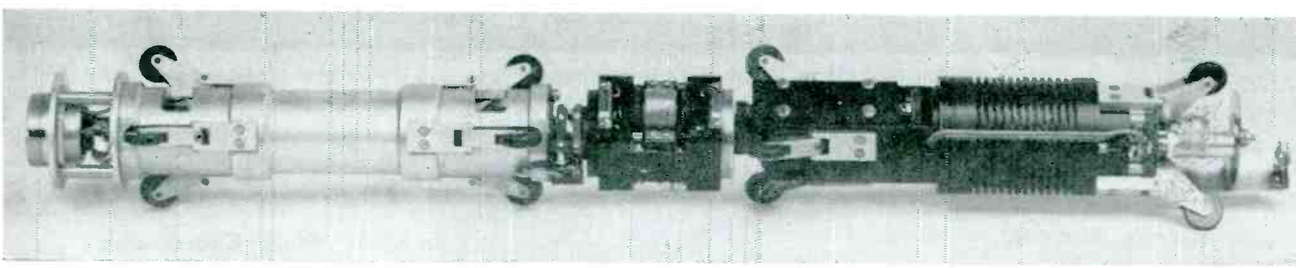
Final Coordination

After completion of the above phase, Mr. X is in a position to start coordinating the material supplied to him by his assistant. This will, no doubt require much rewriting and reorganization to produce a final complete manuscript. With the major diagrams and major writing work properly done, however, final coordination is largely routine editing of text and modification of diagrams to conform to design changes during development and production of the equipment. With the type of manual writing organization described here, there is no last-minute rushing and yet the final product far exceeds the minimum specifications of the military user.

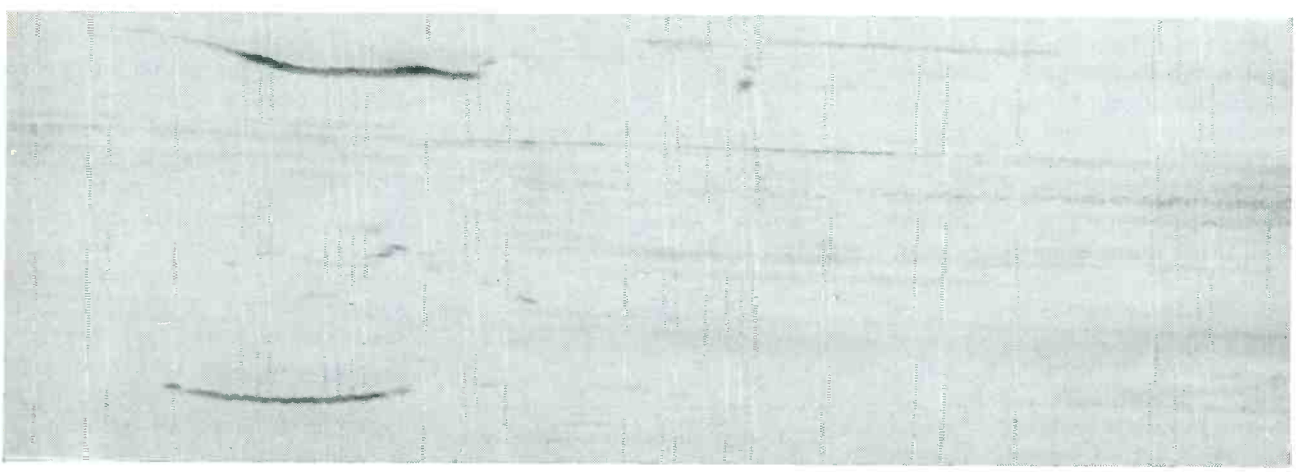
CRAWLER DETECTS



Complete flaw detector setup in shop, showing puller motor just below end of gun barrel crawler almost completely inside barrel, and electronic control rack with recorder on top



Crawler unit of automatic crack detector is pulled through barrel by chain. Motor at center drives rotating pickup that scans barrel as crawler moves through, and also drives Polaroid in photoelectric control system. Four sets of rollers are pushed outward by springs to hold crawler in center despite irregularities



Example of record obtained, showing cracks in a two-foot length of gun barrel

GUN-BARREL CRACKS

After gun barrel or other ferromagnetic tube to be inspected is circularly magnetized, inside surface is magnetically scanned by pickup coil that rotates around crawler. Phototube arrangement on crawler keeps recorder in step with pickup drive motor

By R. D. KODIS and R. SHAW

Physicist
Watertown Arsenal
(Now with Transducer Corp., Boston)

Development Engineer
Graydon Smith Products Corp.
Boston, Mass.

THE current application of steel tubes to functions where failure is a hazard as well as a loss to military or industrial operations has increased the need for a nondestructive production inspection tool for locating cracks in tubes.

In the present solution, based on the induction method, the ferromagnetic tube is magnetized in a circular manner by passing a current through the tube bore. The resulting circular magnetic field is distorted by any magnetic inhomogeneity in the tube, as shown in Fig. 1, so that the flaw is detectable by a search coil. The search coil, in the form of a magnetic recording head, is passed close to the bore surface at a uniform speed. The high definition of the magnetic recording head permits separation of cracks close together.

The complete automatic crack detector system is shown in Fig. 2. The signal from the magnetic recording pickup head is amplified to a power level sufficient to be presented on a facsimile-type recorder. The basic mechanism of the recorder consists of two electrodes, one in the form of a helix mounted on a drum and the other a straight bar. The recording medium, which is an electrosensitive paper, passes between the two electrodes. The helix pitch is equal to the width of the recording medium. For one revolution of the helix drum under the straight electrode, the intersection of the two electrodes travels across the width of the paper. Now, if the detector is revolving about the bore circumference of the tube at the same speed as the helix drum is traveling, the width of the record represents the tube circumference.

As the detector passes longitudinally down the tube, simultaneous paper feed causes the length of the record to represent the length of the tube. Thus each point on the record represents a point on the tube bore in a map-like manner. To obtain this pattern, synchronism of the motions of the recorder and detector must be maintained.

Inspection Specifications

The mechanical specifications required the inspection of tubes with 2.3 inch to 3.3 inch inside diameter and up to 200 inches long, with 100 percent of the tube inspected automatically in a single operation. Rotational speed of the pickup head was selectable at either 1,800 or 900 rpm, and the lengthwise feed was 18, 36 or 72 inches per minute. The pickup head was required to run between 0.005 and 0.015 inch from the wall of the tube, automatically taking care of taper, out of roundness, roughness and crookedness of the tube. The lengthwise position of the pickup head in the tube had to be known within ⅛ inch.

One of the major problems to be solved was the provision of a means for maintaining the specified ±2-degree angular relationship between the pickup head and the recorder. It was considered impractical to use a rod or tube to keep the frame of the crawler vertical while

The statements and opinions expressed are those of the authors, and do not necessarily represent the views of the Ordnance Department.

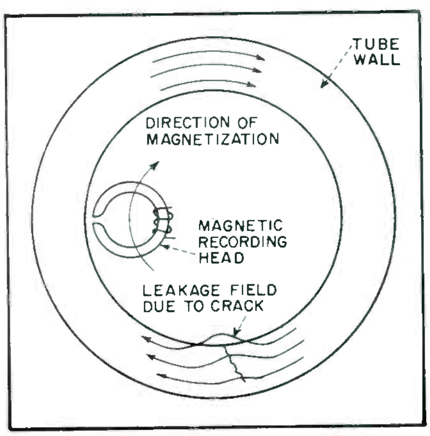


FIG. 1—Method of magnetizing gun barrel

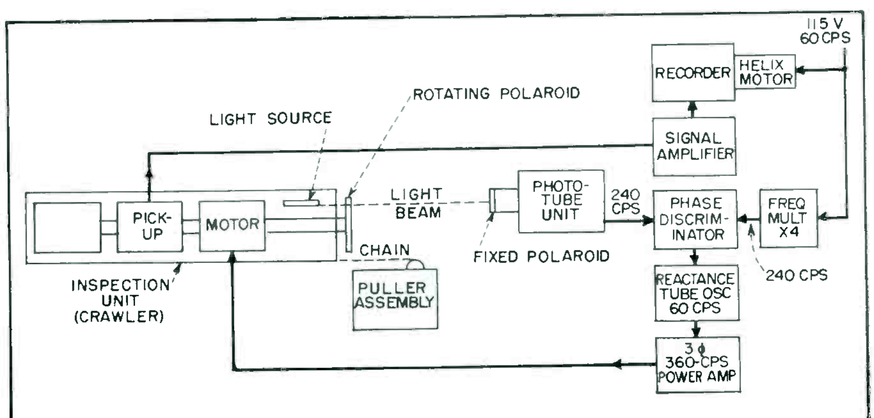


FIG. 2—Units of automatic crack detector for inspecting inside surfaces of tubes

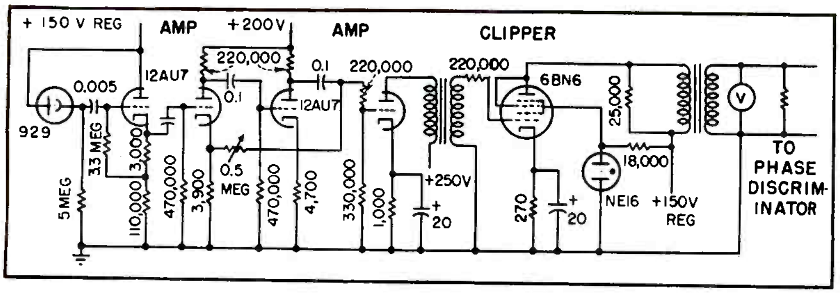


FIG. 3—Circuit of amplifier and clipper used between phototube and discriminator

going the length of the tube to be inspected, as this would have required a rod at least 200 inches long and would have used up an excessive amount of floor space for inspection.

Crawler Design

The method employed used a servo system to drive a synchronous motor in the crawler. Mounted on a shaft revolving at the same speed as the pickup head is a rotating Polaroid with focused light source shining through it axially down the tube. At the end of the tube is a stationary Polaroid with a phototube and amplifier. As one Polaroid is fixed and one related directly to the position of the pickup head in the crawler, the sine-wave output of the phototube amplifier, due to the rotation of the Polaroid, is related to pickup head speed by frequency and to pickup position by phase angle.

The phototube output is compared in an electronic discriminator with the 60-cycle line frequency, as shown in Fig. 2, and the error signal obtained is used to control the frequency and phase angle of the voltage driving the synchronous motor which rotates the pickup head in the crawler.

The problem of variation of inside diameter of the tube is solved by centering the motor in the tube by four sets of three rollers. The three rollers in a set are linked together as in a three-jaw lathe chuck, and spring-loaded outward with a common spring so that the shaft of the motor always coincides with the axis of the tube bore. The pickup head itself is held against the wall of the tube by centrifugal force and the spacing of the head from the wall is determined by two rollers mounted on the pickup head. The crawler unit is provided with two interchangeable jack shafts, one for a pickup head speed of 900 rpm and one for a speed of 1,800 rpm.

The crawler assembly is pulled through the tubing by a length of stainless steel chain. This chain is driven by a motor with appropriate change gears to obtain the different feeds, and the longitudinal position of the pickup head in the tube is read directly to the nearest tenth of an inch by a counter mounted on the chain puller assembly. The stainless steel chain is required to prevent possible magnetic writing on the tube surface, as could be caused by ferromagnetic materials touching the magnetized tube.

Paper Drive

The recorder is an adaptation of a standard Alden 4-inch helix facsimile recorder using Alfax type A electrosensitive paper. The two helix speeds of 1,800 and 900 rpm are obtained by the use of a two-speed hysteresis-type synchronous motor with a direct drive to the helix. The paper drive of 0.01 inch per helix revolution is obtained from a separate motor drive and change gears. After the record is made, the paper, which is translucent, comes forward over a 12-inch-long table made of translucent plastic with a light behind it so that any recording on the back side of the paper can be observed. The

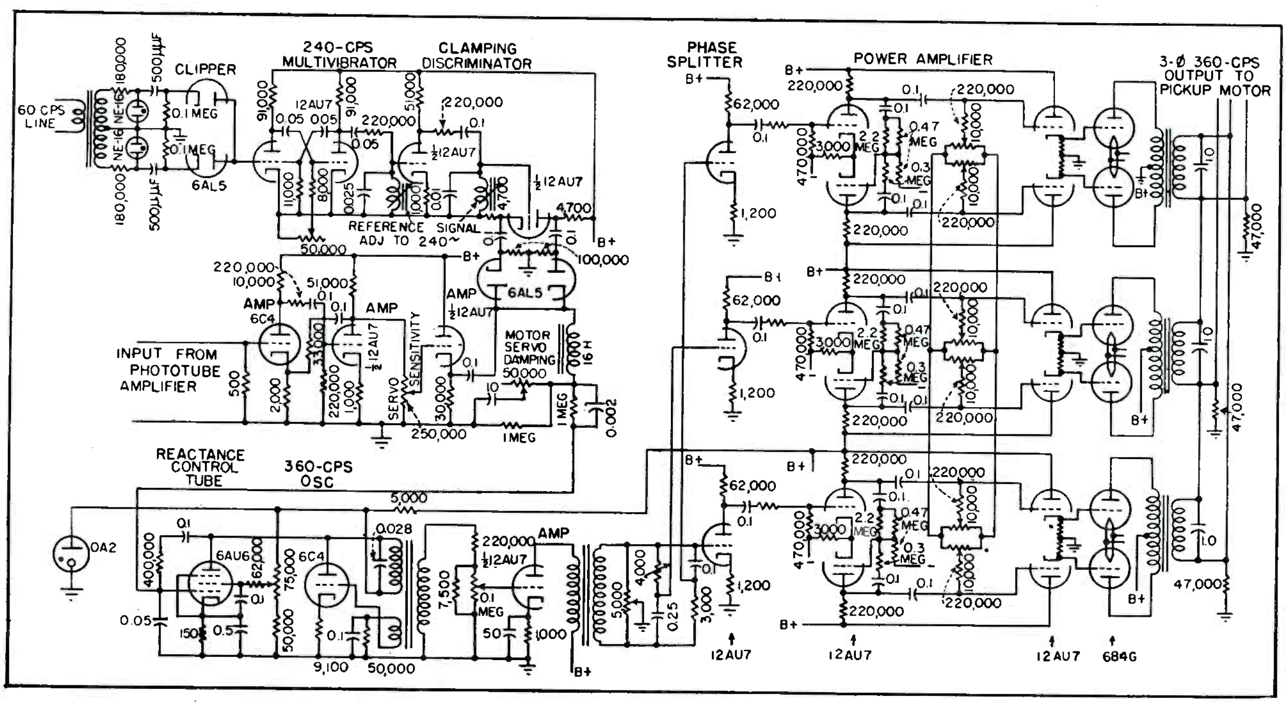


FIG. 4—Circuit for converting 240-cps output of phototube system to three-phase 360-cps power for driving pickup motor

recording of a-c signals is believed to be a novel application of this type of recorder. The completed record is stored on an automatic paper take-up reel.

To avoid cutting the paper when the helix is running but the paper is stationary, the top electrode is automatically lowered by a solenoid only when the feed is turned on. This enables the operator to stop the translation of the crawler down the tube and stop the paper feed without turning off the helix motor and losing synchronism.

Servo System

The sine-wave output of the phototube is amplified and clipped with the circuit of Fig. 3 to provide a square wave of constant amplitude, independent of light source intensity over a range ratio of 50 to 1. Clipping is accomplished with a 6BN6 gated-beam tube. The square-wave output is then fed to the phase discriminator in the main motor control unit, shown in Fig. 4.

Reference voltage for control of the crawler motor is taken from the 60-cycle line which operates the synchronous helix drive motor. A high-voltage 60-cycle signal from the same source is clipped by neon bulbs to provide accurate locking pulses for a 240-cycle multivibrator. This 240-cycle signal is used as reference voltage in a clamping discriminator; when fed with the constant-amplitude signal from the phototube unit, it gives a d-c output proportional to the phase difference of the two voltages. This d-c signal is applied to the reactance control tube of a 360-cycle oscillator, such that frequency is decreased when the motor shaft angle leads the reference and is increased when it lags the reference.

The output of the oscillator is fed to a phase splitter which gives three-phase output, then through a power amplifier to the motor in the crawler, which operates on 140-volt, 360-cycle, three-phase current. The controller thus corrects input to the synchronous motor in the crawler so that the rotating shaft, related to the fixed Polaroid or ground, is synchronous with the 60-cycle line frequency. This relation holds even though the frame of the motor is rotated. Additionally, because of the closed-loop servo-control, the synchronous relation is maintained at constant phase angle essentially independent of motor load.

The helix of the recorder is driven by a hysteresis synchronous motor running at constant load, which results in constant phase angle. The two motors, both related directly to the same 60-cycle line, are thus related to each other. As the pickup head is driven from the crawler motor, the pickup and helix rotate in synchronism with very small relative deviation.

The a-c signal amplifier circuit of Fig. 5 uses push-pull input balanced to ground, which in this type of amplifier results in a very low noise level. Hum cancellations of better than 10,000 to 1 were obtained. The amplifier has essentially flat frequency response well beyond the required recording band and is corrected for phase shift to avoid distortion of the recorded wave pattern on the paper. The voltage gain is such that approximately 10 millivolts input produced full output power of 60 watts peak. Under these conditions, the smallest significant variations of magnetic field in the tube record satisfactorily.

To avoid burning the paper with large input signals, a clipping circuit with a calibrated dial is provided. A ten-turn potentiometer is used for a precision attenuator, and short time stability of amplification is obtained through the use of voltage feedback loops and regulated power supplies.

BIBLIOGRAPHY

R. D. Kodis, The Development of a Flaw Detector for Tubes, *Proc. A.S.T.M.*, 1950.

R. D. Kodis, Magnetic Inhomogeneities in Ferromagnetic Tubes.

Robert Adler, Gated Beam Tube, ELECTRONICS, p 82, Feb. 1950.

J. N. Van Scoyoc and G. F. Warnke, A D-C Amplifier with Cross-Coupled Input, ELECTRONICS, p 104, Feb. 1950.

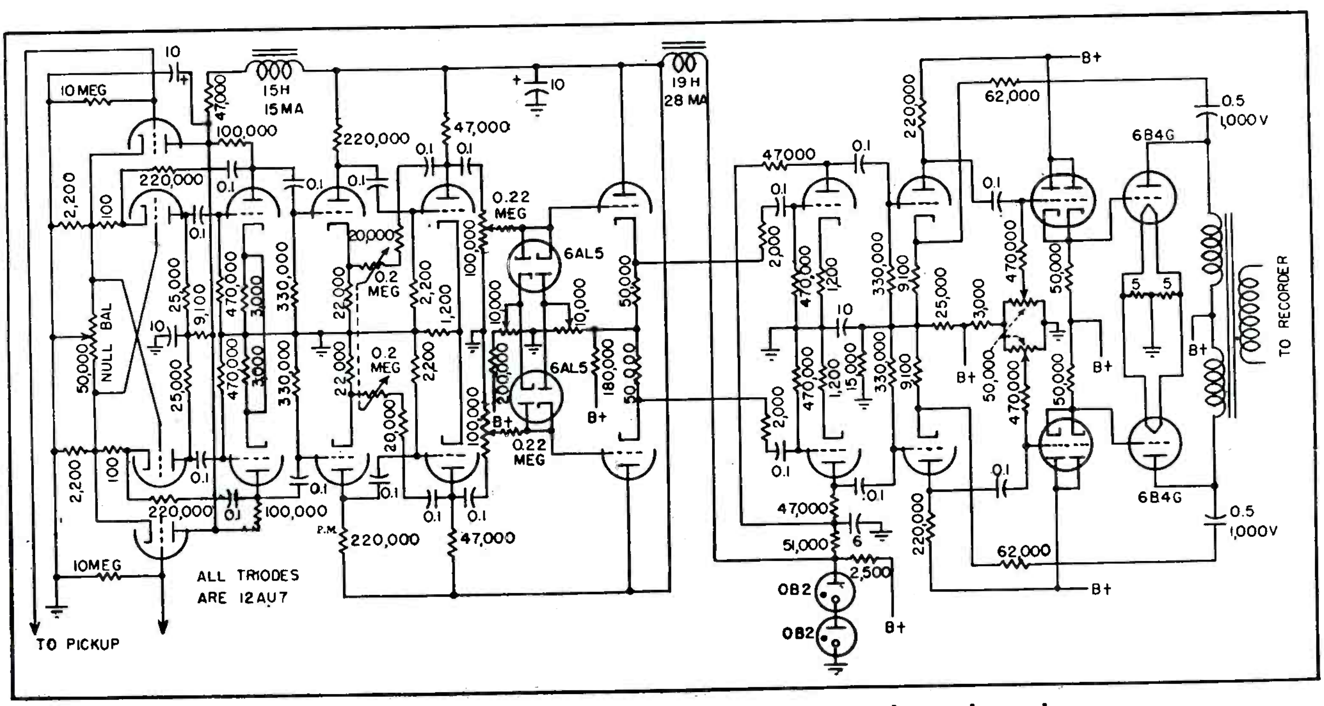
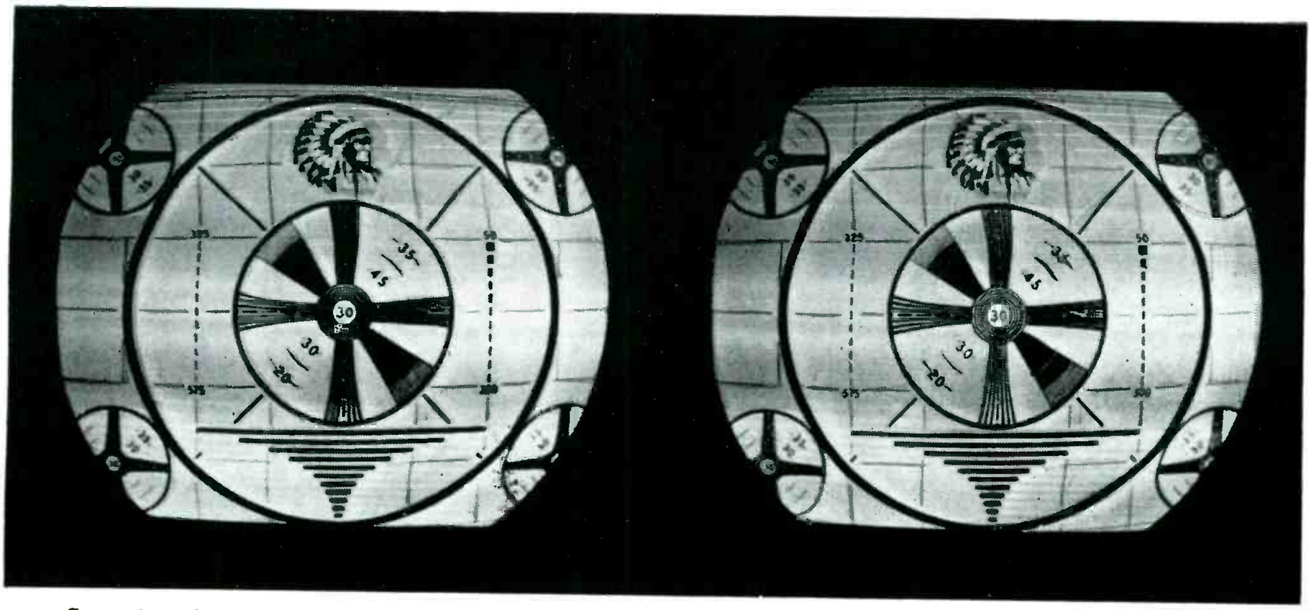


FIG. 5—Circuit of signal amplifier used between magnetic pickup and recorder



Comparison photographs show improvement in picture quality realized by dot arresting. Transmission bandwidth is 3.5 mc

Dot Arresting Improves

Interlaced dot-frequency signals are applied to pair of arresting coils and picture tube grid. Special circuit shifts phase between these signals to remove dot structure from large areas and leave dots in regions of fine detail where they are needed

A METHOD of receiving television signals employing dot interlace without using a separate synchronous detector will be described. Instead, the picture tube is used to detect the signal. This technique may be called dot arresting or deflection sampling. It will also be shown that deflection sampling may be used without introducing excess dot texture.

In a standard television system with transmission bandwidth b mc, the unit step response is essentially complete within $\frac{1}{2}b$ microseconds. During this time, the line-scan proceeds by a distance s, which, for balanced resolution, equals the interline spacing. Since all of this inter-dot space has been swept, smaller detail than s cannot be resolved.

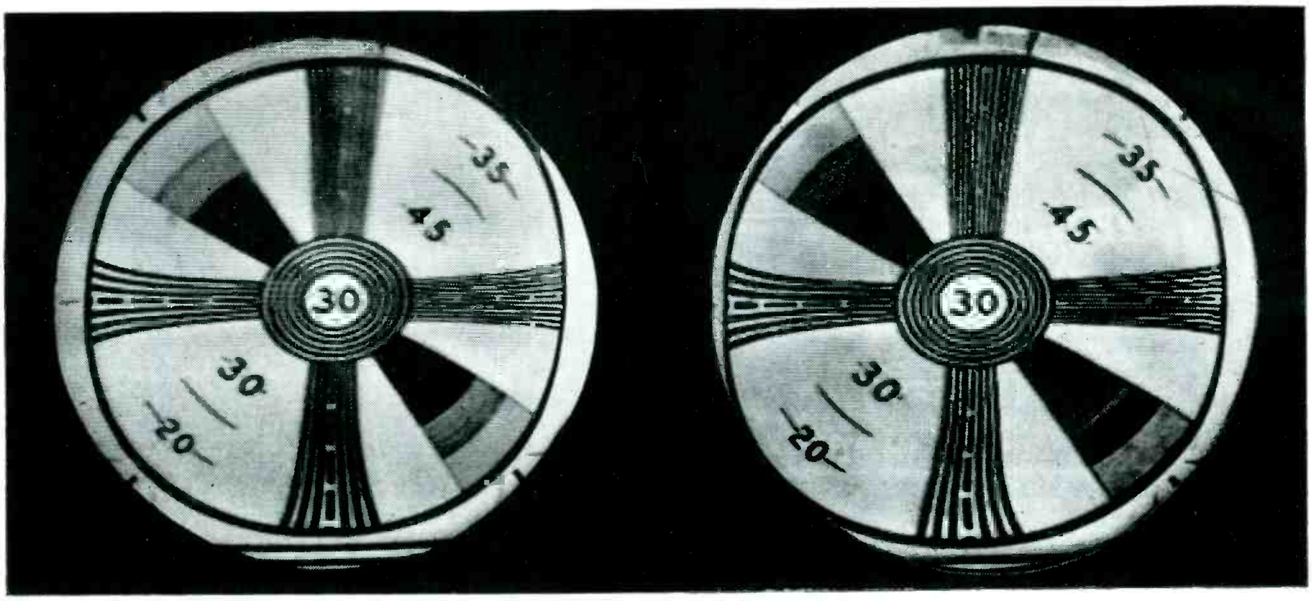
Now, suppose the receiver dot were arrested at the instant when a unit step change of light has to be transmitted. Note that this timing condition implies dot-synchronization between terminals, such as the application of the same scanning motion in the transmitter. If the dot rest period lasts $\frac{1}{2}b$ microseconds, the electrical transient is completed "on the spot", and the signal level at the end of the rest is a sample of the local light value.

If the dot were now suddenly moved along the line, by a distance s, it will reach its new position on schedule, but it has left behind some interdot space, not covered by signal information. This clear space is filled, at a later scan of the same line, by a new set of arrested dots. Since each set has sampled as many picture elements as one standard line-scan, the horizontal resolution is doubled.

Arrestor Field

The start-stop motion just described is produced by adding, to the line deflection, a weak, oscillatory component called the arrestor field, whose amplitude is only a fraction of one percent of the fields commonly used for sweep, and whose frequency is somewhat lower than twice the bandwidth of transmission. In the monochrome tests reported below, we used an arrestor frequency of 7.44 megacycles, which is $3 \times 5 \times 7 \times 9 = 945$ times the half-line frequency. With present standards, ($H = 63$ μsec line blanking ratio 16 percent, aspect ratio 4 to 3) a horizontal definition of 580 lines may be expected, ($580 = 2 \times \frac{3}{4} \times 63 \times 0.84 \times 7.44$), as compared to the 320 lines normally resolved by a 4-mc channel. This has been fully confirmed by practical tests, as shown in the accompanying photographs.

From the foregoing, it appears that dot arresting is related to dot-interlace techniques, previously published in this journal[1]. It can be used to receive dot-interlaced signals and, also, to generate them, both in monochrome and in color. At closer inspection, however, dot arresting seems to have some points to recommend it, both as a refinement of, and as a simplification of



Electronic enlargement in 16-inch tube of portion of test patterns shown in lower left-hand corner of full patterns on page 96

TV Picture Quality

By KURT SCHLESINGER

Motorola Inc.
Chicago, Ill.

the technique of dot-interlaced television. These points are, gain in light output, simplified receiver circuits, and ability to delete dots from large areas.

The light gain is due to the temporary standstill of the dots. The receiver equipment is simplified by obviating a separate synchronous detector and extra-wide-band amplifiers. The selective dot coverage is made possible by using simultaneous beam-intensity modulation in the kinescope to aid dot-arresting, or to wipe it out.

Figure 1 shows the general layout of two receivers for high-definition monochrome using dot interlace. Figure 1A shows a conventional receiver using a synchronous detector, also called a resampler. Figure 1B shows the comparative setup for a receiver using deflection sampling. It will be seen that, in the latter case, a standard television receiver may be used without any alterations other than the addition of the synchronized oscillator and

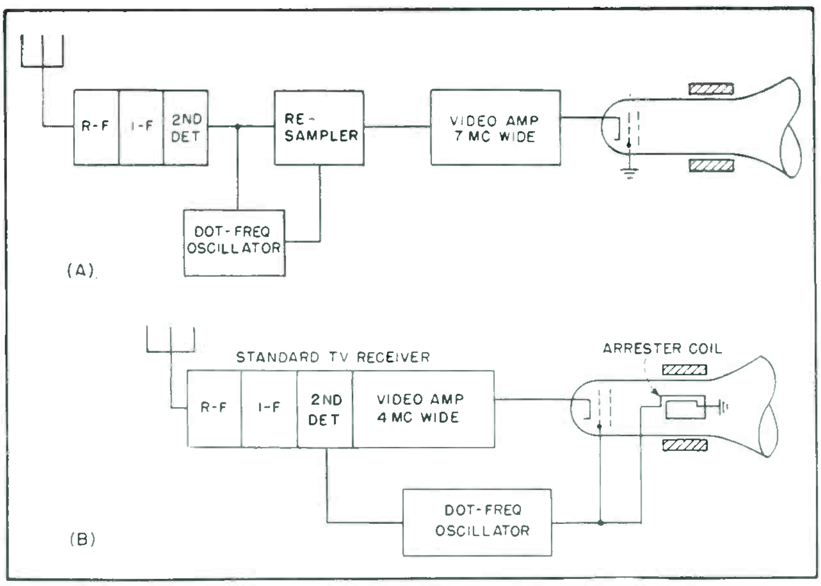


FIG. 1—Dot-arresting receivers. System at *A* uses conventional sampling, while *B* shows deflection sampling system

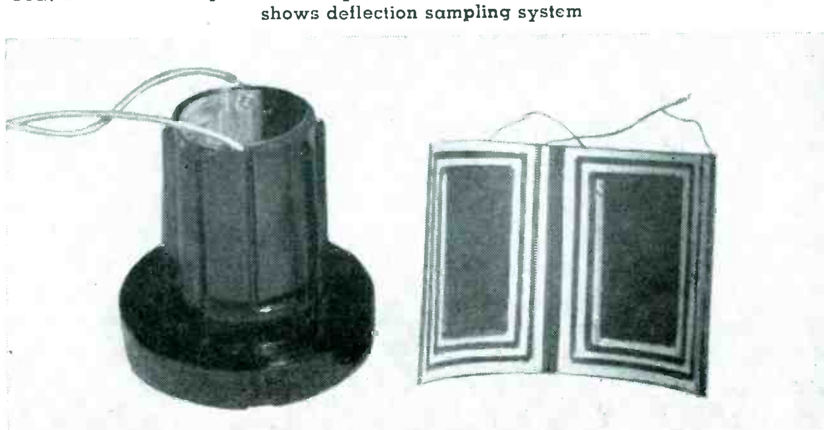


FIG. 2—Anastigmatic deflection yoke and dot arrestor coil assembly

an arrestor coil. In the conventional method of reception, special amplifying means have to be added to the receiver, in order to accommodate the signal which, after the resampler, has a bandwidth of 7 mc.

Figure 2 shows the type of arrestor coil used in the experiments. This is a printed circuit on a paper base, so that it can be slipped between the standard deflection yoke and the glass neck of the tube. Both the deflection yoke shown, as well as the arrestor coil, are designed for minimum deflection defocusing. To this end, both windings have pole slots of 17 deg, leaving about 1/5 of the perimeter unwound. It has been shown in a previous paper[2] that this makes the yoke most nearly anastigmatic. The arrestor coil has one microhenry inductance and requires 3 ampere-turns in operation.

Figures of Merit

While frequency and amplitude of the arrestor field are known, the optimum waveform is still undetermined. Suppose we could generate sawtooth waves with low retrace percentage at 7.5 mc. This is made practical, to some extent, by adding harmonics of the dot frequency to the arrestor current in controlled proportions. If the retrace time is decreased, the rest period increases. Evidently, this would help to boost the light output. But, would it also improve the rendition of fine detail, or rather, degrade it?

To answer these questions, a simple analysis was performed, as shown in Fig. 3, with results presented in Fig. 4. The arrested positions of a square dot a are shown with their spacing s along the line x. The time-motion graph is shown by curves 1 and 2 for the leading and lagging edge of the dot. This start-stop motion is caused by the superposition of the arrestor field (curve 3) to the standard sweep (curve 4).

Subtracting 1 from 2 yields the dot-transit time, or the time needed by the dot to scan its own width. This dot-transit time is shown at 5 and 6 as a function of space and time, respectively. Curve 6 is obtained by projecting 5 back into the time domain using curve 1. From Talbot's Law

$$B = \text{const.} \int_{t}^{t+\theta} I_t dt \quad (1)$$

it follows, that the visual brightness B of an unmodulated beam (I = const.) is proportional, at any one point, to the dot transit time θ at that point.

Let θ_{max} and θ_0 be the longest transit times of dot arresting and of standard sweep, respectively. There will then be a gain in light if θ_{max} is greater than θ_0. This ratio, the brightness merit

$$BM = B_{max}/B_0 = \theta_{max}/\theta_0 \quad (2)$$

may be read right off the transit-time diagram curve 6. In the case of start-stop scanning, for instance, as shown in Fig. 3, the brightness merit becomes

$$BM = p\frac{s}{a} < N \quad (3)$$

where p is the dot rest cycle and N is the dot spacing in dot diameters, also called the dot index. The light gain thus increases with, but is always smaller than, the dot index. (In Fig. 3: $N = 3$, $BM = 2.4$).

The ability of deflection sampling to handle fine detail may be formulated as follows: Suppose the light output B_t of dot arresting is known as a function of time (for instance, curve 6 in Fig. 3). We may then consider it as an optical carrier at the arrestor frequency Ω:

$$B_t = a_0 \pm a_1 \cos \Omega t \quad (4)$$

where a_0 and a_1 are the average, and the first Fourier coefficient, respectively, of the light output function B_t. The signs alternate for two successive scans of the same line.

This brightness pattern B_t is itself modulated by the picture signal

$$S_t = 1 + \cos \omega_1 t \pm \cos(\Omega - \omega_2)t \quad (5)$$

Here, ω_1 and ω_2 are video frequency components of the subject matter, originally inside and outside of the transmission band. The higher frequency ω_2 has been folded back in the transmitter by a synchronous sampler at the frequency Ω and passes through the system as an interlaced frequency $\Omega - \omega_2$.

The process of deflection-sampling in the kinescope is then described by the product

$$B \times S = a_0\left[1 \pm \frac{a_1}{a_0} \cos \Omega t\right] \times [1 + \cos \omega_1 t \pm \cos(\Omega - \omega_2)t] \quad (6)$$

This reconstructs fine and coarse detail at the respective contrast of $a_1 \cos(\omega_2 t)$ and $2a_0 \cos(\omega_1 t)$. The contrast ratio

$$SM = a_1/2a_0 \quad (7)$$

seems to be a suitable figure of merit for dot arresting in handling fine detail. Quite generally, this sampling merit SM is found by making a Fourier analysis of the curve presenting screen brightness B_t as a function of time. In the particular case of Fig. 3, where B_t is a pulse-wave of p percent duty cycle (curve 6) and where the inter-dot-light is blanked out, the sampling merit (Eq. 7) becomes

$$SM = (\sin \pi p)/\pi p \quad (8)$$

The results of this analysis are shown graphically in Fig. 4. This shows the figures for brightness and resolution of deflection samp-

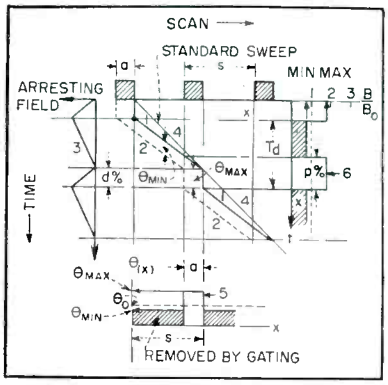


FIG. 3—Analysis of deflection sampling

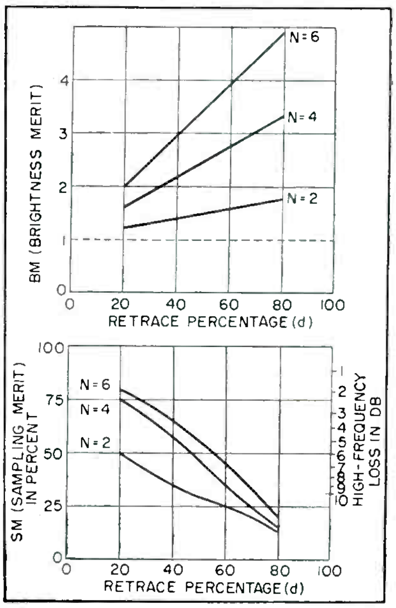


FIG. 4—Curves show effects of different retrace percentages on brightness and sampling figures of merit

ling for various values of the field retrace percentage d and dot index N. It is seen that, unfortunately, these two figures have opposite trends, so that as we gain in brightness, we are losing in resolution. The gain in brightness occurs as the dot arresting cycle d is lengthened, but, at the same time, the light duty cycle p also increases, which causes the sampling merit to drop off sharply. Experimental tests with sawtooth arresting have borne this out; we gained light, but lost definition.

It appears, therefore, that the use of sawtooth waves for dot arresting is justified only if brightness is the prime consideration. The sampling action then has to be done by a separate detector. Such an application is of some interest in color work.

On the other hand, if dot-arresting is to do the complete job of video-multiplex reception, including resampling, long rest periods are ruled out, since the high-frequency loss passes through the 6-db point for a triangular wave (d = 50 percent; Fig. 4B). The use of sine waves, with their simple circuitry, is then clearly indicated as a good compromise between brightness and resolution.

Table I—Brightness and Sampling Merit of Sine Wave Arresting and Gating

Type of Operation	*Fine Detail Rendition*			*Relative Light Output*					
				Peak Brightness			*Average Brightness*		
	$N=2$	$N=4$	$N=6$	$N=2$	$N=4$	$N=6$	$N=2$	$N=4$	$N=6$
Sine Arresting No Modulation	0.24	0.34	0.40	1.5	2.2	2.8	1.03	1.22	1.44
No Arresting Cosine Modulation	0.33	0.45	0.47	0.83	0.95	0.96	0.50	0.50	0.50
Sine Arresting Cosine Modulation	0.46	0.58	0.62	1.0	1.7	2.3	0.53	0.72	0.94
Sine Arresting Square Wave Blanking	0.66	0.72	0.73	1.5	2.2	2.8	0.68	0.86	1.08

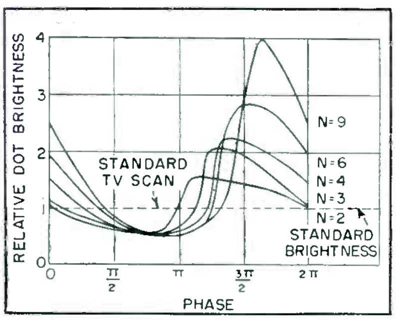


FIG. 5—Considerable improvement in brightness can be realized as shown here for sine wave arresting

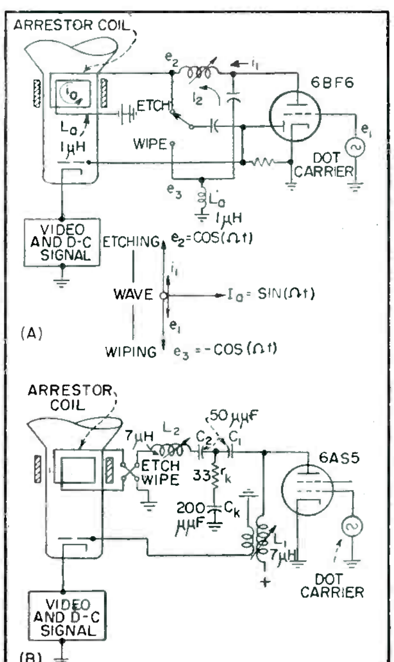


FIG. 6—Circuits for sine wave arresting and blanking

Sine Wave Arresting

Figure 5 shows the light distribution as a function of time, if a sine wave is used in the arrestor coil. The phase is counted from the zero passage of the arrestor-current. The peaks of light are still above standard, and they increase with the dot index, but they are notably smaller than with sawtooth arresting. For interdot blanking, a cosine wave may be used, as shown in the simple circuit of Fig. 6A. If it is desired to utilize the very peak of light output, which occurs about 135 deg ahead of zero-field, the double-tuned circuit of Fig. 6B may be preferred. This yields about 25 percent more light than the simpler circuit.

Table I shows the figures of merit for sine-wave arresting, with and without blanking. Apparently, sine arresting without any beam modulation is falling short of the goal. The same is true for the case that the beam is gated at the dot frequency, but that dot arresting is not employed. It is evident, however, that if sine arresting is used in combination with a suitable modulation of the beam, relatively high figures of merit are obtained. Even better figures occur if the grid is overdriven so that we approach more closely the case of square-wave gating. The resolution figures thus obtained range between 0.5 and 0.7 for low and high dot indexes, respectively. This corresponds to a high-frequency loss ranging from 4 to 6 db. To correct for this, the transmitter may have to use h-f emphasis of the same order.

The brightness-merit of sine arresting is also shown in Table I. With a dot-index of 2, there is no gain in light output over standard scan, and with $N = 4$, the gain is only 1.7 to 1. Higher values are available, however, with higher dot indexes or for square-wave gating on the grid. These gains in peak brightness are a privilege of deflection sampling and are not available with beam intensity sampling alone. Note also, that this gain in light comes without defocusing, since the beam current is not affected.

Practical Test Set-up

With a receiver layout as shown in Fig. 1B, the signal from a conventional video-amplifier (4 mc wide) was fed into the kinescope cathode. The arrestor coil (Fig. 2) and tube-grid were connected and fed as shown in Fig. 6A.

In the transmitter, a standard monoscope was used, and its output was fed to the grids of two triodes, while the sampling frequency was injected into their cathodes, both in push-pull fashion. The combined plate output from this twin-balance modulation is of the single-sideband type, with carrier and video input suppressed. By unbalancing the tubes, a controlled amount of unsampled video is admitted to the 4-mc filter in the output. The combined signal then has video information from zero to 7 mc in a frequency interlaced package, 4 mc wide, with controlled emphasis on the high end of the original video spectrum.

The photographs at the beginning of this article show the appearance of a monoscope test pattern on a 16-inch tube, after passing through a 4-mc channel, with and without dot arresting. It is evident that the expected improvement in horizontal resolution has been obtained. This is so in both the center of the picture and in the corners, as illustrated by the photograph taken from the screen of a tube of the same size (16-inch), but with both sweep amplitudes exploded to about three times normal size. Since this is not an optical enlargement, but actually an electronic magnification, and since the same type of tube is used, this picture is representative for work with a higher dot index. As a result, the dot brightness increased sufficiently to offset the loss of light caused by tripling the scanning speed. In fact, no change of photographic exposure was necessary when taking this picture. It was felt that these tests clearly established the practicality of dot arresting for the reception of sampled signals.

Selective Dot Coverage

In all preceding considerations, as well as in the photos shown, dot arresting was applied continuously so that the dot texture covers all of the picture. Recent developments of video multiplexing have made it desirable to conceal dot texture as much as possible, since it may be objectionable to the public. With deflection sampling, the question arises: Is a deletion of the dots at all possible? A study in this direction was undertaken and a technique of dot wiping was developed. It was found to be practical to confine the dot structure, caused by dot arresting, to areas of fine detail. The wipe-circuits developed for this purpose are simple enough for commercial applications.

Suppose dot arresting is applied to a beam carrying synchronous intensity modulation:

$$I_t = \frac{1}{1+m}\left[1 + m\cos(\Omega t + \varphi)\right] \quad (9)$$

and assume that the phase φ between kine-grid voltage and arrestor coil voltage is adjustable. The relative brightness distribution along the line then follows from inserting Eq. 9 into Talbot's Law.

$$B_t/B_0 = \frac{1}{\theta_0}\int_t^{t+\theta_t} I\,dt \quad (1a)$$

Performing the integration yields Eq. 10.

$$B/B_0 = \frac{1}{1+m}\left[\frac{\theta}{\theta_0} + m\left(\frac{\theta}{\theta_0} - 1\right)\cos\varphi - m\sin\varphi \times \frac{\sin\frac{\Omega\theta}{2}}{\frac{\Omega\theta_0}{2}}\sin\Omega\left(t + \frac{\theta}{2}\right)\right] \quad (10)$$

This expression is simplified, considerably, in three typical cases.

(A) No grid modulation ($M = 0$), dot arresting only:

$$B/B_0 = \theta/\theta_0 \quad (2a)$$

(B) In-phase modulation: $\varphi = 0$

$$B/B_0 = \theta_t/\theta_0 - \frac{m}{1+m} \quad (11)$$

(C) Out-of-phase modulation:

$$B/B_0 = \theta/\theta_0\,\frac{1-m}{1+m} + \frac{m}{1+m} \quad (12)$$

Equation 2a is the light distribution B_t as shown in Fig. 5. Equation 11 informs that a connection of the grid to the arrestor coil, as shown in Fig. 6 will leave this light distribution essentially unchanged; but that the curve, as a whole, is shifted toward black until the inter-dot luminance disappears (for $M = 1$). This improves the sampling merit (Eq. 7), since the area a_0 under the curve decreases, while the Fourier coefficient a_1 does not change. Since dots appear, this is called the "etch" mode of operation.

Equation 12 indicates that the dots will be wiped out, although the jump-scan continues, if the grid modulation is inverted and complete ($M = 1$). The screen will then exhibit one-half of the reference brightness and the picture resolution will decrease to normal. In a practical circuit (Fig. 6), this theory may be confirmed by throwing the switch, as shown, from the ETCH to the WIPE position.

We now proceed to perform this transposition electronically. A block diagram of the equipment is shown in Fig. 7. The circuit is set up to perform wiping as a steady-state condition with the grid connected to a minus cosine voltage, while a sine-

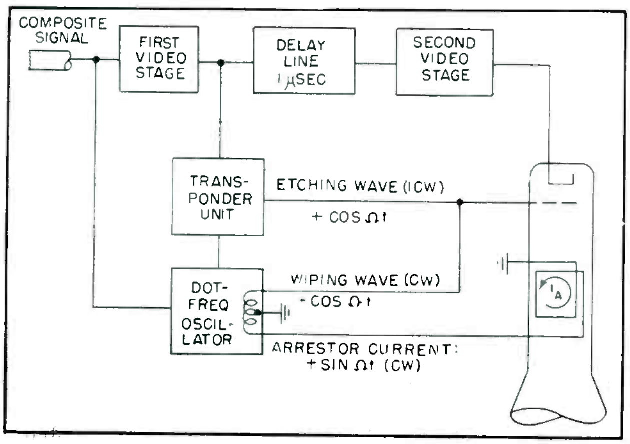


FIG. 7—Setup for dynamic dot arresting and wiping

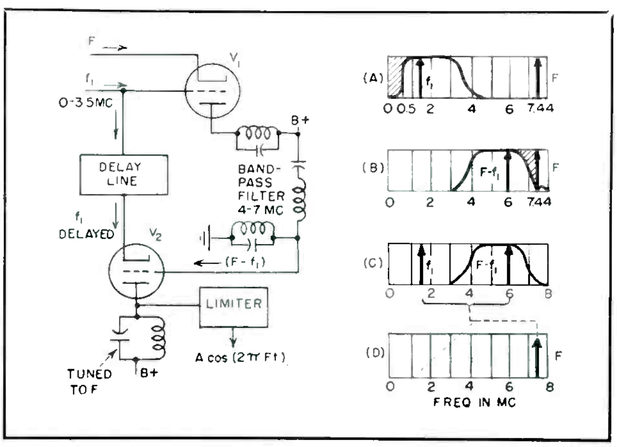


FIG. 8—Selective dot coverage circuit and curves

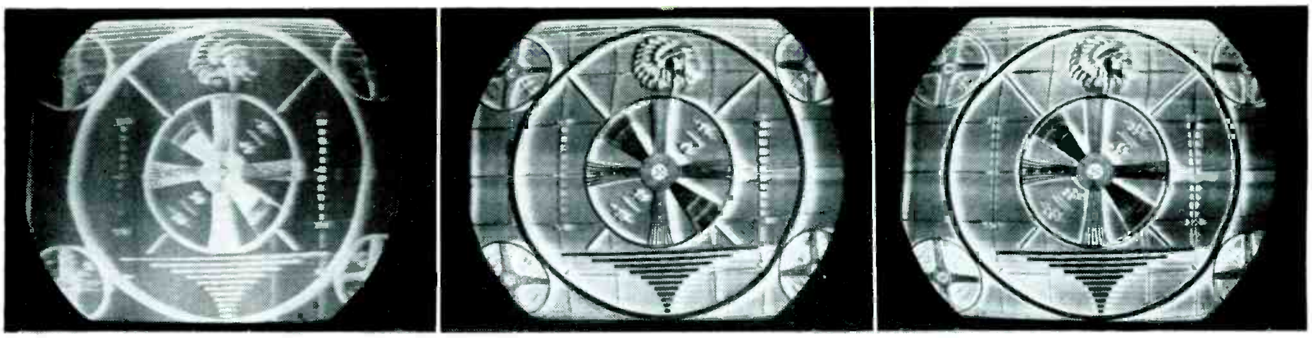


FIG. 9—Dynamic etching and wiping of arrested dots showing selective dot coverage. Dotted areas have been brightened up electronically to facilitate photographic reproduction

wave current passes through the arrestor coil continuously. It is desired, then, to have the grid voltage reverse its phase whenever fine detail appears in the picture. What is needed, therefore, is a sensing circuit for fine picture-detail, whose output overrules the wiping wave by an opposing wave when needed.

This device is known as a transponder unit. It generates the dot frequency with fixed amplitude and phase for all signal frequencies above, but not below, 0.5 megacycle. To take care of the delay in the transponder, the video signal is sent through a delay line before reaching the picture tube.

A simple transponder circuit for selective dot coverage is shown in Fig. 8. This is, actually, a double-modulator, which turns out the sampling frequency F, if, and only if, signal frequency f_1 falls into a predetermined range.

Figure 8A shows the received video spectrum. The shaded portion from 0 to 0.5 mc, leaves the transponder inactive. In V_1 the signal frequency f_1 beats with the sampling frequency F. The resulting lower sideband of F is then sent through a bandpass filter, which cuts off at 7 mc. The cut-off is shown shaded in Fig. 8B.

To recover the sampling frequency F, a second process of modulation is performed in V_2. Here, the signal frequency f_1, after passing through a simple delay equalizer, beats with the sideband $F - f_1$, which emerges from the bandpass filter (Fig. 8C). The result is the sampling frequency (Fig. 8D).

The three photographs shown in Fig. 9, illustrate the process. At left, the picture signal has been cut off and only the selective dot coverage is shown. The dot pattern, as laid down by the transponder unit, has been brightened up, in order to facilitate photographic recording. In normal operation, the background in the dotted areas is no more bright than in the large areas.

It can be seen that dots are laid down only at such areas where high definition is called for, whereas large areas without detail are free from dots.

In the center, video signal has been added as a faint modulation, but no video-delay is provided. It can be seen that the transponder unit reacts with a delay of about 1 microsecond. Parts of the video signal are, therefore, 1 microsecond ahead of time and fall into an area that has been wiped clear of dots. These signals cannot build up to full detail because they do not have the benefit of deflection sampling.

In the right-hand pattern, the video signal has been sent through a suitable delay line. The picture is now coincident with areas that have been prepared by etching in the dot structure. In this case, full definition is obtained. These photographs serve to show that it is possible to use deflection sampling without introducing objectionable dot texture in large areas.

Other Applications

The application of dot arresting to the pick-up camera is entirely feasible. Tests have been made to operate a monoscope that way, and they were generally successful. Deflection-sampling in the transmitter seems to promise some improvement of the signal-to-noise ratio, to a degree corresponding to the values of brightness gain listed above. Another attractive feature seems to be the simplification of circuitry, since the use, without change, of a standard camera amplifier appears possible.

It appears that the technique may be applied to color reception, mainly along two lines: (1) as a method of sampling, and (2) as a way to improve light output.

If dot arresting were to be used for resampling, it becomes necessary to apply it to each of the three scanning beams separately in a 3-phase fashion. This may be done by electrostatic or by electromagnetic means, and presents no particular problems in the dichroic type of color receiver. In a tri-color tube, however, some additional elements for dot-deflection may be required within the tube to perform dot arresting. The external circuit, on the other hand, may then be reduced by three tubes, now used as synchronous detectors.

Concerning the potential brightness gain through dot arresting, it should be borne in mind that the dot index in the color application is twice as high as for monochrome, due to the slower sampling rate[3].

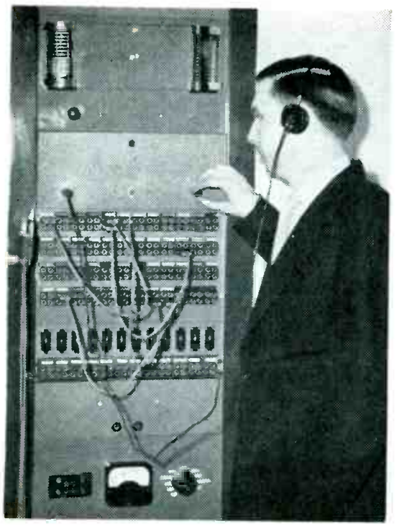
The author wishes to thank D. E. Noble, Vice President in Charge of Research, for his interest in the subject and for his permission to publish this paper. He is further indebted to his associates, V. Graziano and G. Hoffman, for their contributions and assistance, as well as to J. Grigg and G. Costello, for continued efforts and cooperation in building the equipment for the tests.

REFERENCES

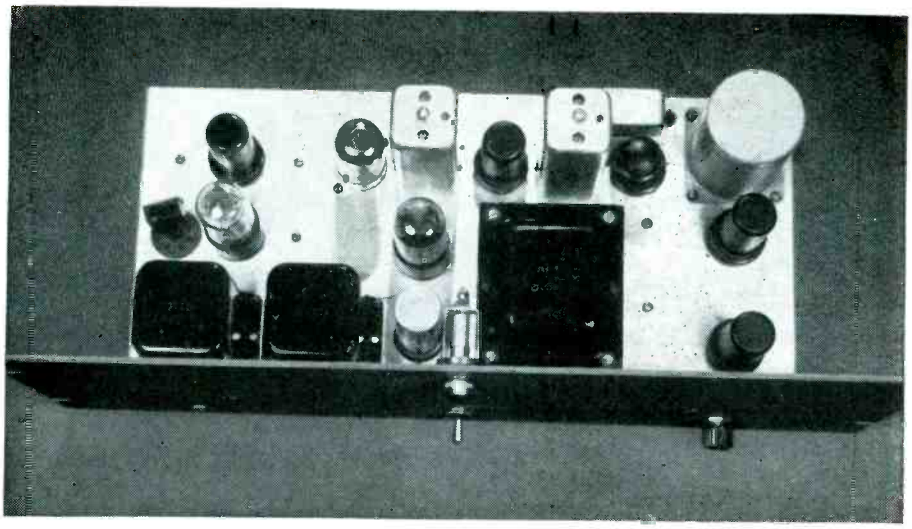
(1) Wilson Boothroyd, Dot Systems of Color Television, Part I: ELECTRONICS, p 88, Dec. 1949, Part II: ELECTRONICS, p 96, Jan. 1950.

(2) K. Schlesinger, Anastigmatic Yoke for Picture Tubes, ELECTRONICS, p 102, Oct. 1949.

(3) RCA Bulletins on Color Television and UHF, Oct. 1949, Jul. 1950.



Front panel has only jack for phone monitor, gain control, and on-off switch



Top view of receiver chassis shows conventional layout on standard rack panel. Crystal at left has fundamental frequency of one-third difference of carrier and i-f

Remote Pickup Broadcast

Crystal-controlled 26-mc receiver can be used by inexperienced personnel to receive remote broadcasts from scenes of emergencies, sporting events, and other on-the-spot affairs. Extreme simplicity insures reliability and ease of operation and servicing

By ADELBERT A. KELLEY

Chief Engineer, WINR, Binghamton, New York

SOME ENGINEERS at the smaller broadcast stations do not appreciate the advantages of adding relay broadcast equipment to their station facilities. Such equipment provides a means for direct broadcast from any point where wire lines are not available, and is particularly adapted to on-the-spot coverage of fires, floods, parades, or certain sports such as golf.

The equipment does not have to be complicated or expensive. Transmitters are commercially available but there are no receivers on the market specifically designed to receive 26-mc relay broadcast signals. General coverage communications receivers are not satisfactory unless they are operated by experienced personnel. Unfortunately, broadcast control operators are not always trained in communications techniques so it is desirable to have as simple a receiver at the control position as possible. It should not drift off the signal or be subject to misadjustment.

Two such receivers are in operation at WINR. One is in a shielded portable carrying case for use at the end of a wire line near the point of origin of any broadcast and is provided with a v-u meter for use in setting levels. Since a wire line is used only when the special event is some distance from the studios, another receiver was permanently mounted in a rack in the control room. The two receivers are almost identical and the rack unit will be described.

The receiver was designed with simplicity in mind. This meant crystal control and the elimination of unnecessary panel controls. The photograph shows only an on-off switch and volume control on the front panel. When the receiver is turned on, it is always tuned on the center of the relay channel and it will not drift off either in the process of heating up or by operator error.

The local oscillator uses an inexpensive 8,500-kc crystal and triples to the low side of the incoming signal to avoid image-frequency interference with the 27-mc amateur and diathermy band. The exact oscillator frequency is, of course, dependent on the operating channel assigned by the FCC and can be found by taking ⅓ of the frequency 470 kc on the low side of the signal.

Noise Silencer

Ignition interference in the 26-mc region makes a limiter a virtual necessity. After trying several noise-silencer circuits, the one shown in the diagram was used.

It is well to note that a high-vacuum rectifier makes a better noise-silencer diode than the popular germanium diode due to its practically infinite back resistance. As a practical example, 1N34 diode caused nearly 30-percent distortion when used in this circuit as compared to 1 percent when using the

Transmitting equipment for remote broadcasts is available at reasonable cost. Receiver described fills need for companion receiving equipment

Receiver

6H6. Since this distortion is apparent mostly at the higher modulation percentages, if the 1N34 is used, the relay transmitter can not be fully modulated without loss of quality.

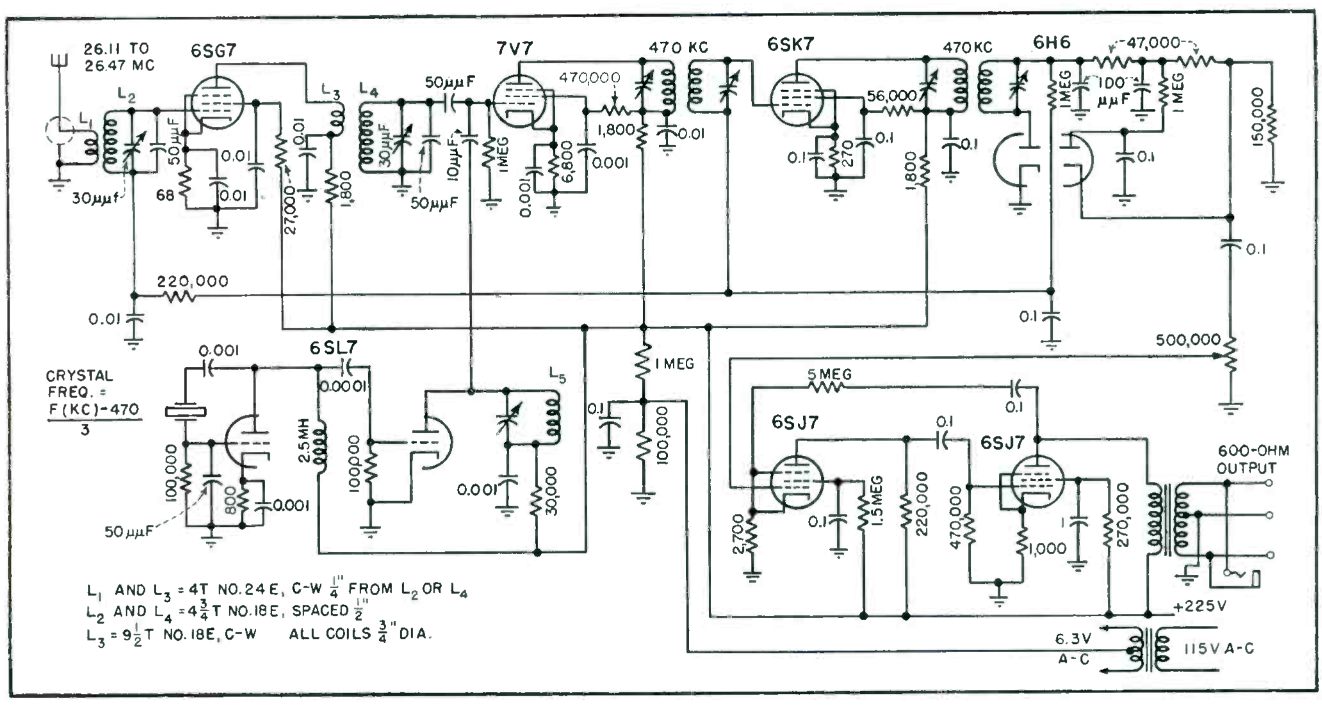
When using the 6H6 diode some care must be taken to avoid heater hum. It was necessary to bias the filament winding center tap positive a few volts and bypass it to ground. This also materially reduces the hum level in the audio amplifier stages.

The audio section uses two pentodes in a low-distortion inverse-feedback circuit. Even more feedback can be employed by reducing the value of the 5-meg resistor in the feedback loop. This reduces the overall audio gain and might be considered if the gain seems excessive. There is no practical advantage, as far as distortion is concerned, since the distortion contributed by the audio stages is only 1.75 percent.

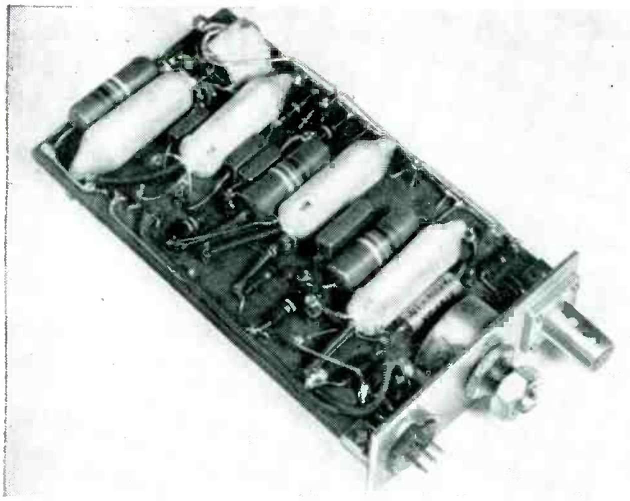
Alignment Procedure

Alignment is best accomplished if the relay transmitter is tone modulated and used as a signal source. If it is not well shielded, it should be moved some distance from the receiver to avoid overload. A crystal of the proper frequency is inserted in the crystal socket and oscillation checked by measuring the grid voltage of the tripler stage. It should be − 15 v as measured by a vtvm. The i-f transformers are then aligned to the correct frequency by using a standard signal generator.

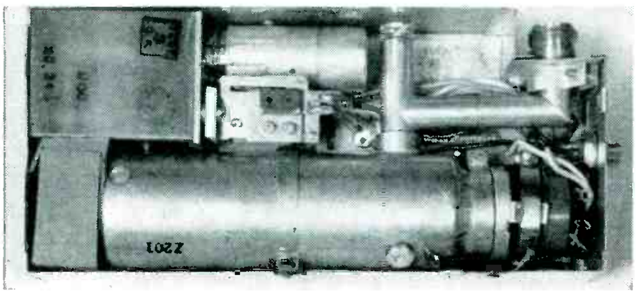
The relay transmitter is turned on, modulated, and the signal is tuned in by varying the tuning of the i-f transformer trimmers. The i-f tuning is the only tuning adjustment that will compensate for a crystal slightly off-frequency so the final i-f adjustment will be some frequency around 470 kc. After the relay signal is located, all the i-f and r-f trimmers are peaked.



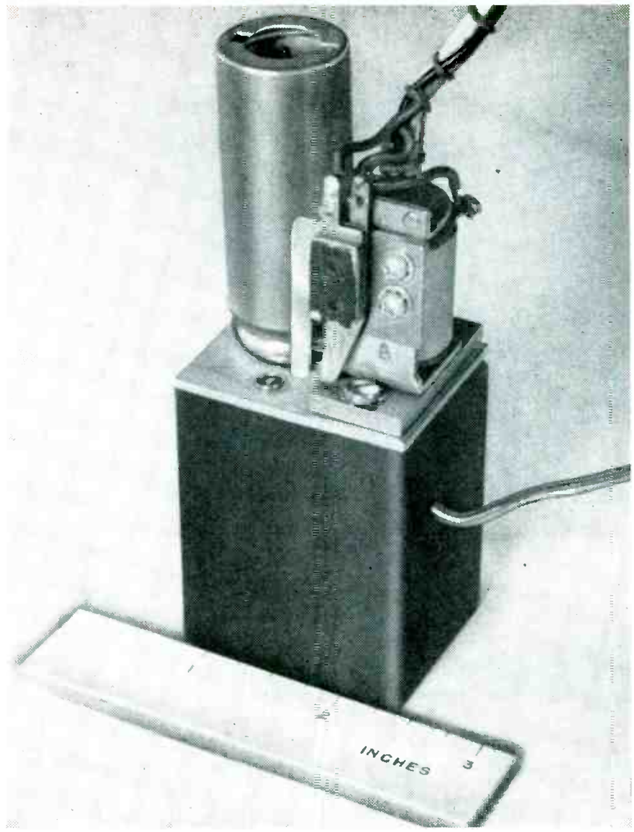
Complete schematic of 26-mc crystal-controlled receiver for remote pickup broadcasts



Complete receiver before hermetic sealing



Transmitter with case removed showing the cavity and modulator



Photograph of the pulse modulator

Miniature RADAR

Azimuth, range and identification of a pilotless plane equipped with radar beacon can be determined. Beacon transmits reply automatically when interrogated. Technique provides range extension for a radar using passive reflection

By R. S. BUTTS
Project Engineer
Melpar, Inc.
Alexandria, Va.

AVAILABLE SPACE in small pilotless aircraft dictated the need for a radar transponder beacon with packages of extremely small size which could be tucked away in fuselage corners or even in wing sections.

Several existing beacons of conventional size set a high standard of field performance and reliability. This fact, in addition to contemplated application to close-in tracking problems where variations in response time may represent an appreciable source of error, left no room for compromise of performance standards.

The design to be described was evolved in several model stages during which field experience was accumulated and applied in overcoming early weak points. For example, 6K4 subminiature tubes were replaced with more rugged types such as the 5703. The miniature radar beacon represents a thoroughly reliable operational equipment typical of what can be accomplished with modern miniaturization techniques without compromise of reliability and performance specifications.

General Description

The purpose of the radar beacon is to transmit automatically a reply from an aircraft to various radar signals and thereby extend the radar range over that obtainable with passive reflection alone. The interrogating source is able to identify as well as determine the azimuth and the range of the beacon-equipped aircraft.

In addition to the power supply, which varies in detail according to

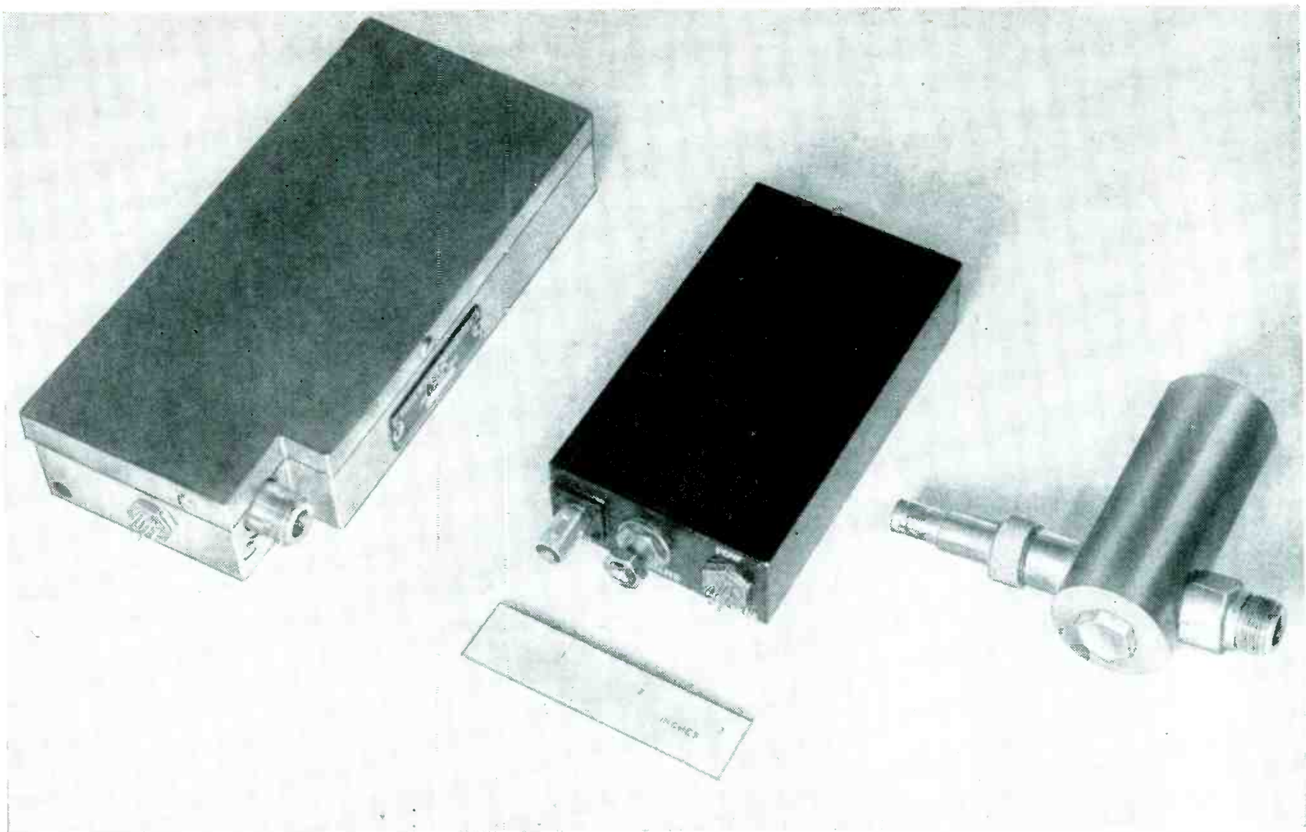


FIG. 1—Major units of the miniature radar beacon. Shown from left to right are the transmitter, receiver and tuned cavity and detector

TRANSPONDER BEACON

the individual application, the beacon consists of three units; the receiver tuned-filter cavity, the video receiver and the pulse transmitter. The total volume of the three units is 83 cubic in. and the weight slightly under 4 lb. Figure 1 is a photograph of the three units.

The filter cavity is a $\frac{3}{4}$-wavelength coaxial cavity tunable from 2,700 to 2,900 mc. Temperature compensation is obtained by making the outer shell of brass and the center rod of Invar. Adjustment of the threaded inner rod is made through an opening in one end.

An antenna input connector assembly contains an input coupling loop. The output connector assembly contains a coupling loop and a mounting for a 1N21B crystal. A $\frac{1}{4}$-wavelength choke removes r-f voltage from the video cable. By mounting the crystal as an integral part of the cavity, a saving in volume resulted compared with arrangements such as the separate tunable crystal mount generally employed. The overall dimensions of the cavity are $4\frac{1}{2}$ by $1\frac{3}{8}$ by $3\frac{1}{2}$ in. and its weight is 0.6 lb.

Frequency Drift

Frequency drift of the cavity does not exceed 4 mc over a temperature range of 100 C. However, when low ambient temperature is anticipated, it is desirable to mount the cavity adjacent to the video receiver so that heat conducted from the receiver will maintain a satisfactory minimum crystal temperature to avoid loss of sensitivity and increased noise.

The cavity has a bandwidth of 10.5 mc maintained in production to a tolerance of $\pm$ 1.5 mc. Insertion loss does not exceed 1.5 db.

The design objectives of the video receiver were to achieve in as small a package as possible reasonably high sensitivity, small time-delay variation and stability with respect to voltage supply changes. For general use it was desired that the receiver be fully responsive to interrogating pulses of 1.0 μsec or longer. A video bandwidth of 200 kc is used to obtain this response. To lessen electron tube microphonism, the receiver response is attenuated below 15 kc. Figure 2 shows the frequency-response characteristics of the video stages.

Figure 3 is a schematic diagram of the video receiver. It contains three gain stages using a triode input and two pentode stages. The circuit receives a negative pulse from the output of the crystal. The first interstage coupling utilizes a large time constant to prevent over-shoot on large input signals when the second grid is driven positive. The second interstage coupling utilizes a short time constant, since a negative-going pulse exists at this point. The short time constant provides the desired low-frequency attenuation.

Output from the third amplifier stage is applied to the grid of a gate tube whose bias is controlled by a potentiometer divider from the plate supply. This adjustment is normally set to clip out input circuit noise and thereby establish a receiver threshold level slightly higher than the input-circuit noise level. The minimum receiver sensitivity is 73 db below 1 watt.

Output from the gate tube is applied to a pulse amplifier and then to a clipper stage. These two stages sharpen the leading edge of low-input signal pulses, minimizing the variation of time delay over wide ranges of input signal levels.

The last two stages of the receiver consist of a blocking oscillator and driver with cathode input-and-output coupling. The pulse transformer used is designed to provide a 2-μsec pulse across a 100-ohm output resistance. The use of a two-tube circuit insures minimum delay in starting of the blocking oscillator. At 70 db below 1-watt r-f input the receiver delay is 0.9 μsec.

The receiver exhibits good stability of sensitivity and time delay with respect to supply-voltage variation. Figure 4 shows the variation of receiver time delay with respect to supply voltages and input signal.

To achieve minimum size and to obtain hermetic sealing, the receiver is cast in Paraplex P-13 resin. The tubes and other components are supported by a phenolic base. The tubes are coated with Melcoat I, a resilient spongy material, to provide thermal shock isolation between envelopes and resin. A metal header on one end of the plate supports a coaxial video-input connector, a miniature connector for power input and pulse output, and a locking-type potentiometer for adjusting the threshold level.

After potting, the receiver is placed in a sheet-metal container painted black for better heat dissipation. The maximum internal hot-spot temperature measured on a tube envelope does not exceed 150C at an ambient of 65C. The receiver is capable of operation for long periods of time at ambient temperatures of at least 75C.

The dimensions of the receiver, including connectors, are 5⅝ by 2⅞ by 1¼ inches. The weight is 1.2 lb.

The Transmitter

The 2C40 lighthouse tube in the transmitter, while not designed specifically for pulsed application, has been widely used in both c-w and pulsed circuits at these frequencies. Very reliable performance has been experienced, providing it is plate pulsed with at least 1,200 volts.

In this radar beacon, the 2C40 tube is operated in a conventional re-entrant cavity. The outer case is brass and the inner conductor consists of a beryllium copper-spring finger section for contacting the plate cap of the tube and an Invar section for temperature compensation. Tuning of the cavity over the frequency range of 2,700 to 2,900 mc is accomplished by moving the plate-choke plunger fingers with an external gear train and tuning rod. Power is taken out of the cavity by a capacitance probe adjustable from the exterior of the cavity. The average peak power output is 180 watts.

The cavity is temperature compensated for average tubes. With tube selection, frequency drift may be maintained to limits of ±2 mc over an ambient range of 100 C. Without selection, frequency drift seldom exceeds ±5 mc.

The schematic diagram of the pulse modulator is shown in Fig. 5. It consists of a resonant charging system with a pulse-forming line and a thyratron discharge tube. The plate of the r-f oscillator presents an impedance of approximately 1,500 ohms to the modulator output.

Impedance of the pulse-forming line was first calculated for a value of 15 ohms and then adjusted experimentally to give optimum power output and spectrum configuration. The output transformer has a turns ratio of 10. The three line capacitors in conjunction with the charging choke have a resonant

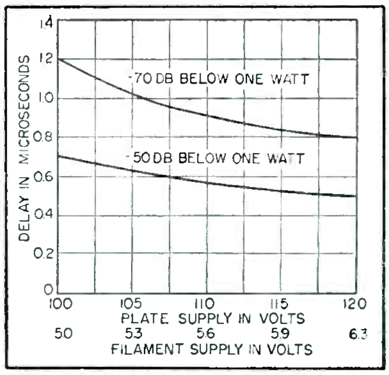


FIG. 4—Effect of supply voltage changes on the receiver sensitivity and internal time delay

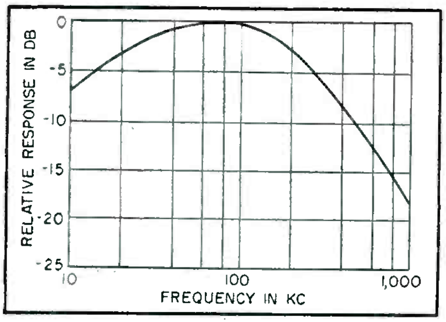


FIG. 2—Frequency-response characteristic

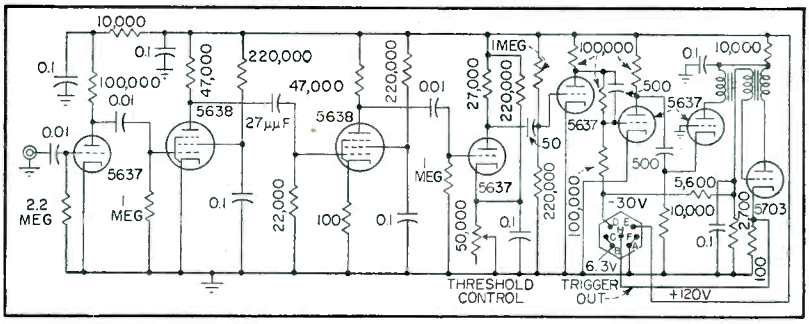


FIG. 3—Schematic diagram of the beacon receiver

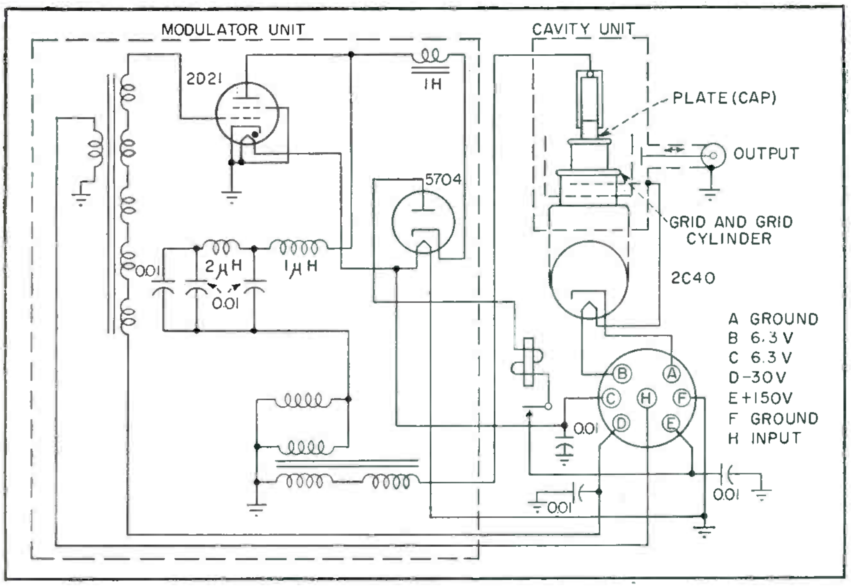


FIG. 5—Schematic diagram of the transmitter

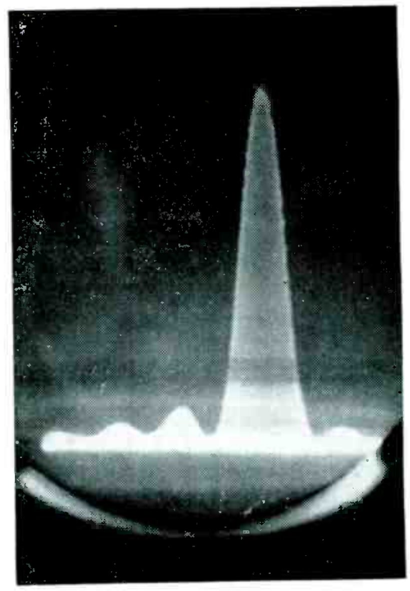


FIG. 6—Photo of transmitted spectrum

frequency of approximately 1,000 cycles. Tube type 5704 is a subminiature type used as a hold-off diode. With a modulator plate supply of 150 volts, the line charges to a peak value of approximately 280 volts and the hold-off diode maintains this value until the next triggering pulse occurs.

Trigger Pulse

The triggering pulse from the receiver is applied to the grid of the thyratron through a 10-to-1 step-up transformer. This allows for a low-impedance coaxial cable connection of the receiver output to the transmitter input.

A bias supply holds the thyratron in a nonconducting state until the application of the trigger pulse. The transmitter will respond to interrogation pulses at any repetition rate up to 2,000 per second. Protection of the transmitter from overinterrogation is accomplished through the use of an overload relay in the plate circuit of the modulator. The relay is connected in buzzer fashion so that it continues to close the circuit until the overinterrogation ceases.

The transmitter r-f output spectrum is shown in Fig. 6. The nominal output pulse width is 0.65 μsec giving a spectrum width of approximately 3 mc. The ratio of the major lobe to the highest minor lobe is 11 db.

The internal delay of the transmitter is approximately 0.1 μsec so that the over-all beacon internal delay is 1 μsec.

The modulator components are mounted on a metal chassis and with the exception of the thyratron and overload relay are potted in Melpak IV-M casting resin. The high voltage lead is brought out the side of the modulator block for connection to the plate end of the r-f cavity.

The modulator and cavity are mounted in a rectangular metal box. The power and trigger input is made through a 7-pin miniature connector on the end of the case. The cavity is tuned from the same end by means of a screw-driver adjustment. Supply leads are bypassed by a set of capacitors in the bottom of the case. The r-f output connector is on the side of the case. The dimensions of the transmitter are $7\frac{1}{2}$ by $3\frac{7}{16}$ by $1\frac{5}{8}$ in. and the weight is $2\frac{1}{4}$ lb.

The complete beacon requires a plate supply of 150 v at 12 ma when operating at a pulse repetition rate of 800. A negative bias supply of 22.5 to 30 v at 3 ma and a heater supply of 6 v at 3 amp are required. The high-voltage plate supply may be obtained from a vibrator, dynamotor or batteries. One installation, requiring only 30 minutes of operating time, utilizes hearing-aid type batteries. In this case, two battery packs, each the size of the video receiver, supply plate power and a Willard type-NT6 storage battery supplies the 3 amp required for the heaters.

The small volume requirements prohibited the use of shock or vibration isolators. Potting of the receiver in resilient casting resin aided in reducing microphonism. All units of the equipment may be mounted directly to a surface of the aircraft. The equipment will perform as intended under conditions of at least 10g vibration in any plane and will withstand at least 50g shock in any direction.

The equipment will operate satisfactorily in ambient temperatures ranging from − 40 to + 75 C and at altitudes up to 60,000 feet. The types of antenna employed vary with individual applications. Quarter-wave stubs are frequently used.

Coding

Coding circuits have not been incorporated in order to keep the size of the equipment to an absolute minimum. The addition of code-recognition circuits in the receiver and code-generating circuits in the transmitter is possible with some modification.

This equipment is based upon an original Naval Research Laboratory design by C. R. Ahern to whom full credit for the basic work is acknowledged.

Improving PROGRAM

Use of delay limiter described prevents sideband splatter on crowded a-m broadcast channels effectively and economically. Fringe area reception is improved, overmodulation peaks are reduced in number and total modulation energy is greater

By DONALD W. HOWE, Jr.

Consulting Engineer
Station WARE
Ware, Mass.

CERTAIN BROADCAST peak-limiting amplifiers are often unsatisfactory on the present crowded and competitive a-m broadcast channels where sideband splatter has to be prevented to avoid interference with nearby adjacent-channel stations and maximum program level is imperative for effective coverage.

As far as coverage is concerned, it would be possible simply to adjust the limiter output to the 100-percent modulation point and to increase the input to get a high average modulation. Most listeners would never notice the distortion. In this case, the transmitter would be overmodulated for several peaks of each loud beat of music. Even some of the new limiters are subject to this criticism since they avoid transient distortion known as "plop" or "thump" by using an attack time of 50 to 100 milliseconds. This practice gives rise to radiations on several adjacent channels with serious consequences.

The device to be described is the result of efforts to improve the operation of the limiter in use at WARE, rather than incur the greater expense of a limiter that would meet our requirements.

The goal set was the fulfillment of the requirements set forth by Maxwell[1]; essentially zero attack time to prevent even occasional overmodulation, flat output level characteristic, and elimination of transients. Any one requirement may be obtained easily at the expense of the others.

The delay limiter was developed to enable the standard limiter to provide zero attack time with the least possible detriment to the second two requirements. Flat output level and elimination of transients may be secured by proper adjustment and balance of a good standard limiter.

The author was formerly assistant professor of electrical engineering at Worcester Polytechnic Institute, Worcester, Mass.

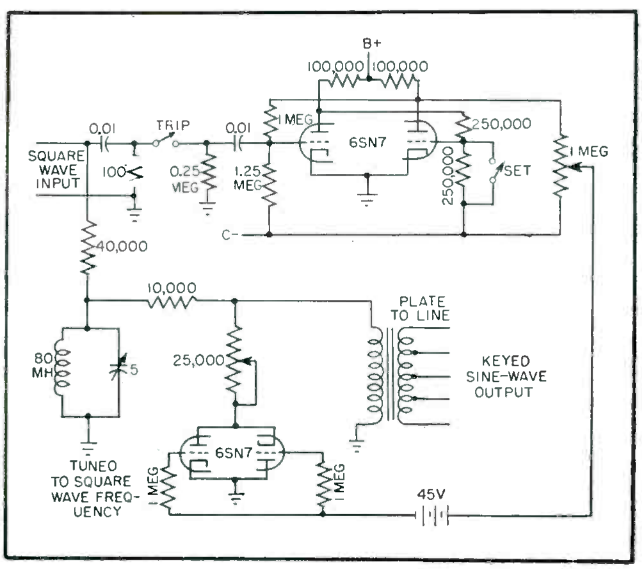


FIG. 1—Circuit to produce increase in amplitude of output sine wave as it goes through zero

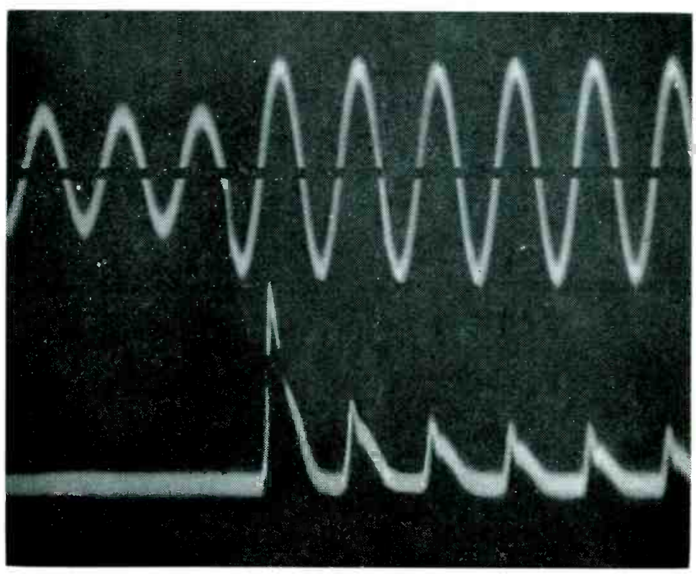
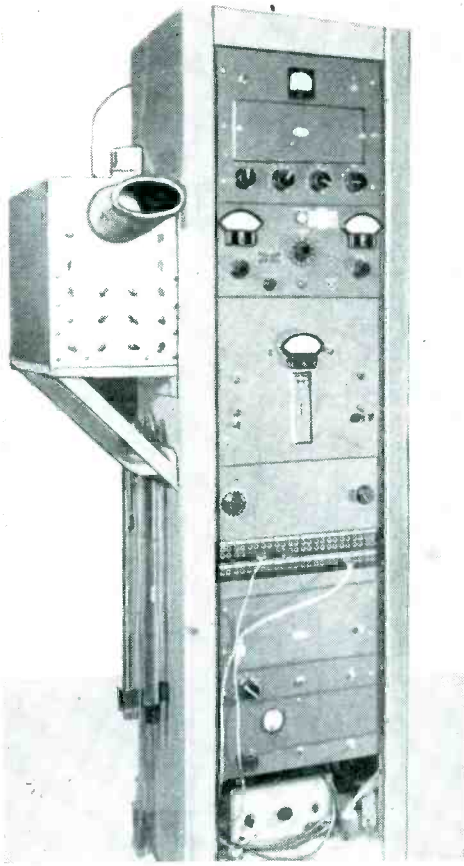


FIG. 2—Delayed standard signal and accelerating pulse. Upper wave is the type produced by the circuit of Fig. 1

LIMITER PERFORMANCE



Audio and monitor rack with standard limiter at top. Delay limiter is in the bottom panel

Chassis layout of complete delay limiter. Delay line coils can be seen projecting through the chassis

Panel of complete delay limiter showing single control. Linear compression scale is obtained by using expanded meter scale

To study the dynamic performance, a standard signal is desirable. The circuit shown in Fig. 1 provides a sine wave whose amplitude can be increased by a known amount on an impulse from an oscillograph switch, the increase occurring where the wave crosses the zero axis. The upper wave in Fig. 2 shows the type of signal produced.

The need for such an electronic switch is shown by the initial transient in Fig. 3. The entire waveform is the response of the limiter as it was received from the factory to a sudden 6-db increase above limiting threshold in a 360-cycle wave. Aside from the mechanical switching difficulties are the defects of the limiter itself: 3.7-db overshoot, about 20-milliseconds attack time and a control ratio (increase in input over increase in output) of 5.5. Such operation cannot provide much increase in program level without serious overmodulation splatter on other stations.

Circuit Development

If the input signal to the limiter were fed through a delay line and the control bias were obtained from a separate amplifier fed from the input to the delay line, the limiter should be able to anticipate peaks. This simple idea is likely to result in overcontrol and was discarded in favor of the pulse method to be described, which simply speeds up the action of the regular limiter.

Consider a limiter having the general type of circuit shown in Fig. 4. Voltage divider R_1-R_2 provides a diode bias so that the limiter gain will be constant up to the limiting point at which the diodes conduct, producing a gain control bias for the control tube or tubes V_1. In general, the larger this diode bias is in comparison to the control tube bias, the greater will be the control ratio or the flatter will be the output level characteristic.

The diodes operate on peaks and because a finite time always is required to charge C_1, one or more peaks get through the limiter before gain reduction is complete, as shown in Fig. 3. If the diode delay bias could be reduced momentarily just prior to the peak of a too large signal wave, the diodes could rectify on the increasing slope of the large signal and would have C_1 charged to a sufficient degree to anticipate the peak without resorting to a clipping action. This reduction in bias is accomplished by a pulse circuit, as shown in Fig. 6.

A block diagram of the whole

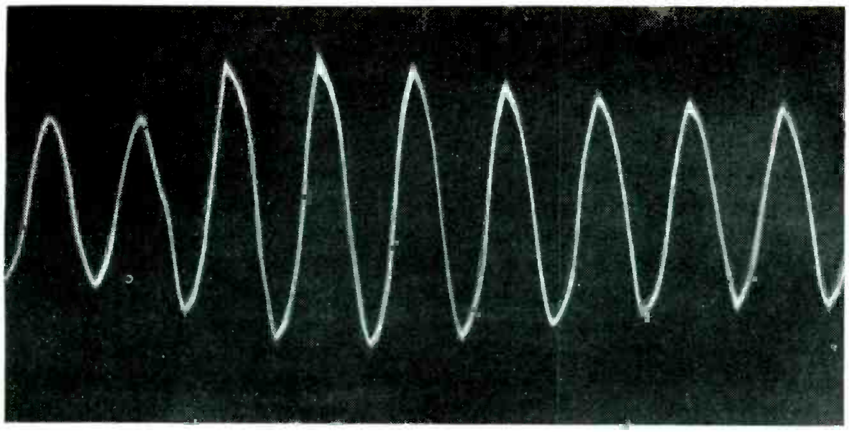


FIG. 3—Performance of a factory-adjusted standard peak limiter to a sudden 6-db increase above threshold.

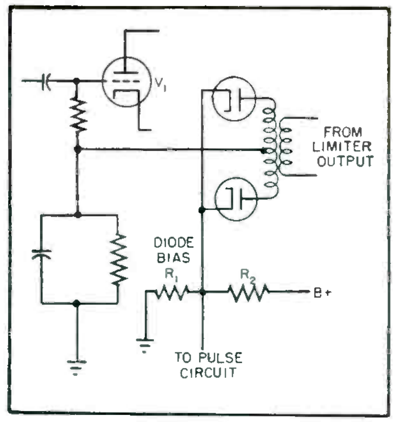


FIG. 4—General type of standard limiter circuit for adapting to delay limiter

device, Fig. 5, will perhaps best explain its operation. The heart of the circuit is the 0.25-millisecond delay line, representing with lumped constants, a distortionless telephone line. The number of elements determine the cut-off frequency, about 27,000 cycles here.

To make up for the delay line losses, an additional stage was added and this provided an opportunity to provide compression to aid the peak limiting. The bias amplifier, fed from the cathode of the 6L7, supplies the agc bias and a monitoring output, as well as supplying undelayed signal to operate the pulse-forming circuit shown in Fig. 6.

In the pulse-forming circuit, the 1N56 and its R-C load provide a voltage for the grid of one-half a 6SN7, which follows the envelope of the signal at least on the increasing side. For any steady signal level the 6SN7 is at or near cut-off by virtue of its high bias resistor. On any sudden increase in signal, however, the tube will conduct until the 0.5-μf cathode capacitor is charged, dragging down the diode bias of the standard limiter before the peak of the delayed signal reaches the output of the limiter. No attempt was made to use full-wave rectification but polarities were carefully chosen so that this speed up acts on the negative modulation peaks. A few peaks above 100-percent positive modulation cause no harm. As additional insurance against negative overmodulation, an adjustable clipper is used which does not operate on any steady-state signal but only before the 6L7 gain is automatically reduced. Even then the tops of high peaks are not really clipped but only rounded.

Three time constants are used to provide correct operation with all types of program material. First, the standard peak limiter has essentially zero attack time, and its release time is usually set about 0.25 second. Second, the 6L7 agc has an attack time of approximately one second, controlled by the 0.25-μf capacitor and its 2-megohm charging resistor. Recovery time is twice as long. Third, when a high level continues for several seconds, the 4-μf capacitor becomes charged, preventing full-gain recovery for ten or fifteen seconds.

Adjustment and Operation

Figure 7 shows the complete diagram of the added unit used. The adjustment of the input signal level, input to bias amplifier controlled by R_1, agc voltage controlled by R_2 and the bias on the pulse amplifier controlled by R_3 are somewhat interrelated and must be adjusted with care. It was found that the highest signal received, −20 db, would allow a compression of 12 db with no more than 2-percent distortion. The meter in the cathode circuit of the 6L7 provides a measure of compression once calibrated.

Flatness of agc characteristic is controlled by R_2. A high setting of R_2 requires a high setting of the input voltage from R_1. Since a compression action rather than a limiting action is wanted here, R_2 should be set low enough to give a gradual gain reduction. Finally R_3 may be

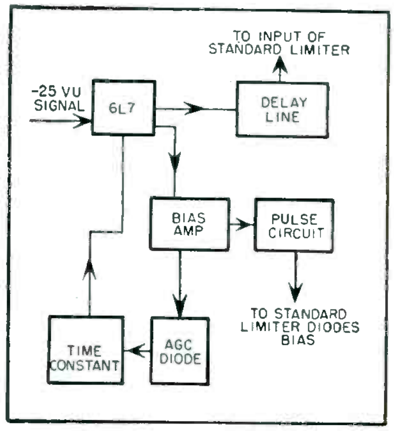


FIG. 5—Block diagram of delay limiter

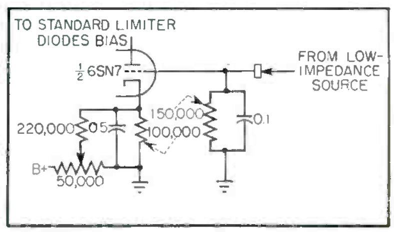


FIG. 6—Pulse-forming circuit used in delay limiter

set so that the pulse tube is completely nonconducting except for sudden increases in program level. An oscilloscope on the diode bias of the standard limiter is useful.

A desirable form of pulse is shown in Fig. 2 in relation to a suddenly increased 500-cycle signal out of the delay line. The single panel control shown in the photograph is the input to the bias amplifier R_1. This control in practice provides an adjustment of the average compression carried and is set to zero when making over-all noise and distortion measurements.

The oscillogram, Fig. 2, shows that the pulse starts only a few degrees after the signal goes through zero in a direction such as to produce negative modulation. If the polarity of the standard signal were reversed, making the first large peak in such a direction as to produce negative modulation, the pulse would start only a few degrees after the previous zero. In this case, the pulse reaches its peak of 32 volts about 30 degrees or 0.17 millisecond before the peak of the input signal to the limiter. The bias on the limiter diodes is then decreased from its normal 75 volts to 43 volts.

If the bias voltage during a pulse is x volts, limiting action will start when the instantaneous value of the input signal is $x/75$ of the normal peak threshold value and should be complete by the time the first peak is reached. Successive pulses after the first are unnecessary and perhaps undesirable since they reduce the steady-state output below the normal value. The oscillogram is not long enough to show the complete disappearance of these pulses when the slow agc has reduced the gain of the input 6L7.

Performance

The unit has been used in conjunction with a Raytheon limiter amplifier and listener response has been gratifying. In many fringe areas where the measured field strengths of other stations are 2 or 3 times the strength of WARE, we have been reported as the loudest signal on the band. This is probably due not so much to the fact that the output of the limiter can be set 3 or 4 db higher without overmodulation as it is due to the reduction of dynamic range by the compressor. Since the service area of a class II, III or IV station is protected from interfering co-channel signals only in excess of −26 db (20 to 1 field strengths), there is not much point in preserving a dynamic range of more than 20 db. The time constant of the automatic gain control of the 6L7 input stage serves to bring the weaker portions of a program out of the mud and in general leads to greater listener satisfaction.

A more scientific test was made with a ten-minute taped program. It was played through once using the standard limiter alone and again using the complete equipment. Thirty overmodulation peaks as indicated by the modulation monitor flashing lamp were observed in the former case, and only three using the delay line limiter. Furthermore, the total modulation energy as indicated by a thermal integrating wattmeter, was 53 percent greater than for the standard limiter. In both cases the limiter amplifier was operated with 5-db maximum limiting and when the delay limiter was used its average compression was 6 db in addition.

A simultaneous oscillogram of output signal and pulse voltage when the unit was operated on program with more than 10 db peak limiting is interesting, as shown in Fig. 8. Note that practically none of the negative signal peaks exceed the 100-percent modulation line but that many peaks extend above the 100-percent positive modulation line. Since the limiter action is designed to anticipate negative modulation peaks only, positive overshoot may be expected. Proper choice of input signal polarity when positive and negative peaks are unequal may result in considerable increase in volume level.

Further Development

Oscillograms taken with the standard test signal were somewhat disappointing in that they showed an overshoot for a small fraction of a cycle. Increased delay may be necessary here or perhaps the pulse circuit should be fed

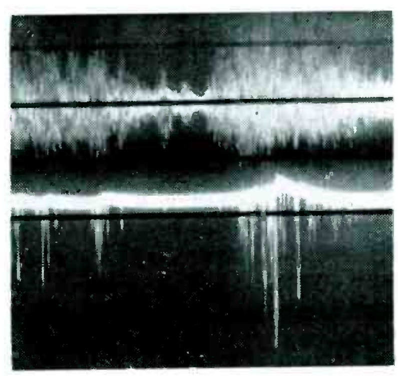


FIG. 8—Program performance of delay limiter showing accelerating pulses for 10 to 15-db limiting

from a cathode follower to avoid output transformer phase shifts.

To prevent a transient rattle in the limiter, it is essential that the gain-controlled tubes be balanced for small and large signals as well as for static current. Individual cathode and screen adjustment together with means for detecting dynamic balance are being installed.

A useful addition would be some means of selecting the polarity of the incoming signal such that the larger peak would always give positive modulation.[2]

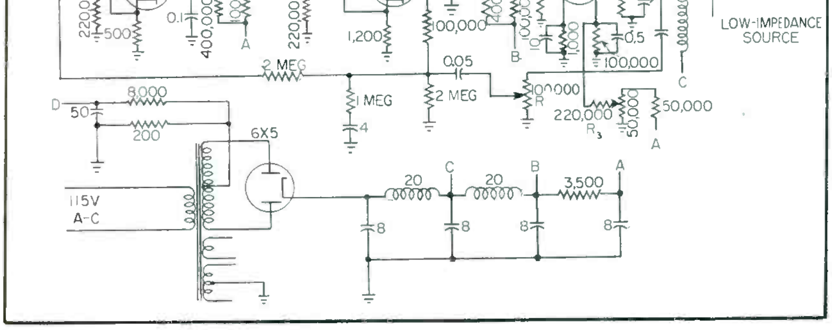


FIG. 7—Schematic diagram of delay limiter

REFERENCES

(1) D. E. Maxwell, Dynamic Performance of Peak-Limiting Amplifiers, *Proc. IRE*, Nov. 1947.
(2) R. P. Crosby, Automatic Phase Reversal Amplifier, ELECTRONICS, **14**, p 64, Oct. 1941.

MULTIPLEXING

How resonant cavities can be employed to give good isolation between channels, no signal loss, sufficient band pass, simple tuning and no interference in receiver circuit. Disadvantages of other possible methods are discussed

SINCE THE CONCLUSION of World War II, progress has been made on multiplexing and duplexing equipments in connection with utilizing the microwave spectrum for communications. The information presented in this paper was obtained as a result of experimental work to determine the best method of combining simultaneously several modulated r-f signals in a single microwave transmission line for communication purposes.

Several possible methods of combining with a frequency-sharing principle are as follows: use of the hybrid T, directional couplers, line stretchers, tunable stubs, multiple-feed antennas, band-pass or band-reject cavities and various special devices for setting up and controlling standing waves.

Use of hybrid T and directional couplers was disregarded because the incident energy splits up into two parts and normally results in an undesirable 3-db loss per coupler or T unless auxiliary equipment is used to recombine the divided energy in the proper phase.

The first attempt at double combining was to use a line stretcher. Figure 1A shows a simple schematic diagram of the laboratory setup. Varying the length of the line stretcher has an effect on both the power output and the crosstalk between channels. Since tuning both klystrons for maximum power output results in a minimum of crosstalk, this is the proper condition to achieve.

The overall results indicate a crosstalk ratio of 47.5 db which represents a higher degree of crosstalk than can be tolerated. Also, there was evidence of klystron frequency pulling so the method was disregarded.

Figure 1B shows a triple combiner using line stretchers. When attempting to combine three or more generators by this method, each generator with its line stretcher must cause a high impedance to appear at the T junction to the other signals. Therefore, a match can no longer be obtained by adjusting the line stretcher over a small range because the line stretcher must be long enough to accumulate enough wavelengths to reject two or more frequencies. Because the combiners had to be so large in size and were extremely difficult to tune, they were finally disregarded.

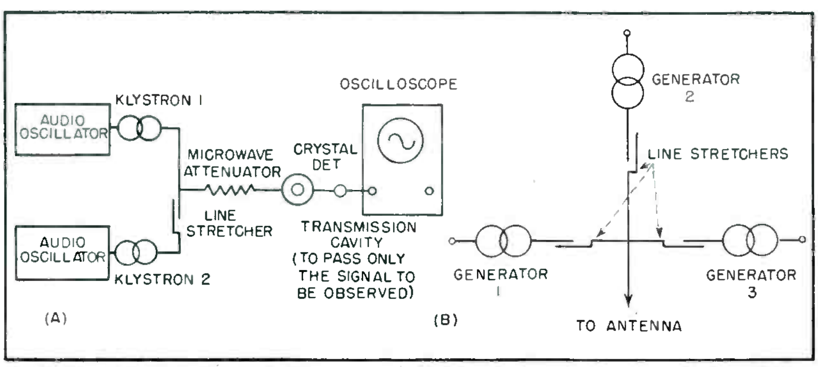


FIG. 1—Double combiner using one line stretcher (A) and triple combiner using line stretchers (B)

Stub Tuners

The next series of tests was performed with stubs using a special double combiner built for the purpose, see Fig. 2A. Here each stub must reject one frequency and pass one frequency for proper operation. Lengths of the stubs are

$$L_3 = (2n_1 - 1)\lambda_{ga}/4 = 2m_1\lambda_{gb}/4$$

$$L_2 = (2n_2 - 2)\lambda_{gb}/4 = 2m_2\lambda_{ga}/4$$

Each of these equations has two unknowns and a simple solution for n and m could be found graphically or by trial and error. For a three-stub tuner, each stub must reject two and pass one frequency and the solution for L becomes increasingly difficult.

It was found best to tune the klystron plunger for maximum output from the klystron and leave it there while the stubs were adjusted and the other dimensions changed as desired.

If the distance between the generators and the T junction is varied, tuning of the stub is affected. However, for certain spacings of the klystrons to the T junction, the stubs had practically no effect and preliminary indications were that the generators were operating properly.

The real reason for disregarding stub tuning is that an excessive number of stubs is required for even a reasonable number of channels. The formula relating the number of channels to the number of stubs required is

$$(n - 1)\,n = k$$

where n is the number of channels and k is the number of stubs re-

KLYSTRONS

By WILLIAM L. FIRESTONE

Microwave Engineering
Motorola, Inc.
Chicago, Ill.

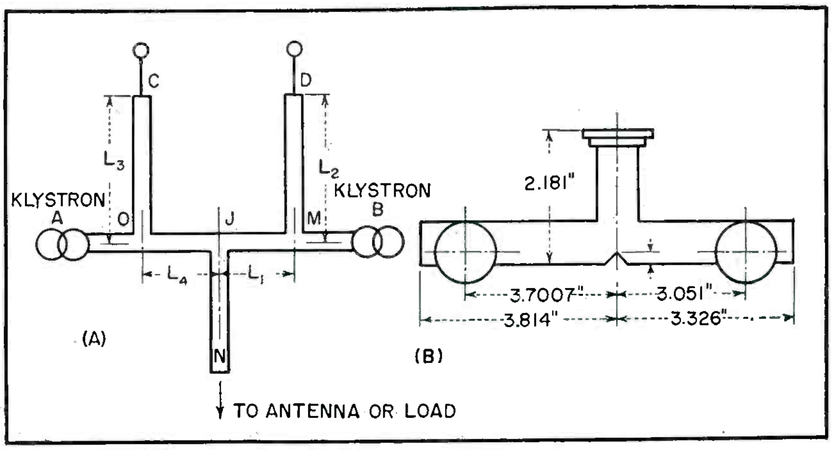


FIG. 2—Combiner using tunable stubs for two channels (A) and fixed-tuned double combiner with notched T (B)

quired. Thus, for six channels, 30 stubs are required.

After stubs were eliminated from consideration, line stretchers were reconsidered except that now the conventional types of line stretchers were replaced with waveguide spacers.

A waveguide spacer is a flat piece of metal of any given thickness whose outer dimensions permit it to be screwed between waveguide flanges and whose inner dimensions are the same as the waveguide. In effect it is a small transformer at short wavelengths.

Advantages of using spacers are that they can always be constructed short in length and their mechanical and electrical length is easily measured. Disadvantages are that they cannot be adjusted as easily and continuously as most conventional-type line stretchers which means that many spacers of different lengths should be kept on hand at all times if they are to be used.

Fixed-Tuned Combiners

Using the waveguide spacers and conventional starting sections (pieces of waveguide that hold the generator and start the energy down the waveguide), several fixed-tuned combiners were developed. The final version of the double combiner is shown in Fig. 2B. The lower frequency channel, in this case 8,300 mc, is the channel that always has the largest amount of crosstalk.

The crosstalk on both klystrons can be better than 60 db down if the klystrons are spaced 200 mc apart. If they are spaced closer than 200 mc, then a loss in power between two and three db will also decrease the crosstalk to the indicated value.

A triple combiner was developed next using the same principles. It worked satisfactorily and all crosstalk readings were better than 68 db below the signal level. It must be kept in mind, however, that the double and triple combiners described depend on a frequency separation of 200 mc to keep the crosstalk down to 68 db.

It is still not known what kind of impedance the complete combiner would present to an incoming signal when this combiner is used as part of a duplexer. If the incoming signal were close in frequency to one or all of the transmitter frequencies, it is likely that the weak received signal would be lost in the transmitter plumbing.

Multiple-feed antennas, one antenna for transmitted signals and one for received signals, were disregarded because the coupling between the two antennas would be excessive. Undesired transmitted signals would get into the receiver circuit at an excessively high signal level and cause crosstalk.

Many experiments were run using every kind of cavity from a cylindrical tunable resonant cavity of high Q to rectangular semitunable resonant cavities of low Q. At all times, the spacing of the klystron to the cavity was kept in mind and the waveguide spacing between channels properly adjusted. Many different klystrons had to be used in any given setup to prove that any arbitrary klystron would work properly in any position or have sufficient power output and f-m modulation capabilities without excessive frequency pulling.

Resonant Cavities

Band-pass and band-reject cavities[1,2,3] are in reality filters. They are called cavities because at microwave frequencies the filters take the form of partially enclosed sections of hollow waveguide.

The ideal rejection filter would reflect perfectly within a certain band and pass perfectly outside of this band. Series-resonant circuits placed at quarter-wave intervals along the waveguide, properly dis-

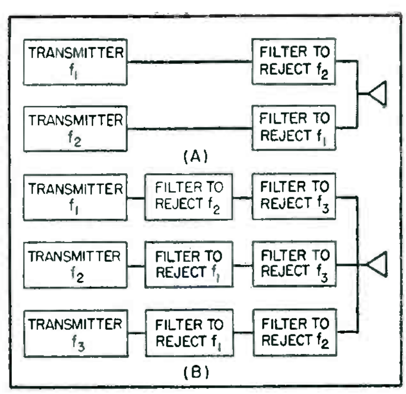
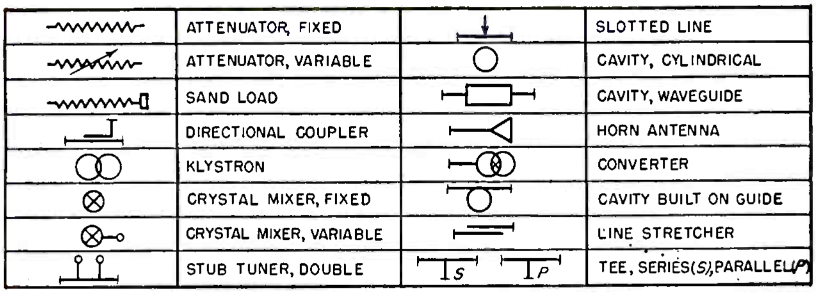


FIG. 3—Block diagrams of combiners using band-reject filters; (A) two channels, (B) three channels



Symbol designations used throughout all illustrations

tributed in impedance and all tuned close to the center frequency of the channel to be rejected, accomplish this end.

The ideal band-pass filter would pass perfectly within a certain band and reject perfectly outside of this band.[1,4] This can be done by using two resonant irises separated approximately by a half wavelength. The irises form a resonant cavity and are coupled to the next pair of resonant irises by a quarter wavelength.

Any number of pairs of irises could be cascaded to give the proper band-pass characteristics although the higher the Q of the individual cavities, and the greater the number of them, the greater would be the insertion loss. This is true because as the Q is increased in waveguide cavities, the coupling is automatically decreased, thereby increasing the insertion loss. Also, insertion losses are additive for series cavities.

Figure 3A shows a block diagram of a combiner using band-reject filters for two channels. If each filter has a high enough rejection to the unwanted signal and a low enough insertion loss to its own transmitter signal, the solution of the combiner is easily obtained.

Figure 3B shows a block diagram of a combiner using band-reject filters for three channels. Six filters are now required. If the frequencies are spaced in some fortuitous manner, it may be possible to reject several frequencies with a single rejection cavity having the proper rejection range.

Assuming no special simplifications are made in respect to frequency allocation and that each cavity is designed to do a single job as indicated, the number of rejection-type cavities or filters required is indicated in Table I.

The table shows that the number of cavities required to combine several channels becomes excessive. The number of stubs required is the same as the number of filters required for a given number of channels, which is to be expected since each stub and each rejection cavity have the same purpose, namely to pass one frequency and reject another. Their manner of accomplishing this purpose is different.

From Fig. 3B, it can be seen that if frequency f_1 is lower than all other frequencies, the two filters in its channel could be combined into one low-pass filter and thereby reject f_2 and f_3. Similarly, if f_3 were higher in frequency than all other frequencies, then it would be possible to replace the two filters in the f_3 channel by one high-pass filter and thereby reject f_1 and f_2. It is important to note that using this procedure would simplify the number of filters only in the highest and lowest frequency channels and could not reduce the number of filters in all other channels.

The final system that was worked out as being the best for multiplexing with a high degree of isolation between channels and without excessive signal loss is very similar to that proposed by A. J. Fox except that all of the details and dimensions of a practical system have been determined.

Final System

In the final version of the system, three transmitters and three receiver channels were all connected to the main line. Figure 4A shows the physical arrangement of cavities in a less complex system utilizing three transmitters and only one receiver. Figure 4B is a schematic diagram of the simpler system.

The receiver channels consist of three cavities $\lambda_g/4$ coupled. Each section has a Q of 150. This combination results in a band-pass characteristic which is sufficiently wide and also permits the received signal to go through with less than two db of loss. It also sufficiently attenuates the transmitter signals so as to permit no interference effects in the receiver circuit.

The transmitter channels have single waveguide cavities with a Q of 100. This value of Q is sufficient to keep other signals out to such an extent that the cross modulation is 68 db below the signal level in the given channel. The cavities cause only one-db loss of transmitter power.

Each transmitter and receiver channel, except the end transmitter, is spaced electrically an odd number of quarter wavelengths (at its own

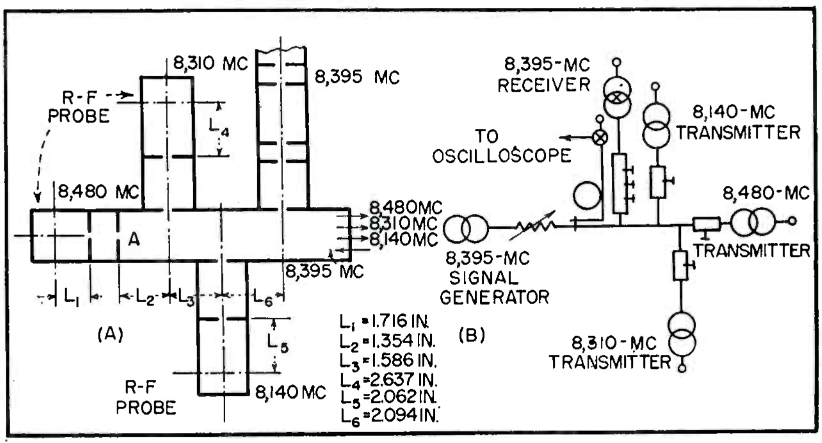


FIG. 4—Physical arrangement of cavities in a multiplexing system using three transmitters and one receiver (A) and schematic diagram of this system (B)

wavelength) from the end transmitter channel which acts as a stub for all other channels.

The 8,310-mc transmitter is spaced electrically from the 8,480-mc cavity by $3\lambda_{g1}/4$, where λ_{g1} is the wavelength at 8,310 mc, see Fig. 4A. This spacing is shown on the diagram as L_2. By comparing L_2 to λ_{g1}, it can be seen that L_2 is in reality 0.6 wavelength but 270 electrical degrees. The mechanical dimensioning is not identical with the electrical dimension because the 8,480-mc cavity presents some reactance at 8,310 mc at point A in Fig. 4A.

Considering that the Q of the cavities is only 100 and that the 8,480-mc klystron presents a certain impedance, it would not be expected that the klystron would present zero reactance at point A, the necessary condition for spacing each channel an odd number of wavelengths from the end channel.

The 8,140-mc channel is spaced $5\lambda_{g2}/4$ electrical wavelengths from the end channel and the 8,395-mc channel is spaced $9\lambda_{g3}/4$ electrical wavelengths from the end channel. The $\frac{1}{4}$, $\frac{3}{4}$ and 7/4 wavelength points were not used because of physical limitations.

Reflections from the transmitter

Table I—Number of Channels Versus Number of Filters

Number of Channels To Be Combined	Number of Filters Required
2	2
3	6
4	12
5	20

cavities were of such a nature as to cause a minimum of frequency pulling of the transmitter klystrons.

The system using three transmitters and three receivers per main waveguide line has been used successfully for many months in a complete microwave link. One of the advantages of the system is its simplicity of tuning. Once it is properly built and aligned there is nothing further to adjust except the klystron frequency.

Since different systems of multiplexing were tested in developmental work over a period of years, many different kinds of laboratory setups were required. A typical laboratory setup for a triple combiner is shown in Fig. 5.

If a simpler version of combining were desired, such as a combiner with only one transmitter and one receiver, it would be possible to eliminate the band-pass cavity associated with the transmitter by proper spacing of all elements. This simplified system is now in actual field use.

Contemporary Work

Engineers of one research laboratory propose a band-pass filter to limit transmitter output spectrum. Use of the band-pass filter also makes the problem of antenna duplexing somewhat simpler.

Antenna duplexing using band-rejection filters only has been proposed but the number of rejection filters needed to protect the receiver mixer crystal completely from burnout and to prevent saturation of the receiver first grid may be impractical. Use of a band-pass filter in the transmitter output circuit together with the previously suggested band-rejection filter in the receiver line would give the required isolation with a minimum of filter elements. This plan makes possible antenna duplexing, smaller frequency separation between transmitter and receiver and limited transmitter spectrum output. Figure 6 shows a block diagram of such an arrangement.

There are different requirements for the multiplexer just described and the combiner or multiplexer developed here. First, in the above system there is no need to combine several transmitters at once because position-modulated pulses are used to send several pieces of information over the same channel. The combiner developed here uses frequency-modulated c-w oscillators and, normally, several channels would be required for carrying different types of signals.

Second, band-pass filters are used only to conserve the use of the r-f spectrum whereas band-pass filters have been suggested herein not only

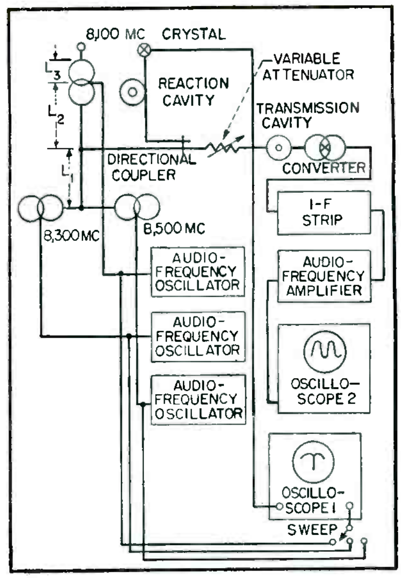


FIG. 5—Setup for a triple combiner

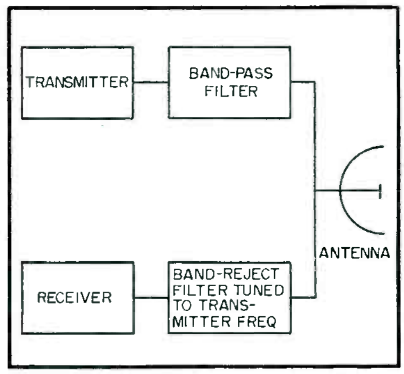


FIG. 6—Relay using resonant cavities

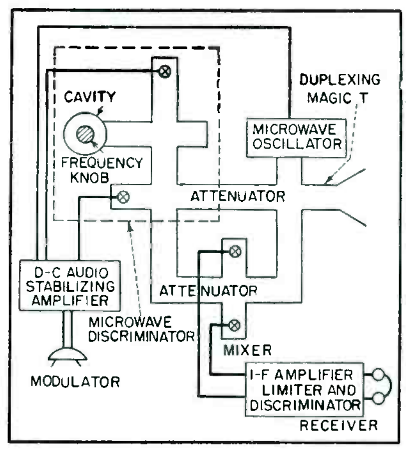


FIG. 7—Duplex system for microwaves

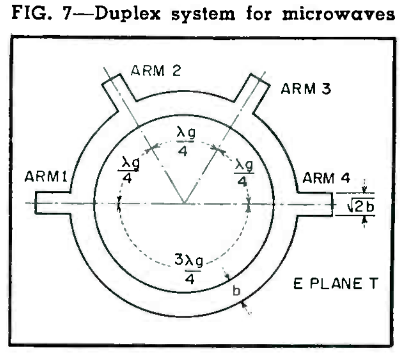


FIG. 8—Hybrid circuit or waveguide ring network

for that purpose but also in order to isolate each channel from the next. Last, from previous discussion the conclusion reached would be to use a multiplexer consisting completely of tuned resonant band-pass cavities.

Duplex System

A duplex system of communications for microwaves, built and explained by R. V. Pound, is a system in which a single microwave oscillator is used as both transmitter and beating oscillator.[5] The oscillator is stabilized at the frequency of a high-Q cavity and frequency modulated about this frequency. If one-half the power is lost when the oscillator is used as a transmitter and one-half is lost when the system is used as a receiver, then for communication between any two stations a total of six db is lost. A block diagram of the duplex communication station is shown in Fig. 7.

There are several factors that simplify the building of such a system, including the following: only voice modulation is used instead of video, only one channel is used at any one time so there are no problems of combining or crosstalk between channels and a total modulation bandwidth of only ten kc is used. There is a loss of six db per channel which is excessive for the development discussed.

Because of the different type of modulation used and the bandwidth required, the system described by Pound is not too concerned with the f-m linearity of the modulated oscillator. This factor can not be ignored in a more complicated system. Much a-m and f-m distortion can be tolerated in a system requiring only intelligible voice to be transmitted.

Nonreflecting Branching Filter

A nonreflecting branching filter for microwaves has been designed by W. D. Lewis and L. C. Tillotson.[3,6] The circuit consists of two hybrid junctions, two identical channel reflection filters tuned to the dropped channel and two quarter-wavelength sections of line. The hybrid circuit is shown in Fig. 8.

The circuit in Fig. 9 as shown

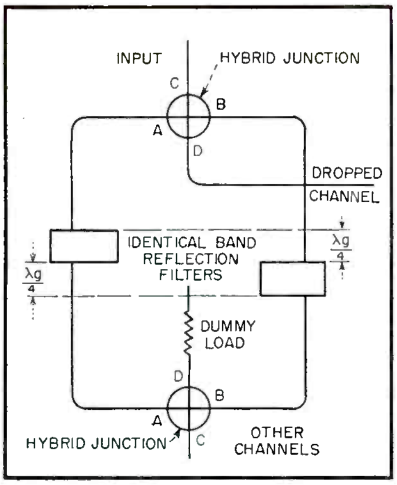


FIG. 9—Constant-impedance channel-dropping filter

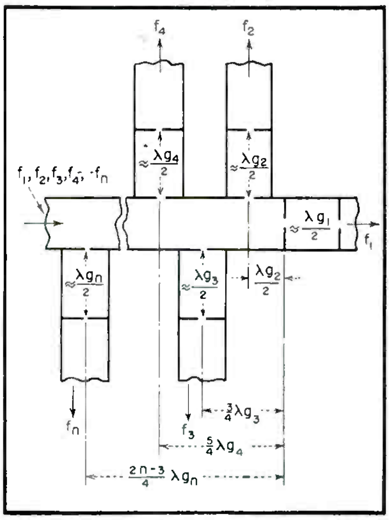


FIG. 10—Multiple separator using resonant cavities

could be called a separator insofar as it separates many signals from each other. If at each point of extraction of a signal the procedure was reversed and a signal was inserted, the result would be a combiner which should function without excessive losses.

Discrimination against other channels and image responses was measured at 20 db or more. To improve crosstalk discrimination it would be necessary to place auxiliary filters in the branch arms which would increase the insertion loss slightly.

Measured insertion loss of the system varied from 0.5 to 1.0 db. This insertion loss was measured between the input line and various output lines with the lowest insertion loss occurring in the lowest frequency channel.

The requirement for crosstalk developed in the system by the author is 68 db or more, making the amount of selectivity of the system just described inadequate.

Multiple Separation

A multiple separator has been considered in which channel filters are connected across a transmission line or waveguide in such a way that power in each signal is diverted to appropriate branches with negligible loss.[7] A diagram of a multiple separator developed by A. J. Fox is shown in Fig. 10.

Several important facts are missing from the discussion of this system, namely; the center frequency and frequency separation between channels, the amount of crosstalk between channels, the insertion loss and frequency band pass of the waveguide cavities and the nature of the spacing between the mixers and the cavities. The author has used the cavities only as a separator and does not indicate their possibility for use as a combiner or in a duplexer.

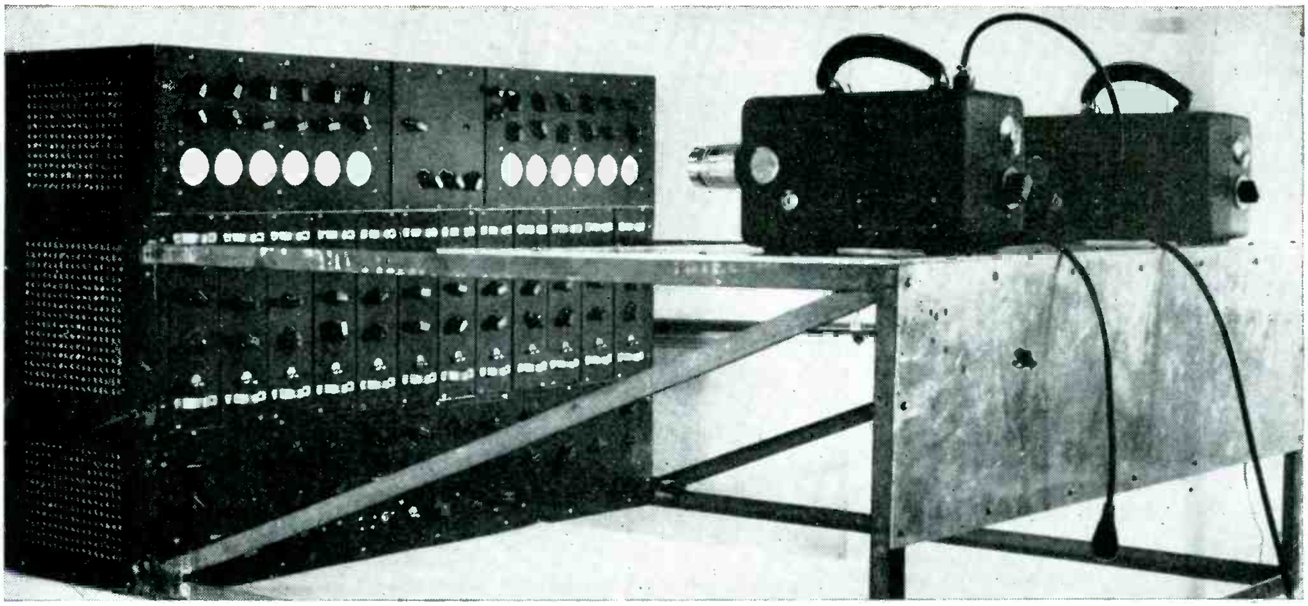
Several microwave relay systems have been discussed by various authors but in most instances only one r-f carrier was used and, consequently, the problems of combining, separating or of crosstalk between channels do not occur.[8,9]

References

(1) R. M. Fano and A. W. Lawson, Jr., Microwave Filters Using Quarter Wave Couplings, *Proc. IRE*, **35**, Nov. 1947.
(2) W. L. Pritchard, Quarter Wave Coupled Wave Guide Filters, *Jour. App. Phys.*, **18**, p 862, Oct. 1947.
(3) W. D. Lewis and L. C. Tillotson, A Non-reflecting Branching Filter for Microwaves, *BSTJ*, **1**, p 83, 1948.
(4) C. G. Montgomery, "Technique of Microwave Measurements," Radiation Laboratory Series, McGraw-Hill, p 522, 1947.
(5) R. V. Pound, A Duplex System of Communications for Microwaves, *Proc. IRE*, **36**, p 840, July 1948.
(6) H. T. Friis, Microwave Repeater Research, *BSTJ*, **4**, p 183, 1948.
(7) G. L. Ragan, "Microwave Transmission Circuits, Radiation Laboratory Series, McGraw-Hill, p 708, 1948.
(8) R. E. Lacy, Two Multichannel Microwave Equipments for the U. S. Army Communication Network, *Proc. IRE*, **35**, p 65, Jan. 1947.
(9) L. E. Thompson, Microwave Relay System, *Proc. IRE*, **34**, Nov. 1946.

Bibliography

Members of the MIT Staff, "Principles of Radar", Sec. Ed., 8-85, 1946.
F. E. Terman, "Radio Engineers Handbook", McGraw-Hill, First Ed., p 565, 1943.
R. I. Sarbacher and W. A. Edson, "Hyper and Ultra High Frequency Engineering", 1947.



Photograph shows instrument for indicating and recording outputs from twelve 500-ohm resistance strain gages

Strain-Testing Railroad Bridges

Dynamic strains in bridge floorbeam hangers are detected by twelve resistance gages. Indication is made on two rows of six 2BP11 cathode-ray tubes which are viewed by two 35-mm moving-film recording cameras. Response is essentially uniform over a frequency range of zero to 50,000 cps

By A. D. M. LEWIS

Instructor in Structural Engineering
Purdue University
West Lafayette, Indiana

IN STUDIES of railroad-bridge floorbeam-hanger failures an instrument was required for investigating the possibility that passage of trains caused high stresses with frequencies as high as 50,000 cycles per second which were responsible for failure of the member by fatigue. The 12-channel cathode-ray strain oscillograph shown in the photograph was designed and constructed for this investigation and for similar studies in structural engineering. It has been used for the measurement of dynamic strains in a railroad bridge near Parsons, Kansas, on a project conducted by Purdue University for the Association of American Railroads.

The arrangement of a strain signal channel is shown in Fig. 1. Strains are detected by means of 500-ohm resistance strain gages

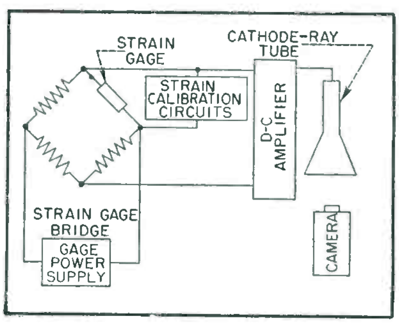


FIG. 1—Setup for one channel in 12-channel strain gage oscillograph

and are indicated by 2BP11 cathode-ray tubes. The cathode-ray tube spot deflections are recorded by 35-mm moving film cameras. These cameras are capable of operation at film speeds of 2 to 70 feet per second. Two cameras are used and six tubes are recorded by each camera. Reference lines are produced by argon glow lamps which are mounted on the panel between the cathode-ray tubes. These lamps are located behind shields in which there is a circular opening drilled by a No. 35 drill. A reference line adjacent to each trace is desirable because an analysis of the record made by a particular tube involves measurements which extend over only a small portion of the film width. Since the reference line is fixed in relation to the cathode-ray tubes, any movement of the cameras relative to the cathode-ray tubes or any lateral motion of the film as it passes through the camera has negligible effect on the accuracy of the results obtained. The reference lines are also made to serve as time scales by blanking the argon lamps at regular intervals of 1 and 10 milliseconds. Viewing of the film and measurement of strains may be accomplished readily by means of a microfilm reader such as found in most large public libraries.

D-C Amplifier Unit

Plug-in d-c amplifiers with essentially uniform response over the frequency range of zero to 50,000 cycles per second are used for amplification of the strain gage signals. Other amplifiers may be substituted for use with suitable transducers for the measurement of quantities other than strain. For example, this equipment has been used for recording the vibration displacements of bridge members by means of linear variable differential transformers.

Each d-c amplifier unit contains three direct-coupled, push-pull triode stages as shown in Fig. 2. In-phase feedback[1] is applied to the cathode of the first stage from the cathode of the last stage and gives the amplifier a number of desirable characteristics for strain gage work: (1) drift caused by power supply voltage changes is small, (2) either single-ended or push-pull input may be used, (3) almost perfect phase inversion is obtained; so push-pull output desirable for cathode-ray tube deflection is obtained from single-ended input, and (4) relatively large changes in d-c level of the input stage grids do not disturb operation of the amplifier.

The feedback potentiometer adjusts the bias of the first stage to the proper operating point. With suitable plate and bias supply voltages, setting of the bias voltage on the first stage also sets remaining stages at their respective operating points. A fixed series resistor prevents the connection of the cathodes of V_2 directly to the negative 150-volt supply with the probable result of excessive grid and plate currents and tube damage. The high-frequency response is improved by the addition of neutralizing capacitors. The first stage is not neutralized because the reactance of the input capacitances is large compared to the 500-ohm resistance of the strain gage.

