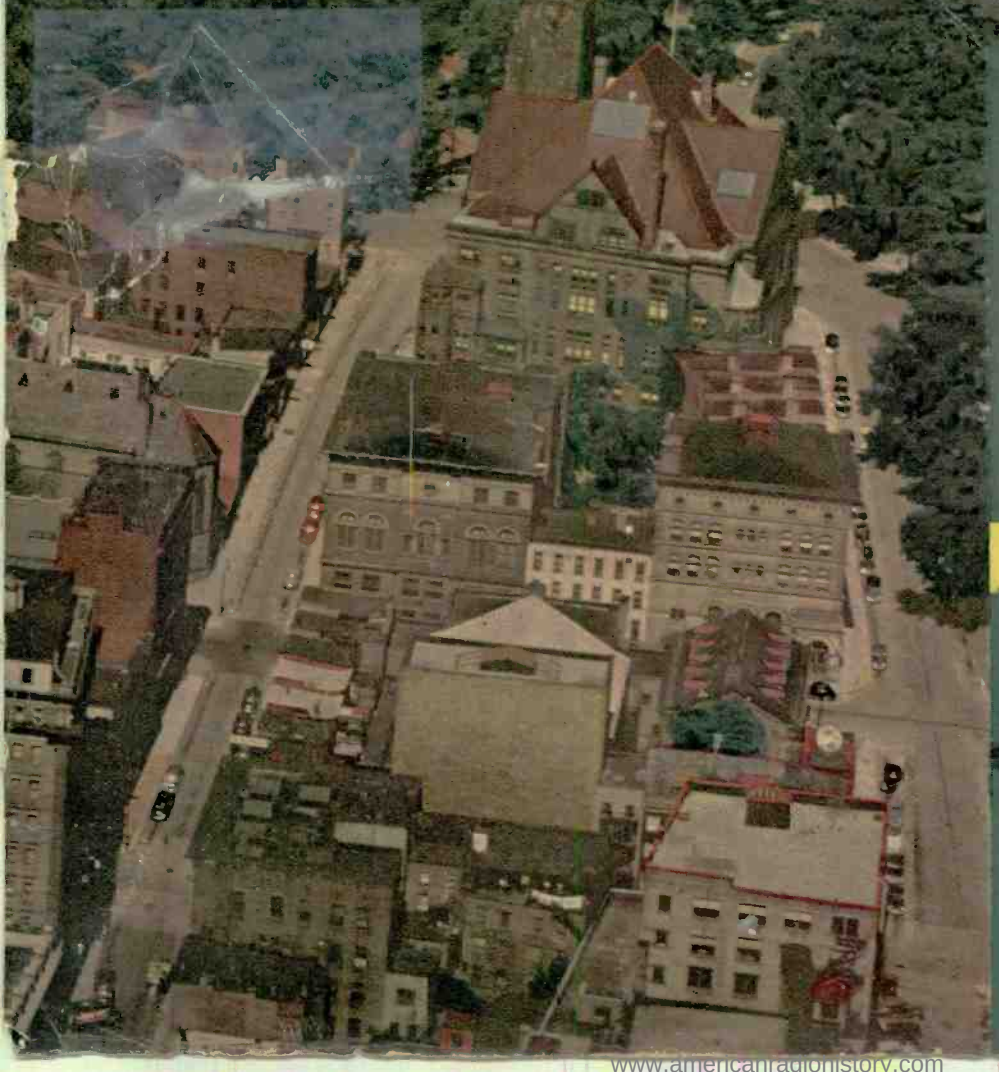
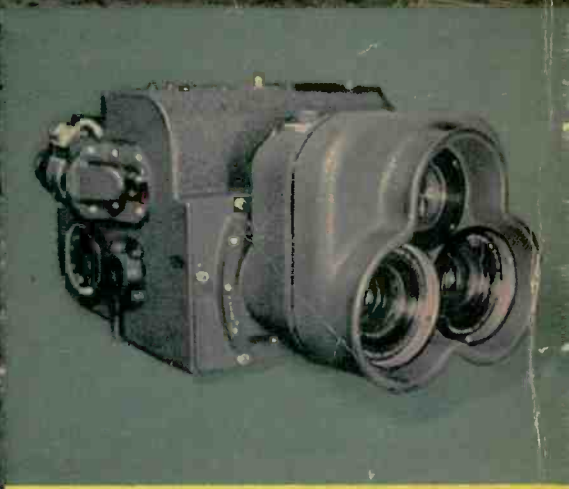
MAY · 1950

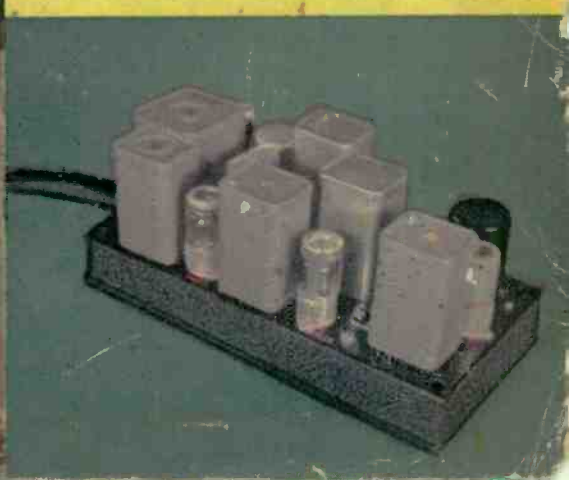
electronics

A McGRAW-HILL PUBLICATION

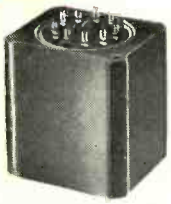




AUTOMATIC EXPOSURE CONTROL

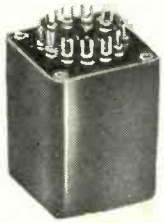


COMPONENTS FOR EVERY APPLICATION



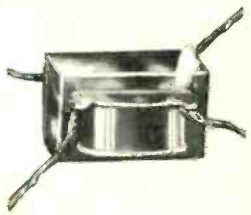
LINEAR STANDARD
High Fidelity Ideal

HIPERM ALLOY
High Fidelity . . . Compact



ULTRA COMPACT
Portable . . . High Fidelity

OUNCER
Wide Range . . . 1 ounce



SUB OUNCER
Weight 1/3 ounce

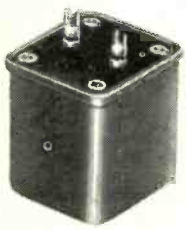
COMMERCIAL GRADE
Industrial Dependability

SPECIAL SERIES
Quality for the "Ham"

POWER COMPONENTS
Rugged . . . Dependable

VARITRAN
Voltage Adjustors

MODULATION UNITS
One watt to 100KW



VARIABLE INDUCTOR
Adjust like a Trimmer

TOROID HIGH Q COILS
Accuracy . . . Stability

TOROID FILTERS
Any type to 300KC

MU-CORE FILTERS
Any type ½ — 10,000 cyc.

EQUALIZERS
Broadcast [illegible]

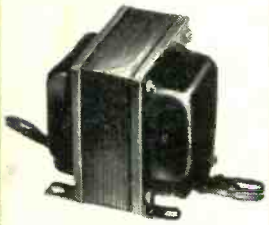
PULSE TRANSFORMERS
For all Services

HERMETIC COMPONENTS
Ceramic Terminals

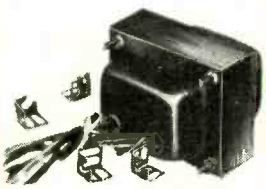
PLUG IN ADAPTER
Impedance Matching

FOSTERITE
Grade 3 JAN Components

CABLE TYPE
For mike cable line



VERTICAL SHELLS
Husky . . . Inexpensive



REPLACEMENT
Universal Mounting

STEP-DOWN
Up to 2500W . . . Stock

LINE ADJUSTORS
Match any line voltage

CHANNEL FRAME
Simple . . . Low cost

United Transformer Co.
150 VARICK STREET NEW YORK 13, N. Y.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

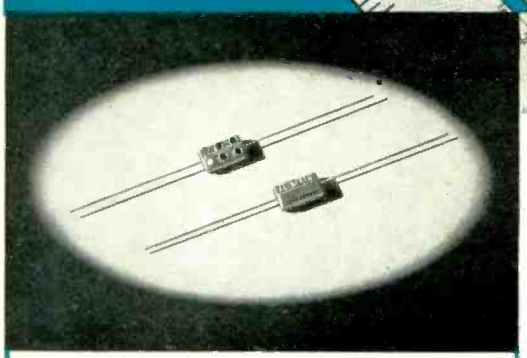
electronics

A McGRAW-HILL PUBLICATION

MAY • 1950

ELECTRONICS: May, 1950, Vol. 23; No. 5. Published monthly, with an additional issue in June, price 75¢ a copy for U. S. and possessions, and Canada; $1.50 for Latin America; $2.00 for all other foreign countries. Directory issue $2.00. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation. Subscription rates—United States and possessions, $6.00 a year, $9.00 for two years, $12.00 for three years, Canada (Canadian funds accepted), $10.00 a year, $16.00 for two years, $20.00 for three years. Latin American countries $15.00 for one year, $25.00 for two years, $30.00 for three years. All other countries $20.00 for one year, $30.00 for two years, $40.00 for three years. Please indicate position and company connections on all subscription orders. Entered as Second Class matter August 29, 1936, at Post Office, Albany, New York, under the act of March 3, 1879. 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.; 621 So. Hope St., Los Angeles 14; 738-9 Oliver Building, Pittsburgh 22. ELECTRONICS is indexed regularly in The Engineering Index.

DELIVERS *as* SPECIFIED



CM 15 MINIATURE CAPACITOR

Actual Size 9/32" x 1/2" x 3/16"
For Television, Radio and other Electronic Applications
2 — 420 mmf. cap. at 500v DCw
2 — 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 CAPACITORS

EL-MENCO is the standard of dependability in capacitors. Each tiny El-Menco Capacitor delivers at maximum in any climate under the most critical operating conditions. Before leaving the factory, they are tested for dielectric strength at *double* working voltage; for insulation resistance and capacity value. Each tiny El-Menco Capacitor meets and beats strict Army-Navy standards. Put them in *your* product and get real performance.

A COMPLETE LINE OF CAPACITORS TO MEET EVERY REQUIREMENT

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

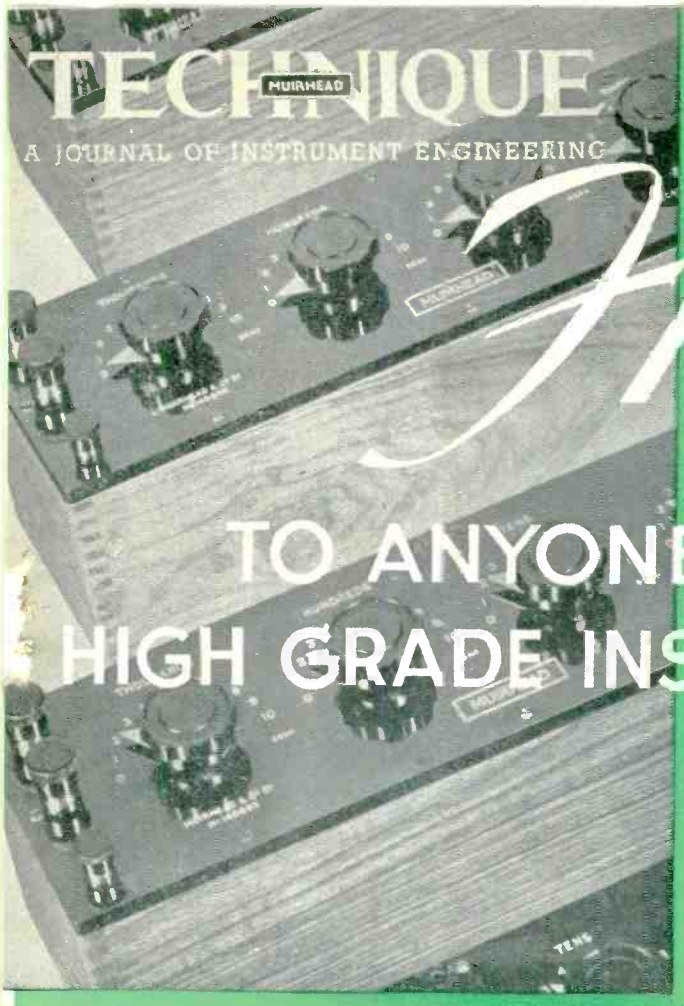
El-Menco

Write on your firm letterhead for Catalog and Samples

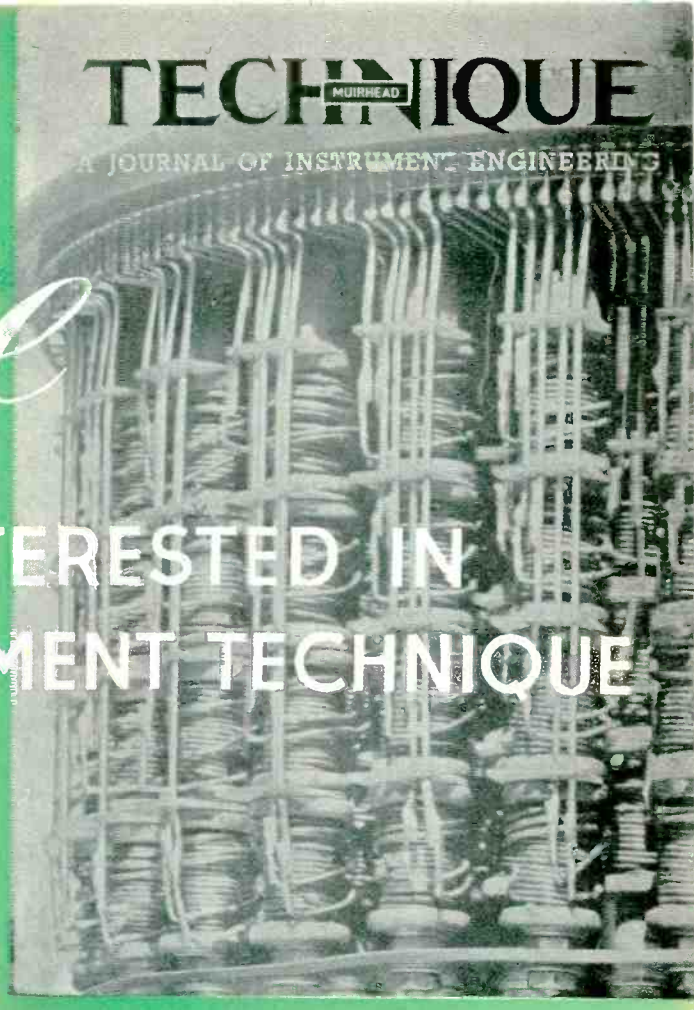
MOLDED MICA CAPACITORS **MICA TRIMMER**

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

ARCO ELECTRONICS, INC. 135 Liberty St., New York, N. Y.—Sole Agent for Jobbers and Distributors in U.S. and Canada

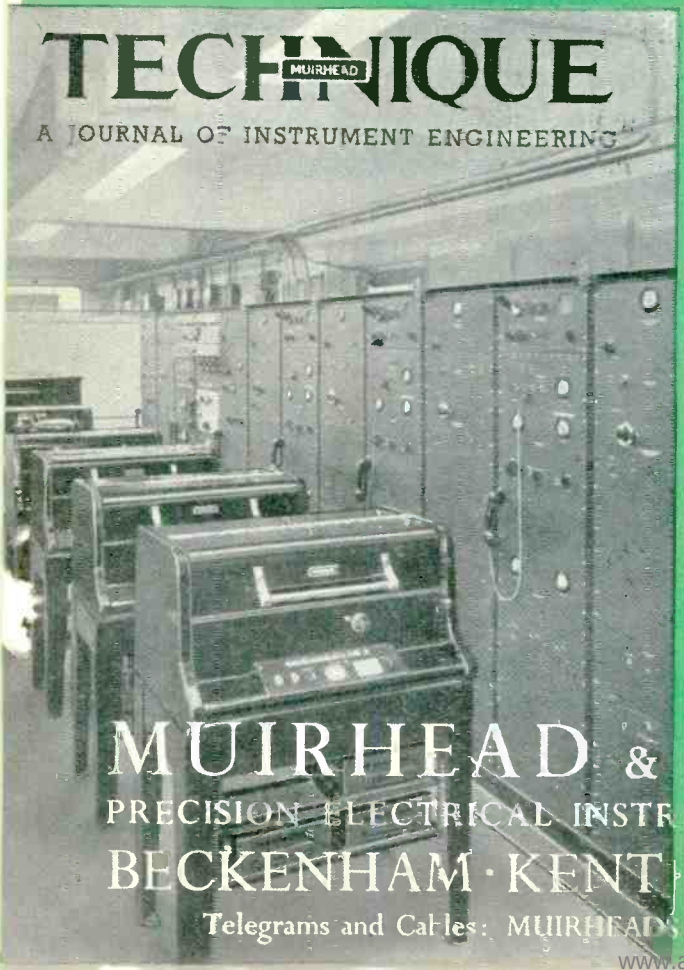


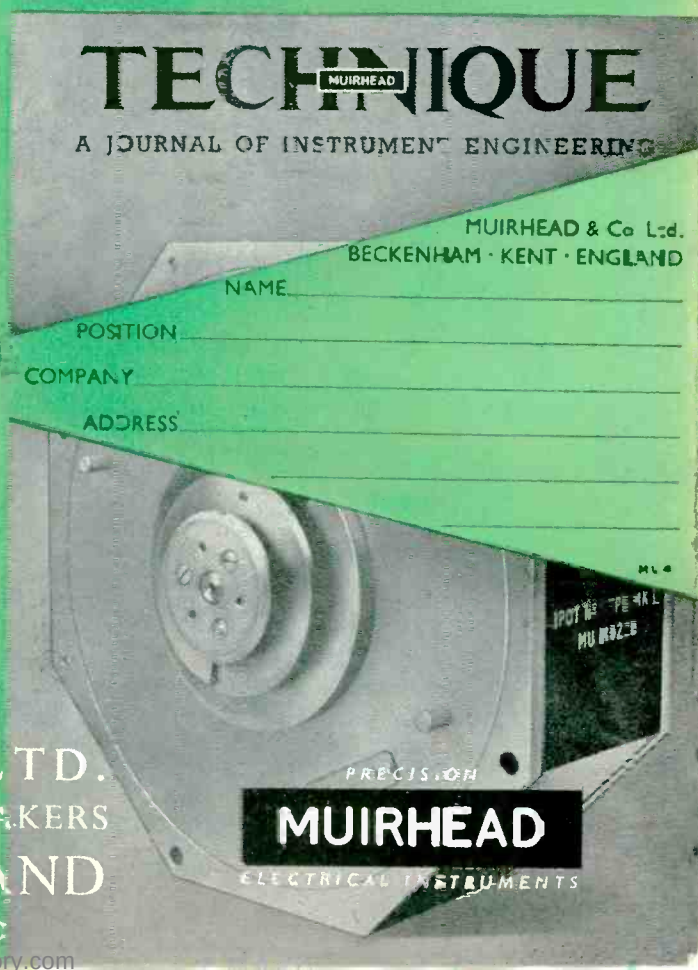
Free



TO ANYONE INTERESTED IN HIGH GRADE INSTRUMENT TECHNIQUE

MAIL THIS COUPON TO-DAY





MUIRHEAD & Co. LTD.

PRECISION ELECTRICAL INSTRUMENT MAKERS

BECKENHAM · KENT · ENGLAND

Telegrams and Cables: MUIRHEADS, ELMERS-END

Age is

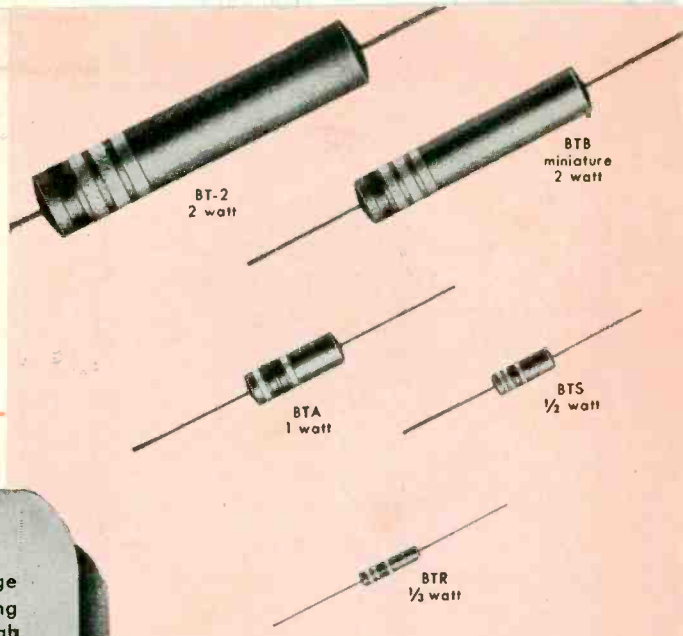
for resistors too!

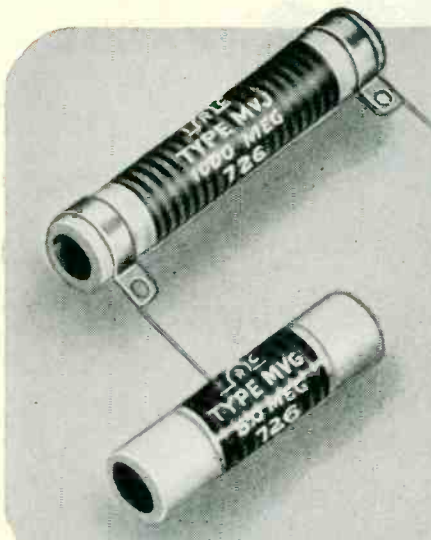
20 years ago, IRC advertised resistors for *television!* And right now, while we produce for today's requirements, electronics 1970 is on our drawing boards. 25 years young this year, IRC combines a quarter-century of specialized engineering with free, fresh thinking on new resistance problems. Result of this concentration:—A unique variety of high-quality, lower-cost resistance products, plus *unbiased* recommendations.

TELEVISION IN 1930

Advertising resistors for television 20 years ago was not nearly so advanced as IRC's present planning for the future.

important





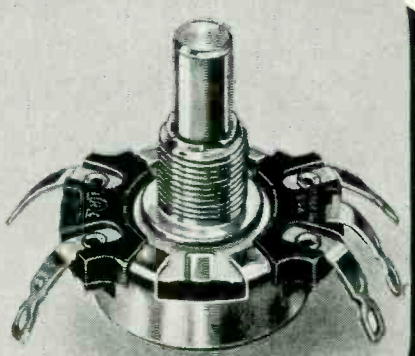
LESS THAN 3% change from original value due to aging has been proven for MV High Voltage Resistors. The resistance coating of Type MV's is stabilized at high temperature. Application of this filament coating in helical turns on a ceramic tube gives a conducting path of long effective length and permits the use of up to 100,000 volts for the MVR resistor. For high voltages where high resistance and power are required Type MV's are available in a wide range of values, sizes and terminals, all described in Bulletin G-1. Use the coupon to get your copy.

AGING IS NO PROBLEM

with Advanced BT Resistors. Filaments are pre-cured and stabilized, practically eliminating any possibility of resistance change through aging. Engineered to meet JAN-R-11 specifications for fixed composition resistors, IRC BT's have established their superiority in all important characteristics. Let us prove it to you . . . check the coupon for 12 page technical data Bulletin B-1. 21 characteristic charts compare IRC performance to rigid JAN specifications.

AFTER 10,000 CYCLES

of rotation IRC's new Q Control shows less than 10% change in resistance for values below 1 megohm, and not over 15% change for values of 1 megohm and above. Noise level after the same rigorous tests remains well within the industry standard for new controls. Investigate the many advantages of this modern size 15/16" diameter control. Complete mechanization in manufacture assures you of absolute uniformity and a dependable source of supply. Coupon brings you full details on Bulletin A-4.



IRC

Wherever the Circuit Says ~~~

Power Resistors • Voltmeter Multipliers • Insulated Composition Resistors • Low Wattage Wire Wounds • Controls • Rheostats • Voltage Dividers • Precisions • Deposited Carbon Precistors • High Frequency and High Voltage Resistors • Insulated Chokes

INTERNATIONAL RESISTANCE COMPANY

401 N. Broad Street, Philadelphia 8, Pa.

In Canada: International Resistance Co., Ltd., Toronto, Licensee

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

Please send me complete information on the items checked below:

☐ MV High Voltage Resistors (G-1) ☐ New Q Controls (A-4)
☐ Advanced BT Resistors (B-1) ☐ Name of Local IRC Distributor

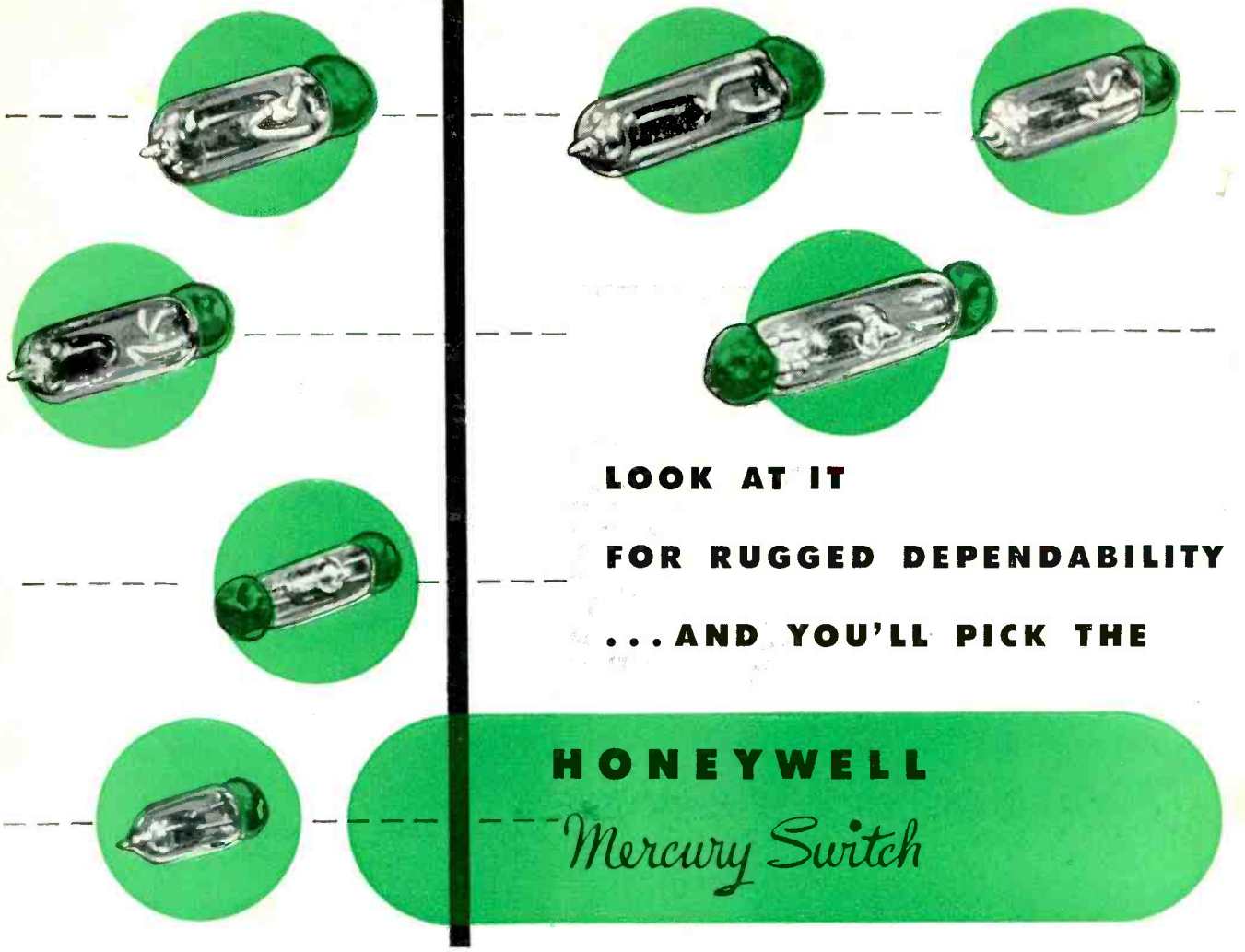
NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

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



LOOK AT IT

FOR RUGGED DEPENDABILITY

...AND YOU'LL PICK THE

HONEYWELL
Mercury Switch

It's THE inside story that counts with Honeywell Mercury Switches . . . the durability built into a simple construction of glass, electrodes and mercury. That's what delivers the rugged dependability of positive action each and every time . . . regardless of dust, dirt, dampness and corrosive atmospheres.

It's just such rugged dependability that has helped Honeywell Mercury Switches set continuous operation records that exceed 50 million cycles.

Honeywell Mercury Switches are tiny and compact . . . are adaptable to unusual mountings . . . and operate at low tilting angles. The complete line is at your command. Write for a copy of Catalog 1343 for down-to-earth information . . . or call in your local Honeywell engineer for a detailed discussion of a particular application.

COMMERCIAL · RESIDENTIAL · INDUSTRIAL
WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

MINNEAPOLIS-HONEYWELL REGULATOR CO.
INDUSTRIAL DIVISION
4428 Wayne Avenue, Philadelphia 44, Pa.
Offices in 77 principal cities of the United States, Canada and throughout the world

FOR
- POSITIVE ACTION
- LOW ANGULARITY
- LONGER LIFE
- WIDE SELECTION

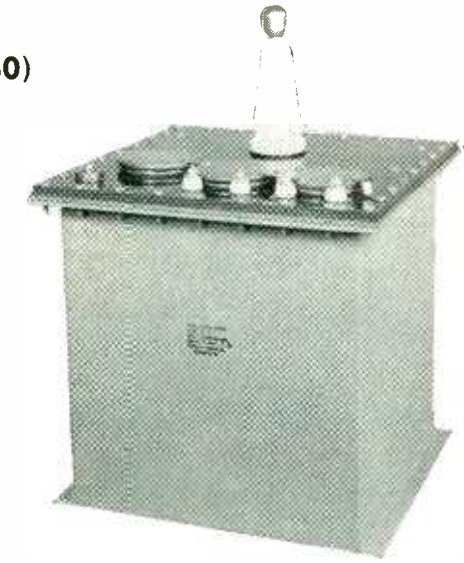
SPECIFY **HONEYWELL** *Mercury Switches*

MINNEAPOLIS Honeywell — *Mercury Switches* FOR POSITIVE ACTION — BROWN INSTRUMENTS

No. 4 of a Series

Another Engineer's Problem Solved*

SUBJECT: 50,000 Volt Power Supply (PS-50)



PROBLEM: To design a 60 cycle power supply to the following specifications:

Input voltage:	117VAC
Output voltage:	50 KV
Output current:	1 ma (at 50 KV)
Output ripple:	less than 1%
Output regulation:	4000 volts per milliampere
Altitude:	7500 feet
Temperature and humidity:	Indoor conditions, U.S.A.
Weight:	less than 100 lbs.
Size:	less than 2 cubic feet

SOLUTION:

The PS-50 weighs only 84 lbs and measures only 12½"x12½" base by 12½" high plus a 6" insulator. Conventional power supplies of comparable electrical performance weigh 250—350 lbs and occupy 3—5 cubic feet. The weight and space savings in the PS-50 are due to the design features embodied in the entire line of HiVolt Power Supplies . . . carefully degassed and dehydrated oil, synthetic plastic insulation and up-to-date engineering.

The distinguishing feature of the PS-50 is the ease by which the three 5825 Rectifiers can be replaced. In other oil-filled supplies, the entire cover must be removed to replace the tubes. The carefully processed oil becomes contaminated. In the PS-50, the rectifier tubes are set in bakelite tube-wells. The oil in these tube-wells does not mix with the oil in the transformer-capacitor compartment. The spacings around the tubes are great enough so that they can be filled with unprocessed oil without danger of corona or flashover. The gasket-sealed covers on the tube-wells are easily removed.

There are separate connections for the filament and plate transformers so that an input variac may be used to change output voltage.

• • •

What is YOUR engineering problem?
Your inquiries will receive immediate attention.

• • •

We manufacture a standard line of Plasticon Capacitors, Pulse Forming Networks and High Voltage Power Supplies.

WRITE FOR OUR CATALOG!

Condenser Products Company

1375 NORTH BRANCH STREET • CHICAGO 22, ILLINOIS

Laboratory Products for CHEMICAL ANALYSIS

G-E X-RAY PHOTOMETER

For analyzing solids, liquids, or gases

This instrument, used to determine the concentration of one element or compound in the presence of others, speeds up routine tests required in process control.

For example, a technician can quickly determine the tetraethyl lead content of gasoline, or the chlorine and sulphur content of oils. Write for GEC-412.

Installation of the G-E X-ray photometer is simple.

G-E MASS SPECTROMETER

For chemical analysis by mass separation

The improved G-E mass spectrometer automatically and accurately records mass concentrations over the mass range of 1 to 330. Readings are direct.

It is well suited for:

routine process control — **study of reaction rates**
research using isotopes — **detection of impurities**

Write for GEC-587.

G-E mass spectrometer gives direct readings—no waiting for photographs.

G-E ULTRASONIC GENERATOR

For industrial research in ultrasonics

To help you carry on industrial research, G.E. offers a new ultrasonic generator for:

Studying oxidation, hydrolysis, and reduction
Transforming immiscible liquids into stable emulsions

Some plants, for example, are studying the use of ultrasonics to degrease products and to develop improved fuels. Write for GEC-544.

G-E ultrasonic generator is simple to operate.

G-E DEWPOINT RECORDER . . . for determining the moisture content of gases

The dewpoint recorder, which records the moisture content of gases, helps you to maintain close quality control of factory processes, thereby reducing spoilage.

For example, you can use the recorder to control mechanical or chemical dryers, and furnace atmospheres. Write for GEC-4613. Apparatus Dept., General Electric Company, Schenectady, N. Y.

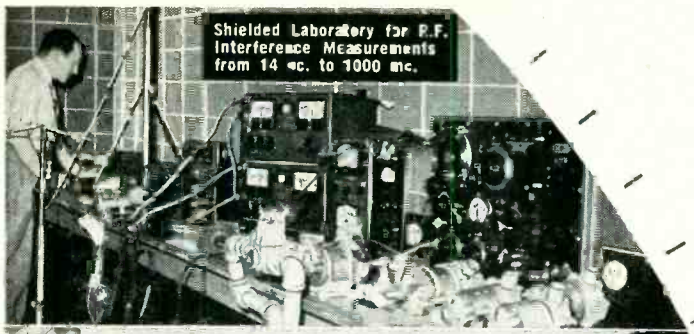
Dewpoint recorder continuously records dewpoint temperature.

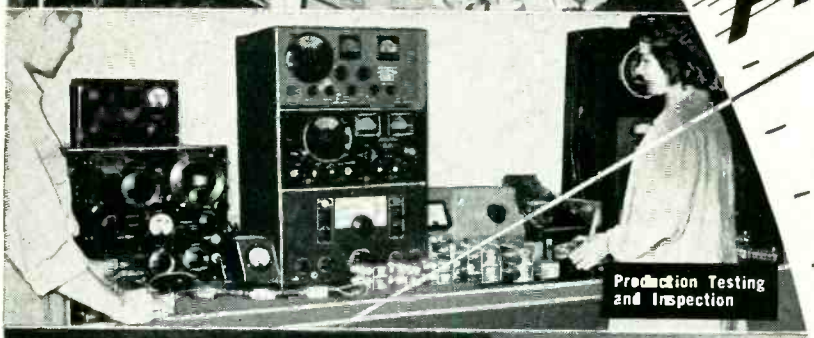
FOR HELP ON your measuring and testing problems . . . call the nearest G-E sales office.

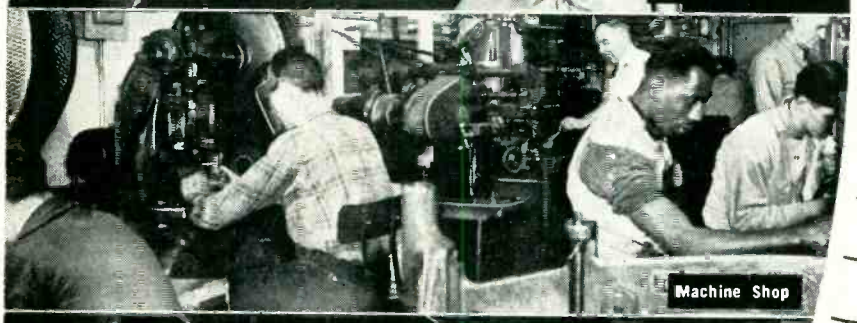
You Can Put Your Confidence in—

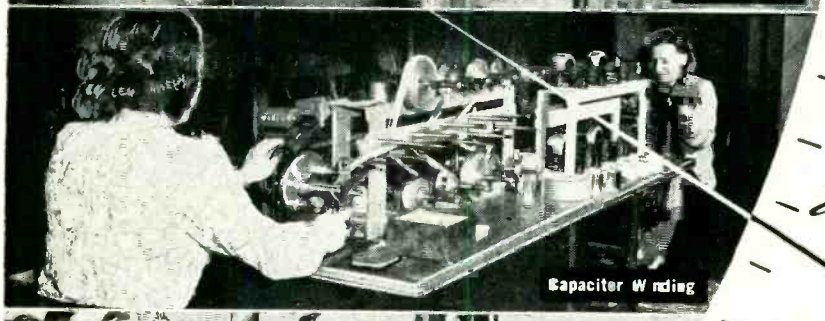
GENERAL ELECTRIC

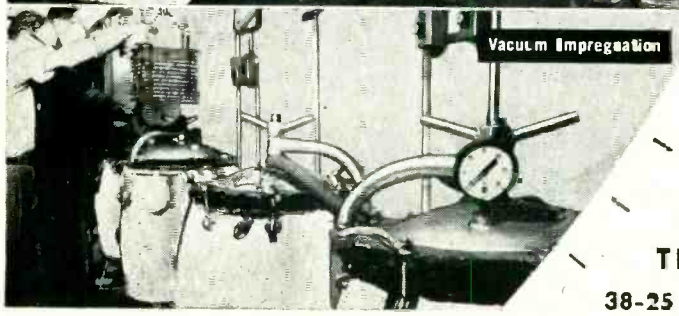
697-24C











FILTRON'S Ahead

in

- **QUALITY**
- **PRODUCTION**
- **ENGINEERING**

FILTRON'S COMPLETE FACILITIES: capacitor manufacturing, coil winding, stamping department, tool and die shop, and assembly department, together with its Engineering and Research laboratories insures quality production and ON SCHEDULE DELIVERY.

FILTRON'S *advanced* engineering, due to constant research and development by engineers with years of R.F. INTERFERENCE experience has resulted in *smaller, lighter,* and more *efficient* R.F. Interference Filters.

FILTRON'S completely equipped shielded laboratory is available for the R.F. Interference testing and filter design for your equipment *...to specification requirements.*

With over *400 standard filters* to choose from, and the engineering know-how to custom design filters to meet specific size and mounting requirements, Filtron's engineers will specify the *right filter* for your application.

FILTRONS are suppressing R.F. Interference in modern Military Aircraft, Naval Equipment and Ground Signal Installations.

FILTERED BY FILTRON means...
RADIO INTERFERENCE FREE PERFORMANCE.

RF INTERFERENCE FILTERS FOR:

Electronic Controls	Signal Systems
Electric Motors	Business Machines
Electric Generators	Electric Appliances
Electronic Equipment	Electronic Signs
Fluorescent Lights	Electronic Heating Equipment
Oil Burners	

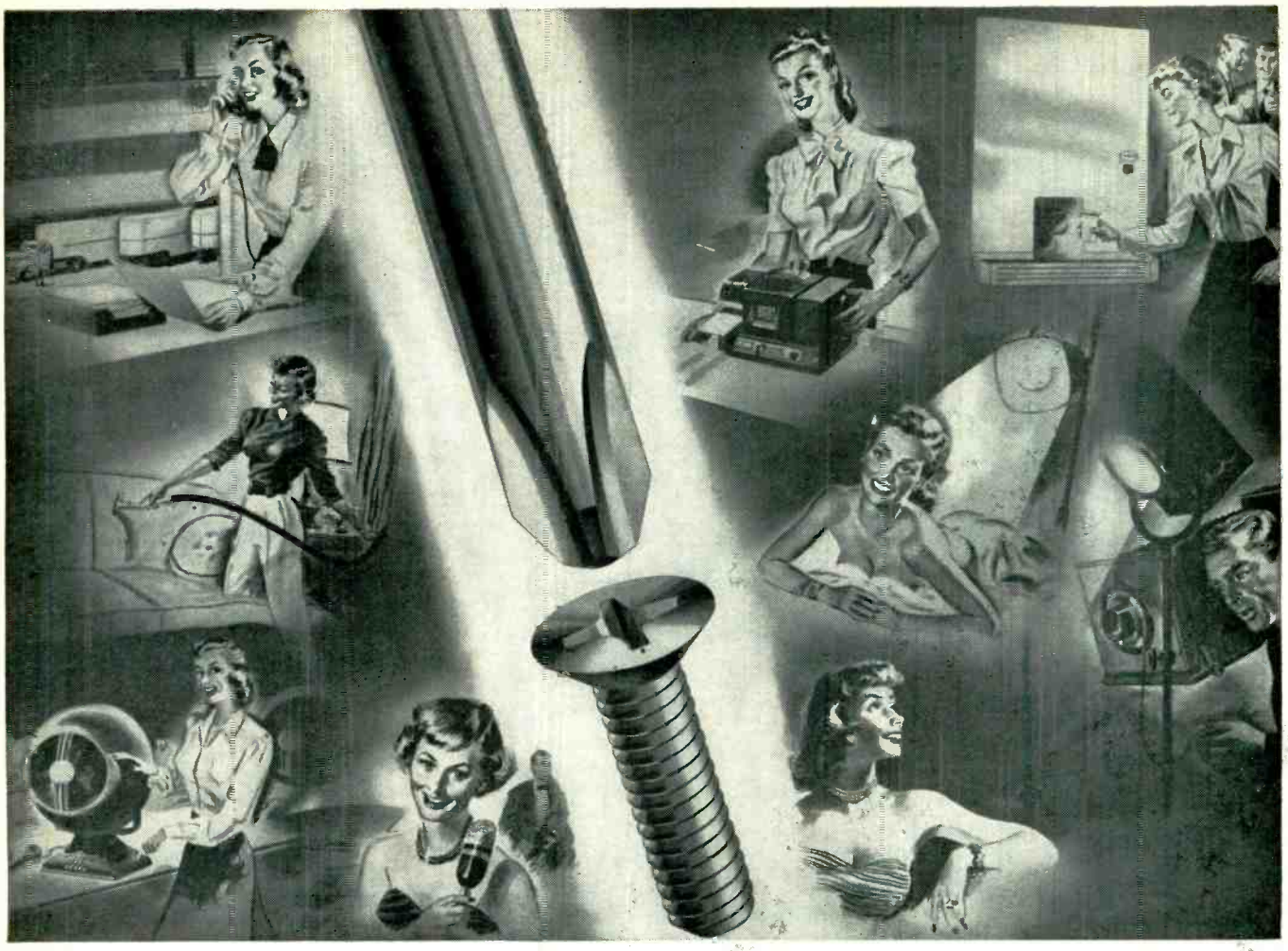
filtered by FILTRON

LOCKHEED XF-90

An inquiry on your Company letterhead will receive prompt attention

THE FILTRON CO., INC.
38-25 BELL BOULEVARD, BAYSIDE, NEW YORK, N. Y.

LARGEST EXCLUSIVE MANUFACTURERS OF RF INTERFERENCE FILTERS



Top Products in Every Line
Cut Costs and Build Sales
with AMERICAN PHILLIPS SCREWS

HOW THEY CUT COSTS: From vacuum cleaners to vending machines; from trucks to office appliances and suntan lamps . . . manufacturers use American Phillips Screws to speed up production, stop spoilage, and cut unit-costs. For these modern fastenings banish fumbling, crooked driving and scarred surfaces . . . *cut assembly time as much as 50%.*

HOW THEY BUILD SALES: On any product, the crossed-recess of American Phillips Screws is a "green light" to buyers who stop and look for an outward index of inward quality. They know that smooth-headed American Phillips Screws protect product-performance by staying tight and resisting vibration. Does *your* product have these two American Phillips advantages of cost-reduction and sales-promotion? No reason why it shouldn't . . . *for American Phillips Screws always cost least to use.* Write for proof.

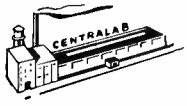
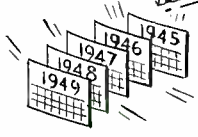
AMERICAN SCREW COMPANY, Main Office: Providence 1, R. I.
Plants at Willimantic, Conn., and Norristown, Pa.
Warehouses at: Chicago 11: 589 E. Illinois St. Detroit 2: 502 Stephenson Bldg.

AMERICAN PHILLIPS Screws

ALL TYPES
ALL METALS: Steel, Brass, Bronze, Stainless Steel, Aluminum, Monel, Everdur (silicon bronze)

ADVENTURES IN ELECTRONIC DESIGN

Centralab's Special Electronic Component Parts Design Service May Solve a Problem for You

How many times  have your design engineers  been called  upon to develop new equipment only to be faced with a new bug —  or special problem of one variety or another? Everything about the new gadget seems  but you need a special part to lick  the special problem. To Centralab Engineers  these queer bugs!  and special problems are as welcome as a Rolls Royce  to a burlesque queen  They look on these problems as their own  and from their bag of 30 years of electronic experience — they always come up with an answer.  Take a look  over the next two pages  . See for yourself  some of these "Specials" in ceramics,  switches  and capacitors  that CRL  has developed to meet special needs during the past few years  . Maybe you'll see one that can help  — or you'll know where to go with your next special problem.  of course!

Centralab — **DEVELOPMENTS THAT CAN HELP YOU**

Division of GLOBE-UNION INC. • Milwaukee

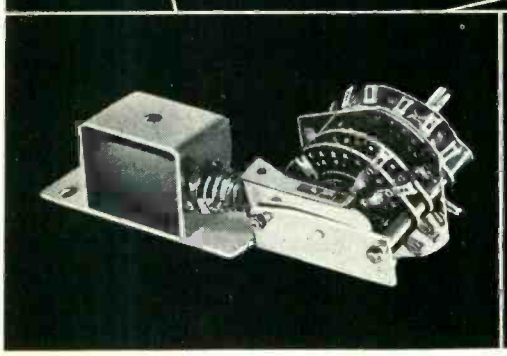
What's your need in

MAY 1950

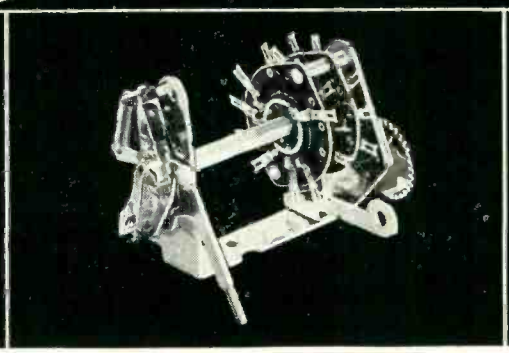
Centralab offers 30 years experience in special electronic part design and manufacture

Define your problem— bring it to Centralab

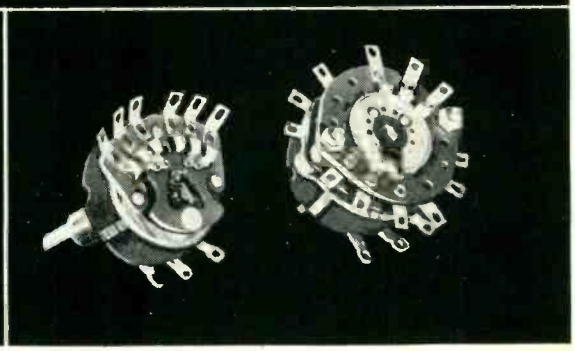
If you have an unusual electronic or ceramic part design and fabrication problem — bring it to Centralab. It may very well happen that with a combination of standard CRL parts — or a slight modification thereof — we can help you solve it. If special requirements warrant — we can design a completely new unit and produce it for you. All we need is your exact requirements as to purpose, size, capacity, voltage and resistance. Write Dept. "E" outlining your problem. No obligation. Centralab Division, Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wisconsin.



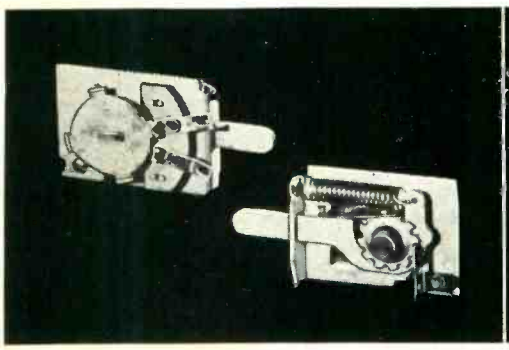
1 A solenoid operated selector switch.



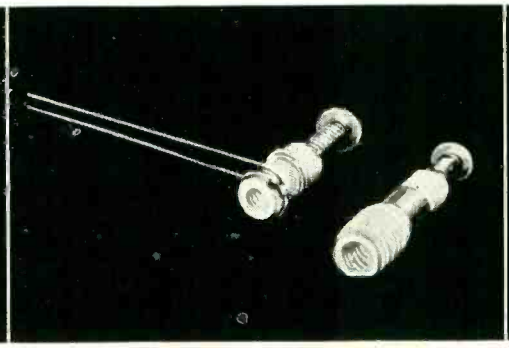
2 Automatic selector switch for automobile radio.



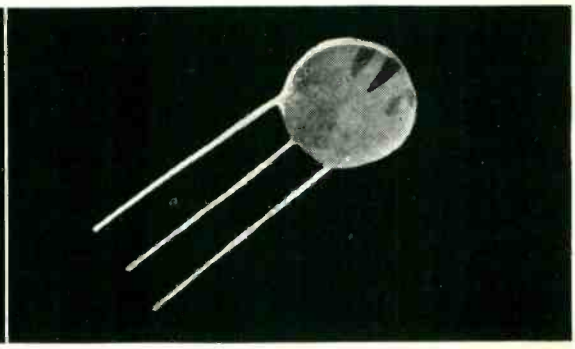
3 Combination control and selector switches.



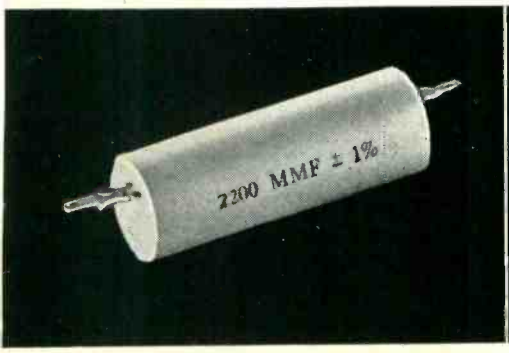
4 Front and rear view—push button type tone switch.



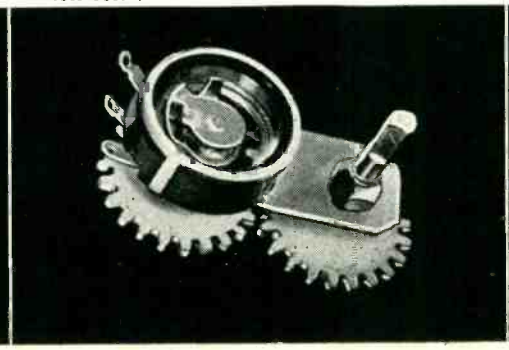
5 Left — dual TV Trimmer. Right — TV trimmer combined with ceramic coil form.



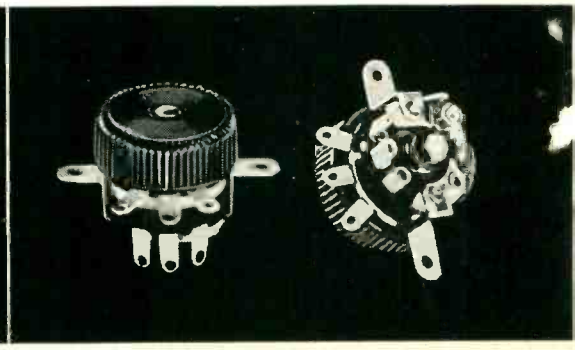
6 5000V dual disc ceramic capacitor. Actual size, slightly larger than a nickel.



7 Special tubular ceramic capacitor — 2200 MMF ± 1%.

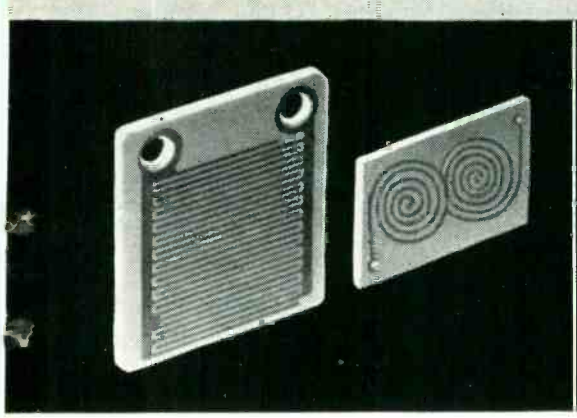


8 Control with offset shaft and operating gears.

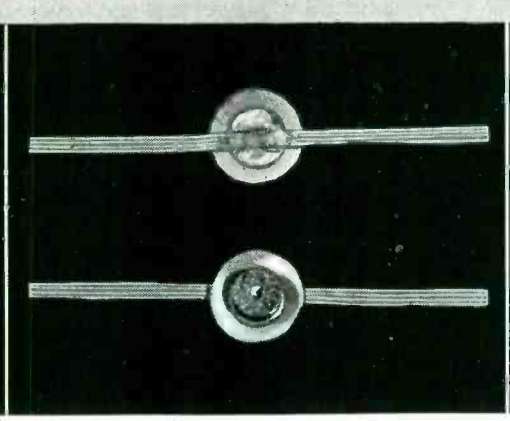


9 Front and rear view — Centralab's miniature (smaller than a dime!) Dual Model 1 Control.

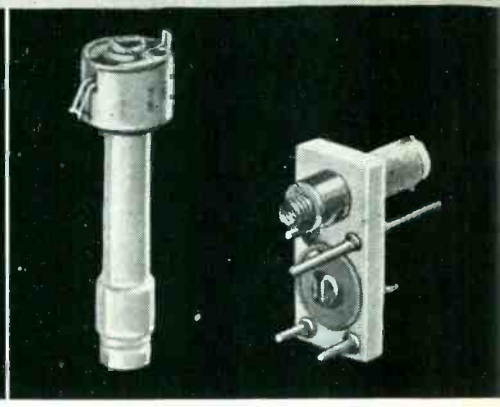
Special Electronic Parts?



10 Examples of special "printed circuit" parts. Left — a fixed value capacitor. Right — an inductance coil.

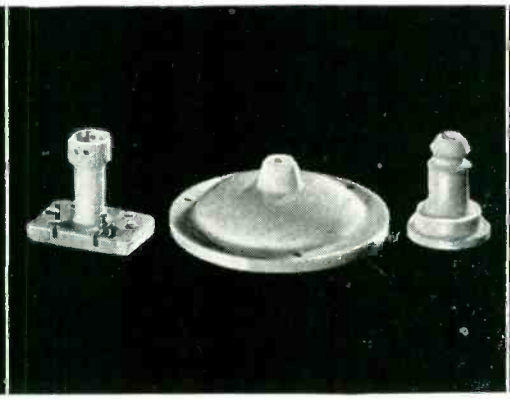


11 Front and rear view — special type by-pass capacitor.

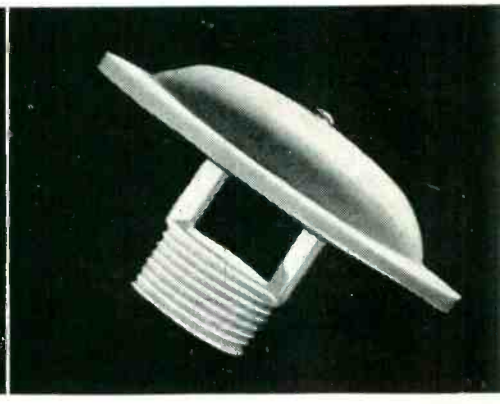


12 Special ceramic coil form and trimmer assembly.

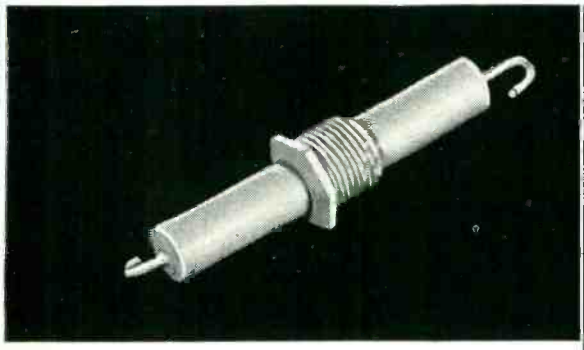
13 Steatite ceramic coil form with bonded metal end.



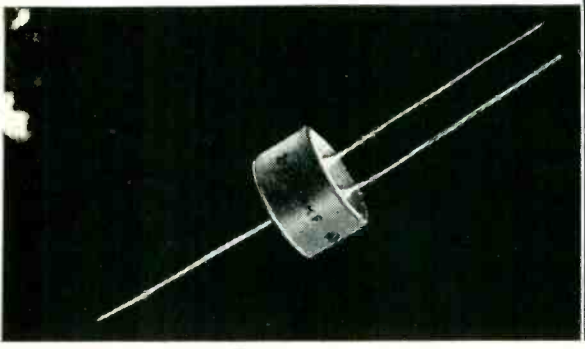
14 Centralab Steatite ceramic used in special forms — coils etc.



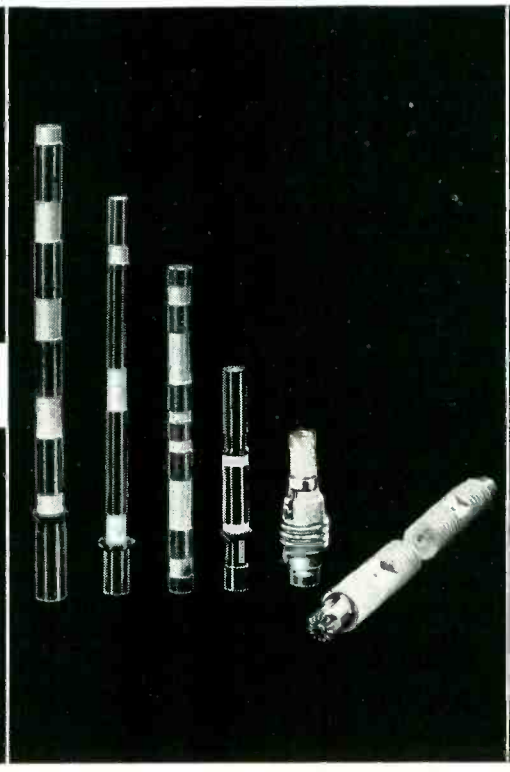
15 CRL Steatite used as part of diffusion system in hot water heater.



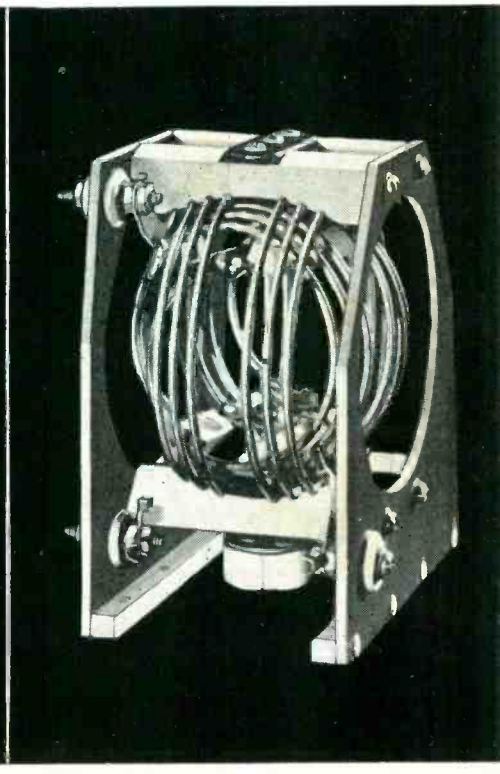
16 Special feed-thru by-pass capacitor.



17 Special 5-10 KV hi-voltage capacitor.



18 Metallized ceramic rods for rotor sections in hi-voltage variable transmitter capacitors, and resonant lines.



19 Special antenna loading variometer.

IMPORTANT BULLETINS FOR YOUR TECHNICAL LIBRARY!

They're factual!

THEY'RE FREE!

Choose From This List!

Centralab Printed Electronic Circuits

973 — AMPEC — three-tube P. E. C. amplifier.
42-6 — COUPLATE — P. E. C. interstage coupling plate.
42-22 — VERTICAL INTEGRATOR — for TV application.
42-24 — CERAMIC PLATE COMPONENTS — for use in low-power miniature electronic equipment.
42-27 — MODEL 2 COUPLATE — for small or portable set applications.
999 — PENTODE COUPLATE — specialized P. E. C. coupling plate.
42-9 — FILPEC — Printed Electronic Circuit filter.

Centralab Capacitors

42-3 — BC TUBULAR HI-KAPS — capacitors for use where temperature compensation is unimportant.
42-4 — BC DISC HI-KAPS — miniature ceramic BC capacitors.
42-10 — HI-VO-KAPS — high voltage capacitors for TV application.
695 — CERAMIC TRIMMERS — CRL trimmer catalog.
981 — HI-VO-KAPS — capacitors for TV application. For jobbers.
42-18 — TC CAPACITORS — temperature compensating capacitors.
814 — CAPACITORS — high-voltage capacitors.
975 — FT HI-KAPS — feed-thru capacitors.

Centralab Switches

953 — SLIDE SWITCH — applies to AM and FM switching circuits.
970 — LEVER SWITCH — shows indexing combinations.
995 — ROTARY SWITCH — schematic application diagrams.
722 — SWITCH CATALOG — facts on CRL's complete line of switches.

Centralab Controls

42-19 — MODEL "1" RADIOHM — world's smallest commercially produced control.
42-85 — MODEL "2" RADIOHM — Radio and TV controls.

Centralab Ceramics

967 — CERAMIC CAPACITOR DIELECTRIC MATERIALS.
720 — CERAMIC CATALOG—CRL steatite, ceramic products.

Look to CENTRALAB in 1950! First in component research that means lower costs for the electronic industry. If you're planning new equipment, let Centralab's sales and engineering service work with you. For complete information on all CRL products, get in touch with your Centralab Representative. Or write direct.

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

203-5

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

☐ 973	☐ 42-24	☐ 42-9	☐ 42-10	☐ 42-18	☐ 953	☐ 722
☐ 42-6	☐ 42-27	☐ 42-3	☐ 42-85	☐ 814	☐ 970	☐ 42-19
☐ 42-22	☐ 999	☐ 42-4	☐ 695	☐ 975	☐ 995	☐ 967
			☐ 981			☐ 720

Name.....

Address.....

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

TEAR OUT COUPON
for the Bulletins you want

Centralab
CRL
Division of GLOBE-UNION INC. • Milwaukee

QUALITY... Plus ADAPTABILITY

CLEVELAND

COSMALITE* AND CLEVELITE* SPIRALLY LAMINATED PAPER BASE PHENOLIC TUBES

Cosmalite is known for its many years of high quality performance. Clevelite is the new improved tubing designed to meet more exacting specifications.

"Cleveland" has an enviable record of service and dependability. Your orders receive prompt attention. Deliveries are made in time for your production schedules.

For the best . . . "Call Cleveland." Samples on request.

*Trade Marks

Of proven Performance in the Radio and Te evision fields

Excellent for Motors, Relays, Trans itters, Fans, Controls, Switches, Bobbins and many others.

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

CANADA	WM. T. BARRON, EIGHTH LINE, RR #1, OAKVILLE, ONTARIO
METROPOLITAN NEW YORK	R. T. MURRAY, 614 CENTRAL AVE., EAST ORANGE, N.J.
NEW ENGLAND	E. P. PACK AND ASSOCIATES, 968 FARMINGTON AVE. WEST HARTFORD, CONN.

STROBOSCOPES

FIVE stock models of stroboscopes for scientific use are manufactured by General Radio Company from designs of Edgerton, Germeshausen and Grier.

These stroboscopes have flash durations from 2 to 10 or 15 *millionths* of a second . . . more than ample to 'stop' motion in almost any machinery used in Industry. They are NOT replaceable by the relatively slow speed "stroblites" or "speed lights" whose average flash duration is about ten *thousandths* of a second, ample for ordinary commercial photography but far too slow to stop motion in machinery.

The applications of G-R stroboscopes are countless. Both as electrical tachometers . . . requiring no mechanical connection to the machine whose speed is being measured . . . and as motion-stopping devices for s-l-o-w speed observation of machines in operation, these stroboscopes are widely used in the design, testing, maintenance and sale of all kinds of mechanical and electro-mechanical equipment.

Most G-R stroboscopes furnish ample light for single- and multiple-flash photography of high-speed motion.

In the study and analysis of any rotating or reciprocating motion, even in the most complex machine, G-R stroboscopes provide a research and design tool whose usefulness cannot be duplicated by any other means. If you have any problem in the operation of any machine or part . . . if you'd like to see your equipment in slow motion . . . even as slow as a fraction of an rpm . . . G-R stroboscopes probably can be of inestimable value.

Our engineering department will be glad to advise you not only in the selection of the correct stroboscope but also how to use it for your particular problem.

GENERAL RADIO COMPANY

for INDUSTRY

Type 631-B STROBOTAC

The original and basic stroboscope. A small, compact, lightweight and simple-to-use device, the STROBOTAC can be operated by anyone with a few minutes practice.

The STROBOTAC contains a Strobotron neon lamp, flashes from which last only 5 to 10 *millionths* of a second. The flashing rate of the lamp is varied manually by a knob to which is attached a drum scale reading directly in rpm from 600 to 14,400. By using multiple flashes the STROBOTAC can be used to measure speed and to slow motion up to 100,000 rpm.

In addition, the Strobotac can be flashed by an external contactor, the a-c line or an oscillator.

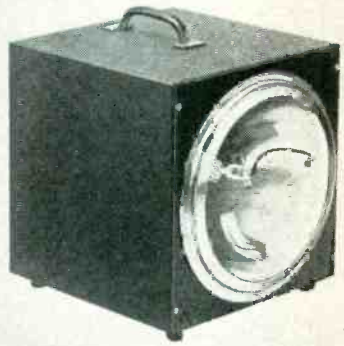
A special TYPE 631-BL STROBOTAC has an additional speed range extending down to 60 rpm for extra-slow-moving machines.

Both STROBOTACS operate directly from any 115-volt 60-cycle a-c line. Both come to you complete and ready for immediate use.

TYPE 631-B STROBOTAC (Standard model) **$125.00**

TYPE 631-BL STROBOTAC (with extra low-speed range) **155.00**

Type 648-A STROBOLUX



The STROBOLUX is an auxiliary light source to be used with the STROBOTAC where considerably higher light output is needed.

The STROBOLUX gives about 100 times as much light as the STROBOTAC. It is particularly useful where large areas are to be illuminated, where photography is required, and on brightly lighted surfaces. Single-flash as well as multiple-flash photographs of areas approximately 2-feet square are possible with the STROBOLUX.

The duration of each flash is 10 to 15 millionths of a second at normal speeds and about 30 millionths at low speeds and for single flashes. The multiple flashing rate is up to 6000 per minute. The accuracy is that of the STROBOTAC.

TYPE 648-A STROBOLUX **$205.00**

Type 1532-A STROBOLUME

The STROBOLUME is an extra-high-intensity light source for use either with the slow-speed Type 631-BL STROBOTAC, an external contactor, or for single-flash photography where the very short flash duration of 10 millionths of a second is necessary

When used with the slow-speed STROBOTAC, the STROBOLUME can be flashed up to 1200 per minute for short periods. An external contactor, attached to a shaft, can be used to flash the STROBOLUME at any speed up to 1200 flashes per minute.

A push button and cord are supplied for single flash work. Several types of contactors are available.

TYPE 1532-A STROBOLUME **$225.00**

Type 1530-A MICROFLASH

For ultra-high-speed photography, the MICROFLASH, with its flash duration of only *2 millionths* of a second, is ideal. It can be used to stop such high-speed motion as projectiles in flight and pressure waves in fluids and gases. Its uses in industry are countless where the study of high-speed motion is desired.

The MICROFLASH operates from an a-c line, is portable and can be fired either from the sound wave picked up by the microphone (supplied with the instrument) or by an external contactor.

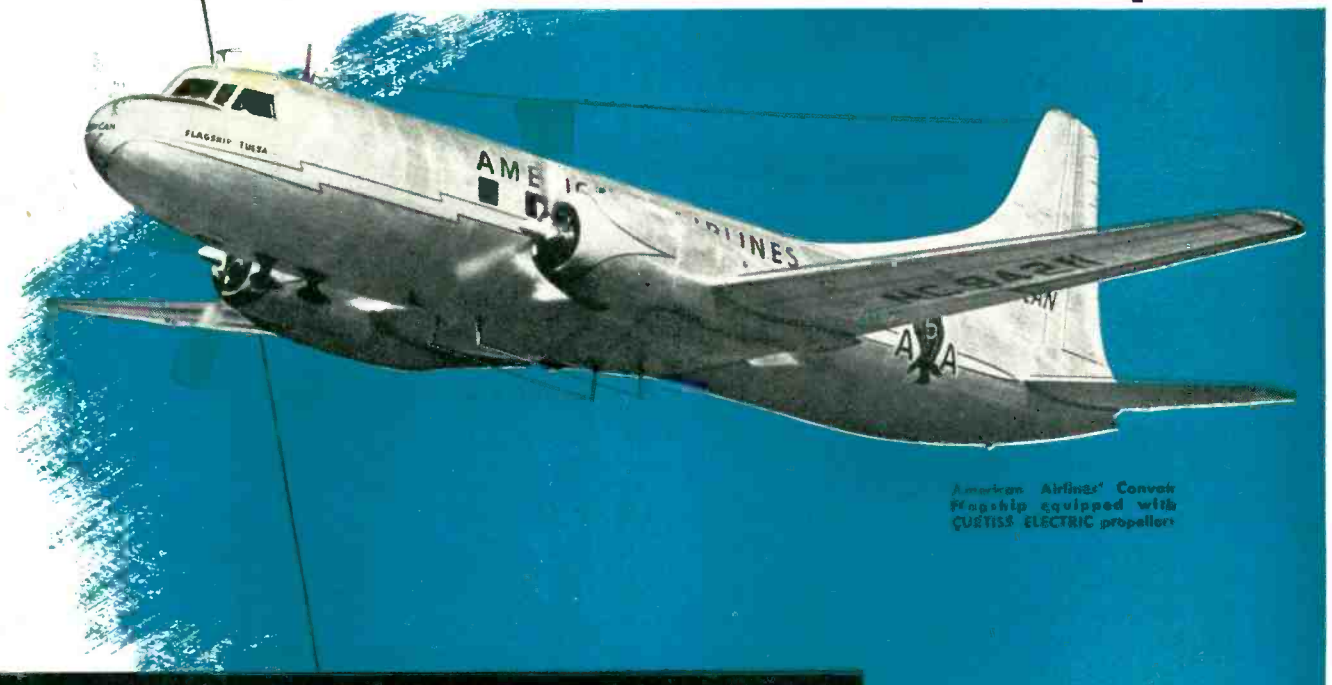
TYPE 1530-A MICROFLASH **$600.00**

WRITE FOR *"EYES FOR INDUSTRY"*

275 Massachusetts Avenue, Cambridge 39, Massachusetts

90 West St., New York 6 **920 S. Michigan Ave., Chicago 5** **1000 N. Seward St., Los Angeles 38**

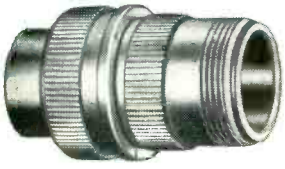
For Vital Control Circuits in Curtiss Electric Propellers



American Airlines' Convair Flagship equipped with CURTISS ELECTRIC propellers

IT'S BENDIX-SCINTILLA ELECTRICAL CONNECTORS

... THE FINEST MONEY CAN BUY



CHECK THESE ADVANTAGES

- Moisture-proof
- Radio Quiet
- Single-piece Inserts
- Vibration-proof
- Lightweight
- High Insulation Resistance
- Easy Assembly and Disassembly
- Fewer Parts than any other Connector
- No additional solder required

SEE OUR EXHIBIT
AT THE
HOUSTON INDUSTRIAL EXPOSITION
May 10 Thru 14, 1950

Unfailing dependability is the standard set by Curtiss propellers and American Air Lines in their selection of equipment.

Bendix-Scintilla is therefore the logical choice for the electrical connectors in the Curtiss Electric propellers on American Flagships.

In fact, wherever circuits must be arranged to connect and disconnect with ease and certainty Bendix-Scintilla is the choice.

Remember whenever there is no compromise with quality—it pays to specify Bendix-Scintilla electrical connectors—the *finest* money can buy.

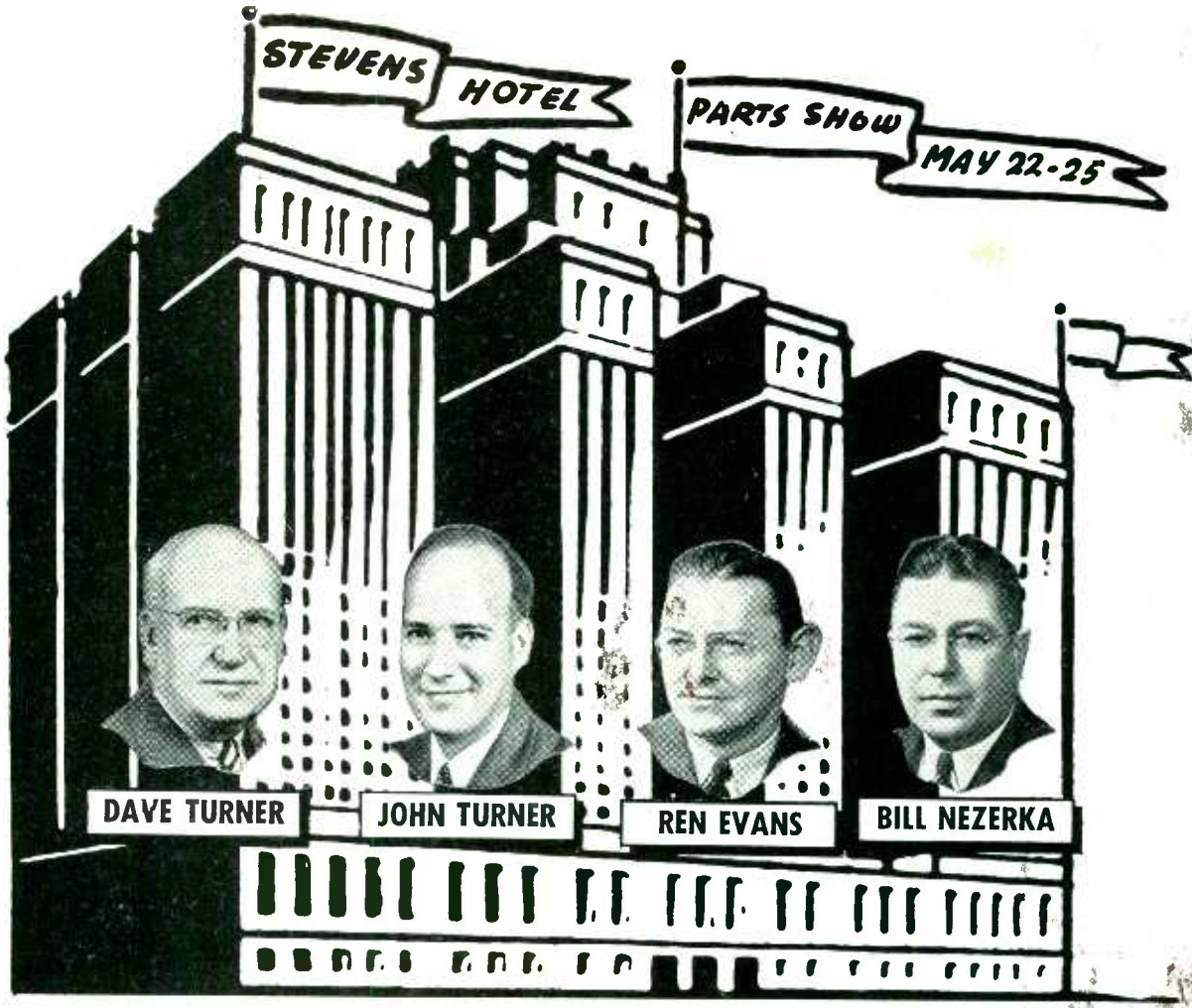
Write our Sales Department for detailed information.

BENDIX SCINTILLA

SCINTILLA MAGNETO DIVISION OF

SIDNEY, NEW YORK

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, New York



THE TURNER GANG

WILL BE LOOKING FOR YOU

IN ROOM 509A STEVENS HOTEL, MAY 22-25

THE TURNER COMPANY

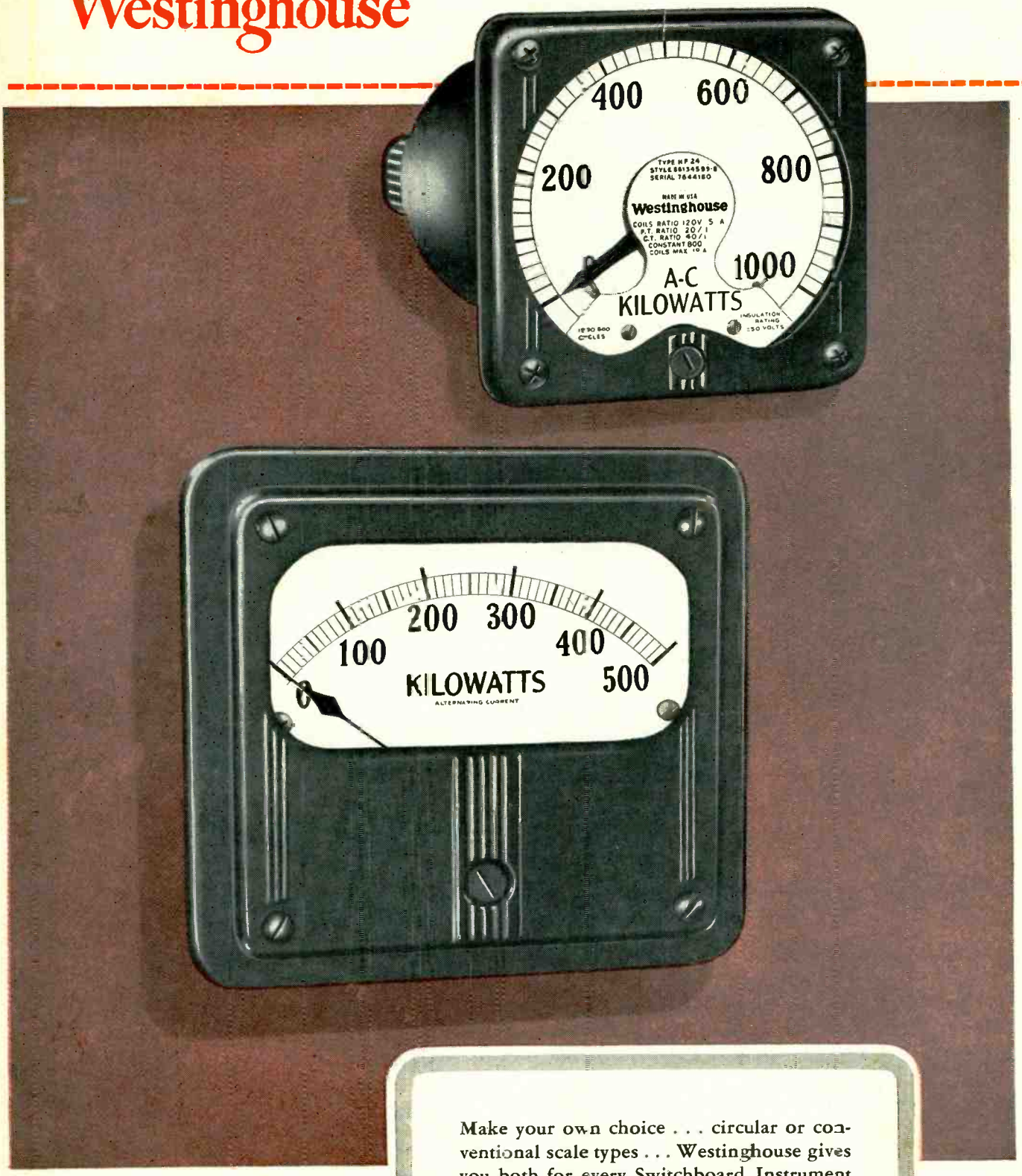
905 17th Street, N.E., Cedar Rapids, Iowa

TURNER

Microphones **BY TURNER**

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

Westinghouse



Make your own choice . . . circular or conventional scale types . . . Westinghouse gives you both for every Switchboard Instrument application. For all your Switchboard Instrument requirements refer to Westinghouse Catalog Section 43-200—ask your nearest Westinghouse Representative.

One customer cut instrument inventory $70,000!

★ **Shipments in 10 days!** Prompt deliveries eliminate major stocking problems. Westinghouse can meet practically every requirement for switchboard instruments within 10 days of receipt of order at the factory.

★ **The most complete line** in the industry . . . for every switchboard and panel requirement . . . available from one source. A-c and d-c current and voltage; single and polyphase; watts and vars; frequency; power factor; synchroscopes; temperature indicators; ground detectors; synchrotie (position indicators).

★ **Meets A. S. A. standards**—Every Westinghouse Switchboard Instrument is built to the rigid specifications of the "American Standards Association".

. . . it takes *all three* to eliminate costly stocks and storage overhead . . . release working capital . . . still meet your own delivery commitments . . . with *assured* high quality!

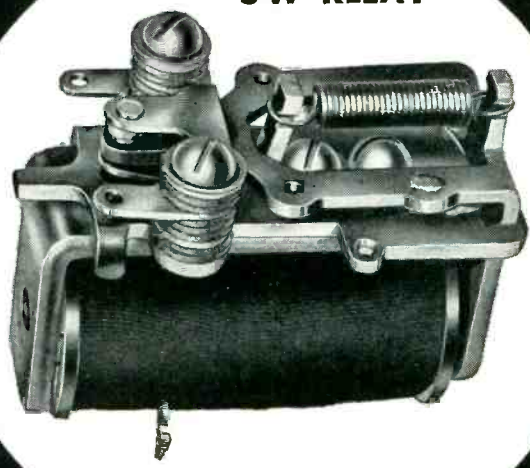
Westinghouse instrument specialists have nationwide experience in solving instrument application problems of all types . . . are ready to help you answer *your* special problems. Phone, write or wire your nearest Westinghouse representative. For complete information on all switchboard instruments, ask for C. S. 43-200. Westinghouse Electric Corporation, 95 Orange Street, Newark, N. J. J-40391

Specify Westinghouse *- get more for your instrument dollar!*

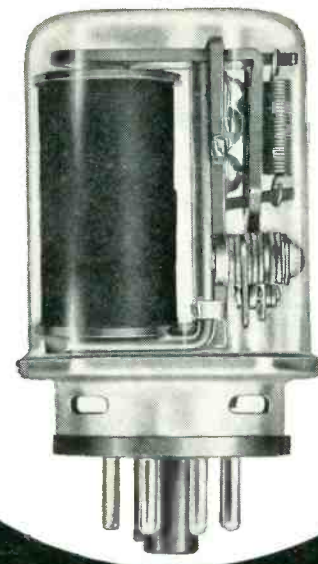
Westinghouse
INSTRUMENTS

NEW SENSITIVE RELAY built for long service

SW RELAY



Hermetically Sealed



Supplied with OCTAL PLUG or SOLDER TERMINALS

Sensitivity Plus Dependability!

The new Allied SW relay offers an economical combination of both these important qualities. Here are the facts on this newest relay in the famous Allied line

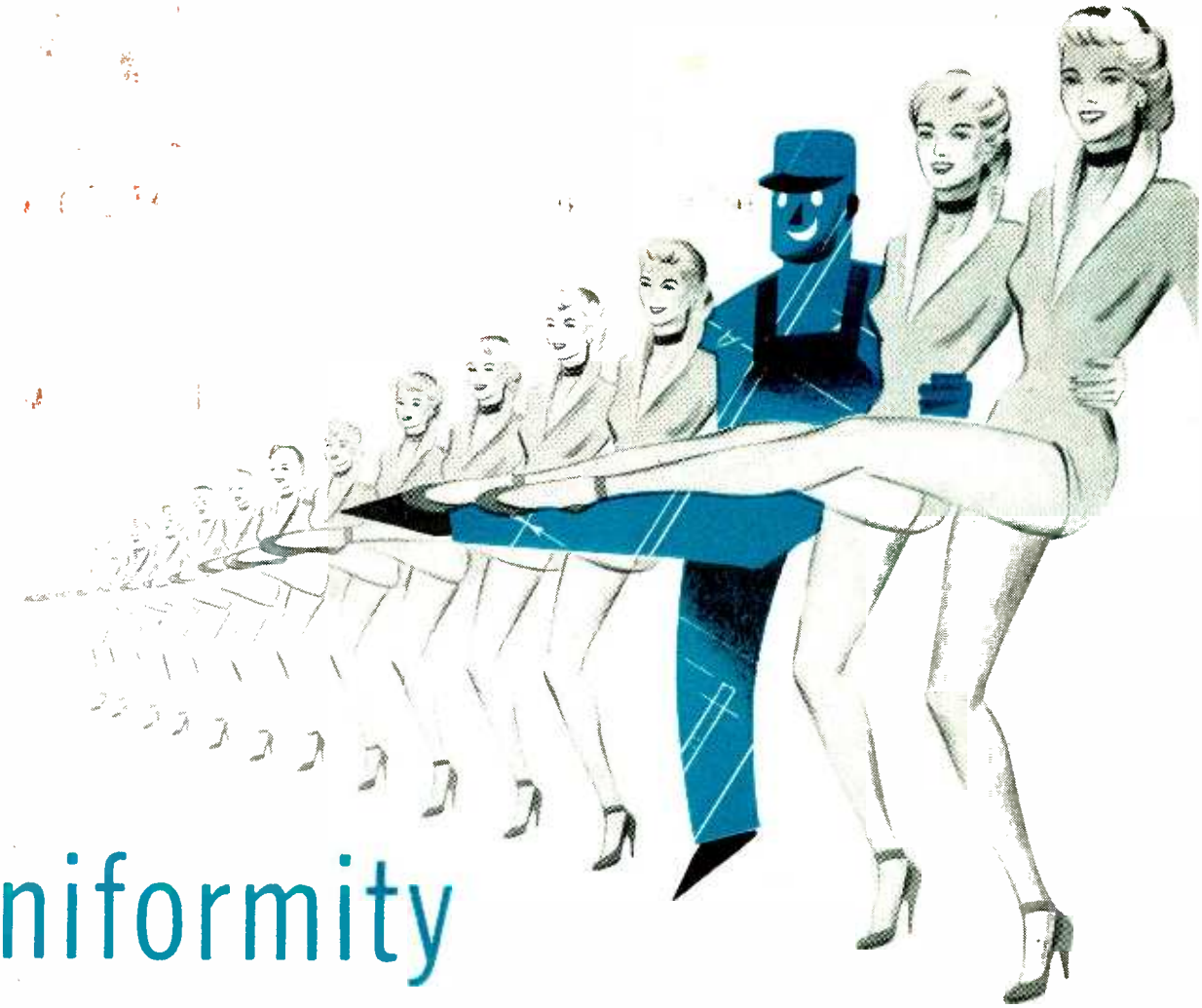
Bulletin SW gives complete details. Send for your copy today.

Be sure to send for your copy of Allied's new Relay Guide. It shows 24 small, compact relays with a detailed table of characteristics and specifications.

SENSITIVITY:	S.P.D.T. .012 watts d.c. } Can be supplied D.P.D.T. .05 watts d.c. } in A.C.
COIL:	Acetate insulated, bobbin or layer wound, 12,500 ohms max.
CONTACTS:	Silver, one ampere non-inductive load at 24 volts d.c. or 115 volts a.c. Armature contact at frame potential.
MOUNTING:	One hole with locating lug. Also available with dust cover or hermetically sealed, plug-in or solder terminals.
DIMENSIONS:	Open Relay—1-19/32", 1-1/16", 1-7/16" Sealed Relay—3-3/16" long, including plug, 1-13/32" wide, 1-19/32" high.
WEIGHT:	2.5 oz.
WEIGHT HERMETICALLY SEALED:	4.5 oz.
SPECIAL APPLICATIONS:	Sensitivity down to .003 watts S.P.D.T., or .012 watts D.P.D.T. Palladium or other precious metal contacts for audio or low voltage circuits, tungsten or alloy contacts for higher current or voltage circuits. Maximum input 4.0 watts at 20°C for 85° rise.

ALLIED CONTROL COMPANY, INC.

2 EAST END AVENUE, NEW YORK 21, NEW YORK



uniformity

Not a foot out of step, not a figure out of line. That's uniformity! Karp Products, too, are always "in line," following the most exacting and precise specifications. That means a saving of time and money on your assembly line. "Uniformity" brings greater efficiency into your production.

Our new 70,000 square foot plant has extensive facilities, including an accumulation of dies and jigs which permits us to fabricate at minimum cost, whether your job is a single unit or a large quantity.

Twenty five years' experience has given our craftsmen a "know how" which is reflected in Karp's quality and accuracy. And you can have this service at competitive prices.

Let us quote on your next requirement of metal cabinets, consoles, chassis, and enclosures. Write today for your FREE copy of our illustrated data book.

KARP METAL PRODUCTS CO., INC.

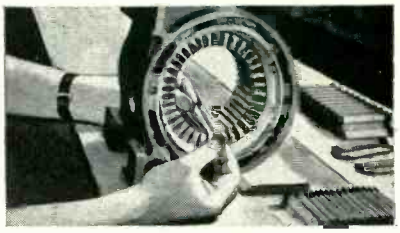
215-63rd Street, Brooklyn 20, New York

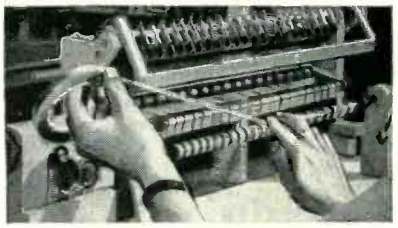
MITCHELL-RAND *NOW* HEADQUARTERS *FOR* PERMACEL

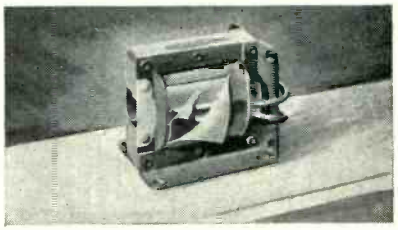
cotton cloth • paper • acetate film

ELECTRICAL TAPES

as for all other Electrical Insulations







Now you can depend upon MITCHELL-RAND to supply your electrical tape requirements for all insulating, tieing and identifying uses . . . and be confident that with MITCHELL-RAND service and PERMACEL TAPES, your electrical equipment and apparatus will have positive insulation and absolute protection.

PERMACEL ELECTRICAL TAPES have great dielectric and tensile strength, great tear-resistance, maximum adhesive firmness, excellent varnish penetration, etc. . . . their backings and adhesives minimize abrasion and electrolytic corrosion . . . resist oil, water and acids . . . provide elasticity . . . stick at a touch and hold everlastingly.

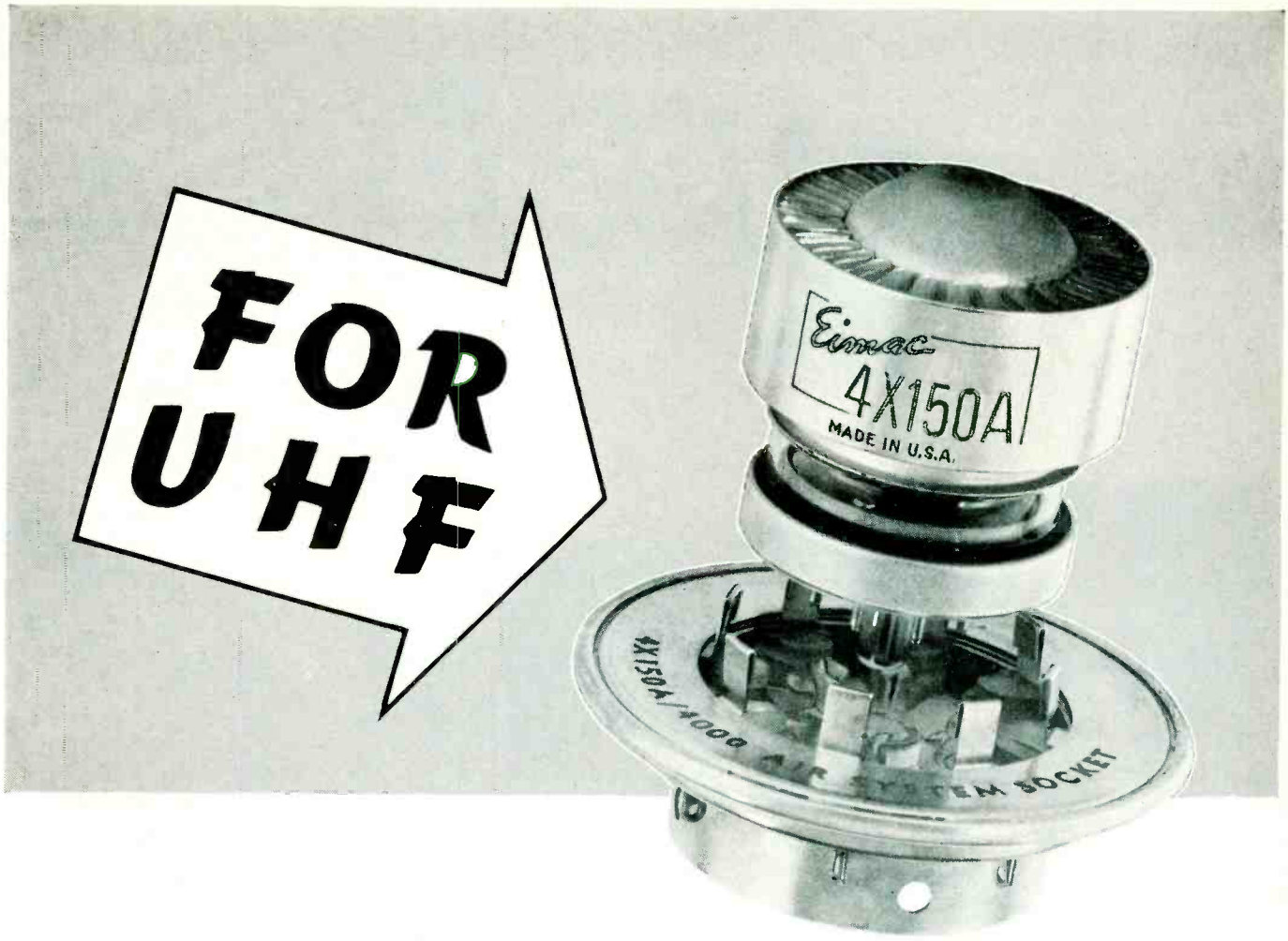
PERMACEL TAPES have what it takes to insulate, protect, tie and identify . . . and often at lower cost!

It will pay you to test PERMACEL ELECTRICAL TAPES . . . write today on your letterhead and MITCHELL-RAND will submit samples and descriptive data.

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 • INSULATED VARNISHES OF ALL TYPES • EXTRUDED PLASTIC TUBING



Now available . . . a UHF, tube and socket package to solve your UHF tube and tube-cooling problems.

The combined use of the Eimac 4X150A tetrode and the new Eimac 4X150A socket makes possible improved circuit arrangement especially at frequencies between 100 and 500 Mc. and also simplifies mechanical design of the tube cooling system.

The tube . . . type 4X150A is a highly efficient beam-power Eimac tetrode capable of handling 150 watts of plate dissipation and delivering as high as 140 watts of useful output power per tube in conventional coaxial amplifier circuits. Its high degree of stability, high power-gain, and high ratio of transconductance to capacitance make it ideally suited for service as a video amplifier, TV sound amplifier, FM & TV r-f amplifier, or in UHF communications, and in STL and dielectric heating applications.

The socket . . . type 4X150A/4000, in addition to insuring adequate cooling of the 4X150A, simplifies circuit construction. It incorporates a 3750 $\mu\mu$f screen bypass capacitor and its terminal design reduces lead inductance to a minimum. The 4X150A/4000 socket is engineered for service in either coaxial line or chassis construction.

Take advantage of the tetrode engineering experience of America's foremost manufacturer . . . Eimac. Write today for complete data on the 4X150A, 4X150A/4000 socket and other high performance tubes contained in the new Eimac tube catalogue.

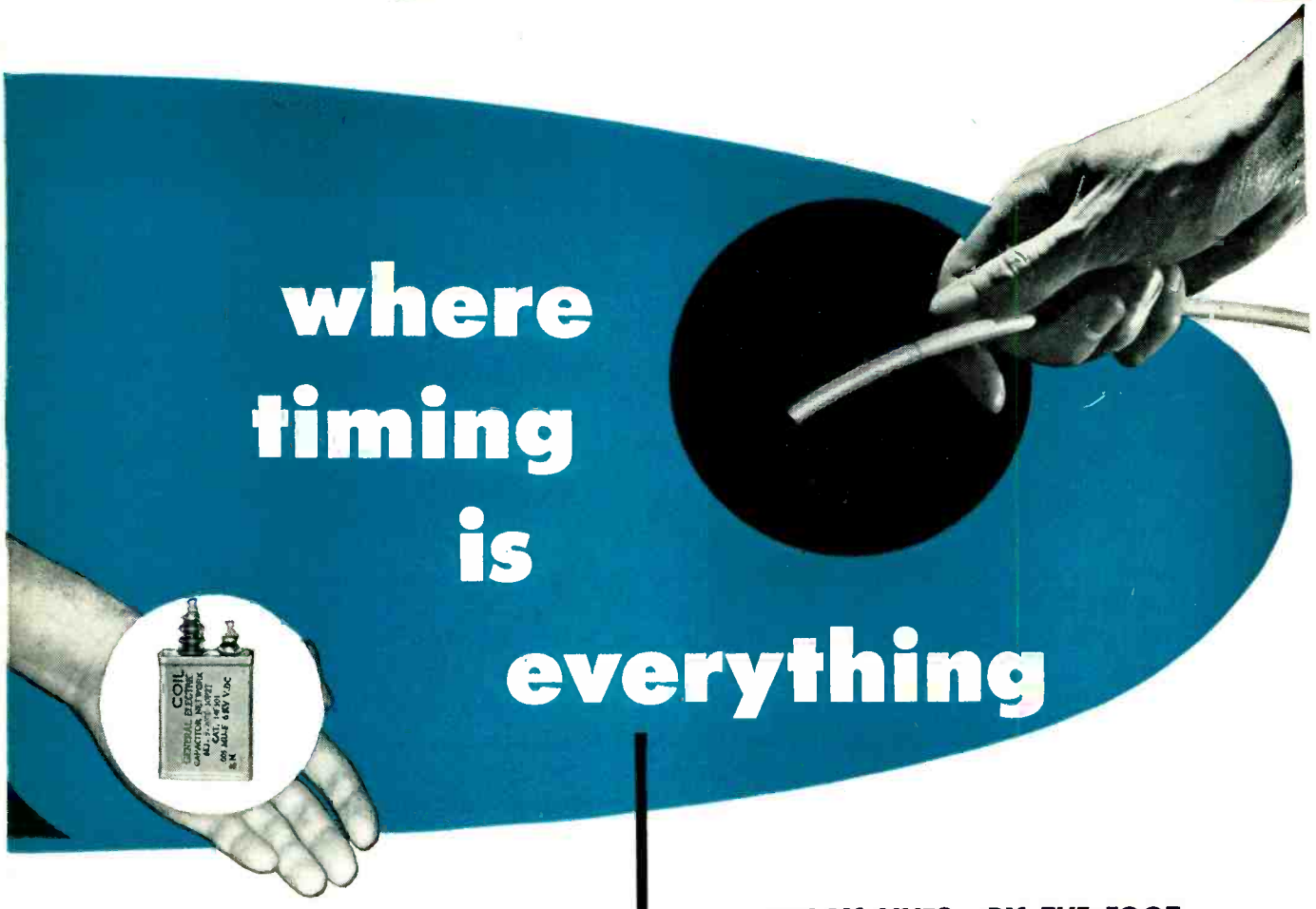
255

Follow the Leaders to Eimac TUBES The Power for R-F

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

ELECTRONICS

Designers



NEW! MIDGET, HIGH-TEMPERATURE PULSE-FORMING NETWORKS

Here's a new, extremely compact and lightweight capacitor pulse-forming network that will operate at temperatures up to 120° C! With a volume of 6 cubic inches, it's just about one third the size of a conventional network with the same rating (6E2-.5-2000-50-P2T).