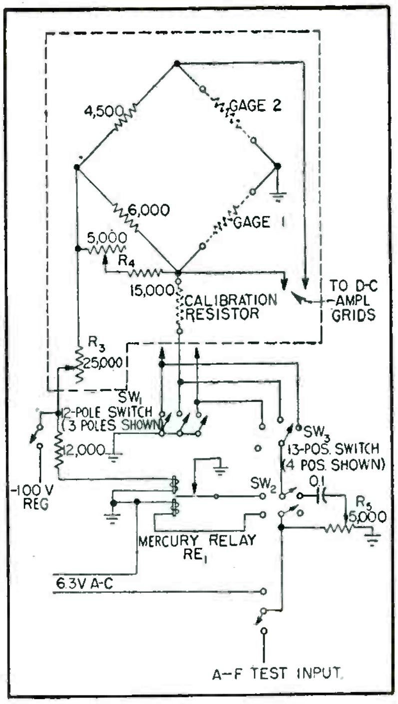


FIG. 4—Indicator circuit is shown connected to a typical bridge

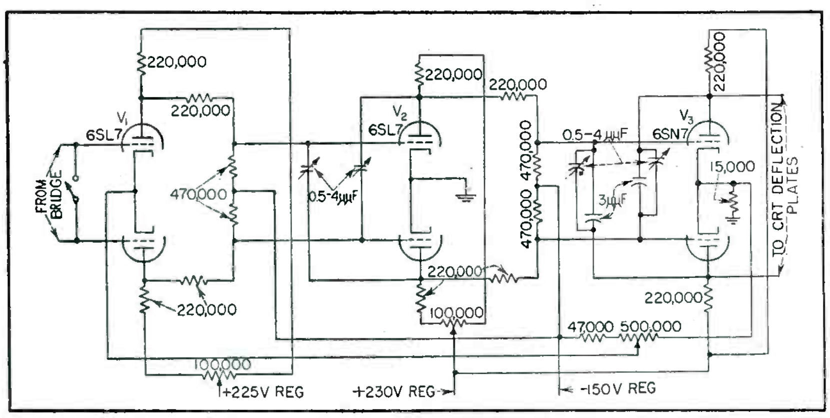


FIG. 2—Direct-coupled push-pull amplifier provides 10,000 gain

The voltage gain of the amplifier is approximately 10,000. A typical drift check after a forty-five minute warmup shows a random drift of approximately plus or minus 0.1 millivolt d-c, referred to the grids, in a period of one minute which is the maximum recording period available with the present cameras. During the period of an hour the drift is in one direction and approximately one millivolt d-c. The deflection sensitivity of the cathode-ray tube and amplifier is approximately 6 millivolts d-c per inch of deflection.

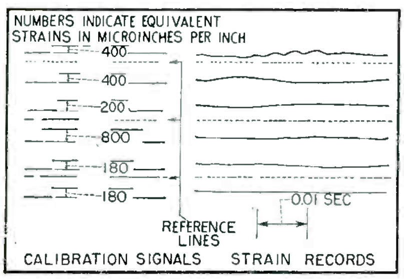
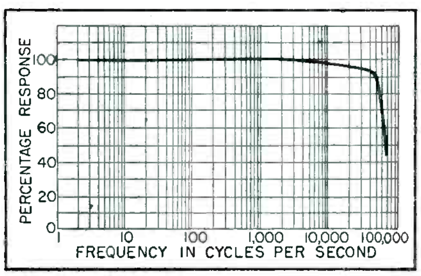


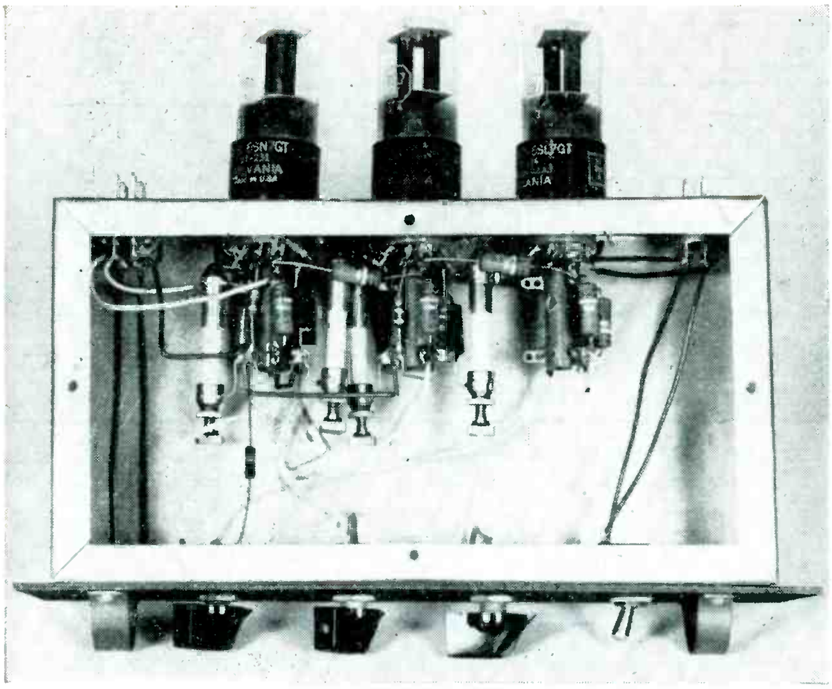
FIG. 3—Sections of typical film record taken from one of the 35-mm cameras



Curve showing frequency response of direct-coupled amplifier shown in Fig. 2

Bridge Circuits

The strain gage bridge circuit is shown in Fig. 4. Gage current is supplied by a negative 100-volt regulated supply. A negative voltage is used because the voltage drop across the strain gages permits a larger cathode-to-plate drop across the first d-c amplifier stage than would be possible with a positive gage supply. Since no means is provided for changing the gain of the d-c amplifiers, sensitivity is con-



Side view of a typical direct-coupled amplifier with flat response from zero to 50,000 cps

trolled by varying the gage current from approximately 4 to 20 milliamperes by means of rheostat R_3. Bridge balance is accomplished by adjustment of R_4.

For each channel a calibration signal equivalent to a given strain is obtained by connecting a resistor of known value, the calibration resistor, in parallel with GAGE 1. This causes a simulated change in resistance of the gage equivalent to that which would result from the strain given by the formula

$$\varepsilon = \frac{R_g}{F(R_c + R_g)}$$

where ε is unit strain, R_g is the gage resistance in ohms, F is the gage factor, and R_c is the value of the calibration resistor in ohms.

The calibration resistor may be connected in parallel with GAGE 1 by either of two means: through SW_1 or through SW_2, SW_3 and mercury relay RE_1. Switch SW_1 connects a calibration resistor across a gage in each of the twelve channels simultaneously. At the beginning of a photographic record this switch is closed instantaneously, and a cathode-ray-tube spot displacement which represents a known strain is recorded as shown in Fig. 3 for each of the twelve channels.

The mercury relay, which is operated at line frequency, connects the calibration resistor in parallel with the gage on alternate half cycles and produces a square wave calibration signal at the input of an amplifier selected by SW_3. A sine wave can also be applied to the input of the amplifiers for checking operation. The amplitude of this sine wave signal is controlled by potentiometer R_5.

A fourth switch selects either a 60-cps signal from a 6.3-volt filament transformer or a signal from an external audio-frequency oscillator. The calibration resistor in series with GAGE 1 acts as a voltage divider to provide a signal of suitable amplitude at the amplifier input. For any usable values of the calibration resistor and a sinusoidal audio input voltage of 7.07 volts rms, the maximum peak voltage obtainable across GAGE 1 will equal or exceed the amplitude of the square-wave calibration signal if the gage current is less than 20 milliamperes.

Cathode-Ray Tube Circuits

The deflection plates of each cathode ray tube are connected directly to the output plates of the corresponding d-c amplifier. The accelerating anode of the cathode-ray tube is connected to the positive 230-volt plate supply, and the cathode is operated at negative 700 volts. Individual focus and intensity controls are provided for each of the 12 cathode-ray tubes. A single potentiometer is used to adjust the intensity of all 12 channels simultaneously.

A conventional sawtooth generator and a phase-inverter amplifier are used to provide a sweep for viewing recurrent waveforms such as the square-wave calibration signal.

Power Supplies

All d-c power supplies with the exception of the cathode-ray-tube high-voltage supply incorporate adjustable electronic voltage regulators. These supplies were built as independent units so they can be used for the operation of equipment other than this particular 12-channel oscillograph or as experimental power supplies in the laboratory. The outputs of all the electronic voltage regulators have peak-to-peak ripple amplitudes of less than 10 millivolts.

The gage power supply furnishes negative 100 volts at 480 milliamperes. Six parallel 6B4G tubes are used as the regulator because of the high current requirements. Either side of this power supply may be grounded by means of a reversing switch so positive output may be obtained for other applications. The output voltage is variable from approximately 90 to 170 volts.

The amplifier power-supply unit contains a negative bias supply and 6L6G regulator tube, a positive supply and two 6B4G regulator tubes for supplying two different plate voltages to the d-c amplifiers, and a negative 700-volt supply for the cathode-ray tubes. The negative bias supply is adjustable from approximately 125 to 300 volts and the positive supplies are adjustable from approximately 150 to 300 volts.

The author acknowledges with thanks the guidance and assistance of J. M. Cage, L. T. Wyly, and A. C. Todd of the Purdue University staff in the design and assembly of this instrument.

REFERENCE

(1) F. F. Offner, Balanced Amplifiers, *Proc IRE*, p 306, March 1947.

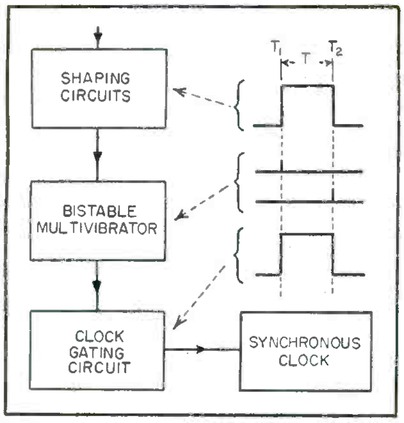


FIG 1—Elementary pulse-measuring system using clutch-controlled clock

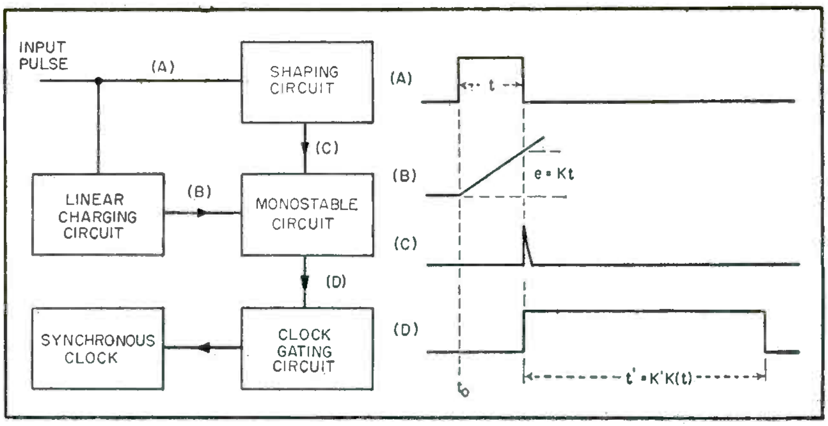


FIG. 2—Basis of the electronic chronoscope (left) and waveforms (right) that show transition from actual pulse, through charging circuit to clock impulse

Wide-Range Electronic Chronoscope

Duration of single or repetitive pulses in the range from 10 microseconds to 1 minute is directly indicated on a high-speed clock. This noncounter instrument measures short intervals with a linear charging circuit that effectively scales up pulse length

By R. G. ROUSH

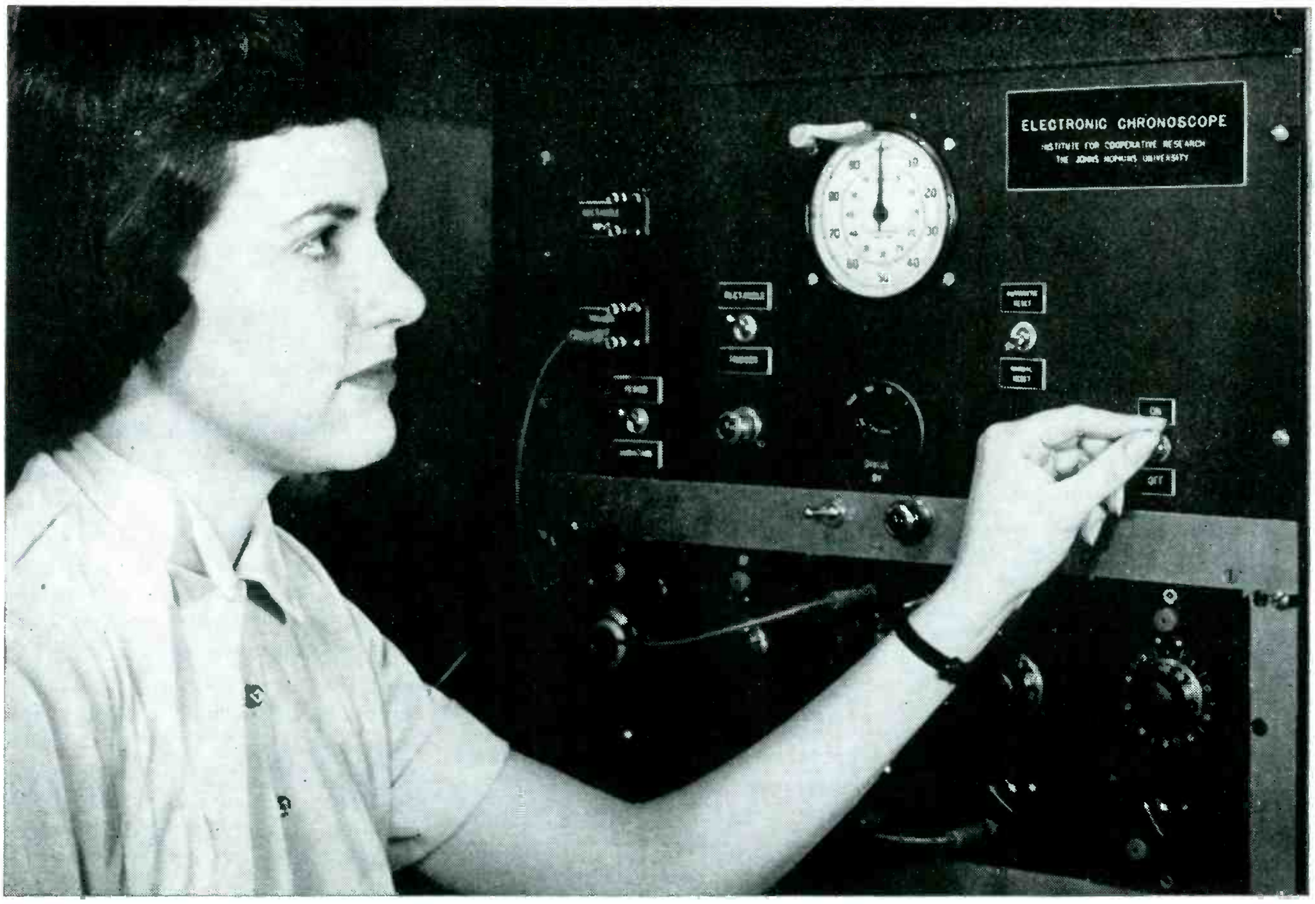
Research Associate
Institute for Cooperative Research
The Johns Hopkins University
Baltimore, Maryland

MANY counter and noncounter type instruments have been previously reported for the measurement of short time intervals. However, these are in general limited to maximum interval measurements of less than a few seconds. This limitation is particularly true of the noncounter instruments, which are also characterized by their inability to select and to measure the duration of a single pulse from a group or repetitive train of pulses. This characteristic seriously limits the use of the noncounter instrument in any application where pulse durations must be continuously monitored without reducing or varying the recurrence frequency to facilitate the measurement. Examples of this sort can be found in experimental psychological laboratories where various types of stimuli are often generated electronically. The rapidity with which the experimenter may vary the conditions is limited by his ability to adjust the equipment while monitoring pulse durations and recurrence frequencies as the stimuli are presented to the subject.

Where no suitable chronoscope is available, conventional oscillography can be satisfactorily employed for pulse lengths below 40 or 50 milliseconds. Above this range some other technique should be employed for accurate measurement since the recurrence frequency of such a pulse is so low that the counting of markers or cycles of a timing wave becomes extremely laborious. The problem of measuring these longer pulse durations has in the past been solved in this laboratory by turning on a high-speed clock for the duration of the pulse. A combination of this method and standard oscillograph techniques has been reasonably satisfactory for most repetitive pulse measurements. The desire for a single unit led to the development of the instrument to be described.

Low-Speed Chronoscope

The basis of a low-speed chronoscope is the high-speed clock system previously mentioned. The model S-1 clock, manufactured by Standard Electric Time Co., has two hands that are driven by a synchronous motor operating at power-line frequency. One hand rotates at 1 rps, and the other is a sweep-second hand that rotates at 1 rpm. The drive shaft for these hands is coupled to the synchronous motor



Complete rack-mounted chronoscope used to measure length of electrical pulse stimuli in experimental psychology laboratory

through a friction clutch. Normally, the hands are prevented from rotating by an electromagnetically operated brake, the friction clutch being allowed to slip. When the brake solenoid is energized, the brake is released, allowing the hands to rotate freely.

The functional block diagram of an electronic circuit designed for this application is shown in Fig. 1. The rectangular input pulse whose duration is to be measured is shaped into two positive-going trigger voltages; one coincides with the leading edge of the input waveform, and the other with the trailing edge. These two voltages are employed to cycle and recycle a bistable multivibrator whose output rectangle has constant amplitude despite variations in the amplitude of the input voltage. This output rectangle is used to gate the clock through a buffer amplifier circuit.

A constant error is present in this system owing to the inability of restoring springs to reapply the brake as rapidly as it was removed by the solenoid. Correction for this error (between eight and twelve milliseconds for various spring adjustments) will allow the measurement of rectangle durations from 20 or 30 milliseconds up to one minute or more, with an accuracy limited primarily by the stability of the power-line frequency.

High-Speed Chronoscope

The adapter circuit shown in block form in Fig. 2 extends the measurement range into the microsecond region. It consists of a capacitor charged during the input-pulse interval, and a monostable or gate circuit to generate a rectangle having a duration proportional to the potential to which the capacitor is charged at the end of the pulse interval. By designing the monostable circuit to give rectangle durations falling within the measurement range of the low-speed chronoscope circuits, the shorter pulse durations are read directly from the clock after applying the proper proportionality factor.

The block diagram shows this system (Fig. 2) in which letters (A) through (D) indicate waveforms.

The input waveform (A) is the pulse whose duration is to be measured. The output of the linear charging circuit (B) is a ramp function whose instantaneous value is $e = Kt$ in which K is a constant of the charging circuit. If the monostable circuit is triggered with a transient voltage (C) derived from the trailing edge of the input pulse, then the duration of the output rectangle (D) will be given as $t' = K'Kt$. The relationship between the clock reading and the actual pulse duration is thus determined by K and K'. Since the generated rectangle duration is to be proportional to the input voltage, K' is a fixed constant and it is only necessary to vary K to change ranges. A suitable choice for K' is one that gives t' the value of one second for the maximum value of e on any range. This would produce one complete rotation of the high-speed clock hand, or full-scale deflection for any of the chosen ranges. For example, a choice of 1/200 second per volt for K' and 2×10^5 volts per second for K would give one complete rotation or full-scale indication for a one-millisecond input pulse. The range switch could therefore be marked with the appropriate scale factor, $\times$ 1/1,000. The clock dial is calibrated in hundredths of a second so that on this range, pulse durations could be read to within ten microseconds. Three such scales, $\times$ 1/1,000, $\times$ 1/100 and $\times$ 1/10 would cover the range from ten microseconds to 100 milliseconds, and a fourth scale would connect the pulse directly to the clock gating circuit as previously described. This range position would be labeled $\times$ 1, and would allow intervals up to one minute to be indicated, and considerably more if the rotations of the 1-rpm hand are counted.

Design Considerations

The limitation on this type of operation is found in the monostable circuit or rectangle generator. In addition to producing a rectangle whose duration is directly proportional to the value of an input control voltage, this circuit must be capable of responding properly to the instantaneous value of the input voltage. The circuit should also possess a high degree of linearity and excellent stability.

A suitable circuit is found in the externally gated plate-to-grid feedback amplifier, or Miller integrator[1,2]. The circuit diagram of the basic rectangle generator employing the Miller integrator is shown in Fig. 3. Consider first the condition in which the input voltage, e, is nonvarying and has the value E. The suppressor grid of V_3 is normally biased beyond plate-current cutoff, and the control grid is held at or near zero bias by the positive grid-return voltage V. The screen is therefore drawing virtually all of the tube space current. The potential to which C is charged, E_x, will thus be approximately equal to the input voltage E. If the suppressor grid is brought abruptly to zero bias, plate-current flow will commence, thus reducing the screen current and allowing the screen voltage to rise abruptly. The flow of plate current reduces the plate potential, thereby opening the connection to the input voltage through the diode. The remaining circuit then becomes a simple plate-to-grid feedback amplifier that functions to discharge C at a rate $i_c \cong V/R_g$. The voltage across C decreases linearly, the plate potential following, until it passes the knee of the plate characteristic curve. At this time the screen is again drawing the major portion of the space current, thereby producing the trailing edge of the generated rectangle. The duration of this rectangle t' is approximately given as $t' \cong R_gC\,E/V$ so that the value of K' for this circuit is $K' \cong R_gC/V$.

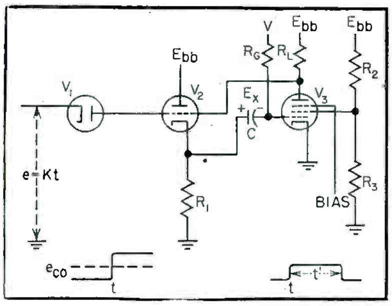


FIG. 3—Basic rectangle generator employing Miller integrator

Under dynamic conditions, the input voltage will not be constant, but will be a relatively high-speed ramp function. The suppressor gate voltage is to be applied at some instant during the ramp function. If the cycle duration of the gated integrator is to be a linear function of the instantaneous value of the ramp function, the potential across C must follow the ramp function input with negligible time lag until the gate is applied. The cathode follower V_2 must therefore charge C at the required rate through the grid conduction resistance of V_3. It has been determined that requisite accuracy of the ramp function is obtained by employing a tube of high g_m for V_2 and placing a diode in parallel with the grid of V_3.

Feedback Circuit

Since the dynamic input to the rectangle generator is to be a positive ramp function, it is necessary to employ a positive-feedback linear sweep circuit[3]. This circuit can be designed to produce the required output amplitude with excellent linearity and stability.

The diagram of an instrument based upon these considerations is shown in Fig. 4. The instrument is designed to measure the time spacing between positive trigger voltages that represent the leading and trailing edges of the input pulse; these are labeled start and stop triggers, respectively. Their derivation from the input voltage pulse will be described later.

Circuit Description

The rectangle generator circuit is nearly identical to the basic circuit shown in Fig. 3. Three ranges have been provided in the linear charging circuit by capacitors C_2, C_3, and C_4. The values of these capacitors in conjunction with the multiplier constant K' of the rectangle generator have been chosen to provide a full scale indication of the clock for pulse input duration of 1, 10 and 100 milliseconds respectively. Full-scale indication of the clock refers to one rotation of the high-speed hand. Adjustment of the factor K' on each range is provided by the potentiometers R_9, R_{10} and R_{11}. These compensate for initial deviations on C_2, C_3 and C_4 from their nominal values. The second triode section in the cathode follower V_4 and the diode V_{1B} connected from the grid of V_5 to ground improve accuracy.

The two bistable multivibrators, V_8 and V_{10}, and associated components have been introduced to provide the switching of the measuring circuits in the proper time sequence. In these circuits the triode section V_{7A} and V_{7B} serve as trigger injection amplifiers, and are turned on momentarily by the input trigger voltages.

Circuit Operation

First consider the circuit operation in the three low-range positions of the range selector switch, S_1. When the reset switch, S_2, is thrown to the RESET position, R_{12} is shorted, thus turning V_{8A} off and V_{8B} on. The negative drop in the plate circuit of V_{8B} is coupled to the plate of V_{10A} through the diode V_9, thereby turning tube section V_{10A} on and V_{10B} off.

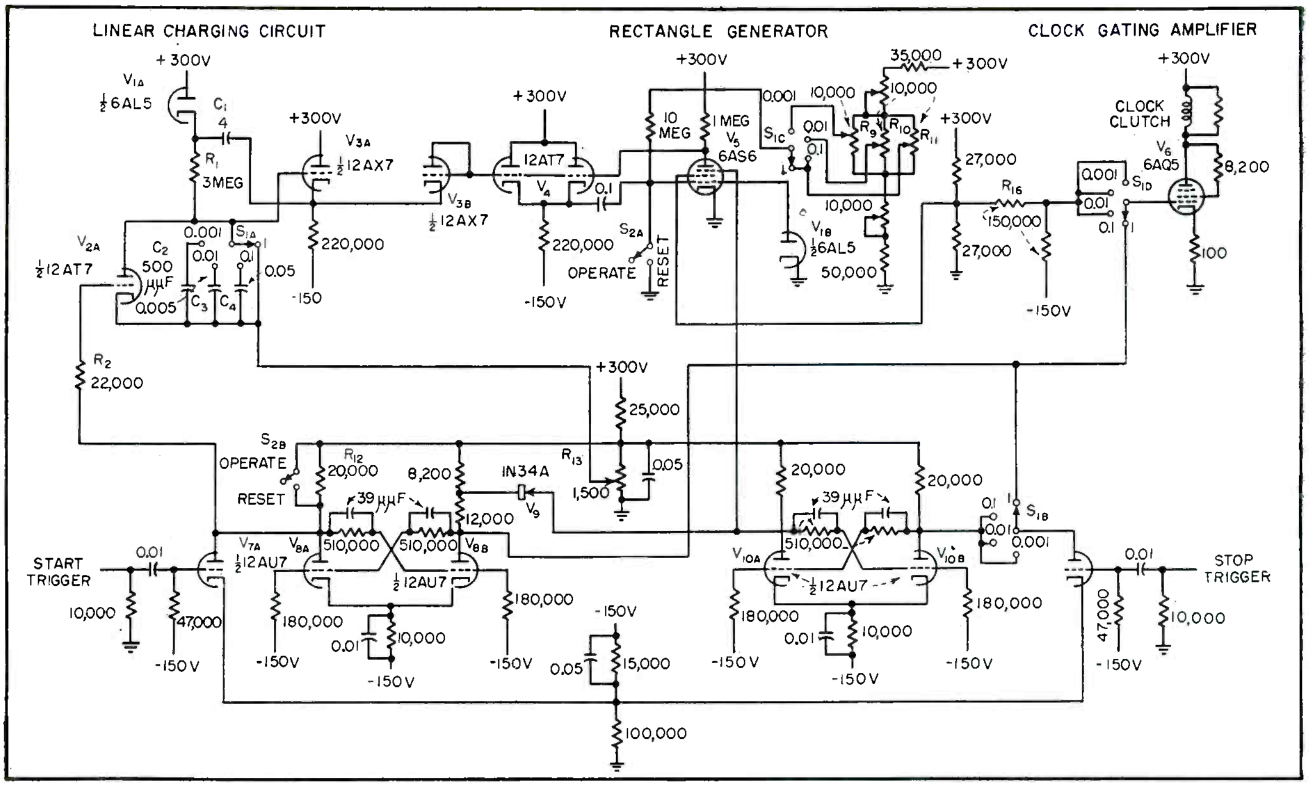


FIG. 4—Complete chronoscope circuit showing terminals for start and stop triggers that are supplied from circuits in Fig. 5

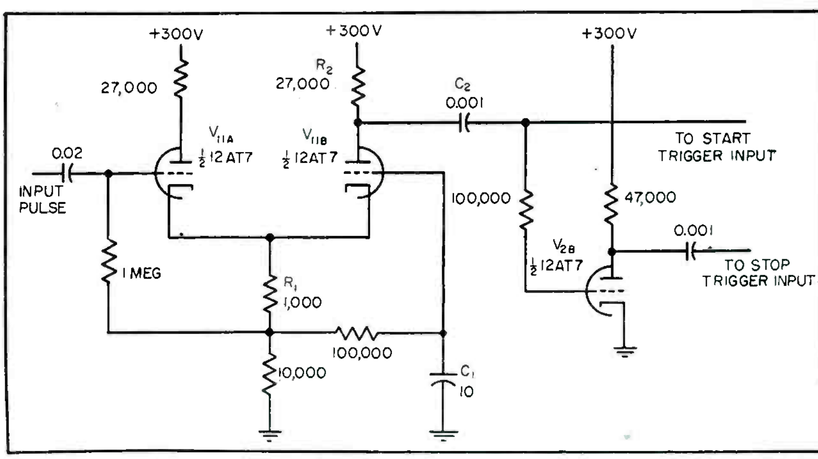


FIG. 5—Circuit diagram showing generation of start and stop triggers from input pulse. These signals are fed to circuits in Fig. 4

The grid of V_{2A} is connected to the plate of V_{8A} through R_2, and its cathode is returned to a tap on R_{13}. Thus, for all positions of this tap in the reset condition, the grid-return voltage of V_{2A} is positive. The grid bias of V_{2A} is therefore approximately zero for all tap positions of R_{13}, and as a result, the drop across this tube is nearly zero. The output of the linear charging circuit in the reset condition can therefore be controlled by R_{13}, the zero adjustment previously described. The Miller integrator is also disabled in this position of the reset switch by the switch section S_{2A}, and the high negative bias on the suppressor grid of V_5 produced by the conduction of V_{10A}.

When the reset switch is thrown to the OPERATE position, the circuit conditions are unchanged until the first start trigger derived from the leading edge of the input pulse arrives. At this time, V_{8A} is turned on, cutting off V_{2A} and allowing the ramp function to commence. The second input, stop trigger, which is derived from the pulse trailing edge will turn on V_{10B}, thereby removing the bias on the suppressor grid of V_5, allowing the Miller integrator to function as previously described.

The output voltage of this circuit is applied to the clock tube V_6, which operates the brake solenoid for the duration of the rectangle t'. It should be noted that if the reset switch is opened after the leading edge of the pulse and before the trailing edge, the circuit will wait for the next leading edge input since V_9 will prevent the bistable multivibrator V_{10} from being cycled until after V_8 has first been cycled. The ramp function is not terminated by the second input trigger, but is allowed to continue to the saturation point of V_{3A}. The Miller integrator in the meantime has completed its cycle of operation, and in doing so, has placed itself in a condition in which additional input triggers will have no effect until the reset switch has been operated.

When the reset switch is again thrown to the RESET position, the suppressor grid of V_5 is biased beyond plate-current cutoff, and V_{2A} is turned on as before. The cathode voltage of V_{3A} cannot fall immediately, however, since C_1 must recharge to its initial potential. The resultant negative-going output of the charging circuit as C_1 recharges would be applied to the control grid of V_5 were it not for S_{2A}. Its function then is to prevent the cutoff of space current in V_5 during the recharging process and the resultant undesirable deflection of the clock hands. Automatic operation of the reset switch can be easily obtained by substituting for S_2 the contacts of a relay that can be closed at the conclusion of the chronoscope operating cycle and reopened after a preset interval of t_R. This delay time, t_R, can be made sufficiently long to allow the resetting process to be complete so that the circuit will automatically select a pulse and monitor its duration at a rate determined by the sum of time, t', and the resetting time, t_R. Such operation can be accomplished by a number of simple delay circuits.

In the fourth range position, or the × 1 position, V_{7B} and the control grid of V_6 are connected to the plate of V_{8B}. Thus, the first pulse will turn off V_{8B}, and the second will turn it back on. The clock may therefore be read directly for time intervals up to one minute, and of course indefinitely if the rotations of the 1-rpm hand are counted either visually, or by electrical means.

Figure 5 shows the pulse-to-trigger conversion circuit, which is required when pulse inputs are to be used. Tube V_{11} is seen as a simple cathode-coupled clipper circuit in which the plate current of V_{11B} is reduced by a positive input or increased by a negative input, C_{17} holding the grid of V_{11B} at fixed potential during sudden changes. If the leading edge of the input pulse is of greater amplitude than the potential required to cut V_{11B} off, this section will be disconnected, allowing C_2 to charge through R_2 and the impedance of the "start" trigger input circuit of the chronoscope proper. A positive trigger is thus generated in time coincidence with the leading edge of the input pulse. Likewise, on the trailing edge, the plate current of V_{11B} will be increased over its quiescent value, thereby producing a negative trigger pulse. This voltage is inverted by V_{2B} to give the second positive input to the chronoscope proper.

In a recent model of this equipment these inputs have been obtained directly from the plates of V_{11A} and V_{11B} and injected directly into the multivibrators V_8 and V_{10} through crystal diodes.

Calibration

The zero adjustment for the three low ranges is accomplished by first triggering the second bistable multivibrator only, and adjusting R_{13} until no deflection of the clock hands occurs. Accurately calibrated input pulses having durations of 1, 10 and 100 milliseconds are then applied to the circuit, and the adjustments R_9, R_{10} and R_{11} made to give the proper full-scale reading on each of these ranges.

Accuracy

The overall accuracy that can be obtained with the chronoscope is limited mainly by the stability of the power-line frequency, since the clock is driven from this voltage source. Variations in power-line frequencies are normally held to within ± 0.1 cps in metropolitan areas, and seldom exceed ± 0.3 cps in any area for a longer time than a few seconds. Under such extreme conditions, the clock accuracy would still be within ± 0.5 percent of its indicated reading.

The linearity of the scale calibration on all ranges, except the lowest, is better than 0.2 percent. On the lowest range, there may be a deviation from a linear scale calibration of −1 percent at 1/10 of full scale, or at the 100-microsecond reading. At 1/20 of full scale on this range, or 50 microseconds, the deviation from linearity is approximately −9 percent. However, in terms of the full-scale calibration on this range, the chronoscope can be read to within 1 percent of full scale, or one scale division down to ten microseconds.

No data is yet available on the long-time stability of the equipment. This will, of course, be limited mainly by the stability of the timing components R_1, C_2, C_3, C_4, R_5, C_5 and the grid return circuit of V_5, all in Fig. 4. These components have been carefully chosen to reduce the drift resulting from temperature variations or from component aging. Normal tube aging and tube replacement will not require a change in calibration adjustments since variations in the tube parameters of both the Miller integrator and the linear sweep generator have a negligible effect upon the gain of these circuits. Regulated power supplies are not required since K' and K will charge proportionally, but in opposite directions, when the plate-supply voltage varies. The charging current for C_2, C_3 or C_4 is directly proportional to E_{bb}, and therefore K is directly proportional to E_{bb}. Thus, if the linear charging circuit and the rectangle generator are both supplied from the same direct-current supply, the chronoscope indication will be unaffected by supply-voltage variations. This statement is of course based on the assumption that the unregulated supply voltage, E_{bb}, will not vary materially during the operating cycle either from line-voltage surges or transient loads. Since the clock buffer amplifier tube V_6 does present a high transient load during the operating cycle, it is desirable to obtain the plate voltage for this circuit from a separate supply source if unregulated supplies are used.

Acknowledgment

The work described in this report was carried out under Contract N5ori-166, Task Order I between Special Devices Center, Office of Naval Research and The Johns Hopkins University, Institute for Cooperative Research.

The valuable comments and suggestions of Ferdinand Hamburger, Jr., professor of electrical engineering, and the assistance of Edmund T. Urbanski and Carroll M. Barrack during the development and design of the equipment are gratefully acknowledged.

REFERENCES

(1) Radiation Laboratory Series, "Waveforms", first edition, 19, McGraw-Hill Book Co., New York, N. Y., p 37, p 195.

(2) S. Seely, "Electron Tube Circuits", First Edition, McGraw-Hill Book Co., New York, N. Y., p 427.

(3) Radiation Laboratory Series, "Waveforms", first edition, 19, McGraw-Hill Book Co., New York, N. Y.

Utility Video Amplifier

Extended frequency response and double-ended low-impedance output to drive a 75-ohm line and monitor are achieved by use of two feedback pairs in cascade. Wide range of useful applications on program lines is indicated

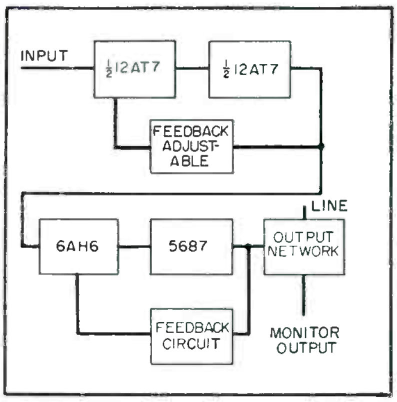


FIG. 1—Arrangement of stages in the amplifier

By E. C. KLUENDER

Broadcast Engineering Section
Commercial Equipment Division
General Electric Company
Syracuse, N. Y.

USE OF FEEDBACK results in some inherent advantages that suggests its incorporation in a utility video amplifier. Feedback assists not only in achieving exceptional amplitude linearity and in extending the high and low frequency responses, but also creates a low-impedance source that lends itself well to driving a 75-ohm line.

Figure 1 shows a simple block diagram illustrating how feedback is employed in an amplifier composed of two feedback pairs in cascade. Overall amplifier gain is controlled by varying the amount of feedback in the first pair. Coupling between the pairs is by means of a large capacitor which results in negligible phase shift for all frequencies concerned.

A schematic diagram is shown in Fig. 2. Two video jacks permit the input to be bridged or terminated. Termination is obtained by inserting a 75-ohm termination plug in one of the input jacks. The input capacitance of the amplifier is 20 $\mu\mu$f. Voltage-type degeneration is fed from the second stage back to the cathode of the first stage, and is adjustable by means of R_6. The low d-c potential existing at the output of the first coupled pair permits the use of a low-voltage, high-capacitance electrolytic capacitor to couple to the second pair.

The circuit for the second pair is identical with the first, except for components. A very high perveance is obtained in the output stage by connecting the plates of a 5687 in parallel.

The feedback circuit includes an adjustable capacitor C_{14} which provides a frequency compensator useful in adjusting overall amplifier response. A negative 5-volt source is used for grid bias purposes and for bucking out the d-c in the output circuit.

Output Circuit

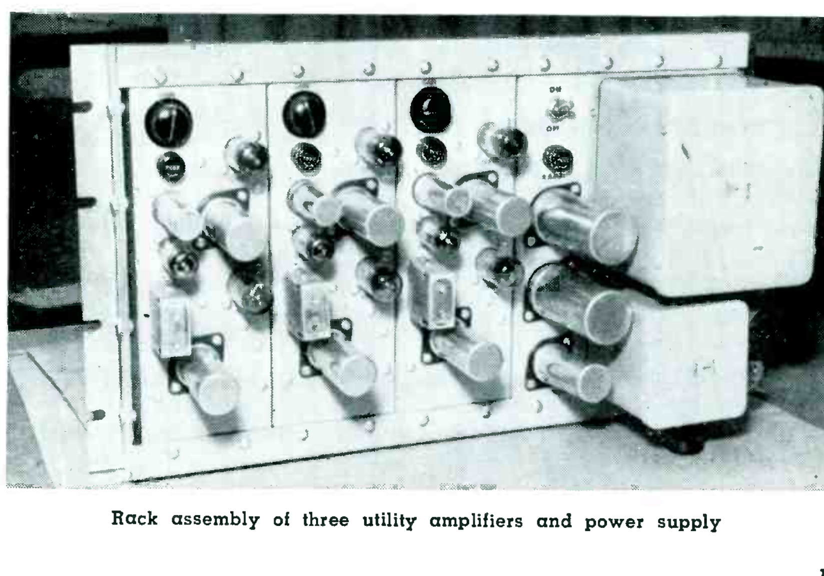
Point *A* (Fig. 2) owing to voltage feedback is a very low impedance driving point (sometimes referred to as a zero-impedance point). Due to the reduction in forward gain as frequency is increased, the impedance of point *A* will rise. The net impedance values are plotted in Fig. 3, while curves A of Fig. 4 and 5 show the resistive and reactive components of this impedance for C_{14} set to maximum capacity.

These curves suggest the use of a series element whose impedance decreases with frequency for feeding a line. Such an element is obtained by using C_{11}, R_{29} and R_{27} in the combination shown in Fig. 2. Making both *R* and *C* adjustable results in a flexible arrangement which has the capability of compensating for the change of impedance of point *A*.

Figure 6 shows a family of curves for typical settings of R_{29} and C_{11}. The wide range of adjustment is quite evident.

The B curves of Fig. 6 are also plotted on Fig. 4 and 5 where they are added to the curves of impedance at point *A*. The net resistive component of output impedance is shown as curve C of Fig. 4; the net reactive component of output impedance is shown as curve C of Fig. 5. Note how effectively B compensates for A in each case.

Actual measurements of output impedance for a utility video amplifier are given in Fig. 7 where



Rack assembly of three utility amplifiers and power supply

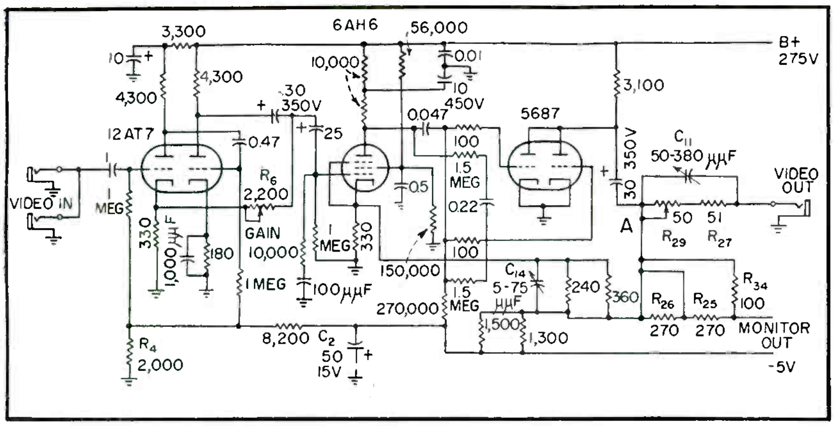


FIG. 2—Complete circuit of one utility amplifier. The low-impedance driving point is designated *A*, at the right of tube 5687

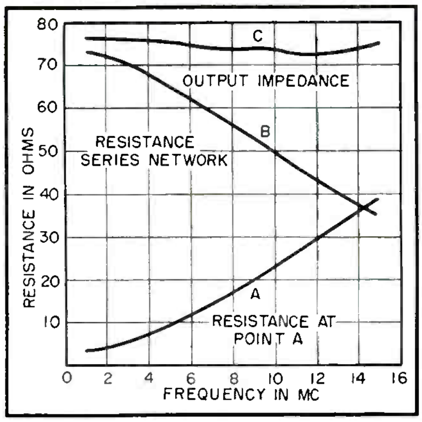


FIG. 4—Resistive components of output impedance

they are plotted with a greatly expanded scale. This typical curve shows only ±1 ohm variation out to 11 mc. The resulting well-matched source impedance such as this is required for obtaining uniform transmission over coaxial cables without reflections. It also represents a close approach to the ideal driving circuit for telephone lines whose impedance varies widely over the transmission band but which are equalized for uniform response from a 75-ohm source.

The recommendations of a Joint Committee of TV Broadcasters and Manufacturers for Coordination of Video Levels are easily met by the amplifier. This committee's recommendation on Standard Termination Impedances is as follows: "It is recommended that the standard termination impedance for both the sending and receiving ends of a line connected for single-ended operation, shall have a value of 75 ohms plus or minus 5 percent. These figures will apply over the television frequency band below 6 mc but not down to d-c."

Monitor Provisions

The ideal place to monitor an amplifier feeding a line is, of course, across the output of the amplifier. Most amplifiers in use at present cannot drive the double termination resulting from connecting low-impedance monitoring lines across their outputs, and this leads to the incorporation of isolation amplifiers.

Use of isolation amplifiers brings about the possibility of a monitor picture not in accordance with what the line is receiving, both in level and quality. The answer lies in using a line amplifier capable of feeding two lines without introducing a series element capable of

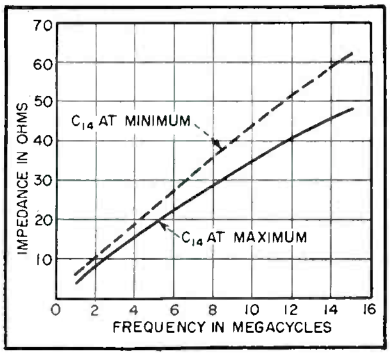


FIG. 3—Plot of point *A* impedance characteristics

failure or extraneous signals. Furthermore, it is desirable that the monitor output have sufficient isolation from the line output to give a true indication of amplifier performance, regardless of changes in line impedance.

The desirable monitor feed characteristics outlined above are achieved by the output circuit employed in this video amplifier. The monitor is fed from point *A* of Fig. 2, the low-impedance driving point. Resistors R_{25}, R_{26} and R_{34} form a divider for obtaining the required monitor ratios.

For a 1:1 monitoring ratio, the resistors are connected as shown in Fig. 2. For a 2:5 monitor ratio R_{34} is removed; for a 1:5 monitor ratio, the jumper across R_{26} is also removed. No capacitor is employed across these divider resistors in the fashion that C_{11} is used for the line feed, since bandwidth adequate for monitoring is obtained without its use.

Isolation Characteristics

For a monitoring ratio of 1 to 1 (equal outputs) the attenuation between the line and the monitor feed is given in Fig. 8. These attenuation figures are obtained by feeding a signal in at the line output jack and measuring the resultant voltage appearing at the terminated monitor output. The shunting impedance effect obtained due to voltage feedback at point *A* is evident.

Table I—Impedance Characteristics at Point *A*

Frequency in Mc	Z	|Z|
C_{14} Set to Maximum		
1	3 + j3	4
3	5 + j11	12
5	10 + j18	21
7	14 + j21	25
9	20 + j25	32
11	26 + j27	37
13	33 + j29	44
15	40 + j27	48
C_{14} Set to Minimum		
1	3 + j5	6
3	4 + j13	14
5	8 + j22	23
7	14 + j29	32
10	28 + j38	47
15	57 + j26	62

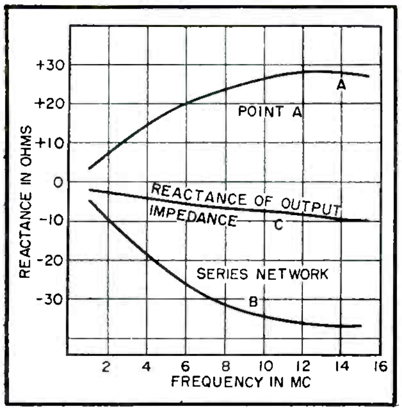


FIG. 5—Reactive components of output impedance

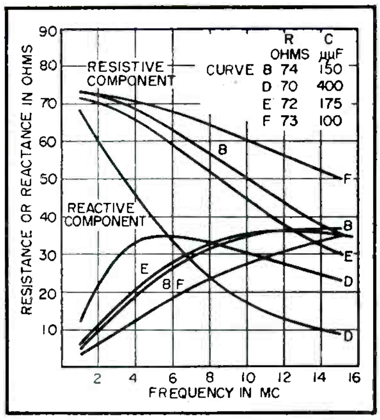


FIG. 6—Family of impedance curves for series networks

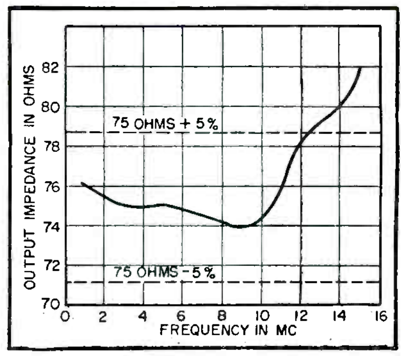


FIG. 7—Output impedance of utility video amplifier

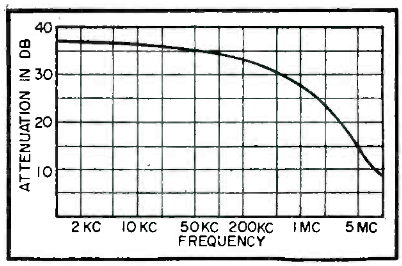


FIG. 8—Attenuation between line and monitor feeds

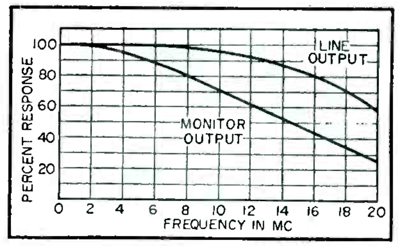


FIG. 9—Frequency response of output to line and monitor

A 60-cycle hum component appearing on the line output terminal due to ground currents in long coaxial runs would be attenuated by about 34 db; this point is off the curve of Fig. 8. The hum component, as well as other extraneous signals will therefore not appear on the monitor, but rather, the monitor will give a true indication of what the amplifier is feeding to the line.

Figure 9 shows the frequency response of the amplifier connected for a monitor signal equal to the line signal, and operating at unity gain. Two 1.4-volt signals are obtained; the frequency response of the monitor signal is also shown.

The maximum gain available with the connection described above is 2.5. As an optional connection, the 1,500-ohm resistor may be removed giving less negative feedback to the final pair. Such a connection may be used when a greater gain (4 maximum) is desired. Under these conditions the monitor will operate at a 1:5 or 2:5 ratio rather than unity, and signals up to 2 volts may be obtained.

Applications

Figure 10A shows the amplifier feeding a telephone line. The driving impedance illustrated in Fig. 7 is the characteristic especially interesting in this application, also the ability to monitor the outgoing line directly is shown in Fig. 10.

Figure 10B illustrates the ability of feeding two 75-ohm lines from a single amplifier. Three amplifiers are shown feeding six house-monitoring circuits. The use of the amplifier as a buffer is shown in Fig. 10C and 10D.

A method of obtaining a choice of signals for monitoring without double terminating a program line is illustrated in Fig. 10E. Only a slight loss of program level (approximately 1 db) is experienced.

Figure 10F shows a simple method of mixing video and sync to obtain a composite video picture. The amplifier gain controls permit an accurate adjustment of percentage sync and output video level. The method illustrated may also be used to mix two video signals. If a common video signal is fed to the input of the two amplifiers, a 4/3 normal gain and 4/3 normal signal output may be obtained.

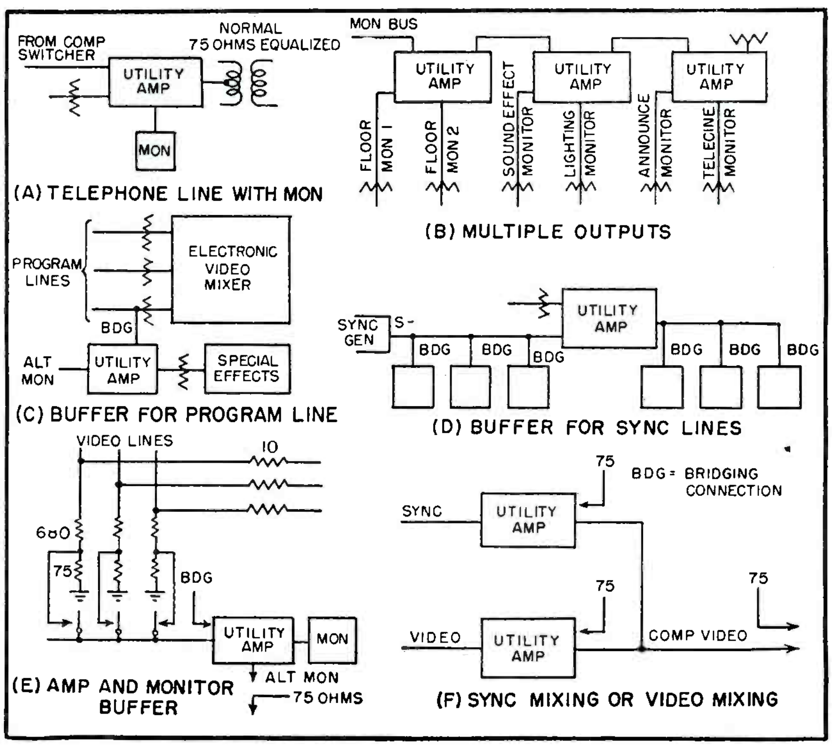


FIG. 10—Typical applications of the video utility amplifier

Audio Amplifier Damping

The meaning and measurement of the damping factor in audio amplifiers are shown, using the Williamson circuit as an example. By means of feedback the amplifier output impedance can be controlled so as to damp out oscillations generated in the load

By **ROBERT M. MITCHELL**
Circuit Applications Engineer
United Transformer Co.
New York, N. Y.

THE growing interest in transient response of electroacoustical systems necessitates increased attention to the means of controlling amplifier output impedance. However, a more convenient concept is the damping factor, *D*, which is defined as the ratio of the load impedance, R_l, to the effective generator impedance, Z_o. It will be shown how the damping factor can be controlled through the use of feedback.

If an impedance-matching device, such as a transformer, is placed between the two impedances, the ratio is that obtained with both impedances referred to the same side of the transformer as shown in Fig. 1. Except where stated otherwise, the output impedance and load impedance are assumed to be resistive.

The term damping factor has been applied to this ratio because it is indicative of the effectiveness of the generator in damping oscillations generated by the load. Since it is expressed as a ratio, it will be the same for any output tap on a transformer and is therefore a more convenient characteristic to use than the effective output impedance itself.

The output impedance of an amplifier will be considered to be the ratio of voltage E to current i obtained when the input is short circuited and the voltage E is applied to the output terminals as shown in Fig. 2.

The damping factor may be varied by changing either R_l or Z_o. Since it is usually desired to obtain a given power output from a given tube, it is not practical to change the load impedance. A method that will change the effective output impedance of the amplifier, but will leave the load unchanged is to apply feedback so that the output stage is included in the loop.

Damping by Feedback

Figure 3 shows a basic one-stage feedback diagram, with polarities not indicated to make the diagram general. It will be noted that this is the so-called voltage type of feedback. If the polarities are such as to make βE oppose e_{in} (assuming the latter no longer zero) the feedback is negative. For this condition

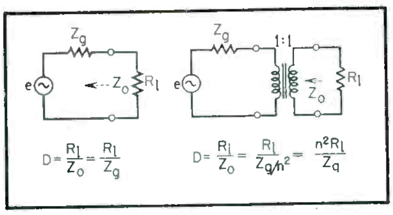


FIG. 1—Damping factor ratio is that with both impedances referred to same side of transformer

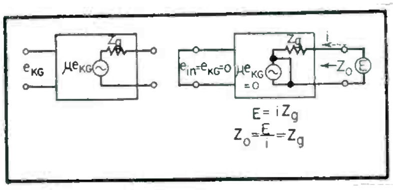
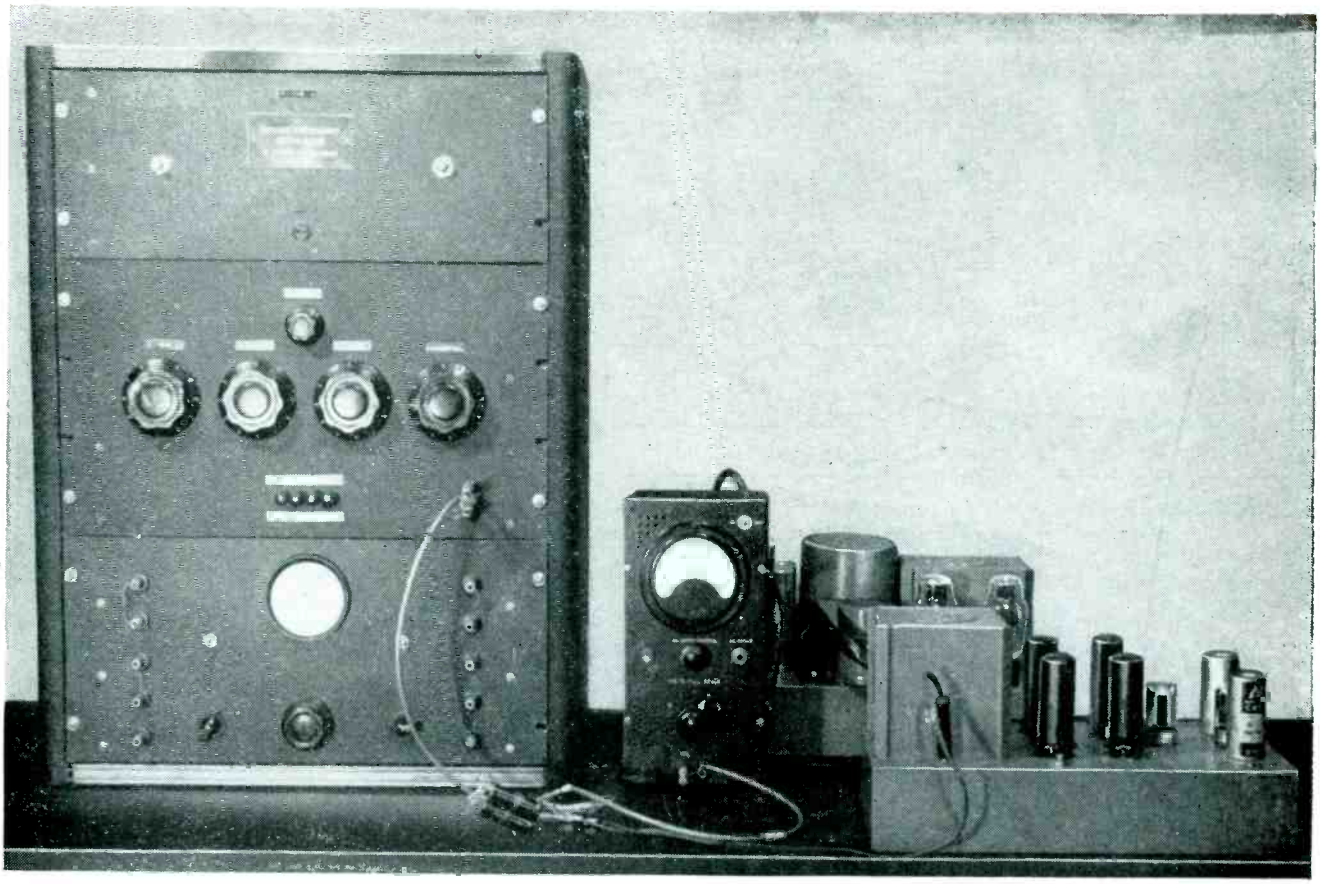


FIG. 2—Conditions under which amplifier output impedance equals E/i

β is considered negative, and the resultant output impedance is less than that without feedback. If the feedback is positive the output impedance is increased. It may be shown that negative-current feedback increases the output impedance, while positive-current feedback reduces it.

It is important that the definition of the original output impedance be clearly understood. If the output impedance without feedback is the plate resistance alone (as in Fig. 3) then this output impedance is changed by the factor $1/(1 - \beta\mu)$, which is not the same factor by which the gain of the stage is changed. If the output impedance without feedback is the plate resistance of the tube in parallel with the load resistance, then the output impedance is changed by the factor $1/(1 - \beta K)$, where K is the stage gain, when feedback is applied. This is the same factor by which the gain is changed. Such a condition would be encountered seldom, if ever, in a loudspeaker output stage, but might arise in connection with an R-C shunt-fed transformer stage. This difference in definition may lead to misunderstanding when different source texts of feedback amplifier design are consulted, unless the distinctions are clearly understood beforehand. In this article, the discussion is confined to the output stage, with the output impedance without feedback being defined as the plate resistance of



Amplifier for which circuit diagram is shown undergoing measurement using the method indicated in Fig. 7

the output tube in every case.

Most practical amplifier circuits generally comprise more than one stage. In a multistage amplifier it is usually preferable to enclose more than the final stage in the feedback loop, since this, among other things, avoids the requirement of large driving voltages for the final stage. For these conditions the feedback diagram is as shown in Fig. 4.

Multistage Feedback Effects

The results are almost identical to those of Fig. 3, with the exception that the gain K of the intervening stages appears in the factor to increase the effects of the feedback for a given μ and β.

The final equation shown in Fig. 4 is that generally found in textbooks for output impedance of multistage feedback amplifiers. In this form it is not particularly convenient to use for calculation, since it requires a knowledge of the gain of the intervening stages.

A simpler, and more convenient equation may be derived as follows.

The damping factor without feedback is

$$D_o = \frac{R_l}{Z_o} = \frac{R_l}{r_p}$$

The damping factor with feedback is

$$D_f = \frac{R_l}{Z_o} = \frac{R_l}{r_p/(1 - \beta K \mu_f)} \qquad (2)$$

$$= D_o (1 - \beta K \mu_f)$$

The gain of the final stage is

$$K_f = \mu_f \frac{R_l}{R_l + r_p}$$

Solving for μ_f

$$\mu_f = K_f \left(1 + \frac{r_p}{R_l}\right)$$

$$= K_f \left(1 + \frac{1}{D_o}\right)$$

Substituting in Eq. 2

$$D_f = D_o \left[1 - \beta K K_f \left(1 + \frac{1}{D_o}\right)\right] \qquad (3)$$

The amount by which the gain is reduced is

$$1 - \beta K K_f = 1 - \beta K_o$$

where K_o is total gain

That is, if $1 - \beta K_o = 2$, the gain is reduced by 2. Letting this gain reduction factor $= F$, we have

$$D_f = D_o [F - (1 - F)(1/D_o)]$$

$$D_f = F(D_o + 1) - 1 \qquad (4)$$

Note that in this final form it is

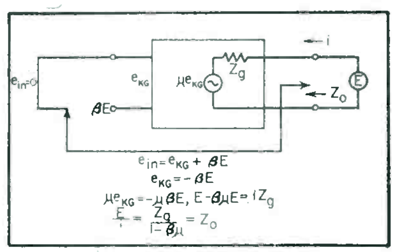


FIG. 3—Output impedance without feedback is represented by plate resistance alone in figure above and in text

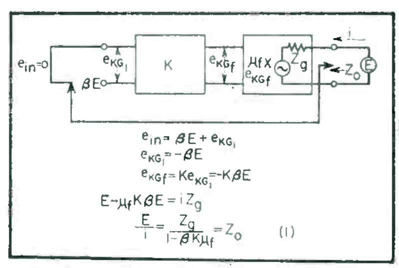


FIG. 4—Conventional concept leading to Eq. 1 above is based on premises illustrated. Equation 4 (see text) is more convenient form

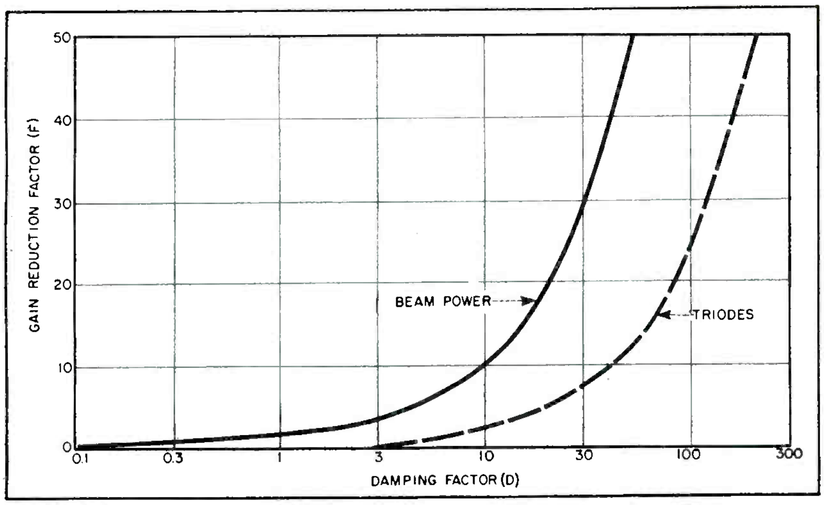


FIG. 5—Curves show changes in damping factor with feedback for typical beam-power and power-triode tubes. Note superiority of triodes

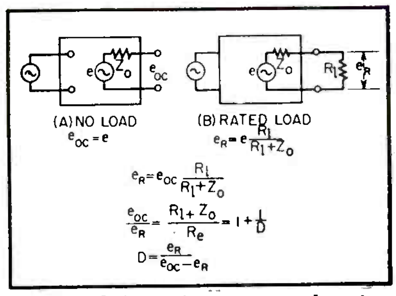


FIG. 6—Method of measuring damping factor by means of no-load and rated-load output voltage shown in bottom equation

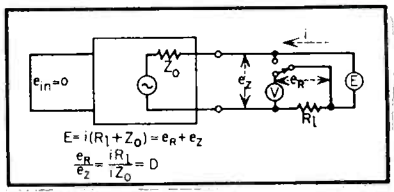


FIG. 7—Simplified method of obtaining damping factor by measurement across series resistor equal to secondary winding

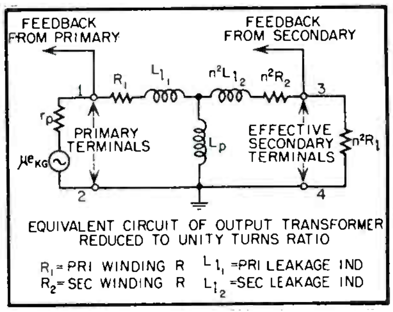


FIG. 8—Limits of the damping factor with feedback obtained from one of two points. See text for discussion

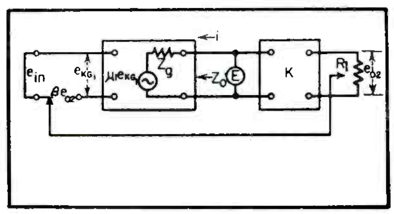


FIG. 9—Effective internal impedance of intermediate stage is reduced by feedback taken from succeeding stage

not necessary to know the actual gain of any of the stages, or the feedback ratio, but only the gain reduction and the original damping factor.

For example, it is desired to compute the damping factor obtained in a push-pull 6L6 amplifier when 20 db of negative voltage feedback is employed.

$F = 10$
$R_l = 5{,}000$
r_p (two tubes) $= 45{,}000$
$D_o = 5{,}000/45{,}000$
$D_f = 10\,(0.111 + 1) - 1 = 10.11$

For a push-pull 2A3 amplifier with the same load and the same gain-reduction factor

r_p (2 tubes) $= 1{,}600$
$D_o = 5{,}000/1{,}600 = 3.12$
$D_f = 10\,(3.12 + 1) - 1 = 40.2$

These results show the tremendous changes in output impedance produced by feedback, especially for beam-power tubes. Without feedback the damping factor of the triode amplifier is some 27 times that of the beam-power tubes. With the same amount of feedback applied to each, the damping factor of the triodes is approximately 4 times that of the beam-power tubes. Or looking at it from another point of view, the same amount of feedback produces a 13-fold change for the triodes, but a 90-fold change for the beam power tubes.

Equation 4 has been used to obtain the graph of Fig. 5. In this graph the two curves show changes in damping factor with feedback for typical beam-power tubes and typical power triodes. From this it may be seen that approximately 12 db of feedback is required to make the damping factor of a beam-power tube equal to that of a triode without feedback. It is also evident that the same amount of feedback will always give a greater damping factor in a triode amplifier than in a beam-power amplifier, since the original damping factor of the triode amplifier is greater.

These curves may be used in several ways, although Eq. 4 is so simple that it may be used almost as readily, especially if the following simplifications are made.

The initial damping factor for most beam-power tubes is approximately 0.1, while it is approximately 3 for most triodes. Using these values the following approximate equations, quite suitable for design purposes, are obtained:

For beam power tubes

$$D_f = F - 1 \qquad (4B)$$

For triodes

$$D_f = 4F - 1 \qquad (4C)$$

Both these equations are reasonably accurate when F is equal to or greater than 2 (6-db feedback). For less feedback, Eq. 4 should be used for beam power tubes, while Eq. 4C is still applicable for triodes.

Similar relations may be derived for current feedback, but since this type is relatively little used over the output stage, they will not be derived here.

Measurement

The measurement of the damping factor is generally done indirectly, that is, it is usually the practice to measure output voltages under differing load conditions, and to calculate the damping factor from the results. However, it is equally easy, and often more accurate, to measure it by other methods, which are also described below.

The first method often consists of measuring the output voltage with no load and with rated load, and then calculating D as shown in Fig. 6. This method is satisfactory for amplifiers with low values of D, such as pentode or beam-power amplifiers with little or no feedback. When the internal impedance is low, as in highly degenerative amplifiers, however, there is very little difference between e_R and e_{OC}. Since the difference of these two terms appears in the denominator, it is possible, when they are almost equal, for an error of a few percent in either of these terms to produce an error of several hundred percent in the answer.

A more accurate procedure is to use a low-impedance-type a-c bridge. For such measurements the signal-input terminals of the amplifier are short-circuited, the output terminals are connected to the unknown impedance terminals of the bridge, and the bridge balanced as in normal measurements.

An even simpler method, and one quite accurate for damping factors as high as 50 or more is shown in Fig. 7. The input terminals of the amplifier are short-circuited and the output terminals are connected to a generator E in series with a resistance R_l, which is the rated value of the secondary winding of the output transformer. The damping factor is then equal to the ratio of the voltage drops across R_l and across the secondary winding respectively. The generator E may conveniently be the 6.3-volt filament winding of a power transformer. In a highly degenerative amplifier almost all the voltage drop will be across R_l; consequently, it must be fairly high power rating.

When E is 6.3 v a rating of 10 watts will be adequate for almost all situations.

Two points of interest concerning damping factor may be pointed out in passing. First, it can be seen from Fig. 8 that when the feedback is taken from the primary of the output transformer (terminals 1 and 2), the damping factor approaches R_l/R_w as a limit, where R_w is the total winding resistance of the transformer referred to the same side to which R_l is referred. When the feedback is taken from the secondary terminals (3 and 4), however, this limit does not exist, and D can theoretically approach infinity.

Internal Impedance

Second, it is demonstrated below by reference to Fig. 9 that the effective internal impedance of a stage inside the feedback loop is also reduced by negative feedback taken from a succeeding stage.

$$e_{in} = \beta e_{02} + e_{KG1}$$
$$e_{KG1} = -\beta e_{02}$$
$$e_{02} = K_2 E$$
$$E + \mu_1 e_{KG1} = i Z_g$$
$$E + \mu_1 (-\beta e_{02}) = i Z_g$$
$$E + \mu_1 (-\beta K_2 E) = i Z_g$$
$$\frac{E}{i} = \frac{Z_g}{1 - \beta \mu_1 K_2} = Z_o$$

This shows, for example, that overall feedback from the final stage of a class-B modulator will reduce the output impedance of the driver stage as well, thereby contributing to reduced distortion by virtue of this action as well as by its normal distortion-reducing action.

Practical Applications

Although feedback can increase the initial damping factor to a high degree, the values realized in practice are somewhat less than theory indicates. The large damping factors that can be achieved in practical design, however, are well exemplified in the 20-watt wide-range, feedback amplifier shown in Fig. 10. This is the commercial type W-20 Williamson amplifier, in which 20 db of negative feedback is taken over four stages and the output transformer. The damping factor of this amplifier without feedback, measured by the method of Fig. 7, is 2 at 50 cycles (a common value of resonant frequency for high-quality low-frequency type loudspeakers). When 20 db of negative feedback is applied the damping factor is increased to 27, which is only slightly less than the theoretical value of 29 based upon the initial measured value of D_o.

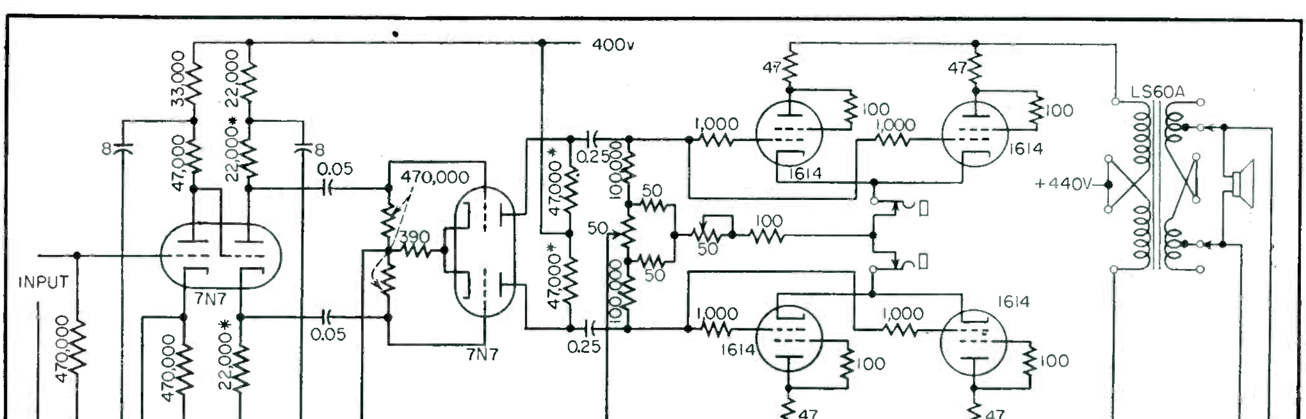


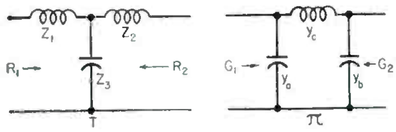
FIG. 10—Circuit diagram of the UTC W-20 Williamson feedback amplifier with damping factor of 27

Network Design Charts

Time-saving universal T, pi and L network design charts covering all normally encountered phase shifts and transformation ratios. Scale multiplying factors are eliminated by normalizing the input and output impedances being matched

By T. U. FOLEY

Broadcast Engineering Section
RCA Victor Division
Camden, N. J.



THE PROBLEM of matching arbitrary impedances to a given transmission-line impedance is common throughout the radio industry. The accompanying charts permit simultaneous solution of matching reactance limits over a range of both phase shift and load resistance. To make the plots universal, it was necessary to normalize to a one-ohm or one-mho transmission line. If the practical line is other than one ohm, it will be necessary to normalize R_2, so that $R_{2n} = R_2/R_1$. Using this value of R_{2n}, enter the chart along this line to the appropriate value of phase shift and interpolate between plotted values of loci, obtaining Z_{1n}, Z_{2n} and Z_{3n} in turn on the three charts. To obtain Z_1, Z_2 and Z_3, simply multiply Z_{1n}, Z_{2n} and Z_{3n} by actual line impedance.

Example 1. Assume a T network is required to match a 35-ohm load to a 50-ohm transmission line with a phase shift of 80 degrees.

(a) $Z_o = 50$ $R_2 = 35$ $\beta = 80°$
(b) $R_{2n} = 35/50 = 0.7$
(c) Enter chart Z_1 at $R_2 = 0.7$ and follow to $\beta = 80°$
(d) Read $Z_{1n} = +0.67$
(e) $Z_1 = j\,50 \times (+0.67) = +j\,33.5$ ohms
(f) Similarly, on chart Z_2 find $Z_{2n} = +0.725$
(g) $Z_2 = j\,50\,(+0.725) = +j\,36.25$ ohms
(h) Similarly, on chart Z_3 find $Z_{3n} = -0.85$
(i) $Z_3 = j\,50\,(-0.85) = -j\,42.5$ ohms

Example 2. Assume a π network is required to match a 35-ohm load to a 50-ohm transmission line with a phase shift of 80 degrees.

(a) $Z_o = 50$, $R_2 = 35$, $\beta = 80°$
(b) $G_o = 1/50 = 0.02$ $G_2 = 1/35 = 0.0286$ $G_{2n} = 0.0286/0.02 = 1.43$
(c) Enter chart Y_a at $G_2 = 1.43$ and follow to $\beta = 80°$
(d) Read $Y_{an} = +1.03$
(e) $Y_a = j\,0.02\,(+1.03) = +j\,0.0206$ or $Z_a = 1/Y_a = -j\,48.5$ ohms
(f) Similarly, on chart Y_b find $Y_{bn} = 0.96$
(g) $Y_b = j\,0.02\,(+0.96) = +j\,0.0192$ or $Z_b = 1/Y_b = -j\,52.1$ ohms
(h) Similarly, on chart Y_c find $Y_{cn} = -1.22$
(i) $Y_c = j\,0.02\,(-1.22) = -j\,0.0244$, or $Z_c = 1/Y_c = +j\,41$ ohms

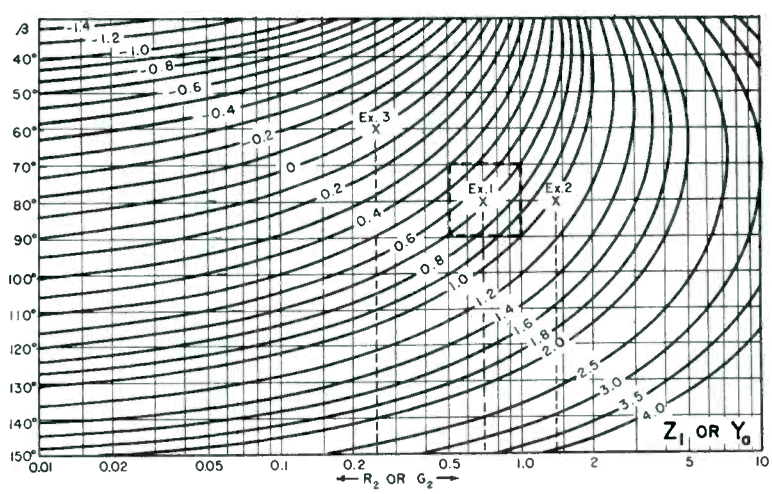
Example 3. Assume an L network is required to match a 12.5-ohm load to a 50-ohm transmission line. (Note that in the case of an L network, we cannot specify both phase shift and load resistance since when one is specified the other is fixed.)

(a) $Z_o = 50$ $R_2 = 12.5$
(b) $R_{2n} = 12.5/50 = 0.25$
(c) (If R_{2n} is less than 1, enter chart Z_1; if R_{2n} is greater than 1, enter chart Z_2)
(d) Enter chart Z_1 at $R_2 = 0.25$ and follow to locus of zero reactance
(e) Read $\beta = 60°$, $Z_1 = 0$
(f) Enter chart Z_2 at $R_2 = 0.25$ and follow to $\beta = 60°$
(g) Read $Z_{2n} = +0.43$
(h) $Z_2 = j\,50\,(+0.43) = +j\,21.5$ ohms
(i) Similarly, find $Z_{3n} = -0.58$
(j) $Z_3 = j\,50\,(-0.58) = -j\,29$ ohms

All of the above illustrations have assumed lagging networks. Reversing the sign of each reactance arm changes from lagging network to leading network.

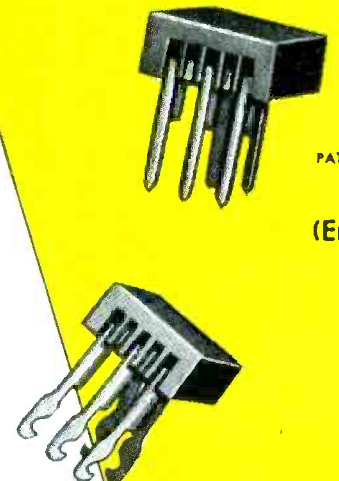
To extend the technique to cover a range of phase shifts over a range of load resistances, the principles of the preceding illustrations pertain. In this case, however, the point plot be-

(continued on page 134)



Cinch SUB-MINIATURE SOCKETS

For printed circuit application contact tails solder direct to sub panel circuit. Hi Tension contacts hold tube in horizontal position.



PATENT PENDING

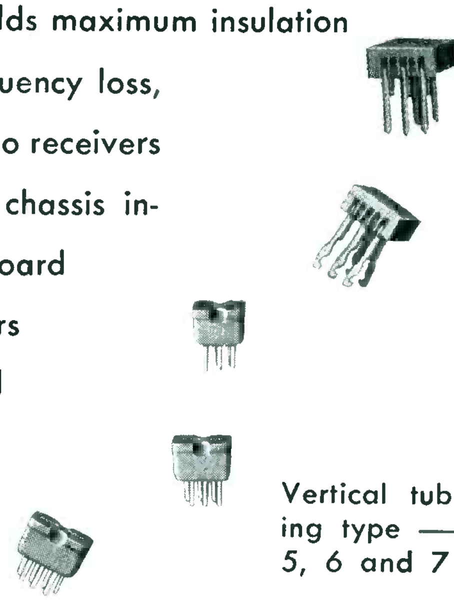
(Enlarged twice)

STANDARD IN COMMERCIAL USE...SERVE MILITARY NEEDS

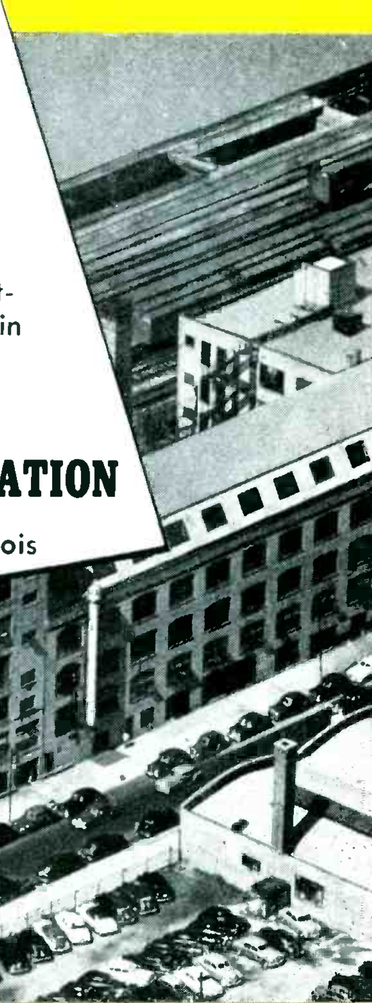
The CINCH sub-miniature socket insures positive electrical contact, holds tubes securely in place, permits easy maintenance and replacement, yields maximum insulation resistance and minimum high frequency loss, and provides manufacturers of radio receivers and hearing aids a labor saving chassis installation which serves terminal board functions while permitting designers to obtain maximum space afforded by the standard flat base tubes.

Consult CINCH

Designed for sub panel conventional wiring—Socket retained in insulation by twisting tails.



Vertical tube mounting type — made in 5, 6 and 7 prong.



Cinch ELECTRONIC COMPONENTS

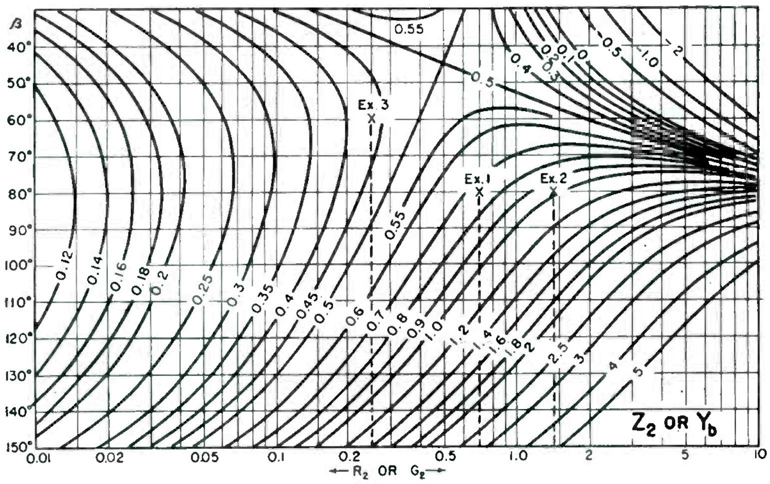
CINCH MANUFACTURING CORPORATION

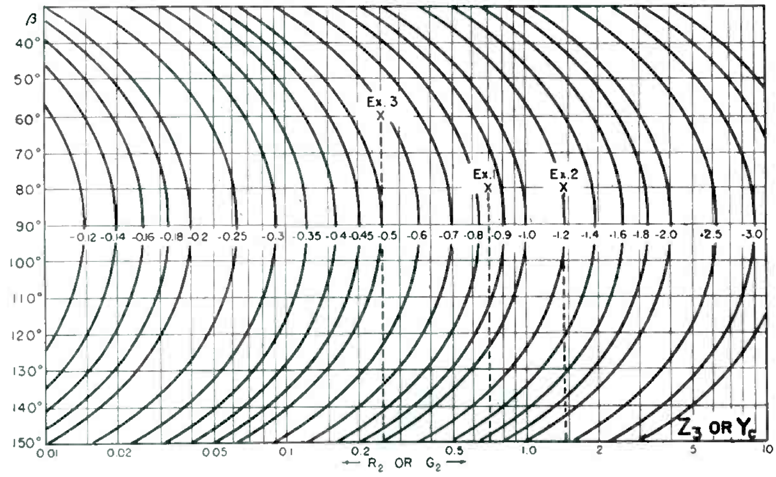
1026 South Homan Ave., Chicago 24, Illinois

Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

Available at leading electronic jobbers—everywhere.

Network Design Charts *(continued from page 132)*





comes a rectangle about the design center. A rectangular template can be made on transparent material to permit evaluation over a range of ±10 degrees from design-center phase shift. Simultaneously, it would cover a 2 to 1 load resistance variation. Other rectangles can be made easily to cover any range of phase shift and load resistance variation.

Example 4. Since the range technique is essentially the same as the point technique, a single illustration will suffice: Assume a T network is required to match a 35-ohm nominal resistance to a 50-ohm transmission line over a resistance range of 2 to 1 centered on 35 ohms and over a phase shift range of 70° to 90°. Following the technique of Example 1, center the rectangle at $R_2 = 0.7$ and $\beta = 80°$ on chart Z_1. Read limits of $Z_{1n} = +0.39 \rightarrow 1.0$. Then

$$Z_1 = j\,50\,(+0.39 \rightarrow +1.0) = +j\,19.5 \rightarrow +j\,50 \text{ ohms}$$

Appendix

Referring to Fig. 1 and 2, equations for reactance arms of T and π networks are:

$$Z_1 = -j\,\frac{R_1 \cos\beta - \sqrt{R_1 R_2}}{\sin\beta} \quad (1)$$

$$Z_2 = -j\,\frac{R_2 \cos\beta - \sqrt{R_1 R_2}}{\sin\beta} \quad (2)$$

$$Z_3 = -j\,\frac{\sqrt{R_1 R_2}}{\sin\beta} \quad (3)$$

$$Z_a = +j\,\frac{R_1 R_2 \sin\beta}{R_2 \cos\beta - \sqrt{R_1 R_2}} \quad (4)$$

$$Z_b = +j\,\frac{R_1 R_2 \sin\beta}{R_1 \cos\beta - \sqrt{R_1 R_2}} \quad (5)$$

$$Z_c = +j\,\sqrt{R_1 R_2}\,\sin\beta \quad (6)$$

These equations may be normalized in terms of R_1 by substituting

$R_{2n} = R_2/R_1$, leaving

$$Z_{1n} = \frac{Z_1}{R_1} = -j\,\frac{\cos\beta - \sqrt{R_{2n}}}{\sin\beta} \quad (7)$$

$$Z_{2n} = \frac{Z_2}{R_1} = -j\,\frac{R_{2n}\cos\beta - \sqrt{R_{2n}}}{\sin\beta} \quad (8)$$

$$Z_{3n} = \frac{Z_3}{R_1} = -j\,\frac{\sqrt{R_{2n}}}{\sin\beta} \quad (9)$$

$$Z_{an} = \frac{Z_a}{R_1} = +j\,\frac{R_{2n}\sin\beta}{R_{2n}\cos\beta - \sqrt{R_{2n}}} \quad (10)$$

$$Z_{bn} = \frac{Z_b}{R_1} = +j\,\frac{R_{2n}\sin\beta}{\cos\beta - \sqrt{R_{2n}}} \quad (11)$$

$$Z_{cn} = \frac{Z_c}{R_1} = +j\,\sqrt{R_{2n}}\,\sin\beta \quad (12)$$

Equations 10, 11 and 12 can be put on an admittance basis as follows:

$$Y_{an} = \frac{1}{Z_{an}} = -j\,\frac{R_{2n}\cos\beta - \sqrt{R_{2n}}}{R_{2n}\sin\beta} = -j\,\frac{\frac{1}{G_{2n}}\cos\beta - \sqrt{\frac{1}{G_{2n}}}}{\frac{1}{G_{2n}}\sin\beta}$$

$$= -j\,\frac{\cos\beta - \sqrt{G_{2n}}}{\sin\beta} \quad (13)$$

$$Y_{bn} = \frac{1}{Z_{bn}} = -j\,\frac{\cos\beta - \sqrt{R_{2n}}}{R_{2n}\sin\beta} = -j\,\frac{G_{2n}\cos\beta - \sqrt{G_{2n}}}{\sin\beta} \quad (14)$$

$$Y_{cn} = \frac{1}{Z_{cn}} = -j\,\frac{1}{\sqrt{R_{2n}}\,\sin\beta} = -j\,\frac{\sqrt{G_{2n}}}{\sin\beta} \quad (15)$$

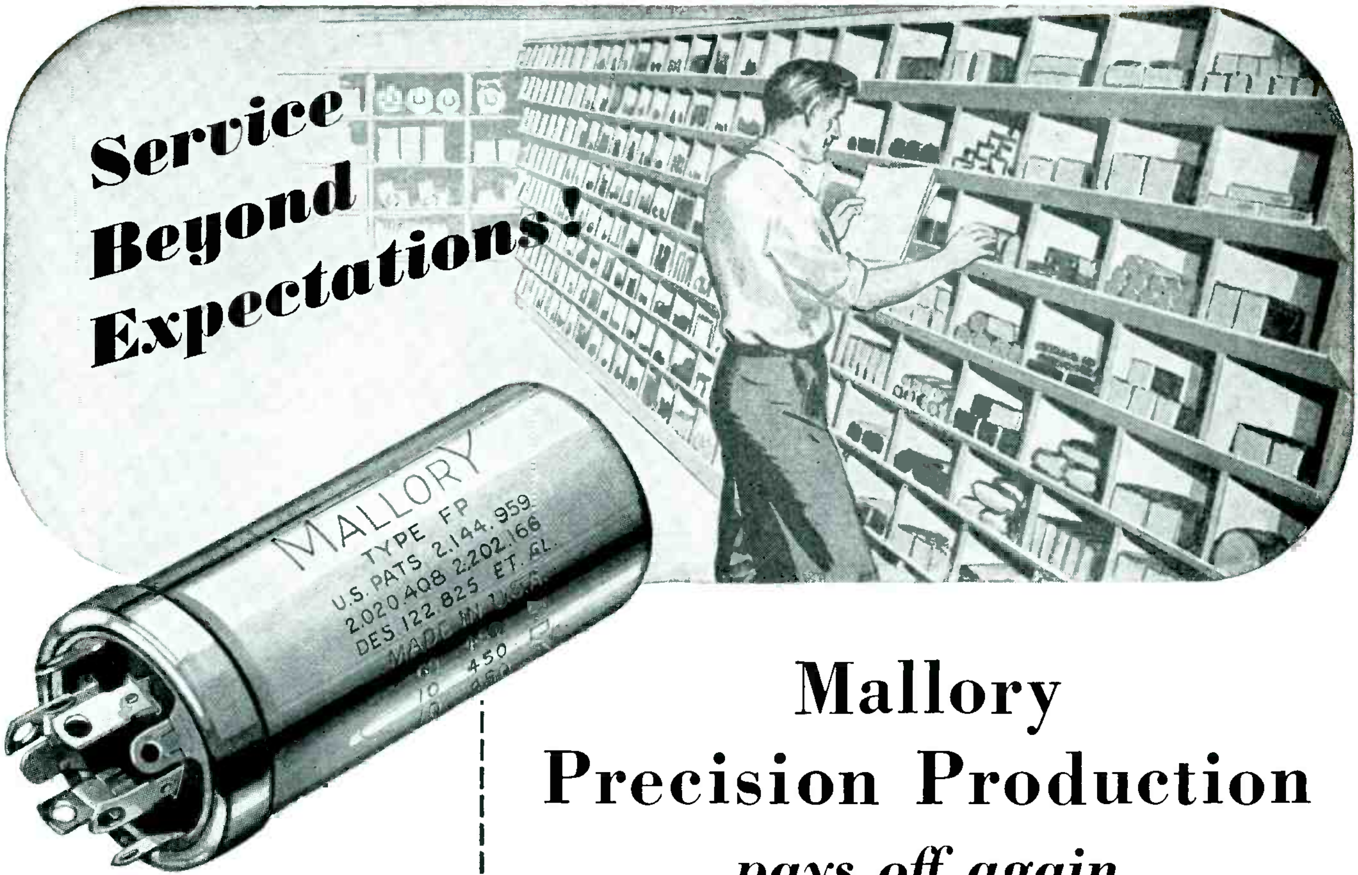
Comparing Eq. 13, 14 and 15 with Eq. 7, 8 and 9, it is seen that the equations for a π network on an admittance basis are identical to the equations for a T network on an impedance basis. Solving for R_{2n} in Eq. 7, 8 and 9 gives

$$R_{2n} = (Z_{1n}\sin\beta + \cos\beta)^2 \quad (16)$$

$$R_{2n} = \left(\frac{1 \pm \sqrt{1 - 2 Z_{2n}\sin 2\beta}}{2\cos\beta}\right)^2 \quad (17)$$

$$R_{2n} = (-Z_{3n}\sin\beta)^2 \quad (18)$$

Equations 16, 17 and 18 were used to calculate points on curves Z_1, Z_2 and Z_3 by holding Z's fixed for each locus, ranging β over 30° to 150° and solving for R_{2n}.



Mallory Precision Production

pays off again in "shelf-life" demonstration

When you specify Mallory Capacitors for television receivers or other equipment where heat is a problem, you can be sure they will stand the test. Mallory FP Capacitors are designed to give long, trouble-free performance at 85°C. —naturally they give even longer service at normal temperatures. In addition, Mallory FP Capacitors are famous for their long shelf life. Write for your copy of the FP Capacitor Engineering Data Folder.

When a large radio and television manufacturer found it necessary to fall back on a supply of two-year-old capacitors, they found that every one of the Mallory Capacitors was ready for immediate use — without re-working of any kind. Because of the scrupulously careful manufacturing methods pioneered by Mallory, they were completely free of corrosion.

Mallory Capacitors have consistently set new high standards of dependability which far exceed normal specifications.

That's service beyond expectations!

P. R. MALLORY & CO., Inc.
MALLORY
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

SERVING INDUSTRY WITH

Electromechanical Products
Resistors *Switches*
TV Tuners *Vibrators*

Electrochemical Products
Capacitors *Rectifiers*
Mercury Dry Batteries

Metallurgical Products
Contacts *Special Metals*
Welding Materials

TUBES AT WORK

Including INDUSTRIAL CONTROL

Edited by RONALD K. JURGEN

Problems in Mobile TV 136
Ultrasonic Cleaning Device 168
Distortion Measurement Device 173
Tube Selection for Heating Equipment 188
Refrigeration for Amplifiers 208
Ultrasonic Soldering Bath 212
Intrusion Alarm System 216
Measuring Flyback Filament Voltage 224

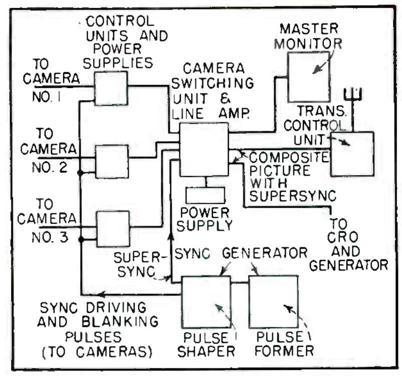


FIG. 3—Simplified block diagram of equipment used. Cameras were located on second deck forward, the microwave transmitter and antenna on top deck, cro and generator on fantail and rest of equipment in the main deck cabin

Problems in Mobile TV

By EDWIN B. PORES

Television Field Engineer
National Broadcasting Co.
New York, New York

BROADCASTING of television programs from remote locations is no longer novel but a commonplace occurrence. The project under consideration was one of a sustaining educational series over WNBT, called "Treasures of New York". The program was scheduled as a tv sightseeing trip of the New York skyline.

Transmission of a 7,000-mc signal from a ship moving at 18 knots posed several technical problems unique in themselves. The objective of this article is to impress upon tv engineers the feasibility of this project under extreme weather conditions. Microwave relay transmission was performed without human line-of-sight while the vessel was under way by manual tracking of both antennas.

FIG. 2—An attempt to load a generator aboard the ship using an improvised wide gangway. A dock crane actually placed unit aboard, as tide shifted

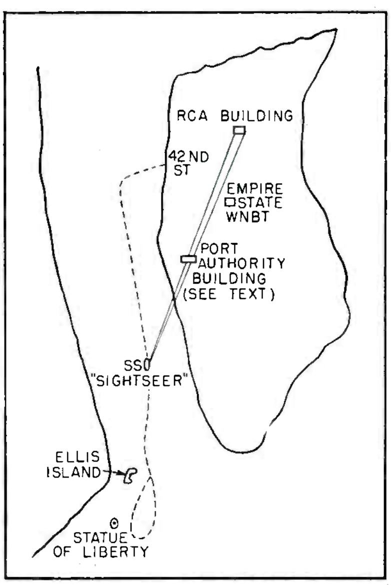


FIG. 1—Map showing path of ship for tv program

A short preliminary field survey was made of the existing facilities, namely a 185-foot excursion boat. Unavailability of alternating current required the loading aboard of a 10-kva mobile gasoline-engine-type generator whose frequency stability will be discussed later in this article.

Preparation

The projected itinerary was charted on a map with special care taken to determine if the microwave receiver located atop the RCA Building would be in the "shadow" of any tall buildings as the vessel sailed down the Hudson River.

Figure 1 shows the first obstacle encountered, the New York Port Authority Building. At the time of the survey it was determined that the microwave signal would not be available as the ship passed through the area of this building and standby pictures were made ready. During one hour of actual program, the survey was corroborated by the loss of three minutes of air time due to the Port Authority Building and two minutes due to the docking of a large freighter which of course could not have been planned for. The audio facilities necessary were twofold, consisting of a radio program circuit and a two-way radio cue circuit. The latter system was to enable the microwave transmitter engineer aboard the boat to be in continuous communication with the microwave receiver engineers atop the RCA Building.

Equipment Installation

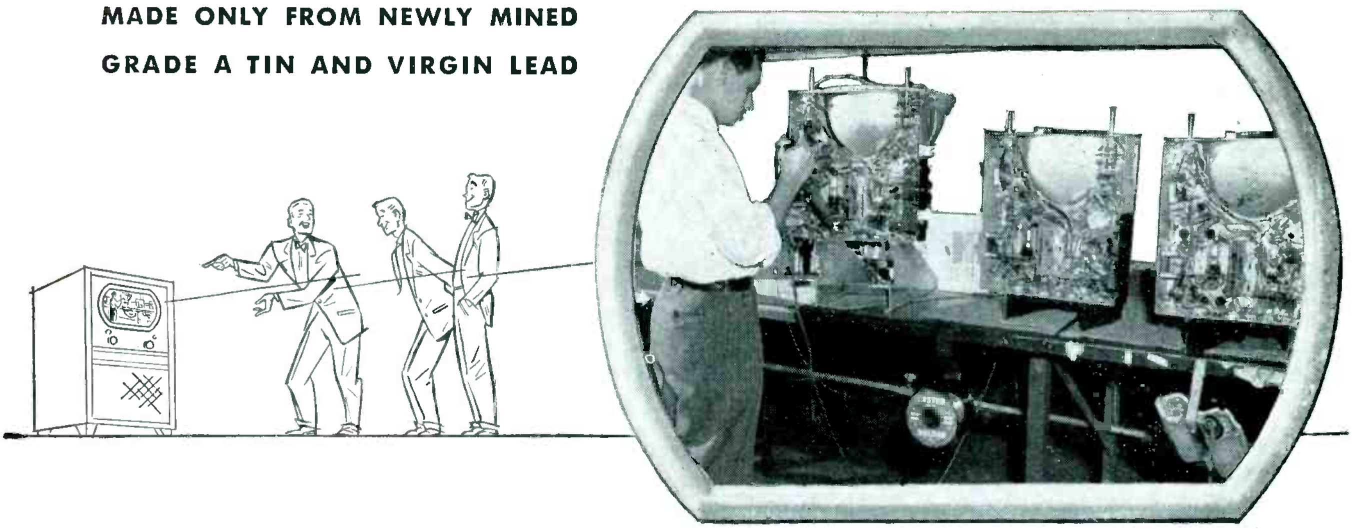
The major loading problem encountered was the hoisting of the power plant. The 10-kva gasoline-engine-driven generator weighed approximately 2,300 pounds. It was planned to have a wide gangway built of timber and at low tide the rail of the ship would have been level with the dock. It can be seen from Fig. 2 that in the process of building the gangway, the tide had already shifted and the plan had to be abandoned. A small dock-type crane was then hired and within a few minutes the power plant was safely aboard ship. The author

KESTER SOLDER

Build more quality into your TV sets with Kester "Resin-Five" Core Solder

TV—the nation's fastest growing business demands the nation's number 1 solder. Kester "Resin-Five" Core Solder, formulated especially for TV, will out perform any solder of the rosin-core type. It easily solders such metals as brass, zinc, nickel-plate, copper, and ferrous alloys.

MADE ONLY FROM NEWLY MINED GRADE A TIN AND VIRGIN LEAD



'Resin-Five' Core Solder

non-corrosive . . . non-conductive

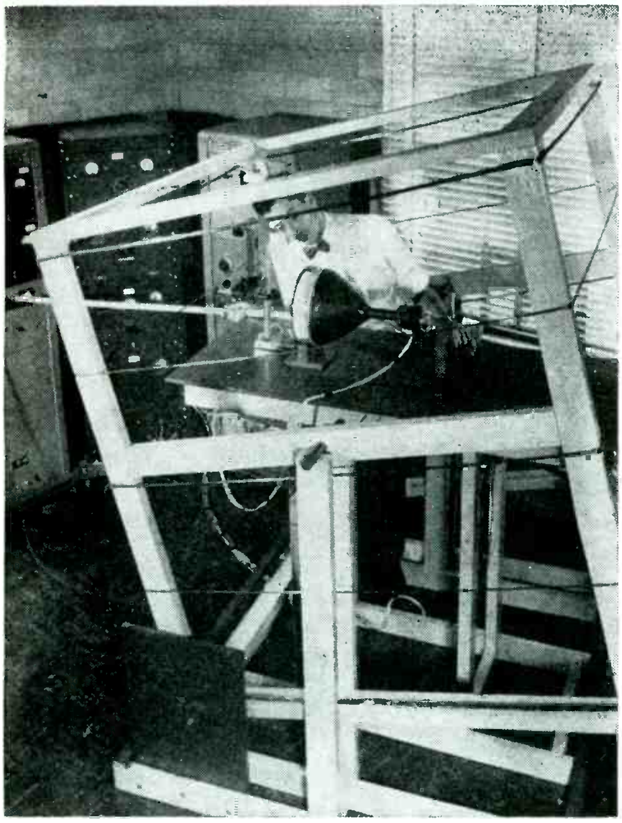
Kester...Standard for the TV and Radio Fields

"Resin-Five" flux is more active and stable than any other rosin-type flux. Yet it is absolutely non-corrosive and non-conductive.

FREE TECHNICAL MANUAL—*Send for Your Copy of—SOLDER and Soldering Technique.*

Kester Solder Company
4204 Wrightwood Avenue • Chicago 39, Illinois
Newark, New Jersey • Brantford, Canada

THE FRONT COVER



The cover picture this month and the accompanying photograph show a Sylvania engineer measuring spherical aberration of an electrostatic lens inside a special coil. The measurements are taken to insure perfect axial alignment of the beam in the tube. Since the greatest source of error in producing a perfect alignment is the earth's magnetic field, the special coil was constructed to produce a uniform magnetic field equal to and opposite in direction to the earth's field.

The structure is entirely of wood and contains no iron. It is oriented exactly along the earth's field and was calculated to produce a field uniform to 1 part in 500 over a volume enclosed by a cylinder 20 in. in diameter and 30 in. long. The axis of the cylinder is the axis of the coil.

To explore the field a special tube was made which operated at 500 v, with approximately 25 cm from cathode to screen. Under these conditions the total deflection produced is 4.15 cm per gauss. The tube was moved around inside the coil and the deflection recorded at various positions. Deflection was negligible except at the extreme edges of the coil, indicating that the net field is zero almost all over the region within the coil. All controls and supplies are outside the coil and adjustments are made with a long wooden rod sharpened to a screwdriver blade at one end which fits slots milled into the various control knobs.

wishes to advise tv field engineers to avail themselves of a crane immediately for mobile installations of this nature as longshoremen save precious engineering time.

All electronic equipment was then brought aboard the ship and installed to form a tv station afloat. The diagram (Fig. 3) of the video components enables one to see a simplified cabling picture which is quite standard in tv field programs.

FIG. 4—An adjustment being made on the throttle of power generator. Oscilloscope is located to the left of the operator but is obscured

However, in this particular installation, it was important that a stable 60-cycle power source be derived from a gasoline-engine-type generator.

Almost constant 60 cycles was obtained in a unique fashion. An oscilloscope powered by the generator was switched to LINE FREQUENCY and the composite picture with supersync was fed to the vertical plates. The electronic sync generator used to produce all the various synchronizing pulses was placed in CRYSTAL position. Therefore, the stability of the composite picture voltage was a function of a crystal-oscillator output. This voltage was then used as a reference to compare with the power generator voltage. Any change in power-unit frequency manifested itself by movement of the composite voltage picture on the oscilloscope. At the indication of such changes, the operator adjusted the engine throttle (Fig. 4) to maintain almost constant 60 cps. A reactance-type frequency meter proved that the power source could maintain its frequency output within ± one-tenth cycle.

FIG. 5—Program audio position showing portable amplifiers and monitoring equipment

The audio facilities shown in the photographs utilized standard a-m and tv equipment to provide all sound and communication channels. It should be noted that the amplifiers, transmitters and receivers employed are of a general type familiar to all radio engineers, hence no special equipment was

(Continued on p 156)

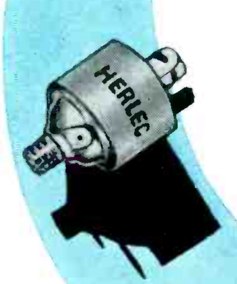
Hermetically-sealed CUP CERAMIC CAPACITORS for Precision tuned Circuits

With SPRAGUE HERLEC Dependability

Top-notch capacitance stability, high Q, and excellent retrace characteristics are only part of the story on Sprague-Herlec Cup Ceramic Capacitors.

In addition, they are small, hermetically-sealed, and easy to mount securely against the effects of vibration and shock. Their extreme stability and compactness make them unexcelled for rigid frequency control applications and as reference capacitance standards in either laboratories or electronic circuits. Low self-inductance likewise makes them valuable in v-h-f bypass applications.

With Sprague-Herlec metal cup ceramic capacitors in precision circuits, it is often possible to control the capacitance tolerance within ± 1% and the temperature coefficient tolerance within ± 10 parts per million!



For complete details write for Engineering Bulletin 603 to either Sprague or Herlec

HERLEC CORPORATION

422 N. 5th Street, Milwaukee, Wisconsin; A wholly-owned subsidiary of the

SPRAGUE ELECTRIC COMPANY

North Adams, Massachusetts

THE ELECTRON ART

Edited by JAMES D. FAHNESTOCK

Oscillograph Field Plotter 140
University of Chicago Synchrocyclotron 140
Auxiliary Current Alters Transistor Characteristics 142
High-Temperature Adhesive-Tape Resistors 236
Ionospheric Cross Modulation 252
Frequency Characteristics of Woven Resistors 260
Bridged-Tee Phase Modulators 268

Oscillograph Field Plotter

By Charles Susskind
and A. R. Perrins
Dunham Laboratory
Yale University
New Haven, Conn.

Several methods of displaying field patterns of radiation from various microwave configurations have been proposed. An approximate representation is obtained with the help of ripple tanks and similar devices, but the analogy is an imperfect one. A more exact picture is obtained by systematically sweeping the field with a small probe and recording the intensity of the intercepted radiation. If a second signal, taken directly from the source via a constant-length path (such as a flexible coaxial cable), is mixed with the signal intercepted by the probe, a plot of the phase fronts is obtained instead. With appropriate modifications, the device can be used for sound waves as well as for microwaves.

The problem of recording the information has been met in the past by amplifying the signal picked up by the probe and feeding it to a recording pen which moves over a metal table covered with current-sensitive paper,[1] or by attaching to the probe a small lamp whose brilliance is controlled by the amplified probe signal, and photographing the light variations (as the lamp scans the field) by means of a time exposure.[2] In each case, the recording device must be rigidly attached to the probe to insure proper correlation, giving rise to the possibility of distorting the recorded pattern by the presence of auxiliary equipment. In addition, the metal-table method necessitates either a comparatively large record or the employment of a pantograph, and the photographic technique can be applied successfully only inside a completely darkened room.

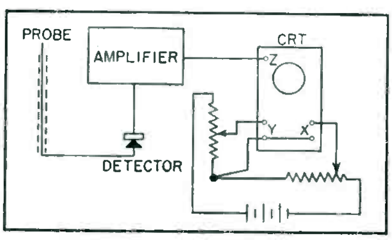


FIG. 1—Simple circuit of oscillograph field plotter

Oscillograph Technique

An alternate recording method consists in correlating the position of the probe with the position of the spot on the screen of a cathode-ray tube by means of the potentiometer arrangement shown in Fig. 1. The resistors shown are actually two lengths of resistance wire mounted at right angles and connected to the horizontal and vertical plates of the oscilloscope so as to form voltage dividers. The modulated signal intercepted by the probe is rectified, amplified, and used to control the intensity of the spot on the screen (z-axis modulation). The probe is caused to scan a rectangular area mechanically through an arrangement utilizing two electric motors, and the pattern swept out by the spot on the crt screen is recorded photographically with a time exposure. This technique combines the advantages of the two methods mentioned above: a record of convenient size is obtained, and total darkness is unnecessary. The equipment can be easily rendered portable and taken outdoors.

Figure 2 is the intensity radiation pattern of a 3-cm microwave horn. The record was made with a preliminary model of the oscillograph field plotter constructed at the Dunham Laboratory of Electrical Engineering, Yale University.

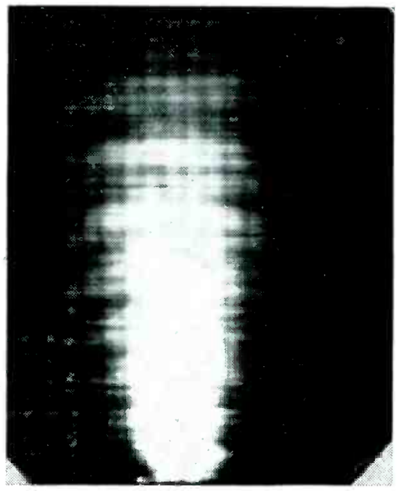


FIG. 2—Intensity radiation pattern of a 3-cm microwave horn

The method described above was developed in the course of an investigation sponsored by the U. S. Air Force under Contract No. AF 19 (122)-270.

References

(1) H. Iams, Phase-Front Plotter for Centimeter Waves, *RCA Review* 8, p 270, 1947.

(2) W. E. Kock and F. K. Harvey, A Photographic Method for Displaying Space Patterns (Abstract), *J. Acous. Soc. Am.* 23, p 149, Jan. 1951.

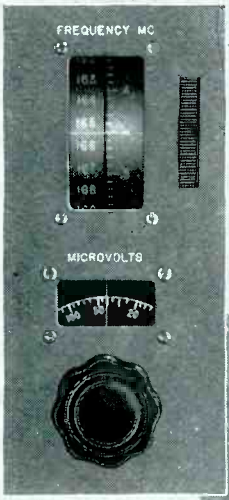
University of Chicago Synchrocyclotron

Believed to be the most powerful atom smasher in the world, the pictured synchrocyclotron will be used as an experimental tool to aid in the investigation of high-energy

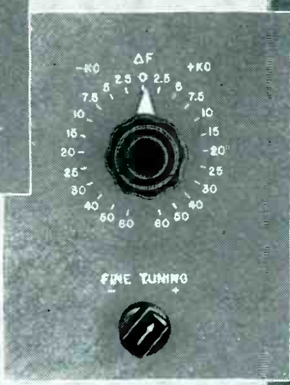
New! TYPE 206-A FM SIGNAL GENERATOR

for Mobile Communications Receivers

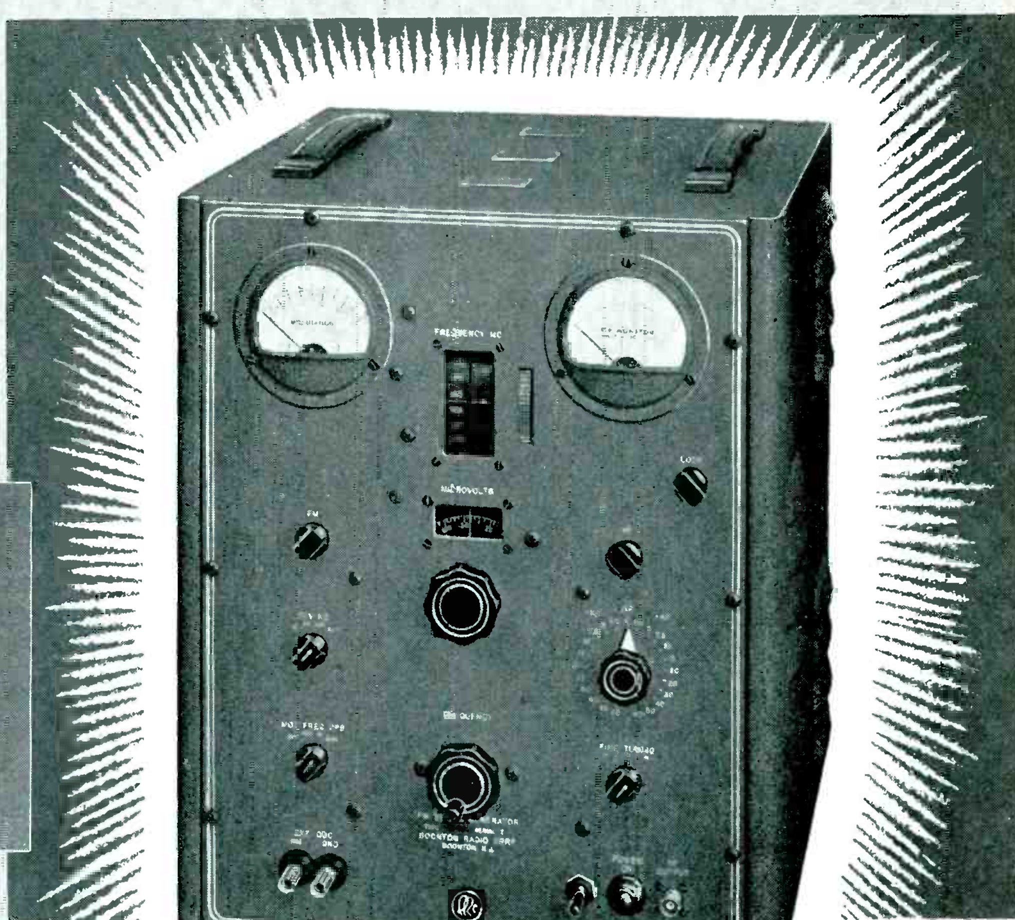
Frequency Range 146 mc to 176 mc



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. ΔF 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.

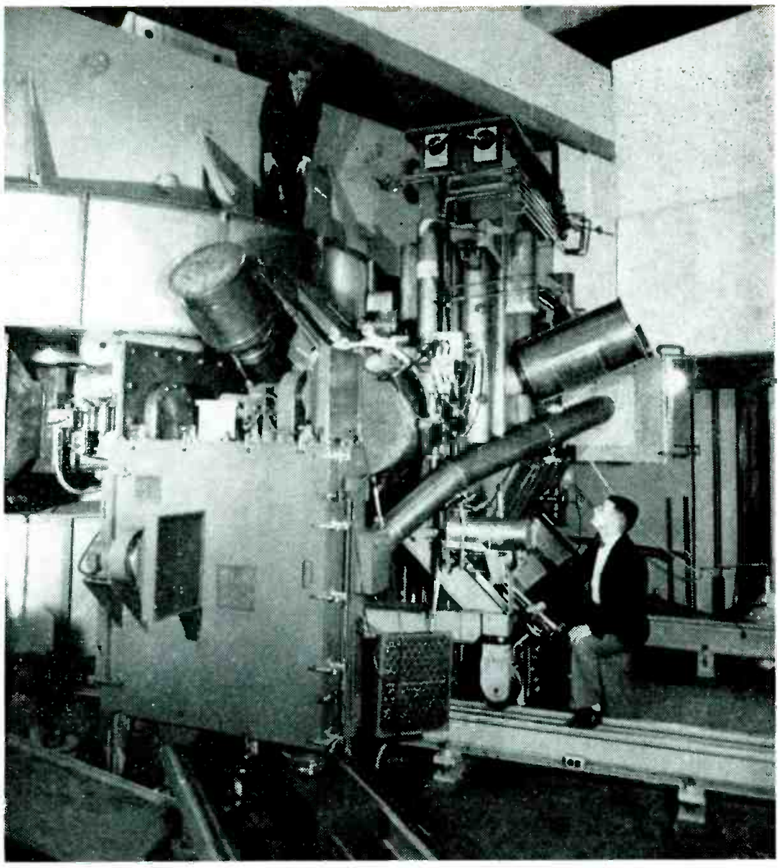
MODULATING SOURCES: Internal AF oscillator at 400 and 1000 cps. External AF oscillator may be used.

Output from internal AF oscillator available for synchronizing or other purposes.

POWER SUPPLY: Provides electronically regulated filament and B voltages.

Write for complete information

BOONTON RADIO *Corporation*
BOONTON · N · J · U · S · A ·



New high-power synchrocyclotron installed at University of Chicago will be used in experiments with high-energy particles

beams on living tissue and other projects other than for purposes of war. The relative size of the parts is emphasized by comparison to the engineer standing atop the magnet.

The $2,500,000 machine has accelerated protons to an energy of 450-million electron volts. The vacuum chamber between the poles of the magnet is made of stainless steel. Its chamber is 19 feet square and two feet thick. It requires only 40 minutes to create a vacuum of 2×10^{-9} atmospheres.

Auxiliary Current Alters Transitor Characteristics

By J. G. Skalnik, H. J. Reich, J. E. Gibson and T. Flynn

Dunham Laboratory of Electrical Engineering
Yale University
New Haven, Connecticut

In the course of an investigation covering the use of transistors in trigger circuits, the authors have found that under certain conditions the characteristics of transistor amplifiers may be improved by the introduction of an auxiliary direct current between an extra probe, located near the collector, and the base. The physical arrangement is shown in Fig. 1.

The effect of the auxiliary current I_a on the current gain of a transistor has been reported elsewhere.[1] The corresponding effect on the voltage amplification of a grounded-base amplifier is similar and is illustrated in Fig. 2. If the direction of I_a is reversed from that shown in Fig. 1, the voltage amplification will decrease in all cases. The curves were all taken at 10 kc but with different emitter-collector spacings. The collector was formed and held constant in position and the emitter was moved to change the spacing. The germanium was n-type. Examination of Fig. 2 shows that decided improvement is obtained when the spacing is large, but that the improvement is negligible when the spacing is more nearly normal. The improvement never appears to be large enough to cause the amplification to be greater than that for the transistor with normal spacing.

In an effort to gain an understanding of the mechanism of the improvement, the constants of the equivalent circuit for a transistor, shown in Fig. 3, were measured. The method of determining these from the slopes of the d-c static characteristics has been described in the literature.[2] No major change in r_b, r_e and r_c was found as a function of I_a, both r_e and r_c decreasing slightly as I_a is increased. This decrease was never found to be more than about ten percent even for

(Continued on p 228)

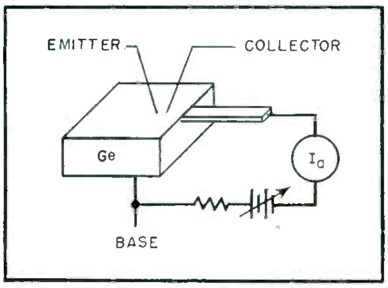


FIG. 1—Physical arrangement of transistor and auxiliary probe

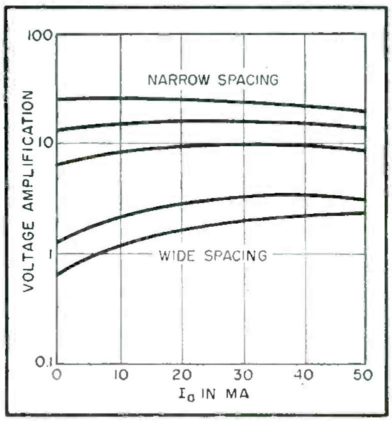


FIG. 2—Improvement in voltage amplification as a function of the auxiliary current. The various curves are for different emitter-collector spacings

AN approved (3303-1)

R-B-M

ELECTRONIC AND COMMUNICATION RELAYS

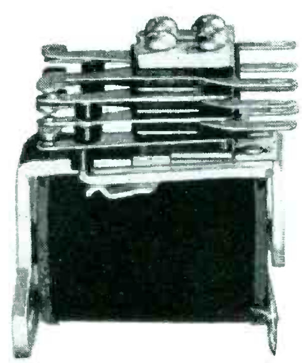
Now Hermetically Sealed

AN approved (3304-1)

● Hundreds of thousands of R-B-M telephone type relays saw Government service in World War II. Now most of these relays are available in hermetically sealed enclosures designed to meet AN specifications.

R-B-M hermetically sealed telephone type relays are available in contact forms up to and including 4-pole, double throw, 3 ampere, 28 Volts D.C. construction. Also 10 ampere rating up to and including 2-pole double throw at 28 Volts D.C. All relays available with approved AN plug connector, or solder connections.

Engineers! What is YOUR hermetically sealed relay requirement? R-B-M is developing new and smaller relays to meet Armed Services requirements. Perhaps one of these will solve your problems. Write giving complete relay specifications, application, quantity and AN specifications applying. Address Dept. F-9.



R-B-M Production and Engineering facilities in two plants, located in different states, (over a quarter million square feet), can assist you in the development and production of special electro-magnetic devices for Armed Services application.

RBM

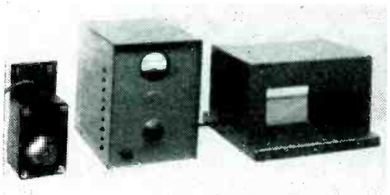
R-B-M DIVISION ESSEX WIRE CORP.
Logansport, Indiana

MANUAL AND MAGNETIC ELECTRIC CONTROLS—FOR AUTOMOTIVE, INDUSTRIAL, COMMUNICATION AND ELECTRONIC USE

NEW PRODUCTS

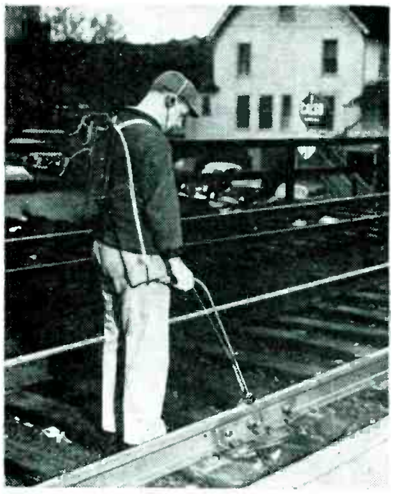
Edited by WILLIAM P. O'BRIEN

New and Improved Test and Control Instruments Are Available . . . Latest Tubes, Components and Allied Products Are Covered . . . Manufacturers' Literature Is Reviewed



Metal Detection Equipment

RADIO CORP. OF AMERICA, Camden, N. J. The Guardsman Series metal detection equipment will inspect meat, bakery products, candy, plastics, paper, rubber, tobacco, textiles, explosives and many other nonmetallic substances for minute tramp metal particles. Shown above to the left is the small round aperture type detection head, and to the right the rectangular type head that will inspect products passing through on a conveyor belt at rates of from 10 ft to 1,000 ft per minute. The control unit is shown in the center. Power requirement is 115-volts, 50 or 60-cycle, 70 watts.



Ultrasonic Flaw Detector

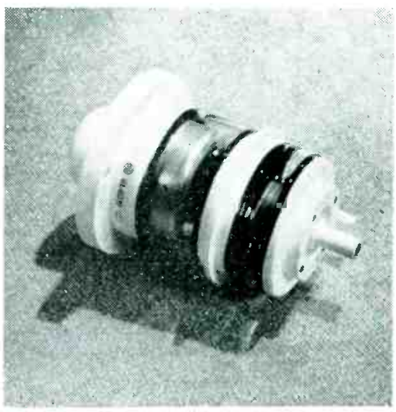
BRANSON INSTRUMENTS, INC., 430 Fairfield Ave., Stamford, Conn. The Audigage flaw detector illustrated was developed originally for testing railroad rail in track but can also be used to test certain other steel and aluminum parts with uniform cross sections. Ultrasonic resonance is employed to generate a tone in the operator's headphones. A perfect rail causes resonance at a frequency reflected in a 1,000-cps tone; the presence of a crack or other flaw is revealed by a distinct change in the pitch of the audible signal. The instrument is turned on by a snap-action switch in the handle; all other controls are set prior to testing. The X-cut quartz crystal transducer is swivel-mounted and remains in contact with the rail despite accidental tilt of the handle. Power is supplied by batteries contained in the instrument case.

Gaussmeter

DYNA LABS, INC., 132 Lafayette St., New York 13, N. Y., has available the D-79 gaussmeter that reads the magnitude and direction of the flux density in an air gap as small as 0.025 in. thick and 0.01 sq in. The flux value is obtained as a steady reading on a d-c meter movement as long as the probe is held in the magnetic field. The probe is ideal for plotting magnetic leakage fields, since it is entirely nonmagnetic and does not disturb the field. This allows in six ranges an accuracy of 2½ percent from 10 gauss for both a-c and d-c magnetic fields.

Preheat Tube Tester

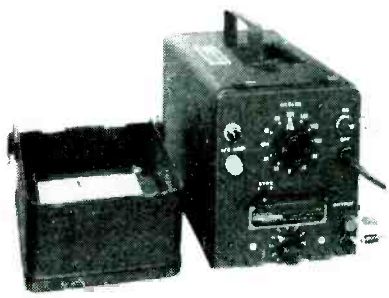
PENNSYLVANIA TESTING LABORATORY, Doylestown, Pa. Type 218 test set will provide for simultaneously preheating 10 tubes of one type with all voltages applied as required before final testing. The equipment comprises 3 variable and regulated d-c power supplies for plate, screen and grid voltages, an a-c filament supply and two sets of load lamps. A patching panel will connect any voltage, load or ground circuit to any specified pin on either octal, loctal, small seven or medium nine-pin tubes.



Power Tube

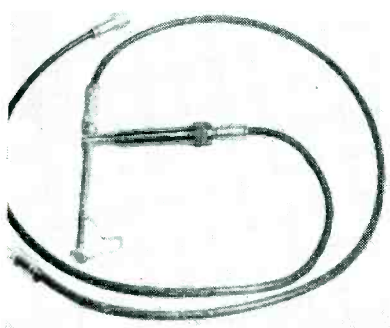
GENERAL ELECTRIC CO., Schenectady, N. Y. Designed for use as a grounded-grid Class-B r-f amplifier

and class-C r-f amplifier and oscillator, the type GL-6039 tube has a water-cooled anode, a cathode with a thoriated-tungsten filament and is capable of dissipating 7 kw. A pair of the tubes is capable of 10 kw output in tv service and 25 kw in f-m. The tube features low lead inductance, large terminal-contact areas and silver-plated metal parts that reduce r-f losses. Neutralization is unnecessary in a properly designed circuit and the problem of filament starting is simplified since special precautions to limit the filament starting circuit are not required.



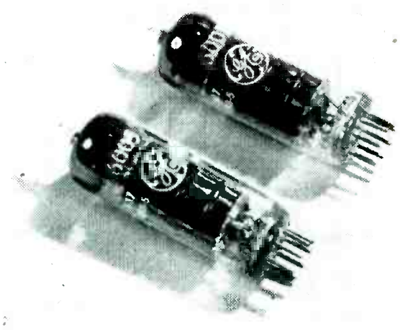
Multifrequency Standard

AMERICAN TIME PRODUCTS INC., 580 Fifth Ave., New York 19, N. Y. Type 2509–2 multifrequency standard provides audio frequencies that are commonly used in meteorological work. It is useful in checking speeds, tachometers, scope sync and the like. Input power is 45 watts at 115 v, 50 to 500 cycles. Output frequencies are 10, 20, 40, 60, 80, 100, 120, 140, 160, 180 and 190 cps. Accuracy is ±0.05 percent from −40 to +70 C.



Microwave Attenuator

POLARAD ELECTRONICS CORP., 100 Metropolitan Ave., Brooklyn 11, N. Y., announces the model SIJ external broad-band microwave attenuator. It operates on the principle of a waveguide beyond cutoff and provides a range of attenuation in excess of 140 db. The attenuator is designed to cover the frequency range from 4 to 12 kmc, and has a 50-ohm impedance.

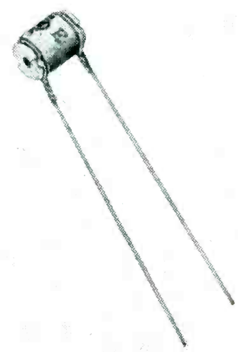


Mobile and Aircraft Tube

GENERAL ELECTRIC CO., Schenectady, N. Y. Type 6005 miniature beam-power amplifier for medium-power audio-frequency service is designed mainly for mobile and aircraft applications where shock and vibration are encountered. It is designed to withstand peak impact acceleration up to 600 g and vibrational accelerations up to 2.5 g. Maximum ratings include: plate dissipation, 12 watts; screen dissipation, 2 watts. Under typical operating conditions the power output is 4.5 watts.

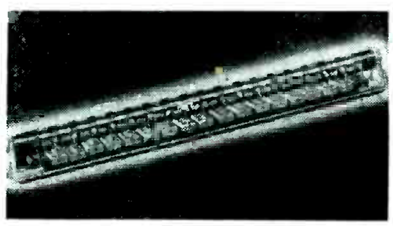
TV Picture Monitor

FEDERAL TELECOMMUNICATION LABORATORIES, INC., Nutley, N. J., has developed the FTL-84A tv picture monitor that will permit a television station to monitor video signals with full assurance that the monitor is not cutting into the picture signal resolution. It is especially useful in the laboratory and production testing of tv video amplifiers. The resolving power has been designed for operation well beyond the specified 600 horizontal lines minimum. Picture size is 14 inches. Deflection circuits have been designed for stable operation and are independent of the separately driven pulse high-voltage supply. The high-voltage supply provides 16 kv.



Tiny Precision Resistors

INTERNATIONAL RESISTANCE CO., 401 N. Broad St., Philadelphia 8, Pa. Type WW-10 subminiature precision resistors measure $\frac{13}{32}$ in. in body length and $\frac{9}{32}$ in. in diameter. Available resistances range from 10 ohms to 0.160 megohm, and tolerance is ± 1.0 percent. The units have a rating of 0.15 watt at 85 C ambient temperature, and a maximum temperature coefficient of 0.0025 percent per deg C from 20 C to 100 C. Maximum voltage is 150 v.



Delay Line

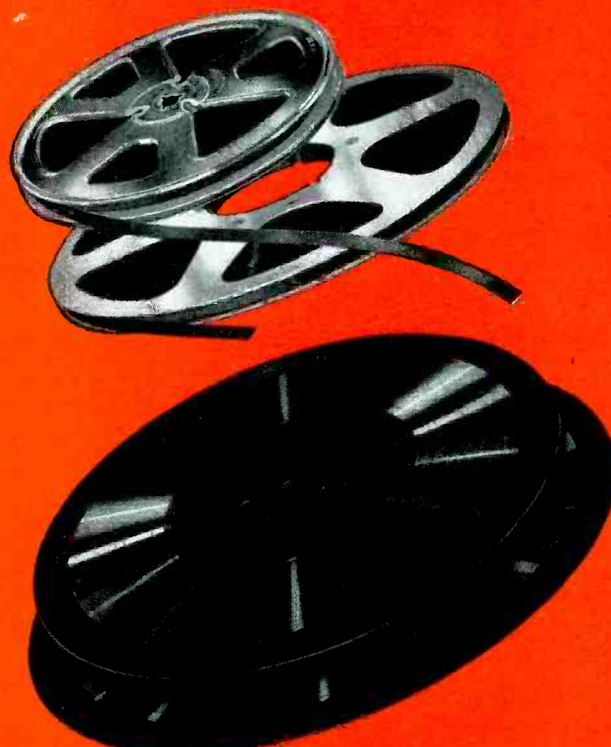
TEL-INSTRUMENT CO., INC., 50 Paterson Ave., East Rutherford, N. J., announces availability of the type 1477-A delay line. This lumped-

(Continued on p 277)

Here's the

RECORD-MAKING COMBINATION

that brings fine music to millions



audiotape* for the original sound

audiodiscs® for the master recording

Today's trend to high fidelity phonograph reproduction demands higher quality than ever before—in both the original sound recordings and the masters from which pressings are made. And the country's leading manufacturers of fine phonograph records have found that Audiotape and Audiodiscs are the ideal combination for meeting these exacting requirements.

Master Audiodiscs—the choice of record-makers for more than a decade—are now used for the *vast majority* of all phonograph records produced in this country. That's because their outstanding performance is a matter of record—known throughout the industry for consistent uniform quality, freedom from humidity effects, and exceptionally low surface noise at all diameters.

Although magnetic recording is relatively new in the record-making field, Audiotape is already widely used for recording the original sound. Here, too, its preference is the result of proved performance. For professional recordists know that they can always depend on Audiotape for the finest in magnetic recording—with unequalled uniformity and minimum distortion at maximum output.

. . . and you get the same unsurpassed performance when you use Audiotape and Audiodiscs in your recording work

There's nothing special about the Audio products used by the phonograph record industry. Except for size, Master Audiodiscs are exactly the same as the Red Label Audiodiscs used anywhere else—with the same superior lacquer, applied by the same precision coating process and meeting the same exacting standards of flawless perfection. And the Audiotape used in record making is *identical* to that which is available for general use by all sound recordists.

If it's *quality* you want, Audiodiscs and Audiotape speak for themselves. **Remember, too, that Audiotape, in both 1250 and 2500 foot reels, is guaranteed splice-free!**

AUDIO DEVICES, Inc.

444 Madison Avenue, New York 22, N.Y.

Export Dept.: 13 East 40th St., New York 16, N.Y., Cables "ARLAB" *Trade Mark

audiodiscs • audiotape • audiofilm • audiopoints

NEWS OF THE INDUSTRY

Edited by WILLIAM P. O'BRIEN

Radio Fall Meeting

THE Annual Radio Fall Meeting will be held at the King Edward Hotel, Toronto, Canada, Oct. 29–31, 1951. Following is the scheduled technical program:

Monday, Oct. 29

9:30 A. M.—General Session (W. R. G. Baker, presiding)

Noise in Television Receivers, by S. J. H. Carew of Stromberg Carlson Co. Ltd.

Suppression of Local Oscillator Radiation in Television Receivers, by John Van Duyne of Allen B. DuMont Laboratories, Inc.

Report of the RTMA Material Bureau, by L. M. Clement of Crosley Division, Avco Mfg. Corp.

2:00 P. M.—Symposium on Reliability of Tubes and Circuits (J. R. Steen, presiding)

Tuesday, Oct. 30

9:00 A. M.—Symposium on Color Television (D. B. Smith, presiding)

2:00 P. M.—Television Session (D. D. Israel, presiding)

A New Miniature Triode for UHF TV Tuners, by K. E. Loofbourrow and C. M. Morris of RCA.

Measurement of Television Gamma or Amplitude Linearity, by W. K. Squires of Sylvania Electric Products Inc.

A UHF Television Converter, by H. R. Hesse of Allen B. DuMont Laboratories, Inc.

6:45 P. M.—Annual Fall Meeting Dinner.

Report on the CCIR Meeting, Geneva, 1951, by Donald G. Fink of ELECTRONICS.

Wednesday, Oct. 31

9:00 A. M.—Symposium—The Receiver as a Link in the Audio Chain (F. H. Slaymaker, presiding)

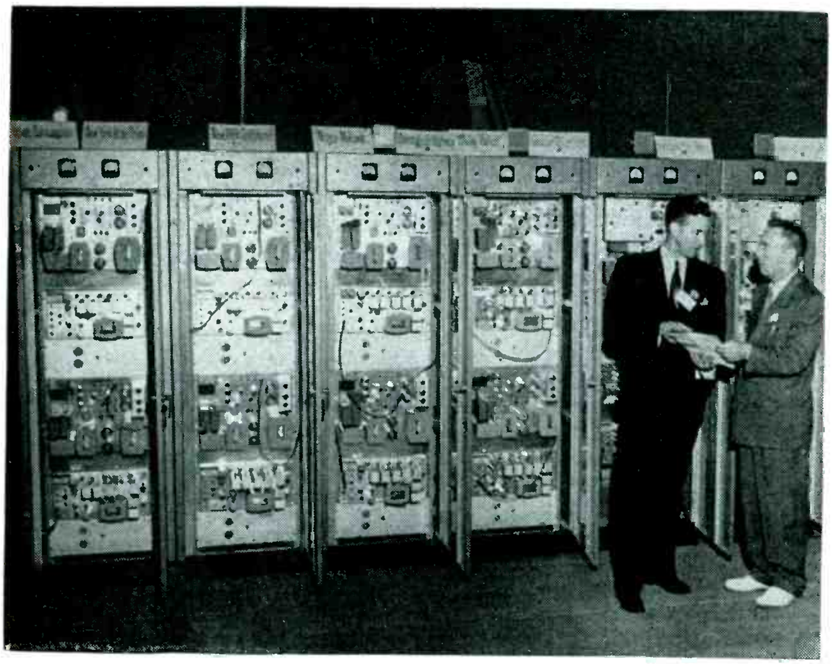
2:00 P. M.—Television Session (F. H. R. Pounsett, presiding)

Phase Linearity in TV Receivers, by H. Kiehne and S. Mazur of Emerson Radio and Phonograph Corp.

The Chromatron—An Electronically Registered Tri-Color Cathode Ray Tube, by Robert Dressler of Chromatic Television Laboratories Inc.

Pencil Triode for Pulsed-Oscillator and Power-Amplifier Service, by John W. Busby of RCA.

NEW MOBILE COMMUNICATIONS CD CENTER



Radio equipment being built by General Electric for installation in a trailer to be used by civil defense officials as the hub of an emergency communications system in Onondaga County, N. Y. The mobile center will have standby transmitting and receiving equipment which will enable CD authorities to operate the radio systems of county and city departments, public utilities and private companies now operating over 400 radio-equipped cars and trucks. Neal F. Harmon (left), G-E civil defense coordinator at Syracuse, discusses system with Harvey S. Smith, Onondaga County civil defense director

NPA Orders for Broadcasters and Hams

NPA HAS prepared the draft of an order permitting broadcast and television stations to apply ratings for required new equipment where construction permits have been granted by the Federal Communications Commission. If NPA can show that the use of such equipment is defense-supporting, approval may open the way to construction of new television stations.

Another order drafted by NPA with the support of the military would allow amateur radio operators to rate their purchase orders for electronic equipment and components. Encouragement for amateurs to join organized civil defense networks has been given by allowing such operators to rate orders to a higher dollar value than nonparticipants. This provision reflects Defense Department policy of keeping amateurs on the air in the event of a national military emergency.

Harbor Radar Tests

FIELD trials of a harbor radar system built by Raytheon for the port of Le Havre, France, have been run recently under sponsorship of the Port of Boston Authority.

The radar transmitter-receiver station occupies a hilltop on Deer Island commanding a view both of the harbor and to seaward. Typical ppi scope patterns received there are relayed by microwave link to Port Authority headquarters in South Boston, some 12 miles distant, where they are displayed. Operators at the control point communicate ship positions by vhf

WHO'S been hibernatin'?

If you'll pardon the pun, we at Delco Radio don't *bear* the slightest resemblance to brother Bruin.

We haven't been hibernatin' . . . not by a long shot!

The fact is we've been too busy for words . . . and *have been* ever since those critical days of World War II when we produced tons and tons of radio and electronic equipment for the armed forces.

You know those fine resonant radios in Cadillacs and Buicks and other GM cars? They're our products. Last year we produced nearly 2,000,000 radios for cars, trucks and other vehicles . . . many more than any other builder in the business.

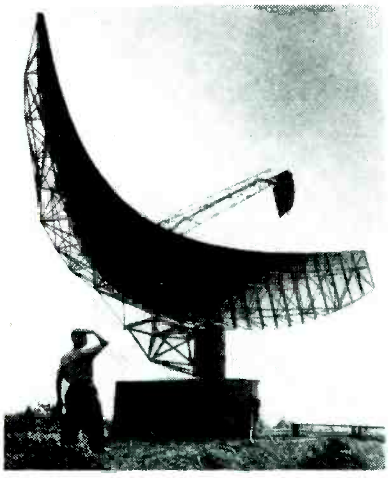
You see, we've really been busy . . . busy getting additional experience . . . busy acquiring greater facilities . . . busy finding new ways to increase production efficiency. And, today, we can truthfully say that we're better prepared than ever to serve our country. Just say the word. We're ready to go!

Delco Radio

DIVISION, GENERAL MOTORS CORPORATION
KOKOMO, INDIANA

radio to the pilots who are bringing them in.

Chief feature of the radar equipment is the five-ton, 8-rpm cylindrical paraboloid antenna illustrated, built to withstand winds of hurricane force when heavily loaded with ice. A power gain of 10,000 is obtained by virtue of its 41-foot physical width. The resultant beam has



Radar scanner for port of Le Havre, France, undergoing tests on Deer Island in Boston Harbor. Constructed entirely of aluminum, including waveguide, the assembly weighs five tons

a vertical width of 10 degrees and a horizontal width of only 0.7 degree.

A feature of the receiving equipment is the display of three previously chosen sections of the harbor on three auxiliary ppi scopes. Concentration on areas of interest results in an expanded scale so that details not easily recognized on the main scope can be picked out on one of the offset presentations.

A 10-cm radar transmitter operates on a center frequency of 3,070 mc with peak power of 15 kw. The rate is 850 pps and pulse length can be made either 0.2 or 0.6 microsecond. Range resolution is 50 yards and bearing resolution 0.7 degree.

The microwave repeater circuit employs standard television relay equipment with special transmitter input and receiver output devices. Frequency of operation during the tests was on 1,970 mc using 50 watts output.

Assignments in the region of 160 mc have been made available by FCC for communications between pilot boats or incoming ships and the control points so that the piloting information can be made immediately available.

The radar equipment has been provided with Raymark circuits so that ships carrying suitable equipment may be positively identified on the indicator scopes.

MEETINGS

Aug. 28-Sept. 8: Eighteenth British National Radio Show, Earls Court, London, England.

Sept. 10-13: Annual Electronic Parts Distributors' Convention and Show, Cleveland Auditorium, Cleveland, Ohio.

Sept. 10-14: Sixth National Instrument Conference and Exhibit, sponsored by Instrument Society of America, Sam Houston Coliseum, Houston, Texas.

Oct. 2-4: Twenty-Eighth Annual Session of the Communications Section of the Association of American Railroads, Chateau Frontenac, Quebec, Canada.

Oct. 4-6: Fourth Conference on Gaseous Electronics, General Electric Research Laboratory, Schenectady, N. Y.

Oct. 8-10: Joint Meeting of the U.S.A. National Committee of URSI and the IRE Professional Group on Antennas and Propagation, Cornell University, Ithaca, N. Y.

Oct. 8-10: AIEE Conference on Aircraft Equipment, Hollywood Roosevelt Hotel, Los Angeles, Calif.

Oct. 22-24: 1951 National Electronics Conference, Edgewater Beach Hotel, Chicago.

Oct. 22-26: AIEE Fall General Meeting, Hotel Cleveland, Cleveland, Ohio.

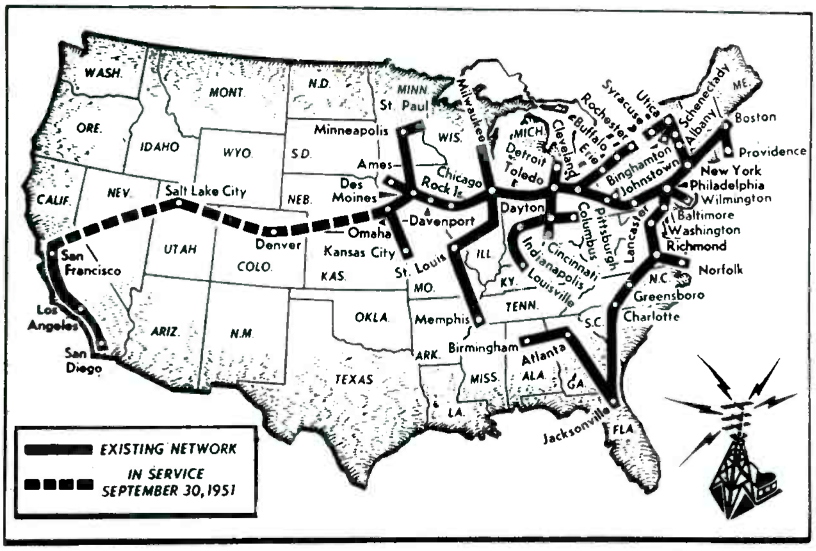
Oct. 29-31: Radio Fall Meeting, sponsored by IRE and RTMA, King Edward Hotel, Toronto, Ontario, Canada.

Nov. 1-3: Third Annual Convention and Audio Fair Exhibition of the Audio Engineering Society, Hotel New Yorker, New York City.

Nov. 12-15: NEMA Convention, Haddon Hall, Atlantic City, N.J.

March 3-6: 1952 IRE National Convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N.Y.

CROSS-COUNTRY TELEVISION



Map charts the existing video network (solid black lines) and new link-up (dotted line) that will inaugurate television's transcontinental coverage on Sept. 30. The basic link will be over the American Telephone and Telegraph's $40,000,000 microwave radio-relay system between New York and San Francisco, Calif., presently in operation as far as Omaha, Neb.

AEC Releases More Patents

Descriptions of 15 patents owned by the U.S. Government and held by the Atomic Energy Commission

(Continued on page 300)

THESE LIFE LINES OF AMERICA...

use long life dependable Sylvania Tubes

Progressive railroads everywhere are now using Sylvania radio tubes for multiple communications systems.

In engine-caboose-signal-tower networks, where clear tone and unfailing dependability are of utmost importance, Sylvania tubes are winning increased acceptance. These tubes are designed, built and tested to take more than their share of vibration and rough treatment.

Also, their clarity and freedom from internal noises make them ideal for critical transportation applications . . . in trains, buses, police cars, taxi cabs.

The Sylvania quality tube line is a complete line. Made in miniature and standard sizes. Also low-drain battery tubes for efficient, compact portable sets.

Get new listings

Call your distributor for new listings and full information. If he cannot serve all your needs immediately, please be patient. Remember, the tube situation is still tight and your distributor is doing his best to deal fairly with all his customers. For further information address: Sylvania Electric Products Inc., Dept. *R-1109* Emporium, Pa. *Sylvania representatives are located in all foreign countries. Names on request.*

SYLVANIA ELECTRIC PRODUCTS INC. 1901-1951 50th ANNIVERSARY FIVE DECADES OF PROGRESS

SYLVANIA

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

NEW BOOKS

High-Frequency Measurements

BY AUGUST HUND. *McGraw-Hill Book Co., Inc., New York,* 1951, *2nd edition,* 676 *pages,* $10.00.

THERE is very little in book form on the subject covered by the title "High-Frequency Measurements" despite the importance of such measurements to communication engineers and physicists. Unfortunately, this second edition does little to alleviate the situation.

The first edition was the only effort in its field when it appeared in 1933. Since then the radio art has changed radically. It is only to be expected that the tremendous growth in the art should necessitate a new edition that would, as the author states in his preface, "bring the book up to date with advances made during the last eighteen years." We might expect that fundamental advances of the past decade would be reflected in the new edition, such as: (1) extending the useful frequency range of signal sources from tens of megacycles to thousands of megacycles, (2) shortening information intervals from fractions of milliseconds to fractions of microseconds, and (3) operating at signal levels close to the noise level.

RELEASED THIS MONTH

Basic Electron Tubes; D. V. Geppert; McGraw-Hill; $5.00.

Electronics; J. Millman and S. Seely; McGraw-Hill; 2nd edition; $7.25.

The Earth's Magnetism; S. Chapman; Methuen's Monograph; Wiley; $1.50.

The High Pressure Mercury Vapour Discharge; W. Elenbaas; Interscience Publishers; $4.00.

Is Book a Complete Revision?

The author states in his preface that "In the second edition, methods are described which cover the entire useful radio-frequency band of present-day applications. This required a complete revision of the text." The publisher's cover flap

(continued on page 310)

Backtalk

This department is operated as an open forum where our readers may discuss problems of the electronics industry or comment upon articles which ELECTRONICS has published.

Scarcity of Engineers?

DEAR SIRS:

IN THE *Business Briefs* department of ELECTRONICS for the past few months, I have read how industries are gorging themselves on technical people in hopes of getting government contracts. I have also noticed the many advertisements for electronics people, which make the present situation look like a pell-mell recruiting campaign. That is not a healthy situation in any industry.

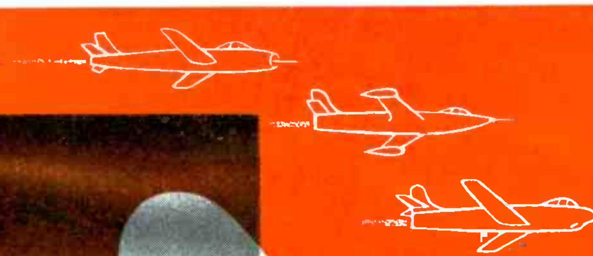
You no doubt know of the large numbers of such people being absorbed by the Air Force and other services through the "Tech Rep" (technical representative or field engineer) program. Large numbers of radio and electronics men are being supplied on contract by Philco, RCA, Gilfillan and others to the services. In my particular organization we have an actual need for about one-tenth the number that has been furnished. And still they keep coming!

In the meantime, the services are grabbing at their reserves for the same type of people, who might better serve the interests of the country at the factory or laboratory where they worked as civilians.

It works out this way: the reservist electronic or radio person sits at a desk doing administrative work to some extent, or next to nothing for there is little to do, while hordes of expensive civilian "tech reps" dabble at building little items of equipment—in short, wasting time.

I can see nothing but lasting damage to the whole electronics in-

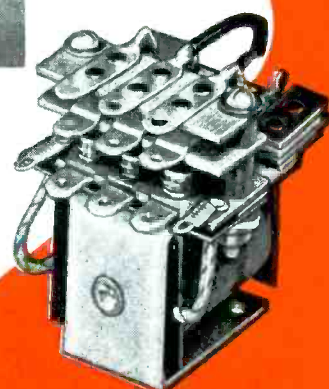
(Continued on page 323)



U. S. AIR FORCE B-50 BOMBER

One OF A LINE

WITH 35,000 STANDARD PARTS TO SPEED YOUR SPECIAL REQUIREMENTS



Series 335 D.C. Relay

"GUARD-A-SEAL"

Guardian engineering developments of hermetically sealed containers specifically designed for aircraft.

A. N. CONNECTOR

SCREW TERMINAL

LUG HEADER

OCTAL PLUG

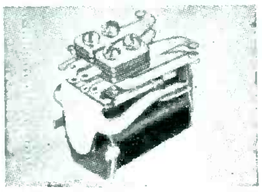
CONTROLS ›››

for Airborne—or Portable Equipment

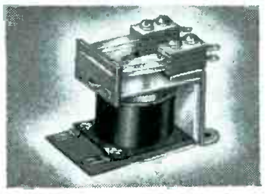
Put jet action into your electrical control design! *Consult* Guardian where many controls, seemingly "Special" in nature, can be produced from more than 35,000 standard Guardian parts. *Consider* the sensational "Guard-a-Seal" units—developed specifically for aircraft and portable equipment—sealed in *aluminum.* Designed to incorporate heavier frames, larger contacts, higher capacity, yet qualified under all AN weight requirements because *the weight is in the relay—not the can!*

AN-3320-1 D. C.

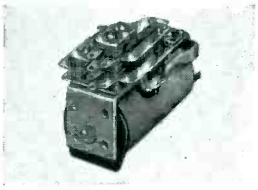
AN-3324-1 D. C.



Series 595 D.C.



Series 610 A.C.—615 D.C.



Series 695 D.C.

ALSO MINIATURE AND SUB-MINIATURE CONTROLS—WRITE

GUARDIAN ELECTRIC

1625-K W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

TUBES AT WORK

(continued from page 138)

FIG. 6—View of radio facilities showing one of the transmitters and some of the line amplifiers

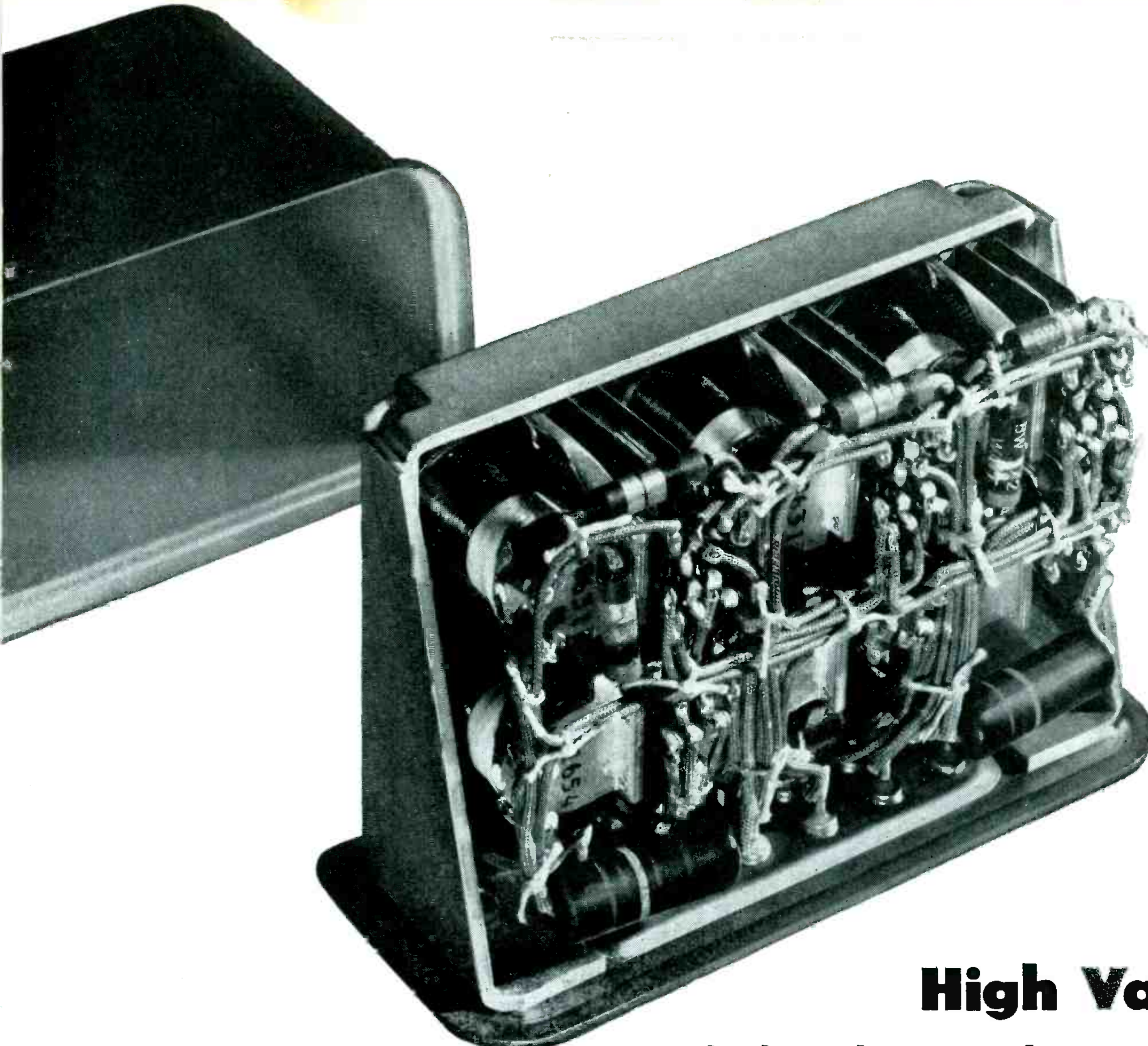
built expressly for this program.

The a-m cue transmitter was located atop the Empire State Building and not the RCA Building due to the juxtaposition of the receiver and transmitter cue-channel frequencies and the probability of resultant feedback. The radio private line provided the microwave and video engineers afloat and ashore a continuous communications path without which the project would not have been possible. The only modifications made to the program-sound-channel transmitter and receiver was to broaden the audio bandwidth over the communications-type bandwidth encountered in the equipment. This is standard practice in the broadcasting of remote programs.

Problems Encountered

The transmission of microwaves from moving objects such as ships and planes has been made possible through the use of electronic tech-

FIG. 7—Side view of 6,962.5-mc transmitter showing 15-40x telescope used for visual sighting



High Vacuum
helps this mechanical brain think clearly

high vacuum research and engineering

THIS little nest of relays is a "brain" which evaluates incoming impulses and issues orders to a mechanism that may be vital in a paper mill, a food processing plant, or an intercontinental bomber.

It took a great many human brain-hours to work out its intricate, compact mechanism. But a few fungus spores drifting in from a warm, humid atmosphere, a little dust, acid fumes, even rapid air pressure variations—any of these might undo the ingenuity that conceived it.

For security against these intruders, the relay manufacturer, C. P. Clare and Company, turned to the service offered by the Electro-Seal Corporation, Des Plaines, Illinois. Within a few minutes after Electro-Seal puts a DPi diffusion pump to work, all traces of moisture and 99.999 per cent of the air have been removed from the sealed assembly. Then a Consolidated Leak Detector is connected to the system and a jet of helium is played over the unit to check for leaks. (This instrument, which embodies another DPi high vacuum diffusion pump, can sound an alarm for a leak so small that a thimbleful of air would take 30 years to get through.)

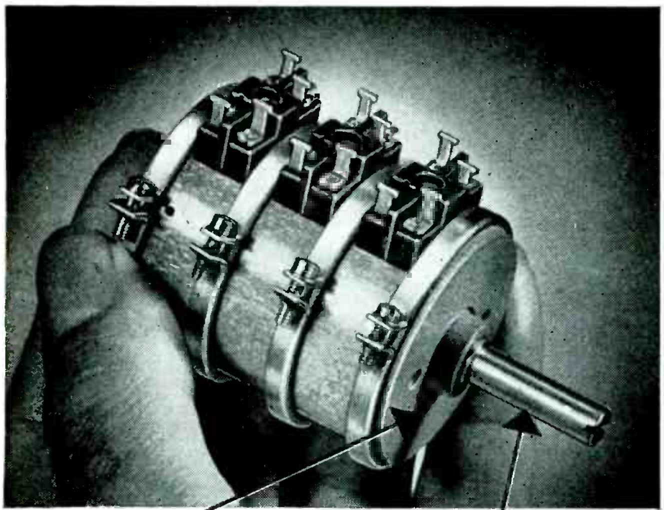
Finally, Electro-Seal backfills with purified inert gas and sends the relay off to a long, useful life and duties for which an unsealed relay might be totally unfitted—demonstrating again how effectively DPi puts high vacuum at industry's service in a relatively new field, as we've been doing for years in the electron tube industry.

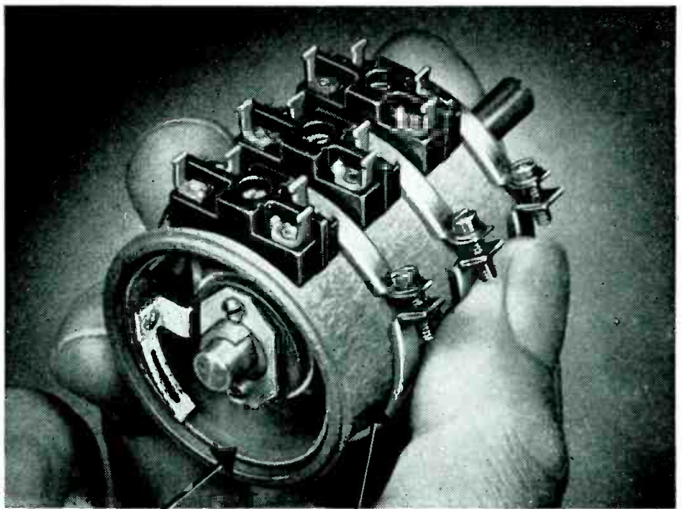
Perhaps we can help you, too. To find out, write to *Distillation Products Industries,* Vacuum Equipment Department, 727 Ridge Road West, Rochester 3, N. Y. (Division of Eastman Kodak Company).

Also . . . vitamins A and E . . . distilled monoglycerides . . . more than 3400 Eastman Organic Chemicals for science and industry

How do you put PRECISION into a potentiometer?...

... At Fairchild we do it by careful design plus scrupulous attention to every phase of manufacture from the selection of raw materials to the precision machining of all mechanical components. Every mechanical part that affects the potentiometer's accuracy is made in our own plant. The result? ***Let's find out by examining one of our new 746 units for precision.***





PRECISION in the shaft. The shaft is centerless-ground from stainless steel to a tolerance of +.0000, −.0002 in. which, together with the precision-bored bearings, results in radial shaft play of less than .0009 in. These accuracies are essential to the utilization of the full precision of the windings and associated gearing.

PRECISION in the housing. Precision-machined out of solid aluminum bar stock, every housing is *perfectly cylindrical*—and stays that way—resulting in better accuracy of potentiometer output. This construction also results in perfect fit and alignment between housings to permit ganging of up to 20 units on a single shaft without any eccentricity of the center cups even though only two bearings are used for the entire gang.

PRECISION in the mounting plate. All critical surfaces of the mounting plate are accurately machined at one setting to insure a shaft-to-mounting surface squareness within .001 in./inch and concentricity of shaft to pilot bushing within .001 in. FIR. Such precision is essential in order to eliminate backlash or binding in the precision gearing used to drive these potentiometers.

PRECISION in the windings. The windings of all Fairchild precision potentiometers are custom-made by an exclusive technique on machines designed and built by Fairchild expressly for the purpose. Guaranteed accuracy of linear windings in this potentiometer is 0.5%; non-linear, 1.0%. Higher accuracies available in other types. Guaranteed service life—1,000,000 cycles.

Do your requirements call for this kind of precision? If you have a special problem, Fairchild Potentiometer Sample Laboratory engineers are always available to help you. For complete data, write, stating your requirements, to *Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Boulevard, Jamaica 1, N. Y. Dept. 140-17A1.*

FAIRCHILD
PRECISION POTENTIOMETERS

niques to automatically track the transmitting and receiving antennas. This would be impractical as far as the tv broadcaster is concerned due chiefly to the cost of equipment and manpower required. Hence, simplicity was the keynote in modifying and adapting the existing RCA tv microwave-relay equipment. The two antenna reflectors were drilled and fitted with telescopes of 15 to 40 power magnification. The plan was to sight visually between the boat transmitter and the RCA Building roof receiver, see Fig. 7 and 8. A 20-inch reflector was used aboard the ship to give a broad antenna pattern while the receiver employed a four-foot parabola, sandbag counterbalanced to facilitate panning.

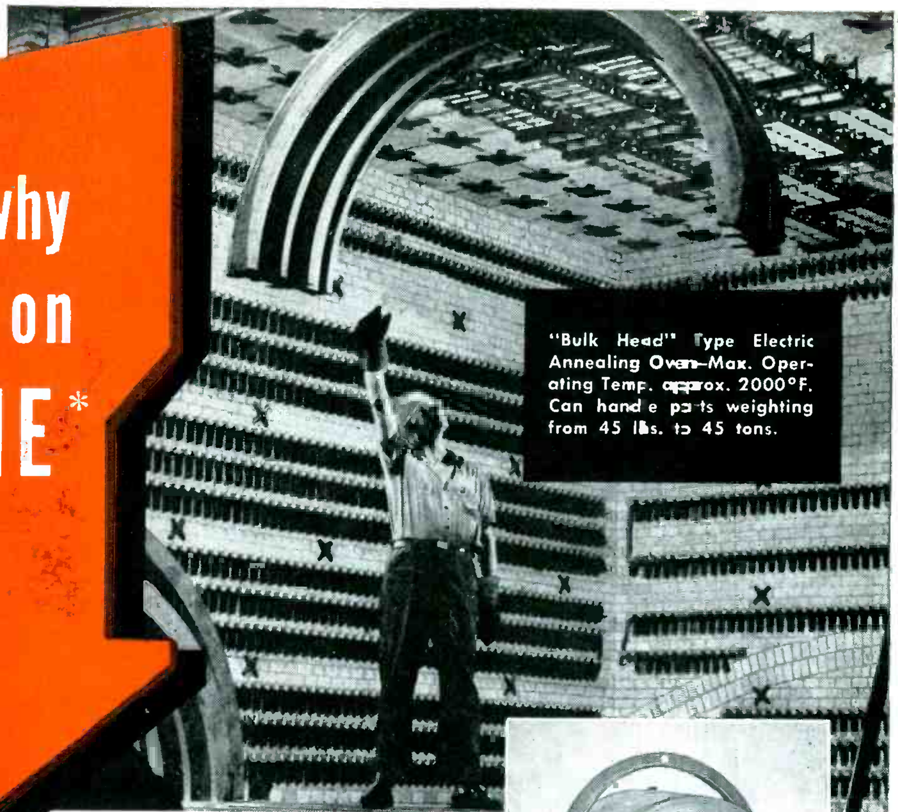
FIG. 8—Microwave receiver antenna. Note the use of a telescope sighted through four-foot parabolic reflector and sand bag for balance while tracking

On the day of the program, fog obscured operations and so the well-laid plans of the field survey had to be abandoned in favor of radio line-of-sight only. The eight-deg beam width of the transmitter antenna scanned the receiver antenna area without visual sight until radio contact was indicated by an oscilloscope and field strength meter connected to the receiver. A third engineer located at the receiver control unit relayed instructions to the men operating the transmitting and receiving antennas.

As the ship got underway the receiver control engineer continu-

5 reasons why you can rely on NICHROME*

in your electrically heated products



(Photographs courtesy of General Electric Company)

1. Nichrome alloys, meticulously developed over a period of 40 years, meet the need for resistor materials that can perform with exceptional suitability at high temperatures. Their high resistivity and resistance to oxidation at high temperatures dictate their choice for heating elements in a host of different products.

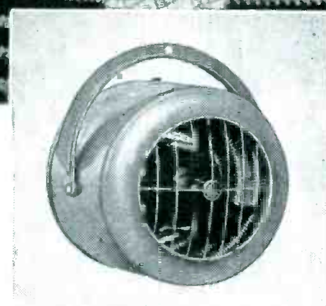
2. Nichrome and Nichrome V are *custom built*—produced to rigid specifications determined by conditions of application and in-use factors. Consequently, *absolute uniformity* is assured from order to order.

3. Nichrome and Nichrome V undergo only negligible changes even when required to meet unusually exacting service demands. Thus delivery of full-rated power is assured thruout a long life of trouble-free operation.

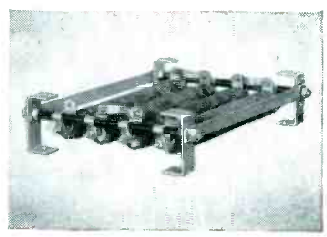
4. Nichrome and Nichrome V afford flexibility of choice, permitting heating elements to be designed economically, with close regard to service requirements. For example: Nichrome is ideal for heating devices, such as cord-connected domestic appliances, operating up to 1700°F.; Nichrome V for electric furnaces, ovens, etc., operating at temperatures in excess of 1700°.

5. Nichrome and Nichrome V are available in different forms—wire, ribbon, strip, sheet and rod. Such variety offers outstanding aid to designer, engineer, and manufacturer.

The different examples of products shown here indicate the wide range of application for Nichrome and Nichrome V. For improved performance and longer life in *your* products, remember these peerless Driver-Harris electrical alloys and consult with us. Although the present emergency is making unprecedented demands upon the resources of the Driver-Harris Company, we shall be glad to make recommendations based upon your specific needs, and serve you to the best of our ability.



Forced-Convection Type Unit Air Heater.



Edgewise-wound resistor—typical of large industrial applications.

Waffle Iron and Sandwich Grill—one of many G.E. appliances.

SPECIAL PURPOSE ALLOYS SINCE 1899 — TRADE MARK REG. U. S. PAT. OFF.

Nichrome and Nichrome V are manufactured only by

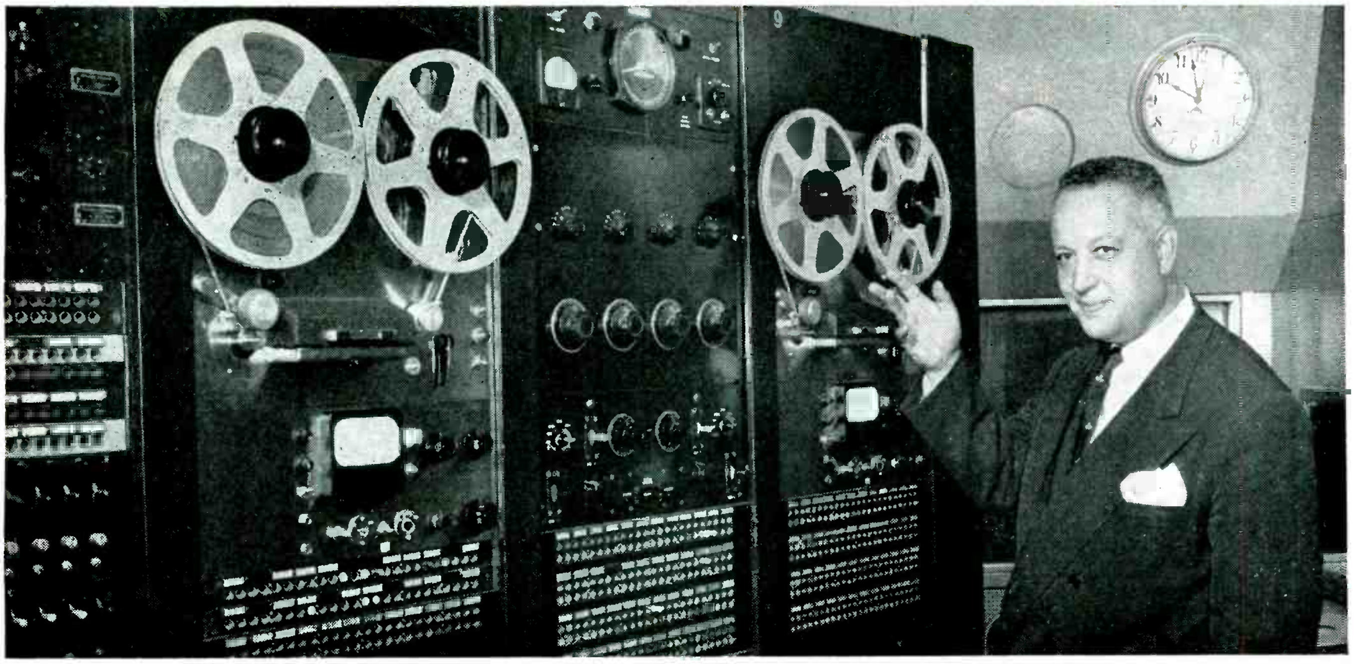
Driver-Harris Company

HARRISON, NEW JERSEY

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

Manufactured and sold in Canada by The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

*T.M. REG. U. S. PAT. OFF.



JIM BELOUNGY supervises the production of hundreds of commercials every week at WCCO.

"I've tried them all . . . and 'SCOTCH' Sound Recording Tape is tops with me!"

Says Jim Beloungy, Chief Engineer, WCCO, Minneapolis-St. Paul

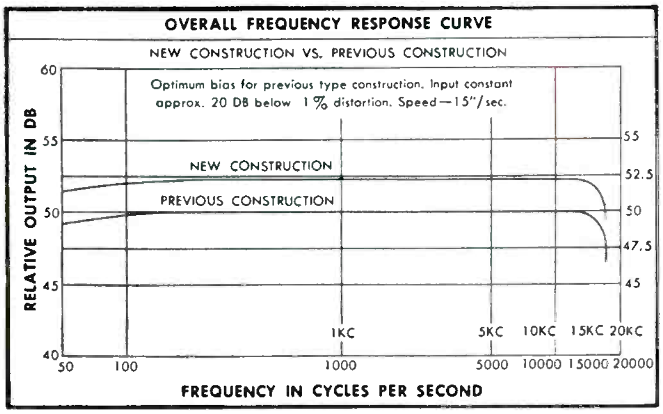


CHART SHOWS HOW new manufacturing improvements have increased overall sensitivity of "SCOTCH" Sound Recording Tape. Continuous laboratory and factory research keeps this tape ahead of the field.

CHECK THESE NEW CONSTRUCTION FEATURES OF "SCOTCH" SOUND RECORDING TAPE!

Used by all major networks and for master recording by major record companies.

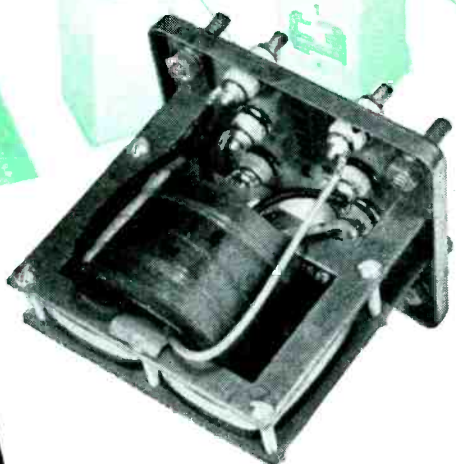
- ✓ Absolute uniformity in and between reels. No re-setting of output levels between reels.
- ✓ Thinner construction means unequaled resistance to temperature and humidity changes.
- ✓ By absorbing moisture uniformly on both sides, "SCOTCH" Sound Recording Tape does not curl or cup, always lies flat on recording head.
- ✓ Special new manufacturing techniques reduce distortion level and eliminate surface irregularities that cause high frequency drop-out.
- ✓ Exclusive lubricating process reduces friction and flutter, increases life of tape. Cuts wear on machine heads and guides.
- ✓ Greater output at 1% distortion than tapes of previous constructions.

Made in U.S.A. by MINNESOTA MINING & MFG. CO., St. Paul 6, Minn., also makers of "Scotch" Brand Pressure-sensitive Tapes, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing, "3M" Abrasives, "3M" Adhesives. General Export: Minn. Mining & Mfg. Co., International Division, 270 Park Avenue, New York 17, N. Y. In Canada: Minn. Mining & Mfg. of Canada, Ltd., London, Canada.

RAYTHEON TRANSFORMER LEADS

Are Insulated and Protected with

NATVAR Varnished Tubing



Raytheon has built transformers from more than 30,000 successful, custom-engineered designs. This illustration shows the interior construction of an oil-filled, hermetically sealed, high voltage rectifier transformer designed to handle a swing of 400 to 2400 cycles at 400 watt capacity. Natvar Varnished Tubing gives excellent protection and contributes to the neat appearance.

"*Excellence in Electronics*" is the motto of the Raytheon Manufacturing Company, Waltham, Massachusetts. This New England producer of a wide range of electrical and electronic apparatus for industry, the armed forces, and the home, is famous for its high standards of quality.

Natvar Grade A-1 and Radio Grade Varnished Tubing are used by Raytheon on many types of transformers because of Natvar's *excellent* electrical and mechanical qualities, its uniformity at all times, and its ability to meet Raytheon's rigid material specifications.

Natvar Varnished Tubing and other Natvar flexible insulations are available from conveniently located wholesalers' stocks or direct from our own.

Natvar

Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Silicone coated Fiberglas
- Varnished papers
- Slot insulation
- Varnished tubings and sleevings
- Varnished identification markers
- Lacquered tubings and sleevings
- Extruded vinyl tubing and tape
- Extruded vinyl identification markers

Ask for Catalog No. 21

THE NATIONAL VARNISHED PRODUCTS *Corporation*

Telephone
Rahway 7-8800

Cable Address
NATVAR: Rahway, N. J.

201 RANDOLPH AVENUE ★ WOODBRIDGE, NEW JERSEY

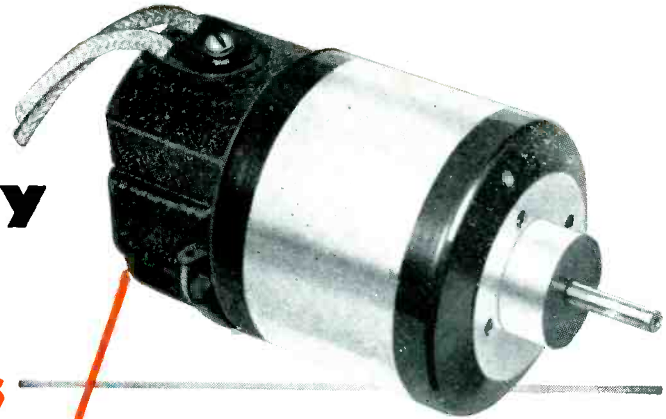
FIG. 9—The microwave transmitter control unit

ously transmitted the receiver field-strength indications over the radio and wire private lines to the ship and RCA roof. The microwave transmitter engineer then rapidly oriented his antenna in the plane of maximum receiver signal while the receiving antenna was tracked at a slightly slower rate. This procedure might be thought of being analogous to the GCA system employed by the airlines to "talk down" weather-bound aircraft. The transmitter control unit engineer shown in Fig. 9 maintained the microwave transmitter aboard ship on frequency.

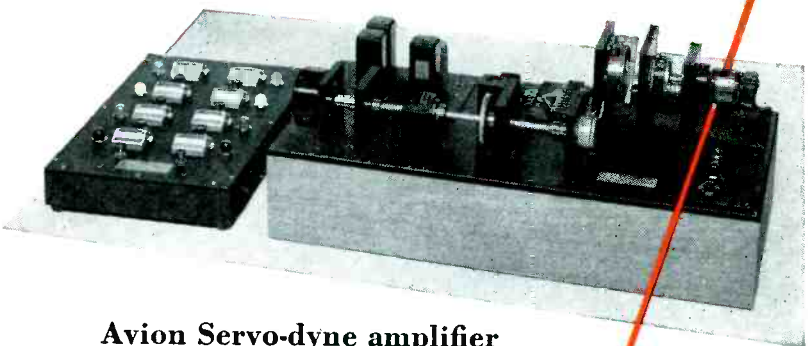
The video output of the three cameras used was connected to the control room set up in a cabin. As mentioned previously, Fig. 3 shows the block diagram of the video components. The switching and video engineers seen in the cabin, Fig. 10, controlled the video levels of the cameras and upon the orders of the program director sent the appropriate camera output with syn-

FIG. 10—Control room showing switching unit, camera control units and master monitor

Developed especially for application in aircraft controls



the Holtzer-Cabot 0810
sub-miniature DC servo motor



Avion Servo-dyne amplifier

Holtzer-Cabot's RBDS-0810 sub-miniature DC servo motor was designed and engineered especially for service in highly sensitive aircraft controls and instruments.

A typical application of this special motor is its use with the Avion Servo-dyne amplifier. The sub-miniature combination of amplifier and motor reduces the size and weight of remote positioning systems in airborne computers and instruments indicating flight conditions.

The model 0810 performs efficiently at altitudes ranging from sea level to 40,000 feet, in temperatures varying from −65° F. to +160° F. and in relative humidity up to 100%. It is a 4-pole motor, measuring only 1⅝" in diameter and 2⁹⁄₁₆" over bearing hubs and weighs but 8½ ounces.

Operating on a normal field current of 6 milliamperes, the motor's armature is separately and continuously excited from a DC source of 24.3 to 29.7 volts. The field assembly consists of two independent high impedance windings, and this assembly is hermetically sealed.

The RBDS-0810 motor provides practically noiseless, variable-speed, reversible operation. It has a very low inertia rotating element for fast response, and delivers a maximum of 1/500 horsepower.

This achievement in small-motor efficiency is further evidence of Holtzer-Cabot's ability to develop and produce fine precision motors for exacting applications.

Specialized engineering skill combined with 75 years' manufacturing experience enable Holtzer-Cabot to build motors to the most demanding specifications.

For additional information write for Bulletin 0810.

HOLTZER-CABOT

DIVISION OF NATIONAL PNEUMATIC CO., INC.

BOSTON 19, MASSACHUSETTS

"Manufacturers of fine electrical apparatus since 1875"

Aircraft instruments and controls

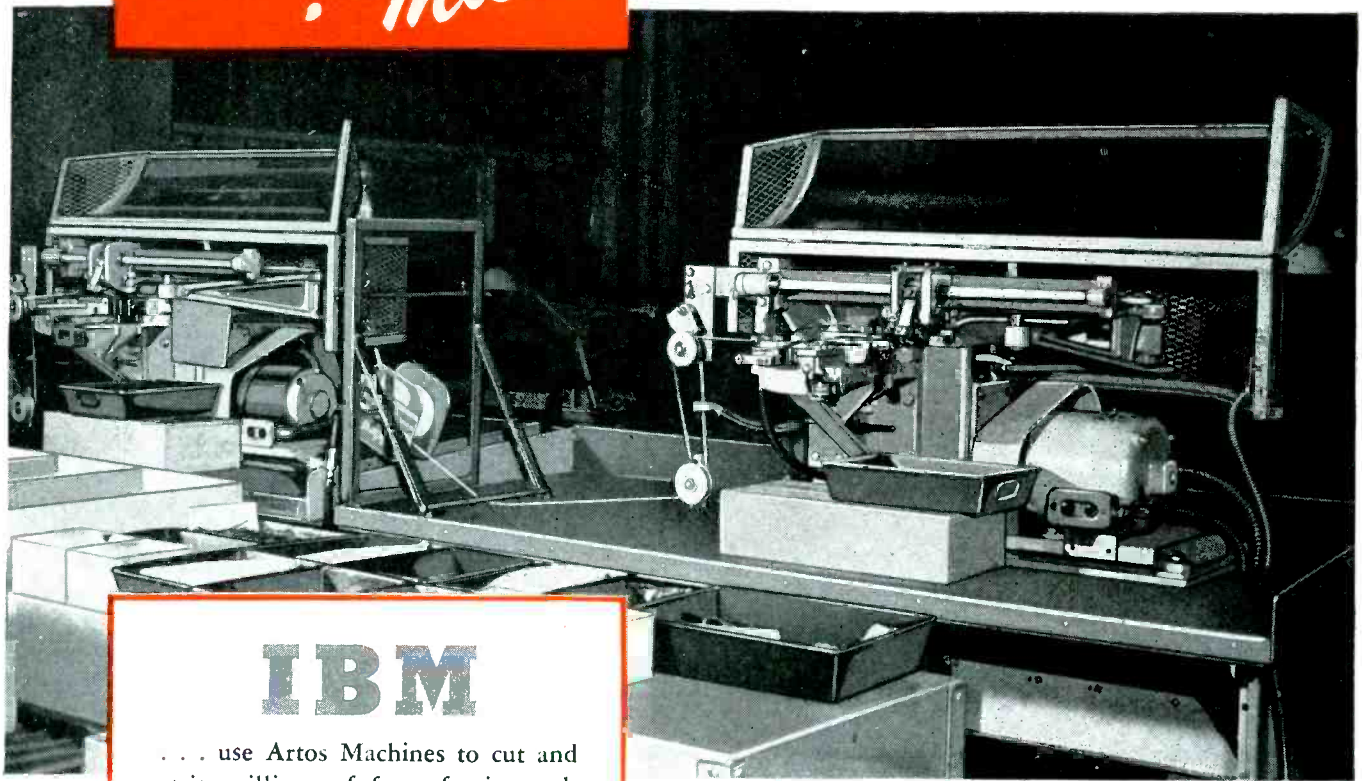
KOLLSMAN INSTRUMENTS

For precision and dependability look to Kollsman

KOLLSMAN INSTRUMENT CORPORATION

Elmhurst, New York • • Glendale, California

Man-Hour "Miser" for Industry-in-a-Hurry...



IBM

. . . use Artos Machines to cut and strip millions of feet of wire each year in the manufacturing of their world-renowned business machines.

ARTOS AUTOMATIC MACHINES

Speed Wire Measuring, Cutting & Stripping at International Business Machines Corporation

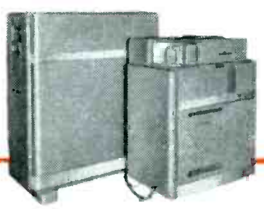
Here is how IBM use Artos automatic machines to speed up production of their products.

PLATING DEPARTMENT Uses an Artos Machine to cut No. 16, 18 and 20 bare copper wire into lengths ranging from 14 to 42 inches for stringing various shape and size of parts for plating operations. About 160,000 wires per month are cut on this application.

COIL COVERING DEPARTMENT Uses two Artos Machines for cutting and stripping No. 18, 20 and 24 lead wires for magnet coils ranging in lengths from 1-7/16 to 5 inches. These two machines run full time and their production is supplemented by partial production of a third machine in another location to produce the required 1,695,000 lead wires per month.

COIL ASSEMBLY DEPARTMENT Uses one Artos Machine to cut spaghetti insulation tubing to various length from 1-½ to 16 inches for a total requirement of 382,000 pieces per month. This machine is also used to cut plastic oil tubing to various lengths used in the lubricating system of IBM machines.

COUNTER ASSEMBLY DEPARTMENT Uses one Artos wire cutting and stripping machine to cut and strip 28 wires for each counter plate varying from 1-¾ to 8-¾ inches in length for a total production of approximately 328,000 pieces per month.



IBM Electronic Calculating Punch

One of the many great IBM machines, this general purpose electronic digital computing machine is helping solve some of the most difficult calculating problems in science, engineering, business and government.

In addition to the above applications at Plant 1, Endicott, New York, Artos Machines are also used at Plant 2, in Poughkeepsie and the Canadian Plant in Toronto, as well as by some IBM sub-contractors on control panel plugwire manufacturing.

You'll probably find an ARTOS AUTOMATIC to match your wire cutting needs exactly. Write or wire for details.

ARTOS

ARTOS ENGINEERING CO.

2743 S. TWENTY-EIGHTH STREET, MILWAUKEE 46, WIS.

FIG. 11—One of three cameras set up on second deck of ship

chronizing pulses to the relay transmitter.

One of the video cameras as shown in Fig. 11 on the deck of the vessel was focused on John Kieran, the program commentator, as he described the panorama of the New York skyline. The two other cameras with long-focal-length lens complements were then ordered to locate objects and landmarks under the direction of the switching engineer through the program director's orders as outlined above.

To the electronics engineer not in the field of mobile tv operations, the facilities required for the program described above might seem cumbersome. However, with the few exceptions of power generator, radio program and private-line facilities and constant tracking of antennas, the equipment is standard RCA field-television paraphernalia. The problems overcome by the NBC field engineering group in providing a tv program from a moving ship should serve as a spur to other mobile tv units to essay programs of a less orthodox nature in the public interest.

The author wishes to express his appreciation for the assistance afforded him by E. Costello, assistant field supervisor, C. Snell, tv field supervisor and M. Jacobson, a-m field supervisor.

Ultrasonic Cleaning Device

AN ULTRASONIC cleaning device has been developed by General Electric to clean tiny openings in electric shaver heads.

The ultrasonic generator used

"... the best house in months."

Temperature 92. Humidity—don't mention it! One of those breathless nights when everybody who can, goes to the movies to get cool. A first-run picture—a full house—the best in months. Then . . . the new air conditioning system "gave up." Cool—warm—hot—stifling. 1,400 people packed into a "sweat-box," growing hotter by the minute. But they didn't stay long—and may think twice before they come again. Result, one very unhappy manager—especially when he finds out that the equipment manufacturer tried to save pennies with inferior electrical insulation.

Electrical insulation guards the life of your product—play safe—use BH Fiberglas* Sleevings.

Take BH Special Treated Fiberglas Sleeving, for instance. Here is an unsaturated sleeving with heat resistance up to 1200° F that is permanently flexible, permanently rounded, and permanently non-raveling through a patented Bentley, Harris process.

Easy to handle, BH Special Treated speeds production. Because crossing strands are permanently crimped it may be cut in short lengths without securing the ends. All corosive, volatile materials have been removed, making BH Special Treated odorless in service and unaffected by heat or age.

BH Special Treated Fiberglas Sleeving is one of a family of electrical insulations, each designed to meet particular conditions in service. Give us a few facts about your requirements—product, temperature, voltages—we will gladly furnish samples for testing purposes.

Address Dept. E-9

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.

What DC Power Equipments do You Need for Military End-Use?

You can meet your requirements with—

Federal

SELENIUM RECTIFIERS

TYPICAL MILITARY EQUIPMENTS
DESIGNED AND PRODUCED BY *FEDERAL*

Aircraft
Portable and stationary ground power units • Airborne power supplies and voltage regulators • Engine starters • Transformer rectifiers

Ground
Automatic and manually-controlled battery chargers • Filtered and regulated power supplies • Radar power supplies • Transmitter power supplies • Telephone battery eliminators • Teletype and telegraph power supplies

Naval
Shipboard and shore power supplies • Regulated power supplies • Power supplies for electronic equipment with magnetic amplifier control

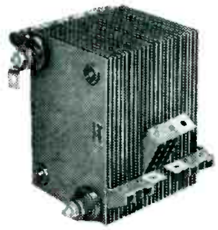
Manufactured to Military Specifications ...to provide ANY DC OUTPUT!

WHEREVER your government specifications call for conversion of AC to DC—be sure to give the job to a *Federal* Selenium Rectifier Equipment . . . compact, rugged, completely self-contained . . . ready to connect to AC . . . ready to deliver *dependable* DC power!

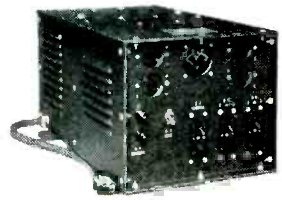
Today, Federal Equipments are serving in a wide range of applications ... from aircraft to submarines . . . from special subminiature to heavy-duty power equipment . . . operating quietly, efficiently, reliably. All are powered by Federal selenium rectifiers . . . famous for long life and trouble-free service ... without expendable parts that require frequent replacement.

MAIL your specifications to *Federal* today! Get the benefit of Federal's years of experience in selenium rectifier design and production. Remember, *Federal* is the *pioneer* company—the *first* to introduce selenium rectifiers to American industry. For quick service, write Dept. E-713

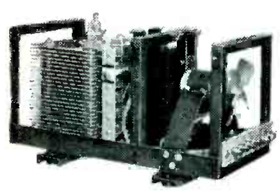
America's Oldest and Largest Manufacturer of Selenium Rectifiers



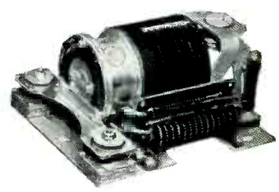
Heavy-duty Federal Selenium Rectifier



FTR 3414-AS Ground Aircraft Power Supply



FTR 3146-BS Aircraft Power Supply



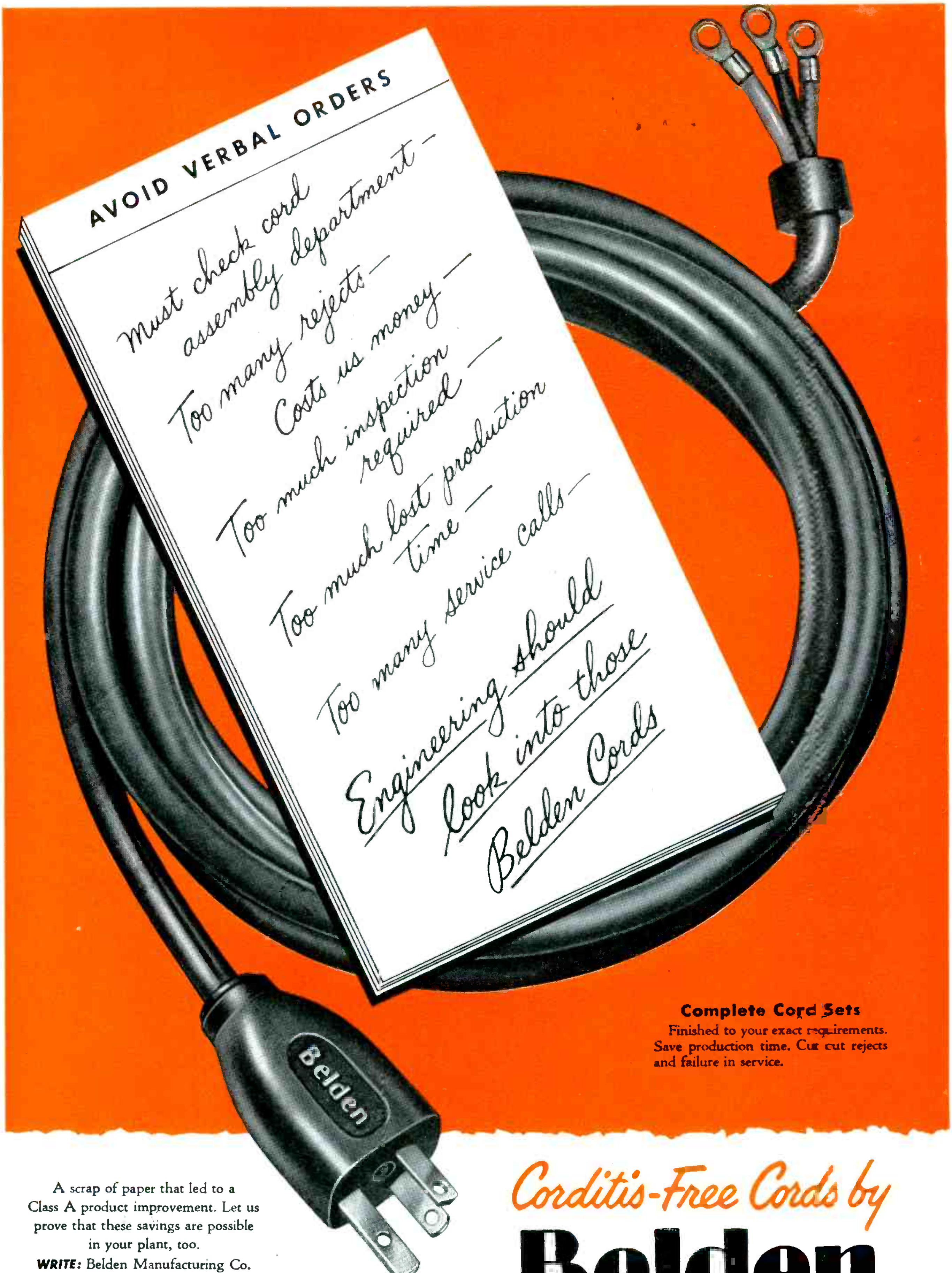
FTR 3141-CS-03 Clip-in Voltage Regulator

FEDERAL TELEPHONE & RADIO FTR

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

SELENIUM-INTELIN DIVISION, 100 KINGSLAND ROAD, CLIFTON, NEW JERSEY
In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.


AVOID VERBAL ORDERS
Must check cord assembly department—
Too many rejects—
Costs us money—
Too much inspection required—
Too much lost production time—
Too many service calls—
Engineering should look into those Belden Cords
Belden

Watch Master

AMERICAN TIME PRODUCTS INC. NEW YORK

Frequency Standards

GUARANTEED ACCURACY
1 part in 100,000
(.001%)

Type 212

TERMINATION
Front and Rear

CONSTRUCTION
Standard 8¾" x 19" Panel

HOUSING
8¾" x 19" x 8" Metal Cabinet

WEIGHT
25 pounds

Uses

Time bases, rate indicators, clock systems, chronographs, geo-physical prospecting, control devices and for running small synchronous motors.

Features

1. **Bimetallic, temperature-compensated fork, no heating or heat-up time is required.**
2. **Fork is hermetically sealed, no barometric effects on frequency.**
3. **Precision type, non-ageing, low coefficient resistors used where advantageous.**
4. **Non-linear negative feedback for constant amplitude control.**
5. **No multi-vibrators used.**
6. **Synchronous clock simplifies checking with time signal.**

Specifications

Accuracy—1 part in 100,000 (.001%).
Temperature coefficient—1 part in 1,000,000 per degree centigrade (or better).
Outputs—

1. **60 cycles, sine wave, 0-110 volts at 0 to 10 watts (adjustable).**
2. **120 cycle pulses, 30 volts negative.**
3. **240 cycle pulses, 30 volts positive and negative. Pulse duration, 100 micro-seconds.**

American Time Products, Inc.,
580 Fifth Ave., New York 19, N. Y.
Gentlemen:
Please send descriptive folder, No. 212

Name...

Company...

Address...

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

product of

AMERICAN TIME PRODUCTS INC.

580 Fifth Avenue **New York 19, N. Y.**

Operating under patents of the Western Electric Company

with the instrument converts electrical energy into sound energy at a frequency just below the broadcast band. The sound energy is then transmitted through a cleaning solvent through which the shaver heads, mounted on a moving chain, are conveyed. As the parts pass through the activated field, grease, oil, metal shavings and lapping compound are removed.

The machine's generator supplies high-frequency voltage to a quartz crystal. The crystal vibrates at its resonant frequency and generates sound waves in the liquid in contact with its upper face. The waves then pass through a thin diaphragm into the cleaning solvent where the cleaning action takes place.

Distortion Measurement Device

By PAUL W. KLIPSCH
*Klipsch and Associates
Hope, Arkansas*

ALL DISTORTION-MEASUREMENT devices depend on the following elements: a signal to be measured, a means of removing the fundamental of the signal and a measuring or indicating device to reveal the residue or distortion. In this simple form one has essentially a harmonic analyzer.

If a plurality of signals are added for intermodulation measurement, the same basic principle holds with a further means for canceling out the several input signals and examining the resulting output components. These components contain not only the harmonic distortion but also the intermodulation products.

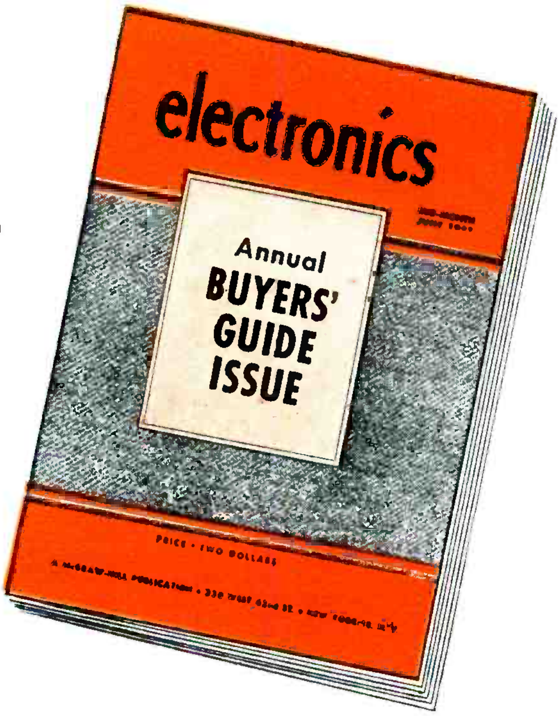
For only occasional measurements of distortion, it is rarely feasible to spend upwards of $1,000 for the equipment required. However, given a cathode-ray oscillograph, an oscillator, a few items from the usual accumulation around any electronics laboratory and a few hours time, a fair tool can be made up that will give the essential information.

Circuit Arrangement

In Fig. 1 is illustrated an arrangement suitable for determining the harmonic distortion in a single-

1951-1952

ELECTRONICS BUYERS' GUIDE



ADVERTISERS in the 1951-1952 GUIDE

YOUR BOOK with the ORANGE and BLACK cover

The 650-page 1951-1952 ELECTRONICS BUYERS' GUIDE is now in the hands of every ELECTRONICS' subscriber. Sent as a bonus issue of ELECTRONICS through the cooperation of over 2,000 manufacturers of electronic and allied products, it is a valuable working tool that will be kept at the elbow of every ELECTRONICS' subscriber and reader throughout the year.

Use it . . . refer to it constantly. Mention ELECTRONICS BUYERS' GUIDE when you write to the manufacturers listed in the directory section and when you purchase products advertised in it. Such evidence of use will insure continued manufacturer cooperation in making this annual your most comprehensive source of buying information.

The products and services of 475 companies are advertised in this 13th issue of ELECTRONICS. In the directory section, more than 2,000 manufacturers are listed under 1,400 product classifications. 2,500 trade names are listed, and the names and addresses of 850 distributors of electronic products are arranged alphabetically by states. It also supplies a 36-page cumulative index to articles published in ELECTRONICS from April 1930 to December 1939.

The 1951-1952 ELECTRONICS BUYERS' GUIDE had the largest print order, and has more total pages, more pages of advertising, and more individual companies' advertising in it than any issue of ELECTRONICS published since the first in April 1930.

A publication's value to an industry is measured by the service it renders to subscribers and readers. When we can mail to every one of our over 30,000 paid subscribers—as a separate, 13th issue—a valuable working tool such as the 1951-1952 BUYERS' GUIDE, we feel we are rendering a valuable service to our subscribers, advertisers, and industry.

The 1952-1953 ELECTRONICS BUYERS' GUIDE will be published Mid-June 1952.

electronics

12 REGULAR ISSUES supplying latest technical information, design and product news

A McGraw-Hill Publication • 330 West 42nd St., New York 18, N. Y.

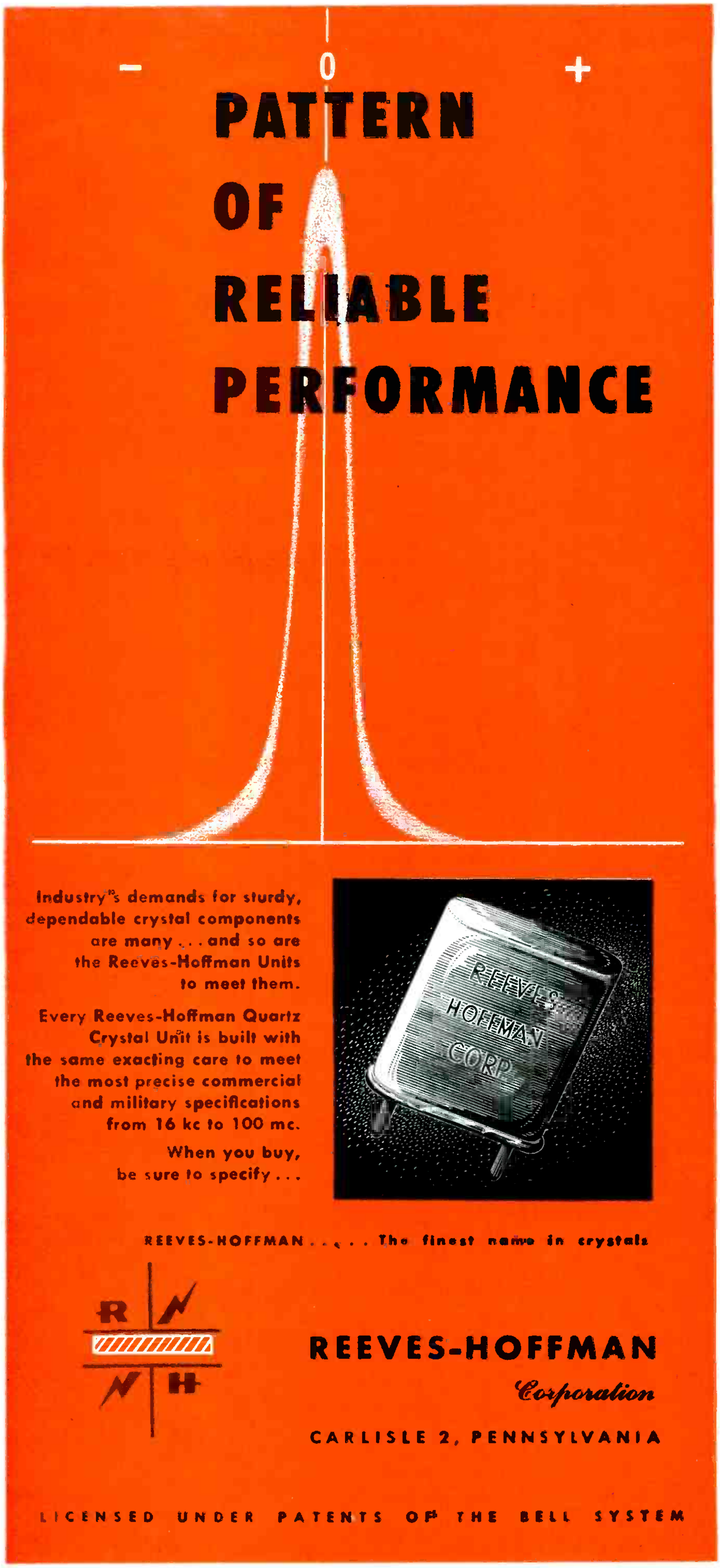
ANNUAL BUYERS' GUIDE supplying all basic product source and technical specifying data

Abalon Precision Mfg. Corp.
Accurate Paper Tube Co.
Ace Engineering & Machine Co., Inc.
Acme Electric Corporation
Acme Electronics, Inc.
Advance Electric & Relay Co.
Advance Electronics Co.
Aerolite Electronic Hardware Corp.
Aerovox Corporation
Air Associates, Incorporated
Air Marine Motors, Inc.
Aircraft-Marine Products, Inc.
Aircraft Radio Corporation
Airdesign, Inc.
Airpax Products Company
Airtron, Inc.
Alden Products Company
Allen Manufacturing Company
Allied Control Co., Inc.
Allied Radio Corp.
Allison Radar Corporation
American Brass Company
American Chronoscope Corporation
American Electroneering Corporation
American Electronics
American Gas Accumulator Company
American Lava Company
American Molded Products Co.
American Phenolic Corporation
American Platinum Works, The
American Television & Radio Co.
American Time Products, Inc.
Amperite Co., Inc.
Anchor Metal Company
Ansonia Electrical Company
Antara Products Div. of
General Dyestuff Corporation
Art-Lloyd Metal Products Corp.
Art Wire & Stamping Co.
Astron Corporation
Atlantic India Rubber Works, Inc.
Atomic Instrument Company
Audio Devices, Inc.
Ballantine Laboratories, Inc.
Barker & Williamson, Inc.
Barry Corp.
Bart Laboratories Co., Inc.
Bead Chain Mfg. Co.
Beam Instruments Corporation
Belock Instrument Corporation
Bendix Aviation Corporation
Eclipse-Pioneer Division
Red Bank Division
Bentley, Harris Mfg. Co.
Beta Electric Corp.
Bird & Co., Inc., Richard H.
Bird Electronic Corporation
Bishop Manufacturing Corporation
Biwax Corporation
Blake & Johnson Company
Bliley Electric Company
Bogue Electric Manufacturing Company
Bond Electronics Corp.
Boonton Radio Corporation
Borg Corporation, Geo. W.
Borthig Co., Inc., George C.
Bowser, Inc.
Bracke-Sieb X Ray Company, Inc.
Bradley Laboratories, Inc.
Brainin Co., C. S.
Brand and Company, Inc., William
Branson Instruments, Inc.
Breeze Corporations, Inc.
British Electronic Group
Browning Laboratories, Inc.
Brush Development Co.
Buchanan Electrical Products Corp.
Buck Engineering Co., Inc.
Burgess Battery Company
Burnell & Company
Bussmann Mfg. Co.
C.G.S. Laboratories, Inc.
Caddell-Burns Mfg. Co.
Calidyne Co.
Cambridge Thermionic Corporation
Carboloy Department of General
Electric Company
Carter Motor Co.
Centralab Division of Globe-Union, Inc.
Centronics Co.
Chatham Electronics, Inc.
Chester Cable Corp.
Chicago Condenser Corporation
Chicago Telephone Supply Corporation
Chicago Transformer, Div. of
Essex Wire Corp.
Churchill Corp.
Ciba Company, Inc.
Cima Corp.
Cinch Manufacturing Corp.
Cinema Engineering Company
Citation Products Co.
Clark Crystal Company
Clarostat Mfg. Co., Inc.
Cleveland Container Company
Cohan-Epner Co., Inc.
Cohn Corp., Sigmund
Coilcraft Incorporated
Coil Winding Equipment Co.
Columbia Wire & Supply Company
Comar Electric Company
Communication Accessories Company
Communication Measurements
Laboratory, Inc.
Conn, Ltd., C. G.
Continental-Diamond Fibre Company
Continental Electric Co.
Cornell-Dubilier Electric Corp.
Corning Glass Works
Cornish Wire Co., Inc.
Craft Manufacturing Co.
Cramer Co., Inc., R. W.
Crosley Laboratories, Inc.
Cross Co., H.
Crowley & Company, Inc., Henry L.
Crucible Steel Company of America
Curtis Development & Mfg. Co.
Dage Electric Company

Dalis, Inc., H. L.
Daniels, Inc., C. R.
Dano Electric Co.
Daven Co.
DeCoursey Engineering Laboratory
Dee Electric Company
DeJur Amsco Corporation
Dial Light Company of America
Dietz Design and Manufacturing Company
Dollar Company, Robert
Communications Equipment Div.
Heintz and Kaufman Division
Driver-Harris Company
Driver Company, Wilbur B.
Dumont Electric Corp.
Duotone Company, Inc.
Ebert Electronics Corp.
Eby, Inc., Hugh H.
Edin Company, Inc.
Edison Incorporated, Thomas A.,
Instrument Division
Eisler Engineering Co., Inc.
Electra Mfg. Company
Electric Indicator Co.
Electric Soldering Iron Co., Inc.
Electrical Industries, Inc.
Electrical Reactance Corp.
Electro Development Corp.
Electro Products Laboratories
Electro-Seal Corporation
Electro-Tec Corporation
Electro-Voice, Inc.
Electronic Coils, Inc.
Electronic Designs, Inc.
Electronic Engineering Associates, Ltd.
Electronic Instrument Co., Inc.
Electronic Measurements Company
Electronic Mechanics, Inc.
Electronic Transformer Company, Inc.
Electronic Tube Corporation
Electrons Incorporated
El-Tronics, Inc.
Emeloid Co., Inc.
Emerson & Cuming Co.
Engineering Co.
Erie Resistor Corp.
Fairchild Camera and Instrument
Corporation
Falstrom Company
Fast & Co., John E.
Federal Manufacturing & Engineering
Corporation
Federal Screw Products, Inc.
Federal Telecommunication
Laboratories, Inc.
Federal Telephone and Radio Corporation
Federated Purchaser, Inc.
Ferranti Electric, Inc.
Flock Process Company, Inc.
Franklin Airloop Corporation
Franklin Mfg. Corp., A. W.
Freed Transformer Co., Inc.
Fugle-Miller Laboratories
Gamewell Company
General Ceramics and Steatite Corp.
General Chemical Division, Allied
Chemical & Dye Corporation
General Electric Company
General Electronics, Inc.
General Precision Laboratory, Inc.
General Radio Company
Glaser Lead Co., Inc.
Glaser-Steers Corporation
G-M Laboratories, Inc.
Gramer Transformer Corp.
Grant Pulley & Hardware Co.
Graphite Metallizing Corporation
Gray Research and Development Co., Inc.
Grayhill
Green Instrument Co.
Grieve-Hendry Co., Inc.
Guardian Electric Mfg. Co.
Hansell, Inc., U.
Harnett Electric Corporation
Harrison Radio Corporation
Harvey Radio Company Inc.
Haydon Company, A. W.
Haydon Manufacturing Co., Inc.
Haydu Brothers
Heath Company
Heiland Research Corporation
Heinemann Electric Company
Heinze Electric Co.
Heldor Manufacturing Company
Helipot Corporation
Heminway & Bartlett Mfg. Co.
Heppner Mfg. Co.
Hermaseal Company, Inc.
Hermetic Seal Products Co.
Hewlett-Packard Company
Heyman Manufacturing Co.
Hickok Electrical Instrument Co.
Highland Engineering Co.
Hillburn Electronic Products
Hi-Test Chemical Corporation
Hobson Bros.
Houlihan Company, T. J.
Hudson Wire Company
Hunt Corporation
Hycon Mfg. Co.
Illinois Condenser Co.
Improved Seamless Wire Company
Indiana Steel Products Company
Inductograph Products, Inc.
Industrial Control Company
Industrial Electronics, Incorporated
Industrial Hardware Manufacturing Co., Inc.
Insl-X Company, Inc.
Instrument Resistors Co.
Instrument Specialties Co., Inc.
International Instruments Incorporated
International Resistance Company
Irvington Varnish & Insulator Co.
J-B-T Instruments, Inc.
JFD Manufacturing Co., Inc.
Jeffers Electronics Inc.
Jelliff Manufacturing Corporation, C. O.
Jennings Radio Manufacturing Company

Johnson Co., E. F.
Johnson & Hoffman, Inc.
Jones Div., Howard B., Cinch Mfg. Corp.
Jones Electronics Company, M. C.
Kahle Engineering Co.
Karp Metal Products Co., Inc.
Kay Electric Company
Keithley Instruments
Keller Products, Inc.
Kellogg Switchboard and Supply Company
Kenyon Transformer Co., Inc.
Kepco Laboratories, Inc.
Kester Solder Company
Keystone Carbon Company
Kings Electronics
King Laboratories, Inc.
Kings Microwave Co., Inc.
Kinney Manufacturing Company
Knights Company, James
Kobzy Tool Co.
Kollsman Instrument Corporation
Krohn-Hite Instrument Company
Kulka Electric Mfg. Co., Inc.
Kurman Electric Co., Inc.
Lambda Electronics Corporation
Lampkin Laboratories, Inc.
Langevin Manufacturing Corporation
LaPointe-Plascomold Corporation
Lavoie Laboratories, Inc.
Lee Mechanical Laboratories, Div. of Lee
Spring Company, Inc.
Leland Inc., G. H.
Lenkurt Electric Co.
Lenz Electric Manufacturing Co.
Lewis Spring & Manufacturing Co.
Liston-Folb Instrument Co., Inc.
Littelfuse, Inc.
Lojack Precision Corp.
Lord Manufacturing Company
Louthan Manufacturing Company
Lukko Sales Corporation
Lundey Associates
Lust, Henry B.
McIntosh Engineering Laboratories, Inc.
MB Manufacturing Company, Inc.
Machlett Laboratories, Inc.
Magnecord, Inc.
Magnetic Amplifiers, Inc.
Magnetic Core Corp.
Magnetics, Inc.
Makepeace Company, D. E.
Malco Tool & Manufacturing Company
Marconi Instruments, Ltd.
Marion Electrical Instrument Company
Markem Machine Company
Measurements Corporation
Mepco, Inc.
Mercoid Corporation
Metal Textile Corporation
Metals & Controls Corp., General Plate Div.
Methode Manufacturing Corp.
Micamold Radio Corporation
Mico Instrument Co.
Micro-Circuits Co.
Mid-West Coil & Transformer Co.
Miles Reproducer Co., Inc.
Millivac Instrument Corp.
Milo Radio & Electronics Corp.
Miniature Precision Bearings, Inc.
Minneapolis-Honeywell Regulator Co.,
Industrial Division
Mitchell Industries, Inc.
Mitchell-Rand Insulation Co., Inc.
Model Rectifier Corp.
Modelectric Products Corp.
Molding Corporation of America
Muckle Manufacturing Co.
Multicore Solders, Ltd.
Multi-Metal Co.
Mycalex Corporation of America
Mycalex Tube Socket Corp.
National Capacitor Company
National Carbon Company a Div. of
Union Carbide & Carbon Corp.
National Company, Inc.
National Electronics, Inc.
National Moldite Company
National Union Radio Corp.
National Varnished Products Corp.
National Vulcanized Fibre Company
Neo-Sil Corporation
Newark Electric Company
New Hampshire Ball Bearings, Inc.
New Hermes, Inc.
New York Transformer Co. Inc.
Ney Company, J. M.
Norrman Laboratories, Ernst
Northern Radio Company, Inc.
Ohmite Mfg. Co.
Ohmweve Company
Olympic Metal Products Company, Inc.
Opad-Green Company
Orthon Corp.
Oster Manufacturing Co., John
Pan American Trade Development Corp.
Panoramic Radio Products, Inc.
Paramount Paper Tube Corp.
Patent Button Co. of Tennessee, Inc.
Patton-MacGuyer Company
Pennsylvania Testing Laboratory
Perfection Electric Co.
Permoflux Corporation
Phalo Plastics Corporation
Philamon Laboratories
Phillips Control Corporation
Pickering & Co., Inc.
Pix Manufacturing Co., Inc.
Planet Manufacturing Corporation
Plastoid Corporation
Polarad Electronics Corp.
Polytechnic Research & Development
Company, Inc.
Potter & Brumfield
Potter Instrument Company, Inc.
Precise Measurements Company
Precision Metal Products Co. of Malden
Precision Paper Tube Co.
Precision Rectifier Corp.
Presto Recording Corporation

Product Development Company, Inc.
Pyroferric Co.
Quaker City Gear Works
Radio Cores, Inc.
Radio Corporation of America
Radio Materials Corporation
Radio Receptor Company, Inc.
Radio Shack Corporation
Rahm Instruments, Inc.
Raytheon Manufacturing Company
Power Tube Division
Special Tube Section
Reeves-Hoffman Corporation
Reeves Instrument Corporation
Reeves Soundcraft Corporation
Republic Foil & Metal Mills Incorporated
Resistance Products Co.
Richardson-Allen Corporation
Richardson Company
Roanwell Corporation
Robinson Aviation, Inc.
Robinson Incorporated, Edward E.
Rogan Brothers
Rohden Manufacturing Co.
Rome Cable Corporation
Rotron Mfg. Co.
Rush Wire Stripper Division, Eraser
Company, Inc.
Russell & Stoll Co., Inc.
Samuel & Co., Inc., J. A.
Sanborn Company
Scientific Electric Div. of "S" Corrugated
Quenched Gap Co.
Servo Corporation of America
Servomechanisms, Inc.
Servo-Tek Products Co.
Sessions Clock Co.
Timer Division
Tyniswitch Division
Set Screw & Mfg. Co.
Shallcross Manufacturing Co.
Shaw Insulator Co.
Sherman Mfg. Co., H. B.
Sherron Electronics Co.
Shure Brothers, Inc.
Shurite Meters
Sigma Instruments, Inc.
Signal Engineering & Mfg. Co.
Sola Electric Co.
Sorensen and Company Inc.
Specialty Battery Company
Speer Resistor Corp.
Spellman Television Co., Inc.
Spencer-Kennedy Laboratories, Inc.
Sperry Gyroscope Company
Stackpole Carbon Company
Stainless, Inc.
Standard Coil Products Co., Inc.
Standard Crystal Company
Standard Electric Time Co.
Standard Transformer Corporation
Staver Company Incorporated
Steiner-Ives Company
Stevens Arnold Incorporated
Stevens Manufacturing Company, Inc.
Stewart Mfg. Corp., F. W.
Stupakoff Ceramic and Manufacturing Co.
Sun Radio & Electronics Co., Inc.
Superior Electric Co.
Superior Tube Company
Switchcraft, Inc.
Sylvania Electric Products, Inc.
Electronics Division
Radio Division
Syncor Products Co.
Taylor Tubes, Inc.
Technical Appliance Corp.
Technicraft Laboratories Incorporated
Telechron, Inc.
Teletronics Laboratory, Inc.
Telex, Electric-Acoustic Division
Tel-O-Tube Corporation of America
Tel-Rad Mfg. Co., Inc.
Tenney Engineering, Inc.
Tensolite Insulated Wire Co., Inc.
Terminal Radio Corporation
Thomas & Skinner Steel Products Co.
Thompson Products, Inc.
Thor Ceramics, Inc.
Times Facsimile Corporation
Titeflex, Inc.
Trad Television Corp.
Transicoil Corporation
Truscon Steel Company
Tung-Sol Lamp Works, Inc.
Turner Company, The
Unimax Switch Div. of the Maxson
Corporation, W. L.
Union Electric Products Co.
United Condenser Corp.
United Electronics
United Manufacturing & Service Co.
United States Electronics Corporation
United States Gasket Co.
United States Testing Company, Inc.
United Transformer Co.
Universal Manufacturing Company, Inc.
University Loudspeakers, Incorporated
Vector Electronic Company
Vectron, Inc.
Victoreen Instrument Co.
Victory Engineering Corporation
Volkert Metal Stampings Inc., John
Vulcan Electric Company
Walker Company, George
Waltham Horological Corporation
Ward Leonard Electric Co.
Waterman Products Co., Inc.
Webster Spring Corporation
Westinghouse Electric Corporation
Weston Electrical Instrument Corporation
White Dental Mfg. Company, S. S.
Wilder Mfg. Co., Inc.
Wilkor Products Inc.
Winchester Electronics Incorporated
Workshop Associates, Inc.
York Co., Inc., Otto H.
Zophar Mills, Inc.



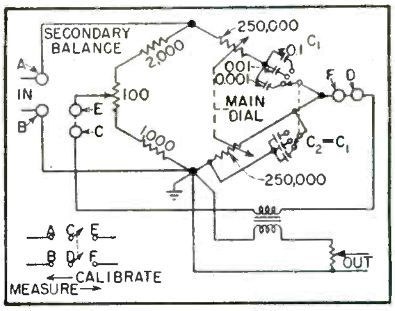


FIG. 1—Wien bridge arrangement for distortion measurement. Arrangement permits both input and output to be grounded and includes calibration means

frequency signal. It is presumed the oscillator is substantially free of distortion otherwise the oscillator distortion must be determined separately. The Wien bridge is adjusted to eliminate the fundamental and the residue is indicated on a cathode-ray oscilloscope, preferably with a two-stage vertical amplifier.

The bridge may be constructed from a pair of ganged volume controls but due to slack in the shaft it would be better to use a pair of ganged controls with accurate tracking. Passable results were obtained from a pair of carbon volume controls but a lot of headaches disappeared when a pair of precision resistors were substituted.

The particular values of bridge elements were chosen for measuring outputs of low-impedance audio amplifiers at about a 16-ohm level. The bridge as shown will impose negligible load under such circumstances. The variable elements are of such value that wire-wound units are feasible.

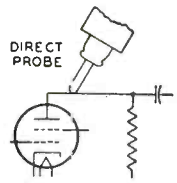
The output transformer superposes its own distortion but this occurs after the fundamental has been eliminated and the added distortion is of low order. If the transformer has excessive leakage inductance it will attenuate the higher distortion components. To detect high-order distortion at high frequencies the transformer should be a good one.

In detecting harmonic distortion, the residue after balance will contain all distortion components. The shape of the curve, the sharpness of any kinks and so forth, will indicate the presence of high-order dis-

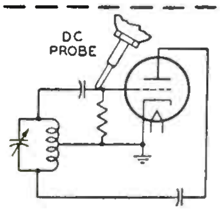
Now ...a NEW Junior VoltOhmyst*

...the WV-77A

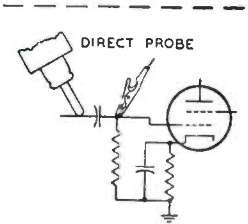
For all regular measurements and specialized measurements as illustrated.



MEASURES AC VOLTS . . . such as signal voltage on plate of tube.



MEASURES DC VOLTS . . . such as oscillator grid bias. One-megohm resistor in probe prevents circuit loading.



MEASURES RESISTANCE . . . such as leakage in coupling capacitor up to 1000 megohms.

Just one probe cable and one slip-on probe handle all measurements.

Check these important features . . .

- ✓ Accurate laboratory calibration.
- ✓ Meter electronically protected against burn-out.
- ✓ Metal case shielding . . . extra stability in rf fields.
- ✓ Sturdy 200-microampere meter movement.
- ✓ Carbon-film 1% multiplier resistors . . . dependability plus.
- ✓ Zero-center scale . . . for discriminator alignment.
- ✓ Frequency response flat from 30 cps to approximately 3 Mc.
- ✓ High ac input resistance for greater accuracy.
- ✓ Constant dc input resistance . . . 11 megohms on all scales.
- ✓ Negative feedback circuits for greater over-all stability.
- ✓ Ohms cable always positive . . . for quick leakage measurements of electrolytic capacitors.
- ✓ Polarity reverse switch . . . eliminates cable switching.
- ✓ ±3% over-all accuracy on +dc scales, and ±5% on ac and −dc scales.

Available from your RCA Test Equipment Distributor

An all-electronic ac-operated vacuum-tube volt-ohmmeter by RCA ONLY $47.50.

Includes DC probe, AC direct probe and cable, ground lead, and alligator clip.

The RCA WV-77A VoltOhmyst* provides the extra features you have tried to find in an inexpensive VTVM. Using the famous VoltOhmyst electronic bridge circuit, 200-microampere meter movement, and carbon-film multiplier resistors, the WV-77A incorporates features you would expect to find only in more expensive instruments. Sturdily built . . . calibrated against laboratory standards . . . and backed by a 12-month warranty . . . the WV-77A has the durability, versatility, and accuracy to please discriminating customers such as service technicians, engineers, amateurs, and military personnel.

As a DC Voltmeter it measures dc from 0.05 volt to 1200 volts in five ranges. Uses 1-megohm resistor in isolating probe; probe has less than 2-uuf input capacitance. Has 11-megohm input; useful for measuring high-resistance circuits such as oscillator, discriminator, and avc.

As an AC Voltmeter it measures ac from 0.1 volt to 1200 volts rms in five ranges. Uses high-impedance diode tube as signal rectifier. Frequency range is more than adequate for measurement of power line, audio, and ultra-sonic frequencies.

As a wide-range Ohmmeter the WV-77A measures resistance from 0.2 ohm to 1 billion ohms in five ranges. Requires only 1.5-volt battery as burn-out protection in measuring such low-power elements as battery-type tube filaments.

The all-new RCA WV-77A VoltOhmyst comes completely equipped with probes and cables as illustrated. For complete details, see your RCA Test Equipment Distributor today . . . or write to RCA, Commercial Engineering, Section 42 IX, Harrison, N. J.

Accessories Available on Order

The WG-289 High-Voltage Probe and WG-206 Multiplier Resistor extend the dc range of the WV-77A to 50,000 volts.

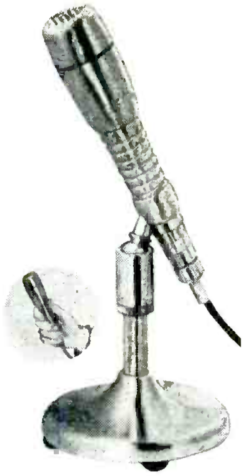
The WG-264 Crystal-Diode Probe extends frequency range of the WV-77A to 250 Mc.

*Reg. U. S. Pat. Off.

RADIO CORPORATION of AMERICA
TEST EQUIPMENT **HARRISON, N. J.**

Microphones BY TURNER

QUALITY **that speaks for itself in every sound application**



The Aristocrat Model 50D

The world's finest dynamic. For TV, FM, AM. Recording, public address and broadcast. Laboratory calibrated. No closely associated auxiliary equipment required.
Response: 50 - 15,000 c.p.s. flat within ± 2½ db.
Level: 56 db below 1 volt/dyne/sq.cm. at high impedance.

The "Competitor" Model 60X

A new low priced crystal desk and hand microphone for economical recording and sound systems, amateurs, dictation machines.
Response: 70 - 7000 c.p.s.
Level: 52 db below 1 volt/dyne/sq.cm.

The Dependable 33X-33D

A general purpose microphone that offers high quality performance at medium cost.

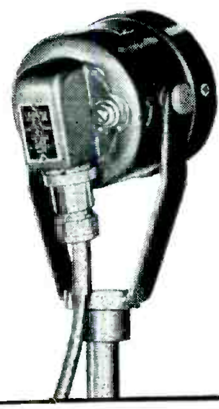
Model 33X Crystal
Response: 50 - 9000 c.p.s.
Level: 52 db below 1 volt/dyne/sq.cm.

Model 33D Dynamic
Response: 30 - 9000 c.p.s.
Level: 54 db below 1 volt/dyne/sq.cm. at high impedance.

The Professional Model U9S Dynamic

A rugged reliable microphone. 4 impedances at your fingertips. A smooth performer at all impedances and frequencies.

Response: 40 - 9000 c.p.s.
Level: 52 db below 1 volt/dyne/sq.cm. at high impedance.

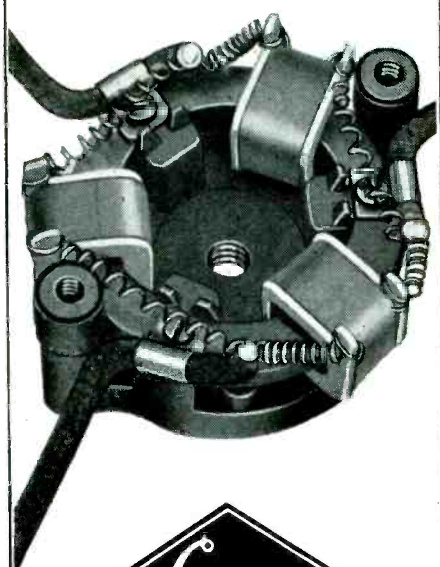


THE TURNER COMPANY
905 17th Street N.E., Cedar Rapids, Iowa
In Canada: Canadian Marconi Company, Toronto, Ontario and Branches
Export: Ad. Auriema, Inc., 89 Broad Street, New York 4, N.Y.

TURNER

Crystals licensed under patents of the Brush Development Company

The Bobbin Type Coils shown below are part of a complex aircraft instrument assembly. No larger than your little fingernail, these tiny coils are mounted on a common core and activate three indicator needles within the same dial. Extreme assembly care and microscopic inspection, at Coto, assure perfect operation under adverse flying conditions.

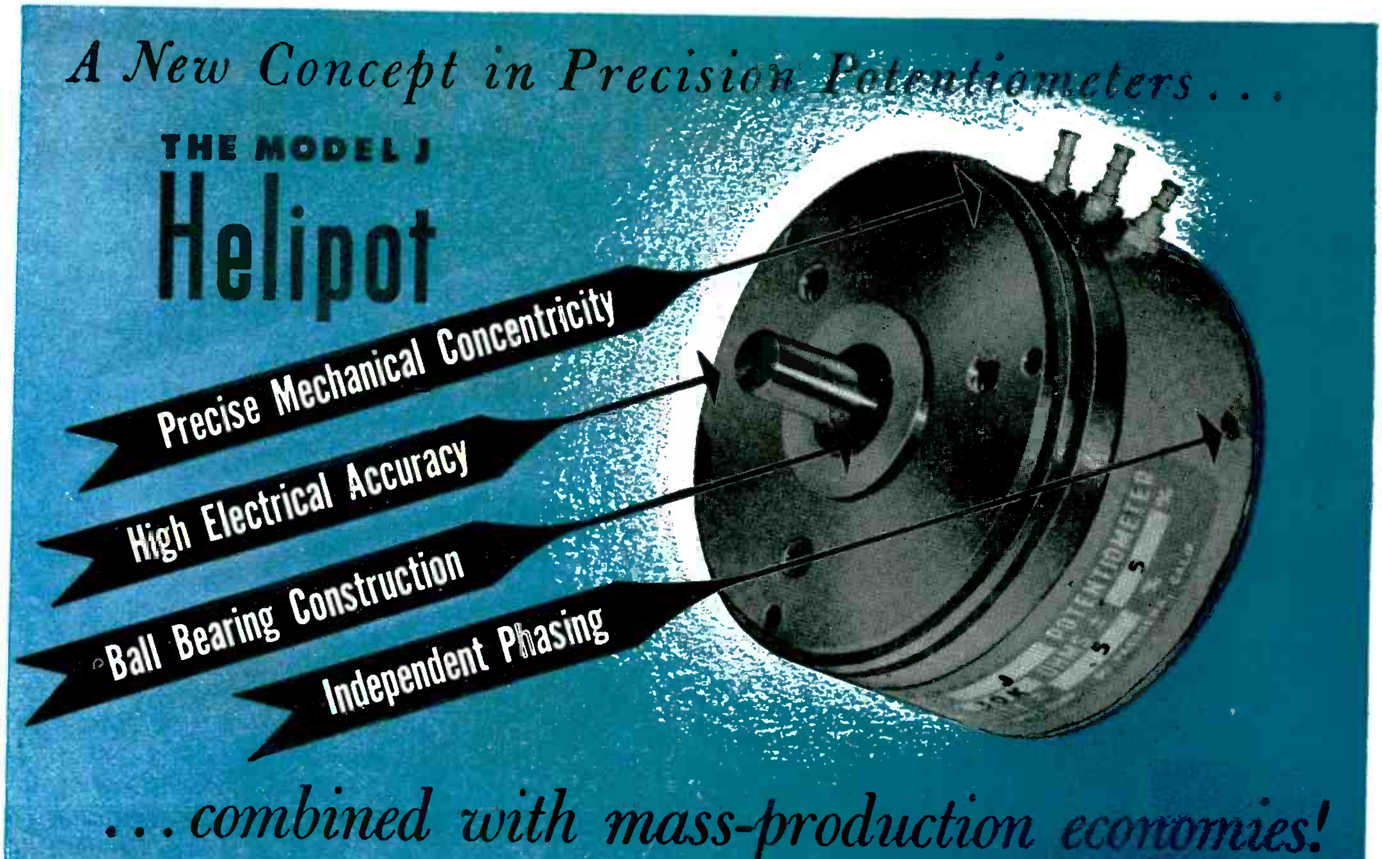


Coto SINCE 1917

Builds Them!

When you need electrical coils, why not take advantage of 34 years of experience, engineering competence, and modern production facilities. Coto coils are built for you, to your specifications.

COTO-COIL CO., INC.
COIL SPECIALISTS SINCE 1917
65 PAVILION AVE
PROVIDENCE 5, R.I.




TYPICAL 6 GANG MULTIPLE ASSEMBLY

***If it's a tough potentiometer problem, bring it to* Helipot**

—for Helipot has facilities and know-how unequalled in the industry for mass-producing precision potentiometers with advanced operating and electrical features.

This recently-developed 'Model J' Helipot, for example, combines several revolutionary advancements never before available in the potentiometer field...

Precise Mechanical Concentricity

Modern servo mechanisms and computer hook-ups require high mechanical precision to insure uniform accuracy when connected to servo motors through close-tolerance gears and couplings.

In the "Model J," close concentricity between mounting surface and shaft is assured by a unique mounting arrangement. The unit can be aligned on either of two wide-base flange registers and secured with three screws from the front of the panel... or it can be secured with adjustable clamps from the rear of the panel to permit angular phasing. Or if preferred, it can be equipped with the conventional single-hole bushing type of mounting.

In addition to accurate mounting alignment, exact rotational alignment is assured by the long-life, precision-type ball bearings upon which the shaft rotates. Precise initial alignment coupled with negligible wear mean high *sustained* accuracy.

High Electrical Accuracy

Helipot products have long been noted for their unusually high electrical accuracy and the "Model J" embodies the latest advancements of Helipot engineering in this field.

For example, tap connections are made by a new Helipot welding technique whereby the tap is connected to only ONE turn of the resistance winding. This unique process eliminates "shorted section" problems!

High linearity is also assured by Helipot's advanced production methods. Standard "Model J" linearity accuracies are guaranteed within ±0.5%. On special order, accuracies to ±0.15% (capacities of 5000 ohms and up) have been obtained.

Ball Bearing Construction

The shaft of each "Model J" is carefully mounted on precision-type ball bearings that not only assure sustained rotational accuracy, but also provide the constant low-torque operation so essential for servo and computer applications. Starting torque is only ¾ of an inch-ounce (±.25 in.-oz.)—running torque, of course, is even less.

Independent Phasing

When using the "Model J" in ganged multiple assemblies, each section can be independently phased electrically or mechanically—even after installation on the panel—by means of hidden internal clamps controlled from outside the housing. Phasing is simple, quick, accurate!

Mass-Production Economies

In addition to its many other unique features, Helipot engineers have developed unusual techniques that permit mass-production economies in manufacturing the "Model J". Actual price depends upon the number of taps required, special features, etc.... but with all its unique features, you will find the "Model J" very moderate in cost.*

Wide Choice of Designs

The "Model J" Helipot is available in a wide selection of standard resistance ranges—50, 100, 1,000, 5,000, 10,000, 20,000, 30,000 and 50,000 ohms... in single- or double-shaft designs... with choice of many special features to meet virtually any requirement within its operating field.

***Write for Bulletin 107 which gives complete data and price information on the versatile "Model J" Helipot!**

THE Helipot CORPORATION

South Pasadena 2, California

***Field Offices:* Boston, New York, Philadelphia, Rochester, Cleveland, Detroit, Chicago, St. Louis, Los Angeles and Fort Myers, Florida. *Export Agents:* Frotham Co., New York 18, New York.**

tortion and the amplitude of the lowest-order harmonic can be measured or estimated.

Without any additions except that of a second oscillator, the device can be used to indicate modulation distortion. The bridge is balanced for one of the frequencies, say the lower, and the envelope of the other frequency examined. A sausage-like pattern indicates the presence of intermodulation and a little calculation will serve to determine the magnitude in appropriate units.

In available components, even precision elements will not track perfectly but mistracking of the variable elements may be compensated for by the variable resistor in the nonreactive arms of the bridge. It has been possible to get a balance of sufficient accuracy to measure 0.3-percent distortion to an accuracy of the order of 5 percent.

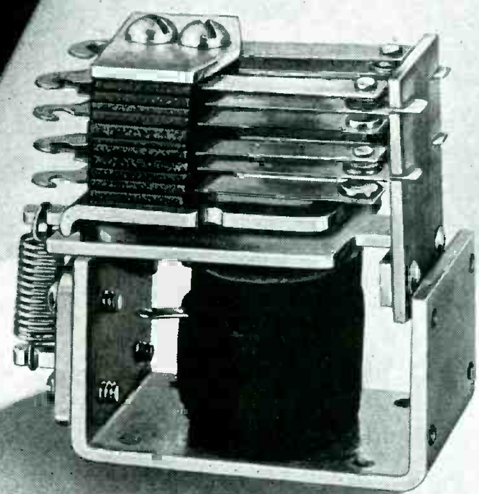
The Wien bridge attenuates not only the fundamental (to null) but also attenuates the distortion components to some extent. If considerable precision of the numerical value of distortion is desired it would be necessary to calculate the attenuation of the bridge for one or more of the residue frequencies. Thus, if distortion figures are to be compared with those obtained by other methods of measurement, some corrections may be applicable. If, however, the results are to be comparative and the device described is the only method to be used, one can get a very accurate relative figure of merit without any corrections.

High Fidelity

As this device was built to evaluate audio equipment in the so-called high-fidelity class, a word about measurements of such equipment is in order. Most amplifiers will show fairly low distortion at 400 cycles. The good amplifier is distinguished from the mediocre or poor amplifier by harmonic tests at many frequencies and particularly at extremely low frequencies. As the low C of the pipe organ (C_3) is 32.7 cycles and this should normally be considered as part of the desired spectrum and as power from the C_3 Bourdon pipe is very large, distortion at and below that frequency

PEAK

IN POWER VERSATILITY QUALITY PERFORMANCE



TYPE PK RELAY

HERE ARE THE FACTS AND FIGURES:

CONTACTS: 10 amp. standard. 24 volts D.C., 115 volts A.C.
15 amp. contacts available.

SENSITIVITY: D.C.: 4 pole 1.5 watts
2 pole .7 watts
A.C.: 4 pole 5 volt amperes
2 pole 2.5 volt amperes
Can also be furnished in 6 pole AC and DC up to 4000 Ohms.

COIL: To 115 volts D.C., 230 volts A.C.

NOMINAL HEAT RISE: D.C. 30°C above room ambient
A.C. 45°C above room ambient

MAX. INPUT FOR 85° RISE: D.C. 5 watts
A.C. 11 volt amperes

MOUNTING: Base or end mounting

WEIGHT: 4.5 oz. 4 P.D.T.

WEIGHT HERMETICALLY SEALED: 7.7 oz.

DIMENSIONS: Open Relay—2 1/16", 1 1/8", 2 1/16"
Sealed Relay—3 1/8", 1 1/2", 2 5/16"
Overall Mounting Flange—3 1/8"
Center to Center Mounting Holes—2 11/16"

A Quality Relay

The new Allied PK Relay is designed to offer versatility in a power relay where quality and low cost are factors. Besides stability in operation its reliability allows a range in applications from high quality instruments to vending machines. The PKU relay will comply with Underwriters' Laboratories requirements and can also be supplied hermetically sealed.

Bulletin PK gives complete details. Send for your copy today.

Be sure to send for your copy of Allied's Relay Guide. It gives the engineering data for 27 Allied relays in a concise tabular form for easy reference.

AL-143

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

should be determined. Sometimes wind noise will produce subsonic amplitudes that will cause serious audible intermodulation distortion. It appears that distortion measurements should be made down to frequencies where the response is down 10 db or more. It is at low frequencies where the exciting current of an output transformer creates maximum distortion which will in turn cross modulate higher frequencies.

Not intended to compete with the distortion analyzers which are marvels of speed, accuracy and convenience, the present offering is suggested as a low-cost device for use where occasional distortion data must be obtained but where the investment in more elaborate equipment is of questionable justification. The device is capable of yielding valuable information and has the advantage that the results are pictorial rather than merely numerical. Qualitative indications of small magnitudes of high-order distortion are evident even in the presence of large quantities of low-order distortion. As it is becoming apparent that a few hundredths of a percent of high-order distortion is more irritating than several percent of low-order distortion, the pictorial representation of the distortion residue may be considerably more valuable than a mere numerical value representing total distortion.

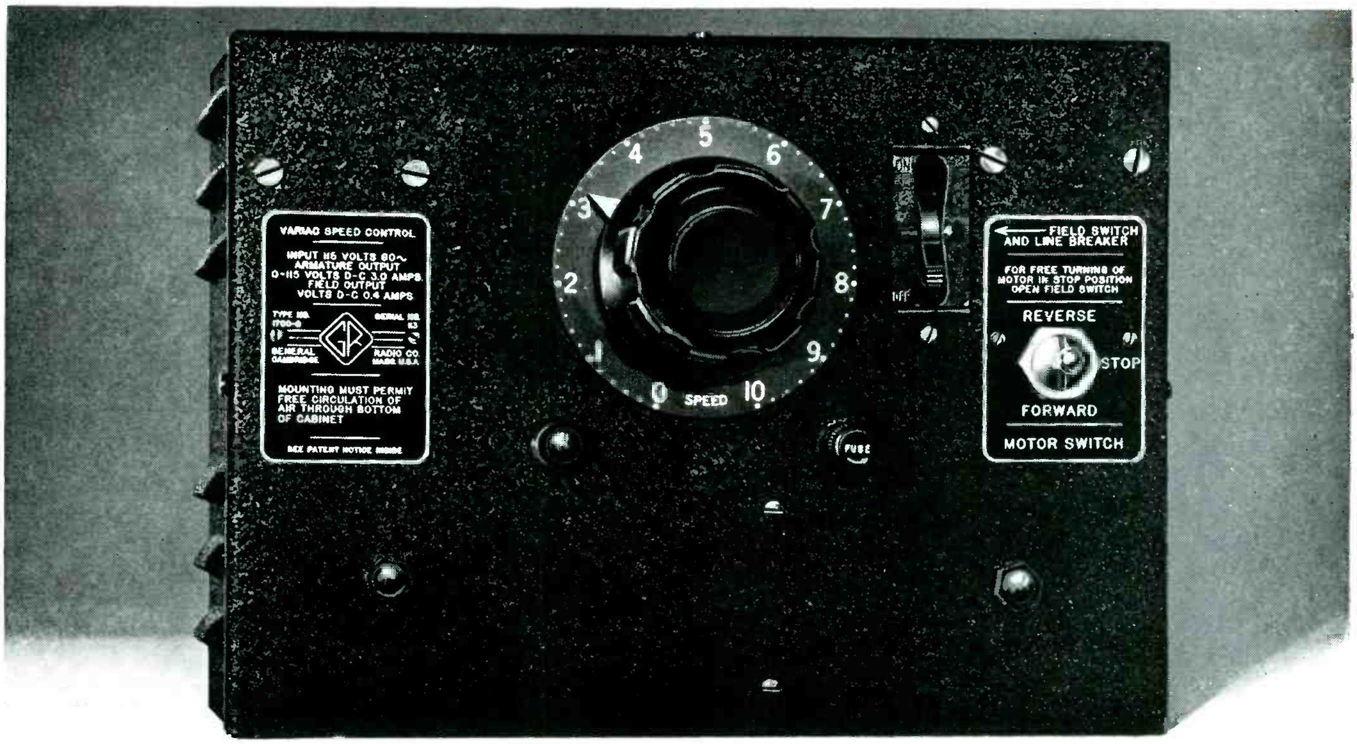
Operation

The signal to be measured is connected to the IN terminals and a cathode-ray oscilloscope, preferably with two-stage vertical amplifier, is connected to OUT terminals.

The bridge is balanced by rotating the main dial while watching the screen. When a minimum is obtained, the secondary balance is adjusted for a further minimum. With a little practice both controls are operated simultaneously to obtain final null of the fundamental. The residue is observed, then the calibration switch is thrown to CALIBRATE position and the calibrated attenuator is rotated until the fundamental is about the same size on the screen as the residue was at the fundamental null. The number of db plus a calculated or

another New Variac® SPEED CONTROL

for 1/3 h.p. D-C motors operating from A-C lines



Selenium Rectifier ☆ Compact Construction ☆ Moderate Price

This new and improved VARIAC Speed Control Features:

Selenium Rectifier — *no waiting for vacuum tube to warm up — not necessary to 'idle' rectifier for instant starting — much less heat — practically indefinite life under ordinary operating conditions — at least 15,000 hours rectifier life for continuous duty in ambient temperature of 40 deg. C.*

Standard 1/3 HP Compound or Shunt Wound Motors — *either can be used — no derating required*

Instant Starting — Extra-Fast Stopping — *dynamic braking — reverse and dynamic braking require no auxiliary equipment — single "FORWARD", "STOP" and "REVERSE" switch conveniently located on control box*

Continuously-Variable Speed Range *down to zero, at constant torque*

Negligible Torque Pulsation — *armature current practically ripple free*

Excellent Regulation — *essentially that of the motor itself*

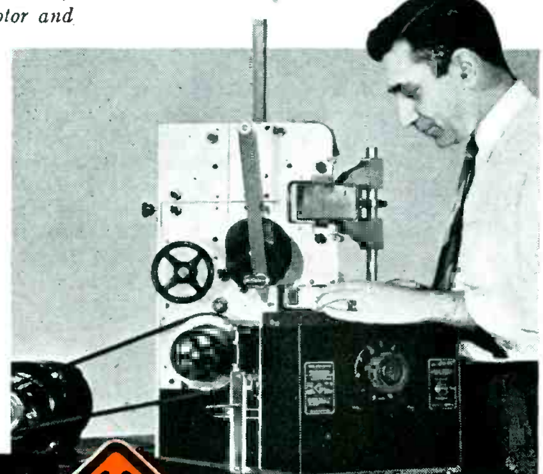
Quick Starting Under Heavy Loads — *very large short-time overload capacity — time-delay magnetic circuit breaker protects motor and control from damage from stalls*

Micro-Switches *can be used as limit devices — not necessary to break the d-c armature current*

Rugged and Compact Construction — *all control equipment and circuits in one small, rugged box — easily installed by any shop electrician — essentially maintenance free — box and control readily mounted on machine to be controlled — plug-jack connections simplify wiring — unit may be removed from box without disturbing wiring*

Type 1700-B Variac Speed Control, *105–125 v, 60 cycles* **$165.00**

Type BC46AB29 *G. E. 1/3 hp semi-enclosed 1750 rpm motor, 115 v, dc, for use with Type 1700-B VARIAC Control* **45.79**

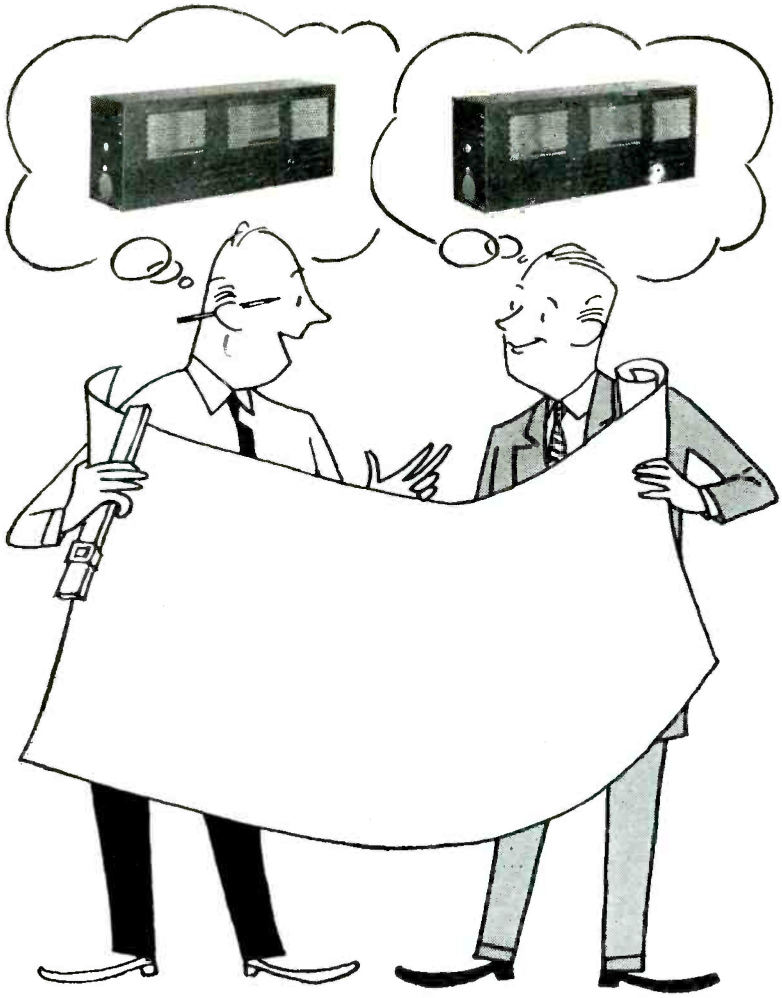


The Type 1700-B VARIAC Speed Control mounted on toroidial winding machine. Note compactness, accessibility of speed-control knob and motor control switch.

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Mass.

90 West Street NEW YORK 6 · 920 S. Michigan Ave. CHICAGO 5 · 1000 N. Seward St. LOS ANGELES 38



We talk *your* Language when it comes to making HOUSINGS!

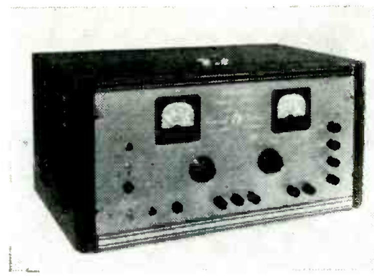
SINCE the beginning of the last war, we've successfully supplied cabinets, control assemblies, chassis and similar equipment to many of the nation's major defense manufacturers. So there's no wasted motion when we talk over your sub-contract requirements—we talk your language! If we can build the equipment you need, our engineers know how to translate blue prints into deliveries in the minimum time and with minimum attention on your part. And of course we pride ourselves in *quality of work* above all else. ● Complete information on our facilities and capacity is yours for the asking.

CALL, WRITE OR WIRE US TODAY!

CORRY-JAMESTOWN MFG. CORP.

CORRY, PENNSYLVANIA

Makers of famous Steel Age office furniture



Regulated Power Supply

Superior Specifications

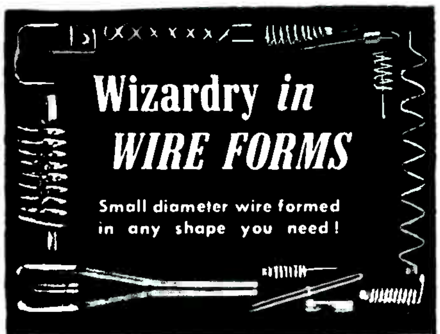
MODEL 100 A

- 0 to +325 v.d.c. 200 ma.
- Regulation within 0.2 volts at any setting.
- Continuously variable.
- Hum less than 2 mv.
- 0 to —150 v. d.c. for bias.
- 2—6.3 v. a.c., 3 amps. each.
- Metered output.
- Rack type panel, with cabinet.
- $325.00 f.o.b. Los Angeles.
- IMMEDIATE DELIVERY.

For information send for Bulletin E-100A

Universal Electronics Co.

2012 S. Sepulveda Blvd.
Los Angeles 25, Calif.



IMMEDIATE CAPACITY FOR DEFENSE SUB-CONTRACTS

STRAIGHTENING & CUTTING
Perfect straight lengths to 12 ft.
.0015 to .125 diameter

WIRE FORMS
.0015 to .080 diameter

SMALL METAL STAMPINGS
.0025 to .035 thickness
.062 to 3 inches wide

★

Specializing in Production of Parts for Electronic and Cathode Ray Tubes

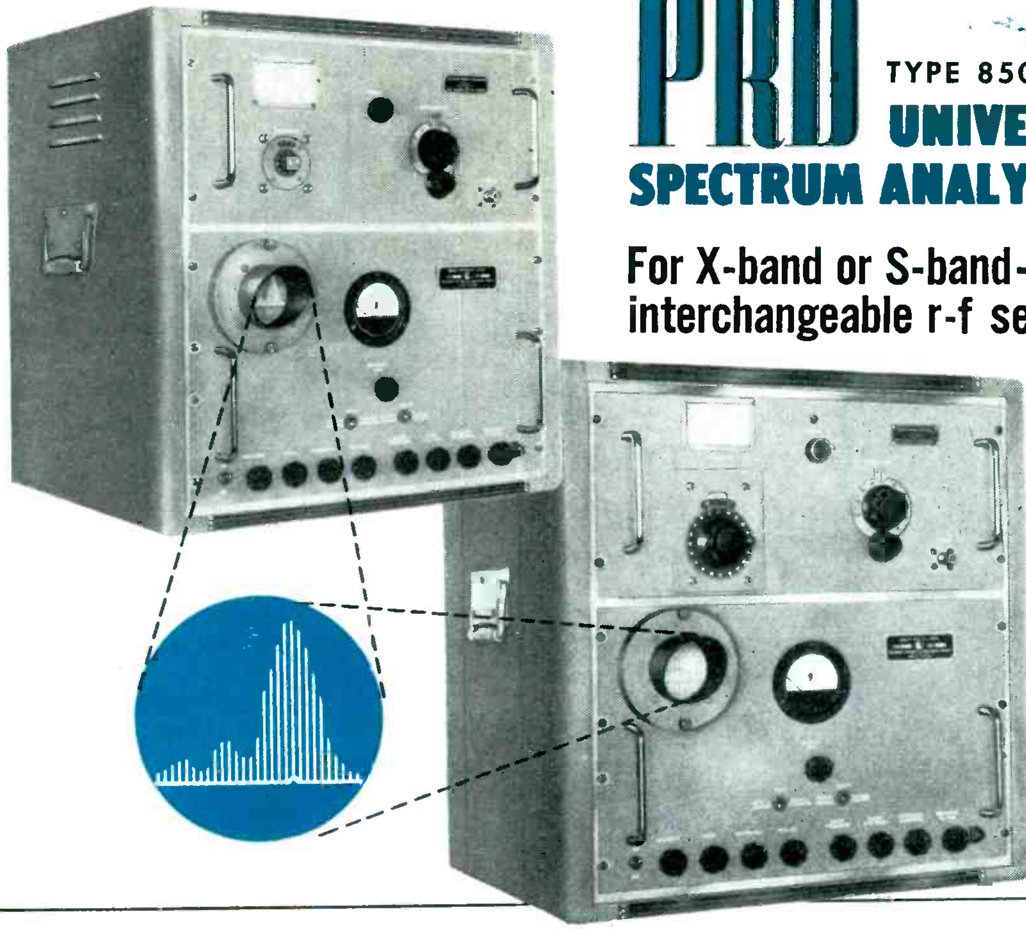
Write for Illustrated Folder
Send Blueprints or Samples for Estimate

ART WIRE & STAMPING CO.
227 High Street Newark 2, N. J.

why SPECULATE on SPECTRA?

PRD
TYPE 850 SERIES UNIVERSAL SPECTRUM ANALYZERS

For X-band or S-band—with interchangeable r-f sections



- ACCURATE R-F PULSE ANALYSIS
- RADAR SYSTEM OSCILLATOR ADJUSTMENT
- DETERMINATION OF MAGNETRON PULLING AND AFC OPERATION
- WEAK SIGNAL DETECTION
- PRECISE FREQUENCY MEASUREMENT
- STANDING WAVE MEASUREMENT BY HETERODYNE METHODS

See PRD Precision Test Equipment at Booth 14, National Electronics Conference, Chicago—October 22 23 and 24, or write for copy of the latest PRD Catalog —address Department E14

There's no excuse for guess-work in r-f pulse analysis. PRD's new spectrum analyzers provide the most up-to-date means for accurate determination of microwave spectra. The simple interchange of demountable r-f panels permits operation at either S- or X-band . . . or at other bands as additional r-f sections become available.

Of particular importance is the versatile arrangement of the microwave components, making possible the independent use of the variable attenuator, frequency meter, mixer, and local oscillator for a variety of bench measurements.

Polytechnic RESEARCH & DEVELOPMENT COMPANY, Inc.

202 TILLARY ST., BROOKLYN 1, NEW YORK

estimated correction for pattern size difference is added to give the ratio of the harmonic residue to the fundamental.

In addition to obtaining a numerical ratio between the residue and fundamental, the cathode-ray picture will reveal the presence and order of magnitude of any high-order distortion components. For example a fine whisker-like transient at some part of the cycle might contain mere thousandths of a percent of distortion but be more irritating to a listener than a measured several percent of second or third harmonic.

Tube Selection for Heating Equipment

By H. J. Dailey and C. H. Scullin
Electronics Engineering Department
Westinghouse Electric Corp.
Bloomfield, N. J.

One of the major problems confronting the designers of induction and dielectric heating equipment is the selection of the electronic tube best suited for a particular application. It is the purpose of this paper to outline guides for aiding in this problem. Although most r-f heaters contain both rectifier and oscillator tubes, only the latter will be discussed here.

Techniques used in the design of equipment for radio-frequency heating have been a natural outgrowth

One of the oscillator tubes used in a 5-kw 450-cycle r-f induction heating generator

Across the country – in less than a minute!

Some day soon, a jet plane will leave New York at 9 A.M....

And be in California—at 9 A.M.!

So fast are modern jets, they come close to following the sun in its flight across the continent. Speed? Yes. But in manufacture, the story is different!

The all-precision jet engine takes almost *four* times as much machining as World War II aircraft. It's long work—but defense deadlines are short!

To speed up jet assembly lines, the plane-makers have learned amazing production tricks. And they've learned an amazing traffic trick, too.

When ordering and shipping parts, the makers of the world's fastest planes use the world's fastest service—Air Express!

Whether your business is jets or jewelry, here are the unique advantages you can enjoy with regular use of Air Express:

IT'S FASTEST — Air Express gives the fastest, most complete door-to-door pick up and delivery service in all cities and principal towns, *at no extra cost.*

IT'S MORE CONVENIENT—One call to Air Express Division of the Railway Express Agency arranges everything.

IT'S DEPENDABLE — Air Express provides one-carrier responsibility all the way and gets a *receipt upon delivery.*

IT'S PROFITABLE—Air Express expands profit-making opportunities in distribution and merchandising.

For more facts call Air Express Division of Railway Express Agency.

AIR EXPRESS

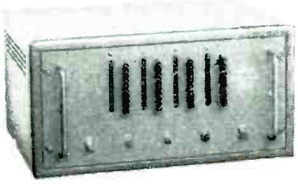
GETS THERE FIRST

ELECTRONIC INSTRUMENTATION

for LABORATORY *or* PRODUCTION LINE!

DECIMAL COUNTING UNIT, MODEL 700 is a direct reading electronic counter capable of operating at speeds up to 30,000 counts per second. Digits from 0 to 9 are presented on illuminated front panel. Electrical reset to zero. Plug-in octal mounting for easy interchangeability. The counter operates on input pulse of 100 volt neg. with 2 microsec. max. rise time. Output will drive following unit in cascade. Dimensions 1 3/8" x 5" x 5 1/4". Wt. 12 oz. Other models to a million counts per second.

ELECTRONIC COUNTER, MODEL 10 was developed to meet the need for a rugged industrial counter operating at speeds up to 6000 counts per minute. Total count is displayed on the Decimal Counting Unit and the mechanical register to a maximum capacity of 9,999,999. Unit may be operated from closing contacts, photocell, or any means that will supply a positive potential of at least 3 volts. All circuitry moisture and fungus proofed. Unit is available in a variety of vapor-proof and explosion-proof housings to meet individual requirements. Dimensions 6 1/4" x 7 1/4" x 6 1/2". Weight approximately 6 lbs.



PRESET COUNTER consists of a series of scale-of-10 electronic counting units each in parallel with a 10-position push-button switch. This instrument accepts counts in the conventional manner at rates up to 10,000 cps. Any number from 0 to maximum capacity may be preset merely by depressing appropriate push-button in each column. Upon reaching the preset count, the unit supplies an output pulse to drive a register, close a gate, divert a production line or perform any other desired function. It then resets to 0 and recycles automatically. Available in any desired capacity.

EVENTS PER UNIT TIME METER, MODEL 554 will automatically count and display the number of events that occur during a precise one second interval at rates up to 100,000 events per second. Accuracy is ± one event. Will operate either manually or automatically to count any mechanical, electrical, or optical occurrences, regularly or randomly spaced, that can be converted into changing voltages. Instrument counts for one second and displays the results on illuminated five-digit panel. Will recycle continuously on automatic operation. Convenient test switch permits 2 second self-check of entire unit. Dimensions 20 3/4" x 10 1/2" x 15". Weight approximately 68 lbs.

TIME INTERVAL METER, MODEL 510 provides a direct reading of elapsed time between any two events in the range of 0.000010 to 1.00000 seconds. Accuracy is ± 10 microseconds. Any occurrences that can be translated into changing voltages may be so timed. Timing may be started and stopped by independent voltages, the polarity of which may be selected by means of toggle switches. Sensitivity control permits selection of the amplitude of start or stop voltages at optimum level for elimination of interference. Dimensions 20 3/4" x 10 1/2" x 15". Weight approximately 58 lbs.

SINGLE/DOUBLE PULSE GENERATOR MODEL 903 is a general purpose laboratory instrument that supplies either single or paired pulses individually variable in amplitude, width and polarity. Pulse spacing is continuously variable from 0 to 10 microseconds, pulse width from 0.10 to 1.6 microseconds and pulse amplitude from 200 volts maximum negative and 50 volts maximum positive for 1000 ohm load, and 10 volts maximum negative and 50 volts maximum positive for 50 ohm load. Single or double pulses are available through separate panel connectors. Repetition rate internally controlled 1 to 1000 cps. Push-button control single cycle. External signal control for any rate up to 1000 cps.

These are basic descriptions of representative standard instruments. A variety of modifications, both standard and special, are available to meet specific requirements. For complete details write Dep't. E.

Berkeley Scientific Corporation

2200 WRIGHT AVE. • RICHMOND, CALIF.

A NATIONAL ORGANIZATION

DANDUX

CANVAS & LEATHER PRODUCTS

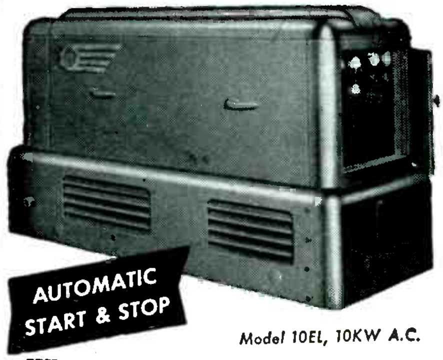
BAGS and CASES
BG BAGS
CW BAGS
RADIO EQUIPMENT
ELECTRONIC EQUIPMENT
RADAR EQUIPMENT
TOOL ROLLS

C. R. DANIELS, INC.

75 West St., New York 6, N. Y.
549 W. Randolph St., Chicago 6, Ill.

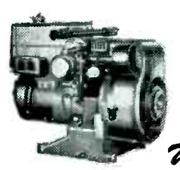
STAY ON THE AIR

WHEN POWER FAILS...with an ONAN Electric Plant



Model 10EL, 10KW A.C.

When storms, floods, or fires interrupt electricity and force you off the air, you lose listeners and income. Guard against loss, assure vital public service during emergencies by installing an Onan Electric Plant. Onan Standby Electric plants serve many network and private stations. Automatic models to 35,000 watts.



PORTABLE ELECTRIC PLANTS FOR MOBILE RADIO USES

Supply A.C. power for broadcasting at scene of events. Light in weight. Can be carried by hand or in trunk of car. A.C. models: 400 to 3,000 watts.

Write for FREE Folder

D. W. ONAN & SONS INC.
7024 University Avenue
Minneapolis 14, Minnesota

of the radio broadcasting field. While there is much common ground between the two applications, there are many factors inherent in the heating field which give rise to problems not usually troublesome in broadcasting. A comparison of some of these problems is given in Table 1.

The induction and Dielectric Heating Apparatus Section of NEMA has assembled "Suggested Standards for Future Design" for electron tubes to be used for induction and dielectric heating. These suggested tube design standards have been converted to the viewpoint of equipment designers to aid in selecting the tube best suited for an application. Purchasers of r-f heating equipment may wish to use these suggestions as criteria when purchasing equipment in order to minimize maintenance problems.

Recommendations

Tubes for induction and dielectric heating should be chosen according to the following recommendations. The tube used should be capable of a plate output power of at least 40 percent in excess of nominal set output. This excess

Table I—Comparison Factors for Broadcast and Heating Tubes

	Broadcast	Heating
Tube Load	Constant resistance	Varies widely both as to resistance and reactance
Ambient Air Temp.	Varies moderately	Varies widely, often high
Air Cooling	Usually clean air supply	Air supply often heavily laden with dust or lint
Water Cooling	Usually clean and constant pressure	Often heavily contaminated and with wide pressure variations
Supply Voltage	Carefully controlled	Often varies widely
Operating Frequency	Constant	Varies widely with load
Instrumentation	Good	Must be held to minimum
Maintenance	Usually good	Varies widely, often rather poor
Grid Excitation Waveform	Usually sinusoidal except for intentional modulation	Often contains high harmonics
Surge Currents	Usually limited by modulation transformer and choke and by filter choke	Usually limited only by reactance of high voltage transformer
Anode Dissipation	Constant except for intentional modulation	Varies widely with load
R-F Grid and Plate Voltage	Constant except for desired modulation	Varies widely with load

PERMANENT CAREERS

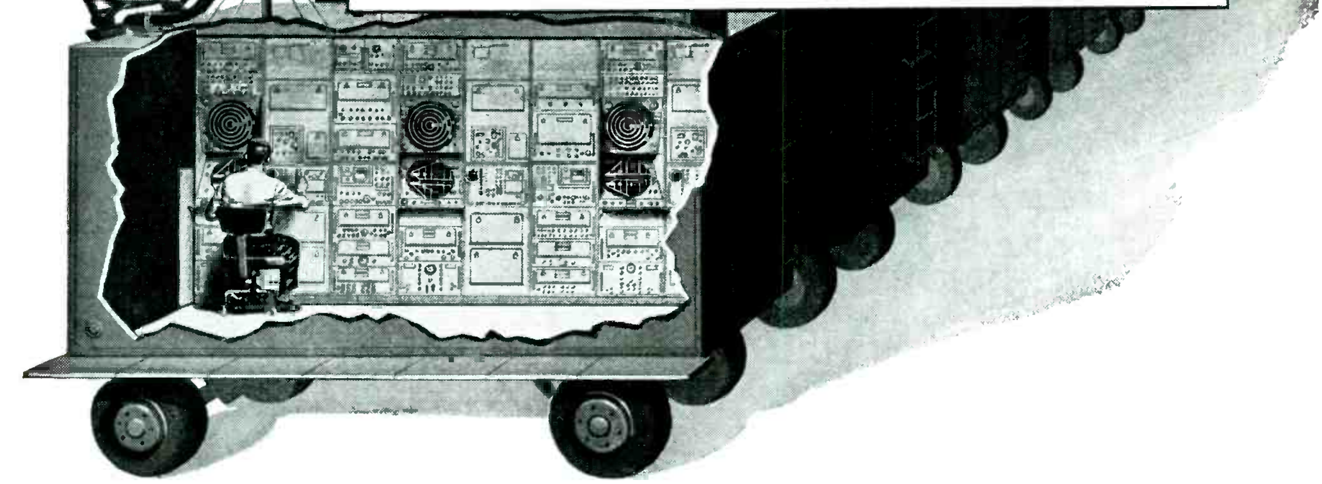
FOR

ELECTRONIC DESIGN ENGINEERS AND PHYSICISTS

IN LOS ANGELES

with GILFILLAN

- the company that developed and produced GCA, the world-famous Radar equipment for landing aircraft in bad weather
- the company that pioneered development of GCA radar equipment for the USAF, the CAA, the USN and the USMC



GILFILLAN OFFERS...