The life expectancy of this 6-kv unit ranges from 3.5 hours at 80° C ambient to 1 hour at 110°. A second new network twice this size has a life of about 330 hours at 100° C—9 hours at 120° C. If you want more data on these new units, write *Capacitor Sales Division, General Electric Company, Pittsfield, Mass.*

DELAY LINES—BY THE FOOT

These G-E delay lines provide a means for delaying signals with a band-width up to 2-megacycles for any time interval from .25 to 10.00 microseconds. They are available in bulk form in lengths up to 100 feet—delay equals approximately ½ microsecond per foot. Characteristic impedances of 1100 and 400 ohms per foot are available. Since the line is very flexible, it may be bent into 4-inch diameter coils.

Ordering line in bulk form makes it possible for you to cut it to the exact length required for your particular application. For complete ratings and specifications, see Bulletin GEC-459.

GENERAL ELECTRIC

Digest

TIMELY HIGHLIGHTS ON G-E COMPONENTS

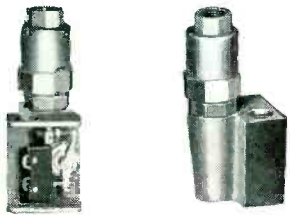
MORE COMPACT RECTIFIER STACKS

If your requirements call for compact selenium stacks for operation in cramped quarters, these new, higher-voltage G-E selenium cells may be your answer. Their 18-volt d-c output means you can design stacks which are about 25% smaller than possible with 12-volt cells. The improved aging characteristics of these cells is made possible by a new G-E evaporation process which deposits selenium on aluminum with greater uniformity. Stacks are available with rated outputs of 18 to 126 d-c volts at 0.15 to 1.20 amperes with inputs of 23 to 180 a-c volts. See Bulletin GEA-5280.

TIME METERS—TO CHECK TUBE LIFE

G-E time meters, with dependable Telechron* motor drive, are especially useful in recording the operating time of radio transmitters or other electronic devices so that tubes may be replaced before they fail. They record operating time in hours, tenths of hours, or minutes, and are supplied for 11-, 115-, 230-, or 460-volt operation. The case is of molded textolite to harmonize with other G-E 3½-inch instruments mounted on the same panel. You'll find more description along with dimensions and pricing information in Bulletin GEC-472.

Reg. U.S. Pat. Off.



NEW! WATER-FLOW INTERLOCK

This new G-E flow interlock provides sure protection against overheating in water-cooled components such as tubes, transformers, and dynamotors. Its function is to open the electrical circuit when water flow is lower than a preset minimum and close it when flow is above this point.

Adjustment can be made to actuate the electrical contact for any flow between 1 gallon per minute and 4 gallons per minute. The cut-in, cut-out differential of the unit is 0.2 gpm. The electrical circuit is rated at 10 amperes at 125 volts a-c, 5 amperes at 250 volts a-c and 3 amperes at 460 volts a-c. Maximum water-line pressure rating is 125 pounds per square inch. The unit is bronze with standard ½-inch fittings and is easy to install and adjust. For further description see Bulletin GEC-411.

NEW! BATTERY-OPERATED VTVM

This new G-E battery-operated electronic voltmeter combines the portability of an ordinary low-sensitivity multimeter with the high sensitivity and versatility of a line-voltage-operated vacuum-tube voltmeter.

Its weight is only 4 pounds (with batteries), its size—3"x6"x8", but it measures *a-c and d-c voltage* in 7 ranges from 0-1 to 0-1000 volts, *d-c current* in 4 ranges from 0-1 to 0-1000 milliamperes, *resistance* in 5 ranges from 100 ohms to 10 megohms, mid-scale value.

D-c input impedance is 11 megohms on all ranges. A-c input impedance is 0.5 megohm shunted with 20 mmf on all ranges. Frequency response is flat within 5 per cent up to 15,000 cycles on all up to and including the 0-100-volt range. More data in Bulletin GEC-622.

General Electric Company, Section D667-5
Apparatus Department
Schenectady 5, N. Y.

Please send me the following bulletins:

(Indicate: ☑ for reference only; ☒ for planning an immediate project)

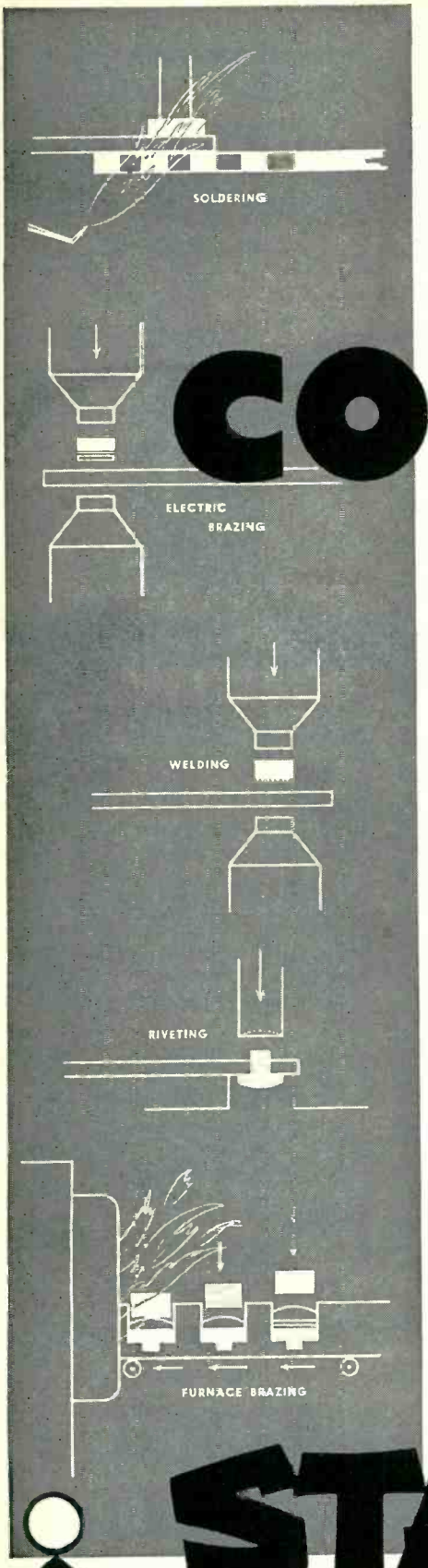
- ☐ **GEA-5280 Selenium rectifiers**
- ☐ **GEC-411 Flow interlock**
- ☐ **GEC-459 Delay lines**
- ☐ **GEC-472 Time meters**
- ☐ **GEC-622 Electronic voltmeter**

NAME .....

COMPANY .....

ADDRESS .....

CITY ..... STATE .....



A money-saving tip on

CONTACTS

LEADING users of Stackpole contacts for original equipment have saved money, assured greater product dependability, not only by having us recommend the most suitable method for attaching contacts to their arms, but also by letting us handle this specialized attachment job.

Based on long experience, Stackpole engineers are fully familiar with the advantages and disadvantages of the various attachment methods for different contact materials and applications. The best, most economical method can quickly be selected—and the entire operation handled on modern equipment and in such a manner that contact performance or durability will in no wise be impaired. Scrap contacts are eliminated—you pay only for those supplied in complete, properly attached form.

WRITE FOR CATALOG 12 describing Stackpole contact types and containing a wealth of helpful contact data including choice of contact materials and contact attachment information.

STACKPOLE CARBON COMPANY, St. Marys, Pa.

STACKPOLE

CONTACTS

All shapes and sizes in SILVER GRAPHITE • SILVER LEAD OXIDE • SILVER NICKEL SILVER MOLYBDENUM • SILVER TUNGSTEN • COPPER GRAPHITE • PRECIOUS METAL

. . . and many special materials

Sorensen
ELECTRONIC EQUIPMENT FOR AVIATION

EQUIPMENT: Sorensen equipment (400 cycle line voltage regulators, Inverters, Regulated DC supplys, Frequency changers and Phase Adapters) are lightweight, designed for conformity to JAN specifications.

TEST EQUIPMENT AIDS: Sorensen's voltage regulating equipment (400 cycle Line Regulators, DC supplys or "Nobatrons") can facilitate the use of test equipment by providing regulated AC or DC power.

SORENSEN: offers the Aviation field three principal types of product:

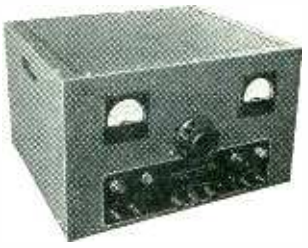
COMPONENTS: Sorensen has a wide range of products which can be used to great advantage in aviation manufacturers' equipment. Chief among these are the 400 cycle variable auto transformers, the Saturable Core reactors and other power components. Equipment units can be designed to meet JAN specifications.

FOSTERITE: In airborne units, Sorensen seals its wound components against humidity by the Fosterite process, a method which adds little to weight or size, and is, therefore, ideal in aircraft electronic design.

TYPICAL SORENSEN AIRBORNE UNITS

400 CYCLE REGULATOR
± 0.5% regulation; 400 cycles ± 10%; 5% distortion; 50 VA to 3 KVA capacities.

ELECTRONIC INVERTER
Inverters and Frequency changes under development. Specifications on request.



DC SUPPLY
0-325 VDC; 0-500 VDC; 300-1000 DC regulated ± 0.5%; 125, 300, 500 ma.

NOBATRON
6-12-28-48-125 VDC from 5-350 amperes; regulated ± 0.25%; 60 or 400 cycles input.

400 CYCLE AUTO TRANSFORMER
0-130 VA; 400 Cycles 5 and 15 amperes.

SATURABLE CORE REACTOR
For magnetic amplifier circuits. Request data book.

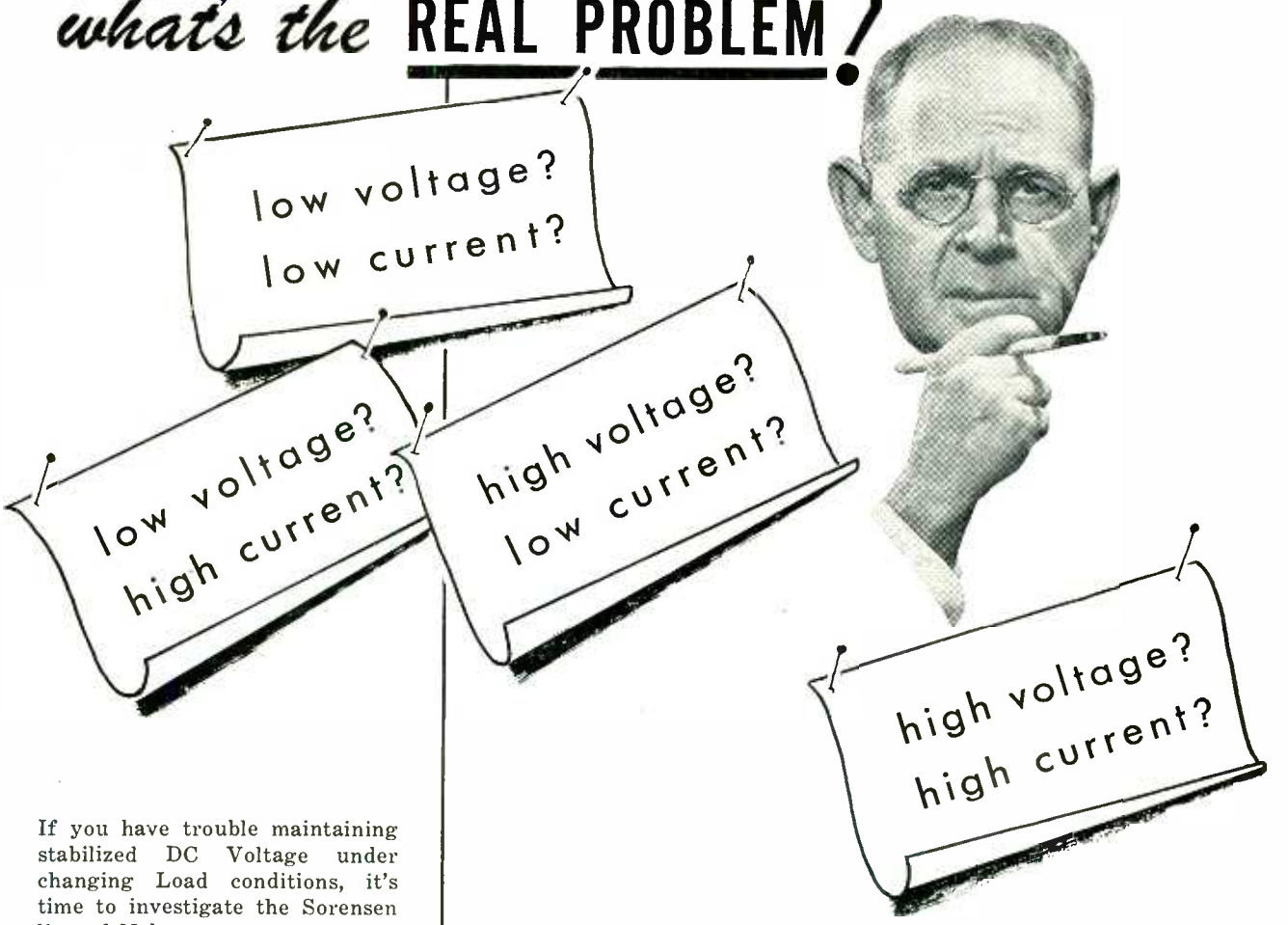
LITERATURE: The following literature is available on request: Catalog A 1049 (AC regulators); Catalog B 1049 (Nobatrons and DC supplys); Catalog C 1049 (wound components and fosterite); Saturable Core Reactor Technical Data sheets; "Aircraft" issue of "Currently."

POWER controlled converted

Sorensen and company, inc.
375 FAIRFIELD AVE. • STAMFORD, CONN.

MANUFACTURERS OF AC LINE REGULATORS, 60 AND 400 CYCLES; REGULATED DC POWER SOURCES; ELECTRONIC INVERTORS; VOLTAGE REFERENCE STANDARD; CUSTOM BUILT TRANSFORMERS; SATURABLE CORE REACTORS

what's the REAL PROBLEM?



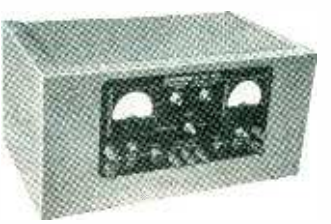
If you have trouble maintaining stabilized DC Voltage under changing Load conditions, it's time to investigate the Sorensen line of Nobatrons.

- **Common Nobatron Specifications:** Regulation Accuracy 0.2% from 0.1 load to full load; Ripple Voltage 1%; Recovery time 0.2 seconds under most severe change in load or input conditions; 95-130 VAC single phase 50-60 cycles: adapter available for 230 VAC operation.

- **Ratings**
  Nobatron — 6, 12, 28, 48, 125 volts from 5-350 amperes.
  B-Nobatron — 325, 500, 1000 volts — 125 ma.; 300 ma. & 500 ma.
  DC Standards — 2, 6, 15, 25, 50, 75, 150, 300 volts — 15, 30 and 50 ma.

- **Problems?** Sorensen Engineers are always at your service to help solve unusual applications.

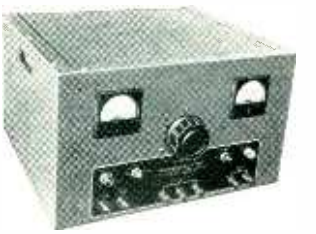
TYPICAL DC SOURCES



MODEL 325B
0-325 volts; 125 ma.

MODEL VS-50-50
50 volts @ 50 ma.

MODEL E-6-15
6 volts; 1.5-15 amperes



MODEL 500 B
0-500 volts; 300 ma.

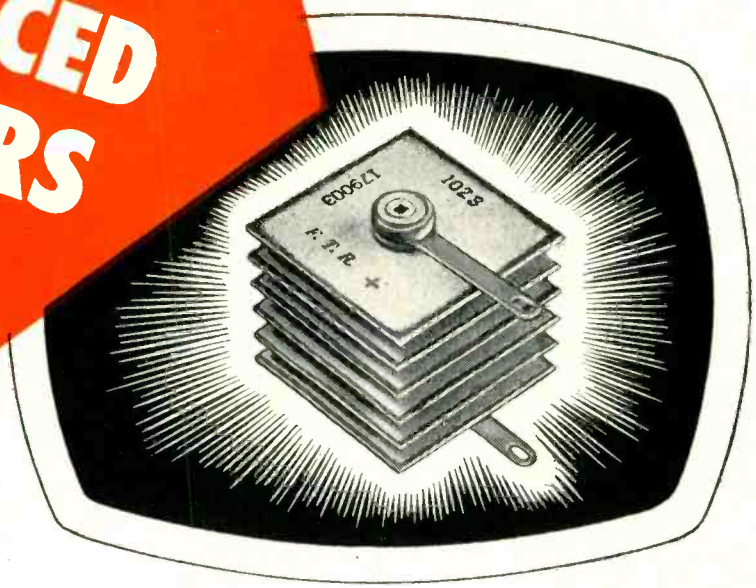
WRITE TODAY For Catalog B1049 For The Complete Line And Prices.

controlled POWER converted

Sorensen and company, inc.
375 FAIRFIELD AVE. • STAMFORD, CONN.

MANUFACTURERS OF AC LINE REGULATORS, 60 AND 400 CYCLES; REGULATED DC POWER SOURCES; ELECTRONIC INVERTORS; VOLTAGE REFERENCE STANDARD; CUSTOM BUILT TRANSFORMERS; SATURABLE CORE REACTORS

The "POWER" behind the Big Trend to LOWER-PRICED TV RECEIVERS



Federal's

Miniature SELENIUM RECTIFIER

The new trend in television is to receivers of higher-than-ever quality . . . at lower-than-ever prices!

The "power" behind this fast-growing swing is Federal's Miniature Selenium Rectifier . . . a vital factor in bringing *better* television to *more* people.

Sales-wise manufacturers are utilizing this revolutionary component to drastically reduce the size, weight and cost of TV receivers . . . by eliminating heavy, bulky, expensive power transformers . . . expendable rectifier tubes . . . filter chokes.

Specifically designed for television service, Federal Miniature Selenium Rectifiers are readily available in ratings to cover the full range of TV power requirements of sets using from 7" to 20" picture tubes.

Write today for full information. Address Dept. F-913.

Made by America's Oldest and Largest Producer of Selenium Rectifiers.

FEDERAL TELEPHONE & RADIO — FTR — An IT&T Associate

Federal Telephone and Radio Corporation

SELENIUM and 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.

Why JAN?

For many years the manufacture of transformers was controlled by individual manufacturer's ingenuity and ability together with his customer's desires and requirements. Inevitably there were as many different constructions and variations for any one type of transformer as there were manufacturers and customers. Each design duplicated the function of another and yet, no two were physically interchangeable.

This became most obvious at the beginning of the last war for each branch of the government services had its own specification for components-transformers as well as all other electronic components.

Development of new equipment, production on existing designs, and replacement of parts for existing equipment all presented their own problems when it came to duplication and interchange of supplies. Standardization was *imperative!*

How JAN?

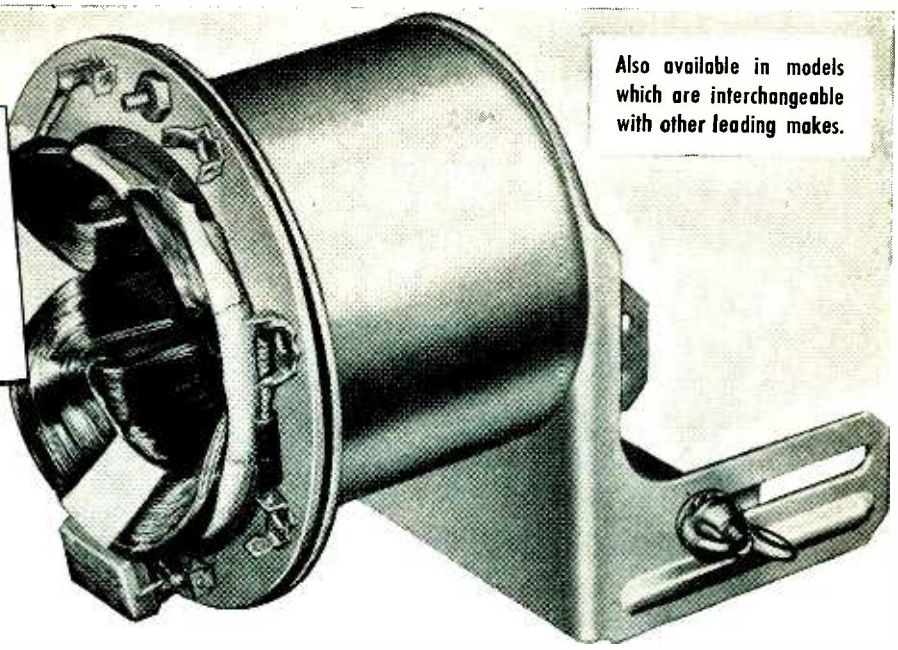
Therefore, the Standards Agency was established by the Armed Forces to correlate manufacturing procedures and devise one best design for a particular job—satisfactory to all military arms, readily available and always interchangeable.

Transformers created a much greater problem than other components due to the many styles and variations in existence, nevertheless standard specifications for the various components, including transformers, were devised by the Standards Agency thru study, development and constant testing.

Thru extensive research in new products and methods, we, at Kenyon, are able to produce high quality transformers, in accordance with the JAN Specification for transformers, namely JAN-T-27.

If you have any questions on JAN Transformers, do not hesitate to call upon Kenyon's engineering staff.

TV RECEIVER MANUFACTURERS—



Also available in models which are interchangeable with other leading makes.

New

DEFLECTION YOKE SWEEPS 70° WITH HIGH EFFICIENCY!

Requires only 20 watts of horizontal input power from 260-volt supply!

A 70° tube is tough to sweep—and to do it correctly takes a lot of power, particularly at 13-14kv. Most yokes today lose efficiency when required to sweep wide-angle tubes.

Now an improved General Electric Deflection Yoke, ready for delivery to manufacturers, licks the problem from the inside out. G-E engineers at Electronics Park found that the key to more sensitivity and greater efficiency was in the design and position of the yoke windings. To get a wire pattern that would assure a high degree of uniformity of the magnetic field, they designed an improved machine that winds coils with knife-sharp precision and without distortion. This process now helps turn out yokes that provide accurately-shaped, straight-sided pictures.

For applications requiring high efficiency, the new yoke is available with ferrite core. The complete G-E line of television components also includes ion traps, focus coils, horizontal sweep transformers, size and linearity controls. General Electric engineers will be glad to consult with you on the applications of these components to your designs. Wire or write: *General Electric Company, Parts Section, Electronics Park, Syracuse, New York.*

You can put your confidence in—

GENERAL ELECTRIC

PRECISION FREQUENCIES

ACCURACY: 1 PART IN 100,000 (OR BETTER) .001%

FOR USE IN SUCH FIELDS AS

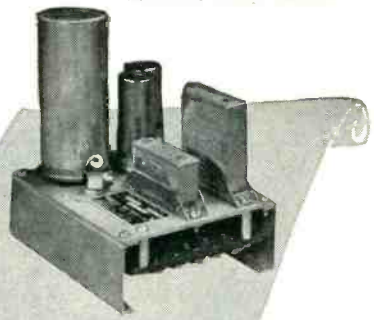
AVIATION
ASTRONOMY
BALLISTICS
HIGH-SPEED PHOTOGRAPHY
VISCOSITY MEASUREMENT
NUCLEAR PHYSICS
TELEMETERING
RADIATION COUNTING
FLUID FLOW
CHEMICAL REACTION
NAVIGATION
SCHOOL LABORATORIES
INDUSTRIAL RESEARCH LABS.
ACCURATE SPEED CONTROL

The controlling unit of these frequency standards is a bi-metallic fork, temperature-compensated and hermetically sealed against humidity and variations in barometric pressure. When combined with related equipment, accurate speed and time controls are afforded by mechanical, electrical, acoustical or optical means.

Instruments of our manufacture are used extensively by industry and government departments on such precision work as bomb sights and fire control.

Whatever your frequency problems may be, our engineers are ready to cooperate.

When requesting further details, please specify the Type Numbers on which information is desired.



TYPE 2001-2. BASIC UNIT
Frequencies, 200 to 1500 cycles. Dividers and Multipliers available for lower and higher frequencies. Miniaturized and JAN construction. Output, 6 volts.

TYPE 2005. UTILITY UNIT
consists of Type 2001-2 and booster to provide 10 watts at 110 V at 60 cyc. Input, 50-100 cyc.

TYPE 2121A. LAB. STANDARD
Outputs, 60 cycle, 0-110 Volts, 120-240 cyc e impulses.
Input, 50-400 cycles, 45 W.

TYPE 2111. POWER UNIT
50 W output. 0-110 V at 60 cyc.
Input, 50-100 cyc., 275 W.

American Time Products, Inc.
580 Fifth Avenue *New York 19, N.Y.*

OPERATING UNDER PATENTS OF THE WESTERN ELECTRIC COMPANY

Still another C-D first!

C-D

NOW BRINGS YOU THE NEW

ROYAL TIGER POLYKANE* CAPACITORS

★ **STURDY**

★ **HUMIDITY PROOF**

★ **–35° to 100°C.**

***Polykane** – a solid synthetic thermosetting compound, developed by C-D engineers for use in Royal Tigers – provides new sturdy construction for operation at temperatures from –35°C to +100°C.

Royal Tiger Capacitors are Polykane impregnated and filled, resulting in exceptionally uniform electrical properties and performance over extra long service life. No oil or wax used within capacitor. End seal or impregnant will not flow at any temperature.

Royal Tiger Capacitors now make possible a standardized line of tubulars for operation at temperatures up to 100°C., thus eliminating need for stocking low and high temperature oil or wax tubular capacitors.

For full details, write for Bulletin RT349. CORNELL-DUBILIER ELECTRIC CORPORATION, Dept. K-50, South Plainfield, New Jersey. Other plants in New Bedford, Brookline and Worcester, Mass.; Providence, R. I.; Indianapolis, Ind., and subsidiary, The Radiart Corp., Cleveland, Ohio.

40TH ANNIVERSARY CORNELL-DUBILIER CAPACITORS ® 1910-1950

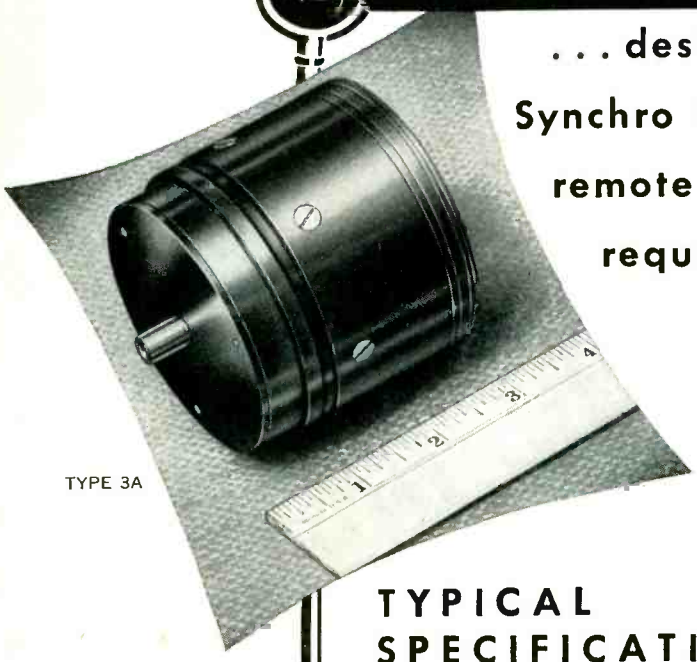
CORNELL-DUBILIER CAPACITORS

RADIART SUBSIDIARY

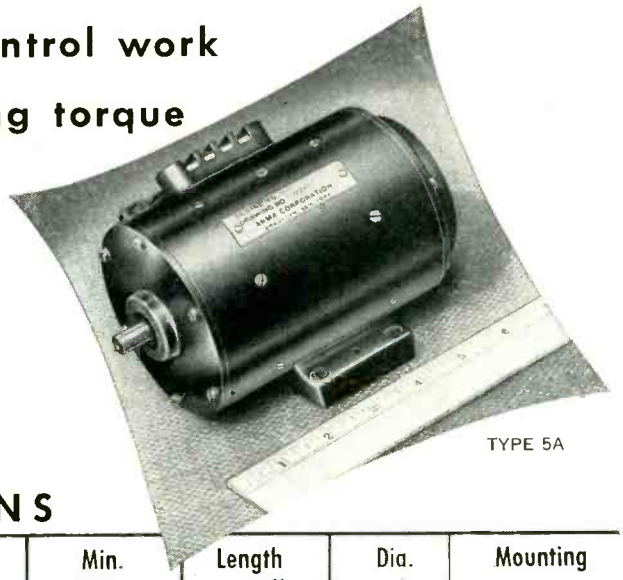
Announcing 2

ARMA STEP MOTORS

. . . designed to replace a Synchro Unit and a servo motor in remote control work requiring torque



TYPE 3A



TYPE 5A

TYPICAL SPECIFICATIONS

	Dwg. No.	Voltage	Weight (Approx.)	Min. Stall Torque	Length Overall	Dia.	Mounting
Type 3A	715774-1	115 V d.c.	3 lb.	22 oz. in.	3-15/32"	3 in.	Flange
Type 5A	51224-1	115 V d.c.	10 lb.	55 oz. in.	6-11/16"	3⅝ in	Bracket type Base

FEATURES

- *Convenient mounting*
- *Accurately ground, true running shaft extensions*
- *Self-contained terminal blocks*
- *Low power consumption*
- *Conservative electrical design, low temperature rise, large creepage distances and air gaps*

COMPARED WITH ALTERNATING CURRENT SYNCHRO UNIT

- Much greater torque available than from same size A.C. Synchros.
- Both are used primarily for the transmission of data from one point to another. Both serve as remote indicators or repeaters.

Step Motor Booklet Just Printed Gives Complete Details
ASK FOR A COPY

ARMA CORPORATION

254 36th STREET, BROOKLYN 32, N. Y.

SUBSIDIARY OF AMERICAN BOSCH CORPORATION

ARMA PRODUCTS RELEASED FOR PRIVATE INDUSTRY

ARMA ELECTRICAL RESOLVERS* ARMA SYNCHROS ARMA INDUCTION MOTORS ARMA INDUCTION GENERATORS ARMA MECHANICAL DIFFERENTIALS ARMA ALTERNATING VOLTAGE COMPARATOR COMPUTING MECHANISMS INDUSTRIAL CONTROLS STABILIZATION DEVICES NAVIGATIONAL EQUIPMENT LIMITRON AUTOMATIC INSPECTION SYSTEM

* Licensed for use under Arma patents Nos. 2,465,624 and 2,467,646. License information available.

QUALITY ARMA INSTRUMENT PRECISION

*TRADE MARK

Combines all the Desirable Properties of Formvar and Nylon Coatings

Years of development work have produced this new and superior magnet wire insulation. Belden Nylclad* Magnet Wire combines the desirable properties of Formvar and Nylon types. Its tough, durable coating eliminates the need for paper or textile-covered wires (in many applications) and reduces winding space requirements. Nylclad* provides increased toughness, increased solvent resistance, and resistance to softening under heat; it is not subject to solvent crazing. Nylclad* means improved windability — more compact coils — many over-all plus values at *no* increase in price.

It will pay you to investigate Nylclad* Magnet Wire — another Belden development that makes for lower over-all costs. Write, today, for test data.

Belden

MAGNET WIRE

Belden Manufacturing Co., 4625 West Van Buren Street, Chicago, Illinois

PRECISION ATTENUATION to 3000 mc !

*Patents applied for

- VSWR less than 1.2 at all frequencies to 3000 mc.
- **Turret Attenuator*** featuring **"Pull — Turn — Push"** action with 0, 10, 20, 30, 40, 50 DB steps.
- Accuracy ± .5 DB, no correction charts necessary.
- 50 ohm coaxial circuit. Type N connectors.

Inquiries are invited concerning single pads and turrets having other characteristics

STODDART AIRCRAFT RADIO CO.
6644 SANTA MONICA BLVD., HOLLYWOOD 38, CALIFORNIA
Hillside 9294

Specify G-E THYRATRONS!

More General Electric thyratron tubes are built and sold than any other make. Here is *leadership* . . . a signpost for the designer of motor-control circuits, pointing to where experience and proved tube quality are waiting!

Choice of types, too, is virtually unrestricted. In the wide range of G-E thyratrons will be found the right tube —small or large, ideal in its design characteristics—for *your* equipment.

Three popular G-E thyratrons are shown here. Each has its special area of application. The GL-3C23 is a gas-and-mercury-vapor tube for motor field control, where inductive loads are heavy. The GL-5544 and GL-5545 are gas-filled tubes especially suited to armature-control work, which involves a higher current—these thyratrons having a charge of inert gas twice that of less modern types, to offset any absorption.

Long, cost-saving life, from features like the higher gas charge of the GL-5544 and GL-5545, gives *extra tube value.* Let General Electric tube engineers work with you in choosing thyratrons that will accent your equipment's economy, help assure its reliability, extend its performance span! Phone your nearby G-E electronics office, or wire or write *Electronics Department, General Electric Company, Schenectady 5, New York.*

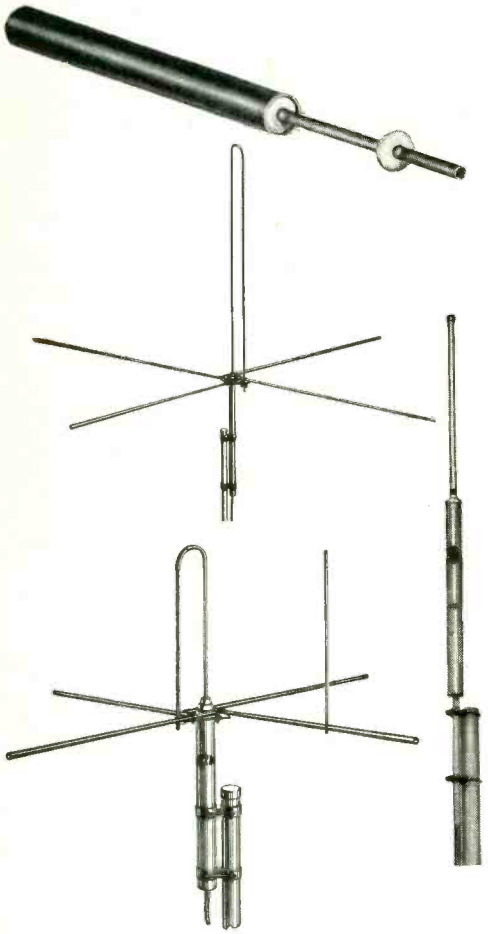
Available now...new G-E tube socket (101J328) that resists the heat produced in heavy-duty service. Made of asbestos-filled phenolic material, with special high-temperature-alloy spring contacts that won't lose their elasticity, and an open design allowing generous air circulation. Universal type: takes both the medium 4-pin base used in the GL-3C23, and the super-jumbo base used in the GL-5544 and GL-5545. Mounts either above or beneath a panel.

	GL-3C23	GL-5544	GL-5545
Filament voltage	2.5 v	2.5 v	2.5 v
Filament current	7 amp	12 amp	21 amp
Peak anode voltage, forward and inverse	1,250 v	1,500 v	1,500 v
Peak cathode current	6 amp	40 amp	80 amp
Avg cathode current	1.5 amp	3.2 amp	6.4 amp

GENERAL ELECTRIC

180-J27

MORE *Andrew* FIXED STATION ANTENNA EQUIPMENT IS USED THAN ANY OTHER KIND!



HERE'S WHY: The topnotch engineering that only the world's largest antenna equipment specialists can give . . . the uniform dependability of Andrew equipment . . . its superior performance . . . the fact that only Andrew makes a complete line of fixed station antenna equipment.

But that's not all. An imposing parade of "firsts" maintain Andrew leadership. Some current Andrew "firsts" are 1) the exclusive Folded Unipole Antenna, 2) the new Hurricane Models, 3) the Corner Reflector Antenna, and 4) a Very High Gain Communications Antenna soon to be announced.

COAXIAL CABLE, Type 737. Significantly, there is more of this Andrew 7/8" diameter cable now in use than all similar makes combined! You get a bonus of extra miles added to your service radius because loss characteristics are exceptionally low.

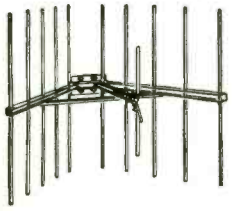
FOLDED UNIPOLE ANTENNAS. Another Andrew "first" and made only by Andrew. Thousands of these popular antennas are in use at fixed stations throughout the world. More new stations are using it than any other antenna. Users acclaim 1) its quieter reception produced by the grounded radiating element, 2) the excellent impedance match, and 3) its greater transmitting coverage.

Extra! Now available in Hurricane Models to insure uninterrupted operation when you need it the most.

COAXIAL ANTENNAS. Most economical where signal-to-noise ratio is high. Above 108 MCS only.

CARDIOID ANTENNAS. If you operate along a shore or border line and want your signal to cover only a certain 180° area, this rugged antenna is made to order for you. It concentrates your signal where you want it and doesn't waste radiation where you don't want it.

CORNER REFLECTOR ANTENNAS. For narrow angle coverage or point-to-point relaying. Concentrates your signal in the exact area where you want it, using a 60° beam. Avoids interference to and from the remaining area. For the 72-76 and 148-174 MCS bands. Only Andrew makes a commercial model of this special purpose antenna—another Andrew "first."



It will pay you, too, to use Andrew fixed station equipment. Write for further information—today!

VERY HIGH GAIN COMMUNICATIONS ANTENNA
(soon to be announced)

The highest gain antenna in mobile communications history. It actually delivers the full gain of 6.5 db as claimed—the same as increasing your power 4½ times! Think of the economy. Now, for the first time, you can cover areas you couldn't reach before! It's another pace-setting Andrew "first." Frequency range is 148-174 MCS.

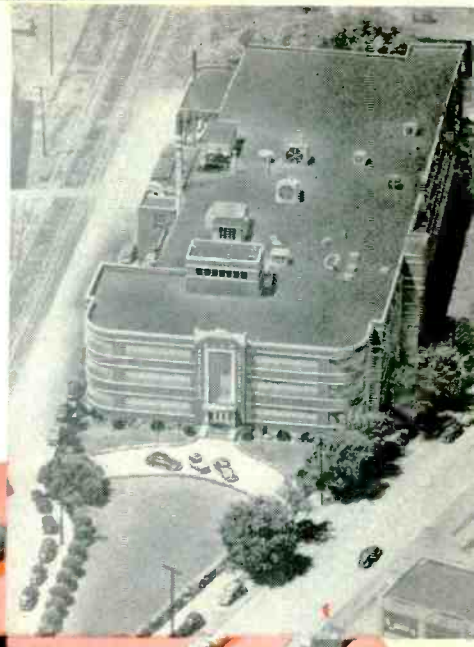
Andrew CORPORATION
363 EAST 75th STREET · CHICAGO 19
World's Largest Antenna Equipment Specialists

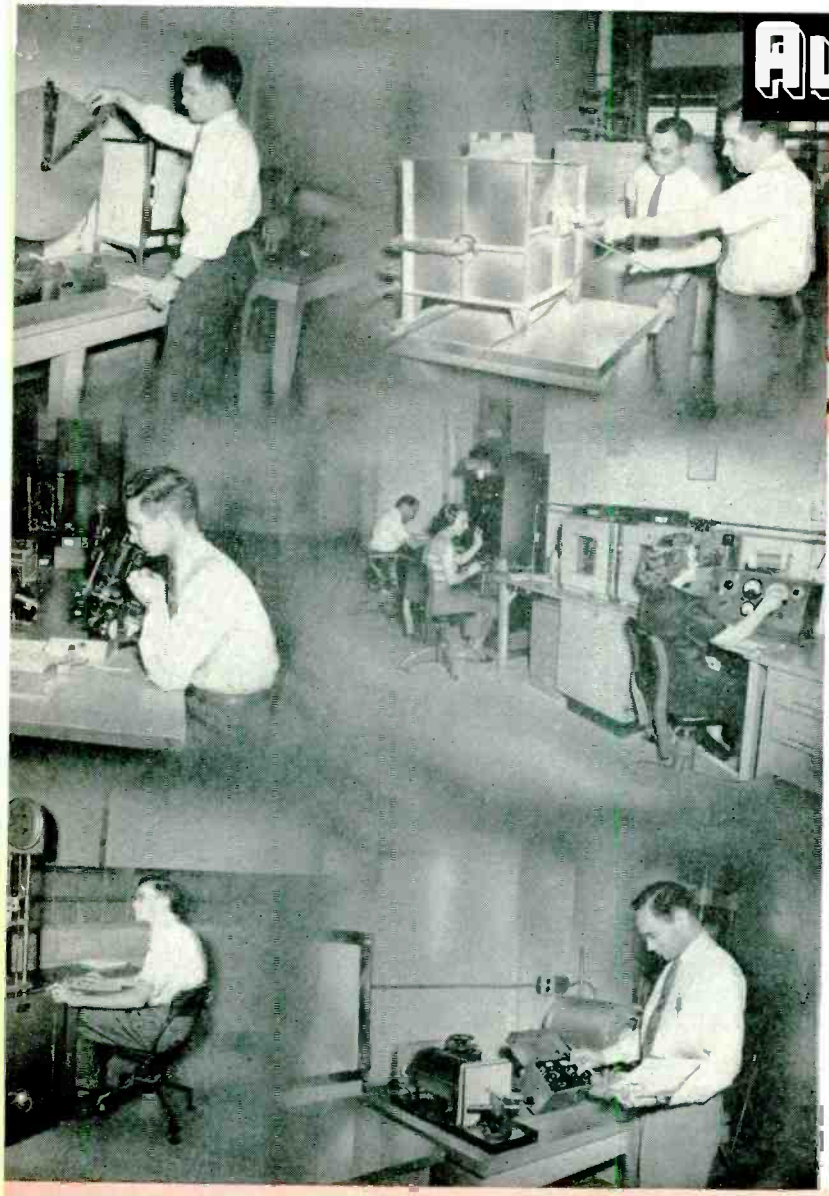
ANDREW

TRANSMISSION LINES FOR AM-FM-TV • ANTENNAS • DIRECTIONAL ANTENNA EQUIPMENT • ANTENNA TUNING UNITS • TOWER LIGHTING EQUIPMENT • CONSULTING ENGINEERING SERVICES

research

at American Lava Corporation is continuous, to anticipate and answer your problems on Custom Made Technical Ceramics





Here are AlSiMag custom made components for radar, radio, television, electric appliance, textile, chemical, metallurgical, gas, petroleum, rubber, carbon and foundry applications.

Here you are most apt to find the answer to any question involving technical ceramics. The Research Division has developed hundreds of highly successful compositions which combine special physical characteristics needed for unusual requirements. These compositions are custom fabricated to your specifications.

AlSiMag's Research Division maintains accurate, cross-indexed records of all research findings to give you a prompt answer on the possibilities of furnishing you any special combinations of physical characteristics you may find desirable.

49TH YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N. J., Mitchell 2-8159 • CHICAGO, 9 South Clinton St., Central 6-1721
PHILADELPHIA, 1649 North Broad St., Stevenson 4-2823 • LOS ANGELES, 232 South Hill St., Mutual 9076
NEW ENGLAND, 38-B Brattle St., Cambridge, Mass., Kirkland 7-4498 • ST. LOUIS, 1123 Washington Ave., Garfield 4959

REVERE FREE-CUTTING COPPER ROD
. . . INCREASES ELECTRONIC PRODUCTION

SINCE its introduction, Revere Free-Cutting Copper has decisively proved its great value for the precision manufacture of copper parts. Uses include certain tube elements requiring both great dimensional precision, and exceptional finish. It is also being used for switch gear, high-capacity plug connectors and in similar applications requiring copper to be machined with great accuracy and smoothness. This copper may also be cold-upset to a considerable deformation, and may be hot forged.

Revere Free-Cutting Copper is oxygen-free, high conductivity, and contains a small amount of tellurium, which, plus special processing in the Revere mills, greatly increases machining speeds, makes possible closer tolerances and much smoother finish. Thus production is increased, costs are cut, rejects lessened. The material's one important limitation is that it does not make a vacuum-tight seal with glass. In all other electronic applications this special-quality material offers great advantages. Write Revere for details.

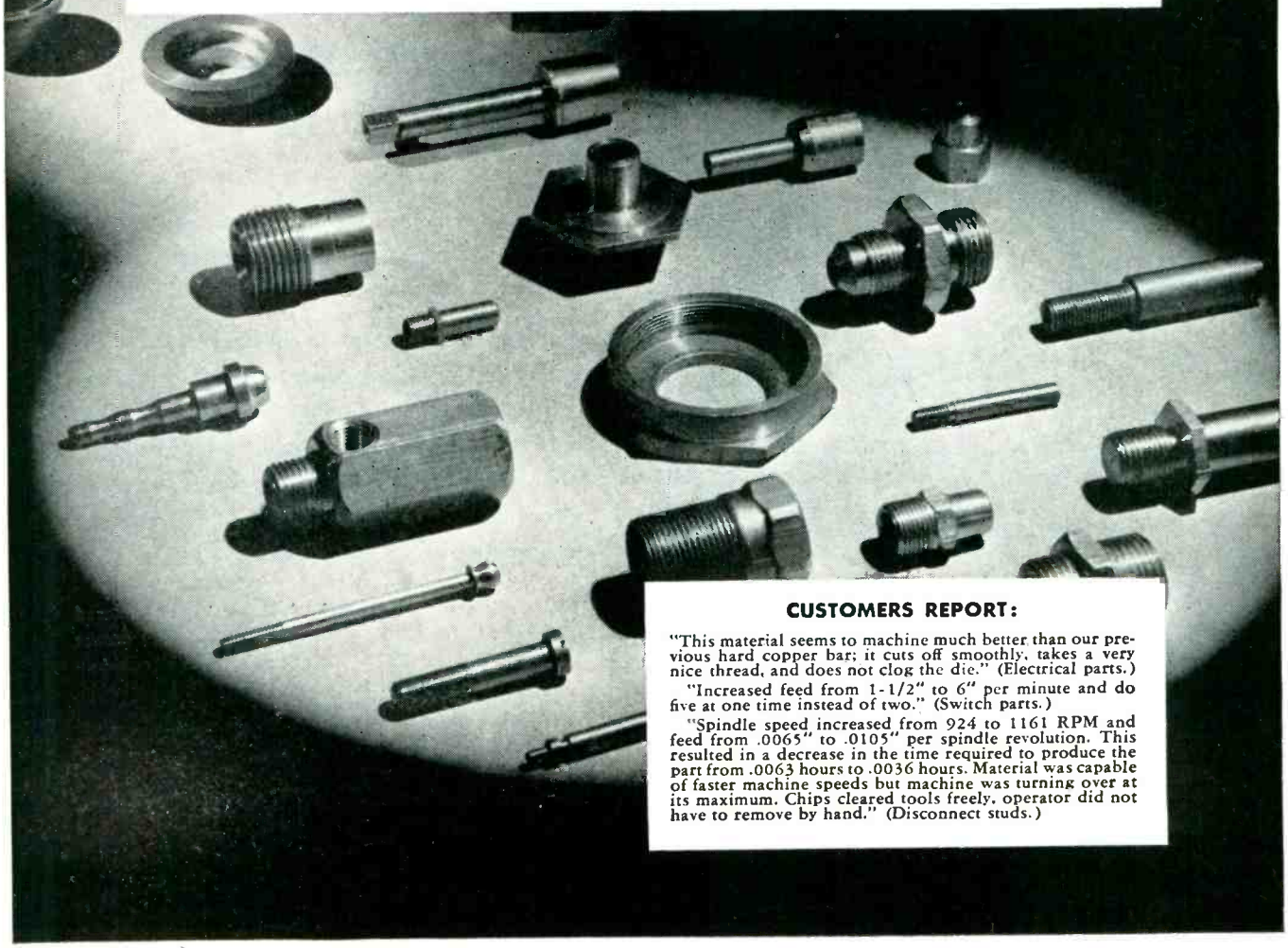
REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue
New York 17, New York

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



CUSTOMERS REPORT:

"This material seems to machine much better than our previous hard copper bar; it cuts off smoothly, takes a very nice thread, and does not clog the die." (Electrical parts.)

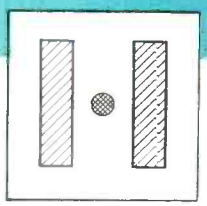
"Increased feed from 1-1/2" to 6" per minute and do five at one time instead of two." (Switch parts.)

"Spindle speed increased from 924 to 1161 RPM and feed from .0065" to .0105" per spindle revolution. This resulted in a decrease in the time required to produce the part from .0063 hours to .0036 hours. Material was capable of faster machine speeds but machine was turning over at its maximum. Chips cleared tools freely, operator did not have to remove by hand." (Disconnect studs.)

805A SLOTTED LINE

PRECISION ACCURACY FOR STANDING WAVE MEASUREMENTS

$475 f.o.b. Palo Alto



RADICAL NEW "PARALLEL-PLANE" DESIGN GIVES -*hp*- SLOTTED LINE UTMOST ELECTRICAL STABILITY

The new -*hp*- 805A Slotted Line employs two parallel planes and a large, circular central conductor, instead of the conventional coaxial configuration. This new design makes possible an electrically stable precision instrument capable of fast, easy measurements of unvarying accuracy. Parallel planes and central conductor are both mechanically rigid. Penetration depth of the probe is less critical than in coaxial slotted lines, and leakage is low because the effective slot opening is less than .001 referred to the coaxial system. Residual VSWR is held to less than 1.04. Probe position may be read to 0.1 mm.

This new approach to the Slotted Line problem makes possible the manufacture of an instrument of maximum accuracy at moderate cost.

SPECIFICATIONS

Frequency Range: 500 to 4,000 mc.

Impedance: 50 ohms.

Connections: Special Type "N" fittings designed for minimum VSWR.

Residual VSWR: 1.04 or better.

Slope: Negligible.

Calibration: Metric, in cm and mm. Vernier reads to 0.1 mm.

Size: 27" long, 8" high, 6" wide.

Carriage: Ball-bearing probe movement. Probe depth adjustable. Probe resonant circuit tunable over freq. range of line. Detector may be standard crystal or employ barretters.

Data subject to change without notice.

WRITE FOR DETAILS

HEWLETT-PACKARD COMPANY

1824-A Page Mill Road · Palo Alto, California

1824

hp laboratory instruments

FOR SPEED AND ACCURACY

NEW -*hp*- 415A

Standing Wave Indicator

The new -*hp*- 415A Standing Wave Indicator is used with the -*hp*- Slotted Line to determine coaxial flatness or measure impedance. It consists of a high gain amplifier of low noise level, operating at a fixed audio frequency. Amplifier output is measured by a voltmeter with a square-law calibration in db and voltage standing wave ratio. The -*hp*- 415A is direct reading, compact and easy to use.

SPECIFICATIONS

Frequency: Fixed at 1,000 cps, ± 2%. Other frequencies 300 to 2,000 cps supplied on special order. Amplifier "Q" is 20 ± 5.

Sensitivity: 0.3 uv gives full scale deflection. Noise-level-to-input equivalent is 0.04 uv.

Calibration: For use with square-law detector. 60 db level covered in 6 ranges. Accuracy ± 0.1 db per 10 db step.

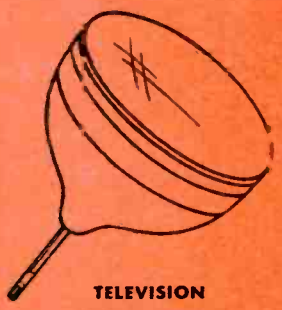
Gain Control: Adjusts meter to convenient level. Range is approx. 30 db.

Detector Input: Connects to Xtal rectifier or bolometer. Bias of 8 v. ± .5 v. delivers approx. 8.75 ma. to a 200 ohm barretter.

Size: 12" long, 9" wide, 9" high.

Data subject to change without notice.

FIVE TIMES LONGER LIFE!

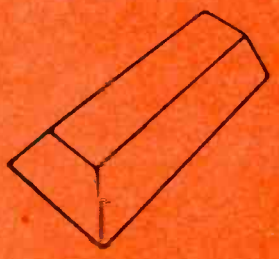


TELEVISION PICTURE TUBES

NEW EYE-APPEAL!

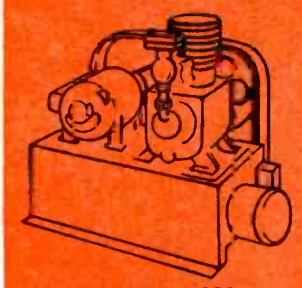
AUTO HORN BUTTONS

BETTER STRENGTH: WEIGHT RATIO!



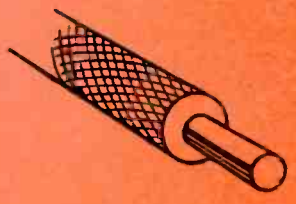
TITANIUM

PRACTICALLY NO MAINTENANCE!



REFRIGERATOR COMPRESSORS

HIGHER THERMAL CONDUCTIVITY!



COPPER

BETTER ANNEALING, LONGER SERVICE!

WATCH HAIR-SPRINGS

INCREASED POTENCY!

VITAMINS

The Touch of Gold

Vacuum processing with Kinney Pumps is "the touch of gold" in our times. Under the touch of low absolute pressures, scores of products today come to life with new qualities — product improvements that make sales curves show new vitality.

In the laboratory, Kinney Pumps have played a big part in the research and development of new vacuum products and processes. On the production-line, too, you'll find these same pumps . . . "sluggin' it out", day after day, year after year. People who know vacuum processing know that Kinney Pumps give low absolute pressures quickly — economically — dependably.

Single Stage Models are available in eight sizes: capacities from 13 to 702 cu. ft. per min. — for pressures to 10 microns Hg. abs. Compound Pumps are furnished in three sizes — capacities 5, 15, and 46 cu. ft. per min. — for test pressures to 0.5 micron Hg. abs. Send for Bulletin V45 — the complete story on Kinney Vacuum Pumps, Oil Separators, and Vacuum Pumping Accessories.

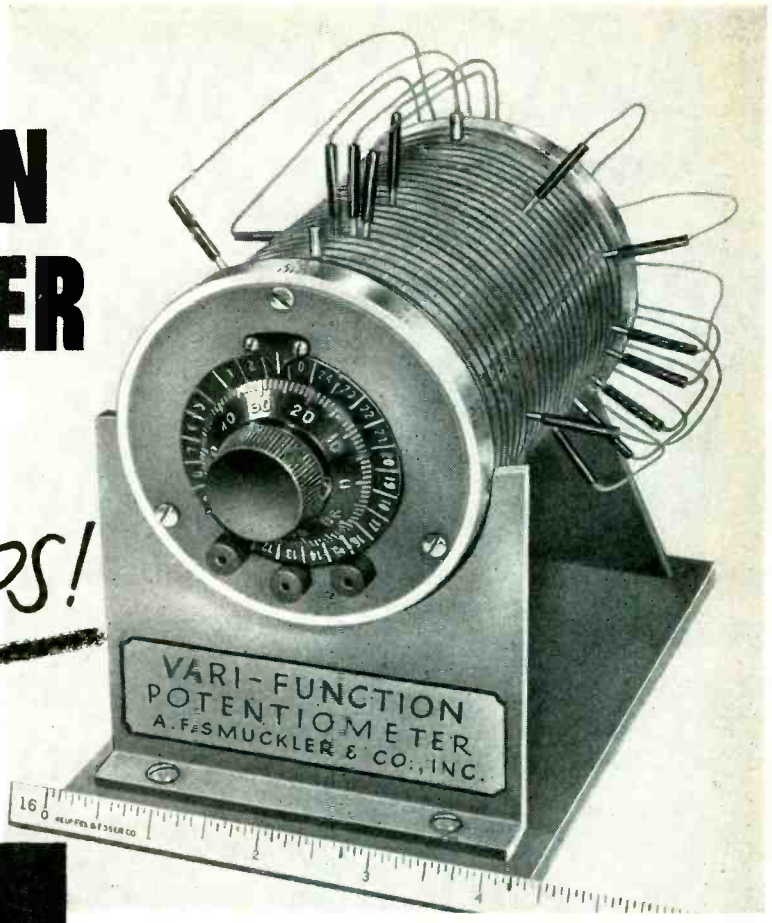
Kinney Manufacturing Company, 3565 Washington St., Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Houston, New Orleans, Philadelphia, Los Angeles, San Francisco, Seattle.

Foreign Representatives: General Engineering Co. (Radcliffe) Ltd., Station Works, Bury Road, Radcliffe, Lancashire, England . . . Horrocks, Roxburgh Pty., Ltd., Melbourne, C. I. Australia . . . W. S. Thomas & Taylor Pty., Ltd., Johannesburg, Union of South Africa . . . Novelectric, Ltd., Zurich, Switzerland.

Making old things better
Making new things possible

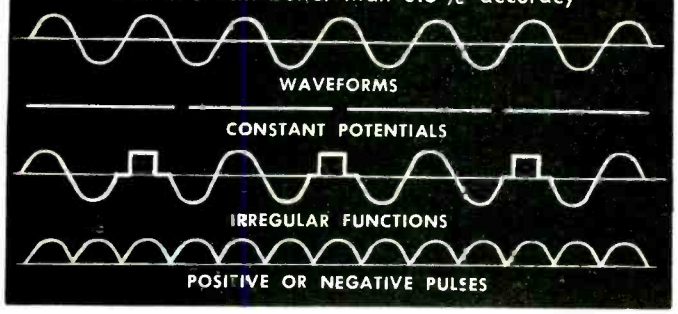
KINNEY Vacuum Pumps

THE NEW
VARI-FUNCTION POTENTIOMETER



Any wave form at your FINGERTIPS!

Produces any form of voltage function including linear functions, waveforms, irregular functions with better than 0.5% accuracy



TYPICAL APPLICATIONS

- Guided Missiles
- Position Indicator
- Gyroscopes
- Flight Control Instruments
- Gun Fire Controllers
- Marine Depth Sounding Apparatus
- Radar
- Electronic Computors
- Flow Controllers
- Flow Meters
- Attenuators
- Servo-Controllers
- General-Application Laboratory Instruments
- Voltage Calibrating Instruments
- Functions Simulator
- Automatic Correction Tables

A revolutionary design of a non-linear adjustable potentiometer

This instrument comprises a helical resistance and a plurality of taps that can be quickly adjusted to produce or reproduce any desired voltage indication or output, as a function of angular displacement.

Voltage forms including linear functions, lines of constant potential, wave forms, and any irregular curves can be reproduced. The function form can be varied quickly by shifting the taps along a calibrated scale.

Available with shaft extension for external coupling and for fixed functions, as required.

CALL OR WRITE TODAY FOR COMPLETE DETAILS — NO OBLIGATION

AFSCO

A. F. SMUCKLER & CO • INC

Electronic and Communication Engineers and Manufacturers

202-208 TILLARY STREET, BROOKLYN 1, NEW YORK

85° BELOW ZERO

would freeze an eskimo

. . . WON'T FREEZE VARGLAS SILICONE

SEND FOR THIS FREE SAMPLE FOLDER

Contains samples for you to test of the revolutionary development of Varflex laboratories . . .

500° ABOVE

would roast the devil

. . . WON'T ROAST VARGLAS SILICONE

Electrical Insulating Tubing and Sleeving lead wire and tying cord

Efficient at 500° F. or more in some applications—yet completely flexible at —85° F. Resistant to moisture and lubricating oil—flame resistant and self-extinguishing—this pioneer silicone tubing and sleeving developed by Varflex is the *strongest of all accepted insulating materials.*

Varglas Silicone is a combination of *Varglas*—continuous filament Fiberglas; moisture and fungus proof; will not burn; strong and flexible at high and low temperatures; chemically inert . . . and *Silicone High Temperature Resin*—which has a natural affinity for Fiberglas; renders it abrasion-resistant, flexible and non-fraying. Normalizing process removes binder and organic inclusions from the Fiberglas; improves electrical qualities and allows uniform impregnation.

Investigate the NEW, low cost VARFLO Sleeving and Tubing if you do not have to allow for an unusually high operating temperature. Samples and prices on request. It's flexible. It takes rough handling without loss of dielectric. It won't fray out. Made with a Fiberglas braid, it won't support combustion—YET COSTS NO MORE THAN COTTON.

Clip and mail this coupon TODAY!

VARFLEX CORPORATION
309 N. Jay St. Rome, N. Y.

Please send me folder containing free samples of Varglas SILICONE products.

Name_____

Company_____

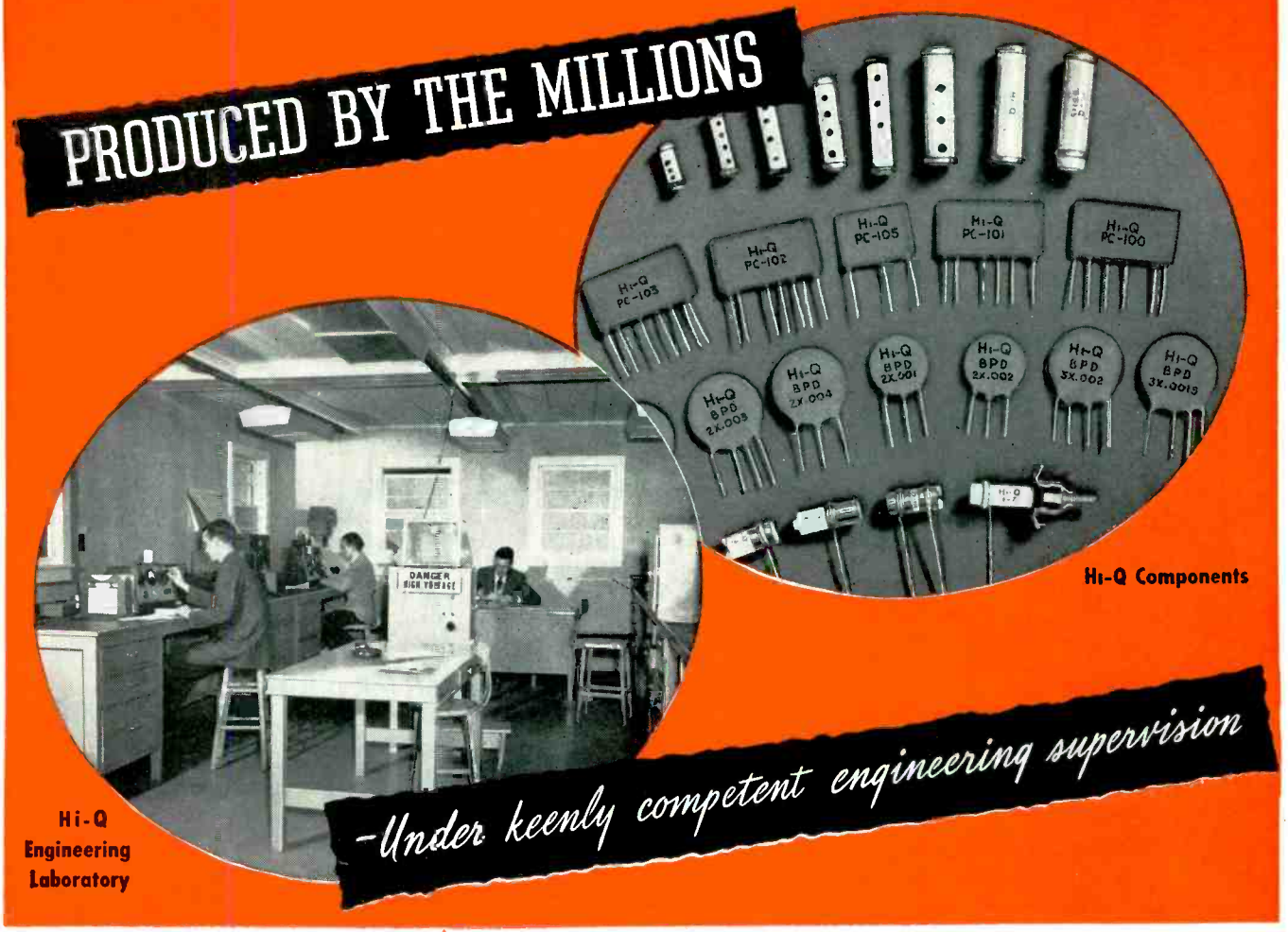
Address_____

City_____ Zone____ State_____

Varflex CORPORATION

Makers of Electrical Insulating Tubing and Sleeving

PRODUCED BY THE MILLIONS



Hi-Q Components

Hi-Q Engineering Laboratory

—Under keenly competent engineering supervision

HI-Q COMPONENTS

Capacitors
Trimmers • Choke Coils
Wire Wound Resistors

BETTER 4 WAYS

- PRECISION
- UNIFORMITY
- DEPENDABILITY
- MINIATURIZATION

● The engineering laboratory is the alert guardian of **HI-Q** quality. No component can be put into production until it has proven that it meets **HI-Q's** exacting standards to the complete satisfaction of these technicians. It is their further responsibility to see that standards are rigidly maintained during production runs. In addition, **HI-Q** engineers are always available to work with your engineers in the development of components to meet your specific needs. Feel free to call on them whenever and as often as you see fit.

Don't miss the brand new **HI-Q** *Datalog. If you haven't received your copy, write to-day.*

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

HI-Q

Electrical Reactance Corp.
FRANKLINVILLE, N. Y.

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

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

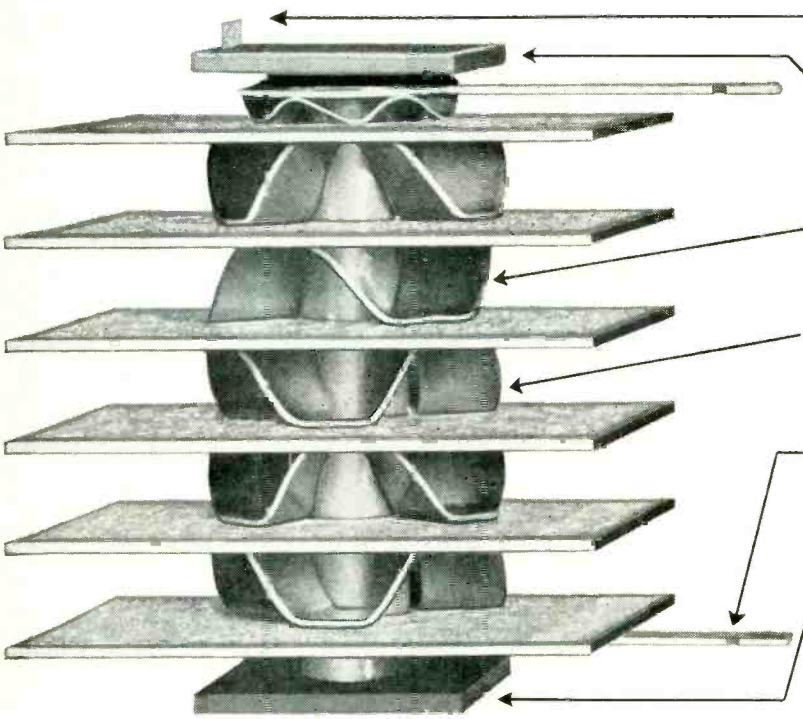
EXPORT ADDRESS: 41 E. 42nd St., New York 17, N. Y., U. S. A.

"Centre-Kooled"©

PAT. APPLIED FOR

SELENIUM RECTIFIERS

With All The Features You Have Been Asking For:



RECTIFIER MODEL 300 ABOVE (Double Size)
15 OTHER MODELS AVAILABLE

1 UNIVERSAL LOCATING PIN
Can be rotated in 90° steps on either side of the rectifier.

2 COLOR CODED
For instantaneous identification of rectifier polarity.

3 CENTER COOLING
Cooled to the "core" by revolutionary spacers.

4 SPRING LOADED
Each spacer acts as an individual spring to guarantee constant assembly pressure under all operating conditions.

5 NOTCHED LUGS
For ease of wiring. Hot tin dipped for ease of soldering.

6 HIGHER LEAKAGE RESISTANCE
Protective end plates of XXP Bakelite insure highest possible resistance to ground under all operating conditions.

7 MODEL NUMBERS
Easily recognized—indicate current rating of rectifiers in milliamperes.

"Centre-Kooled"© SELENIUM RECTIFIERS

Give:

- ***Longer Life***
- ***Lower Temperature***
- ***Ease of Installation***

For Further Information or Engineering Service, Write Dept. E

PACKAGED
FOR DISTRIBUTORS

©

Sarkes Tarzian INC. *RECTIFIER DIVISION*
415 North College Avenue, Bloomington, Indiana

High-Accuracy Beckman pH Meter† relies on D-H ALLOYS

FLOW CHAMBER — with resistance bulb thermometer and electrodes.

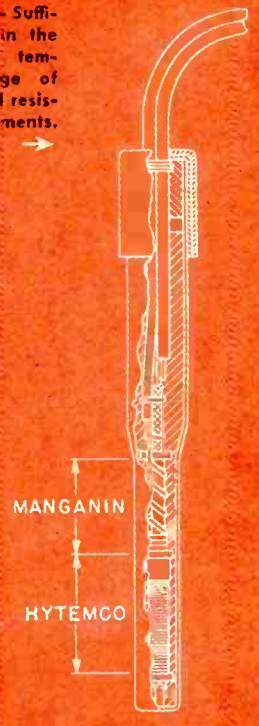
BECKMAN MODEL R pH INDICATOR containing amplifier and precision measuring circuits.

In large industrial installations, where pH control must be continuous or automatic, or both, the temperature of process solutions has to be obtained continuously, in order to compensate for effects of temperature change upon pH.

To accomplish this, the Beckman Model R Automatic pH Indicator provides a flow chamber, or immersion assembly, containing a resistance bulb thermometer in addition to the glass and calomel electrodes used in measuring pH. This resistance thermometer is an element in the feed-back circuit of a stable DC amplifier whose sensitivity is accordingly varied in proportion to the absolute temperature of the process solution.

To assure complete accuracy, the thermometer of the Beckman Model R pH Indicator is wound with D-H HYTEMCO* wire, supplemented with D-H MANGANIN. The high temperature coefficient of HYTEMCO makes it eminently suitable for this application; and the absolutely uniform behavior of this alloy, thruout a wide temperature range, helps the indicator to record pH values with utmost fidelity. The supplementary winding of D-H MANGANIN is required in order to raise the resistance of the assembly to a specific circuit value without increasing the increment of resistance with temperature. This the MANGANIN does very effectively.

RESISTANCE BULB THERMOMETER — Sufficient Hytemco wire is used to obtain the necessary resistance value for the temperature range. A small percentage of Manganin is then added to bring total resistance of winding up to circuit requirements.



In addition to the desirable electrical characteristics of these D-H alloys, however, is the outstanding uniformity of the wire from spool to spool, and the quality "built into" it —as a result of exclusive Driver-Harris know-how and advanced melting, rolling and drawing techniques.

Special alloys for special uses is an important phase of our business. If you have been unable to obtain just what you are looking for, let us know your requirements. We'll gladly put our 50 years of experience at your disposal, and supply you with the alloy best suited to your needs.

†Product of National Technical Laboratories, S. Pasadena, Calif.

Makers of world-famous Nichrome and over 80 alloys for the electrical, electronic and heat-treating fields*

Driver-Harris Company

HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco

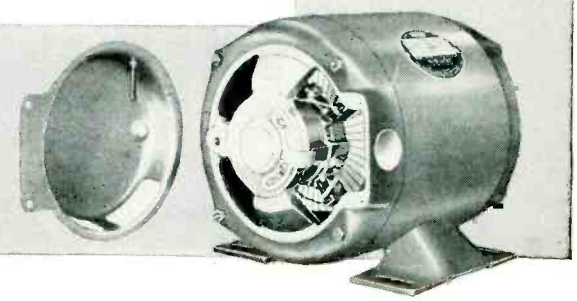
Manufactured and sold in Canada by
The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

FIFTIETH ANNIVERSARY — SPECIAL PURPOSE ALLOYS SINCE 1899 — D-H — TRADE MARK REG. U. S. PAT. OFF.

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

Brown-Brockmeyer solves tough insulating problem *with*

ROGERS DUROID PART



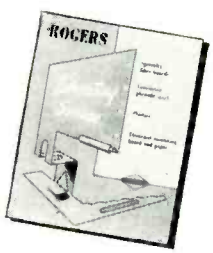
Rogers ability to fabricate this complex component in one piece saved the customer the problem of redesigning the part and complicating assembly with five individual pieces of insulation.

BROWN-BROCKMEYER required a deep drawn and shaped fibrous insulating part. It had been designed to cover a steel support housing for a commutator. The steel housing is used to hold a radial molded commutator for the newly designed "Dyna-Line" brush-lifting motor.

The problem was to find a material with the required electrical and physical characteristics and a fabricator capable of forming and shaping the part to design requirements. Rogers filled the bill on both counts. DUROID, a new Rogers material similar in electrical properties to vulcanized fibre, made the part possible. It could be drawn to the required depth — a virtual impossibility with any other fibrous sheet material. Our Fabricating Division's skill and experience met the challenge of producing this intricate piece with economy and speed.

You can apply this same high order of fabricating efficiency to your requirements for fibrous or laminated phenolic parts. Our range of high quality materials, our specialized knowledge, skills and facilities will SAVE YOU MONEY — AND GET THE JOB DONE.

Write for catalog describing Rogers Corporation's complete fabricating services.



FABRICATING DIVISION, DEPT. E

ROGERS CORPORATION

GOODYEAR, CONNECTICUT

ROGERS

SPECIALTY FIBRE PRODUCTS ELECTRICAL INSULATING BOARDS AND PAPERS DUROIDS • SHOE PRODUCTS	MOLDING AND LAMINATING PLASTICS Boards • Blanks • Pre-shaped Preforms High Strength Molding Compounds Laminated Phenolics	COMPLETE FABRICATING SERVICES ON FIBROUS MATERIALS AND LAMINATED PHENOLICS

IT'S NEW . . .

IT'S DIFFERENT . . .

It's *GENERAL INDUSTRIES'* latest sound reproduction triumph

* Records on tape
* Records on discs
* Plays back both
* Plays any 78 R.P.M. Record

(*) When connected with the proper amplifier.

MODEL 250

TAPE-DISC Recorder Assembly

NOW . . . for the first time . . . General Industries offers you a revolutionary new type of recording instrument —*for both tape and disc use.* Here, indeed, is the answer to a long-standing need for an all-purpose recording unit inexpensive enough to be incorporated in moderately-priced home entertainment instruments.

Yet, despite its low cost, the Model 250 Tape-Disc Recorder offers many quality features . . . is built to the same rigid performance standards which characterize all GI *Smooth Power* products.

A new catalog sheet, describing all of the recording and play-back features of the Model 250, now is available. Write, wire or phone for your copy *today.*

The GENERAL INDUSTRIES Co.

DEPARTMENT B • ELYRIA, OHIO

..this letter speaks for itself!

Admiral Corporation
SERVICE DIVISION
201 E. NORTH WATER STREET · CHICAGO 11 · TELEPHONE MOHAWK 4-4622

Mr. Mal Buehring
Simpson Electric Company
5200 West Kinzie Street
Chicago 44, Illinois

Dear Mal:

This is to tell you how delighted we are here at Admiral with the new Model 303 Simpson Vacuum Tube Volt-Ohmmeter. It certainly is a versatile instrument for television servicing.

The large meter is very legible, and yet the instrument itself is a compact size. I particularly like the AC voltage range, which is the widest I've ever seen on this type of instrument.

Our service engineers think you've done a good job on the Operator's Manual, too, because it is both complete and concise.

Of course, we've used the Simpson Model 260 Volt-Ohm-Milliammeter for years. The "303" is a fine companion instrument to the "260".

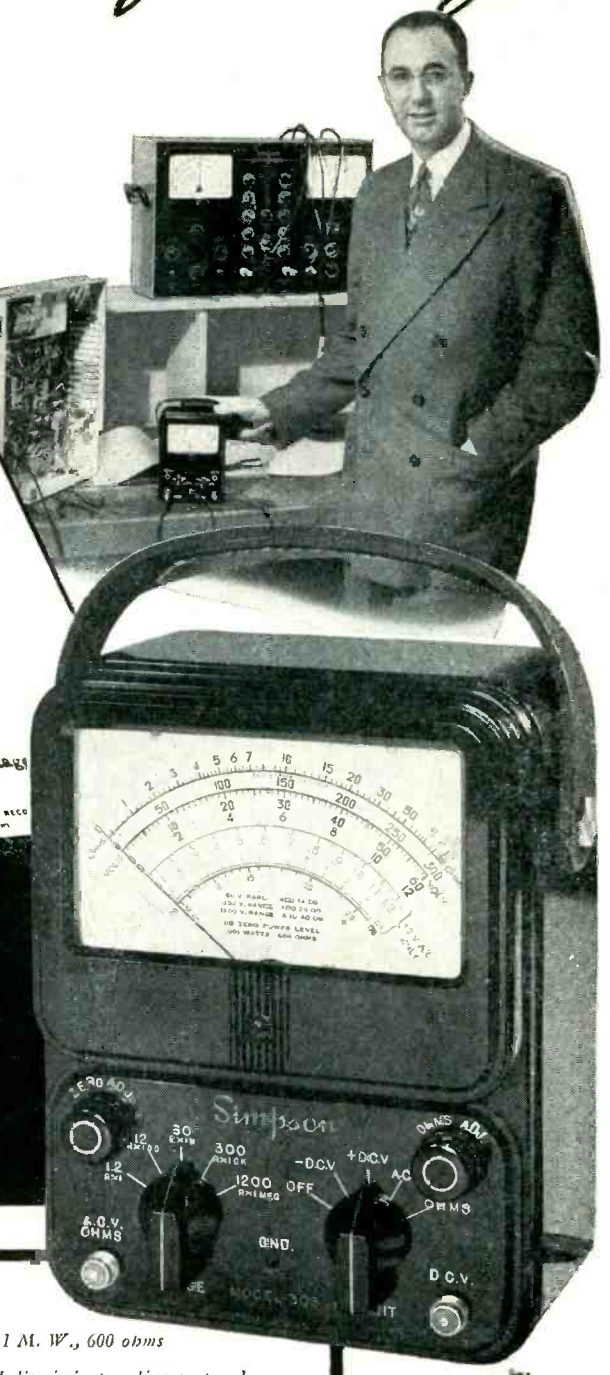
Congratulations!

Sincerely yours,

ADMIRAL CORPORATION
M. J. Schinke
National Service Manager

MJStar

WORLD'S LARGEST MANUFACTURERS OF RADIO PHONOGRAPHS WITH AUTOMATIC RECO
AM-FM Radios · Television · Radio-Phonographs · Refrigerators · Home Freezers



Model 303
VACUUM TUBE VOLT-OHMMETER

SPECIFICATIONS

DC Voltage
Ranges 1.2, 12, 60, 300, 1200 (30,000 with Accessory High Voltage Probe)
Input Resistance 10 megohms for all ranges
DC Probe with one megohm isolating resistor Polarity reversing switch

Ohms *Ranges 1000 (10 ohms center)*
100,000 (1000 ohms center)
1 megohm (10,000 ohms center)
10 megohms (100,000 ohms center)
1000 megohms (10 megohms center)

AC Voltage
Ranges 1.2, 12, 60, 300, 1200
Impedance (with cable) approx. 200 mmf shunted by 275,000 ohms

AF Voltage
Ranges 1.2, 12, 60
Frequency Response Flat to 100,000 cycles

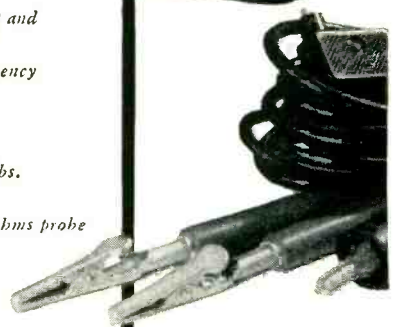
Decibels
Ranges —20 to +3, —10 to +23, +4 to +37, +18 to +51, +30 to +63
Zero Power Level 1 M. W., 600 ohms

Galvanometer
Zero center for FM discriminator alignment and other galvanometer applications

R. F. Voltage
(Signal tracing with Accessory High Frequency Crystal Probe)
Range 20 volts maximum
Frequency Flat 20 KC to 100 M.C.
105-125 V. 60 cycles

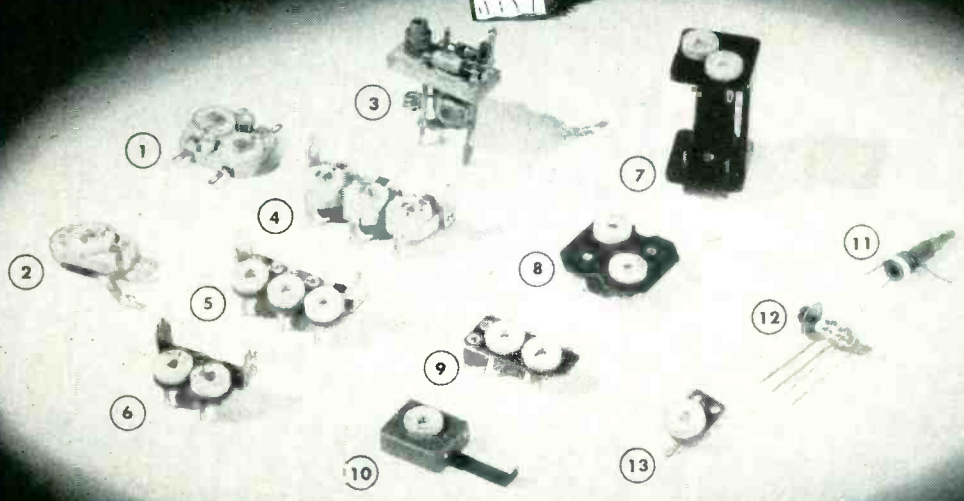
Size
5¼"x7"x3⅛" (bakelite case). Weight: 4 lbs. Shipping Wt.: 6½ lbs.

Dealer's Net Price
Model 303, including DCV Probe, ACV—Ohms probe and Ground Lead—$58.75;
Accessory High Frequency Probe, $7.50;
Accessory High Voltage Probe, $14.85
Also available with roll top case, Model 303RT—$64.75



Simpson ELECTRIC COMPANY
5200 WEST KINZIE STREET, CHICAGO 44, ILLINOIS • IN CANADA: BACH-SIMPSON, LTD., LONDON, ONTARIO
Phone: COlumbus 1-1221

ASK Erie RESISTOR . . .



. . . About *Custom Designed* Trimmers

Pictured above are several custom designed trimmers that incorporate the elements of standard Erie Disc and Tubular Ceramicon Trimmers. Each has been developed for a specific purpose, and each does its job efficiently and economically. Proper design and precision manufacturing, plus our years of experience, are the keynote to Erie quality.

Look at these units carefully. They should suggest the possibility of using Erie Resistor know-how and facilities to make your equipment more compact and more efficient.

Erie has the most complete trimmer line in the industry. We want to work with you in adapting them to your requirements. Inquiries should specify complete mechanical and electrical requirements.

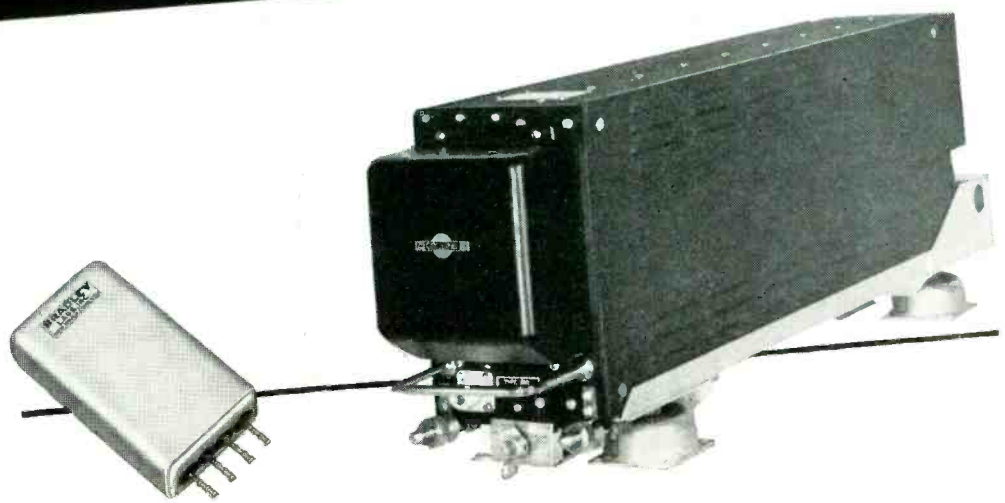
1. Standard Style TD2A Dual Trimmer with mounting pillars.
2. Special ribbon type terminals on standard Style TS2B Trimmer for direct connection to other components.
3. Compact Trimmer—Capacitor—Resistor—Coil Design. A complete oscillator unit.
4. Where special mounting is desired, standard Erie Style TS2A and Style 557 Trimmers can be supplied mounted on brackets.
5. Where special mounting is desired, standard Erie Style TS2A and Style 557 Trimmers can be supplied mounted on brackets.
6. Where special mounting is desired, standard Erie Style TS2A and Style 557 Trimmers can be supplied mounted on brackets.
7. Two trimmer elements become an integral part of this coil form and I. F. top section.
8. Two trimmer elements become an integral part of this coil form and I. F. top section.
9. Special bracket and terminal arrangements or dual trimmer unit.
10. A compact pluggable assembly for mounting a trimmer in parallel with a plug-in crystal.
11. Special tubular ceramic trimmer and variable inductance having one common terminal.
12. Special steatite tubular dual trimmer.
13. Standard Erie Style 557 Trimmer with special bent rotor terminal.

Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND · · · TORONTO, CANADA

A BRADLEY CASE HISTORY



BRADLEY RECTIFIER SOLVES DEMODULATING DIFFICULTY

Collins Radio Company, in its 51R-2 aircraft receiver, uses a Bradley hermetically sealed vacuum-processed selenium rectifier for demodulating an FM signal which provides navigation information in the newly developed omni-range system.

"We were," says Collins, "at one time having considerable trouble in this circuit. Your rectifiers remedied this situation completely. They have contributed a great deal in enabling us to obtain the required performance in our 51R-2 receiver.

"The characteristics of the rectifier are retained even under the extreme variation of temperatures stipulated by the Civil Aeronautics Administration in testing suitability for use in scheduled airlines service."

Through its exclusive vacuum process, Bradley has solved the problem of producing selenium and copper oxide rectifiers that are uniform and consistently true to rating. For improved power conversion in your product, consult Bradley engineers. They can help you obtain the right rectifier for your application.

THE BRADLEY LINE

SELENIUM RECTIFIERS
•
COPPER OXIDE RECTIFIERS
•
SELF-GENERATING PHOTOCELLS

SELENIUM SE8L

SPECIFICATION DATA

1. Reverse current at 150 volts DC 15 microamperes maximum at plus 72° C. to minus 50° C.
2. Forward current at 42 volts DC from 700 microamperes minimum to 2 milliamperes maximum at plus 72° C. to minus 50° C.
3. The unit shall be capable of operating continuously within limits at 95% relative humidity.

BRADLEY LABORATORIES, INC.

82 MEADOW STREET
NEW HAVEN 10, CONN.

Induction Oscillator

Now an induction oscillator which is rugged and dependable is available at a moderate price! HAYDU BROTHERS' answer to your problem in brazing, annealing and hardening—where localized and zonal heating is important—can be solved with this machine of infinite uses.

Maintenance difficulties are overcome easily in the induction oscillator, as Bill Klinder, with his many years of experience in electronics, gave every consideration to make each part readily accessible. Replacement and repair is simplified by listing all parts and their functions in a schematic diagram.

We welcome the opportunity for the engineering staff to analyze any particular problem at no cost or obligation and will gladly work on specified samples. Our production plant for brazing is also equipped to undertake consignments where the expense of a complete unit cannot be met. The induction oscillator can be built to any power specification to meet individual needs.

HAYDU BROTHERS

PLAINFIELD NEW JERSEY

RADIO MANUFACTURERS ASSOCIATION RMA MEMBER

Now!

A Photographic Record of Oscilloscope images in One Minute

FAIRCHILD POLAROID OSCILLOSCOPE CAMERA

This new inexpensive oscilloscope camera produces a photographic record for engineering study *one minute* after the shutter is snapped! *No darkroom processing is required.* It's all done within the camera by the Land method. Prints are 3¼ x 4¼ – small enough to mount easily in a notebook, large enough to permit accurate evaluation.

Two traces – one above the other – can be recorded on one print. This saves time and film as well as facilitating comparison runs. *Writing speeds* ranging up to 1 in/μsec with an accelerating potential of 3000V have been recorded. With higher potentials, speeds to 50 or 60 in/μsec can be recorded.

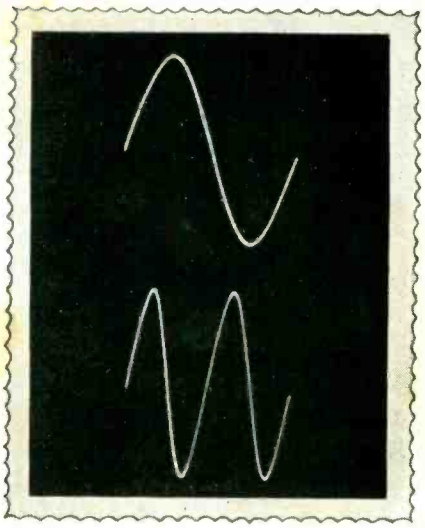
By observing the trace through the viewing port, the operator can record repetitive phenomena as he wishes. Transients are recorded by "bulb" or "time" exposure. The tube face is so well shielded that records can be made in bright light.

Designed for easy installation on any standard 5-inch oscilloscope, the new Fairchild-Polaroid Camera consists of a *scope adaptor*, a *light-tight hood* with viewing port, and a *Polaroid-Land Camera body*.

A specially designed f/2.8 lens with a between-the-lens shutter makes possible sharp, fully exposed photos. A two-position shift device moves the camera to permit two exposures on one print. The whole assembly is lightweight and easy-to-handle.

The required film takes 16 exposures to the roll and may be obtained at small cost in almost any photographic supply store.

For more data, write to 88-06 Van Wyck Boulevard, Jamaica 1, N. Y.



3¼ x 4¼ Print made in one minute with the new Fairchild-Polaroid Oscilloscope Camera.

Fairchild
CAMERA AND INSTRUMENT CORPORATION

The New Fairchild-Polaroid Oscilloscope Camera is available at these outlets:

Tektronix Inc., Portland, Oregon
Electronic Tube Corp., Philadelphia, Pa.
Browning Laboratories Inc., Winchester, Mass.

FOR BETTER TUBE PERFORMANCE

FILAMENT BASE METALS

SYLVALOY
MODIFIED HILO
COBANIC
TENSITE
UNIMET

CARBONIZED NICKEL

RADIOCARB
DUOCARB
POLICARB

GRID WIRE

MANGRID

NOW — MORE THAN EVER BEFORE — ELECTRICAL ALLOYS *MUST BE BETTER*

The critical requirements of television circuits demand better tubes with finer electrical alloys — alloys that are superior electrically, chemically and in physical properties. A logical source for metals to meet these new standards is the Wilbur B. Driver Company, largest producer of carbonized nickel ribbon and filament alloys *for more than twenty years.* Inquiries concerning critical tube applications will receive prompt, capable attention. Write today, outlining your requirements — there is no obligation.

WILBUR B. DRIVER CO.

150 RIVERSIDE AVE., NEWARK 4, NEW JERSEY

BUSINESS BRIEFS

By W. W. MacDONALD

Image Orthicons and associated apparatus are expensive to maintain. So many television stations rehearse shows with the cameras dead, a practice that prohibits monitoring and later permits visual fluffs to get on the air.

Some of the new closed-circuit industrial television systems (about which you will hear more from us in the months ahead) are relatively inexpensive to own and operate, so we suspect that they may soon come into use in tv studios for rehearsals.

Black Gupp of some kind has been sprayed on the face of some clear-glass television picture tubes to clear out stock in view of competition from black-face types. Also, there are rumors of possible price reductions on round-tube types in anticipation of increased popularity for the rectangular variety.

Both trends will bear watching.

Upping of television users from small screens to large screens is already underway in certain markets. Replacement business is already with us.

Cryptic Statement to stockholders by Harry Cohn of Columbia Pictures Corporation reads as follows: *"In the event a point is reached where television should fit into our operations on a basis we deem desirable, we will be in a position to take advantage of any change."*

Experienced as we are in the coining of neat phrases, we doubt if we could have done better ourselves, and further details from Hollywood are awaited with the keenest interest.

Police Vehicles licensed to use radio transmitters total approximately 40,000, according to General Electric. Approximately 13,000 cars are yet to be licensed and these will have equipment in operation within three years if the rate of growth continues as in the past few years. G. E. estimates that police departments will spend $5,450,000 on radio equipment in 1950.

Receiver Sales by licensees during 1949 totalled 13,237,098, worth $823,395,645. Here's the way the total broke down:

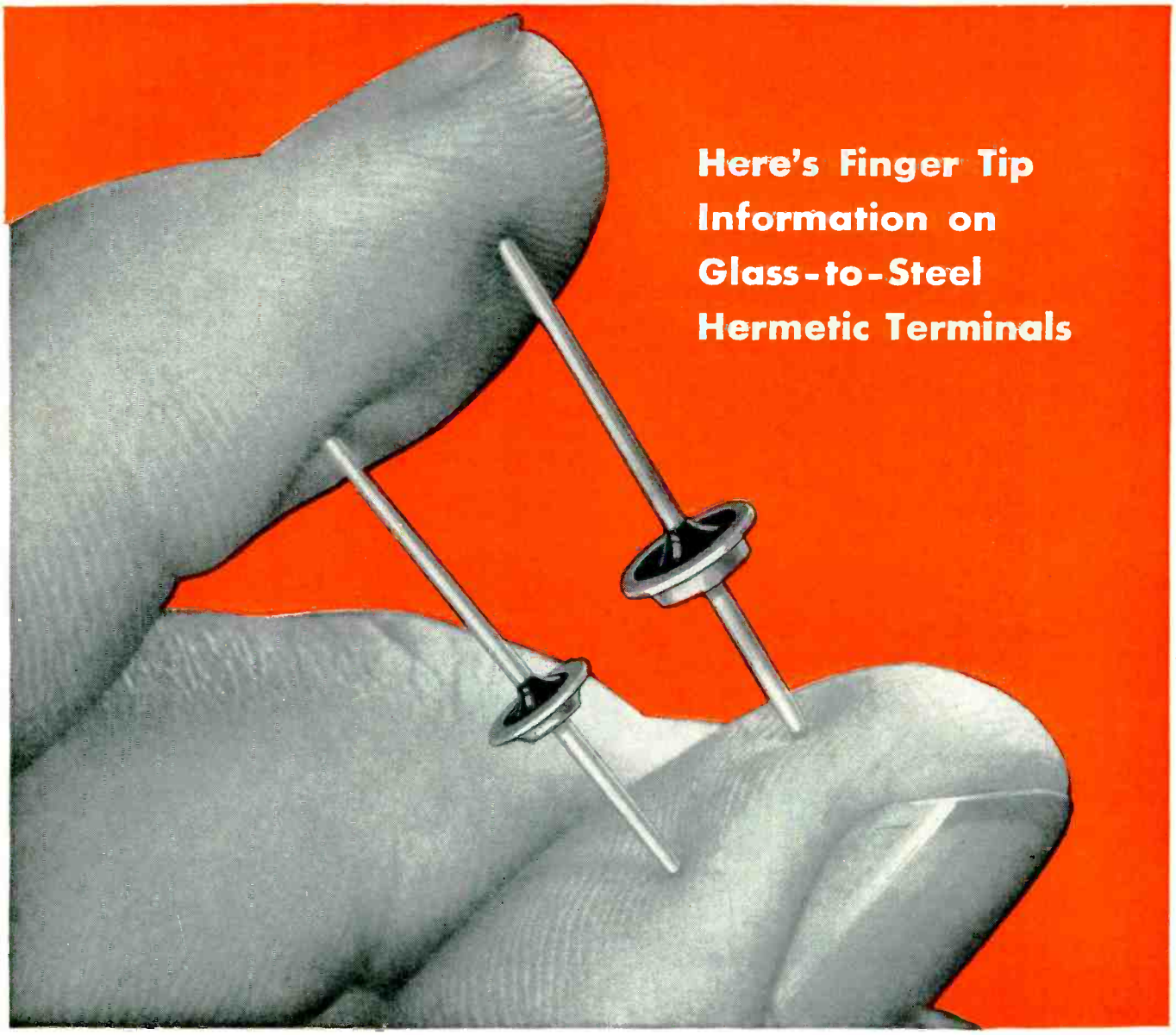
Type	Units	Dollars
Electric		
Table (under $12.50 billing price)	2,149,469	$22,434,688
Table (over $12.50 billing price)		
A-M	1,540,558	27,972,101
A-M/F-M	341,214	10,561,344
F-M (including converters)	36,650	1,043,125
Consoles		
A-M	13,922	606,062
A-M/F-M	16,431	1,335,382
Table-Radio-Phonos		
A-M	360,229	12,516,360
A-M/F-M	16,700	879,015
Console-Radio-Phonos		
A-M	146,717	10,929,486
A-M/F-M	439,910	49,863,573
Battery		
Portable A-C/D-C	1,334,222	24,066,858
Table	89,175	1,663,580
Consoles	1,064	98,103
Auto	3,389,168	100,351,280
Television		
Converters	1,860	519,654
Radio Table Models	1,629,450	251,815,187
Radio Consoles		
Direct Viewing	917,342	194,406,965
Projection	12,702	4,981,847
Radio Phonos		
Direct Viewing	321,416	94,361,547
Projection	902	521,741
Phonographs		
Phono only	383,791	7,346,550
With radio attachment	33,468	348,430
Without Cabinets		
A-M	18,968	429,216
A-M/F-M	16,344	860,555
Television	25,426	3,482,996

CAA has just awarded the largest contract in its history, for 450 distance - measuring - equipment ground stations, to Hazeltine Electronics. Price: $4,210,750. Delivery: November 1950 for the first unit, five more in March 1951 and 40 per month by June 1951.

The contract represents part of CAA's billion-dollar, fifteen-year air navigation equipment program.

All 84,000 Amateurs are not using the band on which you operate. It only seems that way.

Brazil is modernizing its communications system. First step in the program is the placing of a contract with Byington & Company for $1,500,000 worth of telegraph lines and associated facilities. Byington has retained Stand-



• The trend toward hermetic sealing in all phases of electrical manufacturing is gaining impetus. Fusite has pioneered in the field of glass-to-steel hermetic terminals for use in fusion sealing—the only truly hermetic process.

• We have prepared a brochure crammed full of illustrations, specifications, diagrams, and facts about the Fusite wide line of single and multiple electrode terminals.

• We assure you that regardless of your present level of knowledge concerning glass-to-steel terminals, you do not have a complete or accurate picture of the production possibilities of fusion sealing until you know the Fusite story.

Write today for your copy of this literature, to Dept.-E.

TERMINALS ILLUSTRATED: 104SW, Left, 105SW, Right.
Miniature—Straight Wire—Single—Glass-to-Steel Hermetic Terminals.

INSULATE ELECTRICALLY
GLASS TO METAL
FUSITE
TERMINALS
PROTECT PRODUCT PERFORMANCE
SEAL HERMETICALLY

THE FUSITE CORPORATION

CARTHAGE AT HANNAFORD, NORWOOD, CINCINNATI 12, OHIO

ard Electrica, S. A. (an associate of IT&T) as a consultant.

Machine-Tool Programming by automatic electronic means must provide the absolute maximum of flexibility, says R. N. Eck of Cutler-Hammer. The time required to set up the program, and the time required to change from one program to another, is of the utmost importance to industry, he points out.

As Near As We Can Tell, induction heating is about four times as big a business as dielectric heating dollarwise at the present time. The gap will, however, be substantially narrowed in the next few years.

Speaking Of R-F Heating, the FCC regulations make the user responsible for interference but we note in our travels that when equipment kicks up a fuss among other services the manufacturer is almost invariably called in to fix it.

European Countries receiving ECA assistance are rapidly improving their ability to deliver electronic apparatus. Here, according to McGraw-Hill World News correspondents, is the picture overseas:

Country	*Commodity*	*Delivery*
Austria	Radios and parts	Immediate
	Telephone accessories	3–6 months
	Telephone-telegraph stations	1 year
	Tubes	3–6 months
Belgium	Radios and parts	Immediate
	Telegraph accessories	1 year
	Telephone accessories	1–6 weeks
	Telephone exchanges	1 year
	Telephone switchboards	3–8 months
	Teleprinters	2–3 months
	Teleprint exchanges	1 year
Denmark	Measuring instruments	1–2 months
	Radio equipment (f-m)	4–6 months
	Telegraph accessories (automatic)	3–4 months
	Telephone parts	2–8 months
England	Radio, tv and electronic apparatus	Immediate — 18 months
	Tubes (general)	Immediate
	Tubes (cathode-ray)	3–6 months
France	Capacitors (radio)	1 month
	Radios	Immediate
	Speakers	3 months
	Telephone equipment (carrier)	6–12 months
	Telephone exchanges	1–2 years
	Telephone switchboards	3–12 months
	Tubes	Immediate — 3 months
Germany	Radios	1–3 months
	Recorders (magnetic tape)	1–4 months
	Telephone exchanges	3–9 months
	Teleprint exchanges (manual)	3–6 months
	Teleprint exchanges (automatic)	6–9 months
	Teleprinters	Immediate — 3 months

	Transmitters (radio)	6–12 months
	Tubes	1–2 months
Italy	Amplifiers (audio)	Immediate
	Radios and parts	Immediate
	Telegraph accessories	Immediate
	Telephone equipment	Immediate
	Transmitters (small, radio)	Immediate
Netherlands	Capacitors, resistors	3–4 months
	Magnets (permanent)	Immediate — 2 months
	Magnetic materials (low-loss)	3–4 months
	Measuring equipment	Immediate
	Radios	Immediate — 3 months
	Record players, pickups	Immediate — 3 months
	Recording equipment	1–3 months
	Rectifiers (telephone)	2–6 months
	Relays, recorders, counters	Immediate — 4 months
	Servicing equipment (radio)	Immediate
	Signal equipment	Immediate — 4 months
	Sound equipment	Immediate
	Studio equipment (radio)	6–15 months
	Telephone equipment (carrier)	6–15 months
	Telephone equipment (general)	6–15 months
	Telephone exchanges (automatic)	6–15 months
	Television receivers	Immediate — 6 months
	Transmitters (a-m, f-m)	6–15 months
	Transmitters (television)	6–15 months
	Tubes (television)	Immediate
	Tubes (telephone)	Immediate
	Tubes (transmitting)	Immediate
	Tubes (receiving)	Immediate
	Tubes (uhf)	Immediate
Sweden	Radio, tv and electronic apparatus	Immediate — 18 months
	Tubes (general)	Immediate — 6 months
	Tubes (cathode-ray)	Immediate — 6 months
Switzerland	Intercommunication apparatus	6–12 months
	Radios and parts	1 month
	Signalling and detection apparatus	4 months
	Telemetering and remote control	6 months
	Telephone apparatus	1–12 months
	Telephone equipment (carrier)	8–14 months
	Teleprint exchanges (automatic)	6–12 months

A New Subdepartment, *Shop Shortcuts,* made its bow in ELECTRONICS last month, and the second installment appears on p 184 of this issue. It was started on the theory that there is more to our business than just circuits; many subscribers are interested in the mechanics of laying out, producing and testing electronic apparatus.

A new department is never easy to get rolling; authors just don't know that the editors are interested in their wares until they are told. So we're taking this means of telling them . . . we are interested.

A Manufacturer we know has his plant on Skunks Misery Road. If anybody else has a trickier address we would like to know it.

G. B. B. M. Sutherland, in a recent speech, used the following limerick:

Mr. Langley invented the bolometer
Which is really a kind of thermometer,
That will measure the heat
From a polar bear's seat,
At a distance of half a kilometer.

The piece is hereby recorded for posterity.

Mallory Capacitors Deliver *Extreme Dependability in Critical Applications!*

MALLORY NP CAPACITORS

Mallory NP Capacitors are non-polarized and designed for heavy-duty applications where extreme dependability is essential. Priced competitively at ordinary capacitor levels, they are ideal for controls and other unusual circuits. Write for your copy of the Mallory NP Capacitor data folder.

Long trouble-free service has become so synonymous with Mallory Capacitors that customers have come to assign critical responsibilities to them without hesitation.

For example . . . a complex rpm control for diesel-electric locomotives. The failure of a single component would stall the train, blocking rail traffic for hours. For absolute safety and dependability, the manufacturer specified Mallory NP Capacitors in this control.

The Mallory-originated NP Capacitor is widely used in such important applications. This complete confidence is the result of years of *demonstration* of Mallory superiority. Yet Mallory Capacitors cost you no more.

That's results beyond specifications!

And whether your problem is electronic or metallurgical, what Mallory has done for others can be done for you!

P. R. MALLORY & CO. Inc.

MALLORY

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

SERVING INDUSTRY WITH

Capacitors	Contacts
Controls	Resistors
Rectifiers	Vibrators
Special Switches	Power Supplies

Resistance Welding Materials

CROSS TALK

► **DOTS** . . . As this is written, Peter Goldmark has just reported to the FCC the successful application of dot-interlace to the CBS system of color television. We refrain from taking sides in the color-tv question while the matter is "in the courts". But we see no reason for refraining from expressing pleasure over the fact that the ingenious dot method, which improves resolution nearly two to one without increasing the bandwidth, has now been applied to two of the three contesting color systems, those proposed by RCA and CBS. All of which serves as justification for rereading Wilson Boothroyd's two-part article on dot television systems which appeared in the December 1949 and January 1950 issues of this magazine.

It is dangerous to take a stand on technical issues while they are still in a state of rapid flux. But synchronized time-multiplex transmission (the dot method) is so powerful a tool, has such a far reaching effect on spectrum economy, that we feel a voice should be raised. So here goes: *No system of television, whether in color or in black-and-white, should henceforth be introduced to the public unless dot-interlace is employed. Moreover, dot-interlace should be introduced as soon as possible to the 525-line black-and-white system now standard in this country.* Dot-interlace could be introduced without impairing the performance of, and without requiring any change in, any existing receiver, and it would make possible substantially improved performance in receivers of the future.

Any sweeping recommendation on television standards these days is an invitation to a storm of protest, if obsolescence is to be hastened by the proposed change. But dot-interlace by time multiplex can be introduced without obsolescence of any equipment.

Any bugs in this proposal are certain to be called to our attention, pronto. If they come to light we'll pass them on.

►**KUDOS** . . . The exploration of the moon's sub-surface temperature by microwaves (*Crosstalk*, January) has been mentioned by Harlow Shapley as among the ten astronomical events of the year 1949. Dr. Salisbury has promised us a paper on the subject, soon's he get's around to it.

► **SILK** . . . We are continually amazed at the full circles through which electronic developments ultimately travel. First case: the connection between electricity and light was discovered by the British telegrapher May, who discovered the photoconductive property of selenium in 1873. Now in 1950 comes the vidicon (p 70), most sensitive of all television camera tubes, and what does it turn out to be? A photoconductive cell, and a selenium cell at that. Second case: The first recorded instance of man-made static electricity, according to the Greek records, was that produced when silk was rubbed on amber. Three milleniums later, A. D. 1950, we learn that a new source of interference to television reception has been isolated after an exhaustive search. According to "Free Grid" of *Wireless World*, a momentary snow storm on the tv screen has been found to accompany the nearby, rapid removal of silk or nylon hose. A phenomenon, indeed! The surprising thing is that the interference was ever noticed, under the now-identified circumstances.

► **DEPTS** . . . Conversation with subscribers in half-a-dozen cities leads us to believe that quite a few have not yet discovered the department *Business Briefs* appearing immediately ahead of this page. If you are one of those that have overlooked it, we urge you to read this department that briefs facts and figures of interest to men who design, produce and sell electronic equipment.

Two other departments have apparently suffered because of their position, rather than any lack of reader interest, *New Books* and *Backtalk*. We've given them a break this month by starting them off with a full page immediately after the other departments.

ELECTRONIC MACHINES for Business Use

A machine that satisfactorily solves differential equations will not necessarily perform every-day clerical work. The circuit principles are applicable, but much engineering must be done before the office-equipment market can be tapped

By W. B. FLOYD
Research Division
Sears, Roebuck and Co.
Chicago, Ill.

BUSINESSMEN, as well as mathematicians, are fascinated by the possibilities of electronic computation. What they see, primarily, are payroll savings. Of secondary importance, they see the possibility of securing additional facts about their businesses.

When a businessman reads in the newspapers about a machine that will do in thirty minutes what it would take thirty people a month or more to do manually, he naturally asks, "When can I get one of these machines!" He may not think to ask whether or not the machine will actually do the particular clerical jobs that have to be done in his office. He is likely to assume that any machine that will solve difficult mathematical problems will do ordinary clerical work with ease.

This assumption is understandable. The principles of electronic computation are applicable to much of the clerical work encountered in business. Automatic electronic machines undoubtedly will effect a clerical revolution. But some more engineering will have to be done before that happens. A machine that will solve differential equations is not necessarily a machine that will do the everyday paper work of business concerns, and do it economically.

The engineering that remains to be done, before the market for automatic clerical machines can be tapped, is by no means all electronic engineering. First, an industrial engineering job must be done. Business problems must be understood in detail before ideal machines for their solution can be built.

The General Pattern

No two companies have quite the same clerical problems. This fact has been the despair of more than one office-equipment salesman. Nevertheless, a common pattern is discernible in most clerical work.

The pattern starts with the creation or receipt of an original document. A purchasing agent notes an item to be bought; a receiving clerk lists incoming merchandise; a salesperson writes a sales check; a meter reader writes down some numbers. Or a purchase order, subscription, remittance or complaint is received. Millions of entries and papers such as these are the starting point of virtually all of the clerical work that is done in business. They are the input of whatever system is used to ship merchandise, charge customers, maintain stocks, schedule production and account for income and outgo.

The remaining steps are internal to the system itself. They almost invariably include:

One or more lookups, to secure additional information or to check information that is shown on the original document.

A few simple calculations, such as totaling an account or extending an invoice.

Recording the transaction, often under not one but several captions.

Typing final documents such as purchase orders, shipping papers, voucher checks, acknowledgements and hosts of similar papers.

Summarizing the data that has been recorded from the constant flow of business papers. Most accounting and statistical work belongs in this category.

If you think of almost any clerical procedure you happen to be familiar with, you will see that it does involve all of these steps. And in most cases, sorting, lookups, posting and typing far outweigh the arithmetical work that is done.

With the foregoing pattern of clerical work in mind, we can now see some of the important points of contrast between the mathematical computers that have been built and

The CUSTOMER Speaks

BUSINESS BRIEFS (p 60, March) recently called attention to the fact that an

"Important trend everywhere in evidence is an engineering struggle to combine the functions of electronic measuring - telemetering - calculating - indicating - recording devices with those of the garden variety of business machines."

It was pointed out that

"What is needed is a bridge between the two devices, one that need not be monitored by human hands."

This article, by Mr. Floyd, tells what a typical businessman expects of design engineers

Clerical help in one of many departments of a big business concern, typical of the offices where completely automatic electronic machines are needed

the clerical machines that will be built. These contrasts bring out some of the still-unsolved problems in building an ideal clerical machine.

Machines vs Computers

The Input Problem. One fundamental difference between mathematical and clerical work can be stated this way: While mathematicians often have to perform a great many complex operations on a relatively small amount of data, clerks in business offices must perform a few relatively simple operations on a vast amount of data.

Two implications as to machine design are immediately apparent. Input and output capacities assume greatly increased importance. Computation assumes less importance.

To handle clerical input economically, we must do more than merely use the fastest possible keyboards. Every conceivable means must be found to eliminate the manual keyboard altogether, or to hold the required number of key depressions at an absolute minimum and so minimize manual labor.

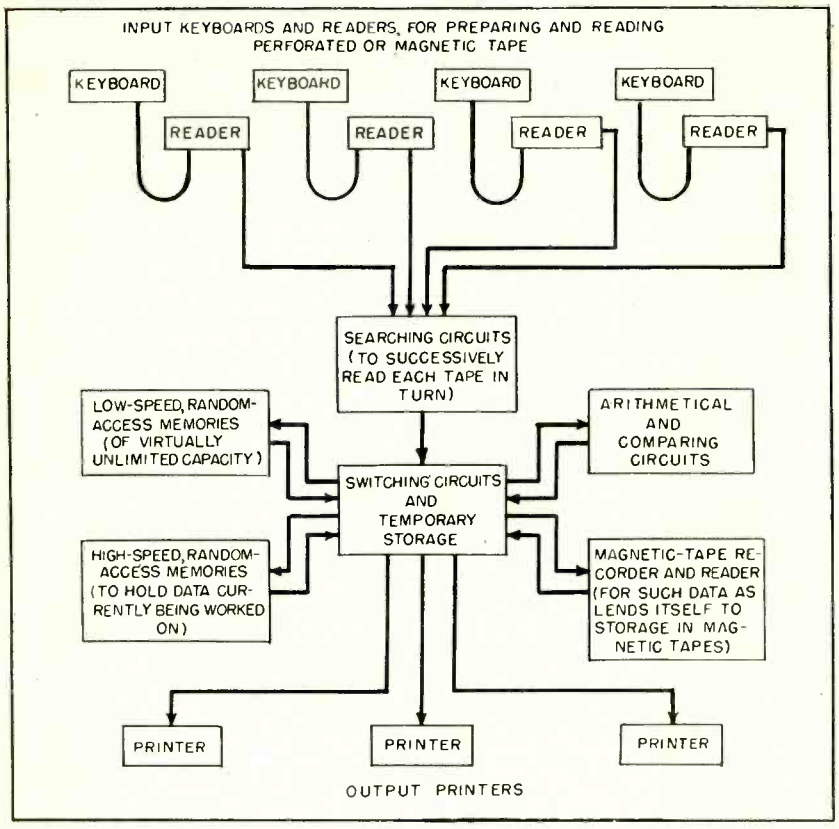
One way to reduce key strokes is to record manually only reference numbers, relying upon the machine's memories to supply all of the remaining data that is regularly associated with these reference numbers. For example, the price and description of a product are usually associated with a stock number. Similarly, the name and address of a vendor or customer can usually be associated with a vendor number or customer number.

Better than reducing manual input is to eliminate it altogether, by producing original documents in machine language to begin with. Equipment recently developed for the retail garment trade illustrates this principle. The marking tickets that are placed on garments are prepared by a special machine that perforates as well as prints code numbers on the tickets. Thus the garment ticket stub, which is removed when the item is sold, can be automatically read by the machines that record and summarize sales.

Much thought is being given to more generally useful means of producing original documents so they can be read automatically. The problem is one of inter-company standardization rather than of finding technical solutions to the problem. There is a need for more standard business documents that can be read mechanically as well as visually. When it costs nearly as much to put data in such form that a machine can use it as it would cost to produce the final documents themselves by manual means, nothing is gained by mechanization.

The Output Problem. The output problem cannot be solved in quite the same way as the input problem. Our whole purpose is a big output of invoices, purchase orders, receiving records, shipping papers, payment vouchers and summary reports. What we must do here is to speed up the output device itself.

A better solution must be found than that of driving electric typewriters automatically. No matter how fast they are driven, we are still printing only one character at



Basic components of the desired electronic machine for general business use

a time. Output printers for commercial use will almost certainly have to be of the line-at-a-time type. Perhaps several lines, or whole documents, will be printed at a single impression. Over 1,000 lines per minute is considered a worthy goal by some engineers who are working on output printers.

Selective Memories. Another basic contrast between most mathematical and clerical problems is the contrast between a batch of work and a flow of work. A big statistical problem constitutes a batch of work. Business documents, like the assembly lines to which they are tied, constitute a flow of work.

Preparing 10,000 invoices may be comparable, in machine time, to solving a single problem in mathematical physics. Yet, in addition to differences in the volumes of input and output, there is another fundamental difference between the two undertakings. All of the data for the mathematical problem can be assembled, in predetermined order, and handled as a unit. The invoices, however, must be prepared as goods are shipped. They cannot be held until a convenient batch of work has accumulated. What this means from a machine-design point of view is that the clerical machine must be able to take work in random order.

A flow of work in random order requires the use of selective memories. The problem is similar to that of a telephone exchange. Telephone calls are received, by the central exchange, in random order. Selectors must be used to connect with the parties called. Were it not for their relatively low speed, telephone selectors could be used, as is, to solve many selective memory problems that will be encountered in designing machines for business use. The computing machine companies must find a faster and less expensive solution.

Electrostatic memories and acoustic delay lines are fast enough, and selective enough, but far too expensive for all but limited use. Magnetic drums are a step toward lower-cost memories of the selective type. But they too are rather expensive.

Memory Capacity. The contrasts we have already mentioned lead to a fourth, important contrast between mathematical computers and clerical machines. This is the difference in required memory capacity. Low memory capacity has been a limiting factor even in some of the mathematical computers that have been constructed. The problem becomes more acute with business machines.

Hundreds of thousands of stock-keeping units are not unusual in a business concern. A large manufacturer must buy and stock a great number of different parts and materials. A large mail-order house has as many as 300,000 stockkeeping units, counting each color and size advertised in each current catalog as a separate stockkeeping unit. Relatively small department stores have from 20,000 to 60,000 stockkeeping units.

When we come to the names and addresses of suppliers and customers we again run into thousands, if not millions, of separate blocks of information to be referred to. Large companies have from 5,000 to 10,000 suppliers. Popular magazines have several million subscribers, and large distributors have hundreds of thousands of names on their mailing lists.

Since so many separate registers or addresses are required, memories will have to be cheap. Ten cents might be more or less arbitrarily taken as the maximum cost of any one register, including whatever circuits or mechanisms are necessary to locate and read it. A cost of one cent or less would be more nearly ideal.

Fortunately, this severe cost limitation is partly offset by another consideration. Density of reference will be low. During any given period of time, selective reference will be made to relatively few of the total number of memory units. This permits relatively slow reference speeds. Several references can be made simultaneously, to different sections of the memory. By making several references simultaneously, look-ups can be kept ahead of computing speed.

A look-up machine, consisting of banks of reference memories together with appropriate selectors, may very well be entirely separate

from the computer itself. Information may feed from several input machines, to a look-up machine, to a computer, and thence to several output printers. All of the machines would be electrically connected. It should not be necessary to manually carry work, in any form, from one machine to the next.

What Business Needs

Electronic clerical machines of the future can have one tremendous advantage over all of their predecessors. They are inherently capable of doing a whole clerical job, from beginning to end and including any foreseeable variations, exceptions or irregularities that may arise. They are inherently capable of being completely automatic, rather than semiautomatic. The selective-sequence principle of electronic computers, or their ability to solve logical as well as mathematical problems, is the key to their promise in this respect.

The nearest pre-electronic approach to automatic clerical equipment is, of course, punched-card machines. They are widely and economically used. Yet these excellent machines have not completely replaced manual operations on all routine clerical jobs, and there are good reasons why they have not done so. Resistance to punched-card methods does not rest on ungrounded conservatism or blind sales resistance. Punched-card machines can be made to perform virtually any series of clerical operations. But, in some applications it costs as much to do the job by machine as it does to do it manually.

The reasons are three-fold: First, a series of separate mechanical operations is required to produce a single result. Cards must be punched, verified, sorted, collated and tabulated before even the first report is forthcoming. Second, few machines are completely automatic. Cards must often be fed in and manually taken away. In addition, there is a manual card-filing problem. The third and greatest handicap of punched-card machines in some applications is their inability to handle certain irregularities. The machines are ideally suited to large volumes of identical work. But variations usually require either a different series of separate manually-attended operations, or manual prehandling, to get work in such form that it can be fed into the regular flow of work. When we see operators going from one machine to another with little groups of cards, or when we see large clerical staffs getting work ready for the machines, we are often witnessing an application that might just as well be performed manually from beginning to end.

The great promise of electronic equipment lies in its inherent ability to overcome these three limitations. A limited manual input may be required, when documents are not in machine language to begin with. But from then on we are dealing with electrical pulses which travel over wires. We do not have to manually carry data from one operation to the next. The machines can operate unattended. And, since they can compare and select, they can recognize and handle irregularities. Whatever rules can be given to a clerk can be given to an electronic machine.

The heart of the fully automatic clerical machine of the future will be the selective-sequence principle. This principle is used in all of the digital computers that have been built. These computers handle information very much as a clerk does, only faster. All information pertinent to the problem at hand is assembled, including complete instructions as to what to do with each item of information. Each item of information is placed in a definite location on a magnetic drum, in an acoustic delay line or in an electrostatic memory.

Programmed instructions then tell the machine to switch information from one location to another until all desired operations have been performed. Numbers to be added are switched to an adding unit and the sum is switched back to a given memory location. Other arithmetical operations are performed in the same manner. Most important of all, from a clerical point of view, is the fact that different items of information can be compared to determine agreement or non-agreement or to determine the larger or smaller. Depending upon the outcome of a comparison, the machine can switch to one prearranged sequence of subsequent operations or to another. It is in this way that irregularities can be recognized and handled.

All of the circuits that are required to do these things are well proven. Computer men may differ as to the best circuits, but we do have workable circuits. Better input, less expensive random-access memories and faster printers are needed, but we already have in selective-sequence computers what is probably the most difficult component of a completely automatic clerical installation.

The Job Ahead

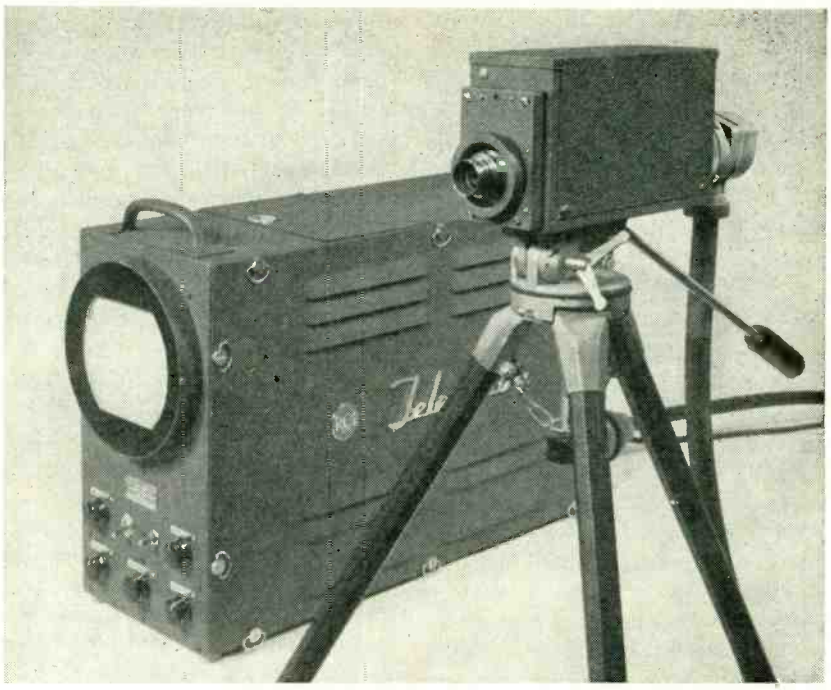
What remains to be done is to decide what sort of machines to build. What components, of what speeds and capacities, are to be put together to do a given clerical job with maximum economy? Before precisely the right machines can be assembled, the requirements of the job must be understood in detail. This is an undertaking for industrial engineers.

All or most clerical work may follow the same general pattern. But similarity ends when we go beyond generalities. No two clerical jobs are identical. Common parts and common sub-assemblies will no doubt be used in all electronic clerical machines, but to do the whole job each machine will almost certainly be modified to suit individual performance specifications.

The industrial engineering that remains to be done is thus twofold. First, enough must be known about clerical work of all types to design the best possible common components. Second, each application must be analyzed in detail before the machine for that application is finally put together.

The desirability of an ideal machine for each clerical job can, perhaps, be overemphasized. Less-than-ideal machines can be sold. But anyone who has experienced the compromises and the borderline decisions that often have to be made in using present-day office equipment cannot help dreaming of a machine that is engineered for their particular work.

Such machines would sell themselves.



Miniature television camera employing the vidicon pickup tube[6], with standard image-orthicon camera in background

The Vidicon

THE PHENOMENON of photoemission of electrons has been widely used for the light-sensitive surface of television pickup tubes. This is true for the image orthicon[1] as well as for its predecessors, the orthicon and the iconoscope.

The related phenomenon of photoconductivity has not been employed in any commercially useful pickup tube. However, this application of photoconductivity has by no means been ignored either in the experimental laboratories or in the patent literature. In fact, one of the earliest proposals for a television system envisioned the use of a selenium photoconductive cell in combination with a mechanical scanning disc. Actually, the sluggish frequency response of the selenium cells made them inadequate for this application. Photoemissive cells which became available in the early part of this century were found to be much more suitable.

During the middle 1930's, work on photoconductive targets for television pickup tubes was carried on in this country[2], as well as in England[3] and Germany.[4] In these experiments an electron beam similar to that used in the iconoscope scanned the photoconductive target. This mode of operation allowed the possibility of obtaining increased sensitivity by means of storage. Furthermore, the photoconductor needed to respond to changes in light intensity no faster than thirty cycles per second as compared to the several million per second that is required for nonstorage operation.

None of these experiments resulted in a useful tube able to compete with the iconoscope available at that time. The principal defects were insensitivity, retention of images and spurious spots on the target. Once again photoconductivity for pickup tubes was set aside at least temporarily in favor of photoemission whose processing art was somewhat more advanced.

Work done during the war on photoconductive materials for infrared detectors has served to focus attention on the basic advantages which photoconductivity has to offer to television pickup tubes. It is well known that the light sensitivity obtainable with photoconductive cells greatly exceeds that reported for any photoemissive cells. Whereas a sensitivity of 50 microamperes per lumen (about 0.10 electron per quanta) is considered good for photoemission, tens of thousands of microamperes per lumen (many electrons per quanta) are not uncommon with some photoconductive materials. (An image orthicon employing a photocathode giving 50 microamperes per lumen has an operating sensitivity comparable to

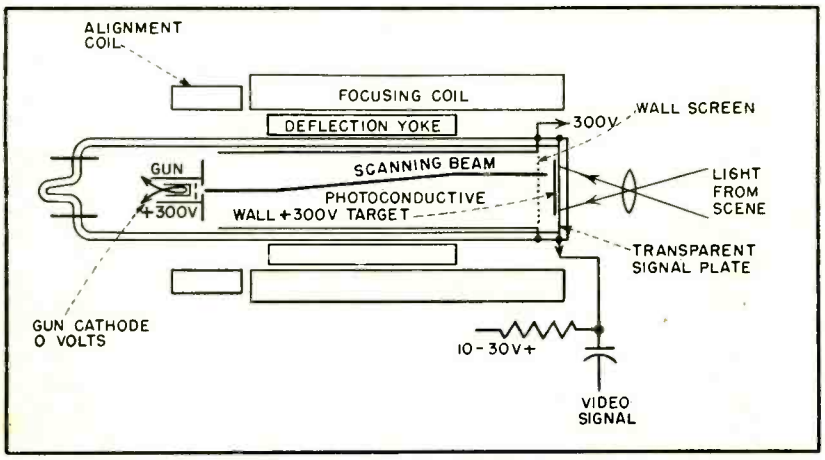
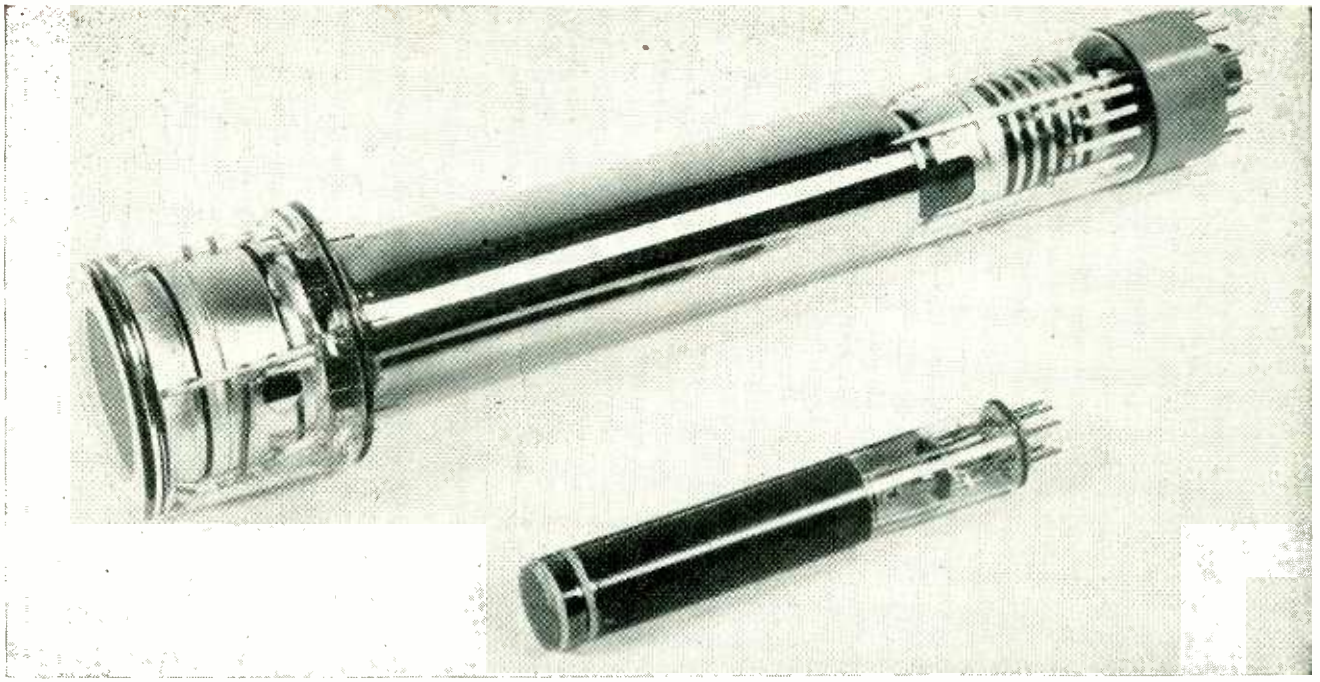


FIG. 1—Cross-sectional diagram of an experimental vidicon photoconductive television pickup tube

Presented at IRE National Convention, New York, March 1950.



Experimental one-inch-diameter vidicon, with the standard commercial image orthicon in the background

Photoconductive Camera Tube

Simplification of design, high sensitivity and good resolution are available in a new tube having a photoconductive target. Its application results in economy of equipment designed for unattended industrial applications as well as broadcast use

By PAUL K. WEIMER, STANLEY V. FORGUE and ROBERT R. GOODRICH

RCA Laboratories
Princeton, New Jersey

that of the human eye.)

If high-sensitivity materials suitable for pickup tube targets could be found, the benefits could be used in two ways. Perhaps least important at present would be the possibility of developing tubes capable of operating at much lower light levels. An improvement of about 10 times over that of the present day image orthicon[5] is theoretically possible, assuming that on the average, the best photoemitting surfaces are only 10 percent efficient. Second and more important, any sizeable increase in target sensitivity would permit such simplification in pickup tube design as to open up entirely new fields of application. The electron image section and the electron multiplier, which have been required in the image orthicon for good sensitivity, may be entirely eliminated. The tube is reduced to the basic elements of gun and target. This makes for economy, compactness and simplicity of operation.

In addition, all the tube dimensions may be scaled down, if desired, because the extra target sensitivity is available to compensate for the reduction in target area. It was easily conceivable that a simple, compact and dependable television pickup tube would find many applications in industry, business and in scientific investigations far wider than that of entertainment broadcasting.

Work on photoconductive pickup tubes has been carried on inten-

sively at RCA Laboratories during the past several years. High-sensitivity materials suitable for targets have been found and many experimental photoconductive tubes of various sizes have been tested. The name "vidicon" has been coined to distinguish these tubes from the photoemissive tubes.

The particular form of vidicon to be described is in an advanced stage of experimental development. It is one inch in diameter and six inches long, and is particularly suited to industrial applications. It appears likely that both larger and smaller forms of vidicons will eventually become available for other applications.

The comparative sizes of the vidicon and the image orthicon are shown in an accompanying photograph. A miniature television camera[6] employing the vidicon is also illustrated.

One-Inch Vidicon

The cross-sectional diagram of an experimental tube given in Fig. 1 shows the relative positions of the gun and the target.

As shown in Fig. 2, the photoconductive material is deposited on the transparent conducting signal plate and scanned directly by the electron beam. A uniform magnetic field is used to focus the beam. The velocity of impact of the beam may be either below first crossover as in the orthicon, or above first crossover as in the iconoscope. The video signal is taken from the target by connecting the amplifier to the transparent signal plate. The wall screen shown in Fig. 1 provides a uniform field in front of the target, but does not appear in the transmitted picture.

Charge-Discharge Cycle

For purposes of explanation, assume that a low-velocity orthicon-type scanning beam is used. A fixed potential of about 20 volts positive, relative to the thermionic cathode, is applied to the transparent signal plate. The beam deposits electrons on the scanned surface of the photoconductor charging it down to thermionic cathode potential. Although considerable field is thereby developed across the opposite faces of the photoconductor, its conductivity is sufficiently low that very little current flows in the dark.

If a light image is focused on the target, its conductivity is increased in the illuminated portions, thus permitting charge to flow. In these areas the scanned surface gradually becomes charged a volt or two positive with respect to the cathode during the 1/30-second interval between successive scans.

The beam deposits sufficient electrons to neutralize the accumulated charge, and in doing so generates the video signal in the signal plate lead. It will be noted that the target is sensitive to light throughout the entire frame time permitting full storage of charge.

The charge-discharge cycle is identical to that of the orthicon with the exception that the positive charging effect is achieved by photoconduction through the target itself, rather than by photoemission from the scanned surface. This mode of operation requires that the resistivity of the photoconductive target be sufficiently high that its time constant exceeds the 1/30-second television frame time. A dark resistivity of 10^{12} ohm-cm or greater is satisfactory.

Many materials such as selenium, sulfur, as well as the sulfides, selenides and oxides are known to be photoconducting. Several of these materials when properly processed have been found suitable for pickup tube targets. The spectral response is a function of the material and the processing. Targets which are sensitive to the entire visible range of the spectrum have been made.

Operating Characteristics

Photoconductive targets free from the spurious spots and lag which troubled the earlier workers, have been made. Sensitivities in excess of 1,000 microamperes per lumen are obtainable. Resolution is limited only by the electron optics of the beam while in the image orthicon a fine mesh screen at the target limits resolution.

The one-inch diameter vidicon is capable of resolving more than 600 lines. Under similar conditions the larger image orthicon will give about fifteen hundred lines. The capacity of the target may be made sufficiently large in any size target that the high light signal-to-noise ratio of the output signal can be as high as needed.

The signal-vs-light curve is linear at low lights as in an orthicon, but with some flattening off at high light levels. In general, the photoconductive targets made to date will not accommodate as wide a range of light levels for a given

Photograph of picture transmitted by a one-inch vidicon

lens aperture as an image orthicon. For extremely bright illumination on the target, the picture loses contrast without any tendency for unstable charge up as in the early orthicon. An image orthicon under similar conditions would maintain good contrast by virtue of the redistribution of secondary electrons on the picture side of the glass target.

In general, pickup tubes with photoconductive targets are simpler in operating adjustments than an image orthicon. The electron image focusing control is completely eliminated, and the target voltage adjustment is somewhat less critical.

The high signal level obtainable at the target removes the need for an electron multiplier whose contribution to spurious spots and shading in the image orthicon has been a steady source of concern. The beam-current adjustment is accordingly less critical. In short, the simplicity of operation of the photoconductive targets combined with their adaptability for small tubes has made them particularly suitable for equipment designed for unattended industrial applications.

Sufficient satisfactory tubes have been constructed in the laborataory to demonstrate the advantages listed above. However, questions of tube life, allowable temperature limits and reproducibility of results will require additional intensive development before equipment reliable enough for industrial use can be made available. For example, conditions necessary to ensure targets free of objectionable time lag are still in an experimental stage.

Sensitivity of the Tube

A one-inch vidicon possessing a target sensitivity of 300 μa per lumen will transmit a noise-free picture with a scene brightness of several foot-lamberts using an f/2 lens. Since this light level is less than ordinarily present in most laboratories or factories, special lighting is not required.

It is impossible to compare the relative sensitivities of the vidicon and the image orthicon without specifying at what light level the comparison is being made. At intermediate light levels, with a few foot-lamberts scene brightness, the two tubes will transmit a picture having about the same signal-to-noise ratio. At higher light levels, the vidicon will deliver a higher signal-to-noise ratio than the image orthicon since its target capacity is higher. At lower light levels its signal-to-noise ratio will be inferior to that of an image orthicon with a multiplier.

This follows from the fact that the noise background for the vidicon is the amplifier noise that remains fixed at all light levels, while for the image orthicon it is shot noise in the scanning beam, which may be reduced somewhat for low signal levels. With the development of still more sensitive targets, the vidicon without a multiplier may be expected to exceed the present image orthicon at all light levels.

It will be noted that the elimination of the electron multiplier will require a stronger beam current at the target of the vidicon than in the image orthicon. Assuming the input noise of the video amplifier to be 2×10^{-3} microampere, a target current of 0.2 microampere is required for a signal-to-noise ratio of 100. This current is about ten times that required in the image orthicon.

Some explanation as to why a smaller pickup tube may require a more sensitive target for equal scene brightnesses is in order. If the entire tube and optical system are scaled down in size, keeping the same f number lens, the quantity of light in lumens intercepted by the lens is reduced. The output signal of the tube in microamperes is also reduced unless the target sensitivity in microamperes per lumen is increased.

On the other hand, if the lens diameter for the small tube were kept the same as for the large tube, no increase in target sensitivity is necessary. However, for the same angle of view this means a faster or lower f number lens. Such lenses, if available at all, are likely to be less highly corrected and more expensive. Thus, in general, the smaller tube will be operated with smaller diameter lenses requiring higher scene brightnesses or more sensitive targets. The gain in depth of focus accompanying the use of the smaller diameter lens may, however, be very useful. Motion picture 16-mm lenses have been found to be satisfactory.

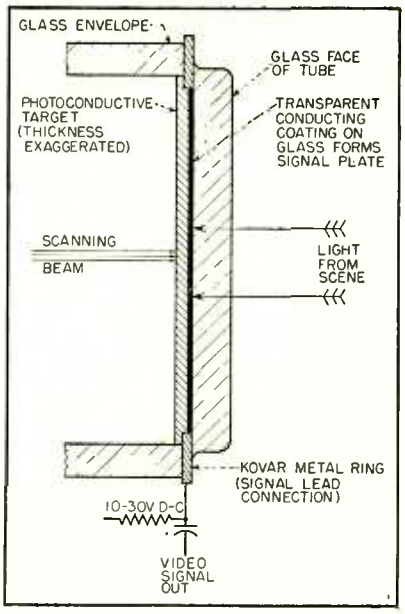


FIG. 2—Detail of the target construction in the experimental photoconductive camera tube

The writers wish to thank V. K. Zworykin and Albert Rose for their continued interest and advice during the course of this work. The construction and testing of tubes has been greatly aided by the cooperation and assistance of A. D. Cope and P. G. Herkart. We are indebted to S. M. Thomsen for preparation of photoconductive materials. The development of miniature camera equipment by R. C. Webb and J. M. Morgan has facilitated the evaluation of tube performance.

References

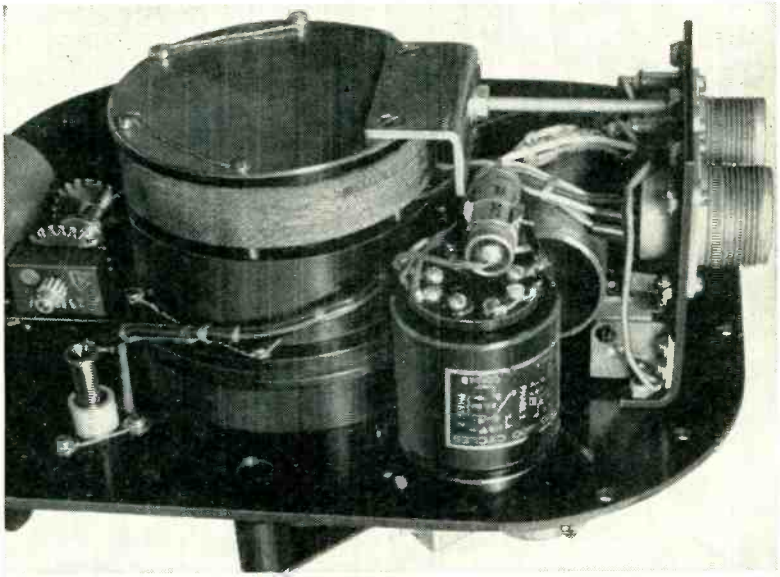
(1) Rose, Weimer and Law, The Image Orthicon—A Sensitive Television Pickup Tube, *Proc. IRE*, 34, p 424, July 1946.
(2) Iams and Rose, Television Pickup Tubes with Cathode Ray Beam Scanning, *Proc. IRE*, 25, p 1048, Aug. 1937.
(3) Miller and Strange, The Electrical Reproduction of Images by the Photoconductive Effect, *Proc. Phys. Soc.*, 50, p 374, 1938.
(4) Knoll and Schroeter, Transmission of Pictures and Signals by Insulating and Semi-conducting Surface, *Phys. Z.* 38, p 330, 1937.
(5) Janes, Johnson and Moore, Development and Performance of Television Camera Tubes, *RCA Review*, 10, p 191, June 1949.
(6) Webb and Morgan, Industrial Television System, paper presented at IRE National Convention, New York, March 1950.

Automatic Exposure

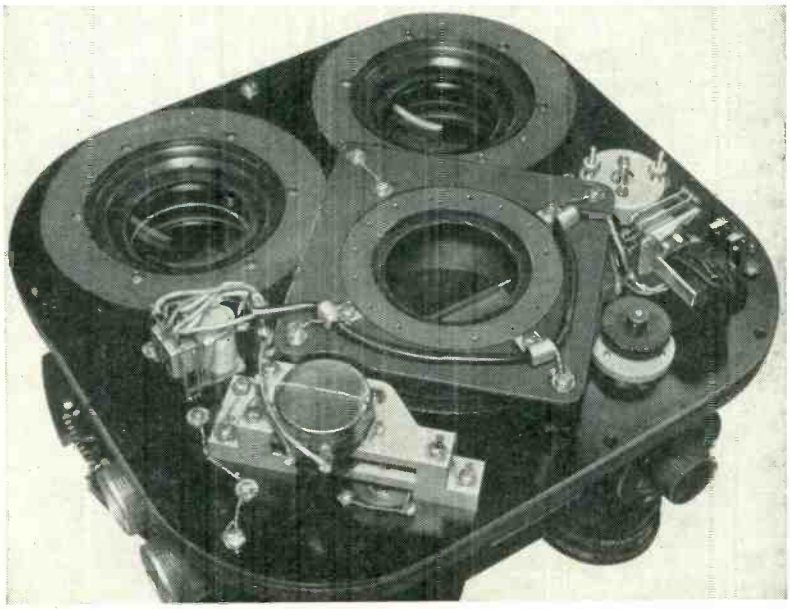
Aerial photography above 600 mph under varying lighting conditions normally demands a compromise in camera settings. A new photoelectric servo control of aperture providing optimum exposure is applicable to motion-picture and television cameras

By GEORGE BRUCK, JOHN HIGGINS and JOHN WARD

Specialties, Inc.
Syosset, N. Y.



Underside of aperture control showing photocell and heater housing (center) and servo motor (lower right)



Lens assembly with cover removed showing camera irises to rear, photocell iris and derivative potentiometer

LOW-ALTITUDE reconnaissance photography at speeds in excess of 600 mph requires rapid automatic adjustment to changing light values. The requirements for good color photography (as illustrated by the front cover of this issue of ELECTRONICS) are even more stringent. Compromises in conventional photography are apparent when the average newsreel is compared with the average studio production. In color work, even the quality of the latter is sacrificed by compromise settings for sequences. In solving the two-fold problem of automatic light control and automatic shutter-speed control, the former has been attacked first by providing a servo system for varying the iris aperture.

The camera so modified is a U. S. Air Force Model S-7 equipped with stereoscopic lenses and an open, slit-type shutter. Film is exposed by being driven past the slit as a function of ground speed and as an inverse function of altitude. This combination synchronizes the moving image on the film. Film exposure time is expressed in equivalent shutter speed; for example, an equivalent shutter speed of 1/25th of a second indicates that the slit width is adjusted, as a function of film speed, so that the passing film receives an exposure equal to that obtained by stationary film behind a conventional shutter operated at 1/25th of a second.

The stereo lens assembly is modified to include an additional lens with variable aperture, a photocell, a photocell heater and thermostat

Control

Assembled lens turret beside control box that contains all the electron tubes

and a motor with the necessary gearing for driving all three apertures. An armored cable connects the lens assembly to an operator's control box containing an amplifier, operating switches, an operating indicator and a warm-up indicator.

Manual selection is provided to preset the control for use with films having ASA exposure indexes of 12, 25, 35, 50 and 100. A separate control is provided to match equivalent shutter speed settings of 1/50th, 1/100th, 1/200th and 1/400th of a second on the camera. Depending on the type of film and the equivalent shutter speed, the control regulates aperture size to permit constant light intensity at the film, even though the maximum illumination encountered may be 40 times greater than the minimum. An indicator shows the operator whether or not light conditions are beyond the scope of his shutter setting and tells him which way to adjust it when required. With these manual adjustments, the control can accept a maximum-to-minimum light ratio of 325 to 1.

How It Works

The basic system is shown in the block diagram of Fig. 1. Assuming normal operation, any change of light intensity reflected from the terrain will change the output of the photocell. A resultant unbalance at the comparator produces an output that is filtered, phase-shifted, and amplified to drive a servo motor geared to the camera apertures. As soon as the apertures reach a position establishing correct light intensity at the photocell (and film) the system corrects itself for balance. A derivative of aperture change is applied to the comparator for antihunt purposes.

Camera equivalent shutter speeds are matched by means of a selector switch that inserts one of several resistors in the reference circuit. The ASA film exposure indexes are matched by means of a selector knob that places one of several calibrated light baffles in front of the photocell. To protect the photocell from stray light when the camera is not in operation, a shutter covers the photocell aperture. A solenoid opens the shutter whenever power is applied to the equipment.

The sensing unit is designed in the form of a barrel, somewhat resembling a small camera as shown in Fig. 2. Mounted at the forward end of the barrel is a Fresnel lens of transparent plastic, which entails less bulk and expense than an equivalent lens of glass and allows the use of a large opening. Very thin, and very finely grooved, the Fresnel lens gives sufficient definition of the image for proper control of the viewing angle.

The barrel aperture is directly geared to the main lens apertures. Perfect proportionality between the photocell and main lens apertures can not be assumed, however. For the larger openings (up to f:1) used at the photocell aperture, the vignetting effect becomes increasingly important so that the actual optical opening deviates from the calculated opening by a considerable factor. Correction is made by inserting a piece of star-shaped, opaque, metal foil behind the Fresnel lens.

The image is formed at a rectangular opening that divides the forward and rear sections of the barrel, and is then diffused in the curved, highly polished rear section enclosing the photocell. This even illumination of the cell prolongs its life, improves its absolute accuracy, and represents almost exactly the average light intensity at the actual film.

While it might seem that a standard vacuum or gas phototube

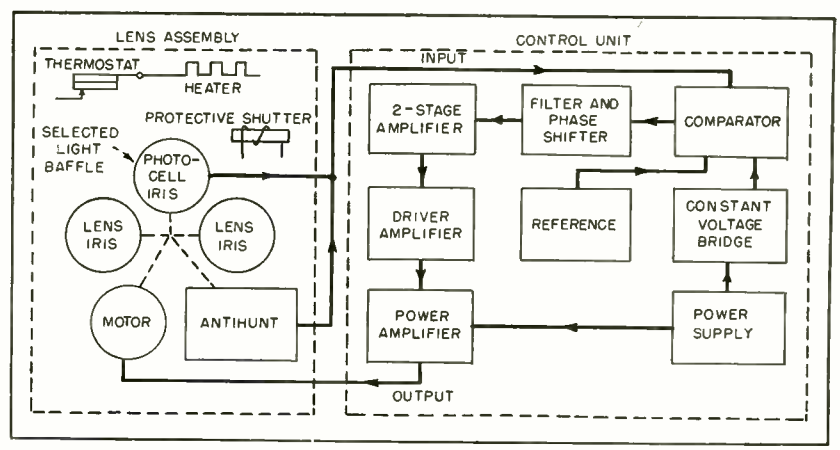


FIG. 1—Elements of the automatic iris aperture control system

would provide satisfactory information, investigation shows them to have a poor absolute accuracy in comparison with the selenium photocell.[1] The only photosensitive element presently known to have a fairly good absolute acuracy is the barrier-layer type selenium photocell. The voltage obtained from this type of cell, however, is extremely low at the light levels encountered, and not suited for direct amplification. Considerable difficulty was encountered in attempts to use a 400-cycle electromechanical chopper to transform the available d-c signal into an a-c signal suitable for further amplification. It therefore seemed desirable to use other methods.

Selenium-type photocells have the property of conducting in one direction if they are not illuminated. Illumination creates some reverse conduction, and with constant voltage applied, the reverse current is essentially proportional to the intensity of illumination. This property is used to advantage here.

It is necessary to obtain constant voltage with a bridge consisting of precision resistors and a tungsten-filament lamp shown in Fig. 3. The lamp filament changes resistance with changes in the 400-cycle supply voltage and unbalances the bridge in the direction necessary to maintain the desired output. Constant applied voltage is requisite for maintaining absolute accuracy

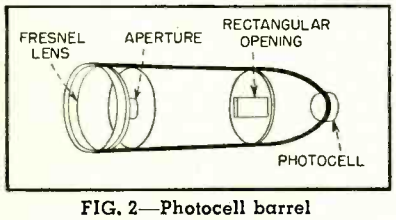


FIG. 2—Photocell barrel

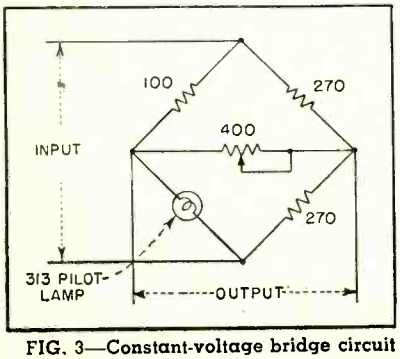


FIG. 3—Constant-voltage bridge circuit

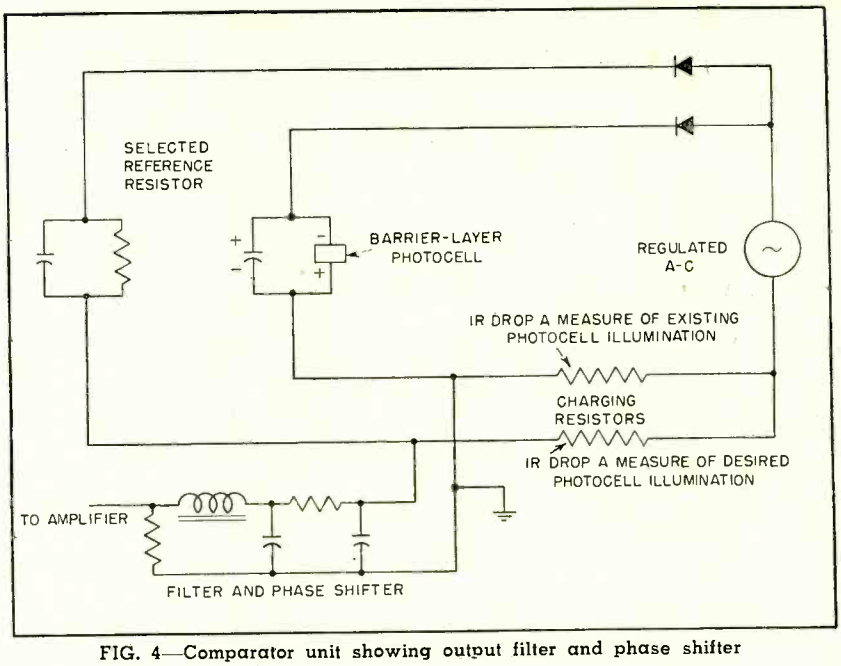


FIG. 4—Comparator unit showing output filter and phase shifter

of the photocell, and the bridge provides a voltage output constant within a few percent.

The constant a-c voltage is applied through a rectifier, building up a constant d-c voltage across the capacitor and photocell represented by the inner circuit of Fig. 4. Current passed by the photocell is approximately proportional to light intensity and it discharges the parallel capacitor at a rate proportional to this illumination. Through the rectifier, the capacitor is recharged once every 2.5 milliseconds to the peak value of the regulated a-c source. The flow of this charging current through a series resistor produces a voltage drop that is the measure of existing photocell illumination.

A reference circuit is connected in parallel with the photocell circuit as shown, duplicating the latter except for a fixed resistor in place of the photocell. The value of the resistor is selected according to equivalent shutter speed in use. The flow of charging current through the series resistor of this circuit produces a voltage drop that is the standard for desired photocell illumination. Voltage drops across the charging resistors of the two circuits are compared in phase opposition. When the voltage drop owing to existing photocell illumination equals the standard for desired photocell illumination, the comparator output becomes zero, indicating that the photocell aperture is the correct size. Since the photocell aperture is geared to the lens apertures, this also indicates that light intensity at the film is correct. When existing illumination needs correction, one voltage predominates, resulting in a comparator output signal of particular magnitude and polarity.

High harmonics in the pulse-type signal from the comparator are eliminated in a filter that also rotates the phase angle ninety degrees. The filter unit consisting of one pi-section with load resistance, supplies an approximate sine-wave voltage to the grid of the first amplifier tube.

Amplifier Design

Servo applications require a limiting amplifier that gives increasing output for increasing error up to a predetermined design point. Beyond this point, an output proportional to error would demand excessively ponderous servomechanisms if, indeed, any mechanisms capable of sensitive control could stand an output proportional to maximum error.

Speed limitations and torque limitations of the aperture drive dictate the size of the motor. This parameter is a measure of the size

of the output tube and of output power. To obtain speed and accuracy, full output power must be reached with little error input, requiring high voltage amplification with powerful limiting action. These characteristics are indicated in the operational curve of Fig. 5.

One disadvantage of a conventional vacuum-tube amplifier is the limitation imposed on the input signal to avoid blocking. A powerful input signal, when peak rectified, builds up a negative bias at the grids of the voltage amplifiers. When stored in the coupling capacitors, this bias takes an appreciable time to dissipate and effectively blocks a subsequent weak signal,

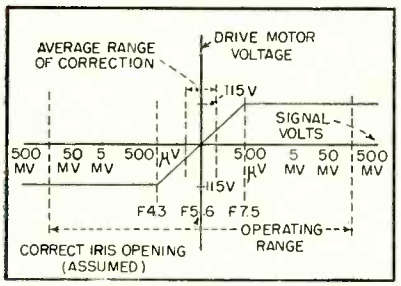


FIG. 5—Characteristic of the aperture control

which, as a result, is not properly amplified. To maintain quick recovery with this type of amplification, the range of signal input is normally restricted.

Restriction of signal input is avoided in the aperture control amplifier by using a Thyrite resistor in the grid circuits of both the second and third stages. This element eliminates blocking and gives the amplifier an extremely rapid recovery time (15 milliseconds for a 60-decibel input overload) as well as a nonlinear gain characteristic. The amplifier has a gain varying so rapidly with the incoming signal that the servo system cannot be considered linear, except immediately adjacent to the null point.

As shown in Fig. 6, the signal is first amplified in one-half a high-mu triode, then amplified a second time in the other half of the tube. The properties of the Thyrite resistor, attached to the grid of the second stage, are such that its resistance decreases as applied voltage increases. Therefore, any powerful signal applied momentarily to this grid is almost immediately dissipated through the resistor, clearing the grid of bias effect.

A Thyrite resistor is also used in the grid circuit of the driver stage further to reduce recovery time and prevent blocking. As the signal input increases from zero to 0.5 millivolt, driver output increases in a ratio that is practically proportional. Above 0.5 millivolt, the output remains constant at full power. One-half a 12AT7 tube serves for the driver, and is transformer-coupled to the last, or output stage of the amplifier.

The output stage shown in Fig. 7 uses a type 5687 double triode operated in Class B. Under normal conditions, this tube could not continuously supply the 12 volt-amperes required for the variable phase of the two-phase servo motor. Because of the intermittency of the service, however, it is possible to use the tube without exceeding its long-time plate dissipation rating. In fact, the tube is used considerably below its maximum dissipation ratings.

Maximum power is obtained by supplying the 5687 grids with a fixed bias of −20 volts. The voltage is obtained from the power transformer through a germanium diode rectifier of the high-back-voltage type and a small, pi-section, inductance-capacitance filter.

Antihunt Circuit

It is generally considered advisable to damp linear servomechanisms with the derivative of the error signal. This practice is not necessarily correct for the nonlinear type dealt with here. In this case, a velocity or viscous damping so calculated that it would represent considerable over-damping for a corresponding linear servo proves more favorable.

The damping signal is the derivative of a voltage proportional to the effective optical aperture and

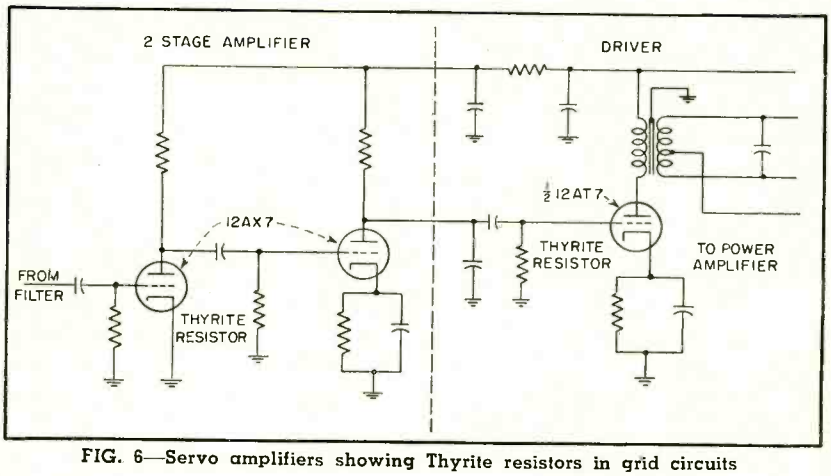


FIG. 6—Servo amplifiers showing Thyrite resistors in grid circuits

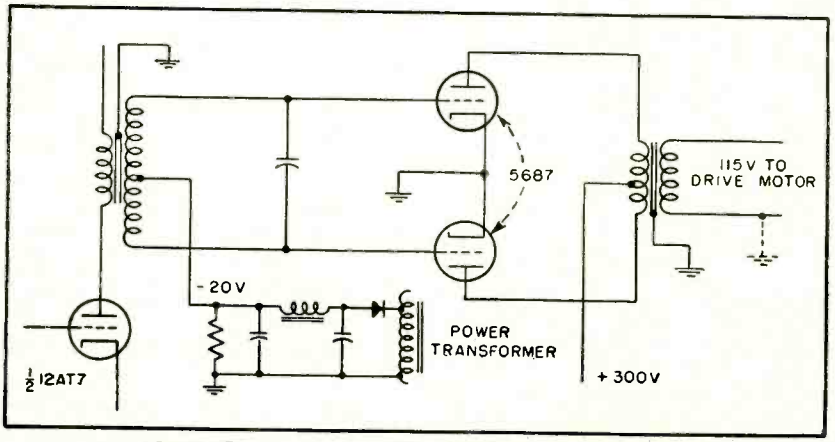


FIG. 7—Servo power amplifier showing source of grid bias

includes the mechanical inertia of the servo system. Therefore, this signal has a maximum value corresponding to the maximum rate of change of the effective lens area. It never needs to be more, regardless of the amount of error. The derivative is added to the input signal, but since the equipment is working on a nonlinear portion of the gain characteristic, the damping factor has no effect until the null point is practically reached. Then, as a large amount of retarding force, it comes into full effect and halts the mechanism abruptly.

The aperture drive is mechanically linked to a variable resistor so that voltage drop across the resistor changes as a function of the aperture opening as shown in Fig. 8. This function has been so determined that the rate of change of voltage is correlated with the rate of change of the lens opening to assure proper damping over the full range of aperture openings from f:2.5 to f:16. The function is highly nonlinear, being approximated by a section of a parabola. To obtain accurate results, it is imperative to make the current through the variable resistance independent of current and voltage variations in the rest of the circuits.

The desired derivative voltage is relatively small and power-supply ripple voltage may easily override it. To avoid this difficulty, a special regulator has been provided that holds the voltage supply to the derivative circuit constant. This regulator comprises a neon tube and the unused half of the driver tube.

The current, through the resistor, used to obtain the rate of change of the aperture is a measure of the actual location of the aperture. The current passes through an offset-zero milliameter located on the control box panel and calibrated in f-stops. It is used as a fairly accurate indication of aperture position and warns of extreme light levels, so that the operator can change equivalent shutter speed before making a series of shots.

Shown in Fig. 9 are the voltage wave shapes observed at various stages of amplification. The ratio of output to input power is approximately 1.5×10^{14}, or about 140 decibels. While this is not an exceptionally high ratio for an audio amplifier, it is extreme for a servo amplifier and would ordinarily lead to objectionable hunting. This effect is avoided by the nonlinear gain and antihunt circuits.

Its sensitivity combined with the nonlinearity makes the aperture control applicable to a wide range of photographic lighting conditions. A white sand beach in midsummer will seldom reflect more than 10,000 foot-candles illumination, while a dark pine forest, on an overcast day, may reflect as little as 10 foot candles. Using a color film of slowspeed (ASA index 35) and equivalent shutter speed as dictated by conditions, the aperture control corrects for illuminations between 32 foot candles and 10,000 foot candles. With a black-and-white film of fairly fast speed (ASA index 100) and equivalent shutter speed as dictated by conditions, the aperture control corrects for illuminations between 16 and 20,000 foot-candles.

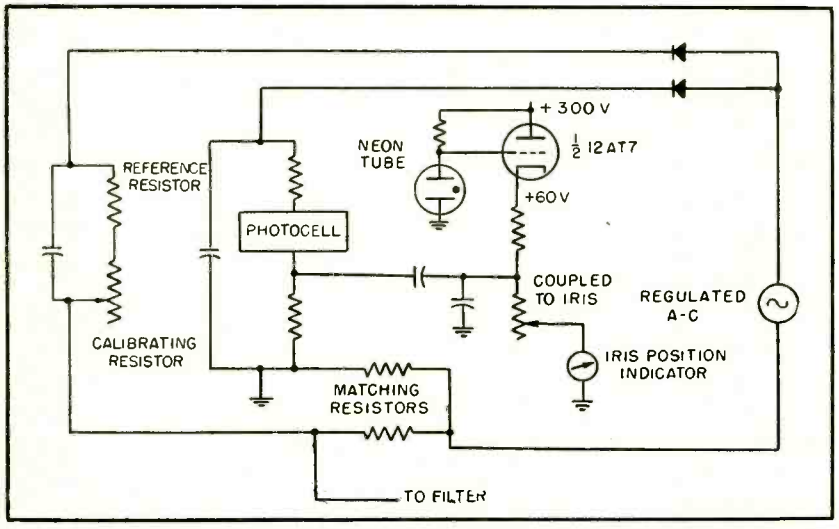


FIG. 8—Method of coupling antihunt derivative circuit into input

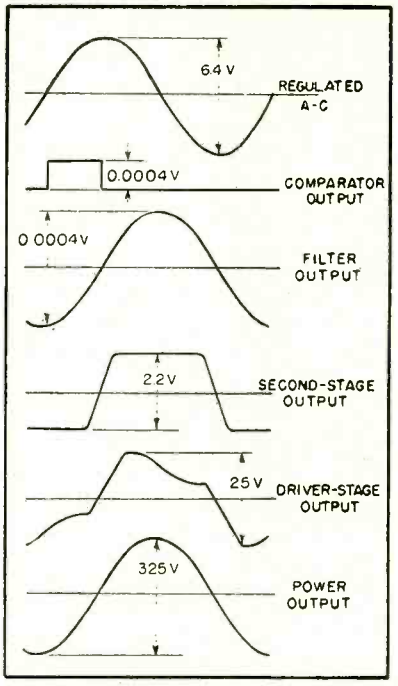


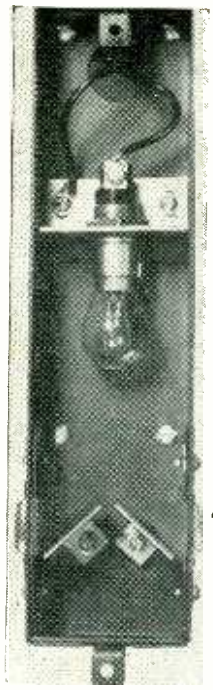
FIG. 9—Voltage wave shapes under conditions of large error (f:0.5 stop)

Further development of the same basic control system demonstrates that the range of aperture correction can be extended to include illumination as low as 1.5 foot-candles. Extension of the range for higher illumination is also possible, but hardly necessary, since no climatic or topographical conditions reflect light above the present maximum. Should a different application require further extension of range upward or downward, the control could be suitably modified.

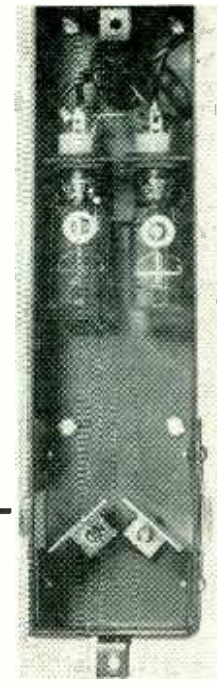
The authors wish to express thanks for cooperation received from personnel of the Aerial Camera Branch of the Photo Laboratory at Wright-Patterson Air Force Base, under Colonel George W. Goddard, Chief, who inspired development of the equipment. Appreciation is especially due to Major Arthur E. Smith, USAF, and Robert Roalef.

REFERENCES

(1) A. H. Taylor, Phototube Characteristics as Influenced by Small Amounts of Gas, *General Electric Review*, p 43, June 1949.



Bowling-Alley Foul Detectors



By ERNEST JELLINEK
Control Division
General Electric Company
Schenectady, New York

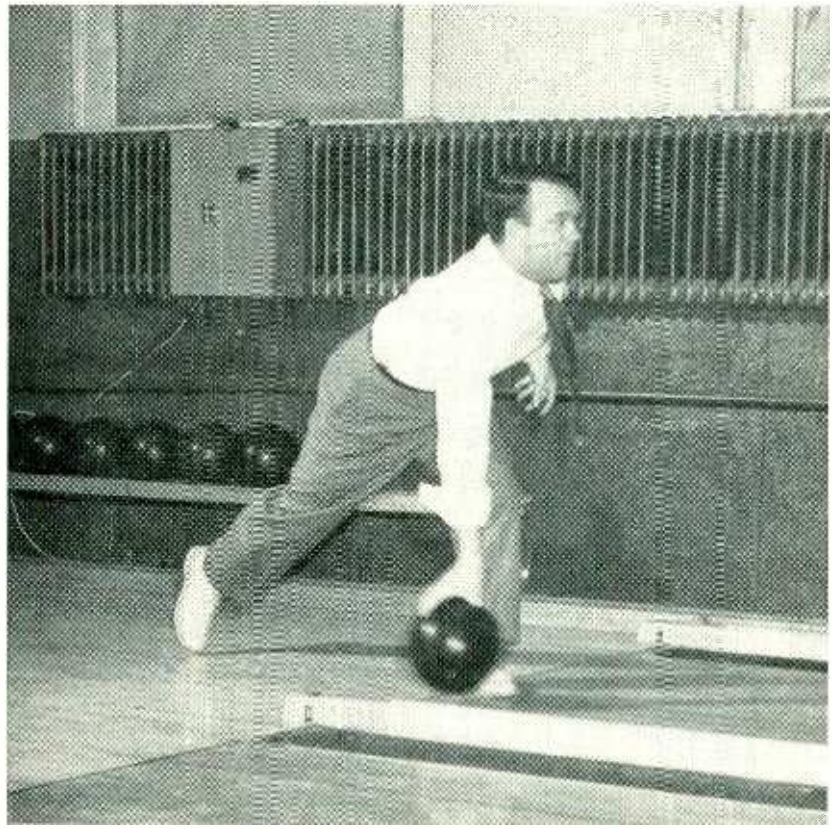
Continual development work on foul detectors and certain revisions of American Bowling Congress rules permit use of photoelectric devices for detecting sliding fouls in league competition. Design considerations and circuit details are explained

PHOTOELECTRIC foul detectors have been known for a good many years, but until recently, certain limitations prohibited their use during league competition. The rules set forth by the American Bowling Congress did not lend themselves to foul-line detection by electronics.

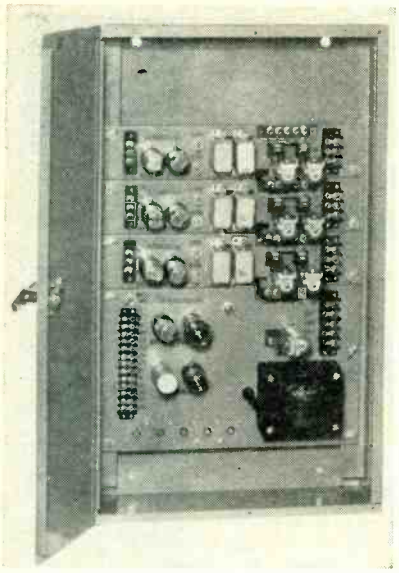
It was noted that over ninety percent of all fouls were of the sliding-foot type, and that fouls of this type were most difficult for judges watching several alleys to detect. The critical line was an infinitesimally narrow one at the front edge of the foul strip. The Congress has since modified its rules and widened the critical line to one-quarter inch. This provides sufficient latitude for the design of practical photoelectric foul detectors, and other types of fouls are readily detected by other players.

Typical Installation

A typical sliding foul detector installation consists of a light source, which projects a narrow light beam along the foul line close to the floor,



Light source and phototube units, shown in detail at the top of the page, are mounted behind rectangular apertures in division boards between alleys



Each panel in the control unit serves two alleys

and a phototube unit at the other side of the alley to receive the beam. A control panel provides voltage for the light source units and receives current from the phototube units. Its function is to operate the proper foul light and a bell when a foul occurs on any alley. Foul lights are located above the pins at each alley, and a common foul bell is energized when a foul occurs on any alley.

The light source and phototube units are designed for mounting at the foul line in place of the division board, or inside the ball return separating two alleys. Each light source is capable of projecting a beam of light in two directions and thus can be used to cover either a single alley or two adjacent alleys. Each phototube holder is similarly designed to cover either a single alley or two adjacent alleys.

For uniform light distribution to the required height a rectangular, rather than a round, beam shape is used. It is $\frac{3}{4}$ inch wide and $1\frac{1}{4}$ inch high, starting $\frac{1}{8}$ inch above the floor.

To obtain good formation of the light beam, a long-focal-length lens system is used. This system is designed so that the projected image of the lamp filament focused on the lens of the receiving unit across the alley is approximately the same width as the lens. In this way, the beam is the same width from one side of the alley to the other. The long-focus system also prevents unwanted light from being received by the phototube.

A three-inch focal-length lens magnifies the image of the $\frac{1}{32}$-inch lamp filament to about $\frac{3}{4}$ inch at the standard alley width of 60 inches. To fit this system into the available narrow width of a division board the focal length is folded at right angles to the foul line by two mirrors. Each mirror reflects light toward the phototube holder on one side. Focusing is accomplished by sliding the lamp bracket. Aiming of the beam is done horizontally by rotating the mirror, and vertically by bending it slightly.

The phototube unit contains two type CE22 end-on phototubes. One or two phototubes may be used in each holder, depending upon whether one or two alleys are being covered.

Foul-Light Circuits

The foul-light relay circuit for any alley must keep the foul light off when the light beam is unbroken. It should not respond to light interruptions lasting less than 0.1 second, to allow the ball to pass through the beam without a foul being indicated, and it must respond to light interruptions longer than 0.1 second, which may be considered due to a foul. It should then light the foul light, transmit a pulse to the foul-bell relay circuit, discontinue being responsive to the light beam if the beam is re-established, it must be ignored until the end of the timing cycle), and it must keep the foul light lit for a fixed period of from ten to fifteen seconds, then reset, and be ready to indicate another foul or continued interruption of the light beam.

The circuit shown in the simplified diagram utilizes only one relay for each alley. The relay is connected so that after responding to a beam interruption it disconnects itself from the phototube amplifier circuit and becomes a timing relay. After completion of the timing cycle, during which it energized the foul light, it resets to its original condition.

The high-impedance phototube circuit is in the grid circuit of a cathode follower which drives the grid of the relay power amplifier. Switching takes place in the lower-impedance circuit between the cathode follower and the power amplifier.

As shown in the diagram, the cathode of V_{1A} is connected through the normally closed contact of RE_1 to its load resistor R_1. This is connected to a bus that is fifty volts negative with respect to the cathode of V_{2A}, which is at ground potential. The cathode potential of V_{1A} follows the grid potential but is about three volts more positive.

The cathode of V_{1A} is connected to the grid of V_{2A} through R_2. The grid of V_{2A} follows the variations of phototube signal voltage and controls the current through RE_1 accordingly. Normally, with light on the phototube, the grid of V_{1A} is drawn negative by phototube current flowing through R_3. No plate current flows, and RE_1 is deenergized. Interrupting the light beam decreases the phototube current and the grids of both tubes become more positive. After a small time delay, due to capacitor C_1, RE_1 becomes energized and a foul is indicated for that alley.

Time-Delay Circuit

The time delay provided by C_1 prevents a foul from being indicated when a ball rolls through the light beam at normal speed.

Capacitor C_1 introduces a capacitance-coupled negative feedback which amplifies the actual RC time constant by approximately the gain of the stage. This occurs because any change of plate voltage will be coupled back to the grid in opposition to the grid change which caused it, thus slowing down any further change. When there is no change of plate current, as when the tube is below cutoff or above saturation, there is no amplification of the time constant.

As explained previously, with the light beam unbroken the grid of V_{2A} is negative with respect to its cathode and the tube is cut off. How far it is negative depends upon the light intensity and the phototube sensitivity at that alley; this may be anywhere from 7 to 25 volts. When the grid potential rises due to interruption of the beam, the time constant does not become really effective until cutoff is

reached. Thus, the time delay is quite consistent for each alley regardless of light intensity or phototube sensitivity. Consequently, no field adjustment is required at the time of installation, nor will readjustment be required as the lamp and phototube age. This would not be true if the delay were obtained with a capacitor across the phototube load resistor R_3, as the charge on the capacitor would be different for each alley.

Disabling Circuit

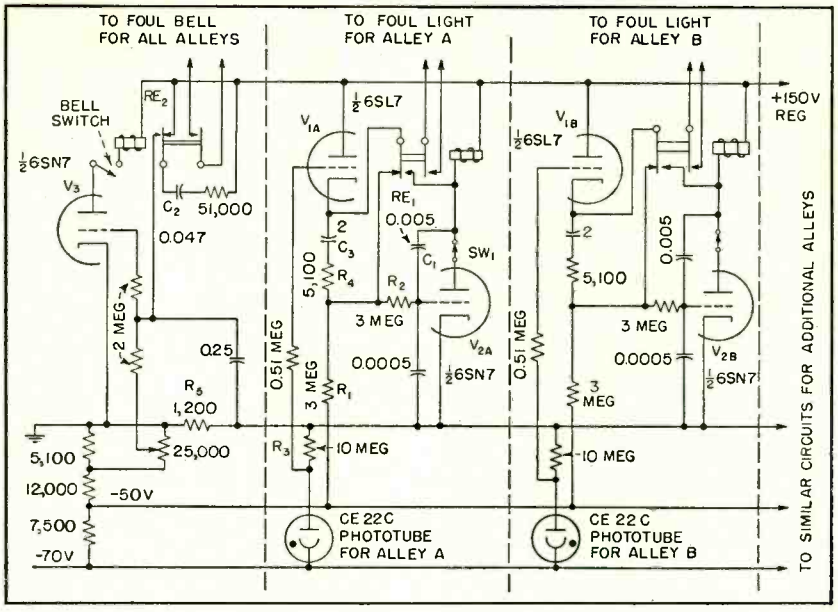
When the foul-light relay becomes energized it turns on the foul light over the corresponding alley and opens the circuit between the cathode follower and the power amplifier, making it no longer responsive to the light beam. It also connects uncharged capacitor C_3 to the plate of V_{2A}. The junction of R_1 and R_4 thus suddenly rises to about 100 volts, causing V_{2A} to suddenly conduct fully. As C_3 charges, this potential comes down towards its ultimate potential of minus 50 volts. This causes a corresponding decrease in plate current of V_{2A}. The Miller effect is used to increase the time delay obtainable with small components. In about 13 seconds the grid of V_{2A} reaches a potential of minus 6 volts and RE_1 becomes deenergized.

This turns the foul light off and recloses the normally closed contact in the cathode-follower circuit. The circuit is thus reset, as the power amplifier is again responsive to the light beam. Also, the timing capacitor C_3 is discharged through resistor R_4 and is ready for another timing cycle. If the light beam is still interrupted, the relay will become energized again and the cycle will repeat. If desired, switch SW_1 may be opened to prevent a foul indication.

Foul-Bell Operation

When a foul is detected, the foul bell must ring for one or two seconds while the foul-light relay remains on for about 13 seconds. The bell circuit must be able to respond to another foul, even though one or more foul-light relays are energized.

To meet these requirements, a circuit was devised to utilize the pulse derived from the sudden increase of current drawn from the power supply when any foul-light relay becomes energized.



A common bell serves all alleys and rings for a few seconds when a sliding foul occurs. Visual indicators on each alley remain lit for about 15 seconds

The current from all foul-light relays flows through a common resistor R_5 in the cathode circuit on the power panel. If any relay picks up, the voltage across this resistor will increase suddenly. The voltage is capacitively coupled to the grid of V_3, the foul-bell relay tube. The positive pulse derived causes RE_2 to become energized, turning on the bell. In a timing circuit similar to that of the foul-light relay, RE_2 connects the grid to C_2. This causes the relay to remain energized until the capacitor charges, bringing the grid potential down. When the relay becomes deenergized, C_2 is discharged by the normally closed contact of the relay, and is ready for another operation in response to a further sudden increase of voltage across R_5.

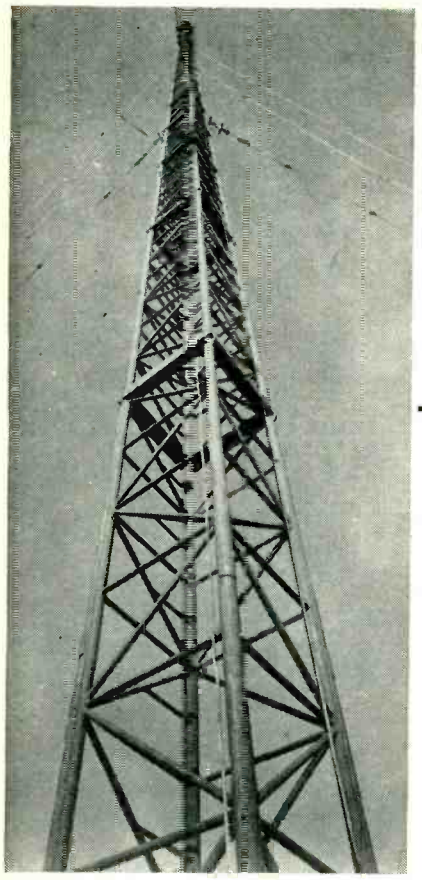
It was noted previously that when the foul-light relay became energized, its current suddenly increased from the value at pickup to the saturation current of the tube. This is the result of RE_1 drawing the grid of V_{2A} positive when it picked up. Even if the light beam is interrupted very slowly, in such a manner that the current increases from zero to the pickup value very slowly, an abrupt increase of at least 5 milliamperes is obtained.

Control and Power

The control unit contains the power supply and the bell-relay circuits for any number of alleys up to sixteen. To this are added from one to eight relay panels to cover the number of alleys at the particular installation up to sixteen. Each relay panel section contains the foul-light relay circuits for two alleys.

It is interesting to note that the design of the d-c plate supply is based on the laws of probability. In an establishment where sixteen alleys are in use simultaneously, the occurrence of ten fouls in a five-hour evening is considered rare. The probability of two of them occurring during the same fifteen second interval is accordingly somewhat remote. The probability that three fouls will occur during the same fifteen-second interval is extremely remote. Therefore, it is safe to design the equipment to indicate a maximum of four simultaneous fouls.

The d-c power supply, instead of being large enough to energize sixteen foul-light relays at once, need deliver only enough power to energize four, which also reduces the problem of regulation of the power supply.



Radio Frankfort loop-fed antenna under construction

Antifading Broadcast Antenna

The service area of a broadcast transmitter within which interference between ground and sky-wave components does not occur can be extended by reduction of high-angle radiation from the antenna. Use of a sectional mast with an insulator cancels the progressive wave usually found on fabricated towers

By HELMUT BRUECKMANN

Consultant
Signal Corps Engineering Laboratories
Fort Monmouth, N. J.

THE RECEPTION of a broadcast station in the frequency range 0.5 to 1.6 mc is frequently affected by fading at relatively short distances, especially at night. This kind of fading, which results from interference of ground and sky wave, is observed at distances of about 50 to 100 miles or more. It causes linear and nonlinear distortion at the receiver, sometimes to an extent which completely spoils a high-quality radio program, even with avc in the receiver. This effect is true also for a high-power station, the signal from which is strong enough to overcome r-f noise. As a result, a considerable part of the potential coverage area of many radio stations suffers from poor reception. In order to achieve an undisturbed primary coverage as large as possible, especially at night time, many high-power radio stations have been equipped with antifading antennas. However, not all of them have been successful.

In 1930, German broadcast stations started to use a single vertical wire or metal rope hung in the axis of a self-supporting wooden tower with a height in the order of half a wavelength and excited electrically at the base. Experience with this kind of antenna in respect to reduction of fading was good. In some cases, the undisturbed night-time primary coverage was increased by 100 percent in area, compared to an antenna with a height of one-quarter wavelength or less. However, the maintenance of the wooden tower proved to be expensive and difficult, and many towers were destroyed by fire or storm. In time they were replaced by self-radiating steel towers which were fed at the base in the same manner as the one-wire antennas. These steel towers were much cheaper, easier to maintain and less subject to hazards. However, they were disappointing in respect to reduction of fading.

Beginning in 1936, several investigators showed that this effect was due to the progressive voltage-current wave along the tower which is superimposed on the standing voltage-current wave as shown in Fig. 1A. This progressive wave carries the energy which is radiated by each element of the antenna or dissipated by losses. In a thin conductor like the one-wire antenna, the progressive wave is small compared to the standing wave and, therefore, the radiation of the progressive wave is almost negligible. In a thick conductor like a steel tower, this is no longer true. The vertical radiation pattern of a simple vertical antenna with height $H = 0.585\ \lambda$ is shown in Fig. 1B, curves 1, 2 and 3, for different values of K.

The distance for which ground and sky wave are equal and, therefore, fading is worst is strongly affected by such modification of the radiation pattern, as illustrated in

Table I—Characteristics of Antenna Operating at 1,195 kc

	Loop-fed			Base-fed
Length of stub in feet between grounded tap and base of mast	58.7	55.1	52.0	*
Height in feet of the current node above ground	−0.8	8.8	16.8	11
Elevation angle in degrees of null of vertical radiation pattern	90	62	54	65
Gain in db in the horizontal direction due to pattern (calculated)	2.15	2.40	2.61	—
Input impedance in ohms of the coaxial transmission line	$100-j51$	$84+j37$	$27+j35$	*
Antenna efficiency in percent, including matching network	73	67	62	73
Losses in stub in percent of the input power	3	10	12	*
Heat losses in percent along the mast (calculated)	0.7	0.6	0.7	0.7
Losses in percent in coaxial transmission line inside mast	1.4	1.4	4.2	*
Ratio of current in percent at current node and at current loop	——	2.9	2.7	26
Voltage in kv across base insulator	5.9	8.3	10.2	9.5
Voltage in kv across sectional-mast insulator	5.7	4.4	6.9	**
Maximum voltage in kv across coaxial transmission line inside mast	6.8	8.0	13.0	*
Standing-wave ratio in coaxial transmission line inside mast	2.2	2.5	7.9	—

* Disconnected
** Shorted
Voltages are for 100 kw rms unmodulated power input.

Fig. 1C. The ground-wave intensity is based on measurements with a certain station as an example. The sky-wave intensity is calculated for perfect reflection from the E-layer as an arbitrary basis of comparison. It is apparent that the distance for which ground and sky wave are equal is reduced considerably with a base-fed mast antenna, compared to a thin vertical radiator, namely from about 135 miles to about 105 miles. This reduction corresponds to a decrease in undisturbed area of 40 percent.

Principle of New Antenna

Around 1940, the author suggested that the shaft of the mast be broken up by an insulator somewhere in its upper part, and that it be excited electrically at this sectional-mast insulator. Although this idea was not in itself new, nobody up to that time had mentioned the advantages of this idea in respect to antifading action.

Disregarding the physical problem of transmitting power to the sectional-mast insulator, by tentatively locating the current source at this point, the basic idea can be illustrated as shown in Fig. 1D. In respect to current distribution, the upper part of the mast works as an open one-wire line and the lower part as a one-wire line terminated by an inductance. According to the flow of energy there is a progressive wave superimposed on the standing wave in each part of the mast, traveling upward in the upper part and downward in the lower part. Each of the two progressive waves is, near the current source, about half as strong as in the case of excitation at the base. The radiation components originating from them cancel each other at least partially because of the opposite direction of the progressive waves. For the sake of brevity, this kind of antenna may be called the loop-fed antenna, in contrast to the base-fed antenna.

As shown in Fig. 2, the current distribution in the lower part of the mast depends upon the induct-

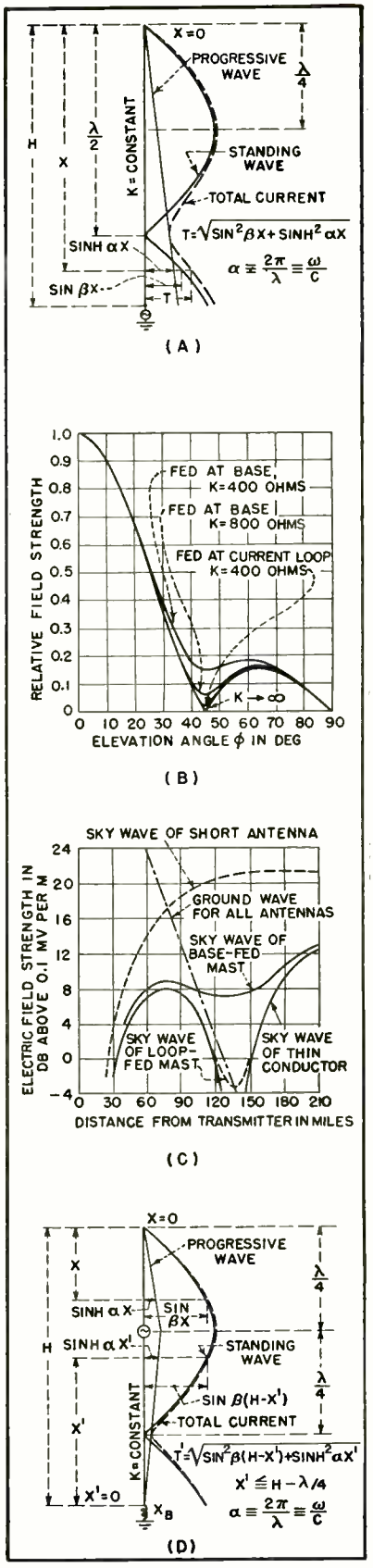


FIG. 1—(A) standing, progressive and total current waves on radiator fed at base, (B) vertical pattern of vertical 0.585-wavelength radiator, (C) sky and ground-wave field strengths, and (D) standing, progressive and total current waves on center-fed radiator

ance which is connected between the base of the mast and ground. This means that the vertical radiation pattern can be controlled by varying this inductance. In order to have a pattern suitable for reduction of fading, it is not necessary to have a current loop at the sectional-mast insulator. Actually a current distribution similar to that in Fig. 2B is more favorable because it allows reduction of the total height of the mast, which can be as low as 0.4 wavelength. Since the inductance at the base can be adjusted conveniently, it is possible to adapt the antenna during operation to a change in ionospheric conditions, as it happens, for example, during spring and fall.

A simple way to feed the antenna at the sectional-mast insulator is shown in Fig. 3A. A coaxial r-f cable is wound as a big coil. Its outer conductor is connected between the base of the mast and ground, representing the inductance mentioned above. The inner conductor of this cable is continued through the inside of the lower part of the mast and insulated from it up to the lower end of the upper part of the mast. This continuation of the inner conductor and the mast itself form a coaxial transmission line, with the mast as the outer conductor. A current equal in phase and magnitude and opposite in direction to the current in the inner conductor flows on the inner surface of the lower part of the mast. No radiation originates therefrom. At the sectional-mast insulator, this current goes around the rim of the mast shaft and continues on the outside surface.

Normally, a tuning and matching network would be introduced at the sectional-mast insulation between the antenna terminals and the coaxial cable. However, in this case it is not necessary. On that part of the coaxial transmission line which is formed by the mast itself and the inner conductor, even a high standing-wave ratio does not matter, both from the standpoints of power losses and break-down voltage of the insulators, because of the great dimensions available. Therefore, it is sufficient to have a matching and tuning network at the lower end of the lower part of the mast shaft where it can be operated conveniently. Even more convenient, the matching network can be installed at the grounded end of the coil of coaxial cable.

In order to determine how much the loop-fed antenna actually improves sky-wave suppression, field strength measurements by airplane were made with a 330-foot high antenna model operated at 1,640 kc. For an elevation angle of 43 degrees, the field strength was reduced by about 14 db compared to the base-fed antenna, and by 23 db compared to a simple short antenna. In effect, the loop-fed mast is about equal to, if not better than, the base-fed one-wire antenna in respect to the sky-wave suppression.

The calculated field strength of the reflected sky wave as a function of the distance, when based on the measured pattern, is shown in Fig. 1C. According to this diagram, the undisturbed primary coverage at night time is increased considerably; namely, by about 30 percent in radius or 68 percent in area, compared to a base-fed mast.

Radio Frankfort Antenna

The first broadcast transmitter which was to have obtained a permanent version of the loop-fed antenna was the 100-kw station in Berlin, Germany. The war prevented this and, instead, such an antenna was erected in 1946 for the 100-kw station in Frankfort-on-Main. Meanwhile, the antenna originally planned for Berlin is thought to have been erected also.

The antenna for Radio Frankfort is a 402-foot steel tower with uniform square cross section. The sectional-mast insulator is at a height of 269 feet so that the upper part of the tower is 133 feet long. The construction of this sectional-mast insulator is similar to that used for station WMAQ.

At the time of the erection in 1947, it was a problem to provide for the necessary inductance between the lower end of the mast shaft and the ground system. This inductance could not be established by a coaxial cable wound into a coil, as indicated in Fig. 3A, because there was no 100-kw cable available. Instead, sections of another mast of identical construction were used to build a kind of short-circuited stub. They are hung up horizontally by strain insulators at a distance of 20 inches above the ground in such a way that they form one big loop with a diameter of 64 feet, as shown in Fig. 3B. One end of this stub is connected to the base of the antenna, the other end is grounded. By moving the tap for the ground connection along the stub, the reactance that is effective between the base of the antenna and ground can be varied conveniently, providing a simple means of adjusting the current distribution along the antenna and, consequently, the vertical radiation pattern.

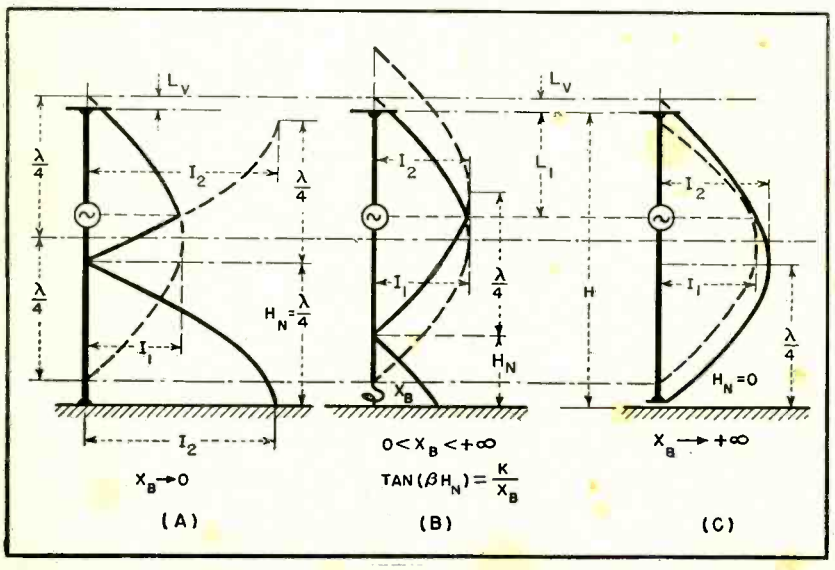


FIG. 2—Effect of variation of series impedance X_B at base of loop-fed antenna on current distribution

In the axis of this stub, the same kind of copper rope as used in the axis of the mast is hung up by strain insulators. At the base of the antenna, it is connected directly to the copper rope in the axis of the antenna. At the other end it is connected to a matching and tuning network. In this way the coaxial transmission line represented by the copper rope inside the antenna and the mast shaft is continued to the point where the outer conductor is grounded. In view of the high voltage-rating of this coaxial transmission line inside the stub, there is no danger of flashing over, even with a high standing-wave-ratio. Therefore, the matching and tuning network could be installed outside the mast shaft in a small tuning house.

The actual performance of this antenna was measured for three different settings of the tap for the ground connection on the stub corresponding to three different radiation patterns. Some of the results are listed in Table I. A total antenna efficiency of 73, 67 and 62 percent was obtained corresponding to a total loss of 1.4, 1.7, and 2.1 db respectively, a relatively high efficiency considering the inexpensive ground system used and the high frequency of 1.2 mc. Even with these losses, the ground-wave field strength is greater than that of a quarter-wave antenna with an efficiency of 100 percent.

Power Losses

About 1.4 to 4.2 percent of the input power was found to be dissipated in the coaxial transmission line inside the tower. This is not too much considering that this coaxial line has a high standing-wave ratio. Another 3 to 12 percent of the input power is lost in the stub. This is due to the low characteristic impedance of the stub, only 62 ohms, which is unfavorable but could not be avoided because of lack of material. Without restriction in material, the losses could have been made much smaller. The balance of about 10 percent loss probably is due chiefly to ground losses. Equally satisfactory are the voltage ratings of the antenna.

Preliminary field strength recordings at night time, at a distance where the fading with a simple quarter-wavelength antenna at the transmitter previously had been serious, showed that the fading at Radio Frankfort is much smaller than the signal of another station equipped with a quarter-wave antenna located at the same place and with almost the same frequency. Final tests have not yet been made in respect to the area undisturbed by fading.

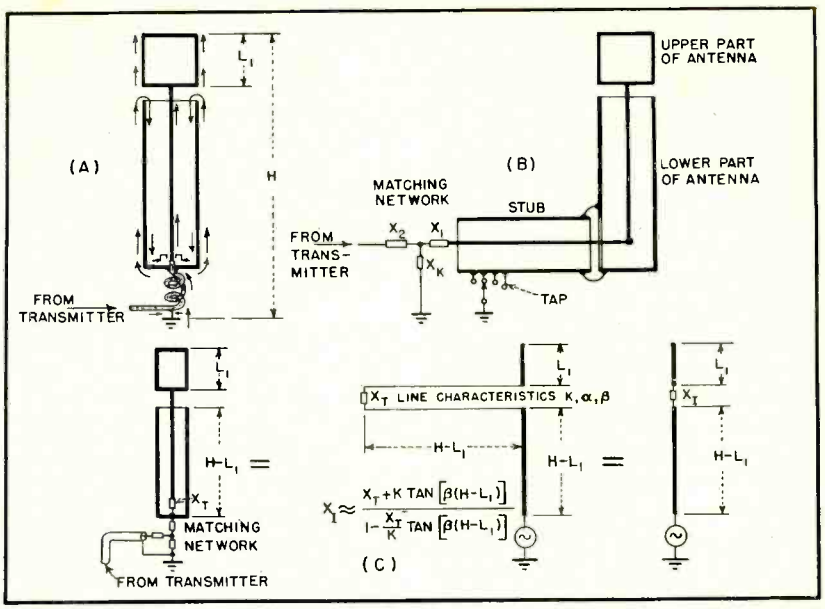


FIG. 3—(A) current flow in loop-fed antenna, (B) loop-fed antenna with matching network outside mast, and (C) equivalent circuit of loop-fed antenna operated as base-fed type

The new antenna also has advantages in respect to its usable frequency range. Full benefit of its antifading action can be obtained in a frequency range of about ±20 percent of the frequency for which it is designed, without any alteration of the antenna itself, just by properly adjusting the tap for the ground connection on the stub. If the antenna is required to operate at a frequency outside of this range, it can be used as a base-fed antenna with the coaxial cable inside the mast working as a stub, shown in Fig. 3C. With this mode of excitation, and with a suitable reactance X_T between the inner conductor and the lower end of the mast, the radiation efficiency at low frequencies is higher than with a simple steel tower because its effective height can be increased by making the input impedance of the coaxial cable inside the mast at the sectional-mast insulator inductive. At higher frequencies the sectional-mast insulator can be used to decrease the electrical height of the antenna in order to obtain a more suitable vertical radiation pattern by making the input impedance of the coaxial cable capacitive. It is also possible to operate the antenna as a simple base-fed mast by short-circuiting the sectional-mast insulator. This possibility may be useful in case of trouble with this insulator.

Acknowledgment is made of the help furnished by Messrs. Gerwig and Graziadei and others involved in the development of the antenna which was carried out under the supervision of the author in the Forschungsantalt der Deutschen Reichspost, Berlin, Germany.

Valuable help in antenna measurements was afforded by Messrs. Haberkant and Behne, employees of Radio Frankfort.

Interest and encouragement were given by R. J. Condon, AMG, and Lt. L. C. Heinzman, then chief engineer of Radio Frankfort.