- excellent financial opportunity. Because Gilfillan jobs require top specialists, most jobs fall into higher pay categories.
- secure, long-term careers with a progressive 40-year-old company.
- outstanding engineering opportunity, ranging from major systems design to detailed circuit design.
- advancement in both pay and responsibility according to ability.

ELECTRONIC ENGINEERS
Having design experience in one or more of the following:

General radar and computing systems
Servo mechanisms *Indicator systems*
Radar transmitter modulators and high voltage power supply systems
Wide band IF amplifiers and receivers
General pulse circuits

MICRO-WAVE ENGINEERS...Having design experience in transmission line components, micro-wave antennas and feeds.

PHYSICISTS...Having practical experience in analysis of radar and radar control systems.

DEGREE NOT ESSENTIAL. Applicants must be capable of assuming responsibility for design engineering.

ADEQUATE MOVING ALLOWANCE...for family and furniture. Your family will enjoy living in Southern California. Wonderful climate the year around. Adequate housing, unexcelled educational facilities.

Interviews can be arranged at convenient cities

WRITE OR CONTACT MR. HOMER TASKER,

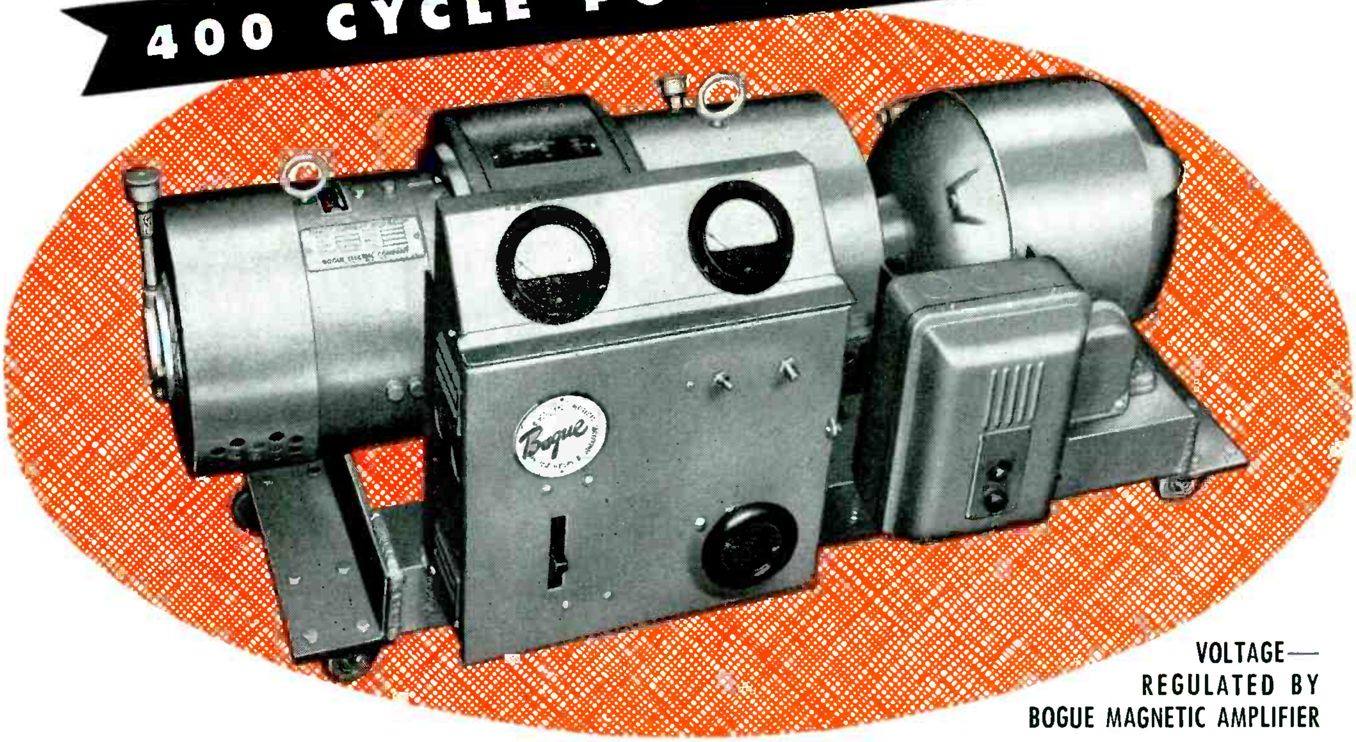
Chief Engineer, Gilfillan Brothers, Dept. E
1815 Venice Blvd., Los Angeles 6, Calif.

ALL REPLIES STRICTLY CONFIDENTIAL

GCA *Gilfillan*
LOS ANGELES, CALIFORNIA

The NEW Bogue Portable

400 CYCLE POWER SUPPLY



VOLTAGE—
REGULATED BY
BOGUE MAGNETIC AMPLIFIER

This compact completely self-contained motor generator set operates from commercial 60 cycle power to furnish up to 5 KW of 400 cycle power for use in testing 400 cycle radio and aircraft equipment as well as operation of high speed machine tools, etc. The unit is complete with starting equipment and automatic voltage regulator to maintain the output voltage constant over varying loads. It can be supplied with either single phase or three phase 60 cycle motor and either single or three phase 400 cycle generator. The output wave form is extremely pure, the total harmonic content of the three phase design being approximately 1%. In order to move the unit from one location to another casters are supplied as standard equipment.

HOW BOGUE SERVES INDUSTRY

Bogue Electric specializes in producing electrical equipment required for special applications such as pure 400 cycle power . . . less than 1% harmonics; low ripple dc generators for precision testing of electronic equipment; magnetic amplifiers for reliable, constant speed and voltage control. Bogue electronic engineers have solved hundreds of confidential problems. They are always available to talk over your specialized control or power problems, too!

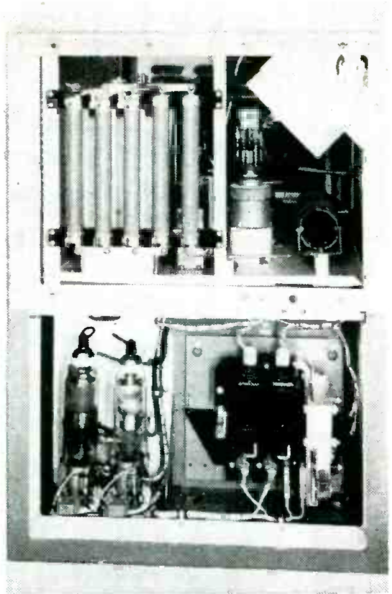
BOGUE ELECTRIC MANUFACTURING COMPANY

Where Precision Coordinated Design...Counts!

50 IOWA AVENUE • PATERSON 3, NEW JERSEY

MAGNETIC AMPLIFIERS • MAGNETIC CONTROLLERS • AC & DC MOTORS
AC & DC GENERATORS • VOLTAGE & SPEED REGULATORS • SWITCHBOARDS

SINCE 1892 SPECIALISTS • Bogue • IN FINE MOTORS & GENERATORS



Inside rear view of the induction heating generator

power capability usually permits the tube to supply the required power output plus circuit losses under widely varying load conditions without exceeding tube ratings, particularly plate input and plate dissipation.

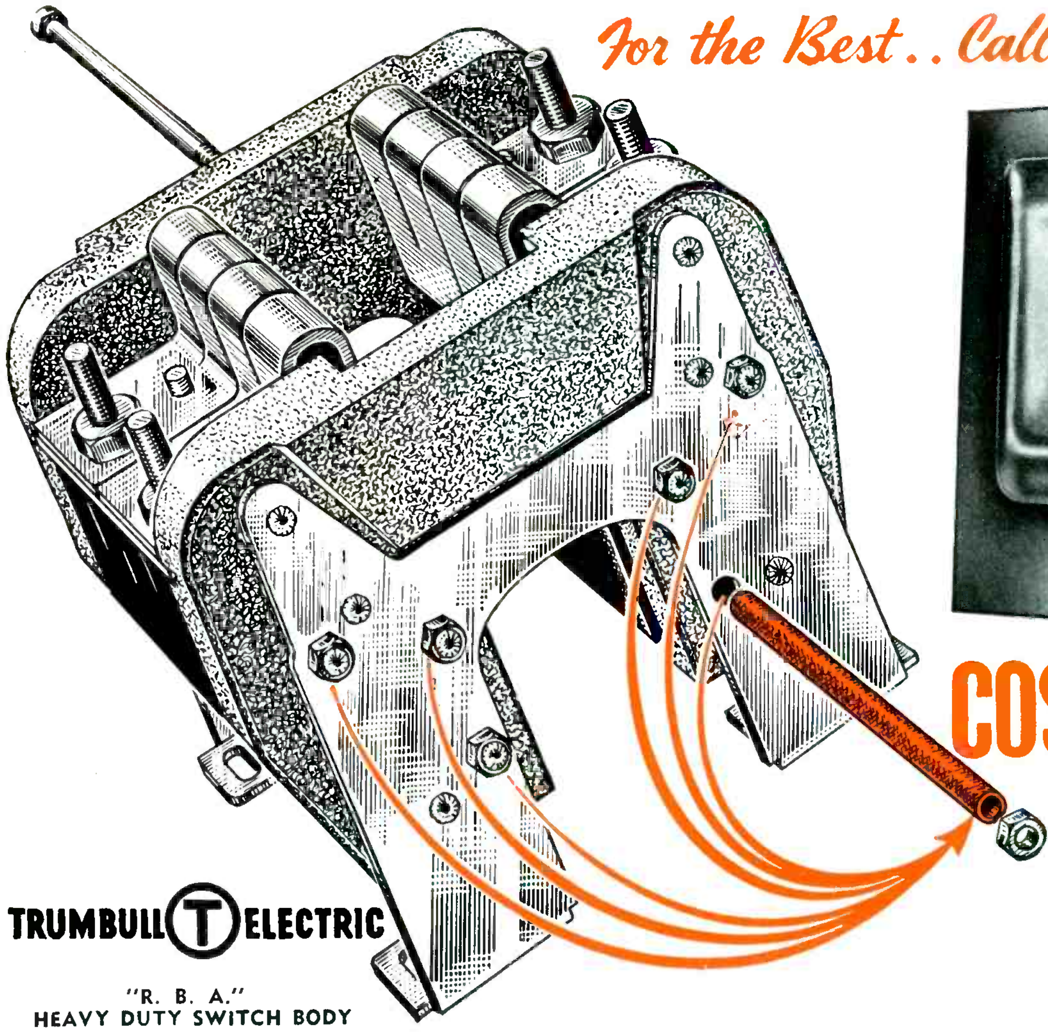
The tube should be capable of a plate efficiency of 65 percent or more. This requirement indicates the minimum plate efficiency to be expected when the set is delivering rated output. From the first two requirements the tube used should be capable of a minimum power input of 215 percent of nominal rated set output.

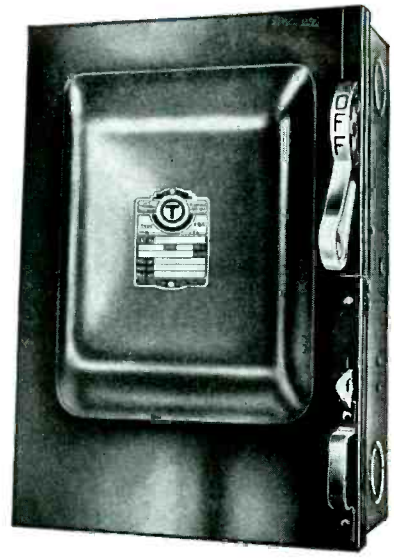
Tubes used should be capable of delivering the desired set output at not less than 65 percent efficiency and at values of d-c grid current and voltage not in excess of one-third the maximum ratings. All other conditions to be within ratings. This requirement will usually permit the equipment to operate within maximum tube ratings when operated partially or wholly without load as may happen in practice.

A water-cooled tube should be capable of operating in an ambient air temperature up to 70 C. The temperature within the tube enclosure is usually above room temperature, therefore this requirement reduces the possibility of tube failure from overheating due to a high ambient temperature.

When water cooled, the cooling

For the Best.. Call Cleveland





COSMALITE

Phenolic Tubing is used in heavy duty switches.

TRUMBULL ELECTRIC

"R. B. A."
HEAVY DUTY SWITCH BODY

6 COSMALITE TUBES INSULATE BODY BOLTS

In their popular "R.B.A." Heavy Duty Industrial Switch The Trumbull Electrical Manufacturing Co. uses Cosmalite Tubing to insulate its body bolts.

The combined electrical and physical properties of CLEVELITE* and COSMALITE* are essential wherever strength, low moisture absorption, high dielectric strength, low loss and good machineability are of prime importance!

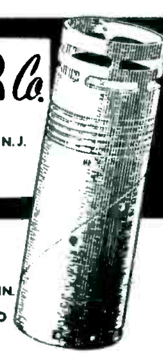
DEPENDABLE - ECONOMICAL - LONG LASTING . . . Why Pay More? Made in diameters, wall thicknesses and lengths to meet special or new adaptations . . . in various grades to meet the most exacting needs. Your inquiry will receive immediate attention.

* Trade Marks

The CLEVELAND CONTAINER *Co.*

6201 BARBERTON AVE. CLEVELAND 2, OHIO

PLANTS AND SALES OFFICES at Plymouth, Wisc., Chicago, Detroit, Ogdensburg, N.Y., Jamesburg, N.J.
ABRASIVE DIVISION at Cleveland, Ohio
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario



REPRESENTATIVES

NEW YORK AREA R. T. MURRAY, 604 CENTRAL AVE., EAST ORANGE, N. J.
NEW ENGLAND R. S. PETTIGREW & CO., 10 N. MAIN ST., WEST HARTFORD, CONN.
CHICAGO AREA PLASTIC TUBING SALES, 5215 N. RAVENSWOOD AVE., CHICAGO

Standard RADIO INTERFERENCE and FIELD INTENSITY Measuring Equipment

Complete Frequency Coverage - 14kc to 1000mc!

VLF!

NM - 10A

14kc to 250kc

Commercial Equivalent of AN/URM-6.
Very low frequencies.

HF!

NM - 20A 150kc to 25mc

Commercial Equivalent of AN/PRM-1. Self-contained batteries. A.C. supply optional. Includes standard broadcast band, radio range, WWV, and communications frequencies.

VHF!

NMA - 5

15mc to 400mc

Commercial Equivalent of TS-587/U.
Frequency range includes FM and TV Bands.

UHF!

375mc to 1000mc NM - 50A

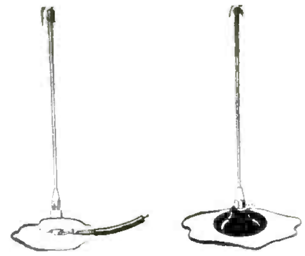
Commercial Equivalent of AN/URM-17.
Frequency range includes Citizens Band and UHF color TV Band.

These instruments comply with test equipment requirements of such radio interference specifications as JAN-I-225, ASA C63.2, 16E4(SHIPS), AN-I-24a, AN-I-42, AN-I-27a, AN-I-40 and others.

STODDART AIRCRAFT RADIO CO.
6644-A SANTA MONICA BLVD., HOLLYWOOD 38, CALIFORNIA
Hillside 9294

VHF Antennas for Civil Defense

For 100 to 250 Megacycles



With amateur mobile in CD limited to 28 mc. upwards, local emergency coordinators now plan extensive use of the 6, 2 and 1¼ meter bands. Mobile operations at these frequencies are working out surprisingly well, too, with excellent coverage using relatively low mobile power. Recognizing the need for inexpensive VHF antennas, Premax offers two new cartop designs. One requires only a single ½" hole for mounting and the other utilizes a suction cup mounting, requiring no holes, yet being always available for service.

See your distributor or write for Catalog

PREMAX PRODUCTS
DIVISION CHISHOLM-RYDER CO., INC.

5101 Highland Ave. Niagara Falls, N. Y.

Linde Trade-Mark

M. S. C.
(Mass Spectrometer Checked)

RARE GASES

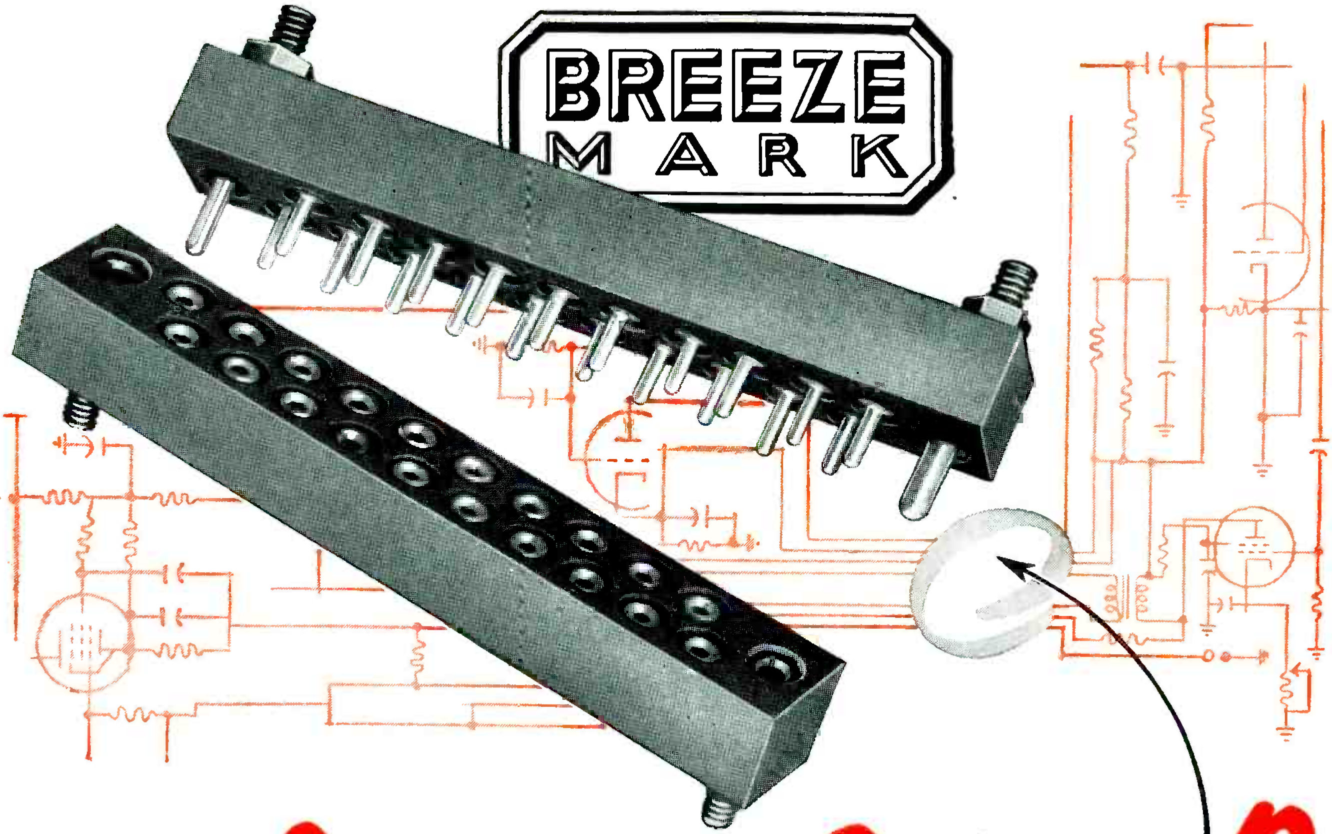
HELIUM · NEON
ARGON · KRYPTON · XENON

LINDE Rare Gases are mass spectrometer checked to assure you gases of *known* purity and uniformly high quality. Available in commercial-size cylinders and glass bulbs.

LINDE, the world's largest producer of gases derived from the atmosphere, can meet your individual needs of purity...volume...mixture...containers...

LINDE AIR PRODUCTS COMPANY
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION
30 East 42nd Street UCC New York 17, N. Y.
In Canada:
Dominion Oxygen Company, Limited, Toronto

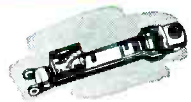
The term "Linde" is a registered trade-mark of Union Carbide and Carbon Corporation



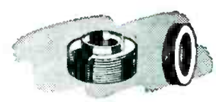
Connector Problem?

...We'll take it from HERE

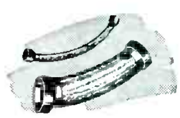
Good ideas for electronic circuitry sometimes run afoul of connector problems. Maybe existing connector units won't hold air pressure gradients, won't stand the heat, aren't rugged enough for the job. Or maybe it's a question of altitude, or under-water application. But if you can sketch the circuit, we'll take it from there. We've engineered so many special connectors, solved so many "impossible" problems, that whatever the requirements are, we can usually provide the answer.



Lightweight actuators for any requirement.



Job engineered, welded-diaphragm bellows.



Flexible conduit and ignition assemblies.

Aero-Seal vibration-proof hose clamps.

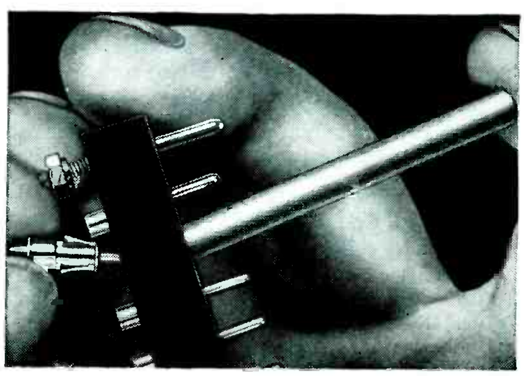
WRITE TODAY for specific information, or send us your sketches. We'll forward recommendations promptly.

BREEZE

Special CONNECTORS

BREEZE CORPORATIONS, INC.

41 South Sixth Street Newark, New Jersey



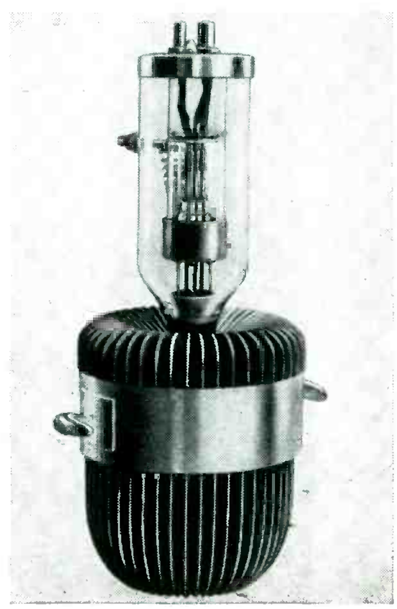
Removable pins in Breeze connectors speed soldering, save time, trouble. Pins snap back into block.

water rate required should be as low as possible for a given dissipation rating. This requirement is an economic advantage and also helps insure adequate cooling at low water pressures. The plate dissipation required should be attainable at water pressures considerably below those normally encountered.

Forced-air-cooled tubes should be capable of operating at full input power with incoming air at a temperature as high as 45 C and an outgoing air temperature not in excess of 100 C except where the latter temperature could not endanger other components. High room temperatures occasionally encountered make the 45 C temperature highly desirable. An outgoing temperature in excess of 100 C may overheat other components if discharged within the equipment. In some cases it may be desirable to discharge the heated air outside the equipment.

Tubes used for induction and dielectric heating should have a filament power requirement as low as possible consistent with a filament life expectancy of at least 5,000 hours for tubes used in equipment having output ratings of 5 kilowatts or more.

The expected filament life of pure tungsten filaments may be calculated with a fair accuracy. The most economical use of tubes in dollars per hour of life usually oc-



Power amplifier tube used in a-m broadcast transmitter

MORE FOR YOUR MONEY

WITH BENDIX SCINFLEX

ELECTRICAL CONNECTORS

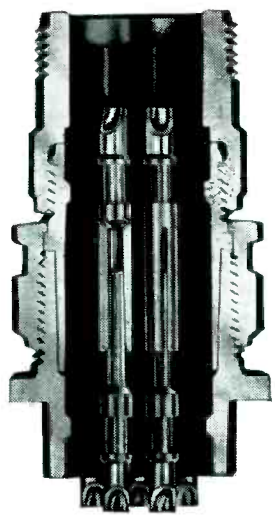
MOISTURE PROOF

PLUS

- Pressure Tight
- Radio Quiet
- Single-piece Inserts
- Vibration-proof
- Light Weight
- High Insulation Resistance
- Easy Assembly and Disassembly
- Fewer Parts than any other Connector
- No additional solder required

The importance of a completely moisture-proof electrical connector can scarcely be exaggerated. But in addition to this important characteristic, there are a host of other exclusive features that make Bendix Scinflex connectors outstanding for dependable performance. For example, the use of Scinflex dielectric material, an exclusive Bendix development of outstanding stability, increases resistance to flash over and creepage. In temperature extremes, from −67°F. to +275°F. performance is remarkable. Dielectric strength is never less than 300 volts per mil. If you want more for your money in electrical connectors, be sure to specify Bendix Scinflex. Our sales department will be glad to furnish complete information on request.

PLUS



SHELL
High strength aluminum alloy . . . High resistance to corrosion . . . with surface finish.

CONTACTS
High current capacity . . . Low voltage drop.

SCINFLEX ONE-PIECE INSERT
High dielectric strength . . . High insulation resistance.

Bendix

SCINTILLA MAGNETO DIVISION of

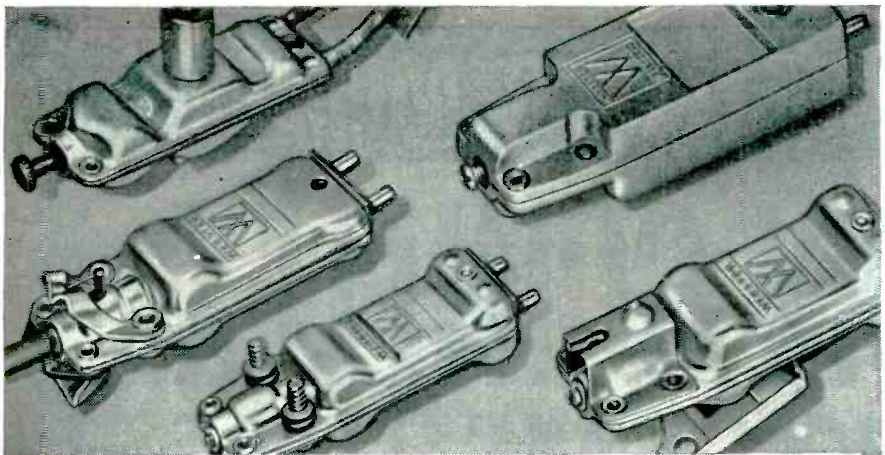
SIDNEY, NEW YORK

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y

BENDIX AVIATION CORPORATION

FACTORY BRANCH OFFICES:

117 E. Providencia Avenue, Burbank, California • Stephenson Building, 6560 Cass Avenue, Detroit 2, Michigan
Brouwer Building, 176 W. Wisconsin Avenue, Milwaukee, Wisconsin • 582 Market Street, San Francisco 4, California



WEBSTER ELECTRIC one of the original manufacturers of crystal cartridges

FOR OVER 20 YEARS

a complete line of cartridges

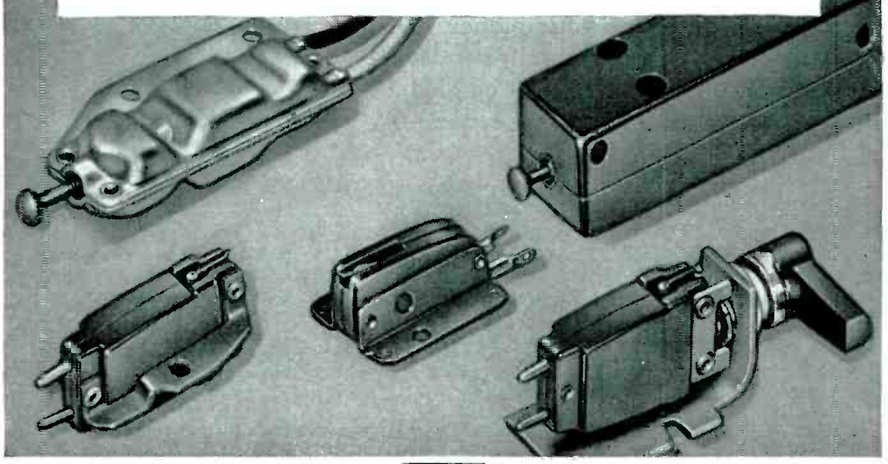
Engineered to meet your requirements

Webster Electric has been making cartridges for years and years . . . starting way back when cartridges were nearly as big as baseballs. The line of cartridges has constantly changed and improved to meet current requirements. Each year has brought improvements until cartridges are now available in thumb-nail size and versatile enough to meet the requirements of 78, 33⅓ and 45 RPM.

Webster Electric has the experienced engineers, manufacturing know-how and long-range experience to make cartridges to meet all of the industry's requirements.

When you need a new cartridge submit your problem to Webster Electric. When your record players or changers are equipped with Webster Electric cartridges, you can be assured of the best in dependable performance.

Webster Electric Company, Racine, Wis., Established 1909

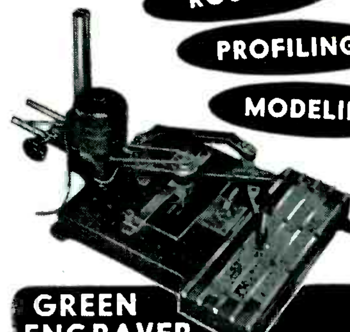


WEBSTER ELECTRIC

RACINE ◆ WISCONSIN

"Where Quality is a Responsibility and Fair Dealing an Obligation"

ENGRAVING
ROUTING
PROFILING
MODELING



GREEN ENGRAVER

Proved Profitable —

Machine Tool, Radio, Electrical and Instrument Mfrs., Sales Promotion and Advertising.

Fast, rugged, convenient—and *inexpensive*. The Green Engraver is tops for low-cost performance —zips out *precision* work on metal, plastics or wood . . . cuts four lines of letters from 3/64" to 1" on curved or flat surfaces . . . operates by tracing . . . makes anyone an expert . . . engraves panels, name plates, scales, dials, molds, lenses and instruments. (Also widely used for routing, profiling and three dimensional modeling.) Electric etching attachment available.

Special attachments and engineering service available for production work.

FREE—Fact-packed folder. Send for yours, today

GREEN INSTRUMENT COMPANY

GREEN

363 PUTNAM AVENUE
CAMBRIDGE, MASS.

Runzel

WIRE, CORD *and* CABLE

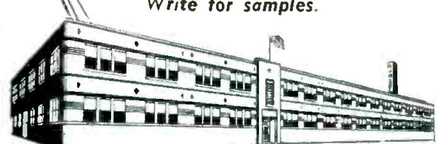
SOLVE YOUR WIRING PROBLEMS

In almost endless variety of colors, sizes and specifications to your order, Runzel products will assist you in your wiring problems.

Shielded wire and cords . . . popular hook-up and lead-in wire . . . speaker cords and all types of insulated wire products.

Geared for fast production . . . Centrally located . . . our facilities for service are unexcelled.

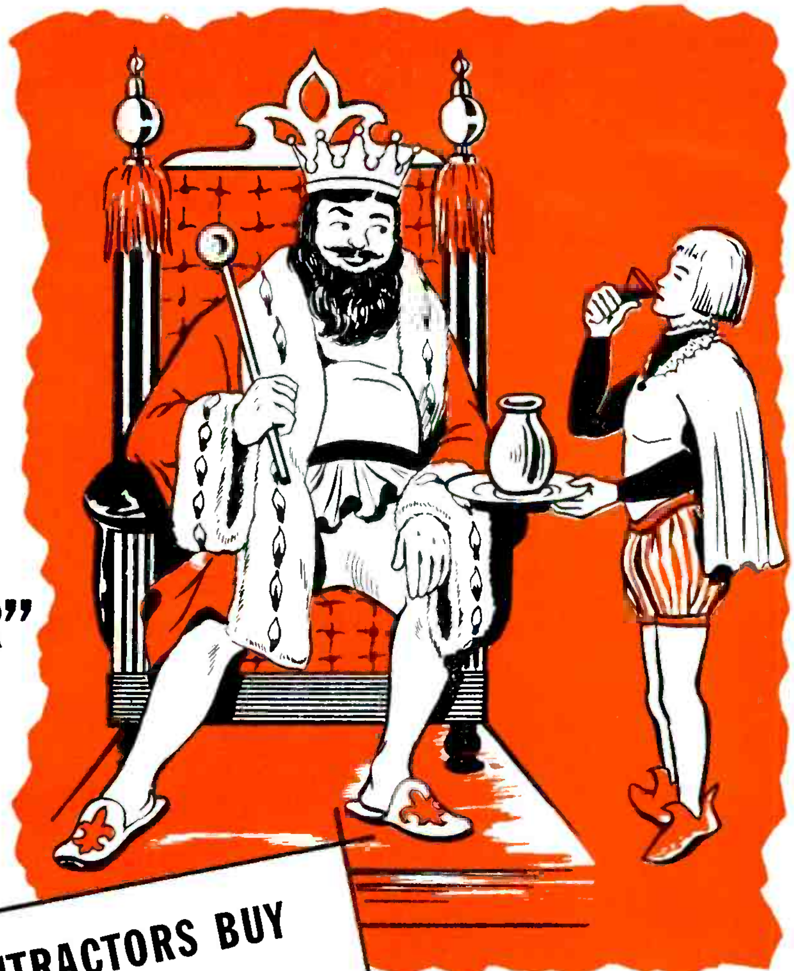
Write for samples.



RUNZEL CORD & WIRE CO.
4723 Montrose Avenue
Chicago 41, Illinois

FIT

FOR A KING *after* THE "ROYAL TASTER"

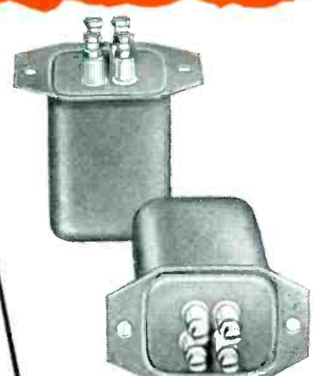


Prudently, kings of old employed the "taste-it-first" method to test the presence of lethal power in bulk food and drink. Wary but wise, you'd say...

NOW GOVERNMENT CONTRACTORS BUY *Transformers* ON A "PROVE-IT-FIRST" BASIS!

We are prepared to submit a production sample GRACOIL TRANSFORMER (hermetically sealed to JAN-T-27 or MIL-T-27 Government specifications or one of open type construction), if your equipment is to be used for awarded prime or sub-contract work. Put your production sample to *any* test. Then order production quantities with absolute confidence of physical and electrical correctness, uniformity and substantial savings on profit-tight contracts.

James M. Blacklidge
PRESIDENT



VERTICAL BLOCKING OSCILLATING TRANSFORMER HERMETICALLY SEALED BUILT TO MIL-T-27

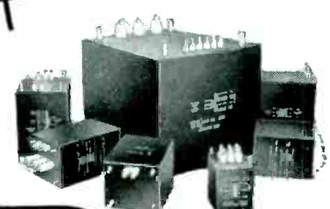


PLATE TRANSFORMER SHOWN (l to r) WITH POWER, FILAMENT, CHOKE, DRIVER, FILAMENT AND SMALLER PLATE TRANSFORMERS ALL BUILT TO MIL-T-27 SPECIFICATIONS. HERMETICALLY SEALED

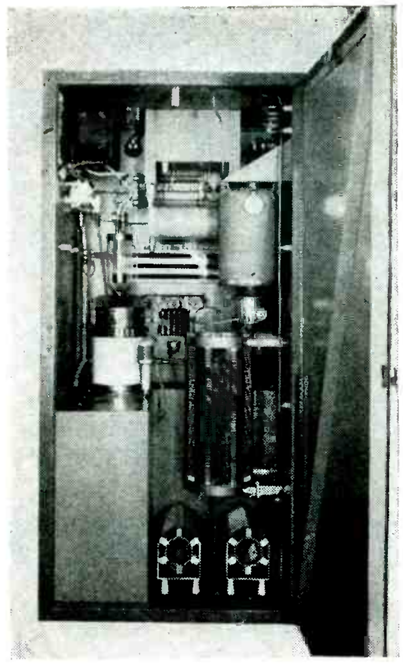
One good Turn—or a Million

FILAMENT AUDIO TRANSFORMERS
•
FILTER REACTORS
•
ISOLATION-STEP-UP STEP-DOWN TRANSFORMERS
•
WINDINGS

GRAMER
TRANSFORMER CORPORATION

2732-K N. PULASKI ROAD • CHICAGO 39, ILLINOIS

SEND YOUR B/P SPECIFICATIONS



Power amplifier cubicle of the a-m broadcast transmitter

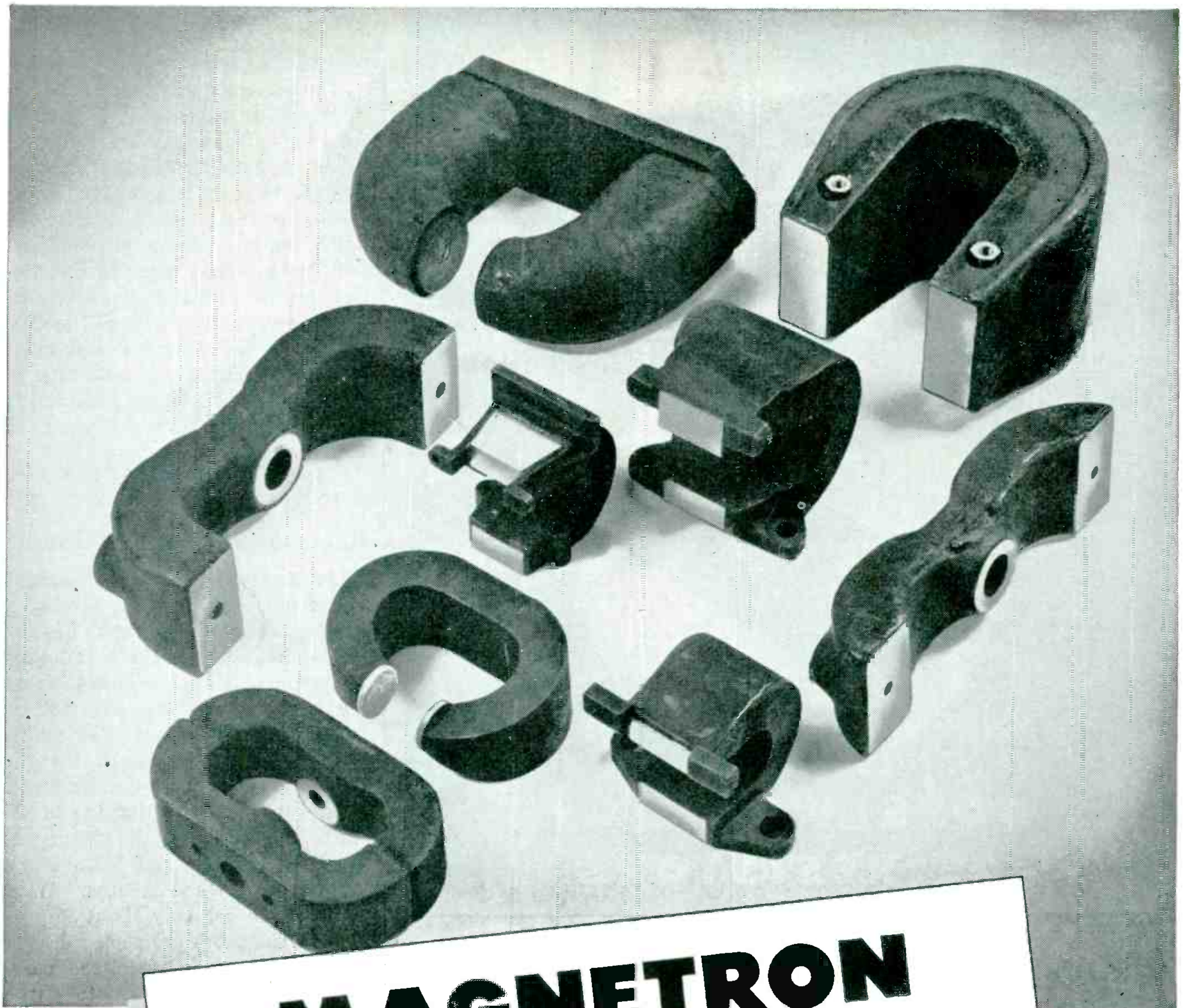
curs when the total cost of filament heating power used is somewhat greater than the cost of a new tube. The selection of 5,000 hours is an approximate minimum for total filament power cost as compared with tube cost and cost of interruption of service for tube replacement purposes.

The tube used should be capable of withstanding an internal flashover surge current for 1/6 second. In general, tube currents should not exceed 20 times the operating d-c plate current.

The tube used should be capable of withstanding 150 percent of maximum rated plate voltage when the control grid is biased to cut off.

The tube used should have sufficiently stable characteristics to maintain the operating plate current of an individual tube within 10 percent of any given set of operating conditions within the rating of the tube.

The most common type of tube operation in r-f heaters is as an unmodulated class-C oscillator. Some tubes have been operated as self-rectifying oscillators with 60 cycles used as a plate supply. However, one survey made of this type of operation indicates that it costs about 40 percent more per kilowatt hour of r-f power than operation



with a d-c power supply.

There is another phase in the application of tubes to r-f heating which is being studied. Where tubes are not operated continuously and the time on is short, it is possible to increase tube ratings to the point where average dissipations will be no greater than for continuous service. This requires a maximum limit on the length of time for averaging. Considerable work must be done on any given tube type to determine accurately its maximum safe possibilities in this type of application.

Refrigeration for Amplifiers

REFRIGERATION of the main amplifier room of Lockheed Aircraft's large public address system has extended life of both tubes and electrolytic capacitors. Where temperatures formerly went up to 130 F, two refrigerating units now maintain the air at about 70 F.

Refrigeration was decided upon when figures showed that the 68 50-watt amplifiers in the room required new 6L6's and 5Z3's every six weeks to three months. With the room cooled, only about 25 percent of the tubes are replaced each year. Electrolytic capacitors had a life expectancy of one to three months before refrigeration and now last two years on the average.

Two small refrigeration units originally used for food preserva-

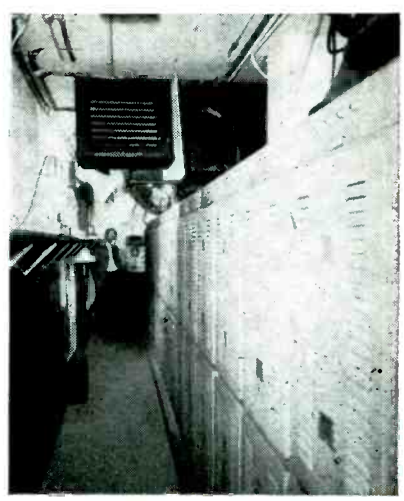
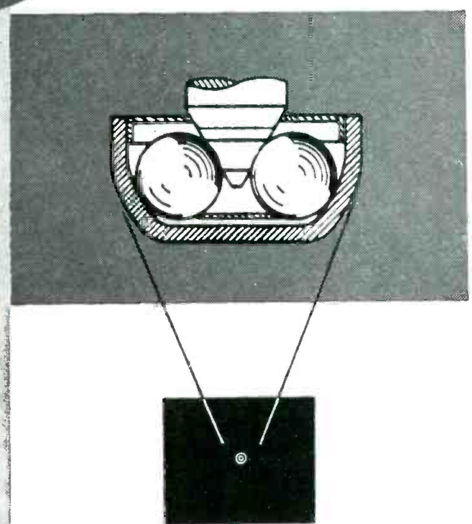


FIG. 1—Cooling radiators used to refrigerate the main amplifier room of a public address system are shown suspended from the ceiling

MINIATURE PIVOT BEARINGS

SIMPLE DESIGN
INEXPENSIVE
AVAILABLE

RMB



Smallest of 98 different types and sizes—shown to scale.

15 YEARS' DEPENDABLE PERFORMANCE

SOME TYPICAL APPLICATIONS

- Small Electric Motors
- Aircraft Instruments
- Scales & Weighing Devices
- Thickness Gauges
- Rollers
- Flow Controllers
- Pressure Gauges
- Gyros
- Vibration Pickups
- Indicating Thermometers & Similar Instruments
- Pilot Trainers

Write today for Catalog No. 7. Over 250 types and sizes of miniature and instrument ball bearings.

LANDIS & GYR, INCORPORATED

45 West 45th St.
New York 19, N. Y.

Steatite

for ELECTRONIC Applications

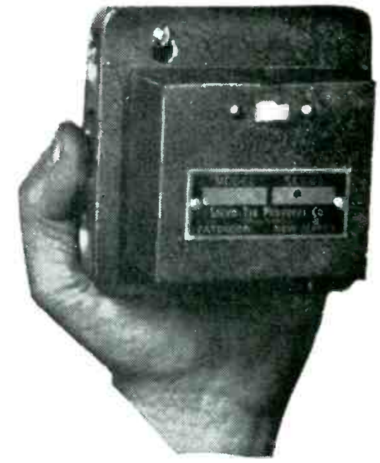
You can specify LOUTHAN low-loss Steatite products with complete confidence in the high quality and dimensional accuracy of the parts. Made to exacting standards, Louthan Steatite insulations have the mechanical and electrical characteristics needed for electronics applications and other electrical service. They are formed to meet your needs and made to close tolerances. Surfaces are smooth, hard, clean and non-absorbent.

Write for Catalog 49-E, describing Louthan Insulations.

THE LOUTHAN MANUFACTURING COMPANY
A Subsidiary of Harbison-Walker Refractories Co.
EAST LIVERPOOL, OHIO

Representatives: H. B. Zeiger, New York 17, N. Y. Glenn Garner Company, Chicago 6, Ill.

ULTRA-SENSITIVE ELECTRONIC RELAY



IMMEDIATE DELIVERY

FEATURES

SENSITIVE — Relay action initiated by external contact as high as ONE HALF MEGOHM with current as low as 1/10000 ampere.

LOW COST — Electronic sensitivity and features at a cost comparable to ordinary relays.

SMALL SIZE — Mounts on a standard 4 inch electrical connector box.

DEPENDABLE — Simplified circuit plus silver relay contacts assures long service life.

ECONOMICAL — No tube filaments to consume power during "OFF" cycle.

VERSATILE — High contact pressure on silver contacts allows conservative rating of four (4) amperes, with a choice of either opening or closing a circuit, or to simultaneously open one and close another.

AUTOMATIC HOLD CIRCUIT — Connecting terminals provide a choice of conventional relay action, or allow a momentary contact to energize relay and cause it to automatically remain energized until manually reset by "Reset" switch.

APPLICATIONS

- LIQUID LEVEL CONTROLS
- SAFETY ALARMS
- STOP MOTIONS
- DROP WIRE DETECTION

Servo-Tek products co
4 Godwin Ave. Paterson, N. J.

tion operate two cooling radiators using fan circulation. The radiators are mounted near the ceiling above the racks containing the amplifiers as shown in Fig. 1. Each 50-watt amplifier contains two 5Z3 rectifiers and four 6L6 beam-power output tubes.

The entire public address system includes more than 1,000 speakers and operates continuously.

Ultrasonic Soldering Bath

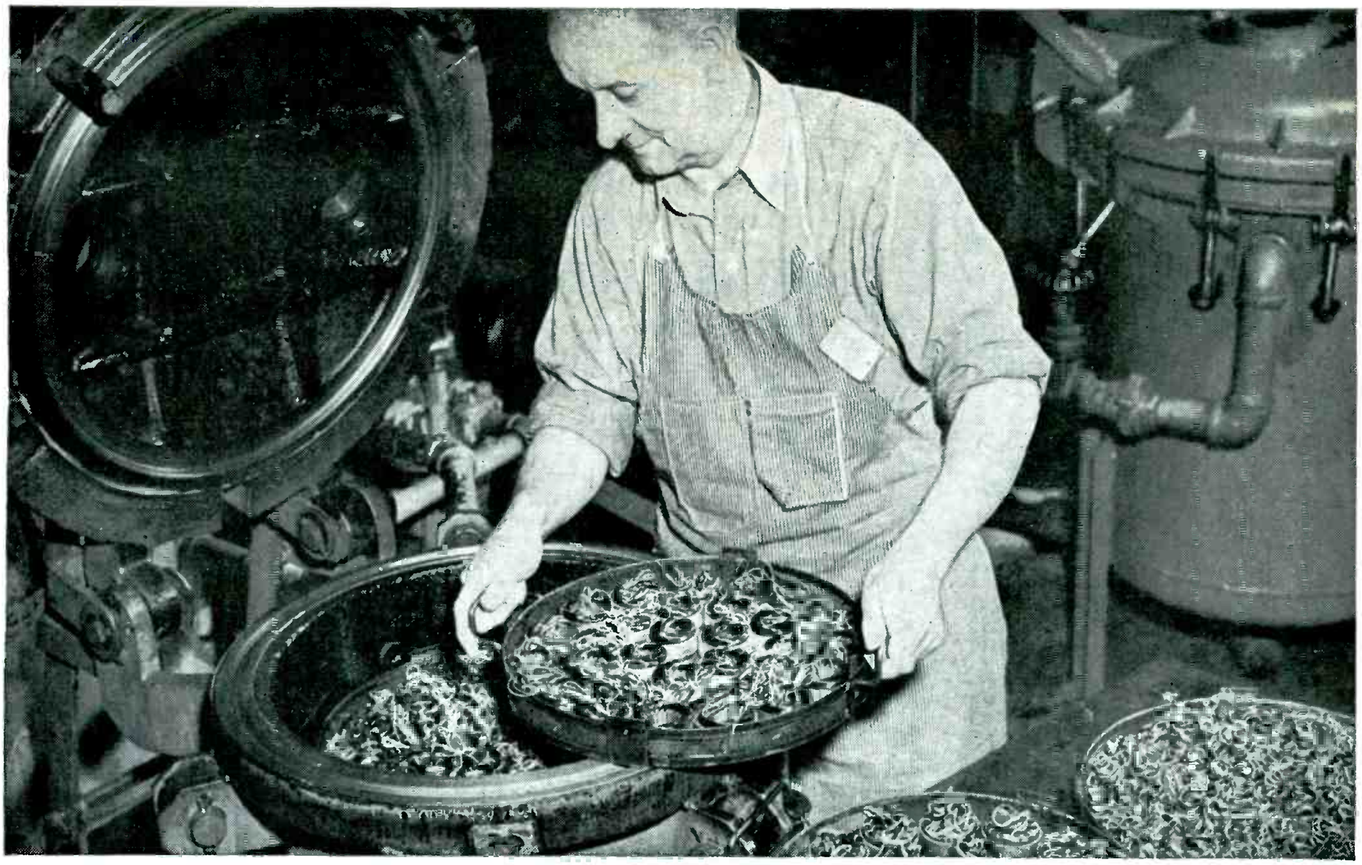
RAPID TINNING of small aluminum and aluminum-alloy articles is made possible by an ultrasonic soldering bath recently introduced by Mullard Limited of London, England. The unit has been developed specifically for the soldering of small and complex-shaped parts. Included in the category of work are such items as foils, wires and tubes.

The process is expected to find extensive use in the making of connections for capacitor foils, in the tinning of aluminum galvanometer suspensions and in the soldering of small tubes and sections to anchorings or mountings.

The new device consists of a small soldering bath $\frac{7}{8}$-in. in diameter and $\frac{3}{8}$-in. deep. The bath is heated by means of a conventional resistance winding. The molten solder in the bath is agitated ultrasonically by means of a magnetostriction transducer composed of a stack of iron-alloy laminations. A control switch on the front of the unit enables the ultrasonic energy to be applied at will.

To obtain the maximum efficiency of operation, it is necessary to excite the system at its natural resonant frequency. In the case of the transducer used, the frequency varies between about 19.5 kc and 21 kc according to the temperature and the intensity of the magnetic field.

The rapid vibration of the bath, resulting from the magnetostriction effect produced in the transducer is used to break up the highly refractory oxide film which normally forms easily on such metals as aluminum. Formerly, one of the few effective ways of removing the films was through the use of fluxes which, on the application of heat or special liquids, release a nascent element to stimulate a violent reac-



tion with the oxide. This is an unsatisfactory method as the reaction is only of short duration and the oxide film reforms immediately after the reaction ceases. The difficulty is overcome with the ultrasonic soldering iron and bath and positive and uniform joints can be obtained easily.

The bath is allowed to heat to its usual operating temperature. The transducer is then energized by closing the switch on the front of the unit. After this, articles can be tinned simply by immersing them into the molten solder contained in the bath. An important advantage of this method is that no flux is required. Moreover, soft solder may be employed. To avoid electrolytic action when soldering aluminum and its alloys, there may be advantages in using a tin-zinc instead of the usual solder with a tin-lead base.

The ultrasonic power necessary to drive the transducer is supplied by an electronic amplifier comprising the power-supply unit. This unit is housed in a metal case with handles and may easily be carried around a factory.

Amplifier Operation

When the amplifier is switched on, a surge of current is applied to the main excitation coil of the transducer. This gives rise to a change in the magnetic field in the magnetostrictive element and therefore in the length of the transducer. The change in length induces a voltage in the pickup coil which is fed back to the amplifier enabling oscillations to be sustained at the natural frequency of the magnetostrictive element, irrespective of any temperature change which may occur.

Use of high-impedance coils eliminates the necessity of using transformers for coupling. This procedure simplifies the amplifier circuit and reduces weight.

Intrusion Alarm System

An intrusion alarm system consisting basically of a transmitter, antenna system, receiver and discriminator has been developed by John E. Tillman while employed in yokes

torroids

shield cans

loop antennas

oscillator coils

i. f. transformers

metal frame padder condensers

magnet and litzendraht textile served wire

compression type mica trimmers

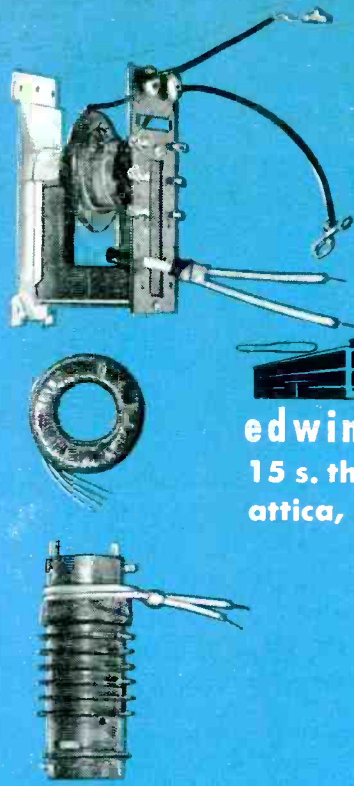
dual compression trimmers

output transformers

antenna coils

assemblies

rf tuners

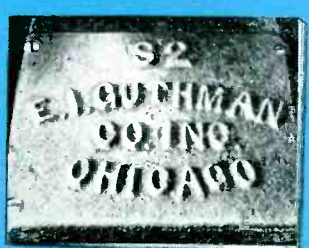


edwin i. guthman & co., inc.
15 s. throop st. chicago . . CH 3-1600
attica, indiana .

preserving Guthman's fine product design....

Quality control by experts

For the outstanding success of finished electronic components, Guthman relies on the constant watchfulness of such long-experienced quality control engineers as Ken Briggs, chief of Quality Control, with fifteen years electronic experience at Western Electric and other major electronic companies. It is he and his staff who bring intact—through mass production—the refinements of laboratory design so carefully developed by our research engineers . . . needless to say, these experts answer only to top management! Such specialized quality control —developed over twenty years as the world's largest maker of coils and basic electronic components—is your assurance of finished products that achieve the ultimate in laboratory specifications. We heartily encourage you to consider using Guthman built parts in your next product design . . . and Guthman engineers will design components especially for you.



Write today to Dept G. for a free descriptive brochure.

BURTON BROWNE ADVERTISING

FOR YOUR PANEL

DIALCO

A NOVEL and UNIQUE CIRCUIT INDICATOR

DESIGNED FOR NE-51 NEON LAMP

For 110 or 220 volt circuits

The required resistor is
an integral part of this assembly
—"built-in."

RUGGED • DEPENDABLE
LOW IN COST

UL

PATENTED: No. 2,421,321
Cat. No. 521308-997

WILL *YOU* TRY A SAMPLE?

Write on your company letterhead. We will act at once.
No charge, of course.

SEND FOR THE 192 PAGE HANDBOOK OF PILOT LIGHTS

Among our *thousands* of *Pilot Light Assemblies* there is one which will fit *your special* conditions. Many are especially made and approved for *military* use. We pride ourselves on prompt deliveries—*any quantity*.

ASK FOR OUR APPLICATION ENGINEERING SERVICE

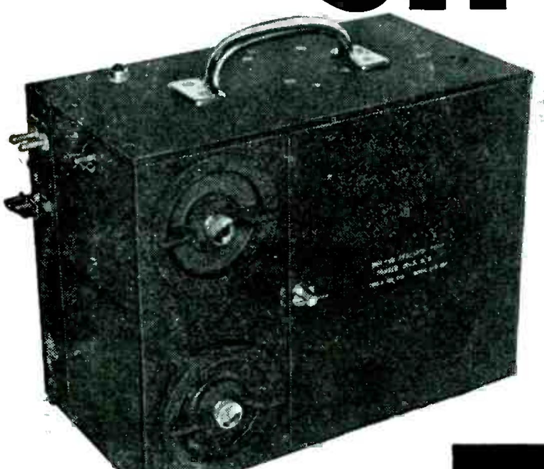
Foremost Manufacturer of Pilot Lights

The DIAL LIGHT COMPANY of AMERICA

900 BROADWAY, NEW YORK 3, N. Y. SPRING 7-1300

FOR RECORDING

strains



- **Portable**
- **Compact (6 3/4" x 9 13/16" x 12 3/4")**
- **Light weight (33 lbs.)**
- **Easy loading**
- **2 to 12 channels**
- **Many other features found only in much larger recorders**

dependable instruments

Heiland
DENVER

Type A-500
12-channel

Oscillograph Recorder

• The Heiland 500, because of the extremely small size and light weight, is widely used in aircraft and guided missile testing and by industrial and general research laboratories. The use of highly sensitive Heiland galvanometers permits the measurement of strains without the use of amplifiers.

For further information write

HEILAND RESEARCH CORPORATION 130 East Fifth Street Denver, Colorado, USA

ELECTRONICS

Just Out—2nd Edition

1 Explains basic electronic principles together with their applications to many problems in electrical engineering and physics. Considers both vacuum and gas filled electronic devices, and discusses television pick-up devices. secondary emission multipliers. cold cathode gas triodes, vapor and fluorescent lighting and modern photocells. This edition includes new material on cathode-ray tubes, electron theory of matter, kinetic theory of gases, F-M cyclotron, betatron, klystron, etc., etc. By J. Millman and S. Seely, Dept. of Elec. Engin., School of Tech. The City College of New York. 598 pages, 392 illus., $7.25

THEORY AND DESIGN OF TELEVISION RECEIVERS

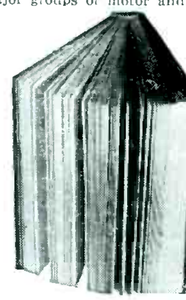
Just Published

2 Gives physical explanations and mathematical theory for the behavior of various television circuits from the engineering viewpoint, as well as discussing their practical design. Covers standards governing television transmission, the theory of circuits and systems, and various receiver servicing techniques. Presents numerous tables, graphs, and schematic drawings that save time and effort. By Sid Deutsch, Polytechnic Research and Development Co., New York. 536 pages, 386 illus., $6.50

ELECTRONIC MOTOR and WELDER CONTROLS

Just Published!

3 Here is practical help for those who must select, install, or service electronic controls for motors and resistance welders. The book explains circuit operation of tube-operated equipment found in the two major groups of motor and resistance-welding control. Each chapter starts with an introduction to a complete electronic equipment and then splits it into its component circuits, pinpointing each operation with simple descriptions and diagrams. By George M. Chute, 348 pages, 187 illus., $6.50



COMPONENTS HANDBOOK

4 This book codifies available information on the properties and characteristics of many classes of electronic components. Includes the results of original measurements made at the Radiation Laboratory on manufactured components. It covers FIXED COMPONENTS, such as wires, cables, resistors, inductors and transformers; VARIABLE COMPONENTS—linear and non-linear potentiometers, phase-shifting and sweep-scanning condensers; ELECTRO-MECHANICAL COMPONENTS—d-c selsyns, generator and line-voltage regulators, etc.; RECEIVING TUBES, including cathode ray tubes. By John F. Blackburn, Mass. Inst. of Tech. 626 pages, 700 illus., $8.00

SEE THEM 10 DAYS FREE

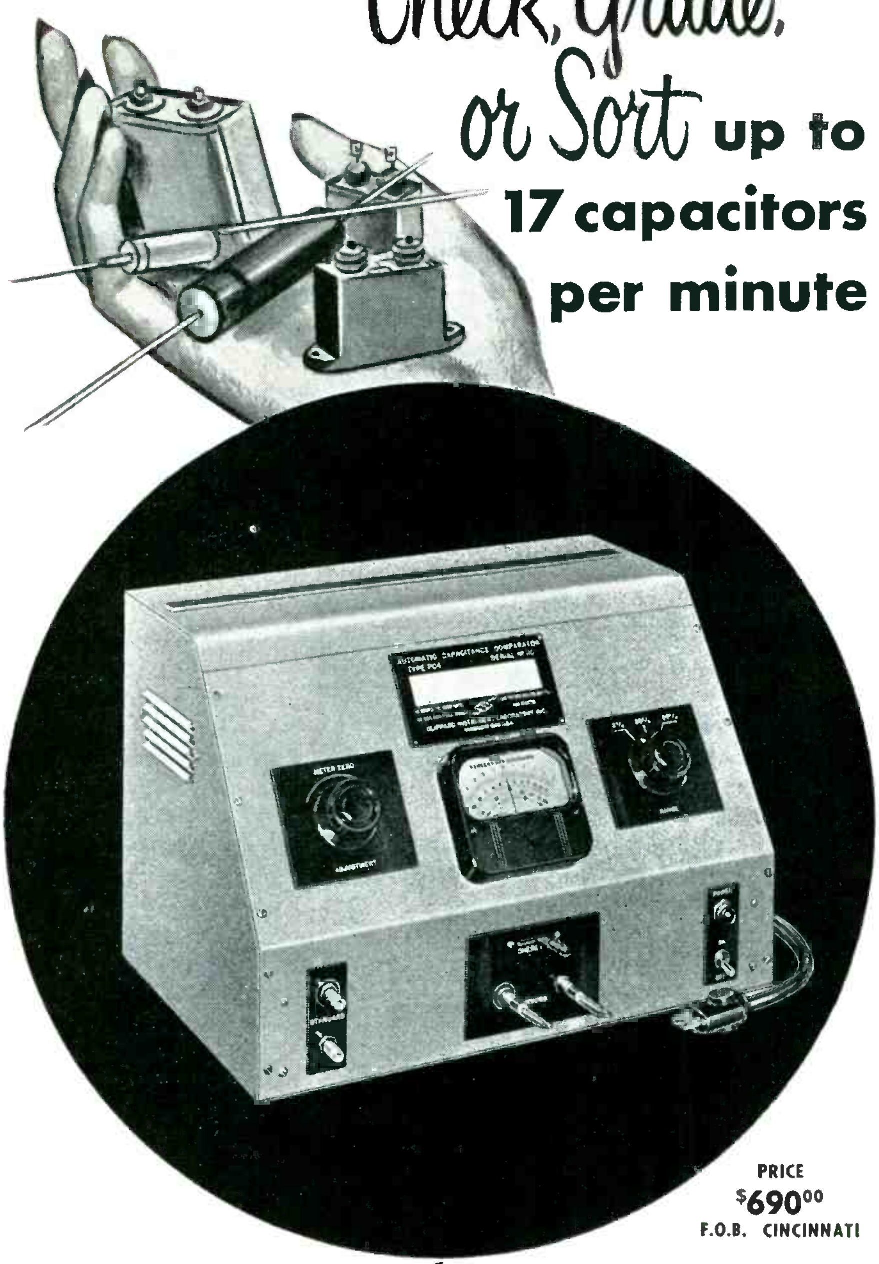
McGraw-Hill Book Co., Inc.
330 W. 42 St., NYC 18

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery and return unwanted book(s) postpaid.

- ☐ 1. Millman & Seely—ELECTRONICS $7.25
- ☐ 2. Deutsch—THEORY AND DESIGN OF TELEVISION RECEIVERS $6.50
- ☐ 3. Chute—ELECTRONIC MOTOR AND WELDER CONTROLS $6.50
- ☐ 4. Blackburn — COMPONENTS HANDBOOK $8.00

(print)
Name ....
Address ....
City .... Zone.... State ......
Company ....
Position L-9-51

This offer applies to U. S. only.



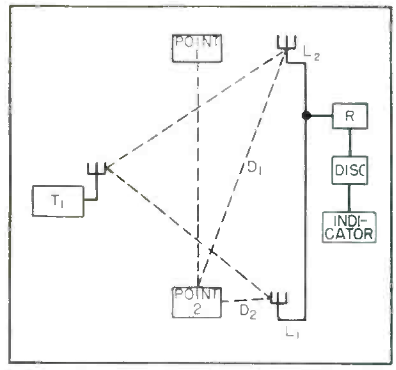


FIG. 1—Sketch illustrating the theory of operation pertaining to the intrusion-detection system

the atomic energy program.

The transmitter T_1, see Fig. 1, radiates amplitude-modulated r-f energy that is received by two antennas. Both of the antennas are terminated by transmission lines. The transmission lines differ electrically by a half wavelength at the operating frequency. The lines are designated L_1 and L_2 and are called the phasing network. The junction of the phasing network terminates at the receiver R.

By positioning the two antennas in reference to the transmitter, it is possible to phase the incoming r-f voltage to a very low level at the receiver. The r-f voltage, by traveling through the unequal lengths of transmission line, reaches the receiver 180 deg out of phase, with a result of essentially a zero voltage.

Upon intrusion, an object or body approaches the r-f field at point 1. R-f energy is refracted by the body to the two antennas. The distances D_1 and D_2 refer to the paths traveled by the refracted r-f energy. Since path D_1 is longer than path D_2, the refracted r-f energy will be in phase at the receiver for various positions of a body between points 1 and 2. Also, the r-f energy will be 180 deg out of phase for other positions of the body between points 1 and 2. The variation of signal voltage is detected by the bridge detector in the discriminator unit and operates the relays which energize the indicating system.

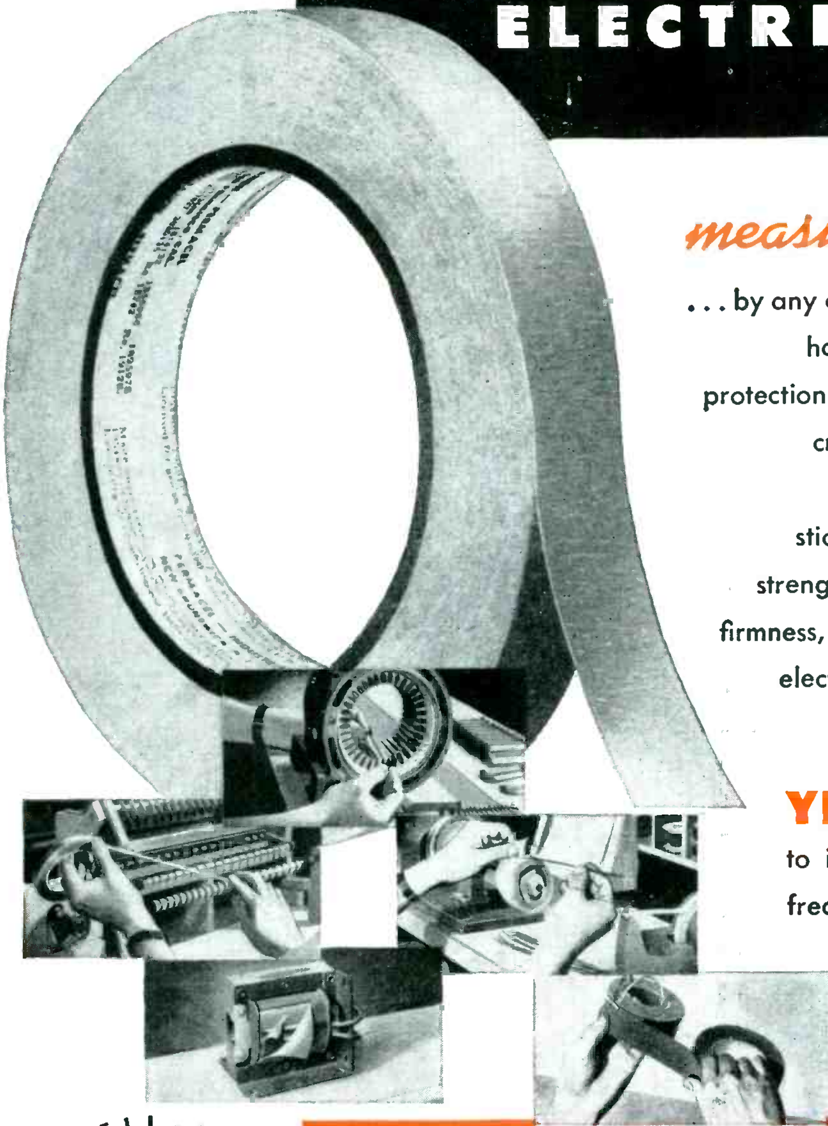
When the paths of two fields cross over as at points X in Fig. 2, it becomes necessary to operate transmitters T at different frequencies. The frequencies should be separated by a minimum of 15 *you can depend upon* **MITCHELL-RAND**

Electrical Insulation Headquarters

for...

permacel

ELECTRICAL TAPES



measure for measure

. . . by any comparison and yardstick, PERMACEL TAPES have the qualities and stamina for everlasting protection and positive cohesion. Made of cotton cloth, crepe or flatback paper, acetate film or cloth, PERMACEL TAPES have instant fingertip stickiness, elasticity, great dielectric and tensile strength, great tear resistance, maximum adhesive firmness, excellent varnish penetration . . . they resist electrolytic corrosion, oils, moisture and acids, etc.

YES... PERMACEL TAPES have what it takes to insulate, protect, tie and identify . . . and frequently at lower cost!

Write to MITCHELL-RAND for free samples and descriptive data.

MITCHELL-RAND · Electrical Insulation Headquarters · SINCE 1889

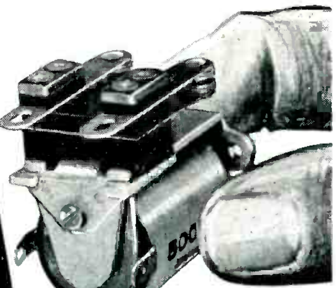
MITCHELL-RAND INSULATION CO., INC.

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

THIS COMPACT RELAY HANDLES

15 AMP. LOADS!



AMRECON
TYPE: CR
A.C. or D.C.

A QUALITY UNIT FOR DEPENDABLE SINGLE-THROW OPERATION IN SMALL SPACE

Here is real load-carrying capacity in small relay size! The reliable little AMRECON Type CR is ideal for loads up to 15 amperes in the single-pole, single-throw, double-break arrangement. Rated at 7.5 amperes, when used in a double-pole, single-throw arrangement. Positive-acting type; standard contacts supplied normally open. Coils are normally rated at 2.75 watts d.c., or 5.6 watts, 60-cycle a.c.—for voltages up to 230 volts d.c., or 440 volts a.c. Contact rating as described above, depending upon contact arrangement—at 115 volts a.c., or 32 volts d.c., non-inductive load. Size: 1-33/64" high, 1-3/32" wide, 1-25/32" long. Weight: 3 ounces.

WRITE FOR COMPLETE INFORMATION

American Relay & Controls, Inc.
4911 W. Flournoy St., Chicago 44, Ill.

ZOPHAR

WAXES
COMPOUNDS

Anti-Corona high heat-resistant compounds for Fly Back Transformers.

Waxes and compounds from 100° F to 285° F Melting Points for electrical, radio, television, and electronic components of all types.

Pioneers in fungus-resistant waxes.

Our efficient and experienced laboratory staff is at your service.

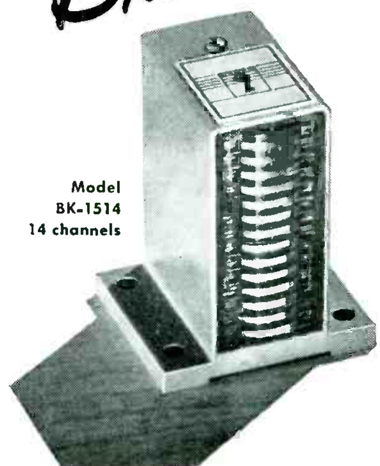
ZOPHAR MILLS 105 YEARS

ZOPHAR MILLS, INC.
112-130 26th Street,
Brooklyn 32, N. Y.

Announcing new

MULTICHANNEL RECORDING COMPONENTS

BY *Brush*



Model
BK-1514
14 channels

- All gaps in exact alignment
- Cast in a block of synthetic resin
- Magnetic shielding between channels
- Nonmicrophonic
- Adaptable to many widely different applications including sound and pulse recording
- Channels available up to 14

Brush also introduces:

Magnetic Recording Rubber (Synthetic)
Watch for new announcements.

For information about these and other Brush Magnetic Recording Components in stock or for special purposes, write

THE BRUSH DEVELOPMENT COMPANY
3405 PERKINS AVENUE
CLEVELAND 14, OHIO

"Our business is the future"

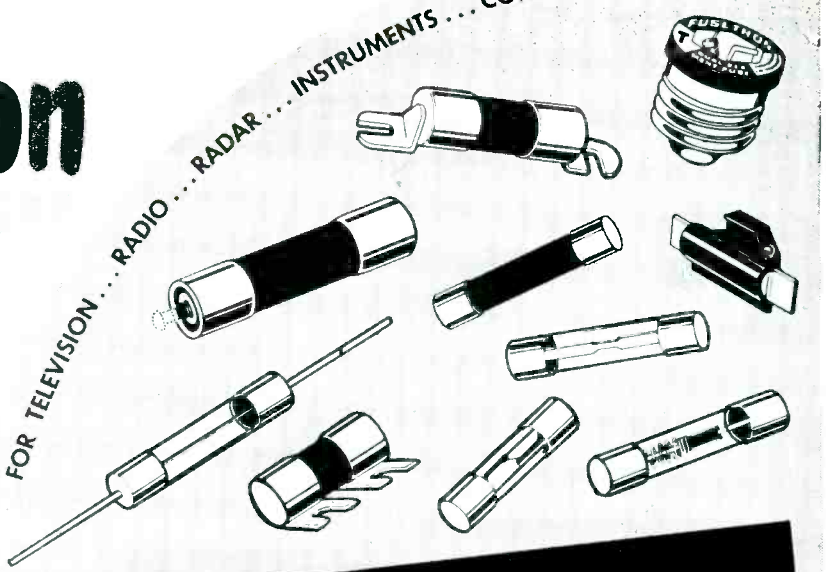
For Protection

of

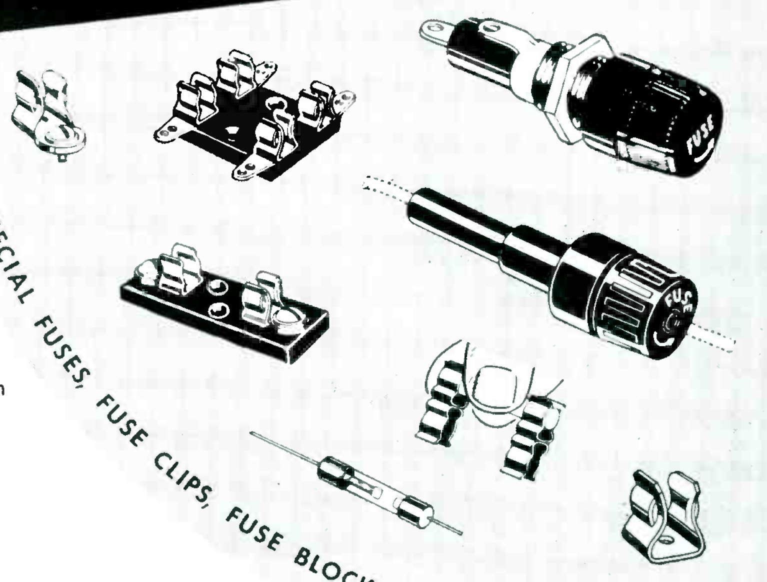
Electrical Circuits

and

Your Reputation



Every BUSS FUSE is Electronically Tested



To assure and maintain top quality and performance each individual BUSS fuse is tested in a highly sensitive electronic device. Fuses that are not correctly calibrated or not properly soldered or whose dimensions are not right are automatically rejected.

That is why a user can depend upon every BUSS fuse to operate properly under all service conditions—and the manufacturer or service man can rely on them to protect against complaints often caused by use of poor quality fuses.

When electrical protection is your problem turn first to BUSS

It is easy to select a fuse to do the job right for BUSS makes a complete line — and behind each BUSS fuse is the world's largest fuse research laboratory and fuse production capacity.

Fuses of Dual-Element (Fusetron slow blowing fuses), Renewable and One-Time types are available in many standard sizes — and many special designs are also obtainable to fit unusual protection needs.

If your problem is "New and Different" turn first to BUSS

In such cases we welcome your requests either to quote — or to help in selecting or designing the special type of fuse or fuse mounting best suited to your conditions.

Submit sketch or description, showing type of fuse contemplated, number of circuits, type terminals, etc. If your problem is still in the engineering state, give current, voltage, load characteristics, etc.

Our staff of fuse engineers is at your service.

BUSSMANN MFG. CO., UNIVERSITY AT JEFFERSON, ST. LOUIS 7, MO.
DIVISION MCGRAW ELECTRIC COMPANY

USE THIS COUPON—*Get All The Facts*

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me Bulletin SFB containing complete facts on BUSS Small Dimension Fuses and Fuse Holders.

Name ______________________

Title ______________________

Company ______________________

Address ______________________

City ______________ State ______________

ELRC-951

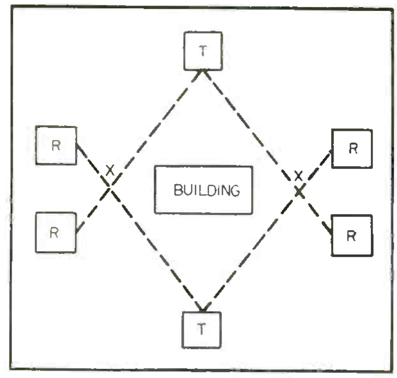


FIG. 2—A typical installation of the system

mc in carrier frequency. If interference still exists, it may be necessary to change the modulation frequency of one transmitter either higher or lower than the other transmitter.

The antennas should be installed on a semirigid mount to facilitate phasing. Jacks are provided at the antenna mounts, making it possible to connect a sensitive a-c meter to the output of the receiver. The meter is used to null the antennas.

The Atomic Energy Commission will grant nonexclusive royalty-free licenses on this government-owned patent application.

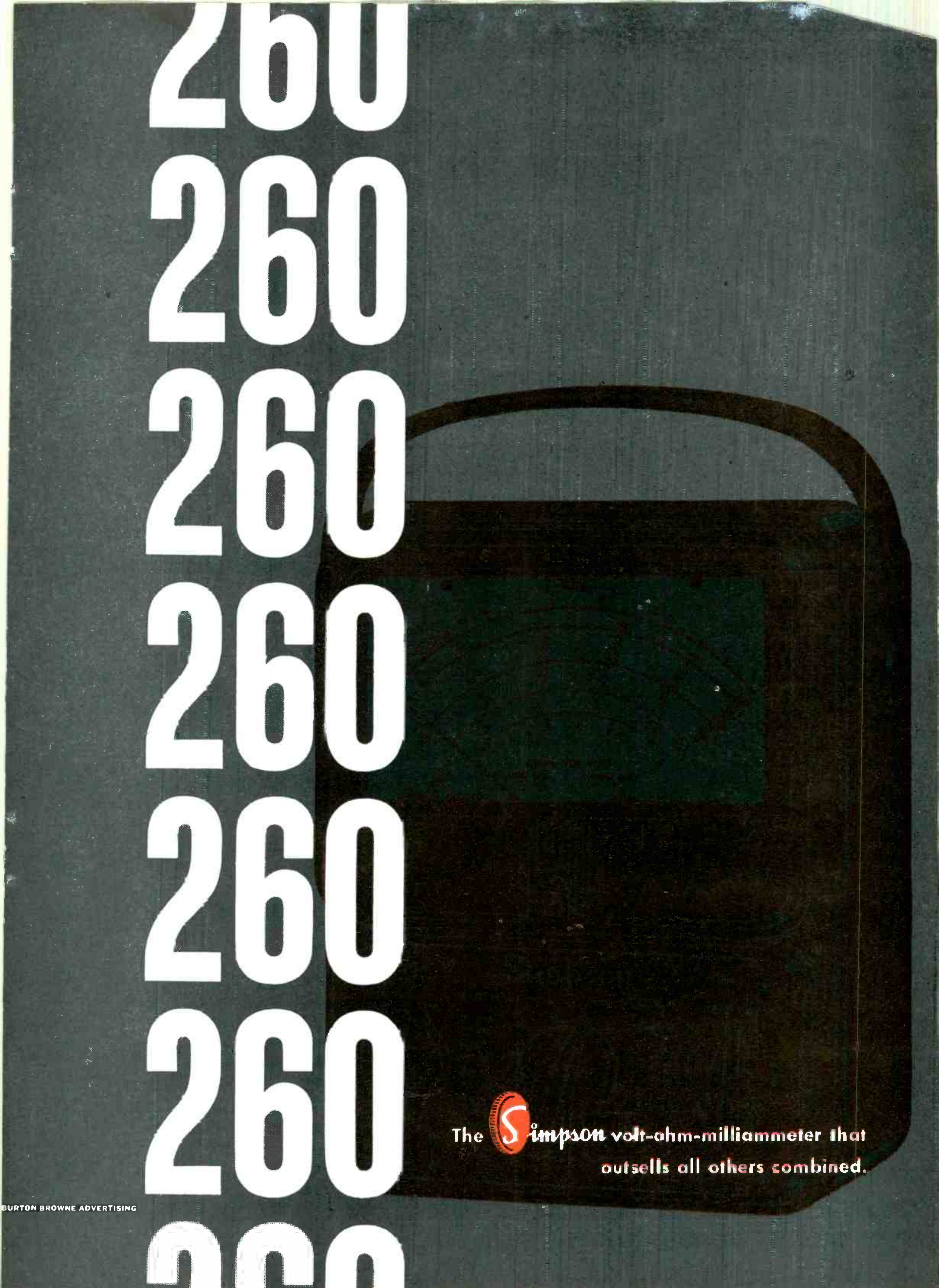
Measuring Flyback Filament Voltage

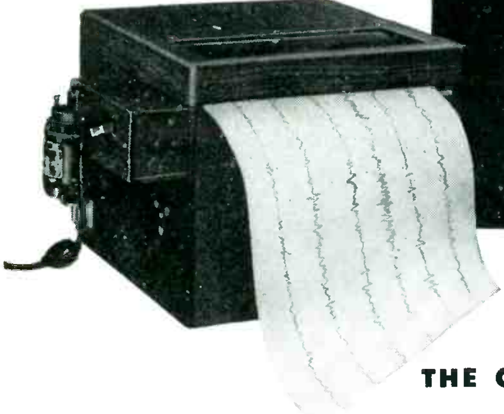
By T. E. Cantor
Riverdale, N. Y.

THE TELEVISION design engineer is at a disadvantage in attempting to measure the filament voltage of the 1B3 or 1X2 high-voltage rectifier tube in flyback circuits, since it is 10 to 15 kv above ground.

The method generally used is to observe the color of the filament and compare it with the color of a similar rectifier-tube filament operated from a battery.

A simple and accurate method is to operate the high-voltage rectifier filament in the circuit from a 1.5-volt battery to maintain the flyback transformer under load. Connect the filament winding of the flyback transformer to another similar rectifier tube or equivalent resistor, and measure the developed filament voltage with a vacuum thermocouple voltmeter. Since the filament being measured can be floating or grounded, there is no high-voltage problem.


260
260
260
260
260
260
260
The Simpson volt-ohm-milliammeter that
outsells all others combined.
BURTON BROWNE ADVERTISING



drift-free d.c. recording

THE OFFNER DYNOGRAPH

Here's a direct writing, high speed oscillograph with microvolt d-c sensitivity—made completely drift-free through an exclusive chopper type amplifier. Now you can obtain a precise record of transient variables—some formerly recorded only by photographic means—at about 100 times the speed of other recorders with comparable sensitivity.

Remember—only the Offner Dynograph gives you all of these features:

Pen Deflection Linearity of 1% with pen response of 1/120th second.

Sensitivity of 150 microvolts d-c per centimeter of pen deflection.

No extra equipment needed with reluctance type pick-ups.

True differential input obtained through special transformer coupling.

Yes, if your need is for accurate, high speed, simultaneous recording of transients in the operation of various equipment—investigate the Offner Dynograph—write today for Bulletin L-311—see the complete specifications and construction details of the Dynograph.

OFFNER ELECTRONICS INC.

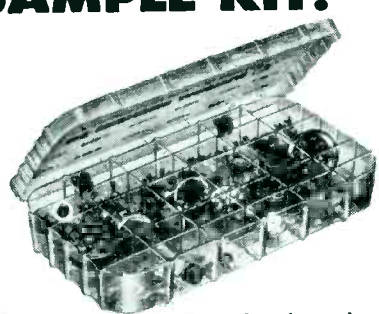
5320 N. Kedzie Avenue Chicago 25, Illinois

E-I HERMETIC SEALING COMPONENTS

ENGINEERS, DESIGNERS, PURCHASING AGENTS! SAVE TIME AND EFFORT

with the **E-I**

SAMPLE KIT!



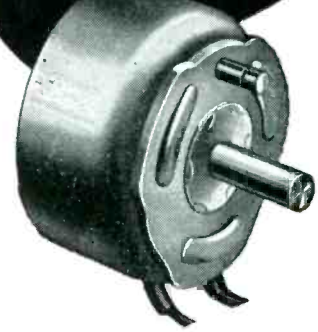
New designers kit contains 81 standard terminals and 11 different headers. These mass produced, economy-priced standard parts solve practically all problems requiring hermetic sealing. Transparent case with labeled bins makes it easy to select the correct component for your needs. The E-I SAMPLE KIT is available at the nominal price of $10.00. Send check with order or request the free E-I illustrated brochure today!

Write for these descriptive bulletins:

849 – Hermetically Sealed Terminals
850 – Hermetically Sealed Multiple Headers
851 – Gasket Type Bushings

ELECTRICAL INDUSTRIES INCORPORATED
44 SUMMER AVENUE • NEWARK 4, N. J.

LEDEX ROTARY SOLENOID



SOLVES MANY REMOTE CONTROL PROBLEMS

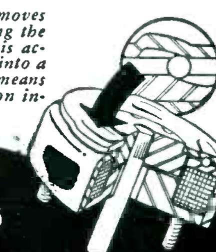
The many production applications of Ledex Rotary Solenoids vary from the dependable, snap-action tripping of airborne bomb releases to the actuation of rugged, hydraulic valves in heavy duty materials handling equipment.

Five Ledex Rotary Solenoid models are manufactured. Diameters range from 1⅛ to 3⅜ inches. Predetermined rotation up to 95° can be engineered to suit your product's requirements. Starting torques for 45° stroke range from ¼ pound-inches to 50 pound-inches.

We supply to quantity users and solicit the opportunity to be of assistance in engineering a Ledex Rotary Solenoid to meet your product's requirements.

MODEL NO.	2	5	6	7	8
Diameter	1⅛″	1⅞″	2¼″	2¾″	3⅜″
Torque lb./inches	¼	5	10	25	50
Weight lbs.	⅛	½	1	2¼	4¼

Magnetic action moves the armature along the solenoid axis. This action is converted into a rotary motion by means of ball bearings on inclined races.



WRITE DIRECT TO

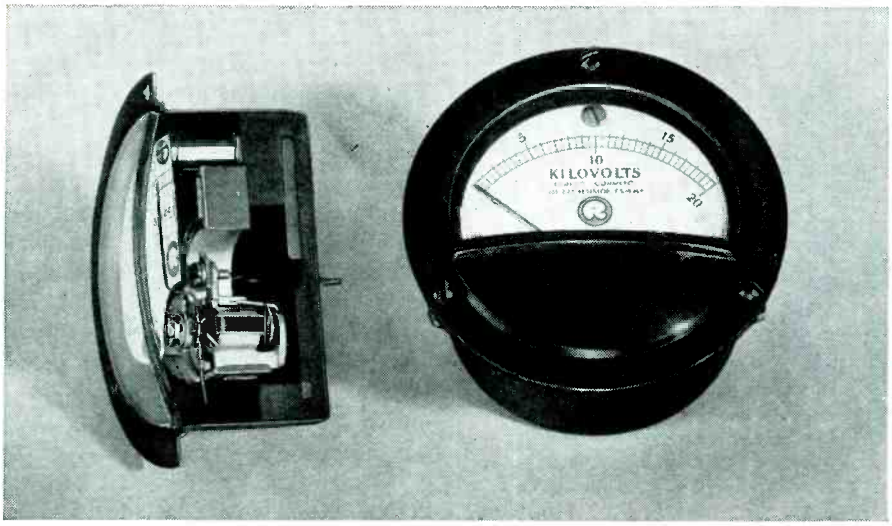
G. H. Leland INC.

118 WEBSTER STREET
DAYTON 2, OHIO

BRIDGEPORT BRASS COMPANY

Copper Alloy Bulletin

"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



One of the shock-proofed meters manufactured by Marion Electrical Instrument Company, Manchester, New Hampshire

Brass Plays Important Role in "Shock-proofed" Electrical Instruments

The natural properties of brass are utilized in many parts of the new shockproof measuring devices manufactured by Marion Electrical Instrument Company.

Brass, being non-magnetic, is unaffected by electrical currents passing through the meters. Thus, the strength of the magnetic field in the instruments is kept constant, and the accuracy of readings is maintained.

Since these sturdy devices are exposed to all sorts of adverse weather and moisture conditions, the non-corrosive properties of copper-base alloys are also important. This is particularly true of the instruments used by the armed forces, since little protection from the elements can be afforded equipment in the field.

Important from a manufacturing standpoint is the ease of fabrication and finishing of brass. Most of the parts, such as the dial pan and magnet retaining plate, are stamped. Others are easily produced on screw machines.

Four parts—three washers and the solder lug—are made of phosphor bronze. This alloy is used because of its high tensile strength and shape retaining qualities.

Built For Signal Corps

The shock-proofed electrical measuring instruments were developed under a contract issued by the U. S. Army Signal Corps. Experience with existing devices during the war had indicated that they were unable to withstand the shock of gunfire and underwater explosions, the intense vibration of jeeps, aircraft and other motorized equipment, and the other abuse to which portable field equipment is subjected.

Completely Redesigned

Preliminary study of the problem revealed two vital requirements. The first was the development of a rubber shock mount for the instrument, and the other was a redesign of all elements, including the basic D'Arsonval movement.

After much research and testing, a rubber compound was developed with the necessary temperature and dielectric characteristics which would also bond well to steel. This mount is molded directly to the case, absorbing most of the external shock and protecting the working parts.

Other improvements included a sharp reduction in the mass of the movement, a special brass magnet retaining plate permitting distribution of shock forces over the largest possible magnet surface, and a double lock to secure the core against deflection under shock.

Beryllium copper is used for all hairsprings, because of its excellent fatigue properties and corrosion resistance.

Copper-Base Alloys in Meter Construction

Part	*Number Per Assembly*
Dial Pan	1
Core Lock	1
Instrument Frame Assembly	1
Magnet Retaining Plate	1
Dial Studs	3
Locking Studs	3
Floating Anchor Disc	1
Anchor Disc Studs	3
Balance Cross	1
Washers	3
Lock Nuts	3
Solder Lug	1
Jewel Screw	1
Tail Piece	1

The new shock-proofed meters, which are hermetically sealed to make them even more durable, are used by all branches of the armed services. They meet the specifications of JAN 1-6 and MIL-M-10304 in addition to the Signal Corps Specification SCL-3069 for which they were originally created. Each meter is rigidly tested according to methods developed by the Signal Corps.

Bridgeport Laboratory Assistance Available

Brass and other copper-base alloys are widely used in the production of electrical measuring instruments. Our laboratory has helped many manufacturers apply these non-magnetic, corrosion-resistant alloys to their products. We will be glad to share this experience with you in solving your problem. (7167)

THE ELECTRON ART

(continued from p 142)

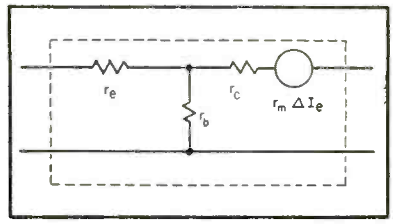


FIG. 3—Transistor equivalent circuit

very large emitter-collector spacings. The quantity r_m is a more rapidly changing function of I_a, however. A good correlation between change in r_m and change in voltage amplification is observed. This is illustrated in Fig. 4, where the initial voltage amplification was less than unity, and in Fig. 5, where the initial voltage amplification was about fifteen. In both Fig. 4 and 5, r_m and the voltage amplification were normalized to unity at zero I_a.

It was found that $r_b << r_e$ in the examples shown in Fig. 4 and 5. If, in the equivalent circuit of Fig. 3, r_b is considered small (approaching a short-circuit) the output voltage is

$$\Delta V_2 = \frac{r_m \Delta I_e R_L}{r_c + R_L}$$

where R_L is the load resistance in the collector circuit. The input voltage under this conditions is,

$$\Delta V_1 = \Delta I_e r_e$$

Thus the voltage amplification is

$$\frac{\Delta V_2}{\Delta V_1} = \frac{r_m R_L}{r_e(r_c + R_L)}$$

In these experiments the load re-

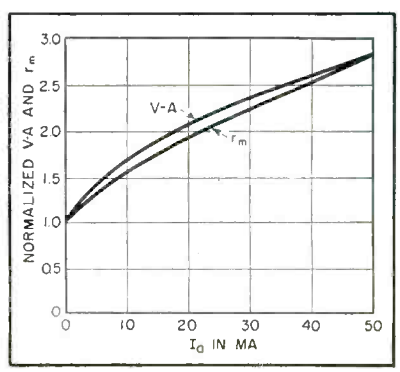
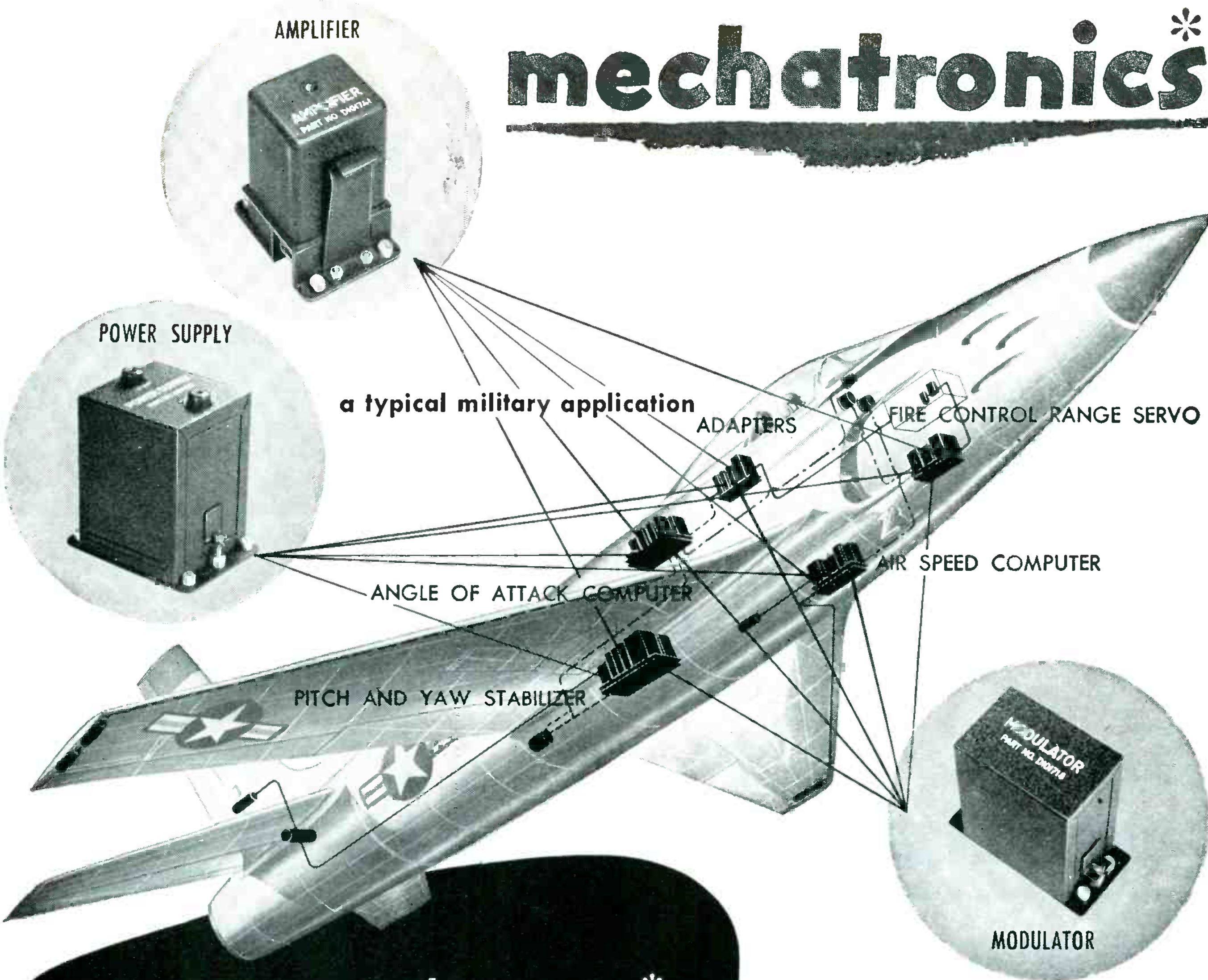


FIG. 4—Comparison of change in voltage amplification and change in r_m as a function of I_a. This is an example of large emitter-collector spacing

Snyder
PHILADELPHIA
Directronic*
MOTORLESS
TV AERIAL SYSTEM
360° ELECTRONICALLY SWITCHED BEAM
SUPERSTRUCTURE INSULATOR ASSEMBLY
• 3 combinations of elements for perfect picture clarity on each channel
• Full 360° electronic orientation
SNYDER
PHILADELPHIA
DIRECTRONIC BEAM SELECTOR
• Gives remote control of element combinations
• Mounts on or near set
*T.M. APPLIED FOR
NO MOTORS OR MOVING PARTS
NO ROOF ORIENTATION
NO ELECTRIC POWER
NO GHOSTS
SNYDER MFG. CO.
ANTENN-GINEERS
PHILADELPHIA 40 • U. S. A.
EXPORT: ROBURN AGENCIES, INC., NEW YORK 7, N. Y.
P. S. ONLY ONE LINE TO INSTALL

mechatronics*



We call it **mechatronics*** as a symbol for Servomechanisms', Inc., *technique* for the multiple and interchangeable use of standard, functionally packaged, servo components in varied electronic and electro-mechanical systems.

mechatronics fulfills the urgent need for

- **Spatial Adaptability**
- **Instant Maintainability**
- **Training Simplicity**
- **Ease of Assembly**

A typical Servomechanisms, Inc., assembly using mechatronic packaged functions.

SERVOMECHANISMS* INC.

*Trademark

Ft. Lauderdale, Florida — El Segundo, Calif.

POST AND STEWART AVES., WESTBURY, N. Y.

sistance was the dynamic plate resistance of a pentode, so $R_L >> r_e$ and

$$\frac{\Delta V_2}{\Delta V_1} = \frac{r_m}{r_e}$$

This equation indicates that the correlation of the voltage amplification with r_m is to be expected if the variation of r_e is small. It should be noted that the above relation is not valid if r_b is not small compared to r_e, as would be the case for very small emitter-collector spacing.

A possible explanation of the effect described is that the field produced by the collector is large in the semiconductor in the region of the point, but very little field is produced in the bulk of the germanium. The voltage that produces I_a, however, may produce a stronger field in the bulk, and this field is such as

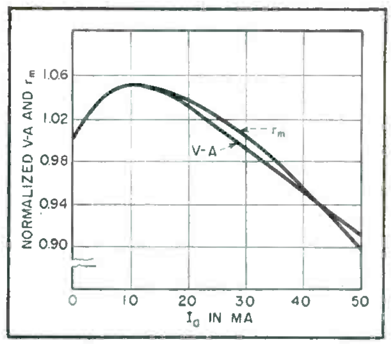


FIG. 5—Comparison of change in voltage amplification and change in r_m as a function of I_a for moderate emitter-collector spacing

to cause a drift of holes from the emitter to the collector side of the semiconductor block. In the region between the emitter and collector, holes are combining with electrons and, if the spacing is large, a majority of the holes may disappear before they get to the collector and the current gain will be small. If the holes are pulled toward the collector by the auxiliary field, they have a better chance of getting to the collector before recombination takes place.

The authors wish to thank the Solid State group of Sylvania Electric Products, Inc. for furnishing germanium blanks and other material as well as for their suggestions and interest in this investigation,

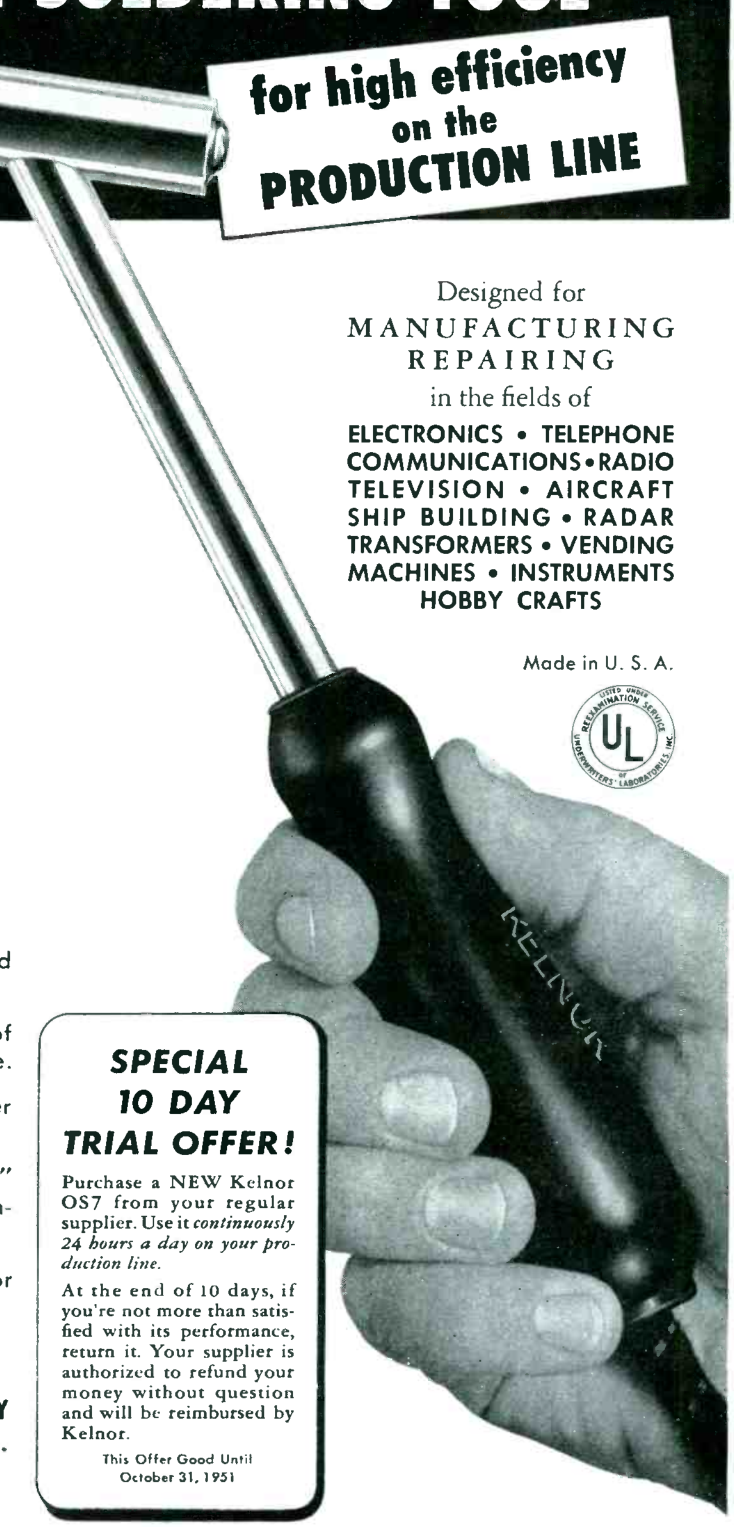
New KELNOR *electric*

TRADE MARK REG. U. S. PAT. OFF. PATENTS GRANTED AND APP. FOR

PRECISION SOLDERING TOOL

for high efficiency on the PRODUCTION LINE

ALL NICKEL PLATED—SHOWN ⅞ ACTUAL SIZE



Designed for
MANUFACTURING
REPAIRING
in the fields of

ELECTRONICS • TELEPHONE COMMUNICATIONS • RADIO TELEVISION • AIRCRAFT SHIP BUILDING • RADAR TRANSFORMERS • VENDING MACHINES • INSTRUMENTS HOBBY CRAFTS

Made in U. S. A.

NEW 125 WATT Improved Heating Element; with simplified replacement assembly.

NEW Handle Tube, larger, stronger

NEW Rugged One-Piece Construction to withstand hard industrial use

NEW Improved All-Ceramic Insulation assembly in head and handle

NEW Accelerated Heat Transfer; soldering temperature in 48 seconds

NEW Replaceable High Alloy Copper Tips, highly corrosion resistant

Other Kelnor Features

SCIENTIFICALLY BALANCED Angle Head increases accuracy, volume of production.

10 OUNCES IN WEIGHT with tip, 6 feet of cord, and plug; so light, operators never tire.

OUTPERFORMS big, heavy irons of much higher wattages.

HARD-TO-REACH places easy to solder. 3/16" tip slips between adjacent wiring without burning insulation.

PLASTIC HANDLE that keeps cool due to Kelnor heating principle.

SPECIAL 10 DAY TRIAL OFFER!

Purchase a NEW Kelnor OS7 from your regular supplier. Use it *continuously 24 hours a day on your production line.*

At the end of 10 days, if you're not more than satisfied with its performance, return it. Your supplier is authorized to refund your money without question and will be reimbursed by Kelnor.

This Offer Good Until October 31, 1951

ALL KELNOR IRONS APPROVED BY UNDERWRITERS' LABORATORIES, INC.

Order from your supplier or write for information to

KELNOR MANUFACTURING CORPORATION

General Offices: 222 Kearny Street, San Francisco 8, California

MIDGET CONDENSER MICROPHONE

for Precision Sound Measurements and High Quality Sound Recording

Built to give years of service without change in calibration. Even without dessicators, Kellogg Midget Condenser Microphones show no detectable drift in laboratory service. Proven in use for optimum performance for more than 15 years.

- RUGGED CONSTRUCTION
- EXCEPTIONAL CALIBRATION STABILITY
- UNAFFECTED BY VARIATIONS IN HUMIDITY

PRINCIPAL CHARACTERISTICS

	MODEL A	MODEL B
RESPONSE (Referred to 1 volt/dyne/cm2)	-59 db	-55 db
FLAT TO WITHIN	± 3 db from 20 to 11,000 cps, for closed cavity without grille.	± 4 db from 20 to 15,000 cps with or without grille for perpendicular incidence in free field.

Users Include government laboratories, universities, audio development laboratories, sound studios and industrial plants manufacturing sound equipment.

- SEND FOR FULL SPECIFICATIONS TODAY! WRITE DEPT. 26-I.

KELLOGG SWITCHBOARD AND SUPPLY COMPANY

Established 1897

MIDGET CONDENSER MICROPHONE

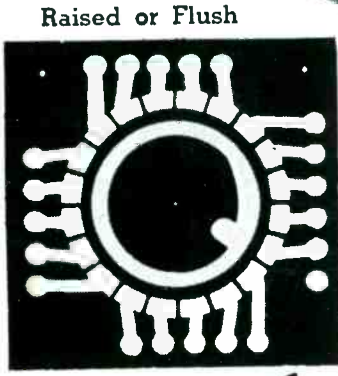
6650 South Cicero Avenue, Chicago 38, Illinois

PRINTED CIRCUITS

CHASSIS ASSEMBLIES --- SWITCHING PLATES --- SUB-ASSEMBLIES --- COMMUTATORS --- REGISTER BOARDS --- TERMINAL BOARDS

SWITCH PLATE CONTACTS

Raised or Flush



CONDUCTIVE MATERIALS: Copper, Silver, Steel, Bronze, Brass, Nickel, Aluminum.
PLATING: Copper, Silver, Nickel, Aluminum, Gold, Silver, Chrome.
INSULATING BASES: Phenolic, Melamine, Silicone, Polyester, Polystyrene, Polyethylene, Lucite, etc.; Ceramics.
OPERATIONS PERFORMED: Die Stamping, Intricate Piercing, Plating, Injection Molding, Machining, Soldering, Assembly, Research.

For additional information, write to PRINTED CIRCUIT DEPT

Emeloid

Supplier of PLASTIC PRODUCTS to The Radio and Electronic fields since 1919

1239 Central Ave., Hillside 5, N. J.

ELIZABETH 2-1944 - 1945 - 1946
N. Y. C., RECTOR 2-8554 - 8555

TRAINED MEN ARE SCARCE!

Are You Sending a MAN *on a Boy's Errand?*

Technically-trained men are getting scarcer. Yet many concerns are tying up their engineers and chemists on routine testing jobs where their talents are not most effectively used.

Why not send your routine testing to an outside laboratory? You can then assign your own trained technical men to your more urgent and unusual problems of product development, trouble-shooting, and tasks involving close familiarity with your own operations.

We are particularly adapted to handle routine problems ordinarily flowing through your laboratories. Our staffs include engineers, chemists, physicists, biologists, and specially trained technicians. Our scientific equipment is unusually extensive and includes such facilities as a radioisotope laboratory and a spectro-chemical laboratory which are, for the most part, outside the scope of the plant laboratory.

Let's get together for discussions. We are sure we can help you release your valuable technical staffs for the critical problems you are facing.

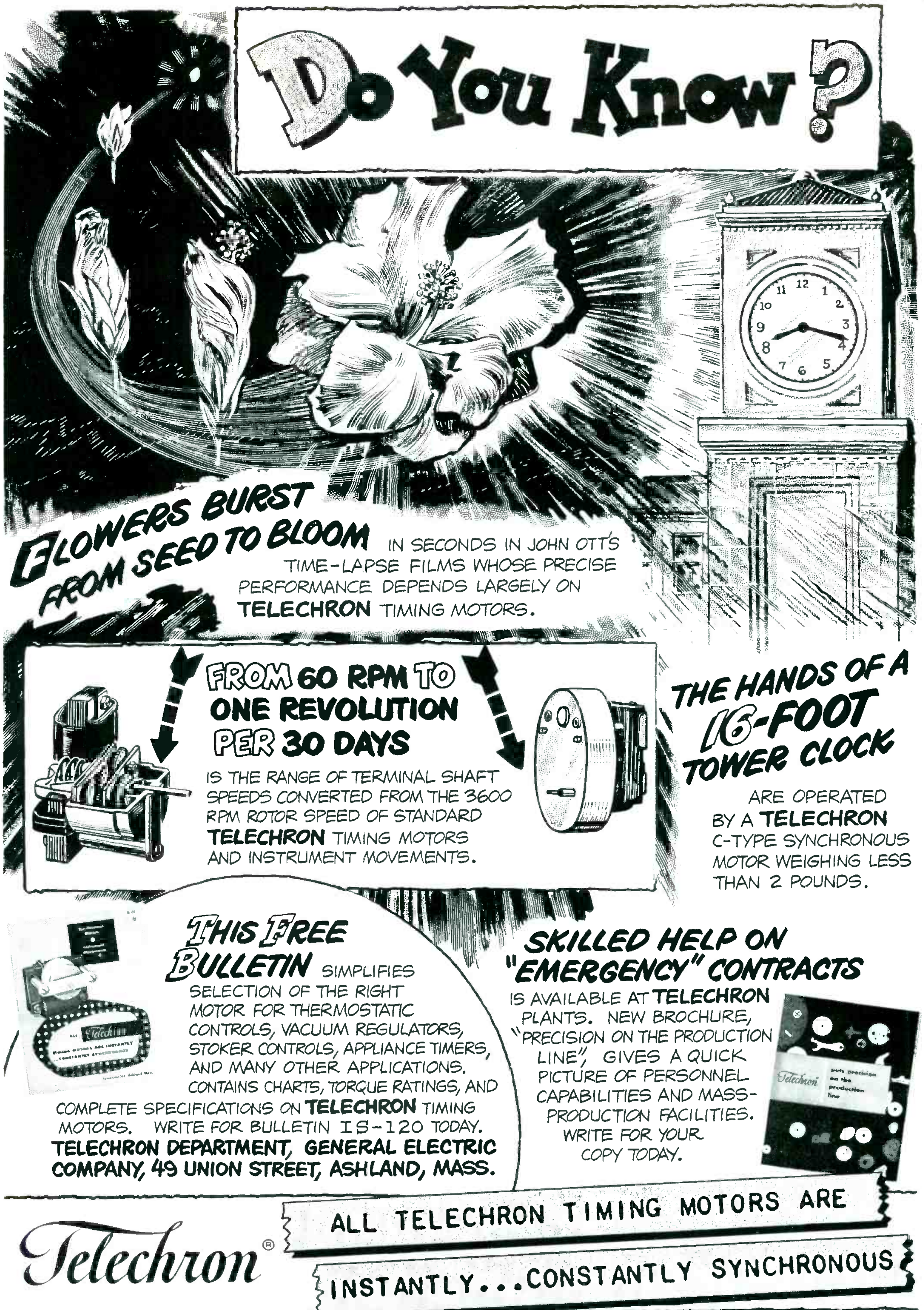
UNITED STATES TESTING COMPANY, Inc.

Established 1880

1550 Park Avenue
HOBOKEN, NEW JERSEY

PHILADELPHIA • BOSTON • PROVIDENCE
CHICAGO • NEW YORK • LOS ANGELES
DENVER • MEMPHIS

Member of American Council of Commercial Laboratories


Do You Know?
FLOWERS BURST FROM SEED TO BLOOM
IN SECONDS IN JOHN OTT'S TIME-LAPSE FILMS WHOSE PRECISE PERFORMANCE DEPENDS LARGELY ON TELECHRON TIMING MOTORS.
12 1 2 3 4 5 6 7 8 9 10 11
FROM 60 RPM TO ONE REVOLUTION PER 30 DAYS
IS THE RANGE OF TERMINAL SHAFT SPEEDS CONVERTED FROM THE 3600 RPM ROTOR SPEED OF STANDARD TELECHRON TIMING MOTORS AND INSTRUMENT MOVEMENTS.
THE HANDS OF A 16-FOOT TOWER CLOCK
ARE OPERATED BY A TELECHRON C-TYPE SYNCHRONOUS MOTOR WEIGHING LESS THAN 2 POUNDS.
THIS FREE BULLETIN
SIMPLIFIES SELECTION OF THE RIGHT MOTOR FOR THERMOSTATIC CONTROLS, VACUUM REGULATORS, STOKER CONTROLS, APPLIANCE TIMERS, AND MANY OTHER APPLICATIONS. CONTAINS CHARTS, TORQUE RATINGS, AND COMPLETE SPECIFICATIONS ON TELECHRON TIMING MOTORS. WRITE FOR BULLETIN IS-120 TODAY.
TELECHRON DEPARTMENT, GENERAL ELECTRIC COMPANY, 49 UNION STREET, ASHLAND, MASS.
SKILLED HELP ON "EMERGENCY" CONTRACTS
IS AVAILABLE AT TELECHRON PLANTS. NEW BROCHURE, "PRECISION ON THE PRODUCTION LINE", GIVES A QUICK PICTURE OF PERSONNEL CAPABILITIES AND MASS-PRODUCTION FACILITIES. WRITE FOR YOUR COPY TODAY.
Telechron
puts precision on the production line
Telechron®
ALL TELECHRON TIMING MOTORS ARE
INSTANTLY...CONSTANTLY SYNCHRONOUS

which was conducted under contract N 7 onr—28808 with the Office of Naval Research.

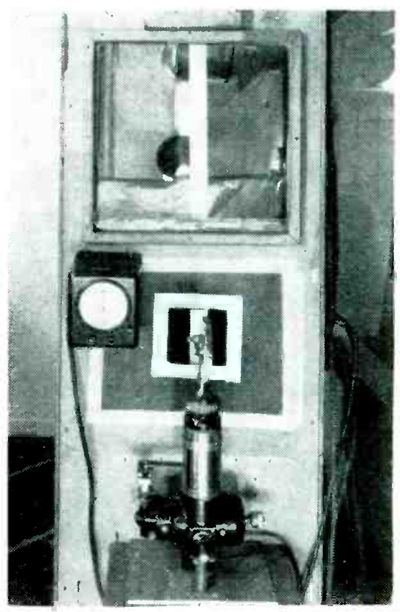
REFERENCES

(1) H. J. Reich, P. M. Schultheiss, J. G. Skalnik, T. Flynn, and J. E. Gibson, Effect of Auxiliary Current on Transistor Operation, (Letter to the Editor) p 682, *Jour. App. Phys.*, May, 1951.
(2) J. A. Becker and J. N. Shive, The Transistor, A New Semiconductor Amplifier, *AIEE* 68, p 215, 1949.

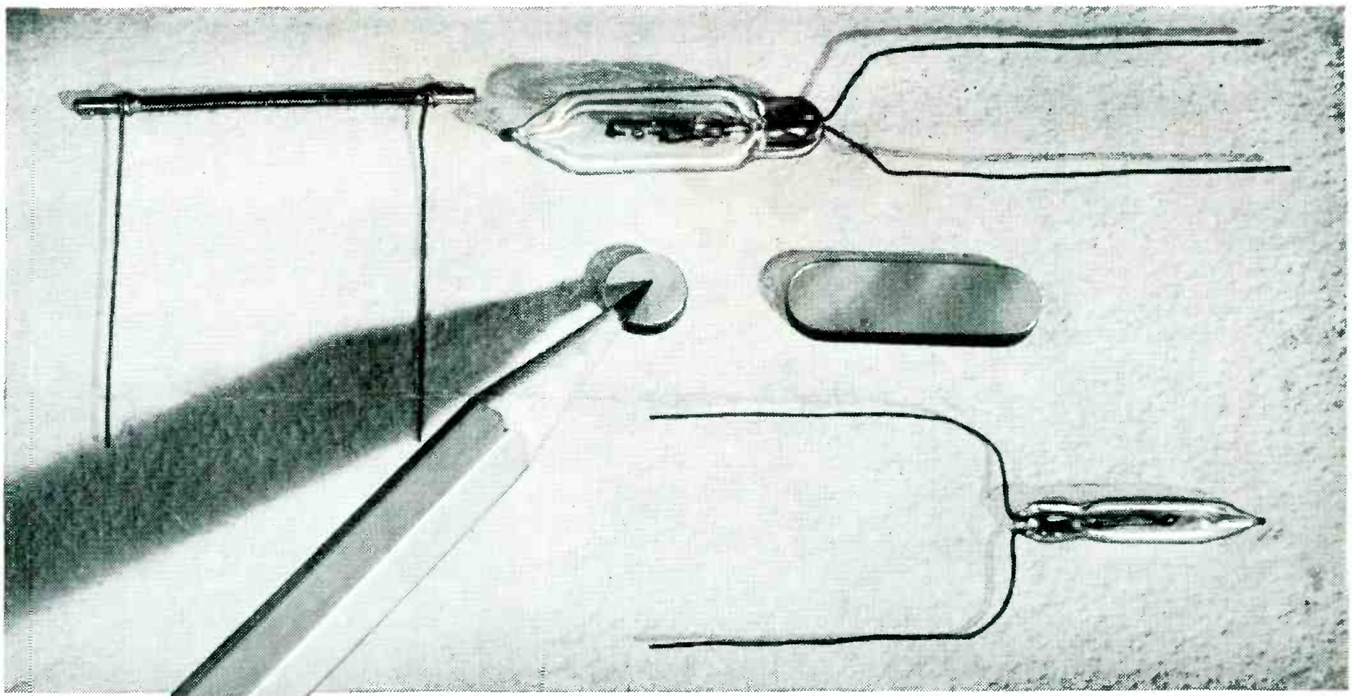
High-Temperature Adhesive-Tape Resistors

PRINTED CIRCUITS are being used increasingly because of their adaptability to economical mass production and because they facilitate miniaturization of equipment. A major disadvantage of the printed circuit method, however, has been the difficulty of incorporating satisfactory resistors in the circuits. This difficulty has been largely overcome by an adhesive-tape resistor method recently devised at the National Bureau of Standards as part of a program of electronics research and development sponsored by the Navy Bureau of Aeronautics.

In this technique, circuits are first printed in narrow metallic bands on insulating bases, leaving



Spray cabinet in which the resistive coating is applied to the National Bureau of Standards high-temperature adhesive tape resistor. Spray gun deposits resistance formulation onto endless belt of thin asbestos-paper tape



and now...

THERMISTORS

Ready to Revolutionize Control and Measurement

Effective immediately, VECO is licensed and geared to produce thermistors in any quantity to specification. Engineers familiar with the characteristics of thermistors will welcome a ready source of these new, extremely sensitive thermal resistors, and will appreciate VECO'S policy of maximum cooperation in engineering and production scheduling.

VECO is fully equipped both in design skills and production facilities to produce thermistors in a full range of types. Beads, washers, discs, rods—similar to familiar Western Electric types, or of advanced types for unlimited applications—can presently be produced to exacting specifications in line with your engineering requirements.

WRITE outlining your measurement or control problems, whatever the nature. Our engineers will study your needs and forward recommendations promptly.

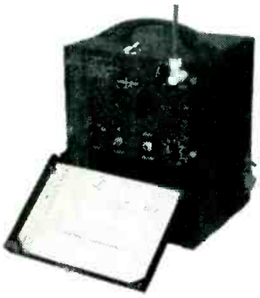
Manufactured under license arrangement with Western Electric Company, Inc.

Victory Engineering Corporation

744 Broad Street Newark, New Jersey
MArket 3-0420

GERTSCH

MODEL FM-1 DIRECT READING VHF FREQUENCY METER



Generates or Measures Any Frequency Between 20-480 MC, With a Minimum Accuracy of ± .005%

DIRECT READING—NO CALIBRATION BOOK FOR PORTABLE OR FIXED STATION USE

For complete information or demonstration, contact the Factory or your nearest Engineering Representative listed below:

Albuquerque, New Mexico
Neely Enterprises
107 S. Washington St., Albuquerque 58731

Camden 2, New Jersey
Edward Braddock
726 Cooper Street, WOodlawn 3-3585

Chicago 40, Illinois
Alfred Crossley & Associates
4501 No. Ravenswood Ave., UPtown 81141

Dallas 5, Texas
Earl Lipscomb Associates
3561 Marquette Street, EMerson 1121

Detroit 6, Michigan
S. Sterling Company
13-331 Linwood Ave., TOwnsend 83130

Fort Myers, Florida
Arthur H. Lynch & Associates
P. O. Box 466, Fort Myers 2-5672

Houston 5, Texas
Earl Lipscomb Associates
2420-B Rice Blvd., LInden 9303

High Point, North Carolina
Bivens and Caldwell
Rm. 807, Sec. Bank Bldg., H. P. 3672

Los Angeles 46, California
Neely Enterprises
7422 Melrose Avenue, WHitney 1147

Sacramento 14, California
Neely Enterprises
309 Ochsner Bldg., GIlbert 3-7461

San Francisco 18, California
Neely Enterprises
2830 Geary Blvd., WAlnut 1-3960

Washington, D. C.
E. R. Hitchcock
734 - 15th St., N. W., EXecutive 5635

EXPORT AGENTS

American Electroneering Corp., 5025-29 W. Jefferson Blvd., Los Angeles 16, Calif.

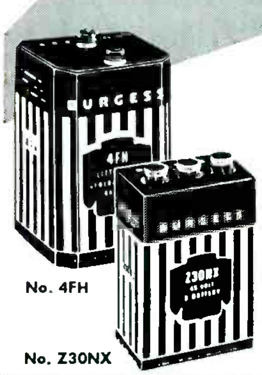
GERTSCH PRODUCTS
INC.

11846-48 MISSISSIPPI AVENUE—LOS ANGLES 25, CALIFORNIA
Mailing Address: P. O. Box 13856, W. Los Angeles 25, California

Independent Research Proves:

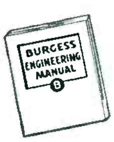
2 out of 3 Engineers Prefer BURGESS BATTERIES!

NO WONDER Burgess is *the* first source for industrial dry batteries. Burgess long-life dependability and uniform, high-level performance are backed by more years of engineering "know-how" than any other batteries. The maintenance of highest quality always is the reason why 2 out of 3 engineers prefer Burgess . . . by independent survey. Check for your local source of supply or write now!



No. 4FH

No. Z30NX



WRITE FOR ENGINEERING MANUAL AND CHECK SHEET—No obligation. By return mail you will receive the FREE Engineering Manual listing the complete line of Burgess Batteries together with detailed specifications; also the Burgess "Check Sheet" on which you may outline your battery requirements in the event that the battery you need has not already been developed. Address:

BURGESS BATTERY COMPANY
(DEPT. E-9) FREEPORT, ILLINOIS

SELENIUM RECTIFIERS

STARTING ON OUR 2ND MILLION

Over 1,000,000 Selenium Rectifiers have been produced by International Rectifier Corporation during the past three years. These include miniature rectifiers, high voltage and high power rectifiers of many different designs and capacities, for a wide variety of applications.

Here at International Rectifier Corporation, we specialize *exclusively* in the development, design and manufacture of Selenium Rectifiers of top quality for dependable performance. One out of every 5 of our employees is a graduate engineer with careful, thorough training.

TYPE V-HM SERIES
5 MILLIAMPERES DC
HERMETICALLY SEALED

Circuit-Half-Wave. In 3/8" metallic case with pigtail leads, the negative lead being grounded to the case. Overall length varies to 0.890", depending on the DC output voltage rating.

PARTIAL LIST OF TYPE V-HM SERIES RECTIFIERS AVAILABLE

DC Output Voltage	Rectifier Part No.	DC Output Voltage	Rectifier Part No.
20	V1HM	160	V8HM
60	V3HM	200	V10HM
80	V4HM	220	V11HM
120	V6HM	240	V12HM

TYPE V-HF SERIES
5 MILLIAMPERES DC

Circuit-Half-Wave. In 9/16" OD Phenolic Tube with ferrule at each end for insertion in Fuse Clips. Overall length varies to 9" depending on the DC output voltage rating.

PARTIAL LIST OF TYPE V-HF SERIES RECTIFIERS AVAILABLE

DC Output Voltage	Rectifier Part No.	DC Output Voltage	Rectifier Part No.
40	V2HF	800	V40HF
80	V4HF	1500	V75HF
200	V10HF	2500	V125HF
600	V30HF	4000	V200HF

STANDARD SELENIUM CELL SIZES

Cell Type No.	U	V	Y	Z	W
Cell Diam. (In.)	1/8	1/4	3/8	1/2	1
Current Rating (ma.)	1.5	5	11	20	75

We manufacture over 500 types of Rectifiers for Special Requirements. Write for further data and literature.

INTERNATIONAL
RECTIFIER CORPORATION
6809 S. VICTORIA AVE • LOS ANGELES 43

Model 666-R

NOTE the wide ranges of this compact pocket-size instrument. Note controls—flush with panel. Then study the inside view. Nowhere will you find, in design and manufacturing quality, the equal of 666-R.

A BASIC TOOL

POCKET-SIZE: VOLT-OHM-MIL-AMMETER
WITH SELF-CONTAINED RESISTANCE RANGES TO 3 MEGOHMS

1. Resistance Ranges from 0-3000 Ohms (.5 Ohm low reading) to 3 Megohms, self-contained. Also A.C.-D.C. Volts to 5000, 10 ranges; and 3 Direct Current ranges.

2. Enclosed Selector Switch, molded construction. Keeps dirt out, and retains contact alignment permanently.

3. Unit Construction—Resistors, shunts, rectifier, batteries, are housed in a molded base integral with the switch. Direct connections without cabling. No chance for shorts.

4. Resistors are precision film or wire-wound types, each in its own compartment.

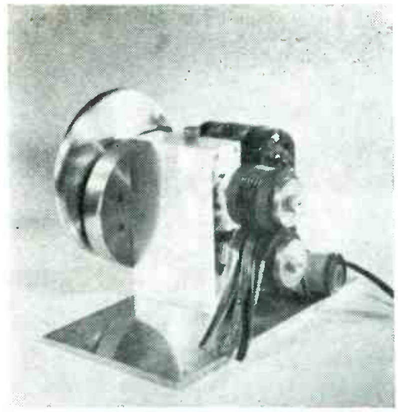
ONLY $26.50—at your Distributor

Prices Subject to Change

FOR THE MAN WHO TAKES PRIDE IN HIS WORK

Triplett

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO, U. S. A.

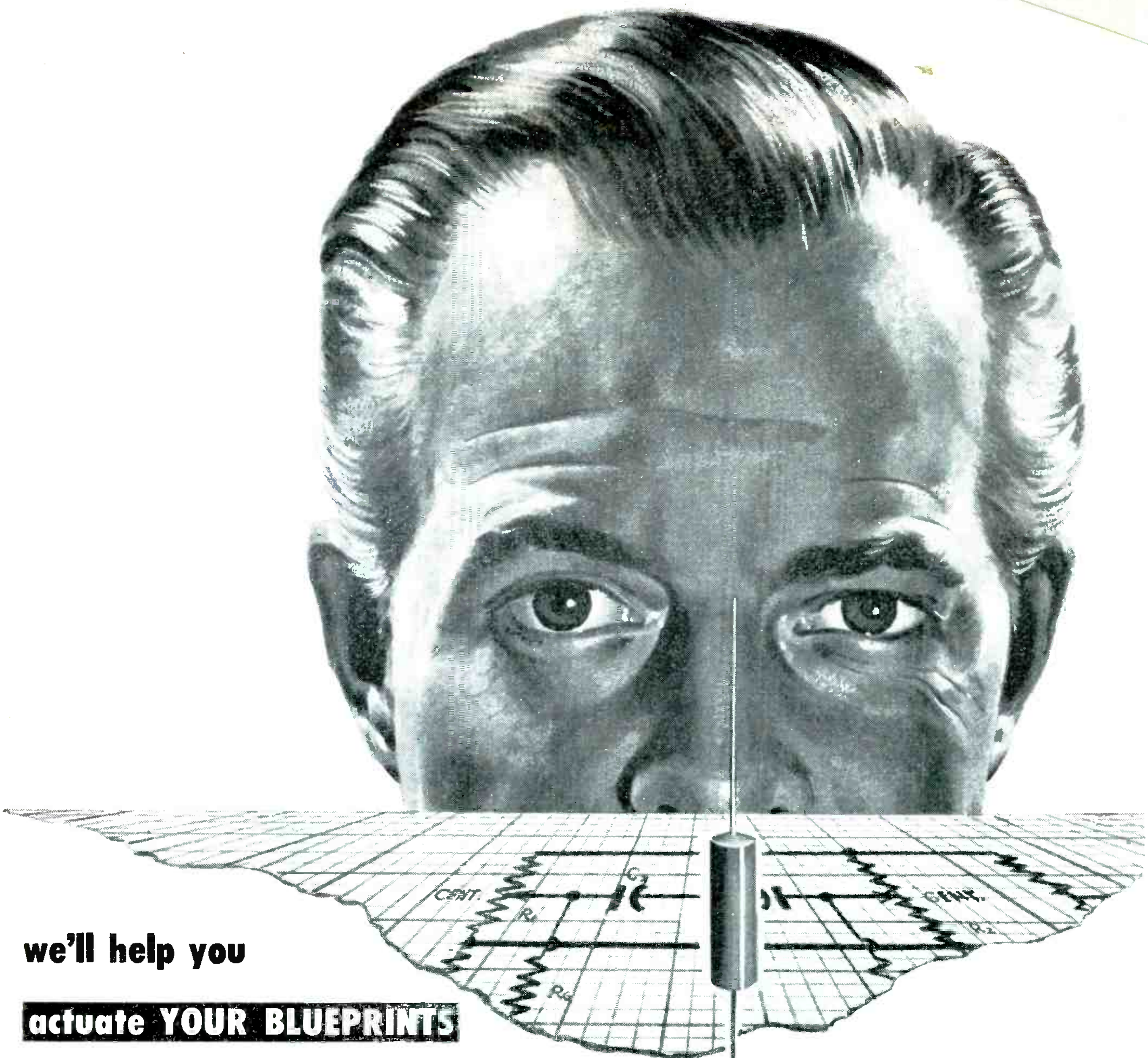


Specially designed tape slitter cuts high-temperature adhesive tape resistor into strips of the desired width. Twelve disk knives, mounted in pairs and spaced by accurately-ground spacers, overlap slightly to give a scissors action

a small gap at each point where a resistance is required; one of the self-adhesive resistors is then cut from a strip and pressed into position. Much better control of resistance values is possible than with previous printed resistor methods, and higher yields of acceptable assemblies are assured. The new method thus appears to combine the advantages of printed resistors and of separately manufactured resistors. The tape resistor was developed to withstand the high temperatures of very compact equipment and operates satisfactorily at temperatures up to 200 C. In other electrical characteristics it is similar to present film-type carbon resistors.

The new tape resistors consist of a mixture of graphite or carbon black, resin, and solvent applied in a thin layer to a thin roll of asbestos paper tape. The resistive coating is sufficiently adhesive to stick to an insulating base plate and to make satisfactory electrical contact with metallic terminals. When the resistor is in position, the resistance film is protected from abrasion and electrical shorts by its asbestos-tape backing. Resistor dimensions are kept constant; a variety of coating formulations give a range of values from about 100 ohms to 10 megohms.