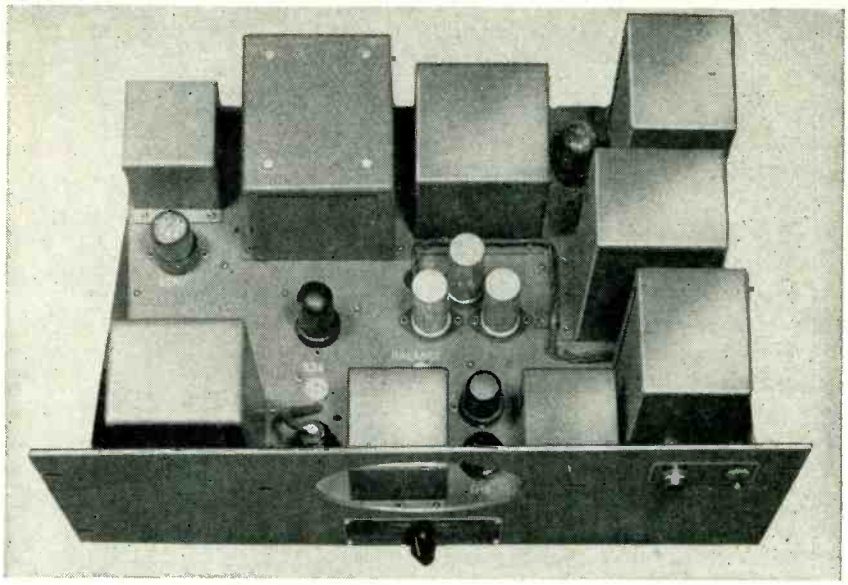
Bibliography

Stuart Ballantine, High Quality Radio Broadcasting, *Proc. IRE*, 22, p 564, 1934.

R. F. Guy, Notes on Broadcast Antenna Developments, *RCA Review*, p 39, April 1937.

By L. L. KOROS*

Advanced Development Section
Engineering Products Dept.
RCA Victor Division
Radio Corporation of America
Camden, N. J.



Commercial transmitter speech inverter manufactured by RCA Victor Argentina

An Improved

USERS of wire line, and particularly radiotelephone service, can never be assured complete secrecy of their communications despite laws made for their protection. When circumstances justify the expense of necessary terminal equipment, speech scramblers or inverters are used that make it virtually impossible to decode or unscramble the enroute message without authorization. Owing to the confidential character of such systems the literature gives a very meagre coverage of specific details, although the basic principles have been published.[1]

This article describes an improved speech inverter system employing equipment that is simple in design. In operation, the adjustments to the variable components are not critical and the overall tolerances are fairly broad.

Design Considerations

Common practice in speech inverters is to let the intelligence flow through a low-pass filter that prevents higher frequencies not essential to the intelligibility of speech from passing into the circuits that follow. The limit is often chosen at 2,700 cps.

The speech frequency band, $f_s \lessgtr 2{,}700$ cps, is introduced into a modulator, together with the inversion frequency f_c, which is usually 3,000 cps. There are speech inverters using several inversion frequencies to increase the difficulties for unauthorized reinversion. The method described here can be applied to more complex systems, also.[2] This frequency of inversion is modulated by the intelligence $f_s \lessgtr 2{,}700$ cps. The modulator is generally a balanced type. It produces different frequency groups, the more important being $f_c + f_s$ and $f_c - f_s$. The output from the modulator flows through a second low-pass filter with the same frequency limit of 2,700 cps. By this process the $f_c + f_s$ group is suppressed and the transmitted frequency spectrum is 300 to 2,700 cps.

Frequencies lower than 300 cps produce higher $f_c - f_s$ frequencies than 2,700 cps. They are rejected by the second filter and frequencies higher than 2,700 cps are not introduced into the modulator. The 400-cps frequency in the passband becomes (after modulation and the second filtering process) 3,000 − 400 = 2,600 cps. The 2,600 cps becomes 3,000 − 2,600 = 400 cps. From the lower frequency is produced a higher one and from the higher, a lower one. Thus the frequency spectrum is inverted. The

* Formerly RCA Victor Argentina, Buenos Aires, Argentina.

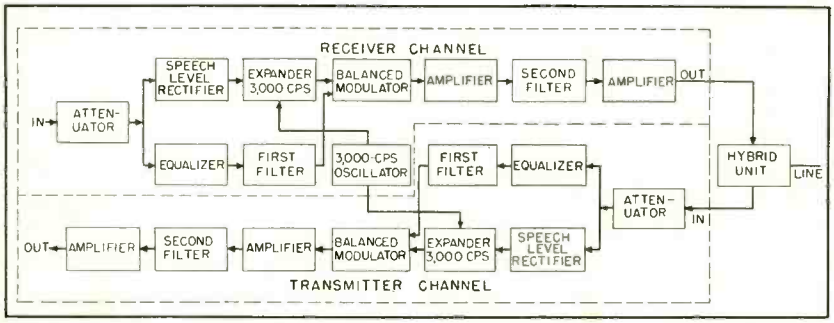


FIG. 1—Two-channel speech inverter showing connection through hybrid unit to line

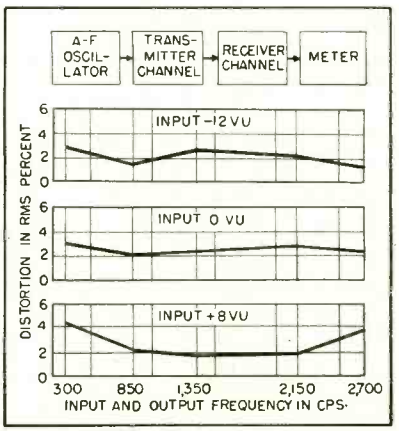


FIG. 2—Distortion in the speech inverter system used for a complete circuit with three input levels

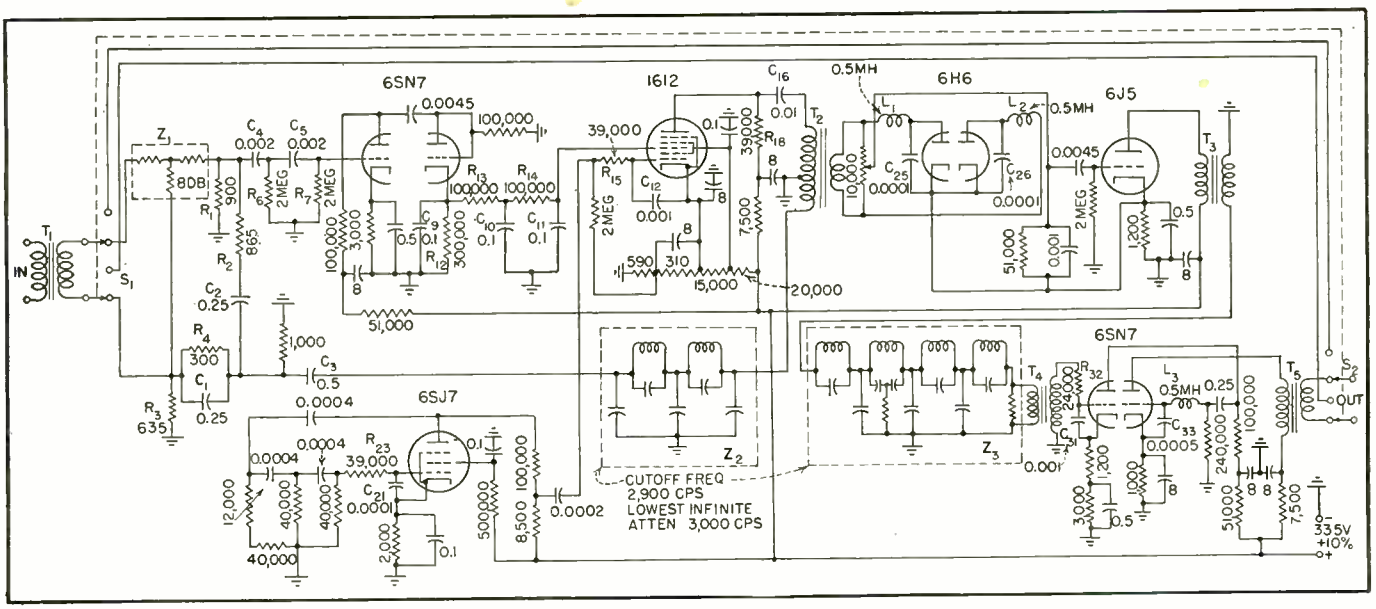


FIG. 3—Circuit diagram of the receiver channel of the speech inverter system

Speech Inverter System

Privacy circuit for radio or telephone line employs double modulation of the conversion frequency and is controlled both by the speech input and the average level of speech input. Frequency response is corrected by an R-C equalizer network. Broad dynamic range, low background noise and low distortion are assured

center frequency of 1,500 cps remains as before. This inverted frequency group is transmitted in the normal manner. A radio-frequency carrier can be modulated with the inverted signal, or the inverted signal is sent over a telephone line.

Unscrambling

If at the receiving end the incoming signal is treated in exactly the same manner as the original input intelligence in the sending-end equipment, the inverted intelligence will be reinverted. The inverted intelligence cannot be understood, but the reinverted signal has the same intelligibility as the original input, provided the process of inversion and reinversion has not introduced extreme distortion.

There are several sources of distortion. The internal carrier frequency of 3,000 cps may be present in the output line because it is not balanced out with sufficient accuracy by the modulator or is not suppressed to the necessary low degree by the second filter. In this case, the 3,000 cps introduces a disagreeable background noise. This tone may be mixed with the hum frequency and harmonics of the power supply. The hum level becomes more disturbing in the speech inverter than in a common amplifier because the modulation factor of the intelligence on the 3,000-cps carrier must be low, as will be shown later.

Further distortion is produced by the modulation of the 3,000-cps carrier. In addition to the lower and upper sidebands the 2 f_c = 6,000 cps and 2 f, frequency groups are frequently present in the output of the modulator circuits. The f_c, 2 f_c, f, and 2 f, frequency groups produce cross-modulation frequencies. Many of these cross modulation products are in the passband of the filter and therefore cannot be eliminated; or they are not in the passband but are not suppressed sufficiently in the second low-pass filter. The $2f_c$ = 6,000 cps and also $3f_c$ = 9,000 cps carrier harmonics contribute to the background noise of the speech inverter.

The inverted intelligence is 3,000 − f,. The 2f, distortion group is in one octave ratio with the incoming intelligence, that is, it is not inverted. The doubling of the input frequency does not impede the intelligibility of the speech. If the level of this distortion is high enough the input direct intelligence can be understood with a common receiver. In this event the purpose of the speech inversion, which is privacy, will not be fulfilled. Furthermore, after passing this tone mixture into a receiver speech-inverter channel, the inverted part of

the speech will be reinverted, and the distortion group of double frequency will be inverted. This kind of distortion produces a dissonant effect.

Distortion

Another type of distortion is often produced by detection of r-f fields from the communications transmitter when the speech inverter is near by. The modulator of the speech inverter inherently tends to detect r-f fields. The leakage r-f field carries inverted speech. This signal will be reinverted and introduced again to the transmitter speech input. Heavy distortion, or in some cases regenerative singing, will be produced in this way.

A type of possible distortion is related to the two low-pass filters. It is hard to meet good frequency response because the lowest frequency of maximum attenuation, which is 3,000 cps, must be near the highest passband frequency. The requirements are, however, that 2,700 cps must be transmitted almost without attenuation. The cutoff frequency of the filters must be chosen, therefore, near 2,800 cps. Considerations of economy often make it difficult to use filters with high-Q coils.[3,4] Even expensive coils with Q between 100 and 130 do not give satisfactory results.

The passband of 300 to 2,700 cps can be considered the narrowest possible for speech transmission. If the inadequate frequency response of the filters reduces the transmission of frequencies on both sides of the center frequency of this narrow band and if, in addition, distortion frequencies from the inadequate conversion process are present at a considerable level in the speech output, the intelligibility will suffer seriously.

If the level of the conversion frequency, f_c, be high, the distorting terms of the double intelligence, $2f_s$, and the cross-modulation products between the $2f_s$ and $2f_c$ terms become lower. By increasing the ampliture of f_c, however, the unsuppressed portion of the same and of $2f_c$ and $3f_c$ becomes more disturbing. If more filter sections of the same quality are used to attenuate these frequencies the frequency response in the passband will be worse. The requirement of low distortion is contradictory to the requirement of low background noise. It was recognized as a further difficulty that the level of f_c, which is adjusted to the average speech level, is not sufficient for high speech input level and is excessive for low speech input level or for the case of no speech input. The designer must meet contradictory requirements.

The New System

To reduce the distortions to negligibly low values and to assure a low background noise level an improved system has been introduced. The favorable results are obtained by controlling the level of the conversion frequency. The conversion frequency is modulated by the speech input, as in conventional circuits, but it is also modulated by the average level of the speech input. The frequency response is corrected by an R-C equalizer network.

Figure 1 shows the block diagram of the new speech inverter system. The speech inverter is composed of transmitter and receiver channels. The receiver unit contains the 3,000-cps oscillator; the transmitter unit contains the power supply. All other components for the two channels are identical.

The input attenuator reduces the reactive component of the input channel impedance to an insignificant value. The 3,000-cps oscillator excites the expander. The speech level rectifier controls the 3,000-cps output of the expander. If the speech level rises, the expander feeds more 3,000-cps carrier to the balanced modulator. If the speech level is below a minimum value or if there is no speech input at all the 3,000-cps signal in the modulator goes down to a low standby level.

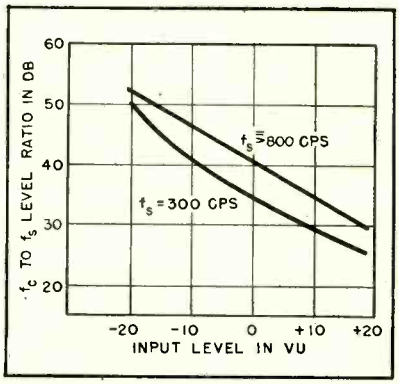


FIG. 4—Conversion and signal frequency levels

This standby level is chosen so low that the residual 3,000 cps and the harmonics of it are better than −50 db below 1 milliwatt at the output of the channel and are consequently inaudible. If the speech level rises, the level of the 3,000-cps tone and the residual of it rises too. Nevertheless, it is not noticeable because it is masked by the speech. Although high-level intelligence is flowing through the speech inverter channel, the 3,000-cps signal and harmonics are still at a relatively low level. As shown in Fig. 2, the rms sum of the remanent 3,000-cps signal, harmonics of it and beats of it with the distortion products of the incoming intelligence remain below a low percentage. The input intelligence will be equalized, and after the first filter, will be fed into the balanced modulator. After the modulator are amplifier stages and a second filter as in the conventional speech inverters.

This speech inverter has no gain or loss. The amplifier stages merely compensate for the losses of the attenuator and equalizer. The normal dynamic range of the input and output is from −12 vu to +8 vu, but no excessive distortion can be observed if the speech level on the line rises to as much as +24 vu (250 mw). With the expander, the level of f_c will be controlled so that a previously fixed ratio will be assured between the f_c and f_s levels. It was determined experimentally that an optimum result can be obtained by keeping the level of the 3,000-cps signal at 25 to 30 db higher in the modulator than the level of the intelligence. This level difference assures the lowest distortion due to the $2f_s$ terms and their beat products. The transmitter and the receiver channels may be coupled by a hybrid unit to the telephone line.

Circuit Analysis

The S_1 and S_2 switch system shown in Fig. 3 inserts or removes the channel from the line. This type of switching can be done because the input and output levels are the same. The intelligence, after passing equalizer elements,

the function of which is described below, reaches one grid of the 6SN7 double triode and also the input terminal of the two-section filter Z_2. The first section of the 6SN7 works as an amplifier, the second section as a diode rectifier and produces with its filter system (comprising R_{12}, R_{13}, R_{14}, C_9, C_{10} and C_{11}) a fluctuating d-c voltage. This voltage is positive with respect to ground and its value depends on the speech input level. The fluctuation is retarded by the time constant of the filter elements. The optimum value of the time constant is about 0.1 second. The fluctuating d-c voltage more or less neutralizes the negative bias of the type 1612 variable-μ pentode. The first grid of the pentode is excited by the 3,000-cps output of the type 6SJ7 oscillator tube. Into one of the primary windings of T_2 is fed the amplified 3,000-cps tone, the amplitude of which is fluctuating with the speech-input level.

The network R_{18}, C_{16} is designed so that transients, produced by the changes of the plate current of the 1612 tube and which are the consequence of sudden speech level changes, cannot be detected on the secondary winding of T_2. The input filter C_4, R_6, C_5, R_7 prevents frequencies below 300 cps, which are out of the passband, from expanding the 3,000 cps level.

In transformer T_2 the filtered intelligence is added to the fluctuating 3,000-cps carrier frequency. The 6H6 tube acts as a balanced modulator to produce the $f_c + f_s$ and $f_c - f_s$ sidebands. The correct setting of potentiometer R_{28} assures the balance. The predetermined level difference between the 3,000-cps and the intelligence on the plates of the 6H6 in the dynamic range is assured by setting of the bias values and the level of the 3,000-cps excitation on the type 1612 tube.

The level of the 3,000-cps signal on the plates of the 6H6, for very low intelligence input, is higher than 30 db with respect to the intelligence. For very high input it is less than 30 db, but not less than 20 db. Nevertheless, the speech inverter cannot be overloaded by loud speaking. With the most excessive input level the $2f_s$ group cannot become higher than about

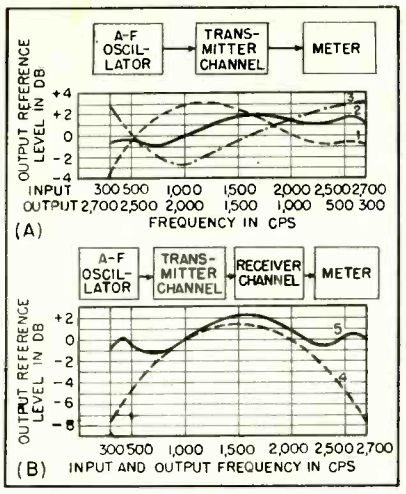


FIG. 5—Curve 1 is response of one channel without equalizer; curve 2 shows response of the equalizer alone; curve 3 is response of one equalized channel. Curve 4 (Fig. 5B) is the frequency response for inversion and reinversion without equalizer; and curve 5 is the same using the equalizer

5 percent of the total; therefore the direct intelligence can never be understood. Figure 4 shows the ratio of the 3,000-cps level to the input intelligence on the plates of the 6H6 modulator tube.

The modulator is followed by a three-stage conventional amplifier with the second filter Z_3 inserted. To make the measurements illustrated in Fig. 2 two channels are connected in series; the output of the transmitter channel is connected to the input of the receiver channel. In this way the complete communication circuit is simulated. The output of the receiver channel has been analyzed for harmonic content with a GR type 636A wave analyzer. The curves show the result of the analysis at 300, 850, 1,350, 2,150 and 2,700 cps for −12 vu, 0 vu and +8 vu speech levels. The distortion curves represent the rms sum of all the frequencies that are present in the output besides the input frequency. Numerous measurements have demonstrated that the analysis at these frequencies gives a good overall picture of the behavior of the instrument so that the straight-line connections between the measured values is justified. The filters used in the speech inverter channel shown in the schematic have Q's of about 25.

The frequency response of the channel, especially in a complete communication circuit using one transmitter and receiver channel, would not be satisfactory without an equalizer. Resistors R_1, R_2, R_3, R_4 and capacitors C_1 and C_2 form an efficient equalizer system. The circuit is similar to the Wien bridge; no infinite attenuation is produced, however, at any frequency. The peaking tendency of the equalizer at the ends of the passband is compensated by capacitors C_3, C_{25}, C_{26}, C_{31}, C_{33}, inductances L_1, L_2, L_3 and resistor R_{32}. Most of these elements serve also with R_{15}, R_{23}, C_{12} and C_{21} in the cancellation of the r-f fields from the inverter channel.

Operational Characteristics

The curves in Fig. 5A show effect of the equalizer on one speech inverter channel and those of Fig. 5B on a complete communication circuit of inversion and reinversion. It is important to equalize both channels.

The frequency response can be corrected by pre-emphasis applied to one end of the transmitter channel and to one end of the receiver channel. The pre-emphasis gains are in this case equal to the sum of the losses at both ends of the passband. This method produces an improved overall frequency response, but for radio communication reduces the distortionless modulation range of the radio transmitter. This reduction of the dynamic range of the transmitter will not result or at least to only a low degree, if both channels are equalized individually.

The author wishes to express his appreciation to H. Zuchenbrojt, RCA Victor Argentina and A. Saenz formerly of the same company, for the valuable cooperation in the design work of the speech inverter and in making the numerous measurements needed during the experimental period.

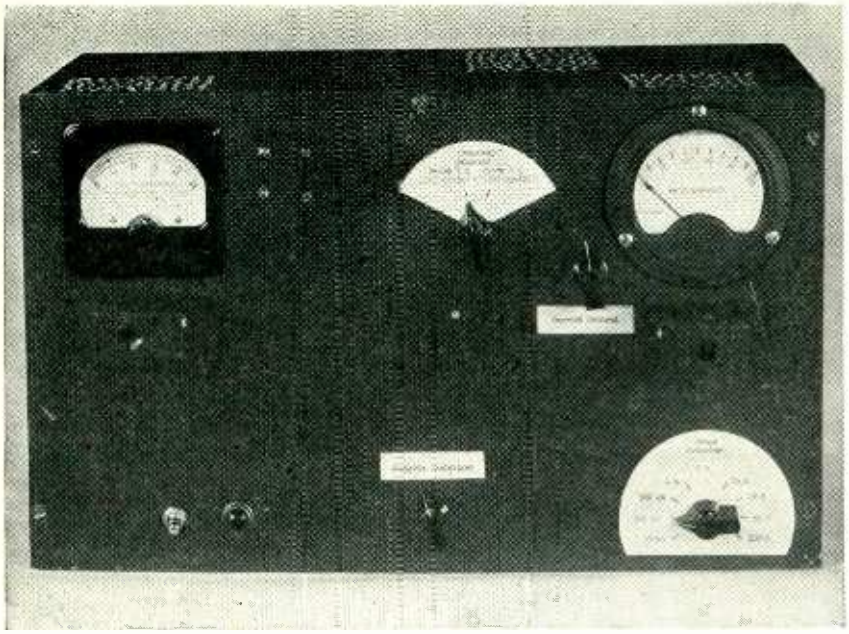
References

(1) W. L. Everitt, "Communication Engineering" Second Edition. McGraw-Hill Book Co., p 393, New York, 1937; William W. Roberts, Speech Scrambling Methods, ELECTRONICS, p 108, Oct. 1943.

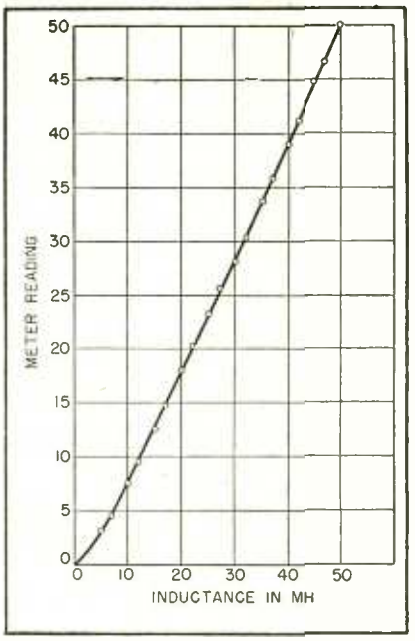
(2) H. J. Reich, "Theory and Application of Electron Tubes" First Edition, McGraw-Hill Book Co., New York, p 126, 1939.

(3) A. T. Starr, "Electric Circuits and Wave Filters", Second Edition, Sir Isaac Pitman & Sons, Ltd., London, 1944.

(4) J. E. Smith, "Simplified Filter Design", RCA Institutes Technical Press, New York, N. Y.



Nine measuring ranges are provided by the switch at lower right of the panel



Calibration curve for the 50-mh range

Inductance Meter

Phase shift through vacuum tube compensates for effect of IR drop in measuring inductance of air or iron-core coils from 5 millihenrys to 100 henrys. Conditions of frequency and current under which the coils operate can be simulated

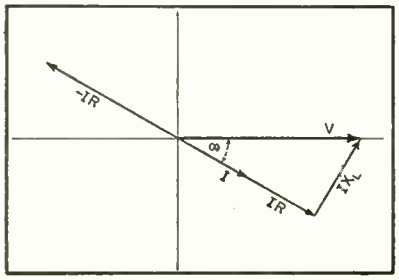


FIG. 1—Vector triangle on which the design is based

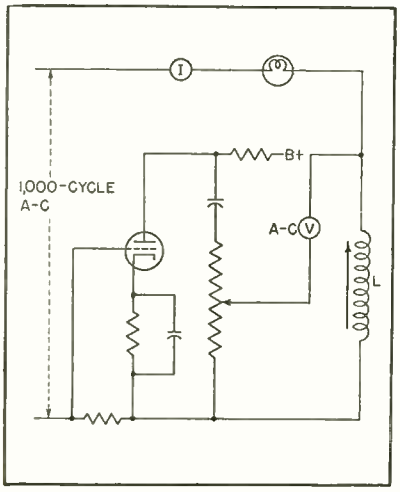


FIG. 2—Simplified circuit of inductance meter

By J. M. MARZOLF
Electrical Engineer
Naval Research Laboratory
Washington, D. C.

AN INDUCTANCE measuring instrument was developed at the Naval Research Laboratory in connection with an investigation of liquid-level indicators for shipboard tanks, one of which employed a variable inductance that changed linearly with the depth of tank liquid. Although this circuit was developed for a particular application, it can also be used as an inductance meter.

In the measurement of inductance, the chief difficulty usually is caused by the finite d-c resistance associated with any coil, which cannot be separated physically from the reactance of the coil or be neglected as is sometimes possible in the measurement of capacitance.

To eliminate this difficulty, the following method was adopted. The voltage across the unknown inductance is measured with a second voltage, equal in magnitude but 180 degrees out of phase with the IR drop in the coil, introduced into the measuring circuit. This relationship can best be shown by the vector diagram in Fig. 1 where V, IR and IX_L form the vector triangle typical of inductive circuits.

Of these quantities, V alone can be measured physically. If, however, an additional voltage $-IR$ can be introduced into the measuring circuit, the meter will indicate the vector sum of IR, $-IR$ and IX_L which will be directly proportional to the unknown inductance, provided the current and frequency remain constant.

Basic Circuit

The manner in which this voltage is introduced into the measuring circuit is shown in Fig. 2, the simplified circuit diagram of the measuring circuit. The grid signal is taken from the pure resistance in series with the unknown inductance. It will, therefore, be in phase

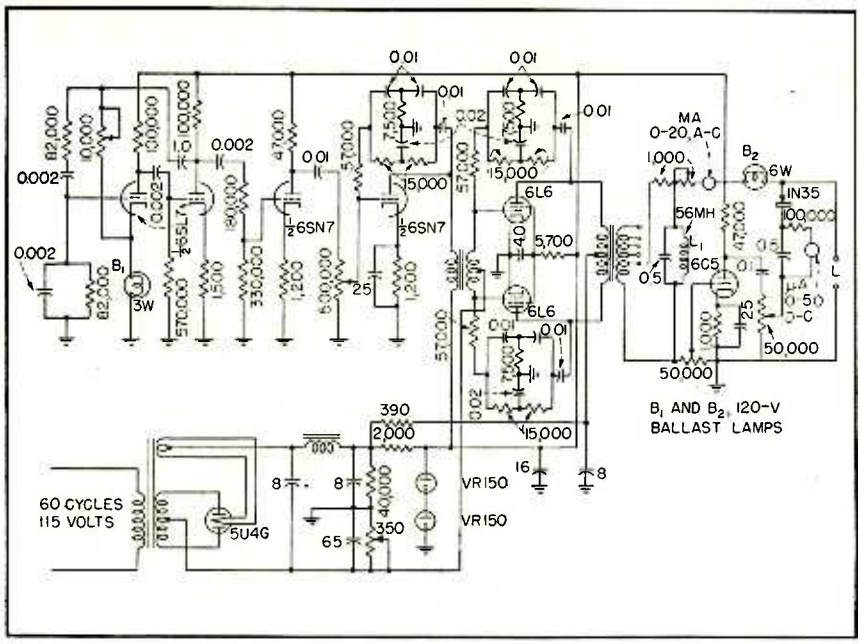


FIG. 3—Complete circuit of inductance-measuring unit and power supply

with the current through the inductance and consequently also in phase with the *IR* drop in the coil as shown in Fig. 1. Thus, the plate signal of the vacuum tube will be 180 degrees out of phase with these quantities, provided the blocking capacitor is large enough to cause only a negligible phase shift. Consequently, the voltage produced across the potentiometer will be in the direction $-IR$ in Fig. 1 and the magnitude of the voltage introduced into the measuring circuit can be adjusted to equal *IR* by means of the variable tap as shown.

Different values of coil inductance or resistance will cause the phase angle α to change, but this change is automatically taken into consideration, since the grid signal is always in phase with the current through the coil and consequently with the *IR* drop in the coil. When properly adjusted, the meter reading will be directly proportional to the unknown inductance and can be calibrated to indicate this quantity directly, provided the frequency and current of the power supply are maintained constant.

A Wien-bridge oscillator-controlled power supply was used because of its excellent frequency stability and the ballast lamp shown in Fig. 2 maintained a substantially constant current.

The a-c meter shown in Fig. 2 should have a high impedance so that the meter current flowing through the grid resistor will have a negligibly small effect on the grid signal. In the model tested, since simplicity and ruggedness were desired, a d'Arsonval type meter (20,000 ohms per volt) with a rectifier was used quite satisfactorily. However, a vacuum-tube voltmeter is preferable due to its higher impedance and more linear characteristics.

In the model tested, the power was supplied by a 1,000-cycle Wien-bridge oscillator with suitable amplifier, equipped with bridged-tee feedback networks to reduce the harmonics to a negligibly small value. The complete circuit is shown in Fig. 3. Care should be exercised in its construction to minimize the frequency drift as the circuit components warm up or else some means should be provided so the circuit will quickly stabilize.

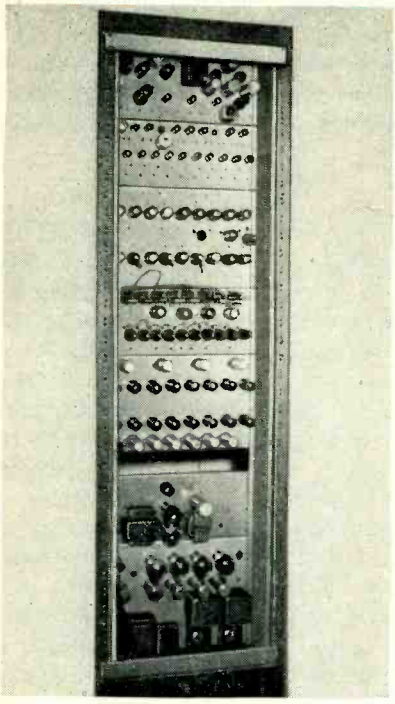
In the operation of this meter, the current and frequency through the unknown inductance are set at predetermined values and the potentiometer in the plate circuit of the inverter tube adjusted to the value which provides a minimum reading on the a-c meter. This minimum reading will indicate the value of the unknown inductance directly, when properly calibrated.

High Range

For extending the range of the meter, it is necessary to change the current through the unknown inductance, the frequency of the power supply or the sensitivity of the indicating meter. By shifting to 100 cycles, the model constructed measures iron-core inductances as high as 100 henrys. The only appreciable error in such a meter, if properly constructed, is due to the fact that it neglects the distributed capacitance in the unknown coil. This error, however, is minimized if a coil current is used which is appreciable with respect to the current due to the distributed capacitance.

This meter can also be used to measure the change in inductance over a given range by inserting a capacitor in series with it of the proper value to balance the initial inductance. When used in this manner, it is particularly important that the harmonics in the power supply be reduced to a low value; otherwise an appreciable error will be introduced in the meter reading, which is most noticeable near the balance point. This circuit can also be used to measure capacitance directly, but the meter reading will no longer be linear, since reactance is an inverse function of capacitance.

The circuit described can be used for coils having a wide range of values of both inductance and resistance and works equally well on air-core or iron-core coils. If designed and calibrated for a given set of conditions the inductance of iron-core chokes or transformers can be measured under the conditions of frequency and current at which they will operate. It is particularly suited for the measurement of the change in inductance in a given circuit where the circuit constants (except inductance) are fixed. Such a circuit can be initially balanced and calibrated and the meter will provide a continuous indication of the change in inductance without further attention.



Sync generator and power supply in a single rack having a total of 93 tubes

By G. ZAHARIS

President, Radio Stations WTIP and W8XGZ, Charlestown, West Virginia

WITH THE EXCEPTION of one slug-tuned oscillator coil, the sync generator to be described contains no variable elements. This design is in direct contrast with conventional synchronizing equipments that incorporate dozens of variable potentiometers. All pulse widths, all pulse positions and the pulse number are determined by a system of binary counters in conjunction with a delay line.

The importance of stability is readily appreciated when it is realized that composite sync and blanking waves for television contain pulses of six fundamental widths at three basic frequencies held in correct phase relationship to a tolerance of 0.3 microsecond. In this generator, determination of sync and blanking waves is a function of circuit configuration and is not subject to variation by operators.

No attempt was made to reduce the number of tube envelopes. A total of 93 tubes is used in this generator and its power supplies. This figure is some 20 tubes in excess of the number common to present designs. The cost of the extra tubes is counter-balanced by stability and freedom from adjustment. All tubes, except those in the basic 31.5-kc oscillator and lock-in circuits, act merely as switches. They have only two operating states—plate-current cutoff and plate current saturation. Many tubes are buffers with short duty cycles.

The leading edges and trailing edges of sync, blanking and driving signals are precisely positioned by a delay line, and inherently stable device. The widths of the vertical components in the sync and blanking signals are fixed by making them a definite number of cycles or pips wide as derived from the basic 31.5-kc oscillator. The exact number is determined by binary counters. All generator output signals are independent of R-C circuits or charge accumulation circuits. In general, the generator exhibits a computer-like behavior in that the output signals are precisely correct or they are completely incorrect.

Use of Delay Line

The basic principle of operation is illustrated in Fig. 1. A sharp pip is applied to a delay line having a high cutoff frequency to retain the steep wavefront. The pip is extracted at tap 1 to actuate the flip-flop oscillator to the ON condition. This same pip is extracted from taps 2 or 3, at a later time, to return the oscillator to the OFF condition. The rectangular pulse produced has the positional stability of the recurrent pips and the pulse width is accurately established by the delay line. By connecting to various taps along the line through switches, the pulse width or position is accurately altered.

In the final equipment, keyer tubes actuated by keying signals replace the switches of Fig. 1. The keying signals serve to position or control the width of the flip-flop oscillator pulses to predetermined requirements. Thus, by using various pips from a delay line keyed in by different keying waves, it becomes possible to generate a desired complex rectangular waveform in one flip-flop oscillator. In the event that the oscillator receives several successive ON and OFF pips, only the first of each group is significant.

Another important characteristic is the immunity of the oscillator pulse to variations in the keying wave. In the sync generator, the rise and fall times of the keying waves may vary in the order of 10 microseconds without affecting the generated pulses. This characteristic leaves the pips in control of the exact timing of rectangular waves.

Figure 2 indicates the manner in which the entire RMA sync signal is generated in one flip-flop oscillator into which are injected suitably keyed pips. Keying wave G in Fig. 3, occurring at the horizontal sweep rate is combined with the three principal vertical keying waves A, B and C to produce a composite keying signal operating keyer K_8. This keyer passes the ON pips from tap 3 to the oscillator at H rate during the picture interval and at $2H$ rate during the three vertical intervals. Thus, tap 3 on the delay line precisely determines all the leading edges of the sync signal.

Similarly, the varying trailing edges of the sync signal are determined by injecting the OFF pips to the flip-flop oscillator. There are three fundamental widths in the horizontal component of the standard sync signal—the equalizing pulse (2.25 μsec), horizontal sync (4.5 μsec) and vertical serration width (4.5 μsec). These widths are established by taps 4, 5 and 1 respectively, and selected by keyers K_9, K_{10} and A_4. Vertical keying signals A and C are combined to operate K_9 and hereby furnish OFF pips from tap 4 during the two equalizing intervals before and after the vertical sync. Tap 4 thus determines width of equalizing pulse.

The horizontal sync width is determined by the OFF pip normally keyed in from tap 5 through K_{10}. This keyer passes OFF pips at all

Synchronizing Generator

Standard synchronizing, blanking, horizontal and vertical driving signals are obtained from a generator based upon binary counters without variable controls. Sync signal parameters are fixed by circuit configuration rather than by R-C or charge accumulation circuits. Stability is high and independent of power supply regulation

times except when K_{10} is keyed out during the vertical sync period. The fact that the oscillator is receiving OFF pips from tap 5 during the equalizing intervals is of no consequence since the oscillator is already receiving OFF pips from tap 4 during these intervals. The trailing edge in the vertical serrations is established by OFF pip 1 through amplifier A_4. These OFF pips are supplied to the oscillator continuously but are only effective during the vertical sync interval when all other OFF pips are absent. The complete sync signal as generated by the flip-flop oscillator is passed through clippers for cleaning both top and base of the composite wave.

The mixed blanking signal is similarly synthesized. The composite keying signal which keys K_8 for the sync ON pips also keys K_7 to supply ON pips to the blanking oscillator. These pips originate from tap 2 on the delay line. The time displacement between taps 2 and 3 establishes the sync front porch. Blanking OFF pips originating from tap 6 are normally keyed in during the picture interval. Time difference between tap 2 and 6 represents the horizontal blanking width. Keying wave F keys out these OFF pips during the vertical blanking interval to establish the vertical blanks that are required.

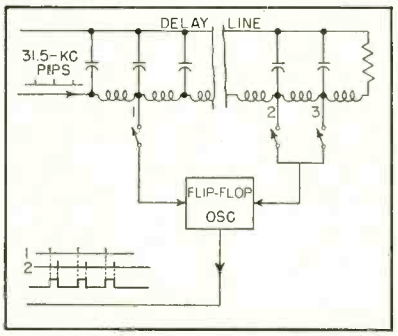


FIG. 1—Method of generating rectangular waves

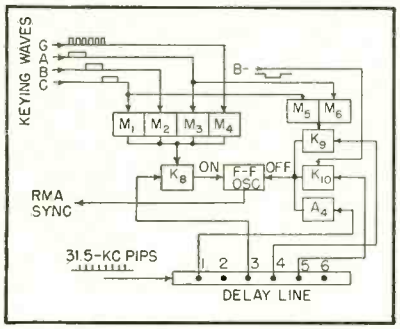


FIG. 2—Simplified diagram to show sync synthesis

It should be noted that the oscillator receives ON pips during the entire vertical blanking period. Only the first one is significant since there are no OFF pips during this period. Time differential between taps 5 and 6 determines the horizontal back porch. It will be apparent that in this method of generating the blanking signal, the leading and trailing edges of the vertical blank are coincidental with those of the horizontal and therefore no last-line jitter can occur at either top or bottom of the frame.

Driving Signals

A similar but less involved approach is made in generating the horizontal and vertical driving signals, indicated in Fig. 4. All keying signals originate from the 31.5-kc basic oscillator that is frequency-controlled by the usual phase discriminator and reactance modulator circuits. The sine-wave output from this oscillator is clipped and differentiated to produce sharp pips that are amplified to approximately 75 volts positive polarity for the delay

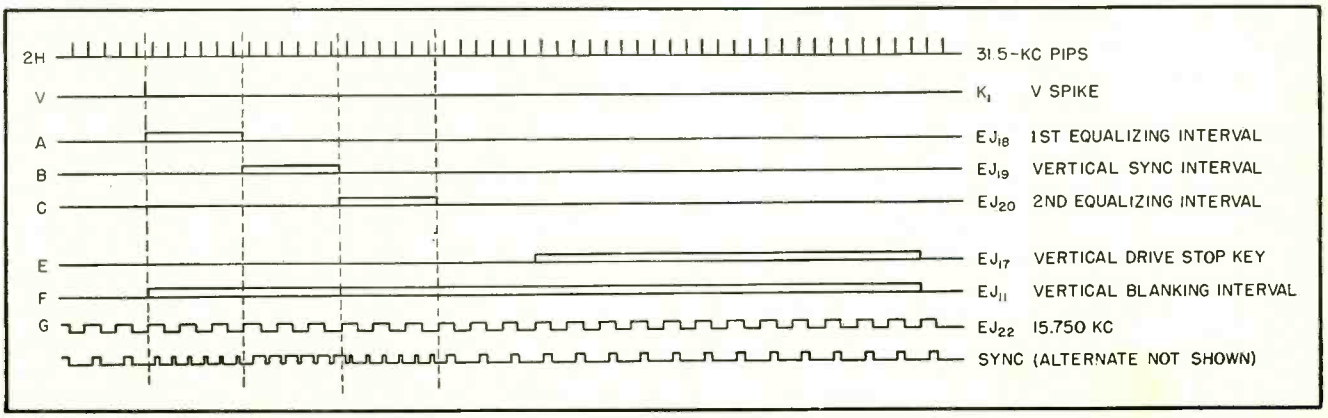


FIG. 3—Relations existing among the various waveforms at different points in the circuit (not drawn to scale)

line input. Binary counter EJ_{22} driven by these $2H$ pips yields the H keying square wave G. The process for generation of keying waves at the vertical frequency begins with division of the 31.5-kc pips by the required 525 divisor, using a cascaded binary type of counter. The normal power of two count is reduced by count-advance feedback.

Group Counts

The counter chain is broken down to groups having counts of 7, 5 and 15 which facilitates checking circuit operation. The 60-cycle output operates a keying system to select every 525th pip from the 31.5-kc train of pips. This circuit assures a stable phase relationship between the 60-cycle spike and delay pips.

The 60-cycle spike initiates EJ_{11} to provide wave F and to key on keyer K_2. This 60-cycle spike also initiates ring counter EJ_{18}, EJ_{19} and EJ_{20} in which the transfer signal is the output from the count-of-six counter. The consecutive rectangular waves A, B and C available at each stage of the ring counter are exactly six pips wide and the group occurs at 60 cycles. These represent the three important vertical intervals—first equalizing, vertical sync and second equalizing.

Eccles-Jordan circuits EJ_{15}, EJ_{16} and EJ_{17} serve to end the blanking period by restoring EJ_{11} to its normal condition. The width of the blanking period is determined by the total count of counters EJ_{12} through EJ_{17}.

In the development of this sync generator it became apparent that there was no place for delicately poised circuits. The loading of a binary counter by directly coupling to a following stage impaired the counter's immunity to variations; buffer tubes were consequently considered an advisable tube expenditure. Grounded-cathode designs were used in the various counters to simplify construction. The grids of such counters provide square waves whose bases are at ground potential, thereby allowing direct coupling to keyer tube grids. Conventional methods for injecting the transfer signal into the ring counter did not yield the desired reliability. The circuit evolved, using a type 6L7 as an injector, leaves

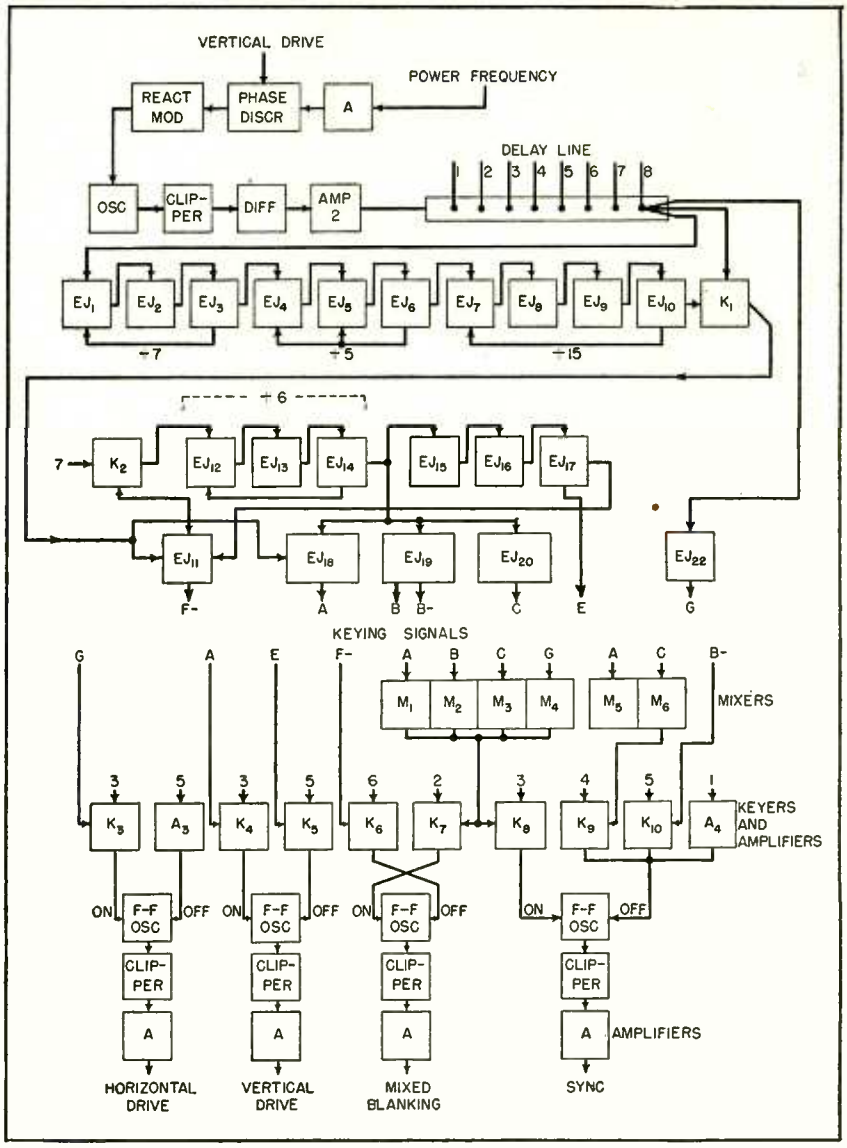


FIG. 4—Interconnections for complete sync generator

nothing to be desired in this respect. One of the injector control grids is connected to the counter stage, rendering the injector insensitive to the transfer pulse. Sensitivity to the transfer pulse is developed slowly only by the stage ready for it.

Design of delay lines is described in the literature. The principal requirement in this instance is a high-cutoff frequency (greater than 2 mc) with losses low enough to yield a 15-v pip at the end of the line, assuming that the input of the line is driven with a type 6L6 or similar tube.

The requirements for the flip-flop oscillators are rather stringent. They must be capable of being excited to a new condition and all potentials throughout the oscillator circuit must reach equilibrium in less than 2 microseconds. If the oscillator is not designed in wide-band fashion, it will not respond to the second of two closely spaced ON and OFF pips as required for generation of the equalizing pulse.

Power supply requirements for the generator are not critical. A plate voltage of 150 volts reduces danger of component breakdown and eliminates cathode and screen resistors that would be necessary to limit plate current if a higher plate voltage were used. The total plate drain is approximately 500 ma. The generator was operated successfully for some time from an unregulated supply. A regulator was subsequently incorporated, primarily for protection from heavy power-line transients.

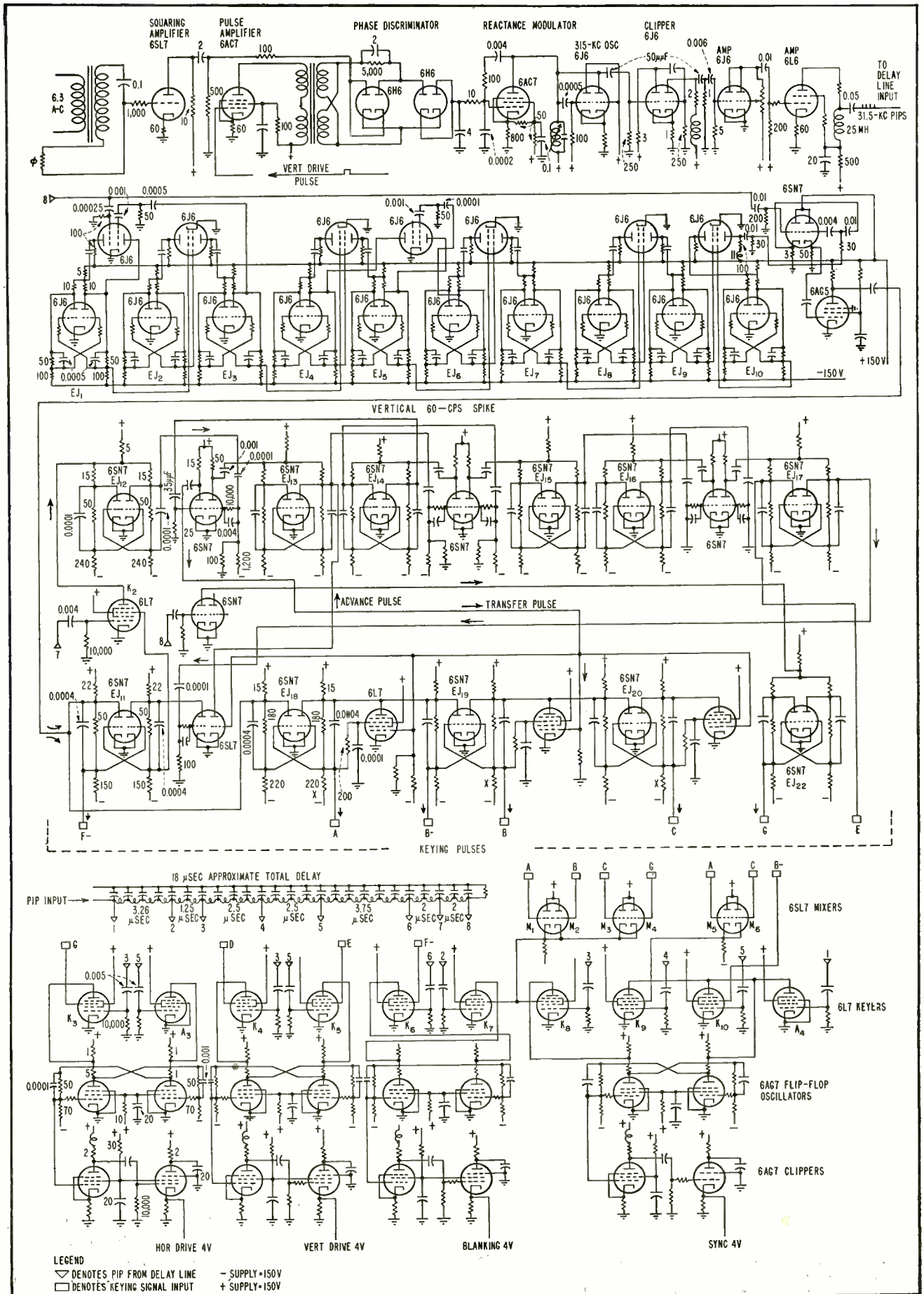


FIG. 5—Schematic representation of the complete sync generator

PHASE-SHIFT

By DeWITT H. PICKENS and J. N. VAN SCOYOC

Armour Research Foundation
Chicago, Illinois

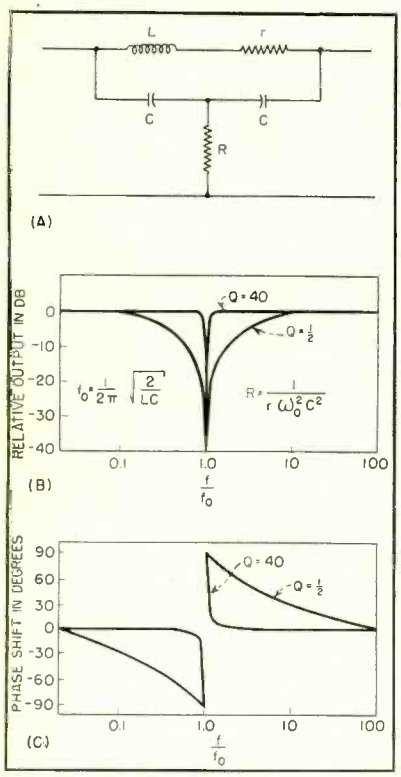


FIG. 1—Phase shift introduced by a bridged-T network changes in sign as frequency passes through null frequency

ANYONE who has conducted laboratory investigations within a given frequency range has at some time or another felt the need for an easily constructed band-pass filter. The presence of undesired signals such as a-c hum and random noise near the frequency region of intelligence-bearing signals has led to an extensive investigation of networks which will eliminate these undesirable frequency components. The object of this paper is to describe the operation of a band-pass filter which employs components normally found in all laboratories, and which does not involve any complicated calculations in its design and construction. This type of filter may in many cases be used in place of the more conventional type filters with their complicated and specialized components.

The basic circuit of the phase-shift filter is a combination of conventional bridged-T networks. The circuit diagram for a bridged-T network is shown in Fig. 1A. Figure 1B shows the attenuation characteristics of bridged-T networks and clearly illustrates the effect of Q on the frequency response of the network. An analysis of the network will yield the expression for the null frequency f_o and the condition for an absolute null in terms of the network parameters.

$$f_o = \frac{1}{2\pi}\sqrt{\frac{2}{LC}}$$

$$R = \frac{1}{r\omega_o^2 C^2}$$

The latter equation expresses the conditions for null.

Figure 1C is a generalized phase-shift characteristic for the bridge-T network. It will be noticed that the sign of the phase shift changes as the frequency passes through the null frequency of the network. It is this characteristic that makes it possible to combine the output of two bridged-T networks to form the attenuation characteristic of a bandpass network. If the outputs of two similar bridged-T networks, whose null frequencies are separated by a given increment, are combined in such a manner that the output of one network is subtracted from the other, the phase

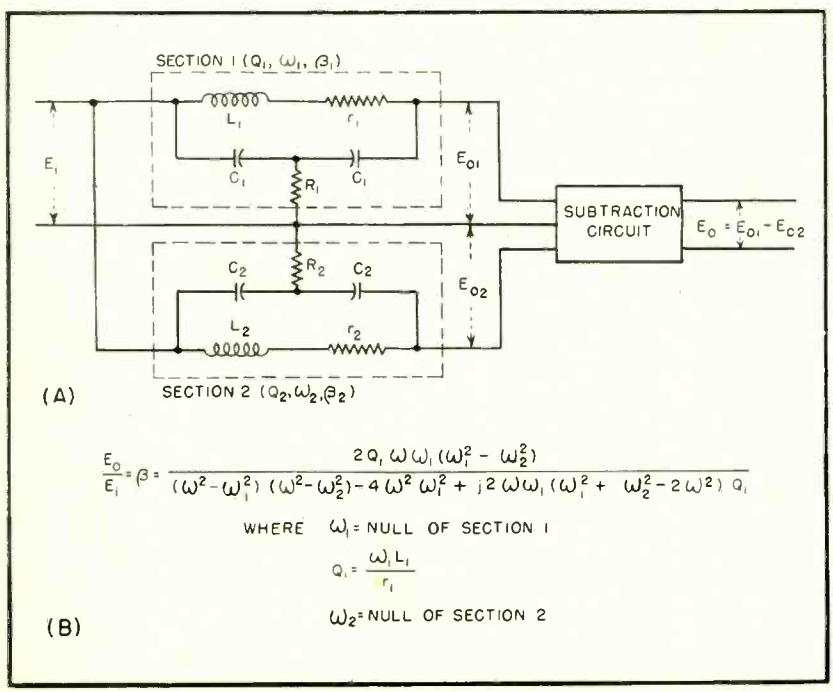


FIG. 2—If the output of a bridged-T network is subtracted from that of a similar network whose null frequency is close to that of the first, the phase relationship between the two outputs is such that they will add near the null frequencies and subtract outside the band between the null frequencies

BAND-PASS FILTERS

Double bridged-T network using readily available components provides good band-pass characteristic at minimum expense. Usable bandwidth depends on allowable dip between null points of the individual bridged-T networks

relationship between the two outputs is such that they will add in the vicinity of the null frequencies and subtract outside the band between the null frequencies. The overall combination has the characteristics of a band-pass filter.

Basic Circuit

Figure 2A is a block diagram of the basic phase-shift filter circuit using the output of two bridged-T networks as an input to a subtraction circuit. Each of the two T sections has its own Q, null frequency and transfer function β. The derivation of the transfer function for the composite circuit is a lengthy and complex process and no time will be devoted to its derivation. The resulting transfer function is shown in Fig. 2B. This expression shows that the transmission characteristic of the phase-shift filter is a function of Q and the null frequencies of the two T sections.

Differential combination of the output of the two T sections which make up the active branch of the phase-shift filter may be accomplished in many different circuits. Several of these circuits will be discussed in detail in a later section of this paper. Basically, these circuits may be grouped in two general classes: (1) direct subtraction circuits, and (2) phase inversion and addition circuits.

Figure 3 is a block diagram of a phase-shift filter in which the desired output is obtained by direct subtraction of the outputs of the two T sections. Figure 4 shows the

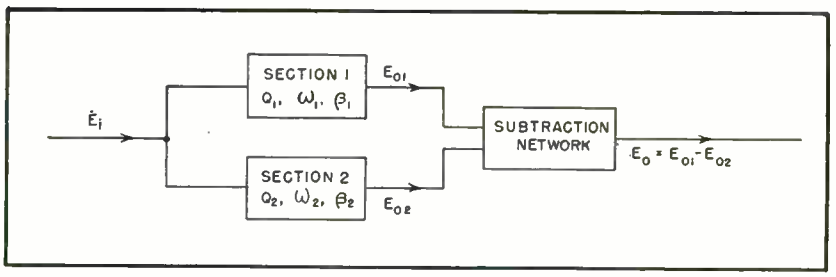


FIG. 3—Direct subtraction method for combining outputs of bridged-T networks

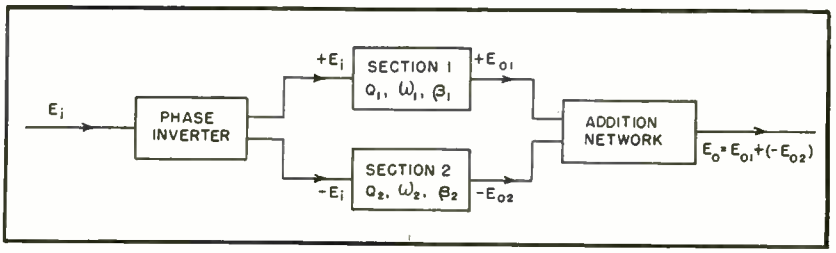


FIG. 4—Phase-inversion—addition type of phase-shift filter

block diagram of the method in which the phase of the input to one T section is inverted and the outputs of the two T sections are put into a summation circuit. The difference between the two transmission characteristics of the T section is then obtained by direct addition of the two signals, one of which has had its phase inverted.

Experimental tests were conducted on a phase-shift filter utilizing two air-core speaker field coils as the inductances in the two T sections. Figure 5 is the circuit diagram of the tested circuit, showing the combining circuit used. The gain characteristic of the cathode-coupled circuit used as a subtraction circuit in these tests was such that the input to one tube had to be attenuated by potentiometer R so that the output represented the true difference between the input signals. This characteristic of the cathode-coupled subtraction circuit will be discussed in greater detail in a later section of this paper.

Figure 6 is a family of attenuation curves obtained by increasing the frequency increment between the null frequencies of the two bridged-T sections. This was accomplished by decreasing the capacitance in one section and resetting the value of the resistance to give an absolute null. The null frequency of one T section was held

constant at 1,800 cps. It will be noticed that as the bandwidth is increased, by increasing the separation between the null frequencies, the output decreases in the passband. This characteristic of the phase-shift filter is similar to that of the conventional tuned coupled circuit. Further investigation revealed that as the bandwidth is increased for a given center frequency this dip in the passband will increase to a point where the circuit is no longer usable as a filter with a single passband.

Passband Dip

Before any attempt is made to design a phase-shift filter, the degree of dip in the passband which can be tolerated must be established. This amount of dip is dependent upon the particular application of the filter. Primarily, though, it must be remembered that limitation of the amount of allowable dip also places a limitation on the maximum bandwidth that may be used. Some median must be established between the width of the passband and the output dip in this passband. Again, this choice will depend on specific applications.

Figure 7 is a family of experimentally obtained universal curves which may be used to determine the allowable bandwidth for a given output dip within the passband. As a matter of choice the curves were obtained for arbitrarily chosen output dips of 3 db, 1.5 db and 0 db. Knowing the midfrequency and the Q of the coils at this frequency, these curves may be used to establish the maximum bandwidth that may be used. The design process to be followed is as follows: The values of the abscissa at the passband limit points on a particular curve, when divided by the midfrequency Q, will yield the ratio of the bandwidth to midfrequency. Knowing the midfrequency, the allowable bandwidth may then be established. The reverse of this process may be used to determine the value of Q necessary to obtain a given passband with a given output dip.

In using these curves it must be kept in mind that they were obtained by laboratory experimentation and do not represent theoretical calculations. The accuracy of the experimental processes was held within the limits of normal laboratory measurements; however, there are present some inherent sources of error. Particular among these is the error imposed by the subtraction circuit. As previously stated, the subtraction circuit used in this experimentation was a cathode-coupled differential amplifier. The initial balance was obtained by attenuation of one input signal.

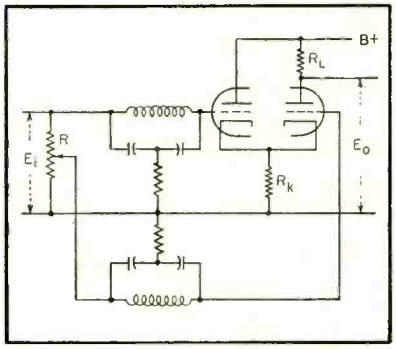


FIG. 5—Phase-shift filter and cathode-coupled subtraction circuit

The degree of error in the output of this circuit is dependent upon the level of the output signal. At the extreme ends of the curves, where the frequency is quite a distance from the midfrequency, the output level became very small so that the error in initial balance of the cathode-coupled circuit became more prominent. At these removed points on the curves, the curve represents more the unbalance and distortion in the amplifier circuit than the actual attenuation characteristic of the phase-shift filter. This residual error would be minimized by cascading identical stages.

To prevent this type of error from becoming of such magnitude as to diminish the utility of the filter circuit, a subtraction circuit whose initial balance can be effected to a very fine point must be used. Several types of familiar differential amplifier circuits and phase-inversion circuits may be used, the choice of which depends upon the relative merits of each. Some of the more familiar circuits of these types are: (1) cathode-coupled amplifier, (2) cross-coupled amplifier, (3) phase-inverter circuit, and (4) push-pull input circuit.

Differential Amplifiers

Figure 8A is a circuit diagram of a cathode-coupled differential amplifier. This circuit is perhaps the simplest of the differential amplifier circuits. The initial balance of this type of circuit is obtained by potentiometer R. The presence of load resistance R_L in the plate circuit of only one tube establishes a different operating point for the two tubes. As a con-

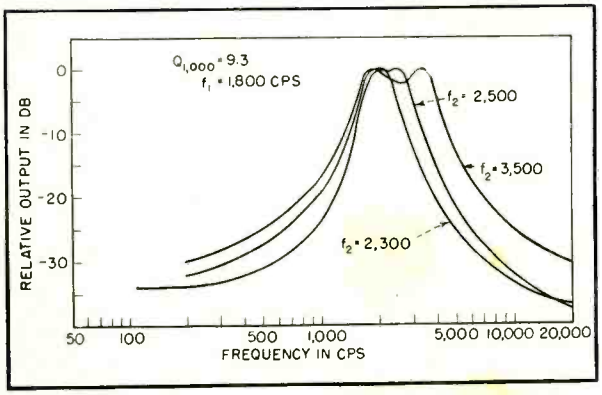


FIG. 6—Attenuation characteristics for phase-shift filter using air-core coils

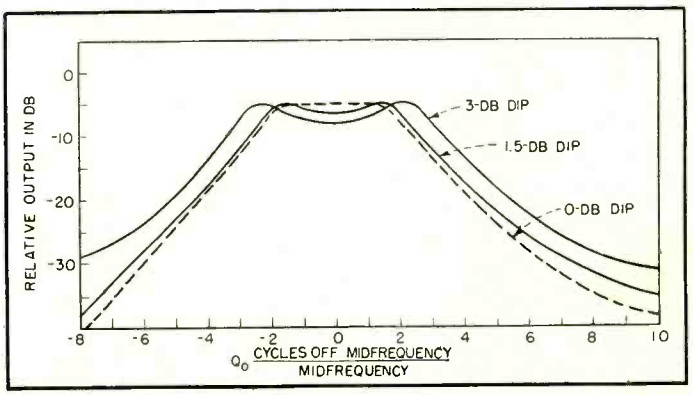


FIG. 7—Universal curves for phase-shift filters derived from experimental data

sequence, the gain from the grid of V_2 is always greater than that of V_1. To offset this difference of gain, the input signal to the grid of V_2 must be attenuated by means of potentiometer R until zero output is obtained with a common input.

Figure 8B is a circuit diagram of a cross-coupled differential amplifier. This circuit affords the highly desirable features of low sensitivity to hum and large dynamic range of input signals, with an output that is proportional to the difference between the two input signals. The tubes V_1 and V_4 are connected as cathode followers, with the cross coupling between V_2 and V_3 providing phase inversion. The input voltage of V_2 is the difference between the output voltages of V_1 and V_4. The input voltage of V_3 is equal to this same voltage but opposite in phase. The output voltages of V_2 and V_3 will then be proportional to the difference between the impressed voltages on V_1 and V_4 but opposite in phase. The overall output will then represent the difference between the two input signals if any degree of symmetry in tube or circuit parameters has been maintained.

To offset any dissymmetry in the circuit, potentiometer R has been inserted. The initial balance of the circuit may be effected by varying R to a point where zero output is obtained with the same signal applied to V_1 and V_4. Since the circuit conditions previously described exist whether the input signal is impressed on both V_1 and V_4, this circuit may be used as a push-pull input stage or a balanced phase inverter.

Figure 9 is a circuit diagram of a phase-inverter subtraction circuit. Its operation is based upon the fact that the plate and cathode voltages of a tube are 180 degrees out of phase with each other. If the plate and cathode resistance of V_1 and V_2 are of equal magnitude then identical inputs to both V_1 and V_2 will produce voltages across the plate of V_1 and the cathode of V_2 which are equal and opposite. When an initial balance is obtained by means of R_0, the output voltage E_0 will be proportional to the difference between the two input voltages E_{i1} and E_{i2}.

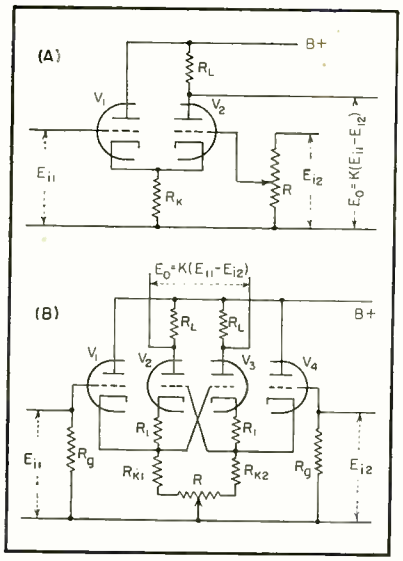


FIG. 8—Cathode-coupled (A) and cross-coupled (B) differential amplifier circuits

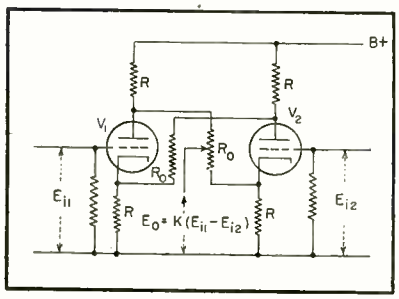


FIG. 9—Phase-inverter subtraction circuit

A system utilizing a balanced center-tapped transformer represents the simplest means of obtaining two equal and opposite voltages.

Choice of Circuits

The choice of which circuit to use as a combining circuit in the phase-shift filter is dependent upon the relative merits of each. Perhaps the simplest method is one utilizing the balanced push-pull output from a transformer. The use of this circuit depends solely upon its availability since the design and construction of such a transformer contributes much complication.

The ease of design and construction of the phase-inverter circuit seems to indicate a high degree of utility; however, it must be pointed out that any difference between the resistances used in the plate and cathode circuit will result in an error in the output signal.

The cathode-coupled amplifier is the median between circuit complexity and performance as a differential amplifier. This circuit, involving two tubes, performs very well as a part of the phase-shift filter. The experimental processes conducted in this investigation indicated that the initial balance of the circuit could be made to the degree of approximately —50 db.

The versatility of the cross-coupled amplifier and its adaptability for use as either a phase inverter or a differential amplifier makes its use very desirable. The condition of initial balance may be effected quite easily. Its low susceptibility to hum and large dynamic input characteristic are also indicative of its utility. The objectionable feature of this circuit is the physical size of the circuit wherein four tubes are required. Again the choice between performance and circuit complexity is an arbitrary one and rests with the particular function to which the filter is applied.

Summary

The similarity of the phase-shift filter's attenuation characteristic to that of the tuned coupled circuit seems to indicate its most important possibility. The performance of specific tuned coupled circuits can be approached to a satisfactory degree by use of a phase-shift filter. In doing so, the complex problems of coil design and coupling factors are eliminated. The simplicity of the phase-shift filter with respect to the tuned coupled circuit, in view of their similar attenuation characteristics, is an argument somewhat in favor of its use. The authors feel that the advantages of this circuit are more pronounced in the audio-frequency range.

The phase-shift filter, with its lack of complex design and construction procedure, lends itself to many applications. At first glance it may appear that an even better performance could be obtained by use of m and k type filters; however, the use of such filters involves an extensive design procedure and many components of specific values. Calculations have shown that if the same number of components were used in cascaded sections of the phase-shift filter its performance would approach that of m and k type filters.

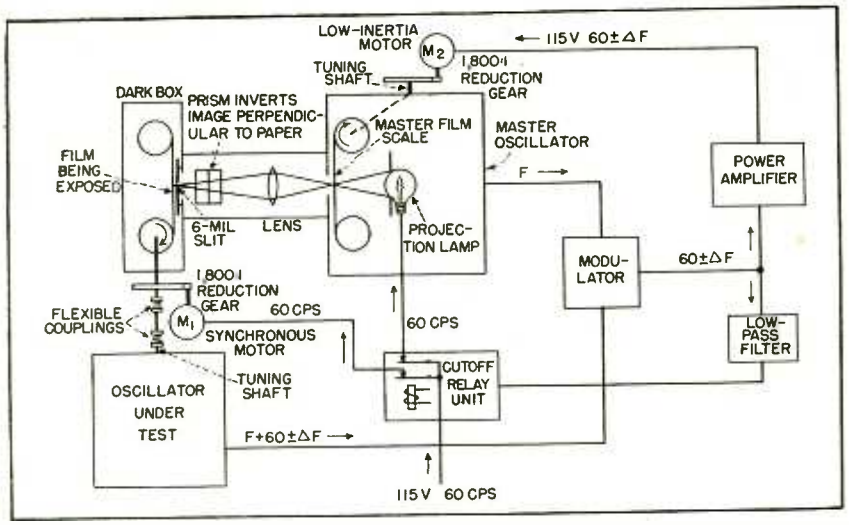


FIG. 1—Speed of master film is determined by difference in frequencies of master oscillator and oscillator under test. Calibration process which originally took 22 hours can now be done in 2 hours

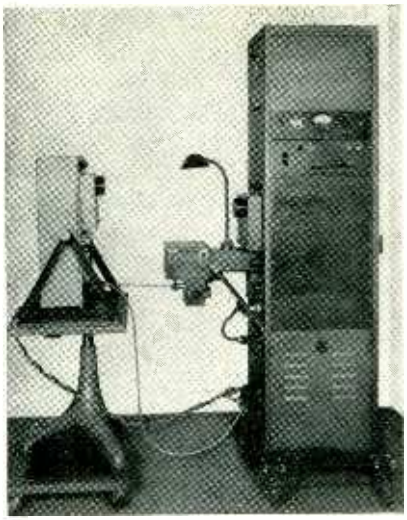


FIG. 2—Tuning knob of oscillator under test (left) is coupled to reduction gear mounted beneath dark box (center)

Calibrating STRIP-TYPE

Two r-f generators, a standard and one to be calibrated, are driven through their ranges in frequency synchronism. Calibration markings on 40-foot master film-strip scale are projected onto unexposed film which becomes frequency scale for new oscillator

By F. W. SCHRAMM
Western Electric Company, Inc.
Kearny, New Jersey

CERTAIN TYPES of oscillators used by the Bell System for testing and maintaining coaxial-cable terminal and repeater equipment require a continuous scale marked at 2-kc intervals over a range of 50 to 3,500 kc. To provide close frequency settings over this 70-to-1 frequency range without switching scales, a continuous length (approximately 40 feet) of 35-mm film is used as a frequency-setting dial.

Calibration of such scales presents a problem. Manual calibration takes about 16 hours, and printing the scale lines and numbers another 6 hours. The photographic calibrating system described here prints the 2-kc markers within ±400 cps in a total time of 2 hours. Its operation is fully automatic and virtually foolproof.

Basic System

The block diagram of Fig. 1 shows the fundamental circuit and the optical arrangement employed. The tuning shaft and the unexposed film scale of the oscillator being calibrated are rotated mechanically by a line-operated synchronous motor through an 1,800-to-1 reduction gear. This motor M_1 causes the oscillator frequency range and film scale to be traversed simultaneously at a constant rate from one end to the other.

The tuning shaft and the accurately printed film scale of the master oscillator are rotated through an identical reduction gear by another 60-cps motor M_2. This motor gets its power from an amplifier whose input is furnished by a modulator circuit. The modulator output signal is the difference between the frequencies of the two oscillators; and when the two oscillators are exactly 60 cps apart in frequency, motor M_2 runs at the same speed as M_1, and the film printed for the oscillator under test will be identical to that of the master oscillator.

If, however, turning the shaft of the oscillator being calibrated causes its frequency to change at some rate different from that of the master oscillator (as is the case—otherwise calibration would be unnecessary), the modulator output signal will differ in frequency from 60 cps by the amount which the two oscillators stray from their normal 60-cps separation. This change will cause a change in the speed of M_2, and thus in the scanning rate of the master oscillator, in such a way that the deviation is immediately

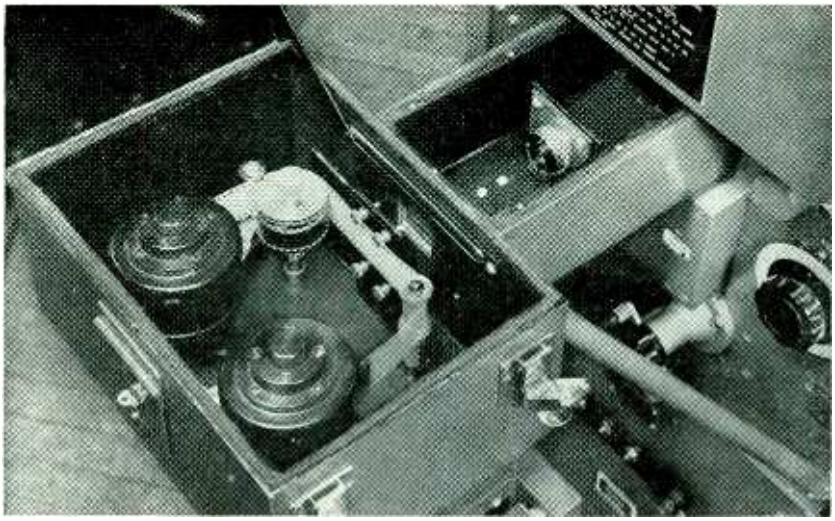


FIG. 3—Two-kilocycle marking lines from master oscillator (right) are projected through optical system to 35-mm film strip of oscillator under test which runs in a light-tight box shown here with cover removed

DIALS

remedied. Thus the two oscillators are synchronized, and the symbols printed on the blank film scale of the test oscillator will be accurately positioned, except for a fixed 60-cps displacement which can easily be compensated for, as will be explained later.

Light from a projection lamp in the standard oscillator shines through the film scale markings of the standard, through an optical system, and through a 0.06-in. slit onto the unexposed film of the oscillator, as shown in Fig. 1. The film is processed in a photographic laboratory and then becomes the frequency-setting scale for the new oscillator.

Calibration Setup

When an oscillator is ready for calibration it is positioned so that its main tuning knob may be attached to the flexible-shaft connection on the reduction gear box as shown in Fig. 2. Power is supplied to the two oscillators from rectifiers mounted in the rack below the master oscillator in the test set.

Since this is a photographic process, the use of a dark chamber is necessary. However, by placing the film to be exposed in a small dark box immediately in front of the master film, the need for a dark room large enough to hold both oscillators is avoided. As shown in Fig. 2, the dark box is fastened to the front of the master oscillator. The box, Fig. 3, contains the optical system and a film-drive mechanism which is a duplicate of that in the oscillator to be tested. This film drive is coupled to the oscillator under test through the flexible shaft so that the film is driven at the same rate as if it were in the oscillator itself. A notch is provided on the sprocket wheel of each drive unit and a mark is placed on the film opposite the notch to provide a means of orienting the scale properly when the film is later mounted in its oscillator.

The lens in the dark box, besides focusing on the film, also inverts the image. Since the film in the box travels in a direction opposite to that in the master oscillator the longitudinal inversion is satisfactory, but to reinvert it crosswise of the film the prism is used.

Starting Procedure

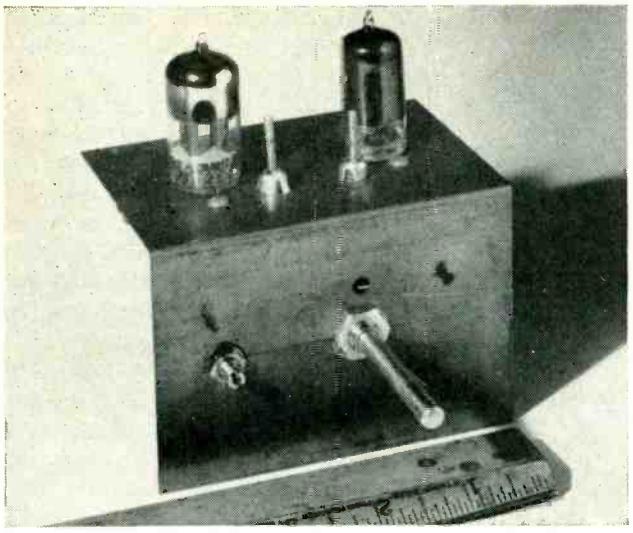
Before the start of calibration the master oscillator is set to approximately 20 kc below the first mark on its scale. The oscillator under test is set to a point still lower in frequency. The low-inertia motor M_2 is then connected to the output of the power amplifier and calibration is started by operating M_1 from the a-c line in a direction to increase the frequency of the oscillator under test. As this frequency rises and passes the frequency of the master oscillator, the output of the modulator passes through zero and rises toward 60 cycles. Motor M_2 picks up speed until the master-oscillator frequency settles down at 60 cycles lower than the test oscillator. This usually takes place well before the first scale mark of 50 kc is reached.

In case of any trouble which might prevent the master oscillator from overtaking the test oscillator the modulator output frequency would continue to rise. Since M_2 will not operate at high frequencies, a low-pass filter with a cutoff at 200 cycles is inserted in the modulator output circuit. If the frequency rises beyond this value, a relay operates to cut off power to both motors and the projection lamp behind the master film. The test oscillator is then run to a frequency lower than the master and started up as before.

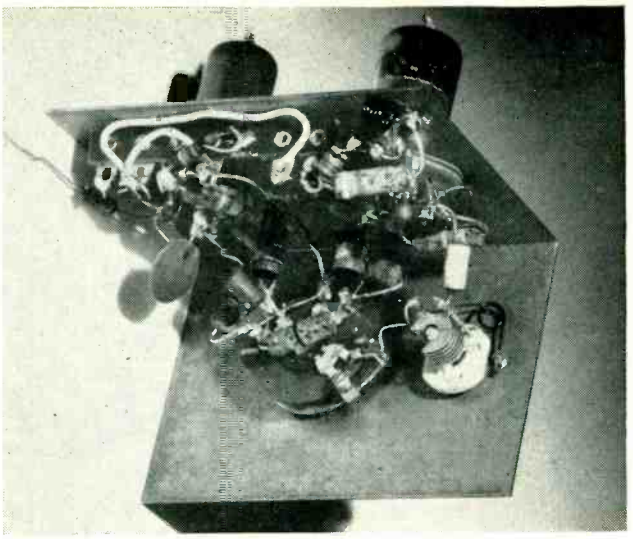
Checking Calibration

After development of the film two check frequencies are marked on the negative at 84 kc and 2,000 kc by comparison with standard frequencies. The 60-cycle scale displacement is compensated for by shifting the fixed oscillator frequency from the 84 kc and 2,000-kc check points during the initial line-up.

Early models of the test oscillator were hand-calibrated in a temperature-controlled room to avoid frequency drift. When done at ordinary room temperatures a realignment at the two check frequencies was necessary after every fiftieth mark to compensate for drift. In the automatic method the period of calibration is so short that frequency drift is negligible provided the test set and standard oscillator are not subject to severe drafts or wide changes in temperature in the room where the calibrating process takes place.



Complete all-channel tuner, whose circuit is shown in Fig. 4B. Tunable coils are in the high-band coupling circuit



Exposed chassis view of tuner at left. Components that look like resistors are IRC fixed-tuned coils

BROAD-BAND

By choosing an i-f above 30 mc, so the image spectrum falls outside the television bands, it is possible to design a low-noise television front end with a broad-band r-f stage, and accomplish station selection by tuning local oscillator only. Selectivity of i-f eliminates adjacent-channel interference

By ARNOLD NEWTON
Consulting Engineer
Brooklyn, New York

THE TELEVISION front end selectivity requirements depend largely on the nature and intensity of the sources of interference in the image spectrums. If an i-f in the 41 to 47 region is chosen, the image spectrum falls well outside the television bands, and it should be possible to devise a selective r-f circuit broad enough to pass all the channels within one band, yet having sufficient selectivity to reject effectively all image signals. With proper design, the i-f selectivity can be relied upon for adjacent-channel rejection.

By eliminating the need for selective r-f tuning, station selection can be accomplished by tuning the oscillator.

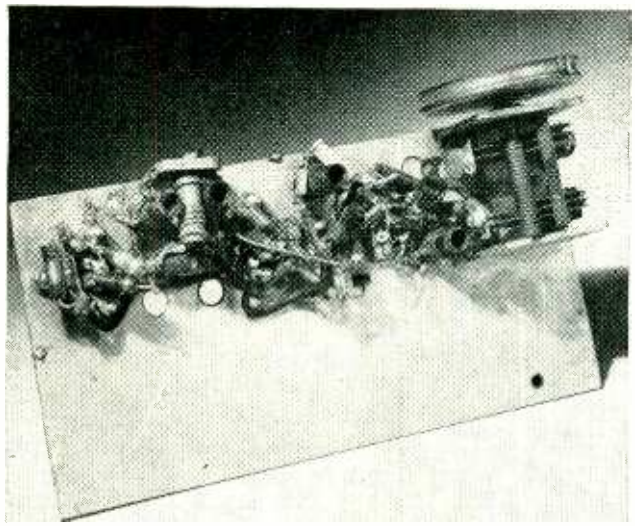
Since the bandwidth required of the r-f stage in such a system is six or seven times that assigned to one channel, a proportional reduction in gain would be expected. Fortunately, however, the improvement in the figure of merit as a result of eliminating the switch and other incidental capacitances makes it feasible to obtain gains which compare favorably with those of switch narrow-band circuits using similar tubes. Also, because only a fraction of the passband is being used at any one time, further increase in gain can be realized by reducing the damping from its critical value, without appreciably deteriorating the resolution.

The antenna and input r-f stage set the ultimate limit of a useful receiver sensitivity. A yardstick of the quality of the r-f stage is its noise figure which is defined as the ratio of the stage's actual noise power output to the noise power output due to antenna thermal agitation noise of an amplifier of identical bandwidth and gain, but introducing no noise of its own.

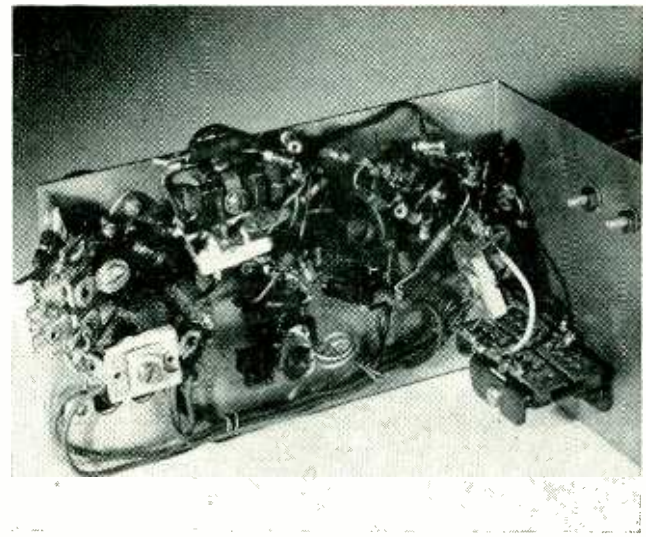
The overall noise figure of a multistage network can be determined by considering the noise contributed by individual stages and the gain of any preceding stages. It can be shown that if the stages have even moderate gains, the noise figures beyond the first stage or the first two stages may be neglected with negligible error.

Circuit Considerations

In order to evaluate different circuits for possible application to broad-band television front ends, the available gains and noise figures of the various configurations must be studied. In the following examples, R_{eq} is the resistance which would give rise to the same



Coils and trimmers between sockets are part of low-band bridged-T coupling network. Circuit for chassis shown is Fig. 4A



Broad-band tuner employing cascode r-f amplifiers, one for each band. Figure 4C shows circuit details

TELEVISION TUNERS

noise output power if introduced in series with the grid of an amplifier identical to the one under consideration, but noise free.

Grounded Cathode. Figure 1A shows the basic grounded-cathode circuit. Its noise figure can be determined by the formula

$$F = 1 + \frac{R_g}{R_i} + \frac{R_{eq}}{R_g}\left(1 + \frac{R_g}{R_i}\right)^2$$

It is seen to depend on the input resistance R_i whose value is set either by bandwidth or input conductance considerations, and R_{eq} of the tube. Under conditions of match, the noise figure is 2 + 4 R_{eq}/R_i.

Theoretically, these formulas apply for both triodes and pentodes. However, with triodes (which are more desirable by virtue of their low R_{eq}) the qualifying condition is stability. Neutralized single-ended triodes are critical in adjustment, especially over a wide band. Push-pull triodes are neutralized more easily, but contribute twice the noise of a single tube.

Grounded Grid. The grounded-grid amplifier, shown in Fig. 1B is degenerative with the feedback voltage developed across the generator impedance due to the flow of plate current. The noise figure is

$$F = 1 + \frac{R_g}{R_i} + \left(\frac{\mu}{\mu+1}\right)^2 \frac{R_{eq}}{R_g}\left(1 + \frac{R_g}{R_i}\right)^2$$

When μ is much greater than unity, as it is in practice, this expression becomes identical to the grounded-cathode expression.

Since the plate current flows through the generator, the tube presents a cathode impedance

$$\frac{e_{kg}}{i_P} = \frac{R_P + R_L}{\mu + 1}$$

Assuming $R_i \gg R_g$, $R_P \gg R_L$, and $\mu \gg 1$, $R_g = 1/g_m$ for match. For a

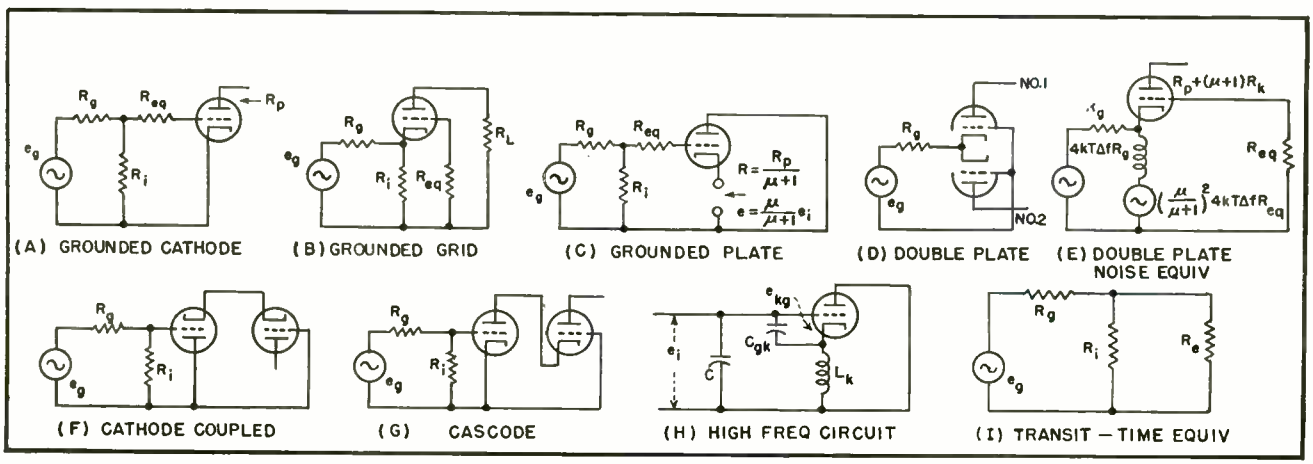


FIG. 1—Basic circuits considered in designing broad-band television front ends

triode $R_{eq} = 2.5/g_m$ and $F = 1 + R_{eq}/R_g = 3.5$. Then $F = 5.5$ db. The voltage gain of a grounded-grid stage is $\frac{1}{2}\ g_m R_L$ under the above assumptions.

Grounded Plate. The noise figure of a grounded plate amplifier or cathode-follower is the same as that of a grounded cathode amplifier.

Because of its lower gain and regenerative tendencies, depending on the nature of the cathode impedance, this circuit has found limited application. Certain variations are useful, however, in double-triode circuit arrangements which will be discussed later.

Double-Plate Grounded-Grid. Before proceeding with the discussion of the other possible combinations of the three basic circuits outlined above, the noise figure of the circuit shown in Fig. 1D will be considered. This circuit offers an easy way of separating the two television bands. The common cathode is the input terminal for all the channels and the plates pass the two bands respectively. Figure 1E shows the equivalent noise circuit of each triode section. The two triodes are assumed identical and the alternate load impedances are assumed small in comparison with the plate resistance at the respective operating frequencies.

Assuming $\mu \gg 1$, and matching the generator by the dynamic tube input conductance, the noise figure is 11.3 db. This circuit is inferior, from a noise figure standpoint, to other triode configurations, but has many practical advantages in its favor.

Cathode-Coupled Triode. The cathode-coupled amplifier combines the qualities of high input impedance and high gain and essentially the favorable noise figure of a single grounded-grid triode. Referring to the circuit of Fig. 1F, it is assumed that the two triodes are identical and the input resistance of the second tube is high in comparison with equivalent cathode impedance of the preceding stage. Using the nomenclature adopted in the previous analysis,

$$F = 1 + \frac{R_g}{R_i} + 2\,\frac{R_{eq}}{R_g}\left(1 + \frac{R_g}{R_i}\right)^2$$

Under conditions of impedance match $F = 2 + 8\ R_{eq}/R_g$.

There is a decided advantage in using this circuit if R_g can be made high.

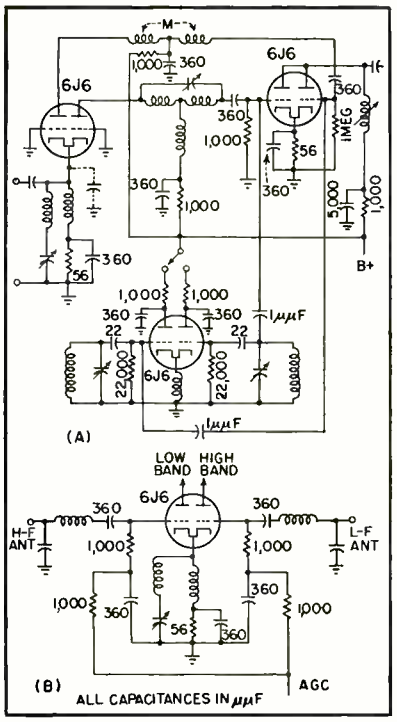


FIG. 2—Common-cathode circuit is antiresonant to frequencies in both television bands but series resonant to f-m band signals

Cascode. The cascode circuit represents another step in the direction of low-noise—high-gain r-f amplifiers. Its circuit diagram is shown in Fig. 1G. Again assuming identical triodes, no cathode resistance, and $\mu \gg 1$,

$$F = 1 + \frac{R_g}{R_i} + \frac{R_{eq}}{R_g}\left(1 + \frac{R_g}{R_i}\right)^2 \left(1 + \frac{1}{\mu^2}\right)$$

Under conditions of match and $\mu^2 \gg 1$, $F = 2 + 4\ R_{eq}/R_g$. The noise figure is better than that of the cathode-couple arrangement, and the gain is higher by 6 db since the voltage gain of the first stage is unity and not one-half as in the cathode-coupled circuit.

Considerations Above 100 MC

Above 100 mc the cathode inductance becomes an important factor in determining the input loading. The input conductance varies directly as frequency squared. Within the range of frequencies where $(g_m \omega L_k)^2 \ll 1$ (Fig. 1H) the input admittance is made up of the capacitance $C + C_{gk}$ shunted by a resistance $1/g_m\ (f_o/f)^2$, where f is the operating frequency and f_o the resonance frequency of the cathode inductance and the grid-to-cathode capacitance.

Another source of loading is the electronic input conductance due to the finite transit time in the cathode to grid space. The input resistance due to transit time is $R_\theta = 20/g_m(\omega\tau)^2$, where τ is the transit time, and R_θ is the damping effect on the circuit. The noise contribution of R_θ is greater than that of an equal external resistance by the ratio of the equivalent tube temperature to room temperature. It is necessary, therefore, to separate R_θ from other input resistors. The noise figure of the input circuit in Fig. 1I is

$$F = 1 + \frac{R_g}{R_i} + \frac{T_1}{T}\,\frac{R_g}{R_\theta}$$

The noise figure of a tube and its input circuit is

$$F = 1 + \frac{R_g}{R_i} + \frac{T_1}{T}\,\frac{R_g}{R_\theta} + \frac{R_{eq}}{R_g}\left(1 + \frac{R_g}{R_i} + \frac{R_g}{R_\theta}\right)^2$$

When the ratio of $T_1/T = 5$ is used, account is taken of the induced noise. This noise component being due to the induced noise voltage in the grid when the grid-to-cathode transit angle is not negligible. It is directly related to R_{eq} and measurements have shown that the choice of $T_1/T = 5$ gives reasonably accurate results.

Antenna Transformers

The design of the input transformer is predicated by the conditions of match and bandwidth. A single-tuned transformer can be used by tapping on either the inductance or capacitance. The split-capacitance form is simpler physically and easier to adjust, but it must be remembered that by its very nature it is also a low-pass filter and sufficient low-frequency selectivity must be secured elsewhere.

The signal plate current is directly related to the available antenna power and inversely related to the product of the bandwidth and input capacitance. If e and r are

the antenna signal voltage and antenna radiation resistance respectively, then

$$i_p = \sqrt{\frac{e^2}{4r}} \frac{g_m}{\sqrt{\pi \Delta F C_i}}$$

Interstage Coupling

Selectivity and figure of merit are the major considerations in the design of the coupling network from the r-f amplifier to the mixer. The response to the image frequency divided by the response to the signal frequency is given as approximately equal to $\Delta f/4f_s$ for a single-tuned circuit and $2(\Delta f/4f_s)^2$ for a double-tuned circuit. In the high band where the sources of image interference are not particularly powerful the mean rejection figure of 5 obtainable with a double-tuned circuit, will be found sufficient, especially when an equal amount of selectivity is secured in the input transformer. A higher degree of selectivity is desirable in the lower frequency band. The lower-skirt selectivity should be high by reasons of i-f rejection and the upper-skirt selectivity should be high enough to reject the image signals. A simple network offering a high degree of selectivity and rejection of selected frequencies outside the passband is the bridged-T.

The need for selectivity not being as great at the higher frequency band, the use of simple circuits is desirable to assure uniform results with the small tuning elements employed. Stagger-tuning offers similar selectivity characteristics with greater simplicity of construction and tuning at some loss of gain.

When the input and output capacitances are lumped, the tuning inductances at the upper frequency channels generally become so small as not to lend themselves to normal tuning methods. To increase the tuning inductance the series instead of parallel arrangement of the output and input capacitances may be used for tuning. The gain and bandwidth product in this case remains the same.

Inasmuch as the r-f amplifier in its wide-band application offers comparatively lower gain the noise properties of the mixer stage cannot be completely disregarded in evaluating the overall noise figure. By this token it is desirable to use a low noise-contributing tube such as a triode. However, due to its high grid-to-plate capacitance care must be exercised in its use both at the low and high bands. At the low band the i-f is close to the r-f passband and it may, therefore, be necessary to include an i-f series-resonant trap in the grid of the mixer depending on the selectivity. At the high band, resonance within the r-f passband of the inductances inherent in the coupling capacitor and elsewhere in the mixer plate circuit should be avoided.

Practical Circuits

The simplest, although from a noise-figure standpoint least satisfactory circuit, is shown in Fig. 2A. Two sections of a 6J6 are used as grounded-grid amplifiers, one for the low and one for the high band. The input matches either a 100-ohm unbalanced line or with the additions of a balun transformer can be made to match a 300-ohm balanced line. The network in the cathode has two frequencies of antiresonance, one in the mid-band of the low and one in the mid-band of the high channels and is series resonant in the f-m band. This aids in matching the line and offers rejection of f-m interference.

The plate circuit of the low-channel amplifier employs a bridged-T as the coupling network to the mixer tuned to reject the i-f. A double-tuned circuit is used to couple the high-band amplifier. The two amplifiers couple into the respective grids of the 6J6 mixer, the plates of which are connected in parallel. By this device there is no need to switch any r-f circuits. Two Colpitts oscillators for the respective bands are used, only one being operative at a time. The bands are switched by switching the B+ voltage to the appropriate triode section of the 6J6 oscillator.

The next circuit to be discussed was proposed but not actually tested. It is identical to the circuit just described except for the r-f stage. It uses a 6J6 in what is essentially a reflex cathode-coupled amplifier.

It is assumed that in either band the tuning elements of the other band bypass the appropriate tube elements. This circuit still retains the basic simplicity of the first, but offers a better noise figure by virtue of the higher impedance at the grid input. The r-f amplifier section is shown in Fig. 2B. There are two inputs available which may be combined by using a proper dividing network.

The circuit of Fig. 3 was considered to exhaust the possibilities of this scheme. It uses four 12AT7 double triodes, one in a cascode circuit for each of the channels and two as oscillator-mixer combinations. Band switching is accomplished by switching the transmission line to the alternate inputs as well as switching the B+ to the oscillators.

Double-tuned input transformers

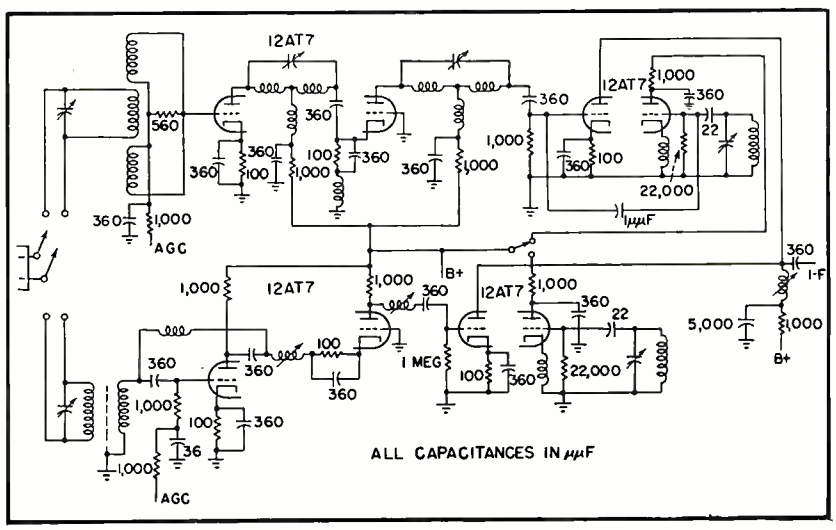


FIG. 3—Broad-band cascode circuits are used, one for each band. Band changing is accomplished by switching B+ and antenna transmission line

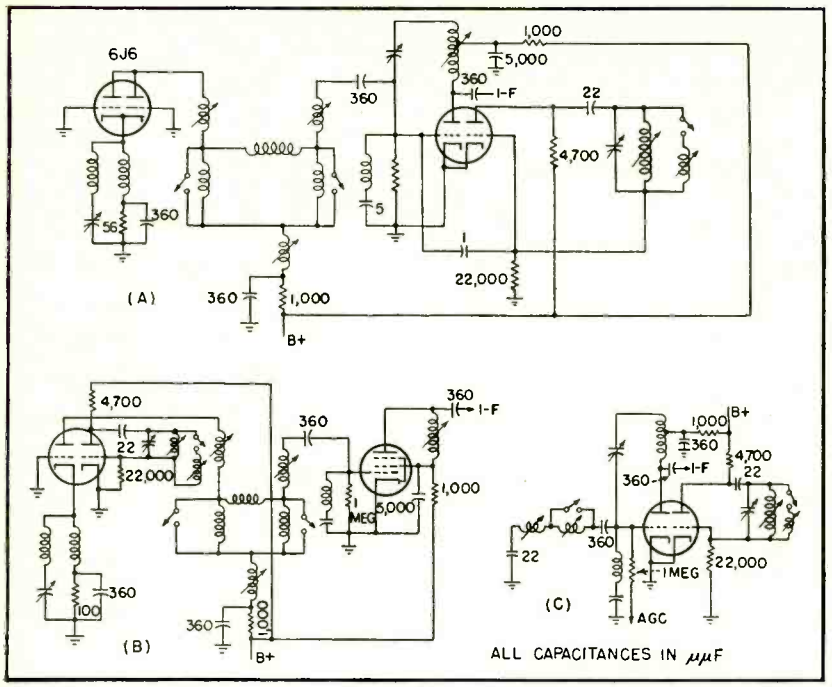


FIG. 4—Greater economy can be realized by these circuits without sacrificing performance. Figure 4C is a complete single-tube tuner with good noise figure. Oscillator radiation troubles can be eliminated by choice of i-f in 40 to 50-mc region

designed to match a 300-ohm line over a pass band of 40 mc are used. Two bridged-T networks are used in the low-band amplifier, the one designed to reject the i-f couples to the mixer and the other designed to reject the f-m couples the plate to the cathode of the cascode. The high band employs a staggered pair in its coupling networks and an inductance is added to tune out the grid-to-plate capacitance. In the low-band amplifier the improvement resulting from tuning out the grid-to-plate capacitance was not enough to warrant the addition of another tuning element. The inductances in the staggered pair, the primary antenna transformer capacitances and the bridged-T trap capacitors were made tunable; all other elements are fixed-tuned. This was found particularly justifiable in the low-band amplifiers where the Q is low (about 2).

By using one section of the tube as an oscillator and the other section in the same envelope as the associated mixer, more favorable and uniform injection of oscillator voltage was obtained. Little detuning was caused by the application of agc.

The common feature of all the circuits described thus far is that band switching is accomplished by applying B+ to the tubes chosen for the selected band, and in one case by switching also the antenna cable at a low r-f impedance level. By dispensing with switching of the r-f coupling circuits it was felt that a higher figure of merit would be realized as a result of eliminating switch capacitances. However, only half of the tubes are used at any particular time. More efficient operation may be secured by switching the r-f coupling circuit. With proper care the figure of merit at the high band need not be compromised and only a slight reduction would be suffered in the low band.

Greater Economy

To meet the need of greater economy, the circuit shown in Fig. 4A was devised. In it, the first 6J6 functions as a grounded-grid r-f amplifier. The cathode network is the same as in Fig. 2, being antiresonant within the two television bands and resonant with the the f-m band. The high-band r-f coupling network is not switched and hence the switch capacitance does not affect it. The low-band circuit appears in series with that of the high band and is switched. The switch introduces an additional 1.5 to 2 $\mu\mu$f of capacitance into the low band-pass filter. Double-tuned inductively-coupled circuits are used for interstage coupling. To suppress the response to image and i-f signals, series-resonant traps are included. The series-resonant filter in the grid of the mixer is tuned to the i-f. In addition to providing the necessary i-f rejection, the mixer grid impedance is also reduced, making it less subject to regeneration. However, in spite of the low grid impedance to the i-f, it was found necessary to neutralize the mixer.

In order to avoid the need for neutralization which calls for an additional tuning adjustment, a pentode mixer may be employed in a circuit shown in Fig. 4B. Here the r-f amplifier and oscillator are combined calling for a double triode with individual cathodes. Oscillator radiation under these conditions is higher and the gain and noise figure is less favorable. Figure 4C shows a tuner comprising a single dual triode, one section being used as an oscillator and the other as a mixer. In spite of the lack of r-f gain preceding the mixer, a good noise figure can be obtained by virtue of the fact that the grid impedance of the triode mixer is high. The main weakness of this circuit is the prohibitive amount of oscillator radiation which is likely to result. This difficulty can be eliminated to some extent by the choice of an i-f in the 40 to 50-mc region which will place the oscillator frequencies outside the tv bands. The choice of a higher i-f, however, will make neutralization more critical and lower the i-f rejection ratio.

The writer wishes to express his grateful acknowledgement to Leo Dwork, Paul Neuwirth and Robert S. Mautner for their valuable contributions to and assistance in preparation of this paper.

Bibliography

Harold Goldberg, Some Notes on Noise Figures, *Proc. IRE*, Oct. 1948.
Henry Wallman, A Low-Noise Amplifier, *Proc. IRE*, June 1948.
W. A. Harris, Some Notes on Noise Theory, *RCA Review*, Sept. 1948.
E. W. Herold and L. Malter, Some Aspects of Radio Reception at UHF, *Proc. IRE*, Sept. 1943.
G. C. Sziklai and A. C. Schroeder, Band-Pass Bridged-T Networks for Television I-F Amplifiers, *Proc. IRE*, Oct. 1945.
J. K. Clapp, An L-C Oscillator of Unusual Frequency Stability, *Proc. IRE*, March 1948.

GAMMA-RAY RADIATION MONITOR

Essentially self-switching over a voltage range of 100,000 to 1, this radiation measuring instrument is based on a scintillation counter. The wide range is accommodated by feeding amplified output of a comparison circuit to a servo motor turning a nonlinear potentiometer shaft geared to an indicator pointer

By LEONARD REIFFEL
Physics Research
Armour Research Foundation
Chicago, Illinois

THE GAMMA RAYS (high-energy x-rays) which are often associated with the experiments and apparatus of nuclear physics represent a danger to personnel. In addition, the constantly increasing use of gamma-active isotopes and other high-intensity sources of penetrating radiation in industrial applications has made it imperative that instruments be developed capable of detecting the danger and measuring its degree.

Various gamma-ray detectors have long been employed by physicists in actual experiments, but only recently have such detectors been applied to the problems of health physics. These detectors, in the usual experiments of nuclear physics, are pushed to the limit of their sensitivity. However, as health monitors they are called upon to operate in intense gamma-ray fields since a human being can tolerate considerable bombardment.

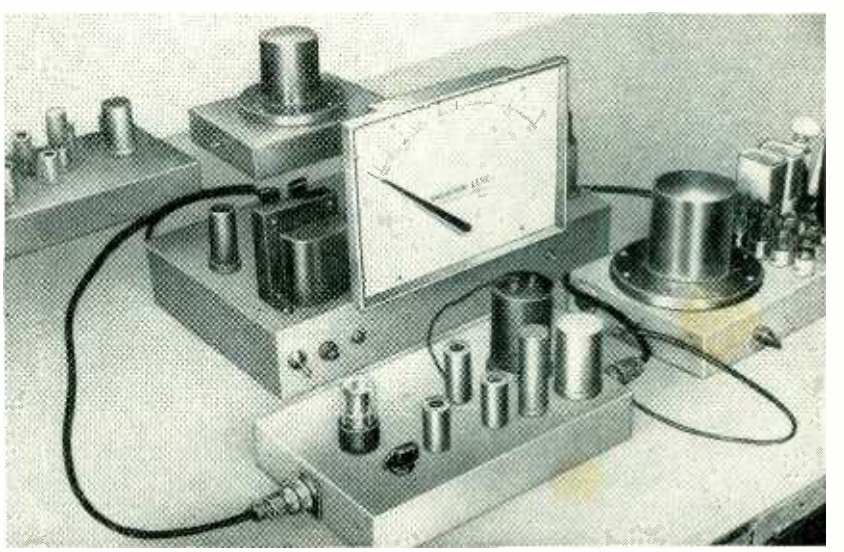
The commonly accepted tolerance dose for a full working day is 0.1 roentgen but this may soon be revised downward. A roentgen is that quantity of gamma radiation which will release (by ionization) 1 esu of charge in one cubic centimeter of air under standard conditions. Since the roentgen is a total quantity of radiation, the tolerance dose may be absorbed in a short time at high intensity or over a full day at reduced intensity. For this reason it is necessary that any dosage rate metering device cover a very wide range of intensities.

Ideally, the instrument should be capable of accurately measuring rates of from 1 milliroentgen per hour to approximately 100 roentgens per hour without manual range switching or attention of any sort. This represents a dosage scale extending over five decades, and corresponds to tolerance working periods of no limit to 4 seconds per day. For a full ten-hour day the maximum average rate would be 10 milliroentgens per hour. It should be stated here that the precision of measurement required for dosages is of the order of 15 percent because of the wide variation in specific radiation effect with irradiated personnel, and the roughness of the data used to set the tolerance level.

There are at least three gamma-ray detectors which are theoretically operable over the required intensity range. These are the Geiger-Muller counter, the ionization chamber and the recently rediscovered scintillation counter.

The Geiger-Muller counter, probably the most convenient and widely used gamma-ray detector at present, is limited to relatively low intensity measurements (low counting rates) because of a 100 to 200-microsecond dead time exhibited by the device after each count. It would thus be difficult to use in radiation fields of the order of roentgens per hour.

Recently some work has been done with G-M counters in which they are used at very high counting rates with the aid of high sensitiv-



Complete radiation instrument consists of servo preamplifier, foreground; probe pick-up and power supply, right; indicator unit, center; dark-current cancellation chassis, and a spare probe unit, background

ity pulse-recording circuits.

The ionization chamber suffers no such high-intensity limitation if a sufficiently large collecting voltage is used. However, the chamber is a high-impedance device which makes the highly desirable feature of automatic range switching difficult to obtain.

Basic Principle

The instrument to be described uses a scintillation counter detector, the choice of which was dictated by the fact that it is a reasonably low-impedance device and is not troubled by saturation effects at high radiation levels.

This is evident from the mechanism whereby the gamma ray is detected in a scintillation counter. The incident gamma collides with an electron in a crystal and gives up a portion of its energy by the Compton process. The recoil electron, in turn, imparts its energy to the crystal which dissipates the energy by fluorescence, thus producing a flash of light or scintillation which is viewed by a photomultiplier tube. Many such happenings may occur simultaneously, permitting very high counting rates.

For monoenergic gamma rays the light output of the crystal is directly proportional to the intensity of the radiation or dosage rate. The d-c photomultiplier current is, therefore, a measure of the radiation dosage rate. Proper operation of a scintillation detector over a range of 100,000 in intensity is readily obtained by judicious choice of the photomultiplier's operating point.

The detector consists of an anthracene crystal $1 \times 1 \times 0.5$ cm and a type 931A photomultiplier tube. The output of the tube is integrated to provide a d-c level proportional to the pulse rate, and is compared to a balancing voltage. Any difference between the comparison voltage and tube output is amplified and used to position a servo motor on a highly nonlinear potentiometer geared to an indicator pointer. The range of photomultiplier output voltage which may be balanced is 100,000 to 1 because of the special potentiometer used.

The criterion for selection of the photomultipliers is low absolute dark current, which, however, is not a difficult requirement to meet since the dark current of all the tubes checked was in the vicinity of 1.0×10^{-9} ampere. The photomultipliers used in the instrument are operated in the vicinity of 900 volts, which must be well stabilized. Since multiple probes are sometimes used with the same indicator, the sensitivities of the tubes are matched by adjusting the voltages on the first two stages.

The crystal is mounted on the phototube and the entire assembly placed in a cylindrical brass housing, which in turn is mounted on a probe chassis and gasketed for light tightness. A serious problem is the electrical leakage across the socket of the tube. The entire base assembly is, therefore, thoroughly cleaned and coated with paraffin. This procedure reduces the no-signal output of the tube by at least a factor of 10.

Circuit Details

The load resistor of the photomultiplier drives an R-C low-pass filter which serves to eliminate the rapidly varying components of the phototube output so the servo system will not act erratically. This R-C integrator circuit serves the second important function of slowing down any step-function increase in radiation level (and multiplier output) which could block the servo amplifier.

The d-c output signal of the integrator circuit is fed to a Brown Instrument Co. converter along with a d-c comparison voltage supplied from the servo-driven slidewire. Since the impedance level at the converter is of the order of one megohm and the applied signal is of the order of 0.1 millivolt at the low end of the range, considerable hum is introduced by the vibrator driving coil. This hum pickup is greatly reduced by opening the converter and rearranging the driving coil leads so that they come out the top of the housing.

The converter, essentially a driven single-pole double-throw switch, is designed so that the contactor arm closes each of the two circuits some 45 degrees of a complete cycle, and shorts both circuits together for about 10 percent of a cycle. This action permits the integrating capacitor C to receive charge via the low-impedance comparison voltage circuit. The capacitor holds this charge easily until the contactor closes the tube circuit, and thus the net voltage change as seen by the first amplifier grid is very nearly zero. To prevent this action, a resistor R is placed in series with the comparison voltage such that the integrating capacitor takes on very little charge from the comparison voltage.

The 60-cycle unbalance voltage derived from the converter is fed to the grid of the first servo preamplifier tube. It was found convenient to heat the filament of this tube by r-f power supplied by a simple tickler oscillator to reduce the 60-cycle pickup.

The circuit of the servo preamplifier consists of two 6AK5's and one 6SL7. This tube line-up yields a gain of the order of 10^6 if the amplifier is linear. The preamplifier is R-C-coupled to two 6N7's which serve as the servo power amplifier.

Special Potentiometer

The servo motor is used to drive the comparison-voltage potentiometer and the indicator needle. The system is geared so the motor, running at 160 rpm, drives the potentiometer through 330 degrees and the needle through 110 degrees in approximately 10 seconds. Since the signal voltage available from the multiplier tube varies over five decades, it is also necessary that the comparison voltage do so. To accomplish this, the wire-wound potentiometer is tapped at four regularly-spaced intervals.

A one-ohm resistor is placed across the first interval, 10 ohms across the second, 100 ohms across the third, 1,000 ohms across the fourth, and no resistance across the last which is one-fifth of a 50,000-ohm potentiometer, or 10,000 ohms. When a voltage is applied across the potentiometer, one ten-thousandth appears across the first interval, one-thousandth across the second and so on. Thus, the ratio of voltages available from the potentiometer is 100,000 to 1 (ratio of voltage on one-tenth of the first decade to full pot voltage).

The total potentiometer voltage is adjusted so the 100 milliroentgen per hour level would fall at the end of the second decade. This adjustment is very stable and requires 21 volts across the entire potentiometer, or approximately 21 millivolts across the second decade.

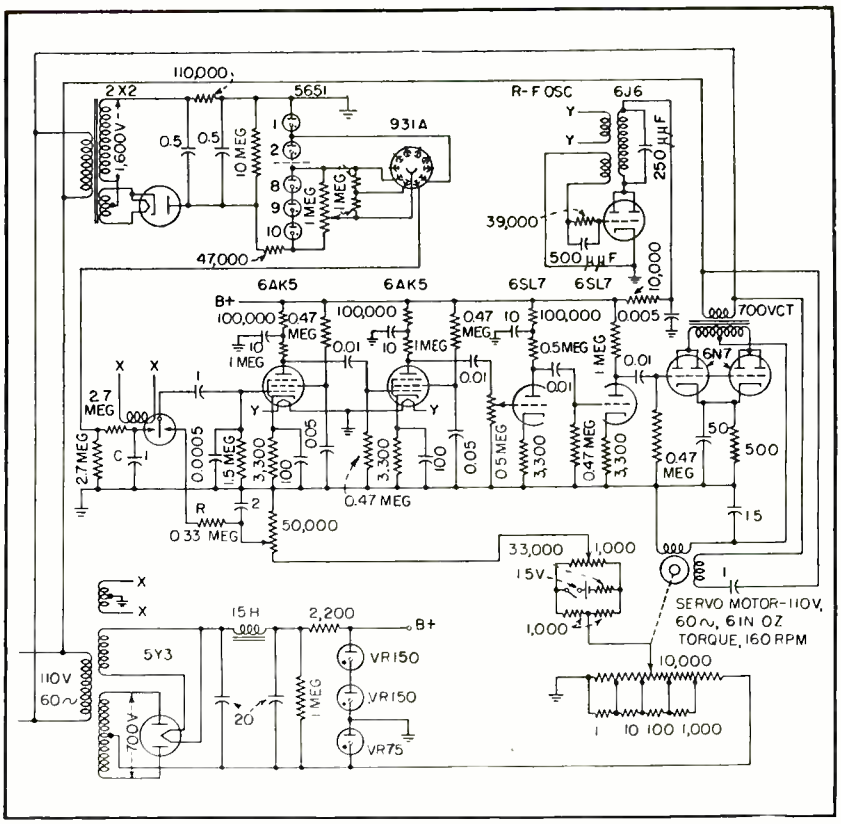
There are two basic limitations to the performance of the instrument. At very low levels (5 mr per hr or less) there are dark-current variations and at very high levels (10 r per hr or more) there is photomultiplier fatigue.

The dark current of the photomultiplier, due to thermionic emission from the photocathode, is strongly temperature-dependent and thus may cause a shift in the zero position of the instrument as the temperature varies. However, with tubes selected for low dark current, this effect is small enough to be neglected providing no levels less than 5.0 mr per hr need be measured to 15-percent accuracy. It was found that a 4-degree C change in temperature caused a shift of the order of 0.7 mr per hr.

For those applications requiring higher sensitivity and accuracy, at least two possibilities are open. First, a thermostatically controlled oven operating at about 40 C (to absorb maximum room temperature) has been used successfully. A Fenwal thermoswitch or similar device and resistor heating element will maintain the temperature to within 0.4 C and thus effect a considerable increase in the minimum measurable signal (at a given accuracy).

Second, a more direct method of cancelling the dark-current pulses has been employed. It is found that the pulses making up the dark current of a photomultiplier tube are considerably smaller than the average current pulse due to a scintillation. This immediately suggests the use of a pulse-height discriminator circuit set to reject dark-current pulses.

However, any direct pulse-height discriminating circuit would become completely blocked at higher radiation levels, and its output would rapidly go to zero. It is thus necessary to employ a discriminator circuit in which blocking does not cause the entire instrument to become inoperative. (At levels which block the discriminator, dark current is unimportant.) This may be done by placing the discriminator circuit in a feedback loop circuit arrangement.



Circuit of gamma-ray radiation monitor. Contacts of the converter are shown in circle at left center

The voltage on the integrating capacitor is thus due only to those portions of the input pulses which are above the discrimination level. This eliminates the dark-current pulses entirely, at the expense of a factor of three in sensitivity which may be made up elsewhere in the instrument.

If the radiation monitor were required to operate over very wide temperature ranges at high sensitivity, it would probably be necessary to combine pulse cancellation and thermostatic control, since there is evidence that the light output of the crystal itself varies somewhat with temperature.

Photomultiplier tubes, when operated at high light levels, exhibit a fatigue effect wherein the output current decreases steadily with time although the illumination is constant.

At low levels of illumination, the recovery per unit time approaches the fatigue rate and the net loss in sensitivity is small. It is thus important to keep the photomultiplier output as small as possible at high radiation levels. In a reasonably good tube, the fatigue is considerably less than 5 percent at a current of 30 microamperes. It is good design to minimize the tube output and maximize the servo system sensitivity. For this reason, the anthracene crystals need not be large, or backed by a reflecting surface. Since the instrument is designed for approximately 30 microamperes of multiplier tube current at 100 r per hr, the minimum current is of the order of 3×10^{-10} ampere (or about one-third of the dark current of the tube). It is, therefore, desirable that tubes be selected for low absolute current.

In certain installations, there is the possibility of cooling the tube to reduce dark current, and at the same time maintain a constant temperature. This technique is not without possible drawbacks, however, since there is some evidence to indicate that fatigue effects are greatly increased at lower temperature.

VTVM CIRCUITS

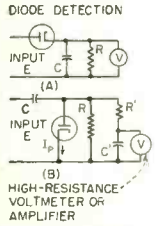
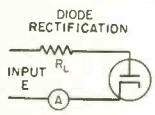
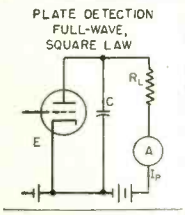
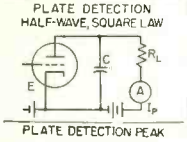
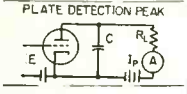
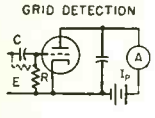
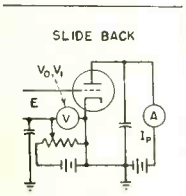
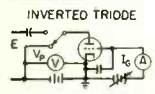
Survey of basic vacuum-tube voltmeter circuits, including pertinent equations, evaluation of circuit performance and accuracy, and frequency and voltage range limitations of each type of circuit

By MYRON C. SELBY

Central Radio Propagation Laboratory
National Bureau of Standards
Washington, D. C.

THE ACCOMPANYING TABLE lists the major functional characteristics of eight fundamentally different detecting circuit elements of vacuum-tube voltmeters.

The major performance desiderata of a vacuum-tube voltmeter for frequencies up to several hundred megacycles are: (1) low-input capacitance; (2) high-input resistance; (3) short internal leads to

Circuit	Principle of Operation	Basic Formulas	Input Impedance
DIODE DETECTION  (A) (B) HIGH-RESISTANCE VOLTMETER OR AMPLIFIER	C charges to E_{PEAK}. R acts to discharge C. In (B), R' and C' act as a filter to keep r-f out of d-c measuring circuit	For linear diode characteristics, $V_{d\text{-}c} = KE_{PEAK}$. $R_{EQ} = \frac{R}{2\,I_P R/E_{PEAK}} = \frac{R}{2\eta}$ η = rectification efficiency = unity (approx.) as R and E increase. For square-law diode, η is function of E	Equivalent of 1 to 25 megohms shunted with 3 to 10 $\mu\mu$f; 10^5 ohms at 300 mc is possible. In general, is function of R and E. At one value of R, input impedance is practically independent of E
DIODE RECTIFICATION 	$R_P = 0$ by assumption $I_{P0} = 0$ by assumption $R_L I_{AV}$ = average voltage of the positive half-cycle	For a sinusoidal input $I_P = \frac{E_{MAX}}{\pi R_L}$	$2R_L$
PLATE DETECTION FULL-WAVE, SQUARE LAW 	Approximate parabolic lower curved portion of I_P-E_C characteristic is used. Average plate current is higher than the quiescent plate current. Biased for $i_P > 0$ throughout the cycle. R_L is usually omitted	$\Delta I_P \cong K(E_1^2 + E_2^2 + E_3^2 + \ldots)$ to a first approximation. $\Delta I_P = \frac{1}{4\mu_0 g_{m0}(r_P + R_L)} \times \left(\frac{\partial g_m}{\partial E_G}\right)(E_1^2 + E_2^2 + E_3^2 + \ldots)$	Approximately 10^7 ohms at frequencies up to few mc shunted by $(C_{GP} + C_{GC})$. May drop to 10^4 or 10^3 at 300 mc depending on tube. $R_G = \frac{1}{Kg_m f^2 \tau^2}$ τ = electron transit time
PLATE DETECTION HALF-WAVE, SQUARE LAW 	Same as above except that tube is biased to cutoff. For large R_L and $C = 0$, i_P is nearly proportional to e_G during positive half-cycles	For relatively large values of R_L and E, $I_P \cong KE_{AV}$. For small r-f voltages and low values of R_L, $I_P \cong K(E_1^2 + E_2^2 + E_3^2 + \ldots)$	Same as above
PLATE DETECTION PEAK 	Tube is biased appreciably beyond cutoff	$I_P \cong KE_{PEAK}$	At negligible transit-time effect $R_G \cong K/f$ $C_G = (C_{GP} + C_{GC})$
GRID DETECTION 	Operates on lower curved portion of grid-current grid-voltage curve and straight or curved portions of I_P-E_G characteristic. $X_C << R$	$\Delta I_P = g_m R \Delta I_G$ over linear portion of I_P-E_G characteristic	Relatively low
SLIDE BACK 	D-C bias adjusted to obtain same plate current with and without r-f input. $I_P = I_{P0}$ = few μa	Peak of positive half-cycle = E_{MAX} = $K(V_1 - V_0)$. K approaches unity as E increases and as sharpness of cutoff increases. May be as low as 0.2 depending on tube characteristics and E. V_0 = d-c voltage at $E = 0$. V_1 = d-c voltages at other values of E	$\frac{1}{\omega(C_{GP} + C_{GC})}$ Input resistance is approaching leakage resistance across input terminals
INVERTED TRIODE 	I_G is reduced when r-f voltage is applied at input. V_P is negative	$E_{PEAK} \cong V_P$ required to produce same I_G. Amplification factor $\cong \frac{1}{\mu}$	Resistance is of order of 1,000 megohms shunted by $C_{CP} + C_{PG}$

terminals; (4) high series-resonance frequency of input-lead inductance and capacitance; (5) freedom from transit-time error; (6) maximum voltage range with minimum auxiliary equipment such as amplifiers and voltage dividers; (7) peak voltage calibration for nonsinusoidal waves and rms for sinusoidal waves; (8) linear scale or large number of overlapping scales for square-law indications; (9) negligible zero drift and steady indication; (10) calibration corrections must not be affected by ordinary line-voltage variations, aging and temperature and humidity changes, must remain reasonably constant and must not be affected by tube replacements; (11) v-t voltmeters must not generate disturbing voltages.

Associated circuits, such as amplifiers, current-balancing circuits and voltage dividers, are equally important in determining sensitivity, linearity, and range of the vtvm.

The table and text are excerpts from NBS circular 481, *High-Frequency Measurements*, by Myron C. Selby, published by the Department of Commerce and available from the Superintendent of Documents, U. S. Government Printing Office.

Output and Waveform Effect	Voltage Range	Frequency Range and Error	Calibration Stability	Remarks
Source impedance must be negligible at all harmonics, and level of harmonics must be low, otherwise error may be as large as percentage harmonics present Output = E_{PEAK}	The upper limit depends on tube rating. With a sensitive d-c voltmeter or a d-c amplifier, the lower limit is a fraction of a volt	Upper limit is affected by series resonance of input L and C, anode to cathode r-f voltages and transit-time error. Range is function of voltage applied. Correction curves may be used to extend range	Good. Depends on constancy of filament voltage and emission. May require yearly calibration	This circuit followed by a self-biasing d-c amplifier seems most suitable for the widest frequency range. To eliminate low-frequency discrimination, the RC constant should be at least 100 at lowest frequency. Input series resonance increases apparent input voltage at fundamental and emphasizes harmonics more than fundamental
No error caused by reversing input, even with unsymmetrical waveform. Output = E_{AV}	Fraction of volt to few hundred volts, depending on R_L and tube rating	Should be calibrated at operating frequency above 1 mc. Probable range up to several mc	Same	R_L may vary from 0 to 1 megohm. For R_L > 100,000, error caused by slight curvature of static tube characteristic is negligible
ΔI_P depends somewhat on waveform. Theoretically there is no turnover. Phase of harmonic has no effect. Output = $(E_1^2 + E_2^2 + E_3^2 + \ldots)$	Fraction of volt to top limit within square-law range of tube (a few volts for commercial tubes)	With commercial tubes, low-frequency calibration will hold within 5 or 10 percent to 20 or 30 mc. At higher frequencies calibration at each frequency is necessary	Poor, as a result of tube aging and variations in d-c voltages	Noise output can be corrected for by subtracting it from total output. That is, $\Delta I_x = \Delta I_{TOTAL} - \Delta I_{NOISE}$
Subject to turnover and phase of harmonics. For output, see remarks	Fraction of volt to value of E causing grid current to flow	Same	Same	Output = E_{AV} if plate current characteristic is linear. = E_{rms} if plate current characteristic is parabolic
Subject to turnover and phase of harmonics (see remarks)	From $E_{MAX} \cong V_G$ to values causing flow of grid currents	Same	Same	Not recommended. Error might be appreciable
Error may be appreciable (see remarks)	Fraction of volt to few volts with receiving type tubes	Approximately to 10 mc	Very poor	When plate rectification takes place in addition to grid rectification, ΔI_P may equal zero at certain level of E. Output = E_{rms} or E_{PEAK} depending on input and operating voltages
Subject to turnover. Output = E_{PEAK} of positive half-cycle	Fraction of volt to few hundred volts. Calibration is indispensable especially below about 10 v. Calibration should be made for given I_P	Approximately to 10 or 20 mc, depending on input capacitance	Good. Practically independent of aging and operating voltage variations	Sharp cutoff is obtained with pentodes connected as triodes, with screen grid used as control element
Subject to turnover. Output = E_{PEAK}	Large voltages, depending on tube design	Possibly to 10 mc (see remarks)	Probably good. No experimental data available	Theoretically frequency range is limited by input capacitance. No experimental data available

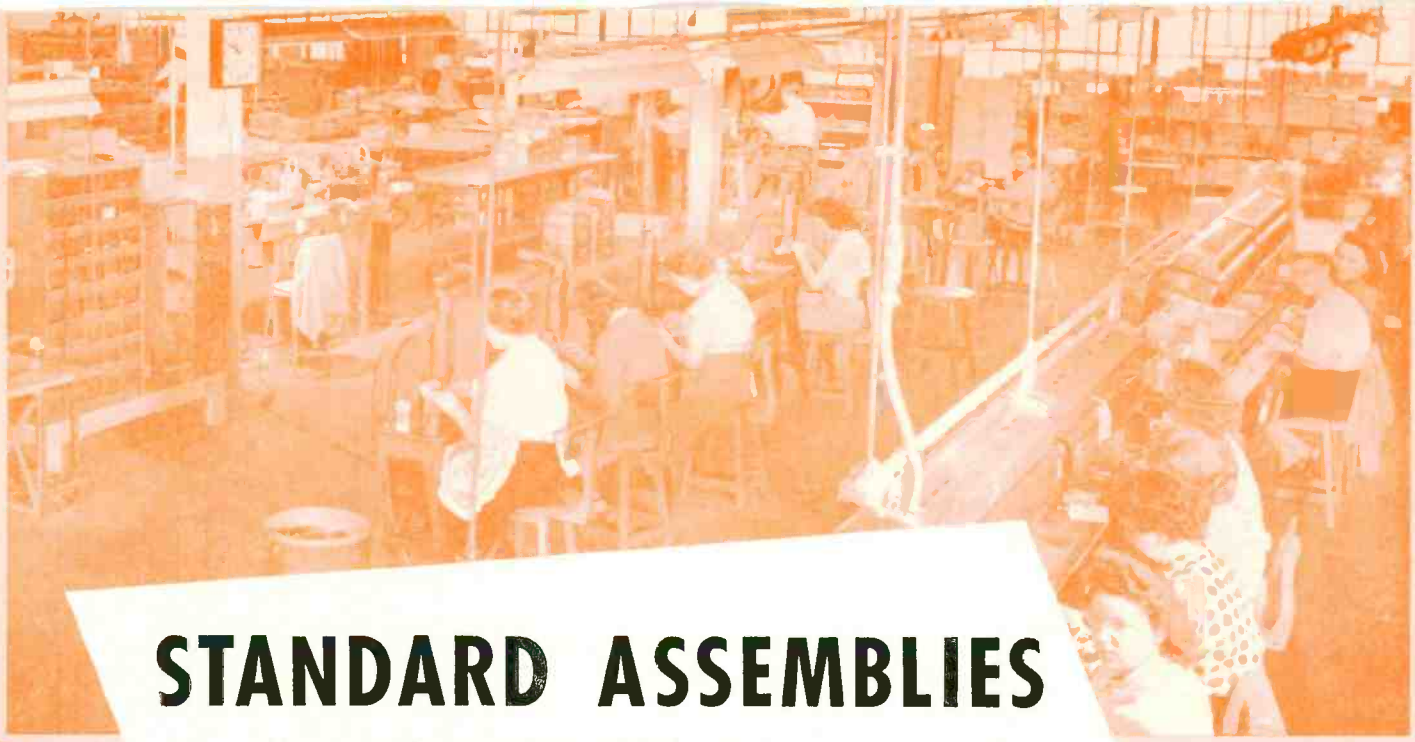
The TRON Family

An alphabetical listing of over 200 words ending in the suffix *tron* is presented here, with definitions, to assist readers in avoiding duplication when a new product or firm name is under consideration.

By W. C. WHITE
Electronics Engineer
General Electric Research Laboratory
Schenectady, New York

Acratron Self-balancing a-c potentiometer-type electron recorder.
Actron Trade name for a group of manufactured devices.
Aeriotron Trade name for a group of receiving tubes manufactured in early years of broadcasting.
Airtron Name of firm that designs and manufactures electronic and aircraft components.
Alphatron Trade name for an ionization gauge.
Amertron Trade name for products of a certain firm.
Aquatron Trade name for an electrolytic water purifier.
Arcotron German high-vacuum tube with external control electrode.
Arditron Trade name for a British photographic flash lamp.
Argostron Trade name for a British stroboscopic discharge tube.
Aspatron British portable atomic pile.
Astron Name of a firm manufacturing capacitors.
Audiotron Trade name for a receiving tube sold in early 20's.
Augetron British high-vacuum multistage electron multiplier tube.
Autotron Trade name for a photoelectric control.
Axiotron High-vacuum thermionic-cathode diode. Magnetic field from filament controls the current.
Ballastron (1) Trade name for an iron wire in hydrogen ballast tube. (2) Trade name for a fluorescent lamp p-f improvement capacitor.
Barytron Same as **Mesotron.**
Betatron Apparatus for the production of very-high-speed electrons.
Bevatron High-energy proton accelerator. Similar to the **Cosmotron.**
Caltron Name of a firm manufacturing electrical specialties.
Calutron Electromagnetic type of uranium isotope mass separator.
Capacitron (1) glass mercury-pool tube in which the arc is started by an external electrode. (2) Multimillion-volt atom smasher. (3) Name of a firm manufacturing electrical components.
Cardiotron Trade name for an electrocardiograph.
Cathetron Same as **Kathetron.**
Cetron Trade name for a certain manufacturer's line of tubes.
Charactron Type of cathode-ray tube that displays a series of letters or numbers.
Chronotron (1) Trade name for a time-delay tube. (2) Apparatus for accurately measuring extremely short-time intervals.
Clarotron Trade name for an early line of radio receiving tubes.
Cletron Trade name for products of a certain firm.
Clinitron Equipment to check for the presence of diabetes.
Convectron Tube to indicate variations from a vertical position.
Cosmotron High-energy proton accelerator. Similar to a **Bevatron.**
Cycletron British name for a form of **Cyclotron.**
Cyclotron Apparatus for producing a beam of high-velocity charged particles.
Dalmotron Trade name for products of a certain firm.
Detectron (1) Trade name for a line of early radio broadcasting tubes. (2) Japanese designation for certain vacuum tubes.
Diatron Trade name for a mass spectrometer.
Diotron An instrumentation circuit using a temperature-limited diode.
Donutron All-metal tunable magnetron.
Duodynatron Japanese dynatron tube in which the secondary electrons originate on a grid.
Duratron Trade name for a hearing aid.
Dynatron High-vacuum triode utilizing secondary emission.
Dynectron Form of commutator utilizing mercury in an evacuated envelope.
Dyotron Single-cavity three-electrode microwave oscillating tube.
Elastron Trade name for a plastic material.
Electron Elementary quantity of negative electricity.
Elecktron Trade name for a mineral product.
Eltron Name of a firm manufacturing electrical equipment.
Emitron British camera tube.
Ertron Pharmaceutical vitamin compound.
Estron Trade name for a synthetic fiber.
Excitron Form of mercury-arc rectifier with a holding anode.
Faratron Trade name of a device for controlling liquid levels.
Filtron Name of a firm manufacturing components.
Flashtron Sensitive gas-discharge relay.
Flextron Trade name for an enlarging lens for tv receivers.
Frenotron British form of diode-triode combination.
Furnatron Trade name for an electronic furnace control.
Fusetron Trade name for products of a certain firm.
Gagetron Trade name for a liquid-level indicator.
Galvatron Trade name for a sensitive electrical recorder.
Gammatron Trade name for a line of vacuum tubes.
Gantron Trade name for a luminescent fabric.
Gasomagnetron Russian form of magnetron tube containing gas.
Gausitron Same as **Gusetron.**
Genetrons Trade name for a series of organic compounds.
Genotron Trade name for high-voltage rectifier tubes.
Germitron Trade name for an ultraviolet lamp unit.
Glastron Trade name for a fabric of woven spun glass.
Gusetron Mercury-arc rectifier tube with high-voltage starting electrode. Same as **Gausitron.**
Hartron Trade name for a tape-recording device.
Hodectron Gas-content mercury-arc tube in which the arc is started by a magnetic pulse.
Hurletron Trade name for the products of a certain firm.
Hytron Trade name for a line of vacuum tubes.
Ignitron Mercury-arc tube containing an ignitor to start arc.
Illitron Trade name for a high-frequency heating line.
Infratron Trade name for an electric space heater.
Instron Testing machine for testing tensile strength.
Ionotron Device using radioactive material to minimize troublesome electrostatic charges.
Isotron Device for the separation of uranium isotopes.
Kalistron Trade name for a plastic material.
Kallirotron British tube and circuit that act as an amplifier or oscillator.
Kathetron Trade name for glow-discharge triode. Same as **Cathetron.**
Kenopliotron Vacuum tube in which the cathode of the triode element is the anode of the diode element. This common element is heated by electron bombardment.
Kenotron High-vacuum thermionic-cathode diode.
Kevatron High-votage particle accelerator.
Kinetrons Trade name for certain cathode-ray tubes.

(continued on page 114)



STANDARD ASSEMBLIES

Here at Cinch are assembled metal components, metal plastic assemblies, and special parts as required, for the nation's Radio and Television sets.

Many time saving, labor and money saving ideas are perfected here. . . many "firsts" engineered here . . . and assembled into workable, durable components for electronic service.

AVAILABLE AT LEADING
ELECTRONIC JOBBERS EVERYWHERE

Cinch
ELECTRONIC COMPONENTS

Cinch
ELECTRONIC COMPONENTS

CINCH MANUFACTURING CORPORATION

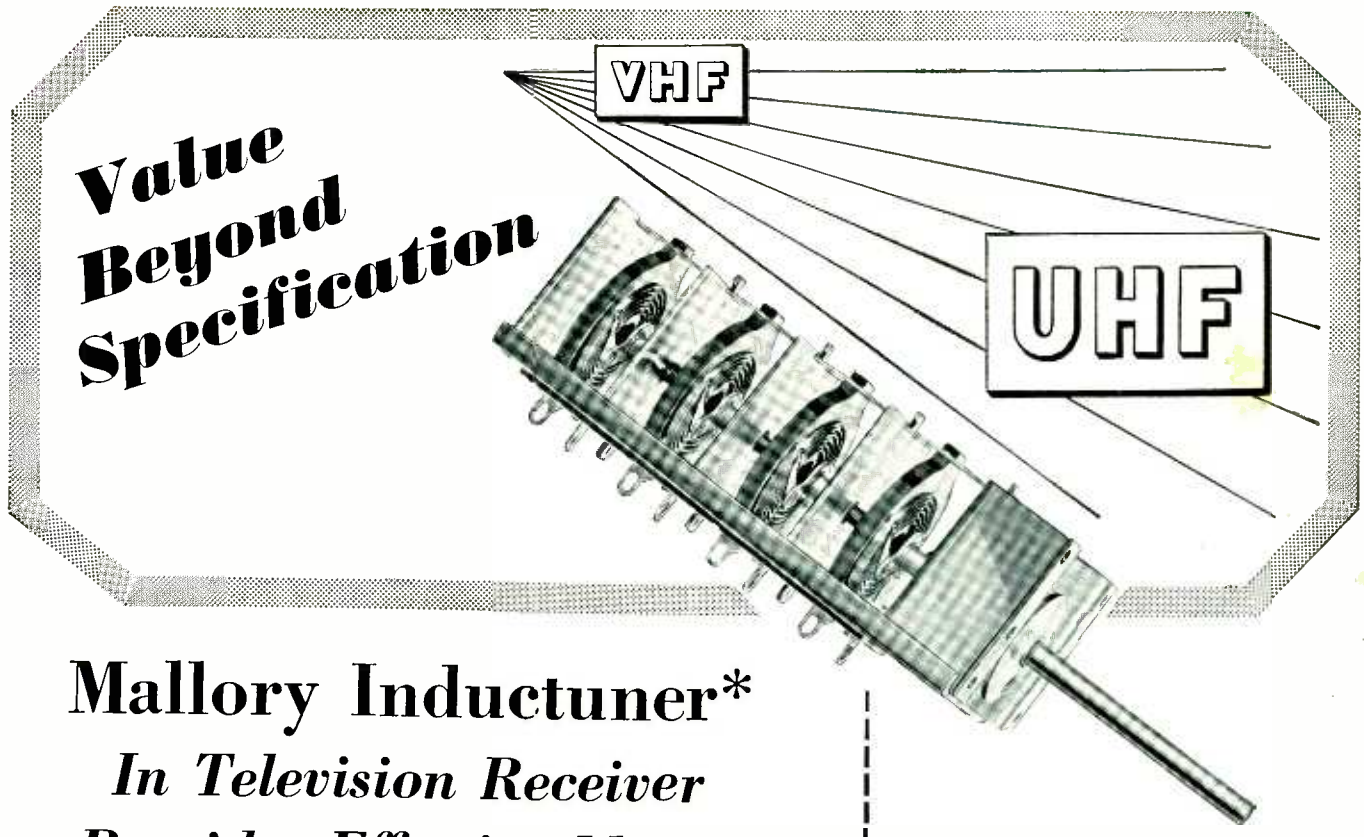
CHICAGO 24, ILLINOIS

Subsidiary of United-Carr Fastener Corporation - Cambridge 42, Massachusetts

The Tron Family

(Continued from page 112)

Klystron High-vacuum multielectrode tube used for production and amplification of vhf.
Kodatron Gas-discharge flash lamp.
Kotron Trade name for a form of selenium rectifier.
Leartron Trade name for a phonograph pickup device.
Lectron Trade name for a solder.
Lextron Trade name for a pharmaceutical compound.
Limitron (1) Trade name for an electron comparator. (2) Trade name for products of a certain firm.
Lumetron Trade name for a colorimeter.
Lustron (1) Trade name for a plastic. (2) Trade name for a prefabricated home.
Luxtron Trade name for a photovoltaic cell.
Magnetron (1) High-vacuum thermionic-cathode diode in which current is controlled by variation of magnetic field. (2) Oscillating vacuum tube for production of vhf.
Maxitron Trade name for an x-ray tube.
Mecanitron Name of a firm and the trade name of its products.
Megatron Trade name for a disk-seal triode.
Meletron Trade name for a firm.
Meretron Trade name of a product made by a certain firm.
Mesotron A charged particle.
Metron Name of a firm.
Microtron Russian apparatus for the acceleration of electrons.
Minitron Trade name for small radio receiving tubes.
Monitron Instrument to detect harmful radiations.
Monotron (1) Trade name for monoscope tubes. Same as **Videotron**. (2) Form of **Klystron** (Russian).
Motron Trade name for equipment manufactured by a certain firm.
Multicardiotron Trade name for a product of a certain firm.
Musitron Name of a firm.
Negatron High-vacuum tube having a negative characteristic.
Neostron British stroboscopic tube.
Neotron (1) Gas-filled pulse generator tube. (2) French vacuum-tube firm and its products.
Neptron Trade name for tubes made by a certain firm.
Neutron Uncharged particle.
Nimatron Automaton to play the ancient Chinese game of Nim.
Nitron Trade name for certain plastic products.
Nobatron Trade name for a d-c power pack.
Nutron (1) Trade name for an early line of radio receiving tubes. (2) Pharmaceutical compound.
Nylatron Trade name for a synthetic dry bearing material.
Omegatron A miniature cyclotron.
Optron Name of a firm and trade name of a product.
Orgatron Name for an electronic organ.
Palletron Electron resonator for production of high potentials.
Penetron (1) Sometimes used to denote a **Mesotron**. (2) Device for measuring thickness.
Pentatron Five-electrode receiving tube.
Permatron Form of vacuum tube in which the current flow is initiated by a magnetic field.
Phanotron Hot-cathode gas-content diode.
Phantastron Controllable linear time-delay circuit.
Phasitron Type of beam deflection tube to produce f-m.
Philcotron Trade name for an electrolytic rectifier cell.
Phonotron Trade name for a line of early radio receiving tubes.
Photo-augetron British form of photocathode multiplier tube.
Pho Tron Name of a firm.
Phytotron Laboratory of botanical research.
Plastron Name of firm and its products in plastics field.
Pliodynatron Dynatron with a control grid added.
Pliotron High-vacuum thermionic-cathode tube.
Plomatron British name for a grid-controlled mercury-arc tube.
Polatron Trade name for a picture tube incorporating a neutral filter device.
Polectron Trade name for a group of dielectric materials.
Polytron Name suggested for a suspected elementary particle.
Positron Elementary particle.
Powertron Name of a firm dealing in electrical equipment.
Precipitron Trade name for an electrical precipitating device.
Prionotron Form of velocity-modulation tube.
Protectron Trade name for devices made by a certain firm.
Pulsatron Gas-filled tube utilized as a generator of pulses.
Pyrotron Trade name for temperature control apparatus.
Quadratron Four-element thermionic-cathode high-vacuum tube.
Radiotron Trade name for a line of radio tubes.
Ray-lectron Name of a firm selling radio devices.
Raytron Name of firm and product used for ground-fault location.
Reactron Trade name applied to some of the products of a certain firm.
Receptron Trade name applied to some of the products of a certain firm.
Rectron Trade name used for a line of tubes.
Remtron Form of discharge tube used in counters and computers.
Resnatron Same as **Resnotron**.
Resnotron High-power high-frequency tetrode of special design.
Rhumbatron Name given to the resonator cavity of early **Klystrons**.
Robotron Name of firm and its product in flashtube field.
Rotron (1) Trade name for an electronic telephone ringing device. (2) Name of a division of company making electronic devices.
Selectron (1) Trade name of a plastic material. (2) Form of memory tube.
Seletron Trade name for a line of selenium rectifiers.
Sendytron Japanese name for a mercury-arc tube having a high-voltage starting electrode.
Sensitron Trade name for some products of a certain firm.
Sentron Short-wave tube of Japanese design.
Servotron (1) British mercury-arc tube with a high-voltage starter. (2) Trade name for an electronic motor control.
Skiatron British device for television picture projection.
Soldetron Trade name of a certain firm's soldering iron.
Solotron Trade name for the products of a certain firm.
Sortron Part of a trade name for a firm's testing gage.
Spectron Name of a firm manufacturing glass parts.
Spirotron Device for decelerating high-speed particles.
Statitron Form of Van deGraaff high-voltage generator.
Stenotron Gas-filled transmitting tube of Russian design.
Stethertron Trade name for an electrical device.
Strobotron Glow-discharge tube used as a stroboscope.
Supertron Trade name for an early line of radio receiving tubes.
Symetron Multiple-tube ring-type amplifier for high frequencies.
Synchrocyclotron Particle accelerator.
Synchrotron Apparatus for producing beam of high-velocity particles.
Syntron Form of electric hammer.
Takktron High-voltage glow-discharge rectifier tube.
Tapestron Trade name for a plastic wall screen.
Tarrytron Trade name for a product of a certain company.
Telectron Name of a radio firm.
Teletron Trade name for a cathode-ray oscillograph tube.
Textron Name of company and its product in textile field.
Theatron Dramatic organization.
Thermatron Trade name for high-frequency heating equipment of a certain firm.
Thermotron Trade name for an early line of radio receiving tubes.
Thyratron Hot-cathode gas-discharge tube in which there are one or more control electrodes.
Toccotron Trade name for division of a company and its products.
Transitron (1) Circuit incorporating a tetrode. (2) French equivalent of the transistor.
Trigatron (1) British triggered spark gap for radar pulsers. (2) Induction-heating device.
Trignitron Trade name for a mercury-arc type of tube used in welding control.
Triotron Trade name for European line of radio tubes.
Trochotron High-vacuum multi-electrode tube for counting circuits.
Tropotron Form of magnetron.
Ultron Trade name for a plastic.
Unitron Trade name for a firm and its battery charger.
Vacutron Trade name for firm and its line of tubes.
Variotron Nom de plume of a British author in the radio field.
Varitron Trade name for a line of commercial cameras.
Vectron Name of a manufacturing firm.
Velocitron Form of mass spectrometer.
Veritron Trade name for an electronic pyrometer.
Vibratron Form of high-Q resonator.
Vibrotron Triode with a movable anode.
Victron Trade name for products of a certain firm.
Videotron See **Monotron** (1).
Visitron Trade name for a projection-type cathode-ray tube.
Vitron Plant food for garden use.
Voltron (1) Trade name for early line of radio receiving tubes. (2) Trade name for insulating compound.
Zyklotron Trade name for a Swiss high-frequency tube.



Value Beyond Specification

Mallory Inductuner*

In Television Receiver Provides Effective Means For Later UHF Conversion

An increasingly important consideration in the design of television receivers is the effectiveness with which they can later be coupled with a converter for UHF reception. Thorough analysis reveals that a front end unit built around a Mallory Inductuner provides flexibility and freedom from interference which are unequalled for this purpose by any other tuning device.

Because of the continuously variable inductance provided by the Inductuner, it is possible to select a conversion frequency that is most desirable from the standpoint of both harmonic and direct IF interference. Simply by the addition of a dial marking at the most desirable point in the unused frequency range between existing channels 6 and 7, the receiver manufacturer can prepare for later UHF conversion under ideal conditions.

This advantage is inherent in the unique design of the Inductuner. It is an important addition to the desirable features listed at the right. These exclusive advantages are available to you at a price no higher than other tuning devices.

That's value beyond specification!

That's why the Inductuner has become the center of growing respect and interest throughout the industry. Your request for detailed technical data will be welcomed.

Outstanding Advantages of the new Mallory Spiral Inductuner:

1. A single control for easy selection and fine tuning of any television or FM channel.
2. Easily adapted to UHF converter use.
3. Excellent stability eliminates frequency drift.
4. Supplied in three- or four-section designs.
5. Far more quiet operation; permits high signal-to-noise ratio in front end designs.
6. Free from microphonics.
7. Greater selectivity on high frequency channels.
8. Eliminates "bunching" of high band channels. Covers entire range in only six turns.
9. Simplifies front end design and production.
10. Reduces assembly costs.

*Reg. trade mark of P. R. Mallory & Co., Inc. for inductance tuning devices covered by Mallory-Ware patents.

Television Tuners, Special Switches, Controls and Resistors

P. R. MALLORY & CO., Inc.

MALLORY

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

SERVING INDUSTRY WITH

Capacitors	Contacts
Controls	Resistors
Rectifiers	Vibrators
Special Switches	Power Supplies

Resistance Welding Materials

TUBES AT WORK

Including INDUSTRIAL CONTROL

Edited by VIN ZELUFF

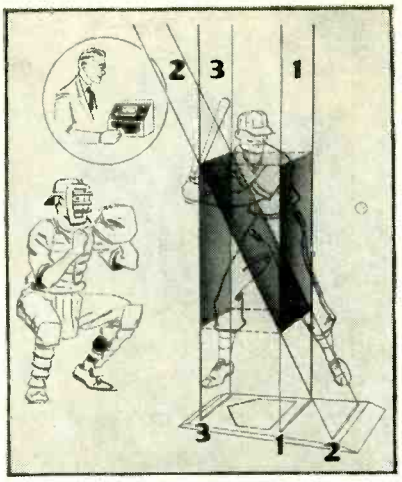
Electronic Umpire (for Baseball)

ANY INVENTIVE electronics or electrical engineer who has ever watched a baseball game has at one time or another considered the possibility of an electronic device capable of determining whether or not a pitched ball crosses home plate within the strike area, which is bounded vertically by the height of the batter's shoulders and knees, and laterally by the extremities of the home plate marker.

As shown in the photograph, the device consists of two main pieces. A ground box, four feet long, 22 inches wide, and 1½ inches deep, is substituted for the conventional home plate. The cabinet, which contains the recording and indicating equipment, is located at some convenient position anywhere up to 25 feet from home plate.

The electronic umpire not only calls the pitched ball a strike or a ball, but it determines the speed of travel as the ball crosses the plate.

In the ground box are lenses and mirrors which enable three phototubes to fence in the strike zone by looking at the sky through three slots in the top of the box, as shown in the drawing. When a ball passes through the strike zone, it casts its shadow on the phototubes in a definite sequence, thereby creating electric impulses which light the strike indicating lamp. An inside or outside ball does not cast its shadow because the phototubes see only the width of the plate. A high or low ball casts its shadow but in an improper sequence. The lamp does not light, indicating a ball was pitched.



The ball must pass through the planes viewed by the phototubes in the proper sequence to be called a strike

The equipment can be adjusted to the height of the player, so that the strike zone outlined will fit any batter, regardless of his height.

The speed of the pitched ball, provided it is a strike, is automatically timed by the device as it passes through the strike zone, giving a reading in feet per second on the recording machine.

The device was developed by General Electric at Electronics Park, Syracuse, N. Y. Their engineers say it will operate even on an overcast day, but not at night. It was developed for training use only and is not intended for use in competition.

Peewee Reese lets a pitched ball go by so it can be judged by the Electronic Umpire

Miniature TV Test Equipment

BY MARVIN KAPLAN

Oak Ridge Products
Chief Engineer
Mfg. Division of Video Television, Inc.
New York, N. Y.

FIELD CHECKS of television receivers are made more convenient by miniature test instruments recently introduced. One of these units is designed to supply signals for video and audio checking of i-f, and high and low bands of a receiver.

All bands are calibrated and tunable on the front panel. A selector switch permits the 6C4 r-f oscillator tube to operate on three bands in a grounded-plate circuit and on a fourth frequency of 4.5 mc as a Hartley oscillator.

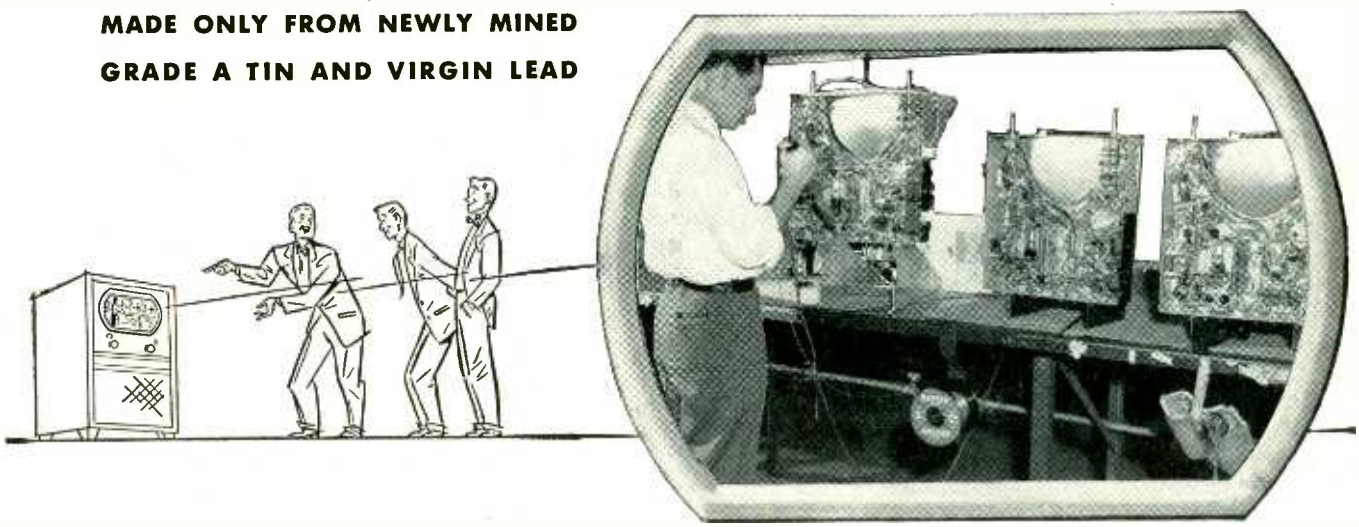
The modulator is a 6J6 twin tri-

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

"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

Kester...Standard for the TV and Radio Fields

SEE US AT BOOTH 111, STEVENS HOTEL MAY 22-25

Sweep generator (top) and r-f signal generator are not much larger than a pack of cigarettes

ode used as a multivibrator to produce a 500-cycle pulse to grid-modulate the master oscillator. Output is taken from a coupling loop around the cathode choke in the r-f oscillator circuit. Modulation is removed by shorting one of the multivibrator grids to the ground.

In band A, a tuning range is supplied from 54 to 82 mc (channels 2 to 5), by means of an air-core self-supporting coil tuned by a variable air capacitor.

In band B, the frequency range is 20 to 28 mc which covers the standard video and sound i-f and trap frequencies. The panel, however, is also calibrated with the second harmonic range of 40 to 48 mc for sets employing the new RMA recommended i-f frequencies.

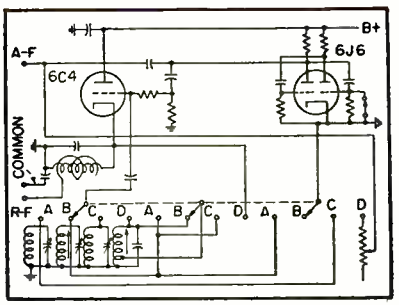
Band C tunes from 85 to 109 mc covering channel 6 and the f-m band. The panel is calibrated also with the second harmonic, 179.75 mc to 215.75 mc for channels 7 to 13. This coil is similar to the one in band A and is tuned in the same fashion.

In the last position of the selector switch two types of signals are supplied simultaneously. The 6J6 multivibrator 500-cycle output is connected with an attenuator control to a jack while the 6C4 oscillator tube is converted to a Hartley oscillator by connecting the cathode of the tube to a tap on a 4.5-mc coil which is pre-tuned at the factory with a fixed capacitor and an iron-core slug. This signal is supplied to another jack by means of the cathode choke coupling loop.

Another instrument in this miniature series is a new type of linearity, sync and sweep tester. Although this unit is called Model 104 Syncro-Sweep generator, it has many other functions. The unit consists of an r-f oscillator section which is calibrated on channel 2 to 5, and a modulator section with a specially designed switching network to provide a variety of frequencies from 400-cycles to about 200 kc. In one position of the selector switch the r-f oscillator is modulated by a variable frequency to provide a series of vertical bars on a television screen to allow a technician to adjust the horizontal linearity of the receiver without a test pattern.

In the second position of the switch, the r-f oscillator is modulated by a variable frequency to provide a series of horizontal bars on the receiver screen which supplies a pattern for adjusting the vertical linearity. In the third position of the switch, a variable frequency modulates the oscillator to provide a transmitted synchronizing signal to check the horizontal sync circuits of a television receiver.

At the same time a saw-tooth



Circuit arrangement of switching functions in the small-size Oak Ridge signal generator

voltage is supplied to an output jack. This signal can be used to generate the horizontal sweep and fly-back voltage in a receiver to help isolate a sweep failure. In the fourth position of the selector switch a variable frequency is supplied to the oscillator to provide a transmitted synchronizing signal to check the vertical sync circuits of a television receiver.

The switch also connects a vertical saw-tooth voltage to an output jack. This signal can be used to generate the vertical sweep in a receiver to help isolate a failure in the sweep circuits.

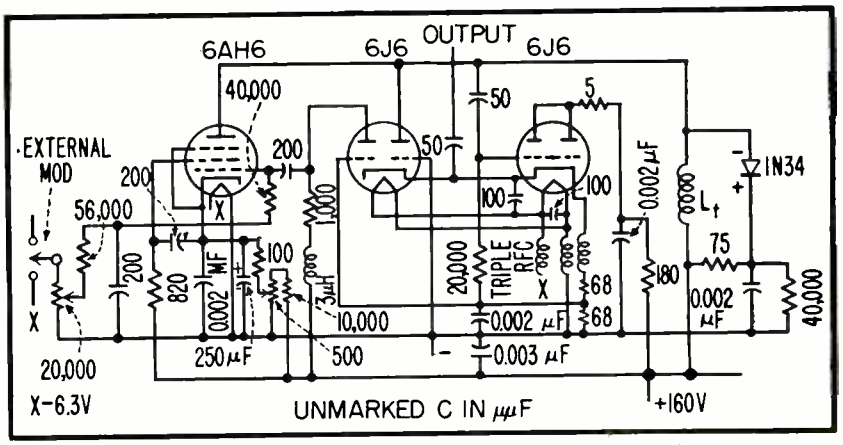
Wide-Range Frequency-Modulated Oscillator

By P. M. Milner
Radiation Laboratory
McGill University
Montreal, Canada

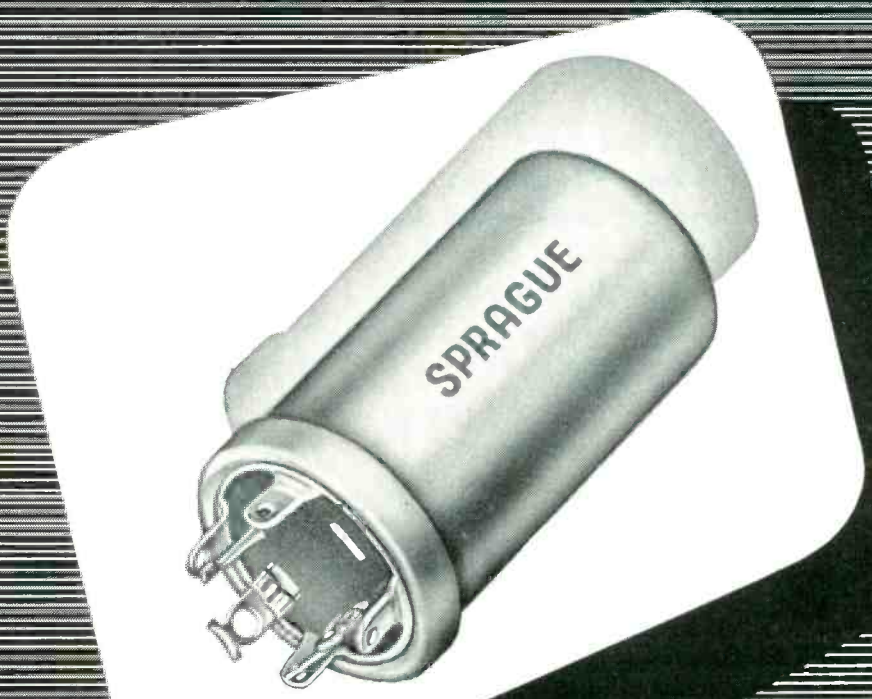
Need arose for a test oscillator with flexible modulation wave form, having a range of 18 to 30 mc for use in the design of control circuits for the McGill synchrocyclotron.

The only previously used circuits of the reactance-tube type known to the author[1] achieve wide deviation by frequency multiplication followed by frequency conversion, resulting in a complicated design

(Continued on p 144)



Final circuit of wide-range f-m oscillator



The Most Widely Used Electrolytics in TV Receivers Today

. . . . Television set makers are turning to Sprague as their major source for electrolytic capacitors.

. . . . Stability under maximum operating conditions plus outstandingly l-o-n-g service life are the reasons for this preference.

. . . . And expanded facilities, now being completed, permit Sprague to accept a larger portion of your requirements.

SPRAGUE

SPRAGUE ELECTRIC COMPANY
North Adams, Massachusetts

PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

THE ELECTRON ART

Edited by JAMES D. FAHNESTOCK

RCA's New Three-Color Picture Tube

SINCE THE RECENT INTRODUCTION of a three-color picture tube, the television industry has become alive with enthusiastic speculation for the immediate future of color television.

The tube, demonstrated in Washington last month by RCA, uses 351,000 color dots, one third of that number being of each of the primary colors, red, blue and green. These color dots are arranged in triangular groups of three dissimilarly colored dots each.

Immediately behind the face of the tube is a metal mash screen containing 117,000 holes. These holes are of approximately the same size as the triangular three-dot groups and are so positioned that they overlap equally the red, green and blue dots of each group.

As the electron beam, or beams, scan the face of the tube, the electrons pass through the holes of the mask. Whether the beam falls on the red, blue or green portion of the individual three-color groups is determined by information contained in the transmitted video signal.

Both single and triple-gun tubes have been produced with the new triangular-dot technique with results that are reported to be exceptionally gratifying.

No information is available as to the relative merits of the single-gun and three-gun versions. The single-gun model requires ten more tubes than a black- and-white receiver, while the three-gun tube necessitates the addition of 19 tubes to a black-and-white circuit.

Receivers

Receivers designed for use with the new tube are completely compatible, since the tube operates on a standard 525-line definition. A television receiver using the new tube will probably cost between 20 and 25 percent more than a black-and-white set, and RCA engineers predict that within a matter of months, color pictures using the tube will be comparable in quality to present-day standards for monochrome pictures.

Because of the fact that all sizes of tubes will have the same number of dots, production techniques are expected to be simpler for larger-sized tubes.

Single-gun three-color picture tube, which is expected to hasten the realization of color television

Ripple Tank for Phase-Front Visualization

CALCULATION or experimental determination of the effects of antenna systems alterations on phase-front configurations are usually very tedious. The Naval Research Laboratory has developed a substitute for such computations by extending the ripple-tank technique used previously for the demonstration of certain two-dimensional phenomena of physical optics. A simplified schematic of the system is shown in Fig. 1.

Equipment

An audio oscillator is the heart of the instrument. Its output is divided between the ripple-forming transducer and a stroboscopic light chopper wheel in such a way that the waves on the surface of a thin film of water appear to be motionless.

The image of the waves is cast upon a ground-glass screen by shining the synchronously chopped light through the waves which act like cylindrical lenses casting stationary light and shadow patterns in accordance with the phase-front pattern set up in the ripple-tank.

The Navy's version is mounted in a six-foot high rack with the ground glass screen at eye level for easy observation. The ripple tank is eleven inches square, and the water film used is approximately a quarter-inch thick. The number of holes in the chopper wheel depends on the problem, since it is sometimes desirable to light every other phase front and sometimes there is cause to light each phase front

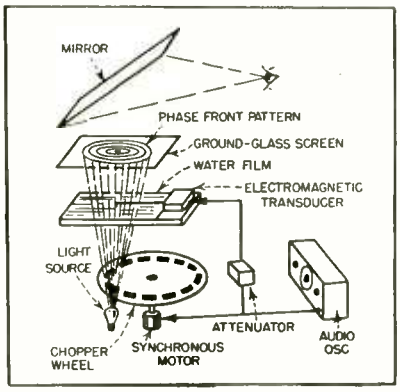
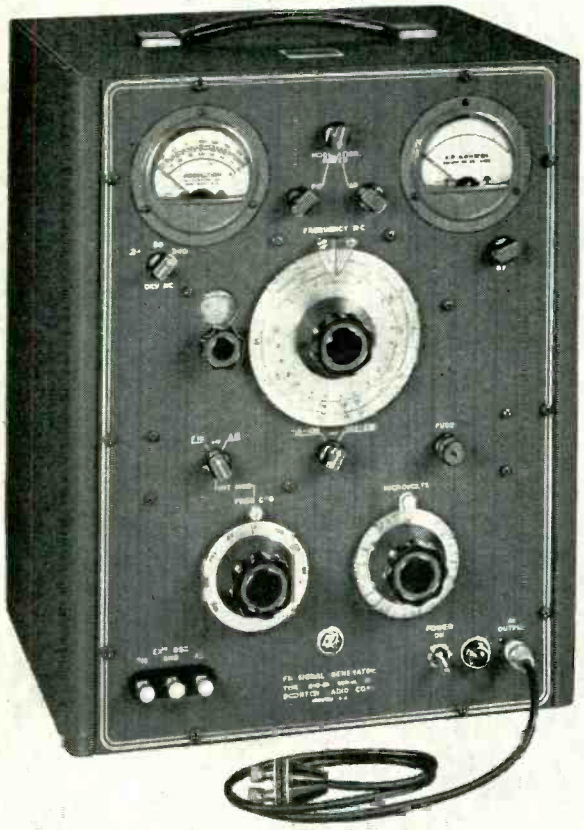


FIG. 1—Basic components of the NRL ripple tank for visual study of phase fronts

Laboratory Instruments for TELEVISION



Type 202-B
FM SIGNAL GENERATOR

Frequency Range
54-216 mc.

Additional coverage from 0.4 to 25 mc. with accessory UNIVERTER Type 203-B

FM SIGNAL GENERATOR Type 202-B

The Type 202-B FM Signal Generator is specifically designed to meet the exacting requirements of television and FM engineers working in the frequency range of 54 megacycles to 216 megacycles. Following are some of the outstanding features of this versatile instrument:

- **RF RANGES: 54-108, 108-216 mc. ± 0.5% accuracy. Also covers 0.4 mc. to 25 mc. with accessory 203-B Univerter.**
- **VERNIER DIAL: 24:1 gear ratio with main frequency dial.**
- **FREQUENCY DEVIATION RANGES: 0-24 kc., 0-80 kc., 0-240 kc.**
- **AMPLITUDE MODULATION: Continuously variable 0-50%, calibrated at 30% and 50% points.**
- **MODULATING OSCILLATOR: Eight internal modulating frequencies from 50 cycles to 15 kc. available for FM, AM.**
- **RF OUTPUT VOLTAGE: 0.2 volt to 0.1 microvolt. Output impedance 26.5 ohms.**
- **FM DISTORTION: Less than 2% at 75 kc. deviation.**
- **SPURIOUS RF OUTPUT: All spurious RF voltages 30 db or more below fundamental.**

If you have an FM or television instrument requirement, let us acquaint you with full particulars and technical data concerning the Type 202-B FM Signal Generator and Type 203-B Univerter.

UNIVERTER Type 203-B

AVAILABLE AS AN ACCESSORY is the 203-B Univerter, a unity gain frequency converter which, in combination with the 202-B instrument, provides the additional coverage of commonly used intermediate and radio frequencies.

- **R. F. RANGE: 0.4 mc. to 25 mc. (0.1 mc. to 25 mc. with no carrier deviation).**
- **R. F. INCREMENT DIAL: ± 250 kc. in 10 kc. increments.**
- **R. F. OUTPUT: 0.1 microvolt to 0.1 volt, ± 1 db. Also approximately 2 volts maximum (uncalibrated).**
- **OUTPUT IMPEDANCE: Approximately 60 ohms at 0.1 volt jack, 470 ohms at 2 volt pin jack.**

DESIGNERS AND MANUFACTURERS OF THE Q METER · QX CHECKER FREQUENCY MODULATED SIGNAL GENERATOR · BEAT FREQUENCY GENERATOR AND OTHER DIRECT READING INSTRUMENTS

BOONTON RADIO Corporation
BOONTON · N·J · U·S·A ·

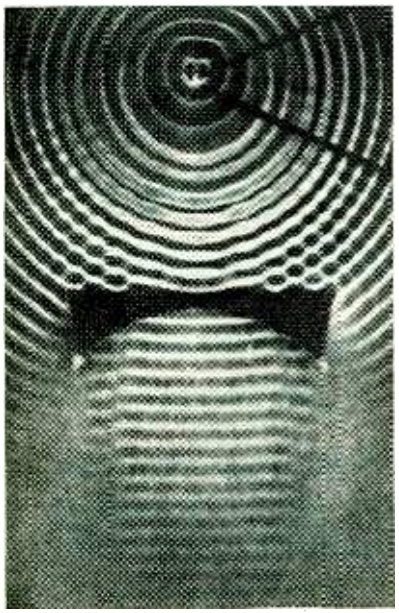


FIG. 2—Typical problems suitable for ripple-tank study include the effects of waveguide lenses on phase fronts

twice, thereby giving the effect of doubling the number of phase fronts.

A photograph of a typical study is shown in Fig. 2. It demonstrates two interesting phenomena. In the first place, two transducers are being used in close proximity to one another. This illustrates the characteristics of multielement antenna structures. This study also stimulates some aspects of W. E. Kock's metal-lens antenna. The lens shown in the photograph was designed for an index of refraction of about 0.55, and was made of ¼-inch thick brass, milled with 32 slots spaced ⅛-inch on centers. The slots were 0.040-inch wide and 3/32-inch deep, and the concave side has a radius of 1¼ inches. Since there is no possibility of interference between the back radiation of the primary pattern and the secondary pattern in the case of the waveguide lens, the side lobe structure due to this cause is absent. Appreciable reflection from the first surface is evident.

The transducer is actually a magnetically driven pin point which is brought into physical contact with the surface of the water. The crest-to-trough amplitude of the waves decreases linearly as the distance from the transducer, as might be expected, for a single isotropic exciter radiating in two dimensions.

The instrument is also usable for single-pulse studies, and when used with models, the reflection of radar-type waves from the surfaces of certain objects can also be studied visually. The ripple tank was shown at the Navy exhibit at the recent IRE Engineering Show in New York, and a description of an earlier experimental model is presented in NRL Report 3559.

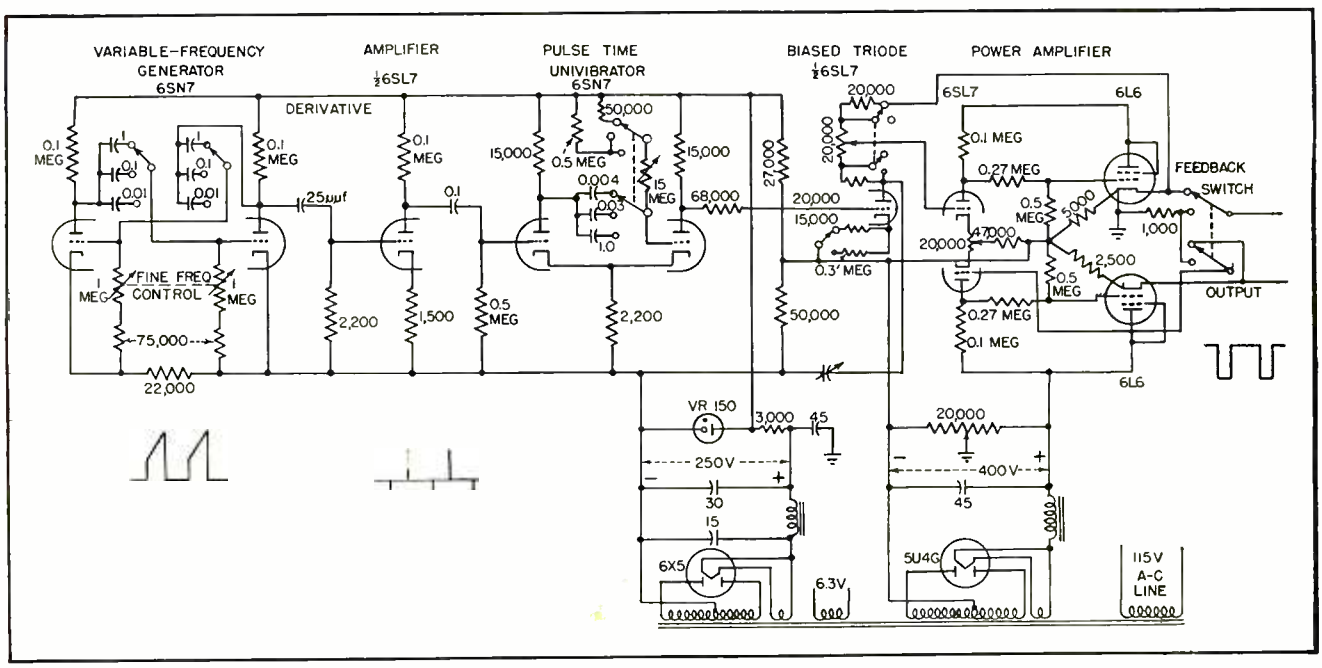
Rectangular Wave Generator for Biological Studies

By JOHN W. MOORE

Physics Department
Medical College of Virginia
Richmond, Virginia

FOR NERVE and muscle stimulation, one method frequently used is the application of a negative rectangular pulse to a small search electrode with respect to a large indifferent electrode (usually at ground potential). The instrument described is ideally suited for this sort of work and has been extensively used in current and voltage transient studies. It has been giving trouble-free service for over two years, producing pulses at continuously variable repetition rates of ⅓ to 400 cps and continuously

(Continued on p 188)



Rectangular wave generator. Feedback loops give choice of current or voltage output, with pulses continuously variable over wide range of frequency and duration for maximum flexibility in excitation of nerves and muscles as well as for observation of electrical transients through biological systems

Designed for industrial microfilming requirements

. . . Kodagraph Micro-File Equipment

TO CONDENSE, PRESERVE, PROTECT YOUR DRAWINGS . . . THE KODAGRAPH MICRO-FILE MACHINE

Place an engineering drawing on the copyboard . . . touch a foot-switch . . . and the machine does the rest—

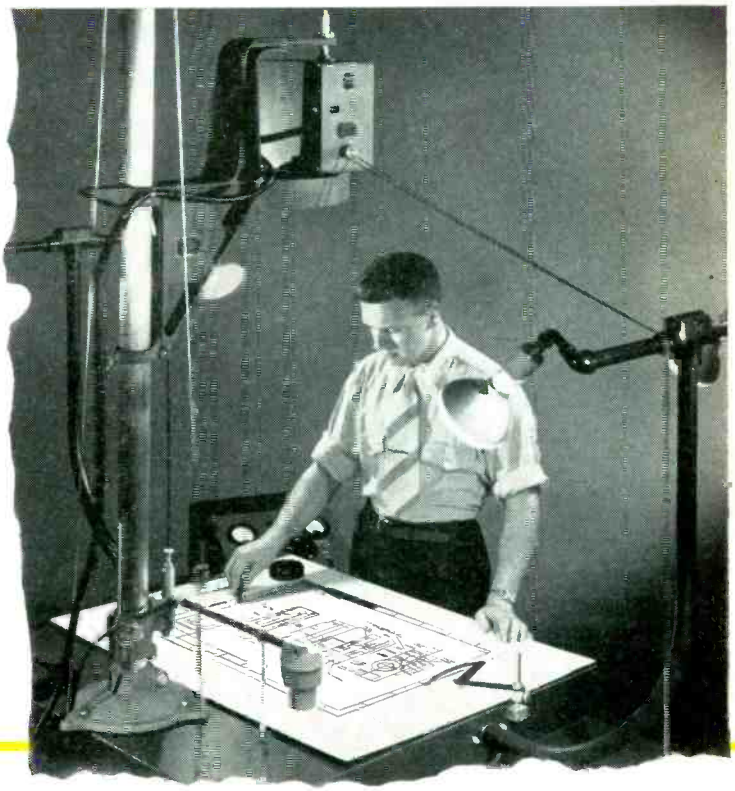
Instantaneously, it takes the picture at great reduction . . . advances the film . . . is ready for the next drawing.

In this manner you can record documents—large or small—bound or unbound. Do it conveniently . . . speedily . . . whenever the demand arises.

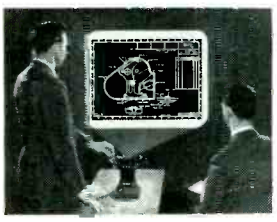
4 different models now available

Kodagraph Micro-File Machines meet the wide range of requirements in engineering departments . . . and in the field. Each is a precision machine . . . designed by Kodak . . . made by Kodak to give you these advantages—

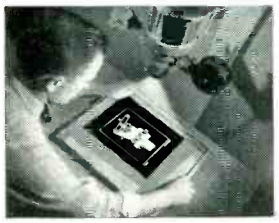
- You can reclaim 98% of your filing space . . . microfilm old records . . . then destroy them, if you wish.
- You can provide branch offices, repair depots with compact, duplicate records on positive microfilm.
- You can simplify reference work . . . file your 16mm. or 35mm. film records at your finger tips . . . ready for immediate review in the Kodagraph Film Reader.



To view your microfilm records in the office . . . the Kodagraph Film Reader. Each image is enlarged sharp and clear . . . easy to read and check . . . on a special green-tinted viewing screen. You can speed the film from image to image . . . get all the information you need—quickly.

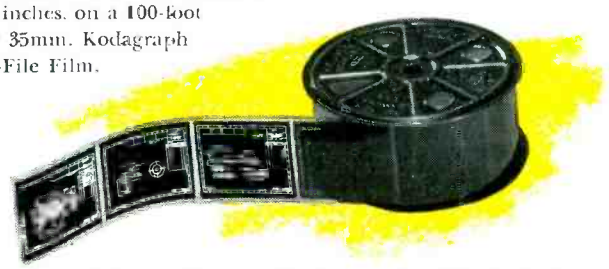


To view your microfilm records in the field . . . the Kodagraph Portable Projector. You can flash your records on any screen or light colored wall . . . magnified at dimensions up to several times larger than the original, if necessary. It is convenient to carry—weighs only twelve pounds.



To make enlargement prints from your microfilm records . . . the Kodagraph Micro-File Enlarger. It produces prints of maximum legibility . . . so sharp that they can be used as intermediates in direct process or blueprint machines.

In weighing the advantages of installing a Kodagraph Micro-File Machine in your engineering department . . . consider, too, the economy of the operation. You can record 675 drawings, size 24x36 inches, on a 100-foot roll of 35mm. Kodagraph Micro-File Film.



For complete information, write today for illustrated literature.

"Kodak" is a trade-mark

EASTMAN KODAK COMPANY
Industrial Photographic Division
Rochester 4, N. Y.

48

Eastman Kodak Company
Industrial Photographic Division
Rochester 4, N. Y.

Please send your literature illustrating Kodagraph Micro-File equipment.

Name _____ (please print)

Department _____

Company _____

Street _____

City _____

State _____

Kodak

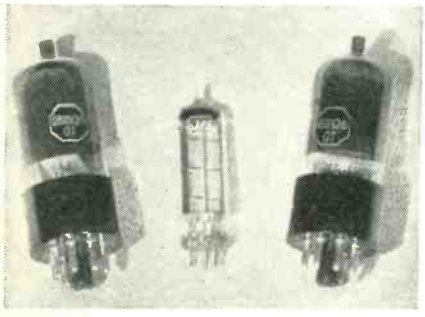
NEW PRODUCTS

EDITED by WILLIAM P. O'BRIEN

Television's Rapid Stride Forward Lends Impetus to Receiver Tubes and Parts Production . . . Temperature and Shock Protection Loom as Vital Factors in Equipment Design . . . Drift is Toward Wider Frequency Ranges for Test Apparatus

Tele Antenna Switch

THE LAPOINTE PLASCOMOLD CORP., Unionville, Conn. With the Vee-D-X antenna switch it is not necessary to attach a separate transmission line every time a different antenna is to be used. By turning the knob the viewer can change over from one antenna to another. The unit is also useful for tv dealers when demonstrating more than one receiver from a single antenna. It features a low-loss switch that prevents leakage, and a terminal strip at the rear which will accommodate three separate leadins as well as the output line to the receiver.

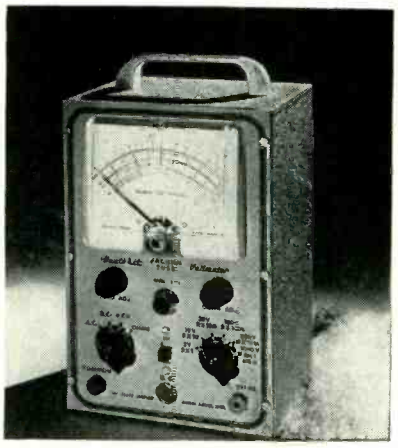


Tele Receiving Tubes

GENERAL ELECTRIC CO., Schenectady, N. Y., has announced three new tubes designed mainly for television receivers. The 6AS5 is a miniature beam-power amplifier intended for use as the audio power-output tube in television and small radio receivers. When operating with a plate voltage of 150 v and an input signal of 8.5 v peak, 2.2 watts of output power can be realized with 10-percent distortion. The 6BQ6-GT and 25BQ6-GT beam-power amplifier tubes are intended for use as horizontal-deflection amplifiers in television receivers. Maximum ratings of the tubes include a plate dissipation of 10.9 w, a plate current of 100 ma and a peak positive surge plate voltage of 5,000 v.

Precision Potentiometer

SOUTHWESTERN INDUSTRIAL ELECTRONIC CO., 2831 South Oak Road, Houston 19, Texas. The new model P-2 precision electronic potentiometer makes potential measurements on high-impedance electrochemical cells or electronic tubes and circuits. It is suitable for measuring potentials from 0 to 3 volts in three ranges. Current flow in the measured circuit is less than 10^{-11} amperes, making it suitable for use with glass electrodes. A built-in standard cell, combined with a 0.1-percent potentiometer and dual-range dial provides an accuracy of ± 1.0 mv plus 0.1 percent.



VTVM

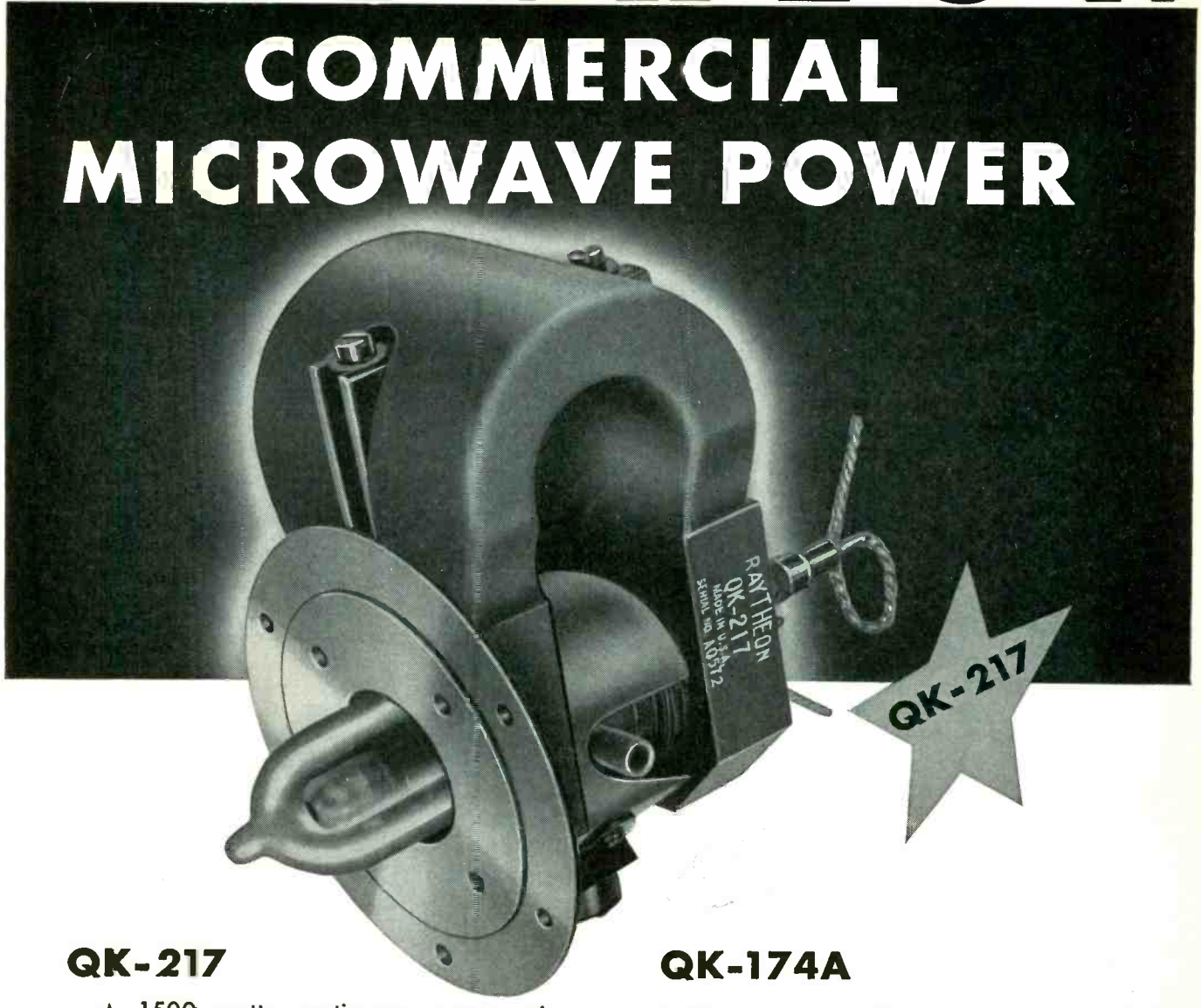
THE HEATH CO., Benton Harbor, Mich., is introducing a new vacuum-tube voltmeter kit. Positive automatic meter protection on all functions is given by the electronic a-c voltmeter and push-pull d-c voltmeter circuit. The 200-μa unit uses Alnico V magnet for fast, accurate readings and one-percent precision ceramic divider resistors. It includes 24 complete ranges, and the meter pointer can be offset from zero for f-m and tv alignment.

Miniature Rectifier Tube

SYLVANIA ELECTRIC PRODUCTS INC., 500 Fifth Avenue, New York 18, N. Y. Type 1V2 miniature high-voltage half-wave rectifier is designed for television receiver pulse rectifying systems and voltage-doubler circuits for magnetically deflected 10 and 12-inch viewing

RAYTHEON

COMMERCIAL MICROWAVE POWER



QK-217

- ★ 1500 watts continuous power at 2450 megacycles.
- ★ Efficiency 50%.
- ★ Unipotential indirectly heated cathode.
- ★ Integral magnet construction.
- ★ Pre-plumbed.

QK-174A

F-M communications magnetron

- ★ Tunable 1990-2110 megacycles.
- ★ Frequency modulation 15 megacycles.
- ★ Power 100 watts.
- ★ Efficiency 35%.

Also a complete line of low power klystrons from 6 millimeters to 30 centimeters and pulse magnetrons both high and low power.

Data available on request

RAYTHEON

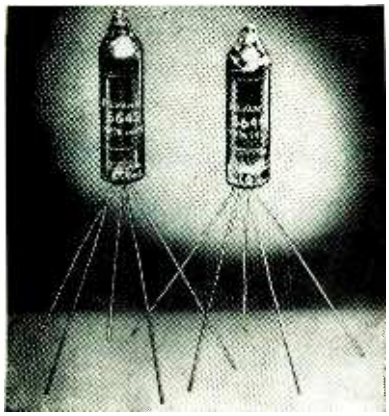
Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY
POWER TUBE DIVISION
Waltham 54, Massachusetts

tubes. It has a peak inverse plate voltage of 7,500, a peak plate current of 10 ma and an average plate current of 0.5 ma.

Enamel-Coated Resistors

HARDWICK, HINDLE, INC., 40 Hermon St., Newark 5, N. J. The new blue-gray enamel coating on the resistors illustrated gives greater protection throughout the most rugged service. Fixed, ferrule and flat-type resistors are especially designed and manufactured in accordance with JAN-R-26A specifications. Write for the recently published resistor bulletin.



Subminiature Triodes

SYLVANIA ELECTRIC PRODUCTS INC., 500 Fifth Ave., New York 18, N. Y. Type 5645 medium-mu triode, suitable for Class A-amplifier applications, is 1.3 in. long and 0.31 in. in diameter. Under typical operating conditions the tube will have a transconductance of 2,700 μmhos and an amplification factor of 20. Maximum rated plate dissipation is 1 watt and plate resistance, 7,400 ohms. Type 5645, a high-mu triode, under typical operating conditions, has a transconductance of 2,400 μmhos, an amplification factor of 70 and a plate resistance of 29,000 ohms. Maximum rated plate dissipation is 0.3 watt. Both types have 6.3-volt, 150-ma heaters and flexible leads.

Marker Generator

APPROVED ELECTRONIC INSTRUMENT CORP., 142 Liberty St., New York, N. Y. Model A-450 marker generator is a precision-built tunable oscillator providing a marker, modulated or unmodulated, for indicating frequencies on a displayed frequency response of a television or any wide-band i-f amplifier when used with a sweep generator and an oscilloscope. Frequency range is 19.5 to 40 mc, accurate to 0.5 percent or better. The unit operates on 115 volts, 60 cycles.

Panel Instruments

MARION ELECTRICAL INSTRUMENT CO., Manchester, N. H. The ruggedized panel instruments illustrated feature high shock testing when subjected to 2,000 foot-pound blows in each of three orientations with respect to direction of applied blow. New hair springs reduce zero shift, raise fatigue point and eliminate deformation under shock. Hermetic sealing of the reduced-weight unit gives complete weather protection in any climate.

Plate Circuit Relays

POTTER & BRUMFIELD MFG. CO., INC., Princeton, Ind. The new design of the series LC plate circuit relays includes molded bakelite coil bobbins with solder terminals on the coil periphery. This provides breakdown insulation up to 2,500 volts rms, and the added space in the bobbin allows windings up to 40,000 ohms. The series requires only 90 milliwatts for reliable operation and the ⅜ silver contacts are rated at 5 amperes.

Tiny TV Receiver Rectifier

SYLVANIA ELECTRIC PRODUCTS INC., 500 Fifth Ave., New York 18, N. Y. Type 1X2 is a double-ended miniature high-voltage rectifier tube designed for use with r-f flyback, and 60-cycle types of power supply for television picture tube anodes. Ratings are as follows: filament voltage, 1.25; current, 200 ma; maximum peak inverse plate volts, 15,000; maximum peak plate cur-

(Continued on page 210)

HERE'S WHAT THEY SAY ABOUT audiotape*

From all parts of the country—from users in every branch of the recording art—hundreds of reports have come in, commenting on the performance of Audiotape. The typical comments quoted below speak for themselves.

If you haven't tried Audiotape yet, why not see for yourself just what it can do to improve the quality of your tape recordings? Your local Audiotape and Audiodisc dealer will be glad to fill your requirements. Or, write to Audio Devices for a free 200-foot sample reel of either paper or plastic base Audiotape. It will speak for itself.

A Recording Service

"We find that your plastic Audiotape meets our requirements far better than the others we were using. We were bothered with flutter before, but now it seems that our discs we duplicate from tape are of much better tonal quality."

A Sound Consultant

"I have tested the samples on several recorders under various conditions. Both paper and plastic base proved to be as fine as any I have yet used--good frequency range and especially low noise level (inherent)."

A Radio Station

"We find Audiotape to be the best so far obtainable. There is less dust, dirt, and grit accumulation from this tape compared to others--as a result our machine runs at more constant speed."

A University

"We are using No. 1251 to record sound tracks for our educational films. We find the product very satisfactory and particularly appreciate the flat tape that does not hump away from the head in the middle."

A Research Laboratory

"Have found your tape the best for my recorder. Very low noise level and very uniform characteristics are its outstanding qualities. Price is also attractive."

A Home Recordist

"We've compared Audiotape with the tape we've been using and were impressed with the fidelity and low noise level. The output for a constant level 1000 cycle input is remarkably good, showing uniform coating."

A Broadcasting School

"I am happy to report that of several brands of tape tried, Audiotape has the lowest consistent noise level. Over-all response is remarkably consistent for all parts of each reel."

An Industrial Firm

"I find that this tape excels all other makes now on the market in quietness, range, and ease of handling. On the strength of the test sample, have disposed of all other makes and am now using only Audiotape."

A Grammar School

"We have used various tapes in our school work here and really know that yours is second to none. You can expect an order from us shortly."

A Radio Station

"We are very pleased with your Audiotape samples. Noise level very low and quality excellent. We use it whenever a good reproduction is desired. We find your tape and your discs best in the field."

A University

"We are delighted with the plastic base sample and in the future plan to order it exclusively. In speech work fidelity is very important, and we feel that the plastic Audiotape is the best we have tried."

A Radio Station

"Results from tapes tested--excellent. Low noise levels --low distortion. Seems to be less capstan slippage than other tapes. Attractive prices. All future purchases by us will include Audiotape."

A College

"Thanks for the Audiotape samples. We are using your plastic base tape exclusively for the original recording of our radio programs. We find that there is practically no loss dubbing from tape to discs."

A Radio Station

"Excellent tape -- much less flutter due to its ability to fit head contours better. All of our new tapes will be Audiotapes."

* *Trade Mark*

AUDIO DEVICES, INC.

444 MADISON AVE., NEW YORK 22, N. Y.

Export Dept.: ROCKE INTERNATIONAL, 13 East 40th St., New York 16, N. Y.

THEY SPEAK FOR THEMSELVES

NEWS OF THE INDUSTRY

EDITED by WILLIAM P. O'BRIEN

New Microwave Installation

ONE of the largest microwave installations in the country will provide modern protective and operating devices for network transmission facilities over the Bonneville power system in the Pacific Northwest. A contract for the system equipment has been awarded by the Bonneville Power Administration to the Philco Corp. of Philadelphia on a bid of $633,492.

The system will link all major dispatching centers, substations and federal power plants in the Pacific Northwest with voice communication, relaying, telemetering and fault-location channels. Construction of six microwave towers and substations for initial installation of equipment between Portland, Vancouver, Wash., and Seattle load and dispatching centers is nearing completion.

Microwave terminal and way stations will be located at Bonneville substations and dispatching centers near Vancouver, North Bonneville, Trinidad, Snohomish, Coulee City, Spokane and Vernita, Wash., and Portland and Troutdale, Ore.

Major power grids to be provided with microwave facilities include high-voltage facilities from Portland-Vancouver to Seattle, with loops to Chief Joseph and Grand Coulee dams and Spokane, and east from Portland to McNary Dam and eventually from Spokane to Hungry Horse Dam and from Portland to Eugene, Ore.

Microwave radio is expected to to effect substantial savings in maintenance and operating costs through instant detection of transmission faults before extensive damage results, and greatly curtail serious system outages through detection and operating facilities.

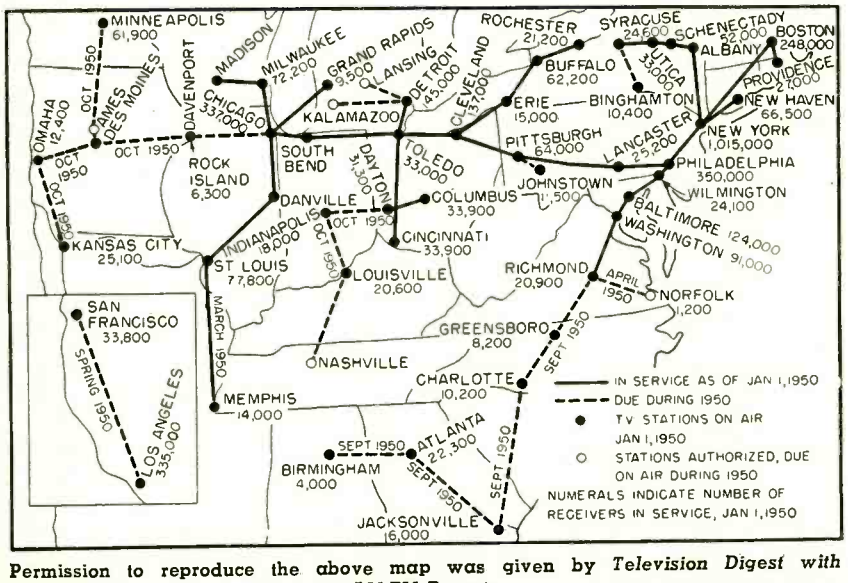
NAB Recording and Reproducing Standards

LEADING recording engineers of the nation met with the full National Association of Broadcasters' recording and reproducing standards committee in Chicago on April 15, at the close of the Engineering Conference portion of the 28th Annual NAB Convention.