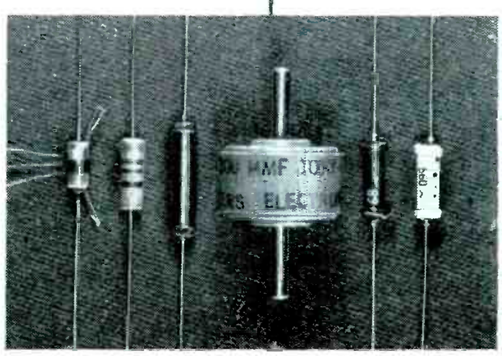
The resistor is manufactured by spraying the resistance mixture onto a moving belt of tape. A 0.002-inch protective film of polyethylene is lightly pressed over the resist-



we'll help you

actuate YOUR BLUEPRINTS

...if electronic components such as molded capacitors are your problem



Other electronic components
also built in quantity
to your most exacting specifications
for stability in service

JEFFERS Electronics INC.

A SPEER CARBON COMPANY SUBSIDIARY

DU BOIS, PENNSYLVANIA

Complete your Circuits with Resistors, Coil Forms and Iron Cores by Speer Resistor Corp., St. Marys, Pa. another SPEER CARBON CO. subsidiary

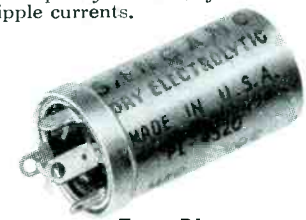
7664

GET Sound QUALITY

with Sangamo Electrolytic Capacitors

Type MT

These wire lead dry electrolytics are easy to mount. Their small size makes them ideal for application in tight spots. Type MT maintains uniform capacity when subjected to heat and high ripple currents.



Type PL

These "twist-lock" electrolytics give long life and dependable performance at 85° C under conditions of extreme ripple currents and high surge voltages. Twist-prong tabs provide for washer or direct chassis mounting.

Type TS

Sangamo octal base electrolytics are the right choice for all applications where quick capacitor changes are required. Aluminum containers cannot contact mounting surface and the base pins are nickel plated to insure good contact.

There's a type for every application...

You give *sound* quality and long life to your audio equipment—tape recorders, amplifiers, intercoms, etc.—when you specify Sangamo Electrolytic Capacitors as standard components. Sangamo Electrolytics are manufactured under carefully controlled conditions for protection against source contamination and to assure corrosion-free elements.

There's a type to meet your exact needs—a few are shown at right. Write for full information.

Your Assurance of Dependable Performance

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

IN CANADA: SANGAMO COMPANY LIMITED, LEASIDE, ONTARIO SC61-9 ance coating for protection in handling and storage; it is easily removed when the resistor is used. An electrically-driven slitting machine quickly cuts the tapes into long strips of the desired width.

At present, the resistor tape, cut to width, is applied to printed circuitry by hand from a continuous spool; the tape is pressed into position and cut off with a razor blade. Plans call, however, for development of a device comparable to a wire stapler which will accept a roll of the resistor tape and apply and cut off a resistor of standard length each time a knob or handle is pressed.

Silicone resin is used for the binder adhesive because of its suitability for high-temperature operation. Since the curing temperature of the silicone resin formulations is high (300 C), and since curing is done after the resistors have been positioned in the circuit, the tape resistor is at present applicable only to glass or ceramic base materials. However, enough work has been done with lower-curing resins to indicate definitely that they can be used in making tape resistors having cure temperatures low enough for application to some heat-resisting plastic materials. These resistors would be suitable for conventional operating temperatures.

The possibility of varying resistor dimensions to obtain a range of values was considered but rejected. This aspect ratio system has the advantage of reducing the number of formulations needed for a complete resistor range, but it complicates equipment design and production. Resistor dimensions were therefore

Adhesive tape r
on a miniature
is pressed in'

GET Sound QUALITY

with Sangamo Electrolytic Capacitors

Type MT

These wire lead dry electrolytics are easy to mount. Their small size makes them ideal for application in tight spots. Type MT maintains uniform capacity when subjected to heat and high ripple currents.

There's a type for every application...

You give *sound* quality and long life to your audio equipment—tape recorders, amplifiers, intercoms, etc.—when you specify Sangamo Electrolytic Capacitors as standard components. Sangamo Electrolytics are manufactured under carefully controlled conditions for protection against source contamination and to assure corrosion-free elements.

There's a type to meet your exact needs—a few are shown at right. Write for full information.

Type PL

These "twist-lock" electrolytics give long life and dependable performance at 85° C under conditions of extreme ripple currents and high surge voltages. Twist-prong tabs provide for washer or direct chassis mounting.

Type TS

Sangamo octal base electrolytics are the right choice for all applications where quick capacitor changes are required. Aluminum containers cannot contact mounting surface and the base pins are nickel plated to insure good contact.

Your Assurance of Dependable Performance

The SANGAMO Tribe
PAPER · MICA · SILVER · ELECTROLYTIC CAPACITORS

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

IN CANADA: SANGAMO COMPANY LIMITED, LEASIDE, ONTARIO SC51-9 ance coating for protection in handling and storage; it is easily removed when the resistor is used. An electrically-driven slitting machine quickly cuts the tapes into long strips of the desired width.

At present, the resistor tape, cut to width, is applied to printed circuitry by hand from a continuous spool; the tape is pressed into position and cut off with a razor blade. Plans call, however, for development of a device comparable to a wire stapler which will accept a roll of the resistor tape and apply and cut off a resistor of standard length each time a knob or handle is pressed.

Silicone resin is used for the binder adhesive because of its suitability for high-temperature operation. Since the curing temperature of the silicone resin formulations is high (300 C), and since curing is done after the resistors have been positioned in the circuit, the tape resistor is at present applicable only to glass or ceramic base materials. However, enough work has been done with lower-curing resins to indicate definitely that they can be used in making tape resistors having cure temperatures low enough for application to some heat-resisting plastic materials. These resistors would be suitable for conventional operating temperatures.

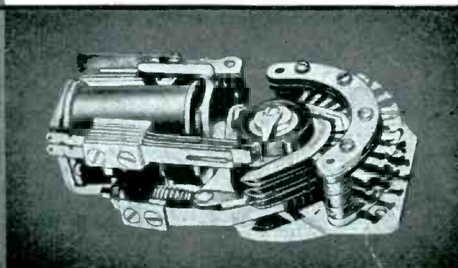
The possibility of varying resistor dimensions to obtain a range of values was considered but rejected. This aspect ratio system has the advantage of reducing the number of formulations needed for a complete resistor range, but it complicates equipment design and production. Resistor dimensions were therefore

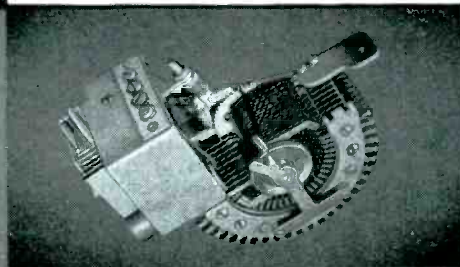
Adhesive tape resistor is set in place on a miniature cylindrical chassis. Tape is pressed into position and cut off with a razor blade

when you specify stepping switches

look for these features

	type 44	type 45
large bank capacity	Up to six 10-point bank levels. Levels can be used independently for 10-point operation...in pairs for 20-point operation...in groups of three for 30-point operation.	From 2 to 10, or more, 25-point bank levels. Levels can be used independently for 25-point operation...or in pairs for 50-point operation.
positive operation	Coil-spring driven; steps when the coil is de-energized. Operation can be either impulse-controlled o- self-interrupted.	Coil-spring driven; steps when the coil is de-energized. Operation can be either impulse-controlled or self-interrupted.
high speed	A typical three-level 10-point switch operating on 48 volts d-c runs approximately 80 steps per second, self-interrupted...35 steps per second, impulse-controlled.	A typical ten-level 25-point switch operating on 48 volts d-c or 115 volts a-c runs approximately 75 steps per second, self-interrupted...35 steps per second, impulse-controlled.
variety of coils	For any d-c voltage up to 110. Regularly provided for operation on 6, 12, 24, 48, 60 or 110 volts d-c.	For any d-c voltage up to 110, or for 115 volts a-c. Regularly provided for operation on 6, 12, 24, 48, 60 or 110 volts d-c.

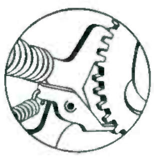




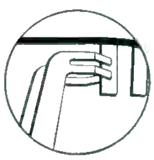
find them in Automatic Electric

telephone type stepping switches

positive stopping
Wipers locked at each step without pawl stop blocks; this simplifies adjustment, eliminates maintenance.



"double twin" wipers
Bifurcated tips touch *both* sides of bank contact...give twice the dependability of twin contacts.



operates at −72°C
Both switches tested to operate efficiently at −72° C...especially important in military applications.

You can meet a wide range of requirements with the unusual flexibility of these two stepping switches. In many applications they can replace 10, 20, or more relays with resultant savings in space and weight. The Type 44 is miniature in size (max. 2″ x 2⅜″ base mount) and weight (avg. 14 oz.). Yet it offers capacity, speed, and smooth-running dependability for your most complicated space and weight applications. The Type 45, the only switch of its kind for both d-c and a-c application, offers even greater capacity and adaptability to the exact number and arrangement of bank levels you need. Write for complete data in Circular 1698-A. Address:

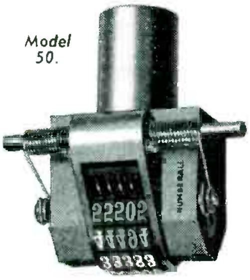
AUTOMATIC ELECTRIC SALES CORPORATION
1033 West Van Buren St., Chicago 7, Ill.
Offices in principal cities

RELAYS PRODUCTS OF THE INDUSTRIAL DEPARTMENT OF **SWITCHES**
AUTOMATIC ELECTRIC
CHICAGO

NUMBERALL
CUTS THE COST OF STAMPING NUMBERS

NUMBERING MACHINES
For Stamping Metal and Plastic Products

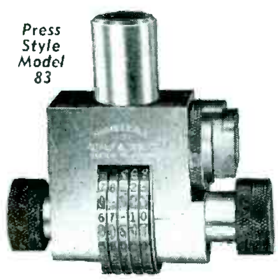
AUTOMATIC INDENTING NUMBERING HEAD—MODEL 50



Model 50.

Automatic indenting numbering heads of consecutive or repeat numbering. 1/32" up to 3/8" high figures can be furnished in sharp face Gothic or shaded Roman figures. Can be used in foot and power presses. Numbers radio, airplane, tool parts, name plates and other objects in brass, steel fiber, plastics. Heads are of sturdy construction and give uninterrupted marking service. Bulletin E50.

SELECTIVE NUMBERING HEADS
All wheels • QUICK SET



Press Style Model 83

Model 83 Heads for all stamping operations requiring quick selective numbering. Wheels engraved with direct sight figures at front of machine. Set to the required character by turning the knobs. By pushing the knobs right or left anyone of the wheels may be engaged. Indexed wheel selector knob serves as a positive stop for every wheel. 1/16" to 1/4" size figures. Letter wheels, with up to 11 letters and a blank on each wheel can also be supplied. Heads are more efficient and durable than old style lever machines. Furnished in sizes from 1 to 15 wheels. Bulletin E83.

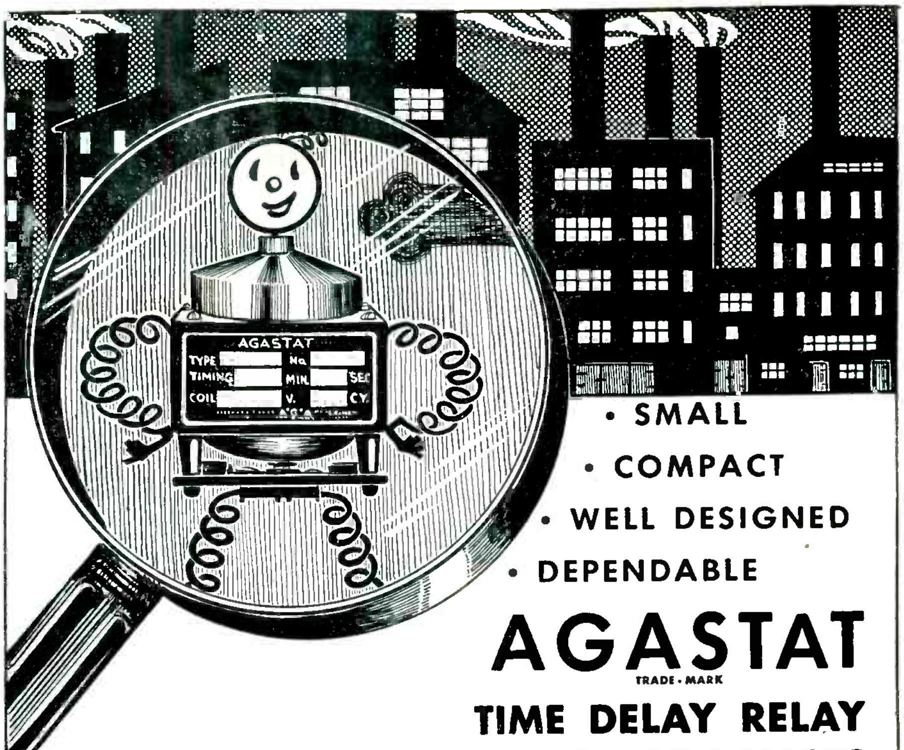
NEW MODEL 70
Multi-Wheel Numbering Machine

MACHINE AND SHANK ALL ONE PIECE

Model 70

The most efficient method of stamping numbers into metal. Repeats the same numbers until changed. Model 70 NUMBERALL Machines are used in all industries to mark various parts. Stamps numbers, etc., quickly . . . neatly. Perfectly aligned. Much better marks are reproduced by these machines than by single stamps or steel type, and at a far lower cost. Shank for Hand or Press and with any number of wheels from 3 to 20. Bulletin E-70.

NUMBERALL STAMP & TOOL CO.
HUGUENOT PARK STATEN ISLAND 12, N. Y.



• SMALL
• COMPACT
• WELL DESIGNED
• DEPENDABLE

AGASTAT
TRADE-MARK

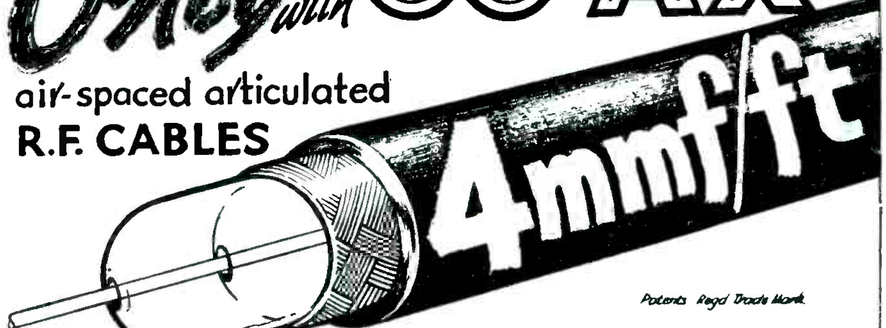
TIME DELAY RELAY
PROTECTS BIG INDUSTRY PROCESSES

Address inquiries to Special Products Division

American Gas Accumulator Company
1027 Newark Avenue, Elizabeth 3, New Jersey

Only with CO-AX

air-spaced articulated
R.F. CABLES



Patents Regd Trade Mark

THE LOWEST EVER CAPACITANCE OR ATTENUATION

•

We are specially organized to handle direct enquiries from overseas and can give

IMMEDIATE DELIVERIES FOR U.S.A.

Billed in Dollars Settlement by your check.
Transaction as simple as any local buy.

LOW ATTEN TYPES	IMPED OHMS	ATTEN db 100ft	LOADING Kw at 100 Mc/s.	O.D"
A 1	74	1.7	0.11	0.36
A 2	74	1.3	0.24	0.44
A 34	73	0.6	1.5	0.88

HIGH POWER FLEXIBLE

LOW CAPAC TYPES	CAPAC mmf/ft.	IMPED OHMS	ATTEN db/100ft 100Mc/s.	O.D."
C 1	7.3	150	2.5	0.36
PC 1	10.2	132	3.1	0.36
C 11	6.3	173	3.2	0.36
C 2	6.3	171	2.15	0.44
C 22	5.5	184	2.8	0.44
C 3	5.4	197	1.9	0.64
C 33	4.8	220	2.4	0.64
C 44	4.1	252	2.1	1.03

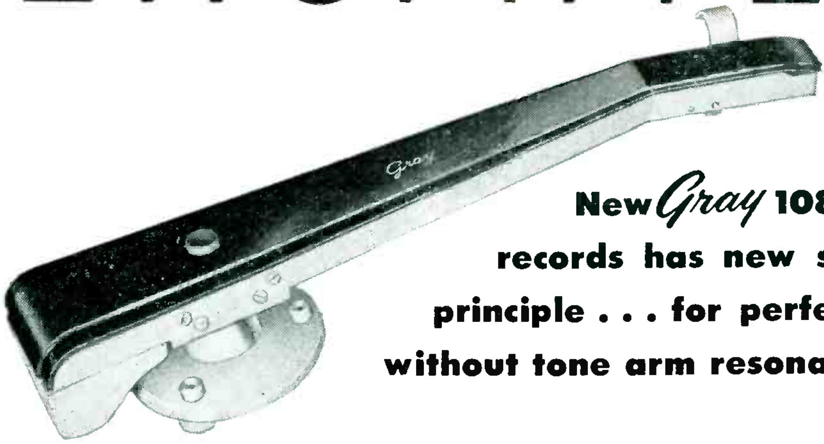
PHOTOCELL CABLE

V.L.C. ★

★ Very Low Capacitance cable.

TRANSRADIO LTD
CONTRACTORS TO H.M. GOVERNMENT
138A CROMWELL ROAD·LONDON S.W.7 ENGLAND
CABLES: TRANSRAD. LONDON.

VERSATILITY!



New *Gray* 108-B Arm for all records has new suspension principle . . . for perfect tracking without tone arm resonances

Perfect tracking of records and virtual elimination of tone arm resonances are only two advantages of this versatile, specially-designed arm — the finest yet developed! It satisfies every requirement of LP reproduction, permits instant changing from 78 r.p.m. to LP (micro-groove) or 45 r.p.m., and *assures correct stylus pressure automatically*. GE or Pickering magnetic pickup cartridges are interchangeable and slip into place quickly and easily. Maintains perfect contact with bad records, accommodates records up to 16" in diameter.

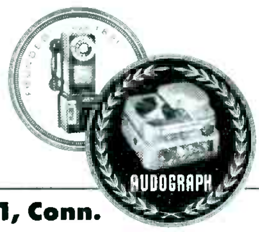
106-SP Transcription Arm —

Assures fidelity of tone for every speed record. Three cartridge slides furnished enable GE 1-mil, 2½ or 3-mil, or Pickering cartridges to be slipped into position instantly, with no tools or solder. Low vertical inertia, precisely adjustable stylus pressure.

Gray Equalizers —

Used as standard professional equipment by leading broadcast stations, these specially-designed equalizers assure highest tonal quality . . . new record reproduction from old records . . . constant velocity frequency response for conventional or LP records. Uses GE or Pickering cartridges.

Please write for bulletins describing the above equipment.



GRAY RESEARCH

and Development Co., Inc., 16 Arbor St., Hartford 1, Conn.

Walter E. Ditmars
President

Division of The Gray Manufacturing Company—Originators of the Gray Telephone Pay Station and the Gray Audograph standardized at a length of 0.5 inch (0.3 inch interelectrode distance) and a width of 0.13 inch ± 0.02 inch. This slight leeway in width permits some adjustment of resistor value in the slitting operating. With constant dimensions, wattage ratings are substantially independent of resistance value, and different contact resistance values due to different contact areas of silver and resistor are eliminated.

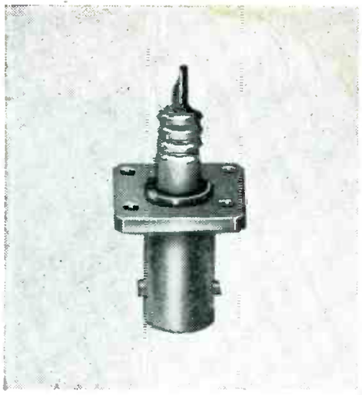
Both natural and synthetic graphites, as well as various carbon blacks, are used in the resistor formulations. Values of resistors are varied by changing the ratio of carbon to resin in the mixture and by using different carbons. The proportion of carbon to resin ranges from 10 to 50 percent. Leaner mixtures give less favorable characteristics.

Tape resistors made from graphite mixtures have proved remarkably stable at ambient temperatures of 200 C. Another advantage of graphite formulations is that unusually low resistance values—down to about 100 ohms—can be obtained. Unfortunately, however, the useful upper limit of the graphite formulations seems to be about 5,000 ohms. Carbon blacks, which are less desirable at high temperatures, give values from 5,000 ohms to 10 megohms. Only a few carbon blacks have been found which yield tape resistors satisfactory for operation at 200 C. For most resistance ranges, however, carbon-black tapes have been made which are satisfactory at 170 C.

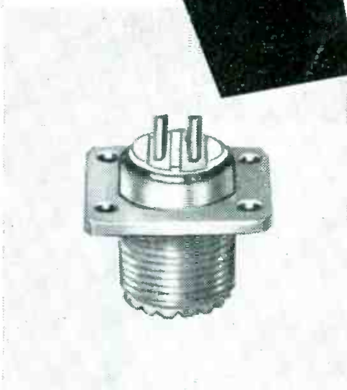
Production Methods

The coating formulation—carbon, resin, and solvent—is agitated with porcelain balls on a ball mill for at least 72 hours before it is sprayed on the tape. Spraying is done in a special cabinet. To secure a uniform coating, the tape, in the form of an endless belt 13 feet long and 1¼ inches wide, is moved rapidly past a spray gun many times as the spray mixture is slowly deposited. A number of infrared heat lamps, mounted within a few inches of the moving tape, hasten removal of solvent during spraying and dry the tape to the desired degree.

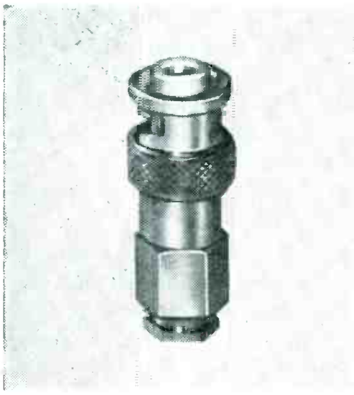
The tape-slitting machine employs 12 disk knives mounted in

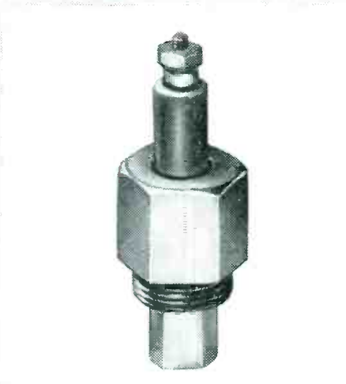


SPECIAL CONNECTORS BY KINGS



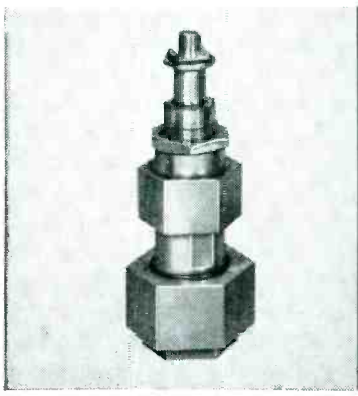
Shown here are several special connectors which Kings has made to meet specific requirements of our customers. These are broad adaptations of standard connectors.





Because of our long experience and flexibility, manufacturers from coast-to-coast rely on Kings for connectors for special applications. Your own connector problems will receive the prompt attention of our well-staffed engineering department.

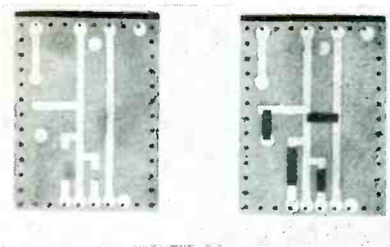
Standard connectors in the N, BN and BNC series, as well as the new C series are available. Write for quotations and delivery dates.



KINGS *Electronics* CO., INC.

40 MARBLEDALE ROAD, TUCKAHOE, N. Y.

IN CANADA: ATLAS RADIO CORP., LTD., TORONTO

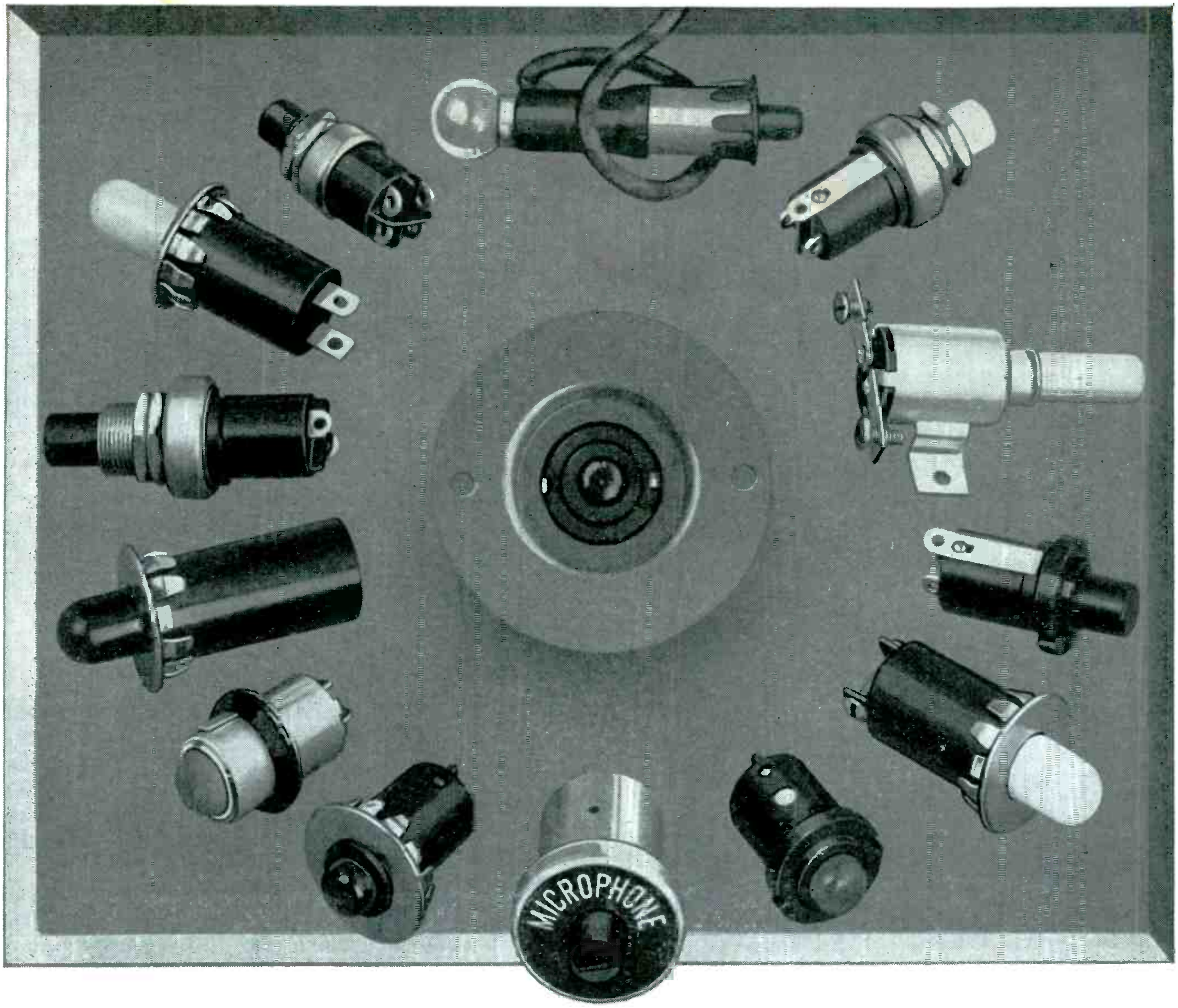


Typical printed circuit without (left) and with (right) the new NBS adhesive tape resistors in place

pairs, slightly overlapping so as to give a scissors action and separated by accurately-ground spacers. A small sample of the tape may be tested for value before the entire tape is slit. Testing is done by cutting the sample into a series of strips varying in width by 0.01 inch over the range 0.11 to 0.15 inch and making up a test plate from these strips. On the basis of test results, the slitter can be set to cut the entire roll into strips of the width necessary to give the desired final resistance value. A single belt of resistance tape yields approximately 1,500 resistors.

Proper curing of the resistors after application to the printed circuitry is extremely important. The curing process hardens the resistor, bonds it more firmly to the plate, and stabilizes its electrical characteristics. Although the optimum cure for different formulations differs considerably, a compromise cure of 4 hours at 300 C has proved satisfactory and has been adopted as standard. Curing is done in a temperature-controlled electric furnace to which an aluminum inner liner has been added to secure more uniform temperature distribution.

In using the resistors at 200 C, it has been found that those made from some formulations change sharply in value during the first 24 hours, then remain stable for several hundred hours. For this reason, there is some advantage in following the standard 4-hour cure at 300 C with a 24-hour treatment at 200 C. As changes in the resin in the resistor film take place quite slowly at room temperature, the resistor tape may be stored for long periods. Its storage life may be



UCINITE SWITCHES . . . *in Volume Production*

There's nothing temperamental about Ucinite switches. They're designed to work faultlessly and keep on working even under the toughest conditions. You'll find them in airplanes, automobiles, refrigerators, radios. You'll find everything from simple, push button switches to watertight and even hermetically sealed switches . . . in all kinds of mountings, with colored buttons and in various combinations of poles and throws. And, if there's a switch or any other small electrical assembly that *can't* be found to suit your purpose, you'll find Ucinite ready with a first-rate design and engineering staff and a plant that's equipped for volume production.

Before bidding on government contracts requiring special electrical components or assemblies, consult your nearest Ucinite field engineer.

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

Specialists in
ELECTRICAL ASSEMBLIES,
RADIO AND AUTOMOTIVE

further extended by refrigeration.

Testing and development of tape resistors are continuing at NBS. This work utilizes a test oven of special design which permits automatic recorded measurements to be made simultaneously on a large number of resistors without removal from the oven. Improved resistance formulations are being sought, particularly for certain ranges. Attempts are also being made to develop a satisfactory additional protective coating for application to the positioned resistor.

Ionospheric Cross Modulation

By GEORGE R. MATHER
Ottawa, Ontario Canada

THE PHENOMENON that is commonly identified as the "Luxemburg Effect" is a process whereby the modulation of a high power unwanted station is superimposed upon the skywave signals of wanted stations.

The wave from which the modulation is transferred is the disturbing wave: The region where the modulation is transferred is the region of cross modulation, and the modulation picked up by the wanted wave is called the transferred modulation. The meaning of these terms is illustrated diagrammatically in Fig. 1.

Theory

The development of the algebraic expressions is a complex problem and for the purpose of this report only a brief explanation will be given. However, there has been considerable effort put into these investigations by other individuals and the results of their work

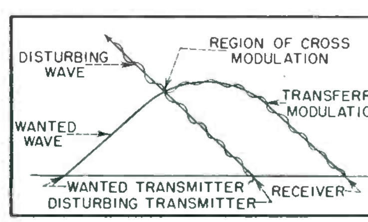
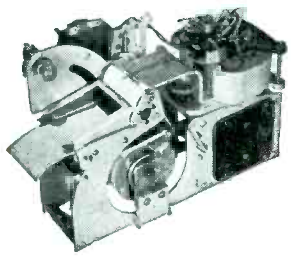
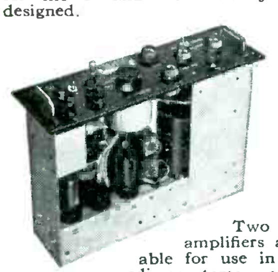
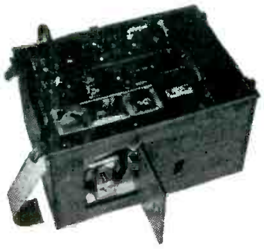


FIG. 1—Simplified representation of factors involved in the so-called Luxemburg effect



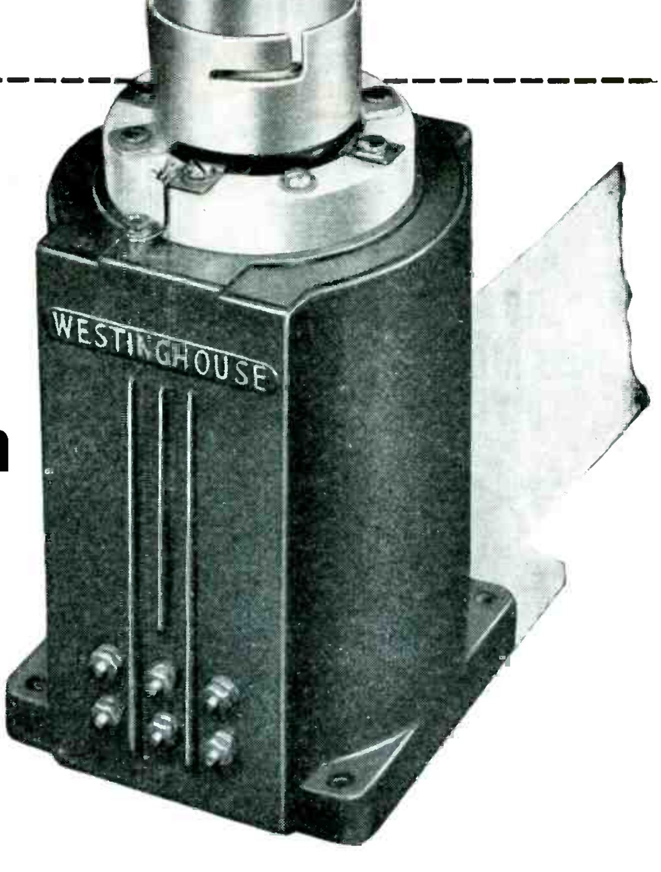




YOU CAN BE **SURE**.. IF IT'S
Westinghouse

Transformer Space-saving problem

SOLVED



Here's a space-saving problem . . . and another example of how Westinghouse applies engineering experience to handle all types of transformer problems.

The problem: To build a more compact filament transformer for use with Phanotron rectifier tubes.

First, the transformer case, core and coils had to be made smaller.

Second, the large standoff insulator between the transformer case and tube socket had to be eliminated. Because the previous case was metal, a large standoff insulator had been used to keep the tube socket, mounted on top of the transformer case, 11,000 volts from ground.

The Westinghouse solution: MOLDARTA and Type C HIPERSIL cores, two Westinghouse engineered products.

Westinghouse Type C HIPERSIL cores, 1/3 smaller than ordinary cores, easily fit the smaller MOLDARTA transformer case.

MOLDARTA, a low power factor, low loss material, also served as the perfect insulator. Thus the large standoff insulator was eliminated . . . the desired compactness was attained . . . and a difficult space-saving problem was solved.

If you have a tough transformer problem, take advantage of the facilities of Westinghouse for quick, practical solutions. Transformers specially designed for all types of electrical and electronic circuits, as well as a wide selection of standardized designs . . . produced in quantity . . . with quality. Call your nearby Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70569

Westinghouse
SPECIALTY TRANSFORMERS

is described elsewhere[1,2].

It is well known that the strength of received skywave signals is a function of the absorption of the wave by the ions in the ionosphere. The absorption in turn is proportional to the collisional frequencies of the ions and this is closely related to the thermal energy of the ions.

Consider then, the relation between the thermal energy of an electron and the presence of a radio wave. When a radio wave traverses the ionosphere there is an exchange in energy and some of the energy of the radio wave is transferred to the electron. Thus the agitational energy of the electrons is increased to a value greater than the thermal energy. When the agitational energy of the electron exceeds the thermal energy the statistical balance is upset and energy is transferred from the electron to the molecules at each collision. This results therefore in an overall increase in the mean thermal energy level and there is an accompanying increase in the collisional frequencies of the ions or indirectly an increase in the absorption coefficient of the ionosphere.

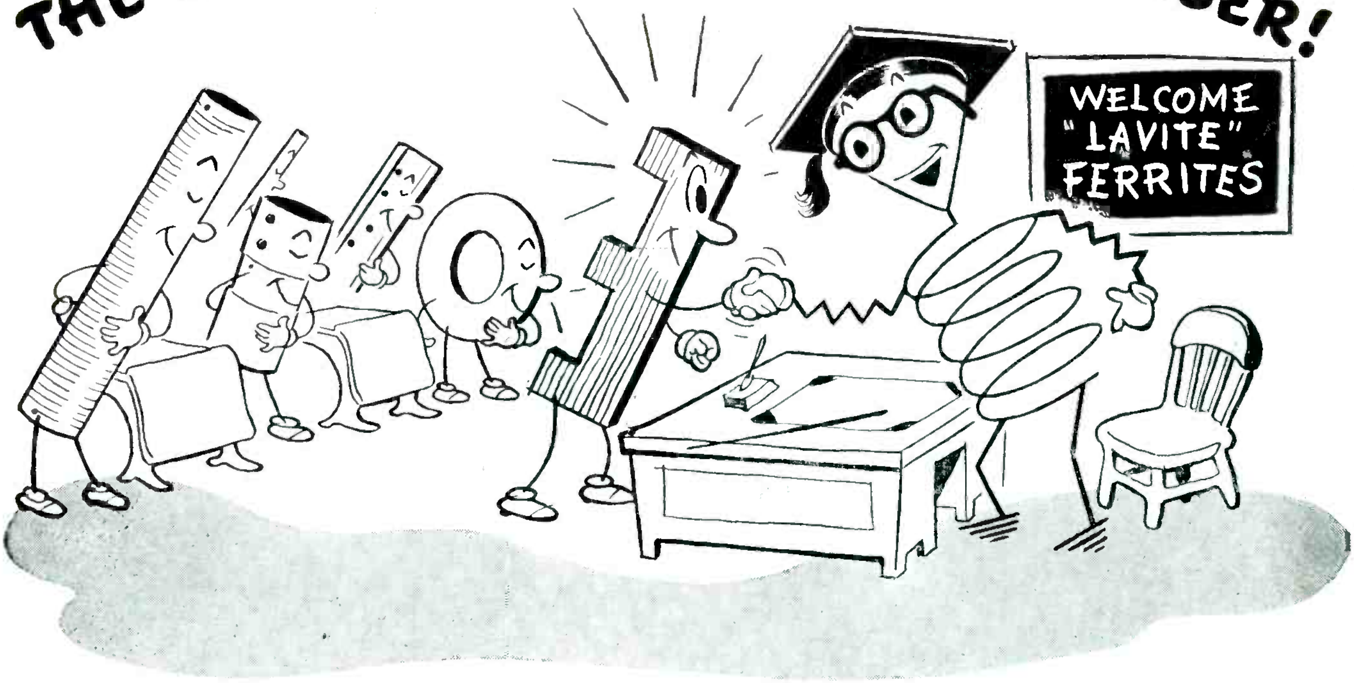
If a second wave now traverses this disturbed portion of the ionosphere it is apparent that it will be subject to a degree of attenuation due to the presence of the first disturbing wave. If the disturbing wave is removed there is an immediate decrease in the attenuation of the wanted wave. Thus a repetition of this process will permit observation of the phenomena of ionospheric cross modulation.

If, however, it is not convenient to pulse modulate the disturbing wave the desired end is achieved by simply amplitude modulating the disturbing wave. This will result in an alternate heating and cooling of the electrons and there will be a periodic variation of the absorption of the wanted wave. The wanted wave will therefore appear modulated and this transferred modulation may be detected on reception of the wanted wave.

Method of Observation

In order to observe the ionospheric cross modulation an experi-

THE "Lavite" CLASS HAS A NEW MEMBER!



Believe me — this new "Lavite" member is a scholar of top flight. "Lavite" Ferrites is mighty versatile. He will reduce the size and weight of your television and frequency modulation components — he offers you: (1) high saturation; (2) higher permeabilities; (3) high Q at FM frequencies; (4) low temperature coefficient of permeability; (5) replacement of conventional magnetic materials at power frequencies; and (6) unlimited application possibilities. But wait — look at his scholastic record below for yourself.

Let me recommend a few Ferrite suggestions to you in connection with your present requirements without obligation — send me your specifications.

D. M. STEWARD MANUFACTURING CO.

3604 Jerrome Avenue Chattanooga, Tennessee

Sales Offices in Principal Cities

And Remember— these are non-critical materials!

• *Ask for general characteristic data on all "Lavite" Technical Ceramics ("Lavite" Steatites, "Lavite" Titanates, "Lavite" Ferrites and others).*

CELEBRATING OUR 75th ANNIVERSARY 1876 1951

TABLE OF PROPERTIES "LAVITE" FERRITES

Property	Symbol	Unit	High Frequency FX-6S Type I	FX-22S Type II	High Saturation FX-15S	Transformer Core Body FX-27S	Antennae Rod Body FX-18S	High Permeability Body
Initial Permeability	μ_o		8–11	15–20	250	850	300	1000
Maximum Permeability	μ		100	120	3000	4000	750	5000
Saturation Magnetization	Bs	Gauss	600	900	5000	3500	3000	4000
Coercive Force	Hc	Oerstad	3.7	3.7	1.0	.25	.80	.15
Q	Q		8% higher than Air Coil	15% higher than Air Coil	33	37	120	5
Curie Point		°C	+200	+200	200	+150	200	150
Temp. Coefficient of μ_o		%/°C	.03	.03	.45	.50	Less than 3.5 (from 80° to 140° F)	.10
Recommended Range for Application			20–200Mc	1–20Mc	1–150Kc	1–150Kc	1 Mc	1–150 Kc
1/μQ Factor							0.000030	
Residual Magnetic	B_r	Gauss	500	615	1900	1500	1600	1500
Resistivity			10^6	10^6	10^6	10^6	10^7	10^6

ment was devised making use of broadcasting stations KYW and WRVA on 1,060 kc and 1,140 kc respectively. The geometry of the experiment is illustrated diagrammatically in Fig. 2. The directional characteristics of the KYW transmitter are utilized so that the effective disturbing power is approximately 113 kilowatts.

The experiments were conducted at 2:00 a. m., EST from June 6 to June 10, 1950 inclusive and were of twenty minutes duration. The transmitter at KYW modulated its carrier to depth of 98 percent with a 100-cps tone. KYW operated with the tone on four minutes and off one minute throughout the test. At 2:15 a. m. KYW cut its carrier.

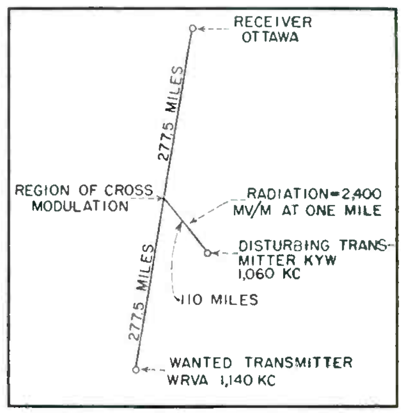


FIG. 2—Experimental setup for studying ionospheric cross modulation

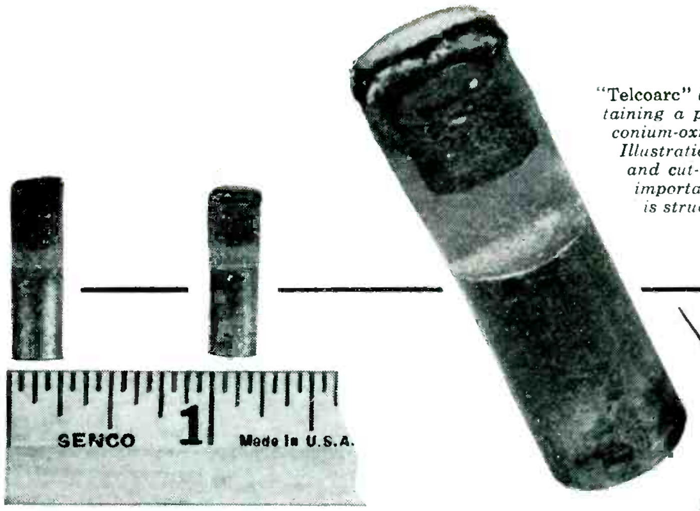
A receiver in Ottawa was tuned to WRVA 1,140 kc, which operated unmodulated on June 6 and 7 and modulated 30 percent with a 440-cps tone on June 8, 9 and 10.

A radio wave analyzer was used in conjunction with the Ottawa receiver to detect and measure the amplitude of the 440 cycle tone and the transferred one hundred cycle tone.

In addition a second receiver in Ottawa made field strength recordings on WRVA and the time that KYW cut its carrier was marked on these records.

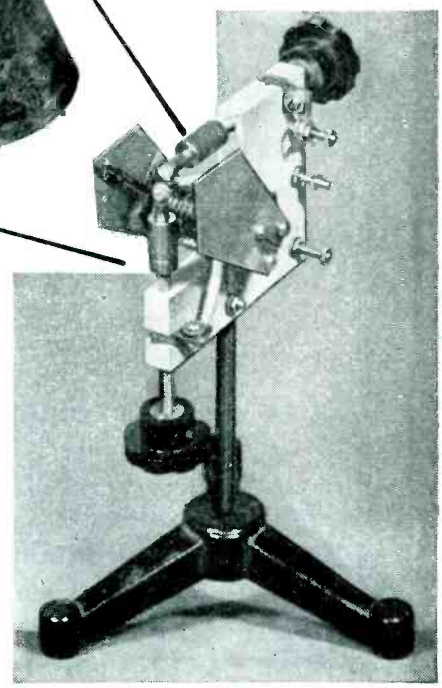
The transfer of the one hundred cycle tone to the WRVA carrier was detected on each of the five nights. The tone was audible in the speaker and was detected by the wave analyzer.

On the latter three tests it was



"Telcoarc" *lamp electrodes are nickel tubes containing a powdered core mixture of 87% zirconium-oxide, 8.7% nickel and 4.3% iron oxide. Illustration shows cut-away of new electrode, and cut-away of used electrode showing the important zirconium cap on which the arc is struck.*

1/8 as bright as the sun ...from 1/4" electrodes



"Telcoarc" *lamps, says Western Union Telegraph Company research, will prompt major developments in the projection, television, photographic, lithographic and photo copying industries, as well as in the medical field. They operate on either AC or DC.*

Another tough metal problem solved by the use of Nickel

Western Union's open-air "Telcoarc" lamps give a controlled, concentrated spotlight one-eighth as bright as the sun. Yet the light is produced by only quarter-inch diameter nickel tube zirconium electrodes.

More than the light, the most unique fact about these lamps is the exceptional long life of the electrodes. In *open-air* at 650 watts, they are consumed at the rate of one inch in 100 hours.

It was no easy task to develop these electrodes. First the engineers had to find a metal for the outer tube to hold the zirconium-oxide filler—*a metal that did not oxidize readily.*

They tested a wide variety of materials. Then they tried Nickel!

The first Nickel tube electrode showed promise; but the core gave trouble. A poor conductor when cold, it had to be heated through the nickel outer tube. Also, a fragile oxide bead formed on the end of the electrode. These two defects indicated the need for a material to be added to the zirconium-oxide, in order to make it conductive when cold, and also to bond the bead and filler to the nickel tube.

More tests were made. Finally, zirconium metal powder was mixed with powdered nickel and pressed into the tube. When tested, the electrode performed satisfactorily and did not progressively oxidize, even with temperatures as high as 6500°F.

* *

Good conductivity and resistance to high temperatures make nickel a valuable and economical metal for use in electronics. For example . . . to weld tungsten filament leads . . . and leads on miniature components.

If you have a special design problem, it will pay you to consider Inco Nickel Alloys. Although much of Inco's production is being diverted to defense, our Technical Service Dept. will be glad to assist you on your problems. Write for "66 Practical Ideas for Metal Problems in Electrical Products."

• • •

MONEL® • "R"® MONEL • "K"® MONEL "KR"® MONEL • "S"® MONEL • NICKEL • LOW CARBON NICKEL • DURANICKEL® • INCONEL® INCONEL "X"®

INCO TRADE MARK

The International Nickel Company, Inc.
67 Wall Street, New York 5, N. Y.

found that the WRVA carrier was modulated to a depth of 0.60 to 0.75 percent by the transferred one hundred cycle tone.

There was no noticeable change in WRVA field strength when KYW cut its carrier.

The transferred modulation was subject to various degrees of stability from intermittent on one or two nights to steady (except for normal fading) on the first two nights.

Precautions Taken

The use of the wave analyzer eliminated any possibility of a confusion of the transferred tone with any background hum (power supply) that may be present. It was verified that the transferred tone disappeared immediately upon the removal of the modulation from the KYW carrier.

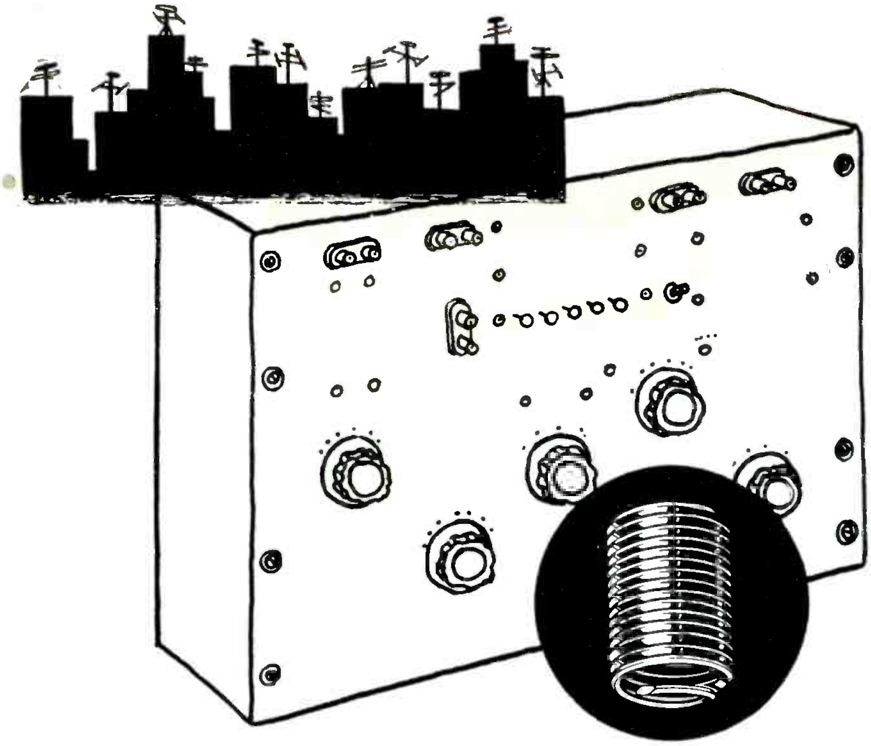
To establish that the phenomenon was not local in origin several checks were made of stations adjacent to the 1,140-kc channel, however, the transferred tone was present only on the WRVA carrier.

The audio tuning of the wave analyzer was varied and there was no signal detected at frequencies other than 100 cycles (exceptions of course was 440 cycles).

This may be considered one of the most consistent phenomenon observed in ionospheric studies in that the transferred tone was detected on each of five consecutive nights. The transfer was evident throughout various degrees of absorption but the dependance on absorption, if any, could not be determined.

The transfer of the audio signal was effected by a disturbing power of approximately 113 kw at KYW. Assuming a linear relationship between power and transferred modulation, modulation of a wanted carrier to a depth of 10 percent would be possible with a disturbing power of a megawatt.

Available literature on the subject indicates that a greater transfer of modulation, then detected in these investigations, is to be expected. This leads us to conclude that perhaps the conditions of these tests were not optimum and more satisfactory results would be obtained with a mobile receiver. A



disturbing transmitter operating on a lower frequency would also contribute to a greater degree of transferred modulation.

It is the desire of the author to extend an expression of gratitude to the Federal Communications Commission and the operators of KYW and WRVA for their kind assistance and co-operation which made the experiment possible.

REFERENCES

(1) L. G. H. Huxley and J. A. Ratcliffe, A Survey of Ionospheric Cross Modulation, *The Proceedings of the Institution of Electrical Engineers*, 96, Sept. 1949.

(2) L. G. H. Huxley, Ionospheric Cross Modulation at Oblique Incidence, *Proceedings of the Royal Society*, **200**, 1950.

Frequency Characteristics of Woven Resistors

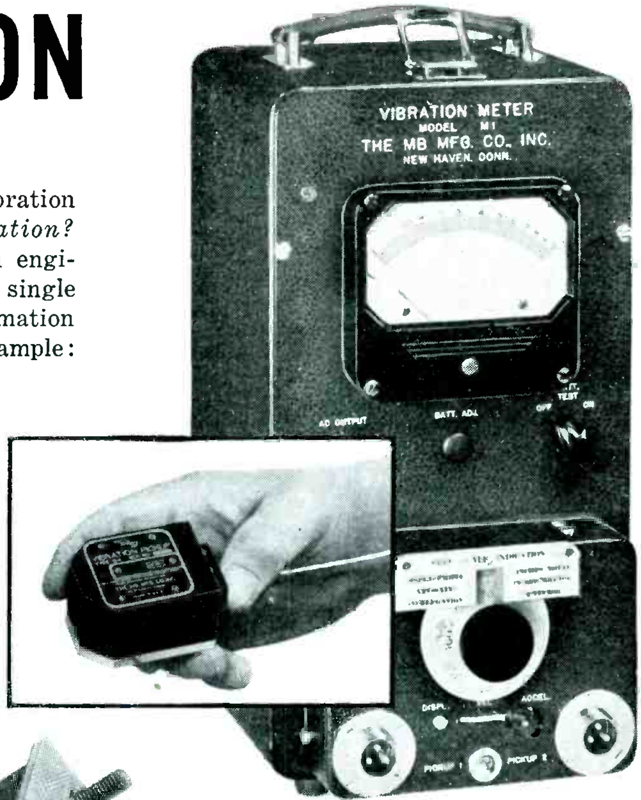
By LAVERGNE E. WILLIAMS
Associate Professor of Electrical Engineering

EDWARD J. ROBB
Assistant Professor of Electrical Engineering
University of Connecticut
Storrs, Connecticut

WHAT is the inductance of a non-inductive woven resistor? The authors have been called upon to answer this question by concerns engaged in work requiring the use of high-power, radio-frequency, and pulse loads. The customer usually finds that the frequency characteristics of commercially available power resistors cannot be furnished by the manufacturer. This paper supplies quantitative data on several types of woven resistors and describes the methods used to improve their frequency characteristics.

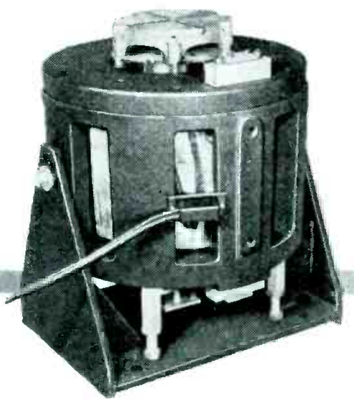
Woven resistors are not new to the electronic art. They have been widely used for heating elements and power loads at frequencies up to several megacycles. Their mechanical flexibility, ease of mounting and cooling and low cost are attractive features for many applications. They can be made in a wide variety of ohmic resistance and wattage values; the ranges of these values can be greatly expanded by using the resistors in series and parallel combinations. Physical size and shape can be made to conform to the specifications of the applica-

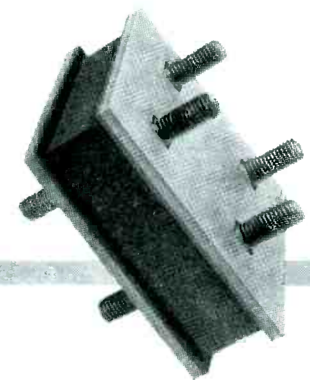
How MB can help you MEET MILITARY SPECIFICATIONS ON VIBRATION



DOES YOUR MILITARY PRODUCTION require vibration *testing?* Shock *absorption*—vibration *isolation?* Representative of MB's specialized vibration engineering, these products show that, from a single source, you can get the equipment and information you need to meet your requirements. For example:

1. **MEASUREMENT** of vibration with MB vibration pickup and meter supplies data for study of disturbing frequencies and for design adjustments. The electrically damped and highly sensitive pickup is convertible for horizontal or vertical operation. Meter gives you accelerations, velocities or displacements of the vibrations directly. Made for each other, the two are the "eyes" for any vibration testing program.





2. **SHAKE TESTING TO MIL-E-5272 and 41065-B** is easily accomplished with MB Vibration Exciters. Model S-3 shown delivers 200-lb force. Others available with 10-lbs to 2500-lbs force ratings—all easily, quickly and accurately controlled for force and frequency.

3. **ISOMODE* SHOCK MOUNTS** have been developed for supporting and protecting aircraft engines from damage while transported in crates or "cans." High load capacity combined with high deflection capacity provides good absorption of shock. **Reg. U.S. Pat. Off.*

4. **MIL-I-5432** (AN-I-16a) can be met with the Type 17 ISOMODE Mount. This unit available for loads from 0.5 to 100 pounds, and controls all modes of vibration with equal efficiency because of equal spring rate in all directions.

Remember, if you need help with a vibration problem, you can save yourself time and work by contacting MB's vibration specialists. For details on any of the above products, address your inquiry to Dept. N5.

THE MB MANUFACTURING COMPANY, Inc.
1060 State St., New Haven 11, Conn.

PRODUCTS FOR MEASUREMENT . . . REPRODUCTION . . . AND CONTROL OF VIBRATION

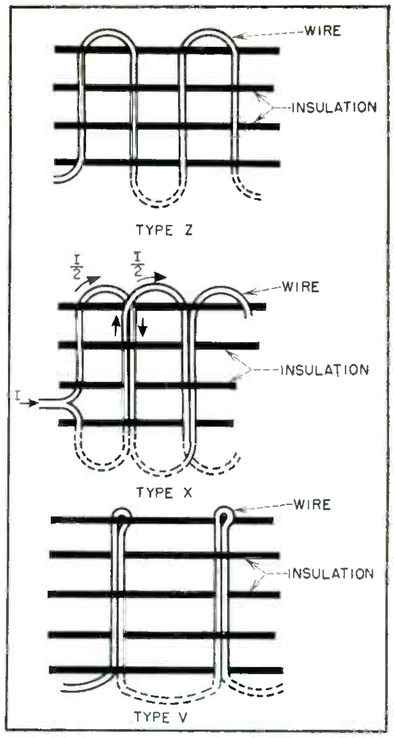


FIG. 1—Different patterns used in making woven resistors

tion, though these determine, to some extent, the reactance characteristic.

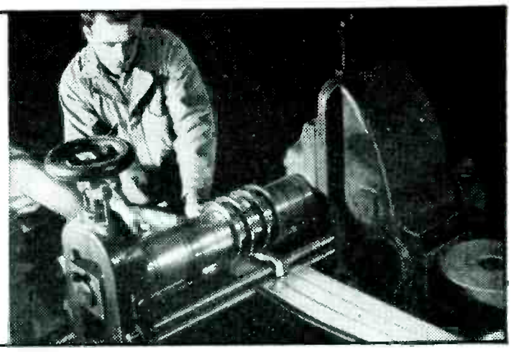
For the purpose of comparison, several resistors were constructed using alloy C wire. All had a direct-current resistance of approximately 90 ohms and a wattage rating of about 500 watts. They were rectangular in shape and about 6 by 8 inches in size. The resistors were woven with cotton and asbestos and impregnated with insulating cement for rigidity. Flexible pig tails were silver-soldered to the ends of the resistance wire (before weaving) and were brought out at opposite ends of the resistor. All measurements were made with a General Radio 916-A bridge and the inductance values presented include the inductance of the pig tail leads from the resistor to the bridge.

Three types of weave were investigated. These are shown in Fig. 1 as the conventional zig-zag (identified here as Type *Z*), the double zig-zag or opposing parallel (Type *X*), and a modified form of Type *Z* (Type *V*). Several resistors of the conventional zig-zag type were constructed to provide a comparison of the relative merits of solid wire

CHASE warehouses from coast to coast offer complete metal cutting services!

These 11 Chase warehouses do SLITTING

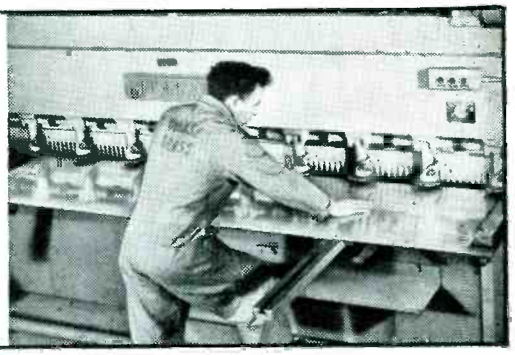
CINCINNATI
PROVIDENCE
LOS ANGELES
INDIANAPOLIS
CHICAGO
PHILADELPHIA
MILWAUKEE
ST. LOUIS
DETROIT
NEW YORK
NEWARK



These 7 Chase warehouses do SHEARING

CHICAGO
PHILADELPHIA
MILWAUKEE
ST. LOUIS
DETROIT
NEW YORK
NEWARK

These warehouses also do slitting



These 4 Chase warehouses do SAWING

DETROIT
NEW YORK
NEWARK
CHICAGO

These warehouses also do slitting and shearing

When it comes time for slitting, shearing or sawing, check the Chase Warehouses listed above for the cutting facilities each of them have.

Naturally, this work is done to your specifications on orders for metals we are able to fill. We'll help out, too, on *your* brass, bronze, copper, aluminum, steel, fibreboard or other materials. Just tell us how you want it. The work will be done accurately.

As usual—call Chase!

Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

CHASE 75th ANNIVERSARY 1876 1951

• *The Nation's Headquarters for Brass & Copper*

Albany† Atlanta Baltimore Boston Chicago Cincinnati Cleveland Dallas Denver† Detroit Houston† Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester† St. Louis San Francisco Seattle Waterbury

(†sales office only)

and stranded wire. In the case of the double zig-zag construction, the effect of twisting the stranded wire was investigated.

Resistance and reactance variations with frequency for the 90-ohm resistors are shown in Fig. 2A and 2B, respectively. The curves identified as Z_1 show the characteristics of type Z resistor woven with solid wire. The series inductance of this resistor was 5.95 microhenrys.

To reduce the self-inductance and skin effect, several type Z resistors were constructed using stranded glass-insulated wire. Resistor Z_2 was woven with 5 strands of No. 34 wire and Z_3 with 12

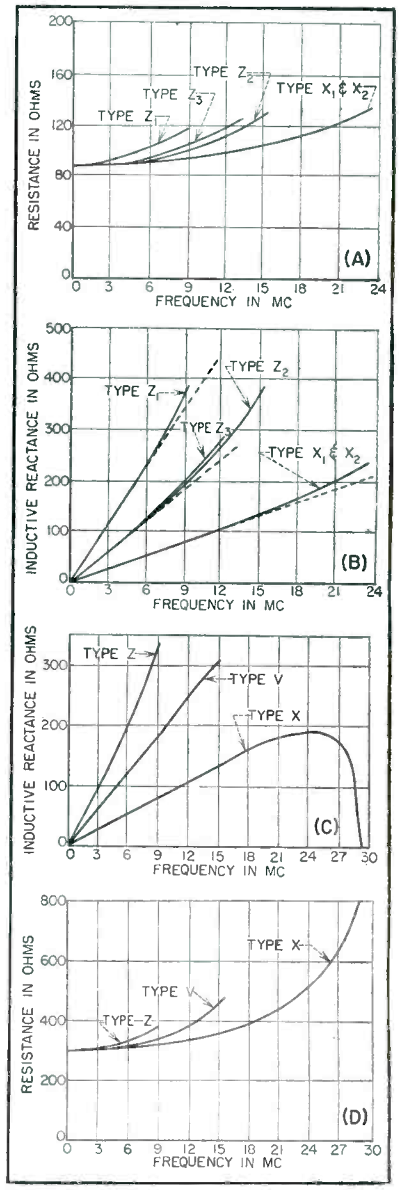
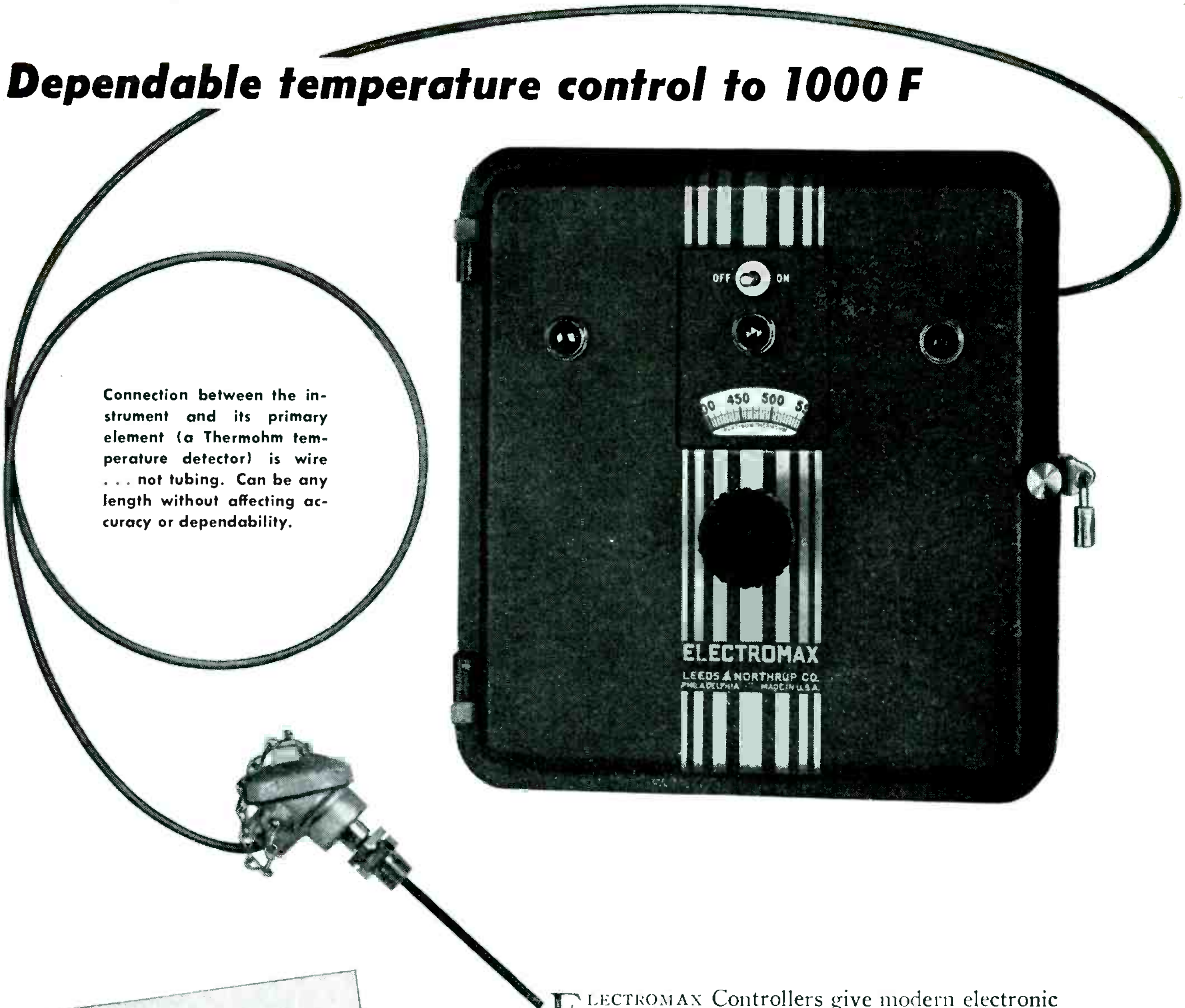
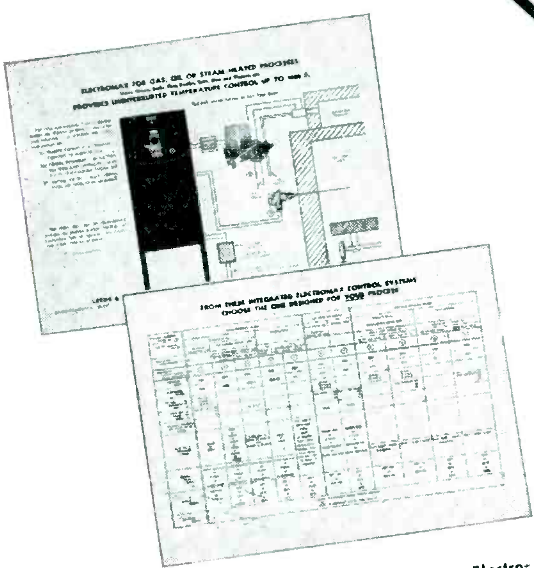


FIG. 2—Curves show dependence of woven resistor characteristics on frequency

Dependable temperature control to 1000 F



Connection between the instrument and its primary element (a Thermohm temperature detector) is wire . . . not tubing. Can be any length without affecting accuracy or dependability.



Typical samples of the information available on Electromax Control. Specify nature of process and whether fuel is gas, oil, steam or electricity.

ELECTROMAX Controllers give modern electronic regulation to thousands of important manufacturing processes. In any application up to 1000 F they exactly fill the bill for non-recording controllers of outstanding dependability.

Electromax has the sensitivity, accuracy and dependability of its big brother Speedomax Recording Controller. Likewise, it is not affected by vibration or building tremors . . . can even be mounted on the frame of a molding press. The instrument needs almost no attention, because it has only one moving part . . . a covered plug-in type relay. There's usually no need to open the instrument door for months at a time.

Electromax Control is available to provide any one of three control actions. For the more simple process requirements, on-off or two position control is usually used. For processes requiring control within unusually close limits, two different types of proportional control are available . . . Position-Adjusting Type and Duration-Adjusting Type. All three types of control action can be applied to electric, steam or fuel heating.

For further information, write our nearest office, or 4979 Stenton Ave., Phila. 44, Penna.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl Ad ND47(2)

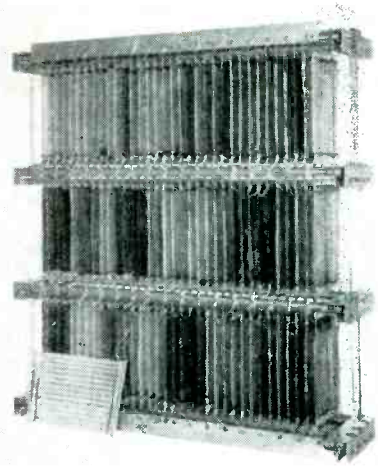


FIG. 3—Woven resistor 9.95-ohm pulse load with 50-kw power rating

strands of No. 37 wire. The self-inductance of Z_2 was 3.18 microhenrys or about one-half that of Z_1 which was made with solid wire. Slight constructional differences and different wire sizes may account for the fact that the 5-strand resistor Z_2 appears to be slightly better than the 12-strand resistor Z_3.

Type X resistors (double zig-zag) were constructed with 12-strand No. 37 wire in which the 12 strands were grouped into bundles. Half of the strands carry current in one direction and the other half carry current in the opposite direction. This is essentially a parallel-opposing arrangement somewhat similar to the Ayrston-Perry winding. In one case, identified as X_1, the strands were twisted. In the second resistor X_2, the strands were parallel (untwisted). No significant difference in the frequency characteristics was observed. The series inductance in each case was 1.34 microhenrys.

The dotted lines in Fig. 2A and 2B have been drawn to aid in calculating the series inductance for each resistor type. They also show the effect of the shunting capacitance which increases the effective inductive reactance in the frequency range shown.

A second set of resistors were woven that had a nominal d-c resistance of 300 ohms. All of these contained two parallel strands of No. 34 wire and one resistor of each type was tested. The experimental

Don't be "blinded" to your future!

THE COURSE OF YOUR CAREER may depend upon what you do about your future—now. A sure way to miss success is to miss opportunity.

Now is the time for qualified ELECTRONIC, ELECTRICAL and MECHANICAL ENGINEERS . . . PHYSICISTS . . . METALLURGISTS . . . CHEMICAL and CERAMIC ENGINEERS . . . as well as TECHNICAL SALES ENGINEERS to decide to take full advantage of the opportunities now open at RCA to achieve professional success.

LIFELONG CAREER OPPORTUNITIES

These are not temporary positions. They are independent of national defense requirements. The openings represent a wide choice of long-term government projects as well as challenging work in the permanent expansion of a diversified line of commercial products.

YOU ENJOY THESE BENEFITS

At RCA, you enjoy professional status, recognition for accomplishments . . . unexcelled research facilities for creative work . . . opportunities for advancement in position and income . . . pleasant surroundings in which to work. You and your families participate in Company-paid hospital, surgical, accident, sickness and life insurance. Modern retirement program. Good suburban or country residential and recreational conditions. Opportunities for graduate study. Investigate opportunities today.

POSITIONS OPEN IN THE FOLLOWING FIELDS:

TELEVISION DEVELOPMENT— Receivers, Transmitters and Studio Equipment

ELECTRON TUBE DEVELOPMENT— Receiving, Transmitting, Cathode-Ray, Phototubes and Magnetrons

TRANSFORMER and COIL DESIGN

COMMUNICATIONS— Microwave, Mobile, Aviation, Specialized Military Systems

RADAR— Circuitry, Antenna Design, Computer, Servo-Systems, Information Display Systems

INDUSTRIAL ELECTRONICS— Precision Instruments, Digital Circuitry, Magnetic Recording, Industrial Television, Color Measurements

NAVIGATIONAL AIDS

TECHNICAL SALES

ELECTRONIC EQUIPMENT FIELD SERVICE

Whatever your plans for the future—you will find the booklet "The Place of the Engineer in RCA" interesting reading. Write for your *free* copy.

MAIL RESUMÉ

If you qualify for any of the positions listed above, send us a complete resumé of your education and experience, also state your specialized field preference. Send resumé to:

MR. ROBERT E. McQUISTON,
Specialized Employment Division, Dept. U-36
Radio Corporation of America,
30 Rockefeller Plaza,
New York 20, N. Y.

RADIO CORPORATION of AMERICA

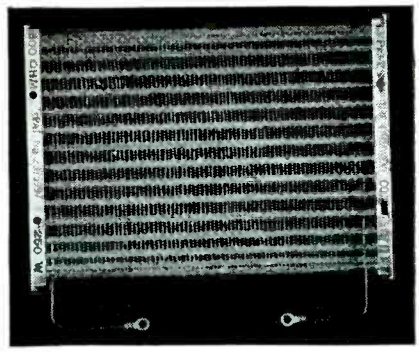


FIG. 4—Close-up of single woven element of 50-kw load shown in Fig. 3

results are shown in Fig. 2C and 2D.

In general the results indicate that the Type *V* is an improvement over Type *Z* but the Type *X* has, by far, the best frequency characteristics. The reactance and resistance curves for the Type *X* resistor were carried through the resonance frequency, and the shape of the curves indicate that the equivalent circuit for the resistor is approximated reasonably well by a series resistance and inductance shunted by a capacitance.

Figure 3 is a photograph of a 50-kw, 9.95-ohm pulse load that utilizes woven resistors, and Fig. 4 is a close-up photograph of a single resistor.

All resistors used in these tests were woven by W. J. Larson of the Ohmweve Company, Hartford, Connecticut.

Bridged-Tee Phase Modulators

BRIDGED-TEE phase modulators have been successfully used in circuits related to radio telemetering, frequency modulation, servomechanisms, and other applications where variable impedance control of phase is required.

Generally, lattice networks which are used for variable-resistance or variable-reactance control of phase require push-pull circuits symmetrical to ground and simultaneous variation in two circuit elements to produce phase modulation. Many of these circuits do not permit grounding one side of the input or output or one end of the controlling impedance. A serious limitation of some networks is the change in attenuation accompanying phase

Here's progress

in transformer core steel

These curves indicate the improvement in properties of Armco Silicon Steels for distribution transformers during the last 20 years.

Note how new Armco TRAN-COR 4-W-O makes it possible to build high-efficiency transformers with low material weight per KVA. Yet there is no increase in core loss or excitating current.

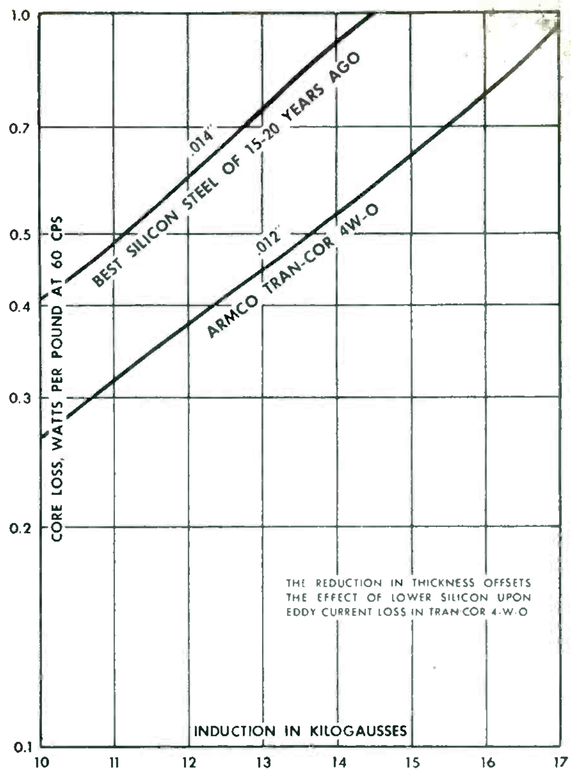
Both Armco TRAN-COR 3-W-O and TRAN-COR 4-W-O are only .012" thick—more easily wound into transformer cores. They make possible redesigns that should permit smaller cores and a saving of copper.

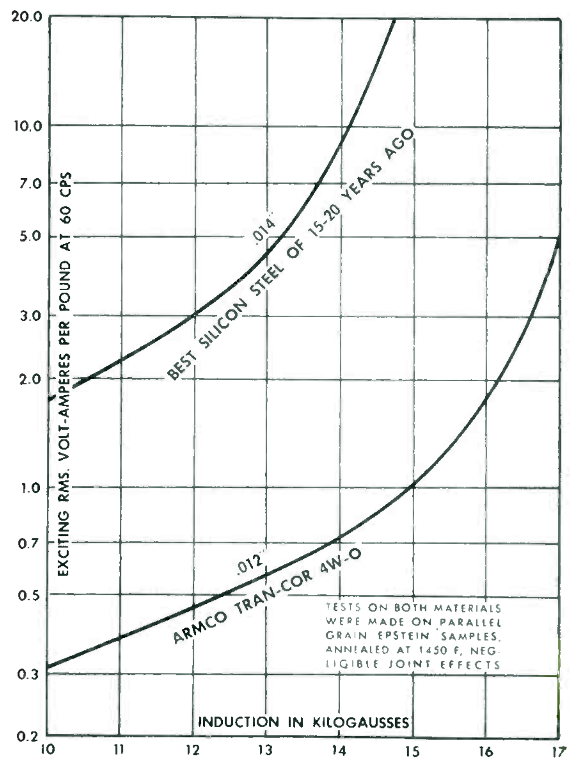
Core loss limits

Armco TRAN-COR 3-W-O and TRAN-COR 4-W-O have core loss limits at 15 kilogausses of .71 and .64 watts per pound respectively.

As Armco Oriented Electrical Steels are fully annealed at the mill, only a moderate temperature (1475 F.) is required to remove the stress introduced by fabricating, and to regain excellent magnetic properties in the formed or stamped core.

Economies resulting from top-notch efficiency in the new Armco "W" series offer many advantages in wound cores of distribution transformers. They save time and money in production, often require less copper, and assure unusually low core loss in operations at high inductions.





ARMCO STEEL CORPORATION

4201 Curtis Street, Middletown, Ohio • Plants and Sales Offices from Coast to Coast • Export: The Armco International Corporation modulation, corrective measures often taking the form of amplitude limiters which follow the phase modulating network. In addition, many networks cannot be loaded appreciably.

The bridged-tee phase modulators overcome all of these restrictive characteristics of networks. Wide-range phase shift with constant attenuation is achieved by variation in a single control impedance. In one version, the circuit may be adapted for voltage control of phase, thus providing a simple and highly stable phase modulator useful in radio communication. The circuits function with a common ground and have the ability to work into low-resistance loads.

The modulator circuit shown in Fig. 1 is designed to obtain a phase shift by varying either the capacitance C_2 or the frequency. With the values of the circuit components as shown and an operating frequency of 4,170 cps, the circuit attenuation remains constant at 16 db and the phase shifts 90 deg as C_2 is varied from zero to 25 $\mu\mu$f.

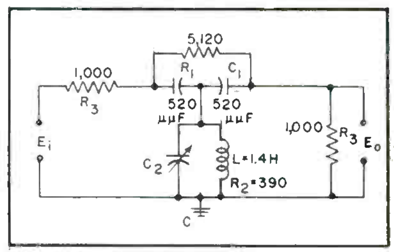
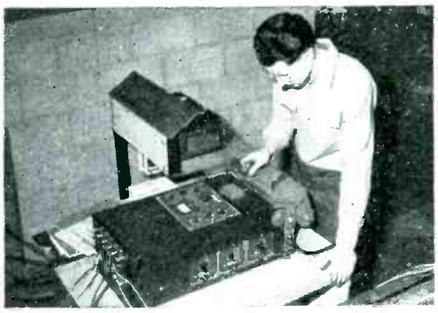


FIG. 1—Bridged-tee circuit for producing phase shift by varying either capacitance or frequency of signal

With C_2 made equal to zero, the bridged-tee network of Fig. 1 functions as a frequency discriminator. As the input frequency is varied from a few cycles per second to approximately 8,000 cycles per second the phase shifts nearly 360 deg while the attenuation remains constant. The phase characteristic is quite linear in the neighborhood of the center frequency.

If R_1 = 114 ohms, R_2 = 1.75 ohms, R_3 = 50 ohms, C_1 = 10.5 $\mu\mu$f, and L = 1.44 μhy, and the circuit is operated at a frequency of 29.1 mc, the phase may be shifted by varying C_2. The attenuation re-

G-E Instrument NEWS



PM-10 Oscillograph Used for Engineering Testing Checks

Electric Products Company of Cleveland, Ohio, are currently using the G-E Type PM-10 oscillograph in engineering tests to check against calculated design characteristics. Electric Products, manufacturers of specialty electric rotating equipment, has found that the PM-10 provides dependable permanent and complete records. These compact case-histories of the tests are then available at any time for their reference and study.

Electric Products has found that the PM-10 will test and record starting, intermediate and full load torque, as well as current and acceleration characteristics.

The General Electric Type PM-10 oscillograph features: simultaneous viewing and recording of as many as twelve separate functions, frequency response up to 7,000 cycles per second, timing lines photographed on the film, and self-contained control rheostats. Convenient and simple to use—the PM-10's wide frequency of response and high sensitivity make it adaptable to many applications.

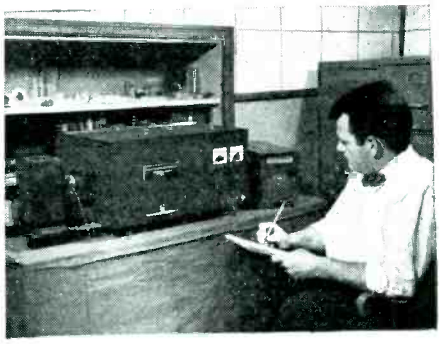
Phoenix Precision Instrument Co. Recommends G-E Galvanometer for Use with Photometer

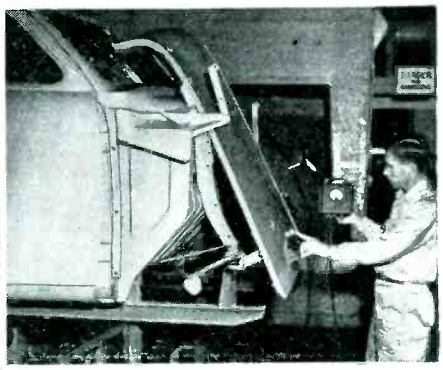
Light Scattering Photometer Aids Study of Vital Dextran

"We prefer the G-E galvanometer because of its simplicity of zero adjustment. Furthermore, it has the short-time response period needed for use with our photometer. Because of these features, we recommend its use in conjunction with the Phoenix B-S light-scattering photometer," reports Mr. Edward J. Fuhrmeister, co-owner of Phoenix Precision Instrument Co., Philadelphia, Pa.

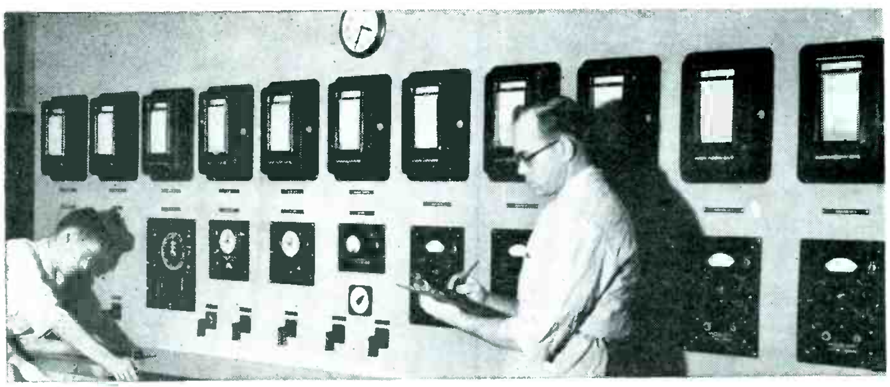
Phoenix Precision Instrument Co., manufacturer of scientific equipment, advises that its customers are currently using their light scattering photometer and the G-E galvanometer to determine the molecular weight of Dextrans, a blood plasma substitute urgently needed by the Armed Forces and Civilian Defense Agencies. Many industrial laboratories, universities, and government agencies are using this instrument combination to measure the molecular weight of high polymers, proteins, and other molecules. The instruments can also be used to measure absolute turbidity, depolarization and dissymmetry of scattering, molecular weights ranging from several hundred to several million, particle size in suspensions, microfluorescence, and extremely low specular or diffuse reflectance and transmittance.

Useful for measuring low values of current or voltage, General Electric portable galvanometers are supplied in forty-eight different ratings; all employ a light-beam mechanism. Features of these galvanometers include: Strong alnico magnets permit compact design. Suspension elements may be interchanged to suit job requirements. The galvanometers are self-contained—no separate lamp stand or scale is necessary.





Ford Motor Company at Norfolk, Va. uses a G-E Type B magnetic thickness gage to check paint quality and thickness on all its cars and trucks. The G-E gage is portable, versatile in its applications, and highly accurate.



New Air Force Propeller Test Console, built for Wright Field, records torsional and linear vibration, torque, and speed on eleven G-E Type CE photoelectric recorders

SECTION A602-216, GENERAL ELECTRIC
SCHENECTADY 5, N. Y.

Please send me the following bulletins:
Indicate:
√ for reference only
X for planning on immediate project

- ☐ PM-10 Oscillograph (GEC-449)
- ☐ Type B Thickness gage (GEC-319)
- ☐ CE Photoelectric recorders (GEC-254)
- ☐ Galvanometers (GEC-694)

NAME ....

COMPANY ....

STREET ....

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

GENERAL ELECTRIC

mains constant at 12 db and the phase shifts 135 deg as C_2 is varied from zero to 5 $\mu\mu$f. A variation of only 2 $\mu\mu$f in C_2 results in a 90-degree phase shift.

Phase shift is produced in the bridged-tee network shown in Fig. 2 by a variation in the resistance R_2. At a frequency of 4,170 cps, the attenuation of the circuit is constant at 30 db; and when R_2 is varied from zero to 10,000 ohms, the resulting phase shift is about 120 deg.

In Fig. 3 the variable phase-controlling resistor R_2 of Fig. 2 is replaced by a varistor including two germanium diodes; consequently, a variable input control voltage modulates the phase. Static tests at 7,250 kc indicate excellent linearity of phase versus bias voltage over a 90-degree phase shift. The nonlinear characteristic of the biased varistor compensates for the nonlinear phase characteristics of the bridged-tee network, resulting in a remarkably linear phase response over the 90-degree range. As in the other forms of the network, the modulation is effected with no change in attenuation.

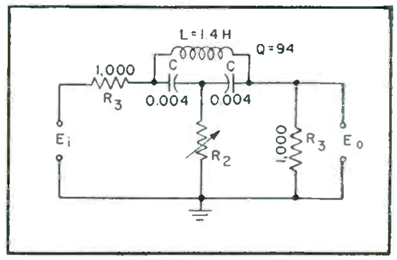


FIG. 2—Variation of resistance R_2 produces phase shift

In the circuit of Fig. 1, in which variable capacitance is the phase controlling element, the following formulas apply:

$$\frac{E_o}{E_i} = -\frac{R_3}{4(R_3 + 2R_2)}\epsilon^{-j2\theta}$$

where $\theta = \text{arc tan}\,\frac{X_{C1}\delta_c}{R_3 + 2R_2}$

provided $\delta_c = \omega^2 LC_2 << 1, Q >> 1,$ $X_{C1} >> R_1,\ X_L = X_{C1}/2,$ and $R_1/2 = R_3 + 4R_2.$

If L or the frequency is considered as the phase controlling vari-

Double Barrel Advertising

Advertising men agree – to do a complete advertising job you need the double effect of both Display Advertising and Direct Mail.

Display Advertising keeps your name before the public and builds prestige.

Direct Mail supplements your display advertising. It pin-points your message right to the executive you want to reach – the person who buys or influences the purchases.

More and more companies are constantly increasing their use of Direct Mail because it does a job that no other form of advertising will do.

McGraw-Hill has a special Direct Mail Service that permits the use of McGraw-Hill lists for mailings. Our names give complete coverage in all the industries served by McGraw-Hill publications – gives your message the undivided personal attention of the topnotch executives in the industrial firms. They put you in direct touch with the men who make policy decisions.

Some people have a wrong conception of Direct Mail. There's no hocus-pocus to it—there's no secret formula—nor is there need for an extensive department to plan and execute your mailing program. You don't even need your own mailing lists.

Probably no other organization is as well equipped as McGraw-Hill to solve the complicated problem of list maintenance in industrial personnel. Our lists are compiled from exclusive sources, based on hundreds of thousands of mail questionnaires and the reports of a nationwide field staff, and are maintained on a twenty-four hour basis.

In view of present day difficulties in maintaining your own mailing lists, this efficient personalized service is particularly important in securing the comprehensive market coverage you need and want.

Ask for more detailed information today. You'll be surprised at the low over-all cost and the tested effectiveness of these hand-picked selections.

McGRAW-HILL
PUBLISHING COMPANY, INC.
330 WEST 42nd STREET, NEW YORK 18, N. Y.

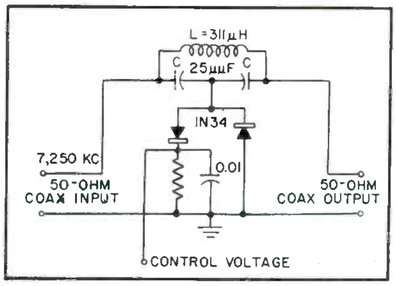


FIG. 3—Bridged-tee phase modulator responds to voltage changes

able in Fig. 1, the following formulae apply:

$$\frac{E_o}{E_i} = -\frac{R_3}{4(R_3 + 2R_2)}\epsilon^{-j2\theta}$$

where $\theta = \text{arc tan}\dfrac{2X_L - X_{C1}}{R_3 + 2R_2}$

provided $X_{C1} >> R_1$, $C_2 = 0$, and $R_1/2 = R_3 + 4R_2$.

The formulas below are applicable to the circuits of Fig. 2 and 3, in which variable resistance is the phase controlling element.

$$\frac{E_o}{E_i} = i\frac{R_3}{4X_C}\epsilon^{+j2\theta}$$

where $\theta = \text{arc tan}\dfrac{X_C}{R_3 + 2R_2}$

provided Q (inductor) $>> 1$, and $X_L = 4X_C >> 2R_3$.

The bridged-tee phase-shifting circuits described were developed at the National Bureau of Standards for use with variable-resistance or variable-reactance telemetering pickup devices to produce phase modulation in multiplex time-division telemetering systems, and frequency modulation in multiplex frequency-division telemetering systems.

Applications

The network using voltage-control of phase (Fig. 3) has proved successful as a phase-modulating unit inserted in the coaxial coupling between low-level stages of a frequency-modulated high-frequency transmitter. In general, this bridged-tee phase modulator should be used in low-level applications in which the relatively high attenuation does not incur a serious power loss.

NEW *precision* DIFFERENTIAL *in the* FORD *tradition*

Only 1 Spider Gear

available in:
- 3/16-inch
- 1/4-inch
- 5/16-inch

shaft diameters

This new development, Ford's latest in precision computing mechanisms, incorporating Zerol gears, makes for higher accuracy, far less friction, with a resultant greater life expectancy—a differential of fine Ford precision.

- **LOW FRICTION:** This smooth-running differential is unique—its exceptionally low friction is the same in either direction.
- **HIGH ACCURACY:** Lost motion does not exceed 5 minutes of arc on the 1/4-inch and 5/16-inch differentials and 7 minutes on the 3/16-inch differential.

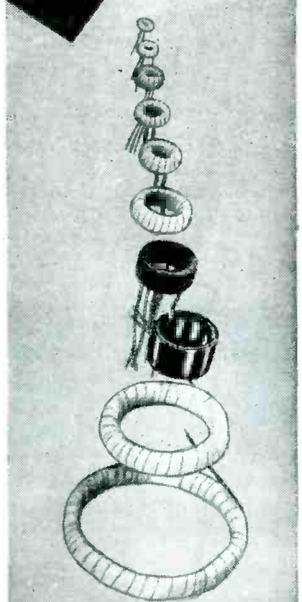
FORD

FORD INSTRUMENT CO.

Division of The Sperry Corporation

31-10 Thomson Avenue, Long Island City 1, N.Y.

IN YOUR NEXT DESIGN... TAKE FULL ADVANTAGE OF THE SUPERIOR CHARACTERISTICS OF... DX TOROIDAL COILS



Where a circuit calls for an efficient coil of a high Q factor—when space and weight are limited, *specify DX TOROIDS.*

DX TOROIDS require less space for a given inductance. They have no coupling effects in adjacent circuits as their fields are entirely contained within the perimeter of the coils. Shielding does not affect the Q.

DX TOROIDS have a wide application in a number of electronic equipments—particularly airborne radar and miniature assemblies. Toroidal "off-center" and focus coils; band pass, high and low pass filters; inter-stage and output transformers improve performance with substantial savings in space.

DX Radio Products Company has devoted 10 years to the development of design and methods of winding TOROIDS. Our experience and extensive facilities are at your service. Just tell us your requirements. We will design your coils or build them to your exact specifications and submit samples promptly.

Write or Wire DX Today

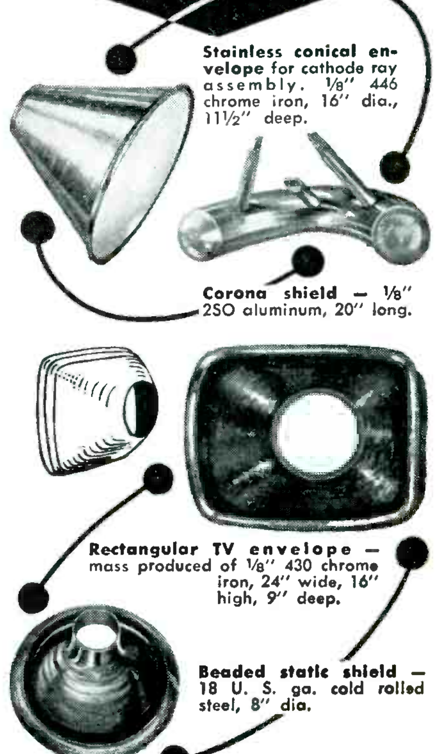
DX COMPONENTS

DX RADIO PRODUCTS CO.

GENERAL OFFICES: 2300 W. ARMITAGE AVE., CHICAGO 47, ILL.

Spincraft
SKILL WILL DO IT ®

provides *a low cost source* for the Production of Electronic Parts



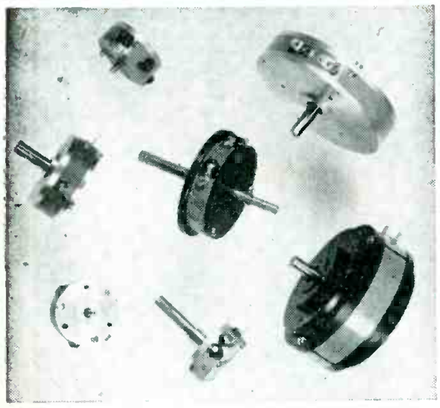
STUDY these illustrations of Spincraft "engineering" — interesting examples of a high order of ability to "work" metal by spinning and fabricating. Best of all, these methods pay off in time gained — and substantially lower costs, both on large and small runs.

Progressive new Spincraft techniques may help simplify your production problem in any metal — just as they have helped others in the electronics industry. Your inquiry is welcome — and you are invited to send for the new Spincraft Data Book, a stimulating source of ideas for engineers, designers and plant production men. Write today.

Spincraft
SKILL WILL DO IT ®
INCORPORATED

4143 W. State St. Milwaukee 8, Wis.

Heretofore known as Milwaukee Metal Spinning Co.



PRECISION POTENTIOMETERS

Type RL-270:

Wedding ring type . . . five sizes charted below. Gamewell Potentiometers are precision instruments in every respect. They feature close limits in electrical characteristics and mechanical construction, low electrical noise, low torque, and long life. All types operate at —55°C. to +55°C., 95% relative humidity at altitudes up to 50,000 ft. Non-linear windings are available.

CONDENSED SPECIFICATIONS	RL-272	RL-270	RL-271	RL-275	RL-277
Diameter (in.)	5	3	2	1⅝	1¼
Rating (watts)	12	6	3	2	1.5
Torque, max. (oz. in.)	1	1	1	½	½
Weight (oz.)	15	6	3	2	1
Mounting: 3 holes ⅛" deep	#8-32	#8-32	#8-32	#6-32	#4-40
Mounting circle diam. (in.)	3.250	1.750	1.250	1.000	1.000
Max. resistance (ohms) ± 10%	500,000	275,000	160,000	105,000	64,000
Min. resistance (ohms) ± 10%	460	250	150	105	80
Max. useful angle (deg.)	358±½	356±½	354±½	352±½	350±½
Max. resolution (%)	0.05	0.08	0.15	0.2	0.25
Min. resolution (%)	0.01	0.015	0.025	0.04	0.05
Linearity (%)	±0.10	±0.10	±0.15	±0.25	±0.30

Standard Shaft: single end, ¾" extension; specify if otherwise.
Double ended shaft special; specify diameter and length.
Multiple sections can be ganged; add ⅜" to the overall length for each additional section.
Terminals will be positioned on the circumference as required for taps and winding angle.
Expected life of all types over 1,000,000 cycles.

FOR COMPLETE DETAILS SEND FOR BULLETIN F-68-A

GAMEWELL TRADE MARK REG. U.S. PAT. OFF.

THE GAMEWELL COMPANY
NEWTON UPPER FALLS 64, MASSACHUSETTS

FOR POSITIVE AND INEXPENSIVE SHIELDING

—use Metex "Electronic Weather Strips"

Because they combine exceptional *resiliency* with good *conductivity*, Metex Electronic Products made of knitted wire mesh offer an unusually effective means of sealing and shielding a wide variety of types of electronic equipment.

As closures for sheet metal cabinets, for instance, the resiliency of "Metex" assures positive conductive contact *at every point* between cover and cabinet —eliminating costly machining for close tolerances. Metex Gaskets also assure resilient metal-to-metal contact between flanges, and can be combined with rubber compounds to function both as a shield and as a seal.

Applications in which "Electronic Weather Strips" have already proved their effectiveness include pulse modulator shields, wave-guide choke-flange gaskets, replacement of beryllium-copper fingers and springs on TR and ATR tubes.

We will be glad to put our experience at your disposal. A letter to Mr. R. L. Hartwell, outlining your problem, will receive immediate study. For preliminary information, write for bulletin "Metex 'Electronic Weather Strips.'"

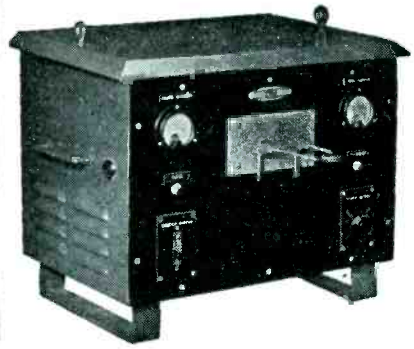
QUALITY METEX PRODUCTS

METAL TEXTILE CORPORATION

641 EAST FIRST AVENUE, ROSELLE, N. J.

---

2 KW VACUUM TUBE BOMBARDER OR INDUCTION HEATING UNIT



For Only $650.

Never before a value like this new 2-KW bench model "Bombarder" or high frequency induction heater . . . for saving time and money in surface hardening, brazing, soldering, annealing and many other heat treating operations.

Simple . . . Easy to Operate . . . Economical Standardization of Unit Makes This New Low Price Possible.

This compact induction heater saves space, yet performs with high efficiency. Operates from 220-volt line. Complete with foot switch and one heating coil made to customer's requirements. Send samples of work wanted. We will advise time cycle required for your particular job. Cost, complete, only $650. Immediate delivery from stock.

Scientific Electric Electronic Heaters are made in the following ranges of Power: 1-2-3½-5-7½-10-12½-15-18-25-40-60-80-100-250KW.

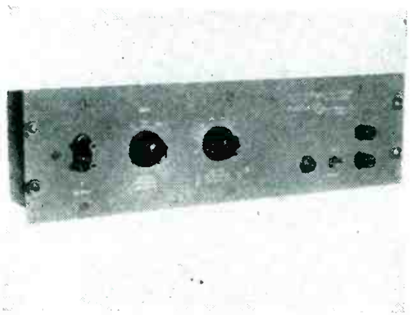
Scientific Electric

Division of

"S" CORRUGATED QUENCHED GAP CO.

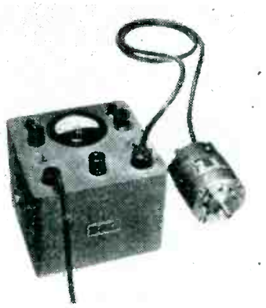
107 Monroe St., Garfield, N. J.

virtually all of the low voltages required in the normal experimental laboratory setup. It features two regulated d-c supplies completely independent and isolated from ground and each other. They may be used singly or in any combination with either the positive or negative terminal grounded. In addition, a filament supply, a negative 150-volt bias supply and a nominal 28-volt d-c supply (suitable for relay, small motor or similar applications) are included in the unit.



Sonic Response Indicator

PANORAMIC RADIO PRODUCTS, INC., 10 South Second Ave., Mt. Vernon, N. Y., has brought out the model G2 sonic response indicator to be used as an adjunct to the model AP-1 sonic analyzer. The new instrument may be used for research, development or production line testing of the frequency response characteristics of amplifiers, speakers, filters, transmission lines and receivers. It has a calibrated frequency scale, a linear or logarithmic (40-db range) amplitude scale, and logarithmic frequency sweep, with 1-cps sweep rate. Output of the device being tested need be only 500 μv for full-scale deflection.



Motor Control

INDUSTRIAL CONTROL CO., Straight Path and Arlington Ave., Wyan-

S.S.White MOLDED RESISTORS

The resistors that give you...

- ***Inherent low noise level***
- ***Good stability in all climates***

STANDARD RANGE
1,000 OHMS TO 9 MEGOHMS

These resistors are used extensively in commercial equipment, including radio, telephone, telegraph, sound pictures, television, etc. They are also used in a variety of U.S. Navy equipment.

HIGH VALUE RANGE
10 TO 10,000,000 MEGOHMS

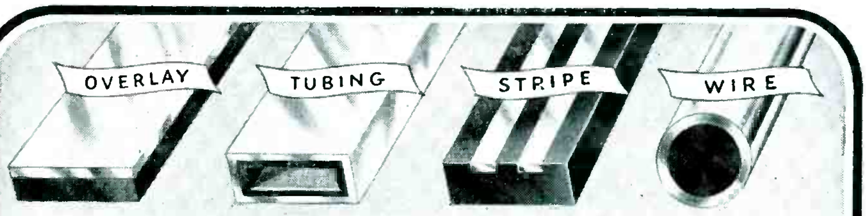
This unusual range of high value resistors has been developed to meet the needs of scientific and industrial control, measuring and laboratory devices — and of high voltage applications.

SEND FOR BULLETIN 4906

It gives details of Standard and High Value Resistors, including construction, characteristics, dimensions, etc. Also described are S. S. White 80X Resistors, designed for extremely high voltage equipment. Copy with Price List sent on request.

THE S.S.White INDUSTRIAL DIVISION
DENTAL MFG. CO. Dept. R, 10 East 40th St.
NEW YORK 16, N. Y.

WESTERN DISTRICT OFFICE: Times Building, Long Beach, Calif.



The Finest of Laminated Materials . . .

We are providing manufacturers with a complete line of precious metals laminated to non-precious base metals made to their exact specifications within the following limitations:

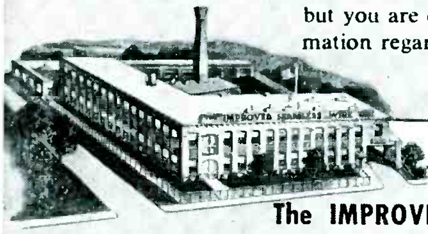
SHEET STOCK: Maximum width—5"
Minimum width—¼"
Thickness—down to .003"

TUBING: Maximum diameter 1" x .050" wall

WIRE: All sizes down to .0045" diameter also squares, rectangular and odd shapes.

In addition to laminated materials we also furnish alloyed gold and silver in sheet, wire or tubing form.

The many varied applications of our materials cannot be listed here, but you are cordially invited to inquire for information regarding your requirements.



The Home of IMPROVED Service

The IMPROVED SEAMLESS WIRE COMPANY
INCORPORATED 1898
775 Eddy Street, Providence 5, Rhode Island

PHYSICISTS And SENIOR RESEARCH ENGINEERS

• • •

POSITIONS NOW OPEN

• • •

Senior Engineers and Physicists having outstanding academic background and experience in the fields of:

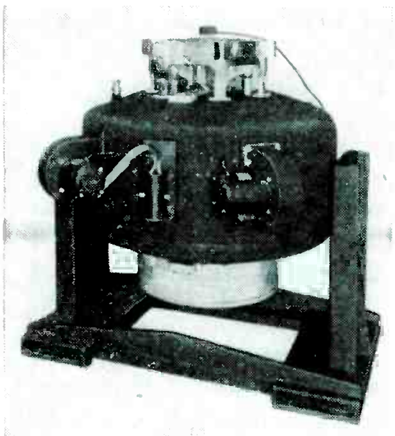
- Microwave Techniques
- Moving Target Indication
- Servomechanisms
- Applied Physics
- Gyroscopic Equipment
- Optical Equipment
- Computers
- Pulse Techniques
- Radar
- Fire Control
- Circuit Analysis
- Autopilot Design
- Applied Mathematics
- Electronic Subminiaturization
- Instrument Design
- Automatic Production Equipment
- Test Equipment
- Electronic Design
- Flight Test Instrumentation

are offered excellent working conditions and opportunities for advancement in our Aerophysics Laboratory. Salaries are commensurate with ability, experience and background. Send information as to age, education, experience and work preference to:

NORTH AMERICAN AVIATION, INC.
Aerophysics Laboratory
Box No. K-4, 12214 S. Lakewood Blvd.
DOWNEY, CALIFORNIA

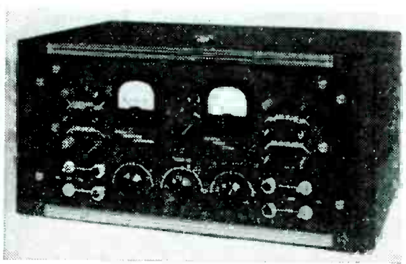
(continued from p 146)

constant line is equipped with 18 taps to facilitate the selection of delay intervals ranging from 0.05 μsec to 0.9 μsec. Characteristic impedance is 680 ohms; bandwidth, 4.3 mc; and overall dimensions, 9¾ in. long, ⅞ in. wide, and 1¼ in. high.



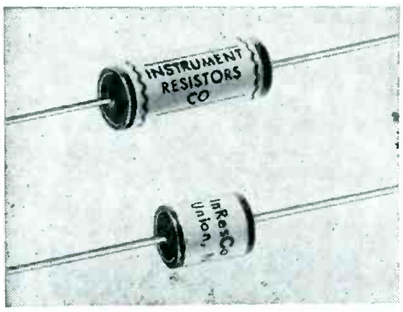
Vibration Exciter

THE MB MFG. CO., 1060 State St., New Haven, Conn., is in production of its new model C-25 vibration exciter that has the capacity for meeting specification MIL-E-5272 on vibration testing. It is rated at 2,500-lb continuous vector force and delivers 15 g under 100-lb load. This shaker features accurate, continuous, easy control of both frequency and force, with electrical interlocks to prevent improper operation of the equipment. Weight of moving components is approximately 65 lb. The table has a 20-in. diameter and is shielded from a-c or d-c fields.



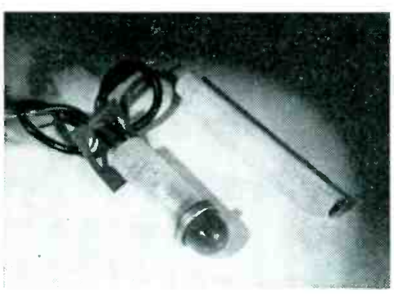
Multiple Power Supply

BRISTOL ENGINEERING CORP., Lincoln Ave. & Pond St., Bristol, Pa. Model 610 multiple power supply includes in a single compact unit danch, Long Island, N. Y. Model 301-A speed control consists of a special motor and a companion control box operating from the 115-volt, 60-cycle line. The combination provides finger-tip control of motor speed from 50 to 5,000 rpm. A front panel meter calibrated in rpm gives the motor speed directly. In the laboratory the control can be used to drive segmented disks, synchronous switches, rotating antennas, data devices and the like. It is useful in industrial applications as the drive in coil-winding machines, conveyor belts, textile spinning and weaving.



Subminiature Resistors

INSTRUMENT RESISTORS CO., 1036 Commerce Ave., Union, N. J., announces a new line of subminiature resistors designed to meet JAN-R-93 specifications. Type SM-15 measures $\frac{5}{16}$ in. in diameter by $\frac{3}{8}$ in. long. Power rating is 0.15 watt, maximum resistance, 200,000 ohms. Type SM-30 measures $\frac{5}{16}$ in. in diameter by $\frac{3}{4}$ in. long. Power rating is 0.30 watt, maximum resistance, 400,000 ohms. Tolerance of 1.0 percent is standard but 0.1 percent can be supplied on special order.



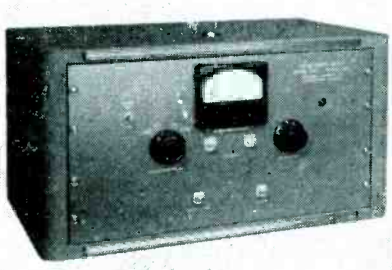
Pilot Light

INDUSTRIAL DEVICES, INC., Edgewater, N. J. The Omni-Glow model 1010 is a neon light encased in a

nylon tube that slips through the mounting panel and is held in place with a special nut supplied with the unit. Operating on a voltage range of from 75 to 250 volts a-c or d-c, it provides a pleasing, soft light with practically no heat. It withstands vibration and shock, as well as voltage overloads, that would ruin the usual incandescent pilot light.

400-Cycle Resolver

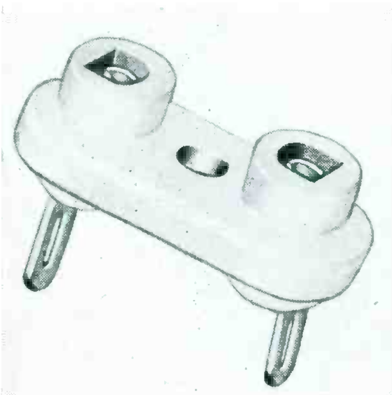
FORD INSTRUMENT CO., 31-10 Thomson Ave., Long Island City 1, N. Y., announces a new 400-cycle, continuous rotation resolver with 99.9-percent accuracy in trigonometric computations. An associated high-gain feedback amplifier isolates the resolver from the load and compensates for phase shift and any variation in frequency. Two or more resolver-amplifier systems can be connected in cascade to multiply sine and cosine functions. The size 15 flange-mounted resolver is both corrosion and fungus resistant. Overall length is 2.5 in.; diameter, 1.44 in.; shaft diameter, 0.125 in.; and weight, 8 oz.



Capacitance Meter

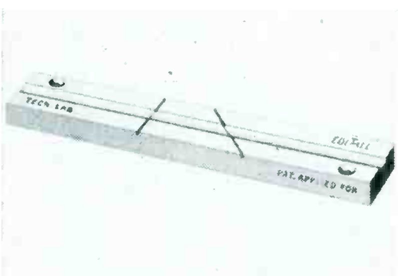
MACLEOD AND HANOPOL, INC., 10 Joiner St., Charlestown 29, Mass., has available a direct-reading, self-

contained, a-c operated instrument for production measurement of small values of direct capacitance. Full scale ranges are 0.1, 1.0, 10 and 100 $\mu\mu$f. Absolute accuracy is better than 5 percent and reproducibility is better than 0.5 percent. Measurements are made at 500 kc. Power factor is not measured. Losses at power factors below 0.05 have negligible effect on capacitance readings. Variations in 60-cycle line voltage, from 95 to 135 volts, do not affect the accuracy of measurement.



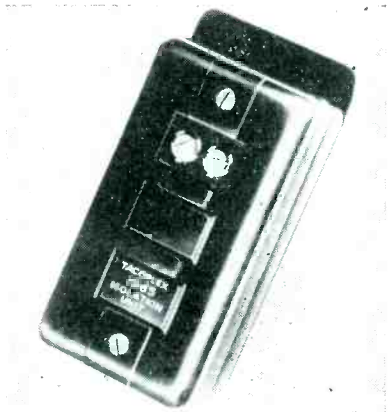
Crystal Socket

E. F. JOHNSON CO., Waseca, Minn., is offering a new extremely compact crystal socket designed for use with holders having standard 0.050-in. pins spaced 0.486 in. The sockets are made from Steatite that has been Dow Corning-200 treated to resist moisture absorption. Contacts are phosphor bronze, silver plated, with tinned terminals. The socket mounts by means of a single hole $\frac{1}{8}$ in. in diameter.



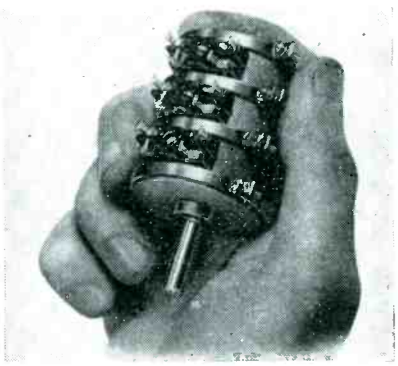
Splicing Block

TECH LABORATORIES, INC., Bergen & Edsall Boulevards, Palisades Park, N. J., has announced a new and improved splicing block for use in editing NAB standard $\frac{1}{4}$-in. magnetic tape. The tape is held in a groove, which is machined to extreme accuracy with a curved bottom, and is designed to grip the tape snugly without mechanical aids. The block is made from duraluminum and can easily be fastened on any recording machine or any other place where the work is performed. It is designed to be used with Minnesota Mining Co.'s No. 41 splicing tape especially furnished in $\frac{7}{32}$-in. width.



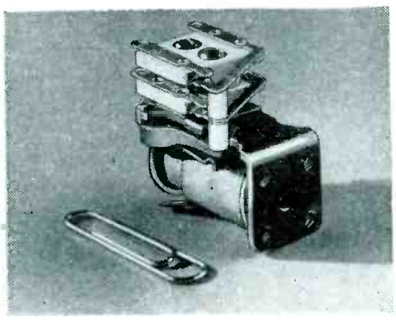
TV Isolation Box

TECHNICAL APPLIANCE CORP., Sherburne, N. Y., has available a new isolation box for multiple-set operation. It contains a matching network of resistors providing an isolation factor between receiver of at least 30 db with a minimum signal drop across the outlet. There is no power required as in the case of the cathode-follower-type of isolation box. Terminals are provided for 300-ohm twin-lead to the receiver.



Precision Potentiometer

FAIRCHILD CAMERA AND INSTRUMENT CORP., 88-06 Van Wyck Blvd., Jamaica, N. Y. Type 746 precision potentiometer is of all-metal construction to retain accurate mechanical tolerances and also permit functional tolerances to be held more closely. It is designed to permit the ganging of up to 20 units on a single shaft. The unit measures 1.75 in. in diameter. General specifications cover both linear and nonlinear windings over a range of resistances up to 100,000 ohms, and guaranteed accuracy of 0.5 percent linear and 1.0 percent nonlinear based on overall resistance. Torque is 1.5 ounce-inches. Service life is guaranteed to 1,000,000 cycles of operation.



Midget Relay

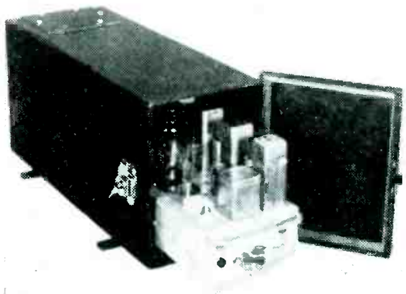
R-B-M DIVISION, ESSEX WIRE CORP., Logansport, Ind., has developed a new low-loss midget relay. Maximum capacitance between contacts and to ground is 2½ $\mu\mu$f. It can be furnished with single pole, normally open or normally closed; 2 pole, normally open or normally closed; and spdt contact form. Maximum rating is 3 amperes noninductive at 28 v d-c. The two-pole normally open relay is illustrated. The relay is also available up to 4-pole double throw in standard contact arrangement, designed for airborne armed services application.

Sweep Generator

KAY ELECTRIC CO., Pine Brook, N. J. The Kilo-Sweep is an all-electronic sweep generator with internal crystal-positioned pulse type markers designed especially to cover the frequency range from 50 kc to 2 mc. It has continuously variable sweep width to 100 kc maximum. Standard frequency markers are located at 0.5, 1.0 and 2.0 mc. Price is $525.00.

Ferramic Cores

General Ceramics and Steatite Corp., Keasby, N. J., offers a complete line of Ferramic cores in cup, ring, or E and I types. Ferramic is a soft magnetic material that performs with high efficiency at high or low frequency. Its outstanding characteristics include light weight, high permeability, high volume resistivity and low loss factor. Cores of this material can be extruded, molded or machined to the desired shape at relatively low cost. Laminations are not required, which reduces assembly time on components and simplifies design.

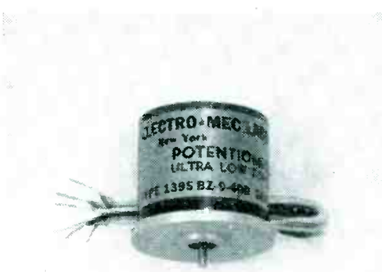


Communication System for Mines

General Electric Co., Schenectady 5, N. Y., has developed an improved carrier-current f-m transmitter-receiver for mine communications. The equipment, which includes power supply and control and tuning units, provides two-way voice communication between a fixed mine station and a mine locomotive, between two fixed stations, or between two locomotives operating on a common supply line. A stable source of voltage for the set is provided by means of a 6-volt storage battery. The battery is charged from a d-c trolley line through dropping resistors or from a motor-generator set on the locomotive. The equipment operates at a fixed frequency of 100 kc providing an audio-frequency response of 300 to 3,000 cycles.

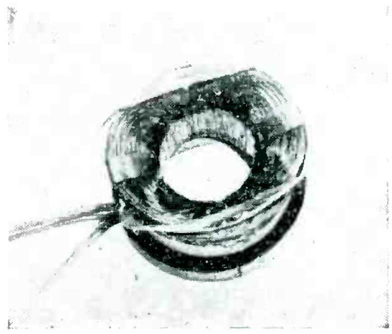
Kinescope

RADIO CORP. OF AMERICA, Harrison, N. J. Model 21AP4 metal-shell rectangular picture tube has a picture size of 18⅜ in. x 13$\frac{15}{16}$ in. with slightly curved sides and rounded corners. Employing magnetic focus and magnetic deflection, it has a maximum high-voltage rating of 18,000 volts; an ion-trap gun for use with an external single-field magnet for eliminating ion-spot blemish; a diagonal-deflection angle of 70 deg; a horizontal-deflection angle of 66 deg; a neck length of 7$\frac{3}{16}$ in.; and substantially less weight than a similar all-glass tube.



Precision Potentiometer

ELECTRO-MEC LABORATORY, 225 Broadway, New York 7, N. Y., has available a new type of precision potentiometer (voltage-dividing resistor) with two electrically separate sections. Originally developed to overcome a space and weight problem in a guided missile, the two-in-one design features have made the devices useful in aircraft and industrial instruments. Current carrying capacities up to 100 ma provide two outputs sufficient to operate simultaneously controlling and recording or indicating instruments without amplification. The two resistor sections are offered in values between 50 and 60,000 ohms each and with accuracies up to 0.065 percent. Approximately 1½ in. long by 1¼ in. in diameter and with a 0.078 diameter shaft, the instrument weights only 0.79 ounce.



Cosine Yokes

MERIT TRANSFORMER CORP., 4427 N. Clark St., Chicago, Ill., is now manufacturing two cosine yokes. The MDF-70 has distributed winding for edge-to-edge picture focus. High-efficiency ferrite core permits use with all picture tubes up to and including 24 inches where they require 70-deg deflection. It is recommended for use with HVO-6 and HVO-7 ferrite core flybacks. The MDF-30 is of the same design as MDF-70 but has high horizontal and low vertical inductance for use with HVO-8 air core flyback, in direct drive systems. All yokes are equipped with network and leads.

Adjustable Voltage Reference

GENERAL PRECISION LABORATORY, INC., 63 Bedford Road, Pleasantville, N. Y. A new, adjustable, all-electronic secondary standard cell operates from a-c mains to provide a continuously variable d-c supply over the wide range of 0.0001 to 10 v. It is a precision unit designed primarily to work with high-impedance devices—for d-c amplifier testing, calibration of d-c oscilloscopes and v-t voltmeters, determination of vacuum-tube characteristics and other uses in industry and in the laboratory. Maximum output impedance is 1,000 ohms, with accuracy maintained at 0.1 percent of full scale. A multiple-turn potentiometer is provided having divisions of 0.001 of full scale. The circuit is operable with input voltages of 105-130 volts, 50-60 cycles, with full accuracy.

Literature

Sweep Signal Generators. Kay Electric Co., 25 Maple Ave., Pine Brook, N. J., has published a folder dealing with new sweep signal generators operating at video, ultrasonics, low and high radio frequencies and at intermediate frequencies. Also described is a line of precision resistors, the Stablohms. Illustrations and technical specifications are included.

Conduit and Cable Fittings. The Thomas & Betts Co., Inc., Butler St., Elizabeth, N. J. Electrical conduit fittings and cable fittings for all types of raceways are listed in complete, easy-to-find form in the new 64-page bulletin No. 65. Included are locknuts; bushings; elbows; pipe straps; conduit supports; connectors and couplings for rigid conduit, for armored cable, for nonmetallic sheathed cable and for service entrance cable; grounding equipment; floor boxes and junction boxes; and tubelets. An illustrated table of contents is a further aid to quick identification.

TV Catalog and Replacement Guide. Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill., has available a television catalog and replacement guide listing more than 1500 models and chassis built under seventy-nine brand names. In addition to listing all replacement items by model number manufacturers' part number and Stancor stock number, it identifies each by code number signifying power transformer; filter reactor; horizontal and vertical output transformers; horizontal and vertical blocking-oscillator transformers; audio output transformer; and deflection yoke or focus coil.

Tube Testing. The Hickok Electrical Instrument Co., 10527 Dupont Ave., Cleveland 8, Ohio. A 16-page booklet illustrates and describes the different theories and the four basic methods of tube testing. It includes circuit diagrams and formulas. It also contains a summary of a survey on the nature of failures of tv receiver tubes.

Automatic Voltage Regulators. The Superior Electric Co., Bristol, Conn. Bulletin S351 describes in detail the workings of a Stabiline automatic voltage regulator in maintaining a constant output voltage regardless of fluctuations in a-c input line voltages and changes in output load. All standard models of both IE and EM types are discussed. Illustrations, outline drawings and performance data are given.

Function Plotter. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa., has issued instrumentation data sheet 10.05 dealing with the ElectroniK function plotter, an instrument that continuously records the relationship between two variables, showing one as a function of the other. One of the two measuring systems embodied in the unit described actuates the pen; the other, the up and down movement of the chart. Numerous applications, operation, instrument characteristics and other essential technical information are given.

Paper Tubulars. Cornell-Dubilier Electric Corp., South Plainfield, N. J. Bulletin No. 143 is devoted to the Sealpup, an extremely small and dependable type of metallized paper tubular capacitor, with a positive seal against moisture. It ranges in size from 0.175 in. x $\frac{11}{16}$ in. to 0.750 in. x $2\frac{3}{16}$ in. diameter and length. It is available in a complete eleven-capacitance range, from 0.01 to 2.0 $\mu\mu f$ at 200, 400 and 600

volts d-c working, and is designed for both military and commercial equipment. It may be used in a range from −55 to +95 C. For temperatures higher than +60 C voltage derating is necessary.

Ultrasonic Generator. Ultrasonic Engineering Co., P. O. Box 46, Maywood, Ill., has published a 4-page folder on the laboratory and industrial type 500-watt ultrasonic generator that features wide frequency range, adjustable power output, portable transducer, automatic dosage periods, and complete shielding and grounding. Accessories data and prices are included.

Insulation Data. Irvington Varnish & Insulator Co., Irvington, 11, N. J., has issued technical information on a comprehensive line of class H insulating materials for continuous operation at temperatures of 175 C or higher. The new bulletin gives electrical and mechanical properties, standard thicknesses, lengths and widths and suggested fields of application for: Silicone varnished Fiberglas; Silicone glass mica; Silicone saturated and Silicone coated asbestos; Silicone rubber-coated Fiberglas; and Silastic tape. Use of the materials described permits the design of more compact equipment.

Permanent Magnets. Thomas & Skinner Steel Products Co., 1122 E. 23rd St., Indianapolis, Ind. Developments in design and application of permanent magnets in machinery and electronic equipment is contained in a new handbook. The book contains curves for an Alnico V magnet with nominal characteristics of 4½ million-BH energy product. Sections of the publication, illustrated with graphic charts and formulas, cover the physical and magnetic properties of permanent magnet materials, types of magnets (open and closed circuit), problems of magnet design, and methods employed in manufacturing, stabilizing and magnet testing.

Strip Chart Recorder. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia

44, Pa. Instrumentation data sheet 10.0-6 describes the duplex ElectroniK recorder that simultaneously plots two totally independent variables on one chart. The instrument covered embodies two complete measuring systems and recorders that can be actuated from any d-c source. The data sheet discusses the operation and constructional features of the instrument together with numerous applications for which it is adaptable.

Self-Insulated Terminals. The Thomas & Betts Co., Inc., 36 Butler St., Elizabeth, N. J., recently issued data sheet S4 giving complete technical information on a new line of self-insulated Sta-Kon terminals that are particularly suitable for use in cramped quarters to prevent the danger of short circuits between adjacent terminals on closely mounted studs. Applications described include electronic equipment, instruments, industrial control apparatus, aircraft wiring and railway and marine service.

Printed Circuit Guide. Centralab Division of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc., has available a printed electronic circuit replacement guide. It lists 269 printed circuit plates as used by 69 manufacturers. Replacements are easy to select from a cross-reference chart that designates the Centralab catalog number for a given manufacturer's part number. Only 19 stock units are required to cover these replacement requirements.

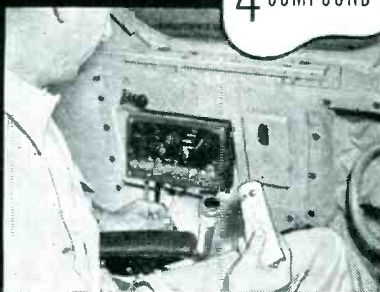
Transformer Catalog. Standard Transformer Corp., 3578 Elston Ave., Chicago 18, Ill., has issued a catalog classifying and indexing 441 transformers and related components. Each listing includes electrical specifications, dimensions, weight and list price. Illustrations show each mounting type in detail.

Snap-Action Switches. Micro Switch, 7 Spring St., Freeport, Ill. Bulletin 54 is a four-page circular divided into sections, each of which deals with one clearly defined group of switches. It catalogs, describes,

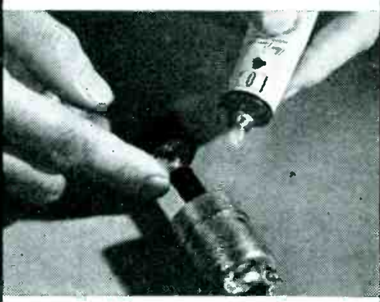
The Nonmelting Silicone Insulating and Waterproofing Compound that is stable from —70° to over 400° F.

Meets all Requirements of AN-C-128a

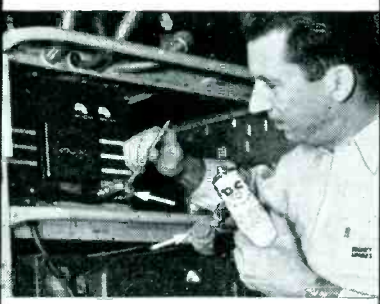
DOW CORNING 4 COMPOUND



Dow Corning 4 applied by brushing to AN connector receptacle of pilot's "jack box" prevents interference caused by moisture at this critical junction in aircraft communications system.



Dow Corning 4 applied by brushing to AN connector on V. H. F. Transmitter Receiver excludes moisture without appreciable change in resistance across properly mated pin and socket connections.



Arrows show where Dow Corning 4 is used on variable inductance rollers in a Collins-Western Electric V. H. F. Transmitter Receiver to lubricate, minimize resistance and reduce leakage losses.

Photos courtesy Braniff International Airways.

More water repellent than paraffin, Dow Corning 4 Silicone Compound is highly resistant to oxygen, ozone and deterioration caused by corona discharge.

Write Today! **for your copy of our new booklet on Dow Corning 4 Compound. Address Department BD.**

FIRST IN SILICONES

DOW CORNING CORPORATION

MIDLAND, MICHIGAN

ILLINOIS ELECTROLYTIC CAPACITORS

of *"Time Tested Quality"*

FOR EVERY ELECTRONIC APPLICATION

Seventeen years of production experience, making millions of quality capacitors, has created this complete, outstanding ILLINOIS CONDENSER line. There's a full Jobber line of capacitors for every TV and radio replacement purpose; capacitors for the entire electronics industry—capacitors that meet the highest standards of dependability.

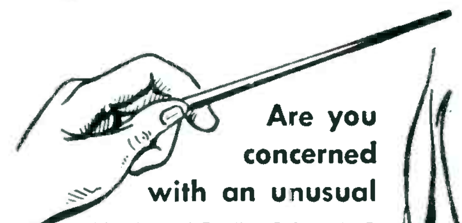
This engineering and manufacturing experience enables ILLINOIS CONDENSER COMPANY to meet every demand for new capacitor types, whether for peace or defense applications.

Write for catalog or tell us your needs. There is an ILLINOIS ELECTROLYTIC CAPACITOR exactly suited for the job—a capacitor of "Time Tested Quality."

ILLINOIS CONDENSER CO.
1616 NORTH THROOP STREET • CHICAGO 22, ILL.

EXPORT DIVISION: 15 Moore St., New York 4, N. Y. U. S. A.
CABLE ADDRESS: "MINTHORNE"

HEAT RESISTANT WIRES FOR EVERY APPLICATION . . .



Are you concerned with an unusual HEATING PROBLEM?

We make a specialty of insulated resistance wire. Perhaps we can help you. We can furnish either straight wire or flexible core wound elements. Our heat resisting insulations are supplied in glass, asbestos or combinations. Write or call us about your problem.

- HEATING UNITS
- HEATING ELEMENT
- RESISTANCE LINE CORD
- THERMOCOUPLE WIRE
- ASBESTOS LEAD & FIXTURE WIRE
- INSULATED RESISTANCE WIRE
- FIBERGLAS INSULATED WIRE
- WIRE TO ANY SPECIFICATIONS

Send your electronic control, communications or appliance wiring specifications for a recommended solution by our engineers.

FOR A TRIAL ORDER OR A CARLOAD *consult*

THE LEWIS ENGINEERING CO.
Wire Division
NAUGATUCK CONNECTICUT

and illustrates a few representative switches in each classification. Sections into which the bulletin is divided are as follows: heavy-duty limit, medium-duty limit, explosion-proof, high-capacity enclosed, die-cast enclosed, basic, V3 switches and actuators.

Parabolic Antennas. The Workshop Associates, Division of The Gabriel Co., 135 Crescent Road, Needham Heights 94, Mass., has released a new catalog on parabolic antennas. Studio-transmitter link, police, pipeline control, railroad, utilities and many other applications are covered by the antennas described, which are for 940, 2,000 and 7,000-mc bands. Several photographs show the reflectors, feeds and mounts, and specifications are given for heating and deicing equipment. Complete electrical specifications are listed for each model.

Radiotelephones and Direction Finders. Applied Electronics Co., 1246J Folsom St., San Francisco 3, Calif. Marine radiotelephones and direction finders are cataloged in a variety of styles and sizes in a new eight-page folder, form 351. Five combination transmitter-receivers are listed with normal communication ranges from 50-200 miles to 300-1,200 miles and with output powers from 16 to 200 watts. A 50-watt transmitter is shown for applications where a direction finder or separate receiver exists. Four models of inside-and-outside-loop direction finders are listed, described and illustrated.

Solder Catalog. Federated Metals Division, American Smelting and Refining Co., 120 Broadway, New York, N. Y., has published an educational, 36-page illustrated brochure on the nature, properties and uses of solder. Separate sections are devoted to thermal effects, mechanical properties, principles of soldering, and fluxes. Next, the selection of the proper solder for a job is explained; fusible alloys are described. Then follows a list of practical applications and a resume of specifications and technical data.

ECONOMY ACCURACY STABILITY COMPACTNESS

IN PRECISION • RESISTORS

★ ★ ★

Have your Cake . . . and Eat it, too, with

JELLIFF ALLOY 1000 RESISTANCE WIRE

The new high in Resistivity—1000 ohms/cmf plus an impressive array of important electrical and physical characteristics, make our new ALLOY 1000 the most desirable material for windings in compact, precision resistors of all types. And the best thing about it is that you don't gain one characteristic at the cost of serious losses elsewhere. Write today for Bulletin 17, with the full story and technical data on

JELLIFF ALLOY 1000 RESISTANCE WIRE

THE C. O. **JELLIFF** MANUFACTURING CORPORATION SOUTHPORT, CONN.