The meeting was held to consider adoption of additional recording and reproducing standards, mainly devoted to magnetic tape recording. Most recent NAB recording and reproducing standards prior to this were adopted at the 1949 NAB convention. The standards apply to all types of recording and reproducing, and serve as engineering guides to manufacturers as well as recording engineers and audio specialists.

New standards proposed are designed to standardize magnetic tape reels, hubs and flanges, so that tape may be played more satisfactorily on all makes of equipment. After approval by the NAB board of directors the new sections will be incorporated in the printed Standards.

1950 TELEVISION NETWORK ROUTES



Permission to reproduce the above map was given by *Television Digest with AM-FM Reports*

Electronic Components Conference

A THREE-DAY conference sponsored by the AIEE, IRE and RMA, with the cooperation of the military services, the Research and Development Board of the Department of Defense, and the National Bureau of Standards will be held May 9 to 11, at Washington, D.C.

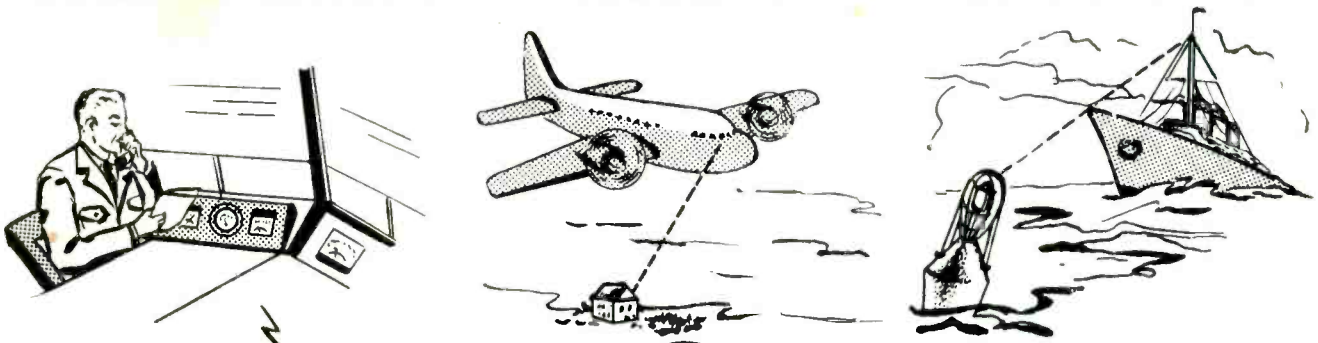
Purpose of the conference is to discuss improved quality components for greater dependability of radio-electronic equipments, unitized packaging as a means of simplified maintenance, miniaturization, and circuit elements suitable for unit package design. Discussion will be from the viewpoint of military equipments, commercial aviation, industrial instrument and control, commercial radio and television, and mobile communications equipments.

Advance registration for the conference may be obtained by sending $2 to A. E. Zdobysz, Bureau of Aeronautics, Building W, Room 1W91, Navy Department, Washington 25, D. C. Reservations for copies of the conference report may be made before May 9 through A. E. Zdobysz, conference treasurer, or through R. S. Gardner, AIEE headquarters, 33 W. 39th St., New York 18, N. Y., either before or after the conference.

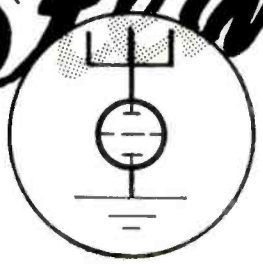
Industrial Fellowships in Electronics

A NUMBER of graduate and advanced research fellowships are offered by MIT for study and re-

COMMUNICATIONS AIRCRAFT NAVIGATIONAL



INTEGRATED Electronic Systems



Complete systems . . . built from your own blueprints, or designed and developed from an idea.

Modern, up-to-the-minute U.H.F. facilities are available to convert these designs into complete assemblies fabricated to do the job dependably. Quantity no problem, and competent understanding of government contract procedures.

U H F

A Few Typical Installations Include:

- **VHF Omnidirectional Radio Range**
- **UHF Communication**
- **Microwave Navigational Aids**

LAVOIE PRODUCTS also include: Oscilloscopes, Electromyographs, Frequency Standards, Frequency Meters, Square Wave Generators, etc., etc.

A LAVOIE Facilities Report may be had if you will address us on your letterhead, or a consultation will be arranged to suit your convenience . . . without obligation.

Lavoie Laboratories

RADIO ENGINEERS AND MANUFACTURERS
MORGANVILLE, N. J.

***Specialists* in the Development and Manufacture of UHF Equipment**

search in the field of electronics. They are known as Industrial Fellowships in Electronics and are sponsored jointly by a group of industrial organizations concerned with the advancement of electronics and its applications.

Applicants must satisfy the requirements for admission to the graduate school on recommendation of the Department of Physics or the Department of Electrical Engineering. Recipients of such fellowships will pursue programs of study and research leading toward advanced academic degrees in physics or electrical engineering. It is expected that the area of specialization of a Fellow will fall within the field of electronics.

There will be awarded a few Advanced Research Fellowships to candidates possessing the Ph.D. degree or its equivalent who, without enrolling as graduate students, wish to pursue advanced studies and research in electronics at MIT.

Recipients of a graduate student fellowship will be awarded a stipend varying between $1,200 and $1,800 according to their experience and qualifications, and in addition will be granted a credit to meet the tuition fee. Advanced research fellowships will range from $2,400 to $3,600 according to the qualifications of the recipient.

Applicants for an industrial fellowship in electronics should communicate with the Director, Research Laboratory of Electronics. Application should be made at least four months prior to the intended date of entrance.

MEETINGS

MAY 3–5: 1950 Dayton IRE Technical Conference, Dayton Biltmore Hotel, Dayton, Ohio.

MAY 9–11: Conference on Improved Quality Electronic Components, 1317 F Street N W, Washington, D. C.

MAY 12–13: Fourth annual meeting of the Armed Forces Communications Association, Hotel Commodore, N. Y., and Fort Monmouth, N. J.

MAY 22–25: Parts Distributors Show, Hotel Stevens, Chicago.

JUNE 1–2: Fourth National Convention and Fifth Midwest Conference of the American Society for Quality Control, Milwaukee Auditorium, Milwaukee, Wisc.

JUNE 12–16: AIEE Summer and Pacific General Meeting, Huntington Hotel, Pasadena, Calif.

JUNE 26–30: Annual Meeting and 9th Exhibit of Testing Apparatus and Related Equipment, Hotel Chalfonte-Haddon Hall, Atlantic City, N. J.

AUG. 23–26: AIEE Pacific General Meeting, Fairmont Hotel, San Francisco, Calif.

AUG. 27–31: NEDA National Convention and Exhibition, Cleveland Public Auditorium, Cleveland, Ohio.

AUG. 28–31: APCO National Conference, Hotel Hollenden, Cleveland, Ohio.

SEPT. 11–23: URSI Ninth General Assembly, Zurich, Switzerland.

SEPT. 13–15: Sixth Annual Pacific Electronic Exhibit, Municipal Auditorium, Long Beach, Calif.

SEPT. 18–22: Fifth National Instrument Conference and Exhibit, Memorial Auditorium, Buffalo, N. Y.

SEPT. 25–27: National Electronics Conference, Edgewater Beach Hotel, Chicago, Ill.

OCT. 17–21: AIEE Midwest General Meeting, Netherland Plaza Hotel, Cincinnati, Ohio.

New Memory Tube

DEVELOPMENT of a radio tube that can remember what it is told and reproduce its information on request was recently announced at the IRE Convention and Radio Engineering Show in New York City, by engineers from MIT.

The new tube, which looks like a glass automobile muffler with an extra pipe coming out of one end, has been developed for use in a high-speed computing machine now under construction at MIT under the auspices of the Office of Naval Research.

Its 400-digit memory should make the tube useful in any computer, communication and information-handling systems using coded data at high speeds. The new memory tube will hold its information indefinitely, as long as power is supplied. It can receive a number to be remembered in twenty-millionths of a second and give one out, when needed, just as fast. When it puts a number into storage, the tube sends back a check signal which verifies that the correct number has been memorized. The tube can also report on stored information without erasing it and old signals can be cleared by putting new ones on top of them.

Storage tubes of the type described are important in computing machines because they can be used as notebooks in which the machine keeps track of problems, instructions, and partial answers in the course of a computation.

The new tubes operate by storing dots of electric energy on a round storage surface. Each tube will record a choice of only two digits—either zero or one, yes or no—in any of 400 different positions. The development is thus especially tailored to the needs of that type of computing machine which solves all its problems in terms of so-called binary digits. In such machines a numerical system involving only two digits is substituted for the familiar ten-digit system. Conventional numbers higher than 0 and 1 are represented by combinations of those two. The electrostatic storage tube might treat the number 2 by remembering an 0 in one location and a 1 in a different location.

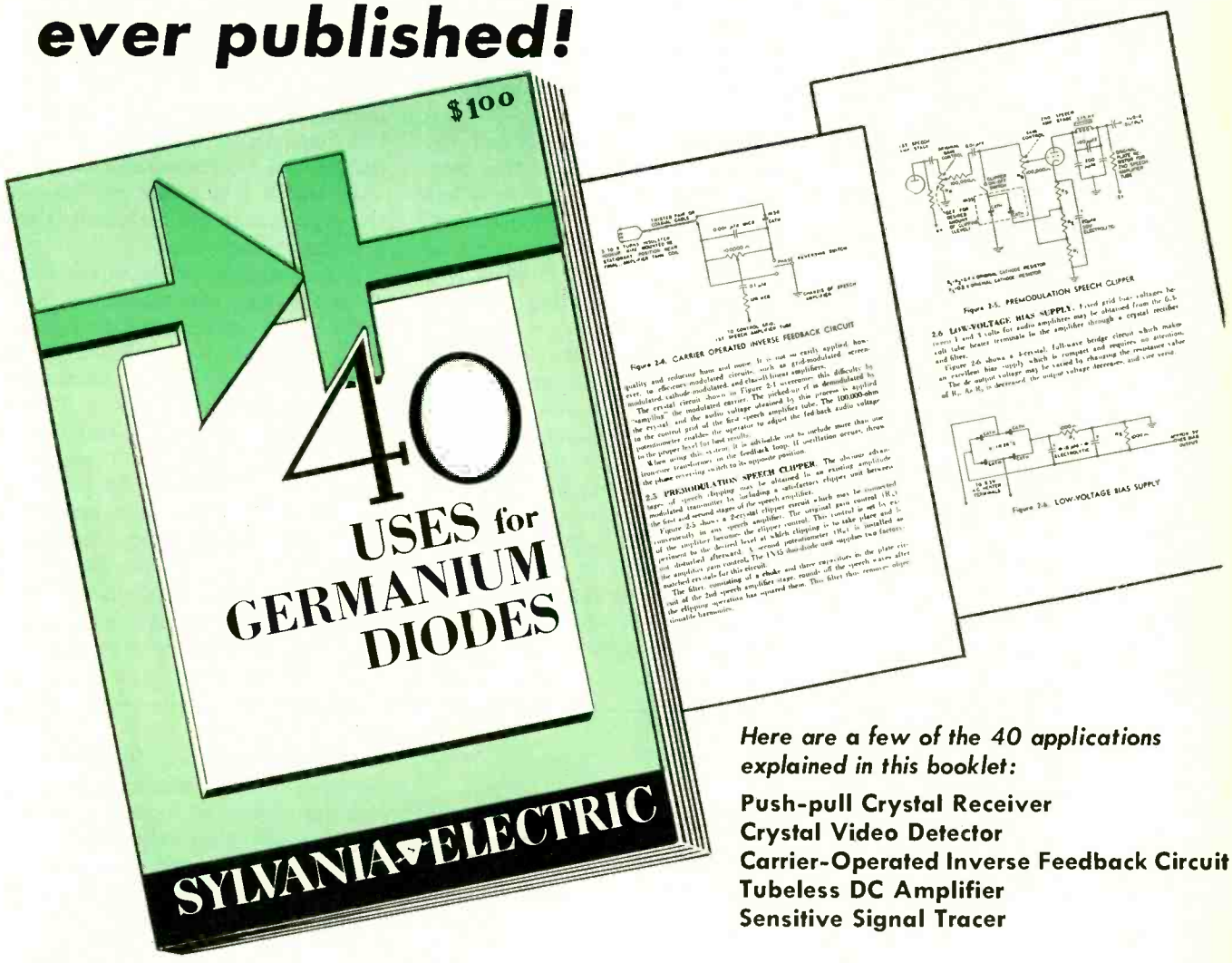
The storage tube is built somewhat like a television tube. A fast, high-voltage electron beam is used as the writing beam to apply yes or no voltages to a storage surface. A smaller stream of low-speed electrons continuously sprays this same target surface to hold the information from leaking off.

The storage tube's memory takes place on electrical islands made by beryllium metal deposited on a sheet of insulation in a minute checkerboard pattern. The writing beam of the tube can select a small area of this storage surface consisting of 10 to 20 adjacent beryllium islands, and apply either of two voltages, one meaning yes and one

(Continued on page 248)

ENGINEERS, TECHNICIANS, HOBBYISTS—

Here's the most complete collection of Germanium Diode Applications ever published!



Here are a few of the 40 applications explained in this booklet:

Push-pull Crystal Receiver
Crystal Video Detector
Carrier-Operated Inverse Feedback Circuit
Tubeless DC Amplifier
Sensitive Signal Tracer

Sylvania's new handy-sized book, "40 Uses for Germanium Diodes," presents for the first time all the most important applications of germanium diodes. In it, the engineer and technician will find time-saving devices and simplified circuits. Hams, hobbyists and experimenters will find plans for a host of interesting instruments and gadgets, from crystal receivers to voltage and frequency multipliers. Simple, clear explanations, plus more than 40 separate diagrams, describe germanium diode applications in receiver and transmitter circuits, instrument construction and electronic "gadgets."

This book is full of new circuit ideas. It will save you time and money. It costs only $1. Mail the coupon today with your dollar and your copy will be sent you at once.

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

SYLVANIA ELECTRIC

Sylvania Electric Products Inc.
Advertising Dept. E-1005
Emporium, Pa.

Please send me "40 Uses for Germanium Diodes." Enclosed is $1.00.

*Name*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

NEW BOOKS

Frequency Modulated Radar

BY DAVID G. C. LUCK. *McGraw-Hill Book Co., New York*, 1949, 466 *pages*, $4.00.

AT THE CONCLUSION of World War II, little time was lost in publishing in great detail virtually all phases of the theory and techniques associated with pulse radar. The MIT Radiation Laboratory Series is perhaps the most notable example, but several other books, plus a great number of articles in the periodical literature, have served to give pulse radar extended coverage and discussion. It is, therefore, surprising to note that even at this late date, little reference is available on the subject of f-m radar. Despite the fact that f-m altimeters were used by all principal contestants in the last war, no substantial information has been provided except in classified reports.

This book is aimed at and succeeds well in correcting this oversight. Written originally as a final Navy report on an extensive development and production contract undertaken by RCA, it deals with basic theory, applications and systems design.

Theory is presented in simplest possible form. To insure this, the author confines his analysis to the case of symmetrical sawtooth modulation, so that the upsweep beat note and downsweep beat note have constant values except near turnover points. In this way a clear physical picture is presented, as well as the basic factors which establish ultimate performance. This accomplished, other types of modulation and their particular advantages are briefly discussed, exclusive of mathematical detail.

The basic elements of the system as used in practice are described, such as antenna, oscillator, amplifier, limiter and counter. In this connection a very clear, if somewhat limited, account is given of beat-frequency waveform, its treatment by circuits of different characteristics, and its ultimate effect in producing fixed errors. In a section on simple fire-control kinematics, the directness and economy with which f-m radar can supply the needed data for certain tactical problems is described.

A substantial portion of the book discusses the characteristics and makeup of several military systems, such as AN/APN-1 Altimeter, AN/APG-4 Automatic Bombing, and several others. These descriptions are necessarily brief, but in general include block diagram, simplified schematic, and a discussion of significant features, such as primary function, indicator display, and controls provided. In addition, several equipments are discussed whose developments were

(continued on page 134)

BACKTALK

This Department is Operated as an Open Forum Where Readers May Discuss Problems of the Electronics Industry or Comment Upon Articles Which ELECTRONICS Has Published

Electrons to the Rescue

DEAR SIRS:

WILL YOU ADD THIS LETTER to the museum you will have when your 30,000 readers send in their solutions to Prof. Schumann's dilemma?

The professor complains of mice. Your *New Products* department lists, in the March, 1950, issue, page 214, what is the good gentleman's *best* solution.

Would you be willing to contribute your most dog-eared copy of ELECTRONICS for bait?

As a subsidiary topic, may the coined word CAAT be considered along with Mr. Wouk's COVAT? (*Backtalk*, March 1950) The COntinuously - Adjustable-Auto-Transformer which he first mentions is just as amenable to alphabetizing and with as good or better results.

HAROLD S. HANSON
New York, N. Y.

Gain of Helical Arrays

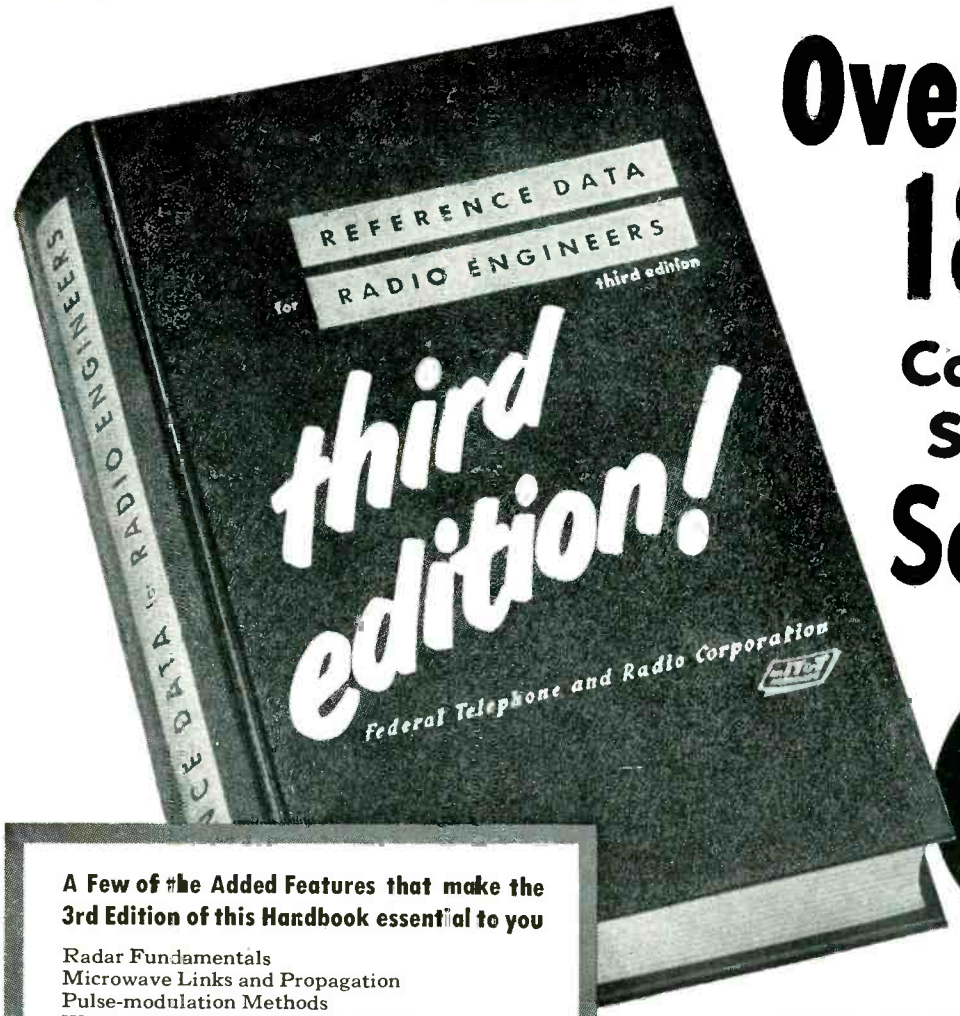
DEAR SIRS:

E. DILLON SMITH'S article in the February issue of ELECTRONICS, "Constructing Helical Antennas", deserves commendation for presenting in practical form a new technique of the antenna field.

I was impressed, however, by the exceptionally high values (listed in Table III) of power gain claimed for antenna systems composed of helical arrays as compared to the dipole system. Upon investigation it appears that Mr. Smith obtains these values theoretically by multiplying the measured gain in decibels of an individual helix by the number of elements in the array. This procedure leads to erroneous results.

The gain of an antenna depends only upon its radiation pattern which, in turn, is a function of the spacing and the radiation pattern of the individual array elements. An exact determination of power gain requires an integration process on the radiation patterns; this cannot be done here since Mr. Smith supplies no data on his spacings. An approximate method, de-

(continued on page 258)



Over 18,000 Copies Sold Since Last September

Only $3.75 PER COPY
green flexible Fabrikoid binding

A Few of the Added Features that make the 3rd Edition of this Handbook essential to you

Radar Fundamentals
Microwave Links and Propagation
Pulse-modulation Methods
Wideband Interstage Circuit Design
Filter-Network Design
Transformers and Other Components
Expanded Antenna Data
Multi-vibrators and Special Oscillators
Electroacoustics Theory and Practice
Bridges and Impedance Measurements
Microwave Tubes and Circuits
Servo-Mechanism Fundamentals
AM, FM, and TV Broadcasting
Transmission-Line Formulas Greatly Expanded
Spurious Frequency Responses
Expanded Mathematical Formulas
Laplace Transforms
Summary of Maxwell's Equations

THIS FAMOUS DATA BOOK BELONGS IN YOUR REFERENCE LIBRARY!

- Over 100% more material.
- 640 pages packed with useful data.
- Contains material never before available in such detailed, complete, convenient form.
- Over 111,000 copies of 1st and 2nd editions in use to date.
- Adopted as a supplementary text by more than 150 colleges.
- Compiled by the physicists and electronic specialists of the Federal Telecommunication Laboratories, Inc. and the International Telephone and Telegraph Corporation.

Over 100,000 satisfied users attest to the real worth of this indispensable data book. Now it has been revised and enlarged from 322 to 640 pages . . . jampacked with the kind of reference data you need to have on hand.

Over 653 charts and diagrams and 207 tables give quick answers to the problems that come up in practical radio, television and electronic work. The handy subject index makes it easy to find the exact information you require.

Federal Telephone and Radio Corporation

Publication Department—67 Broad Street, New York 4, N. Y.

---GET YOUR COPY NOW—USE THIS COUPON---

FEDERAL TELEPHONE AND RADIO CORPORATION
Publication Dept. E-50, 67 Broad Street
New York 4, N.Y.

I enclose_____dollars, for which send me_____ copies, at $3.75 per copy.*

*Name*_____

*Address*_____

*City*_____ *Zone*_____ *State*_____

*For 12 or more copies, sent in bulk to a single address, the price per copy is $3.00.

not complete until after the war.

There is no doubt that in certain single-target problems requiring rapid measurement of speed and range, f-m radar has decisive advantages over pulse radar. In a final section of the book the author compares them for multiple-target problems. Here pulse radar stands in the stronger position, the chief reason perhaps being the simplicity of data display. However, several calculations and arguments are presented (admittedly not yet confirmed by experiment) to show that for systems of equal average power, antenna gain, etc, the two systems are quite equivalent in theoretical data-gathering ability. Economical display and use of this data by f-m systems will, in the author's opinion, emerge when the latter has received a fuller share of development effort.—JOHN F. MCALLISTER, JR., *General Electric Co., Electronics Park, Syracuse, N. Y.*

Advances in Electronics, Volume II

EDITED BY L. MARTON, *National Bureau of Standards. Academic Press Inc., New York*, 1950, 378 *pages*, $7.60.

ENCOURAGED by the reception of Volume I by the scientific community, the editors of that volume have now gathered together eight additional small monographs and have produced a second volume of what promises to be an annual yearbook.

This book deals more with physical electronics than with engineering electronics, the first three of the included papers covering aspects of electron focusing and the fourth, cathodoluminescence. The second half of the book approaches engineering to a slightly greater degree, the subjects treated being breakdown in dielectrics, microwave magnetrons, ferromagnetic phemonena and spectroscopy.

The authors are five-eighths international, as the contents below will indicate. As in Volume I, the approach is thoroughly technical. Each chapter represents a survey of present-day knowledge of the subject. The contents of this volume follow:—

Cathode Ray Tube Progress in the Past Decade with Special Reference to Manufacture and Design, by Hilary Moss, Elec-

NEW BOOKS (continued)

tronic Tubes, Ltd., Reading, England.

Electron Lenses, by P. Grivet, University of Paris, France.

Field Plotting and Ray Tracing in Electron Optics—a Review of Numerical Methods, by G. Liebmann, Associated Electrical Industries Limited, Aldermaston, Berkshire, England.

Cathodoluminescence, by G. F. J. Garlick, University of Birmingham, England.

Intrinsic Dielectric Breakdown in Solids, by H. Fröhlich and J. H. Simpson, University of Liverpool, England, and National Research Council, Ottawa, Canada.

The Microwave Magnetron, by Gunnar Hok, University of Michigan.

Ferromagnetic Phemonena at Microwave Frequencies, by George T. Rado, Naval Research Laboratory.

Microwave Spectroscopy, by Donald K. Coles, Westinghouse Research Laboratories.—K. H.

Terrestrial Radio Waves

BY H. BREMMER. *Elsevier Publishing Co., Inc., New York*, 1949, 343 *pages*, $5.50.

DR. BREMMER, whose name has long been associated with the theory of radio-wave propagation, here presents the results of many years of inspired effort. The work is entirely mathematical although one chapter is devoted to a collection of formulas for numerical evaluation of ground-wave intensities, and a number of graphs exhibit the basic phenomena of both ground wave and ionospheric transmission for a number of radio frequencies and varying soil and ionospheric conditions.

The author is to be commended for avoiding the pitfalls associated with discussion of an assumed plane earth and plane ionosphere and for the emphasis he has given to physical interpretation of the necessarily complex mathematical discussion. In general, he uses two methods for treatment of the electromagnetic field, one having the characteristics of diffraction theories and the other leading to geometric-optical interpretation.

After a short introduction the work is divided into two parts; five chapters deal with transmission in a homogeneous atmosphere and five discuss extension of the theory to ionospheric transmission and refraction in the lower atmosphere. The influence of the earth's magnetic field is considered in the final chapter.

It is the reviewer's belief that, in the case of ionospheric transmission, this is the first serious evaluation of what may crudely be called the focusing and defocusing effects of the atmosphere on pencils of rays. It is clearly shown that these

NEW BOOKS (continued)

often have more serious effects upon the field intensity than does absorption. Unfortunately it is apparently beyond the scope of even the complex mathematics of this book to deal with multiple stratification, so that the interesting effects of combined *E* and *F*-layer transmission are not derived.

The order of the mathematical transformations and approximations used will be discouraging to most radio engineers, but the author has usually managed to keep his line of reasoning clear. It is to be regretted that the subject is necessarily so complex, but it is an important one. This work brings much of it within the realm of analytical discussion. The book is not one to be read lightly, but it will generously reward intensive study. —J. A. PIERCE, *Cruft Laboratory, Harvard University.*

Electronics: Experimental Techniques

National Nuclear Energy Series, Division V, Volume 1, *edited* BY W. C. ELMORE AND MATTHEW L. SANDS. *McGraw-Hill Book Company, New York,* 1949, 417 *pages,* $3.75.

IN THE EXPERIENCE of this reviewer this is the first book written by physicists for physicists which deals exclusively with electronic techniques. The title is correctly chosen only for physicists. The definition of the content as given in the flyleaf cover represents much more faithfully the intention of the authors. This is not a treatise on experimental electronic techniques; it is a volume describing in detail a series of excellent devices which have been designed, tested and modified until they meet satisfactorily many of the needs of the nuclear physicist. The devices are described for other physicists who will encounter the same or very similar problems. Whether this volume will also be used effectively to constitute the basis for the design of completely new circuits is a debatable question.

This book is the first one of Division V of the National Nuclear Energy Series prepared by the technical section of the Manhattan project; this series will eventually

here's STABLE VOLTAGE *for Sensitive Equipment*

Stabilizers are used for such voltage-sensitive devices as: motion picture sound equipment, radio testing equipment, telephone equipment, laboratory equipment, and even regulating circuits for rural home appliances.

how to get a steady 115 volts...

General Electric Voltage Stabilizers automatically level out variations in line voltage between 95 and 130 v *almost instantaneously*. They deliver, to voltage-sensitive equipment, a constant a-c potential.

- **Rated output is 115 volts**—for any input between 95 and 130 volts. (Other output voltage ratings are available.)
- **Variation from rated output** is less than ± 1% for constant loads of unity power factor.
- **Ordinary voltage surges**—caused by inductive kicks, switching, etc.—are absorbed.
- **Stabilizers have no moving parts,** require virtually no maintenance.

Illustrated is the 50-volt-ampere model. Others are available with ratings from 15- to 5000-va. For general information write for Bulletin GEA-3634B. Apparatus Department, General Electric Company, Schenectady 5, N. Y.

Your G-E office will be glad to evaluate your particular needs; or we can advise you by mail if you will give us data and a description of the circuit and load. Address inquiries to Specialty Transformer Sales Division, 1635 Broadway, Ft. Wayne, Indiana.

GENERAL ELECTRIC

411-78

consist of about 60 volumes. Division V of these volumes covers the work done at the Los Alamos Laboratories.

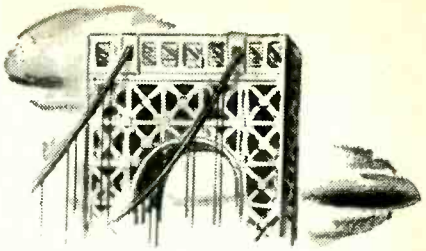
In some cases circuits are described with but few explanations of design criteria. In other cases, exhaustive qualitative and sometimes quantitative discussions are given. It appears strange to a radio engineer, but perhaps not to a physicist, to find in the same volume many pages on circuit components and construction practices which can be found in handier form in most reference books or which are well known to anybody who has done any amount of work in an electronics laboratory, and at the same time to see only a few pages devoted, for instance, to feedback circuits. Descriptions of the Los Alamos equipment which form the bulk of the text are often of the instruction-book type, are very thorough and include mechanical layout information.

In the first chapter electrical components and chassis construction problems are dealt with. In the second chapter, the only one devoted exclusively to basic information, one finds descriptions of the fundamental elements of electronic circuitry from the most elementary to the most advanced type. Short descriptions are given of R-C amplifiers, shunt-peaking coils, delay lines, relaxation oscillators, phase inverters, multivibrators and flip-flop circuits. Particular emphasis is always given to transient response of all the circuit elements. This emphasis makes this chapter very interesting and it is to be regretted that only one chapter has been devoted to this part of the subject matter.

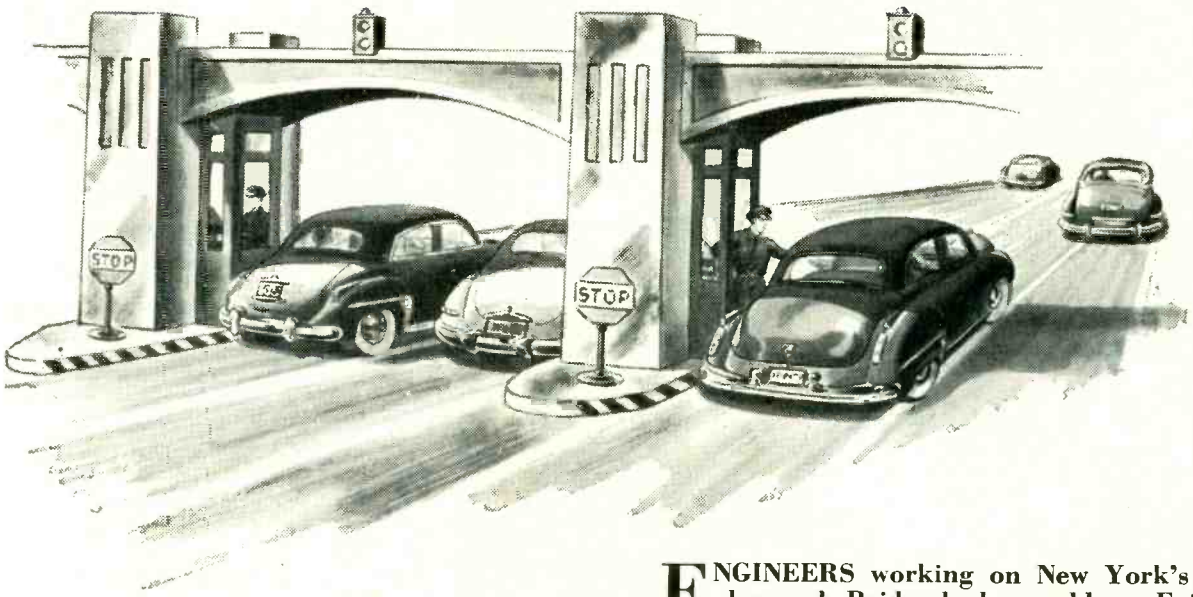
The large mass of material and the little space devoted to it made it impossible for the authors to maintain a balanced presentation. The information presented is often sketchy and incomplete, and reference must often be made to the detailed equipment descriptions in the following chapters to fill some of the gaps.

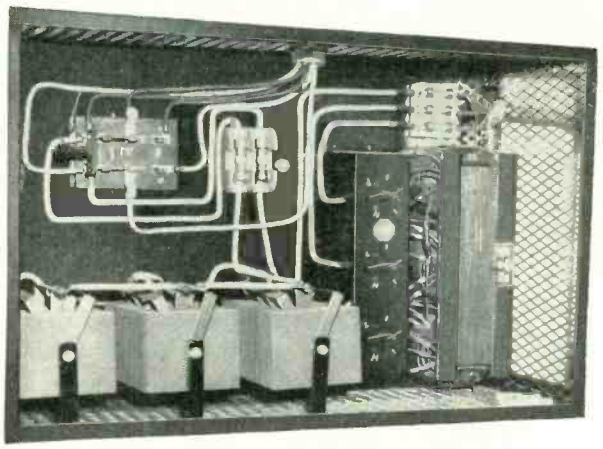
The third chapter covers voltage amplifiers, particularly pulse amplifiers; pulse shaping and transient response of wideband amplifiers are also thoroughly discussed. It

OTHER TYPES OF RECTIFIERS TOOK THEIR TOLL AT THE TOLL GATES



. . . THEN Seletron SELENIUM RECTIFIERS BRIDGED THE GAP!





INSTALLATION AT TRIBOROUGH BRIDGE, OPERATING D.C. RELAYS AND COUNTERS RECORDING THE NUMBER OF CARS AND TOLLS COLLECTED.

60 VOLTS OUTPUT, 45 AMPS. CONTINUOUS DUTY, IN USE 24 HOURS A DAY, 365 DAYS A YEAR.

ENGINEERS working on New York's great Triborough Bridge had a problem: Existing rectifier installations controlling 22 toll lanes were not efficient. . . They were far too bulky for the current and voltages delivered. . . They generated too much heat.

The solution? Ralph M. Thompson of the Electronic Signal Company, Williston Park, L. I., to whom the contract was let chose and installed SELETRON *Selenium* Rectifiers built on Aluminum . . . and the problem ceased to exist! For SELETRON *Selenium* Rectifiers actually require no more than 1/5th the space needed for the old equipment; they have low internal heat losses, and afford much better voltage regulation.

The Triborough Bridge installation is typical of hundreds of other applications where "job-rated" SELETRON *Selenium* Rectifiers have paid off in top performance. They are available in a variety of assemblies to cover a wide range of currents and voltages.

Perhaps you have a tough rectification problem that SELETRON engineers can solve. Will you write and tell us about it now? Our general catalog is yours for the asking, too. Just address Dept. ES-29.

SELETRON DIVISION

RADIO RECEPTOR COMPANY, INC.

Since 1922 in Radio and Electronics

Sales Department: 251 West 19th St., New York 11, N. Y.

Factory: 84 North 9th St., Brooklyn 11, N. Y.

is regrettable that in a book published in the year 1949 no mention is made of distributed amplifiers and that the concept of noise figure is not even introduced. Pulse amplifiers built by the Los Alamos Laboratory are described in detail together with some d-c amplifiers and some miscellaneous low-frequency, wide-band and pulse-stretching amplifiers.

The fourth chapter covers electronic counters, which are obviously a subject of paramount importance for nuclear physics. From this chapter on, to the end of the book, the reader gets more and more often the impression that the authors are condensing the instruction books prepared by the Los Alamos Laboratory. It must be stated, however, that detailed descriptions are given of the methods employed for the testing and construction of these circuits and some general discussions of the basic problems are added. In the last chapters oscillographs and associated equipment are discussed; test and calibration equipment, power supplies and control circuits conclude the volume.

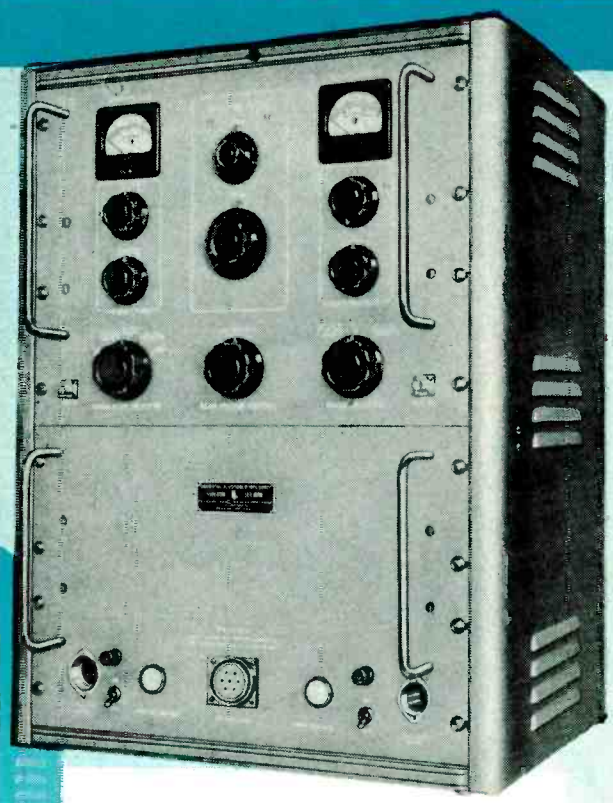
In conclusion, about two-thirds of the 400 pages of this book are devoted to descriptions of equipment and one-third to information of a general type. The equipment described appears to be of very high quality; with few exceptions, nearly the best available today. There is little doubt, therefore, that this volume will be at least for a few years of the utmost usefulness in all physics laboratories. On the other hand, the average radio engineer will consult this book only if he deals with problems which approximate those encountered by physicists. Since clever circuits and interesting details are hidden in the description of a piece of equipment, the experimenter will not find this book conducive to radical departures from established techniques.

It is clear now why it is difficult to make general statements on the value of this book. The goal of collecting in a single place the information on high-quality equipment built at Los Alamos has been reached very successfully. The usefulness of this book and its perma-

KILOVOLTS for KLYSTRONS

NEW **PRD**

POWER SUPPLY for microwave oscillators



PRICE
$1250.00
F.O.B. BROOKLYN, N.Y.

CONTINUOUSLY VARIABLE
Carefully regulated beam voltage supply provides cathode-to-grounded-anode potential in two ranges with choice of operation from 800 to 1500 volts at 65 ma or to 3600 volts at 25 ma.

DIRECT READING CONTROLS
— coarse and fine — allow repeller voltage to be accurately adjusted from —20 to —750 volts.

GRID VOLTAGE
may be varied continuously from —300 volts to a positive value limited by the klystron grid current.

PANEL METERS
indicate beam voltage and current directly.

The Type 801 Universal Klystron Power Supply has been developed by PRD to meet the increasing need of research and production engineers for a unit to operate the many high voltage klystrons now in use throughout the microwave spectrum.

Provision is made for c-w, square-wave, sawtooth, and external modulation of conventional internal cavity klystrons, external cavity oscillators, and the new millimeter tubes now coming into use in microwave spectroscopy.

Excellent voltage stabilization guarantees a maximum of oscillator frequency stability. Carefully controlled modulation wave-shapes insure accuracy of standing wave measurements and spectrum analysis when made with oscillators powered by this supply.

Polytechnic RESEARCH & DEVELOPMENT COMPANY, Inc.
202 TILLARY ST., BROOKLYN 1, NEW YORK

PRD

JUST OFF THE PRESS! The new 95-page catalog describing the complete PRD line of microwave test equipment is now available — write for your copy today to Dept. E-8.

nent value would have been greatly enchanced if the title of the book had more accurately represented its content and if a more complete treatment has been given of the basic circuit elements, even at the price of less detailed equipment descriptions.—E. G. FUBINI, *Supervising Engineer, Airborne Instruments Laboratory, Mineola, New York.*

Elementary Pile Theory

BY HARRY SOODAK, *Research Associate, Massachusetts Institute of Technology* AND EDWARD C. CAMPBELL, *Senior Physicist, Oak Ridge National Laboratory. John Wiley & Sons, Inc. New York,* 1950, 75 *pages,* $2.50.

IN A CHAIN-REACTING pile, fast neutrons are produced by fission. Some of these neutrons, after being slowed down by a moderator, strike other fissionable nuclei to produce additional neutrons and thus keep the chain reaction going. This volume deals with the processes within such a reactor or pile; as such it is of interest to any engineer or scientist who wishes to have in concise form the basic facts about these nucleonic reactions.

The elementary part of the title means that the elements of the subject are found in the book; the subject itself is not so elementary. In fact, it is no more elementary or simple than the derivation of the three-halves law for electron emission, or of the use of Maxwell's equations to understand what happens in waveguides. If, however, the reader is willing to undergo slight mental effort, he will learn a great deal about this new form of energy with which all engineers must sooner or later deal, each in his own way.—K. H.

• • •

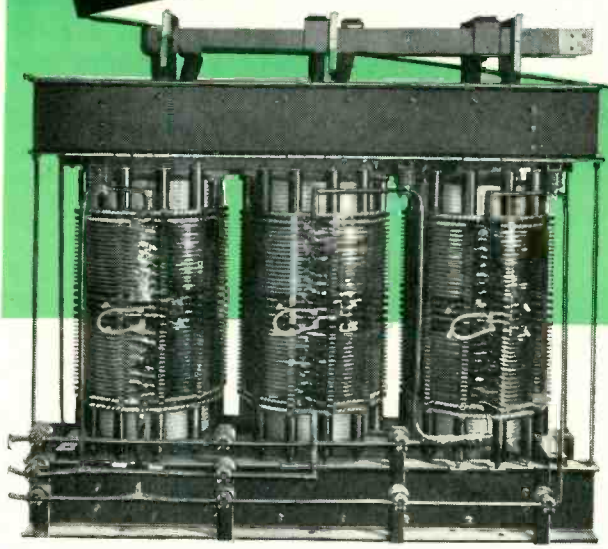
Books Received for Review

TELEVISION TUBE LOCATION GUIDE. Compiled and published by Howard W. Sams & Co., Inc., Indianapolis, Ind., 1950, paper cover, $1.50. Over 200 television receiver chassis layout diagrams with all tubes identified by type and function.

RADIO OPERATING QUESTIONS AND ANSWERS. By J. L. Hornung. McGraw-Hill Book Co., New York, 1950, 10th Edition, 588 pages, $4.50. Answers to FCC examination questions for all seven elements, including a total of 266 questions dealing with special air navigation problems and other topics in the new Element 7.

DRY-TYPE TRANSFORMERS REQUIRE EXCEPTIONAL INSULATION

Sorgel USES NATVAR FIBERGLAS*



Core and coil assembly of a Sorgel 1500 kva., 3 phase, 12,500 volt air-cooled transformer ready for mounting in the steel enclosure of a unit sub-station. Coils are disc type, separated and supported by steatite spacers. It is built to operate at temperatures up to 80°C. above normal ambient. Natvar Varnished Fiberglas and Varnished Fiberglas Sleeving are used to insulate coils and leads. Natvar Varnished Fiberglas Tape is used for extra end turn insulation.

Air-Cooled, Dry-Type Transformers are built by Sorgel Electric Company, Milwaukee, to meet the increasing demand for large distribution transformers that can be installed *inside* buildings as unit sub-stations without construction of fireproof vaults.

Transformers are housed in compact steel enclosures together with the necessary switches, meters and circuit breakers. They take up very little space, and can be placed at load centers, eliminating long secondary feeders and improving plant layout.

Natvar Varnished Fiberglas, Varnished Fiberglas Tapes and Varnished Fiberglas Sleeving are Class B insulation, approved for 85°C. temperature rise. All Natvar flexible insulations are consistently uniform, no matter when or where purchased. They are immediately available either from your 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

*FIBERGLAS is the trade-mark (Reg. U.S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with glass fibers.

THE NATIONAL VARNISHED PRODUCTS Corporation

TELEPHONE RAHWAY 7-8800

CABLE ADDRESS NATVAR: RAHWAY, N. J.

201 RANDOLPH AVENUE ★ WOODBRIDGE, NEW JERSEY

TUBES AT WORK

(continued from page 118)

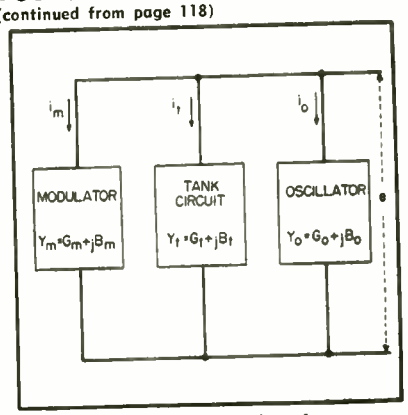


FIG. 1—Basic circuit for frequency-modulated oscillator

and low output. The circuit to be described provides at least as great a deviation with a substantial saving of space and tubes.

The basic circuit has been divided into oscillator tube, tank circuit, and modulator tube (including the phase-shifting network), as shown in Fig. 1.

Let G_o, B_o; G_t, B_t; G_m, B_m; be the conductances and susceptances respectively of the oscillator, tank circuit, and modulator tube. Then the two equations governing the oscillations are:—

$$B_o + B_t + B_m = 0 \qquad (1)$$

$$G_o + G_t + G_m = 0 \qquad (2)$$

It may be shown that the best tank circuit for the present purpose is the usual parallel L-C network.

Results of mathematical analysis are shown in the graph of Fig. 2. Curves of susceptance against frequency are drawn for two parallel L-C circuits, both having the same C, 16 $\mu\mu$f, but for curve A, L is large, 160 μh, and for curve B, L is small, 1.6 μh. Each curve cuts the frequency axis at the value of ω_o for the curve. Values of $\Delta\omega$ for positive values of B_m are shown as a_1 and b_1. Negative values are a_2 and b_2.

For the maximum deviation, a

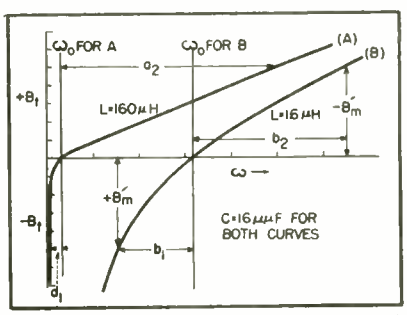


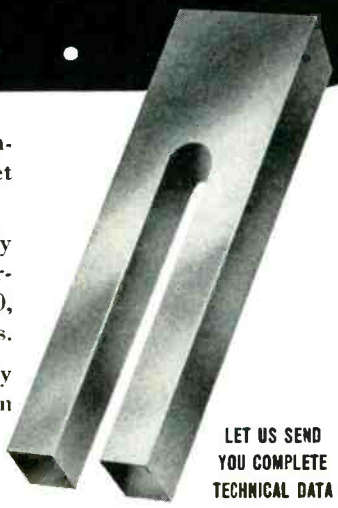
FIG. 2—Curves showing the change of resonant frequency of two L-C circuits when a fixed susceptance is shunted across each circuit

Tuning Forks for precision frequency control . . . .

Philamon Laboratories manufactures a complete line of tuning fork resonators to meet your frequency control requirements.

Temperature-compensated and hermetically sealed, the resonators are available in accuracies from 1 part in 3,000 to 1 part in 100,000, for operation over wide temperature ranges.

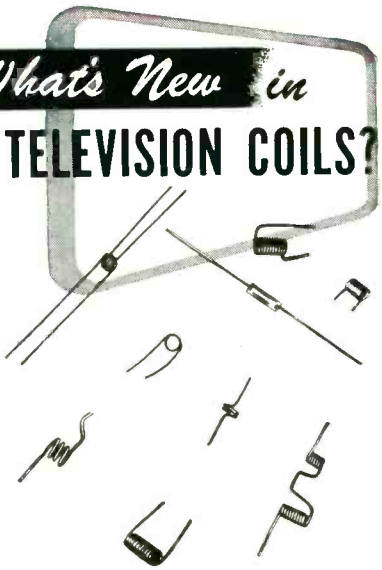
The resonators may be obtained individually —as a part of compact sub-assemblies—or in completely engineered equipment.



LET US SEND YOU COMPLETE TECHNICAL DATA

PHILAMON LABORATORIES
5717 Third Avenue, Brooklyn 20, N. Y.

What's New in TELEVISION COILS?



DEPEND ON LEWIS SPRING ENGINEERS to keep abreast of the latest developments in television coil design and application. New and improved types including double coils with four leads, units with coils cemented to ceramic resistors and other choke, contact, band-tuning and channel coils such as shown above are being mass-produced by Lewis for leading TV manufacturers.

Take advantage of the up-to-the-minute know-how, experience and facilities of Lewis to help design and produce television coils to your specifications. You'll appreciate the efficiency, prompt delivery and economy in which Lewis will satisfy your demands.

There is a Lewis Engineer near you who will welcome the opportunity to check your requirements and quote delivery and price. Call or write us today without obligation.

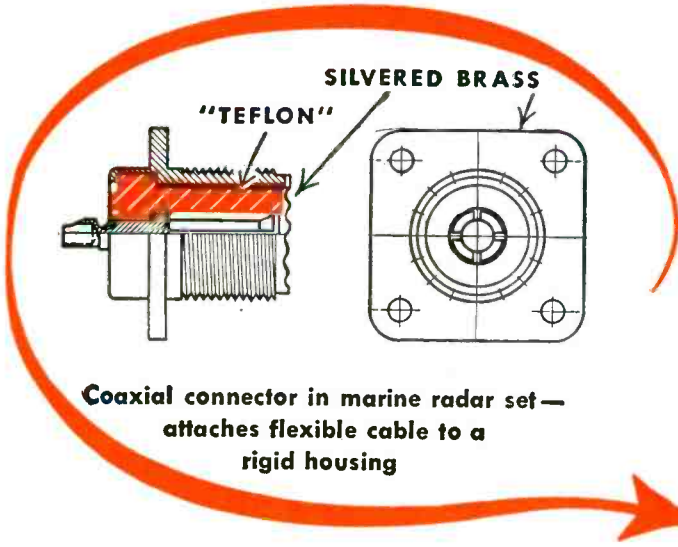
LEWIS SPRING & MANUFACTURING CO.
2656 West North Ave., Chicago 47, Illinois

Lewis PRECISION SPRINGS

THE FINEST LIGHT SPRINGS AND WIREFORMS OF EVERY TYPE AND MATERIAL

DU PONT "TEFLON"*

gives maximum efficiency, durability in co-ax connectors for Sperry radar set



Coaxial connector in marine radar set— attaches flexible cable to a rigid housing

Connectors made by Industrial Products Division, Danbury-Knudsen, Inc., Danbury, Conn., for Sperry Gyroscope Co., Great Neck, L. I., N. Y.

Tough new plastic has low dielectric constant, low loss factor, excellent heat-resistance

When a material requirement calls for *low* dielectric constant, *low* loss factor, high heat-resistance, toughness, resiliency—there is *one* material that has all these properties, Du Pont "Teflon" tetrafluoroethylene resin. That's why "Teflon" is superior to all other materials for use in high-frequency connectors. That's why Sperry uses "Teflon" for the insulation in the coaxial connectors for this marine radar set. "Teflon" provides unequaled transmission efficiency plus outstanding durability.

First, "Teflon" has a low dielectric constant (2.0), constant over the entire range of frequencies measured to date. This minimizes step discontinuities that produce reflections of power. In addition, it has a low loss factor (0.0005)—so that little power is lost at the connector, and the insulation does not heat up in service.

Along with these outstanding electrical properties, "Teflon" has high heat resistance (serves up to 500°F.), eliminates danger of melting the insulation when soldering connections during assembly. It's tough, too, even at temperatures as low as -90°F., won't break or crack if connectors are dropped or banged, has just enough resiliency to give and conform when stressed during installation.

"Teflon" is supplied by Du Pont in standard shapes (rods, tubes, sheets and tape) and molding powders. Or we will recommend molders or fabricators who can supply finished parts of "Teflon." Write today for more information. Our technical staff will be glad to help you. E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Plastics Sales Offices: 350 Fifth Ave., New York 1, N. Y.; 7 S. Dearborn St., Chicago 3, Ill.; 845 E. 60th St., Los Angeles, California. *REG. U. S. PAT. OFF.

DU PONT
REG. U. S. PAT. OFF.
PLASTICS
Better Things for Better Living
. . . through Chemistry

large tank inductance, a small tank capacitance, and a negative value of B_m are required. The negative value of B_m indicates that the voltage on the grid of the modulator tube is lagging the voltage on the anode.

The minimum value of C_t is the stray capacitance across the tank circuit, the major contributors to which are the oscillator and modulator tube capacitances and the capacitance loading of the phase-shift network. The need for small C_t also limits the maximum useful value of L_t because above a certain size, the advantage to be gained by further increase is lost by the resulting increase in C_t.

Two-Tube Unit

The calculation of the theoretical maximum value of B_m to be obtained with the resistance-capacitance phase-shift network directly shunting the tank (Fig. 3), is long and not very useful, so it will not

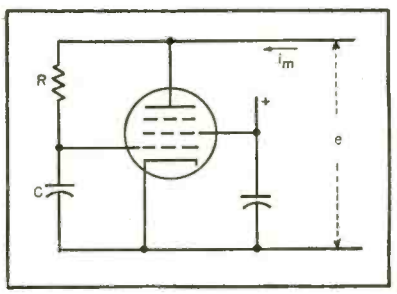


FIG. 3—R-C phase-shift frequency modulator

be described here. However this circuit has the advantage of requiring only two tubes, and will give adequate bandwidth for many purposes.

To make B_m negative, the resistor should be between the anode and the grid of the modulator tube; and to keep the impedance of the phase-shift network high, the input capacitance of the tube should be used for the other element of the network. To prevent shunting of the resistor by the grid-anode capacitance, a pentode must be used as modulator, and a tube having high mutual conductance and low interelectrode capacitance, such as the 6AK5, is necessary. To utilize the maximum mutual conductance, the r-f signal on the grid of the modulator should occupy only a

VMF SERIES of all-metal fractionating oil-diffusion pumps

Pump	Speed liters per sec. at 1x10-4 mm. Hg	Required Fore-pressure microns Hg	Recommended Forepump Capacity liters per sec.	Approxi-mate Wattage
VMF-2	2	100	0.1	85
VMF-5	5	100	0.1	85
VMF-10	10	100	0.1	135
VMF-20	20	100	0.1	200
VMF-50	50	100	0.5	325
VMF-80	60	70	0.5	300
VMF-100	100	100	0.5	375

BETTER vacuum opens new markets for electronic tube manufacturers. It puts longer and longer life into electronic tubes of all kinds. That's good business because it strengthens user confidence in the equipment that employs the tubes. And that's what widens markets for you and your customers.

DPi offers an oil-diffusion vacuum pump with the most economical pumping speed for every port of every exhaust machine—a rugged, compact, inexpensive metal pump that reduces pressures down to 10^{-6} mm. Hg and lower. We'll be glad to make specific recommendations.

Or, if you are interested in any other high vacuum application, you'll do well to put your problem up to DPi.

DPi
HIGH VACUUM RESEARCH AND ENGINEERING

VACUUM EQUIPMENT DEPARTMENT

DISTILLATION PRODUCTS *industries*

727 RIDGE ROAD WEST, ROCHESTER 3, N. Y.

Division of Eastman Kodak Company

Distillers of Oil-Soluble Vitamins and Other Concentrates for Science and Industry; Manufacturers of High Vacuum Equipment.

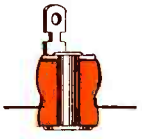
CAPACITORS

Silicone-Sealed for Life!

Silicone—the amazing new synthetic—made headlines when General Electric brought it out during the war. It's news again today—for G.E. has now made Silicone bushings and gaskets a *standard feature* of all its specialty capacitors up through 5000 volts.

This means that your new G-E capacitor is sealed positively, permanently—for maximum life. For Silicone seals by compression alone, without the use of contaminating adhesives. It will never shrink, loosen or pull away—it remains elastic at any operating temperature a capacitor will ever meet. Moreover, it is impervious to oils, alkalies and acids, and its dielectric strength is permanently high.

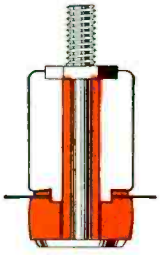
This exclusive G-E feature—with the use of highest grade materials, with strictest quality control and individual testing—make General Electric capacitors finer and more dependable than ever before. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



Silicone bushings used with capacitors 660-v a-c, or 1500-v d-c and lower.

Silicone bushings and plastic cups used with capacitors 660-v a-c, or 1500-v d-c and lower.

Silicone gaskets and plastic stand-offs used with capacitors rated 2000-v d-c and lower.



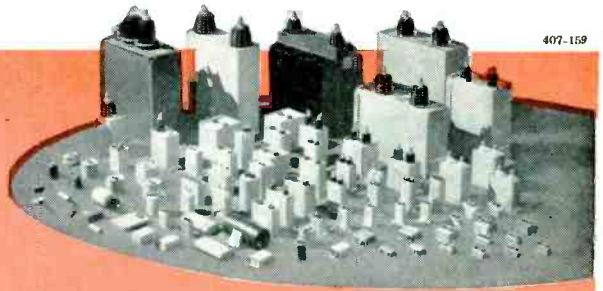
Silicone gaskets and porcelain stand-offs used with capacitors rated 2500-v to 5000-v d-c.

GENERAL ELECTRIC

Specialty Capacitors FOR

- Motors
- Luminous-tube transformers
- Fluorescent lamp ballasts
- Industrial control
- Radio filters
- Radar
- Electronic equipment
- Communication systems
- Capacitor discharge welding
- Flash photography
- Stroboscopic equipment
- Television
- Dust precipitators
- Radio interference suppression
- Impulse generators

AND MANY OTHER APPLICATIONS



fraction of the grid base.

Adjustment of the phase-shift network to produce a phase shift of 45 degrees at the highest frequency of the oscillator would give the maximum reactive component of the anode current, but unfortunately it would give an equal resistive component which, in practice, usually makes $G_m > -G_o$, thus violating the condition for oscillation of Eq. (2).

The limitation to the maximum value of B_m appears therefore to lie in the design of the oscillator. In practice with a 6AK5 modulator and 6J6 oscillator, the resistor to be used in conjunction with the input capacitance of the tube must not be less than about 800 ohms. An inductance of 2 to 3 μh in series with the resistor increases the sweep a little and reduces the load imposed by the phase-shift network on the oscillator.

Amplifier Added

A better method of feeding the modulator, Fig. 4, is to use an amplifier which can be adjusted to give a phase shift closely approximating 90 degrees with less attenuation than the R-C network just described, and with much less loading of the oscillator.

To avoid positive feedback between the modulator and the amplifier, the amplification is achieved without phase reversal by a grounded-grid triode, cathode fed by a cathode follower.[2]

Most conventional oscillators depend on a transformer action of the tank coil to provide positive feedback, and it is to be expected that if the greater part of the oscillatory current is shunted through the modulator tube, this will interfere with the operation of the oscillator. To relieve the tank coil of this

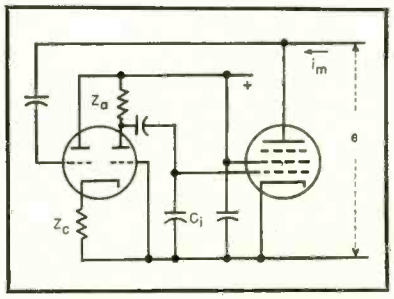
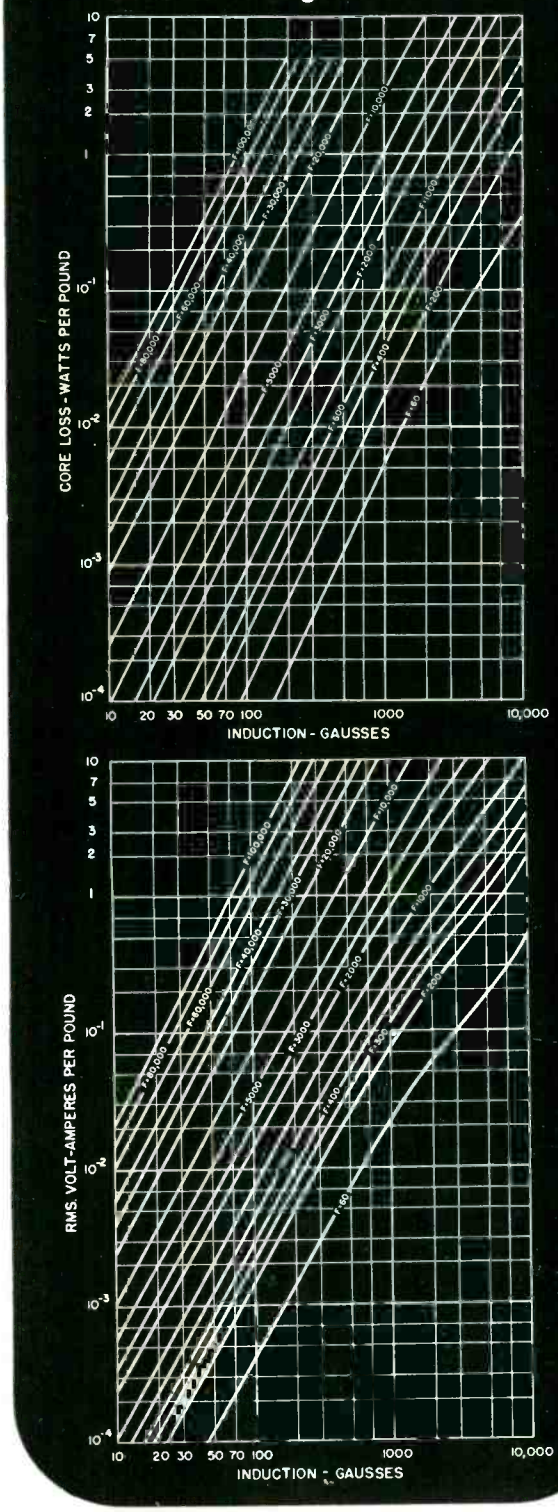


FIG. 4—Amplifier phase-shift frequency modulator

Tests at 100,000 cycles a second

Core loss and excitation characteristics of .002" high quality ARMCO Thin-Gage Electrical Steel.



show top magnetic properties of this .002" steel

Operating advantages of the newest grades of Armco Thin-Gage Electrical Steel for high-frequency equipment are demonstrated by a series of tests made in Armco's Research Laboratories.

Magnetic characteristics of .002" steel have been accurately determined up to 100,000 cycles a second.

These tests reveal superior permeability from lowest to highest inductions; low core loss over a wide range of frequencies; and adequate insulation for even the highest volt-per-turn designs.

Armco Thin-Gage Electrical Steel is given a full-annealed treatment and insulated at the mill. No additional annealing is necessary except for relieving coiling strains after cores have been wound.

Whenever your applications involve changes in magnetic flux equivalent to frequencies from 400 to as high as 1,000-000 cycles a second, this steel has five definite advantages.

1. Supplied in coils 12⅜ inches wide for high-speed manufacturing operations.
2. Skin-effect is not appreciable at high frequencies.
3. Stacking factor is high (400 sheets of Armco .002-inch insulated steel make a stack only 1-inch high).
4. CARLITE Insulation on both sides assures minimum inter-lamination loss.
5. Hysteresis is exceptionally low.

Whether you are manufacturing high-frequency devices or your equipment is in the "idea stage," be sure to look into the advantages of Armco Thin-Gage Silicon Steel. Write for more information.

ARMCO

ARMCO STEEL CORPORATION

4490 Curtis Street, Middletown, Ohio • Plants and Sales Offices from Coast to Coast • The Armco International Corporation, World-Wide

STANDARD RI-FI* METERS

14kc to 1000mc!

DEVELOPED BY **STODDART** FOR THE ARMED FORCES.

AVAILABLE COMMERCIALLY.

VHF!
15 MC to 400 MC
NMA - 5

Commercial equivalent of TS-587/U.
Sensitivity as two-terminal voltmeter, (95 ohms balanced) 2 microvolts 15-125 MC; 5 microvolts 88-400 MC. Field intensity measurements using calibrated dipole. Frequency range includes FM and TV Bands.

VLF!
14 KC to 250 KC
NM - 10A

Commercial equivalent of AN/URM-6.
A new achievement in sensitivity! Field intensity measurements, 1 microvolt-per-meter using rod; 10 microvolts-per-meter using shielded directive loop. As two-terminal voltmeter, 1 microvolt.

HF!
150 KC to 25 MC
NM - 20A

Commercial equivalent of AN/PRM-1.
Self-contained batteries. A.C. supply optional. Sensitivity as two-terminal voltmeter, 1 microvolt. Field intensity with ½ meter rod antenna, 2 microvolts-per-meter; rotatable loop supplied. Includes standard broadcast band, radio range, WWV, and communications frequencies.

UHF!
375 MC to 1000 MC
NM - 50A

Commercial equivalent of AN/URM-17.
Sensitivity as two-terminal voltmeter, (50-ohm coaxial input) 10 microvolts. Field intensity measurements using calibrated dipole. Frequency range includes Citizens Band and UHF color TV Band.

Since 1944 Stoddart RI-FI* instruments have established the standard for superior quality and unexcelled performance. These instruments fully 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. Many of these specifications were written or revised to the standards of performance demonstrated in Stoddart equipment.

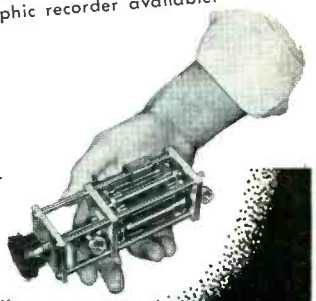
The rugged and reliable instruments illustrated above serve equally well in field or laboratory. Individually calibrated for consistent results using internal standard of reference. Meter scales marked in microvolts and DB above one microvolt. Function selector enables measurement of sinusoidal or complex waveforms, giving average, peak or quasi-peak values. Accessories provide means for measuring either conducted or radiated r.f. voltages. Graphic recorder available.

*Radio Interference and Field Intensity.

Precision Attenuation for UHF!

Less than 1.2 VSWR to 3000 MC.
Turret Attenuator:
0, 10, 20, 30, 40, 50 DB.
Accuracy ± .5 DB.

Patents applied for.



STODDART AIRCRAFT RADIO CO.

6644 SANTA MONICA BLVD., HOLLYWOOD 38, CALIF.
Hillside 9294

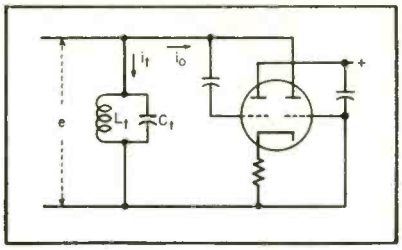


FIG. 5—Negative conductance oscillator

phase-reversing function a cathode-coupled positive-feedback amplifier is connected across the tank circuit (Fig. 5), where it behaves like a negative conductance and maintains oscillations so long as the positive conductance across the circuit does not exceed $g_o/2$, where g_o is the mutual conductance of each triode.

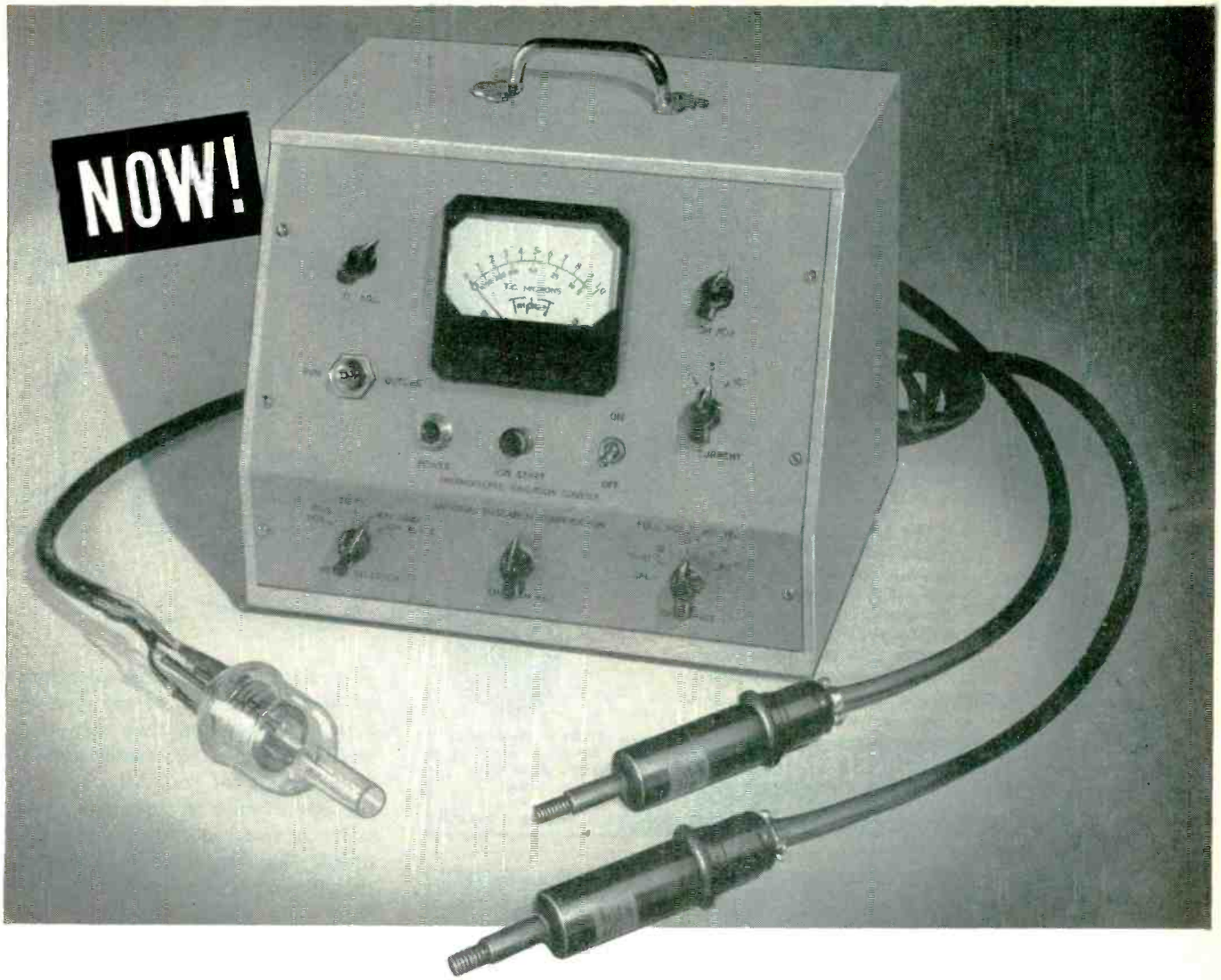
As mentioned earlier, the r-f voltage on the grid of the modulator must be small compared with the grid bias. This means about 1 volt peak to peak for low-capacitance tubes such as the 6AK5 and 6AH6. At the highest frequency, the gain of the phase-shifting amplifier is about 0.5, so the oscillator voltage should be limited to about 0.7 volt rms. This may be done very conveniently by shunting the tank coil with a crystal diode suitably biased back to act as a clipper.

Final Design

The final circuit is quite practical. The two cathode followers feeding the grounded-grid amplifiers for the oscillator and the modulator have been combined to simplify wiring and save a cathode choke. To reduce the amount of clipping by the diode, and so avoid undue generation of harmonics, the oscillator amplifier bias has been increased until oscillations are only just maintained over the whole range. A 6AH6 was chosen for the modulator because its grid characteristic gives rise to a more linear frequency-voltage relationship. It also gives a slightly wider deviation than the 6AK5.

Tank inductance L_t consists of 52 turns of 34 g. enamelled copper wire, wound 30 turns per in. on a ½-in. diameter polystyrene former, with a 1-in. long iron dust core located at about the center of the winding. The inductance is about 16μh, and the self-capacitance of the order of 1 $\mu\mu$f.

The cathode choke has an in-



Only $337.50*

for this Unusual New Gauge Control that covers *ALL* the Useful High Vacuum Range

This new gauge control represents a real advance in the measurement and control of high vacuum. In designing it, our engineers have ingeniously simplified the long-accepted circuits . . . developed an instrument that is smaller yet more convenient and flexible than ever before. The one Ionization and two Thermocouple Gauges fill *all the needs of scientific and commercial work.* But there are many other advantages, so write . . . *today.*

** Type 501 Thermocouple Gauges and type 507 Ionization Gauges extra.*

FEATURES

Total Range:
1 mm. to 1 x 10^{-8} mm.

One Logarithmic Scale:
0-1 mm. Hg.

Five Linear Scales:
0 to 5 x 10^{-3} mm. Hg.
0 to 1 x 10^{-3} mm. Hg.
0 to 1 x 10^{-4} mm. Hg.
0 to 1 x 10^{-5} mm. Hg.
0 to 1 x 10^{-6} mm. Hg.

Protective Circuit — Ionization Gauges have survived more than 100 bursts to full atmospheric pressure.

Alarm Circuit indicates trouble or controls auxiliary equipment.

Ionization Grid Current can be stabilized at 1, 5 or 10 mils.

Instantaneous comparative measurements of high vacuum and fore-pressure.

Low Leakage Cable assures accurate readings at pressures below 10^{-6} mm.

Readily Portable (with dimensions of 13" by 11 13/16" x 9 3/8").

Outgassing Circuit included.

INDUSTRIAL RESEARCH • PROCESS DEVELOPMENT
HIGH VACUUM ENGINEERING AND EQUIPMENT

METALLURGY • DEHYDRATION • DISTILLATION
COATING • APPLIED PHYSICS

National Research Corporation

Seventy Memorial Drive, Cambridge, Massachusetts

In the United Kingdom: BRITISH-AMERICAN RESEARCH, LTD., London S. W. 7, England — Glasgow S. W. 2, Scotland

G.E.'s 9574 all-purpose* insulating varnish provides BETTER BONDING BETTER PENETRATION NO SLUDGING

Mr. Guy W. Probst

That's what Guy W. Probst, owner of the Lockhaven Electric Repair Co., Lockhaven, Pa., says about General Electric's 9574. Here is his statement:

"G-E all-purpose insulating varnish 9574 gives you a cover coat you can see and that fills up between the Formex wires. I've had very good success with it on armatures up to 2000 RPM. On formed coils I can bake before forming and the turns don't come apart when you pull the coil. I've had no trouble with sludging, and all my work is hot dipped. I find that I only use about half as much 1201 Glyptal as a cover coat on 9574 as I had to use over the varnish I had been using, and I get higher gloss and better bonding when 1201 is used over 9574."

**G-E 9574 gives excellent results on all types of coils except extra-high-speed armatures. It is one of G.E.'s complete line of electrical insulating materials, including adhesives, wedges, cements, compounds, cords and twines, sleeving, wire enamels, mica, papers and fibers, permafils, tapes, tubing, varnished cloths, varnishes.*

EASY TO USE

BAKES AT LOWER TEMPERATURES than is possible with most other synthetic varnishes.

PENETRATES EASILY into the deepest coils.

NO SPECIAL THINNER required (just petroleum spirits).

STABLE—will not tend to harden in the tank.

SEND FOR BULLETIN!

If you haven't yet tried G-E 9574, get in touch with your local G-E Distributor, or write for our new bulletin to Section K-2, Chemical Department, General Electric Company, Pittsfield, Mass.

You can put your confidence in

GENERAL ELECTRIC

CD50-K2

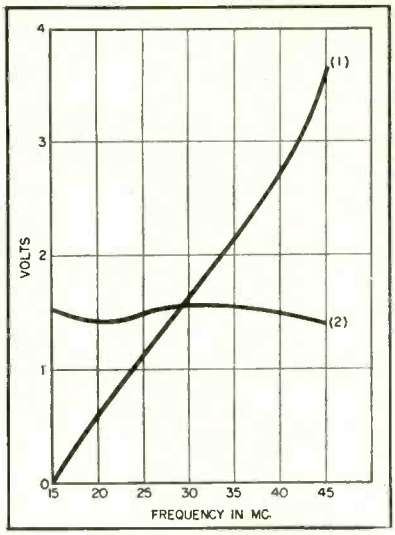


FIG. 6—Frequency plotted against modulation input voltage is shown by curve 1. Curve 2 is peak r-f output voltage plotted against frequency

ductance of about 6 μh and consists of three interleaved windings, each of 100 turns of 28 g. enamelled copper wire, wound on a $\frac{5}{16}$-in. diameter bakelite rod 3-in. long. The two heater leads were first close wound side by side on the first layer, then the cathode lead was wound on a second layer between the other two wires. Like the tank inductance, this choke should have as high an inductance as is consistent with low self-capacitance, but the problem is complicated by the requirement of low resistance for the heater leads.

The circuit is constructed on a bakelite panel to reduce stray capacitance. The frequency of this oscillator is dependent to a rather large extent on the supply voltage, so that a stabilized power supply is indicated, particularly if small frequency deviations at modulation frequency other than that of the line are to be a requirement.

The three-tube unit shown will cover the range 10 to 50 mc and if an output voltage of only a few millivolts is required, this may be obtained from the 5-ohm resistor in the anode of the cathode follower. If a higher output is required it is least disturbing to the operation of the circuit if the output is taken from the cathode of the cathode follower, but even there a load of 5 μμf reduces the sweep by several megacycles. The voltage at this point varies considerably with frequency, falling to minimum at

THERMOPLASTIC INSULATED WIRE IN ALL SIZES

SURCO A-10

TESTS ON NO. 20 SOLID CONDUCTOR INSULATED WITH WHITE SURCO A-10

U/L Approved for Continuous Operation at 105°C

	1/32" Wall (no jacket)	1/64" Wall (nylon jacket)
FLEXIBILITY TEST 1. 60 days at 113°C	No evidence of cracking	No evidence of cracking
2. 7 days at 136°C	No evidence of cracking	No evidence of cracking
(Meets low temperature requirement of -40°C when tested according to JAN-C-76)		
SLOW COMPRESSION TEST Actual force in pounds to ground	81.3	59.8
FLAME TESTS Horizontal Test	Self-extinguishing no falling particles	Self-extinguishing no falling particles
Vertical Test (As described in Underwriters' Standard for Thermoplastic Wires)	Specimens meet requirements satisfactorily	Specimens meet requirements satisfactorily
VOLTAGE BREAKDOWN TEST As received – 2000 V/min. Ave. breakdown KV	No failure 23.9 KV (1/64" wall)	No failure 24.7 KV
After 60 days at 113°C-2000 V/min. Average breakdown KV	No failure 21.5 KV (1/64" wall)	No failure 24.0 KV
INSULATION RESISTANCE TEST 12 hrs. in water at 15.6°C Megohms/1000'	988 megohms	1270 megohms

Data appears as on the approval and test report from Underwriters' Laboratories, Inc.

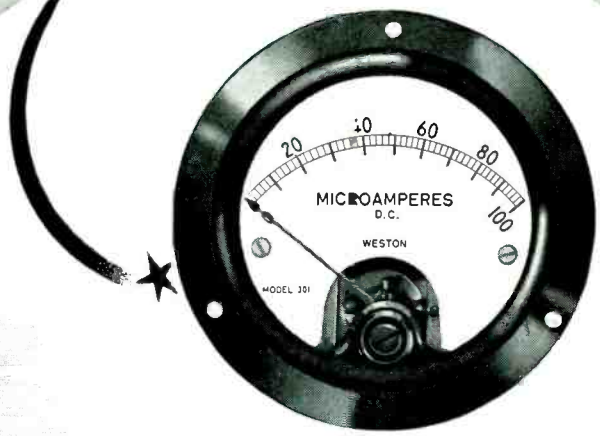
SURCO PRODUCTS REG. U.S. PAT. OFF.

Surprenant

MFG. CO.

199 Washington St., Boston 8, Mass.

Trustworthy



...in Constancy
...in Value

Wherever an electrical measurement provides essential information . . . whether in the manufacture of electrical components, the inspection of purchased parts or finished products, or in the operation of some electrical machine . . . far-sighted buyers specify "meters by WESTON". Experienced buyers know that in value, and in performance, there is no substitute for WESTON instruments. Ask your nearest WESTON representative for all the facts, or write for bulletin A-7-B. WESTON Electrical Instrument Corporation, 618 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON
Panel Instruments

Albany • Atlanta • Boston • Buffalo • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Houston • Jacksonville • Knoxville
Little Rock • Los Angeles • Meriden • Minneapolis • Newark • New Orleans • New York • Orlando • Philadelphia • Phoenix • Pittsburgh • Rochester
San Francisco • Seattle • St. Louis • Syracuse • Tulsa • Washington, D. C. • In Canada, Northern Electric Company, Ltd., Powerlite Devices, Ltd.

about 20 mc and rising to about two or three times that value at the high and low-frequency ends of the sweep. This is due to the fact that at high frequency, the cathode-ground capacitance of the cathode-coupled amplifier causes a phase lag over and above that at the grid of the modulator, resulting in a negative conductance component of modulator admittance.

In the model constructed, a two-stage cathode-coupled amplifier, which has a falling output above 20 mc and which is low-frequency compensated by means of a series-tuned filter in parallel with the cathode load of the first stage, is fed from the cathode of the oscillator. The output is about 1 volt rms with a variation of less than ± 0.05 volt from 15 to 45 mc as shown in Fig. 6.

The frequency limits are from a minimum of 10 mc when the modulator is cut off to 50 mc at which point instability sets in, but the frequency variation is seriously nonlinear near the extremes. The usable range depends on the degree of linearity demanded. The curve of frequency against modulation voltage between 15 and 45 mc is shown in Fig. 6, and it may be seen that from 15 to 40 mc it is linear to within ± 250 kc or ± 1 percent, and the whole range shown is sufficiently linear to be useful for most purposes.

Acknowledgement is gratefully made to J. S. Foster, Director of the McGill University Radiation Laboratory, for the opportunity of working on this project, and to R. W. Jackson of the above laboratory for helpful discussions during the course of the work.

REFERENCES

(1) H. D. Helfrich, Jr., Wide Deviation Reactance Modulator, ELECTRONICS, p 120, April 1948.
(2) G. C. Sziklai and A. C. Schroeder, Cathode-coupled Wide Band Amplifiers, *Proc. IRE*, p 701, Oct. 1945.

Compact Industrial Television System

THE VIDICON, new photoconductive pickup tube for television described in this issue of ELECTRONICS, has made possible a television camera unit only 10 inches long, 3 inches wide and 5 inches high. It

THESE LEADING SET MAKERS

Emerson · Admiral · hallicrafters · BENDIX RADIO · Westinghouse · Motorola · Sparton · PHILCO · STROMBERG-CARLSON · Majestic · Sentinel · TRAV-LER · GAROD · SETCHELL-CARLSON, INC. · airking · CROSLEY

Seen these Hytron firsts in popular new TV sets? The prominent TV set makers shown are using them. And the list is growing. Du Mont, for example, now uses the 1X2 and 6BQ6GT. You'll see many more of these famous tubes. And many more new Hytron types designed for low-cost TV for the mass market. When you buy these Hytron firsts, follow the leading set manufacturers. Buy the original. Buy Hytron!

choose one or more of THESE HYTRON TV FIRSTS

HYTRON TV FIRST

1X2 compact, high-voltage TV rectifier.

HYTRON TV FIRST

6U4GT high-perveance damping diode.

HYTRON TV FIRST

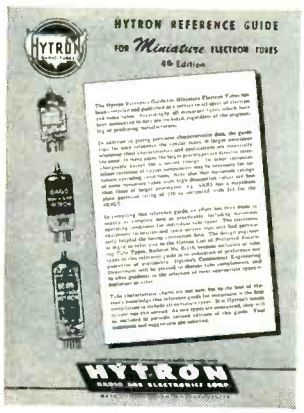
6BQ6GT, 25BQ6GT extra-performance deflection amplifiers.

HYTRON TV FIRST

12BH7 twin-triode sweep amplifier with superior efficiency.

HYTRON TV FIRST

16RP4 original rectangular TV picture tube.



NEW 4th EDITION

Hytron Reference Guide for Miniature Electron Tubes

Miniature types are multiplying fast. You need this Hytron Reference Guide. Originated by Hytron, it is unique. Lists all miniatures to date, regardless of make. Six pages of pertinent data. 132 miniatures — 41 of them new. 70 basing diagrams. Lists similar larger prototypes. Free from your Hytron jobber. Get your copy of this old friend brought up to date — today.

OLDEST MANUFACTURER OF RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

HYTRON RADIO TUBES

MAIN OFFICE: SALEM, MASSACHUSETTS

Manufacturer's tests confirm superiority of PALINEY* #7 for brushes on new Rectilinear Potentiometer . . .

"Our experience has confirmed your tests and those of the Radiation Laboratory regarding brush wear. Less than a week ago we completed a life test on one of our 2" Rectilinear Potentiometers in which the brush traveled the full length of the resistance element five million times before failure occurred. The wire used in the resistance element was .0014 diameter."

PALINEY* #7 . . . a precious metal alloy containing gold, platinum and palladium . . . is giving outstanding service as the sliding contact in many types of potentiometers where long life, low noise and maintained linearity are essential. This and other Tested NEY Precious Metal Alloys are also being used successfully in numerous precision contact and slip ring applications requiring controlled wear resistance, high conductivity and freedom from tarnish and corrosion. Write or call our Research Department for additional technical data, outlining your problem if possible.

THE J. M. NEY COMPANY 179 ELM ST., HARTFORD, CONN.

SPECIALISTS IN PRECIOUS METAL METALLURGY SINCE 1812

** Reg. T.M. J. M. Ney Co.*

G. M. GIANNINI & CO., INC.
697 Morris Turnpike
Springfield, New Jersey

POLARAD TELEVISION Equipment

for studio • laboratory • manufacturer

SYNCHRONIZING GENERATOR

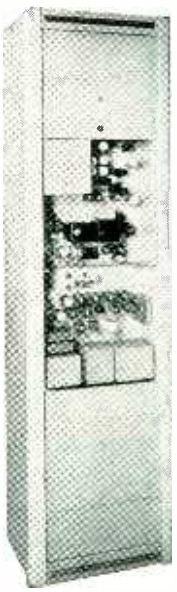
Model PT 101—Television

FEATURES

- Built-in 3" oscilloscope with synchronized sweeps for viewing Timing and Video Output pulse wave forms.
- Synchronized marker system for checking pulse width and rise time.
- Extreme stability, insured by deriving all pulses from leading edge of master oscillator pulse.
- Means for checking synchronizing pulses in odd and even fields.

SPECIFICATIONS

525 line, interlocad, 60 fields, 30 frames, RMA Synchronizing pulses held to tolerance specified in the NRTPI report of 1945. Output Pulses: Synchronizing, Video Blanking, Camera Blanking, Horizontal Driving, Vertical Driving Pulses. 5 volts across 100 ohm termination. Dual output jacks. 115 volts 50/60 cps. Complete with tubes.



TELEVISION MONOSCOPE SIGNAL SOURCE

Model PT 102

- Composite Video Signal
- Wide Band Video Amplifier, 6 DB down at 10MC
- Dual outputs for feeding two 75 or 100 lines
- Black positive or Black negative output
- Resolution greater than 600 lines

INPUT: Vertical and Horizontal Driving pulses. Camera and Kinescope Blanking Pulses.

OUTPUT: Composite Video Signal, 3 Volts, 100 ohm line 115 volts 50/60 cps. Complete with tubes and including high and low voltage power units.

•

100 METROPOLITAN AVE.
BROOKLYN 11, NEW YORK

Polarad Electronics Corporation

Television engineers and consultants to the nation's great television stations.

SMALL

PARTS

Cost less when made by

MULTI-SWAGE

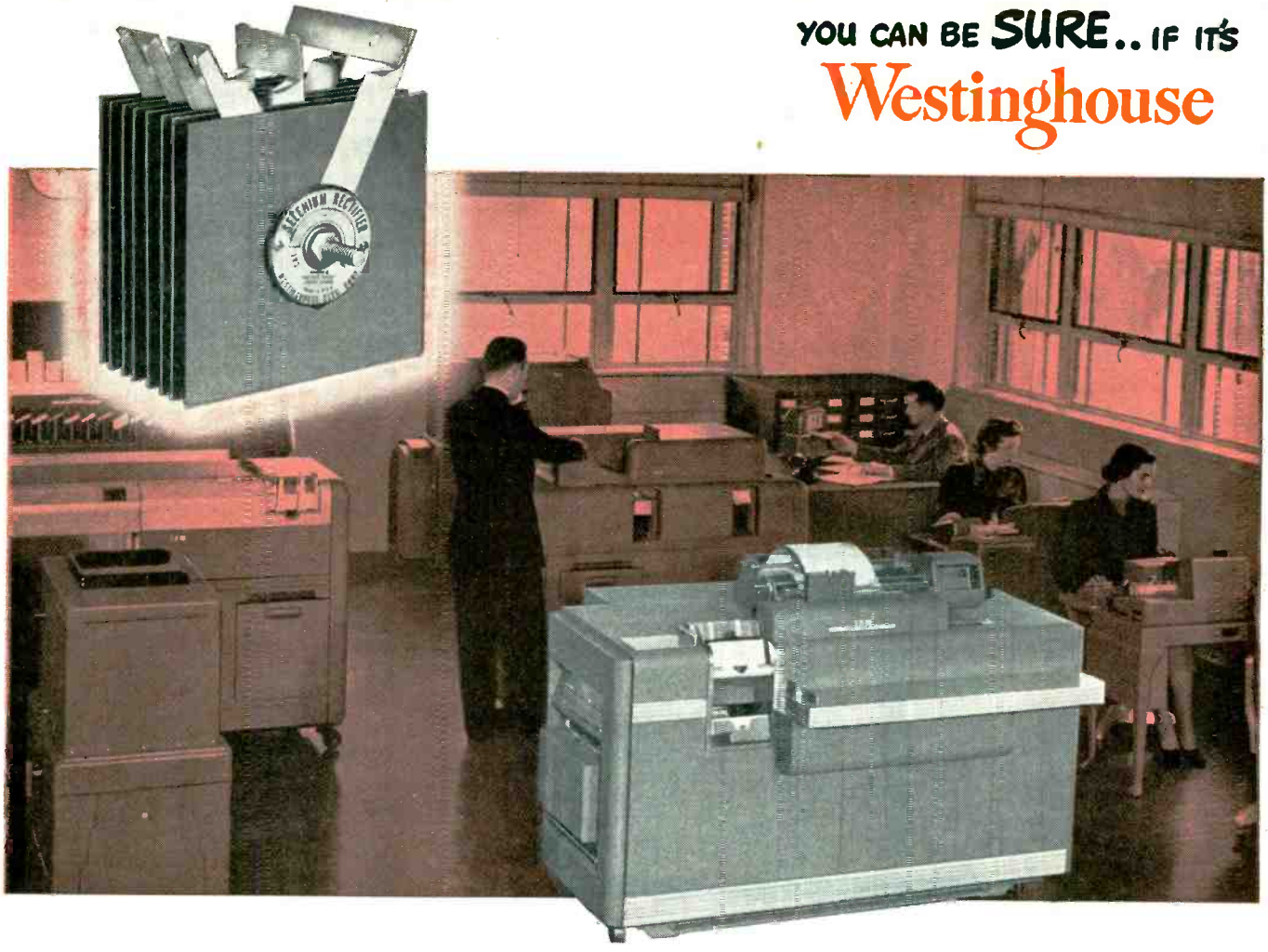
The economy way to get a million small parts similar to these —

Examine the tubular and solid metal parts shown here twice size. If you use anything similar . . . in quantities of over a million . . . important savings can be yours. Send us the part and specs. Our quotation will show why the Bead Chain Company's MULTI-SWAGE Process has long been known as the most economical method of making electronic tube contact pins, terminals, jacks and sleeves. And, why more and more users of mechanical parts (up to ¼" dia. and to 2" length) employ our facilities. WRITE for Data Bulletin.

THE BEAD CHAIN MANUFACTURING CO.,
Tr. Mark 88 MOUNTAIN GROVE ST., BRIDGEPORT 5, CONN.

YOU CAN BE SURE.. IF IT'S

Westinghouse



Selenium Solves a Problem for the IBM problem solver

In building this complex problem solver, IBM chose Rectox Selenium Rectifiers. Thus, power supply maintenance is "just a memory" now on the IBM electrical brain.

Selenium rectifiers need little attention . . . require no periodic lubrication . . . have no rotating parts to wear and replace. You can install them in your equipment and forget them.

In addition, high-voltage selenium cells open the door to savings through cell reduction. Higher voltage cells (24 volt, d-c/33 volt, rms compared to conventional 20 volt, d-c/26 volt, rms) cut the number of cells required. And fewer cells mean lower costs.

Maybe you have a similar problem. Our engineers will be glad to work with you to find an economical answer. Get a copy of DB-19-025 from your local Westinghouse representative. Or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-21590

Westinghouse

Rectox

RECTIFIERS AND CHARGERS FOR ALL INDUSTRIES

weighs el nds.

A complete system comprising a camera and viewing monitor consists of only the camera and one other unit, the master control monitor unit weighing 58 pounds. It is 26 inches long, 26 high and 8½ inches wide. The two units are interconnected by a multiwire cable that handles video and sweep voltages in addition to power. Similar equipment used by television engineers on remote pickups and employing an image orthicon weighs 800 pounds and consists of five units.

The monitor unit of the industrial system contains all power supplies and sweep generators, a total of 42 tubes. A seven-inch picture tube is also mounted in the monitor. The 60-cycle line is employed for vertical synchronization. Multivibrators count down from the 31.5-kc horizontal oscillator for comparison with 60 cycles.

The camera unit contains two tubes, a 6AG5 and a 12AT7 to handle the video signal fed to the low-impedance line. A considerable portion of the bulk of the small camera unit is taken up by a motor which mechanically focuses the lens. Control of focusing is done at the monitor where the image is viewed.

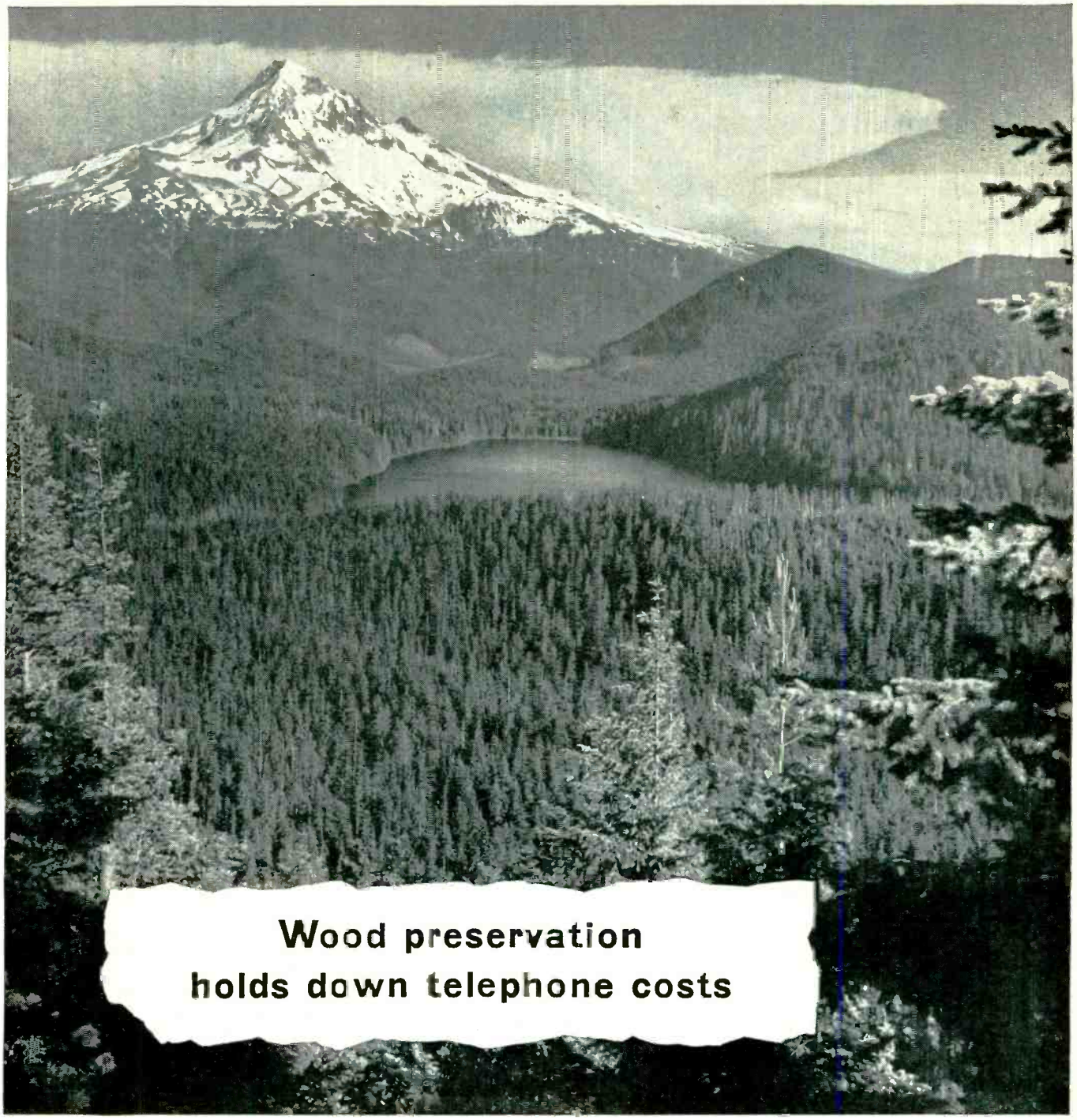
A conventional RMA standard video signal is produced by the equipment and this feature allows use of mass-produced home receivers to be used as extra monitors. Estimated cost of a typical installation is $6,500. The vidicon is expected to be priced at about one-fifth that of the image orthicon.

Recording Mass Spectrometer

PROGRESS in semiautomatic and automatic methods of analyzing gases, liquids, and solids has increased in rapid strides during the past few years.

The new recording mass spectrometer is an excellent example of modern analytical tools. The versatility of the instrument permits highly varied applications in the petroleum, chemical, rubber and associated process industries and nuclear energy laboratories.

As denoted by its name, the mass



Wood preservation holds down telephone costs

Poles are a substantial part of the plant that serves your telephone; making them last longer keeps down repairs and renewals that are part of telephone costs. So Bell Laboratories have long been active in the attack on wood-destroying fungi, the worst enemies of telephone poles.

Better, cleaner creosotes and other preservatives have been developed in co-operation with the wood-preserving industry. Research is now being carried out on greensalt—a new, clean, odorless preservative. Even the products of atomic energy research have been pressed into service—radioactive isotopes are used to measure penetration of fluids into wood.

Treated poles last from three to five times as long as untreated poles. This has saved enough timber during the last quarter century to equal a forest of 25,000,000 trees. More than that, wood preservation has enabled the use of cheaper, quickly growing timber instead of the scarcer varieties.

This and other savings in pole-line costs, such as stronger wires which need fewer poles, are some of the reasons why America's high-quality telephone service can be given at so reasonable a cost. It is one of today's best bargains.

BELL TELEPHONE LABORATORIES

Exploring and Inventing, Devising and Perfecting, for Continued Improvements and Economies in Telephone Service.

NEW MANUALLY-OPERATED "STICK" WINDER GETS "ELECTRICAL MANUFACTURING" DESIGN AWARD - UNIVERSAL NO. 108

A fully automatic coil winding machine pays its way only when the runs are long enough to justify the expense of the set-up time required.

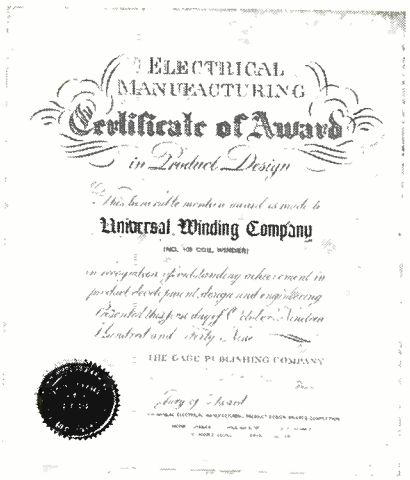
Since many coil lot sizes are small, only a portion of the market requirements can be filled economically by the use of automatic machinery.

This situation, together with the obsolete condition of many of the manually-operated winders in the electrical and electronic parts industries created the necessity for developing a manually-operated winder of *modern* design to supplement the automatic type.

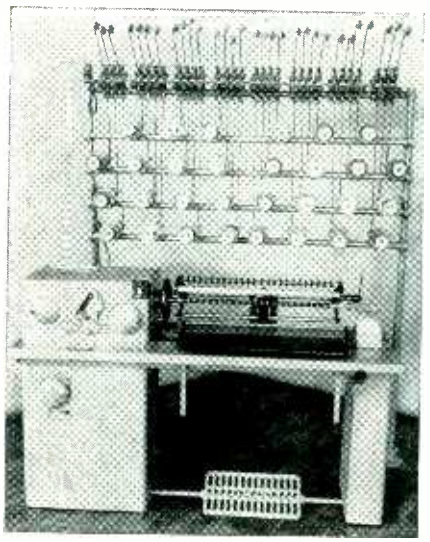
No. 108 COIL WINDER

The No. 108 Coil Winder was developed by the Universal Winding Company to meet the demand for a modern manually-operated machine to wind paper-insulated coils in multiple or "stick" form.

Its design received an Honorable Mention Award in the 11th Annual Product Design competition sponsored by "Electrical Manufacturing."


ELECTRICAL MANUFACTURING
Certificate of Award
in Product Design
Universal Winding Company
THE CAHNERS PUBLISHING COMPANY

The objective of Universal engineers was to produce an integrated unit, clean and functional, with labor-saving features which would warrant replacement of present equipment, and with a selling price low enough to be attractive to the predominantly "job shop" type of market characteristic of the ever-changing electrical and electronic parts industries.



No. 108 Coil Winder.

After extensive field surveys and an analysis both of suggestions made by electrical engineers, superintendents and operators, and of their criticisms of existing machinery, our engineers determined upon the basic principles for the 108 Coil Winder that are incorporated in the following outstanding features.

Quick Set-Up All machine functions are built around the idea that quick set-up and finger-tip control are the best means of creating savings in the use of skilled labor during machine set-up.

Flexibility The machine can be adjusted quickly to accommodate changing requirements of wire size, coil length and diameter.

Note convenience of controls.

Accessibility Operations involved in preparing and finishing coils vary from job to job, but access to the coil stick is completely unhampered and all coils are readily processed. Accessibility features are also provided for ease of maintenance and adjustment.

Simplicity Since operators of this type of machine are usually women and may be disturbed by any complexity of controls and adjustments, the simple external appearance of this machine promotes confidence.

Cost Compared with an automatic machine winding the same type of coils, the cost of this machine is very modest, considering its efficiency and the high quality of its construction.

Bed The bed is a single casting, extending the full length of the machine, and is of aluminum to cut down weight. The supporting columns are made of single steel sheets, formed and welded and are braced at the bottom by steel straps which serve as feet. The left-hand one houses the motor and drive mechanism and the right-hand one is a cupboard for the operator's personal belongings.

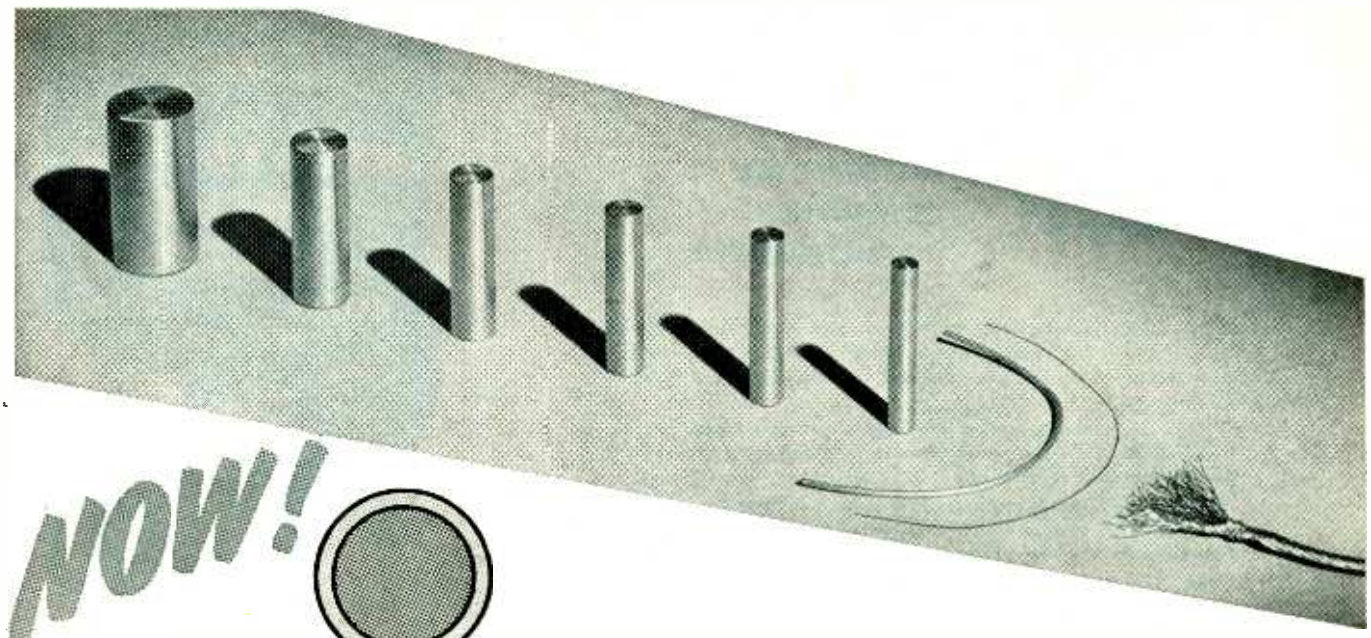
For free literature on design features, write for "Getting the Most from Coil Winding No. 14."

Panel of new G-E mass spectrometer showing Electronik strip chart recorder

spectrometer analyzes a gaseous mixture first by ionizing the gas and then by sorting these ions according to their mass. The sample to be analyzed is admitted in the form of neutral gas molecules to the spectrometer. The gas molecules are fed into the ionization chamber at low pressure from an expansion volume through a leak so as to obtain a constant flow without discrimination into the spectrometer tube where a high vacuum is maintained by continuous pumping.

In the ionization chamber, some of the gas molecules of each constituent are converted to positively charged ions as a result of colliding with electrons emitted by the heated filament. Other neutral molecules which are not affected by the electric field in the chamber are withdrawn by an exhaust pump. The ionized molecules are accelerated by high voltage and focused into a beam which passes through the narrow collimating slit into a region within the spectrometer tube where no electric field exists.

In the spectrometer tube, the ion beam is deflected by the varying magnetic field which causes ions of specific mass to follow orbital paths of a certain radii. With the magnetic field at a certain known intensity, ions with a particular specific mass follow a definite path through the magnetic field and pass



NOW!

Nickel-Clad Copper Conductor

Combining toughness and corrosion-resistance of *Nickel* with the superior conductivity of *copper*

For many years electrical designers and maintenance men have been looking for a really *tough* conductor . . . one able to withstand abusive conditions, yet having good electrical characteristics as well.

Now, thanks to the technical skill of the Alloy Metal Wire Co., Inc., Prospect Park, Pa., such a conductor is available.

The outstanding advantages of Nickel-clad copper conductor are strength, corrosion-resistance, and resistance to high-temperature failure. Its electrical conductivity is 70% that of copper alone.

Among the many applications where Nickel-clad copper conductor is being used with outstanding success are: lead wires for electronic tubes, heating appliances, infra-red ovens, resistance and induction furnaces. It is also used for special power lines, fixture wiring in corrosive atmospheres and spark plug electrodes.

For electronic tube uses in particular, Nickel-clad copper wire offers many important advantages. It provides excellent conductivity for uses where exposed copper is not desirable. It does not oxidize, flake, or embrittle under the high temperatures encountered during stem making, sealing and exhausting. Welds are strong and flexible. Nickel-clad copper wire can be welded to molybdenum and tungsten as well as to itself.

Nickel-clad copper conductor is available in rods from ½ in. to .031 in. diameter; and in round and flat wire, coils or spools, solid or stranded, in all commonly used sizes.

If you would like to try this new conductor, write directly to Mr. Dave Schmid, Alloy Metal Wire Co., Inc., Prospect Park, Penn. He will send samples of the type you require.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N.Y.

EMBLEM OF SERVICE
NICKEL INCO ALLOYS
TRADE MARK

Monel® • "K"® Monel • "KR"® Monel • Nickel • "D"® Nickel • Low Carbon Nickel • Inconel® • Duranickel® • Permanickel® • Inconel "X"®

D-C-P*

***DIFFERENTIAL COMPUTING POTENTIOMETER**

NOW—add or subtract two variables in one instrument—with one voltage source! This compact unit does work of two potentiometers—saves cost by eliminating one—has high inherent accuracy of a single potentiometer.

When one variable rotates shaft and other rotates body of this Type 748 Potentiometer, net voltage sum or difference is brought out through coin-silver precision slip rings in cover plate, shown above.

Linearity of 0.10% is guaranteed—and the high resolution, long life, low noise level, and low torque found in all Fairchild Precision Linear Potentiometers can be depended upon as always.

Suggested applications for this new precision instrument include use in servomechanisms for computing or power amplification, direct replacement of 2 single potentiometers when one is being used for compensation or correction purposes, etc. For details, address: Dept. N, 88-06 Van Wyck Boulevard, Jamaica 1, N. Y.

Fairchild
CAMERA AND INSTRUMENT CORPORATION

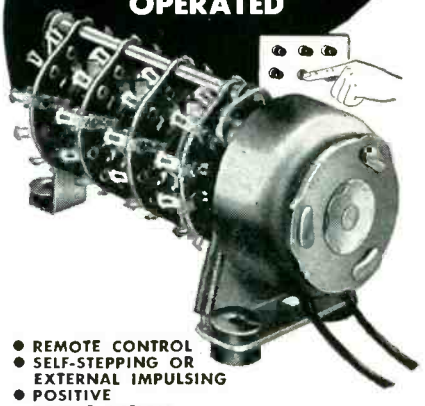
INSULATION
FORMVAR • FORMEX • ENAMEL
STRIPPED CLEAN IN SECONDS
with X-VAR

1. DIP WIRE in X-VAR for 3 seconds.
2. WITHDRAW and watch coating disintegrate.
3. WIPE CLEAN. Operation completed in seconds.

X-VAR is non-corrosive, non-creeping — leaves wire ready for soldering. Now in use by leading manufacturers of electrical products. *Write for FREE SAMPLE for testing.*

FIDELITY CHEMICAL PRODUCTS CORP.
472 Frelinghuysen Avenue, Newark 5, New Jersey

LEDEX
RELAYS and CIRCUIT SELECTORS
ROTARY SOLENOID OPERATED



- REMOTE CONTROL
- SELF-STEPPING OR EXTERNAL IMPULSING
- POSITIVE DETENT ACTION

for REMOTE CONTROL of MULTIPLE COMPLEX CIRCUITS

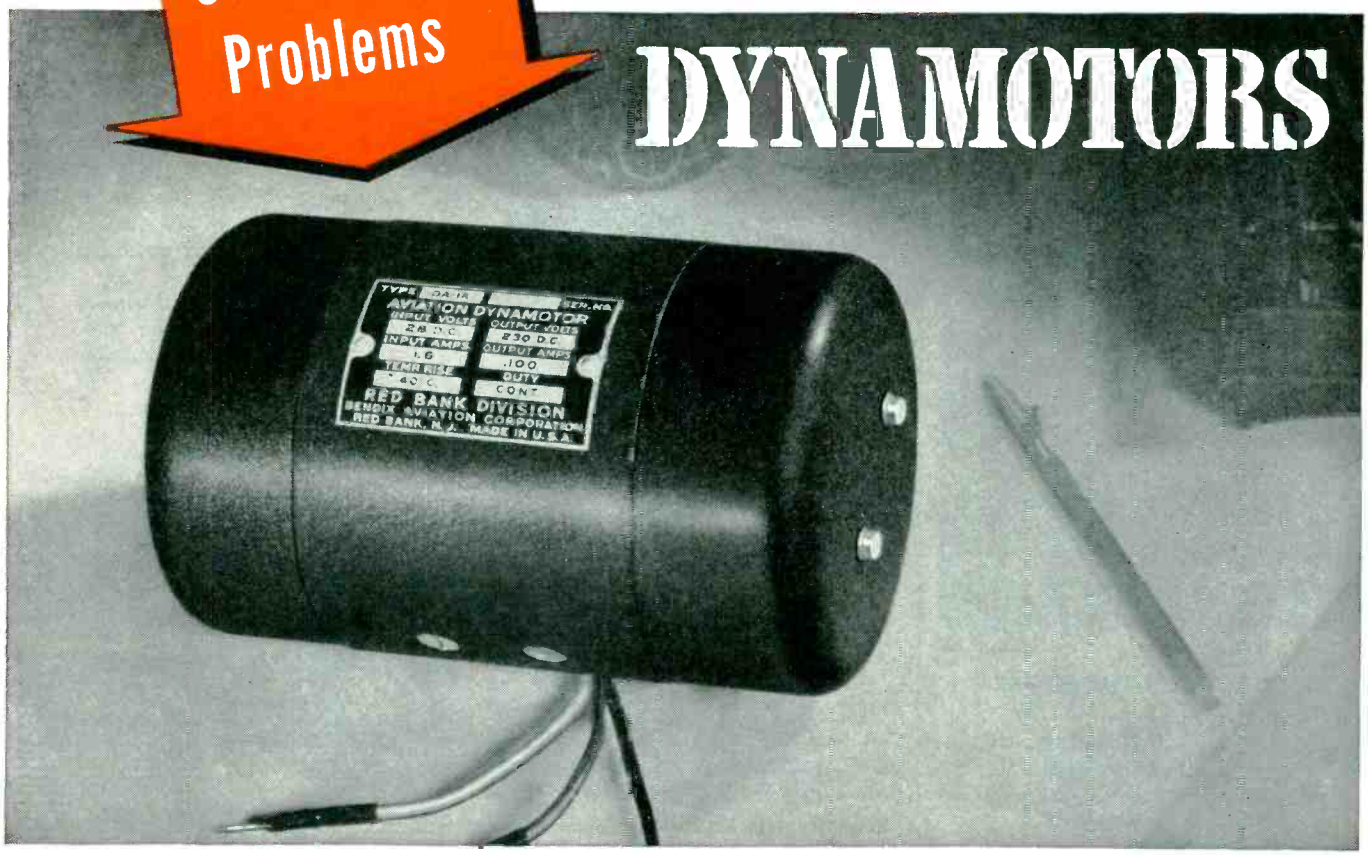
Many versatile designs of stepping, counting, adding and subtracting, latching, and *circuit selecting* relays are made possible by the combination of the Ledex Rotary Solenoid and wafer type rotary switches. Self-stepped or externally impulsed, the device is immediately adaptable to many remote control applications. A choice of wire sizes permits a wide range of operating voltages and power requirements. Various types of mountings further increase its adaptability. In addition to its positive control of multiple, complex circuits, a reserve of mechanical power is available for the performance of duties other than switching operations.

We supply to quantity users and solicit the opportunity to be of assistance in solving multiple circuit relay problems.

WRITE DIRECT TO
G. H. Leland INC.
118 WEBSTER STREET
DAYTON 2, OHIO

Let **Bendix** Solve Your Problems

SPECIALIZED DYNAMOTORS



. . . Promptly and at Moderate Cost!

Bendix dynamotors are built to supply the *exact* power requirements of your equipment—to work from any input voltage and to deliver the necessary power at any output voltage. Dual or triple output voltages are available for high and low-level portions of the circuit, or for biasing. For critical circuits, regulated outputs will simplify your design problems, especially since a regulated filament supply can be obtained as a bonus when regulating the high voltage output. Bendix will build your dynamotors to the usual military specifications or to meet even more rigid requirements, such as operation at higher temperature, or altitudes in experimental equipment.

Samples or production units of special dynamotors are priced competitively. A definite proposal will be made upon receipt of the details of your problem. For immediate information call our Engineering Staff—Red Bank 6-3600, Red Bank, New Jersey.

THE RIGHT DYNAMOTOR FOR EVERY PURPOSE

- Sizes—2¾" to 5¼" diameter
- Power Range—10 to 500 watts
- Input Voltage—6 to 115 volts
- Output Voltage—6 to 1500 volts
- Single and multiple output and input
- Plain and regulated types

RED BANK DIVISION OF BENDIX AVIATION CORPORATION
RED BANK, NEW JERSEY
Export Sales: Bendix International Division, 72 Fifth Avenue, N. Y. 11, N. Y.

RED BANK DIVISION
Bendix AVIATION CORPORATION

Operator introduces gas sample into analytical mass spectrometer. After sample system has been evacuated, a low pressure of the gas is fed into a measured volume of the system and provides for the mass-spectrometric analysis of the unknown gas

through a narrow collector slit to reach the collector plate and produce a measurable electric current.

As the magnetic field intensity is varied by changes in the current through the magnet, the mass spectrum is scanned. By correlation of changes in magnet current with movement of the Brown recorded chart, the time divisions of the chart indicate the mass numbers being measured. To adjust automatically the sensitivity and speed of the recorder for optimum recording of each mass peak, a precollector circuit is employed.

The precollector circuit includes a precollector which comprises a fine wire electrode. This electrode collects ions of the mass number under measurement prior to their passing through the collector slit to the collector plate. The current from this electrode, therefore, constitutes a preliminary measurement of the abundance of the mass which is about to be measured.

Circuits in the recorder respond to mass and its abundance before measurements so that the recorder can be automatically adjusted.

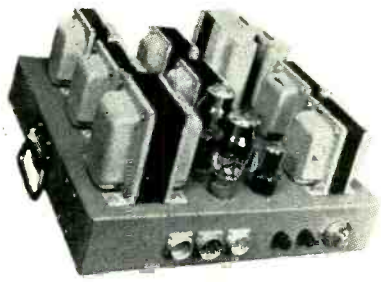
The General Electric recording mass spectrometer provides an extremely wide scanning range. With a fixed geometrical arrangement of spectrometer tube and collector electrodes, the specific mass is proportional to the square of the magnetic field strength, and inversely

½% REGULATION! WITH THE NEW "A.E.C" REGULATED POWER SUPPLY UNITS

Right: **MODEL PSR-102**...200 to 1000 volts D.C. at 0 to 500 ma. 6.3 volts A.C. center-tapped at 10 amp; ½% or better regulation under any conditions of operation within ratings. 20 MV. or less peak-to-peak ripple voltage. Output impedance effectively zero. High voltage continuously variable from 0 to 1000 volts.
NET PRICE F.O.B. FACTORY.....**$695.00**

Left: **MODEL PSR-100**...30 to 500 volts D.C. at 0 to 300 ma. 6.3 volts A.C. center-tapped at 6 amp; ½% or better regulation under any conditions of operation within ratings. 10 MV. or less peak-to-peak ripple voltage. Output impedance effectively zero. High voltage continuously variable from 0 to 500 volts.
NET PRICE F.O.B. FACTORY.....**$395.00**

Above, right: **MODEL PSR-105**...200 to 400 volts D.C. at 0 to 200 ma. from each of two separately controlled outputs, or 200 to 400 volts D.C. at 0 to 400 ma. 6.3 volts A.C. center-tapped at 10 amp; ½% or better regulation under any conditions of operation within ratings. 10 MV or less peak-to-peak ripple voltage. Output impedance effectively zero. Output voltages continuously variable. NET PRICE F.O.B. FACTORY.....**$695.00**

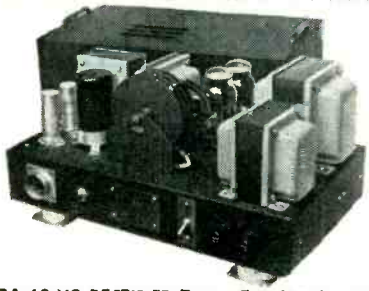


TCS POWER SUPPLY MODEL PS-106. Designed for use with U.S. Navy type TCS-1 thru TCS-12 transmitter-receiver for 110 or 220 volt A.C. applications. INPUT: 110/220 volts A.C. 50/60 C.P.S. OUTPUT: 400/450 volts D.C. at 200 ma. 225 volts D.C. at 120 ma. 12 volts D.C. at 1.5 amp. 12.6 volts A.C. at 4 amp
NET PRICE F.O.B. FACTORY.....**$200.00**

TEST EQUIPMENT FOR AIRCRAFT INSTRUMENT LANDING SYSTEMS

TS/67-C ILS SIGNAL GENERATOR...A crystal-controlled RF signal generator for sensitivity measurements and alignment of glide path and localizer receivers. Frequency coverage: 332.6, 333.8, 335, 108.3, 108.7, 109.1, 109.5, and 110.3 mcs.
NET PRICE F.O.B. FACTORY.....**$1,100.00**

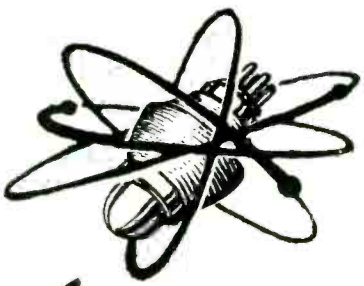
TS/170-C GLIDE PATH TEST SET...Battery operated portable test oscillator which provides a crystal-controlled signal at 332.6, 333.8 or 335 mcs., which may be 30% modulated from an internal source at 90, 150, 1000 cps. or unmodulated as desired, for glide path channels GX, GY, and GZ.
NET PRICE F.O.B. FACTORY.....**$190.00**



RA-62 VG RECTIFIER Power Supplies for Ground Station Operation of SCR 522 VHF Radio. SPECIFICATIONS: INPUT: 110/120/220/240 volts A.C. 50-70 cps, 225 watts. OUTPUT: 300 volts D.C. at 300 ma. 150 volts D.C. at 30 ma. 13 volts D.C. at 4.4 amp.
NET PRICE F.O.B. FACTORY.....**$138.00**

TS/173-C LOCALIZER TEST SET—*Left*...Battery operated portable test oscillator which provides a crystal-controlled signal at 108.3, 108.7, 109.1, 109.5, 109.9, or 110.3 mcs., which may be 30% modulated from an internal source at 90, 150, 1000 cps. or unmodulated as desired, for localizer channels U, V, W, X, Y and Z.
NET PRICE F.O.B. FACTORY.....**$200.00**

MB-2 MARKER BEACON TEST UNIT—*Right*...A crystal controlled, portable, 75-megacycle transmitter whose output may be tone-modulated at 400, 1300 or 3000 cycles per second, as desired.
NET PRICE F.O.B. FACTORY.....**$140.00**



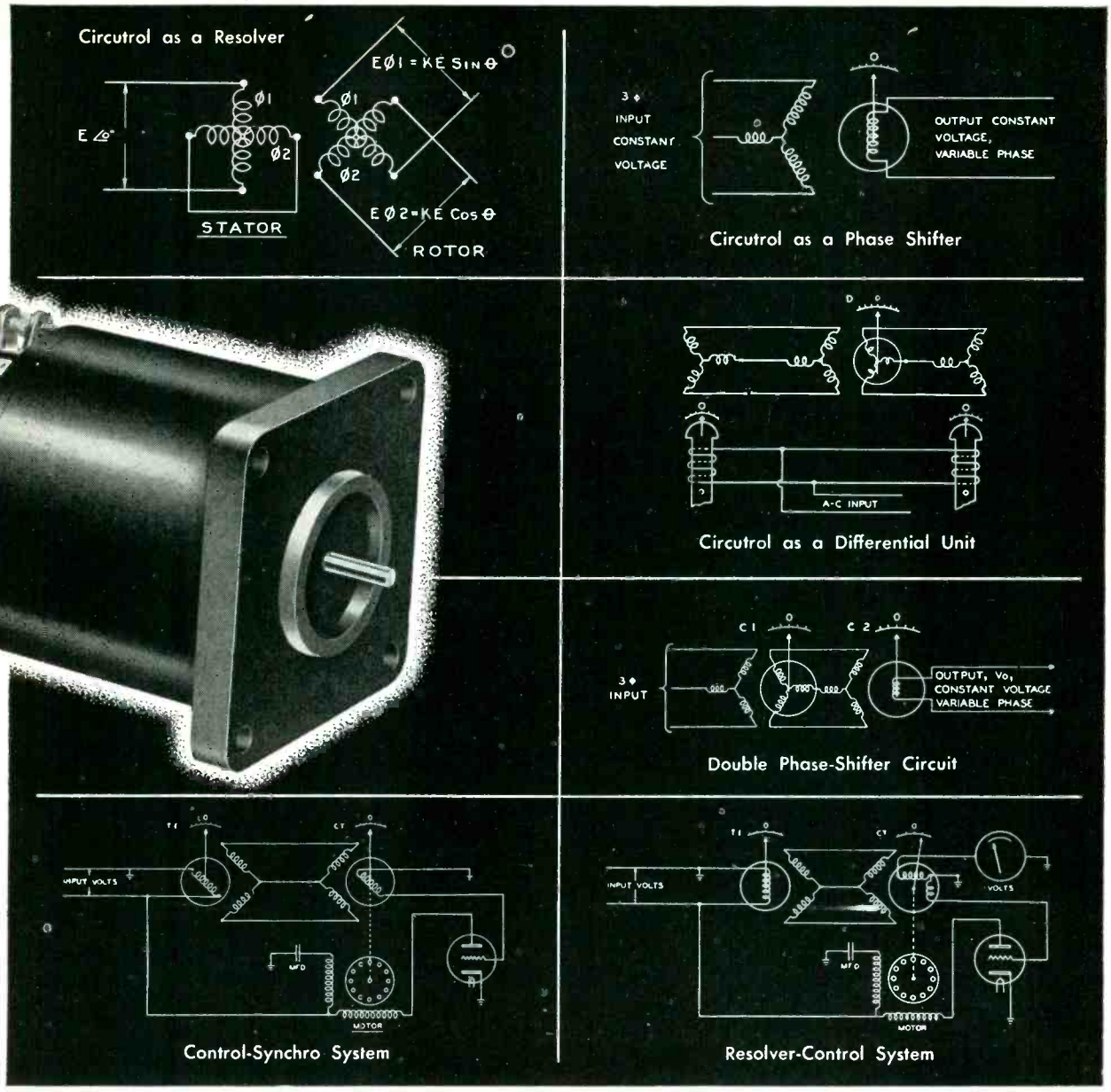
American Electroneering Corp.

2112 South LaBrea Avenue · Los Angeles 16, California

Additional information, all units, available on request.

Telephone: WEbster 3-5829

Cable: AMETRONEER Teletype: L.A. 641



For Electronic Computation

Kollsman Circutrol units offer a high degree of versatility as phase shifters, indicators and controllers. And when two or more are connected electrically, the solution of many complicated problems and functions is possible. These units are designed with high impedance windings to perform over a wide range of voltages and frequencies — characteristics that facilitate working them directly into any electronic circuit.

The Circutrol is but one of a complete line of miniature special-purpose AC motors engineered and manufactured by Kollsman Division, specialists for over twenty years in precision aircraft instrumentation and control. Each unit represents the solution to specific requirements. Among those available, you may find the exact answer to your control problems. If not, the experience and skill of Kollsman engineers may be called upon to produce units to your particular needs. For complete information, address: Kollsman Instrument Division, Square D Company, 80-64 45th Avenue, Elmhurst, N. Y.

KOLLSMAN INSTRUMENT DIVISION

SQUARE D COMPANY

ELMHURST, NEW YORK GLENDALE, CALIFORNIA

proportional to the first power of the accelerating voltage. A mass range of 1 to 300 is readily obtained with automatic magnetic scanning. Higher masses to 400 can be measured by adjusting the accelerating voltage. The mass of an ion is the sum of its nuclear particles, for instance CO_2 has a mass of 44—C=12, O=16.

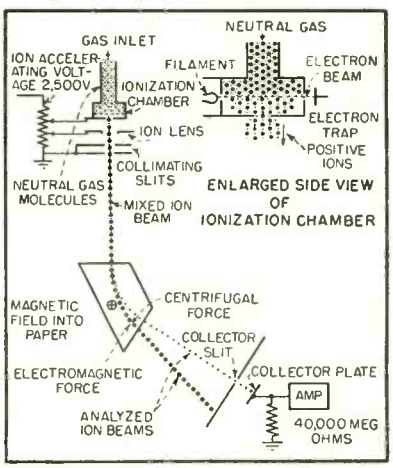
With the recording type of spectrometer, analytical results become apparent coincident with the scanning of the mass spectrum and the presence of any isotopes is revealed before the analysis is complete. The operator can reanalyze any portion of the mass spectrum immediately should results prove unsatisfactory and because analyses are recorded, notes can be made directly on the chart to facilitate later analysis.

The apparatus is provided with adjustable ionization potentials to permit separation of certain isomers. Samples can be in the gaseous, liquid or in certain cases the solid state. The automatic change of recorder sensitivity incorporated in the instrument prevents multiple traces on the mass spectrum record.

With the recording type of analysis, the average time required to record the mass spectrum from mass 1 to mass 100 is approximately 10 minutes.

The time required to scan depends upon the number of peaks because the recorder is automatically slowed down as each peak is being recorded. Full-scale peaks require about four seconds to be recorded.

A continuous indicating dial on



Block diagram of the complete instrument

COPPER ALLOY BULLETIN

PRODUCT IMPROVEMENT EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared Each Month by Bridgeport Brass Co. "Bridgeport" *Headquarters for BRASS, BRONZE and COPPER*

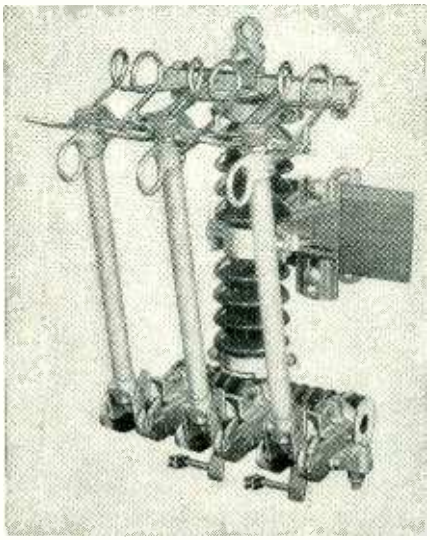
High Conductivity and Reliability Essential in Alloys for Power Transmission Equipment

Power distribution equipment made by Railway and Industrial Engineering Co., Greensburg, Pa., is designed for ruggedness and dependability. For this reason, materials are selected for high conductivity, excellent mechanical properties and resistance to corrosion.

All current-carrying parts are of copper and its alloys. Switch blades on the Type TTR are made from Bridgeport's high conductivity copper pipe, which has a conductivity better than 100% IACS at 68 deg. F soft.

In the type R3T horn gap switch, good spring properties and good conductivity are required. Bridgeport's Phono-Electric 840 was chosen to assure dependable high-pressure contact at all times. Phono 840 resists wear, corrosion and arcing, and is much stronger than copper, with 40% of copper's conductivity.

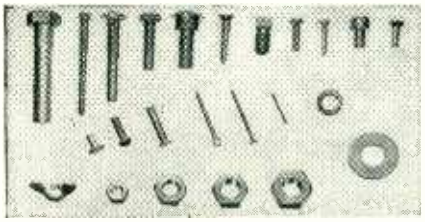
Phono-Electric 840 is also used in the Type TTL group-operated horn gap switch and the open type repeating cutouts, for dependable, high-pressure, good conductivity contacts. These applications are typical of the uses of Phono-Electric 840 Bronze in pole line and power transmission hardware, U-bolts, wire connectors, etc., where strength, toughness, good electrical conductivity and resistance to corrosion from weathering are required.



Open type repeating cutouts use Bridgeport's Phono-Electric No. 840. Courtesy Railway and Industrial Engineering Company.

Bridgeport's No. 609 Silicon Bronze for Dependable, High Strength Fasteners

The increasing demand for high strength, rust-free fasteners able to stand up over long periods of time without attention is being met by Bridgeport's No. 609 Silicon Bronze, developed about fifteen years ago by Bridgeport Brass Company. This alloy is used successfully for bolts, nuts, U-bolts, wire and cable connectors, nails, cotter pins, etc., for hardware on power transmission lines which are exposed to the elements and subjected to vibration in high winds or to heavy ice loads. Other uses are for electrified transportation systems and for the manufacture of building and marine hardware, etc.



High strength, corrosion-resisting Silicon Bronze screw products. Courtesy H. M. Harper Company.

Bridgeport's No. 609 Silicon Bronze (approx. 98% copper, 2% silicon), because of its fine corrosion resistance, high strength and other engineering properties, is finding increasing use where reliability is required and under conditions too severe for ordinary materials.

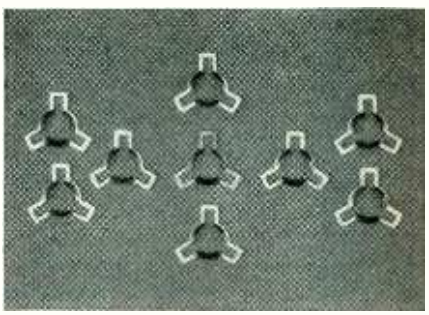
From a manufacturing standpoint, Bridgeport's No. 609 has fine workability. Its unusual malleability, even in the hard drawn condition, permits cold upsetting and roll threading operations for making cap and machine screws, nuts, bolts and similar screw products, with a great saving in the number of operations as well as reduction of scrap. When cold upset from hard drawn wire, screws can easily attain tensile strengths of about 100,000 lbs. per square inch. When properly made, they do not require heat treatment after upsetting.

No. 609 and other engineering alloys are described in Bridgeport's 128-page Technical Handbook, which also contains valuable information about other copper-base alloys, suggested applications, specifications and other data. A copy will be sent upon request.

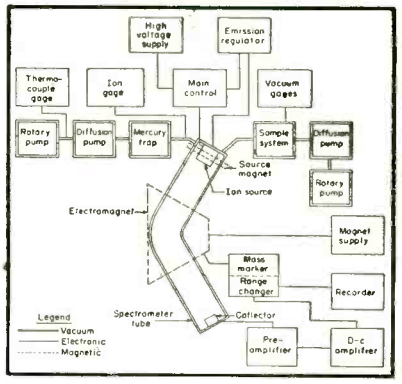
632 Silicon Bronze Makes Dependable Spring-Type Bearing Retainer

One of the engineering features that contributes to longer life of Signal Universal Heater Motors made by Signal Manufacturing Co., Inc., Lynn, Massachusetts, is the accurate alignment of the sealed-for-life bearings. Proper line-up during assembly and under any deflections during operation is secured by seating the bearing in the spherical pocket of the motor case, where it is retained by a strong spring made of Bridgeport's Silicon Bronze 632.

This stiff spring provides the uniform pressure necessary for a tight, firm fit against the case pocket, and yet is resilient enough to allow for some motion during line-up. However, it must be strong enough to prevent any turning of the bearing, even at shaft speeds up to 10,000 rpm.



Bearing Retainers made from 632 Silicon Bronze used in fractional horsepower motors for automotive and marine heaters, defrosters, windshield wipers, etc. Courtesy Signal Manufacturing Co., Inc., Lynn, Mass.



Principle of operation of the mass spectrometer is illustrated above

the instrument panel automatically rotates in synchronism with the sweep of the magnetic field to indicate each mass number. In conjunction with this, a mass marker identifies every fifth mass on the recorder chart by means of a second recorder pen to provide ready reference for subsequent analytical calculations.

The Brown ElectroniK high speed strip chart recorder incorporated in the spectrometer reproduces peak heights whose relative intensities vary from 1 to 3,000. A range of 1 to 3,000 is accomplished through the operation of an automatic range changing system. The recorder chart comprises an 11-inch wide strip of paper with uniform divisions from 0 to 100. All peaks can be read with an accuracy for each scale which is the same percentage of full-scale peak intensity.

Industrial Uses

In nuclear energy laboratories, the instrument simplifies and expedites the solution of many problems in gas analysis. For example, where deuterium (heavy hydrogen) is a factor, the abundance of hydrocarbon materials in which a hydrogen atom has been replaced with a deuterium atom, can be quickly and accurately ascertained.

In the petroleum industry analysis by mass separation aids in setting up distillation columns for optimum operation, thereby effecting a reduction in costs and an improved efficiency. Analysis of process streams in thermal cracking units permits evaluation of potential outputs and processing efficiency. In catalytic cracking, the study of operating unit conditions feasible with the spectrometer aids

Now There's a Magnecorder for Every Tape Recording Need

NEW! PT63-A Offers 3 Heads

Monitor from the tape!

A new professional tape recorder with three separate heads: erase, record, playback for monitoring from the tape. This PT63-A Magnecorder incorporates all other fine features of the PT6-A. The new PT63-J Amplifier for single microphone recording includes separate playback amplifier.

NEW! the Talk of the Shows

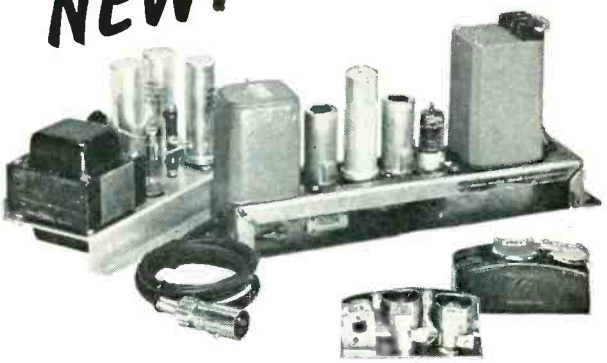
Magnecorder PT7 Console

3 Heads In a single housing. Separate heads for erase, record, playback or monitoring from the tape. Separately alignable, replaceable.

New Features New positive drive eliminates timing errors. Push-button controls can be remotely operated. Accommodates 10½" N.A.B. reels on all models including portable.

Also Available As PORTABLE or RACK MOUNT
Same features included. Separate amplifier for each purpose. Portable amplifier has high-level mixing for three microphones.

NEW!



Three Heads and Amplifier Kit

Converts Your PT6-A To Monitor From Tape

Complete conversion kit includes new three-head unit, additional monitor amplifier and power supply. Three-head unit simply plugs into receptacle for present two heads on your PT6-A Magnecorder.

SPECIFICATIONS JUST RELEASED
Write for detailed information on these latest Magnecorder developments.

Magnecord, INC., CHICAGO 1, ILL.

360 NORTH MICHIGAN AVENUE

World's Largest and Oldest Manufacturers of Professional Magnetic Recorders

in revising and adjusting the cracker to obtain top production with the desired ratio of paraffins, olefins, and other hydrocarbon products. The apparatus also facilitates the analysis of light hydrocarbon streams such as overheads and bottoms of depropanizers and debutanizers.

With the mass spectrometer, chemical analysis of small quantities can be performed without the special techniques and painstaking work required by the usual methods. Minute liquid and certain solid samples can be readily vaporized so as to produce sufficient gas molecules for a complete automatic analysis. In addition, considerable time is saved in the identification of isotopes and impurities by this method of analysis.

In isotope research, the relative intensity of the isotope is immediately apparent and traces of rare isotopes are immediately indicated. Safe, non-radioactive isotopes can be concentrated and used as tracers in biological and chemical studies, using the mass spectrometer to interpret results.

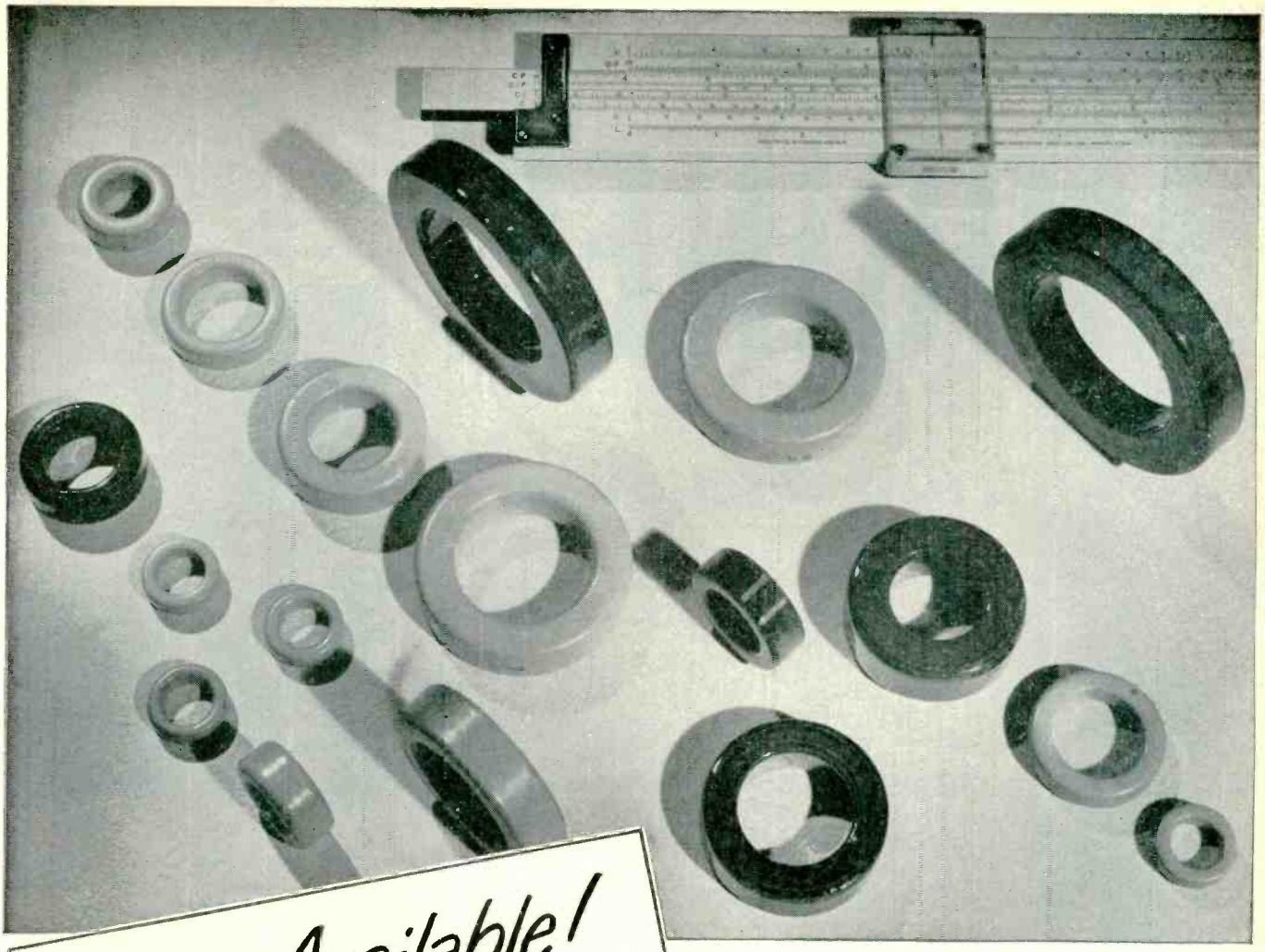
Mass spectrometry is also an effective tool in studies of molecular structures for the purpose of revealing the nature of the chemical and electrical bonds which hold together various complex molecules.

SHOP SHORTCUTS

ENDS of fairly heavy wires used in cable were difficult to secure in position while cord was applied. Spiral springs mounted above and below working area now hold wire ends between turns while cable is formed yet permit rapid placement and removal.

Westinghouse Electric Corp.
Baltimore, Maryland

INSPECTION and testing incoming components requires considerable time for setting up the test jigs and equipment. This time is saved by establishing semi-permanent test locations with all necessary instruments adjusted for specific components. Operators move from position to position as the load of incoming material shifts. Fortu-



Now Available!

MOLYBDENUM PERMALLOY POWDER CORES*

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

COMPLETE LINE OF CORES TO MEET YOUR NEEDS

- ★ Furnished in four standard permeabilities—125, 60, 26 and 14.
- ★ Available in a wide range of sizes to obtain nominal inductances as high as 281 mh/1000 turns.
- ★ These toroidal cores are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.

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

** Manufactured under licensing arrangements with Western Electric Company.*

W&D 2930

THE ARNOLD ENGINEERING COMPANY

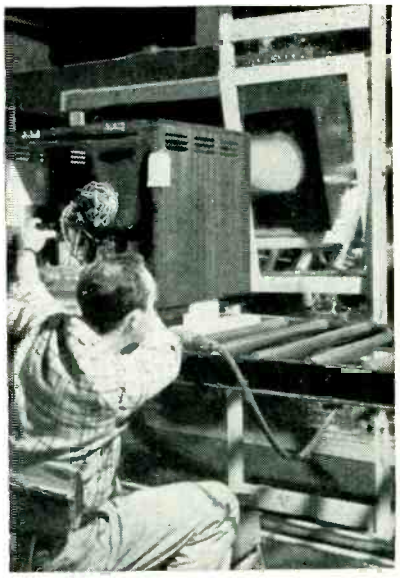
SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

147 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS

nately additional space was available.

Television Receiver Mfg. Div.
Allen B. Du Mont Labs, Inc.
East Paterson, N. J.

MIRROR is used by operator at chassis tie-down position to watch the crt mask on the front panel while properly locating chassis. To



have easy accessibility to bolts at bottom of chassis, the operator sits on a special stool while bolting chassis with air-operated gun.

Television Receiver Mfg. Div.
Allen B. Du Mont Labs, Inc.
East Paterson, N. J.

DENTAL MIRRORS and adjustable fluorescent lights are used by operators at inspection positions to examine the underside of soldered connections. Up-ended chassis ride

on moving conveyor and each girl inspects a specific portion. Troughs are used for keeping tools and inspection tags.

Television Receiver Mfg. Div.
Allen B. Du Mont Labs, Inc.
East Paterson, N. J.

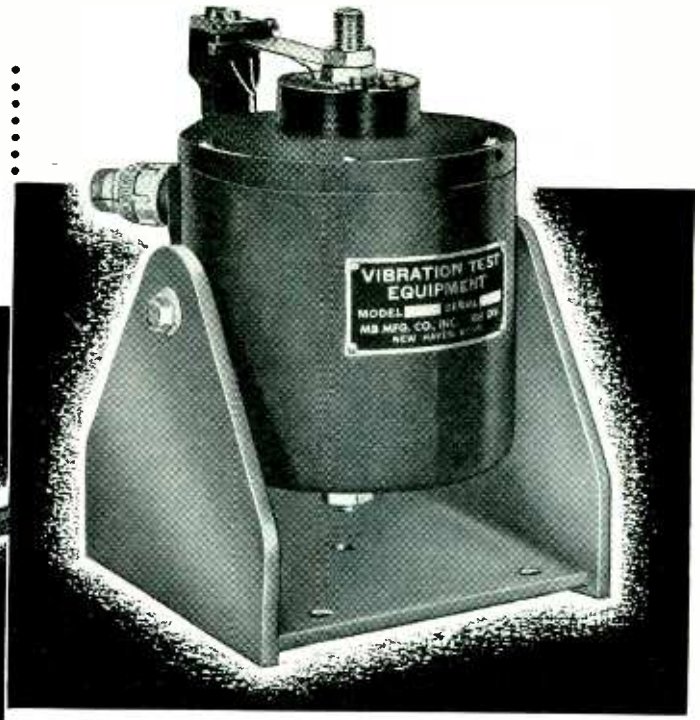
How to get to the bottom of VIBRATION troubles.. *fast!*

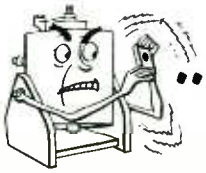
DETECT and measure vibration with this MB PICKUP

You'll find many tough vibration problems greatly simplified by the information an MB Pickup supplies. This sensitive instrument tells you how much vibration is being generated in your product. It enables you to check the efficiency of vibration isolation suspensions. It offers you a means for analyzing troubles from disturbing frequencies. As a quality control tool, it can also be used to check whether vibration is within acceptable limits.

This precision-built MB Pickup has virtually no lower limit to the amplitudes it can detect. Yet, it will withstand rough treatment and can be used for study of high energy vibrations as well. Attached to equipment under test, it transforms vibratory motions to electrical waves which you then feed to oscilloscope for visual inspection; or to vibration meter or analyzer for quantitative data.

Write for full details and specifications.





...*SHAKE* out the answer with this MB EXCITER

Here's the versatile shaker that is helping many leading companies turn out a better product — by shaking out "bugs" and exposing potential service problems.

It reproduces the vibratory effect of *years* of service within hours. Force and frequency are adjusted with a twist of the dial. Thus, not only can you easily "scan" products and parts for vibratory response, but also fatigue-test them, even to destruction. Used in conjunction with stroboscopic light, MB Exciters permit you to observe *visually* the vibratory motions. The shaker operates silently, and can help you locate and eliminate noise.

MB Exciters are being used for testing such objects as tubes, electrical components, assemblies, chassis, castings, forgings—even heavy mechanical equipment. Let us show *you* how to profit with one.

SEND FOR BULLETINS

No. 210-K5 gives you full details on the line of MB Exciters; No. 124-K5 on MB Vibration Pickups.

THE MB MANUFACTURING COMPANY, Inc.

1060 State St., New Haven 11, Conn.

PRODUCTS FOR *MEASUREMENT*...*REPRODUCTION*...AND *CONTROL* OF VIBRATION

THE ELECTRON ART

(continued from p 122)

variable pulse durations of 20 μsec to 1.5 sec.

Multivibrator

The circuit diagram is shown above. The variable-frequency generator is a simple stable multivibrator with three frequency ranges provided by ganged capacitor steps: 0.33 to 3.3 cps; 3.3 to 37 cps; 37 to 400 cps. A dual potentiometer provides fine adjustment.

A derivative of the multivibrator wave form is taken by a small time constant RC circuit (5×10^{-8} sec). The resulting spikes are amplified and reversed in polarity by a triode stage. The amplified spike is used to trip a univibrator of variable recovery time. The input side of the univibrator is normally non-conducting and a positive pulse is needed to trip it. The time for recovery after triggering is varied in three steps by capacitor selection: 20 μsec to 0.006 sec; 0.003 sec to 0.05 sec; 0.03 sec to 1.5 sec. The capacitor selected is charged through a variable resistance to give fine control. Minimum time for each range is determined by a fixed resistor switched in series with the variable control as the time range is chosen.

Univibrator

The multivibrator used has a small as well as large abrupt change in its output wave. After the derivative has been taken, amplified, and applied to the univibrator, there remains in addition to the main trigger spike a small spike slightly more than ½ cycle later which resets the univibrator if it has not recovered by itself before this time.

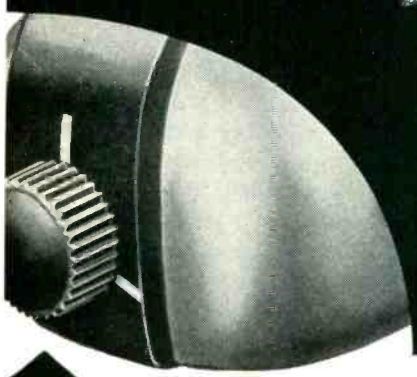
Biased Triode

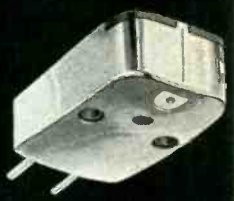
The output wave of the univibrator is rectangular at the top, but undershoots on recovery. This signal is therefore directly coupled to another triode stage which is biased below cutoff when the univibrator is quiescent. It conducts on the positive swing from the univibrator, producing a rectangular voltage wave of negative polarity at the plate. The high-potential end of the resistor is grounded and the signal is taken between ground and the tap on a potentiometer in

NO MORE!

NO MORE PLUG-IN CARTRIDGES!
NO MORE EXTRA PICK-UP ARMS!

with the new..... *Fairchild*
TURRET-HEAD ARM





NOW_ All 3 CARTRIDGES in ONE ARM

lateral, vertical and microgroove – or any other combination desired

SIMPLY TURN KNOB to select cartridge...

Pressure Changes Automatically

New miniature version of the Fairchild moving coil cartridge permits this revolutionary advance.

- OPTIMUM PERFORMANCE ASSURED by separate cartridge for each function. Mount any 3 of four cartridges listed at right in one arm.
- OPTIMUM GROOVE TANGENCY—offset design.
- NEW VISCOUS DAMPING—NO ARM RESONANCE.
- FITS ALL TRANSCRIPTION TABLES—mounting radius, 13 3/8"; height above record surface, 1 7/8"; base height adjustable.
- **3 WAY TURRET-HEAD ARM . . . . . $65.**

MINIATURE DYNAMIC CARTRIDGE, shown above, fits all arms and record changers—standard RMA mountings—Diamond Styli mounted perpendicular for back cuing.

- LINEAR FREQUENCY RESPONSE—constant velocity device—moving coil design for low mass moving parts and freedom from distortion.
- NO HUM PICKUP—extremely small coil winding keeps induced hum at least 15db below other professional type cartridges.
- HIGH LATERAL COMPLIANCE in conformance with good pickup design.
- CONNECTS TO MICROPHONE CHANNEL—low impedance—feeds through equalizer directly to the input of console at microphone level.

CARTRIDGES WITH DIAMOND STYLI	LOW PRICED
Unit 212—Lateral 2.8 mil	$42.50
Unit 211—Lateral 2.2 mil	42.50
Unit 210—Lateral 1.0 mil	47.50
Unit 213—Vertical	50.00

Fairchild RECORDING EQUIPMENT CORPORATION

154 St. & 7th Avenue • Whitestone, New York

the plate lead. The potentiometer may be switched next to, or away from, the plate to give two steps of signal voltage differing by a factor of two.

Other steps of signal amplitude are obtained by switching the cathode resistors. For the values given, a change of about 15 in the signal is obtained. The small capacitor connecting the triode plate to its negative supply was added to remove a small spike overshoot on the leading edge of the rectangular wave at some gain settings.

Power Amplifier

The d-c power amplifier input is at ground potential, which is approximately 180 volts above its negative supply. The small resistance between the 6SL7 cathodes is provided to balance the output to zero in the no-pulse condition. A choice of current or voltage feedback is provided, allowing the selection of a rectangular current or voltage wave to the load.

Classical nerve and muscle rectangular wave excitation are usually accomplished by using a high voltage and a high resistance in series with the electrodes so that constant current is obtained through the tissue regardless of its impedance changes. Setting this amplifier to the current feedback position provides the same condition.

Two power supplies were conveniently available from a single transformer. The large coupling capacitor between them improved the stability on the lowest frequencies.

The work herein described was supported by the Baruch Center of Physical Medicine of the Medical College of Virginia.

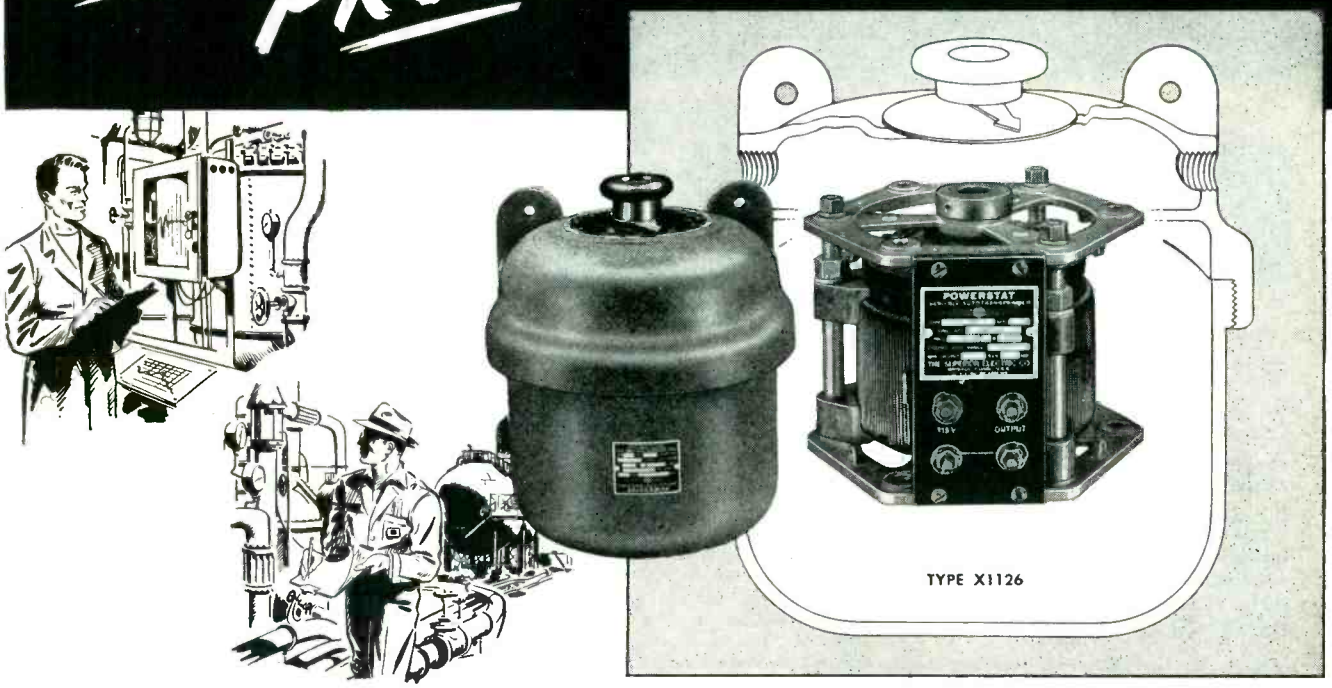
Microseismic Arclight Timer

BY JOSEPH A. VOLK
St. Louis University
St. Louis, Missouri

MICRO-OSCILLATIONS in the ground and in the air are and have been for several years the subject of extensive research work. One microseismic research project at the Institute of Technology of Saint Louis University, under contracts with ONR, utilizes, to a certain extent, experience gained in recording quarry blasts of the Missouri

ANOTHER SUPERIOR FIRST...

EXPLOSION PROOF POWERSTATS



FOR OPERATION IN HAZARDOUS AREAS

Another major advancement in voltage control — the Explosion-proof POWERSTAT variable transformer — is now offered by The Superior Electric Company. This new POWERSTAT provides safe operation in hazardous areas where a small arc or spark could cause an explosion.

The Explosion-proof POWERSTAT is enclosed in a case which will withstand internal gas or vapor explosions. The case is also designed to prevent the ignition — by internal spark, flash, or explosion — of the gas vapor *surrounding* the enclosure.

Type X-1126, shown above, is rated at 115 volts, 50/60 cycles, 1 phase input with 0-135 volts, 12 amperes output. It is Underwriters' Approved for Class 1, Group D service.

Like all POWERSTATS, this new unit is quality manufactured and ruggedly designed to stand the severest usage, providing precision control for dependable, accurate service. The development of the Explosion-proof POWERSTAT is a continuation of the Superior policy of providing voltage control equipment to suit each requirement. Whether your application involves a unit for 115, 230, or 460 volts . . . 25, 50/60, 400/800 cycles . . . single or three phase . . . manual or motor driven . . . air, oil-immersed, or hazardous atmosphere operation — remember that *there's a* POWERSTAT *to do the job.* Refer your problems regarding use of POWERSTATS to our experienced engineers.

WRITE TODAY FOR COMPLETE INFORMATION
405 MEADOW STREET

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

SECO

POWERSTAT VARIABLE TRANSFORMERS • VOLTBOX A-C POWER SUPPLIES • STABILINE VOLTAGE REGULATORS

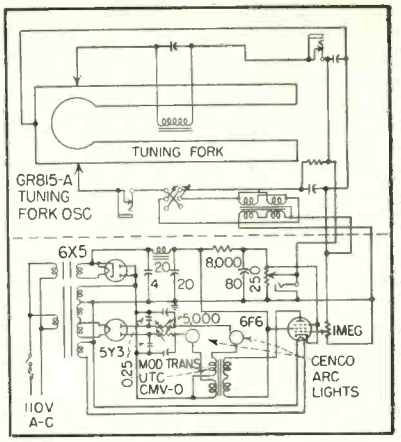


FIG. 1—Schematic diagram of arc-light timer for use in microseismic research

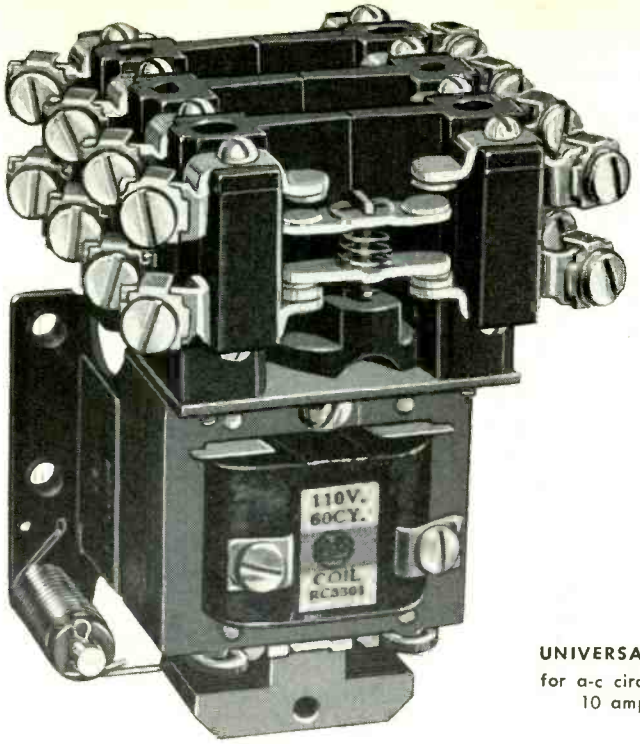
Portland Cement Company in the northwestern part of St. Louis county.

Since the periods of both the quarry blast waves and the microseisms are short, the basic requirements for establishing a convenient time base are essentially the same. Timing markers of 1/50 to 1/100 second have been found most convenient and are most widely used today in the field of seismic research.

The most common recording system shows the seismometer response together with superimposed timing lines. These lines are reflected from a simple mirror galvanometer which is excited by a 50-cps tuning-fork oscillator. While this method of timing is basically simple, it has many disadvantages which eventually led to the elimination of the mirror galvanometer through the use of an arc-light tube in conjunction with the usual tuning-fork oscillator. The light is pulsed to give accurately spaced flashes which are reflected onto the photographic recording strip along with the seismometer response.

The timer circuit is shown in Fig. 1. Two Cenco arc lights are used. Each of these may be used

FIG. 2—Microseismic timer showing two Cenco arc lights, the modulator chassis and the GR tuning-fork oscillator



UNIVERSAL RELAY
for a-c circuits up to 10 amperes.

SOLENOID CONTACTORS
from 10 to 900 Amperes

When power supply circuits carry substantial currents . . . or are switched frequently . . . or their functioning must be foolproof . . . the relays and contactors used in such circuits must be rugged, consistent in action . . . and trouble free.

Allen-Bradley relays and contactors are extremely compact for their ratings . . . but designed for tough service. They are built up to a high quality standard . . . not down to a price. They have but one moving part . . . there are no trouble breeding pins, pivots, levers, or flexible shunts. The double break, silver alloy contacts are maintenance free.

For sturdy, long lived switching units, specify Allen-Bradley solenoid contactors . . . made in a full range of sizes up to 900 amperes. Send for catalog, today.

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

100 AMPERE CONTACTOR
Allen-Bradley solenoid contactor for circuits up to 100 amperes. Double break, silver alloy contacts are totally enclosed. Simple, straight line solenoid action means long, trouble free operating life.

LIMIT SWITCHES OF ALL TYPES
The Allen-Bradley line of Bulletin 801-802 limit switches covers a remarkable assortment of pilot controls for automatic limiting of control circuits. All types of standard and precision limit switches are available with lever arms, rollers, forks, and chain controls.

A-B Quality

ALLEN-BRADLEY
RELAYS • RESISTORS
Sold exclusively to manufacturers of radio and electronic equipment

QUALITY

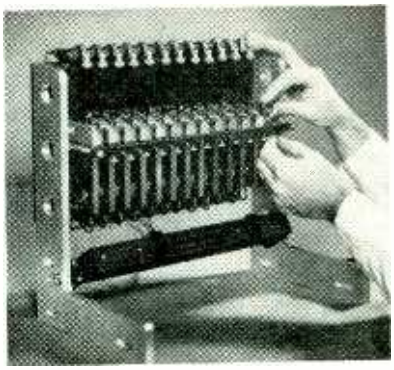


FIG. 3—An 8-watt fluorescent lamp is used to generate 12 synchronized timing pulses in the setup shown

with up to six typical recording channels. The small but intensive light spot, only 0.004-inch diameter, is ideal for pin-point recording spots. The main disadvantages of these types of lights is their rather high starting voltage and the wandering spot.

The starting relay in the power supply usually used with the Cenco arc light has been dispensed with by the use of a high-impedance power supply delivering a no-load voltage of approximately 1,250 volts d-c. As soon as the arc lights fire, the arc light current causes the arc light voltage to drop to about 35 volts which is automatically maintained over a wide range of line voltage variation.

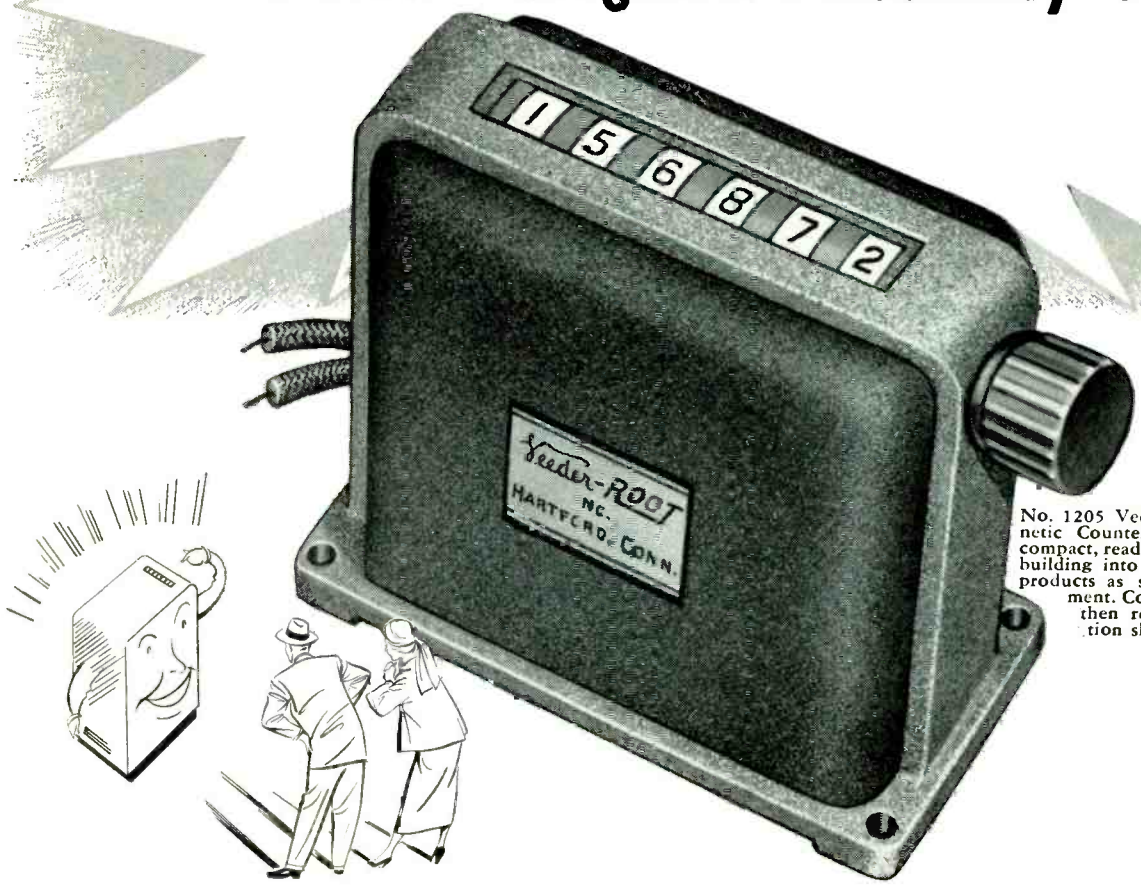
The plate current of the 6F6 is controlled by the tuning-fork oscillator. Thus a time marker of 1/50 sec is inserted so that the arc light serves as both recording light and time-base marker. The tuning-fork used requires 4 volts at approximately 20 ma.

10-CPS Beatnote

By purposely introducing a 60-cps component through the d-c filter system, a 10-cps beatnote is obtained which is useful in counting the timing lines. This aid is most helpful when paper speed of the recording camera is slow, say 1/3 cm per sec or less.

Figure 2 shows the arclight timer with the covers of the main components removed. The useful life of the Cenco lights is approximately 400 hours, which is considered sufficient for any but continuous recording purposes. Intermittent use can as much as quadruple the life of these tubes. Where longer life is desired, the Sylvania 1130-B should be used,

How to give Your Product a New "Magnetic Personality"...

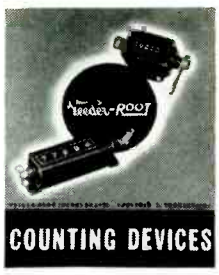


No. 1205 Veeder-Root Magnetic Counter (AC only) is compact, readily adaptable for building into many types of products as standard equipment. Counts to million, then resets. Specification sheet on request.

...give it a Sales Build-up with Built-in Magnetic Counters

Lucky are the products that can avail themselves of the added usefulness—*the new sales-magnetism* — imparted by this modern Veeder-Root Magnetic Counter. And such products vary as widely as currency-counting machines, conveyors, electronic equipment, and other electrically operated devices equipped with contact switches.

But if your product has a "hidden talent" for counting either electrically *or* mechanically, Veeder-Root engineers know how to discover and develop that talent . . . and how to enable your product *to talk to your customers in any terms they want.* In terms of any units of performance, production, volume, length, or what have you. Yes, Veeder-Root Counters not only help sell the products they're built into . . . they can even prove the product's service guarantee! Now, when would you like a "talent scout" to look at your product . . . *to see whether you can count yourself lucky, too?* Just write.



Write for 8-page "Count Book" which shows all types of V-R electrical, mechanical, and manual counters . . . standard and special.

VEEDER-ROOT INC., HARTFORD 2, CONN.

In Canada: Veeder-Root of Canada, Ltd., 955 St. James Street, Montreal 3.
In Great Britain: Veeder-Root Ltd., Kilspindie Road, Dundee, Scotland.

Veeder-Root COUNTERS

its life being approximately 10,000 hours.

The Cenco arclight may be replaced by an 8-watt fluorescent light, provided a long enough optical path, together with individual condenser lens, is provided. In this case, it is most practical to mount the fluorescent light inside a metal tubing with a number of slots corresponding to the number of channels required. This type of mounting is shown in Fig. 3 for a 12-mirror-galvanometer recorder. The light passes through the slits to the mirror galvanometers and is reflected back to the recording slot.

Magnetic Tape Is Memory for Computer

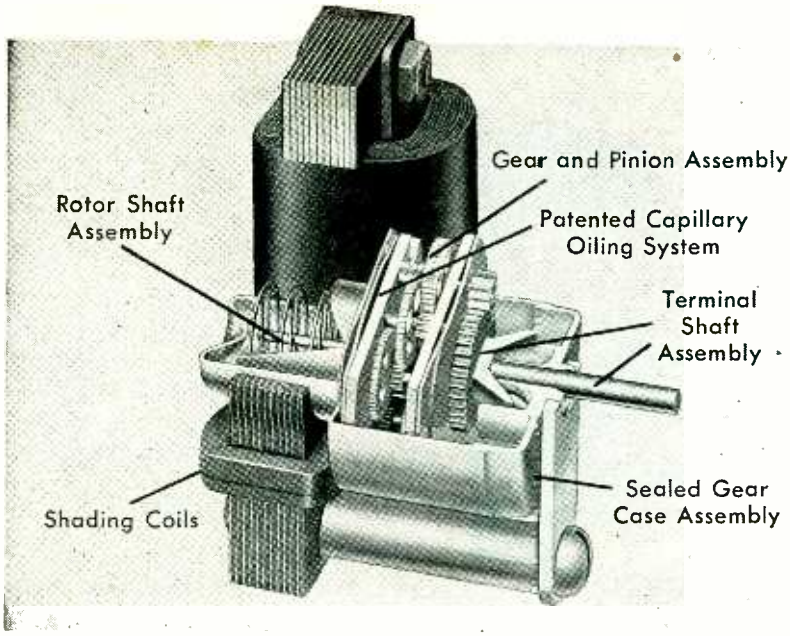
A MEMORY SYSTEM capable of storing 64,000 digits and leading a computing machine through a complex mathematical problem of 4,000 steps is a part of Harvard University's new Mark III calculating machine, to be used by the U. S. Navy Bureau of Ordnance.

The system consists of eight storage drums and a sequencing drum. Problems are solved by feeding information on a magnetic tape to the sequencing drum, which in turn commands the computing section to accomplish the desired operations with the numbers in the storage drum. The results come out of the machine on another magnetic tape.

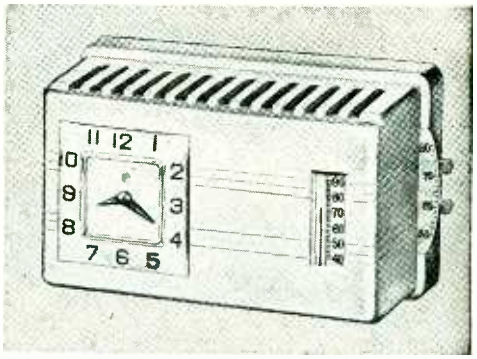
Both the information for carrying out given operations and the numbers with which the operations are performed are represented by small magnetic spots on the surface of the rapidly rotating drums. An elaborate system of recorders and play-backs circulates the information between the drums and other parts of the machine. The drums revolve at speeds up to 120 revolutions per second and the magnetic spots move by the recording and play-back heads at speeds greater than 150 miles per hour.

Coding Keyboard

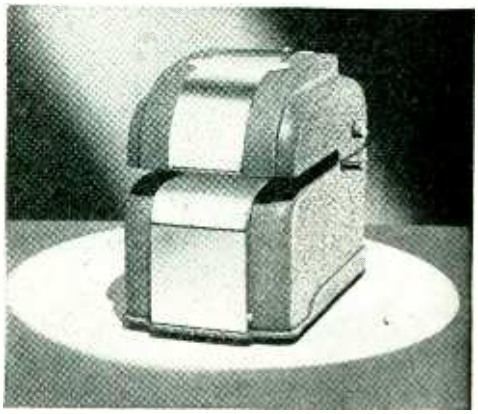
A coding box speeds up the process of translating mathematical symbols and operations into a language the machine can use. Over 200 keys each have a number or mathematical symbol. The operator in effect copies his equations on



Telechron Type B Synchronous Motor. For switches, recording-controlling mechanisms and other medium duty controlling purposes. Other models available with lower or higher torques for light or heavy duty applications.



Controlling the timing of heat regulators is typical of the jobs well done by Telechron Type H3 light duty motors.



Most time-stamps and recorders owe their accurate timing to Telechron Type B motors because such applications demand a motor that is instantly, constantly synchronous.

Unique Oiling System Prolongs Timing Accuracy

Capillary action in the spaces between each bearing and capillary plate of Telechron Timing Motors draws a specially formulated oil from the reservoir at the bottom of the sealed gear case. This keeps bearings and pivot surfaces constantly covered with a thin coating of oil. Oil creepage along the shafts, pinions and gears maintains complete, continuous lubrication. Brass terminal gear baffles meter the right amount of oil to the terminal shaft bearing . . . cutting down bearing wear and making the sealed-in oil supply last for years.

This oiling system is just one of many reasons why *all Telechron Timing Motors are instantly, constantly synchronous* . . . and why designers concerned with split-second timing or precise control of lightweight moving parts invariably specify Telechron motors.

If accurate timing enters into your product design, talk things over with a Telechron Application Engineer. Backed up by the experience that makes all electric timing possible (virtually all frequency-controlling master clocks in power stations are made by Telechron), he can probably show you how to save time and money by fitting a standard Telechron motor into your product. In the meanwhile, get complete data by mailing the coupon below. Telechron Inc. A General Electric Affiliate.

Telechron®

ALL TELECHRON TIMING MOTORS ARE INSTANTLY . . . CONSTANTLY SYNCHRONOUS

TELECHRON INC.
40 Union Street
Ashland, Massachusetts

Please send me information on sizes and types of Telechron Synchronous Motors. My possible application is:

Instruments	☐	Communications Equipment	☐
Timers	☐	Other (please fill in)	
Electric Appliances	☐	.....	
Cost Recorders	☐	.....	
Advertising, Display Items	☐	.....	
Juke Boxes	☐	.....	
Air Conditioning & Heating Controls	☐	.....	
		☐ Please send new Catalog	

NAME .....

COMPANY .....

ADDRESS .....

CITY ..... ZONE .....

STATE .....

this keyboard, for recording on magnetic tape all the commands the machine needs to solve his problem. Complex problems that used to take days and weeks to code for a machine can now be prepared almost as fast as an operator can punch the keys on the box.

A magnetic tape is used for answers because Mark III turns out answers faster than a typewriter can print them. The tape is fed to a tape reader which relays the answers to a battery of five typewriters.

Error Detectors

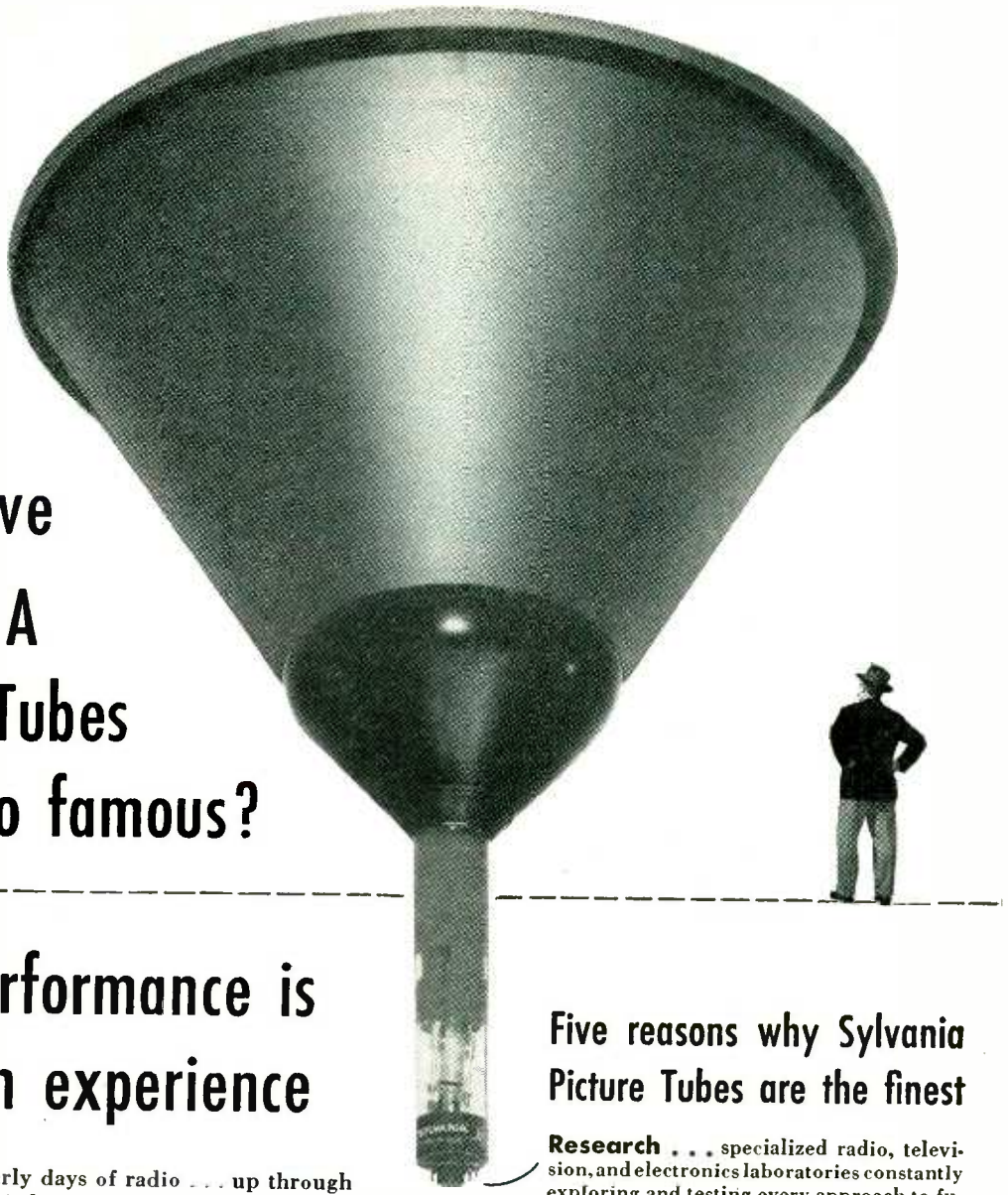
Computations of the machine are checked at several points for possible errors. During the mathematical operations in the arithmetic section of Mark III, answers are double-checked at every stage in the problem before going on to the next stage. To insure that the final typed results are correct, all numbers are recorded twice on the magnetic tape by two parallel and independent systems. Unless both numbers on the tape are identical, the striking action of the type bars sets off an alarm and stops the typewriters.

To eliminate errors that might creep into answer sheets during type-setting and printing of permanent records, the results are printed directly to pages which can be photographed and printed by offset lithography for publication in quantity.

Mark III, which was begun in May, 1946, has been built for the Bureau of the Ordnance of the U. S. Navy to be used at the Naval Proving Ground Command at Dahlgren, Virginia. It is anticipated that testing operations will have been completed by the first of the year and the machine will go to the Navy at that time. The complete instrument is about 30 feet long and 15 feet wide and weighs close to 10 tons. It contains about 4,500 vacuum tubes for the electronic operations, 3,000 relays and 2,500 magnetic heads and playbacks to carry the information to and from the storage drums.

Project Personnel

Dr. Benjamin L. Moore, Assistant Director of the Computation Laboratory and Dr. Way Dong Woo, Assistant Professor of Applied



Q. Why have SYLVANIA Picture Tubes grown so famous?

A. Their performance is rooted in experience

Step by step, from the early days of radio . . . up through the development of multi-element tubes, and on to electronics and television . . . Sylvania has progressed to a position of leadership in today's TV picture tube industry.

During the war period, Sylvania's production of precision radar equipment and cathode-ray tubes added much to the skills and know-how of Sylvania engineers.

Still further contributions to Sylvania's high standing in the picture tube field have come from this company's half-century experience in lighting . . . and in perfecting new phosphors for the finest in fluorescent lamps.

Born *AND* Made—It's important to remember that Sylvania is a picture tube *manufacturer* . . . not merely an assembler!

Every Sylvania part is quality controlled by Sylvania craftsmen. Even the micro-fine tungsten filaments are drawn and tested in Sylvania plants. That's why we say Sylvania picture tubes are born *and* made to serve better . . . last longer. For full information, write: Sylvania Electric Products Inc., Dept. R-2105, 1740 Broadway, New York 19, N. Y.

Five reasons why Sylvania Picture Tubes are the finest

Research . . . specialized radio, television, and electronics laboratories constantly exploring and testing every approach to future improvement.

Background and Experience . . . 25 years a recognized leader in highest quality radio and electronic tubes. Developed new fluorescent lighting phosphors and techniques applicable to TV picture tube production.

Engineering Development . . . alert engineering procedures assure efficiency and speed production of all Sylvania products.

Quality Control . . . a continuing program of checking and rechecking every step of every process to assure, beyond question, the perfect performance of Sylvania Picture Tubes.

Enlarged Plant Facilities . . . 2 great plants, devoted exclusively to TV picture tube production, assure quick delivery to your factory anywhere.

SYLVANIA ELECTRIC

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

Mathematics at Harvard University, were directly in charge of its development, design and construction. Mechanical design and construction of the internal high-speed magnetic drum storage system, one of the major components of Mark III, was the work of Robert Wilkins, assisted by Dexter Smith. The adder and multiplier were largely the work of Charles Coolidge. Marshall Kinkaid was mainly responsible for the over-all design of the sequencing circuits. The input and output circuits were constructed by Richard Hofheimer. Charles Richards, who had previously worked on Mark II and will go to Dahlgren with Mark III, also worked on design problems throughout the construction period.

Dr. Howard Aiken, co-inventor of the original calculating machine and director of the Harvard Computation Laboratory, had general supervision of the project.

Antilogarithm Circuit

CIRCUITS of the type shown in Fig. 1 have long been used, with variable-μ type tubes, for extracting logarithms directly. For instance, using a 6SK7, the plate current follows the grid voltage logarithmically over a range of grid voltages from -10 to -20 volts when a cathode resistance of 10,000 ohms is used. The type 6SG7 displays similar characteristics when its grid is operated between -4 and -10 volts.

In an article in February, 1950, *Review of Scientific Instruments*, F. Curtis Snowden and Harold T. Page reveal that if this type of circuit is operated in reverse, as shown in Fig. 2, antilogarithms can be extracted directly, as might be expected. A 6SK7 is connected as an inverted triode; the signal is applied to the plate, which acts as

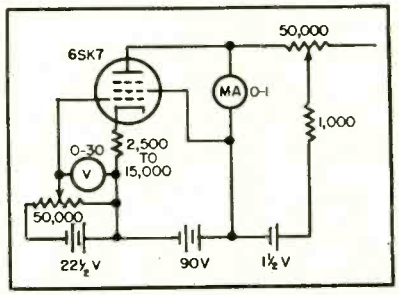
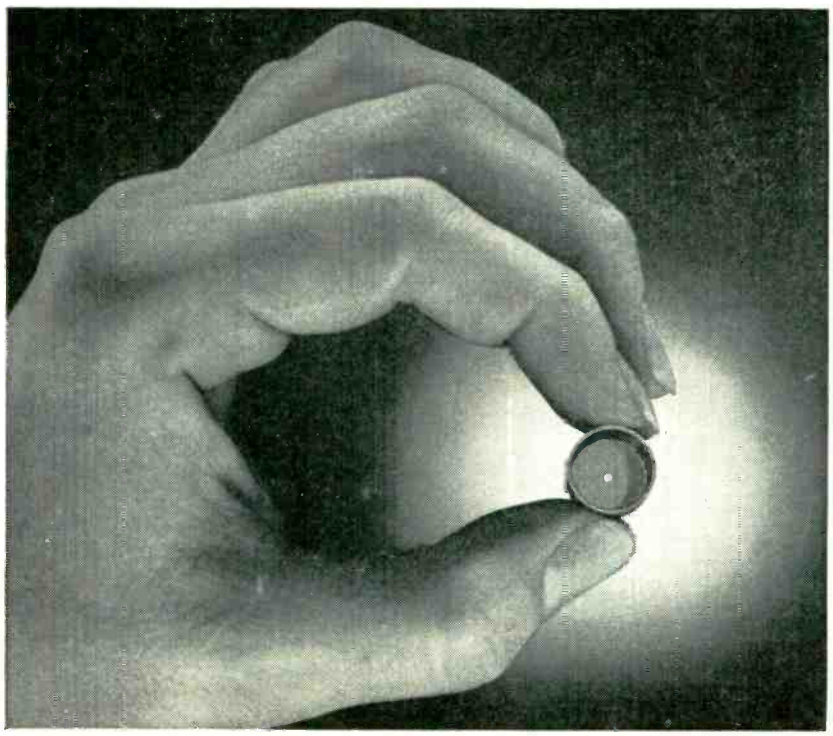


FIG. 1—Well-known circuit which extracts logarithms directly

Through this portal pass the nation's top stars

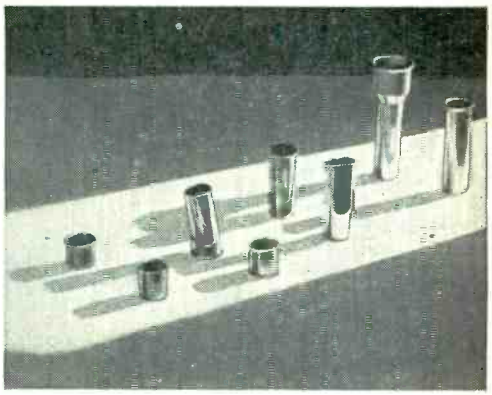


● You may not recognize the object pictured above. It is the first grid cylinder for a cathode ray tube gun structure, photographed from an unusual angle. The hole is only .040" in diameter —and the grid itself is deep drawn in one piece to save unnecessary welding and assembly operations by TV tube manufacturers.

This is tubing technology in operation. It is an example of Superior's superiority in electronic research, production know-how and facilities, and metallurgy. It is one product of hundreds pioneered for the electronic industry by Superior.

You may already be one of our valued customers and friends —nearly all electronic manufacturers are. If small Seamless or †WELDRAWN tubing can help anywhere in your product Superior can help you. To find out how, write Superior Tube Company, 2500 Germantown Avenue, Norristown, Pennsylvania.

All in a Day's Work—Chemical Laboratory continually samples raw materials; checks and controls quality from suppliers.



Sized and Shaped for TV—Hundreds of tubular parts are produced by Superior from WELDRAWN Type 305 (18-12) stainless steel.

Space and Time—188,000 square feet—over 4 acres—for developing, producing, and testing small tubing . . . plenty of space . . . and people who take time to give you a good product and good service.

Which Is The Better For Your Product . . .

SEAMLESS . . . ? The finest tubes that can be made. In all O.D.'s from 1⅜" and lower. Excellent for forming, bending, machining, etc., carbon, alloy, stainless, non-ferrous and glass sealing alloys.

Or LOCKSEAM*. . . ? Produced directly from nickel alloy strip stock by our patented machines. Available in a wide range of nickel alloys. Round, rectangular, oval or square, cut to specified lengths, beaded or flanged.

†REG. U. S. TRADEMARK—SUPERIOR TUBE COMPANY
*MFD. UNDER U. S. PATS. SUPERIOR TUBE COMPANY

Superior
THE BIG NAME IN SMALL TUBING
All analyses .010" to ½" O.D.
Certain analyses (.035" max. wall) Up to 1½" O.D.

Electronic Products for export through Driver-Harris Company, Harrison, New Jersey • Harrison 6-4800

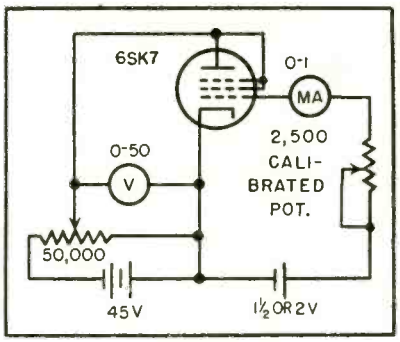


FIG. 2—Inverted-triode circuit for direct determination of antilogarithms

a grid, and the output is drawn from the grid element, which acts as a plate.

The range of input (plate) voltages over which the output (grid) signal will maintain its antilogarithmic relationship with that of the input (plate) is dependent on several factors, most important of which is the tube type and the characteristics of the particular tubes of a certain type. The desired relationship held for a grid voltage range of from — 18 to — 30 volts with a load resistance of 1,000 ohms. When glass tubes are used the lower limit of the range is extended to about — 15 volts.

The output from the circuit must be amplified in order to be put to any useful work.

Measuring pH of Biological Fluids

By Allan Hemingway and E. B. Brown

Department of Physiology
Medical School
University of Minnesota
Minneapolis, Minn.

In the measurement of the pH of blood with the glass electrode it is necessary to measure a d-c voltage of the order of magnitude of a fraction of a millivolt in a circuit having a resistance of 10 to 200 megohms. At the same time exact temperature control of the glass electrode must be maintained which necessitates a water bath which in turn introduces errors due to insulation leakage. Many of the difficulties in the measurement of blood pH have been eliminated by the circuit devised by Burr, Nims and Lane.[1, 2]

There are, however, some annoy-

Now! Get extra quality— without extra cost— in wire-wound components!

➔ When you specify *I-T-E* for wire-wound products, you get components specially designed to meet the exacting and changing needs of the electronics industry. And all I-T-E units are engineered for extra quality—given the same thought in design, the same care in fabrication that the most complicated I-T-E Switchgear devices receive!

CHECK YOUR NEEDS AGAINST THIS LIST:

I-T-E FOCUS COILS

Available in two types: The first utilizes an electro-magnet; the second combines a permanent magnet with an adjustable electro-magnet. I-T-E Focus Coils are made for use with tubes 10″, 12″, and 16″ in size. Information required to manufacture: Type of tube; second anode voltage; focusing current; types of mountings and leads desired.

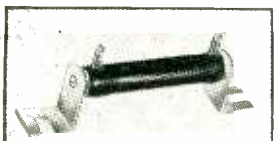
I-T-E DEFLECTION YOKES

I-T-E Deflection Yokes are built to have uniform characteristics. During manufacture, wire size and quality are checked constantly. Coils are impregnated with a special moisture-resistant thermo-plastic material which has been properly cured to insure a firm coil with a minimum of losses. Deflection Yokes can be had with wire leads, resistors, and capacitators made to your specifications.

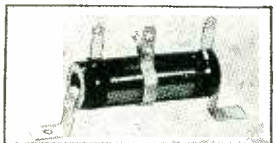
I-T-E "METCLADS" (Metal-Clad Resistors)

Made of highest-grade resistance wire, wound on a special heat-resistant bakelite strip, and insulated by special phenolic coating. The resistance element is completely enclosed in a metal case of either brass- or zinc-plated steel. Brass terminals are securely anchored to the bakelite base strip and are tinned for easy soldering. I-T-E "Metclads" are available in lengths from 2″ to 12″; in wattages from 7 to 42. Mountings can be made to your specifications.

I-T-E ENAMELED RESISTORS



STANDARD FIXED RESISTORS
from 5 to 200 Watts



ADJUSTABLE RESISTORS
from 10 to 200 Watts.

OVAL RESISTORS
for limited space requirements
—from 30 to 75 Watts.

FERRULE RESISTORS—for connection through fuse-clips in installations where rapid insertion and removal is a factor—from 12 to 200 Watts.

For complete information on any I-T-E wire-wound products, write, specifying your needs.

RESISTOR DIVISION

I-T-E Circuit Breaker Company
19th & Hamilton Streets, Philadelphia 30, Pa.

I-T-E Wire-Wound Products: RESISTORS • DEFLECTION YOKES • FOCUS COILS • SPECIAL PRODUCTS

ing and irritating difficulties which make operation of their instrument a task requiring considerable skill and experience. The worst feature of this circuit was the almost continual drift caused by the changing voltage of the storage battery which this circuit requires.

A pH meter has been built using Raytheon CK 570 AX tubes in the Wynn-Williams type of circuit which was used by Burr, Nims and Lane for pH measurement. The instrument so constructed has now been in operation for a year and has given excellent service when used to measure pH of blood whose temperature is controlled in a water bath. The advantages of the new type of pH meter over the older type include exceptional stability and freedom from drift, a simpler arrangement for initial bridge balancing, operation from readily available dry cells, and a rapid warmup period.

Schematic Circuit

The schematic circuit of the pH meter is shown in Fig. 1. The two electrometer triodes have a filament power supply from a single 1.5-volt number 6 dry cell. A 10-ohm variable potentiometer between the positive terminals of the filaments allows an adjustment to be made of the relative filament currents in the event that the characteristics of the two tubes are not identical. In well-matched tubes this variable resistance may not be necessary. When the two tubes are electrically matched by varying this resistance slight variations in filament battery voltage do not change the balance of the bridge circuit.

The two tubes have a common grid voltage obtained from the grid potentiometer. Originally the grid of right-hand tube was connected directly to filament. With this

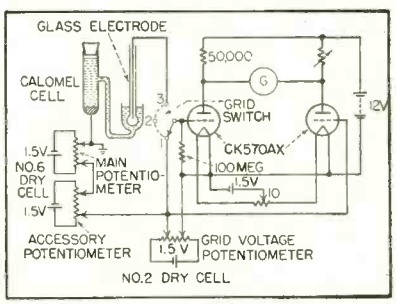


FIG. 1—Simplified schematic of stable biological pH meter

Announcing... a revolutionary new oscilloscope

Horizontal sync-pulse as displayed on WO-57A screen

Check these important features!

- ✓ **Sensitivity**—25 millivolts per inch deflection.
- ✓ **Frequency Response** of vertical amplifier—flat within 3 db from zero to 500 kc; down only 55% at 1 Mc; useful beyond 2 Mc.
- ✓ **Transient Response**—tilt and overshoot less than 2%.
- ✓ **Utility**—provided with frequency-compensated and calibrated step attenuator. Also has vernier control and calibrated voltage source.
- ✓ **60-Cycle Sweep**—with phasing control.
- ✓ **Input Capacitance**—less than 15 uuf with WG-214 accessory probe.

Plus these outstanding extras

- \+ **Trace Expansion**—two times screen diameter for sweep-alignment applications.
- \+ **Direct Coupled Vertical Amplifier**—separate jacks for DC and AC signal measurements.
- \+ **Linear Sweep**—range 15 to 30,000 cps, with preset fixed positions for viewing vertical and horizontal TV sync pulses and oscillator waveforms.
- \+ **Exclusive**—sweep direction reversing switch—positive or negative syncing.
- \+ **Push-Pull Amplifiers**—produce sharper trace and reduces astigmatism.
- \+ **Standardized case** fits test racks WS-17A and WS-18A.

Power supply . . . 105/125 volts, 50/60 cycles.

$137.50 Suggested User Price

The RCA WO-57A

High Gain—Wide Band—DC and AC Input.

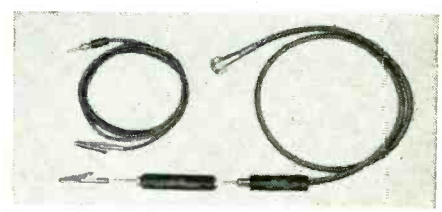
The WO-57A is an outstanding innovation in portable oscilloscope design. Especially suited for television, this new scope is excellent for laboratory, factory, or shop use . . . for viewing and measuring square waves, pulses, TV sync signals, and sine waves.

Unusually versatile . . . newly designed from stem to stern . . . the RCA WO-57A Oscilloscope is a triumph of engineering.

Incorporating the features of far more expensive instruments . . . and with a sensitivity and response equal to that of many laboratory units . . . the WO-57A is the first inexpensive oscilloscope wholly equipped to handle every TV and radio service job.

Direct-coupled amplifiers are used to provide low frequency response flat down to dc. Excellent low-frequency square-wave reproduction, essential for correct sweep alignment, is thus assured. High-frequency square-wave response up to 100 kc enables the WO-57A to reproduce blanking and sync pulse wave shapes with fidelity heretofore unobtainable in moderately priced service-type oscilloscopes.

For complete technical details, ask your RCA Test Equipment Distributor for the bulletin on the new WO-57A, or write RCA, Commercial Engineering, Section E42Y, Harrison, New Jersey.