LEKTROMESH • RESISTANCE WIRE • SCREENS • STRAINERS • WIRE CLOTH • PARTS • WIRE MESH • DIPPING BASKETS

WIRE PRODUCTS SINCE 1880

COMPOUNDS

Scientifically compounded for specific applications from waxes, resins, asphalts, pitches, oils, and minerals. Available in wide range of melting points and hardnesses. Special potting compounds are heat conducting and crack resistant at extremely low temperatures. Recommendations, specific data, and samples will be furnished on request.

for

IMPREGNATING
radio coils
transformer coils
ignition coils
wire coverings
paper tubes and forms
porous ceramics

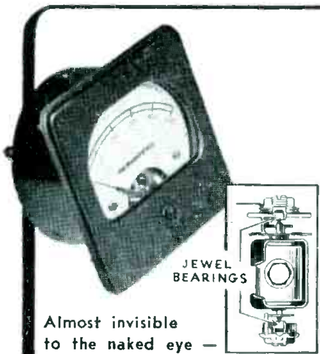
DIPPING
Coils
Transformers
Condensers

SEALING
condensers
batteries
switch base terminals
socket terminals
light fixtures

POTTING
Radio Transformers
Light Units
Loading Coils
Condensers

BIWAX CORPORATION

3445 HOWARD STREET
SKOKIE, ILLINOIS



Almost invisible to the naked eye — yet precision depends on these quality controlled Bird Bearings

"Precision first!"

says famous instrument manufacturer

. . . specifies Bird Jewel Bearings

Microampere Meters from this leading manufacturer* are world famous for top precision — owe much credit to quality construction that includes Bird Jewel Bearings. Two precision-made jewels — used as bearings for armature — assure smooth response . . . guarantee a *lifetime* of accurate operation.

Discover how Bird Jewel Bearings can solve *your* miniature bearing problems with unset or set assemblies to suit your requirements — write for information.

**Name on request*

Richard H. Bird **& Co., Inc.**
1 Spruce Street, Waltham 54, Mass.
Mfrs. of glass and sapphire jewel bearings for instruments, dials and gauges of all types

"I'm a BOEING engineer!"

You'll say that with pride. Men who can meet Boeing engineering standards share the prestige of leadership. They are doing vitally important work in the most challenging of all fields.

Boeing's Engineering Division has been growing steadily for 35 years. Today, it offers extraordinary career opportunities for the following:

Experienced and junior aeronautical, mechanical, electrical, electronics, civil, acoustical and weights engineers for design and research; servo-mechanism designers and analysts; and physicists and mathematicians with advanced degrees.

Here, at Boeing, you'll find stability and opportunity. You'll face the challenge of working on such vital programs as the B-47 and B-52 jet bombers, guided missiles and other revolutionary developments. Openings are available at both Seattle and Wichita. Your choice of location—the Midwest or Pacific Northwest. You'll enjoy good salaries that grow with you, and Boeing provides a moving and travel expense allowance.

Yes, you'll be proud to say, "I'm a Boeing engineer!"

WRITE TODAY TO THE ADDRESS BELOW OR USE THE CONVENIENT COUPON

JOHN C. SANDERS, Staff Engineer—Personnel
DEPT. H-9
Boeing Airplane Company, Seattle 14, Wash.

Engineering opportunities at Boeing interest me. Please send me further information.

Name ____________

Address ____________

City and State ____________

NEWS OF THE INDUSTRY

(continued from page 150)

have been transmitted to the U.S. Patent Office for registry and listing in the official register of patents. A list of the patents having to do with the electronic field, giving number, title, inventor and abstract is as follows:

Patent No. 2,556,457; title—Pulse Width Modulation; inventor—R. J. Watts; abstract—A simple pulse width modulation circuit is described wherein a rapid transmission of intelligence with high signal-to-noise ratio is obtainable.

Patent No. 2,557,761; title—Flux Phase Indicators; inventor—W. M. Powell; abstract—A device is described that will graphically depict the magnetic flux phase difference between points in a varying magnetic field.

Patent No. 2,558,485; title—Cable Testing Systems and Methods; inventor—J. D. Gow; abstract—This covers a testing device adapted to measure and indicate the position of an inner conductor of a coaxial cable with respect to the cable sheath; a feeding mechanism automatically feeds the cable through the device, and the unit may be affixed to the cable at any position.

Patent No. 2,558,698; title—Electromagnetic Pumps; inventor—E. J. Wade; abstract—This describes an electromagnetic liquid metal pump of increased efficiency which uses a series of insulating barrier vanes inside the liquid metal conduit to reduce the tendency of the electric current to diverge in passing through the liquid metal.

Patent No. 2,559,259; title—Method of Making a Source of Beta Rays; inventor—J. R. Raper; abstract—A source of pure beta emissions is prepared by incorporating a potential beta emitter such as red phosphorous into a suitable plastic, forming into a desired shape, and thereafter subjecting to neutron irradiation.

Patent No. 2,560,166; title—Pulse Analyzer; inventor—W. E. Glenn, Jr.; abstract—This describes a pulse analyzer that employs a modified cathode-ray-type tube for counting pulses of voltage of short duration and the same amplitude over a large range of amplitudes.

Patent No. 2,560,167; title—

AEROCOM MEANS TROUBLE-FREE SERVICE!
From Ground To Air or Point to Point

Although demand for Aerocom equipment still exceeds our ability to offer immediate deliveries, you may wish to evaluate its possible future use in solving your communication, navigation, or meteorological problems.

The model 12GLX-M, 1KW Beacon Transmitter illustrated, operates on a single frequency in the range 200-415 Kcs. Oscillator coil can be supplied crystal-controlled or self-excited. Tone oscillator provides 30% high level modulation for identification when keyed with Aerocom's model AK-3B automatic keyer. The unit can also be voice modulated. Power supply . . . any stable voltage in the range 200-240 volts, 50/60 cycles, single phase. Overall dimensions in CM, 56W x 62D x 177H. Net weight 286 kilos.

AER -O- COM

3090 DOUGLAS ROAD MIAMI 33, FLA.

Reg. U. S. Pat. Off.

Little thought-of facts about capacitors

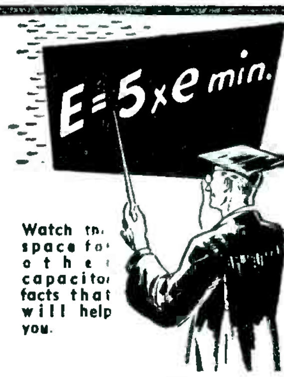
The short time breakdown voltage of a well-made D.C. capacitor is not less than 5 to 6 times the actual working voltage at 20°—

E = 5 × e min
E = Breakdown voltage
e = Rated d.c. working voltage

INDUSTRIAL CAPACITORS are unvaryingly held to this formula.

Designed for maximum safety and the smallest possible volume, INDUSTRIAL CAPACITORS are the most widely used capacitor in industrial applications.

WRITE TODAY FOR DETAILED CATALOG



Watch this space for other capacitor facts that will help you.

INDUSTRIAL CONDENSER CORP.

Sales Offices in All Principal Cities
3243 N. California Ave.
Chicago 18, Illinois

PERFECTION THROUGH INSPECTION IN EVERY DANO COIL

- Form Wound
- Paper Section
- Acetate Bobbin
- Bakelite Bobbin
- Cotton Interweave
- Coils for High Temperature Applications

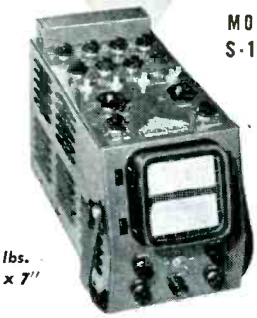
ALSO, TRANSFORMERS MADE TO ORDER

Inspection and testing! No Dano coil can be "shipped out" unless it passes methodical testing and inspection in all vital stages of production operations. That's why you can always be sure of perfect performance in every Dano coil.

THE DANO ELECTRIC CO.
MAIN ST., WINSTED, CONN.

THE TWIN TUBE POCKETSCOPE
® BY WATERMAN

MODEL S-15-A



Wt. 16¼ lbs.
12" x 6" x 7"

A new concept in multiple trace oscilloscopy made possible by Waterman developed RAYONIC rectangular cathode ray tube, providing for the first time, optional screen characteristics in each channel. S-15-A is a portable twin tube, high sensitivity oscilloscope, with two independent vertical as well as horizontal channels. A "must" for investigation of electronic circuits in industry, school, or laboratory.

Vertical channels: 10mv rms/inch, with response within —2DB from DC to 200kc, with pulse rise of 1.8μs. Horizontal channels: 1v rms/inch within —2DB from DC to 150kc, with pulse rise of 3μs. Non-frequency discriminating attenuators and gain controls, with internal calibration of traces. Repetitive or trigger time base, with linearization, from ½cps to 50kc, with ± sync. or trigger. Mu metal shield. Filter graph screen. And a host of other features.

WATERMAN PRODUCTS CO., INC.
PHILADELPHIA 25, PA.
CABLE ADDRESS: POKETSCOPE

WATERMAN PRODUCTS INCLUDE:

- S-10-B GENERAL POCKETSCOPE
- S-11-A INDUSTRIAL POCKETSCOPE
- S-14-A HI-GAIN POCKETSCOPE
- S-14-B WIDE BAND POCKETSCOPE
- S-21-A LINEAR TIME BASE

Also RAKSCOPES, LINEAR AMPLIFIERS, RAYONIC® TUBES and other equipment

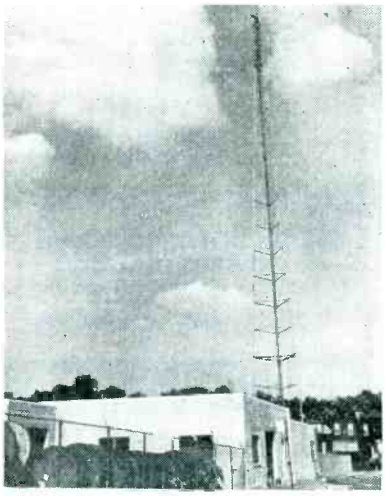
WATERMAN PRODUCTS

Pulse Shaping Circuit; inventor W. E. Glenn, Jr.; abstract—The circuit described comprises a pulse sharpener, an amplifier, a pulse flattening circuit, and a cathode-follower output circuit.

Licenses for all the above patents will be granted to applicants on a nonexclusive, royalty-free basis. Applicants for licenses should apply to the Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington 25, D. C., identifying the subject matter by patent number and title.

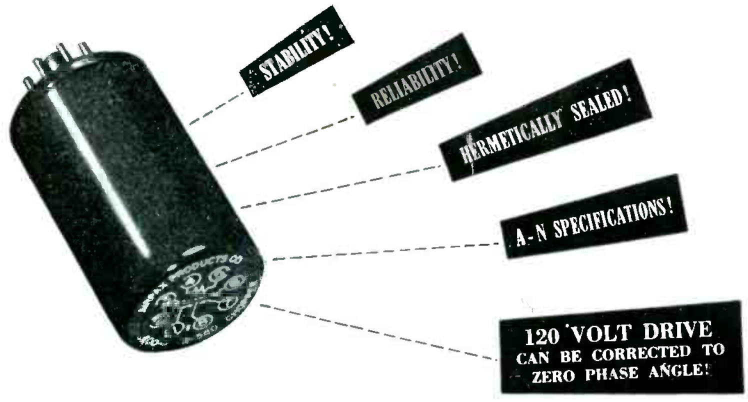
Communications Center Dedicated

ONE of the nation's most modern police, fire and civil defense communications centers, built around a two-way mobile communications system designed and installed by RCA, was recently officially dedicated in Philadelphia. It is the second complete communications center opened by the city this year. Both stations operate under the call letters KGB-476 in the 150 to 174-mc band.



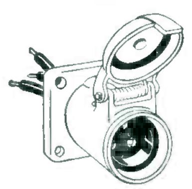
250-foot RCA antenna-mast towers above Philadelphia's new municipal communications center which was officially opened last month

The new station is located in West Philadelphia, about four miles from the heart of the city. It has four 250-watt transmitters (two each for police and fire channels), eight station receivers and two custom-built consoles. By means of this station equipment, either or both of the stations can maintain continuous contact with the city



STABILITY!
RELIABILITY!
HERMETICALLY SEALED!
A-N SPECIFICATIONS!
120 VOLT DRIVE CAN BE CORRECTED TO ZERO PHASE ANGLE!

TOUGH as an elephant's trunk!



Consult a Joy Engineer

mobile communications equipment. Under the contract, 150 RCA Super Carfone 30-watt high-frequency f-m transmitter and receiver units have also been installed in fire and police vehicles.

Television Committee Named

ROBERT C. SPRAGUE, chairman of the board of the RTMA, recently reappointed W. R. G. Baker chairman of the RTMA Television Committee for the ensuing year. Thirteen members of the top-level RTMA committee were also named.

Following is the complete membership of the committee: W. R. G. Baker of General Electric Co., chairman; Benjamin Abrams of Emerson Radio & Phonograph Corp.; Robert S. Alexander of Wells-Gardner & Co.; Max F. Balcom of Sylvania Electric Products Inc.; W. J. Barkley of Collins Radio Co.; H. C. Bonfig of Zenith Radio Corp.; John W. Craig of Crosley Division, Avco Mfg. Corp.; Allen B. DuMont of Allen B. DuMont Laboratories Inc.; J. B. Elliott of RCA Victor; E. K. Foster of Bendix Radio Division; Paul V. Galvin of Motorola Inc.; W. J. Halligan of The Hallicrafters Co.; L. F. Hardy of Philco Corp.; W. A. MacDonald of Hazeltine Electronics Corp.

BUSINESS NEWS

AEROCOIL INC., Union City, N. J., is a company recently organized for the manufacture of coils, coil assemblies and specialized electronic equipment.

MINUTE MAN PRODUCTS, INC., manufacturer of metal parts for the electronic, television and allied fields, has moved to greatly expanded quarters at 430 E. 102nd St., New York, N. Y.

INTERNATIONAL RESISTANCE CO. has purchased the Hardy Instrument Co., manufacturer of Microstak rectifiers. All further operations of the latter company will continue under the IRC name, and will be transferred from New York

NEW ONE-PACKAGE CONTROL SYSTEM

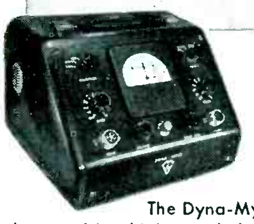
for

DIFFERENTIAL TRANSFORMERS

or

STRAIN GAGES

at the Flip of a Switch



DYNA-MYKE

The Dyna-Myke Model 129-B is a precision, high speed, dynamic micrometer using linear differential transformers as the sensing element. It measures and provides for recording such phenomena as force, torque, strain, vibration, acceleration, temperature, pressure, thickness, surface finish, etc., with a linear frequency response of DC to 1000 cps. Direct displacements are measured in five ranges from ±.1 inch to ±10 micro inches. On standard magnetic recorders a sensitivity of 1 micro inch per millimeter is available. A toggle switch converts the Dyna-Myke to a high frequency, high sensitivity strain gage indicator. The output is used to drive any type of magnetic, null balance or galvanometer recorder—or the DC or modulated carrier may be viewed on an Oscilloscope. Selsyn motors may be driven for remote indication or control. Request Technical Bulletin 129-B for full details.

DYNA-METER

The Dyna-Meter Model 144, when used with the Dyna-Myke, indicates by neon lights the peak amplitude of transients as fast as 1 millisecond. This indication may be instantaneous or a memory feature may be used to maintain the reading until reset. Built-in power relays provide on-or-off control to any plus or minus limits established by the Dyna-Myke. The combination of the Dyna-Myke and the Dyna-Meter offers many applications to industrial processes resulting in the elimination of scrap *at the source*. Uses in connection with machine tool operations are particularly impressive. Request Dyna-Meter Technical Bulletin 144.

Custom Builders of Electronic Instruments Since 1943

INDUSTRIAL ELECTRONICS, INCORPORATED

8062 Wheeler St., Detroit 10, Mich.

CHOOSE *the right* STANLEY IRON *for every job*

CHECK THESE IMPORTANT FEATURES

- √ Heating head sealed at working end, protects against flux fumes.
- √ Uniform flow of heat for continuous soldering.
- √ Balanced for easy handling.
- √ Pure copper replaceable tips.
- √ Cord strain relief.
- √ An iron for every purpose.
- √ Choice of screw-in or plug-in tips.
- √ Available in standard voltages.
- √ Armor Clad Tips available for all sizes of irons — last 3-10 times longer on production soldering

SEND for this NEW helpful folder on Stanley Electric Soldering Irons and Armor Clad Tips. FREE →

STANLEY TOOLS, NEW BRITAIN, CONN.
THE TOOL BOX OF THE WORLD

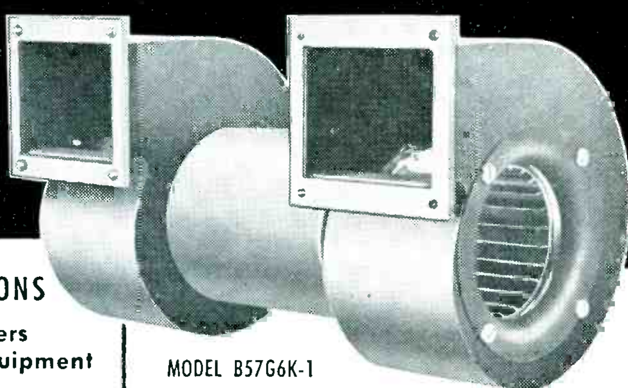
STANLEY
Reg. U.S. Pat. Off.

HARDWARE • TOOLS • ELECTRIC TOOLS • STEEL STRAPPING • STEEL

Special CENTRIFUGAL BLOWERS

for Maximum CFM • High Shock • Critical Mounting

Designed at low cost to meet your specifications. Standard units also available.



MODEL B57G6K-1

APPLICATIONS

- Transmitters
- Radar Equipment
- Amplifier Equipment
- High Ambient Temperatures
- High Humidity Applications

SPECIFICATIONS

MODEL B57G6K-1: 115 volt AC • 60 cycle • single phase • 4 mfd. • 120 CFM at 0.5″ SP—220 CFM at 0″ SP • Silicon impregnated • Fungus proof.

EAD

EASTERN AIR DEVICES, INC.

585 DEAN STREET • BROOKLYN 17, NEW YORK

to 401 North Broad St., Philadelphia, Pa.

GENERAL ELECTRIC CO. recently began construction on a new six million dollar receiving tube plant at Anniston, Alabama. It will employ over 2,000 people when completed.

EDWIN I. GUTHMAN & CO., INC., manufacturer of coils and other electronic components, has opened a new plant in Attica, Ind., which will essentially duplicate the Chicago plant operation.

ELECTRO CRAFT INC., Stamford, Conn., manufacturer of electronic and electromechanical devices, has acquired Castle Metal products, Inc., in a recent merger, and has moved to a new building at 68 Jackson St., Stamford.

HYTRON RADIO & ELECTRONICS CORP. recently became Hytron Radio & Electronics Co., a division of Columbia Broadcasting System, Inc. Management and general policies of Hytron will remain the same as before the acquisition. The company is also now building a receiving tube manufacturing plant at Danvers, Mass.

REX RHEOSTAT CO., Baldwin, L. I., N. Y., continues to manufacture its original line of tubular slide-wire rheostats, potentiometers and resistors, even though it has sold its manufacturing rights for vitreous-enamelled, round power rheostats for 50 to 500 watts.

UNIFORM TUBES, manufacturers of small precision tubing, recently moved from Philadelphia to a larger plant at Collegeville, Pa.

DUKANE CORP. is the new name of Operadio Mfg. Co., St. Charles, Ill., manufacturers of intercommunicating and sound equipment.

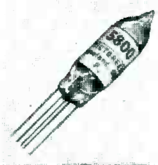
PERSONNEL

LOUIS KAHN, director of research for Aerovox Corp., New Bedford, Mass., was recently appointed consultant on components, Panel of Components, and also chairman of the Capacitor Subpanel, Research

Electrometer Circuit Components

QUALITY and ASSURANCE

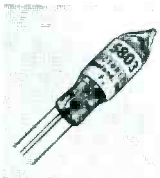
5800 ELECTROMETER TETRODE



The 5800 is a low filament power, subminiature tetrode designed specifically for electrometer applications. The envelope has been specially treated for low leakage and the emission has been stabilized for DC amplifier applications.

CHARACTERISTICS	
Filament Voltage	1.25 v
Filament Current	10 ma
MAXIMUM RATINGS	
Filament Voltage	1.5 v
Plate Voltage	50 v
Average Cathode Current	500 μa
TYPICAL OPERATION	
Plate Voltage	+4.5 v
Accelerator Grid Voltage (g_1)	+3.4 v
Control Grid Voltage (g_2)	−3 v
Amplification Factor	1
Transconductance	15 μmhos
Plate Current	12 μa
Accelerator Grid Current	300 μa
Control Grid Current	10^{-15} amp

5803 ELECTROMETER TRIODE



A subminiature triode to supplement the 5800 tetrode. The same high quality construction and testing goes into both these tubes. This tube is useful in one-stage circuits to drive a micro-ammeter or a micro-relay. The lighter grid current is compensated for by the higher transconductance.

CHARACTERISTICS	
Filament Voltage (AC-DC)	1.25 v
Filament Current	10 ma
MAXIMUM RATINGS	
Filament Voltage	1.5 v
Plate Voltage	50 v
Average Cathode Current	500 μa
TYPICAL OPERATION	
Plate Voltage	7.5 v
Grid Voltage	−1.7 v
Transconductance	150 μmhos
Plate Current (Zero Signal Condition)	100 μa
Grid Current	2×10^{-14} amp

HI-MEG RESISTORS

Victoreen's Hi-Meg Resistors have been developed for use where stability, accuracy, and high humidity operation are of prime consideration. The resistor element is vacuum sealed in a glass envelope. The glass has been treated to lower the leakage resistance and the resistor has been aged to prevent drift.

CHARACTERISTICS	Min.	Max.
Resistance Range*	10^8	10^{12} ohms
Toleran e from your Specified Resistance*	−10	+10%
Tolerance from Labeled Resistance	−1	+1%
Temperature Coefficient	−.06	−.15%/°C
Voltage Coefficient	−0	−.03%/v
OPERATING CONDITIONS	**Min.**	**Max.**
Temperature	−40	120°C
Voltage	.0001	1000v
Relative Humidity	0	98%

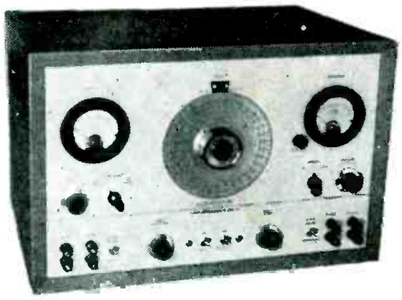
*Higher resistance or closer tolerances are available on special request.

BETTER COMPONENTS MAKE BETTER INSTRUMENTS

Victoreen Instrument

5806 HOUGH AVE. CLEVELAND 3, OHIO

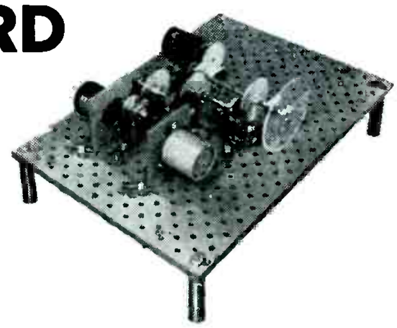
SERVOSCOPE®



Test analyzer for use in development and PRODUCTION of SERVOMECHANISMS and PROCESS CONTROLS. Measures FREQUENCY RESPONSE, PHASE SHIFT 0.1 to 20 CYCLES SINE WAVE, SQUARE WAVE, MODULATED CARRIER, 50 to 800 CYCLES.

SERVOBOARD

A FLEXIBLE SET of PRECISION mechanical parts for quickly coupling motors, synchros, potentiometers to form assemblies of Servo systems, regulators, computors.



SERVO

SERVO CORPORATION OF AMERICA

DEPT. E-9 NEW HYDE PARK, N.Y.

A.W. Haydon Timing

again "PREFERRED WHERE PERFORMANCE IS PARAMOUNT"

The A. W. Haydon Motor was chosen to drive the Airesearch Rate of Change Control. This instrument regulates the rate at which pressure in an airplane's cabin changes, and positive timing is of prime importance. Other aircraft applications in which similar Haydon Motors are used include gun door controls, vacuum tube protector circuits, controls for wing and propeller de-icing, propeller feathering, camera intervalometer, hydraulic bypass, fuel tank purging as well as recorder chart drives, trim control, telemetering and destructor control.

The A. W. HAYDON COMPANY
235 NORTH ELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electrical Timing Devices

and Development Board for the Armed Forces.

EDWARD W. ALLEN, JR., has been promoted from chief of the Technical Research Division to chief engineer of the FCC.

E. C. QUACKENBUSH, previously associated with connector and wiring device manufacturers, has been named to head the engineering department of Cannon Electric Co.'s newly created eastern division at East Haven, Conn.

BEARDSLEY GRAHAM, formerly with Bendix Aviation Corp., has been appointed an assistant chairman of the department of engineering of Stanford Research Institute, Stanford, Calif.

B. Graham

J. E. Browder

JAY E. BROWDER, formerly with Sperry Gyroscope Corp., was recently appointed chief of the radio communications engineering section of Kollsman Instrument Corp., Elmhurst, N. Y., manufacturers of precision aircraft instruments and systems.

JOHN F. LORBER, previously associated with Raytheon Mfg. Co., Waltham, Mass. and RCA Institute of New York, recently joined Hycor Co., Inc., North Hollywood, Calif., as chief engineer.

E. G. BOWEN, chief of the Radio-Physics Division of Australia's national research organization, has been voted the Thomas L. Thurlow Award for 1950 by the Institute of Navigation.

NATHANIEL B. NICHOLS, formerly professor of electrical engineering at the University of Minnesota, has been appointed manager of the research division of Raytheon Mfg. Co., Waltham, Mass.

NEW BOOKS

(Continued from page 152)

refers to the book as, "This completely revised Second Edition . . ."

If the material from the first edition were sufficiently fundamental to be as true today as it was yesterday, there would be no objection to retaining it. But, of the 373 illustrations used in the first edition published in 1933, 340 have been used, intact, in the new edition. New plates have been added to make a total of 417 illustrations. These illustrations, in many cases, are schematic diagrams (with component values) of "typical" test equipment. The tube lineups will start many an old timer reminiscing. Except for one circuit which used a 6C5 and a 6N7 and a second, which used an 885, the remaining 415 figures utilize the following tubes: 112, 01A, 40, 12 and 12A, 80, 58, 99, 71, 22, 1852. On page 413 are tabulated the characteristics (including B and C battery voltages) for the five tubes most frequently mentioned in the text. The table is not just a convenience as it was in the first edition; it is a necessity because none of the tubes listed are mentioned in current tube handbooks.

The recent literature has been full of articles on new measuring techniques, especially in the microwave region. A glance at the footnote references does not seem to reflect this trend. In the first 200 pages of the book, there are 154 footnote references to published literature. Of these 122 were dated before 1933.

As for the text, almost 400 of the 675 pages are verbatim material from the first edition. The new pages contain additional or expanded material (chiefly on oscilloscopes, modulation, lines and aerials, wave propagation and miscellaneous measurements).

The author and publisher consider these changes to be "a complete revision." Rather, it seems to these reviewers that little was done to bring the material from the first edition up to date.

Are Signal Generators Covered?

The author states that the material that has been added to the second edition is up to date. His preface to the second edition begins

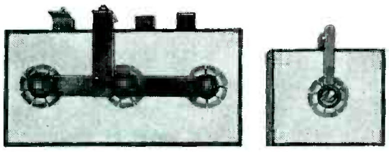
by stating that ". . . changes have been made to bring the book up to date . . . (the book) now gives procedures which are useful at low radio frequencies, at medium radio frequencies, at very high frequencies, at ultra high frequencies, and at super high frequencies." Near the close of the preface the author states that "This book is a reference book for radio and electronic laboratories." The publisher promotes the book as "a comprehensive reference." Therefore, information on, for example, signal generators, should be located quickly for any frequency in this broad spectrum.

The table of contents identifies Chapter II as dealing with high-frequency sources and other apparatus; no other chapter seems more applicable to signal generators. Less than a dozen of the approximately five dozen pages of the chapter deal with signal sources; most of the chapter is on cathode-ray tubes. Two signal generators are described that cover frequencies "up to 5,000 kc/sec." Instead of exact and up-to-date constructional details, one reads that the range can be covered "by using interchangable coils and a straight-line frequency condenser of about 0.001-μf to change the frequency within the range. If a 0.001-μf condenser is not available, a 0.005-μf condenser will do." Practically all of the dozen pages are taken verbatim from the first edition.

Since this book is a reference work, it should be easy to locate the information we seek. In the index, under "lighthouse tube", we are referred to page 625. A lighthouse tube and a rocket tube are mentioned but no further data are presented on their use. Under "klystron, noise level of" we are referred to page 588. Page 588 contains a table (taken verbatim from the first edition) that has nothing to do with klystrons. The reviewers, having read more of the book than the reference reader is likely to, found, on page 598 two sentences about noise level in klystrons. The magnetron is not mentioned in the index (nor does it appear to be mentioned in the book). Microwaves are mentioned on one or two

SYNTRON

SELENIUM RECTIFIERS



Made by a new process to a uniform, high quality for continuous, heavy-duty service.

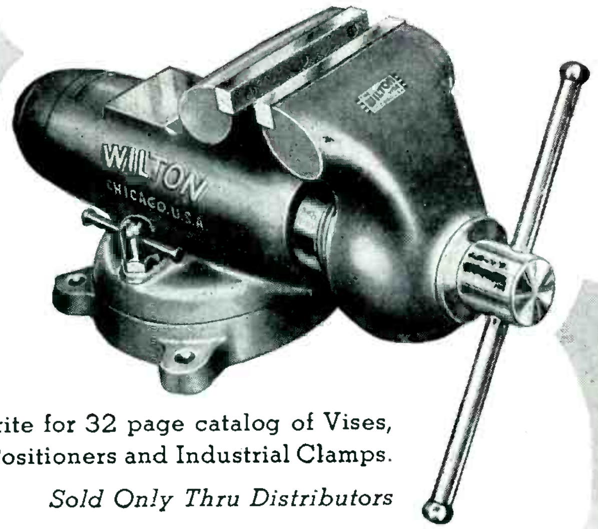
1" sq. to 12" x 16" cells—in stacks, or single cells for customer assembly.

Write for literature

SYNTRON CO.

241 Lexington
Homer City, Pa.

Men Who Use Them Know...
WILTON
IS THE FINEST NAME IN VISES



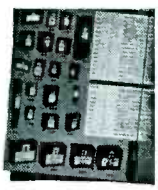
Write for 32 page catalog of Vises, Work Positioners and Industrial Clamps.

Sold Only Thru Distributors

WILTON TOOL MFG. CO.

925T WRIGHTWOOD AVE.
CHICAGO 14, ILL.

SPECIALTY

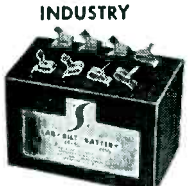


LAB-BILT DRY BATTERIES

INDUSTRY

Write for New
FREE CATALOG

Here are complete descriptions of 78 Lab-Bilt Batteries of industrial and hard-to-get types. Specification Sheet enables you to order batteries especially designed to your own requirements. No order is too small. Specialty makes and ships FRESH Lab-Bilt Batteries without delay. Get this new catalog today.



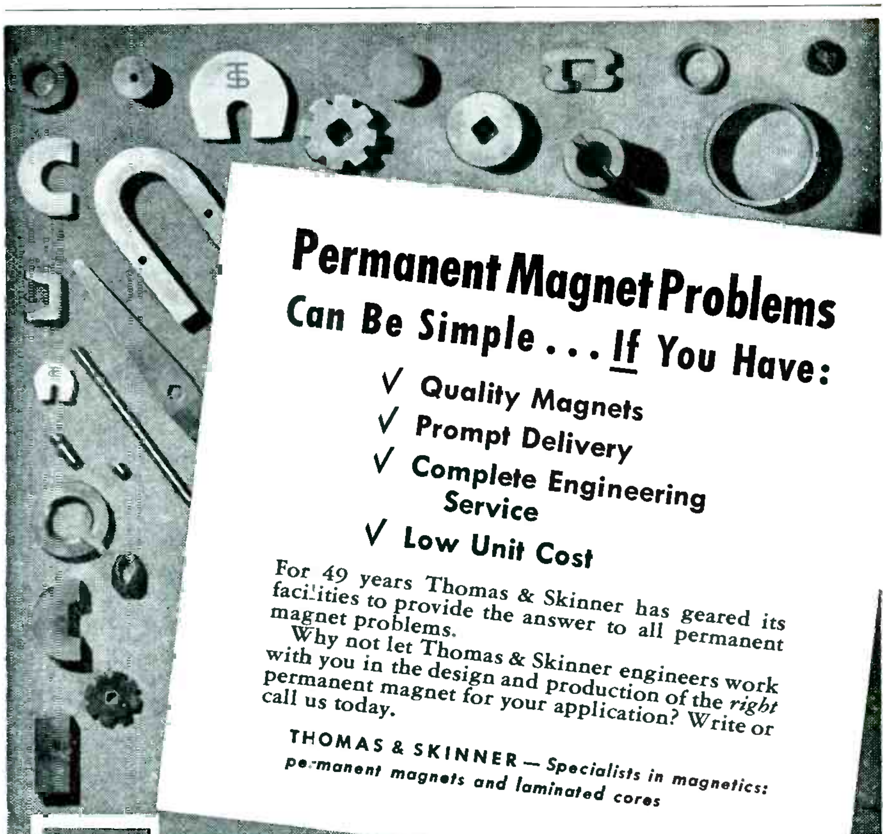
LABORATORY

RADIO AND IGNITION

SPECIALTY BATTERY COMPANY

Ray-O-Vac RAY-O-VAC Subsidiary

MADISON 10, WISCONSIN



Permanent Magnet Problems
Can Be Simple . . . If You Have:

- √ Quality Magnets
- √ Prompt Delivery
- √ Complete Engineering Service
- √ Low Unit Cost

For 49 years Thomas & Skinner has geared its facilities to provide the answer to all permanent magnet problems.

Why not let Thomas & Skinner engineers work with you in the design and production of the *right* permanent magnet for your application? Write or call us today.

THOMAS & SKINNER — *Specialists in magnetics: permanent magnets and laminated cores*

THOMAS & SKINNER Steel Products Company
1120 East 23rd Street • Indianapolis, Indiana

of the 676 pages of this edition.

Thus, for our efforts to learn about signal generators, we have been rewarded, despite comprehensive promises in the preface, by less than a dozen pages written nearly two decades ago, a few new sentences, and one typographical error (reference to page 588 instead of page 598) in a place where an error is a genuine annoyance. Considering the importance of vhf and uhf oscillators for measuring everything from molecular properties to antenna radiation, this is a poor showing.

A single unacceptable sample is hardly sufficient basis on which to reject the entire book. There is a reasonable amount of additional material on cathode-ray tubes and oscilloscopes. Let us, therefore, sample the book on its own ground by referring to this second edition for information on recording high-speed transients.

Is Oscilloscope Section Up-to-Date?

We find information on high-speed oscilloscopes with sweep rates up to 100 kc, but not much on vertical amplifiers. Pages 91 and 92 deal with observing and photographing traces. The material is based on a reference dated 1894 by which "recording speeds of 500 km/sec, and details up to one-millionth of a second can be followed on the photographed trace." That is, frequency components up to a megacycle can be photographed by this method with writing rates of 50 cm per μsec. Would any reader need to refer to a special book on measurements to do this well? As for doing better, a variety of commercial equipment based on simpler techniques than the one described are available for photographing traces, even a micro-oscilloscope for recording frequencies as high as 3,000 mc has been available for several years (see ELECTRONICS, December 1947, page 200). Yet the best this book offers is a technique over a half century old.

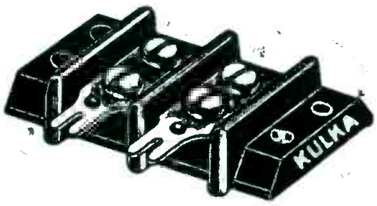
Is Noise Data Correct?

Let us look for information on signal-to-noise ratio, the third of the three specific advances previously listed. Pages 590 to 600 are devoted to "Remarks and Experi-

Simplify Your Wiring With KULKA TERMINAL BLOCKS

Eliminate Splicing • Stop Leaks and Shorts • Increase Insulation

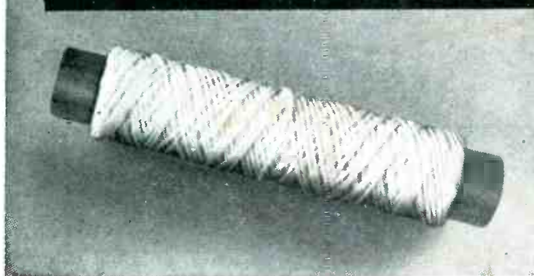
Blocks of high tensile strength Bakelite (or other plastics to gov't spec.) and come in 4 sizes—with 1 to 23 terminals. Screws and solder lugs of nickeled brass. Lugs in several styles, also eyeletted to block. Marker strips come plain or printed, or blocks can be engraved.



Write Dept. E for Catalogue

KULKA ELECTRIC MFG. CO. INC. Mt. Vernon, N. Y.

Sensational New NYLON Lacing Cords win approval of "Big Name" Companies*



*names on request

"Never anything like it before", say the big companies in the electronics field. They're referring to Heminway & Bartlett's new fungus-proof Nylon Lacing Cords, specially coated to resist mold and micro-organisms and at the same time retain malleability.

With a tensile strength to suit your particular problem, and a synthetic resin finish with a melting point of over 190°, these new cords meet every installation requirement.

We'll be glad to give you complete information, including samples for field testing. No obligation, of course.

THE HEMINWAY & BARTLETT MFG. CO., 500 Fifth Avenue, New York 18, New York. *Branches*: Chicago, Ill., St. Louis, Mo., Cincinnati, Ohio, Charlotte, N. C., Gloversville, N. Y.

HEMINWAY & BARTLETT FUNGUS-PROOF *Nylon Lacing Cords*

McIntosh

WORLD'S FINEST AUDIO AMPLIFIER

A SOUND INVESTMENT FOR FINE MUSIC

50 Watts (peak: 100)
50W-2 . . . $249.50

McINTOSH, the world's most advanced amplifier, is unequalled for quality reproduction of any sound source. Highest Efficiency — over 65%; Less Than 1% Distortion at Peak Power; Dynamic Range: Over 70 db; Frequency Response: 20-20,000 cps.

AE-2 Amplifier Equalizer . . . $74.50

SEND FOR *Free* CATALOG Dept. B-2

McINTOSH ENGINEERING LABORATORIES, INC.
320 Water St., Binghamton, N. Y.

THE NEW TEC

WIDE-BAND • HIGH-GAIN

FIVE INCH

OSCILLOSCOPE T-601-B

- **Y AMPLIFIER**
  10 mv. rms/in. — 3db 2 cy. 12 Mc.
- **X AMPLIFIER**
  250 mv. rms/in. — 3db 2 cy. to 250 Kc.
- **INPUT**
  1.5V. visible for marking
- **RECURRENT SWEEP**
  10 cycles to 100 Kc.
- **TRIGGERED SWEEP**
  10 µs. to 10^5 µs.
- **INTERNAL CALIBRATOR**
  Measures 10 mv. to 500 v. P-P
- **PROBE**
  10 mmf. 2 megohms
- **Phaseable 60 cy. Sweep & Sync.**
- **$399.50 FOB N. Y. C.**

Write for detail sheet E-91.

The TEC model T-601-B is a general purpose high quality cathode ray oscilloscope with all the features requisite to precision laboratory equipment. Sturdy construction, highest grade components and top engineering design, the T-601-B is widely used in the country's top laboratories.

TEC **TELEVISION EQUIPMENT CORP.**
238 WILLIAM ST., NEW YORK 7, N. Y.
IN CANADA THE AHEARN & SOPER CO LTD, OTTAWA

mental Procedures on the Signal-to-Noise Ratio in Receivers." Four of these pages are devoted to splitting hairs on two definitions of noise figure, when in almost all cases, Friis' definition is the one most commonly used. Two pages are devoted to measurement of noise figure. These pages describe the measurement of the noise figure of an f-m receiver, and use the c-w signal generator technique. No mention is made of either temperature-limited diodes or gaseous discharges as absolute noise sources. Since these latter methods are used almost to the exclusion of c-w signal generator techniques, the discussion is rather abstract. The remaining three pages are devoted to generalities of the origins of noise in radio receivers, and some general design criteria. As for the former, the book mentions "thermal agitation noise in circuit impedances and shot noise." No mention of such other noises as partition noise and induced grid noise is made. As for the design criteria, to quote directly: "It is especially the first tube in a receiver which causes most of the noise, since the noise voltage occurring at the output of this tube is due to shot and thermal agitation noise and is amplified in all succeeding stages.* It therefore seems advisable to operate the first tube at high gain but with the smallest possible plate current. (!) At least this seems to be a good compromise. A high-voltage-gain provision from the antenna to the first tube seems also to be a good practice . . . ."

Thus, not only do we fail to find useful or up-to-date information on some subjects, but we find half-information and misleading statements on other subjects.

Will the Book Help Students?

In the preface the author asserts that the book "is also well adapted for a one-year course for students of senior and first-year graduate standing." Considerable portions of the text are devoted to rudimentary descriptions of circuit operation that should be familiar to seniors, such as a page describ-

* This type of non sequitur occurs many times in the text.

ing the operation of a relaxation oscillator. Such obsolete information is a hindrance to students. No pretense of emphasizing fundamentals can mask the fact that techniques are presented against a background of technology that is now outdated.

Responsibility of Author

Because the author's preface and the publisher's jacket promise so much for this book that it does not contain, the undersigned were stimulated to reflect on the responsibilities of authors, publishers and reviewers.

How did the author expect this book to contribute to the utilization of modern methods of measurement? The subject is quite broad, reaching into several fields of specialization. Can one individual master the entire subject and still find time to write an up-to-date book on it? If one writes a book, should it be complete, or just more complete than any other in the field? These are unanswerable questions; we believe, however, that engineers and scientists expect something of their professional ideals to be reflected in the books on which they rely.

Responsibility of Publisher

The publisher's imprint carries much the same features of recognition as a brand name. The publisher of this book is well known for the authoritative technical books that he markets. The publisher certainly screens manuscripts before printing them. On what basis does he screen them? Does he assume that, because the book market does not readily saturate, a new book on a particular subject will sell about as well as its predecessors regardless of its content? Or does he consider content also?

We believe that technical books—books used as sources of information—are unique among commercial commodities. Except in the trivial case where the reader knows as much about a subject as an author, we read technical books to learn. The learner is in no position to judge the factuality of what he reads! He necessarily reads with entirety; between us we have obtained a representative sampling. The frequent departure from vernacular English, the scattering of information on a topic through many portions of the book, added to the paucity of directly usable material on modern techniques make the book difficult reading. We obviously do not recommend it. But in presenting this review we have endeavored to present representative facts in sufficient detail to substantiate our conclusions.

There is still need for a book that bridges the gap between books on fundamentals and instrument manufacturers' catalogs, a book that presents *modern* techniques of high-frequency measurements. — MATTHEM T. LEBENBAUM, *Ass't Supervising Engineer, Radar Section, and* FRANK H. ROCKETT, JR., *Engineer. Airborne Instruments Laboratory Mineola, New York.*

THUMBNAIL REVIEWS

GOVERNMENT ADMINISTRATION OF THE COPPER INDUSTRY IN WORLD WAR II. By John W. Douglas. Available at $1.00 from John W. Douglas, Republic Foil & Metal Mills Inc., 55 Triangle St., Danbury, Conn., 51 pages, paper-covered, $1.00. General study of formation and development of War Production Board as specifically related to copper, copper products and finished articles made therefrom. Based on notes made by author while chief of the Brass Mill Branch and assistant director of The Copper Division of WPB.

BIBLIOGRAPHY OF TECHNICAL REPORTS (Jan.-June 1950). Office of Technical Services of U. S. Department of Commerce, Washington 25, D. C., $1.00. Foreign and domestic technical reports received by OTS in this period are indexed according to subject.

OPPORTUNITIES IN TELEVISION. By Jo Ranson and Richard Pack. Vocational Guidance Manuals, Inc., 45 W. 45 St., New York, 1951, 128 pages paper-covered, $1.00. Analyses of job opportunities in all entertainment, engineering, service and business phases of the television industry, with appendix that includes bibliography, list of television stations, NBC job inventory and glossary of terms. Typical salary figures are given for each job.

HANDBOOK OF POWER RESISTORS. H. F. Littlejohn Jr. Ward Leonard Electric Co., Mount Vernon, N. Y., 1951, 195 pages, $3.00. Design, construction and use of resistors capable of handling 5 watts or more, including: General Resistor Considerations; Materials for Resistors; Types of Resistors; Criteria for Selection; Standard Types and Sizes of Resistors; Making of a Vitrohm Resistor; Resistor Standards; Definitions; Useful Data; Bibliography.

MATHEMATICAL METHODS IN ELECTRICAL ENGINEERING. Myril B. Reed and Georgia B. Reed. Harper & Brothers, New York, 1951, 338 pages, $5.00. Streamlined essentials of mathematical background for electrical engineering, with emphasis on manipulative aspects. Nonessential techniques, subtle ideas, theoretical aspects and outmoded treatments are omitted. Topics, examples and problems are presented in the language of the electrical engineer.

confidence or, lacking confidence, looks elsewhere. Any basis for screening technical manuscripts that neglects determining whether they contain the information attributed to them is, we believe, fallacious.

A row of reliable reference books is an engineer's bread and butter; but any engineer who foregoes $10 worth of bread and butter for this book on the strength of the author's and publisher's claims for it is, in our opinion, needlessly cluttering up his back closet.

Responsibilities of Reviewers

And what of the responsibilities of reviewers in this chain? Should reviewers describe the contents of books and hold their counsel, or should they, as we have tried to do here, analyze books critically? If one attempts to evaluate a book, on what basis should he do so: technical content, style, adequacy of illustrations, organization, index, typography? Even if a technical reviewer is objective, he may single out features of a book that are unimportant to a reader with a different interest in the subject.

To review a book, one must read it more carefully than he would normally. The reviewer must also think sufficiently about the book to come up with some concrete comments, comments that he must commit to writing. Why go to all this effort? Will the review, which will probably not be published until after the book has been on the market for some months, aid many readers in their selection?

We believe that the reason engineers do book reviewing is that there is a great stimulation in reading a factual and lucid presentation of useful technical information. Having read such a book, one naturally wants to bring it to others' attentions.

On the other hand, if the book seems inadequate, one is obligated to wade through it page by page to be able to thoroughly document adverse criticisms. There is no stimulation to sustain one who is confronted with such a book; quite the contrary, one is haunted by the knowledge that to discredit it is to court ill will.

We have not read this book in

BACKTALK

(continued from page 154)

dustry in this double-barreled drain on our technical resources by (1) contracting for large numbers of civilians with nothing in mind for them to do, and (2) grabbing the reservists out of industry where they are needed to produce the items the services want.

Recently we were told by a manufacturer that he was all too glad to modify a standard item to another range of frequencies *if* the staff had time to do it. They didn't, as they were really under-manned, and excessively busy with government contracts.

This insatiable greed on the part of the services for technical manpower for nontechnical jobs puts us in the same class of nations as Russia with respect to industrial efficiency. I speak as an interested observer, being an engineer who got caught in the grab-bag reserve recall.

It seems the mistakes of the last war are being repeated. This squandering of skills is bound to damage industry and put us on the road to scientific suicide. I hope the concerted efforts of all who are interested can focus the minds of our leaders on the true resources of a nation at war—one of which is scientific supremacy.

LIEUTENANT,
A. A. C. S.
Overseas

Improved Sync

DEAR SIRS:

THE ARTICLE in your January 1951 issue, "Improved Vertical Synchronizing System", by Robert C. Moses of Sylvania Electric Products Inc. was very interesting to me. I have been wondering for nearly four years whether any American manufacturer was ever going to make use of the principle described. Now I am wondering whether the lack of earlier American application has been due to overlooking previous development and publication, since the article acknowledges none.

The principle of vertical synchronizing signal separation by differentiation followed by preset clipping was described by P. Mandel of Radio-Industrie, Paris, in "Large-Screen Television Projector", (*Proc.*

IRE, p 1,463, Dec. 1949), and by J. Haantjes and F. Kerkhof of N. V. Philips' Gloeilampenfabrieken, Eindhoven, in "Home Projection Television, Part III Deflection Circuits", *Proc. IRE*, p 408, March 1948. The latter paper was read at the IRE Convention in March 1947.

JOHN K. FRIEBORN
Providence, Rhode Island

Diaphote

DEAR SIRS:

I RECENTLY came across the following article entitled "Transmitting Colors By Telegraph" in the May, 1880, issue of *The Californian*. Because of the current interest in color television, I thought that you might be interested in reading it.

"The latest advance in the science of telegraphy is the construction of a device by which forms and colors can be sent by wire as readily as words and signs. The instrument consists of four essential parts, namely: a receiving mirror, transmitting wires, a galvanic battery, and a terminal or reproducing mirror. The receiving mirror is about six by four inches in area, from which issue about seventy small insulated wires, gathered together into one about one foot back of the receiving mirror. Just before reaching the reproducing mirror, each little wire is again separated and connected with that mirror in sections, as with the first.

"The theoretic action of the instrument appears to be as follows: The waves of light from the object to be transmitted fall on certain divisions of the mirror, and the light and accompanying heat appear to produce momentary changes, either chemical or mechanical, in the amalgam of the mirror, which consists of a peculiar compound of selenium and chromium. These changes are so modified by the electric current that each little wire takes up its connected form and color and transmits the same to the end of the wire, where it is again reproduced, so as to be readily seen in the reproducing mirror; or it may be thrown upon a screen and thus enlarged for more convenient examination or study. The greater or less distinctness of the transmitted im-

FACTORY PRECISION

Instrument REPAIR and Standardizing

Prompt service whether your problem involves one or a hundred units. Our laboratory is fully equipped and technically staffed to handle the most complicated instruments and accessories.

Prompt Service

Certified Accuracy

PANEL METERS
VOLT-OHM METERS
Tube Checkers; Vacuum Tube Volt Meters and Laboratory Instruments

Standard Products Inc.
WHOLESALE DISTRIBUTORS
650 E. Gilbert, Wichita 11, Kansas

Inquiries Invited

Polarad *Electronics Corporation*

PRECISION LABORATORY INSTRUMENTS

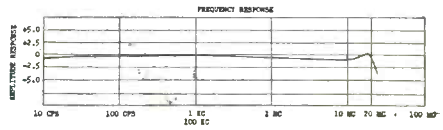
New improved 10 cps to 20 mc

VIDEO AMPLIFIER

Model V2

- Flat frequency response from 10 cps to 20 mc ± 1.5 db.
- Uniform time delay of .02 microseconds.
- Gain of 50 db.
- Frequency compensated high impedance attenuator calibrated in 10 db steps from 0-50.
- Fine attenuator covers a 10 db range.
- Phase Linear with frequency over entire band.
- Extended low frequency response permits accurate analysis of television signals.

This unit is designed for use as an oscilloscope deflection amplifier for the measurement and viewing of pulses of extremely short duration and rise time, and contains the Video Amplifier Unit, Power Unit and low-capacity probe.



Specifications

Input Impedance: Probe—12 mmf + 470.000 ohms; Jack—30 mmf + 470.000 ohms; Output Impedance 18 mmf + 470,000 ohms each side push pull; Max. Input Volts 500 peak to peak with probe; Max. Output Volts 120 volts peak to peak (push-pull); Power: 115 volts 50/60 cps AC Line; Size 19¼" x 22" x 14¾".

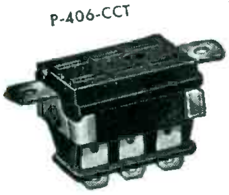
Write Dept. E-9 for complete details.

POLARAD ELECTRONICS CORPORATION
100 Metropolitan Ave., Brooklyn 11, N.Y.

FOR PUBLIC ADDRESS, RADIO, and kindred fields, JONES 400 SERIES PLUGS & SOCKETS

of proven quality!

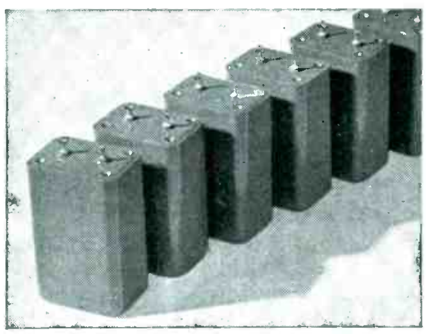
P-406-CCT



S-406-AB

Socket contacts phosphor bronze cadmium plated. Plug contacts hard brass cadmium plated. Insulation molded bakelite. Plugs and sockets polarized. 2, 4, 6, 8, 10, 12 contacts. Steel caps with baked black crackle enamel. Catalog No. 18 gives full information on complete line of Jones Electrical Connecting Devices — Plugs, Sockets and Terminal Strips. Write

HOWARD B. JONES DIVISION
CINCH MANUFACTURING CORPORATION
CHICAGO 24, ILLINOIS
SUBSIDIARY OF UNITED-CARR FASTENER CORP.



PHASE ANGLE PROBLEMS?

Acme is producing filters with less than 5° total phase shift variation over a temperature range of −55 to +85 C. These filters solved a problem in a computer system and also effected a substantial reduction in size and weight.

They exemplify the exceedingly close phase shift tolerances Acme can hold when required. Variation between individual filters can be held to less than one degree.

Do you have a phase angle problem that may be solved with an Acme filter?

Acme ELECTRONICS, INC.
300 No. Lake Ave., Pasadena 4, Calif.
Formerly Acme Metal Die, Inc.

Wave Filters • Delay Lines • Magnetic Amplifiers • Special Transformers & Chokes • Toroidal, Universal & Solenoid Wound Inductors

---

ELECTRONICALLY REGULATED

LABORATORY POWER SUPPLIES

RACK MODEL 32

STABLE • DEPENDABLE • MODERATELY PRICED

STANDARD RACK MOUNTING
PANEL SIZE 10½" x 19"
DEPTH 9"
WEIGHT 38 LBS

- **INPUT:** 105 to 125 VAC, 50-60 cy
- **OUTPUT #1:** 200 to 325 VDC at 300 ma regulated
- **OUTPUT #2:** 6.3 Volts AC CT at 5A unregulated
- **OUTPUT #3:** 6.3 Volts AC CT at 5A unregulated
- **RIPPLE OUTPUT:** Less than 10 millivolts rms

For complete information write for Bulletin E

LAMBDA ELECTRONICS CORPORATION
CORONA NEW YORK

less proper proportion of the component parts of the amalgam.

"This new and interesting invention has been introduced to the scientific world by Dr. H. E. Licks, of South Bethlehem, Pennsylvania. At the first exhibition of his discovery before a body of scientific gentlemen, various objects, such as a penknife, an apple, a tradedollar, and so forth, were shown, and readily distinguished by all present, both in form and color, by being thrown upon a screen. When a watch was held before the mirror for a space of five minutes, the minute-hand was distinctly seen to move. A flower and a portion of a theatre-bill were distinctly transmitted; and when the head of a kitten was projected upon the screen, the audience testified its complete satisfaction by most hearty applause. The instrument is called a 'diaphote', from the Greek dia (through), and photos (light). Much may be reasonably expected from the probable scientific and industrial applications of this instrument. By the union of the telephone and the diaphote the possibility of friends, when separated widely, being able both to hear and see each other, as if talking face to face, may be one of the pleasant anticipations of the early future."

SIDNEY K. GALLY
Pasadena, California

Corrections

DEAR SIRS:

THERE are some important errors in your printing of my article "Amplitude of Vibration in Piezoelectric Crystals" in the April issue of ELECTRONICS.

On page 206, line 25, the equation $K_o/R_s = 1/k$ should read: $X_s/R_s = 1/k$.

On page 208, Table 1, Eq. 7, k should have the exponent 2.

On page 210, line 15, $\delta f/f|I|^2$ should read: $\Delta f/f|I|^2$.

In Fig. 1, the factor 10^{-3}, which was connected originally with the ordinate figures to the unit term of the ordinate, was moved. In doing so, the sign of the exponent must be changed. Instead of 10^{-3}, it must read 10^3. Otherwise, the graph will give completely wrong values. The same applies to Fig. 2, where the factor of the unit term of the ordinate must read 10^{10}. Please note that the dimension of the ordinate unit term in Fig. 1 $(\text{milliampere})^{-1}$ is also left out.

On page 214, in line 5 and 4 from the bottom, it must be read: $(f - f_S)/(f_A - f_S)$, instead of $(f - f_S)/(f_4 - f_S)$.

Furthermore the following words should be inserted in page 206, line 15 from the bottom, after "frequency,"

> and then is operated in another circuit close to its antiresonant frequency."

It would be appreciated very much if these corrections could be published in one of the next issues of ELECTRONICS.

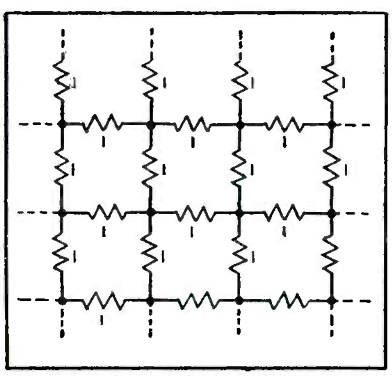
EDUARD A. GERBER

Signal Corps Engineering Laboratories Elberon, New Jersey

Electronics Quiz

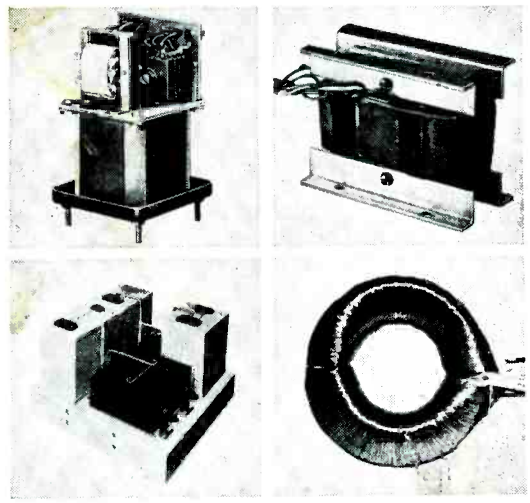
THIS MONTH'S quiz problem is submitted by J. E. Eckert of the RCA Laboratories Division at Princeton, New Jersey. For his problem, Eckert will receive our check for $5.00, as will all other contributors whose quiz problems are used in this department.

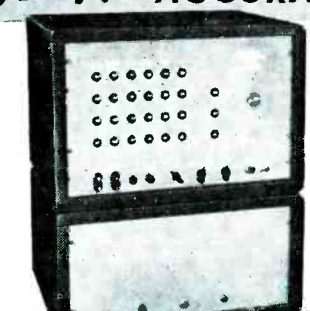
Consider a plurality of 1-ohm resistors connected in square fashion as shown in the diagram and extending out



to infinity in a single plane only. Upon looking into the mesh across any one of the 1-ohm resistors, what will be the impedance seen?

The answer to this problem will be published in next month's issue.





CONTACTS
FOR THE FIELD OF ELECTRONICS

BMC *Manufacturers of*

ELECTRONIC AND ELECTRICAL APPLIANCES • ELECTRONIC PROTOTYPES

BRUBAKER MANUFACTURING COMPANY INC.
9151 Exposition Drive • Los Angeles 34, California • TExas 0-5313

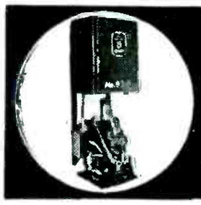
FINE RIBBONS OF TUNGSTEN and Molybdenum
Quality and accuracy in our fabrication of Tungsten & Molybdenum Ribbons have characterized our service to the Electronic industry.
A development of
H. CROSS Co.
15 Beekman St., New York 7, N. Y.

SUB-CONTRACTING
MILITARY and COMMERCIAL
receivers — test equipment
transmitters — controls
sub-assemblies
TELETRONICS LABORATORY, INC.
Westbury, L. I., N. Y., Westbury 7-1028

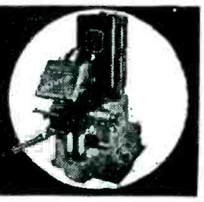
FOR MAINTENANCE OF MOBILE COMMUNICATIONS SYSTEMS
MICROMETER FREQUENCY METER — FM MODULATION METER
LAMPKIN LABORATORIES, INC.
Bradenton, Florida

EL-TRONICS, INC.
Research, development, and manufacture of electronic equipment—a single model to large quantities.
Write Today for Free Resume of Our Plant Facilities
Specialists in Geiger-Muller equipment
2647-67 N. Howard St.-Phila. 33, Pa.-GArfield 5-2026

COILS WOUND
TO MEET ANY REQUIREMENT
Send us your specifications for quotation.
INDUSTRIAL SPECIALTIES CORPORATION
323 Atlantic Ave., Brooklyn 2, N. Y.
ULster 5-0488



EISLER Manufactures Complete Equipment for:
SPOT WELDERS, Electric, for 1/4 to 250 KVA.
TELEVISION TUBE GLASS WORKING EQUIPMENT.
TRANSFORMERS, Special and Standard Types.
INCANDESCENT LAMP Manufacturing Equipment.
FLUORESCENT TUBE Manufacturing Equipment.
NEON SIGN MAKERS EQUIPMENT.
ELECTRONIC EQUIPMENT, Vacuum Pumps, etc.
WET GLASS SLICING and Cutting machines for Laboratory use.
EISLER ENGINEERING CO., Inc. 751 So. 13th St., Newark 3, N. J.



Shorted Turn Indicator
MODEL 101C BULLETIN 42
HUNTINGTON BEACH, CALIF.
KARTRON

FLUXES
SODERING
BRAZING & WELDING
ALLEN
L. B. ALLEN CO. INC. Chicago 31, Ill.
6751 BRYN MAWR AVE.

---

use this
CONTACTS SECTION
to

- PROMOTE NEW USES
- PROMOTE NEW USERS
- GET NEW SALES OUTLETS
- REACH ALL BUYING INFLUENCES
- EFFECTIVELY ** ECONOMICALLY

IF IT'S here...
IT'S news...

IT'S WORTH STOPPING TO SEE!

Maybe Industry doesn't maintain show windows on Fifth Avenue or State Street or Wilshire Boulevard like America's great department stores. But your industry has a mighty effective show window . . . *and this is it* . . . this magazine. In these advertising pages alert manufacturers show their wares. Here you will find up-to-the-minute news about products and services designed to help you do your job better, quicker, and cheaper.
To be well-informed about the latest developments in *your* business, *your* industry . . . and to stay well-informed . . . *read all the ads too.*

McGRAW-HILL PUBLICATIONS

PROFESSIONAL SERVICES

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE

$1.50 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.
POSITION WANTED & INDIVIDUAL SELLING OPPORTUNITY undisplayed advertising rate is one-half of above rate, payable in advance.
PROPOSALS $1.50 a line an insertion.

INFORMATION:

BOX NUMBERS count 1 line additional in undisplayed ads.
DISCOUNT 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).
EQUIPMENT WANTED OR FOR SALE Advertisements acceptable only in Displayed Style.

DISPLAYED—RATE PER INCH

The advertising rate is $14.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
AN ADVERTISING INCH is measured 7/8 inch vertically on one column, 3 columns—30 inches—to a page.

ELECT.

NEW ADVERTISEMENTS received at the N. Y. Office, 330 W. 42 St., N. Y. 18, by August 30th will appear in the October issue, subject to limitation of space available. The publisher cannot accept advertising in the Searchlight Section, which lists the names of the manufacturers of resistors, capacitors, rheostats, and potentiometers or other names designed to describe such products.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

ENGINEER, THOROUGHLY experienced in mechanization and elimination of hand operations. Also with production experience in mass produced, low cost electronic assemblies, preferably with direct experience in the manufacture of radio rotary switches or volume controls. P-1254, Electronics.

ELECTRONIC ENGINEERS established manufacturer requires energetic and resourceful development engineers in field of industrial and electronic instruments. Prefer persons with degree and one to five years experience in development of instruments and electronic apparatus. Write E. T. Anderson, Charles Engelhard, Inc., 850 Passaic Avenue, East Newark, N. J.

EXECUTIVE ENGINEER to co-ordinate research, development and production departments. Heavy training and experience in gas discharge tubes and electronic apparatus, business and executive ability required. Excellent opportunity with progressive established Newark, N. J., area manufacturer. Reply education, experience, etc., P-1658, Electronics.

SELLING OPPORTUNITY OFFERED

FABRICATOR OF signal corps and aircraft wire has following territories open for good production salesmen Cleveland, Los Angeles, Detroit, Fort Worth. SW-1623, Electronics.

EMPLOYMENT SERVICE

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1920, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. L, 241 Orange St., New Haven.

POSITIONS WANTED

SUPERVISOR-ENGINEER, B.S.E.E., over 9 years experience. In charge of design, development, and construction of electronic test equipment and consequent group supervision in nationally known tube, television and radio companies. Methodical organizer and planner. PW-1627, Electronics.

TV ENGINEER, designed TV Pix Reproducer. Chief instructor 5 yr TV Camera. Engineered 120mc CAA Transmitter 3 yr. PW-1553, Electronics, 520 N. Michigan Ave., Chicago 11, Illinois.

GRAD. E.E. 10 years' exp. Design, Development, relays, electronic equipment, service, communications and productions. Unusual ability to produce. PW-1634, Electronics.

EMPLOYED GRADUATE Engineer, age 29, 5 years experience in circuit design of UHF, Transmitting, Control, Audio, and special measuring gear. Am interested in position with progressive, stable company with good opportunities to offer. Am interested in new and challenging work in a congenial atmosphere and in a location where the climate is mild and there is no housing shortage. PW-1670, ELECTRONICS.

A Company to Consider

If you are a capable engineer or physicist, have considered looking into opportunities for a greater professional growth on a challenging program, and prefer a smaller company geared administratively and attitude-wise for technical results, we would like to hear from you.

AIRCRAFT ARMAMENTS INC.
4415 Reisterstown Rd.
Baltimore 15, Maryland

GENERAL PRECISION LABORATORY

NEEDS SENIOR ENGINEERS IN THE FIELDS OF

MICROWAVE SYSTEMS RESEARCH
COMPUTER AND SERVO DEVELOPMENT
MOTION PICTURE PROJECTOR DESIGN
AND RELATED WORK

and

ELECTRONIC FLIGHT TEST AND TV FIELD ENGINEERS

The Laboratory is located in the heart of Westchester County—a stimulating and pleasant rural area—convenient to New York.

For a position with a progressive and expanding organization submit resume to:

Personnel Director, General Precision Laboratory
63 Bedford Road, Pleasantville, New York

POSITIONS WANTED

PH.D AGE 48, married—experience research, production, management in USA and Europe espec. electronic components—resistors, capacitors, ceramic to metal seals—and insulating and dielectric ceramic materials. Presently employed, excellent commercial abilities, foreign languages and knowledge of current European conditions seeks interesting position with European branch of American company preferably in Paris, France. PW-1195, Electronics.

MANUFACTURERS

Qualified man in Jersey Shore area is available to represent manufacturers of electric and electronic equipment in local government agencies. Address Representative, Box 184, Sea Bright, N. J.

PATENTS

Consult A. John Michel.
Registered Patent Att. specializing in Electronics. 15 Park Row, New York 38, N. Y. Tel. CO-7-9034.

Consult: Z. H. Polachek,
Reg. Pat. Attorney, 1234 Broadway, New York 1, N. Y.

WANTED

ANYTHING within reason that is wanted in the field served by Electronics, can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

BENDIX RADIO DIVISION

Bendix
AVIATION CORPORATION

TV RECEIVER DESIGN ENGINEERS —Progressive TV Design Section has excellent opportunity for highly experienced men with proven ability. Desirable openings also available for promising young engineers. We will be pleased to discuss salaries at all levels.

ELECTRONICS ENGINEERS — At all salary and experience levels.

RESEARCH ON: Antennae, Servomechanisms, Microwave ccts. and other phases of communications and navigation equipment.

PRODUCTION DESIGN OF: Military and commercial communications and navigation equipment.

FIELD ENGINEERS — Supervise installation and maintenance of radio and radar equipment. Factory training will be given. Base salaries from $4200 to $6900 per year. 25% bonus for time spent overseas. Traveling and living expenses paid by Bendix. Insurance plan.

TEST AND INSPECTION ENGINEERS — Practical knowledge of radio, radar, or TV manufacturing processes. Good knowledge of radio fundamentals essential. Base salaries from $3900 to $5880.

TECHNICAL WRITERS — Knowledge of radar fundamentals or radio required. Work closely with engineers to gather material for instruction and maintenance manuals. Base salaries from $3400 to $4300.

LABORATORY TECHNICIANS — Require knowledge of radio fundamentals and skill in use of measuring instruments and laboratory equipment. Previous industrial experience essential. Salaries from $262 to $321 per month.

BASE SALARIES FOR ALL POSITIONS LISTED ABOVE ARE SUPPLEMENTED BY UP TO 30% FOR REGULARLY SCHEDULED 48-HOUR WEEK.

Housing is no problem in Baltimore.

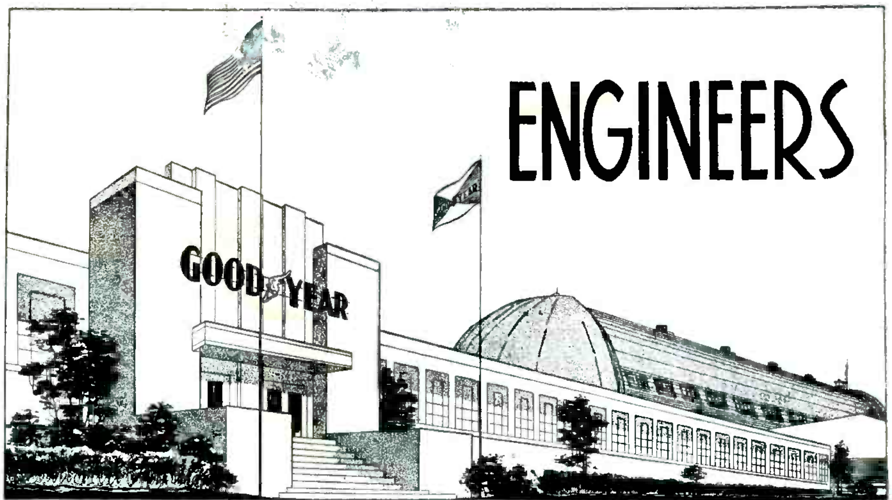
Excellent group insurance and family hospitalization plan.

Attractive retirement plan for professional personnel.

Write for application:

Engineering Personnel Supervisor
Department E
BENDIX RADIO DIVISION of
Bendix Aviation Corporation
Baltimore 4, Maryland
TOwson 2200

ENGINEERS



ENGINEERING WITH A FUTURE

RESEARCH • DEVELOPMENT • DESIGN

The continued and steady growth of established research and development projects has opened a number of unusual opportunities for outstanding and experienced men.

ENGINEERS • SCIENTISTS • PHYSICISTS

Positions are available in our organization for qualified personnel in the following fields:

Circuit Analysis	Aerodynamics
Microwaves	Applied Mathematics
Analog Computers	Physics
Servomechanisms	Flight Test
Dynamics	Design

Openings exist at several levels, and inquiries from recent graduates are also invited. Salaries are based on education, ability, and experience. Liberal salary, vacation, insurance, and retirement plans are yours if you qualify.

If you are interested in a secure future in these experimental fields, write and give full details to Mr. C. G. Jones, Salary Personnel Department.

GOODYEAR AIRCRAFT

GOODYEAR *Aircraft* CORPORATION
Akron 15, Ohio

ELECTRONIC ENGINEERS

SENIOR DEVELOPMENT: Extensive experience pulse circuity, computers, nuclear instruments. Requires leadership qualities, initiative, ingenuity.

New modern lab and plant. Congenial engineering group enjoying excellent working conditions with bonuses and other benefits.

Not a war baby—company in sixth year, growing steadily—top job security. Interested? Send resume and photograph.

BERKELEY SCIENTIFIC CORP.
P. O. Box 1826
2200 Wright Ave. Richmond, Calif.

ELECTRONIC ENGINEERS

SENIOR ENGINEERS or PHYSICISTS
Degree and experience in Radar, Pulse Circuits, Digital or Analogue Computers, or Servomechanisms
JUNIOR ENGINEERS and recent graduate in EE or Physics.

ELECTRONIC ENGINEERING COMPANY
OF CALIFORNIA
180 S. Alvarado St. Los Angeles 4, Calif.

Engineers . . .
Physicists . . . .
Chemists . . . . . .
Metallurgists . . . .

A Reminder
from
GENERAL ELECTRIC

Tremendous material resources . . . the stimulation of highly creative work . . . long-range security and professional recognition . . . these are but a few of the assets General Electric offers you in unusual positions now available in:

Advanced Development, Design, Field Service and Technical Writing.

If you have a Bachelor's or Advanced Degree in Electrical or Mechanical Engineering, Physics, Metallurgy or Physical Chemistry and experience in the Electronics Industry, you can expand your training and experience to the fullest in openings in connection with:

.. MILITARY RADIO & RADAR
.. MOBILE COMMUNICATION
.. MULTIPLEX MICROWAVE COMMUNICATIONS
.. ELECTRONIC COMPONENTS
.. TELEVISION, TUBES and ANTENNAS.

Please send resume to:
TECHNICAL PERSONNEL
ELECTRONICS PARK

GENERAL ELECTRIC
Syracuse, New York

ATOMIC ENERGY INSTALLATION
NEEDS
ELECTRONICS ENGINEERS

Two to ten years' experience in research, design, development or test. Patent history desirable but not necessary. A variety of positions open for men, with Bachelor's or advanced degree, qualified in one or more of the following fields:

- RELAYS
- PULSE CIRCUITS
- SERVO-MECHANISMS
- LOW POWER APPLICATION
- TELEMETERING
- UHF TECHNICIANS
- INSTRUMENTATION
- QUALITY CONTROL

TEST EQUIPMENT RELATING TO THE ABOVE

CAREER DRAFTSMEN

EXPERIENCED CAREER DRAFTSMEN WITH NO COLLEGE DEGREE.

These are PERMANENT POSITIONS with Sandia Corporation in Albuquerque, New Mexico. Sandia Laboratory is operated by Sandia Corporation, a subsidiary of Western Electric Company, under contract with the ATOMIC ENERGY COMMISSION. This laboratory offers good working conditions and liberal employee benefits, including paid vacations, sick leave, and a retirement plan.

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. The "Heart of the Land of Enchantment." Albuquerque lies at the foot of the Sandia Mountains, which rise to 11,000 feet. Climate is sunny, mild and dry the year 'round.

Make Application to:

PROFESSIONAL EMPLOYMENT DIVISION
SANDIA CORPORATION
SANDIA BASE ALBUQUERQUE, NEW MEXICO

WANTED
MANUFACTURER'S REPRESENTATIVES
Many Territories Open

Prominent New York electronic manufacturer wants representatives now contacting manufacturers and laboratories to sell 5" wide-band high-gain oscilloscope in the $400 class.

Please write full details of lines now handled, area covered and other pertinent facts.

RW 1625 ELECTRONICS
330 W. 42nd St., New York 36, N. Y.

ENGINEER WANTED

Must be thoroughly experienced in manufacture of cathode ray tube gun mounts. Executive type. Must be able to handle complete production of established mount manufacturer. Sales background. Opportunity to participate, if desired. State full particulars in first letter.

P-1520, Electronics
330 W. 42nd St., New York 18, N. Y.

Engineers and Technicians

Land-Air, Inc., engaged in a major expansion program, has immediate and near future requirements at Holloman Air Force Base (vicinity Alamogordo, New Mexico) for expert eelctronic and optical engineers and technicians to work with cinetheodolites, special optical instruments, recorders, radars, telemeters and special electronic devices as used for guided missile test instrumentation. Work consists of operation, maintenance, design, development and construction with time spent both in the laboratory and on the range.

Salary offer, based on application or personal interview, are commensurate with education, training, experience, position responsibility and other factors. Monthly salary ranges: Engineers—$460—$740; Technicians—$360—$480.

Personal and family transportation reimbursed, paid group insurance and other benefits. Write for application form to:

LAND-AIR, INC.
Holloman Air Force Base, New Mexico

POSITIONS OPEN
Location
KANSAS CITY, MO.

Electronic & Mechanical Engineers

ELECTRONIC ENGINEERS: Must have considerable development experience in radio transmitting and receiving equipment. Ability to fill position of Senior Project Engineer a requisite.

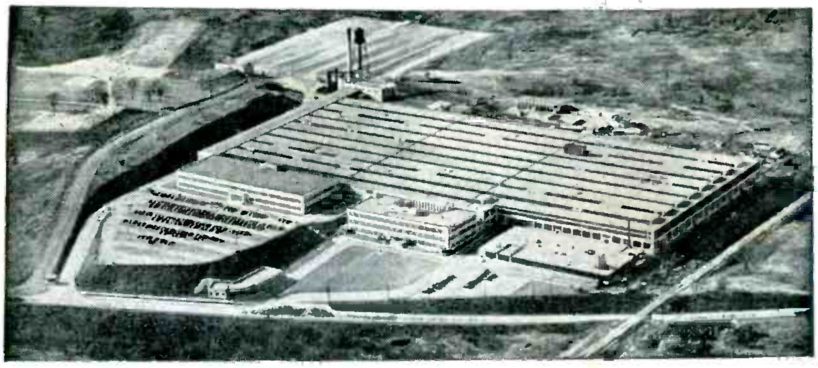
MECHANICAL ENGINEER: Must have development experience in mechanical design of electronic or similar precise equipment. Practical and theoretical knowledge of materials, finishes, sheet metal, and machine shop design are basic requirements. Position is one of considerable responsibility.

SALARY: Open.

These positions are permanent.

Write stating educational and professional history direct to:

Jay V. Wilcox, *President*
WILCOX ELECTRIC COMPANY, INC.
1400 Chestnut St., Kansas City 1, Mo.
Dependable communications since 1931



Development Engineers for Electronic Aircraft Armament

ELECTRONIC INSTRUMENTATION • ELECTRONIC COMPONENTS • SERVOMECHANISMS • RADAR • ELECTRONIC PACKAGING • CALIBRATION AND TESTING ENGINEERS FOR PRODUCTION

Job openings range from recent graduates to Engineers with years of experience. Attractive employee benefits include group insurance and pension plans; paid holidays and vacations.

Send complete resume, listing salary requirements and availability, to:

Technical Employment Supervisor, Station 483-M

THE EMERSON ELECTRIC MFG. CO.
8100 Florissant • St. Louis 21, Missouri

LEADERS IN THE ELECTRICAL INDUSTRY SINCE 1890

Wanted

ENGINEERS AND SCIENTISTS

Unusual opportunities for outstanding and experienced men.

These top positions involve preliminary and production design in advanced military aircraft and special weapons, including guided missiles.

Immediate positions include:

Electronic project engineers
Electronic instrumentation engineers
Radar engineers
Flight test engineers
Stress engineers
Aero- and thermodynamicists
Servo-mechanists
Power plant installation designers
Structural designers
Electro-mechanical designers
Electrical installation designers

Excellent location in Southern California, Generous allowance for travel expenses.

Write today for complete information on these essential, long-term positions. Please include resume of your experience & training. Address inquiry to Director of Engineering,

NORTHROP AIRCRAFT, INC.
1009 E. Broadway
Hawthorne (Los Angeles County) California

Announcing

Unusual opportunities in

SOUTHERN CALIFORNIA

Senior men with degrees and several years of proven accomplishment may achieve further personal growth by working with some of the nation's outstanding scientists in the West's largest laboratories.

CHALLENGE AND OPPORTUNITY

for physicists and engineers in the fields of electron tubes, computers, precision electronics, solid state, system analysis, servo-mechanisms, intricate mechanisms, radar, guided missiles, microwaves.

HUGHES LABORATORIES OFFER

NEW AIR-CONDITIONED BUILDINGS WITH THE FINEST MODERN LABORATORY FACILITIES AND EQUIPMENT.

SOLID LONG RANGE PLANS FOR A CONTINUING FUTURE.

INTRIGUING — VITAL DEFENSE PROJECTS PLUS A STRONG PROGRAM FOR

ADVANCED DEVELOPMENT OF NEW PEACETIME PRODUCTS

EXCELLENT EMPLOYEE BENEFITS

FREQUENT SALARY REVIEWS

COMPANY SPONSORED PROGRAM FOR ADVANCED EDUCATION

AMPLE GOOD HOUSING AVAILABLE

Send resume to

HUGHES
RESEARCH AND DEVELOPMENT LABORATORIES
CULVER CITY, CALIF.

CAPACITOR ENGINEER

Excellent opportunity for man thoroughly experienced in the design and production of small paper capacitors.

Must be capable of taking complete charge of Southern California plant.

Salary open.
Moving expenses paid.

Telephone collect for appointment

Hopkins Engineering Co., Inc.
831 Munsey Bldg., Washington, D. C.
Tel Republic 7975

Don't Forget the Box Number

WHEN answering the classified advertisments in this magazine, don't forget to put the box number on your envelope. It's our only means of identifying the advertisement you are answering.

ELECTRONIC ENGINEERS AND PHYSICISTS

FOR RESEARCH IN TELEVISION AND ALLIED FIELDS

EXCELLENT OPPORTUNITIES FOR SPECIALISTS IN

- UHF CIRCUITS
- CATHODE RAY TUBE DESIGN
- ELECTRONIC CIRCUITS
- VACUUM TUBE TECHNIQUES

QUALIFIED APPLICANTS ARE INVITED TO WRITE:

MANAGER, TECHNICAL EMPLOYMENT

WESTINGHOUSE ELECTRIC CORP.
306 4TH AVE., PITTSBURGH, PA.

CORNELL AERONAUTICAL LABORATORY, INC.

an affiliate of Cornell University

employs about 700 people on vital research work in all branches of aeronautical science. We are gradually expanding our scientific staff, and have several permanent positions open for:

ELECTRONICS ENGINEERS
PHYSICISTS
MECHANICAL ENGINEERS
AERODYNAMICISTS
AERONAUTICAL ENGINEERS
CHEMICAL ENGINEERS

in such fields as:

GUIDED MISSILES
RADAR RESEARCH
BASIC AND APPLIED PHYSICS
ELECTRONIC COMPUTERS
SYSTEMS ANALYSIS
AIRCRAFT PRECISION INSTRUMENTATION
WIND TUNNEL RESEARCH
FLIGHT RESEARCH
DEVELOPMENT ENGINEERING
HEAT TRANSFER
THERMODYNAMICS

Minimum requirement is a B.S. Advanced degrees are even better, but experience to back up the degree is really best. We pay industrial wages. Other tangible advantages here (for example, our self-sponsored internal research policy) should be of particular interest to men with intelligence, ingenuity, and initiative. Send us your resume; all inquiries are strictly confidential. Promising candidates will be invited to Buffalo for interviews at Laboratory expense.

CORNELL AERONAUTICAL LABORATORY, INC.
P. O. Box 235, Buffalo 21, New York

ELECTRONICS ENGINEERS ENGINEERING PHYSICISTS

Several engineers required for development of electronic circuitry, electro-mechanical devices, analog and digital computing equipment.

Positions offer security in a laboratory located in desirable residential area. Apply in writing and furnish information as to education and experience.

JET PROPULSION LABORATORY
California Institute of Tech.
4800 Oak Grove Drive
Pasadena 3, Calif.

ENGINEERS • • DESIGNERS

Key positions affording excellent promotional opportunities for graduate engineers with several years design, development and product experience in the following fields as applied to aircraft:

Servo-Mechanisms
Electronic Controls
Automatic Pilots
Electric Motors
Service Engineers
Design Checkers
Electro-Mechanical Design

Leading aircraft accessories manufacturer. Large backlog for development and production. Located in friendly residential city.

Excellent security possibilities due to current and anticipated contracts not totally dependent on rearmament program.

Interviews arranged at Company expense with qualified applicants. Send experience resume to:

Employment Manager
LEAR, INC.
110 Ionia, N.W.
Grand Rapids, Michigan

WANTED

ELECTRICAL ENGINEER

Minimum 3 years antenna or microwave plumbing research or design experience. To supervise small laboratory group. Supervisory experience not essential.

Salary to $10,000 year

Rapid Advancement possibilities — We are well established in electronics field and are steadily expanding — Permanent. Liberal employment benefits.

DORNE & MARGOLIN
P. O. Box 366
Bethpage, Long Island, N. Y.

WANTED

ELECTRONIC ENGINEERS ELECTRONIC TECHNICIANS

Southeastern concern has need of several good men for work in Jacksonville and other Florida areas. 1—Designer, 1—Production Engineer, 5—Licensed Marine Radio Technicians. Apply giving full details of training and experience. Enclose photo.

P-1687, Electronics
330 W. 42 St., New York 18, N. Y.

WANTED

WANTED

Any quantity

SCR-284 BC-312
SCR-522 BC-348

A) Surplus, complete, brand new, unused.

B) Surplus, complete, reconditioned, excellent shape & working order.

OFFERS: F.O.B. New York to be submitted with detailed description of condition & complete list of items composing each unit to: . . . .

W-1412, Electronics
330 W. 42nd St., New York 18, N. Y.

WANTED

We Need Your Surplus Electronic Equipment

WE PAY TOP $$$ FOR:

RADIO RECEIVERS	AN CONNECTORS
TRANSMITTERS	CLAMPS
ARC-1	PLUGS
ARC-3	CORDS
ART-13	RELAYS
CONTROL BOXES	TELEPHONE
INDICATORS	MATERIALS

WE BUY *ANYTHING!*

WRITE, WIRE TODAY!

TELL US WHAT YOU HAVE

W-1453, Electronics
330 W. 42nd St., New York 18, N. Y.

NEED ART-13; ARC-1; ARC-3; DY-17; TS-12; TS-13; MN-26 J or K; BC-342; BC-312; 1-100; BC-348; BC-611 Handie Talkie (or any part); BC-788 A, AM, B or C; 1-152A, AM, B or C; TS-67; teletype; test or any other equipment. Will trade. Write:

BOB SANETT (W6REX)
4668 Dockweiler, Los Angeles, California

WANTED

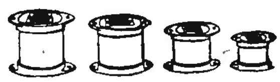
Tubes, Test equipment, Condensers, & general inventories. Highest prices paid.

W-9948, Electronics
330 W. 42nd St., New York 18, N. Y.

(Additional Wanted Ads on page 368)

BRAND NEW — U. S. GOV'T. SURPLUS — GUARANTEED

HIGH POWER TR. MICA

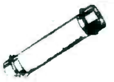


G-1 TYPE		G-2 TYPE		G-3 TYPE		G-4 TYPE	
.0001	6KV	.0001	10KV	.0001	20KV	.0002	30KV
.00015	5KV	.00015	10KV	.00015	20KV	.002	20KV
.0002	6KV	.0002	10KV	.0003	20KV	.0025	25KV
.0008	6KV	.000247	12KV	.0004	20KV	.004	15KV
.0047	6KV	.0003	10KV	.00045	15KV	.005	8KV
.005	5KV	.000375	10KV	.0005	20KV	.01	15KV
.01	4KV	.0004	5KV	.001	20KV		
.032	2KV	.0005	10KV	.0011	20KV		
.04	1KV	.00057	10KV	.0024	15KV		
.051	1.5KV	.00065	10KV	.004	12KV		
.08	1.5KV	.001	6KV	.25	1.6KV		
.09	1.5KV	.003	6KV	.25	6.KV		
		.003	8KV				

OTHER H.V. MICAS

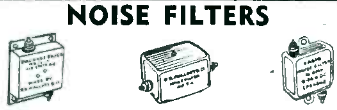
.0001	12.5KV	.01	7KV
.007	15KV Type 75A	.02	8.5KV
.01	5KV		

Type "F" and "NIF" GLASS FERRULE RESISTORS



Ohms	Watts	Ohms	Watts	Ohms	Watts
1	15	1000	50	6300	40
2.	20	1000	90	6500	120
2.2	15	1250	20	7500	15
4	90	1500	20	8000	90
5	15	1500	50	8200	40
6.2	15	1500	120	10,000	15
10	15	1600	40	10,000	40
15.	50	1800	15	10,000	90
20	15	2000	15	12,000	15
20	90	2000	20	12,500	15
26.	20	2000	50	12,500	90
32	90	2000	90	12,500	120
40:	90	2000	120	13,000	20
40:	12	2500	15	15,000	120
50.	15	2500	20	16,000	M-O-M
60.	20	2500	50	16,000	50
100	15	2675	38	16,000	90
100.	50	3000	20	20,000	50
125	90	3000	50	20,000	120
150:	50	3100	40	25,000	90
160	20	3100	90	25,000	120
200:	50	3150	15	35,000	120
270	20	3150	90	40,000	90
400	20	3300	20	50,000	MFC
600	40	4000	20	1000,000	120
630	90	4000	50	300,000	MFC
800.	50	4500	20	500,000	M-O-M
1000	13	5000	40	600K	MFC
1000	15	5000	50	4.0 Meg.	MFB
1000	20	6000	50	40.0 Meg.	M-O-M
1000	40	6000	120	100. Meg.	MVP

NOISE FILTERS



MALLORY NF.1-1
MALLORY NF12-6 EG
MALLORY NF12-7
SPRAGUE JX-51
SPRAGUE JX-51A
SPRAGUE JX-51B
SPRAGUE JX-55D
SOLAR EA-107
SOLAR EA-109
SOLAR EA-121
SOLAR EA-142
SOLAR EA-125L
SOLAR EB 102
SOLAR ED-101
SOLAR EF-100
SOLAR EF-102
SOLAR EF-104
SOLAR EL-109
SOLAR EL-111
SOLAR EL-113
SOLAR FL 14, EV106
SOLAR FL16, EV-125

LEVER SWITCHES

Over 100 Varieties in Stock of Mossman #4101 Series

1% PRECISION RESISTORS

Standard Brand

Ohms	Ohms	Ohms	Ohms
6.	500	5910	72K
24.	636	6000	75K
28.	680	6550	76100
34.6	733	6800	83700
35.7	743	7000	90K
38.6	750	7500	100K
40.	946	15K	110K
47.7	1000	17K	115K
75.	1250	18380	120K
78.8	1260	19500	125K
80.	1280	20K	130K
88.	1477	20500	135K
100	1485	21K	140K
107.85	2000	22K	145K
110	2142	29500	220K
125	2170	30K	235K
200	2500	32K	260K
215	2800	33800	347K
225	3460	37500	390K
248	3500	38140	500K
280	3760	39K	750K
286	4280	40500	800K
800	4500	47710	1.0 Meg.
370	5000	60K	4.0 Meg.
400	5294	61K	10.0 Meg.
450	5470	61430	
	5500	70K	

POWER RHEOSTATS

Ohms	watt	ea.	Ohms	watt	ea.
.5	25	1.98	225	50	2.53
.5	50	2.81	250	25	2.23
.5	150	5.93	250	50	2.53
1	50	2.81	300	50	2.53
2	50	2.81	300	100	4.27
2	100	4.68	350	25	1.98
2	225	6.59	350	100	4.26
2	300	8.42	370	25	1.98
3	100	4.67	378	150	6.59
3	225	6.58	400	25	1.98
3x3	300	19.95	400	75	3.90
4	225	6.60	500	25	1.98
5	25	1.97	500	75	3.95
5	100	4.68	500	50	2.53
6	25	2.23	500	100	4.39
6	75	3.90	500	150	4.68
7	25	1.98	585	150	6.60
8	50	2.53	750	25	2.23
10	25	2.23	750	150	5.95
10	100	4.27	1000	25	1.98
12	25	2.23	1000	150	5.93
12	50	2.53	1200	225	7.20
15	25	1.98	1250	50	2.66
15	75	3.90	1250	150	6.59
15	100	4.38	1500	25	2.53
20	50	2.53	1500	50	2.65
25	25	2.23	1800	150	6.24
50	25	1.98	2000	25	2.23
50	50	2.53	2000	50	2.53
60	25	1.98	2250	150	6.24
75	25	1.98	2500	150	6.24
75	75	3.90	2500	25	2.23
75	100	4.39	2500	50	2.53
80	50	2.53	2500	100	4.68
80	500	12.46	3000	25	2.39
100	25	1.98	3000	100	4.68
100	50	2.53	5000	25	2.53
100	100	4.39	5000	50	2.85
125	25	2.53	7500	50	2.85
150	50	2.53	7500	100	5.31
175	25	2.53	10000	50	3.12
185	25	1.98	10000	100	5.51
200	25	1.98	15000	25	3.29
200	100	4.27	20000	150	8.43

Specify whether shaft required is for knob or screwdriver adjust.

SELECTOR SWITCHES

Pole	Pos	Deck	Type	Each
1	11	1	Bak-n/shtg	.60
1	21	3	Bak-n/shtg	.89
2	2	1	Cer-shtg	.50
2	6	2	Bak-n/shtg	.60
2	11	2	Bak-n/shtg	.75
3	4	2	Bak-n/shtg	.58
5	3	2	Cer-n/shtg	.98
6	11	6	Bak-n/shtg	1.95
10	5	5	Cer-shtg	2.25
16	2	4	Bak-n/shtg	1.35

Many other types in stock

"AN" CONNECTORS

Large Variety Available At Great Savings

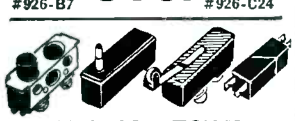
Send your specs and let us quote

BIRTCHER TUBE CLAMPS

#926-A
#926-A1
#926-A14
#926-B
#926-B1
#926-B7

FROM **35c.**

#926-B22
#926-C
#926-C1
#926-C5
#926-C10
#926-C24



MICROSWITCHES

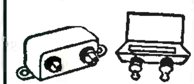
A-#Y2-RS13 SPST "S" plunger, metal housing norm. op....... .59
B-#B-RS10 SPDT Type "S" plunger, 2-circuits: one op and one cl .... .59
#WZ-RL8 (not illus.) SPST leaf actuator, norm. cl......... .59
#R-RL2T (not illus.) SPST 10a 125 vac roller plunger, norm. closed .... .59
C.G.E. SWITCHETTE 10a/115voltsAC
#CR-1070-C103A3 SPST closed.. .59
#CR1070-C103E3 SPST open .... .59
#CR1070-C103R3 SPST closed... .59
#CR1070-C123C3 DPST op/cl... .59
(Many other types in stock)

OIL CONDENSERS

Mfd.	Voltages Avail.
.1	3-6-20K
.25	2-3-3½-4-5K
.5	600-1½-3K
1	600-1-1½-2-5-6
2	400-600-1-1½-2 3-4K
4	600-700-1-1½K
6	400-600-1½-2K
8	600
10	600-2½K
15	600-1K
30	90-vac. 3-ph
100	230-vac. 3-ph
3x4	500
3x8	600
4x3	600
4x8	600
3x10	90-vac

Special Prices on Request

BATHTUBS



Mfd.	Voltages Avail.
.033	400
.05	2-4-600
.1	4-6-1K
.15	600
.25	2-4-600
.35	400
.5	4-6-1K
.75	600
1	1-2-4-6-1K
2	4-600
4	50-100
8	500
25	25-50-75
40	25
50	25
100	15
200	12
300	6
2x.01	2-400
2x.02	6-1500
2x.045	600
.046x.055	600
.2x.05	6-1500
.1x.05	200
.1x.5	400x50
2x.1	4-600
2x.16	600
2x.2	600
2x.25	4-600
.3x.5	500
2x.5	4-600
1.x.05	500
1.x.1	300
1.x.5	200
2x1	600
2x10	25
2x200	9
3x.001	600
3x.05	600
3x.1	4-600
3x.25	4-600
3x.5	100-600
.015x.03x.045x.06x.12/	600

Also available CHANNEL Types. Special Prices on request.

SHOCKMOUNTS

100P-1....	1 lb.	.15
100P-2....	2 lb.	.15
100PR-2....	2 lb.	.15
100P-3....	3 lb.	.15
100P-6....	6 lb.	.20
150P-4....	4 lb.	.20
150PH-8....	8 lb.	.45
100PL-1....	1 lb.	.15
150P-7....	7 lb.	.25
156P-6....	6 lb.	.35
200PD-15..	15 lb.	.59
200PHN-35	35 lb.	.75
204P-112...	112 lb.	.98

TERMINAL BOARDS

5 terminal	.98
8 terminal	1.67
12 terminal	2.49

TYPE "J" POTENTIOMETERS

TYPE "J" $1.50 TYPE "JL" $1.75 — TYPE "JJ" $2.95

ohms	ohms	ohms	ohms	ohms
50*	2500*	100 K*	500–500*†	130 K–130K*
65*†	4000†	100 K†	600–600†	150 K–150K†
200†	5000†	125 K*	1500–1500†	250 K–250K†
300†	10 K*†	200 K*	2000–2000*†	350K–5K†
400*†	15 K*†	250 K*	2000–50K*	350K–25K†
500†	20 K*†	250 K†	2200–24K†	300K–300K†
600*†	25 K*†	500k*†	20K–2000†	350K–350K*
750†	30 K*†	1meg†	25K–10K†	800K–75K*
1000*†	50K*†	1meg†	35K–5000†	1meg–1meg†
1500*†	80K†	2meg†	50K–50K*	2meg–2meg†
2000*†		2meg†	100K–100K*	4meg–4meg†

TYPE "JJJ" $4.95

ohms	ohms
20K-200K-20K†	750K-750K-750K†
45K-27K-2500†	800K-800K-800K†
700K-700K-700K†	1meg-1meg-1meg†

* 1/8" screwdriver slotted shaft.
† Knob type shaft.

TRANSMITTING MICAS

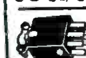
mfd.	wv	type	ea.	mfd.	wv	type	ea.
.0001	600	4	.36	.0015	600	4	.36
.0003	600	4	.36	.00162	600	4	.42
.00005	600	4	.29	.002	600	4	.39
.00005	2500	9	.57	.002	1200	4	.72
.0001	600	4	.29	.0025	600	4	.39
.0001	2500	9	.57	.003	600	4	.43
.00015	600	4	.36	.004	600	4	.45
.0002	600	4	.29	.005	1200	9	.92
.00025	600	4	.29	.0047	600	4	.47
.0005	600	4	.29	.005	2500	9	1.86
.0005	2500	4	.75	.006	800	4	.54
.0005	2500	9	.77	.01	600	4	.65
.0006	2500	9	.85	.01	1200	9	1.41
.0007	600	4	.36	.02	600	4	.92
.00075	300	4	.36	.02	1250	9	2.12
.0008	600	4	.36	.025	600	4	1.08
.0009	600	4	.36	.03	300	4	.99
.001	600	4	.36	.03	600	4	1.34
.001	1200	4	.54	.043	600	4	1.75
.001	1200	9	.57	.05	300	4	1.19

(Many other sizes in stock)

"UG" and "UHF" CONNECTORS

UG-9/U	UG-25/U	83-1F
UG-10/U	UG-27/U	83-1J
UG-12/U	UG-27/AU	83-1AP
UG-14/U	UG-57/U	831RTY
UG-15/U	UG-58/U	83-1SP
UG-16/U	UG-87/U	83-1R
UG-18/U	UG-88/U	83-1D
UG-19/U	UG-123/U	83-1SPN
UG-20/U	UG-185/U	83-22R
UG-20/U	UG-206/U	CN 49120
UG-21B/U	UG-260/U	CN 49121A
UG-22/U	UG-290/U	CN 49151
UG-24/U	83-1AC	PRICES

Jones Connectors



P-101-¼	.25
P-101-¾	.30
S-101-D-MOD ...	.33
S-302-AB	.13
S-304-CCT	.25
P-306-AB	.16
P-306-CCT-L	.33
S-306-FHT	.24
S-308-AB	.21
P-312-AB	.24
P-312-CCT-L	.42
P-315-FHT	.40
P-315-EB	.30
P-315-CCE	.40
S-315-AB	.36
S-318-AB	.43
P-324-FHT	.74
P-324-EB	.58
S-330-AB	.84
S-404-AB	.33
P-406-AB	.33
S-406-CCT	.58
S-408-CCT	.69
S-2408-SB	.53
P-2412-SB	.61
S-2412-CCE	.87
S-502-DB	.97
P-508-CE	2.55
P-510-CE	3.04
P-512-CE	3.52

Jones BARRIER STRIPS

2-140-Y	.13
6-140-Y	.33
10-140-¾W	.53
10-240	.38
18-240	.66
4-141-W	.30
4-141-¾W	.30
7-141-Y	.49
12-141-Y	.82
13-141-Y	.89
15-141-Y	1.02
2-142-Y	.20
4-142-Y	.36
8-142	.48
3-150	.53
4-150-Y	.83
4-151	1.30
5-151	1.60
4-152	1.89
2002	.04
2008	.07
8-54	.22
8-6	.18
4-140-Y	.23
17-240 on 21.....	.63
20-160-R/L	.51
20-161-R/L	.52

Many other types in stock

MALLORY PUSH SWITCH

#2001	S.P., make cont., non-L.........	.52
#2003	S.P.D.T., non-lock	.56
#2003L	S.P.D.T., lock............	.56
#2004	D.P., make 2 non-L.........	.64
#2004L	D.P., make 2 lock.........	.64
#2006	D.P.D.T., non-lock	.78

HUNDREDS OF OTHER ITEMS AVAILABLE

Open a/c to Rated Concerns. Prices net FOB our whse NYS *and subject to change without notice*

ALEXANDER MOGULL CO., INC.

161 Washington St., N. Y. 6, N. Y. — WOrth 4-0865

Coaxial relay K-101—SPDT—24v DC	$ 6.59
Set of 83-1SP coax-connectors for above	1.36
RG59U coaxial cable—75 ohm 150′ roll $11.95 300′ roll	22.50
300 ohm twin lead. 300′ minimum—per ft	.03
Sigma plate relay 800 ohm—SPDT	2.49

R·H·S
SPECIALS OF THE MONTH

1000KC crystal BT cut	$3.95
3″ scope shield	1.29
2 speed dial drive for ¼″ shaft ratios 5:1 1 to 1	.39
ATC 100 mmfd air trimmer screwdriver shaft	.29
Centralab 850 S 50MMF 5KV button cond	.39
25.6 mfd @ 1000v cont. 2000v int	6.95

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

Tube	Price
OA3/VR75	$1.69
OB3/VR90	1.29
OC3/VR105	1.49
OD3/VR150	1.29
1B22	3.45
1B23	12.50
1B24	9.95
1B26	3.95
1B27	24.50
1B29	2.75
1B32	8.95
1B36	24.96
1B38	32.50
1N21 Xtal	1.25
1N21A "	2.25
1N21B "	4.25
1N22 "	1.35
1N23 "	2.25
1N23A "	3.25
1N23B "	6.95
1N27 "	1.69
1N34 "	1.40
1N34A "	1.40
1P23	3.95
1P24	1.79
1P36	2.95
1S21	6.95
2AP1	11.95
2AP5	6.95
2C21/RK33	.69
2C22/7193	.49
2C26A	.49
2C34/RK34	.89
2C39	24.50
2C40	8.95
2C43	14.95
2C44	1.49
2C46	7.50
2C51	6.95
2D21	1.79
2E22	1.95
2E24	4.89
2E26	3.69
2E30	2.29
2J21A	9.95
2J22	8.45
2J26	29.50
2J27	29.50
2J30	99.50
2J31	39.50
2J32	39.50
2J33	39.50
2J34	39.50
2J36	97.50
2J37	12.75
2J38	12.75
2J39	39.50
2J40	39.50
2J46	39.50
2J48	29.50
2J49	39.50
2J50	22.50
2J54B	39.50
2J55	97.50
2J61	49.50
2J62	49.50
2K25/723AB	29.50
2K28	36.25
2K29	24.50
3AP1	12.95
3B22/Elic.	2.95
3B23/RK22	4.85
3B24	5.95
3B24W	7.95
3B25	4.65
3B26	3.95
3B27	3.95
3B28	8.95
3BP1	8.95
3C22	64.50
3C23	$9.95
3C24	2.25
3C31/C1B	3.49
3C45	19.95
3CP1	2.25
3CP1S1	2.95
3DP1	4.95
3DP1A	6.95
3DP1-S2A	8.95
3D21A	1.98
3E29	14.95
3FP7	3.95
3GP1	4.75
3HP7	3.95
465A	14.21
4-125A	26.95
4-250A	29.95
4AP10	4.95
4B22/EL5B	9.95
4B24/EL3C	7.95
4B25/6CF	8.95
4B26/2000	8.95
4B28	4.95
4B32	9.95
4C27/CV92	49.50
4C35	34.50
4E27/257B	17.95
5AP1	3.69
5AP4	3.69
5BP1	5.95
5BP4	5.95
5CP1	4.95
5CP7	4.95
5C22	55.00
5D21	24.50
5FP7	1.95
5GP1	4.95
5JP1	24.45
5JP2	24.45
5JP4	24.45
5J23	12.95
5J29	12.95
5J30	49.50
5J32	99.50
5LP1	15.95
5NP1	5.95
6AS6	3.69
6C21	24.50
6F4	5.95
6J4	6.95
7BP7	8.95
9GP7	14.95
9JP1	14.95
9LP1	19.95
9LP7	14.95
10BP4	22.50
7DP4	17.95
10	.49
12DP7	16.95
12GP7	16.95
12HP7	16.95
12LP4	22.50
15E	1.19
15R	.89
16AP4	42.50
16CP4	42.50
19T8	2.90
23D4	.45
28D7	.98
30 Special	.59
35TG	4.95
45 Special	.39
53A	5.95
75TL	6.95
100R	.89
100TH	9.95
121A	2.98
203A	8.95
204A	69.50
211	$ .69
212E	49.50
215A	.19
217C	8.95
227A/5C27	5.95
249C	3.95
250R	12.95
250TH	22.50
250TL	21.50
274A	5.50
274B	2.65
276A	9.95
293A	2.98
294A	5.75
300B	9.95
304TH	27.50
304TL	29.95
305A	34.95
307A/RK75	5.95
310A	8.95
316A	.65
323A/B	24.50
327A/5C37	4.95
328A	13.95
331A	12.95
350A	8.95
350B	4.95
368AS	7.95
371A	1.49
371B	.98
388A	2.75
393A	6.95
394A	4.95
417A	12.95
434A	4.95
446A	4.95
446B	4.95
450TH	47.50
450TL	47.50
527	12.75
559	1.39
562	97.50
575A	13.95
701A	5.95
702A	3.95
703A	7.95
704A	1.05
705A	2.95
706BY	33.50
706CY	39.50
706FY	42.50
706GY	42.50
707B	17.95
708A	4.95
709A	3.95
710A/8011	1.75
713	1.45
714AY	6.95
715A	7.95
715B	9.75
715C	29.95
717A	1.69
721A	2.59
722A	2.95
723A	9.95
723A/B	14.95
724B	3.89
725A	7.95
726A	6.95
726B	29.50
726C	49.50
730A	12.95
750TL	79.50
800	1.95
801A	.49
802	4.49
803	4.49
804	9.95
805	4.49
806	29.95
807	1.98
808	$7.25
809	2.45
810	9.95
811	3.25
812	2.95
812H	6.95
813	8.95
814	3.95
815	2.95
816	1.30
826	.98
828	12.75
829	12.95
829B	14.95
830B	3.95
832	12.95
832A	12.95
833A	39.50
836A	3.95
837	1.69
838	2.95
841	.45
843	.39
845	4.95
849	29.50
851	69.50
852	29.95
860	.695
861	29.50
864	.39
865	1.45
866A	1.39
866JR	1.29
869B	49.50
872A	2.95
874	1.49
876	.59
878	2.25
884	1.85
885	1.49
902	11.95
905	3.59
908	12.95
918	1.69
919	2.79
922	.98
923	1.05
927	1.59
930	1.20
931A	4.95
954	.39
955	.45
956	.45
957	.45
958	.45
959	.69
991/NE16	.39
1603	5.25
1613	1.25
1614	2.25
1616	.98
1619	.35
1622	3.25
1624	1.98
1625	.45
1626	.45
1629	.35
1630	.98
1631	1.29
1632	.79
1633	.75
1634	.75
1636	3.25
1638	.65
1641	.98
1644	.98
1654	2.39
1665	1.45
1851	1.89
1960	.79
1961	4.99
2050	$1.25
2051	1.45
8005	5.95
8011	1.75
8012	3.95
8013	2.95
8014	29.95
8020	1.29
8025	5.95
9001	2.25
9002	2.25
9003	2.25
9004	.75
9005	2.95
9006	.49
C1JA	9.95
C5B	9.95
C6A	7.95
C6J	6.95
C100D	1.49
CK502AX	2.95
CK503AX	2.95
CK505AX	2.25
CK506AX	2.25
CK507AX	2.25
CK512AX	2.25
CK517AX	8.45
CK1005	.89
CK1006	2.25
E1148	.35
EF50	.69
F123	8.75
F127A	22.50
F128A	89.50
F606	37.60
F660	79.50
FG17	3.95
FG27A	8.75
FG32	7.95
FG57	14.95
FG81A	3.95
FG105	22.95
FG172	34.50
FG146	8.98
FG434A	4.95
FG451	.89
FG502A	1.85
FG562	97.50
FG592	14.95
HF125	14.95
HF300	19.95
HY114B	.79
HY115	.79
HY615	.29
KC4	37.50
KU610	6.95
ML101	69.50
REL21	3.95
RK20	9.95
RK25	4.49
RK33	.69
RK34	.89
RK48A	4.49
RK59	1.49
RK60/1641	1.69
RK65	24.50
RK72	.59
RK73	.59
RX21A	2.95
RX120	8.95
V70D	6.95
VR78	.69
VR91	1.49
VR92	.98
VT127A	3.95
VT158	14.95
VU29	2.95
VU111	1.49
WL468	12.95
WL530	12.75
WL531	12.75
WL532	$2.95
WL578	1.29
WL616	37.50
WL619	18.95
WL677	34.50
WL681	22.50
OA2	2.95
OA4G	1.35
OB2	2.95
OZ4	.98
O1A	.90
1A3	1.32
1A4P	1.30
1A5GT	1.05
1A6	1.10
1A7GT	1.35
1AB5	.98
1B3/8016	1.85
1B4	1.30
1B5/25S	.98
1B7GT	1.75
1C5GT	.98
1C6	1.05
1C7G	1.05
1D5GP	1.15
1D7G	1.15
1D8GT	1.15
1E5GT	1.65
1E7G	1.55
1F4	.95
1F5G	.98
1G4	1.10
1G6GT	.95
1H4G	.95
1H5GT	1.05
1H6GT	1.48
1J6	1.35
1L4	.98
1LA4	1.15
1LA6	1.35
1LB4	1.30
1LC5	1.10
1LC6	1.18
1LD5	1.30
1LE3	1.18
1LG5	1.15
1LH4	1.75
1LN5	1.30
1N5GT	1.05
1P5GT	1.05
1Q5GT	1.18
1R4	1.05
1R5	1.39
1S4	1.50
1S5	1.50
1T4	1.50
1T5GT	1.18
1U4	1.30
1V	.89
1X2	1.60
2A3	1.65
2A4G	1.40
2A5	1.05
2A6	.98
2A7	.98
2B7	1.20
2V3G	.98
2X2	.65
2X2A	1.95
3A4	.69
3A5	1.95
3B7/1291	.69
3D6/1299	.69
3LF4	1.10
3Q4	.95
3Q5GT	1.25
3S4	1.10
3V4	1.25
5R4GY	3.75
5T4	1.95
5U4G	.98
5V4G	$2.40
5W4	1.10
5X4G	1.28
5Y3GT	.89
5Y4G	.98
5Z3	1.05
OZ4	1.40
6A3	1.35
6A4LA	1.45
6A6	1.25
6A7	1.10
6A8	1.25
6AB7	1.49
6AC5GT	1.40
6AC7	1.65
6AD7GT	1.45
6AE6G	1.05
6AF6G	1.45
6AG5	1.35
6AG7	1.65
6AH6	2.10
6AJ5	2.65
6AK5	2.25
6AK6	1.85
6AL5	.98
6AQ5	1.20
6AQ6	1.20
6AR5	1.25
6AT6	1.05
6AU5	2.35
6AU6	1.10
6AV6	1.05
6B6G	1.25
6B7	1.25
6B8G	.85
6BA6	1.05
6BC5	1.25
6BE6	1.15
6BF6	1.05
6BG6G	2.45
6BH6	1.20
6BJ6	1.48
6BQ6	2.50
6C4	1.40
6C5	.85
6C6	1.10
6C8G	1.10
6CB6	1.45
6D6	1.10
6D8	1.15
6F5	1.15
6F6	1.25
6F7	1.05
6F8G	1.35
6G6G	1.35
6H6	1.25
6H6GT	1.15
6J5	.89
6J5GT	.79
6J6	1.75
6J7	1.40
6K5GT	1.35
6K6GT	1.30
6K7	.98
6K8	1.35
6L5G	1.25
6L6	3.00
6L6G	2.65
6L6GA	2.65
6L7	1.25
6L7G	1.25
6N7	1.45
6Q7	1.45
6R7	1.20
6S7G	1.59
6S8GT	1.35
6SA7	1.15
6SC7	1.75
6SD7GT	1.50
6SF5	1.10
6SF5GT	1.20
6CF7	1.25
6FG7	$1.50
6SH7	1.10
6SJ7	1.30
6SK7	1.50
6SL7GT	1.50
6SN7GT	1.60
6SQ7	1.15
6SR7GT	1.10
6SS7	1.50
6ST7	1.45
6SU7GTY	2.25
6SV7	1.45
6T7G	1.65
6T8	1.65
6U5G	1.25
6U6GT	1.25
6U7G	1.05
6V6	2.00
6V6GT	1.50
6W4	1.15
6W7G	1.30
6X4	1.05
6X5GT	1.05
6Y6G	1.48
6Y7G	1.55
6ZY5G	1.20
7A4/XXL	1.10
7A5	1.10
7A6	1.10
7A7	1.10
7A8	1.80
7AG7	1.65
7B4	1.10
7B5	1.10
7B6	1.10
7B7	7.10
7C4	.79
7C5	1.10
7C6	1.25
7C7	1.20
7E5	.89
7E6	.89
7E7	1.05
7F7	1.10
7H7	1.10
7K7	1.49
7L7	1.10
7N7	1.65
7Q7	1.10
7R7	1.15
7S7	1.35
7V7	1.35
7W7	1.45
7X7	1.69
7Y4	.98
7Z4	.98
12A	.79
12A6	.75
12A7	1.25
12A8GT	1.05
12AH7GT	1.85
12AL5	1.35
12AT6	1.05
12AT7	2.25
12AU6	1.35
12AU7	1.45
12AV6	1.10
12BA6	1.25
12BE6	1.25
12C8	1.05
12F5GT	.98
12H6	.98
12J5GT	.79
12J7GT	1.05
12K7GT	1.05
12K8	1.05
12Q7	.98
12SA7GT	1.15
12SC7	1.45
12SF5	1.20
12SF7	1.05
12SG7	1.05
12SH7	1.05
12SG7	$1.15
12SH7	1.50
12SL7	1.10
12SN7	1.35
12SQ7	1.25
12SR7	.98
12Z3	1.10
14A4	1.20
14A7	1.15
14B6	1.15
14F7	1.15
14F8	1.30
14H7	1.20
14J7	1.25
14N7	1.30
14Q7	1.15
14R7	1.20
19	1.30
24A	1.20
25L6GT	1.10
25Z5	1.05
25Z6GT	1.05
26	.98
27	.95
28D7	.98
30	.89
31	.89
32	1.05
32L7GT	1.15
33	1.05
34	.98
35/51	.98
35A5	1.10
35B5	1.10
35C5	1.25
35L6GT	1.30
35W4	1.25
35Y4	1.05
35Z3	1.05
35Z4	1.05
35Z5	1.05
36	1.05
37	.89
38	.98
39/44	.68
41	.98
42	.98
43	.98
45	1.10
45Z3	1.05
45Z5	1.05
46	1.10
47	1.10
48	2.15
49	1.10
50A5	1.10
50B5	1.25
50C5	1.25
50L6GT	1.15
50Y6	1.25
53	1.35
56	.98
57	1.05
58	1.05
59	1.25
70L7	1.30
71A	1.25
75	1.25
76	.89
77	.89
78	1.10
80	1.20
82	1.20
83	1.35
83V	1.35
84/6Z4	1.10
85	1.10
89Y	.89
117L7/M7	1.75
117N7	1.75
117P7	1.75
117Z3	1.05
117Z6	1.25

FULL-WAVE SELENIUM RECTIFIER STACKS

Max. A.C. Input Volts RMS	Max. D.C. Volts Output	Cell Size in Inches	Max. D.C. Amps. Output Continuous	Order by This Number	Price
SINGLE PHASE BRIDGE					
0-18	0-14.5	1¾″ x1¾″	1.3	18B4D1S1	$ 3.95
"	"	2-3/16″x2-3/16″	2.4	18B4E1S1	4.95
"	"	3⅜″ x3⅜″	6.6	18B4F1S1	7.95
"	"	4½″ x5″	13.0	18B4K1S1	12.95
"	"	5″ x6″	17.5	18B4J1S1	15.45
"	"	4½″ x5″	26.0	18B4K1S2	22.50
"	"	4½″ x5″	39.0	18B4K1S3	37.50
"	"	4½″ x5″	52.0	18B4J1S3	47.50
"	"	4½″ x5″	70.0	18B4J1S4	54.50
0-40	0-34	1¾″ x1¾″	0.60	40B4D1S1	4.95
"	"	2-3/16″x2-3/16″	1.2	40B4EW1S1	6.95
"	"	3⅜″ x3⅜″	3.2	40B4FW1S1	9.75
"	"	4½″ x5″	6.0	40B4K1S1	14.95
"	"	5″ x6″	9.0	40B4JW1S1	17.50
"	"	4½″ x5″	12.0	40B4K1S2	28.75
"	"	5″ x6″	18.0	40B4JW1S2	34.50
"	"	4½″ x5″	25.0	40B4J1S3	42.50
"	"	4½″ x5″	34.0	40B4J1S4	54.25
"	"	5″ x6″	36.0	40B4JW1S4	62.25
0-120	0-100	1¾″ x1¾″	0.60	40B4D3S1	12.45
"	"	2-3/16″x2-3/16″	1.2	40B4EW3S1	14.95
"	"	3⅜″ x3⅜″	3.2	40B4FW3S1	24.50
"	"	4½″ x5″	6.0	40B4K3S1	32.50
"	"	5″ x6″	9.0	40B4JW3S1	42.50
CENTER-TAP					
10-0-10	0-8	1¾″ x1¾″	1.2	20C2D1S1	2.35
"	"	2-3/16″x2-3/16″	2.4	20C2EW1S1	3.10
"	"	3⅜″ x3⅜″	6.4	20C2FW1S1	4.25
"	"	4½″ x5″	12.0	20C2K1S1	6.95
"	"	5″ x6″	16.0	20C2J1S1	8.95
"	"	4½″ x5″	24.0	20C2K1S2	14.75
"	"	4½″ x5″	36.0	20C2K1S3	19.65
"	"	4½″ x5″	48.0	20C2J1S3	27.50
"	"	4½″ x5″	64.0	20C2J1S4	34.50
"	"	4½″ x5″	80.0	20C2J1S5	42.50
"	"	4½″ x5″	84.0	20C2KW1S7	49.50
"	"	5″ x6″	96.0	20C2J1S6	55.50
"	"	4½″ x5″	128.0	20C2J1S8	67.50
3 PHASE BRIDGE					
0-120	0-150	1¾″ x1¾″	0.90	40B6D3S1	24.50
"	"	2-3/16″x2-3/16″	1.8	40B6EW3S1	29.50
"	"	3⅜″ x3⅜″	4.75	40B6FW3S1	42.50
"	"	4½″ x5″	9.0	40B6K3S1	79.50
"	"	5″ x6″	12.5	40B6J3S1	86.75

SPECIAL RECTIFIERS ON REQUEST

TRANSFORMERS—115V 60 CY HI-VOLTAGE INSULATION

2700 @ 2 MA; 6.3v @ .6A; 2.5v @ 1.75A	$ 4.45
2500v @ 15 MA	3.49
1540v @ 5 MA; 340-0-340 @ 300 MA	4.35
925v @ 10 MA; 525-0-525v @ 60 MA; 2x5v @ 3A; 6.3v @ 3.6A; 6.3v @ 2A; 6.3v @ 1A	4.85
415-0-415v @ 60 MA; 5v @ 2A; 115/230 Dual Pri	4.25
400-315-0-100-315v @ 200 MA; 2x6.3v @ 9A; 5v @ 3A; 2.5v @ 2A	5.35
325-0-325v @ 12 MA; 255-0-255v @ 240 MA.	4.25
300-0-300v @ 65 MA; 6.3v @ 2.5A; 6.3v @ 1A; 2x5v @ 2A	3.25
0-17.4/21.6/25.8v @ 400 MA; 6.4v @ 5A; 2.6v CT @ 2.5A Pri 115/230	3.85
12.6v CT @ 10A; 11v CT @ 6.5A	6.35
3x10v @ 7A	6.95
6.5v @ 12A; 6.3v @ 2A; 115v @ 1A	3.50
6.5v @ 8A; 6.5v @ 6A; 2.5v @ 1.75A	4.17
6.3v @ 1A; 2.5v @ 2A $2.29 4-0-4v @ 1A	.87
6.3v CT @ 1A	1.29
5v CT @ 20A; 10 KV INS	8.95
.6v @ 15A RMS	1.47

TRANSFORMERS—220v 60 Cyc

512.5-0-512.5 @ 427 MA	$ 5.35
3x5v @ 6A; 4v @ .25A	2.95
3x6.3v CT @ 3A; 6.3v CT @ 1.6A	2.95
10v CT @ 6.5A; 6.3v CT @ 2.5A; 6.3v CT @ 1.8A 220/440 Pri	3.95
Step Up/Down 110/220. 500 watt	10.95

FILTER CHOKES HI V INS

.025 HY @ 1.36A	$1.98
3 HY @ 50 MA	.39
5 HY @ 70 MA/.2 HY @ 350 MA. Dual	2.39
10 HY @ 55 MA	.89
10 HY @ 250 MA	3.95
10 HY @ 100 MA	1.29
13 HY @ 130 MA	1.59
15 HY @ 70 MA	1.39
10/20 HY @ 85 MA	$1.49
15 HY @ 100 MA	1.69
5.3 HY @ 225 MA	2.79
6.6 HY @ 175 MA	2.10
8 HY @ 150 MA	1.79
200 HY @ 10 MA	2.95
325 HY @ 2 MA	2.95
600 HY @ 1 MA	2.95

OIL CONDENSERS—DC RATINGS

MFD		Volts	Price
3x.1	MFD	600v	$ .59
.25	"	"	.35
.5	"	"	.45
1	"	"	.69
2	"	"	.85
2x2	"	"	1.15
4	"	"	1.29
6	"	"	.98
8	"	"	2.49
10	"	"	2.79
3x.1	"	1000v	.85
.5	"	"	.89
1	"	"	.67
2	"	"	1.75
4	"	"	1.85
8	"	"	3.55
20	"	"	4.25
.5	"	1500v	1.02
1	"	"	1.19
2	"	"	1.69
4	"	"	2.69
.1	"	2000v	1.75
.25	"	"	1.92
.5	"	"	1.95
1	"	"	2.09
2	"	"	2.85
4	"	"	4.45
8	"	"	4.95
.1	MFD	2500v	$1.15
.25	"	"	1.25
.5	"	"	1.35
2	"	"	3.45
.01	"	3000v	1.25
.05	"	"	1.30
.1	"	"	1.35
.25	"	"	2.75
.5	"	"	2.85
1	"	"	2.95
2	"	"	4.25
4	"	"	6.95
1	"	3600v	3.98
.25	"	4000v	3.49
.5	"	"	3.75
1	"	"	3.95
2	"	"	5.75
3	"	"	5.89
.1	"	5000v	2.75
.25	"	"	2.95
1	"	"	3.10
.01	"	7500v	2.25
.02	"	"	2.25
.03	"	"	2.35
.05	"	"	2.35
.1	"	"	4.95
2x.1	"	"	7.95
.02	"	12000v	12.75

HIGH CAPACITY CONDENSERS

MFD		Volts	Price
2x3500	MFD	25v	$3.47
2500	"	3v	.35
3000	"	25v	2.45
650	"	80v	1.29
2000	"	15v	1.69
2000	MFD	35v	$ .57
100	"	50v	.45
4000	"	30v	3.25
2350	"	24v	2.25
10000	"	25v	4.57

PHONE DIGBY 9-0347

RADIO HAM SHACK Inc.
189 GREENWICH STREET . NEW YORK, N. Y.

WRITE FOR QUANTITY PRICES

Prices subject to change without notice. F.O.B. NYC, minimum order $10.00. 20% deposit required. All merchandise guaranteed.

WANTED! WANTED!

ATTENTION colleges, schools, hams, industrials! Highest prices paid for surplus equipment, parts, and tubes. We are especially looking for test equipment TS-12, 13, 35, 14/AP, 15/AP, 146/UP, 173, 174, 175, 239, 259, 263. Any types with TS prefix. Write, wire or call.

R·H·S

SPECIALS OF THE MONTH

WANTED! WANTED!

APR-4, 5, 7 and tuning units. ARC-1, 3, ART-13, ATC, APS-10, microwave equipment in S, K, X-band. APS-15, APQ-13, ASP-32, SCR-300, 284, 694, etc. BC-221, 342, 348. BC-1016 tape recorders. Write, wire or call.

RADAR—COMMUNICATIONS AND TEST EQUIPMENT

TS-35/AP X-band Signal Generator. Pulsed and C.W. freq. range. 8400-9600 mcs. This unit will measure power and frequency. 115v 60-2600 cyc.

TS-3/AP S-band Frequency and Power Meter. Portable. Battery operated. Complete with all cables.

TS-33/AP X-band Frequency Meter. 8500-9600 mcs. Contains crystal detector and indicating meter. Output to scope will indicate pulse wave shape.

TS-62/AP X-band Echo Box. 8400-9600 mcs. tuned and untuned input. Will indicate resonance on meter. Complete with pick up antenna and cable.

TS-268/UP Crystal Diode Test Set. Used to check 1N21, 1N22, 1N23, etc. Battery operated. Portable. Complete with spares.

TS-89/AP Voltage Divider. 1:10 and 1:100 ratios. Wide band for true pulse shape. Output to scope.

TS-10/APN Altimeter Test Set. Good condition. Complete with cables and dummy antenna........$35.00

TS-12/AP V.S.W.R. Test Set for X-band. Complete with amplifier, slotted line, termination, adaptors, etc. In 2 carrying cases. Excellent.

TS-45/APM-3 X-band signal generator. 8400-9600 MCS pulsed & CW output. Used to check APS4 & similar sets.

TS-36/AP X-band Power Meter. Consists of power measuring circuit. Horn antenna, co-ax to wave guide adaptor, connecting cable and probe. Will measure either absolute or relative power. Nominal band of usefulness is approx. 8.5-9.7 KMC. Excellent condition.

TS-118/AP R.F. Wattmeter for the range of 20-750 mcs. Will measure power up to 500 watts. Complete.

TS-174/U Freq. Meter. Freq. range is 50-250 mcs. High freq. version of BC-221. Excellent Condition $385.00

TS-16 altimeter test set. Used to check various altimeters or as an accurate wavemeter. New....$29.95

TS-61/AP S-band Echo Box. Using meter provided it is possible to maximize the XMTR adjustment and determine relative power output. Complete with probe and cable. Very good condition......$140.00

TS-13/AP Xa band signal generator, wave meter, wattmeter. Precision lab microwave. Test set. Will provide either pulsed or CW output in Xa band. Input 115v 60-800 cys.

TS-226/AP used to measure peak power output of any xmitter in the range of 200-1000 mcs. Has provision for oscilloscopic signal observation and built in calibration. Part of AN/APM-29. Excellent.

TS-14/AP consists of S-band signal generator, freq. meter, wattmeter and cables. Power input is 115v 50-2600 cyc. Used to check various S-band radars and beacons.

TS-170/ARN-5 XTAL controlled test osc. with the following freq. ranges: 332.6, 333.8, 335.0 depending on XTAL in use. This set is used to align glide path receivers. Batteries and antenna are self contained. Excellent condition.

OTHER TEST SETS

TS-278/AP	TS-184/AP	TS-19/APQ-5
TS-100/AP	TS-189/U	TS-92/AP
TS-102/AP	TS-110/AP	TS-40/CRN-2
TS-47/APR	TS-164/AR	TS-348/AP

AN-APS-3 Airborne X-band Search and Homing radar. Complete. Contains RF head, modulator, synchronizer, control boxes, plugs, antenna, etc. 115v 400 cyc. Excellent condition $375.00

ASB-5 L-band Search and Homing radar. Complete. Contains xmitter, receiver, power unit, control box, plugs, etc. 115v 400 cyc. Excellent condition $125.00

SCR-518 Radar Altimeter. 500 mcs. equipment. Complete with xmitter, receiver, control box, power unit, junction box with all cables, racks, etc. Unit will indicate altitude up to 50,000 ft. Power input is 28v. New condition $99.50

AN-APS-15 R.F. Head and Modulator. X-band. Complete with all tubes. Good condition........$99.50

AN-APA-23 Automatic Signal Strength and Time Recorder. Unit will scan a receiver thru its range and record all signals on electrosensitive paper. Input is 115v 60-2600 cyc. and 28v DC. Excellent condition $175.00

DYNAMOTORS AND POWER UNITS

Type	Input Volts	Output Volts	Output Amps	Price
DM-19	12	500	.200	$6.95
PE-125	12v*24v	475	.200	14.50
DM-32	28	250	.060	1.75
DM-33	28	570	.160	2.95
DM-34	12	220	.080	8.95
DY-12	12	275	.110	
		500	.50	
PE-73	28	1000	.350	10.00
PE-94	28	300	.260	
		150	.010	
		14.5	.5	2.25
PE-97	Vibrator Power Supply			8.95
PE-98	12v	300v		35.00
PE-101	28	400		
		800		5.75
PE-103	6 & 12	500	.160	35.00
PP-18-AR	Vibrapack			15.95
RA-42	(for BC-639 Receiver)			29.95
ATR	Inverter 12v	110v AC	125 watts	14.95

AN/CRT-3. Victory Girl. Dual frequency emergency lifeboat xmitter. Complete with xmitter, kite hydrogen generator, etc. New in knapsack. C.A.A. approved $69.50

AN-APR-5 Radar Search Receiver. Freq. range 1000-3100 mcs. Will detect signals up to 10,000 mcs. with reduced sensitivity. Contains oscillator and mixer cavity, IF strip, power supply. Input 60-2600 cyc. 115v. Excellent condition $375.00

T-50 Radiotelegraph Transmitter complete with power supply and all accessories with spares. Portable. New in cases $275.00

AN-APT-5 300-1500 mcs. xmitter cavity oscillator using 3C22 lighthouse tube. Power output 30 watts. Noise modulated. Excellent condition. Complete with all tubes....................$149.50

SK-1M Radar Receiver Indicators. Freq. 195 mcs. 2 R.F. stages. 3 IF stages. 1 video, etc. New condition $125.00

AN/TPS—1 SEARCH RADAR. This is a pack portable ground search radar for the detection of aircraft up to 100 miles. Range and azimuth data is displayed on a 7" P.P.I. and 5" "A" scope. This set was called the G.I.'s radar because of its ruggedness, dependability and ease of servicing. Complete tech data is as follows:

Range Max. 100 Mi. Min. .25 Mi.	P.R.R. 200 per sec.
Azimuth Mech. 360° Automatic 360° Accuracy ±30	Pulse width 2 micro sec.
Scanning manual automatic	Beam width 3° horiz. 13° vert.
Presentation 7" P.P.I. 5" A scope	
I.F.F. not provided but has provision for.	Power input 1100 W at 115v 400 cyc. and 180 W at 27v D.C.
Frequency 1074-1086 mcs.	
Power output 150 K.W.	Weight: 1,518 Lbs.

SCR-515 (BC-645) contains xmitter, receiver, dynamotor PE-101, control box, manual, etc. New $18.95

AN/PPN-1 EUREKA! Ground portable, beacon responder. Unit will work into the AN/APN-2 transponder for purposes of homing. C. W. communication can also be carried on between plane and ground. Unit comes complete with xmitter, receiver, power pack, phones, etc. Brand new in knapsack. AN/APN-2 EQUIPMENT CAN BE SUPPLIED ON ORDER.

SCR-269/G Automatic Radio Compass. Freq. range 200-1750KC. Complete with BC-433-G receiver, BC-434, LP-21, 1-81, 1-82, BK22, etc. Very good condition $129.95

SCR-300 Frequency Modulated Transceiver. Freq. range 40-48 mcs. complete with 18 tubes, handset and antenna. Powered from self contained battery pack. Excellent condition. Weight approx. 35 lbs. with battery, each $275.00

TCS Marine Radio Telephone and Telegraph Xmitting and Receiving Equipment. Freq. range 1500-12000 KC. Consists of xmitter, receiver, antenna loading coil, remote control box, power unit, cables, etc. Power input is 12 or 32v D.C. We can supply an 110v AC power supply for stationary use at additional cost. Excellent condition.

SCR-536 Xmitter-Receiver (handy-talkie). Freq. range 3885-5500KC. Complete with coils, tubes, crystals. Very good condition $89.95

AN/APA-10 Panoramic Adaptor for use with any receiver with following IF's: 455KC, 5 mcs, 30 mcs. Unit will give panoramic presentation (1 mc wide for 455KC input) (100KC for 5MC input) (2MC for 30 mcs input). Power input 115v 400 cyc. but can be changed with the addition of a proper power transformer. Excellent condition $175.00

10 CM R.F. package. 2700 mcs. Consists of BC-1007 modulator & BC-1091 RF head. Power output approx 40 KW. Complete with tubes........$195.00

RT-39/APG-5 10 CM LHTR R.F. head & modulator. Low power approx 2 KW. Lighthouse tube rec & trans w/T.R. tunable. New..................$135.00

SCR-510 Freq. Modulated Portable Transceiver. Covering range of 20.0-27.9 mcs in 80 channels 100KC apart. Complete equipment consisting of BC-620 transceiver, power supply PE-97A, T-17 mike, handset, AN-45 antenna, battery operated or 6 or 12v input. Excellent condition $69.95

SCR-610 similar to SCR-510 except for freq. range which is 27.0-38.9 mcs. Excellent condition..$79.95

AN/APA-11 Pulse Analyzer to work with Search Receiver for analysis of received pulsed signals. PPS, pulse width, wave shape, can be displayed on an CR tube. Unit can also be used as a standard oscilloscope for general servicing work. Input is 115v-400-2600 cyc. but can be changed with the addition of a 60 cyc. transformer. Very good condition.

SCR-694 Field Radio. Light weight version of SCR-284. Freq. range is 3.8-6.5 mcs. Power output is A1-20. A3-5: comes with transceiver BC-1306, GN-45 or 58 hand generator, antenna system, microphone headset, etc. In excellent condition.

CY-30/TRC-1 antennas. Freq. range 70-100 mcs. complete with antenna, poles, wires, etc. In carrying case.

SCR-522 VHF Airborne Command Equipment. Freq. range 100-156 mcs. in 4 channels receiver and transmitter. Crystal controlled. Complete equipment. Consists of trans/rec. control box BC-602, dynamotor PE-94, AN104A antenna, plugs, etc. Power input with PE-94 is 28v. Excellent condition. We can supply PE-98 dynamotor for 12v input at additional cost.

COMMAND EQUIPMENT

ARC-5 274N OTHERS

RECEIVERS

ARA 500-1500KC. New....................	$24.95
R-28/ARC-5	29.95
455B 6-9 mcs. Good	19.95
433 200-1750KC. Good	29.95
ARR-2 234-258 mcs. New	19.95

TRANSMITTERS

T-23/ARC-5	$ 49.95
696-A 3-4 mcs. New....................	29.95
TYPE O 5.3-7 mcs. New....................	9.95
AVT-23 3000-13,000KC complete w/control box, manual, etc. C.W. or phone. 14 or 28v input. Brand new. Original cases....................	79.50
BC-950A 100-156 mcs. New....................	59.95

ACCESSORIES

BC-456 Modulator. Good	$ 2.25
BC-450 Control Box (3 rec). Used............	1.25
BC-451 Control Box (xmitter). Used...........	.98
BC-442 Relay Unit (ANT.). Used............	1.95

Flexible Shafting Available

MISCELLANEOUS SPECIALS!

Sound Powered Chest and Headsets MI-2454-B type O. mfg. RCA. Brand new in original boxes. Pair	$ 2[illegible]
Trailing Wire Antenna Feed Tube. New......	
Goniometer for SCR-277 Direction Finder. Excellent	
RL-7 Interphone Control Box. New........	
FT-154 BC-348 Shock Mounts............	
AN/CRW Receiver for Remote Control..	
BC-1206 Beacon Receiver 200-400KC. Excellent	[illegible].95
MN-26-Y Compass Receiver. Very go[illegible]........	[illegible]4.95
BC-433G Compass Receiver, 200-1[illegible]0KC in [illegible] bands. Excellent	39.95
BC-778 Gibson Girl 500KC. Good condition....	3.95
BC-1016 Tape Recorder. Complete. New......	459.50
CFI Unit with 200KC Xtal. New............	14.95
BC-733D receiver with tubes..............	29.95
BC-329 Transmitter. Excellent	89.95
QBG-1 Sonar complete with Hydrophone. Excellent	125.00
BC-608 automatic keyer for SCR522..........	5.95
AN/104A Antenna for SCR-522, ax handle. New	3.95
BC-1284 lighthouse tube preamplifier. Excel..	69.95
ASB 500 mcs YAGI Antenna Dual 6 Element..	14.95
Single 5 Element....................	8.95
AN/APA-17 Radar Direction Finding Antenna, back to back parabola, freq. range 300-1000 mcs. Horizontally and vertically polarized. Excellent	59.00
BC-996 Interphone Amplifier. Good..........	9.95
ART-13 Loading Condensers. Excel............	4.95
CW-3 Less Coil & Crystals. New............	29.50
CU-25 Loading Box for ART-13............	49.95
AS-27/ARN5 Antennas. Very good...........	4.95
SA-1/ARN-1 Part of ARN-1. Very good......	2.95
ID-80/APA-17 Indicator. Excel	129.95
RBM-4 Receiving Central. Complete with all Power Supplies. Carrying Case & Cables. New	325.00
AVR-15 Aircraft Receiver. Very good.........	19.95
BC-923 Receiver. Very good	39.95
BC-800 Xmitter/Receiver. Very good.........	39.95
RA-300 FM Exciter. (MFG Tempco). New..	32.50
A-55 Dummy Antennas. Very good...........	2.25
BC-1365 Control Box. Good............	3.95
FL-8 Filter	3.95
FL-5 Filter. Less Cables. Fair............	2.65
3C-16-D GSAP Gun Camera Computers with all Access. In Carrying Case. Excel...........	19.95
AT-2A/APN-2 Antenna. Fair cond............	4.95

Spares for ARC-5 & 274/N, APX-1, ASG-10. We have a large stock of TS-34A/AP spares.

CORDS AND PLUGS

CG-(172/173) CPN-8 CM Coax Patch Cable. New	$4.95
CX-548/CRD-3 Cable. New	1.25
CX-546/CRD-3 Cable. New	1.25
CD-508A w/SW 14-U & 2 Cord Attachments with JK-48 Jack & PL-68 Plug. New..............	.75
CD-307A with PL-55 and JK. New..............	1.29
PL-55 Plug. New	.49
83-168 Adapter. New	.17
83-1SP Connector. New....................	.69
83-1R Coax. Connector. New....................	.69
83-1AP Angle Coax. Connector. New..........	.22
83-1J Feed Thru. New....................	1.10
83-1F Feed Thru. New....................	1.55

BC-221 FREQUENCY METER

This is a Terrific Value! QUANTITY IS LIMITED—so first come, first served. They are just like new, with original calibration charts. Range 125-20,000 KC with crystal check points in all ranges. Complete with crystal and tubes........................ONLY **$72.50**

PHONE DIGBY 9-0347
WRITE FOR QUANTITY PRICES

Prices subject to change without notice. F.O.B., NYC minimum order $10.00. 20% deposit required. All merchandise guaranteed.

RADIO HAM SHACK Inc.
189 GREENWICH STREET . NEW YORK, N. Y.

A LEADING SUPPLIER OF ELECTRONIC & AIRCRAFT EQUIPMENT

IMMEDIATE DELIVERY -- FULLY GUARANTEED

A C MOTORS

5071930 DELCO, 115 V., 60 Cy., 7000 RPM. PRICE $6.50 EA.

TELECHRON SYNCHRONOUS MOTOR, Type B3, 110 V., 60 Cy., 4 W., 2 RPM. PRICE $5.00 EA.

TELECHRON SYNCHRONOUS MOTOR, Type BC, 110 V, 60 Cy., 6 W., 60 RPM. PRICE $4.00 EA.

EASTERN AIR DEVICES, Type J33, Synchonous, 115 V., 400 Cy., 3 φ, 8000 RPM. PRICE $15.00 EA.

HAYDON TIMING MOTORS 110 V., 60 CY.

TYPE 1600, 2.2 W., 4/5 RPM. PRICE $3.00 EA.

TYPE 1600, 2.2 W., 1/240 RPM. PRICE $3.00 EA.

TYPE 1600, 2.3 W., 1 RPM. PRICE $3.00 EA.

TYPE 1600, 2.2 W., 1-1/5 RPM. PRICE $3.00 EA.

TYPE 1600, 3.5 W., 1 RPM. With shift unit automatic engaging and disengaging shaft. PRICE $3.75 EA.

TYPE 1600, 2.2 W., 1/60 RPM. PRICE $3.00 EA.

SERVO MOTORS

CK1, PIONEER, 2 φ, 400 Cy. PRICE $10.00 EA.

CK2, PIONEER, 2 φ, 400 Cy. PRICE $14.00 EA.

CK2, PIONEER, 2 φ, 400 Cy., with 40:1 reduction gear. PRICE $15.50 EA.

0047-2-A, PIONEER, 2 φ, 400 Cy., with 40:1 reduction gear. PRICE $ [illegible].00 EA.

[illegible]NEAPOLIS HONEYWELL Type B, Part No. [illegible]AY, 115 V., 400 Cy., 2 φ, built-in re[illegible]n gear, 50 lbs. in torque. PRICE $10.00 EA.

[illegible]IS HONEYWELL Amplifier Type [illegible] V., 400 Cy., Used with above [illegible]RICE $10.00 EA, WITH TUBES

REMOTE INDICATING COMPASSES 26 V., 400 CY.

PIONEER TYPE AN5730-2 Indicator and AN5730-3 Transmitter. PRICE $40.00 PER SET

KOLLSMAN TYPE 680K-03 Indicator and 679-01 Transmitter. PRICE $15.00 PER SET

D C MOTORS

DELCO TYPE 5069625 Constant Speed, 27 V. D.C., 120 RPM. PRICE $15.00 EA.

JOHN OSTER TYPE C-28P-1, 27 V., 0.7 Amp., 7,000 RPM, 1/100 H. P. PRICE $5.00 EA.

JAEGER WATCH CO. TYPE 44K-2 Contactor Motor, 3 to 4.5 V. Makes one contact per second. PRICE $2.50 EA.

GENERAL ELECTRIC TYPE 5BA10AJ52C, 27 V., 0.65 Amp., 14 oz. in torque, 145 RPM. PRICE $6.50 EA.

GENERAL ELECTRIC TYPE 5BA10AJ37, 27 V., 0.5 amps., 8 oz. in. torque, 250 RPM. PRICE $6.50 EA.

GENERAL ELECTRIC TYPE 5BA10AJ18D, 27 V., 0.7 Amps., 110 RPM, 1 oz. ft. torque. PRICE $6.50 EA.

BARBER-COLMAN CONTROL MOTOR, Type AYLC 5091, 27 V., 0.7 Amps., 1 RPM. Contains 2 adj. limit switches. 500 in. lbs. torque. PRICE $6.50 EA.

WHITE RODGERS ELECTRIC CO., Type 6905 No. 3, 12 V., 1.3 Amps., 1½ RPM, torque 75 in. lbs. PRICE $10.50 EA.

RECTIFIER POWER SUPPLY

GENERAL ELECTRIC TYPE 6RC146. Input 230 V., 60 Cy., 3 φ, adjustable input taps. Output 130 Amps., at 28 V. D.C. Continuous duty. Size 46" high, 28" wide and 17.5" deep. PRICE $225.00 EA.

INVERTERS

WINCHARGER CORP. PU-16/AP, MG750. Input 24 V. D.C., 60 Amps. Output 115 V., 400 Cy., 1 φ, 6.5 Amps. PRICE $75.00 EA.

HOLTZER CABOT TYPE 149F, Input 24 V. D.C. at 36 Amps., Output 26 V. at 250 V.A., 400 Cy., and 115 V., 400 Cy., at 500 V.A., 1 φ. PRICE $55.00 EA.

PIONEER TYPE 12117. Input 12 V. D.C., Output 26 V., 400 Cy. at 6 V.A. PRICE $30.00 EA.

PIONEER TYPE 12117. Input 24 V. D.C., Output 26 V., 400 Cy. at 6 V.A. PRICE $30.00 EA.

PIONEER TYPE 12116-2-A. Input 24 V. D.C. at 5 Amps. Output 115 V., 400 Cy., 1 φ at 45 watts. PRICE $100.00 EA.

GENERAL ELEC[illegible]C TYPE 5D21NJ3A. Input 24 V. D.C. at [illegible] Amps. Output 115 V., 400 Cy., 485 V.A., PRICE $25.00 EA.

LELAND PE 218. In[illegible] 24 V. D.C. at 90 Amps. Output 115 V., 40[illegible] Cy., 1 φ at 1.5 K.V.A. PRICE $47.50 EA.

PIONEER AUTOSYNS

TYPE AY[illegible], 26 V., 400 Cy. PRICE $8.50 EA.

TYPE AY5, 26 V., 400 Cy. PRICE $8.50 EA.

TYPE AY14G, 26 V., 400 Cy. PRICE $15.00 EA.

TYPE AY14D, 26 V., 400 Cy. PRICE $15.00 EA.

TYPE AY54D, 26 V., 400 Cy. PRICE $10.00 EA.

TYPE AY131D Precision Autosyn. Price $35.00 EA.

PIONEER AUTOSYN POSITION INDICATORS & TRANSMITTERS

TYPE 5907-17. Dial graduated 0 to 360°, 26 V., 400 Cy. PRICE $25.00 EA.

TYPE 6007-39. Dual Dial graduated 0 to 360°, 26 V., 400 Cy. PRICE $40.00 EA.

TYPE 4550-2-A Transmitter, 26 V., 400 Cy., 2:1 gear ratio. PRICE $20.00 EA.

VOLTAGE REGULATORS

LELAND ELECTRIC CO. TYPE B, Carbon Pile type. Input 21 to 30 V. D.C. Regulated output 18.25 at 5 amps. PRICE $6.50 EA.

WESTERN ELECTRIC TRANSTAT VOLTAGE REGULATOR Spec. No. V-122855, Load K.V.A. 0.5. Input 115 V., 400 Cy. Output adjustable from 92 to 115 V. PRICE $10.50 EA.

RATE OR TACHOMETER GENERATORS

EASTERN AIR DEVICES J36A, .02 V. D.C. per RPM. Max. speed 5000 RPM. PRICE $12.50 EA.

ELECTRIC INDICATOR CO. TYPE B68 Rotation Indicator, 110 V., 60 Cy., 1 φ. PRICE $14.00 EA.

GENERAL ELECTRIC TACHOMETER GENERATOR TYPE AN5531-1. Variable frequency, 3 φ output. PRICE $20.00 EA.

GENERAL ELECTRIC TACHOMETER GENERATOR TYPE AN5531-2. Variable frequency, 3 φ output. PRICE $25.00 EA.

ALL PRICES F. O. B. GREAT NECK N. Y.

SYNCHROS

1F SPECIAL REPEATER, 115 V., 400 Cy. PRICE $15.00 EA.

2J1F3 GENERATOR, 115 V., 400 Cy. PRICE $5.50 EA.

2J1G1 CONTROL TRANSFORMER, 57.5/57.5 V., 400 Cy. PRICE $3.50 EA.

2J1F1 GENERATOR, 115 V., 400 Cy. PRICE $4.00 EA.

5SDG DIFFERENTIAL GENERATOR, 90/90 V., 400 Cy. PRICE $20.00 EA.

5G GENERATOR, 115 V., 60 Cy. PRICE $50.00 EA.

W. E. KS-5950-L2 Size 5G, 115 V., 400 Cy. PRICE $10.00 EA.

D C ALNICO FIELD MOTORS

DIEHL TYPE S.S. FD6-23, 27 V., 10,000 RPM. PRICE $6.50 EA.

DELCO TYPE 5069466, 27 V., 10,000 RPM. PRICE $15.00 EA.

DELCO TYPE 5069370, 27 V., 10,000 RPM. PRICE $15.00 EA.

DELCO TYPE 5072400, 27 V., 10,000 RPM. PRICE $10.00 EA.

BLOWER ASSEMBLIES

JOHN OSTER TYPE MX215/APG, 28 V. D.C., 7,000 RPM, 1/100 H.P. PRICE $8.50 EA.

WESTINGHOUSE TYPE FL, 115 V., 400 Cy., 6,700 RPM, Airflow 17 C.F.M. PRICE $7.50 EA.

DELCO TYPE 5068571 Motor and Blower Assembly, P.M. Motor, 27 V., 10,000 RPM. PRICE $15.00 EA.

GENERAL ELECTRIC D C SELSYNS

8TJ9-PAB, TRANSMITTER, 24 V. PRICE $4.00 EA.

8DJ11-PCY, INDICATOR, 24 V. Dial marked −10° to +65°. PRICE $6.00 EA.

8DJ11-PCY, INDICATOR, 24 V. Dial marked 0 to 360°. PRICE $7.50 EA.

MISCELLANEOUS

SPERRY A5 AMPLIFIER RACK, Part No. 644890. PRICE $20.00 EA.

SPERRY A5 CONTROL UNIT, Part No. 644836. PRICE $7.50 EA.

SPERRY A5 AZIMUTH FOLLOW-UP AMPLIFIER, Part No. 656030, with tubes. PRICE $5.50 EA.

SPERRY A5 DIRECTIONAL GYRO, Part No. 656029, 115 V., 400 Cy., 3 φ. PRICE $25.00 EA.

PIONEER TYPE 12800-1 GYRO SERVO UNIT, 115 V., 400 Cy., 3 φ. PRICE $20.00 EA.

ALLEN CALCULATOR TYPE C1 TURN & BANK INDICATOR, Part No. 21500 28 V. D.C. PRICE $15.00 EA.

TYPE C1 AUTO-PILOT FORMATION STICK, Part No. G1080A3. PRICE $15.00 EA.

PIONEER GYRO FLUX GATE AMPLIFIER Type 12076-1-A, 115 V., 400 Cy. PRICE $40.00 EA.

INSTRUMENT ASSOCIATES

363 GREAT NECK ROAD, GREAT NECK, N. Y.
Telephone GReat Neck 4-1147

Write for Catalog NE100

U. S. Export License-2140

Western Union address: WUX Great Neck, N. Y.

NEW YORK'S RADIO TUBE EXCHANGE

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
OA2	$2.00	2J32	69.95	5CP1	4.95	323A	25.00	724A	4.95	876	.90
OA3	1.50	2J36	105.00	5CP7A	15.00	327A	3.95	724B	6.95	878	1.95
OA4G	1.35	2J38	17.95	5D21	27.50	350A	7.95	725A	9.95	884	1.95
OB2	3.00	2J42	150.00	5JP1	27.50	350B	5.95	726A	6.95	885	
OC3	1.75	2J49	109.00	5JP2	17.50	357A	27.50	726B	56.00	889R	
OD3	1.50	2J50	69.50	5JP4	27.50	368AS	6.95	726C	69.00	913	
C1A	4.95	2J61	75.00	5LP1	18.95	371B	1.95	728AY	27.00		
C1B	6.95	2J62	75.00	5LP1A	19.50	385A	4.95	730A	28.[illegible]		
1B21A	2.75	2K25	47.50	5R4WGY	3.75	388A	2.95	801A			
1B22	3.95	2K28	37.50	6C21	29.50	393A	8.95	802			
1B23	9.95	2K29	27.50	C6A	3.95	394A	8.95	803			
1B24	17.95	2K41	99.00	C6J	7.95	MX408U	.75	80[illegible]			
1B26	2.95	2K45	199.50	7BP7	7.95	417A	17.95				
1B27	19.50	2V3G	2.10	7DP4	10.00	434A	17.9[illegible]				
1B32	4.10	3B24	5.50	12AP4	55.00	446A					
1B38	33.00	EL3C	5.95	15E	2.95	450TH					
1B42	19.95	3C24	1.95	15R	.95	450TL					
1B56	49.95	3C31	5.95	NE16	.45	464A	[illegible]				
1B60	69.95	3C45	13.95	FG17	6.95	471[illegible]	2[illegible]				
1N21	1.35	3DP1A	10.95	RX21	3.95	[illegible]	1[illegible]				
1N21A	1.75	3E29	15.50	35T	4.9[illegible]	[illegible]530					
1N21B	4.25	SN4	5.50	45 Special	[illegible]	[illegible]L531					
1N22	1.75	4A1	1.75	RK39	2.95	700A/D					
1N23	2.00	4B26	6.95	VT52	.35	701A					
1N23A	3.75	4C27	25.00	RK72	1.95	703A					
1N23B	6.75	4C28	35.00	RK73	1.95	705A					
1N27	5.00	4E27	17.50	100TH	9.00	706AY	48.50	83[illegible]			
1N48	1.00	4J25	199.00	FG105	19.00	706CY	48.50	832			
1S21	6.95	4J26	199.00	F123A	8.95	706A	17.95	832A	9.[illegible]	[illegible]	
2B22	4.95	4J27	199.00	203A	8.95	707B	27.00	833A	49.9[illegible]	2051	
2B26	3.75	4J30	395.00	211	.75	714AY	5.95	834	7.95	8012	
2C34	.35	4J31	99.00	217C	18.00	715A	7.95	836[illegible]	4.95	8013	
2C39	32.00	4J32	99.00	242C	10.00	715B	15.00	837	2.95	8013A	
2C40	27.00	4J33	99.00	249C	4.95	715C	25.00	838	4.95	8014A	
2C43	27.00	4J37	99.00	250TL	19.95	717A	1.75	845	5.59	8020	
2C44	.90	4J38	89.00	274B	3.00	718AY/EY	48.50	849	52.50	8025	6.95
2D21	1.75	4J39	99.00	304TH	15.00	719A	29.50	851	80.50	9001	1.75
2E22	3.75	4J41	99.00	304TL	14.50	720A/B/C/D/Y		860	4.95	9002	1.50
2E30	2.75	4J52	350.00	307A	4.95		96.00	861	39.50	9003	1.75
2J26	27.75	C5B	2.95	310A	7.95	721A	3.95	866A	1.79	9004	.75
2J27	29.95	5BP1	4.95	311A	7.95	722A	3.95	869B	37.50	9005	1.90
2J31	29.95	5BP4	4.95	312A	3.95	723A/B	24.95	872A	3.95	9006	.35

This Month's Special 4C28 .... $35.00 OTHERS

ATTENTION PURCHASING AGENTS AND BUSINESS MANAGERS

WE PURCHASE COMPLETE INVENTORIES AND ELECTRONIC PARTS AND TUBES FOR CASH.
CAN WE HELP YOU TO OBTAIN URGENTLY NEEDED ELECTRONIC MATERIALS?
OUR ORGANIZATION IS DEDICATED TO SERVE THE ELECTRONIC FIELD.
YOU CAN REACH US ON TWX NY1—3235

TEST EQUIPMENT

ATTENTION PURCHASING AGENTS AND BUSINESS MANAGERS

WE BUY—WE SELL—WE EXCHANGE—WILL PAY CASH FOR YOUR INVENTORY NO MATTER HOW SMALL OR LARGE. —TURN YOUR OVERSTOCKED ITEMS INTO CIRCULATION

Test Equipment

Microwave K Band 24,000 MC

TSKI-SE Spectrum Analyzer
K Band Flap Attenuator

X Band 10,000 MC

TS 12 Unit 1 USWR Measuring Amplifier, 2 channel
TS 12 Unit 2 Plumbing for above
TS 83 X Band Power and Frequency Meter
TS 35 X Band Pulsed Signal Generator
TS 36 X Band Power Meter
TS 45 Band Signal Generator
TS 146 X Band Signal Generator
TS 263 Navy Version of TS 146
TS 62, TS 102, TS 168
X Band Magic T Plumbing
X Band Tunable Crystal Mounts
TVN #3EV Bridge, Cy 94

S Band 3000 MC

TS 102, TS 270
TS 125, TS 155, TS 127
RF 4 Electrically Tuned S Band Echo Box
BC 1277/60ABQ S Band Pulsed Signal Generator
PE 102 High Power S Band Signal Generator

L Band

Hazeltine 1030 Signal Generator 145 to 235 Megacycles
Measurements Corp. type 84 Standard Signal Generator
TS 47, 40 to 400 MC Signal Generator
TS 226, AN/UPMI

Audio Frequencies

RCA Audio Chanalyst

LIBERTY ELECTRONICS, INC.

Broadcast Wave Bands

162C Rider Chanalyst
Short Wave Adapter for 162C
TS 174 Signal Generator

Oscilloscopes

TS 239A Lavoie
BC 1287A used in LZ sets
Supreme 564
APA10, APA28
TS 34 Oscilloscopes WE
TS 126

Other Test Equipment and Meters

TS 15/A Magnet Flux Meter
General Radio V T Voltmeter 728A
Calibrator WE 1-147
General Radio 1000 cycles type 213
Limit Bridges
Boonton Standard instructions
Model 40 Pyrometer
Rawson, meters 0-10 Microampere 0-2 Millivolt

RADAR Sets & Parts

APS 3—APS 4—R-111/APR5A

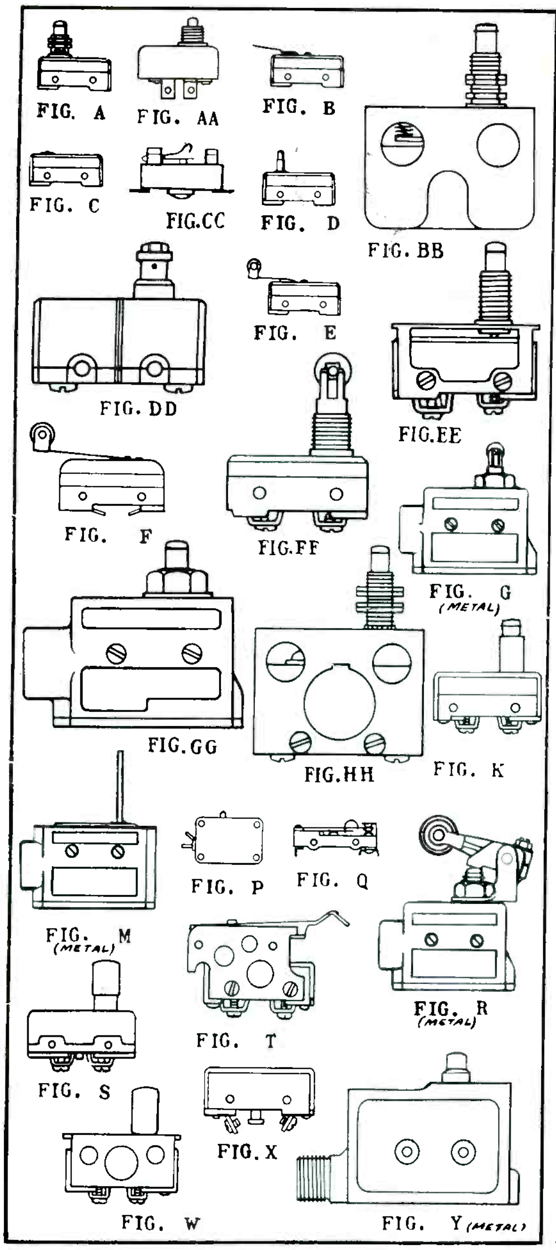
Minimum Order $25.00

Prices Subject To Change

PHONE WORTH 4-8262 — 135 LIBERTY ST., NEW YORK 6, N.Y.

IMMEDIATE DELIVERY OF *Top Quality* MINIATURE SWITC[HES]

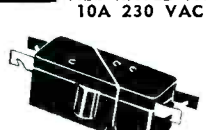
This list of brand new standard [...] resents only a few of m[...] quantities of most typ[...] quirements. Write [...]



Stock #	Mfr.	[illegible]	Contact		
41MC2	ACRO	2a [illegible]	NO		
41MM2	MU	[illegible] of	SP		
41MC5	MU	[illegible]	[illegible]		
41MC26	[illegible]	APG210			
41MC17	MICRO	B-1			
41MC16	MICRO	B-1T			
41MC7	MICRO	B-14			
41MD62	MICRO	B-R			
41MD46	MICRO	B-RL18	[illegible]	B	
41MD63	MICRO	B-RS36	S[illegible]	D	
41MD23	MICRO	BD-RL32	SPDT	B	
41MLH	MICRO	BZRQ41	SPDT	W	.95
41MD51	MICRO	BZ-R37	SPDT	C	.70
41MD2	MICRO	BZE7RQT2	SPDT	GG	1.70
41MD21	MICRO	BZ-7RST	SPDT	D	.80
41MD38	MICRO	BZE2RQ9TN1	SPDT	G	2.65
41MD6	MU	CUM 24155	NO	E	.80
41ML1	MU	D	NO	BB	1.50
41MC12	MICRO	D in case	NC	Y	1.45
41MD34	KLIXON	ES692070	NC	CC	.50
41MD65	MICRO	G-R26	NO	C	.60
41MD60	MICRO	G-RL	NO	B	.80
41MC11	MICRO	G-RL 5	NO	B	.80
41MD61	MICRO	G-RL35	NO	B	.80
41MD41	MICRO	G-RL43	NO	B	.80
41MD64	MICRO	G-RS	NC	D	.55
41MD66	MICRO	G-RS36	NC	D	.60
41MC32	ACRO	HRO 7.1P2TSP1	NO	K	.65
41MC19	ACRO	HRO 7.4P2T	NO	S	.60
41MD8	ACRO	HRRC 7.1A	NC	C	.55
41MD27	ACRO	HRRO 7.1A	NO	C	.60
41MC31	MICRO	LN-11 HO3	SPDT	M	1.70
41MC18	MU	MLB 321	SPDT	B	.95
41MD1	MU	MLR 643	NC	B	.70
41MD55	PHAO	PS 2000	SPDT	C	.85
41MC28	ACRO	RC71P2T	NC	A	.70
41MD45	ACRO	RO1P2T	NO	A	.80
41MD22	ACRO	RO2M	NO	E	.80
41MD28	ACRO	RO2M12T	NO	E	.80
41MC25	MICRO	R-RS	NC	D	.50
41MD47	MICRO	R-RS13	NC	D	.50
41MD9	MICRO	SW-186	NC	D	.50
41MC10	MICRO	WP3M5	NC	AA	.50
41MC4	MICRO	WP5M3	NC	AA	.50
41MD[illegible]	MIC[illegible]				
41[illegible]	MIC[illegible]	[illegible]	NC		
41MD57	MICRO	WZR31	NC		
41MD31	MICRO	WZRD	N[illegible]		
41MD19	MICRO	WZRL8			
41ML3	MICRO	WZRQ41			
41ML2	MICRO	WZV7RQ9T			
41MC21	MICRO	X757			
41MD37	ACRO	XC1A	NC	C	
41MC5	ACRO	XD45L	SPDT	B	
41MD4	MICRO	YZ	NO	C	.75
41MD40	MICRO	YA2RLE4D13	NO	E	.70
41MD24	MICRO	YZ2YLTC1	SPDT	B	.55
41MC1	MICRO	YZ2YST	SPDT	D	.60
41MD13	MICRO	YZ3R3	NO	C	.60
41MD56	MICRO	YZ3RLTC2	NO	B	.80
41MC14	MICRO	YZ3RW2T	NO	F	.90
41MD49	MICRO	YZ7RQ9T6	NO	FF	.85
41MD32	MICRO	YZ7RST	NO	D	.60
41MC13	MICRO	YZ7RA6	NO	EE	1.00
41MO25	MICRO	YZRQ1	NO	A	.80
41MC20	MICRO	YZRQ4	NO	S	.60
41MD59	MICRO	YZRQ41	NO	W	.75
41MD20	MICRO	YZ7RQT	NO	K	.65
41MD42	MICRO	YZRTX1	NO	X	.95
41MC22	MU	Z	NC	Y	1.45
41MD44	ACRO	Blue Stripe	SPDT	C	.70
41MD52	MU	Blue Dot	SPDT	E	.90
41MC8	MU	Red Dot	NC	C	.65
41MD18	MICRO	Open Type	SPDT	Q	.50
41MD39	MU	Green Dot	NO	B	.80
41MC29	MU	Green Dot	NO	D	.55
41MD26	MAXSON	Precision	SPDT	B	.95

[illegible]	.. 5	[illegible]	.. 5	[illegible]	1.75
[illegible]	1.95	[illegible]	1.00	[illegible]	199.50
[illegible]	45	[illegible]	4.25	[illegible]	12.95
[illegible]	[illegible]	[illegible]	5.95	914	75.00
[illegible]	.95	[illegible]4	13.50	931A	6.95
[illegible]	.75	805	5.95	954	.35
[illegible]	5.00	806	25.00	955	.55
[illegible]	22.50	807	1.69	956	.69
[illegible]	12.50	808	3.50	957	.29
[illegible]	25.00	809	2.45	958A	.69
[illegible]	7.50	810	11.00	959	.69
[illegible]	6.95	811	3.15	975A	17.95
[illegible]	3.95	813	8.95	991	.45
		814	3.95	E1148	.29
		815	4.50	1280	1.95
		816	1.45	1611	1.95
		829	9.95	1613	1.38
		829A	11.95	1616	2.95
		899B	15.95	1619	.89
		[illegible]B	11.50	1620	5.95
		[illegible]23	5.95	1622	2.75
		[illegible]	[illegible].95	1624	2.00
		[illegible]	[illegible]5	1625	.45
				1629	.69
				1851	1.85
				2050	[illegible]
				9[illegible]	[illegible]
				[illegible]	.25
				[illegible]	2.95
				[illegible]	5.95
				[illegible]	29.95
				[illegible]	3.50

SWITCHETTES ALL RATED AT 10A 230 VAC



STOCK NO.	MFR. TYPE NUMBER	CONTACTS	TERMINALS	PRICE
41SF3	CR1070C103-A3	N.C.	SIDE	$0.53
41SF2	CR1070C103-B3	N.O.	END	.53
41SF8	CR1070C103-C3	1—N.O. 1—N.C.	END	.53
41SF7	CR1070C103-E3	N.O.	SIDE	.53
41SF9	CR1070C103-F3	1—N.O. 1—N.C.	SIDE	.53
41SF12	CR1070C123-B3	N.O.	END	.53
41SF10	CR1070C123-C3	1—N.O. 1—N.C.	END	.53
41SF5	CR1070C123-D3	N.C.	SIDE	.53
41SF4	CR1070C123-J2	SPDT	END	.53
41SF11	CR1070C124-M4	SPDT	SIDE	.53
41SF1	CR1070C128-C3			

Order direct or through your local parts jobber

SEeley 8-4143

WIDE SELECTION OF ELECTRONIC COMPONENTS AT

WELLS

- Tubes • Resistors • Condensers • Wire and Cable
- Volume Controls • Co-ax Connectors • Relays • Rectifiers
- Transformers • Chokes • Micro Switches, Toggles • Antennas
- Accessories • Electronic Assemblies • Dial Light Assemblies

WELLS SALES, INC.

MANUFACTURERS AND DISTRIBUTORS: WRITE FOR CATALOG

833 W. CHICAGO AVE., DEPT. SL, CHICAGO 22, ILL.

Reliance Specials

TIMING MOTOR

8 RPM 115V 60 cyc
E. Ingraham Co.
$1.95

GEAR ASSORTMENT

100 small assorted gears. Most are stainless steel or brass. Experimenters dream!................Only $6.50

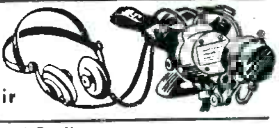
VERNIER DIAL or DRUM (From BC-221)

DIAL—2⅝" dia. 0-100 in 360°. Black with silver marks. Has thumblock. DRUM—0-50 in 180°. Black with silver marks ....either, 85¢

SOUND POWER HANDSET

Brand New!
Includes 6 ft. cord. No batteries or external power source used.
$17.60 pr.

Sound Powered Chest Set RCA—With 24 Ft. Cord
$17.60 per pair



Variac—General Radio 100W removed from equipment **$10.00**

400 CYCLE INVERTERS

Leeland Electric Co.

#10800 In: 20-28 V.D.C., 92 A. 8000 R.P.M. Out: 115V, 400 Cyc. 1 phase, 1500 V.A. 90 PF.......................$12.95

3AG FUSES

AMP	Per 100	AMP	Per 100	AMP	Per 100
1/8	$4.00	1	2.00	6	3.00
1/5	4.00	1½	3.00	10	3.00
1/4	$4.00	5	3.00	15	3.00
				20	3.00

DELAY NETWORK—ALL 1400Ω

T 113—Approx. 1.2 micro sec. delay............ } 95¢ each
T 114—Approx. 2.2 micro sec. delay............ }
T 115 Similar to T 114 with tap brought out.... }

BEARINGS

Mfg. No.	ID	OD	Thickness	Price
MRC5028-1	5 1/2	6 1/2"	1"	$3.50
MRC7026-1	5 5/64	6 15/64	9/16	3.50
Timken 37625	4 5/16	6 1/4	29/32	4.25
MRC-7021-200	4 1/8	5 9/32	23/64	2.95
Fafnir B545	2 1/16	2 5/8	1/4"	1.00
MRC 106 M2	1 17/64	2 7/16	25/64	1.75
MRC 106 M1	1 13/64	2 7/16	25/64	1.60
Federal LS 11	1 1/8	2 1/2	5/8	1.75
Norma S 11 R	1 1/8	2 1/8	3/8	1.25
Fafnir B 541	1 1/16	1 1/2	9/32	.55
Hoover 7203	5/8	1 9/16	7/16	.90
Norma 203 S	5/8	1 9/16	7/16	.90
Schatz	3/4	1 3/4	9/16	1.00
N5 5202-C13M	1/2	1 3/8	1 3/8	1.00
ND 3200	25/64	1 5/32	11/32	.55
Fafnir S 3K	3/8	7/8	7/32	.45
MRC 39 R1	11/32	1 1/32	5/16	.45
ND CW 8008	5/16	5/16	13/32	.45
MRC 38 R3	5/16	55/64	9/32	.45
Fafnir 33K5	3/16	1/2	5/32	.25

NEEDLE BEARINGS

TORRINGTON B108 1/2" wide 5/8" 13/16" 30¢

Brand New METERS—Guaranteed

0-1 Amp. R.F. 2½"..$3.29 | 0-80 Amp. D.C. 2½".$2.25
0-10 ma D.C. 3½"... 3.95 | 0-7.5V. A. C. 3½"... 3.46

SELENIUM RECTIFIERS

Full Wave 200 MA 115V............................$1.79
Half Wave 100 MA 115V............................ .91

SPAGHETTI SLEEVING—assortment—99 feet.....$1.00

TYPE "J" POTENTIOMETERS

150	SD	2000	SD	5000	3/8"	50K	SD*
300	SD	2000	1/2"	10K	3/8"	70K	SD
300	3/8	2000	SD*	10K	SD*	80K	SD
400	3/8	2500	1/2"	15K	1/4"	100K	3/8
500	3/8	2500	SD	15K	SD*	200K	SD*
1000	7/8	3000	3/8	25K	3/8"	250K	SD
1000	SD*	4000	3/8	25K	SD*	500K	1/2"
1500	SD	5000	SD*	30K	SD*	1 Meg	SD

* Split locking bushing — $1.50 each

JONES BARRIER STRIPS

Type	Price	Type	Price	Type	Price
2-140Y	$0.13	4-141W	$0.30	9-141Y	$0.64
3-140¾W	.19	5-141	.26	10-141	.50
6-140	.25	5-141¾W	.37	17-141Y	1.17
10-140¾W	.53	7-141	.36	3-142	.21
2-141	.13	7-141¾W	.49	8-142	.69
3-141¾W	.24	8-141¾W	.58	2-150	.39
3-141W	.24	9-141	.64	3-150	.54

TIME DELAY RELAY

Raytheon CPX 24166 KS 10193-60 Sec. • 115 V., 60 cycle • Adj. 50-70 Seconds • 2½ second recycling time—spring return • Micro-switch contact, 10A • Holds ON as long as power is applied • Fully cased • ONLY $6.50

AN CONNECTORS

IMMEDIATE SERVICE
PHONE! WIRE! WRITE! YOUR NEEDS

NEW COAXIAL CABLES

	Ohms	Price per 1,000 Ft.		Ohms	Price per 1,000 Ft.
RG-6/U	76	$150	RG-35/U	71	$450
RG-7/U*	97.5	65	RG-37/U	55	40
RG-15/U	76	160	RG-39/U	72.5	180
RG-21/U	53	100	RG-41/U	67.5	295
RG-22A/U*	95	150	RG-54/U	58	65
RG-24/U	125	240	RG-55/U	53.5	65
RG-25/U	48	575	RG-57/U*	95	100
RG-26/U	48	75	RG-58/U*	53.5	60
RG-27/U	48	290	RG-59/U*	73	70
RG-29/U*	53.5	50	RG-77/U*	48	100
RG-34/U	71	175	RG-78/U	48	80

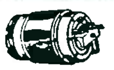
Add 25% for orders less than 1,000 feet.
*No minimum order—others 250' minimum.

COAXIAL CABLE CONNECTORS

15¢ UG 175/U — $1.30 83-1F — 30¢ ANGLE — 80¢ 83-1J — 40¢ 83-1R — 9¢ HOOD

83-1AC	$ .42	83-22J	$1.40	UG58/U	$ .63
83-1AP	.30	83-22SP	1.15	UG59A/U	2.25
83-1F	1.30	UG-12/U	.63	UG60/U	2.40
83-1H	.09	UG13/U	.63	UG85/U	2.05
83-1J	.80	UG19B/U	1.95	UG87/U	1.75
83-1R	.40	UG21/U	.67	UG88/U	1.25
83-168	.15	UG21B/U	1.45	UG167/U	2.00
83-185	.15	UG22/U	1.10	UG175/U	.15
83-2AP	2.00	UG24/U	.67	UG176/U	.15
83-2H	.25	UG25/U	.60	UG201/U	2.05
83-2J	1.65	UG27/U	.68	UG206/U	.63
83-2R	1.30	UG27A/U	2.95	UG281/U	.60
83-21SP	2.10	UG30/U	2.50	UG290/U	1.60
83-22AP	1.10	UG57/U	2.30	UG499/U	1.25

DIFFERENTIAL



115 V., 60 Cyc. #C78249 **$3.95 ea.**
3⅜" dia. x 5⅜" long

Used between two #C78248's as dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted)......$4.50
Mounting Brackets — (Bakelite for selsyns, and differentials shown above...............35¢ pair

2J1G1 SELSYNS $2.95

BRAND NEW 400 CYCLE
Can be used on 60 cycle

POSTAGE STAMP MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd
4	23	47	85	220	500	910	.003	.0062
5	24	50	90	240	510	.001	.0033	.0065
7	25	51	100	250	560	.0011	.0035	.0068
7.5	26	56	110	270	580	.0012	.0036	.007
8	27	60	120	300	600	.0013	.0039	.0075
8.2	30	62	125	350	620	.00136	.004	.008
10	33	68	130	370	650	.0015	.0044	.0082
15	35	70	150	390	680	.001625	.005	.009
18	39	75	160	400	750	.002	.0051	.01
20	40	80	175	430	800	.0026	.0056	
22	43	82	180	470	820	.0027	.006	

Price Schedule
8.2 mmf to .001 mfd.................................5¢
.0011 mfd to .001625 mfd...........................7¢
.002 mfd to .0082 mfd..............................12¢
.01 mfd...22¢

SILVER MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
10	40	82	155	275	430	680	.002	.0039
18	47	100	170	300	466	700	.0023	.004
20	50	110	180	325	470	800	.0024	.0047
22	51	115	200	350	488	875	.0026	.005
23	60	120	208	360	500	900	.0027	.0051
24	62	125	225	370	510	.001	.00282	.0056
27	66	130	240	390	525	.0011	.002826	.006
30	68	135	250	400	560	.0016	.003	.0082
39	75	150	270	410	570	.001625	.0033	

Price Schedule
10 mmf to .001 mfd..................................10¢
.001625 mfd to .0024 mfd............................20¢
.00282 mfd to .0082 mfd.............................50¢

FILAMENT TRANSFORMER

Pri., 115V., 60 Cyc. — Sec. { 6 V. @ 35 A. or 12 V. @ 18 A. or 24 V. @ 9 A. } **$6.50**

PULSE TRANSFORMERS

UTAH—9262 9278 9340
WESTERN ELECTRIC—D166173 D161310
KS8696, KS9365, KS9565, KS9800, KS9862, KS13161
GENERAL ELECTRIC—K2731, 80-G-5
JEFFERSON ELECTRIC—C-12A-1318
CROSLEY—W-226262-4
DINION COIL—TR1048, TR1049
also 352-7250-2A; 352-7251-2A; T-1-229621-60

PRECISION RESISTORS—¼ WATT—30¢

2	10.48	12.32	14.98	62.54	125	414.3
2.5	10.84	13.02	15.8	79.81	147.5	705
3.5	11	13.52	16.37	105.8	220.4	2,193
5	11.25	13.89	32	123.8	301.8	3,500
6.03	11.74				366.6	59,148

PRECISION RESISTORS—½ WATT—30¢

1.	10.58	70	290	2,230	8,909	33,300
.2	11.1	71	298.3	2,250	9,000	35,888
.25	13.15	75	389	2,500	10,000	36,000
.334	13.3	80	397	2,850	12,000	37,000
.444	13.52	87	400	3,330	13,333	39,000
.502	15	90	500	3,400	14,825	40,000
.557	18.75	97.8	600	3,427	15,000	41,700
.627	20	100	607	3,500	15,750	43,766
.76	21.5	120	705	3,995	15,755	45,000
1	25	123.8	723.1	4,000	15,810	47,000
1.01	30	125	785	4,101	16,000	50,000
1.02	34.75	147.5	800	4,285	16,700	56,000
2	40	148.7	855	4,300	17,000	59,000
2.04	44.73	150	900	4,451	19,860	59,905
2.5	45	178	970	4,750	20,000	68,000
2.54	46	179.5	1,060	5,000	20,150	70,000
3.07	49	180	1,100	5,714	21,300	75,000
3.25	50	210	1,150	5,900	22,500	79,012
3.7	52	220	1,200	6,000	23,300	80,000
3.87	55.1	230	1,264	6,500	25,000	90,000
5.24	60	235	1,375	7,000	26,667	92,000
5.26	61	240	1,400	7,300	30,000	100,000
5.89	65	250	1,490	7,500	31,500	120,000
7	66	260	1,500	8,000	32,700	140,000
7.6	66.6	270	1,573	8,500	32,888	180,000
8	69	286	1,876	8,800	33,000	400,000

PRECISION RESISTORS—1 WATT—35¢

.1	2.58	27.4	179.5	1,700	6,000	34,000
.11	2.6	28	206	1,800	7,000	35,000
.147	2.66	30	215	1,900	7,500	37,000
.2	3	35	250	2,000	7,800	40,000
.25	3.1	38	270	2,200	8,000	45,000
.31	3.39	43.6	300	2,215	8,250	50,000
.4	4.29	45.5	312	2,250	9,000	55,000
.861	4.3	49.75	321.7	2,413	10,000	56,000
1	4.7	50	400	2,500	12,000	60,000
1.01	5.21	54.25	420	3,055	12,420	65,000
1.166		60	425	3,300	12,500	68,000
1.17	10.5	71	.....	3,800	15,000	70,000
1.21	12.8	75	565	4,572	18,000	75,000
1.25	15	80	800	.....	20,000	80,000
2	18	100	1,000	5,221	.....	84,000
2.5	25	112.8	1,200	5,400	30,000	.....
2.55	.....	.....	.....	.....	.....	95,000

PRECISION RESISTORS—1 WATT—45¢

100,000	175,000	296,000	390,000	550,000
105,000	195,000	300,000	399,000	560,000
120,000	200,000	310,000	400,000	590,000
.....	220,000	320,000	413,000	600,000
132,000	245,000	340,000	423,400	645,000
145,000	249,000	348,000	450,000	650,000
149,500	250,000	350,000	.....	700,000
150,000	260,000	375,000	520,000	750,000
166,100	270,000	376,000	522,000	876,457

1 MEGOHM 1 WATT 1%—65¢; 5%—45¢

PRECISION RESISTORS—2 WATT—60¢

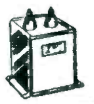
4,385 5,000 6,000 10,000 23,000

UNIVERSAL JOINTS

3/16" hole x 3/8 O. D. 1-1/8" long—steel or aluminum 50¢
1/4" hole x 1/2 O. D. 1-1/8" long—aluminum only 75¢

OIL FILLED

MFD	V.D.C.	Price	MFD	V.D.C.	Price
.125	35,000	$35.95	.5	2,000	1.95
.125	27,000	28.95	.3	2,000	1.75
.25	20,000	19.95	.1-.1	2,000	1.65
.1	12,000	2.95	.02	2,000	.79
.15-.15	8,000	2.75	2	1,500	1.79
.02	8,000	1.89	1	1,500	1.50
.1	7,500	1.95	6	1,000	2.25
.05	7,500	1.75	4	1,000	1.99
.03	7,500	1.69	3	1,000	1.59
.1-.1	7,500	1.98	2	1,000	.90
.1	7,000	1.85	1.02	1,000	.65
.02-.03	7,000	1.40	1	1,000	.65
1	6,000	5.95	7	800	1.98
.1	6,000	2.75	1	800	.55
.03-.03	6,000	1.35	8-8	600	1.59
.01-.03	6,000	1.35	8	600	2.05
2	5,000	5.95	7	600	1.75
.25	5,000	2.95	4	600	1.63
2	4,000	4.95	4 x 3	600	1.95
.3 x .2	4,000	2.50	2	600	.69
.1	4,000	2.25	1	600	.49
.06	4,000	1.45	8	500	1.55
.1	3,500	1.95	4	500	.98
.25	3,000	2.25	4	200	.39
.1	3,000	1.75			
4	2,500	4.95			
8	2,000	4.95			
6	2,000	4.65			
4	2,000	4.25			
3	2,000	3.75			
2	2,000	2.95			
.5-.1	2,000	1.95			



2 mfd 4,000 V.D.C. G.E.
$4.95

OILED FILLED A. C. CONDENSORS

MFD.	V.A.C.	Price	MFD.	V.A.C.	Price
.2	750	$ .69	30	330	$6.50
8	660	4.95	25	330	5.95
6	660	4.95	20	330	5.50
5	660	4.50	15	330	4.50
4	660	4.25	10	330	3.95
2	660	3.25	6	330	2.95
1	660	2.35	4	330	1.95
28	440	6.95	3	330	1.25
15	440	4.95	2.5	330	.98
6	440	3.50	2	330	.65
5-3	440	3.95	10	220	2.95
4.4	375	2.15			

1N34 Crystal Diode.................................79¢

Minimum Orders $3........All orders f.o.b. PHILA, PA.

RELIANCE MERCHANDIZING CO.

Arch St. Cor. Croskey Phila. 3, Pa. Telephone RIttenhouse 6-4927

MICROWAVE RECEIVERS

AN/APR-1 Receivers and tuning units TN-1 (38 to 95 MC) TN-2 (76-300 MC) TN-3 (300-1000 MC).
AN/APR-4 Receivers and tuning units TN-16 (38-95 MC) TN-17 (76-300 MC) TN-18 (300-1000 MC), TN-19 (950-2200 MC).
R111A/APR-5A Receivers. 1000 to 6000 MC.

MODEL AN/APA-10 PANORAMIC ADAPTER

Designed for use with receiving equipment AN/ARR-7, AN/ARR-5, AN/APR-4, SCR-587 or any receiver with I.F. of 455kc. 5.2mc. or 30mc. With 21 tubes including 3" scope tube. Converted for operation on 115 V. 60 cycle source.
PRICE $245.00
AN/APA-10 80 Page Tech Manual..........$2.75

LAVOIE FREQ. METER

375 to 725 MCS

Model TS-127/U is a compact, self-contained, precision (± 1 MC) frequency meter which provides quick, accurate readings. Requires a standard 1.5V "A" and 45V "B" battery. Has 0-15 minute time switch. Contains sturdily constructed HI-"Q" resonator with average "Q" of 3000 working directly into detector tube. Uses 957, LS6 and 3S4 Tubes. Complete, new with inst. book. Less batteries. Write for descriptive circular...... $69.50

SWEEP GENERATOR CAPACITOR

High speed ball bearings. Split stator silver plated coaxial type 5/10 mmfd. Brand new...... $2.50

BC-348 RECEIVER PARTS

for Models C, E, H, K, L, M, P, R.

Dial Mechanism assemblies. 1st, 2nd, 3rd, 4th I.F. transformers. C.W. osc. and xtal filter trans. with xtals. All R.F. coils. Front panels. Shock mounts. Large quantity misc. hardware sub assemblies, etc. Write your requirements.

MISCELLANEOUS EQUIPMENT

TS-127/U Lavoie Freq. Meter—375 to 725 MC.
TS-47APR Test Set—40 to 500 MC.
213-A DuMont C.R. Modulation Monitor.
BC1203 APN-4 Test Set.
6255A H.P. Interpolation Osc.
TS-23/APN Test Set.
TS-487/U Peak to Peak VTVM.

G. E. SERVO AMPLIFIER

Type 2CV1C1 Aircraft Amplidyne control amplifier. 115 volts—400 cycles. Dual channel. Employes 2-6SN7GT and 4-6V6GT tubes. Supplied less tubes.
New $22.50

LINEAR SAWTOOTH POTENTIOMETER

W.E KS-15138

Has continuous resistance winding to which 24 volts D.C. is fed to two fixed taps 180° apart. Two rotating brushes 180° apart take off linear sawtooth wave voltage at output. Brand New $5.50

8,000-VOLT TRANSFORMERS

Primary: 115 V., 60 cycles.
Secondary: 8000 V., C.T., 800 V.A.

Brand new in sealed cans $27.50

CRYSTAL DIODE

Sylvania 1N21B. Individually boxed and packed in leaded foil. Brand new.................$4.25

SYNCHRO DIFFERENTIAL GENERATOR

Ford Inst. Co. Type 5SDG. Brand New....$22.50
Electrolux Torque Motor..................$16.50

MOTOR GENERATORS

2.5 KVA Diehl Elec. Co. 120V D.C. to 120V A.C. 60 cy. 1Ph., .4PF. Complete with Magnetic Controller, 2 Field Rheos and Full Set of Spare Parts including Spare Armatures for Generator and Motor. Full specs. on request. New.....$285.00
2 KVA O'Keefe and Merritt. 115V DC to 120V AC, 50 cy. Idles at 3 Ph. syncs motor on 208V, 50 cy. New. Export crated.............$165.00
1.25 KVA Allis-Chalmers. 230 DC to 120 AC, 60 cy. 1 Ph. Fully enclosed. Splashproof, Ball Bearings, centrifugal starter. New, complete with kit of Spare Parts..........................$175.00
M.G. 164. Holtzer-Cabot Motor: 440V, 3Ph, 60 cy., .90A, 1/3HP, 1750 RPM. Generator: 70V, 3Ph, 146 Cy.. .140KVA. Exciter: 115DC, 1A. New $67.50
Type CG-21302. 440V AC, 60 cy, 3Ph, 1500 VA to 875 DC and 300V DC. New............$69.50

INVERTERS

Onan MG-215H. Navy type PU/13. Input 115/230, 60 cy, 1 Ph. Output 115, 480 cy, 1 Ph. 1200W and 26V DC at 4 amps. New............$295.00
G.E. Model 5D-21NJ3A. Input: 24V. DC, Output: 115V. 400 cy., 485 Va. New...............$29.50
Leland Elec. Co. Model PE206A. Input: 28V. DC, 38 Amps. Output, 80V., 800 cy, 485 VA. New $22.50
G.E. J8169172. Input: 28V. DC, Output: 115 400 cycles at 1.5 KVA....................$32.50

DYNAMOTORS

Navy-Type CAJO-211444. 105/130V DC to 13V DC at 40A or 26V DC at 20A. Radio Filtered. Complete with Line Switch. New..............$89.50
Eicor. 64V DC to 110V AC, 60 cy. 1 Ph. 2.04 Amps. New $24.50
Eicor. 32V DC to 110V AC, 60 cy, 1 Ph, 0.43 Amps. New $22.50
Type PF94C. For use with SCR522 Transmitter-Receiver. Brand new in export cases...........$15.00
Carter 6V DC to 400V DC at 375 mils. New $39.50

AMPLIDYNES

G. E. Model 5AM21JJ7. 4600 R.P.M. Motor Compound wound. 150 Watts. Input: 27V DC. Output: 60V DC. Sig. Corps. U.S. Army MG-27-B. New $34.50
Edison type 5AM31NJ18A. Input: 27 volts, 44 Amps., 8300 RPM. Output: 60V DC at 8.8 amps. 530 Watts. New $22.50

SMALL D.C. MOTORS

G.E. Model 5BA50LJ2A. Armature 27V D.C. at 8.3A. Field 60V DC at 2.3A. RPM 4000. H.P. 0.5. New $27.50
Electrolux Corp. of Canada. P/O vent fan assembly for SCR-602-T6. 1/35HP. 28.5V, 2.15 amps., 2200 RPM. Price................$16.50
Oster type E-7-5. 27.5V, 1/20HP, 3650 RPM. Shunt wound. Price $15.00
Dumore Co. Type EBLG. 24V DC., 40-1 gear ratio, for use with type B-4 Intervalometer. Price $17.50

RADAR ANTENNAS

Type SO-1 (10 CM.) Complete assembly with reflector, waveguide nozzle, drive motor and synchros, etc. New in original cases..............$279.50
Type SO-3 (3 CM.) Surface Search type complete with reflector, drive motor, synchro, etc., less plumbing. New in original cases..........$189.50
Type SO-13 (10 CM.) Complete assembly with 24" dish with feedback dipole. Complete with synchros, drive motor, gearing, etc. New in original cases $149.50
Also in stock—spare reflectors, nozzles, probes, right angle bends for SO-1 antennas.

400 CYCLE TRANSFORMERS

AUTO. 400 cy. G.E. Cat No. 80G184. KVA .945S—520P. Volts 460/345/230/115. New. $4.95

FILAMENT. 400/2600 cy. Input: 0/75/80/85/105/115/125V. Output: 5V3A/5V3A/5V3A/5V3A/5V6A/5V6A/6.3V6A/6.35A. New $2.95
THYRATHRON POWER. 400/1600 cy. Raytheon UX-8876, 400/1600 cy. Pri: 115, Sec: 50-0-50V at 1.5A, 6.3V at 1 2A. Test r.m.s. 1780. New..$2.75
PLATE WECO KS9560, 400/800 cy. Pri: 115V. Sec: 1350-0-1350 at .057A (2700 V Total). Elecstat shlded. Wt. 2.3 lbs. New...................$2.95
Plate. Thordarson #T46889. 1650 VA. Pri: 105-120V. 500 cy. 1 PH. Sec: 5600V. Center tapped. 1.5KV insulation. Brand new..............$49.50
SCOPE PL. & FIL. WECO 9556. 400/2400 cy Pri: 115. HV Wdg. 1125V at .008A. Fil. Wdgs. 6.4V4A/2.5V1.75A/6.4V.6A. Elecstat shlded. Wt. 1.4 lbs. New $2.75
FILAMENT. 400/2400 cps. WECO KS9553. Pri: 115V. Sec: 8.2V1.25A/6.35V1.5A Elecstat shlld. Wt. 0.5 lbs. New...........................$1.95
PLATE & FIL. 400/2600 cy. Pri: 0/80/115V. Sec: #1=1200VDC at 1.5MA. Sec. #2=400VDC at 130MA. Fil. Secs: 6.4V4.3A/6.35VO.8A. (ins. 1500V)/5V2A/5V2A $4.95
RETARD. 400 cy. WECO KS9598. 4 Henry 100MA $1.75

60 CYCLE TRANSFORMERS

FILAMENT. Raytheon Hypersil Core, Pri: 115V. Sec: 6.3V22A/6.3V2.4A/6.3V2.25A/6.3VO.6A Ins. for 1700V $5.95
High Rectance Trans. G. E. type Y-3502A.—60 cy., Voltage 11200-135. Inductance H.V. Winding 135 Henries. Output: Peak Voltage 22.8KV. Cat. 8318065G1. New $89.50
High Voltage Trans. Westinghouse Pri: 115, 60 cy. Sec: 15,000 C.T., 60 MA. Good for Hi-Pot test set up $29.50

PULSE TRANSFORMERS

PULSE [illegible]ECO KS-9563. Supplies voltage peaks of 350[illegible] [illegible]a 807 tube. Tested at 2000 Pulses/sec and 500[illegible]V peak. Wdg. 1-2=18 ohms. Wdg. 1-3=72 ohms. L of Wdg. 1-3=.073-.082H at 100 cps. $5.00
PULSE. WECO KS-161310, 50 KC to 4MC 1¾" Dia. x 1⅞" high, 120 to 2350 ohm[illegible] New ....$[illegible]

RAYTHEON VOLTAGE REGULA[illegible]

Adj. input taps 95-130V., 60 cy. 1 Ph. Output: 115V., 60 Watts, ½ of 1% Reg. Wt. 30 lbs. 6⅛" H x 8¼" L x 4⅝" W. Overload protected. Sturdily constructed. Tropicalized. Special.........$14.75

HIGH VOLTAGE CAPACITORS

.25 MFD., 20KV	$26.50
.25 MFD., 15KV	22.50
.5 MFD., 25KV	34.50
1 MFD., 15KV	34.50
1 MFD., 7.5KV	12.50

SOUND POWERED PHONES

Western Electric No. D173312, Type O. Combination headset and chest microphone. Brand new including 20 ft. of rubber covered cable.......$17.50
Automatic Elec. Co. No. GL843AO. Similar to above but including Throat microphone in addition to chest microphone. Brand new with 20 ft. rubber covered cable $10.00
U. S. Instrument Co. No. A-260. Complete with 20' cable and plug. Brand new.............$13.50
W. E. type TS-10M Handset. New.........$16.50

PARABOLOIDS

Spun Magnesium dishes 17½" dia. 4" deep. Mounting brackets for elevation and azimuth control on rear. 1½ x 1⅝" opening in center for dipole. Brand new, per pair.......................$8.75

SWEEP GENERATOR CAPACITOR

High speed ball bearings. Split stator silver plated coaxial type 5/10 mmfd. Brand new........$2.50

WESTERN ELECTRIC CRYSTAL UNITS

Type CR-1A/AR. Available in quantity—following frequencies—fundamentals.
5910—6450—6370—6470—6510—6610—6670—6690—6940—7270—7350—7380—7390—7480—7580—9720—Kilocycles.

$1.25 each

All prices indicated are F O B Bronxville, New York. Shipments will be made via Railway Express unless other instructions issued.

ELECTRONICRAFT
INC.
27 MILBURN ST. BRONXVILLE 8, N. Y.
PHONE: BRONXVILLE 2-0044

All merchandise guaranteed. Immediate delivery, subject to prior sale.

All Prices Subject to Change Without Notice

METERS

3 MA DC 2½" R—Simpson black scale........$3.35
500 Microamps, DC—2½" round—Sun.......... 4.30
1 ma. DC Fan type—4" scale (rem. from equipt) 3.95
500 ma. DC 2½" R.—General Electric......... 2.95
2 amp. RF 2½" Sq.—Simpson................. 3.15
5 amp. AC 4½" R.—JBT...................... 4.11
10 amp. RF 3½" R.—Simpson................. 4.95
50 amp. AC 3½" R.—General Electric......... 4.11
3 amp. RF 3½" R.—Weston................... 6.00

MAGNETRONS

2J21A	2J37	3J31	706BY
2J22	2J38	4J31	706CY
2J26	2J39	4J33	[illegible]
2J27	2J40	5J23	706GY
2J31	2J41	5J29	714AY
2J32	2J48	700B	718AY
2J33	2J49	700C	718BY
2J34	2J56	700D	720B/C/DY
2J36	2J61	706AY	725A
			730A

KLYSTRONS

2K23	2K33	417A	723A/B
2K25	2K45	707A	726A
2K26	2K54	707B	726B
2K29	2K55	723A	5611

OIL-FILLED HIGH VOLTAGE ISOLATION TRANSFORMERS

Pri. 400V 60 cy. Sec. 115V 200VA Insulated for 50KV DC—G. E. Form EIR—36"H x 13"D......$125.00
Pri. 115V 60 cy. Sec. 115V 250VA Insulated for 35KV DC—G. E. Form EIR—29"H x 12½" D....$125.00

VOLTAGE DIVIDER

G.E. Cat. 8248886G-1 and 9001934G-1 17,246,400 ohms 35KV 70:1 ratio wire wound shielded oil-filled 40"H x 12"D........................$77.50

2φ LOW INERTIA SERVO MOTORS

KOLLSMAN Type 937-0240—85/68V 100 cy 5 watts RPM—new.................$12.95
G.E. Type FPE-25-11 75V 60cy 4 watts—..................................$34.50

OIL FILLED CONDENSERS

MFD	V		Price	MFD	VDC	Price
2	600		$ .45	.1	2500	$ .69
4	600		1.65	1-1	2500	3.85
4	600	R'd	1.65	32	2500	15.80
6	600		1.85	3x.2	4000	2.95
8	600	R'd	1.85	1	5000	4.88
10	600	R'd	1.95	.01-.03	6000	1.65
8-8	600		1.95	.1	7000	1.79
1	1000		62	.045	16KV	4.70
2	1000		89	.05	16KV	4.95
4	1000		1.85	.075	16KV	8.95
8	1000		2.45	.25	20KV	18.95
1	1500		.89	50	220VAC	4.95
4	1500		2.95	7	660VAC	4.25
.1-.5	2000		.87	8	660VAC	4.50
1	2000		1.95			

HIGH VOLTAGE TRANSFORMERS

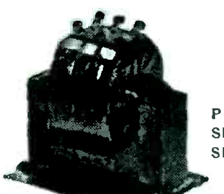
G.E.—Pri. 115V 60 cy Sec. 6250V 80 MA—12.5 KV Ins............$18.50
G.E.—Pri. 115V 60 cy. Sec. 6250/3850/2600V 56 MA 12.5 KV Ins......................$18.50
Raytheon—Pri. 115V 60 cy. Sec. 8500/6450V CT 43 MA Hermetically sealed.....................$22.50

CRYSTAL DIODES

1N21	$1.19	1N23	$1.49	1N34	$ .79
1N21A	1.69	1N23A	3.25	1N38	1.66
1N21B	4.00	1N23B	5.25	1N45	.94
1N22	1.99	1N27	1.79	1N52	1.05

ANTENNAS

AT-38A/APT (70 to 400MC)...................$13.70
AT-49/APR-4 (300 to 3300MC)................. 13.70
DZ-2 Loop antenna with pedestal............22.50
AN-74B (125 to 150MC)...................... 3.25
AN-65A (P/O SCR-521)...................... 1.50
AN-66A (P/O SCR-521)...................... 1.75
AIA-3CM conical scan.....................125.00
ASB Yagi—5 element 450 to 560MC.......... 7.00
ASB Yagi—Double stacked 6 element......... 12.70
ASA Yagi—Double stacked 370 to 430MC..... 29.40



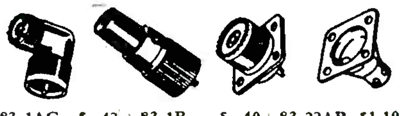
WESTINGHOUSE HYPERSIL TRANSFORMER

PRI-115V. 60CY ¾ KVA
SEC #1 - 240V - 1.56A
SEC #2 - 240V - 1.56A
WT. 30 LBS.

$14.50 EACH

Terms 20% cash with order, balance C. O. D. unless rated. All prices net F.O.B. our warehouse, Phila., Penna., subject to change without notice.

COAXIAL CONNECTORS



83-1AC	$ .42	83-1R	$ .40	83-22AP	$1.10
83-1AP	.30	83-1RTY	.65	83-22R	.68
83-1F	1.30	83-1SP	.50	83-22SP	1.15
83-1H	.10	83-1SPN	.50	83-168	.15
83-1J	.80	83-1T	1.30	83-185	.15

FULL LINE OF JAN APPROVED COAXIAL CONNECTORS IN STOCK

UHF		N	BN		BNC
UG-7	UG-23	UG-37	UG-102	UG-175	UG-254
UG-12	UG-24	UG-57	UG-103	UG-176	UG-255
UG-18	UG-27	UG-58	UG-104	UG-185	UG-260
UG-19	UG-27A	UG-85	UG-106	MX-195	UG-264
UG-21	UG-29	UG-86	UG-108	UG-197	UG-274
UG-21B	UG-30	UG-87	UG-109	UG-201	UG-275
UG-22	UG-34	UG-88	UG-146	UG-206	UG-276
UG-22B		UG-98	UG-166	UG-236	UG-290
			UG-167	UG-245	UG-291
			UG-171		UG-306

M-358	MC-277	PL-259A	PL-325
M-359	MC-320	PL-274	SO-239
M-359A	PL-258	PL-284	SO-264
M-360	PL-259	PL-293	TM-201
93-C	49120	D-163950	ES-685696-5
93-M	49121A	D-166132	ES-689172-1

TYPE "J" POTENTIOMETERS

Resis.	Shaft	Resis.	Shaft	Resis.	Shaft
60	SS	5K	1/4"	50K	3/8"
60	9/16"	5K	3/8"	50K	1/2"
100	SS	5K	1/2"	100K	SS
200	SS	10K	SS	150K	1/2"
250	1/8"	10K	3/8"	200K	3/8"
500	SS	10K	1/2"	250K	SS
500	5/16"	15K	SS	250K	3/4"
500	1/2"	15K	1/2"	250K	3/8"
500	5/8"	20K	SS	500K	SS
650	1/2"	25K	SS	500K	1/4"
1K	SS	25K	1/4"	500K	7/16"
2K	3/8"	30K	1 1/8"	1 Meg	SS
2500	SS	40K	SS	2.5 Meg	SS
4K	SS	50K	SS	5 Meg	SS
5K	SS	50K	1/4"		

DUAL "JJ" POTENTIOMETERS

50	SS	500	SS	1 Meg	SS
100	SS	1K	SS	2.5 Meg	SS
250	SS	2500	SS	5 Meg	SS
330	SS	10K	SS	1K/25K	3/8"

TRIPLE JJJ POTENTIOMETERS

100K/100K/100K—3/8" 20K/150K/15K—3/8"

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......................$8.92 ea.

F. W. BRIDGE SELENIUM RECTIFIERS

AC Volts Input — 18 / DC Volts Out — 14.5		AC Volts Input — 40 / DC Volts Out — 34	
1.3 Amps	$3.85	0.6 Amps	$4.60
2.4 Amps	4.95	1.2	5.95
6.6 Amps	7.75	3.2	8.95
13.0	12.75	6.0	15.50
17.5	15.75	9.0	17.50
26	22.75	12	26.95
39	35.50	18	32.50
52	38.50	25	42.50
70	49.50	36	55.50

130 VAC ½ WAVE STACKS

75MA	$ .88	150MA	$1.30	250MA	$1.75
100MA	1.10	200MA	1.57	400MA	2.60

GENERATORS

- Eclipse-Pioneer type 716-3A (Navy Model NEA-3A) Output—AC 115V 10.4A 800 to 1400cy. 1 φ; 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

THYRATRONS & IGNITRONS

OA4G	FG-41	FG-271	722A
C1A	FG-57	393A	873
1C21	FG-67	394A	884
2A4G	FG-81A	GL-415	885
2B4	91	KU-610	1665
2D21	FG-95	KU-623	1904
3C23	FG-105	KU-628	2050
3C31	FG-166	KU-634	2051
4C35	FG-172	WL-652	5550
C5B	FG-178	WL-672	5551
5C22	RX233A	WL-677	5552
C6J	FG-235A	WL-681	5557
FG-17			5560
FG-33			

TEST EQUIPMENT

- I-222A Signal Generator..................* $79.50
- I-72K Signal Generator...................$48.50
- Vibrotest Mod. 218 Megger...............* $45.00
- C-D Quietone Filter Type IF-16 110/220 V AC/DC 20 Amps.........................* $9.00
- TS-127/U Freq. Meter w/spares............$69.50
- TS-143/CPN Oscilloscope ....* $95.00
- Dumont 175A Oscilloscope...............*$225.00
- LM-20 Frequency Meter....................* 49.50
- Gen. Radio 757-P1 Power Supply.........* $27.00
- TS-6/AP Frequency Meter.................* $42.00
- L & N KS-7470 Null Volt Test Set........* $60.00
- A.W. Barber Labs. VM-25 VTVM.............* $86.00
- TS-10A/APN Delay Line Test Set...........$45.00
- TS-19/APQ-5 Calibrator $75.00
- REL W-1158 Frequency Meter 160-220 Mc.$32.95
- 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..................$9.95
- I-138A Signal Generator—10 cm ....* $185.00

All Items New Except Where Noted * (Exc. Used Condition)

MISCELLANEOUS EQUIPMENT

Amperex 1B98 Gamma Counter....................$ 9.87
Powerstat 1226—115/230V Input—0-270V out @ 9 amp................................ 37.00
EIMAC 35 TG Ionization Gauge.................. 5.95
ATR Inverters 6VDC to 110 VAC 60 cy 75W.. 22.95
ID-6/APN-4 Indicator 29.50
R-7/APS-2 Receiver 49.50
R-78/APS-15 Receiver 49.50
FL-8 1020 cycle filter........................ 1.75
RM-29 remote control unit..................... 8.95
RM-14 remote control unit..................... 8.95
RTA-1B 12/24 V dynamotor...................... 40.00
BC-1206-CM2 Receiver 12.95
CY-230/MPG-1 Radar Console...................575.00
G.E. Type JP-1 portable current transformer.. 32.50
ASB-4 Radar equip. Complete................... 69.75
T-9/APQ-2 less tubes.......................... 16.50
RCA AVR-15 Beacon Recvr....................... 15.50
TBY Trans-Recvr 29.95
Pioneer Type 800-1B Inverters—28VDC to 120V 800 cy 7 amp AC (used)................... 22.65
G.E. Inverter—28VDC to 120 VAC 800 cy 750VA 1 φ................................ 39.50
Navy SD-3 Radar complete.................... 1200.00
Navy DP-14 Direction Finder complete..... 385.00

PULSE TRANSFORMERS

UTAH 9262 9278 9280 — **UTAH** 9318 9340 9350

G.E. 68G-627	Westinghouse 232-AW2
G.E. 68G828	Westinghouse 232-BW2
G.E. 68G929G1	AN/APN-4 Block Osc.
G.E. 80G13	Philco 352-7149
G.E. K-2469A	Philco 352-7150
G.E. K-2744B	Philco 352-7071
AN/APN-9 (901756-501)	Philco 352-7178
AN/APN-9 (901756-502)	Raytheon UX-7350
AN/APN-9 (352-7250)	W.E. D-161310
AN/APN-9 (352-7251)	W.E. D-163247
Westinghouse PH-1	W.E. D-163325
Westinghouse 132-AW	W.E. D-164661
Westinghouse 139BW2F	W.E. KS-9563

AN/APA-23 RECORDER

Sweeps any receiver through its tuning range and permanently records frequency and time of received signals on paper chart. Power input—(motor) 27V DC 1.5A, and (recorder) 80/115V AC 60-2600 cy 135W.

Originally designed to record pulse or sine-wave modulated signals received by AN-APR-1, AN/APR-2, AN-APR-4, AN/APR-5, BC-348, S-27, SX-28. BRAND NEW.........................$147.[illegible]

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 E3-200-67P. 7.5 KV. "E" Circuit 3 microsec. 200 PPS. 67 ohms Imped. 3 sections........$6.75
7.5 E4-10-60-67P, 7.5 KV. "E" Circuit 4 sections. 16 microsec. 60 PPS, 67 ohms imped.........$8.25
15 E-4-91-400-50P, 15KV "E" circuit .91 microsec. 400 PPS. 50 ohms imped. 4 sections.......$12.00
15-A-1-400-50P. 15KV, "A" Circuit, 1 microsec. 400 PPS. 50 ohms imped.................$37.50
15 E7-2-200-50P, 15KV "E" Circuit, 2 microsec. 200 PPS, 50 ohms imped., 7 sections......$42.00

SYNCHROS

Size 1, 3, 5, 6, 7 and 8 generators, motors, control transformers, differential generators, and differential motors in stock.

AY-101D	5F	M	C-69406-1
AY-120D	5G	N	C-78248
AY-130D	5N	X	C-78249
1CT	6DG	2J1F1	C-78410
1F	6G	2J1G1	C-78411
5B	7DG	2J1H1	C-78415
5CT	7G	C-44968-6	C-79331
5D	A	C56701	C-78254
5DG	B	C-69405-2	C-78670

SEND FOR COMPLETE LISTING
SYNCHRO CAPACITORS IN STOCK

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST. PHILA. 6, PA.
Telephones - MARKET 7-6771-2-3

ELECTRO—THE BEST FOR ELECTRONIC SURPLUS

SUPERIOR POWERSTAT

Type 1126-3Y, Pri.: 230V, 3 ph, 60 cy. Output: 0-270 Volts 7 KVA. May be separated and used as three 0-115V, 1 ph, 60 cy, 2.0 KVA units. Brand New $100.00

Transtat .25 KVA. Fixed winding 115/1/60. Commutator range 103-126 V. Max AMPS. 2.17.....$9.45
.5 KVA Fixed Winding 115/1/400 Commutator range 92-115 V Max Amps. 5.5..........$4.50

TRANSFORMERS
All have 115V 60 cy Primary

Hammond RE14032. Sec. #1 thru 4: 5V @ 2A; Sec. #5: 5V @ 6A..........$4.25
Amertran #7180. Sec. 2. 5VCT @ 25VA..........$3.95
KV Trans #1523. Sec. #1: 5V @ 20A; Sec. #2: 5V @ 10A..........$12.50
Thordarson Type T-6F68. Sec. 6.3V @ 2.7A., 5KV Ins..........$4.50
Hammond REL10350. Sec. #1: 580VCT @ 55MA; Sec. #2: 5V @ 2A; Sec. 3: 6.3V @ 2A..........$3.95
Raytheon UX8724. Sec: 0.5V @ 0.5MA..........$1.35
Federal W15-38. Sec. #1: 300V @ 10MA; Sec. #2: 25V @ 500MA; Sec. #3: 6.3V @ 630MA; Sec. #4: 6.3V @ 450MA..........$3.95
Thordarson T92R21. Sec. #1: 770VCT @ 200MA; Sec. #2: 6.3VCT @ 3A; Sec. #3: 6.3V @ 1.5A; Sec. #4: 5V @ 3A..........$5.50
W.E. #KS8606. Sec. #1: 108V @ 177MA; Sec. #2: 5.13V @ 4A; Sec. #3: 6.3V @ 1A; Sec. #4: 2.5V @ 7.5A..........$3.95
Westinghouse Type GF. Sec. 20V @ 200VA..........$5.25
Raytheon U7420. Sec. #1: 225V @ 180MA; Sec. #2: 6.3V @ 2.5A..........$3.25
Bendix 530178. Sec. 1.5V @ .005 MADC..........$1.25
Raytheon UX6906A. Sec. #1 & #2: 6.3V @ 600MA; Sec. #3: 6.3V @ 2.25A..........$4.25

The following 115V 400 cy Primary

Raytheon UX8547. Sec. 1000V @ .0025A; Sec. #2: 6.15V @ 700MA..........$3.95
Sperry 702719. Sec. #1: 700 VCT @ 315MA; Sec. #2: 200VCT @ 100MA; Sec. #3: 18V @ 600MA; Sec. #4: 6.3V @ 15A; Sec. #5: 5V @ 6A..........$4.35
Raytheon UX8302C. Sec. #1: 6.3V @ 4.7A; Sec. #2: 5V @ 3A; Sec. #3: 6.3V @ .6A..........$3.50
Sperry #702541. Sec. #1: 1800VCT @ 60MA; Sec. #2: 350VCT @ 120MA; Secs. #3 & #4: 5V @ 3A; Sec. #5: 6.3V @ 5A; Sec. #6: 6.3V @ 2A..........$5.25
Sperry #702523. Sec. #1: 740V @ 12MA; Secs. #2 & 3: 2.5V @ 3A; Secs. #3 & 4: 6.3V @ 2.25A..........$3.25
W.E. #SP1035. Sec. #1: 900V @ 410MA; Sec. #2: 875V @ 410MA; Sec. #3: 780V @ 410MA..........$3.25
Federal #RA6404-1. Sec. #1: 550/0/165/550 @ 200MA; Secs. #2 & 3: 5V @ 3A; Sec. #4: 6.3V @ 2A; Sec. #5: 25V @ 2.2A..........$4.00
W.E. #KS8986. Sec: 990/875/780VCT @ 420MA $3.25
Raytheon UX8486A. Sec: 5V @ 5A 13.5KV Test..$3.50
Raytheon UX7358. Sec: 1-6500V @ .005A..........$4.25

Stancor Modulation A3871. For single 6L6 (class) A1. Pri: 4500 Ohms; Sec: 8500 Ohms..........$1.75
Raytheon Output UX7489A. Pri: 3600 Ohm 70MA; Sec: 720 Ohm 0-MA..........$1.75
Raytheon Pulse WX5137. Pri: 4KV 1 Mu. Sec.: Sec: 16KV 16A..........$6.75
G.E. #68G457. Pri: 1/1.5/3.6/8/10V; Sec: 50-50V 100W..........$2.95
Raytheon #U7658B. Pri: 270V 60 cy; Sec: 13.5V @ 450MA..........$2.00
G.E. #69G500. Pri: 450V; Sec: 6V @ 3VA..........95¢
Federal RA6403-1. Audio. Pri: 8000 Ohm @ 9MA; Sec: 600 Ohm..........$1.65
Federal RA6408-1. Audio. Pri: 2500 Ohm; Sec: less than 1-Ohm..........$1.65
Amertran 23882 Audio Output. Pri: 4000/1000 Ohms @ 0-MA; Sec: 4000 Ohms. DB level: +28..........$1.95
Raytheon Interstage UX8442. Pri: —40V; Sec: +40V..........$1.00
W.E. Oscilloscope Input #ES677584-1 SC#4G1670A/T5..........95¢
Federal Driver RA6407-1. Pri: Tapped Unbalanced 15000 Ohms @ .006A DC; Sec: 1770 Ohms; 200 to 5000 cy. ±1½DB..........$1.75

DAVEN SOUND ATTENUATORS

Type 350-A, Network, ladder, linear, imped. 30/30 ohms. 2DB attenuation. 10 W dissipation..........$3.95

Westinghouse Watthour Meters

Type CS, 240V/60cy/1ph 15 Amp., 3 Wire, new $12.50
Type CS, 120V/60cy/1ph 15 Amp., 2 Wire, new $9.50
Type CA, 120/60cy/1ph 15 Amp., 2 Wire, new $9.50
W.E. Test Set I-115..........$9.50

GC-9 XMITTER. With spare parts kit. Frequency range 3-18 MC and 300-600 KC. Band switching 100 w output. Brand new in original mfg. crates. Comes with tubes and spare parts kit. Comes in three units: high and low frequency xmitter and rectifier. Dimensions: 14" deep x 27" long x 29¼" high. Net wt. 137 lbs. Shpg. wt. approx. 250 lbs. Finished in black crackle shock mounted. Has 7 meters for indicating plate and grid current, also antenna current. Operates 110V 800 cycles. Single phase and 24V DC. Contains 2—803 tubes, 1—807, 1—801, 2—837, 1—5Z3, 2—1616. Comes with maintenance manual and test data..........$99.50

MINE DETECTOR SCR 625

Detects metallic objects (ferrous or non-ferrous) to a depth of approx. 6 ft. Find outboard motors on the bottom of lakes, locate underground piping, treasure, metallic fragments in lumber, etc. New, complete with inst. book, $65.00. Used but like new..........$45.00

MOTORS AND GENERATORS

OSTER TYPE D-4-2, 24VDC, 1/60 HP, 1800 RPM, Shunt Wound..........$9.95
OHIO ELEC #CP35220, 115VAC 60 cy, 1 ph, 1/40 HP, 3400 RPM, Cont. Duty..........$12.50
G.E. Model 5BA10A522, 24VDC, 0.55A, 10 oz/in torque 1400RPM..........$5.95
Universal Elec. #523, 115VDC, 1.2A 5000RPM...$4.95
W.E. #KS5603, 24VDC, 0.6A, 5000RPM, Shunt wound..........$2.95
G.E. #5BY9E8, Permanent Magnet type, 140VDC, .025A 1800RPM..........$8.95
EMC, SPN37952, 32VDC, 1/30HP, Gear reduced to 21RPM..........$12.95
Gen'l Industries, 115VAC, 60cy, .65A 80RPM geared to 20-30RPM..........$3.95
Elec. Spec. Type JA1, 24VDC, 15A ¼HP, 3800 RPM..........$14.95
Warren Synch. Type B3, 115VAC, 60cy, 4W, 12 RPM..........$5.95
Flyer Type 1623, 110VAC, 25cy, 30W 78RPM, gov. cont...........$7.95
Dynamic Hi-Press Axial w Fan, Mod 586SCR4, 24-28VDC, ⅓HP, 8000RPM, 25CFM. Used..........$8.95
Lear #C004, 24VDC, 1.5A 7500RPM 8W..........$8.95
Oster Series Motor, Type C-2BP-1A, 27.5 Volts DC 1/100 HP 7000 RPM..........Price $8.50
Westinghouse #1171391, 27VDC, ⅛HP, 6.5A, 5000 RPM, Series..........$9.95
Emerson #1610212, 24VDC, 160 oz/ft torque, 100 RPM..........$9.95
Elinco F-16 Rate Generator, 2 ph [illegible] volts/100 RPM..........$17.95
Autosyns, Pioneer AY-59D..........$24.95

DC SERVO MOTORS

White Rodgers Elec. Co. (6905X-46). 24 VDC @ .65 Amps. Torque 50 in lbs. ½ RPM reversible, comp. w/limit switch, relays and selenium rectifiers on top of motor, to keep AC out of motor, 5x5x4..$12.95

Pioneer Gen-E-Motor Dynamotor #SS2669. Input 18V; Output 450V @ 150MA..........$3.95

CONVERTERS PU-16/AP, input 28VDC; output 115 VAC 400 cy. 6.5A..........$59.50

INVERTERS PU-7/AP, input 28VDC; output 115 VAC 400 cy. 21.6A..........$59.50

INVERTERS PE-218, input 28VDC; output 115VAC 400 cy at 1.5 KVA..........$29.95

WIRE WOUND RHEOSTATS
Standard Brands

#241D, 250/250 ohms 50W w/½" shaft..........95¢
#241D, 300/300 ohms 50W w/½" shaft..........95¢
#241D, 400/400 ohms 50W w/½" shaft..........95¢
#50D, 30/30 ohms 50W w/½" shaft..........95¢
Model J, 16/16 Ohms 50W w/½" shaft..........$1.25
Model J, 0.5 ohms 50W..........95¢
Model J, 5 Ohms 50W..........95¢
Model J, 75 ohms 50W..........95¢
Model J, 150 ohms 50W..........95¢
Model J, 800 ohms 50W..........$1.25
Model J, 1000 ohms 50W..........$1.25
Model J, 5000 ohms 50W..........$1.4[illegible]
Model H, 60 Ohms 25W..........75¢
60 Ohms 25W..........65¢
Model H, 100 Ohms 25W..........75¢
Model H, 175 Ohms 25W..........75¢
Type PR, 15 Ohms 25W..........75¢
All size potentiometers and rheostats in stock. Write us your requirements on all carbon or wirewound.

BC-375E Transmitter complete w/tuning units. Brand New..........$50.00

DECK ENTRANCE INSULATORS
(Bowl and Flange Type)

Mfd. by Ohio Brass Co. heavy galv. metal flange 10½" D., porc. bowl set in rubber gaskets. Top bell 7¾" D. brass feed thru rod 10½" L. Insul. dist. between top bell and flange 6½"..........$3.95

HEAVY DUTY TRANSFORMERS

G.E. Cat. #7479965. Pri: 230V 60 cy Sec: 16.4/8.2VCT; 11/5.5V @ 60A. 8½H 9½L 6½W..........$25.00
G.E. Cat. #79G365. Pri: 203.5V 60 cy Sec: 6.3V @ 250 Amperes..........$39.50
G.E. Cat. #7479971. Pri. 230/208V 50/60 cy; Sec: 1365/1300/1235VCT 735VA. 7½ x 5½ x 8½....$29.50
G.E. Cat. #7479972. Pri: 230/208V 50/60 cy; Sec: 2450/2350/2210VMS. 2.85 KVA..........$49.50
G.E. Cat #7475695. Pri: 115V 60 cy. Sec: 3530/3720/3910 V. M.S. 1.31KVA..........$47.50
Maloney Elec. REL10383. Pri: 115/230V 50/60 cy. Sec: 0/21000 Volts @ 100 MA DC. Half Wave. 0.1 Filled. 16"D 16"W 20"H excl. of ins..........$125.00

HIGH VOLTAGE REACTORS

Cat. #26F628 rated 0.1 Mu-F @ 12KV DC....$ 4.95
#7520 rated 2 x .1 Muf @ 7500 VDC..........17.50
Cat. #14F64 rated 0.25 Mu-F @ 20KV DC..........17.50
Cat. #14F71 rated 0.25 Mu-F @ 32.5 KV DC..35.00
Cat. #A7548 rated 2x.25 Mu-F @ 6000 VDC....12.50
CD Paper rated 0.5 Muf @ 25 KV DC..........45.00
#RC-2151 rated 2x.5 Muf @ 9000 VDC..........25.00
Cat. #120063 rated 0.65 Mu-F @ 12.5 KV DC..15.00
Type FP rated 1.0 Mu-F @ 10 KV DC..........32.50
Cat. #14F63 rated 1.0 Mu-F @ 15 KV DC....$37.50
Cat. #AE6734 rated 1.0 Mu-F @ 25 KV DC....75.00
#TK60020 rated 2.0 Muf @ 6000 V DC..........22.50
Cat. #14F338 rated 4.5 Muf @ 7500 V DC....35.00
Cat. #14F13 rated 5.0 Muf @ 10 KV DC..........45.00

ELAPSED TIME METERS

Mfd. by R. W. Cramer Co. Type RT-2H. 0-10,000 hours by tenths. 115 Volts 60 cycle. Large Quantity Available..........$9.75

REACTORS AND CHOKES

Raytheon #U11010. Rated 10H @ 1.2 A DC....$49.95
G.E. Cat. #7479974. Rated 2.5H @ 2.3A DC..$3[illegible].50
G.E. Cat. #7479964. Rated 50H @ .025A DC..$2[illegible].50
Ind #CK3016. Rated @ 20H @ 60MA DC.....$2.95
Thordarson #T48853. Rated 6H @ 80MA DC.. $1.50
Raytheon #U-7423. Rated 1.2-1.6H @ 0.0MA D[illegible] $2.25
Raytheon #U-6313. Rated 0.016H @ 14A DC..$5.50
Raytheon #UX8887D. Rated 30H @ .03A DC....$5.[illegible]
G.E. Cat. #7472403. Rated 5H @ .035A DC 4K[illegible] Test..........$2.[illegible]5
Thordarson #T45921. Rated 7H @ 0.9A DC 10KV Test..........$19.50
Raytheon UX9114A. Rated 0.100H @ 1.4A DC..$3.00
Zenith 95G40. Rated 150H @ 1.0 MADC.....$2.25
Raytheon UX9116. Rated 0.30H @ 2.0A DC....$3.00
Raytheon WX-5148. Dual. Rated 1.75/1.75 @ 0.25/0.25A DC..........$3.50

W.E. Sine Wave Generator KS5913L02 16V 2 Ph. 1725 RPM, driven by W.E. motor KS5913L01. 115V 60 cy. 1 Ph. 1/50 HP 1725 RPM..........$17.95

JACK BOX BC-1366, contains plugs, selector switc[illegible] potentiometer, etc...........

G.E. VOLTAGE REGULATOR MODEL 3GV[illegible] for use w/115V 60 cy supply, 23-35KV comple[illegible] Tubes..........[illegible].95

TOR

RELAYS

G.E. #CR2791- B100J4, 3PDT, [illegible] 15A Contacts..........$1.25
Allied DO9D28, 3PDT 6VDC, 15A contacts.....$1.35
Leach Type 1054ARV, 3PST on make, SPST on break, 20-32 VDC, 15A contacts..........$1.25
G.E. #CR2791-B100F3, DPDT 24 VDC 5A contacts 75¢
G-M #13013, DPDT, 24 VDC, 15A Contacts..........95¢
Price #311, DPDT, 28 VDC, 10 Amp cont. 1900 ohm coil..........95¢
G-M #13020, DPST on make, 3PST on break, 24VDC, 15A contacts..........$1.25
Allen Bradley X89309, SPST double make, 24VDC 200 A..........$2.50
A-B Bulletin X95545, type B6B, SPST Double Make, 24 VDC, 200 Amp..........$2.50
Dunco Thermal Time Delay 115 VAC 60 Cy. SPST, 1 min delay..........$1.95

WESTINGHOUSE HQS PHASE SELECTOR RELAYS. for selective Pole Carrier Relaying, 3 unit per set $95.00

RECTIFIERS

IT&T Selenium, Bridge, #EE29, 10 plates 1" dia. Input 18VAC Output 14VDC @ .15A..........$2.25
IT&T Selenium, Half Wave, #FE4, 4 plates 1⅜" dia. Input 18VAC Output 7.5VDC @ .45A..........$1.00
Westinghouse #103B Copper Oxide, Half Wave, 4 plates 1⅝" D. Input 4VAC Output 3VDC @ .25A. $1.75
G.E. Model 6RS5F10, Selenium, Full Wave, 24 plates 1" D. Input 54VAC Output 36VDC @ .2A......$3.95
B-L #BL202S1, Selenium, Full Wave, 24 plates 1" D. 220VAC Output 180VDC @ .0075A..........$3.95
Westinghouse #854029A, Copper Oxide 13 plates 3⅝" D. Bridge, Input 65VAC Output 45VDC @ .32A..$9.95

HEAVY DUTY COPPER OXIDE RECTIFIERS

FEDERAL TEL & RADIO DC POWER SUPPLY. Input: 220 volts 60 cy 3ph. Output: 28 volts DC 130 Amperes cont. duty. Complete w/ meters. Like new..........$275.00

HAMMETT ELECTRIC RECTIFIERS MODEL SPS-100B. Input: 220 volts 60 cy 3 ph 13A. Output: 15 volts at 130 Amperes. 30 Volts at 65 amperes. cont. duty. Complete w/volt and ammeters. Like new..........$225.00

MALLORY RECTOSTARTER TYPE APS-20. Input: 230 Volts 60 cycle 3 ph. Output: 12 VDC at 600A for 1 min. 200A for 1 hr., 130A cont. Output: 24VDC at 300A for 1 min., 100A for 1 hr., 65A cont. Complete w/volt and ammeters. Like new..........$225.00

ALL MERCHANDISE BRAND NEW UNLESS OTHERWISE NOTATED

ALL PRICES F.O.B. BOSTON. ORDERS ACCEPTED FROM RATED CONCERNS ON OPEN ACCOUNTS NET 30 DAYS. MINIMUM ORDER $3.00

ESCO ELECTRO Sales Co.

Dept. E 110 PEARL STREET BOSTON 10, MASS. LIberty 2-7890

SUPERIOR VALUES FROM
AMERICA'S LARGEST ELECTRICAL CONVERSION HOUSE

HIGH FREQUENCY CONVERSION EQUIPMENT

ONAN 400 CYCLE MG SET. Motor: 7½ H.P. operative at 220/440 V 3φ, 60 cy. V belted to self-excited alternator with output of 4 KVA. 115 Volts, single ph. 400 C.P.S. Alternator is self-excited with secondary output of 14 VDC 40 Amp. With Voltage Regulator built-in. Price $592.00
With single phase Motor....$642.00

ELECTRIC SPECIALTY FREQUENCY CHANGERS Type BFS52/BFRS354 Input: 220 Volts, 3 Ph. 60 cy. 3600 RPM. Output: 250 Volts, 20 Amps, single ph. 180 Cyc. 5000 VA. 3000 Watts. Brand New. Compact ball bearing units for operation of Hi-cycle equipment. SPECIAL PRICE $160.00

ONAN 800 CYCLE MG UNIT. Employing 5 H.P. Motor operative at 220/440 Volts, 3φ, 60 Cy. V belted to self-exc. generator with output of 1.5 KVA. 115 Volts, single ph. 800 CPS, and secondary output of 500 Watts 28.5 VDC 17.5 amperes. PRICE....$289.00

HOLTZER-CABOT MG152F. Input: 28 Volts DC at 52 Amp. Output: 115 Volts, 400 cps. 3 phase, 750 va.; .9 P. F. also secondary output of 26 Volts, 400 cycles, single phase at 250 va.; voltage and frequency regulated. REBUILT LIKE NEW....$65.00

ONAN 2 BEARING MG UNITS. Motor: 115/230 Volts, single phase, 60 cy. Generator: .6 KVA 115 Volts, 5.3 Amps. 480 C.P.S. Price....$165.00

ECLIPSE 800 CYCLE GENERATORS. Flange mounting with spline shaft. Output is 115 VAC 10.4 Amp. 90% P.F. 800 Cycles, 1200 V.A. with secondary output of 28.5 VDC, 60 Amperes. Self excited. Price $39.00

BRITISH MADE 500 CYCLE MG SETS. Motor: 230 Volts, 3 PH—50 Cycles, XX-Alternator: 5 K.W. 180 Volts, 27.8 Amp. 500 Cycles, Excitation—110 VDC. When used at 60 Cycle current. Output is 600 cycles, 220 Volts. Price....$353.00

WINCHARGER PU-7/AP: Input. 28 VDC, 160 Amps. Output: 115 VAC. single ph. 2500 V.A. 400 C.P.S. Frequency and Voltage regulation built-in. Price $87.00

HOMELITE 400 CYCLE POWER PLANTS. PU-6/tps-1 Single cylinder engine, air-cooled governed to operate at 4000 RPM. Generator rated at 1400 Watts, 120 Volts, 400 Cycles also secondary output of 27 VDC, 400 watts. Brand new in original cases with instruction book, and complete spare parts. An exceptional unit to procure 400 cycle current or to be used as a lighting plant. Price $150.00

GENERAL ELECTRIC 400 CYCLE UNITS. Operate at 26 VDC 100 Amp. Output: 115 VAC 1φ, 400 CPS. 1500 V.A. With filter system built-in. Price....$29.50

LOUIS ALLIS FREQUENCY CHANGER SETS.
(2) Pri: 25 H.P. 220/440-3-60; Sec. 15/10.8 K.W. 3300/2200 RPM. 306/220 Volts 35/35 Amps. 2 ph. 500/360 C.P.S. Price....$1050.00
(3) Pri 10 H.P. 220/440-3-60; Sec: 7.5 K.W. 440/220 V. 17/8.5 Amp. 3000/1200 RPM. 360/180 Cycles, 2 ph. Price $750.00
We can supply these units for 400 cycle output and with transformers to supply 3 phase, wye output. Write for further information.

BENDIX-ECLIPSE 800 CYCLE AERO UNIT. Input: 24-28 VDC, 75 amps. Output: 115 V. 10.5 Amp. 800 C.P.S. Complete filter system mounted thereon. Price $22.50

CROCKER-WHEELER 500 CYCLE SET. Operate at 110 Volts, D.C. 29.6 Amps. Output: 120 Volts, single ph. 500 cycles 2.5 KW. Price....$146.95

WESTINGHOUSE HIGH FREQUENCY UNITS. Input: 115 Volts, D.C. 2.7 Amps. Output: 14.4 Volts, .139 Amp. 450-2550 Cycles. Frequency variation is obtained with built-in controller on end of unit. Price $48.50

GE DUAL OUTPUT MG SETS. Consist of Motor rated 3 H.P. 220/440 V. 3φ. 60 Cy. directly coupled to 2 generators. Output .5 K.W. 220 Volts, 2.27 Amp. 525 Cycles. Also .5 K.W. 110 Volts. D.C. 4.55 Amp. 3 separate units mounted on common bed plate. Price $150.00

WESTINGHOUSE 180 CYCLE ALTERNATORS. 750 V.A. Output: 110 Volts, 3 Phase, 180 C.P.S. 3000 R.P.M. Separately excited at 110 VDC. Price..$44.00
Also available with built-in exciter. Price......$78.00

GENERAL ELECTRIC HIGH FREQUENCY UNIT. Operating at 440-3-60 .75 amp. Output, 70 Volts, 3 ph. 148 cyc. 220 Watts, 1.8 amperes. An ideal unit for experimental work or for operation of equipment. SPECIAL PRICE $34.50

GE HIGH FREQUENCY MG SETS. Motor: 250 VDC 4 amp. Alternator: 600 watts, 125 single ph. 4.8 amp. 500 cycles. Brand new. Price....$90.00

MARCONI MG UNITS. Operative at 110 VDC to deliver 500 VAC, 6 amp. 3 K.W. 240 cycles. Extending shaft permits driving complete unit to obtain dual self-excited generator. Price....$89.00

HOLTZER-CABOT 500 CYCLE MG SET. Motor: 110 VDC. GENERATOR: 5 KVA 230 VAC. 1φ 500 Cyc. Rebuilt. Price $271.50

CROCKER-WHEELER 500 CYCLE MG SET. Compact 2 bearing Unit. Operative at 120 VDC, 7.3 amps. Output: 250 Volts, 5 amp. 500 cycles. Rebuilt Price $88.88

ESCC HV UNITS. Operative at 11.5 VDC 28 Amp. Output: 575 VDC. .25 Amp. also 55 VAC. .91 Amp. 1φ, 500 Cycles. Price....$39.75

HOLTZER-CABOT HIGH FREQUENCY MG SETS. Compact 2 bearing units with input of 120 VDC, 7 amps. Output: 120 Volts, 3φ 320 Cycles. Has shaft extension permitting use as dual generator. Price $112.90

WESTINGHOUSE HIGH FREQUENCY UNITS. Operate with input of 115 VDC to deliver 17 VAC. 1050 to 1650 cycles. An excellent value....$25.50

ESCO DUAL FREQUENCY UNITS. Motor operates at 120 VDC, 10 amperes. Delivers 70 Volts at 120 Cycles or 200 Volts at 720 Cycles. Price....$95.00

GE MG UNITS. Motor: 110 Volts, D.C. 31.5 Amperes, in a single compact unit with output of 120 Volts, 20.8 Amp. single ph. 500 cycles. Like New. Price....$95.00

500 CYCLE MG SETS. British made motor generator, 8 KW, 2 bearing unit, input 180-240 VDC, output 180 volts, 1 φ weight app. 1000 lbs. Price....$425.00

INVERTER UNIT PE206A. Input: 27.5 VDC, 28 amp. Output: 80 Volts, single ph. 800 CPS. 500 VA. Price $19.00

RLX DUAL GENERATORS. Flange mounted. Output: 500 Watts, 1300-2600 Cycles, also 12-14 VDC 750 Watts. Price $25.50

ELECTRIC SPECIALTY HIGH FREQUENCY CONVERTER UNIT. Primary: 32 VDC, 16 amperes, 3000 R.P.M. Ball Bearings. Secondary: 350 volts, 1500 cycles. .75 amps. 275 V.A Single Ph. Built-in frequency control. Specially Priced at....$30.00

BENDIX POWER MG SET. Consists of G.E. 2 HP Rep-Ind Motor, 115 volts, single phase, 60 cyc. directly connected to Bendix alternator with output of 120 volts, 700 cyc., 600 watts and DC output of 14.5 volts, DC, 22 amp. Brand new. Price....$225.00

CONTINENTAL DC/AC SET. Motor: 1.5 HP, 230 VDC, 3440 RPM. Output: 120 VAC, 6.6 amps., 8 KW. 800 cyc., 1 ph., also output of 14 VDC, 4 amps., Model CG21637. Compact 2-bear. units. Completely rebuilt. Price $89.00
Also available with input of 440-3-60 and same output. Price $107.50

WINCHARGER PU-16/AP INVERTER. Type MG750. Input: 28 volts, 60 amp. Output: 115 volts, 6.5 amp. 400 cyc., 1 ph. Brand new. Price....$69.50

HOLTZER-CABOT MG 221. Compact 2 bear. units for low current 400 cyc. Operates at 32 VDC, 8.5 amp. Output: 110 volts, 1.0 amp., 1 ph., 100 watts, 400 cyc. Brand new. Price....$69.50

HOLTZER-CABOT MG 218. Operates at 115 VDC, 2.3 amp. with same output. Price....$79.50

LELAND INVERTER TYPE MG 4A. DC Input: 27.5 volts, 38 amp., 6000 RPM. Output: 115 volts, 1 ph., 400 cyc., 500 VA. Like new and fully guaranteed. Price $39.50

GENERAL ELECTRIC MODEL 5D21NJ3A. Input: 27 volts, 35 amp. Output: 115 volts, 485 VA, 1 ph., 400 cyc. Price $31.50

LOUIS-ALLIS 3 UNIT MG SET. Consists of 5 HP motor operative at 220/440-3-60 directly coupled to alternator with output of 115 volts, 1 ph., 400 cyc. and with exciter unit all mounted on steel base. Brand new. Price $565.0

HOLTZER-CABOT TYPE CAJ-211168 MG UNITS. Compact 2 bear. operative at 115 volts, 1 ph., 60 cyc., ½ HP. Output: 115 volts, 4 amp., 233 cyc., 3 ph., also 24 VDC at 5 amp. Brand new. Price....$36.00

NORMAND ELEC. CO. (BRITISH MFG.) MG UNIT. Motor: 220 VDC, 3.8 amp., 2 HP, 4200 RPM, directly connected to H. F. alternator with output of 1400-2800 cyc., 1200 watts. Exc. 24 VDC. Price....$70.0

MARCONI MG UNIT. ¼ KW, operates at 110 VDC to deliver 110 VAC, 300 cyc., supplied with field rheostat for variable frequency output. Price....$70.00

PIONEER MG UNIT. Input: 115 VDC, 3.4 amp. Output: 140 VAC, 1.2 amp., 350 cyc. Complete with field rheostat for variable frequency output. Price $60.00

ESCO MG UNIT. Operative at 120 VDC, 25 amp., 4 HP. Delivers 115 VAC, 1 ph., 1050 cyc., 2 KW. An exceptionally fine macine for laboratory use. Can be used with field rheostat for frequenoies up to 2000 cycles. Price....$175.0

ESCO INVERTER UNIT. Prim: 12 VDC, 20 amp., 1800 RPM. Sec: 140 VAC, 1 amp., 140 VA, 360 cyc. With field rheostat for frequency outputs up to 800 cyc. Price $69.50

HOLTZER-CABOT MG UNIT. Operates at 115 VDC. 8.2 amp. to deliver 55 VAC, 6 amp., 195 cyc., 3 ph., 1950 RPM with field rheostat for frequencies up to 400 cyc., 3 ph. Price....$80.0

HOLTZER-CABIT MG UNIT. Motor: 120 VDC, 5 amp., 2500 RPM. Output: 75 VAC, 9 amp., 500 cyc., 675 VA, 1 ph. Price....$49.0

GENERAL ELECTRIC HIGH FREQ. MG SET. Consists of 3 HP motor operative at 220-3-60, directly connected to alternator with output of 220 VAC, 22.7 amp., 1 ph., exciter unit rated at .5 KW, 110 VDC. 3 units are directly coupled. Price....$295.0

G.E. MG SET MODEL 5LY56AB5A. Motor: 1.1 HP, 250 VDC, 4 amp. Generator: 600 watts, 125 VAC, 4.8 amp., 560 cyc., 1 ph. Price....$79.50

WESTINGHOUSE AMPLIDYNE TYPE MG SETS

Motor: Type CS, Fr. 204, 208 v. 3 ph., 60 cyc., 4 amps, 1.5 HP, directly connected to 2 DC gen. (1) 125 VDC, 2.8 amp., .35 KW. Gen. (2) 250 VDC. 2 amp., sep. exc. 35 volts. The 3 units are contained in one housing. Brand new. The generators have similar characteristic of an amplidyne with a set of control fields and are completely enclosed with rubber gaskets on the enclosing covers, which can be removed for increased KW output. An exceptional value at....$183.0

GEN. ELECTRIC AMPLIDYNES

Model 5AM73AB89; Input: 115 VAC, 1φ, 60 cyc. 9 amp. Output: 375 K. W. 250 VDC, 1.5 amp......$86.00

Model 5AM73AB89; Input: 115 VAC, 1φ, 60 cyc. 9 amp. Output: 375 K.W. 250 VDC, 1.5 amp......$86.00
Model 5AM65FB2A; Input: 115 VAC, 3φ 60 cyc. 5 amp. Output: 500 watts, 250 Volts, 2 Amp......$144.00
Model 5AM49AB30; Input: 440 Volts, 3 phase, 60 cyc. 1 amp. output: 115 Volts, D.C. 3.25 amp. 3450 RPM $88.00
Model 5AM73AB58; Input: 110/220 volts, single phase, 60 cyc. Output: 250 Volts, D. C. 1.5 amp. 375 watts, 3450 RPM $100.00
Model 5AM31NJ18A; Input: 27 VDC, 44 amp, 8300 RPM. Output: 60 VDC, 8.8 amp. 530 watts......$12.95
Model 5AM78AB10; Input: 32 VDC, 60 amp. 2 H.P. 2200 RPM; Output: 250 Volts, D.C. 3 amperes; 750 Watts $190.00
Model 5AM45DB26; Input: 440 V. 3φ, 60 cyc. Output: 125 V.D.C. 1.0 Amp....$55.00
Model 5AM49AB7A; Input: 440 Volts, 3φ, 60 Cyc. Output: 375 Watts. 250 V.D.C. 1.5 Amp. Price $100.00

ALLIS-CHALMERS MOTOR GENERATOR

Input: 115 VDC at 14 amp. 3600 RPM, Ball Bearings. Output: 1.25 KVA; 80% PF 120 Volts, AC, 1 Ph. 60 cyc. 10.4 amp. Cenerifugal automatic controller permits line start operation. Fully enclosed. Rebuilt. $85.00. Also available for 230 VDC operation at the same price.

GENERAL ELECTRIC DC/AC MG SETS

Four Bearing Marine Units: 25 HP 230 Volts, DC coupled to alternator 18.75 KVA; 80%PF; 1800 RPM Output: 115 Volts, AC. Single Ph. 60 cycles. Ball Bearings. 4 bearing set; marine duty. Brand New. $545.00

HERE IS EXCEPTIONAL VALUE

Robins and Myers Motor Generator Units. Operate at 110 Volts, AC, single phase, 60 cyc. and deliver 22/40 Volts, DC. Can be used with field rheostat to supply 24/28 VDC for the operation of aero equipment from lighting line. Rated at 40 watts but will deliver 200 watts for intermittent operation. Gear head built into one end rotates external shaft at 225 RPM. An exceptional value at $18.75 each. With field rheostat $20.00. Also available for operation at 115 VDC at $12.50 and with rheostat at $13.75 each. Both units have 1/4 HP Motor. Stock up on these sets while they are available. Special price on quantity. Rebuilt.

Esco AC Motors: built-in magnetic brake for quick reversing. Double shaft, ball bearings. Rated: 2½ HP—30 minutes, marine duty; 440-3-60. Brand new in original cases. SPECIAL PRICE....$34.00

INDUCTION VOLTAGE REGULATOR

Type IRT, form M, 1.64 KVA, 3 phase, 60 cycles, cont. duty. Outdoor service. Primary: 208 V., 10.5 load amps. Oil-filled Wgt. 365 lbs. 33 x 17" x 14"....$90.00

ESCO DC/AC MG SETS. Motor: 115 Volts, 1½ HP line start; built in voltage regulator, frequency control, filtered; ideal for television, radar or any application requiring constant voltage and frequency. Output: 115 V.A.C. 1φ, 60 Cyc. 460 V.A. Brand New......$120.00

JANETTE ROTARY CONVERTERS

110 VA. Input: 110 VDC; Output: 110 VAC, single phase, 60 cycles; 3600 speed. With filter for elimination of radio interference. Reliably rebuilt. Special Price $19.95

IDEAL AC/DC M-G UNIT. 110 V. 1φ, 60 cy. input: 110 VDC 2.28 amp. .25 KW output. 2 bearing unit thoroughly rebuilt and guaranteed. With rheostat. Price $55.00

GE DC Generators. Consists of three separate generators in one unit. 3600 RPM. Delivers 1200 V., 450 V. .25 a. and 115 V. 1.3 amp. Price....$24.00

British Alternators. 1.5 KVA., 230 Volts, 1φ, 400 CPS, sep. exc. Price....$115.00

Crompton-Parkinsen Alternators. 3 KVA. .7 PF. 110 VAC, 1φ, 60 cy. 1800 RPM. sep. exc. Price....$170.00

DC Manual Controllers, mfg. by Marconi Co. of England. Enc. type. For starting duty of 24 VDC Motors, rated at .7 HP. A really hard-to-get unit at a give-away price. SPECIAL....$4.90

PIONEER DYNAMOTOR. Type PS250. Input: 12 VDC, 4.9 amp. Output: 350 VDC, .100 amp., brand new. Price $14.00

BRITISH DC/AC MG UNITS. Operate at 100/110 VDC, 4 amps., 3000 RPM. Output: 230 VAC, .87 amp., 50 cyc. Wt: 132 lbs. Brand new. Price.......$42.50
With field rheostat for 60 cyc. output. Price....$50.00

G.E. 3 PH. TRANSFORMERS. 3 KVA, 418/429/440 Pri. 140 volts, 3 ph. Sec. Price....$45.50

G.E. SELSYN MOTORS. Model 2JD65FA2. 120/55 volts, 60 cyc. Price....$18.50

BOGUE ELECTRIC AC/DC MG SET. Consists of 5 HP motor in center directly connected to 2 12 volt, 160 amp. generators. Will deliver 24 volts at 160 amp. or 12 volts at 320 amp. Condition like new. Price $375.00

IF IT'S FROM ONE FREQUENCY TO ANOTHER; FROM DC TO AC OR AC TO DC, IF IT'S FROM ONE VOLTAGE TO ANOTHER, THEN CALL ON US.

Established in 1922 **WILLIAM I. HORLICK COMPANY** *Tel. HAncock 6-2480*
409 ATLANTIC AVE. BOSTON 10, MASSACHUSETTS

These XFRMRS are Army Spec. All Underrated.

Comb. Transformers—115V/50-60 cps input.

Item	H.V.	Amp.	Filaments	Price
CT-142	645VCT	.050	5V/2A, 6.3V/1.2A	$4.25
CT-825	360VCT	.340	6.3VCT/3.6, 6.3VCT/3A	3.95
CT626	1500V	.160	2.5/12, 30/.100	9.95
CT-15A	350VCT	.070	6.3/.6, 6.3/1.8, 3 lbs.	2.95
CT-071	110V	.200	33/.200, 5V/10, 2.5/10	4.95
CT-378	2300V	4 MA	2.5/2	6.95
CT-367	580VCT	.050	5VCT/3A	2.25
CT-721	550VCT	.100	6.3/1, 2.5VCT/2	2.95
CT-99A	2x110VCT	.010	6.3/1A, 2.5VCT/7A	3.25
CT-91A	726V	.100	5V/3A, 6.3/3.5	3.25
CT-441	50V	.200	5V2.4, 5V/1.2	2.29
CT-403	350CVT	.026 MA	5V/3A	2.75
CT-931	585VCT	.036	5V/3A, 6.3V/6A	4.25
CT-610	1250	.002 MA	2.5V/2.1A, 2.5V/1.75A	4.95
CT-137	350VCT	.026 MA	5V/3A	2.75
CT-866	330V	.065	6.3V/1.2, 6.3V/600 MA	1.75
CT-319	330VCT	.085	5V/2, 6.3/7.5, 6.3/3	3.25

Filament Transformers—115V/50-60 cps input.

Item	Rating	Each
FT-781	866 Trans. 2x2.5/5A	$2.25
FTG-31	2.5V/2.5, 7V/7A (Tape @ 2.5V/2.5A), 16 lbs.	9.95
FT-674	8.1V/1.5A	1.10
FT-157	4V/16A, 2.5V/1.75A	2.95
FT-101	6V/.25A	.79

Plate Transformers—115V/50-60 cps input.

Item	Rating	Each
PT-976	Auto: 120VCT/10 MA	$0.69
PT-31A	2x300V/5 MA	.79
PT-46A	4080VCT N.L. 3% to 18" Hx6" Wx7" L 20 lbs.	29.95
PT-033	4150V/400 MA 11½x9¼ Wx9" D 70 lbs.	49.95
PT-75-2	3780/3446/3112VCT/77 MA	10.95
PT-28-1	4600VCT/.077	12.95
PT-403	Auto: 70V/1A	2.29
PT-160	1120VCT/770 MA, 590VCT/82 MA, 25 lbs.	24.95
PT-170	Auto: 156/146/137/128—.71A	3.29
PT-139	42V/46V/50V/55V/15.2A 7⅛ x 7" W x 6¾" H	10.95
PT-31A	2 x 300V/5 MA	.79
PT-976	120VCT/10MA	.79
PT-12A	280VCT/1.2A	2.95

Item	Pri.	Output	Price
STF-946	210/220/230	25V/4A 3½" H x 2¼" x 2¼" D	$2.39
STF-638	230	5V/9A 5⅛" H x 4½" x 3¾"	1.25
STF-05A	115/230	2 x 5V/7.57" H x 7" x 5" D	4.25
STF-682	220	30-25-20V/1 MA	.69
STF-968	230	2.5V/6.5A	1.45
STF-405	230/115	5V 12/9A	2.95
STF-370	220/440	3 x 2.5V/57, 2.5V/15A, 5½ x 5 x 4½	5.25
STF-11A	220	2 x 40V/.05/2 x 5V/6A, 12.6/1A	2.95
STF-631	230	2 x 5V/27A 2 x 5V/9A, 100/4H x 5 x 7 30 lbs.	24.95
STF-96B	230	2.5/6.5A	1.95
STF-608	220	24V/600, 5V/2A, 2 x 6.3V/1A	2.25

SPECIAL PLATE TRANSFORMERS

Item	Pri.	Output	Price
STP-945	210/20/30	1100CVT/300 5¼ x 4 x 3½	$5.90
STP-643	230V	2 x 230/.05	1.29
STP-780	82V	4000V/.002	1.29
STC-627	230V	1500/160, 110V/.200, 3.3V/.200, 5V/10, 2.5-1.4/10	12.95
STC-611	230V	200V/200, 4 x 6.3V/.9	2.95
STC-16A	220V	260V/.03, 100V/1, 6.3V/4.2	2.95
STC-607	220V	700VCT/75 MA, 40VCT/.100, 15/10/15V/100 MA	3.95
STC-612	230V	400V/.30, 190/.30, 2 x 5V/2.5 w/2-866 Socket	3.95

FILTER CHOKES

ITEM	RATINGS	PRICE
CH188M	5 HY 200MA	$1.79
CH488	10 HY .030A	.79
CH791	Dual 1.75-.125 HY 100 MA	.59
CH86C	Dual .01-3.5HY 950-75MA	1.10
CH981	15HY .110A	1.59
CH22-1	1HY .100A	.49
CH779	.6HY .490A	1.25
CH25A	SW .09/.018HY 3/.3A	8.95
CH922	10000HY.0MA	2.75
CH043	2.2HY 80MA	.59
CH047	2HY 200MA	1.25
CHC29	SW15/29HY 150MA	3.25
CH867	1.8HY .180A	.95
CH323	2.1HY .200A	1.95
CH360	15HY 15MA	.98
CH7A-1	.577HY 7.7MA	1.79
CH791	1.75HY .100A	.59
CH161	Dual 30HY .020A	1.45
CH373	11 .5HY 90MA	1.39
CH21-A	.045HY .900A	1.69
CH045	5HY .040A	.79
CH136	25HY 80MA	2.25
CH702	6HY .150A	.99
CH163	25HY .070A	1.25
CH756	30HY 25MA	.79
CH67-1	.35HY .35A	2.49
CH38A	Dual 20HY .100A	2.95
CH064	SW .3/6HY .570/.130A	8.95
CH366	20HY .300A	7.95
CH110	25HY .065	1.00
CH189	120HY 17MA	2.49

FULL WAVE BRIDGE SELENIUM RECTIFIERS

18 VAC IN. 14 VDC OUT.	
2A	$2.95
4A	4.89
6A	6.90
8A	7.49
12A	9.79
24A	18.34
36 VAC IN. 28 VDC OUT.	
1A	$3.95
2A	5.79
4A	9.89
8A	13.69
12A	19.49
24A	34.53
54 VAC IN. 42 VDC OUT.	
2A	$6.95
4A	14.49
120 VAC IN. 100 VDC OUT.	
2A	$14.45
8A	42.50
12A	65.15

SPECIAL RECTIFIERS ON REQUEST

Hi-Current Chokes

.1 HY—12 Amp—46 Ohms $14.95

.01 HY—2.5 Amp—Cased $2.25

Low-Voltage Transformers
Primaries 115v, 60 Cycle

36V-40V at 3.5 amps.....$3.7
24v-1.5A ....
8v-1.5A.

Transmitters 40-Watt Output
These Famous V.F.O. Drivers Available

4—5.3MC. $5.95
5.3—7MC. 5.95
274N (ARC5)
Used. Good Cond.

PE 157 Vibropack for BC 745

Runs on 2V DC. Obtained from small Willard Rechargeable battery contained in case which is charged from 6 Vac or DC. Also contains 5" PM Speaker & Jacks for Mike Hd-sets. Used, excel-lent $9.95

T.V. Transformer, 7" or 9" scope, 3000v / 5 MA. 720vct /200 MA, 6.4 / 8.7A, 6.4 / 6A, 5/3A, 1.25/3A, 115V 60 cy Input. Price $3.95

.2-PHANTOM ANTENNA

antenna is a Signal Corps type, and may be used for pre-tuning rigs for either single wire, doublet, or coaxial fed antennas. Unit consists of two coils two resistors, variable condenser and indicating lamps, completely enclosed in circular can, 3" in diameter, 6½" high, having bracket for wall mount, or rear of can. Used chiefly by Signal Corps for tuning mobile equipment.

MOBILE MODULATION KIT

T-103 Mike to 6J5 grid.
T-102 6J5 to Modulators, PP 6v6 or PP 6L6.
T-104 Mod. Trans. PP 6v6 or PP 6L6 to 829, 832, or 2E26.
KIT & DIAGRAM $2.98

B-19 MKII TRANS-RECEIVER
Less Power Pack..$32.50
B-19 Power Pack...$8.95

ARC5 MODULATOR MD7/ARC5 Plate Modulator w/ dynamotor complete w/ Tubes 1—12J5, 2—1625, 1—VR50. Good cond. Price $6.95
BC456 Screen Mod. $2.25

ID-24 ARN-9 Dual 0-200 Microamp. Movement in 3" Case. ILS Equipment $9.95

VARISTORS

D-167176	$ .95
D-172155	$2.25
D-172307	$1.7
D-167208E	$1.85
D-172175	$1.65
D-168687	$ .95
D-171812	$ .95
D-171528	$ .95
D-165593	$1.25
D-162356(308A)	$1.50

THERMISTORS

D-166288	$1.50
D-167332 (tube)	$1.50
D-170396 (bead)	$1.50
D-167613 (button)	$1.50
D-164699 for MTG. "X" band Guide	$2.50

DYNAMOTORS

Type	Input Volts	Input Amps.	Output Volts	Output Amps.	Radio Set	Price
PE86	28	1.25	250	.060	RC 36	$2.95
DM416	14	6.2	330	.170	RU 19	6.95
DM33A	28	7	540	.250	BC 456	4.95
DM42	14	46	515	.110	SCR 506	4.95
			1030	.050		
			2/8			
PE101C	13/26	12.6	400	.135	SCR 515	5.95
		6.3	800	.020		
BD AR 93	28	3.25	375	.150		4.45
23356	27	1.75	285	.075	APN-1	3.50
35CO458	28	1.2	250	.060		
ZA-085	12/24	4/2	500	.050		
ZA-056	12/24	8/4	12/275	3/110		
B-19 pack	12	9.4	275	.110	Mark II	
			500	.050		
D-104	12		225	.100		12.69
			440	.200		
DA-3A	28	10	300	.060	SCR 522	8.45
			150	.010		
			14.5	.5		
5053	28	1.4	250	.060	APN-1	3.95
PE73CM	28	19	1000	.350	BC 375	
CW21AAX	13	12.6	400	.135		9.95
	26	6.3	800	.020		
		9	1.12			
BD 77KM	14	40	1000	.350	BC 191	12.95
PE94	28	10	300	.200	SCR	
		11	150	.010	522	
			14.5	.5		

INVERTERS

PE 218-E: Input: 25 28 vdc. 92 amp. Output: 115 v. 350-500 cy 1500 volt-amperes. Dim: 17"x6½"x10". New (as shown) $49.50
PE 218-H: Same as above except size; 16½" x 6" x 10". New $49.50
PE 218H, used, good cond.................$22.00
PE 206: Input: 28 vdc, 38 amps. Output: 80 v. 800 cy, 500 volt-amps. Dim: 13" x 5½" x 10½". New $12.50

MICROWAVE TUBES

MAGNETRONS

Tube	Frq. Range	Pk. Pwr. Output	
2J27	2965–2992 mc.	275 KW	$25.00
2J31	2820–2860 mc.	265 KW	38.50
2J21-A	9345–9405 mc.	50 KW	12.50
2J22	3267–3333 mc.	265 KW	25.00
2J26	2992–3019 mc.	275 KW	37.50
2J32	2780–2820 mc.	285 KW	
2J38 Pkg.	3249–3263 mc.	5 KW	39.50
2J39 Pkg.	3267–3333 mc.	87 KW	39.50
2J49	9000–9160 mc.	58 KW	75.00
2J61	3000–3100 mc.	35 KW	75.00
2J62	2914–3010 mc.	35 KW	75.00
3J31	24,000 mc.	50 KW	85.00
5J30			35.00
718DY	2720–2890 mc.	250 KW	35.00
720BY	2800 mc.	1000 KW	75.00
720CY	286 mc.	1000 KW	75.00
725-A	9345–9405 mc.	50 KW	50.00
730-A	9345–9405 mc.	50 KW	50.00
700 A, B, C, D			35.00
706 AY, BY, DY, EY, FY, GY			55.00

KLYSTRONS

723A 723A/B—2K25 726A 707A

"CW" MAGNETRONS

QK 62 3150-3375 mc.
QK 59 2675-2900 mc.
QK 61 2975-3200 mc.
QK 60 2800-3025 mc.
New, Guaranteed ....Each $87.50

CR—TR—PULSE TUBES

705A	721	3EPI	724A
3DPI	3FP7	5J30	724B
3GPI	5CPI	15R	

MANY OTHER TYPES AVAILABLE. SEND YOUR REQUIREMENTS.

PULSE EQUIPMENT

MIT. MOD. 3 HARD TUBE PULSER: Output Pulse Power 144 KW (12 KV at 12 Amp). Duty Ratio: .001 max. Pulse duration: 5, 1.0, 2.0 microsec. Input voltage: 115 v 400 to 2400 cps. Uses: 1-715B, 4-829-B, 3-'72's, 1-'73. New......$110.00
APQ-13 PULSE MODULATOR. Pulse Width .5 to 1.1 Micro Sec. Rep. rate 624 to 1348 Pps. Pk pwr. out 35 KW Energy 0.018 Joules..............$49.00
TPS-3 PULSE MODULATOR. Pk. power 50 amp, 24 KW (1200 KW pk): pulse rate 200 PPS. 1.5 microsec. pulse line impedance 50 ohms. Circuit—series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New with all tubes...............$49.50
APS-10 MODULATOR DECK. Complete, less tubes $75.00

PULSE NETWORKS

15A—1-400-50: 15 KV, "A" CKT. 1 microsec 40 PPS, 50 ohms imp......................$42.
G.E. #6E3-5-2000-501P2T, 6KV "E" circuit, 3 sections .5 microsecond, 2000 PPS. 50 ohms impedance ....$6.
G.E. #3E (3-84-810) (8-2.24-405) 50P4T: 3KV "E" CKT Dual Unit: Unit 1, 3 sections, 84 Microsec. 810 PPS, 50 ohms imp.: Unit 2, 8 Sections, 2.24 microsec. 405 PPS, 50 ohms imp.............$6.50
7.5E3-1-200-67P. 7.5 KV, "E" Circuit, 1 microsec 200 PPS, 67 ohms impedance, 3 sections....$7.50
7.5E4-16-60.67P, 7.5 KV, "E" circuit, 4 sections 16 microsec. 60 PPS, 67 ohms impedance......$15.00
7.5E33-200-6FT, 7.5 KV, "E" Circuit, 3 microsec 200 PPS, 67 ohms imp, 3 sections.............$12.50

PULSE TRANSFORMERS

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. #166173 Hi-Volt input transformer, W.E. impedance ratio 50 ohms to 900 ohms. Freq. range: 10 kc to 2 mc, 2 sections parallel connected, potted in oil $36.00
W.E.-KS 9800 Input transformer. Winding ratio between terminals 3-5 and 1-2 is 1.1:1, and between terminals 6-7 and 1-2 is 2:1. Frequency range: 380-520 c.p.s., Permalloy core.....................$6.00
W.E. #D169271 Hi Volt input pulse Transformer $27.50
G.E. K2450A. Will receive 13KV, 4 micro-second pulse on pri. secondary delivers 14KV. Peak power out 100KW G. E. $34.50
G.E. #K2748A. Pulse Input line to magnetron $36.00
Ray. UX 7896—Pulse Output Pri. 5v, sec. 41v.$7.50
Ray UX 8442—Pulse Inversion:—40v + 40v...$7.50
RAY UX 7350-7307—PRF 1 MC .05 microsec..$5.00

OIL CONDENSERS

Mfd.	Volt.	Price
5	50	$0.45
650	80	1.95
15	220 AC	2.20
1	500	.40
0.5	750 AC	1.59
0.5	1000	.69
2x0.5	1000	.70
1	1000	.75
1.5	1000	.85
2	1000	.90
4	1000	1.75
3x.01	1200	1.35
1	1500	1.30
1.5	1500	1.40
2	1500	1.45
2x0.1	2000	1.10
2x0.1	4800	1.20
0.1	6000	2.39
2x0.1	7000	1.75
0.1	7500	1.25
2x0.15	8000	4.75
.015	16000	8.95
.0016	15000	5.95
.25	20000	
1	25000	
.5	25000	
1	7500	

MANY OTHERS

SILVER MICA BUTTONS

MMF.	MMF.	MMF.
40	175	500
50	180	2000
100	185	

$7.50 PER 100

TEST SETS

TS 102/AP
TS 62/AP
TS 36/AP
TS 12 UNIT 2
TS 69/AP
TS 33/AP
CW60-ABM
LU-1
LU-3
TS 159
TS 226
TS 250/APN
TS 89
I-203-A
TS 11/AP
BC 438
CS60-ABW
I-158
I-222
I-185
TS 268/U
Send For Further Info. & Price

All mer. guar. Mail orders promptly filled. All prices F.O.B. N.Y.C. Send MO or Chk. Only shipping chgs. sent C.O.D. Rated concerns send P.O.

MIN. ORDER $3.00 **COMMUNICATIONS EQUIPMENT CO.** MIN. ORDER $3.00

131 Liberty St., New York, N. Y. Dept. E-9 Chas. Rosen Phone: Digby 9-4124

COMMUNICATIONS

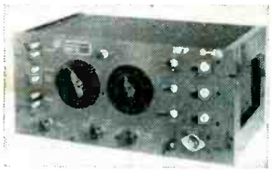
3cm Research Equipment 1" x ½" WAVEGUIDE

1" x ½" waveguide in 5' lengths, UG39 flange to UG40 cover, silver plated .... $7.50 per length
Rotating Joint supplied either with or without deck mounting.
UG 40 choke flanges .... $17.50 each
Micrometer Head Wavemeter (Ordnance absorption type) supplied with calibration curve .... $85.00 each
2J42 Magnetron Pulse Modulator, 14Kw max. rating 7Kw min. Plate voltage pulsed 5.5kv. 6.5 Amp. 1001 duty cycle, 2.5 usec pulse length max. filament 6.3v .5 amp. Includes magnetron mtg. and blower. Requires 3C45 and 2-3B24. New $75.00
TS-268 Crystal Checker $35.00
Bulkhead Feed-Thru Assembly $15.00
Pressure Gauge Section 15 lb. gauge and press nipple $10.00
Pressure Gauge, 15 lbs $2.50
Dual Oscillator-Beacon Mount. P/O APS 10 Radar for mounting two 723A/B klystron with crystal mts. matching slugs, shields $42.50
Dual Oscillator, Mount. (Back to back) with crystal mount, tunable t[illegible]mination, attenuating slugs .... [illegible].50
Directional Coupler. UG-40/U Take off 20 DB .... [illegible]50
Directional Coupler, type "N" take off 20 DB calibrated .... [illegible]0
2K25/723 AB Receiver local oscillator Klystron Mount, complete w[illegible]tal mount. Iris coupling and choke coupling to TR .... [illegible]
TR-ATR Duplexor section for above .... [illegible]
CU 105/APS 31 Direction Coupler 25 DB .... [illegible]
723AP Mixer—Beacon dual Osc. Mnt. w/xtal holder .... $1[illegible]
Waveguide Section 12" long choke to cover 45 deg. twist & 2½" radius, [illegible] deg. bend $4.50
Twist 90 deg. 5" choke to cover w/press nipple $6.50
Waveguide Sections 2½ ft. long silver plated with choke flange $5.75
3 cm. mitred elbow "E" plane unplated $12.00
UG 39 flanges .... 85¢
UG 40 chokes $1.00
90 degree elbows #E or H plane 2½" radius $12.50
90 degree twist 6" long—UG39 to UG 40 .... $8.00
45 degree twist $8.00
40KW X Band radar, complete as described and illustrated in July, 1951, Electronics.—APS-4 under belly assembly, less tubes $375.00

1¼" x ⅝" WAVEGUIDE

Tunable Termination. Precision adjust $65.00
Low Power Termination $25.00
Magic Tee $45.00
90 Degree Elbows. E or H plane $12.50
Waveguide Lengths, cut to size and supplied with 1 choke, 1 cover, per length .... per ft. $2.00
31 Dir-Coupler WG output calibrated—25 db nominal $17.50
Flex sections, 12" Rubber Coated $14.50
Mitred Elbow H Plane UG51-UG52 .... $12.00
6" St. sect, choke to choke $3.50
APQ #3 Constant Z Rotat. Jnt $22.50
CG 98[illegible]/APQ-13 12" Flex. Sect. 1¼" x ⅝" OD $10.00
Wave Gd. Run 1¼" x ⅝" Gd. consists of 4 ft. sect. w/RT angle bend on one end. 2" 45 deg. bend on other end $8.00
X Band Wave Gd. 1¼" x ⅝" O.D. 1/16" wall aluminum .... per ft. 75¢
Slug Tuner Attenuator W.E. guide. Gold plated $6.50

PULSE EQUIPMENT



MODULATOR UNIT BC 1203-B

Provides 200-4,000 PPS. Sweep time: 100 to 2,500 microsec. in 4 steps, fixed mod. pulse, suppression pulse, sliding modulating pulse, blanking voltage, marker pulse, sweep voltages, calibration voltages, fil. voltages. Operates 115 vac. 50-60 cy. Provides various types of voltage pulse outputs for the modulation of a signal generator such as General Radio #804B or #804C used in depot bench testing of SCR 695, SCR 595, and SCR 535.

New as shown $125.00

MIT. MOD. 3 HARD TUBE PULSER: Output Pulse Power: 114 KW (12 KV at 12 amp). Duty Ratio: .001 max. Pulse duration: .5, 1.0, 2.0 microsec. Input voltage: 115 v. 400 to 2400 cps. Uses 1-715-B, 1-829-B, 3-72's, 1-73. New $110.00

APQ-13 PULSE MODULATOR. Pulse Width .5 to 1.1 Micro Sec. Rep. rate 624 to 1348 Pps. Pk. Pwr. out 35 KW. Energy 0.018 Joules $49.00

TPS-3 PULSE MODULATOR. Pk. power 50 amp. 24 KV (1200 KW pk); pulse rate 200 PPS. 1.5 microsec: pulse line impedance 50 ohms. Circuit—series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New with all tubes $49.50

APS-10 MODULATOR DECK, Complete, less tubes $75.00

10 CM RF PACKAGE. using 2J22 magnetron, freq. modulator range 3267-3333 mc, complete with power supply and pulser giving apx. 20 kv @ 30 A. 1 usec, 1000 PPS Power output 265 kw. ⅞" rigid coax plumbing thruout. Uses 417A klystron mixer, 6Ac7 preamp. Pulser is **715 B HARD TUBE.** Complete RF unit, pulser unit, receiver front ea. new, with tubes. Requires 115v. 400 cy ac primary source $385

MICROWAVE TEST APPARATUS

10 CM RESEARCH EQUIPMENT

Coaxial Wavemeter, W.E., Transmission Type, using type "N" fittings. Calibrated between 3400-4500MC. $99.50

LHTR. LIGHTHOUSE ASSEMBLY Part of RT39 APG 5 & APG 15 Receiver and Trans Cavities w/assoc. Tr. Cavity and Type N CPLG. To Recvr. Uses 2C40. 2C43. 1B27. Tunable APX 2400-2700 MCS. Silver Plated $49.50

BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Rice .... $47.50 ea.

MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated $45.00

SIGNAL GENERATOR. using 417A klystron, 2700-3300 mc. Output approx. 50 mw. 115 vac power supply. With tubes, new $425.00

REGULATED POWER SUPPLY for GL 446 type lighthouse tubes (2C40, etc.) 115 vac. 60 cycles. Panel Mounting. Less tubes $32.50

COAX. CRYSTAL MOUNT, type N connectors $17.50

RT-39/APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr-TR cavity compl. recvr & 30 MC IF strip using 6AK5 (2C40. 2C43. 1B27 lineup) w/Tubes.

721A TR BOX complete with tube and tuning plungers $12.50

McNALLY KLYSTRON CAVITIES for 707B or 2K28. Three types available $4.00

TS 268 CRYSTAL CHECKER $35.00

F 29/SPR-2 FILTERS, Type "N" input and output $12.50
WAVEGUIDE to ⅞" Rigid Coax "Doorknob" adapter choke flange, silver plated broad band $32.50
AN/APR5A 10 cm antenna equipment consisting of two 10 cm waveguide sections, each polarized 45 degrees .... $75.00 per set
POWER SPLITTER: 726 Klystron input dual "N" output $5.00
MAGNETRON COUPLING FOR TYPE 720 MAG. to 1½" x 3" Waveguide $35.00
AS14A/AP-10 CM Pick up Dipole with "N" Cables $4.50

⅞" RIGID COAX—⅜" I.C.

RIGHT ANGLE BEND, with flexible coax output pick-up look $8.00
SHORT RIGHT ANGLE bend, with pressurizing nipple $3.00
RIGID COAX to flex coax connector $3.50
STUB-SUPPORTED RIGID COAX, gold plated 5' lengths. Per length $5.00
RT. ANGLES for above $2.50
RT. ANGLE BEND 15" L. OA $3.50
FLEXIBLE SECTION. 15" L. Male to female $4.25
FLEX COAX SECT. Approx. 30 ft $16.50

1.25 CM RESEARCH EQUIPMENT

Complete 24,000 MC RF Head, including 2K33 Klystron, 3J31 Magnetron and Magnet, all plumbing, and associated circuitry, in standard A-N Pressurized housing. New, $1100.00

Low Power Load $20.00
Shunt Tee $35.00
Waveguide Lengths, 2" to 6" long, gold plated with circular flanges and coupling nuts .... $2.25 per inch
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
"K" Band Directional Coupler .... $49.50 ea.

SUPERSONICS

QCU Magneto striction head RCA type CR 278225—New $95.00
Stainless Steel streamlining housings for above $18.50
QBG Driver Amplifier, New $200.00
QCU Magneto striction head, coil plate assembly, new $14.50
QCQ-2/QCS Magneto striction head coil plate assembly $14.50
QCQ2 Sonar complete set—Write for details.
QC-RCA magneto striction head assy. consists of coil, plate, nickel diaphragm plate, milled steel body unassembled $65.00
Supersonic Oscillator RCA 17-27 Kc. Rec. Driver. Osc. 115 v 60 cy. AC. Designed for use w/200 watt drive. New less tubes $39.50
WEA-1 Console, Consists of Rec. Ind. Osc. Remote training control 200 watt driver amp. 17-27 kc range $450.00
QBF Sonar mfg. WE complete console consists of 10-40 kc rec. driver osc. ind. & control unit, and driver amplifier 22-28 kc. Write.
QJA Sonar QBF w/OJA adapter kits w/cathode ray tube indication. Write.

Mail orders promptly filled. All prices F.O.B. New York City. Send money order or check. Only shipping sent C.O.D. Rated concerns send purchase order.

ALL MERCHANDISE

131 LIBERTY ST., Dept. E9
Phone Main 4-8373-4-5-6

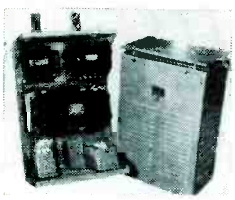
NEW YORK, N. Y.
P. J. PLISHNER

EQUIPMENT CO.

POWER EQUIPMENT

50KW Deisel Generator
Delco Generator Mod. #1-3659
50KW 120 Volt DC 500 Amperes
1500 RPM Stab Shunt wound 60° C Rise
Navy Spec. #17-C-7
CUMMINS DIESEL
SBMH 63 Model HGD Eng. #45751

VOLTAGE REGULATOR



Mfg. Raytheon: Navy CRP-301407: Pri: 92-138 v. 15 amps. 57 to 63 cy. 1 phase. Sec: 115 v. 7.15 amp. .82 KVA. .96 PF. Contains the following components:

REGULATOR TRANSFORMER: Raytheon UX9545. Pri: 92-138 v. 60 cy. I PH. Sec: 200/580 v. 5.55/5.26 amps, 400 c rms test.

FILTER REACTOR: .1 56 hy, 5 amps, 4000 v Raytheon UX 9547.

TRANSFORMER: Pri: 186 v, 5 amps; Sec: 115 v. 7.2 amps. Size: 12" x 20" x 29". Net wt. approx. 250 lbs. Entire unit is enclosed in grey metal cabinet. New, as shown $99.50

7.5 KVA Gasoline generator sets. Type PE99, 115 volts, 60 cycle, single phase AC, unused $550.00

115 Ampere circuit breaker. ITE MODEL KJ ...... $15.00 each

Stepdown Transformer. Pri. 440/220/110 VAC, 60 Cy. 3KVA, Sec., 115 Volts, 2500 volts insulation. Size 12" x 12" x 7" $39.50

Plate Transformer. Pri. 115V 60 Cy. Single phase AC Sec., 17,600 Volts @ 144 MA. Oil emmersed $95.00

RADAR SETS

APS-2, Airborne, 10 CM, Major Units, New
APS-4, Airborne, 3 CM, Compl.
APS-15, Airborne, 3 CM, Major Units, New
SD-4, Submarine, 200 MC, Compl., New
SE, Shipboard, 10 CM, compl., New
SF-1, Shipboard, 10 CM, Compl., New
SJ-1, Submarine, 10 CM, Compl., Used
SL-1, Shipboard, 10 CM, Compl., Used
S[illegible], Portable, 10 CM, Compl., Used
S[illegible], Portable, 10 CM, Compl., Used
[illegible] Shipboard, 10 CM, Compl., Used
A-6[illegible], Shipboard, 10 CM, Compl., Used
Mark 4, Gunlaying, 800 MC, Less Ant., Used
Mark 10, Gunlaying, 10 CM, Compl., New
CPN-[illegible], Beacon, 10 CM, Major Units, Used
CPN-8, Beacon, 10 CM, Complete New Less Ant., New
SCR-533, IFF/AIR, 500 MC, New
Airborne Radar Altimeter, 500 MC, Compl., New
SCR-545, Early Warning Rad[illegible] Trailer, Complete
SM Radar, 10 CM, Early Warning, Used

CAA RADIO RANGE INSTALLATION

SCR 277, Trailer, consisting of a complete low frequency radio range installation, including portable tower, gasoline generator, communications equipment. This unit is standard and approved. Write for details and price.

PULSE—RADAR

RC 145 IFF GROUND STATION EQUIPMENT

RC 145 includes: Receiver and Transmitter BC 1267A; Power Unit RA 105A; and Indicator Panel 1-221A.

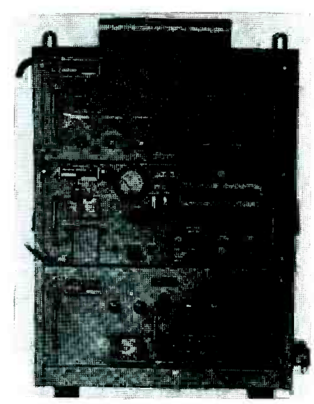
The 8 tube transmitter delivers **1 KW peak power between 157-187 mc.** using PP 2C26 tubes, an 829 modulator, and several pulse forming and clipping tubes. There is plenty of room to install crystal oscillator, multipliers and modulators. The **lecher line plate circuit** and antenna coupler are adjustable from the front panel. Both receiver and transmitter can be matched independently to the antenna in use by adjustments on the front panel. The dials are not calibrated in frequency.

The receiver is a **13 tube superhet,** as follows: RF stage—6AK5; RF stage 6AK5; Mixer—6AK5; H. F. Osc.—6C4; Five IF Stages—6AG5; Second Det.—6H6; Tuning Eye—6E5; Video Amp.—6AG5; Cathode Follower—6AG5.

The I.F. frequency is 11 mc. and is stagger tuned to bandwiwth of 4 mc. Power is supplied to the receiver from the main power supply. There is a jack for audio output from the second detector. Receiver dials are not calibrated in frequency. Tuning range 157-187 mc.

The indicator panel has controls for turning on and off a beam antenna rotating motor and various tubes and circuits to indicate the position of the antenna. Includes 1 **selsyn motor.** (8 tubes)

The power required is approx. 450 watts at **117 volts 60 cycles.** The power supply is fused on the front panel, and circuit breakers are used in the HV and Fil. primaries. (7 tubes). The relay rack measures 39 5/16" high, 26⅜" wide and 20½" deep. There is a blower mounted in the top of this rack. In all, there are 36 tubes supplied with the equipment. The weight of the entire equipment is approximately 400 lbs.



These units are brand new.

Price $375 ea.

Wavemeter for above 75.00
Dipole Array for above 85.00

GUARANTEED

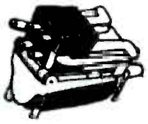
Mail orders promptly filled. All prices F.O.B. New York City. Send money order or check. Only shipping charges sent C.O.D. Rated concerns send purchase order.

131 LIBERTY ST., Dept. E9 — NEW YORK, N. Y.
Phone Main 4-8373-4-5-6 — P. J. PLISHNER

RELAYS ARE OUR SPECIALTY
WE HAVE OVER ~~200,000~~ 300,000

WE ALSO HAVE LARGE STOCKS OF:

APC's	Crystals	Relays
Binding Posts	Filters	Resistors
Cable	Fuses	Servo Xfmrs.
Capacitors	Hardware	Shock-Mounts
Ceramicons	Iron Core Slugs	Sockets
Ceramics	Knobs	Spaghetti
Chokes	Potentiometers (sine-cosine)	Switches
Coils	Pulse Xfmrs.	Transformers
Controls		Tubes
		And Others



MINIATURE RELAYS

55251 **TELECHRON**, 24VDC, SPST n.o. (1A) 300 ohm, #R174 .... $ .90

55340 **PRICE**, 24VDC, SPST n.o. (1A) 300 ohm #R170 .... .90

55342 **TELECHRON**, 24VDC. Makes 3 Breaks One, (2As, 1C) 300 ohm. Anti-Capacity Arms, Low Loss Bakelite Insulation, #R171 .... 1.25

55526 **COOK**, 24VDC, Makes 2, Breaks One, (1A, 1C) 300 ohm, Ceramic Insulation, #R107 .... .95

55528 **G.E.** 12VDC, 6PST n.o. (6As), 150 ohm, #R426 .... 1.50

55531 **COOK** 12-24VDC, Makes 4, Breaks 2 (2As, 2Cs), 150 ohm #R405 .... 1.25

55589 **RBM**, 24VDC, DPST n.o. (2As. 300 ohm, #R245 .... 1.25

55836 **G.E.** 24VDC, SPDT, (2As) 250 ohm, #R402 ....ea. 1.25

55837 **G.E.** 24VDC, Double Make, 300 ohm, #R108G 1.00

55837 **RBM**, Same as R10SG, #R10SR 1.25

55837 **ALLIED**, Same as R10SG, #R108 .... 1.50

D163221 **AMER. TOTALIZATOR**, 24VDC, DPDT 300 ohms, Anti-Capacity Arms. #R134 .... 1.25

GUARDIAN, 24VDC, SPST, n.o. 300 ohms, Anti-Capacity Arm, Ceramic Insulation, #R106 .... .59

23012-0 **RBM**, 24VDC, SPDT, 250 Ohms, #R172 .... 1.25

7251 **ARC** 24VDC, SPDT, 300 ohm #R406 .... 1.25

7252 **ARC**, 24VDC, DPST, n.o. (2As) 300 ohm, Anti-Capacity Arms, Ceramic Insulation, #R354 .... 1.25

A13415 **CLARE**, 12VDC, DPST, n.o. (2As) 120 ohms, #R246 .... 1.25

A21577 **CLARE**, 24VDC, DPST n.o. (2As) 250 ohms, #R352 .... 1.15

P3**LEACH** (Pair on Bakelite Strip) Each relay; 6VDC, SPDT, 125 ohms. #R353..pr. 2.25

ZH77628-1 **AUTOMATIC**, 12VDC, Make One, Break Two (1B, 1C) 640 ohms Dual Telephone Type Contacts #R244 .... .85

7472679 **G.E.** 3VDC, SPST, n.c. (1B) 30 ohms, #R59A .... .59

2VDC, SPDT, 125 ohms, #R173 .... .69

73A23 **ALLIED**, 24VDC, Make 3, Break 1, (2As, 1C) 300 ohms, #R403 ....ea. 1.25

TB 302 **PRICE**, 24VDC, Make 3, Break 1, (2As, 1C) 300 ohms, #R404 ....ea. 1.25

B10059-11 **CLARE**, 24VDC, 4PDT, 300 ohm, #R426 .... 1.50

R10 **COOK**, 12-24VDC, 3PST n.o. (3As), One contact 10A, 250 ohm, #R427 .... 1.50

TS2A VARIABLE CERAMICONS

CAPAC. 1.5 to 7; 1.5 to 7.5; 3.5 to 30; 5 to 40 .28 ea., $25.00/c

Dual 7-45 mmf ea sec .... .45 pr.,$40.00/c

HI-VOLTAGE

GLASS TO METAL SEALS (FEED THRU)

MANY TYPES AND SIZES

Send us blueprints or samples for our Quotes

12 LB TREASURE CHEST 12 LB

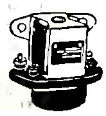
JUST THE THING FOR YOUR LAB!

12 lbs of miscellaneous ELECTRONIC PARTS—ALL GOOD—ALL USABLE—NO JUNK—NO MECHANICAL PART such AS RELAYS, CONTROLS, CAPACITORS. XFORMERS, CHOKES, SWITCHES, RESISTORS, ETC.

Worth many times the purchase price! Odd pieces left over from displays, samples, and quantity sales, closed out at fraction of value because of difficulty in stocking. . .

$2.00 **$2.00**

SOLENOIDS



B5A ALLEN BRADLEY 24VDC SPST 50A 100 ohms #R105 .... $1.95

B5A HART Cat. #692R4 SPST 50A, 150 ohms, #R105H 1.95

B5A SQUARE "D" 24VDC SPST 50 A 150 ohms #R25 .... 2.25

B5A CUTLER HAMMER 24VDC. SPST 50A 100 ohms #R24 .... 2.25

B4 AUTO LITE 24VDC, SPST 200A 90 ohms #R174 .... 3.50

B4 HART M569A Cat. #694R19, 24VDC. SPST 200A, 75 ohms #R127A 2.95

B8 CUTLER HAMMER 6041H139A, 24VDC. SPST 200A, 10 ohms #R130 .... 3.95

B8 AUTO LITE SPEC #32424A, 24VDC, SPST 200A 6 ohms #R128 .... 2.75

D1 ECLIPSE D1EA 53528 24VDC SPST 200A 6 ohms #R126 .... 2.95

CUTLER HAMMER 6041H36A, 12VDC, SPST 200A 17 ohms #R121 .... 3.95

D1 CUTLER HAMMER D1-9432181, 24VDC, SPST 200A 50 ohms 3.95

LEACH 5030CSP, 12VDC, SPST 50A, 25 ohms #R125 .... 1.95

LEACH 79733, 24VDC, Dble Make & Break 50A, and SPST n.o., 65 ohms #R131 .... 2.50

G.E. 429896, Plastic Enclosed, 24VDC, SPST 50A 150 ohms #R23 .... 2.95

G.E. CR2792D116W2 Plastic Enclosed, 12VDC, SPST 100A, 30 Ohms #R23B 5.50

EPCO S47D, 12VDC, SPST 30A, 35 ohms #R122 2.95

RBM BN5, 24VDC SPST 50A, 200 ohms #R224 1.95

G.E. CR2800384A3, 24VDC, SPST, 200A, 50 ohms #R59B 3.95

G.E. CR9533K100A2, 24VDC, 2 switchettes, DPST n.c. & SPST n.c. long throw #R132 .... 9.95

GUARDIAN 34585 Dual Latching 24VDC ea section: Double Make & Break & Alternate Double Make, Break. 100A contacts, 24 ohms #R223 .... 8.75

G.E. M29J682-1 (No Contacts) 10-12VDC—Micalex Flipper Arm. Releases at 2VDC #R167 .... 1.25

CUTLER-HAMMER 6041H158A 12VDC, SPST n.o. 50A, 25 ohm #R428 .... 1.95

CERAMIC & FEEDTHRU CAPACITORS

Type	No.	MMF	Tol.	Ea.	perC
Button	FA	240	±10%	.18	15.00
Standoff	FA	345	±10%	.18	15.00
Disc		2000	±10%	.40	30.00
Standoff	324	1000	±10%	.12	10.00
Feedthru		55	±10%	.10	9.00

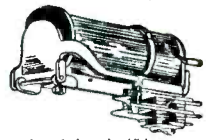
H-F TIE POST

Low-Loss Yellow Bakelite Insulation, pictured actual size (4-40 Thread)....$7.50/C $60.00/M

Write Us Your Needs for Immediate Quote

Universal general corp.
324 CANAL ST. N. Y. 13, WA 5-9642

TELEPHONE TYPE RELAYS



107 **COOK**, 3-6VDC, 6 make, 1 break (5As, 1C), 12 ohm, Part of BC654, #R407 .... $ 2.95

A8053 **CLARE**, 6500 ohm, 8maDC, 3 makes (3As) Octal plug base, #R408 .... 3.95

5035A7 **AUTOMATIC**, 1300 ohm, 8maDC, SPST n.o., (1A), #R103 .... 1.25

KURMAN, 3300 ohm, 7 maDC, 3 make, 1 break (3As, 1B), 5 amp contacts, #R243 .... 2.95

A18258 **BENDIX** (Cook 102) 8-12 VDC, Copper Slug, Slow Release, SPDT, 200 ohm, Part of SCR 522, #R365 .... 2.49

P32505 **STROMBERG-CARLSON** 12VDC, SPDT n.o. (2As), 200 ohm, Anti-vibration contacts, Part of ABK, #R92 .... 1.49

P32504 **STROMBERG-CARLSON** 6VDC, SPST, n.o. (1A), 100 ohm, Anti-vibration contacts, #R02 .... .49

R5229A1 **AUTOMATIC** 6VDC, 3PST n.o. (3As), 75 ohms, Slow Release, #R412 .... 2.50

R5021A1 **AUTOMATIC** 1300 ohm, 20maDC, SPST n.c. (1B), #R413 .... 2.95

SHORT TELEPHONE RELAYS

A11996 **CLARE** (H77519-1) 24VDC, 3PST n.o. (3As), 2000 ohm, #R94 .... $ 1.75

6385 **ARC** 12VDC, SPST n.o. (1A), 10A contact, 200 ohm, Part of ARC5 or SCR 274N, #R13 .... 1.50

C58180 **BENDIX**, 12VDC, DPDT & SPST n.c. (2C, 1B) 150 ohm, Part of SCR522, #R58 .... 2.00

A22268 **CLARE**, 12VDC, SPST n.o. ([illegible]), 200 ohm, #R411 .... 1.50

5586 **W.E.**, 12-24VDC, SPST n.o. (1A [illegible]0 ohm, #R414 .... 1.25

D170788 **W.E.**, 4850 ohm, 8maDC, SPDT, #R92 .... 2.50

WESTERN ELECTRIC

TYPE E

UR1147 1000 ohm, 10ma DC, 4 makes (4As), #R415 .... $ 1.75

E1383 1000 ohm, 10ma DC, SPST n.o. (1A), #R409 .... 1.50

E780 2100 ohm (2X1050 ohm), 40ma DC, 2 make, 2 break, (2As, 2Bs), #R410 .... 2.00

SIGMA TYPE 4F 8000 ohm, SPDT (1C), Can be adjusted to perate on 0.5 ma, #R425 .... $3.95

ALLIED RELAYS

			Each
BO6D40	77VDC, DPDT, 2380 ohm	#R356	$2.25
BO6D35	24VDC, DPDT, 240 ohm	#RO4	1.75
BO13D35	24VDC, SPST, double make, 240 ohm	#RO6	1.25
O9D28	6VDC, 3PDT, 14 ohm	#R225	2.25
BJ6D36	24VDC, DPDT, 255 ohm	#R420	1.55
BJX-4Z	12 or 24VDC, SP DBLE break, 240 ohm C.T.	#R226	1.25
55837	24VDC, Double make, 300 ohm	#R108	1.50
BO1535	24VDC, Double make, & Break 240 ohm	#R238	1.30
BO1332	12VDC, 80 ohm, Coil & Frame only (no contacts)	#RC358	40
BOYX3	1VDC, SPST, n.o., 1 1/2 ohm	#R35:	1.50
BOY13D	20VDC Double make & break 550 ohm	#R360	1.95
AR	12VDC, SPST n.o., 75 ohm	#R429	1.00

DIFFERENTIAL 803476 DUAL 8000 ohm 2.5 ma. coils, Armature pivoted between poles, all contacts normally open. SPDT 5A, contacts Hi-speed. Suitable for P. P., bridge or balanced circuits where differential action is required #R362........$4.95

5R1-2 27.5VDC. Double Make & Break, 150 ohms, 9000 Volts Hi-Pot Insulation #R418........$22.50

TERMS

PRICES FOB OUR PLANT. Min. Order $5.00

DIVERSITY RECEIVING EQUIPMENT

BRAND NEW! EXPORT PACKED!

OVERCOMES FADING IN RADIO TELEGRAPH COMMUNICATION AT HI-FREQUENCIES

- Designed to operate from a 100-260 volt, 25-60 cycle Single Phase Power Source
- Power consumption approximately 70 to 80 watts
- Front panel finished in baked black wrinkle lacquer
- Tube line up: 3-6A6; 1-77; 1-1V; I neon; 1-80; 1-6F8G; 2-6SJ7; 1-VR150/30
- Overall dimensions: 19" wide x 14" deep x 21" high—Export packed 21" wide x 20" deep x 36" high
- Equipment weight: 111 lbs. Export packed 211 lbs.
- Complete instruction book supplied with each unit

Mfg. by
SCHUTTIG & CO., Wash., D. C.

EXTRA PARTS

2 extra sets of tubes
Weinbridge oscillator
Power transformer
Condensers and resistors
Meters, switches and plenty of extra parts

LIMITED QUANTITY

Special
$299.50

Write for Free descriptive circular

OTHER ELECTRONIC EQUIPMENT

STROMBERG-CARLSON SCOPE TRANSFORMER
Oil-filled 400 cycle
T-101 A, B, & C. **$24.75**

VULCAN 12 Volt Soldering Irons 100 watt **$4.95**

ELECTRO PNEUMATIC RAMS
Model FQ. Maximum Air Pressure 350 lbs/IN2
24 volts **$24.75**

TUBES
4AP10—$4.95
5AP4 Scope Tubes **GE - G for 481 $1.49**

LIFE-BOAT TRANSMITTER 500 KC
5 Watts, T-500 PRA **$14.95**

U. S. Navy 24 hr. self regulating clock
Model 561-2CG. Mfrd. by I.B.M.
24 volt DC, 6 watts. Price **$11.95**

INVERTERS
US Army Air Corps Vibrator Inverter
Mfg. Type No. S-667
Input voltage 28V DC Capacity 6 lamps
10 Amps at 3 volts
Mfg. by Electronic Labs. **$12.95**

US Army Air Corps Vibrator Inverter
Type A-4 Input voltage 12 DC
Capacity 2 lamps 15 Amps at 3 volts
Mfg. Type No. S659
Mfg. by Electronic Labs. **$6.95**

ATR Inverter
Input voltage 12 DC
Output voltage 110 AC
125 Watt **$24.95**

MC131 Ringers—$1.25
C-158 coils .... $.35 each
10 feet 3 Wire Tinsel Cords CC343A .... $.35
Army Blinker Lights Less Batteries...... $1.00 each
Brand New **BC-223AX** the latest of BC-223 series in cases with 3 Tuning Units

***Crystal Duplicators for testing crystals $49.50**
Manufactured by North American-Phillips
*Used

Throat Microphones $.98 each
Brand New—Western Electric
Lip Microphones (used) $.98 each

VARIABLE CONDENSERS
for type ARC-5 Receivers Glass Bead insulation. Packed ball bearing gears. Worm-geared drive—30-1 gear ratio.
Capacity—17MMFD-90MMFD **$2.95**

Dual-Condenser connect . with flexible shaft
#7321 connected to #5302 Transmitting condenser—glass bead insulation flexible shaft coupling worm-geared drive—50-1 gear ratio double space plates provision for tuning dial. Capacity—28MMFD-150 MMFD **$4.95**

Dial Scales for ARC-5 Equipment
6-9-1MC 5.3-7MC 1.6-9MC
Large Quantity 9¢ each

2 Gang Broadcast Condenser
with drum and 5 push-buttons
Capacity .00038MMFD **$1.19** each

Butterfly Condensers—(used) about 35MMFD 49¢ each

RECONDITIONED RECORD PLAYERS
Gov. Surplus 33 1/3 RPM with built-in amplifier AC Only **$19.95**

RECORD PLAYERS AC-DC RECONDITIONED
Government Surplus
78-33 1/3 RPM **$24.95**

WHAT HAVE YOU? **WE WANT TO BUY** *FOR CASH* WHAT DO YOU NEED?

Wire—Write—Phone—BArclay 7-3588—Mr. Marino—Mr. Tanza—Mr. Hewitt—Mr. Bender

MARINO RADIO CO.

Television, Radio and Electronic M·R *Supplies*

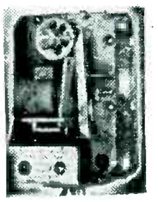
203 GREENWICH STREET (Near Fulton St.) NEW YORK 7, N. Y.

BArclay 7-3588


So much depends on
QUALITY
IN
POTENTIOMETERS,
RESISTORS, CONDENSERS
WHY NOT BUY THE BEST?
KNOW – Most widely used
JAN approved components
Call us about it - ACademy 2-0018
LEGRI S COMPANY
158 W. 99th St., New York 25, N. Y.

• THANKS to YOU and YOUR HEARTY APPR[illegible]VAL of OUR GOOD S[illegible]VICE — WE are Now S[illegible]g You from Our Spaci[illegible]ew Store at 2102–04 M[illegible]ket Street

EAGLE ADJUSTABLE TIME DELAY RELAY.



110 volt 60 cy with double throw Micro switch. Can be set from 1½ to 58 minutes. Includes attractive 3¼ x 4½ x 2¾ black cover. Made to sell for $26. SALE PRICE $6.95

POWER POTENTIOMETERS

Ohm	Watt	Bush-ing	Shaft	Cat. No.	Price
2	25	5/8S	1/8SD	O-H	$1.04
3-3	25	1/2	1/2	I	1.04
15	25	3/8	1"	C	1.04
15	25	3/8	1 1/8	D-245	1.04
15	25	1/2	1 1/4	D-I	1.04
20	25	1/2	1/2F	D-245	1.04
25	25	1/2	1/2F	C	1.04
25	25	3/8	1"	D-245	1.04
25	25	1/2	3/8S	I	1.04
30	25	3/8	1"	C	1.04
50	25	3/8	1 1/8	D-245	1.04
50	25	5/8	1/8SD	O-H	1.04
75	25	1/2	7/16	O-H	1.04
100	25	3/8	1"	D-245	1.04
100	25	1/2	1/2	H	1.04
350	25	3/8	1 1/8	O-H	1.04
500	25	3/8	11/16	D-245	1.04
800	50	3/8	7/16F	O-J	1.24
1K	25	1/2	1/2	O-H	1.17
3K	25	3/8	1 3/16	D-245	1.20
5K	25	1/2	1/8SD	I	1.24
5K	25	3/8	7/8FS	D-245	1.24
20K	25	1/2	1/8SD	D-245	1.40

AN CONNECTORS

Over 2500 Different Types In Stock — See June Electronics for Price Schedule, Page 311

COAXIAL CONNECTORS

J 201 kly tee	[$4.50	UG85/U BN plug	$.60
M358 UHF tee	1.30	UG87/U BN recp.	.60
M359 UHF angle	.35	UG88/U BNC plug	1.50
PL258 UHF junc.	.70	UG89/U BNC jack	1.50
PL259A U plug	.50	UG105/U twin ju	1.25
PL274 UHF junc	1.30	UG106/U 83-1H	.10
SO239 UHF socket	.45	UG173/U bushing	.35
UG9/U N plug	.60	UG175/U bushing	.18
UG12/U N plug	.60	UG176/U bushing	.18
UG21/U N plug	.60	UG260/U plug BNC	1.50
UG27/U N angle	.60	UG275/U kly plug	4.50
UG28/U N tee	2.00	UG290/U BNC recp.	1.50
UG58/U N recp.	.60	UG203/U UHF plug	.45

UTAH X[illegible]24T3 TYPE PULSE TRANSFORMERS

UTAH 9287D

Windings: three
D.C. res: 4.2, 4.4, 4.8
L.: tot. pri. 3.2 mh
true pri. 1.6 mh
leakage 17 micro H
Dist. capacitance between windings: 90
Zo: 430 ohms
Turns: 100
Core: 16 strips .002" hypersil wound in three turns
Optimum pulse width: 0.9 microseconds
Sharpest pulse: (B.O.) 0.25 microseconds

Write for prices, giving exact quantity required.

HAROLD H. POWELL

2102 MARKET ST. PHILADELPHIA 3, PA.

WITHIN FOUR BLOCKS OF B&O PENNSYLVANIA STATIONS

NEW PHONE LOCUST 7-5285

4 WATT. POT.

5K or 10K mica filled body, wire-wound $ .45

10 AMPERE FILTER

60 db att. .15 to 30 Mcs. permalloy core. D170738 .... $3.00

SERVO MOTOR

400 cy 2 phase, 40:1 gear train, low inertia 10047-2A $12.50

TUBES

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
*[illegible]A5GT	.75	7G7	1.20	VT62	.50	841	.43
*[illegible]	1.25	7H7	.85	VT128	.65	851	75.00
[illegible]	1.25	12A[illegible]	.90	VU111S	.50	861	40.00
*[illegible]	.8[illegible]	[illegible]6	.75	1B24	15.00	864	.73
[illegible]		[illegible]	1.05	1N21 XL	[illegible]	869B	29.50
[illegible]		[illegible]	.65	1N22 XL	1.[illegible]	872A	3.50
[illegible]		[illegible]	.75	2C26A	.25	954	.37
*[illegible]		[illegible]	1.00	2C34	.50	1616	1.98
6AB7	[illegible]	[illegible]	[illegible]5	2C44	1.00	1619	.85
[illegible]AK5	1.7[illegible]			2X2/879	.60	1625	.47
6B8	.95			3C24	2.50	1626	.40
*6B8G	.85	[illegible]		[illegible]	14.00	1629	.65
*6C5	.75	1[illegible]		[illegible]	25.00	1630	.90
6H6	.75	28D[illegible]		[illegible]	.60	1631	1.27
*6J8G	1.05	3[illegible]		[illegible]	.80	1632	.75
*6K7	.80	38		[illegible]	.17	*1641	1.50
6K7GT	.70	39/44		[illegible]	4.95	1642	.65
*6L7G	.72	*50		[illegible]	75	2051	1.50
6N7	1.00	*57		[illegible]	[illegible]	*5670	5.90
6R7G	.71	76				*5814	4.55
6S7G	.75	*77				7193	.25
6S[illegible]7	.75	*85		[illegible]	2[illegible]	[illegible]012	3.50
6SH7GT	.80	*117Z6GT	.9[illegible]	[illegible]	[illegible]00	[illegible]	2.25
6SN7GT	1.05	1005	.45			9[illegible]	1.75
6SN7GTA	1.20	4A21	.75			9002	1.50
6U7G	.65	615	.15	80[illegible]		9003	1.80
*7A6	.75	MX408U	.75	805		9006	.30
7C4	.77	10Y	.55	807			
7E5 (1201)	.85	VT52	.50	813			

MANY OTHER JAN TYPES AVAILABLE

Items marked * do not have name of standard manufacturer on tube. They are FIRST QUALITY (not seconds) and meet full specifications with our 100% guarantee. Samples to quantity users.

ALL LISTINGS ARE QUALITY GUARANTEED. INQUIRIES REGARDING THESE AND OTHER REQUIREMENTS GIVEN PROMPT ATTENTION. USUAL DISCOUNTS TO MANUFACTURERS AND JOBBERS.

PARTS

TRANSFORMERS

PLATE TRANSFORMER, 5000 volt, center tapped, 350 MA. Primary 115 volt, 60 cycle. Unmounted and not potted, overall dimension 6½ inches x 6 inches x 7 inches, weight 37 lbs. ....New. $25.00

PULSE TRANSFORMER

68G828-G1 ....New. $5.50

SWITCHES

ROTATING SWITCH, Ceramic Construction, 3 Pole, Double Throw, Shaft beyond bushing, ½ inch New. $1.00

CORDS

CD-133, Rubber Covered PL-55 Plug with 15 inch Rubber Cord ....New. $ .50

CD-652 ....New. $25.00

TELEPHONE, 8A-WP, Similar to WE 53B, 5 foot, Red ....New. $1.10

TELEPHONE, Patch, WE D171060, 5 foot, Green New. $1.10

PLUGS

TELEPHONE PLUG, Equivalent to PL-55, with Screw Terminals Inserted, Samples furnished to quantity users....New. $.30

BUTTERFLY CONDENSER

SPECIFIED RANGE, 74-320 MC, NEW, EXCELLENT CONDITION..........$12.50

All items subject to prior sale. Shipments BEST WAY C.O.D. if desired. Rated accounts net ROG.

T. R. LOWENTHAL CO.

ELECTRONIC COMPONENTS

Technical Radio Since 1919

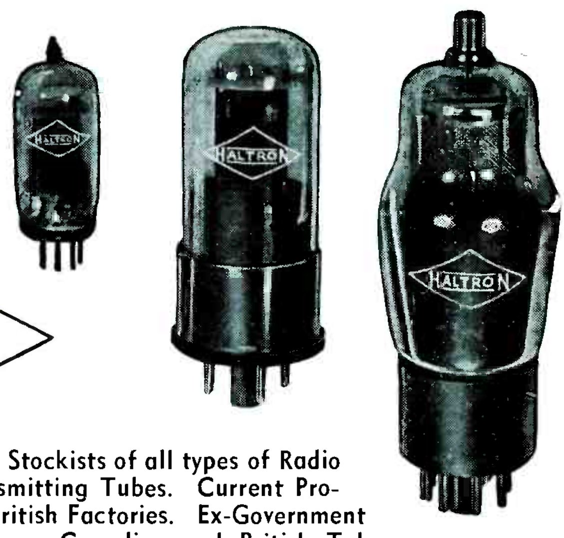
1205 WEST SHERWIN AVENUE, CHICAGO 26, ILLINOIS
PHONE: ROGERS PARK 4-0784

American & Canadian enquiries to our Agents:

POLAS MERCANTILE
115 Broadway
New York, 6
Telephone: Rector 2-8595

ALL OTHER ENQUIRIES TO LONDON

HALTRON



Leading Exporters and Stockists of all types of Radio Receiving and Transmitting Tubes. Current Production of main British Factories. Ex-Government Surplus, American, Canadian and British Tubes in Original Brands. Suppliers to Foreign Governments, Airlines, etc.

HALL ELECTRIC LTD

89, CHARLOTTE ST., LONDON, W.1.

Phones: MUSEUM 9661 (5 lines)
Cables: HALLECTRIC, LONDON

POTENTIOMETERS

CODE FOR ABBREVIATIONS
S—Screwdriver Shaft
L—Locking Shaft
Mi—Milled
WS—With Switch
AS—Added Shaft
X—Solder
*—2 Lug

TYPE "J" POTS

OUR #	OHM	BUSHING	SHAFT
8-410	50	3/8	1/4 S
8-446	60	L	5/8
8-447	60	L	S
8-623	150	3/8	1/4 S
8-390	300	1/4	3/8
8-631	500	1/4	3/8 Mi
8-368	500 w/s	1/4	3/8 Mi
8-454	1000	3/16	S
8-391	1000	1/4 AS	3
8-614	1000	1/2	2 1/2 AS
8-613	1000	1/4	S
8-611	1200	1/4	1/4 S
8-632	1500	1/4	1/4 S
8-443	1500	1/4	1/4 S
8-338	1500	3/8	1/8
8-365	2000	3/8	S
8-633	2000	L	S
8-634	2000	1/4	3/8 S
8-606	2500	1/2	S
8-344	2500	1/4	1/8 Mi
8-406	2500	1/4	S
8-345	2500	3/8	S
8-603	4000	3/16	1/4
8-635	5000	3/8	2 1/2 AS
8-658	5000	1/4	3/8 S
8-420	10000	1/4	S
8-385	10000*	1/4	1/4 Mi
8-434	10000	1/4	1/4 S
8-363	10000	1/4	5/16 Mi
8-294	10000	1/4	3/16 Mi
8-594	10000	1/4	S
8-591	10000	1/2	7/8 W
8-593	10000	1/4	1/4 Mi
8-637	10000	1/4	2 1/4 AS
8-590	15000	1/4	1/4
8-386	15000	1/4	S
8-668	20000	1/4	1/4
8-436	20000	L	S
8-369	20000	L AS	2 3/4
8-526	20000	L	2 3/4 AS
8-527	20000	1/2	S
8-529	20000	1/4	3/8 Mi
8-530	20000	3/8	1/4 S
8-639	20000	L	2 7/16 AS
8-640	20000	3/8	1/4 S
8-525	25000	L	2 3/4 AS
8-450	25000	1/2	S
8-535	25000	1/4	3/8
8-389	25000	3/8	3/8 WS
8-451	25000	L	S
8-415	30000	1/4	S
8-313	30000	1/4	5/16 Mi
8-412	35000	1/4	1/4
8-379	40000	L AS	2 3/4
8-500	40000	L	S
8-642	40000	L	2 1/2 AS
8-659	50000	L	1/2 Mi
8-378	50000	L AS	2 3/4
8-306	50000	1/4	S
8-328	50000	1/4	1/4 S
8-329	50000	3/8	S

LISTED HERE ARE BUT A SMALL PART OF OUR POTENTIOMETER STOCK AVAILABLE FOR IMMEDIATE DELIVERY.

FOR EVERY USE

One of the reasons for CLARK-REISS popularity in the field is that C-R "delivers the goods."

What do YOU need? Just name the quantity. C-R carries *in stock* thousands upon thou[...] of Potentiometers in every [...] every *national manufacturer,* [...] 1.25 ohm to 10 megohm range.

ATTENTION! Wholesalers & Manufacturers

Why risk shortages and fluctuating prices? Now you can bring your stock up to completion . . . maintain a healthy inventory and reserve of potentiometers you need.

CLARK-REISS also has a complete stock of

Carbon Resistors
Wire Wound Resistors
Stripohn Resistors
Precision Resistors
Bathtub Condensers
Oil-Filled Condensers
Electrolytics
Paper Tubular Condensers
Metal Shielded Condensers
Moulded Paper Condensers
Mica Condensers
Ceramic Condensers
Toggle Switches—Relays, &c.

CODE FOR ABBREVIATIONS
S—Screwdriver Shaft
L—Locking Shaft
Mi—Milled
WS—With Switch
AS—Added Shaft
X—Solder
*—2 Lug

TYPE "J" POTS

OUR #	OHM	BUSHING	SHAFT
8-432	50000*	1/4	5/8
8-573	50000	L	1/2 AS
8-587	50000	1/4	1/2 Mi
8-586	50000	1/4	1/2
8-585	50000	1/4	1/4
8-583	50000	L	5/8 AS
8-580	50000	3/8	1/4 S
8-576	50000	1/4	S Wired
8-575	50000	1/2	3/16 S
8-644	50000	L	2 1/4 AS
8-672	50000 X	3/8	3/8
8-401	60000	3/8	1/4 S
8-263	70000	3/8	S
8-398	75000	1/2	1/4
8-660	100000 X	3/8	1 S
8-661	100000	1/4	S
8-662	100000	1/4	1/4
8-559	150000	L	7/8
8-472	150000	1/4	1/4
8-327	1 Meg	1/4	S
8-541	1 Meg	1/4	S Wired
8-671	1.5 Meg	1/4	3/8 Mi
8-255	2 Meg (*)	1/4	3/8 Mi

DUAL TYPE "JJ"

OUR #	OHM	BUSHING	SHAFT
8-448	60	L	5/8
8-549	600	1/4	1/4
8-504	600	1/4	5/16
8-288	600/5K	1/4	3/8 Mi
8-349	1500/25K	3/8	3/8 WS
8-431	1800	3/8	1 1/2
8-651	1800/2300	3/8*	3/8 Mi
8-435	2500	1/4	1/4
8-654	3000	1/4	1/2 S
8-652	5K/35K	1/4*	3/8
8-429	5K/2K	3/8	3/8
8-396	5000/700	L	S
8-506	10K/500	3/8	5/8
8-507	10K/20K	1/4	3/8
8-433	15000	1/4	1/4 S
8-392	20K/35K	1/4	3/8
8-650	20K/500K	1/4	5/16 Mi
8-252	20K/700K	1/4	1/2
8-467	25000	L	S
8-508	25000	1/4	3 AS
8-372	25K/2500	3/8	3/8 SS
8-509	25K/400K	1/4	5/16
8-511	30000	3/8	3/8 Mi
8-649	30000	L	S
8-512	30000	3/8	1
8-510	30000	L	S
8-502	30K/40K	3/8	5/16
8-376	35000	1/4*	5/16 Mi
8-665	40K/20K	1/4*	3/8
8-666	100000	1/4	1/4 S
8-303	150000	1/2	S
8-394	200000	3/8	5/16 S
8-520	1 Meg	1/4	S
8-523	2 Meg	L	3/8 AS
8-308	2 Meg	1/4	S

TYPE "JJJ"

OUR #	OHM	BUSHING	SHAFT
8-505	10000	3/8	1/2 Mi W
8-399	150000	3/8	1/2

CLARK-REISS DISTRIBUTORS,
55 WALKER ST., NEW YORK 13, N. Y.
BEEKMAN 3-0474

Write today for catalog 951, or send us your requirements. Immediate reply assured. Company letterhead please.

BRAND NEW – GUARANTEED – SURPLUS – METERS ! !

R. F. AMMETERS

1.5 **AMP**, GENERAL ELECTRIC DW-52, 2½" round flush metal black scale.........@ $3.50
2 **AMPS**, WESTON 425, 3½" round flush bakelite case ....@ $8.50
2.5 **AMPS**, WESTON 425, 3½" round flush bakelite case ....@ $8.50
2 [illegible] **AMPS**, SIMPSON 35, 3½" round flush bakelite case ....@ $5.[illegible]
[illegible] **AMPS**, WESTON 425, 3½" round flush bakelite case, with external thermocouple.......@ $9.50
3 **AMPS**, WESTINGHOUSE NT-35, 3½" round flush bakelite (JAN type MR35W00wRFAA) @ $6.50
5 **AMPS**, GENERAL ELECTRIC DO-44, 3½" round flush bakelite case..............@ $7.50
5 **AMPS**, GENERAL ELECTRIC DO-44, 3½" round flush bakelite case with external thermocouple ....@ $8.50
5 **AMPS**, GENERAL ELECTRIC DW-44, 2½" round flush bakelite case, black scale...@ $4.50
8 **AMPS**, GENERAL ELECTRIC DW-52, 2½" round flush bakelite case (JAN type MR25-W008RLAA) ....@ $3.95
10 **AMPS**, WESTON 425, 3½" round flush bakelite case, MR35W010RFAA ....@ $9.50

D. C. VOLTMETERS

30 **VOLTS**, GRUEN 250M, 2½" round flush metal case ....@ $3.50
75 **VOLTS**, GENERAL ELECTRIC DO-40, 3" round non-flanged, ring mounted flush bakelite case, 1000 ohms per volt..............@ $4.95
5/125 **VOLTS**, DUAL RANGE, WESTON 506, 2" round flush metal, ring clamp mounted (non-flanged) approx. 135 ohms per volt, plus button for high range ....@ $4.00
150 **VOLTS**, GENERAL ELECTRIC DO-53, 3" square flush bakelite case..............@ $7.50
150 **VOLTS**, GENERAL ELECTRIC DO-41, 3½" round flush bakelite case, 1000 ohms per volt ....@ $7.50
150 **VOLTS**, HOYT 17-L, 3½" round flush metal case, red line at 110 volts..............@ $6.00
300 **VOLTS**, SUN 2AP380, 2½" round flush bakelite case, 1000 ohms per volt, (JAN type [illegible]-300DCVV) ....@ [illegible].00
500 **VOLTS**, WESTON 506, 2½" round flush bakelite case, 1 MA movement complete with Weston type 8, external resistor box (JAN type MR25W500DCVV) ....@ $9.50
750 **VOLTS**, **WESTINGHOUSE** NX-35, 3" round flush bakelite case, 1 MA movement complete with external resistor....................................@ $8.95
2 **KILOVOLTS**, GENERAL ELECTRIC DO-53, 3" square flush bakelite case, 1 MA movement complete with 1000 ohms per volt precision ferrule-type multiplier ....@ $10.95
4 **KILOVOLTS**, DEJUR AMSCO # 310, 3½" round flush bakelite case, 1 MA movement....@ $4.50

D. C. MILLIAMMETERS

2 **MILLIAMPS**, WESTINGHOUSE NX-35, 3½" round flush bakelite case (JAN MR35W002DC-MA) ....@ $5.50
3 **MILLIAMPS**, GRUEN GW-587, 2½" round flush bakelite case, scale calib. 30 & 450 MA and 3000 volts....................................@ $3.50
5 **MILLIAMPS**, SIMPSON, 2" square flush bakelite case, special scale with red mark at 3, caption "Volts" ....@ $3.50
5-0-5 **MILLIAMPS**, WESTERN ELECTRIC D-165647, 3½" round flush bakelite case, concentric style movement approx. 160° deflection, scale calib. 50-0-50 ....@ $4.00
15 **MILLIAMPS**, GENERAL ELECTRIC DO-58, 4" x 4½" rectangular flush bakelite case @ $4.95
15 **MILLIAMPS**, SIMPSON 26, 3½" round flush bakelite case (JAN type MR25W015DCMA) @ $6.00
20 **MILLIAMPS**, GENERAL ELECTRIC DO-53, 3" square flush bake case ....@ $5.50
25 **MILLIAMPS**, GENERAL ELECTRIC DO-41, 3½" round flush bake case..............@ $5.50
113 **MILLIAMPS**, BURLINGTON, 31 B, 3½" round flush bakelite case, special 3 color scale, no calibrations, caption "Power Indicator"....@ $3.00
150 **MILLIAMPS**, GENERAL ELECTRIC DO-41, 3½" round flush bakelite case..............@ $5.50
150 **MILLIAMPS**, T[illegible]LETT, 2" square flush bake case, black scale ....@ $3.95
150 **MILLIAMPS** [illegible] EN 508, 2½" round flush bakelite cas[illegible] ....@ $3.95
150 **MILLIAM**[illegible] CTEL # 350, 3½" round flush bakelite [illegible] by Elect. Div. of US Time Corp. ....@ $4.00
150 **MILL**[illegible] EDE, 3½" round flush bakelite case ....@ $4.00
200 **MILLI**[illegible]**PS**, MARION, 3½" round flush bakelite case, knife edge pointer..............@ $4.00
200 **MILLIAMPS**, SIMPSON 26, 3½" round flush bakelite case (Jan type MR35W200DCMA) @ $5.95
300 **MILLIAMPS**, GRUEN GW-529, 3½" round flush bakelite case (JAN type MR35W300DCMA) @ $4.95
500 **MILLIAMPS**, DEJUR AMSCO 312, 3" square flush bakelite case....................@ $5.00
800 **MILLIAMPS**, DEJUR AMSCO # 310, 3" round flush bakelite case S. C. # 3F980.......@ $4.50
1000 **MILLIAMPS**, WESTERN ELECTRIC D-55049, 3½" round flush bakelite case, concentric style movement with 190° scale length........@ $4.00

D. C. AMMETERS

1 **AMP**, WESTINGHOUSE NX-35, 3½" round flush bakelite case (JAN type MR34W001DCAA) @ $6.00
5 **AMP**, GENERAL ELECTRIC DO-40, 3" round, non-flanged, ring mounted flush bakelite case @ $4.95
10 **AMP**, GENERAL ELECTRIC DO-40, 3"round, non-flanged, ring mounted flush bakelite case @ $4.95
30 **AMPS**, GENERAL ELECTRIC DW-51, 2½" round flush bakelite case (JAN type MR24W030-DCAA) ....@ $4.50
30-0-30 **AMPS**, GENERAL ELECTRIC DW-51, 2½" round flush metal case ....@ $4.50
50-0-50 **AMPS**, GENERAL ELECTRIC DO-41, 3½" round flush bakelite case, black scale, with lum. markings ....@ $5.50

A. C. AMMETERS

0-3 **AMPS**, SIMPSON 55, 3½" round flush bakelite case ....@ $8.10
0-10 **AMPS**, SIMPSON 55, 3½" round flush bakelite case ....@ $8.40
100 **MILLIAMPERES**, WESTON 476, 3½" round flush bakelite case, 400 cycles..............@ $7.50
150 **MILLIAMPERES**, GENERAL ELECTRIC AO-22, 3½" round flush bakelite case........@ $5.50
250 **MILLIAMPERES**, GENERAL ELECTRIC AW-41, 2½" round flush bakelite case. Made for Daco, red blocking on scale..............@ $3.50

A. C. VOLTMETERS

8 **VOLTS**, WESTON 476, 3½" round flush bakelite case ....@ $4.95
15 **VOLTS**, WESTINGHOUSE NA-35, 3½" round flush bakelite case, (JAN MR35W015ACVV) @ $5.50
40 **VOLTS**, WESTINGHOUSE NA-33, 2½" round flush metal case, black scale lum. markings. calib. for 400 cycles....................@ $3.50
40 **VOLTS**, WESTINGHOUSE NA-33, 2½" round flush metal case, black scale lum. markings. (These were originally calib. for 400 cycle use but have been adjusted for 60 cycle)....@ $3.95
75 **VOLTS**, WESTON 517, 2" round flush metal case, ring-clamp type mtg. non-flanged..@ $3.50
300 **VOLTS**, BURLINGTON 22A, 2½" round flush metal case ....@ $6.00
300 **VOLTS**, TRIPLETT 232-C, 2½" round flush metal case ....@ $6.00

We specialize in electrical Instruments. Over 75,000 meters in stock. Send for our latest circular showing our complete line of Surplus-New-Guaranteed meters.

MARITIME SWITCHBOARD
338 Canal St., N. Y. 13, N. Y.
Worth 4-8217

Orders accepted from rated concerns, public institutions and agencies on open account, others please send 25% deposit, balance C.O.D. or check with order. All prices FOB our warehouse, N.Y.C.

We carry a comprehensive line of equipment for communications and offer it for sale backed by a hard earned reputation for quality materiel.

Currently we are offering:

RCA Communications Transmitter

Model MI-8167, a 350 watt C.W. and 250 Watt 'phone operating in the frequency range of 2000 to 20,000 kcs., from 220 V. AC 50/60 cycle input. Beautifully constructed and self contained. Speech amplifier and tubes included. All complete and new, packed for export.

Complete descriptive data on request.

Other choice selected guaranteed Transmitters, receivers and combinations for all types of services and wattage.

COMMUNICATION DEVICES CO.

2331 TWELFTH AVE. NEW YORK 27, N. Y.
Cable: COMMUNIDEV TEL. AD-4-6174, 5

MONEY BACK GUARANTEED
ELECTRONIC SURPLUS MATERIAL

*OIL CAPACITORS—Standard Brand units
*BATHTUBS—Side-Top-Bot Terminals, most values in stock—50 to 1500 volt units
CHANNEL TYPES—YAT - YAB - WAT - WAB—ditto
BATHTUB cased low voltage electrolytics

INVESTIGATE OUR PRICES
A Penny Post Card Will Save You $$$

Large quantities—example 100,000 units of 2X0.1 mfd 600 VDCW ST, TT, BT, DYR

ROTARY SWITCHES***SPECIALS

2P3T..$.35	*3P6T.. .45	*7P4T.. .55
1P11T.. .45	*2P10T.. .65	*3P10T.. .85
*2P11T.. .75	*3P11T.. .95	*Multi-wafers

TRANSFORMER BUYS—Hermet. sealed 750V CT @ 250 MA 5V/3A 12.6V/5A......$9.95
Power Choke for above 5 hy 100 ohm.. 2.95
600V CT @ 70 MA 6.3V/4A.......... 3.95

FILTER, LOW PASS, input & output Z —50,000 ahms Flat within ±2DB from 0-1650 cy, cutoff—25 DB at 1700 cy, 500 units avail. @ $9.95

SELENIUM RECTIFIER, Full wave bridge, up to 90 VAC input, 150 ma cont. duty, 20 plates special $1.50

G E Thyrite #K-8396832-1 voltage regulator, 3rd harmonic generator, current rating 5-40 ma @ 21-33 volts 1½ watts max. in air—package of 5....................................$1.45

ELECTRONIC SPECIALTY SUPPLY CO.
BArclay 7-2684-5
56 Lispenard Street New York 13, N. Y.

BRAND NEW STOCK

ELAPSED TIME METERS—General Electric. Sym. B305. Indicates 1-99,999 hours. 115 VAC. 60 cycles. 3" round bakelite case. Square, flush face .... $12.00 each

DC SERVO MOTORS—White Rogers Electric Co. 6905 Series. 24 VDC. Torque 150 in. lbs. Reversible. Control box on top has limit switches, relays, and selenium rectifiers to block AC out of motor. 5x5x4". Can be supplied in either 2½, 3, or 5 RPM models. $11.50

INDUCTION VOLTAGE REGULATOR—G.E. #3263300. Sym. VR-107. Type AIRS. Single phase, 60 cycles. 0.507 KVA. 460 volts primary. Output voltage can be varied 78.6% above and below this value at 1.4 load amperes over entire range. Motor operated. Weight 122 lbs. $75.00

VIBRATOR INVERTER—Electronic Laboratories, Inc. Type S663. Input 24 VDC. Output 3 volts at 1.5 amperes $1.50

NOISE FILTER—Mallory #NF2-0 Modified. 35 volts DC. 200 amperes $2.50

NOISE FILTER—General Electric #1C-206. 100 amperes. 50 VDC. $2.00

ROTARY SWITCHES—Hart #1188-1. 7 poles. 4 position. 25A at 115 VAC. 15A at 230 VAC. Knob furnished marked: high, low, medium, and off $1.50

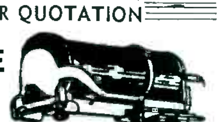
Prices FOB St. Louis.
25% on all COD orders.

McNEAL ELECTRIC & EQUIPMENT CO.
4736 Olive St. St. Louis 8, Mo.

CONDENSERS • TRANSMITTING MICAS
BATHTUBS • UPRIGHTS • SOCKETS
CONTROLS - RHEOSTATS - MANY OTHERS

SEND US YOUR NEEDS FOR OUR QUOTATION

TELEPHONE RELAYS



CLARE, TYPES C, D & E
COOKE, AUTOMATIC—ELECTRIC

ALL TYPES of COILS and PILE-UPS

CLARE TYPE K MINIATURE TELEPHONE RELAYS.

CLARE Type G Half Tel. Relays
1) 3600 OHM COIL, SPDT $2.00
2) 3300 OHM COIL, SPST, A.D $1.50

Chase Electronic Supply Co.
222 Fulton St.
New York 7, N. Y.
HOllis 4-5033

TUBE REBUILDING

Large Transmitting and Power types

Economical • Guaranteed

FREELAND PRODUCTS CO.
700 DRYADES ST., N. O., LA.

SURPLUS COMPONENTS FOR SALE

Bathtubs, oils, micas, xformers, chokes, relays, trimmers, sockets, odd items, etc.
Surplus lots purchased.

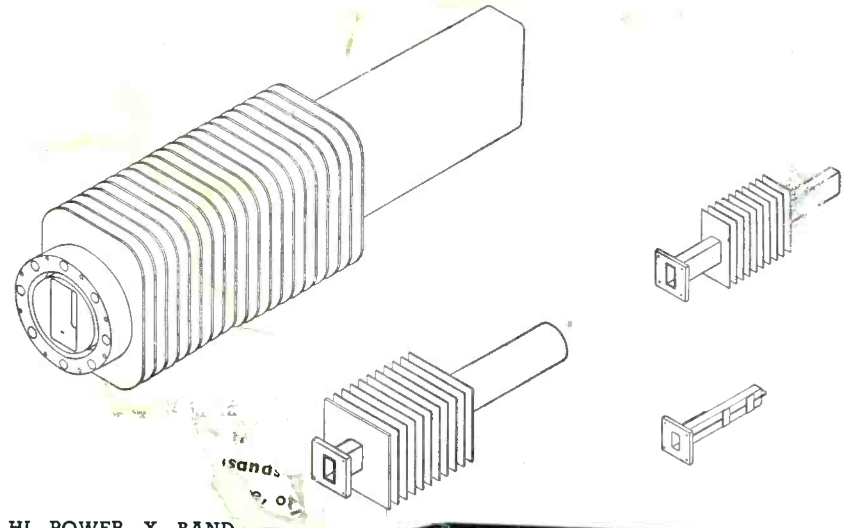
EMPIRE ELECTRONICS
Box 41, Midwood Stat., Brooklyn 30, N. Y.
Phone BRyant 9-1220

FOR SALE

Beryllium Copper Strip
.0062 (+ — .0005) x 5" x 60"
No. 1 — B & S Hard
700# Available

GLOBE TRADING COMPANY
1815 Franklin Street Detroit 7, Michigan

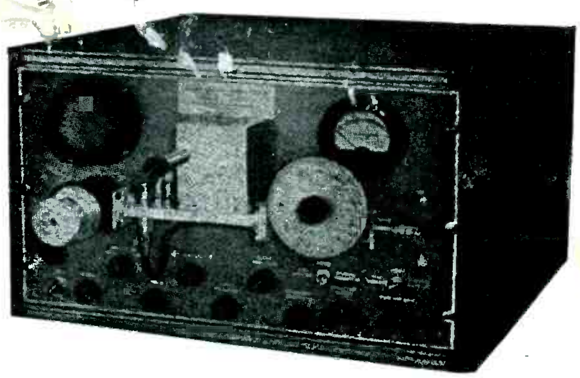
TEST EQUIPMENT



HI POWER X BAND TEST LOAD, dissipates 350 watts of average power for ⅝" x 1¼" waveguide, VSWR less than 1.15 bet. 7 and 10 KMC $150.00

S Band Test Load TPS-55P/BT, 50 ohms $12.00

HI POWER S BAND TEST LOAD, dissipates 1000 watts of average power, for 1½" x 3" waveguide. Range 2500 to 3700 MC.



8 Band Spectrum Analyzer 8500-9600 Mc., calibrated linear below cut-off attenuator, calibrated frequency meter, tuned mixer, 4 i.f. stages, 3 video stages overall gain 125 db., reg. power supply.

S Band Spectrum Analyzer 2700-3900 Mc., similar to above.

TS-62 X Band Echo Box with r.f. cable and pick-up antenna.

TS-33 X Band Frequency Meter. 8500-9600 Mcs. Crystal detector and 50 microamp. meter. Indicates Resonance. Connection for scope available.

TS-45A-APM-3 Signal Generator. 8700-9500 mc., 110 V. 60-800 cps.

30 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, detector, 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, 60-2600 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

UPN-1 S Band Beacon Receiver-Transmitter $75.00

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

TS-110 S Band Echo Box 2400-2700 mc. portable $110.00

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 synchroscope $30.00

Waveguide Below Cut-off Attenuator L 101-A U.H.F. Connectors at each end calibration 30-100db $15.00

High Voltage motor operated switch, 18 KV., 5 Amps peak, Schweitzer-Conrad No. QA-35582 .... $50.00

TEST SETS

TS—36	TS—100	TS—126
TS—47	TS—125	TS—226

ELECTRO IMPULSE LABORATORY

62 White Street Red Bank 6-0404 Red Bank, N. J.

SURPLUS EQUIPMENT

POWER RHEOSTATS

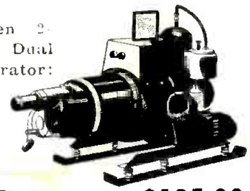
Standard Brands: Ohms 100 Watt 48 ... 100 Ohms 150 watt; 1.0 amp.

Boxed, Brand New with Knob $2.50 each—or—
$25.00 per Doz.

PIONEER AUTOSYNS

AY-1......26 Volt—400 Cycle $1.95
AY-5......26 Volt—400 Cycle $5.95
AY27D $25.50

POWER UNIT PV-6/TPS-1



Gasoline driven 2-cycle engine. Dual voltage generator: 120 VAC; 1400 Watt; 400 cycle; 28 VDC; 14.3 amps.

BRAND NEW $195.00

SERVO MOTOR 10047-2-A: 2 Phase; 400 Cycle; with 40-1 Reduction Gear $10.00 ea.

400 CYCLE MOTORS

AIRESEARCH: 115V; 400 Cps; Single phase; 6500 RPM; 1.4 amp; Torque 4 6 in. oz.; HP .03..................**$10.00 ea.**

400 CYCLE MOTORS

EASTERN AIR DEVICES TYPE JM6B: 200 VAC ¼ amp; 3 phase; 400 cycle; 6000 RPM ....$12.50 ea.

INVERTERS

PE 218 LELAND ELECTRIC
Output: 115 VAC; Single Phase; PF 90; 380/500 cycle; 1500 VA. **INPUT:** 25-28 VDC; 92 amps; 8000 RPM; Exc. Volts 27.5. **BRAND NEW** ....**$39.95 ea.**

12116-2-A PIONEER
Output: 115 VAC; 400 cyc.; single phase; 45 amp. **Input:** 24 VDC; 5 amp..**$90.00 ea.**

10563 LELAND ELECTRIC
Output: 115 VAC; 400 cycle; 3-Phase; 115 VA; 75 PF. **Input:** 28.5 VDC; 12 **amp.** ....**$80.00 ea.**

10486 LELAND ELECTRIC
Output: 115 VAC; 400 Cycle; 3-phase; 175 VA; 80 PF. **Input:** 27.5 DC; 12.5 amp; Cont. duty ....**$90.00 ea.**

SYNCHROS

1F Special Re... 115V-400 Cycle) **$15.00 ea.**
2J1F3 Ge... 15V-400 cyc) **.$7.50 ea.**
1F (115/... 60 cyc.) ....**$70.00 ea.**
5F Motor (115/90 volt—60 cyc.) **.$60.00 ea.**
5G Generator (115/90 volt—60 cyc.) **$50.00 ea.**
5SDG Differential Generator (90/90 volts—400 cyc.) ....**$30.00 ea.**
5DG Differential Generator 90/90 volts—60 cys. ....**$50.00 ea.**

SEND YOUR REQUEST FOR ALL TYPES OF SYNCHROS
PLEASE ENCLOSE FULL AMOUNT WITH ORDER
ALL PRICES F.O.B. PASADENA UNLESS OTHERWISE SPECIFIED
EQUIPMENT FULLY GUARANTEED

C and H Sales Company

BOX 356-E EAST PASADENA STATION • PASADENA 8, CALIFORNIA

3DP1-S2	$ 7.95	F.G.105	$17.50
3HP7	$3.50	VT-4C	$ .50
5FP7	$ 1.85	700-A	$27.50
1C6	$ .45	714-A	$ 5.95
705-A	$ 1.50	725-A	$ 7.95
721-A	$ 3.50	VT-25	$ .65
3B27	$ 3.75	12SJ7	$ .60
801	$ .85	2J22	$ 5.95
2C26	$ .45	2J31	$37.50
1642	$ .50	2J32	$52.50
954	$ .45	5J23	$11.75
956	$ .60	CW4J-26	$175.00

SEXTANTS—U.S. A.A.C. #F1-125 Type A-10 (Agfa-Ansco) Bubble Type. Contains Optical Prisms, Lenses and Recorder. Very good condition, with case $5.75

H.F. D.F. RECEIVER—BC-1005-A. Part of SCR-555 A. Freq. 18-65 Mc. 2 Bands. 15 Tubes. (3) 4 ½" Sq. Meters (G.E.) Read. 0-15 V.D.C., 0-50 Ma. D.C. & 75-0-75 Ma. D.C. with Tubes & Dynamotor. Wood Carry Case.
Exc. Cond. $52.50

V.H.F. TRANSMITTER & RECEIVER—BC-800 (part of RC-192-A) Freq. 160-186 Mc. Rec.: 2 RF.; 5 I.F. @ 30 Mc. 4 Mc. wide. Trans.: Pulse Mod. 2 C26 OSC. 80-115V @ 400-2600 Cyc. & 24 V.D.C. Ideal for Mobile or Video use. With tubes, cables, accessories & manual. Wood Chest. BRAND NEW, WHILE THEY LAST.....$59.50

H.F. FM SELECTOR RECEIVER—R32/ARW-2. Double conversion super, uses 5 Mc. and 456 KC. IF. Channels, Local Oscs. are crystal controlled. Freq. Range 30-42 Mc. for 28 V. operation, with tubes, xtals & Dynamotor. NEW..........$65.00

WAVE GUIDE PRESSURIZING KIT—AN/APS13 (CPR-10198-A) Assembly Consists of Hand Pump, Dehydrator Cylinder, Gauge (30 lb.) and 6 ft. Hose with fitting.
New Overseas Pack $11.95

U.H.F. COAX—W.E. #K.S. 8088. Low Cap. Double Shld. with P1-259 Conn. on Ends.
New—24 ft. length $2.45

COMPASS RECEIVER R5/ARN7 Unmodified, complete with tubes, Dyn. BRAND NEW..$99.50

BC—733-D RECEIVER—with tubes, crystals and manuals. New, export packed..............$29.95

RADAR RECEIVER CONSOLE—part of SCR-270. Rack includes BC-1232 A Receiver, BC-988-A Calibrator, BC-986-B oscilloscope, M-337-A plot shelf, BD-117-A shelf panel and PE-138-A power supply. Size: 20½" x 27½" x 61½". Wt. 800 lbs. 115V. 1 ϕ 60 cyc. Less Tubes. New Orig. Crate $195.00

STEPPER SWITCH—W.E. #D-166509. Coil: 29.7 ohms D.C. 22 pos. 6 poles; Gold plated contacts and wipers. Semi-circular construction with coil and oper. mech. at one end. NEW..........$21.50

INTERFERENCE FILTER—Miller #7884 EL 220 V. 10 Amp. D.C. .03 ohms @ 60 cyc. .056 ohms. Single Ckt. Shielded. Used, Good Cond.....$1.49

NEON LAMP—G.E. #NE-2 1/25 W. St. Volts: A.C.-65, DC-90. NEW per 100..............$6.75

PLATE RELAY—Differential type. 2 Coils 8000 ohms ea. 4 Poles. 2 Ckts. Norm. Closed. Each coil closes one and opens one ckt. Silver Contacts rated at 110V. A.C. @ 2.5 Amps. New....$1.69

VINYL TUBING—Black. 5/16" I.D. x 7/64" Wall. Fresh Stock. 40 ft. lgth..............$1.25

RUBBER TUBING—5/16" I.D. x 7/64" Wall. New 80 ft. lgth..............$2.45

MOTOR DRIVEN Pots. and other components for ID-XA-8/APQ-10.

Write us of your requirements. All material subject to prior sale. Prices f.o.b. Oak Park. 25% Dep. Req. on all C.O.D. orders. Min. Foreign Order $50.00

FOREST SALES COMPANY, Inc.

702 MADISON STREET   OAK PARK, ILLINOIS   EU 6-1663

REAL VALUES!

SCR 625 FAMOUS ARMY MINE-DETECTOR

for prospectors—miners—oil companies—plumbers—etc.,—etc.,—etc.

This unit is being offered now at a considerable reduction in price. Recently advertised at $79.50 it is now available in the same brand new wrappings in suitcase style carrying case (less batteries) at

$59.50

WHILE THEY LAST!

CABINET CH-118

Olive drab in color, this cabinet has a full length interlock access door on the rear. The front takes the standard 19" panels with 60 inches of height and 20 inches deep. It is shock mounted on a heavy steel platform and has a two-inch protrusion fully covering one side to accommodate wave trap and wiring. Louvered vents allow air circulation top and bottom. Each F.O.B. Chicago.................. **$34.50**

RA 52—RECTIFIER

A transtat controlled rectifier to produce high voltage DC from 110 VAC 60 cycle source. Up to 11,500 volts DC at 50 watts. Metered high voltage (0-15KV) and current (0-20 MA). New.................. **$74.50**

BC 768

Radio Receiver Chassis Complete except for 13 tubes. This chassis with standard 19" panel front contains the receiver for 493.5 MC complete with power supply and an additional low voltage power supply that originally supplied the keyer BC 770 as described below. 110 VAC 60 cycles is the primary voltage.

Five 10 mfd-600 VDC oil filled GE condensers are used as filters. Five stages of 40 MC IF's.

Two of 10.4 MC, 6.3 VAC Transformer and of course power transformers—chokes and miscellaneous parts. All units are in good condition as removed from new equipment. Even the salvage value is a great deal more than the low price of.................. **$9.95**

BC-769 Transmitter P/O RC-100, less tubes..$6.95
BC-770 Keyer P/O RC-100, less tubes.......$4.95

MISCELLANEOUS SPECIALS!

	Used	New
RA 10 DA Receiver	Used $17.50	$24.95
BC 347 Interphone Amplifier		2.95
RC 442 Less Condenser	Used $1.49	1.95
APS 13 UHF Antenna, Pair		.98
I-97 Bias Meter	Used $3.95	4.95
RL 42 Antenna Gearbox Motor and Reel	Used $4.95	7.50
One Tube Interphone Amplifier — Small compact aluminum case fully enclosed 2¼" x 3¾" x 5¾" Less Tube		.79
40 Amps Circuit Breaker		.59
I 82 F Five Inch 360 degrees compass indicator and Selsyn receiver		4.95
A-81-2 Transmitters Selsyn for I 82 indicator		2.45
(Both I 82 & Trans. Selsyn for $7.00)		
PE-101 Dynamotor		2.75
Thermal converter Weston Type D, model 507, range .12 amp		.59
BC-1023, Marker Beacon Receiver, complete with tubes, shock mount and instruction manual		9.95
BC-923 27-38 MC. FM Receiver complete with tubes	Used $24.50	
BC-924 27-38 MC. FM Transmitter, complete with tubes	Used $19.95	
BC-684 27-38 MC. FM Transmitter, less dynamotor	Used $19.95	
10 meter modification kit for BC-610		3.95
SCR-183 complete 12 volt set with all coils, tubes, dynamotor and control units		49.50
ARB Control Box		1.95
ARR2 Control Box		.89

CATHODE RAY TUBES

3FP7 ..$1.95	5FP7 ..$1.97
4AP10 .$ .95	5GP1 ..$3.95
5BP4 ..$3.95	16DP4 $19.95
5CP1 ..$4.95	16JP4 $19.95

PRICES UPON REQUEST

T 85/APT5 Transmitter	TS 10/APN Test Set
R 132/TPS10 Receiver	TS 16/APN Test Set
TS 36/AP Test Set	TS 27/TSM-1 Test Set
	TS 251 Test Set

Shipments FOB warehouse. 20% Deposit on orders. Minimum order $5.00. Illinois residents, add regular sales tax to remittance. Prices subject to change without notice.

ARROW SALES, Inc.

Dept. E6
1712-14 S. Michigan Ave., Chicago 16, Ill.
PHONE: HArrison 7-9374

COLUMBIA ELECTRONICS LTD.

TELEVISION CAMERA

350 line resolution. Easily converted to present RMA standards. Circuits available with camera. Complete, like new.

TEST EQUIPMENT
Complete Line!

SIGNAL GENERATOR 804-C
DUMONT 224-A OSCILLOSCOPE
I-77 HICKOK TUBE CHECKER
I-208 FM SIGNAL GENERATOR
RPC MODEL 644 MULTIMETER
FERRIS MICROVOLTER MOD. 18-C.

IE-36 (New)	TS-111/CP
I-139 METER	TS-126
I-212	TS-128
TS-3/AP	TS-127/U
TS-5/AP	TS-170/ARN-5
TS-10B/APN	TS-182/UP
TS-15A/AP	TS-184A/AP
TS-19/APQ-5	TS-204/AP
TS-24A/ARR-2	TS-250/APN
TS-34/AP	TS-348/AP
TS-36/AP	TS-375/U
TS-61/AP	UPM-1(Complete)
SL-1 Slotted Line Test Set	WE I-193 Range Calibrator for I-146
TS-100/AP	
TS-102A/AP	

RC-184 IFF EQUIPMENT
Brand New. Complete.

COMPLETE RADAR
APS-4 MARK 16
APS6

RECEIVERS
APR-4 APR-5

SCR-720 EQUIPMENT
SCR-584 PARTS

HEADSETS
HS-33 Brand New

MK-20A/UP — New, INDIVIDUALLY BOXED

SCR-291 DIRECTION FINDING EQUIPMENT—NEW

MP-22 MAST BASE With Hardware and Bracket.

U/16 U PLUGS MG19A—New R5/ARN-7

VARIAC TRANSTAT AMERTRAN
Input 0-115 V., 50-60 cycles; output 115 V 100 amps. 11.5 Kva. Excellent condition.

SEE COLUMBIA ELECTRONICS AD ON PAGE 368

COLUMBIA ELECTRONICS LTD.
524 S. San Pedro St., Los Angeles 13 CALIF.
Cable Address: COELECT
ALL ITEMS SUBECT TO PRIOR SALE

PERFORMANCE GUARANTEED

TEST EQUIPMENT

We believe we stock the most comprehensive variety of military and commercial electronic test equipment available. A partial list follows:

TS-1ARR	TS-87/AP	TS-226A	BC-906/D
TS-3A/AP	TS-89/AP	TS-233/TPN-2	BC-949/A
TS-8A/U	TS-96/TPS-1	TS-268	BC-1060/A
TS-10A/APN-1	TS-98/AP	TS-270A/UP	BC-1066/A
TS-12	TS-100	TS-323	BC-1201/A
TS-13	TS-101AP	I-56	BC-1203
TS-14	TS-102/AP	I-95/A	BC-1287/A
TS-15B/AP	TS-108/AP	I-106/A	BC-1277
TS-16/APN	TS-110/AP	I-122	BE-67
TS-19	[illegible]18/AP	I-145	LAD
TS-27/TS	[illegible]AP	I-177	LAF
TS-32A/TRC-1	TS-1[illegible]AP	I-178	LAG
TS-33	TS-153	I-208/A	LU2
TS-34	TS-155A/AP	I-212	LU3
TS-34A	TS-170/ARN-5	I-222/A	OAA-2
TS-35A	TS-173/UR	I-225	TTS-4BR
TS-36	TS-174	I-233	TTX-10RH
TS-45/APM-3	TS-175	IE-21/A	TSS4SE
TS-47/APR	TS-184/AP	IE-36	TSX4SE
TS-51/APG-4	TS-197/CPM-4	IF-12/C	
TS-62	TS-203/AP	BC-221	
TS-69/AP	TS-204/AP	BC-376	

Each piece guaranteed. All accessories and instructions furnished.

(We will purchase your test equipment at highest prices. Send your list for a prompt reply.)

Cable: WESLAB **Telephone: WE 5-4500**

Weston Laboratories
Weston 93, Mass.

SAVE $ $ ON BRAND NEW TUBES

OA2	$1.69	2K25	$33.95	6F7	$.89	50	$.98	809	$2.25
OB2	1.50	2K25/723A/B	33.95	6J4	5.95	EF50	.89	813	9.95
OC3/VR105	1.35	2K28	29.95	6J5GT	.50	RKR72	1.65	829	8.95
OD3/VR150	1.10	2K29	29.95	6K4	3.49	RKR73	1.65	829B	13.90
1A3	1.10	2K45	115.00	6L6	2.25	76	.69	832A	9.95
1B3GT	1.15	3A4	.98	6L7	1.10	78	.79	836	5.50
1B22	3.25	3A5	1.59	6SG7	1.19	83	1.69	837	1.20
1B24Sylv.	16.95	3AP1	10.95	6SH7GT	.89	250R	9.95	851	52.55
1B27	19.95	3B7/1291	.60	6SJ7	.89	304TH	16.50	860	4.58
1LN5	.75	3B24	4.50	6SL7GT	.89	304TL	9.95	872A	2.75
1N23	1.29	3B28	7.50	6ST7	.89	307A	5.50	874	.95
1R4/1294	1.10	3C22	59.50	6V6GT	.69	350A	6.95	884	1.79
IT5GT	.98	3C23	8.50	7B4	.69	350B	5.95	923	1.69
IV	.79	3E29	14.50	7C23	59.50	388A	1.50	955	.45
2C39	23.00	3Q4	.89	7F7	1.00	394A	4.50	958A	.45
2C40	6.75	3S4	.89	7V7	1.19	417A	13.50	1616	.95
2C43	23.00	4E27	17.50	12A6	.80	WL530	19.95	1624	1.75
2C44	1.20	4J31	89.50	12C8	1.09	700A/B/D	16.50	1625	.4
2C51	5.95	4J41	89.50	12GP7	11.95	706CY	39.50	1626	.4
2E30	2.25	4x150A	42.50	12H6	.89	706GY	39.50	1629	.3
2J21A	9.50	5D21	22.50	12K8	.89	707B	14.95	2050	1.9
2J22	9.95	6A3	1.49	12SH7	.89	715B	12.95	2051	1.50
2J31	29.50	6AB7/1853	1.19	12SK7	.69	717A	1.19	8020	1.25
2J32	49.50	6AJ5	1.89	12SL7GT	.69	723A	7.50	8025	5.95
2J33	39.50	6AK5	1.39	12SN7GT	.79	723A/B	14.50	9001	1.50
2J34	39.50	6AN5	5.95	12SQ7GT	.79	724B	2.75	9002	1.25
2J40	39.50	6B8	1.10	12SR7	.89	725A	7.50	9003	1.50
2J48	24.95	6BL7GT	1.20	24G/3C23	1.75	726A	6.75	9004	.65
2J56	179.50	6C5	.79	28D7	1.29	726B	29.50	9005	1.75
2J62	38.95	6F4	4.50	32L7GT	.98	807	1.79		

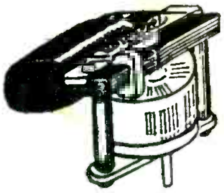
1000's OF OTHER TYPES IN STOCK! WRITE AND TELL US YOUR REQUIREMENTS!

We carry a complete stock of Radio & TV Tubes and Electronic Parts. Send us your requirements.

J. S. H. SALES CO.
Dept. E4, 7552 Melrose Ave., Los Angeles 46, Calif.

WE PAY HIGHEST PRICES FOR SURPLUS STOCKS OF TUBES AND ELECTRONIC PARTS. Send us your list!

Genuine TELECHRON Motors



2 RPM	$2.90
3 RPM	3.90
3.6 RPM	3.15
1 RPM	3.95
60 RPM	4.30

One of Each $15.00

ZENITH 1951 TV Remote Control Motor Units

Reversing switch on end of 17 foot cable. Powerful 4 RPM clutch motor.

Will drive anything

Can be used for door opener, window raiser, model RR turntable. Complete with transformer. **$12.90** 6 for $70.00

MARKTIME 5 HOUR SWITCH

A 10 amp. timing device. Pointer moves back to zero after time elapses. Ideal for shutting off radios and TV sets when you go to bed. Limited supply at this special PRICE.... **$4.90**

Also available in 15 min., 30 min., 1 hr. at $5.90

Single Pole 6v. Very Small Relay	$ .60
Veeder-Root Counter, Rotary	.90
Veeder-Root Counter, Ratchet	2.25
No. 18 Enameled Copper Wire, 1¾ lb. coil	2.00
Solenoid, works on 24v. D.C. and 115 v. A.C.	1.50
½ amp. 6 v. Transformer	1.15
4½ amp. sealed 6 v. Transformer	2.75
MU and ACRO Switches assorted	4 for 1.00
115 v. A.C. Motor, for fan or experiment	1.50
1800 RPM, 115 v. A.C. Motor	4.50
Guardian, No. 4, 115 v. A.C. Solenoid	3.50
Price Bros. No. 1A, 115 v. A.C. Solenoid	1.50

LUCKY PURCHASE ENABLES US TO OFFER YOU THESE MAGNETS!
ALNICO — 7% COBALT — *Actual Size*
39¢ EACH — 3 FOR $1.00

Ely bakelite Binding Posts	.12
TELETYPE, 1/40 H.P. 110 v. D.C. Motor	3.50
W-L, 100 watt fixed, 1000 ohm Resistor	.60
Arrow-H & H, DPDT Toggle Switch	.65
C/H Off center, SPDT Toggle Switch	.35
Antenna Rotator or Door Opener.	
Powerful Geared, 24 v. D.C. or A.C. Motor, with Transformer	7.50
3 Wire Rubber Cable for Above	.03½
GE Argon Glow Lamps	4 for 1.00
100 for $20.00	

ELAPSED TIME METERS $15.50

GONIOMETERS
Micro Switch
Solenoids
Relays
Electric Counters

EST. 1923 **BLAN** EST. 1923

64 Dey St., New York 7, N. Y.

D.C. MICROAMMETERS

0-200 Ua 3" sq. G.E. DO-50.........$ 9.00
0-50 Ua 3" sq. G.E. DO-50......... 13.00

PORTABLE INSTRUMENTS

Molded Bakelite Case 7"x4½"x3"

D.C. MICROAMMETERS

5...10...50...microamperes

THERMOCOUPLE MILLIAMMETERS

1.5...5...10...milliamperes

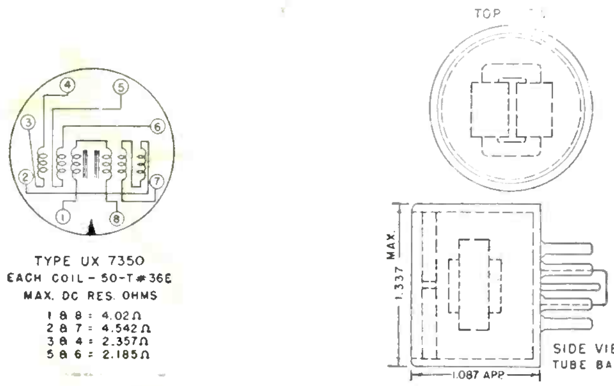
Available in multiple range combinations

PRECISION ELECTRICAL INSTRUMENT CO.
146 Grand Street New York 13, N. Y.

PULSE TRANSFORMERS

Tube base plug in type

Here are precision made, high quality compact pulse transformers wound on hypersil cores. They are built in octal bakelite tube bases and can be adapted to many uses. Kindly distribute this data to key personnel in your Electrical Engineering Department, to your Technical Library, to your Electronic Equipment Buyers and to any person who should have knowledge of this item.



OTHER DATA

★—Completely impregnated and sealed.
★—Physically small, measuring only 1.377" dia. x 1.087" high.
★—Convenient to use—merely plug into an octal socket—simplifies production.
★—Schematic of winding sequence and connection pressed into disc covering top of tube base. Schematic designates socket connections.
★—The coils are wound on high-grade tested hypersil cores.
★—Used in some of the Navy's modern and highly accurate Radar and Direction Finding Equipment
★—Standard types—Manufactured by Raytheon Manufacturing Company.
★—Quantities available—immediate delivery.

SUGGESTED USES

★—Blocking Oscillator, Multivibrator and Scope Circuits.
★—Wherever Accurate Timing and Triggering are necessary.
★—Unexcelled in circuit applications for generating low power and low voltage pulses.
★—Can be used in circuits utilizing repetition rates from 0 to well over 1 MC and pulse widths ranging from .05 Microsecond up.

PRICE $4.50 EACH—Immediate Delivery

HATRY and YOUNG
THE *Elect* IN ELECTRONICS
42-44 Cornhill, Boston 10, Mass.
Lafayette 3-2546

TUBES Price - Slashed ! Receiving & Transmitting

RMA Guaranteed—Standard Brands

OA2 $1.59	OZ4 $.59	7C4/1203A $.89	**TV PICTURE TUBES BLACK FACE**
OB2 1.69	1R5 .89	12AT7 1.19	
OC3/VR105 1.29	5U4 .79	12AU7 1.19	
OD3/VR150 1.19	5V4 1.39	12BH7 1.19	
2E25A/HY65 4.89	5Y3 .49	12SA7 .79	10BP4 $22.50
3EP1 5.39	6AC7 1.29	12SK7 .79	12LP4 23.50
3HP7 3.49	6AG5 1.29	12SQ7 .69	14BP4 24.50
5FP14 16.99	6AL5 .79	35A5 .98	16GP4 32.50
7BP7 7.89	6AU6 .79	35L6 .89	16HP4 32.50
7CP1 12.49	6BC5 .89	35W4 .69	17BP4 32.50
304TH 12.49	6BG6 1.89	35Y4 .89	19AP4 36.50
304TL 12.49	6BN6 1.39	35Z5 .59	20CP4 39.50
803 2.49	6BQ6 1.59	50A5 .98	24AP4 74.50
805 2.99	6K7 .59	50B5 .98	
885 1.29	6SA7 .69	50L6 .75	
905 2.29	6SN7 1.09		
954 .29	6V6 .89		
1624 1.49			
1629 .35			
7193 .29			
8020 1.25			
9003 1.89			
9006 .29			
GLA71A 2.75			
CK1005 .79			

FREE: Write for catalog . . . tubes, parts and accessories for radio and TV! Also special electronic instruments catalog.

Minimum order: $5.00. 25% deposit with order, balance C.O.D. Include postage with order. All merchandise subject to prior sales, F.O.B. New York, N. Y.

SPEAKERS *All Alnico V—Priced Extra Low*

4" PM	$1.59	4" x 6" 1,500 ohm	$1.69
5" PM	1.69	8" Auto 4–6 ohm	2.89
4" x 6" PM	1.79	8" PM	3.25
6" PM	1.89	12" PM	6.69
6" 62 ohms with output trans.	2.79		

SPECIAL OFFER!—DEDUCT 5% from the price of any speaker in lots of 10 or more. Can be assorted.

GENUINE MOLDED CONDENSERS

Fresh Stock—All Mineral Oil Filled
100° Centigrade—Meets Jan C91 tests
ALL 600 VOLTS

Cap.	Per 10	Per 10
.001	$.79	$6.90
.002	.79	6.90
.005	.79	6.90
.01	.89	7.90
.02	.89	7.90
.05	1.09	9.90
.1	1.25	11.50

ELECTROLYTIC CONDENSERS

All Guaranteed Fresh Stock.

	Ea.	Lots of 10
20x20—150V.	$.39	$3.70
40x40—150V.	.45	4.30
50x30—150V.	.45	4.30
25—25V.	.19	1.50
20—250V.	.29	2.59
8—450V.	.39	3.69
10—450V.	.39	3.69
16—450V.	.59	5.69

The Rose Company
100 Park Place New York 7, N. Y. COrtland 7-6195

RADAR
SCR 545A [illegible] Track. Complete trailer, power supply and spare parts. Nearly new. Write for description and price.

PORTABLE PUMP ASSEMBLY
Leland, 110 v. 60 c. 1 ph., 1/3 H.P. motor and D. Roper #2 hydraulic pump. 300 lbs. PSI max., 125 lbs. PSI continuous [illegible] gallons per mi[illegible] $52.00

SEARCH LIGHT
[illegible] 12" Curtis Lighting, Inc. 115 v. a-c or d-c, 1000 w[illegible] bulb. [illegible] mount assembly that gives 3[illegible] station [illegible] & vertic[illegible] ...$[illegible]7.50

W[illegible] COOLING HEAT [illegible]
1[illegible] KW, Westinghouse [illegible] visual & electri[illegible] & [illegible] indic[illegible] 10 v. 60 c. Complete in [illegible] housing 24"x31"x52" $165.00

MOTOR
Bendix 1/15 HP, 115 v. 60 [illegible] ph. 1725 RPM..$4.75

GENERATOR
Bendix [illegible] NEA3. Output 115 v. a-c 10.4 amps, 300 cy. SP. and 28.5 v. d-c, 60 amps @ 2400 RPM. Self excited, splined drive. New. Orig packing..$27.50

BATTERY CHARGER TRANSFORMER
G. E. Cat. #WS-99316. Pri. 105-115-125 v. 60 c. Sec. 105-90-75-60-45-30 v. @ 6 amps. each side of center tap. Voltage reduced 15% and 20% thru tapped primary; two x 5v. 18 amp. C.T. (Tungar filaments) [illegible] two x 7 v. 10 amp. 7¾" [illegible] x 8-¾" w. x 5½" d. Wt. 56 lb. New, orig. packing. G. E. price $52.00...$17.50
2 for $30.00

NEW!
[illegible] prices
[illegible] values
• equipment
• components
Note: All merchandise not designated as new is guaranteed to be in excellent to new condition.
EPCO
1527 E. 7th St.
Los Angeles 21, Calif.

POWER SUPPLY COMPONENTS
TRANSFORMERS
Plate, American Transformer Co. Spec. 29108. Pri. 115 v. 60 cy. 10.4 KVA. Sec. 17,600 v., 520 amps., 35 KVA test..$65.00
Plate, American Transformer Co. Spec. 29108. Same as above but center-tapped to handle 1 amp @ 8800 v........$75.00

Filament, American Transformer C[illegible] Spec. 29166, Type WS, .050 KV[illegible] [illegible]0 cy SP., 35 KV. test, 12 h[illegible] op[illegible]rating. Pri. 115 v., Sec. 5 v., [illegible] w/integral st[illegible] off insulator and [illegible] for #371 872, etc. rectifier tubes..........$12.50
2 for $2[illegible]—4 for $40.00

CAPACITORS
9.12. mfd., 1265 v. 60 c. a-c or 4000 v. d-c power factor correction 5.0 KV. A.R. Cat. #252[illegible]908 ......$17.50
.25-.25, [illegible]0 v. d-c or .125 @ 12,000 v. d-c, [illegible] Cat. #A7548, oil........$3.75
1.25/1.2[illegible] mfd., 7500 v. Cat. #26F360 $12.50
2x.15 mfd., @ 8000 v. or .075 mfd. @ 16,000 v. Vitamin Q..............$2.90

RESISTORS
Fixed, w.w. 160,000 ohm, 200 w. ferrule ends $1.00
Fixed, w.w. 5,000 ohm, 200 w. ferrule ends $1.00

METERS
3" Westinghouse & Weston 0-1 ma. d-c movement, calibrated 0-4 or 0-20 KV Mod. 301, NX35 .... 4.95
3" Westinghouse & Weston 0-120 amp. a-c calibration, 3 amp f.s. deflection. Includes doughnut current transformer 40/1 ratio. Mod. NA35 & 476...........$8.50

RELAY
Magnetic overload, Allen-Bradley #810, 6.3-18.1 amps. 600 v. max..........$7.95

RECTIFIER
Dry Disc, 6.5 v. [illegible] FWCT 2.2 v. d-c @ 3 amps ....$ .75 4 for $2.00

TRANSTAT
115/230 v. 50/60 c. 0-260 v. 2.5 amp output ....$17.50 2 for $30.00

CONTACTOR
Allen-Bradley & Westinghouse, 115 v. 60 cy. coil, DPST, 15 amps..........$4.95

HIGH VOLTAGE RECTIFIER POWER SUPPLY
Variable output 0-15,000 v. d-c @ 500 mils. Input 115 v 60 cy. SP. Army type RA-38. Size 63½" x 53¾" x 56¾". Wt. 2040 lbs. Units are new, complete with spare tubes and remote control. Write for detailed information.

ASTRO COMPASS

The Astro Compass is a precision Instrument measuring 8¾" high x 5¼". Furnished in Carrying Case. Designed to provide accurately (a) True heading of Aircraft or boat. (b) True bearing of a distant object. (c) The relative bearing of distant objects.

Of special interest to Astronomers & Experimenters.

$9.50 Each

Mounting Base for above Astro Compass..$1.10 Ea.

OAK CERAMIC ROTARY SWITCH
2 Deck 4 Position, 2 Circuits per Deck. Silver Contacts throughout—Non-shorting......$.90 Ea.

PRECISION RESISTOR
18,000 OHMS ½ Watt 1% Tolerance ....$.40 Ea. 10 for $3.50

MAGNETS ALNICO-3# ROUND STOCK
Furnished in Wooden Box containing 2 Magnets. One—4¼"L x 11/16" dia. The 2nd 1⅜"L x 11/16" dia. Larger one in Brass Case. Both $1.10 Set.

C-H AIRCRAFT SWITCHES
3 hole mounting. Bat handles, luminous tips.
B-10 SPST Mom. off........$.18 ea. 10 for $1.65
B-1-B SPDT ....$.18 ea. 10 for $1.65

SPECIAL
Oil Filled Capacitor, .1 Mfd. 10,000 Volts DC Dim. 3¾" x 6¼" x 1¾". Cat. # 23F430......$3.85 ea.

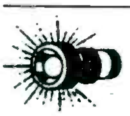
Minimum order $2.00
All prices, net FOB New York—Immediate Delivery

B & B DISTRIBUTORS
222 Fulton St. New York 7, N. Y.
Rector—2-0432

SILVERPLATED REFLECTOR—Overall Dimensions 4⅝", Reflecting Surface 4¼", Depth 1⅜". Individually boxed **25¢ ea. $20.00** per 100.

Eastern Air Device J50 Centrifugal Blower, 115 volt 60 cycles 0.1 amp. 1 PH 10 C.F.M. Continuous duty 1.0 M.F.D. Capacitor start with Capacitor **$10.75**; without Capacitor **$10.25**

Eastern Air Device J50E Dual Centrifugal Blower, 115 volt 60 cycles 0.1 amp. 1 PH 20 C.F.M. Continuous duty 1.0 M.F.D. Capacitor start with Capacitor **$18.75**; without Capacitor **$18.25**



Miniature lamp T1¼. 3 volt .19 amp. Airplane Indicator, Amb. Ctd.
10 for **$1.00**
100 for **$8.50**

VOLTMETER Weston 833 130v. A.C. 400 cycles 2¼ flush bakelite Aircraft mounting black scale Fluorescent numerals removed from new equipment..........**$3.50**

AMMETER, 150/300 dual range Triplet 341A 3½" rectangular flush bakelite 5 amp Movement @ $4.95 with external current transformer for 150 amp.
Only $7.50

Square D Circuit Breakers Push Type AN3161-35 35 amp. @ 30 volt D.C.
$1.15 each

Square D Bat Handle Circuit Breaker Type AN3160-10 30 volt @ 10 amp
$1.25 each

SEND FOR FREE BULLETIN
Telephone Digby 9-2188-9
A. Cottone Company — ELECTRONIC MECHANICAL & OPTICAL COMPONENTS
336-340 CANAL ST., NEW YORK 13, N.Y.
ALL PRICES F.O.B. N. Y. CITY

PHOTOCON SALES

1062 N. Allen Ave. SYcamore 4-7156
Pasadena 7, Calif. RYan 1-8271

WRITE FOR OUR NEW 24 PAGE SURPLUS SALES CATALOG

WE WILL BUY YOUR NEW OR CLEAN USED ELECTRONIC SURPLUS: ARC-1, ARC-3, BC-224, BC-348, BC-312, BC-342, ATC, ART-13, APS-13, BC-221, LM's, TS-12, TS-13, TS-23, TS-34, TS-35, IE-19A, I-222, SCR-522, TS-100, I-100, or any BC, I, IE, TS, APR.

APR4, APR5A, APR7, TS-34, 804CS2, APA-38, BC-348, ART-13, TS-12, ARC-1
WRITE FOR PRICES

L. & N. 8662 Potentiometer EXCELLENT	$300.00
L. & N. 4725 Wheatstone Bridge with 2420C Galvanometer	350.00
Weston 769 Electronic Analyzer LIKE NEW	225.00
Weston 799 Insulation Tester 0–10,000 meg LIKE NEW	75.00
Weston 779 Analyzer LIKE NEW	125.00
Weston 665 Volt-Ohm-Milliameter, case, and model 666 socket selector LIKE NEW	100.00
Bristol Dynamaster Recorder-Controller KRQ1531 for Resistance Thermometers 130–145 ohm LIKE NEW	500.00
Bristol Pyromaster Potentiometer Recorder Controller KR531 0–10M.V. EXCELLENT	400.00
Variac—General Radio Type 50A O-135V. @ 50 amps EXCELLENT	95.00
APN-1 Altimeter Indicator 0–1MA. shunt, 250° dial NEW	2.95
2" Aircraft Meter 1–0–1 milliameter scale calibrated 50–0–50 NEW	1.95
MG075-G-1 Onan Motor Generator Motor 115/230V. 60 cy. single phase. Generator 115V. AC. 480 cy. 5.3 amps, 26V.D.C. @ 4 amps NEW	190.00
Weston Model 506 Voltmeter 0–20,000 volts with 4 Model 505 multipliers NEW	39.50

One of the largest and most complete electronic surplus stocks in the country. We have thousands of tubes, capacitors, plugs, accessories, transmitters-receivers, test equipment, etc. Send us your requirements.

TERMS: Prices f.o.b. Pasadena, California 25% on all C.O.D. orders. Prices subject to change without notice.

TUBE SPECIALS

1B3	$1.35	6BF5	.85	6V6M	1.75
2A3	1.25	6BF6	.85	6W4	.85
1V	.75	6CD6	2.25	12A6	.70
5V4	1.20	6K6ET	.75	12A8	.80
5Z3	.85	6H6M	.85	12J5GT	.65
6AB4	.95	6J7M	1.05	12K8Y	.80
6AG5	.90	6K7M	.85	12AY7	4.50
6AK5	1.20	6L6M	2.25	12SF7M	.85
6AK6	1.25	6N7M	1.20	14A7	1.05
6AG7	1.65	6R6	1.50	14B6	1.05
6AT6	.70	6SF5GT	.85	14R7	1.25
6AV6	.70	6SH7M	.95	19T8	1.25
6B4	1.35	6SC7	1.25	25W4	.90
6C4	.85	6SL7GT	1.1[illegible]	59	1.50
6BC5	.95	6SS7	.95	89Y	.75

Many more types in stock. Write for quotations.

OA4	$1.25	CK70	4.95	832A	11.95
2C51	5.95	RKR73	1.50	837	1.35
2E25	5.95	75TH	6.75	1603	5.95
2E30	2.00	T200	16.95	1620	6.50
2D21	1.6	211C/VT4C	1.75	1632	.65
3A4	.95	3C24/24E	1.50	1633	.65
6D4	2.50	350B	5.50	8025	5.75
6J4	5.50	394A	5.50	9001	1.75
T20	2.25	72[illegible]AB	14.	9002	1.50
TUF20	3.95	726A	6.50	9005	1.75
TZ20	2.25	807	1.65	3AP1A	12.50
TZ40	3.25	809	2.2	3BP1	6.95
45S	.35	829B	13.95		

All tubes are subject to prior sale. 20% deposit required balance sent COD plus postage. We buy anything in electronics.

Nat Adelman
168 Washington St. New York 6, N. Y.
CO 7-6091

CONDENSERS OUR SPECIALTY
OIL FILLED & TRANSMITTING MICA TYPES
All Values and Voltage Ratings
We Invite Your Inquiries
TECHNICAL RADIO PARTS CO.
557 McDonald Ave., Brooklyn 18, N. Y.

SHEET METAL MACHINERY
NEW & USED—COMPLETE LINE OF
Box Brakes, Press Brakes, Notchers, Shears, Punches, Rolls, Spot Welders — Di-Acro, Pexto, Whitney Equipment, etc.,
B.D. BROOKS, INC. 361 Atlantic Ave.
Boston, Mass. Tel. HAncock 6-5200

WESTINGHOUSE TYPE HQS PHASE SELECTOR RELAYS
For Selective-Pole Carrier Relaying.
Brand New, Complete. Original cost $650.00 per set. 3 units per set. Only 40 sets in stock. Write for circular available.
$95.00 each
ELECTRO SALES CO., INC.
108-110 Pearl St., Boston 10, Mass.

Oil Condenser Specials

10 mfd.—600 V............$ .75
Three term. bat. mntg. channel type. Dims. 3¾" x 3½" x 2". Two 5 mfd. sections rated 400 V at 72 deg. "C". 1800 V test. Meets commercial specs. for 600 V. operation up to 40 degs. "C". Ideal for filter or power factor application where ruggedness and durability are paramount. Carton of 24, weight 42 lbs. ....$.65 ea.

8 mfd.—600 V
Measuring 4½" H 2" Dia. with bkt. $1.69
4 mfd.—600 V Rect........ $1.25
5 mfd.—660 VAC
(1500 VDC) Porc. Terms..... $2.59
2 mfd.—600 V
2⅜" H x 2" Dia. with bkt.... $ .48
17 mfd.—25 V Type TLAD... $ .79
3 mfd.—600 V............ $ .59
3 mfd.—300 V
7852 Sing. Term. 2 mntg. studs $ .10
1.2 mfd.—800 V
7210 Sing. Term. 3 mntg. studs $ .14
1 mfd.—600 V
Bot. Terms Channel Type..... $ .50
.2 mfd.—1000 V ST batltub.. $ .19

Large quantities of bathtub, channel and upright oil conds. from 25 V to 25KV. Trans. & Rcvng. micas. Standard brand pots and 25 Watt rheos. Inquiries solicited.

WANTED

Condensers of all types in any quantity. Also other standard components. Top prices.

Write:—Art Hankins, Owner

MONMOUTH RADIO LABS.
Box 159 OAKHURST, N. J.

WESTINGHOUSE HIPERSIL CORES

OVER 20,000 UNITS IN SEVERAL DIMENSIONS. AVAILABLE FOR IMMEDIATE DELIVERY. SEND FOR LIST WITH COMPLETE DESCRIPTIONS.

RAYTHEON MFG. CO.
Surplus Sales Dept. Waltham, Mass.
Tel. Waltham 5-5860—Ext. 2

3,000 CYCLE GENERATOR FOR SALE

Driven by 3 phase, 60 cycle, 220/440 volt motor. Output 2 KVA. 115 volts. In Perfect Condition. Never Used for More than 10 Minutes at a Time; Total Operation 2 hours.
FS-9861, Electronics
330 W. 42 St., New York 18, N. Y.

INQUIRIES INVITED for
ANY QUANTITY **TUBES** Immediate Action
COMPONENT PARTS
DRILLICK
ELECTRONIC SALES CO.
5281 W. Pico Blvd. Los Angeles 19, Calif.

CHECK THESE MONEY-SAVING SURPLUS "BUYS"!

OUT GOES OUR ENTIRE STOCK

During this Fabulous, All-Out, Clear-Out WAREHOUSE CLEARANCE SALE

COMPARE THESE PRICES!

Junction Boxes & Control Units

Quantity On Hand	Description	Single Price	[illegible]
1	RM-42	$24.95	
6	RM-6 Remote Controls	14.95	$74.50
6	RM-29	7.49	35.00
1	RM-27	14.95	
1	RM-45A	24.95	
800	BC-606G Interphone Control Boxes	.98	400.00
35	U3/APA-19	4.95	100.00
30	C45/ARC-1	9.95	200.00
100	BC-451A	1.95	100.00
25	J17/ARC-5	2.95	35.00
2	J60-AXT-2	14.95	20.00
	TEST EQUIPMENT		
5	BC-753A Course Directors	25.00	100.00
1	I-145	25.00	
3	I-122 Signal Generators	65.00	200.00
8	BE-67	20.00	150.00
1	I-149	25.00	
9	TS-92/AP	125.00	1000.00
1	78-B Signal Generator	[illegible]0.00	
10	BC-949A Range Calibrators	12.50	100.00
3	ME-73A Alignment Sets	7.50	20.00
5	TS-126 Synchroscopes	125.00	500.00
1	BC1203-B	100.00	
9	I-222 Signal Generators	60.00	500.00
2	I-233 Range Calibrators	25.00	45.00
3	TS-110/AP	65.00	150.00
12	TS-204	25.00	250.00
12	TS-164 (Cases Only)	10.00	100.00
40	TS-323 (Cases Only)	5.00	175.00
30	BC-376	75.00	1300.00
50	I-139 Test Meters	10.00	350.00
50	TS-16	25.00	800.00
40	TS-10	20.00	500.00
30	BC-906	9.00	150.00
4	IE-21	125.00	400.00
6	GR 815A Standards	10.00	50.00
1	TS-184/AP	100.00	
1	TS-189/U	65.00	
	MISC. PARTS & EQUIPMENT		
11	BC-1155A, less tubes	9.95	75.00
2	AN/PPN-2, Complete, new	99.95	150.00
2	BC-307A Transmitters	17.50	30.00
20	AN/CRC-7 Handle Talkies	24.95	400.00
6	MAB Walkie Talkies	34.95	175.00
19	AM14-APT (Hi-Pwr 2 meter final)	9.95	150.00
6	T116/APT5A	69.00	350.00
12	AN/PPNI	49.50	500.00
7	AM23A/ARQ8 Noise Generators	9.95	50.00
2	BC797 VHF Airport Transmtr & 2 201A Recvrs	395.00	700.00
3	BC1068A Receivers	39.00	100.00
3	AN/CRT3 Gibson Girls (CAA Approved)	59.50	150.00
30	RL-42 Antenna Reels	3.95	75.00

THOUSANDS OF ITEMS NOT LISTED HERE! SEND US YOUR REQUIREMENTS OR SEE OUR PREVIOUS ADS!

$$$$$$$$$$$$$$

All merchandise has been priced at cost, near cost and below cost to make room for our expanding Aircraft Division. Some items are used, some new, all are in fair to excellent condition. But every item, whether you buy singly or our entire stock, is an outstanding bargain. If you don't find what you want listed here, see our previous ads or write us. Prompt replies to all inquiries!

ORDER DIRECT FROM THIS AD
Prompt shipment of all orders. Cash with order. Minimum order $3.00. 35% deposit on all C.O.D. orders. Shipments by truck or RR Express collect. California buyers please add state sales tax. All prices subject to change. All merchandise subject to prior sale.

ALVARADIO SUPPLY CO.

Dept. L-17, 341 S. Vermont Ave., Los Angeles 5, Calif., DUnkirk 8-2211

TIME DELAY

Relays, Cramer TD2-120S & 60S
115 V. 60 Cy. New.............Ea. $12.95
EMPIRE, BOX 41 MIDWOOD STATION
BROOKLYN 30, N. Y. BRYANT 9-1220

FOR SALE

ELECTRICAL STEEL

We can offer about 26,000# of Hi-Grade Strip—.005 x 12⅜" "Hipersil" 3¼% Transformer grade — In Coils weighing about 900# each—Material new and prime but outside wrap weather discolored.

GLOBE TRADING COMPANY
1815 Franklin Detroit 7, Michigan
Phone—WOodward 1-8277

FOR THE BEST IN ELECTRONIC SURPLUS

SEE OUR AD IN NEXT ISSUE OF ELECTRONICS!!

WE HAVE A MOST COMPLETE AND VARIED STOCK OF COMMUNICATION, RADAR, TEST, SOUND, AND SPECIAL ELECTRONIC EQPT. FOR IMMEDIATE DELIVERY.

— TELEMARINE —
COMMUNICATIONS COMPANY
540 West 27th Street
NEW YORK 1, NEW YORK
Cable Address: Telemarine, N. Y.

DEPENDABILITY IN ELECTRONICS

WE ARE NATIONAL DISTRIBUTORS OF PARTS, TUBES AND EQUIPMENT. WE SOLICIT INQUIRIES FROM ORGANIZATIONS WHO APPRECIATE INTELLIGENT SERVICE AND HONEST PRICES, PARTICULARLY AT THESE CRITICAL TIMES.

NORMAN RADIO DISTRIBUTORS INC.

94-29 MERRICK BOULEVARD JAMACIA, N.Y.- REpublic 9-4651

INDEX TO ADVERTISERS

Acme Electric Corp. 274
Acme Electronics, Inc. 325
Aeronautical Communications Equipment, Inc. 301
Air Associates Incorporated 51
Aircraft-Marine Products, Inc. 70
Airpax Products Company 303
Alden Products Co. 17
Allen-Bradley Co. 54
Allen Co., Inc., L. B. 328
Allied Control Company, Inc. 183
Allied Radio Corp. 321
Allmetal Screw Products Company, Inc. 214
Altec Lansing Corporation 250
American Chronoscope Corporation 232
American Electrical Heater Co. 196
American Gas Accumulator Company 246
American Lava Corp. 181
American Phenolic Corporation 156
American Relay & Controls, Inc. 222
American Television and Radio Co. 214
American Time Products, Inc. 172
Ampex Electric Corporation 323
Anchor Metal Company 369
Andrew Corporation 184
Arco Electronics, Inc. 30
Arma Corporation 36
Armco Steel Corporation 269
Arnold Engineering Co. 207
Art Wire & Stamping Company 186
Art-Lloyd Metal Products Corp. 214
Artos Engineering Co. 167
Astron Corporation 206
Audio Devices, Inc. 147
Automatic Electric Sales Corporation 18, 245

Bakelite Co., A Div. of Union Carbide & Carbon Corp. 55
Ballantine Laboratories, Inc. 290
Barker & Williamson, Inc. 289
Barry Corporation 78
Bead Chain Manufacturing Co. 152
Beaver Gear Works, Inc. 232
Belden Manufacturing Co. 171
Bell Telephone Laboratories 191
Bendix Aviation Corporation, Eclipse-Pioneer Division 272
Bentley, Harris Manufacturing Co. 169
Berkeley Scientific Corporation 190
Beta Electric Corp. 317
Bird & Co., Inc., Richard H. 299
Bird Electronic Corp. 316
Birtcher Corporation 242
Biwax Corporation 299
Boeing Airplane Company 299
Bogue Electric Mfg. Co. 195
Boonton Radio Corporation 141
Borg Corporation, George W. 318, 319
Bowser, Inc. 154
Breeze Corporations, Inc. 199
Bridgeport Brass Co. 227
Brubaker Mfg. Co. 328
Brush Development Company 35, 222
Burgess Battery Company 238
Burlington Instrument Co. 206
Burnell and Company 57
Bussmann Mfg. Co. 223

Calidyne Company 277
Cambridge Thermionic Corp. 204
Cannon Electric Co. 264
Carborundum Company, The 66
Centralab, Div. Globe-Union, Inc. 11, 12, 13
Chase Brass & Copper, Sub. of Kennecott Copper Corp. 263
Chicago Telephone Supply Corp. 24, 25
Chicago Transformer, Div. of Essex Wire Corp. 292
Cinch Manufacturing Corp. 133
Cincinnati Electronics Company 23
Clarostat Mfg. Co., Inc. 69
Cleveland Container Company 197
Clippard Instrument Laboratory, Inc. 220
Cohn Corporation, Sigmund 293
Columbia Technical Corp. 323
Condenser Products Company 8, 9
Cornell-Dubilier Electric Corp. 26
Corning Glass Works 16
Corry-Jamestown Mfg. Corp. 186
Coto-Coil Co., Inc. 178
Crane Packing Company 321
Cross Co., H. 328

Dage Electric Company 311
Daniels, Inc., C. R. 190
Dano Electric Company 301
Daven Co. Third Cover
DeJur Amsco Corp. 285
Delco Radio Division, General Motors Corporation 149
Dial Light Company of America 218
Distillation Products Industries 157
Dow Corning Corporation 297
Driver-Harris Company 161
DuMont Electric Corp. 182
DuMont Laboratories, Inc., Allen B. 42
DuPont de Nemours Company (Inc.), E. I.
Electrochemicals Dept. 283
Polychemicals Dept. 153
DX Radio Products Co. 276

Eastern Air Devices 305
Eastman Kodak Company, Industrial Optical Sales Div. 173
Edo Corporation 68
Eisler Engineering Company, Inc. 321, 328
Eitel-McCullough, Inc. 67
Electra Mfg. Company 320
Electric Indicator Co. 254
Electrical Industries, Inc. 226
Electrical Reactance Corp. 59
Electro Motive Mfg. Co., Inc. 31
El-Tronics, Inc. 328
Emeloid Co., Inc. 234
Erie Resistor Corporation 60

Fairchild Camera & Instrument Corp. 158
Federal Telecommunication Laboratories, Inc. 32
Federal Telephone & Radio Corporation 170
Filtron Co., Inc., The 19
Ford Instrument Company 276

Gamewell Company 280
General Radio Company 185
General Electric Company
Apparatus Dept. 46, 65, 72, 73, 271
Carboloy Dept. 28, 29
Electronics Dept. 37, 286
Telechron Dept. 235
General Transformer Company 262
Gertsch Products, Inc. 238
Gilfillan Brothers 193
Glaser Lead Co., Inc. 194
GM Laboratories, Inc. 321
Gramer Transformer Corporation 203
Graphite Metallizing Corp. 154
Gray Research & Development Co., Inc. 247
Green Instrument Co. 202
Guardian Electric Mfg. Co. 155
Guthman Co., Inc., E. I. 217

Harder Co., Donald C. 319
Hardwick, Hindle, Inc. 22
Hathaway Instrument Co. 294
Haydon Company, A. W. 307
Haydon Manufacturing Co., Inc. 236
Heiland Research Corporation 218
Heli-Coil Corporation 260
Helipot Corporation 179
Heminway & Bartlett 315
Hewlett-Packard Company 20, 21
Heyman Manufacturing Co. 326
Holtzer-Cabot Division of National Pneumatic Co., Inc. 165
Hudson Wire Company 282
Hytron Radio and Electronics Co. 38

Illinois Condenser Co. 297
Improved Seamless Wire Company 278
Industrial Condenser Corp. 301
Industrial Electronics, Inc. 305
Industrial Specialties Corp. 328
Instrument Resistors Company 295
International Nickel Company, Inc. 257
International Rectifier Corp. 238
International Resistance Co. 4, 5
Irvington Varnish & Insulator Company 43, 213

Jackson Electrical Instrument Company 248
Jeffers Electronics, Inc. 241
Jelliff Mfg. Corp., C. O. 299

Jensen Manufacturing Company 14, 15
Johns-Manville 266
Johnson Co., E. F 325
Jones Div., Howard B., Cinch Mfg. Corp. 303
Joy Manufacturing Company ....

Kahle Engineering Co 284
Karp Metal Products Co., Inc 49
Kartron 328
Kay Electric Company 52
Kellogg Switchboard & Supply Co 234
Kelnor Manufacturing Corporation 233
Kenyon Transformer Company, Inc 259
Kepco Laboratories, Inc 50
Kester Solder Company 137
Kings Electronics Co., Inc 249
Knights Co., James 304
Kollsman Instrument Corp 166
Krohn-Hite Instrument Company 164
Kulka Electric Mfg. Co., Inc 315

Lambda Electronics Corporation 325
Lampkin Laboratories, Inc 328
Landis & Gyr, Incorporated 210
Lapp Insulator Co., Inc 45
Leeds & Northrup Co 265
Leland, Inc., G. H 226
Lenkurt Electric Co 309
Lens Electric Manufacturing Co 215
Leonard Electric Products Co., Inc 295
Lewis Engineering Co 297
Lewis & Kaufman, Inc 160
Lewis Spring & Manufacturing Co 306
Linde Air Products Co., A Division of Union Carbide & Carbon Corp 198, 314
Link Aviation, Inc 302
Litton Industries 211
Lord Manufacturing Company 256
Louthan Manufacturing Company 210

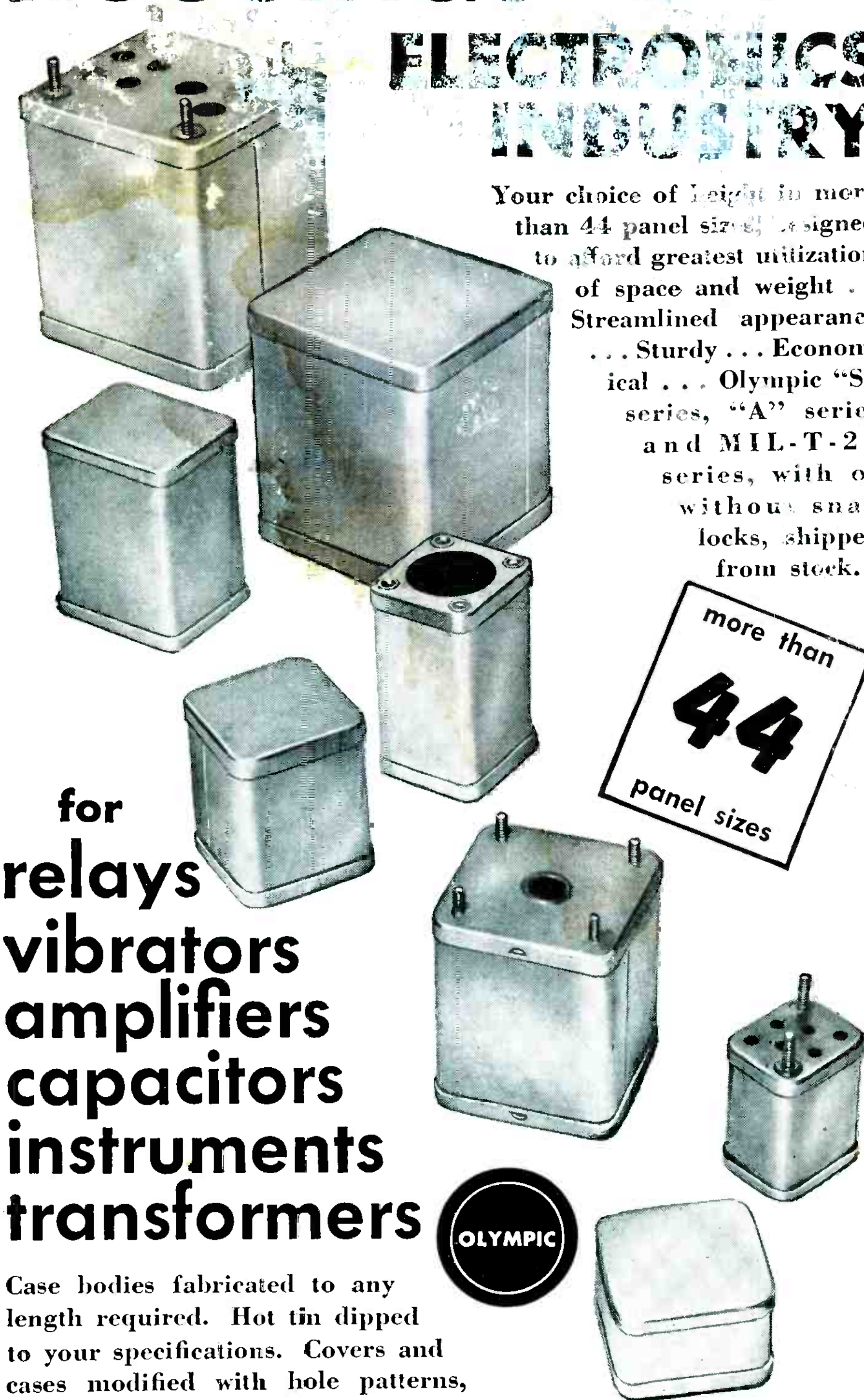
Magnecord, Inc. 244, 275
Magnetic Amplifiers 327
Mallory and Company, Inc., P. R. 80, 135
Marion Electrical Instrument Company 2
Markem Machine Company 240
MB Manufacturing Company, Inc 261
McGraw-Hill Book Co 218
McIntosh Engineering Laboratories, Inc. 315
Measurements Corporation 303
Metal Textile Corporation 280
Metals & Control Corp., General Plate Div. 34
Methode Manufacturing Corp 312
Mico Instrument Co. 194
Millen Mfg. Co., Inc., James 152
Milo Radio & Electronics Corp 180
Minneapolis-Honeywell Regulator Co. 41, 206
Minnesota Mining & Mfg. Co 162
Mitchell-Rand Insulation Co., Inc 221
Monson Corporation 308
Mosinee Paper Mills Company 270
Muirhead & Co., Ltd 3
Multicore Solders, Ltd 7
Mycalex Corporation of America 58

National Company, Inc. 274
National Moldite Company 224
National Varnished Products Corporation, The 163
Neo-Sil Corporation 33
New Hermes, Inc 311
New York Transformer Co., Inc 216
Newcomb Spring Corporation 168
Ney Company, J. M 309
North American Aviation, Inc 182, 278
North Electric Mfg. Co 228
Northern Radio Co., Inc 282
Nothelfer Winding Laboratories 324
Nuclear Instrument & Chemical Corporation 230
Numberall Stamp & Tool Co 246

Offner Electronics, Inc 226
Ohmite Mfg. Co 16A, 16B
Olympic Metal Products Co., Inc 371
Onan & Sons, Inc., D. W 190
Opad-Green Company 317
Oregon Electronics Mfg. Co 258

Panoramic Radio Products, Inc 320
Paramount Paper Tube Corp 319
Park Metalware Co., Inc 284
Permoflux Corporation 300
Phalo Plastics Corp 322
Pickering & Co., Inc 317
Plastoid Corporation 53
Polarad Electronics Corp 325
Polytechnic Research & Development Company, Inc. 187
Potter Instrument Co., Inc 327
Precision Apparatus Co., Inc 372
Precision Paper Tube Co 240
Premax Products, Div. Chisholm-Ryder Co., Inc. 198
Presto Recording Corporation 63
Pyramid Electric Co 76

HOUSINGS for the ELECTRONICS INDUSTRY



Your choice of height in more than 44 panel sizes, designed to afford greatest utilization of space and weight . . Streamlined appearance . . . Sturdy . . . Economical . . . Olympic "S" series, "A" series and MIL-T-27 series, with or without snap locks, shipped from stock.

more than 44 panel sizes

for relays vibrators amplifiers capacitors instruments transformers

OLYMPIC

Case bodies fabricated to any length required. Hot tin dipped to your specifications. Covers and cases modified with hole patterns, cut-outs, mounting brackets or other special requirements.

Facilities available for fabrication of sub-assemblies.

OLYMPIC
METAL PRODUCTS COMPANY INC.
P. O. Box 71 A **Phillipsburg, N. J.**

Ra[illegible] Corp. of America ... 177, 2[illegible]7, 310, Back Cover
Radio Receptor Company Inc 74
Radio [illegible]k Corporation 200
Radio [illegible] Television Incorporated 293
Railway Express Agency Air Express Division 189
Ra[illegible]and Corporation 10
Raytheon Manufacturing Co. ... [illegible]5, 279
R-B-M Division, Essex Wire [illegible] 143
Reeves-Hoffman Corporation 176
Re[illegible]er Co[illegible] 322
[illegible]e Copper & Brass, [illegible] 6
[illegible]e[illegible] Corporation 284
[illegible]o Cable Corporation 281
Ranzel Cord & Wire 202

Sanborn Company 252
Sangamo Electric Co 243
Scientific Electric Div. of "S" Corrugated Quenched Gap Co 280
Scintilla Magneto Division of Bendix Aviation Corp. 201
Secon Metals Corporation 369
Servo Corporation of America 307
Servomechanisms, Inc. 231
Servo-Tek Products Co. 210
Sessions Clock Company, Timer Div. 192
Shakeproof, Inc. 159
Shallcross Manufacturing Co. 39
Sigma Instruments, Inc 79
Simpson Electric Co. 225
Snyder Mfg. Co 229
Sorensen & Company, Inc 47
Southwestern Industrial Electronics Company 194
Specialty Battery Company 313
Spincraft, Incorporated 276
Sponge Rubber Products Company 64
Sprague Electric Company 139
Stackpole Carbon Co. 40
Standard Electric Time Co 324
Standard Piezo Company 282
Standard Pressed Steel Co. 242
Standard Products, Inc. 325
Standard Telephones and Cables Limited 268
Standard Transformer Corp 298
Stanley Tools 305
Staver Company, Incorporated 317
Stevens Arnold, Inc. 295
Steward Manufacturing Co., D. M. 255
Stoddart Aircraft Radio Co 198
Sturtevant Co., P. A. 319
Superior Electric Co 61
Superior Tube Company 56
Sylvania Electric Products, Inc 77, 151
Synthane Corporation 71
Syntron Co. 313

Technology Instrument Corp 296
Tektronix, Inc. 188
Telechrome, Inc. 326
Teletronics Laboratory, Inc 328
Television Equipment Corp 315
Tensolite Insulated Wire Co., Inc 316
Terpening Company, L. H. 287
Thomas & Skinner Steel Products Company 313
Thompson Products, Inc 48
Titeflex, Inc. 242
Transicoil Corporation 291
Transradio, Ltd. 246
Triad Transformer Mfg. Co. 311
Triplett Electrical Instrument Co. 239
Tung-Sol Lamp Works, Inc 205
Turner Company 178

Ucinite Company 251
Union Carbide and Carbon Corp.,
Bakelite Company 55
Linde Air Products Co. 198, 314
United Condenser Corporation 274
United States Testing Company, Inc 234
United Transformer Co. .... Second Cover
Universal Electronics Co 186
University Loudspeakers, Inc 318

Varflex Corporation 219
Veeder-Root, Inc. 209
Victoreen Instrument Company 307
Victory Engineering Corporation 237

Waldes Kohinoor, Inc 75
Ward Leonard Electric Company 208
Ward Products Corp 212
Warren Wire Company 230
Waterman Products Co., Inc 301
Webster Electric Company 202
Western Gold & Platinum Works 230
Westinghouse Electric Corp 253
White Dental Mfg. Company, S. S. ... 278, 288
Whitehead Stamping Company 284
Wilton Tool Mfg. Co 313
Winchester Electronics, Inc 293
Workshop Associates, Inc 44

Zophar Mills, Inc 222

PROFESSIONAL SERVICES 329

SEARCHLIGHT SECTION
(Classified Advertising)

EMPLOYMENT
Positions Vacant 330-336
Selling Opportunities Offered 330
Positions Wanted 330
Selling Opportunities Wanted 330
Employment Services 330

EQUIPMENT
(Used or Surplus New)
For Sale 337-368, 370

WANTED
Equipment 336, 368

ADVERTISERS INDEX
Adelman, Nat 366
Admiral Corporation 332
Airborne Instruments Laboratory, Inc 332
Aircraft Armaments Inc 330
Alvaradio Supply Co 367
American Electrical Sales Co 364
American Electronics 368
Arma Corporation 335
Arrow Sales, Inc 362
Barry Electronics Corp 364
B & B Distributors 366
Bendix Aviation Corp 331
Berkeley Scientific Corp 331
Blan 365
Brooks Inc. B. D 366
Brush Development Co 335
California Institute of Technology 336
C & H Sales Co 362, 368
Chase Electronics Supply Co 361
Clark-Reiss Distributors 359
Columbia Electronics, Ltd 363, 368
Communications Devices Co 360
Communications Equipment Co 349, 350, 351
Cornell Aeronautical Laboratory, Inc 336
Cottone & Co., A 366
Dorne & Margolin 336
Drillick Electronic Sales Co 367
Drive-In Theatre Mfg. Co 368
Electro Impulse Laboratory 361
Electro Sales Co 347, 366
Electronic Engineering Co., of Calif 331
Electronic Speciality Supply Co 360
Electronicraft, Inc 345
Emerson Electric Mfg. Co 334
Empire Electronics Co 361, 367
E P C O 366
Forest Sales Co 362
Freeland Products Co 361
General Electric Co 333
General Motors Corp., AC Spark Plug Div. 332
General Precision Laboratory, Inc 330
Globe Trading Co 361, 367
Goodyear Aircraft Corp 331
Hall Electric, Ltd 358
Harmar Co., The 354
Hatry & Young 365
Hopkins Engineering Co., Inc 334
Horlick Co., William I 348
Hughes Research & Development Laboratories 334
Interstate Appliance Co 364
Instrument Associates 340
J. S. H. Sales Co 363
Kellett Aircraft Corp 335
Land-Air, Inc 333
Lear Inc 336
Lectronic Research Laboratories 346
Legri S. Company, Inc 356
Liberty Electronics, Inc 341
Life Electronic Sales 352
Lowenthal Co., T. R 358
Marino Radio Co 355
Maritime International Co 364
Maritime Switchboard 360
Maxson Corp., The W. L 332
McNeal Electric & Equipment Co 361
Mogull Co., Inc., Alexander 337
Monmouth Radio Laboratories 367
Norman Radio Distributors, Inc 367
Northrop Aircraft, Inc 334
Phillips Petroleum Co 335
Photocon Sales 366
Powell, Harold H 357
Precision Electrical Instrument Co 365
Radio Development & Sales Co 368
Radio & Electronic Surplus 364
Radio Ham Shack, Inc 338, 339
Raytheon Mfg. Co 367
Reliance Merchandizing Co 344
Rose Company, The 365
Sandia Corp 333
Sanett, Bob 336
Servo-Tek Products Co., Inc 342
TAB 370
Technical Radio Parts Co 366
Telemarine Communications Co 367
Universal General Corp 353
Vitro Corp. of America, The 335
Wells Sales, Inc 343
Westinghouse Electric Corp 336
Weston Laboratories 363
West Region Electronics 368
Wilcox Electric Co 333
Wilgreen 364

This Index is published as a convenience to the readers. Every care is taken to make it accurate, but ELECTRONICS assumes no responsibility for errors or omissions.

PRODUCTS OF W[illegible]RLD-[illegible]

D[illegible]VEN

CREATIVE-ENGINEERING

TYPE T-330

DAVEN ATTENUATORS

Exclusive Features:

1. "Knee-Action" Blade
   - Tamper proof
   - Uniform contact pressure and low contact resistance over the life of every unit.
   - Each rotor blade individually supported to give positive contact in operation under all types of conditions.
2. Brass Case of 2-Piece Construction
   - Greatly reduces clearance space required for removal of cover in rear of unit.
3. "Lock-Tite" Dust Cover
   - Held by positive, bayonet-type lock which prevents cover from falling off under stress of vibration.
4. Enclosed Roller-Type Detent Mechanism
   - For extra long life and positive indexing.
   - Addition of detent does not increase depth of unit.
5. Low-Loss Molded Terminal Board
   - For high resistance to leakage.
6. Rigidly Supported Resistor Strips
   - With air insulation.

YEARS AHEAD, CREATIVE-ENGINEERING has always characterized Daven's efforts in the production of electronic components and equipment.

The unit illustrated above is only one in a complete line of Daven's world-famous attenuators. Because this Company has pioneered and created so many worth-while improvements in units of this type, you can do no better than to specify Daven Attenuators.

Daven's skilled staff of specialist-engineers is at your "beck and call" to help with your problems in the selection of the right attenuators for the equipment you are designing.

Write for complete catalog data.

THE DAVEN CO.
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY

An improved miniature complement for TV tuners...

RCA-6X8 Triode-Pentode Converter

	Triode Unit	Pentode Unit
Heater Voltage (AC or DC)	6.3 volts	
Heater Current	0.45 ampere	
Plate Voltage	100	250 volts
Grid—No. 3 voltage	—	0 volts
Grid—No. 2 voltage	—	150 volts
Cathode-Bias Resistor	100	200 ohms
Amplification Factor	40	—
Plate Resistance (Approx.)	6900	750000 ohms
Transconductance	5800	4600 µmhos
Grid—No. 1 Bias (Approx.) for Plate Current of 10 µamp	-10	-10 volts
Plate Current	8.5	7.7 ma
Grid—No. 2 Current	—	1.6 ma

RCA-6BQ7 Medium-Mu Twin Triode

Heater Voltage (AC or DC)	6.3 volts
Heater Current	0.4 amp
Plate Voltage	150 volts
Cathode-Bias Resistor	220 ohms
Amplification Factor	35
Plate Resistance	5800 ohms
Transconductance	6000 µmhos
Plate Current	9 ma
Grid Volts (Approx.) for plate current of 10 µamp	-10 volts

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

New RCA 6BQ7 and 6X8 provide higher gain, reduced noise factor, and simplified tuner design

Two important new miniature tubes . . . specifically designed to improve the performance of VHF television tuners . . . have been developed by RCA in its continuing program of television research.

The RCA-6BQ7 medium-mu twin triode is intended primarily for use as the first RF amplifier in VHF tuners, or as a low-noise IF pre-amplifier in UHF television receivers employing a crystal mixer. Because of its high transconductance, low input capacitance, low input loading, and low plate-to-cathode capacitance, the RCA-6BQ7 gives especial advantages in driven grounded-grid or cascode-type circuits. In such circuits, this new tube provides a reduction in noise with resultant improved receiver sensitivity. It also reduces oscillator radiation.

The RCA-6X8 triode-pentode converter is approximately equivalent to a 6J6 triode unit and a 6AG5 pentode in one envelope, and therefore contributes to the simplification of front-end designs. It is designed primarily for use as the oscillator-mixer in VHF tuners having 40 Mc IF systems. Its low value of output capacitance enables the pentode section to work into a high-impedance plate circuit with resultant increase in mixer gain.

The RCA-6X8 is also especially suitable as an oscillator-mixer in AM/FM receivers.

RCA Application Engineers are at your call in adapting the RCA 6BQ7 and 6X8 to your specific designs. For prompt service, phone the nearest RCA office*. . . or write RCA, Commercial Engineering, Section 42IR, Harrison, N. J.

*(East) Humboldt 5-3900, 415 S. 5th Street, Harrison, N. J. (Midwest) Whitehall 4-2900, 589 E. Illinois Street, Chicago, Ill. (West) Madison 9-3671, 420 S. San Pedro Street, Los Angeles, Calif.

RADIO CORPORATION of AMERICA

ELECTRON TUBES — **HARRISON, N. J.**