Probe Kit (WG-214)—$7.50. Includes input cable with direct probe, slip on low-capacitance probe, and ground lead for observation of sync pulses, oscillator wave-forms and video signals without undue circuit loading.

Available from your RCA Test Equipment Distributor

RADIO CORPORATION of AMERICA
TEST EQUIPMENT **HARRISON, N. J.**

newer arrangement adjustment of the grid voltage to obtain the floating grid potential does not cause the excessive unbalance of the bridge which occurred in the older circuit. This adjustment for floating grid potential is made each time the instrument is used and usually one setting a day will suffice.

To adjust for floating grid potentials the grid switch is thrown from position 1 to position 2 while the grid voltage is varied. When there is no change in galvanometer current as the grid switch is thrown from position 1 to position 2 the grid potential is that of the floating grid and grid current is zero.

The main potentiometer as in most pH meters will read in pH units, that is, one revolution of the slide wire and one coil of the accompanying resistor decade will furnish a voltage varying from 57 to 63, the exact voltage being set for a particular temperature of the glass electrode. The pH meter functions in the usual manner with the vacuum-tube circuit functioning as a null instrument to indicate the balance between the voltage of the glass electrode and half cells, and the measuring voltage obtained from the main potentiometer.

The main potentiometer is best constructed from the slide wire and decade coils of a commercial potentiometer, a Leeds and Northrup student type being used in the instrument described. All variable potentiometers were General Radio, using type 314 where possible and type 214 for the lower values. The circuit diagram shown is, of course, extremely simplified for purposes of brevity of explanation of the basic principle involved.

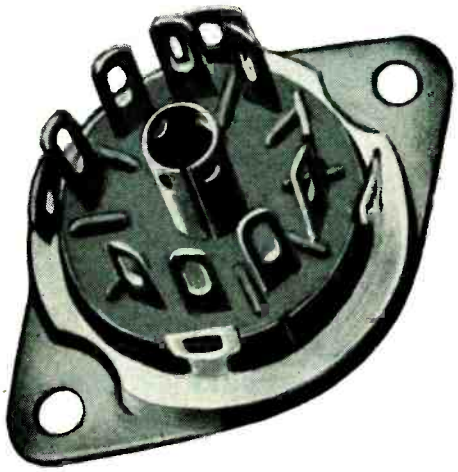
Performance

An important improvement in this meter in comparison with other, especially commercial, pH meters is the use of ordinary batteries which are readily available and the avoidance of special-purpose rectangular-type batteries. A common annoyance in biological laboratories is the replacement of special-purpose batteries which are not available except in electronic or laboratory supply stores and sometimes only available by mail order purchase. For this reason the

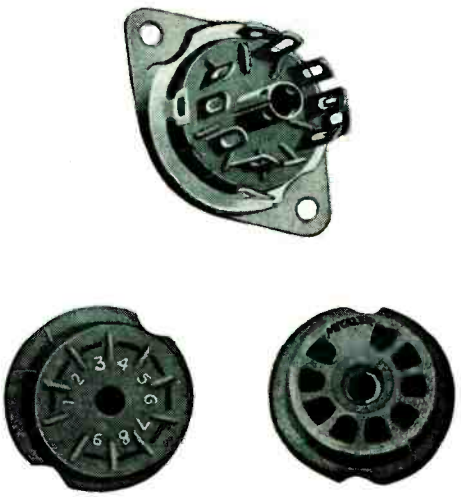
Announcing

NEW MEMBER OF THE MYCALEX FAMILY

9 Pin Miniature Tube Sockets



Enlargement of the new 9 (NOVAL) pin miniature tube socket.



Above: Complete 9 pin miniature socket.
Below: Precision moldings in MYCALEX actual size two views.

We are proud to announce the addition of a 9 pin (NOVAL) miniature tube socket to the MYCALEX line. It has all the electrical characteristics of the widely used MYCALEX 410 and 410 X 7 pin tube sockets and fully meets RMA standards.

The NOVAL is injection molded and produced in two qualities to satisfy different requirements.

MYCALEX 410 for applications requiring close dimensional tolerances. Insulation loss factor of .015 (at 1 MC) yet compares favorably in price with mica filled phenolics.

MYCALEX 410X for applications where general purpose bakelite was acceptable but with an insulation loss factor of only .083 (at 1 MC). Prices compare with lowest quality insulation materials.

Write us today and let us quote you prices on your particular requirements. We will send you samples and complete data sheets by return mail. Our engineers are at your disposal and would be glad to consult with you on your design problems.

Mycalex Tube Socket Corporation

"Under Exclusive License of Mycalex Corporation of America"

30 Rockefeller Plaza, New York 20, N. Y.

SINCE 1919 MYCALEX THE INSULATOR TRADE MARK REG. U.S. PAT. OFF.

MYCALEX CORP. OF AMERICA

"Owners of 'MYCALEX' Patents"

Executive Offices: 30 Rockefeller Plaza, New York 20, N. Y. Plant and General Offices: Clifton, N. J.

present pH meter has been constructed to use only commercial readily available batteries, namely the number 2 and number 6 dry cells.

A satisfactory galvanometer is the Rubicon type 3414, sensitivity 0.0045 microampere per mm, resistance 540 ohms. The circuit including batteries but not including galvanometer is shielded in a wooden box lined with tin plated iron. The glass electrode is in a water bath using a compressed air driven stirrer.

The sensitivity of the instrument as measured by the galvanometer scale is 5-mm galvanometer deflection per 0.01 pH. The galvanometer is stable and can be read to 0.1 mm. The instrument does not use line power and hence is free from power main difficulties and has the added advantage that it can be used as a field instrument.

REFERENCES

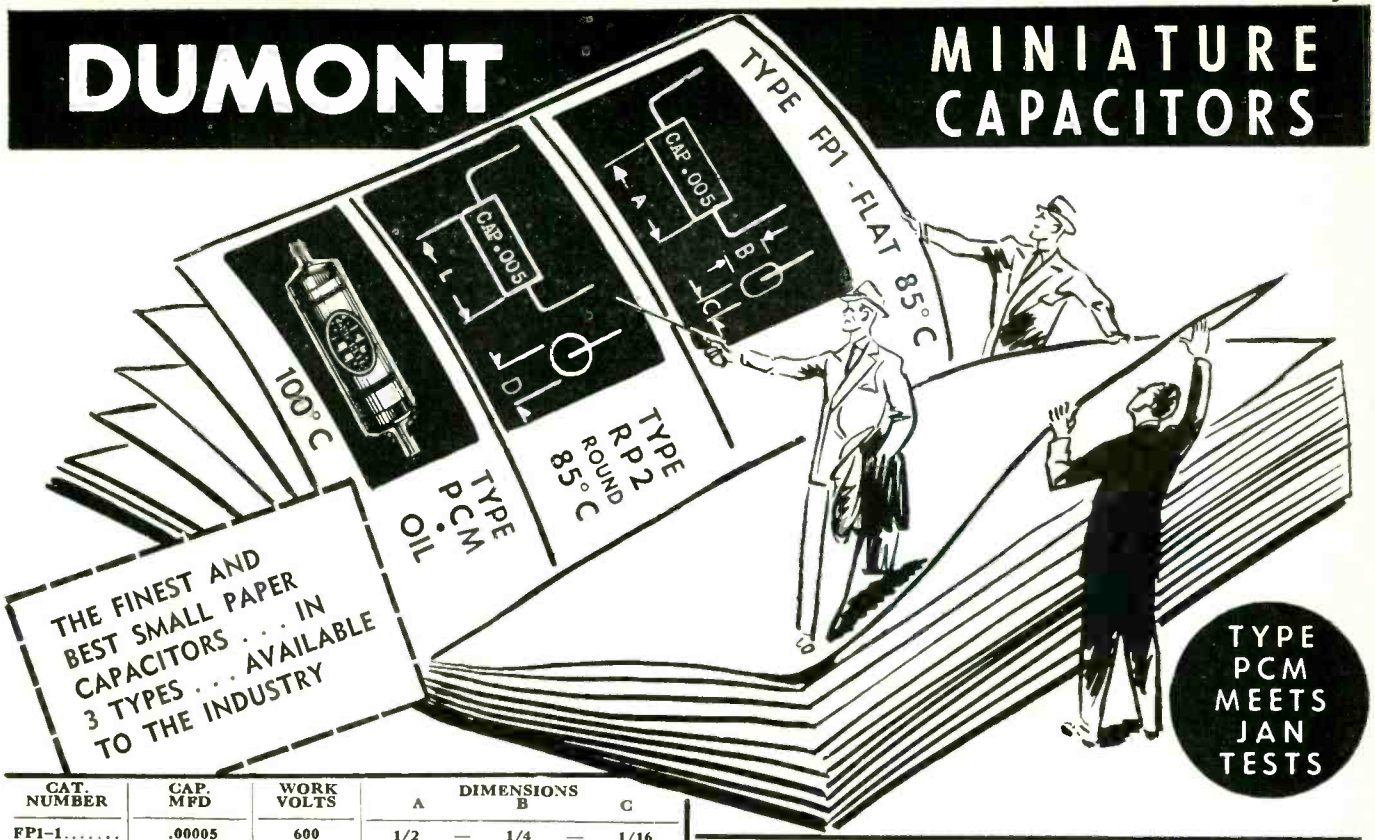
(1) H. S. Burr, L. F. Nims and C. T. Lane, *Yale J. Biol. Med.*, p 65, Sept. 1936.
(2) L. F. Nims, *Yale J. Biol Med.*, p 26, Oct. 1938.

SURVEY OF NEW TECHNIQUES

A PROTECTIVE GRID near the thin aluminum window of a Geiger-Muller counter for beta rays prevents arcing to the window and consequent damage thereto. Potential gradient between the anode wire and the grid wire is made slightly greater than between anode and window, so that arcing due to overload will occur between anode and grid. The technique is described in detail in U. S. patent 2,452,524 issued to Herbert Metten of Sylvania Electric Products Inc.

USE of lycopodium powder to show nodal patterns of loudspeakers at various frequencies was described by Murlan S. Corrington at the recent Audio Fair in New York City, as a method of investigating transient distortions. The speaker is laid on the floor face up with the powder sprinkled on its cone. The voice coil is then energized at various frequencies. The resulting dust patterns are directly related to the manner in which the speaker handles the suddenly applied and suddenly removed sine wave.

DUMONT MINIATURE CAPACITORS



CAT. NUMBER	CAP. MFD	WORK VOLTS	DIMENSIONS A	B	C
FP1-1	.00005	600	1/2	1/4	1/16
FP1-2	.0001	600	"	"	"
FP1-3	.00025	600	"	"	"
FP1-4	.0005	600	"	"	"
FP1-5	.001	200	"	"	"
FP1-6	.001	600	1/2	3/8	1/16
FP1-7	.002	200	1/2	1/4	1/16
FP1-8	.002	600	1/2	1/4	1/8
FP1-9	.005	200	"	"	"
FP1-10	.005	400	5/8	3/8	1/8
FP1-11	.005	600	"	"	"
FP1-12	.01	200	1/2	3/8	1/8
FP1-13	.01	400	5/8	3/8	1/8
FP1-14	.01	600	"	"	"
FP1-15	.02	200	"	"	"
FP1-16	.02	400	5/8	3/8	3/16
FP1-17	.02	600	"	"	"
FP1-18	.03	200	5/8	5/8	1/8
FP1-19	.03	400	3/4	3/8	1/4
FP1-20	.03	600	"	"	"
FP1-21	.05	200	5/8	3/8	3/16
FP1-22	.05	200	3/4	3/8	1/8
FP1-23	.05	400	3/4	1/2	3/16
FP1-24	.05	600	"	"	"
FP1-25	.1	200	3/4	3/8	1/8
FP1-26	.1	400	3/4	5/8	1/4
FP1-27	.1	600	3/4	5/8	3/8
FP1-01	.25	100	"	"	"
FP1-28	.25	200	1	5/8	5/16
FP1-29	.25	400	1 1/4	5/8	3/8
FP1-30	.25	600	"	"	"
FP1-31	.5	100	1 1/2	1/2	1/4
FP1-32	.5	200	1 1/2	5/8	3/8
FP1-33	.5	400	1 1/2	1	5/8
FP1-34	.5	600	1 1/2	1	5/8
FP1-35	1.0	50	1 1/2	5/8	3/8
FP1-36	1.0	100	1 1/2	1	5/8
FP1-37	1.0	200	1 1/2	1	1
FP1-38	1.0	400	1 1/2	1	1
FP1-39	2.0	50	1 1/2	7/8	3/8
FP1-40	2.0	100	1 5/8	1	5/8
FP1-41	4.0	50	1 5/8	1 1/8	7/8
FP1-42	4.0	100	1 5/8	1 1/4	1
FP1-43	4.0	200	1 5/8	1 1/2	1
FP1-44	4.0	400	1 5/8	1 1/2	1
FP1-45	6.0	50	1 5/8	1 1/2	1

CAT. NUMBER	CAP. MFD	WORK VOLTS	DIMENSIONS LENGTH	DIAMETER
RP2-1	.00005	600	1/2	3/16
RP2-2	.0001	600	"	"
RP2-3	.00025	600	"	"
RP2-4	.0005	600	"	"
RP2-5	.001	200	"	"
RP2-6	.001	600	1/2	1/4
RP2-7	.002	200	1/2	3/16
RP2-8	.002	600	5/8	1/4
RP2-9	.003	200	1/2	3/16
RP2-10	.003	600	1/2	1/4
RP2-11	.005	200	5/8	3/16
RP2-12	.005	400	5/8	1/4
RP2-13	.005	600	"	"
RP2-14	.01	200	"	"
RP2-15	.01	400	3/4	1/4
RP2-16	.01	600	"	"
RP2-17	.02	200	"	"
RP2-18	.02	400	3/8	3/8
RP2-19	.02	600	"	"
RP2-20	.03	200	"	"
RP2-21	.03	400	"	"
RP2-22	.05	200	"	"
RP2-23	.05	400	3/4	1/2
RP2-24	.075	200	3/4	3/16
RP2-25	.1	200	3/4	3/8
RP2-26	.25	200	1	3/8
RP2-27	.5	200	1 1/2	1/2
RP2-28	1.0	100	1 1/2	3/4
RP2-29	2.0	100	1 1/2	1

WRITE FOR SAMPLES AND INFORMATION NOW

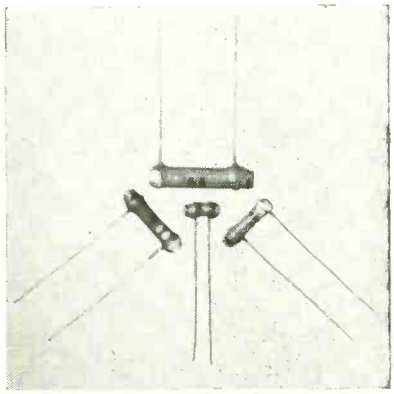
CAT. NUMBER PCM PBM	CAP. MF.	100 V D X L	CAT. NUMBER PCM PBM	200 V D X L	CAT. NUMBER PCM PBM	400 V D X L
1	.0001	3/16 — 1/2	21A	3/16 — 1/2	41A	1/4 — 7/8
2	.00025	" "	22	" "	42	" "
3	.0005	" "	23	" "	43	" "
4	.001	" "	24	3/16 — 7/8	44	" "
5	.002	" "	25	3/16 — 7/8	45	" "
6	.003	" "	26	" "	46	" "
7	.004	" "	27	" "	47	5/16 — 7/8
8	.005	" "	28	" "	48	" "
9	.01	3/16 — 7/8	29	1/4 — 7/8	49	" "
10	.015	" "	30	" "	50	" "
11	.02	1/4 — 7/8	31	5/16 — 7/8	51	3/8 — 7/8
12	.025	" "	32	" "	52	7/16 — 7/8
13	.03	5/16 — 7/8	33	" "	53	1/2 — 7/8
14	.04	" "	34	1/2 — 7/8	54	9/16 — 1 1/8
15	.05	3/8 — 7/8	35	" "	55	5/8 — 1 1/8
16	.1	7/16 — 7/8	36	1/2 — 1 1/8	56	" "
17	.15	1/2 — 1 1/8	37	5/8 — 1 1/2	57	5/8 — 1 1/2
18	.2	9/16 — 1 1/8	38	" "	58	" "
19	.25	" "	39	" "	59	11/16 — 2
20	.5	5/8 — 1 5/8	40	5/8 — 2	60	3/4 — 2
21	1.0	3/4 — 1 5/8	41	3/4 — 2	61	3/4 — 3

DUMONT ELECTRIC CORP. 308 DYCKMAN ST. NEW YORK, N. Y.

NEW PRODUCTS

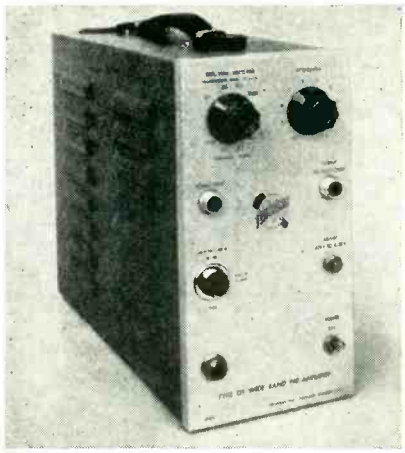
(continued from p 126)

rent, 10 ma; maximum d-c load current, 1 ma; and maximum supply voltage frequency, 300 kc. Overall height is 2 11/16 in.



Ceramic Capacitors

CENTRALAB DIVISION OF GLOBE-UNION INC., 900 Keefe Ave., Milwaukee 1, Wis. The new line of ceramic BC Hi-Kap capacitors may be had in 48 different values and four sizes, with tolerances of 20 percent from 10 $\mu\mu$f through 2,200 $\mu\mu$f, and guaranteed minimum values from 2,500 $\mu\mu$f through 10,000 $\mu\mu$f. They are rated at 600 working volts d-c and are flash tested at 1,000 volts.



Wide-Band Preamplifier

TEKTRONIX INC., Portland, Oregon. Type 121 wide-band preamplifier was designed primarily to increase the sensitivity of types 511, 511-A and 511-AD c-r oscilloscopes. Maximum gain of 100, plus the combined attenuator and gain controls, permit a sensitivity range from 2.5 mv per cm to 25 v per cm without

WILLIAM BRAND & COMPANY

Manufacturers of

TURBO

VARNISHED TUBING, SATURATED SLEEVING, THERMO-PLASTIC TUBING, FIBROUS GLASS TUBING, VARNISHED CAMBRICS, TAPES, MICA AND MICA PRODUCTS, WIRE MARKERS AND INSULATED WIRE

announces the removal of its General Offices from New York City to its Main Plant in

WILLIMANTIC, CONNECTICUT

TELEPHONE: WILLIMANTIC 3531-3457

SALES OFFICES AND REPRESENTATIVES TO SERVE YOU IN PRINCIPAL CITIES:

NEW YORK
WILLIAM BRAND & COMPANY
276 Fourth Avenue
New York 10, N.Y.

CLEVELAND
MR. JOSEPH H. CLARK
R #1 Headlands Road
Painesville, Ohio

PITTSFIELD, MASS.
McKENZIE & SHUGG, INC.
Box 484
Pittsfield, Mass.

NEW JERSEY & NEW YORK CITY
R. T. & W. A. MURRAY
614 Central Ave.
East Orange, New Jersey

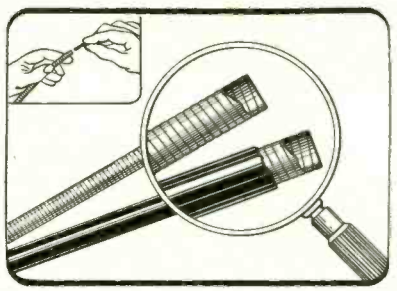
CHICAGO
WILLIAM BRAND & COMPANY
1313 West Randolph St.,
Chicago, Ill.

PHILADELPHIA
MR. JAMES MAGUIRE
522 Drexel Building
Philadelphia, Penna.

DETROIT
MR. RALPH HULTON
6432 Cass Avenue
Detroit, Michigan

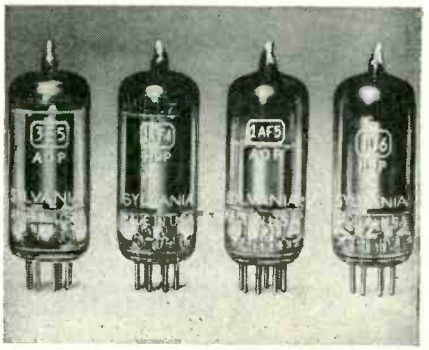
UPPER NEW YORK STATE
MARTIN ANDREWS
North Road
Fayetteville, N.Y.

the use of attenuators on the oscilloscope. The bandwidth, in excess of 10 mc, preserves the rise time of the oscilloscope.



Wire Shielding

KUPFRIAN MFG. CO., 218 Prospect Ave., Binghamton, N. Y. A vinyl-covered Monocoil wire shielding supplements the full line of flat-wire, helically-wound types. Advantages reside in preventing grounding of the casing at more than one point, or in providing high-voltage insulation. Complete description and a chart showing full range of sizes appears in bulletin 5065.



Portable Radio Tubes

SYLVANIA ELECTRIC PRODUCTS INC., 500 Fifth Avenue, New York 18, N. Y. The new tubes illustrated enable A batteries in portable receivers to last about three times as long as with other available tubes. These low-drain tubes include type 1U6, a heptode converter with oscillator anode as a separate element; type 1AF5, a diode pentode; type 1AF4, a sharp cutoff r-f pentode; and type 3E5, a beam-power output tube. All have 25-ma filaments and 7-pin miniature button bases. Power required is 2.1 w or one-half the average required for other avail-

THE ONE 3-INCH TUBE

combining these modern features...

for "HAIR-LINE" performance

Here is the modern achievement in a compact, three-inch cathode-ray tube providing the brilliant, "hair-line" trace long desired for best performance of portable oscillographs and industrial cathode-ray monitoring devices.

With performance at the highest premium, the special features of the DuMont Type 3RP-A have been combined to make high sensitivity compatible with short overall length; and to obtain a fine trace free from the distortions usually found in short tubes as sensitive as the Type 3RP-A.

Because of the new, ingenious design of the vertical deflection plates of the Type 3RP-A, the position of the cathode-ray beam does not affect deflection sensitivity, thereby substantially eliminating pincushioning and trapezoidal distortions.

New production techniques are applied for the first time to the commercial production of three-inch cathode-ray tubes to obtain a flat face which provides more usable screen area, eliminates parallax distortion, and carries through the high performance standard set by the advanced design of the Type 3RP-A electron gun.

COMPACT DESIGN...
Maximum length of 9⅛ inches *plus* high sensitivity.

BALANCED DEFLECTION...
For uniform spot focus maintained over the entire trace.

CURVED DEFLECTION PLATES...
For uniform deflection sensitivity.

FLAT FACE...
For more usable screen area with minimized parallax distortion.

"HAIR-LINE" TRACE...
Provided by small spot and fine focus.

Electrical Data

Heater Voltage	6.3 Volts
Heater Current	0.6 ±10% Ampere
Focusing Method	Electrostatic
Deflecting Method	Electrostatic
Phosphor	P1
Fluorescence	Green
Persistence	Medium

Typical Operating Conditions

For Anode No. 2 Voltage of	1,000	2,000 Volts
Anode No. 1 Voltage for focus	165 to 310	330 to 620 Volts
Grid No. 1 Voltage	−22.5 to −67.5	−45 to −135 Volts
Deflection Factors:		
D1D2	73 to 99	146 to 198 Volts D-C per Inch
D3D4	52 to 70	104 to 140 Volts D-C per Inch
Anode No. 1 Voltage for focus	16.5% to 31% of Eb2 Volts	
Grid No. 1 Voltage	2.25% to 6.75% of Eb2 Volts	
Anode No. 1 Current for any operating condition	−15 to +10 Microamperes	
Spot Position (Undeflected)	Within 15 Millimeters square	

DUMONT for Oscillography

ALLEN B. DU MONT LABORATORIES, INC., *INSTRUMENT DIVISION*, 1000 MAIN AVENUE, CLIFTON, NEW JERSEY

able types. The tubes will also operate over a range of 1.4 to 1.1 v.

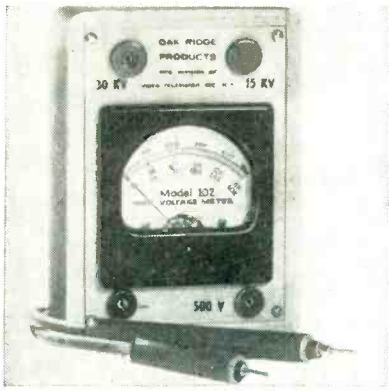
Alkaline Storage Battery

YARDNEY ELECTRIC CORP., 105 Chambers St., New York 7, N. Y. The Silver-cell alkaline storage battery uses silver and zinc as active materials. It is one-third to one-fifth the weight of commonly used batteries, and one-half to one-third the bulk. Ampere-hour efficiency approaches 100 percent and energy efficiency is 85 percent. An important feature of the battery is its great resistance to mechanical shock. Five types now available range from 0.5 ampere-hour to 40 ampere-hour capacity.

D-C Power Supply

THE SUPERIOR ELECTRIC CO., Hannon Ave., Bristol, Conn. The Varicell provides a stabilized and regulated source of variable d-c voltage from a-c power lines. It operates from a 95 to 135-volt, 60-cycle, single-phase a-c line; delivers a d-c output variable from 0 to 30 v. Allowable output current available at any voltage setting is 15 amperes. Stabilization and regulation are given as 0.25 percent for an output

setting between 6 and 30 v. The rms ripple voltage does not exceed ±0.1 v.

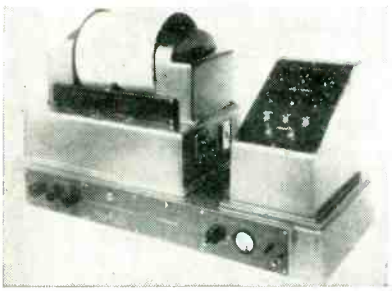


TV High-Voltage Tester

OAK RIDGE PRODUCTS, 239 E. 127th St., New York 35, N. Y. Model 102 miniature tv high-voltage tester features a precision 10,000 ohms per volt movement and three scales: 0 to 500 v, 0 to 15 kv, and 0 to 30 kv, and comes complete with special high-voltage test lead. It measures 5¾ in. × 4 in. × 2¼ in.

Tele Antenna

TECHNICAL APPLIANCE CORP., Sherburne, N. Y. Type 900 television antenna features four driven elements, two in the vertical plane and two in the horizontal plane, in place of parasitic elements, thus giving far greater control of the field pattern, and also permitting lobe switching. With this design it is possible by means of a diplexer network to eliminate entirely cochannel interference. Front-to-back ratio ranges up to 20 to 1.



Infrared Spectrophotometer

THE PERKIN-ELMER CORP., Glenbrook, Conn. Model 21 double-beam

ERIE RESISTORS CORP. PRODUCTS

- **CERAMICON® TRIMMERS**
  Styles TS2A—TD2A—532—537—& others
- **CERAMICON® and GP® CAPACITORS**
  NPO—NO80—N750—& others
- **DISC CERAMICON®**
  Styles 811 & 821
- **FEED-THRU CERAMICON®**
  Styles 362 & others
- **SILVER BUTTON® MICA CAPACITORS**
  Styles FA-CB—& others

® *trade name registered*

FROM STOCK in NEW YORK

we are continuing to supply our customers with "rare" and much needed resistors and J potentiometers in all values—also dual JJ and triple JJJ for immediate delivery.

Authorized Distributors:

LEGRI S CO. INC.

130 West 102nd St., New York 25, N.Y.
Phone: ACademy 2-0018

---

steatite
by GENERAL CERAMICS

GENERAL — STEATITE INSULATORS

Low loss insulators for all frequencies in standard stock shapes or special designs

General Ceramics low loss insulators function efficiently in all frequency ranges and are capable of withstanding most all conditions of shock or vibration. Specification of standard shapes offers an opportunity to effect production economies. For unusual designs or mechanical specifications consult General Ceramics engineers. Estimates without obligation.

General CERAMICS and STEATITE CORP.

GENERAL OFFICES and PLANT: 21 CROW'S MILL ROAD, KEASBEY, N. J.

MAKERS OF STEATITE, TITANATES, ZIRCON PORCELAIN, ALUMINA, LIGHT DUTY REFRACTORIES, CHEMICAL STONEWARE, IMPERVIOUS GRAPHITE, FERRITES, COAXIAL CABLE

REQUIREMENTS:

Special Airborne-type Transformer

- ✓ PERMAFIL-IMPREGNATION
- ✓ HIPERSIL CORE
- ✓ GREATER OUTPUT PER POUND
- ✓ 400 TO 2400 CYCLES
- ✓ MEETS JAN SPECS. CLASS A GRADE 3

SOURCE: FOR HIGHLY SPECIALIZED APPLICATIONS

THE TRANSFORMER SOURCE IS SPERRY

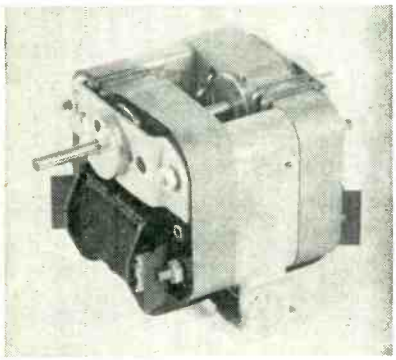
Vacuum - impregnated, HIPERSIL core, open or cased transformers to meet exacting electrical requirements in any given case size. Special design skills, premium materials, painstaking manufacture of custom units. If you have a transformer problem, consult us immediately.

WRITE FOR SPECIFICATION FORMS TO FACILITATE NEGOTIATION SERVICE.

Sperry

SPERRY PRODUCTS, INC.
DANBURY, CONN.
TELEPHONE: DANBURY 4000

infrared spectrophotometer records directly in percent transmission against a linear wavelength scale on large charts, and is useful in both academic and industrial laboratories. Speed of scanning ranges from 3 minutes to 100 hours for the rock-salt region. Time of response varies from a few seconds to more than a minute for full-scale deflections. Overall range is from less than 2 microns to 15 microns in the rock-salt region. Chart scales are uniform from 1 to 50 in. per micron by integral factors; and chart size, about 32 × 11 in.

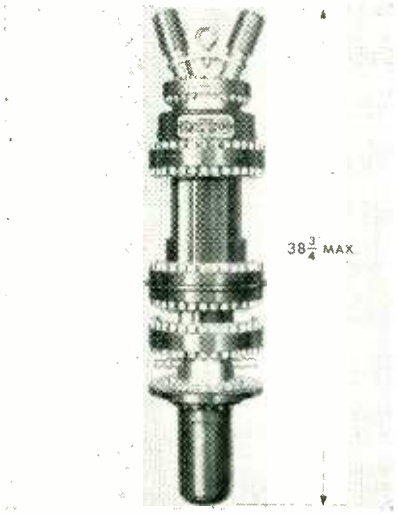


Tandem Motors

BARBER-COLMAN CO., Rockford, Ill. For wire recorders, vending machines and other applications requiring a reversible motor, the DYAB tandem units have high torque and excellent speed-torque characteristics. Maximum output is 0.004 hp. They feature propor-

AMPLISTAT designed for educational use demonstrates magnetic amplifier principle, facilitates experiments in motor-speed control, consists of a saturable reactor and rectifiers. *General Electric Company, Schenectady 5, N. Y.*

tioned field and concentricity of rotor in stator, centerless ground stainless steel shaft supported in wick-type bearings, and molded plastic spool. Units are available with several shaft diameters and various shaft extensions.



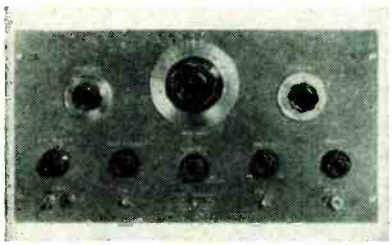
High-Power Beam Triode

RADIO CORP. OF AMERICA, Harrison, N. J. The 5831 superpower beam triode is capable of generating several hundred kilowatts of power at high efficiency and with exceptionally low driving power. It is primarily of importance in high-power c-w applications and in international broadcasting service. In unmodulated class-C service it has a maximum plate-voltage rating of 16,000 volts, a maximum plate input of 650 kw and a maximum plate dissipation of 150 kw. The tube requires less than 2 kw of driving power.

Torque Unit

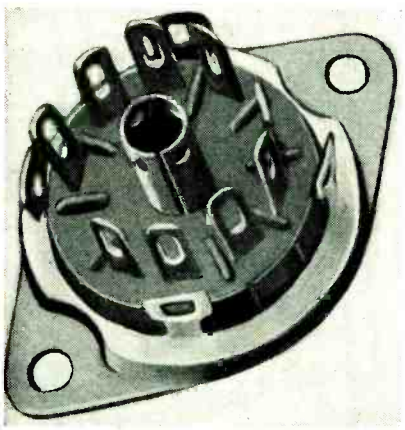
SERVO-TEK PRODUCTS CO., 4 Godwin Ave., Paterson 1, N. J. The torque unit illustrated, for use in velocity servos and motor integrator sys-

tems, consists of a permanent-magnet field-type 27.5-volt armature d-c motor with a d-c rate generator coupled to its high-speed shaft (10,000 rpm maximum). A 250-rpm maximum low-speed output shaft is coupled to the motor through suitable gear reductions. The torque unit motor supplies an output torque of approximately 6 in. per oz whereas tachometer output voltage per rpm is available in various models at from 2 to over 10 volts per 1,000 rpm of motor speed.



Pulse Generator

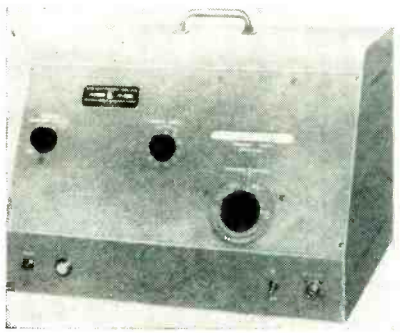
HEWLETT-PACKARD Co., 395 Page Mill Rd., Palo Alto, Calif. Model 212A general-purpose pulse generator was designed for radar, television and nuclear work. Among its outstanding features are a 0.02-μsec pulse rise and decay time, a 50-watt pulse, and a 0.07 to 10-μsec continuously variable pulse length. A low internal impedance of 50 ohms or less insures a pulse shape virtually independent of load. Repetition rate is continuously variable from 50 to 5,000 pps.



Miniature Tube Socket

MYCALEX TUBE SOCKET CORP., 30 Rockefeller Plaza, New York 20,

N. Y., announces the addition of a 9-pin miniature tube socket to its line. The sockets are obtainable in Mycalex 410 which was developed for applications requiring close dimensional tolerances not possible in ceramics and at much lower loss factor than mica-filled phenolics; and in Mycalex 410X which has been developed to compare favorably with general-purpose Bakelite in economy but with a loss factor of only about one-fourth of that material.



UHF Sweep-Frequency Oscillator

POLYTECHNIC RESEARCH AND DEVELOPMENT CO., INC., 202 Tillary St., Brooklyn 1, N. Y. Type 901 uhf sweep-frequency oscillator generates frequency-modulated r-f signals throughout the 470 to 890-mc range with a maximum power output of at least 2 volts. This will permit its use for the rapid and accurate alignment and test of receivers and tuners operating in the new uhf television band.

VHF Transmitter

LEAR, INC., AIRCRAFT RADIO DIVISION, 110 Ionia Ave. N.W., Grand Rapids 2, Mich. Model RT-10CP

six-frequency vhf transmitter is designed to meet the minimum space requirement on an aircraft instrument panel. Radiated output is more than 2 watts. The unit weighs 10 oz, measures $2\frac{7}{32} \times 1\frac{1}{16} \times 7\frac{27}{32}$ in. overall.

Tele Field Strength Meter

APPROVED ELECTRONIC INSTRUMENT CORP., 142 Liberty St., New York 6, N. Y., has introduced the Model A-460 lightweight portable television field strength meter. The unit is calibrated from 50 to 30,000 μv. It is designed with self-contained power supply, 115 volts, 60 cycles.

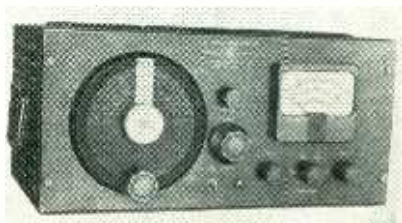
Beam Power Amplifier

SYLVANIA ELECTRIC PRODUCTS INC., 500 Fifth Ave., New York 18, N. Y. Type 6AU5GT high-perveance beam-power amplifier is designed for use as a horizontal deflection amplifier in high-efficiency deflection circuits for tv receivers. Features include low-mu, high plate current at low plate voltage and high operating ratio of plate current to number 2 grid current. The

tube has a 6.3-volt, 1.25-ampere heater. Under typical operating conditions transconductance will be approximately 6,000 micromhos; mu, approximately 5.9. Maximum plate dissipation is 8 watts; peak positive pulse plate voltage is 4,500 v; and maximum d-c plate voltage, 450 v.

Power Transformer

SOLA ELECTRIC CO., 4633 W. 16th St., Chicago 50, Ill. Type CVE power transformer corrects line voltage variations of 100 to 130 volts to ±3 percent or less at its outputs. It provides high-voltage plate and filament windings (6.3 volts and 5 volts) on the same core.



F-M Modulation Monitor

BROWNING LABORATORIES, INC., 742 Main St., Winchester, Mass. Model MD-25 modulation monitor is designed to cover 30 to 50 mc, 72 to 76 mc, and 152 to 162 mc in four bands making it possible for the one instrument to be used in checking transmitters on widely separated frequencies or on different bands. Coarse and fine tuning controls permit precise adjustment to the carrier frequency. Either upward or downward swing can be measured up to 20 kc with an ac-

NOW—ON SALE AT HANDY & HARMAN DEALERS—EVERYWHERE

in handy 5-ounce packets . . .

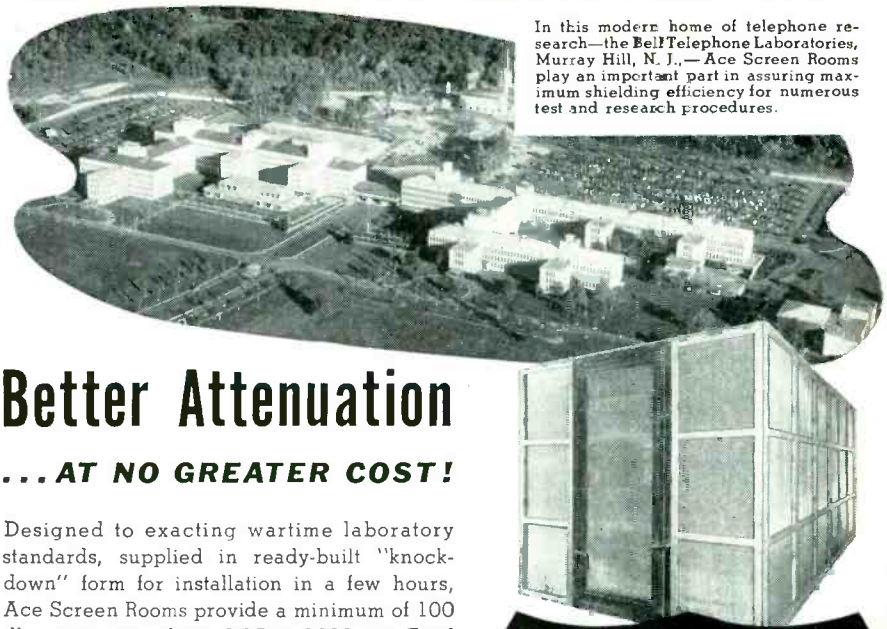
Now you can get this versatile, fast-acting low-temperature silver brazing alloy in convenient, sturdy 6½" square packets. Just the thing for—small shops—plumbers—refrigeration, electrical and other service men—maintenance and repair crews, etc. Also for all shops that make ferrous and non-ferrous metal products for silver alloy brazing trial work, tool repairs, etc. Each package contains a 5-ounce coil of EASY-FLO 45 1/16" wire (approx. 330 lineal inches)—also torch brazing instructions and a "Quick Facts" folder giving full details about EASY-FLO 45.

WRITE TODAY FOR OUR LIST OF DEALERS

and order a supply of packets from the nearest one.

HANDY & HARMAN
82 FULTON ST., NEW YORK 7, N. Y.
Bridgeport, Conn. • Chicago, Ill. • Los Angeles, Cal. • Providence, R. I. • Toronto, Canada
Agents in Principal Cities

ON THE JOB AT THE FAMOUS BELL "LABS"



In this modern home of telephone research—the Bell Telephone Laboratories, Murray Hill, N. J.,—Ace Screen Rooms play an important part in assuring maximum shielding efficiency for numerous test and research procedures.

Better Attenuation

. . . AT NO GREATER COST!

Designed to exacting wartime laboratory standards, supplied in ready-built "knock-down" form for installation in a few hours, Ace Screen Rooms provide a minimum of 100 db. attenuation from 0.15 to 1000 mc. Total cost is no greater than that of "homemade" screen rooms of far lower efficiency. Numerous sizes are available and rooms can readily be moved or enlarged as required. Write, wire, or 'phone for details.

ACE ENGINEERING & MACHINE CO.
3642 N. Lawrence St.
Philadelphia 40, Pa. **REgent 9-1019**

ACE
READY-BUILT "UNIT CELL"
SCREEN ROOMS

WIRE-WOUND CONTROLS

- ★ Winding skill second to none
- ★ Large and small controls
- ★ Velvety-smooth rotation, always
- ★ Minimized wear-and-tear
- ★ Taps and tapers. Tandem units

CLAROSTAT SERIES 58 and 43 CONTROLS

The large-sized Series 58 Clarostat rheostat or potentiometer offers laboratory-grade performance at mass-production cost. 1-21/32" dia. 1 to 100,000 ohms. 3 watts, linear. The finest standard wire-wound control made!

The midget Series 43 control is a real space-saver. Only 1⅛" dia. 1 to 10,000 ohms. 2 watts, average.

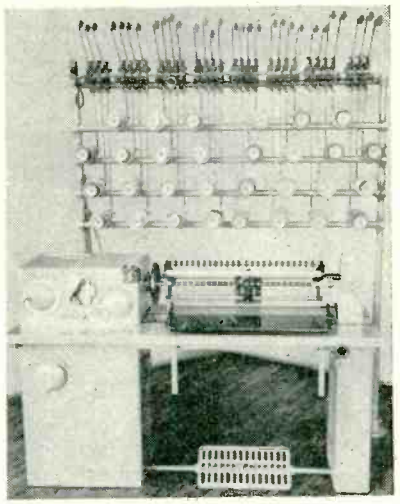
Hundreds of thousands of Clarostat wire-wound controls are in daily use. Their performance, dependability and long life, are a matter of record.

Ask for Bulletins 116 and 118.
Let us quote on your needs.

CLAROSTAT *Controls and Resistors*

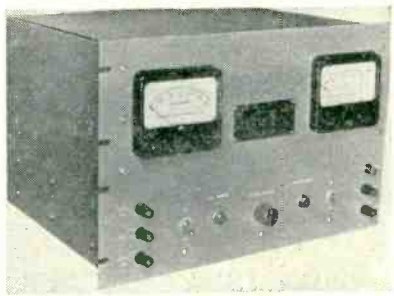
CLAROSTAT MFG. CO., INC. • DOVER, NEW HAMPSHIRE • *In Canada:* CANADIAN MARCONI CO., LTD. *Montreal, P. Q., and branches*

curacy of better than 1 kc on a 4-in. meter.



Coil Winding Machine

UNIVERSAL WINDING CO., P. O. Box 1605, Providence 1, R. I., announces a manually-operated coil-winding machine designed for the production of paper insulated coils in multiple or stick form. A more positive lay of wire is provided by the unit's leadscrew gearing that is independent of traverse and is designed as a turns-per-inch system. Power is supplied by a ½ hp a-c constant speed motor driving through an adjustable-sheave speed controller to a multiple-disc friction clutch attached to the spindle. Speed range is 400 to 2,200 rpm and speed selection is made by turning a crank on the front of the column.



Regulated Power Supply

AMERICAN ELECTRONEERING CO., 2112 South La Brea Ave., Los Angeles 16, Calif. The outstanding feature of the PSR-100 regulated power supply, a versatile laboratory instrument, is the regulation of the high-voltage output. Regulation is

AGAIN IN 1950 . . . IT'S

ATLAS

Again Atlas leads the field with its new line of speakers and projectors.

Again Atlas makes the news in the Sound System field.

Atlas Reproducer units continue to retain the famous "Atlas V Plus" super-efficient magnetic assembly and in addition many more "Extra Plus" features. A new reversed dome, blast proof diaphragm is now standard in the high power, high fidelity models. Built-in transformers, designed for either constant 70 volt or constant impedance audio circuits are included. Improved appearance—functionally designed for maximum convenience. Double seal weatherproofing. All this and more without any general increase in price.

Atlas projectors have a new micrometically calculated and controlled rate of expansion. Atlas non-vibrant projectors are rugged and fine in appearance. Sound energy is not dissipated in rattle vibration, distortion or cancellation.

The new improved line of Atlas speakers are really new from the voice coil to the final lock washer. It's really the "modern look" in speakers, a new high in overall performance.

Let Atlas speakers play an important part in your SOUND PROFITS.

Write for our new catalog — the most complete line of speakers, microphone stands and sound accessories.

ATLAS SOUND CORPORATION
1450 39th Street
Brooklyn 18, N. Y.

. . . Up to Ten Taps

LECTROHM TAPPED RESISTORS

Flexibility to specific resistance requirements, in variations of from one to ten taps. Lectrohm TAPPED RESISTORS are noted for quality *features* that add up to real efficiency. • Silver-soldered connections. • Vitreous enamel coatings. • Close tolerance. • Dependable stability. Standards from stock, or special designs. Another member of the famous *Lectrohm Line*. Remember, if you have a difficult resistance problem, Lectrohm engineering service is here to help.

Learn about Lectrohm Resistors.
Send for catalog.

LECTROHM
INCORPORATED

5903 Archer Ave. Chicago 38, Ill.
Division of
The National Lock Washer Co., Newark, N. J.

Same Recipe...

But Oh, What a Difference in Cooks!

There's nothing secret about the formulae for permanent magnet materials. But there's plenty of difference in the finished product . . . a difference that is determined by the *know-how* of the fabricator.

Thomas & Skinner permanent magnets reflect our 49 years of experience in the design and fabrication of the right magnet for every application. Let us "cook up" the *right* magnet for you. Write or call us today.

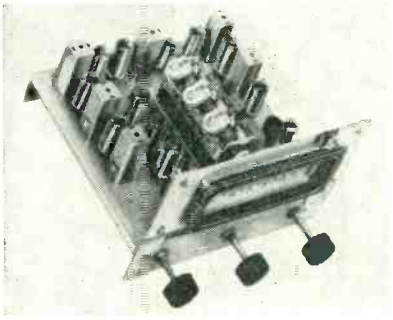
Thomas & Skinner—Specialists in magnetics: *permanent magnets and laminated cores.*

THOMAS & SKINNER Steel Products Company
1120 East 23rd Street · Indianapolis, Indiana

0.5 percent for any output voltage from 30 to 500 volts d-c under any load conditions from 0 to 300 ma, and any line-voltage variations from 105 to 125 volts a-c. Ripple voltage is less than 10 mv peak-to peak at maximum rated voltage and load; impedance, effectively zero at any frequency; ambient temperature rise, approximately 30 C.

Amplitude Modulator

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1023-A amplitude modulator is designed for use with signal generators for receiver tests where a-m is desired with negligible incidental f-m. Modulation up to 80 percent at 60 cycles is provided internally. External modulating frequencies between 20 cycles and 15 kc can be used. Input and output impedances are 50 ohms. Radio-frequency range is 10 mc to 150 mc with a gain of 0.1 and 10.1 mc to 11.3 mc with a gain of 10.



F-M/A-M Tuner

APPROVED ELECTRONIC INSTRUMENT CORP., 142 Liberty St., New York 6,

NATIONAL

- Proven
- Dependable
- Quality

POPULAR NATIONAL KNOBS

These are the most popular knobs of their type ever designed—because of their clean, functional, chrome-and-plastic styling and because of their sturdy construction. All fit ¼" shafts. For commercial applications they can be supplied in quantity in special colors and with special calibrations.

There is a National quality knob and quality dial for every purpose. Write for new catalog of National components and equipment.

National

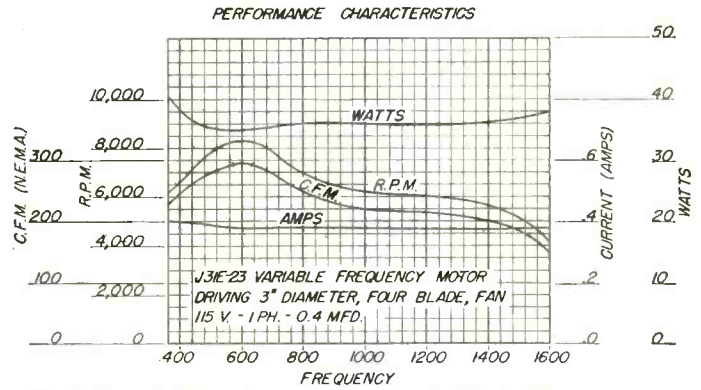
NATIONAL COMPANY, Inc.
MALDEN, MASSACHUSETTS

Looking for Something Special?

IN A VARIABLE FREQUENCY BLOWER

EAD HAS IT!

Our J31E-23: Designed to operate 50-60 cy. and 360-1600 cy.



OPERATION @ 50 Cycles: .18 Amps—17 Watts—2600 RPM—90CFM.
OPERATION @ 60 Cycles: .18 Amps—15 Watts—3300 RPM—110CFM.

MINIMUM CHANGE IN CURRENT, POWER, DELIVERY AND SPEED OVER MAXIMUM FREQUENCY RANGE. SMALL SIZE—2" diameter x 3⅛".

EASTERN AIR DEVICES, INC. 585 DEAN STREET BROOKLYN 17, N.Y.

SYNTHESIS

IS A HIGH CLASS WORD FOR DESIGNING SERVO MECHANISMS

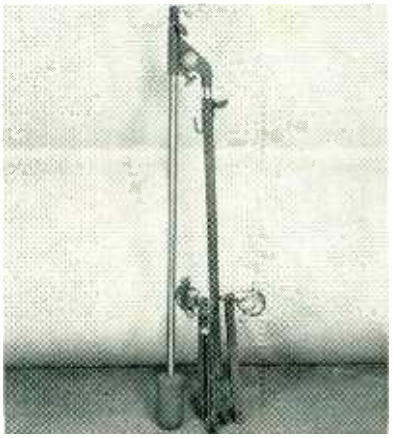
...SERVOSCOPE IS A HIGH CLASS INSTRUMENT FOR SERVO SYNTHESIS!

WRITE FOR INFORMATION

- **MEASURES** amplitude & phase vs. frequency
- **CARRIERS** accepted, 50 to 800 cps
- **MODULATES** chosen carrier, 0.1 to 20 cps
- **ANALYZES** D.C. or A.C. automatic controls
- **SUB-AUDIO** sine generator, 0.1 to 20 cps
- **SQUARE WAVE** generator, 0.1 to 20 cps
- **PHASE READING** to 1° accuracy, 2 methods
- **LINEAR SWEEP** for external use, 0.1 to 20 cps

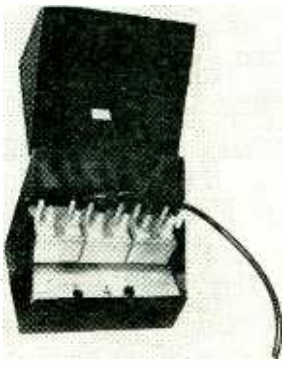
SERVO CORP. OF AMERICA
NEW HYDE PARK, N.Y.

N. Y. Model A-710 f-m/a-m tuner can be mounted in either horizontal or vertical positions with the appropriate scale supplied. It receives f-m broadcasts from 88 to 108 mc and a-m broadcasts from 540 to 1,800 kc. Power requirements are 170 volts d-c, 20 mils and/or 140 volts d-c, 37 mils, 6.3 volts, 4 amperes.



Studio Boom Stand

RADIO CORP. OF AMERICA, Camden, N. J. Type KS-3B lightweight boom stand for proper microphone positioning in broadcast and television studios is easily adjusted for heights from 5 ft 2 in. to 8 ft 8 in., with horizontal arm extensible from 3 to 6 ft. Once the stand is properly placed its casters can be secured by means of foot-operated locks.



Master Antenna Distribution Assembly

LYNMAR ENGINEERS, 1721 Delancey St., Philadelphia 3, Pa. The No. PD-16 distribution equipment feeds six television receivers from one

CRYSTAL CALIBRATOR

MEASUREMENTS CORPORATION

Model 111

FREQUENCY RANGE: .25Mc.—1000 Mc.

FREQUENCY ACCURACY: ±0.001%

A Dual-Purpose Calibrator

- CRYSTAL-CONTROLLED OSCILLATOR
- CRYSTAL RECEIVER 2 Microwatt Sensitivity

Designed for the Calibration and Frequency Checking of Signal Generators, Transmitters, Receivers, Grid-Dip Meters and other equipment where a high degree of frequency accuracy is required.

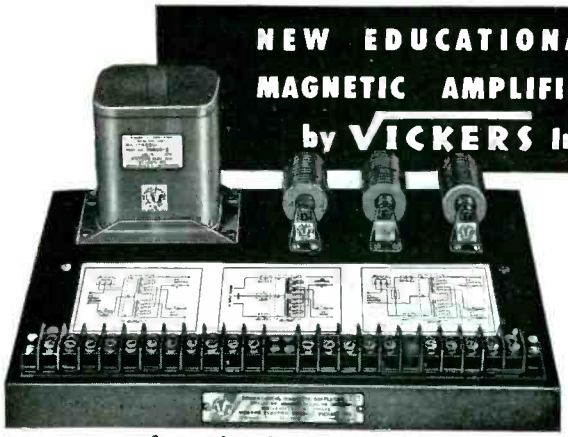
Harmonic Range:
.25 Mc. Oscillator: .25-450 Mc.
1 Mc. Oscillator: 1-600 Mc.
10 Mc. Oscillator: 10-1000 Mc.

117 volts, 50/60 cycles; 18 watts, 6" wide, 8" high, 5" deep; 4 lbs.

MEASUREMENTS CORPORATION

Boonton New Jersey

NEW EDUCATIONAL MAGNETIC AMPLIFIER by VICKERS Inc.



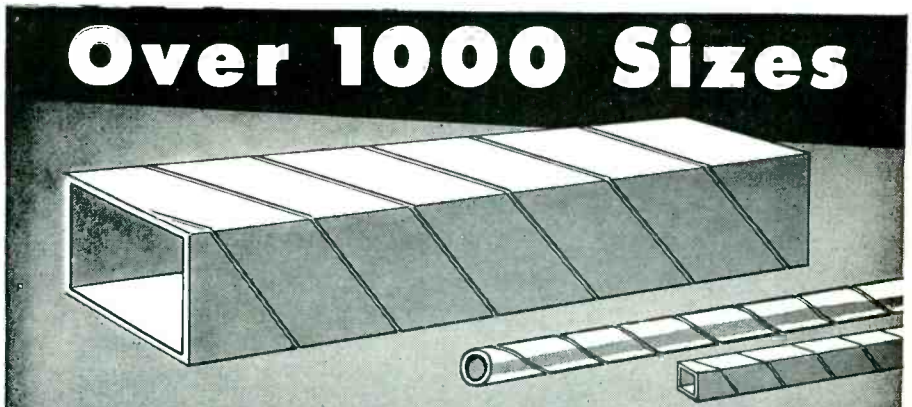
for School and Industrial Laboratories

- A unit designed by Vickers Electric Division to help students and industrial personnel obtain a wider knowledge of the characteristics and applications of high-performance self-saturating magnetic amplifiers.
- All three basic single-phase self-saturating circuits may be studied, and the educational unit can actually be used in operating controls circuits. Gives d-c or a-c output, uses d-c or a-c control power.
- Magnetic Amplifier Laboratory Manuals and Magnetic Amplifier Design Bulletins included with each educational unit.

Write for information and price.

VICKERS ELECTRIC DIVISION
VICKERS Inc.
1801 LOCUST STREET • ST. LOUIS 3, MISSOURI

Over 1000 Sizes



PARAMOUNT SPIRAL WOUND PAPER TUBES

SEND FOR ARBOR LIST OF OVER 1000 SIZES

Convenient, helpful listing of over 1000 stock arbors. Includes many odd sizes of square and rectangular tubes. Write for Arbor List today. No obligation.

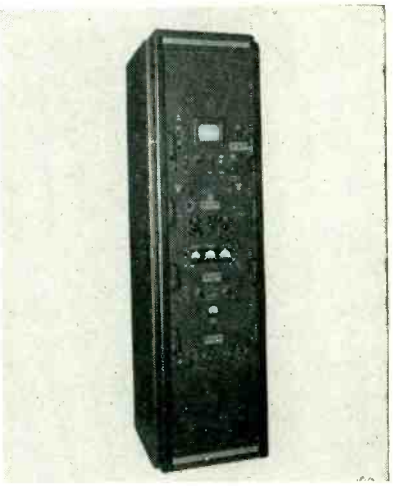
Square • Rectangular • Triangular Round and Half-Round

With a wide range of stock arbors . . . plus the specialized ability to engineer special tubes . . . PARAMOUNT can produce the exact shape and size you need for coil forms or other uses. *Hi-Dielectric, Hi-Strength.* Kraft, Fish Paper, Red Rope, or any combination, wound on automatic machines. Tolerances plus or minus .002". Made to your specifications or engineered for YOU.

Inside Perimeters from .592" to 19.0"

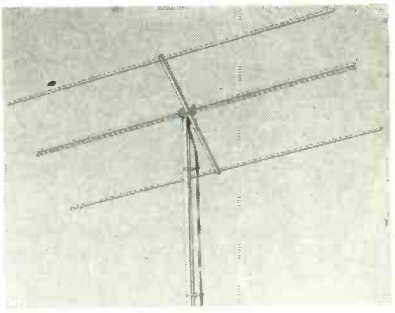
PARAMOUNT PAPER TUBE CORP.
616 LAFAYETTE ST., FORT WAYNE 2, IND.
Manufacturers of Paper Tubing for the Electrical Industry

antenna system. It is composed of three coupling units, each of which feeds two tv sets, a power supply and a mounting cabinet. Operation is based on low-pass filter theory in which the filter elements are made up of the interconnections and internal circuit constants. Cutoff frequency is approximately 230 mc.



Spectrum Analyzer

POLARAD ELECTRONICS CORP., 100 Metropolitan Ave., Brooklyn 11, N. Y. Model LSA direct-reading spectrum analyzer features continuous unidial tuning over the entire range with 5-kc resolution at all frequencies; a frequency which can be read to an accuracy of 1.0 percent; and dispersion, completely independent of frequency and variable from 250 kc to 25 mc. A 5-in. crt display unit, klystron power unit and low-voltage power unit are provided.



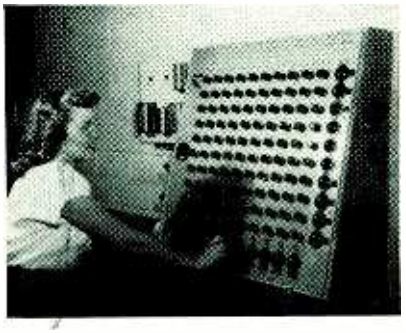
Three-Element Beam

THE LAPOINTE-PLASCOMOLD CORP., Unionville, Conn., is now in production on the model EC three-element

beam antenna. The stepped-up driven element affords an excellent match to 300-ohm line. If desired, a special T match can be provided for a 72-ohm match. It uses a 1-in. boom and ½-in. element of 61ST duraluminum. For additional gain it may be stacked at a half wave, and a stacking harness is available.

Dielectric Heater

HIGH FREQUENCY HEATING CO., 143 Glen Park Ave., Gary, Ind. The 1.5 AH preform heater is a bench machine for heating plastics, rubbers and other dielectric materials. It will raise the temperature of 1⅓ lb of average material 170 degrees in one minute. The loading tray is 6 × 8 in. and will accommodate material up to 3 in. high. High-frequency energy is provided at 40 mc.



Electrical Computer

PHILLIPS PETROLEUM CO., SPECIAL PRODUCTS DIVISION, Bartlesville, Oklahoma. Type 66 Spectro electrical computer solves simultaneous linear equations of the type encountered in infrared and mass spectrometry. It uses d-c electrical potentials substituted for the unknowns in the equations and solves the equations by a method of iteration. Results of spectroscopic analy-

keep with it!

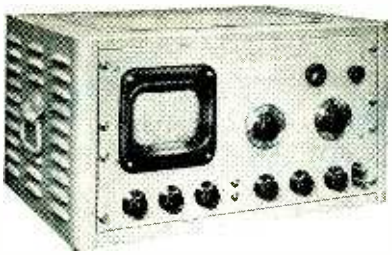
Be sure you get that famous ALTEC 21B quality from over-active announcers and recording artists by using the new 155A Chestplate. Because of the microphone's perfect positioning, you may readily obtain the sound separation you desire from vocalists working with an orchestra... without false bass! With this new adaptation of the 21B, sports announcers can always override even the noisiest crowds, for the 21B does not limit at audio peaks. Its smooth frequency response permits use in high-level sound fields which would ordinarily cause acoustic feedback.

The 155A Chestplate is compact, lightweight and contains a matching unit which permits its use up to 400 feet away from associated equipment.

Send for brochure giving technical information on ALTEC 21B Miniature Microphone adaptations.

ALTEC
LANSING CORPORATION

1161 N. VINE ST., HOLLYWOOD 38, CALIF.
161 SIXTH AVE., NEW YORK 13, NEW YORK



USES

- Ultrasonic Vibration Measurements
- Harmonic Analysis
- Cross Modulation Studies
- Noise Investigations
- Determining Transmission Characteristics of Lines and Filters
- Monitoring Communications Carrier Systems
- Checking Interference, Spurious Modulation, Parasitics, Effects of load changes, shock, humidity, component variations, etc. upon frequency stability
- Telemetering

SPECIFICATIONS

Frequency Range: 2 KC—300KC, stabilized linear scale
Scanning Width: Continuously variable from 200KC to zero
Four Input Voltage Ranges: 0.05V. to 50V. Full scale readings from 1 millivolt to 50 volts
Amplitude Scale: Linear and two decade log
Amplitude Accuracy: Within 1db. Residual harmonics suppressed by at least 50db.
Resolution: Continuously variable. 2KC at maximum scanning width, 500c.p.s. for scanning widths below 8KC.

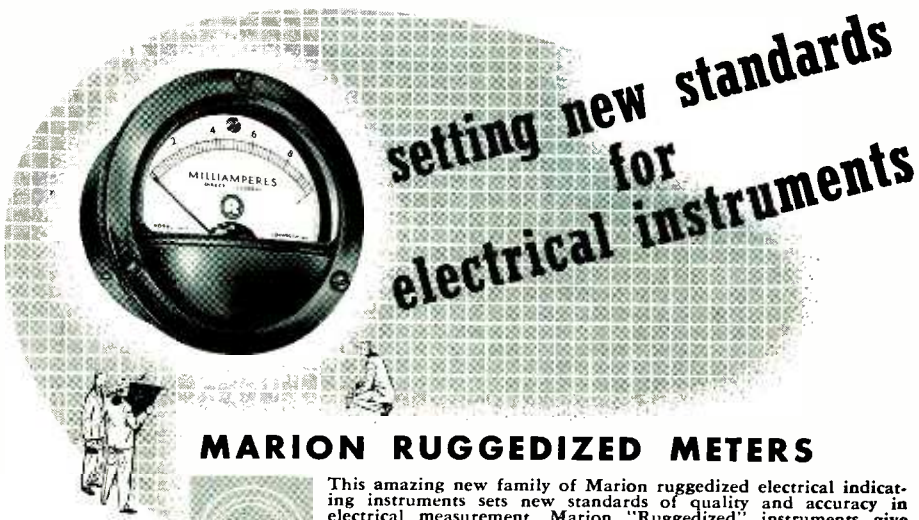
WRITE NOW For Complete Information, Price and Delivery

Available Now!

Easy, Fast Ultrasonic Spectrum Analysis WITH MODEL SB-7 PANORAMIC ULTRASONIC ANALYZER

An invaluable new direct reading instrument for simplifying ultrasonic investigations, the SB-7 provides continuous high speed panoramic displays of the frequency, amplitude and characteristics of signals between 2KC and 300KC. The SB-7 allows simultaneous observation of many signals within a band up to 200KC wide. Special control features enable selection and highly detailed examination of narrower bands which may contain signals separated by less than 500c.p.s. The instrument is unique in that it provides rapid indications of random changes in energy distribution.

PANORAMIC RADIO PRODUCTS Inc.
8 SOUTH SECOND AVE. MOUNT VERNON, N. Y.



MARION RUGGEDIZED METERS

This amazing new family of Marion ruggedized electrical indicating instruments sets new standards of quality and accuracy in electrical measurement. Marion "Ruggedized" instruments give better performance in *any* application. Use them with confidence even where you never before dared use "delicate instruments." They exceed all JAN-1-6 requirements, are *hermetically sealed* and completely interchangeable with existing JAN 2½" and 3½" types.

Marion Ruggedized instruments perform perfectly under critical conditions of shock, vibration, mechanical stress and strain. Hermetic sealing makes them impervious to weather and climate.

When you want the *best* in meters for any application —from bulldozers to Geiger Counters—insist on Marion, the name that means the most in meters.

Send for our booklet on Marion Ruggedized Instruments. Marion Electrical Instrument Company, 401 Canal Street, Manchester, New Hampshire.

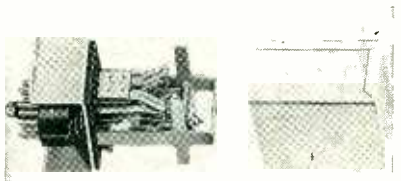
MARION MEANS THE MOST IN METERS

Manufacturers of hermetically sealed meters since 1944

marion meters

Trademark
©1950 Marion

sis of hydrocarbon samples have been computed to an accuracy of 0.1 percent with the instrument. Bulletin 278 gives a detailed description of the unit and its uses.

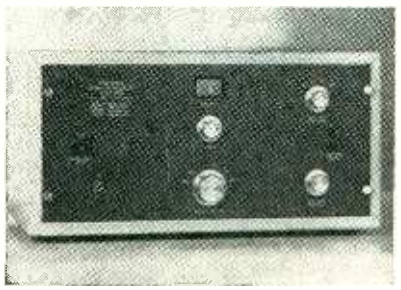


Relay Enclosure

C. P. CLARE & Co., 4719 West Sunnyside Ave., Chicago 30, Ill. Illustrated is the new dust-tight plug-in enclosure for the small type J relay, showing cover removed. Steel cover and Neoprene gasket, through which terminals are closely fitted, effectively occlude dust. Installation is facilitated by use of a standard radio-type plug, which also reduces wiring costs. Full description is given in bulletin 108.

High-Impedance Transformer

AMERICAN TRANSFORMER CO., Newark, N. J. Transformers for use with specific tubes have been designed to limit the inrush and operating currents to the values recommended by tube manufacturers. A table is available showing ratings for individual tube requirements, including data for single or polyphase operation.



ULF Oscillator

KROHN-HITE INSTRUMENT CO., 580 Massachusetts Avenue, Cambridge 39, Mass. Model 410-A wide-range, ultra-low frequency oscillator com-

bines the subaudio with the normal audio frequencies and provides both sine and square-wave outputs over the frequency range from 0.02 to 20,000 cps. Six frequency bands are provided, each covering a full decade, with continuous control of frequency. The unit features an ability to recover quickly from bandswitching and similar disturbances. Sine-wave output recovers to 90 percent of steady-state amplitude in less than 2 cycles of the dial frequency.

Frequency Standards and Dividers

ANALYSIS INSTRUMENT CO., P.O. Box 231, East Paterson, N. J., is manufacturing frequency standards incorporating a new type divider. The divider, when used in conjunction with crystal or tuning-fork standard oscillators, makes possible a more compact arrangement for supplying motor drive frequencies for facsimile and similar applications. Illustrated is a complete frequency standard for delivering 60 cycles from a 90.72-kc crystal-controlled oscillator.

Circuit Breaker Attachment

SAFETY DEVICES MFG. CO., 570 7th Ave., New York, N. Y. A new lightweight circuit-breaker attachment designed to convert small snap-action switches into circuit breakers operates over a wide temperature range. Called the Therm U adapter, the device weighing only 0.3 oz may be used to replace circuit breakers in aircraft.

Literature

Pulse Rise Time Indicator. Electronic Systems Co., 555 E. Tremont

Ave., New York 57, N. Y. Description, illustration and specifications of the model 632-B pulse rise time indicator are given on a single page. The instrument covered is intended for the accurate plotting of the rise time of rapidly rising positive voltage pulses, employing a specially designed delay line of variable length and a vtvm.

Electrical Contacts. Gibson Electric Co., 8361 Frankstown Ave., Pittsburgh 21, Pa. A line of Steelback electrical contacts consisting of silver facing individually bonded to steel backing for projection welding to contact supports, is illustrated and described in circular 501. Specifications for standard contacts are included.

Nuclear Instrumentation. Kelley-Koett Instrument Division, 20 E. Sixth St., Covington, Ky., is now publishing Kelefax, a new bimonthly publication of interest to personnel engaged in radiation and industrial instrumentation, nuclear science and technology. It contains articles by members of the engineering staff and guest authors, useful reference data and tables, and announcements of new products.

Radiographic Materials. Eastman Kodak Co., X-Ray Division, Rochester 4, N. Y. A new 16-page catalog of materials for industrial radiography describes films for use with x-ray equipment of varying kilovoltage and with specimens of varying thickness and density. Information on relative speeds and contrast of different x-ray film emulsions is provided in a handy chart.

General-Purpose Pulse Generator. Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif. Volume 1, No. 6 of the Journal is a four-page description of the model 212A, a 0.07 to 10-μsec general-purpose pulse generator. Included are specifications and photographs of oscilloscope traces of three typical major output pulses of different duration.

Coaxial Measuring Equipment. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. A

recent 4-page folder describes and illustrates a line of uhf measuring equipment for college, and research and development laboratories. The components included are designed for measurements on antennas, oscillators, amplifiers, transmitters, receivers and overall systems such as communications, data transmission, remote control and dielectric heating equipment.

Disc Ceramics. Cornell-Dubilier Electric Corp., South Plainfield, N. J. The Tiny Mike line of miniature ceramic disc capacitors is treated in a recent two-page catalog insert. The capacitors treated, used chiefly in tv, f-m and vhf applications, are designed for bypass and coupling in assemblies that are compact and in miniature electronic equipment. The units described are 19/32 in. in diameter and 5/32 in. thick.

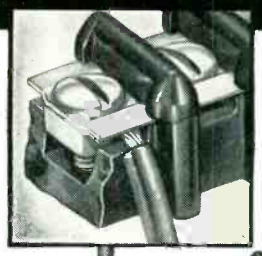
Germanium Diodes. General Electric Co., Syracuse, N. Y. A new loose-leaf book entitled "Welded Germanium Diodes" covers every necessary aspect of this component from general sales information to service notes and applications. References to additional information in the literature are included. Price is $1.25.

Tube Characteristics. Sylvania Electric Products, Inc., Emporium, Pa. The new radio tube characteristics chart is comprised of 28 pages of technical data. Types are listed in numerical and alphabetical order. Complete instructions on the use of the chart are included.

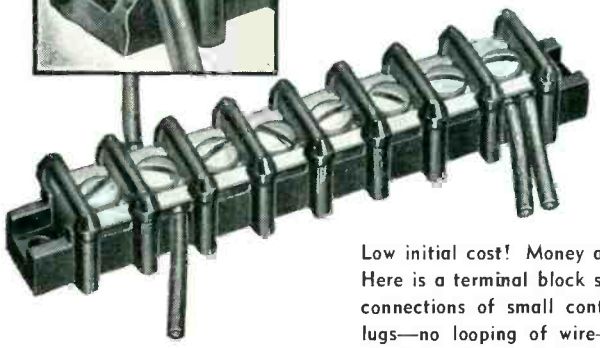
Power Supplies. Furst Electronics, 12 S. Jefferson St., Chicago 6, Ill. Six types of electronically regulated power supplies are shown in a four-page folder. Information given for each includes maximum output power, output voltage and current, maximum ripple voltage (rms) and size.

Slow-Speed Oscilloscope. A. E. Cawkell, 7 Victory Arcade, The Broadway, Southall, Middlesex, England. Leaflet No. 7 gives a general description, design information and specifications for the type SP10 slow-speed oscillo-

For #18 Stranded or #16 Solid Wire or Smaller



CURTIS TYPE "E" Terminal Blocks



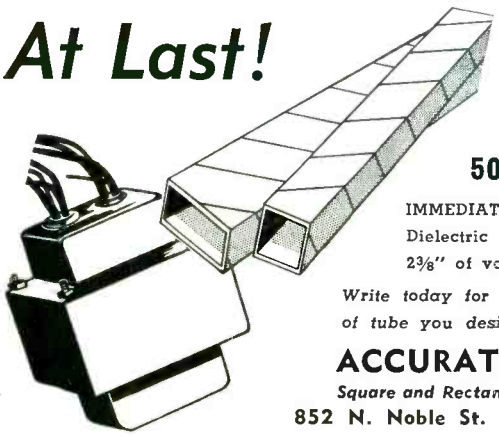
Low initial cost! Money and labor saving assembly! Here is a terminal block specially suited for making connections of small control wiring to blocks. No lugs—no looping of wire—no removing of screw—simply loosen one screw, insert stripped wire between clamping members and tighten screw. Wire is held so firm that it will break before pulling out. Type "E" Block is of solid base construction, eliminating possibility of grounding. Available with from 1 to 22 terminals.

Request Bulletin 123 for complete data and prices.

CURTIS DEVELOPMENT & MFG. CO.

Terminal Block Sales
4522 W. Madison St., Chicago 24, Illinois
Factory—Milwaukee 16, Wisconsin

At Last!



PAPER TUBES for Coil Winding up to 7½" x 7½" wall thicknesses to ¼"

50,000 possible ARBOR sizes

IMMEDIATE DELIVERY on "STOCK" sizes of Dielectric Kraft tubes, from ⅜" x ⅜" to 1½" x 2⅜" of various wall thicknesses, in 25" lengths.

Write today for prices on ANY dimension or quantity of tube you desire.

ACCURATE PAPER TUBE CO.

Square and Rectangular Paper Tubes for Coil Winding

852 N. Noble St. Chicago 22, Ill.

Quality controlled

SAPPHIRE and GLASS JEWEL BEARINGS

Performance proved for precision and long life by world's leading makers of *electrical, aircraft and timing instruments; compasses; weather recorders; all testing, indicating and recording apparatus.*

Unset or set in screws or bushings to suit requirements. Write for brochure.

Serving industry with fine jewels since 1913

Richard H. Bird & Co., Inc.
3 Spruce Street, Waltham, Mass.

---

it's FALSTROM for metal forming-

FORMED AND ASSEMBLED BENCH BOARD

SEE OUR CATALOG IN SWEET'S

1. CONTROL CENTERS
2. ENCLOSURES
3. PANELS
4. BOXES

FALSTROM service is fast, competent, complete. It includes forming, punching, welding and finishing. Piping, wiring and accessories can be built in when desired. Falstrom engineers will even procure and install your instruments to your specifications. All work performed by Falstrom is done by engineers and technicians thoroughly familiar with each phase of production. Mechanics skilled in working with steel, aluminum and stainless steels assure finest workmanship. Falstrom installations are in service throughout the electrical, chemical and petroleum industries—have been an accepted standard of excellence since 1870. For a practical, economical solution to your metal forming problems, go to Falstrom!

TO GET ALL THE FACTS, FILL OUT AND MAIL THE HANDY COUPON BELOW

FALSTROM COMPANY

93 FALSTROM COURT • PASSAIC, N. J.

Gentlemen:

Please send full information at once. I am interested in Nos.....

NAME.....

TITLE.....

COMPANY.....

STREET.....

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

scope for use wherever very slow speed waveforms are required to be observed.

Insulating Compound. Dow Corning Corp., Midland, Mich., has published a 16-page booklet on the uses of DC4 silicone compound for waterproofing and insulating aircraft ignition systems and electronic equipment. Many illustrated applications are given.

Time Measuring Instruments. American Chronoscope Corp., 316 W. First St., Mount Vernon, N. Y. A 4-page bulletin illustrates and describes a line of electromechanical chronoscopes, input adapters and photoelectric adapters for measuring significant operating times from 10 μsec to 3 sec.

Electrical Contacts. Fansteel Metallurgical Corp., North Chicago, Ill. A new 36-page illustrated booklet contains information on electrical contacts of value to design engineers. It includes a thorough discussion of contact materials, their properties, advantages and uses. The booklet also contains a glossary of electrical contact engineering terms and a series of captioned illustrations enabling recognition of symptoms of contact failure.

Transformer Bulletin. American Transformer Co., 178 Emmet St., Newark 5, N. J. Bulletin 110-02 describes an improved line of air-cooled (dry-type) transformers. It contains 8 pages of information and data, including tables which list standard ratings with dimensions, weights list prices and wiring diagrams of transformers in capacities up to 200 kva, single-phase, and 300 kva, three-phase.

Airborne Equipment Protection. The Barry Corp., 177 Sidney St., Cambridge 39, Mass. Catalog 502 deals with vibration isolators and mounting bases used to protect electronic equipment and other sensitive apparatus against shock and vibration encountered in aircraft applications. Two pages of the catalog discuss principles involved in shock and vibration control, with special emphasis on the effect of air damping.

COSSOR for QUALITY

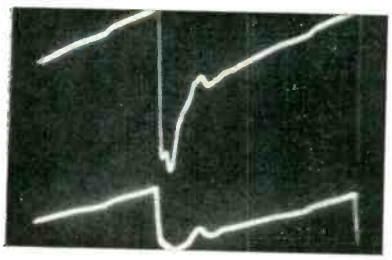
TWIN BEAM OSCILLOSCOPES

compare. . .

INPUT VS. OUTPUT
VOLTAGE VS. CURRENT
CAUSE VS. EFFECT

with
twin beams in exact time synchronism
plus
accurate voltage and time measurement controls at your fingertips.

IS YOUR WORK TV?



TV horizontal output tube waveform
upper trace—grid volts
lower trace—cathode current

STUDY THIS PHOTO—note exact phase comparison given by unique Cossor twin beam tube. . .no need for electronic switching with attendant troubles.

Photographed on Cossor Model 1035 with Model 1428 Camera.

Cossor simplifies scope photography.

Model 1035 Scope for wide band amplifiers and fast traces.
Model 1049 Scope for DC amplifiers and slow traces.

both with the
COSSOR TWIN BEAM TUBE

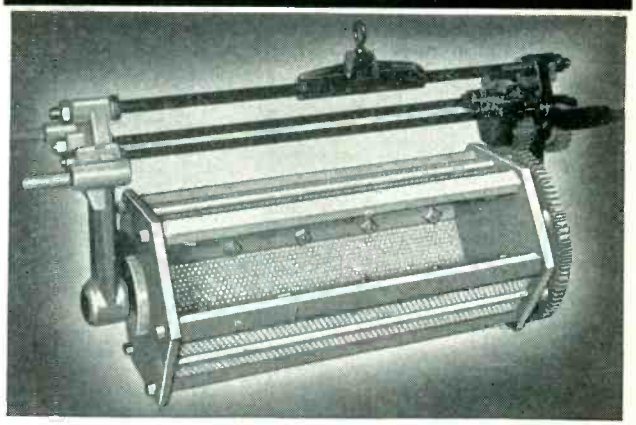
Write today for details and demonstration.

ALL MODELS AND COMPLETE SPARES IN STOCK NEW YORK AND HALIFAX

COSSOR (CANADA) LIMITED
Windsor St., Halifax, Nova Scotia
★
BEAM INSTRUMENTS CORP.
Room 208, 55 W. 42nd Street,
New York 18, N. Y.

FORMICA makes a grade that "Makes The Grade"

YOU CAN DO IT BETTER WITH FORMICA



Electroplating barrels . . . call for the outstanding chemical resistant properties of Formica laminated plastics. Whether you require resistance to acids, alkalies, oxidizing agents or inorganic salts, Formica has a grade that "makes the grade". And Formica has many other special grades for special applications. Formica comes in sheets, tubes and rods . . . can be molded and postformed . . . machines easily. For complete information send today for your free copy of 16-page "Productive Formica".

Write **FORMICA**
4640 Spring Grove Ave.
Cincinnati 32, Ohio.

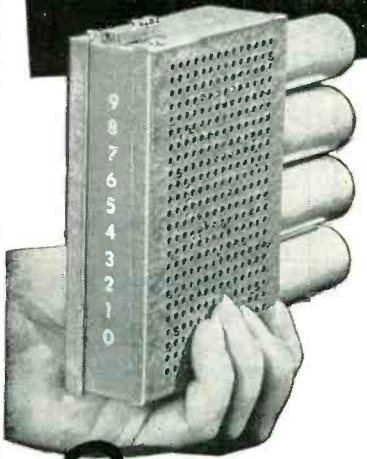
16-mm color sound movie, "The Formica Story", pictures Formica "at work in industry". Available for group showings. Write for film.

Productive **FORMICA** at Work in Industry

---

for { **ELECTRONIC COUNTING APPLICATIONS**

MODEL 700 *Berkeley* **DECIMAL COUNTING UNIT**



This versatile component is adaptable to a wide range of applications in counting, timing and frequency measurements. It has scale-of-ten direct reading based on a reliable binary circuit. It has easily met power and pulse input requirements and is designed for plug-in operation. It is a self-biased unit, which, although for operation at 300 v., functions consistently at 200 to 450 v. It can be easily built into your apparatus. Combined with these advantages are miniature size and sturdy construction. Price $55.00. Discounts on quantities. Send for Bulletin DCU-114.

Now in production, Berkeley's new Time Interval Meter. Ask for Bulletin TIM-114 for full information.

Berkeley Scientific Company
SIXTH AND NEVIN AVENUES • RICHMOND, CALIFORNIA

NEWS OF THE INDUSTRY

(continued from page 130)

meaning no. Then later the beam can be redirected at the area on which needed information is stored in order to read off the signal it applied earlier.

On the electrical characteristics of the beryllium mosaic, according to the engineers, depend the reliable fast storage and reading which make this tube so promising for high-speed electronic computer applications. The mosaics are made by special equipment in a high-vacuum chamber.

The MIT engineers reported that their new electrostatic storage tube should be useful in any application where high-speed storage of digital coded information is needed.

Future improvements of the tube resulting from work now in progress are expected to decrease access time to 6 to 12 μsec and increase storage density to 1,024 digits.

Thermocouple Tables To Be Revised

Now under way at the National Bureau of Standards is an extensive project for the revision of all the common thermocouple tables. Present plans call for the publication during 1950 of eight tables giving the temperature-emf relations for platinum-platinum rhodium, chromel-alumel, and copper-constantan thermocouples.

The temperature-emf tables for thermocouples previously issued by the Bureau have been widely used in science and industry, not only to convert thermocouple voltages into the equivalent measured temperatures but also in the preparation of purchase specifications for thermocouple wire and in defining the relation between impressed emf and scale reading for pyrometers which indicate temperature directly. Recently, however, in accordance with international agreement, the Bureau adopted the absolute electrical units and began using the definitions of the new International Temperature Scale of 1948 both in its own research program and in calibrating instruments for other laboratories and industries. Revision of the thermocouple tables was then advisable in order to make

them consistent with former usage.

In the preparation of the tables, emphasis is being placed on convenience for use. Thus, explanatory text will be short, numerals will be as large as practical, and layout of pages and headings will be arranged to facilitate interpolation. The argument will be presented at one-tenth the interval given in the original tables. Inverse tables, formerly lacking, will also be included. Each table, together with its inverse, will be issued as an NBS Miscellaneous Publication and, when announced, will be available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Prior to publication, inquiries should be addressed to Pyrometry Laboratory, National Bureau of Standards, Washington 25, D. C.

BUSINESS NEWS

POLARAD ELECTRONICS CORP., manufacturers of television broadcast equipment, test equipment and microwave systems, have moved to larger quarters with increased facilities for production and development at 100 Metropolitan Ave., Brooklyn, N. Y.

HOFFMAN RADIO CORP., Los Angeles, Calif., has added 20,000 sq ft of floor space to its local plants through the purchase of property on South Grand Ave., adjacent to the rear of its plant No. 3.

THE AMERICAN GAGE & MACHINE CO. has merged with the Simpson Electric Co., Chicago, Ill., manufacturer of electrical measuring instruments and radio and television test equipment.

INSULINE CORP. OF AMERICA has acquired 10,000 sq ft of additional factory space in Long Island City, N. Y., for the manufacture of television antennas and accessories.

RADIO ENGINEERING LABORATORIES have consolidated operations into their main plant at 36–40 37th St., Long Island City, N. Y.

REEVES SOUNDCRAFT CORP., manufacturers of transcription record-

ing blanks and sapphire needles, recently began to manufacture and sell magnetic recording tape.

RADIO CORP. OF AMERICA recently held dedication ceremonies for its new Marion, Indiana, television picture tube plant. The ceremony

Small forest of electron guns moves along production line at RCA's new Marion, Ind., plant

marked the installation of basic machinery and conveyor-belt systems which will eventually make the plant one of the biggest mass-producers of tv picture tubes.

ACME ELECTRIC CO., Cuba, N. Y., has begun construction of a new 15,000-sq ft-floor-area building adjacent to its plant No. 1 to increase production of tv transformers.

ELECTRICAL REACTANCE CORP., ceramic capacitor manufacturer, will double its present capacity with the establishment by August 1 of a new $400,000 plant at Olean, N. Y.

ALLEN B. DUMONT LABORATORIES, INC., recently opened its 175,000-sq ft Allwood plant in Clifton, N. J., to be devoted exclusively to c-r tube production.

PERSONNEL

CHARLES M. SCHEDLBAUER, formerly chief engineer of Electronic Associates, Inc., Long Branch, N. J., is now the company's director of sales.

FRANK GOLDSTEIN, a member of the engineering staff of radio station

WMOR, Chicago, during the past year, was recently appointed chief engineer of that station.

CURTIS B. PLUMMER has been promoted from chief of the television broadcast division of the FCC's Bureau of Engineering to chief engineer in charge of the new Office of Chief Engineer.

C. B. Plummer

D. McDonald

DONALD MCDONALD, formerly with the Aeronautical Research Center, U. of Michigan, has been appointed director of the Signal Laboratories section of the Cook Research Laboratories, Chicago, Ill.

EDWARD B. DOLL, formerly chief engineer at North American Philips Co., has joined the engineering staff of Stanford Research Institute, Stanford, Calif.

JOSEPH H. COPP, previously associated with General Electric Co. as audio and television systems engineer, has been appointed audio facilities engineer for the American Broadcasting Co.

LEWIS P. TABOR, senior research engineer in the Franklin Institute Laboratories for Research and Development, has been elected chairman of the Institute's Science and Arts Committee.

EDMUND C. ALTENBERGER, formerly with Essex Electronics, has joined Fugle-Miller Laboratories, Metuchen, N. J., as chief engineer responsible for the design of new television coil assemblies.

LAVERNE M. POAST has joined the firm of Craven, Lohnes and Culver, consulting radio engineers at Washington, D. C., as a new partner.

GERALD C. SCHUTZ, formerly chief of the radar techniques unit at Air Materiel Command, has been appointed chief electronics engineer

of Gibbs Mfg. and Research Corp., Janesville, Wisc.

JOHN A. WILLOUGHBY, former acting chief engineer of the FCC, has been appointed assistant chief engineer in the new Office of Chief Engineer.

JOSHUA SIEGER, director of research and development at Freed Radio Corp., New York, since 1948, was recently promoted to vice-president in charge of engineering.

J. Sieger

R. Bowen

JOHN A. RANKIN, chief engineer at Hoffman Radio Corp., Los Angeles, Calif., for the past nine months, has become vice-president in charge of engineering.

DALE POLLACK, consulting radio engineer, announces the removal of his laboratory and office to his new building on Dayton Road, Waterford, Conn.

JOSEPH P. STEPHANILE, formerly engaged in technical and engineering work with Government installations, is now associate electronics engineer at Telrex, Inc., Asbury Park, N. J.

ALBERT W. HULL, inventor of the magnetron, recently retired as assistant director of the General Electric Research Laboratory, Schenectady, N. Y., but will continue to serve the laboratory as a consultant.

JOHN M. PEARCE, former head of the electronics section of The Glenn L. Martin Co., has been named chief electronics engineer and head of the new electronics department in the company's engineering division.

JOBE JENKINS, formerly electronics group engineer, is now in charge of the systems development and analysis units of the electronics department at The Glenn L. Martin Co.

veloped by Mr. John Ruze of this laboratory, states that the power gain will be slightly less than the value given by

$$G = \frac{27{,}000}{\beta_h \beta_v}$$

where G is the power gain of the array over that of a half-wave dipole, and β_h and β_v are half-power beamwidths expressed in degrees in the horizontal and vertical planes, respectively.

Using this formula and the beamwidths as given in Table III of the article, the power gain of the various arrays (with a dipole for a transmitting antenna) over that of a pair of dipoles is as follows:

Array No.	1	2	3	4	5
Power Gain	18	33	77	84	105
Gain in Db	12.5	15.2	18.9	19.2	20.2

The system power gain will be increased by 6.0 decibels in each case if the single-turn circular antenna is substituted for the transmitting dipole.

In general, the gain of any practical antenna cannot be increased indefinitely without running into the grave obstacles encountered in the design of super-gain systems.

WALTER ROTMAN
Antenna Laboratory
A. F. Cambridge Res. Labs.
Cambridge, Mass.

Paralleled Thyratrons

DEAR SIRS:

THE SHORT NOTE entitled, "Operating Small Thyratrons in Parallel", which appeared on page 202 of your March issue was read with much interest. The technique disclosed was developed during the war for parallel operation of thyratrons such as the 2050 and 2D21 for modulation of low and medium-power radar transmitters.

Resistances, inductances, and center-tapped coils have been successfully used in the cathode circuits with cross connections to the shield grids. This work was undertaken by the undersigned at the RCA Laboratories and is referred to in U. S. Patent 2,481,925, Sept. 13, 1949, and By H. H. Wittenberg in the March 1949 *RCA Review*.

H. R. HEGBAR
Cuyahoga Falls, Ohio

PROFESSIONAL SERVICES

Consulting—Patents—Design—Development—Measurement

in

Radio, Audio, Industrial Electronic Appliances

AMPLIFIER CORP. of AMERICA
Research, Design, Development and Manufacturing Engineers
Specializing since 1936 in All Phases of MAGNETIC TAPE RECORDING FOR ALL APPLICATIONS
Precision Regulated Power Supplies
A. C. Shaney, Chief Engineer
398-7 Broadway — New York 13, N. Y.

WHEN TIME IS SHORT . . . .
put the solution of your problems up to a specialized Consultant whose professional card appears on this page. His broad experience may save you months of costly experimentation.
ELECTRONICS
330 West 42nd St., — New York 18, N. Y.

PICKARD AND BURNS, INC.
Consulting Electronic Engineers
Analysis and Evaluation of Radio Systems
Research, Development & Design of Special Electronic Equipment
240 Highland Ave., — Needham 94, Mass.

CROSBY LABORATORIES
Murray G. Crosby & Staff
FM, Communications, TV, Industrial Electronics, High-Frequency Heating
Offices, Laboratory & Model Shop at:
126 Herricks Rd., Mineola, N. Y.
Garden City 7-0284

HANSON-GORRILL-BRIAN INC.
Product & Mfg. Development
ELECTRICAL - ELECTRONIC
HYDRAULIC - MECHANICAL
One Continental Hill — Glen Cove, N. Y.
Glen Cove 4-1922

ALBERT PREISMAN
Consulting Engineer
Television, Pulse Techniques, Video Amplifiers, Phasing Networks, Industrial Appliances
Affiliated with
MANAGEMENT-TRAINING ASSOCIATES
3308-14th St., N.W. — Washington 10, D. C.

EDGERTON, GERMESHAUSEN & GRIER, INC.
Consulting Engineers
Research Development and Manufacture of Electronic and Stroboscopic Equipment
Specialists in High-Speed Photography
160 Brookline Avenue, — Boston 15, Mass.

KENT LABORATORIES, INC.
Model Work in Metal & Plastics
Electro - Mechanical
Design - Development - Manufacture
Precision Mechanical Specialists
230 Warburton Ave. — Hawthorne, N. J.
Telephone HA wthorne 7-6777

SERVO CORPORATION OF AMERICA
Consultants on
Electronic Control Problems for Industry
New Hyde Park — Long Island, N. Y.

ELECTRO-MECHANICAL RESEARCH INC.
Specialized Research and Manufacture
High and Low Frequency Circuit Development
Electronic Measuring and Test Equipment
Optical and Infra-Red Studies
Special Geophysical Equipment
Automatic Inspection Devices
Ridgefield, Conn.

MEASUREMENTS CORP.
Research & Manufacturing Engineers
Specialists in the Design and Development of Electronic Test Instruments
Boonton, N. J.

SERVO-TEK PRODUCTS CO., INC.
Servo-Systems • Position Recorders Motor-Integrator Systems
Specialists in Electronic Motor Speed Control
4 Godwin Avenue — Paterson, N. J.
Tel. ARmory 4-3366 — Teletype PAT 199

ELECTRONIC ENGINEERING CO. of CALIFORNIA
Radio and Electronic Consulting and Designing.
180 S. Alvarado — Los Angeles
DUnkirk 7-8323 — California

MICROCIRCUITS COMPANY
Consultation-Development-Manufacture
PRINTED CIRCUIT APPLICATIONS and PAINTS
Conducting, Resistance, and Magnetic Paints, Pastes and Hot Melts for Experimentation and Production
New Buffalo — Michigan

TECHNICAL MATERIEL CORPORATION
Communications Consultants
RADIOTELETYPE • FREQUENCY SHIFT INK SLIP RECORDING TELETYPE NETWORKS
121 Spencer Place — Mamaroneck, N. Y.

ERCO RADIO LABORATORIES, INC.
Radio Communications Equipment
Engineering - Design - Development - Production
Pioneers in Frequency Shift Telegraph
Garden City • Long Island • New York

Eugene Mittelmann, E.E., Ph.D.
Consulting Engineer & Physicist
High Frequency Heating—Industrial Electronics
Applied Physics and Mathematics
549 W. Washington Blvd. — Chicago 6, Ill.
State 2-8021

ANDREW W. VINCENT
CONSULTANT
Development and Models
Electromagnetic relays & devices Audio and intercommunication equip. Remote control selection circuits, Telephone equipment.
300 W. High Terrace — Rochester, N. Y.
Genesee 2648

PAUL GODLEY CO.
Consulting Radio Engineers
GREAT NOTCH, N. J.
Est. 1926 — Little Falls 4-1000

NIAGARA ELECTRON LABORATORIES
CONSULTATION - DESIGN - CONSTRUCTION
MFG. THE THERMOCAP RELAY
Specializing in solution of problems of electronic and electro-physical instrumentation for the research or analytical laboratory. Industrial plant problems also invited.
Andover, New York Cable Address: NIATRONLAB

YARDENY LABORATORIES INC.
Research and Development
Remote Controls and Electro Chemical Generators of Energy
105 Chambers Street — WO 2-3534, 35
New York, N. Y.

THE REAL VALUE

of placing your unusual problem in the hands of a competent consultant is that it eliminates the elements of chance and uncertainty from the problem and provides real facts upon which to base decisions.

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:

$1.20 a line, minimum 4 lines to figure advance payment count 5 average words as a line.
INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of above rate, payable in advance.
PROPOSALS $1.20 a line an insertion.

INFORMATION:

BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 1 line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH

The advertising rate is $10.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

ELECT.

NEW ADVERTISEMENTS received by May 2nd will appear in the June 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

ELECTRICAL DESIGN Engineer by large, modern, eastern manufacturing firm for experimental development work, in industrial electronics. Applicant must have degree in electrical engineering with communications or electronic option or equivalent in 10-15 years practical experience. Give details including age, education, experience, references, availability and salary expected. P-6070, Electronics.

TECHNICAL WRITER: An opportunity for an experienced technical report writer. Preferably an electrical engineering graduate with experience in the field of electronic development. Research Laboratory located adjacent to Washington, D. C. Salary commensurate with experience. P-6267, Electronics.

EMPLOYMENT SERVICE

SALARIED PERSONNEL, $3,000-$25,000. This confidential service, established 1927, 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, Conn.

POSITIONS WANTED

COMMUNICATIONS TECHNICIAN 14 yrs. exp. all phases. Design & Mfr. Comm. & Electronic eqpt. Patents. Travelled Europe & SA. 9 yrs. Brazil. PW-2220, Electronics.

ENGINEER PRESENTLY employed over 20 years of successful experience in research, development, production, esp. of insulating and high K Dielectric Ceramic Materials and their application in the field of Electronic Components, seeks responsible and attractive connection with progressive manufacturer. Pref. location: area of New York or Los Angeles. PW-6200, Electronics.

RADIO-ELECTRONICS Technician: American, age 27, single, desires long term position anywhere in Philippines. Amiable disposition. Speaks some Tagalog and Visayan. 10 years military, amateur and commercial radio experience. PW-6165, Electronics.

ENGINEERING PHYSICIST—Employed, age 30, two years college teaching, three years research and development work, desires midwestern connection. PW-2466, Electronics.

SELLING OPPORTUNITY WANTED

SALES ENGINEER — Bachelor of electrical engineering; competent, personable; own business experience, varied engineering background including sales; willing to travel. SA-6308, Electronics.

Announcing Formation of New

SALES ENGINEERING AGENCY

for Industrial Electronic Components and Instruments covering Upper New York State.

Competent, experienced representation with established contacts.

Openings available for a very limited number of lines.

RA-6271, Electronics
330 W. 42nd St., New York 18, N. Y.

PROJECT ENGINEER
AVAILABLE

Fire control; telemetering; computers servomechanisms; magnetic amplifiers; electronic instruments. Resume upon request.

PW-6307, Electronics
330 W. 42nd St., New York 18, N. Y.

RADIO TELEVISION SALES and SERVICE STORE FOR SALE

Located busy corner, Indiana town of 45,000. R.C.A., Zenith franchises make sales $10,000 yearly; service about the same. Long lease available on ultra modern salesroom. For further details write

BO-6310, Electronics
520 N. Michigan Ave., Chicago 11, Ill.

BUSINESS OPPORTUNITY WANTED

Executive Engineer will purchase all or part interest in established television, radio, electronics or acoustical manufacturing or laboratory enterprise in which can take active part.

BO-6234, Electronics
520 N. Michigan Ave., Chicago 11, Ill.

CONTRACT
ENGINEERING—MANUFACTURING
electronic and electro-mechanical devices
• developed to meet your specifications
• manufactured per sample or drawings
TELETRONICS LABORATORY, Inc.
Westbury, L. I., N. Y.—Westbury 7-1028

Time is money. Save it by referring to our ACCUMULATIVE INDEX FOR ELECTRONICS BIBLIOGRAPHY

Simple and Dependable

Write for descriptive literature
TECHNICAL INDEX SERVICE
Box 632 Asbury Park, New Jersey

When Writing Your Ad

Provide an indexing or subject word.

Write it as the first word of your ad.

If it is a Position Wanted or Position Vacant ad, make the first word the kind of position sought or offered.

This will assure proper classification in the column.

The right is reserved to reject, revise or properly classify all Want Advertisements.

Proper Classification increases the possibility of Prompt Returns

U. S. Government

Notice to Contractors

GENERAL SERVICES ADMINISTRATION
Community Facilities Service
Washington 25, D. C.

Sealed proposals will be received by Rufe B. Newman, Jr., Director, Public Works Construction Division, Community Facilities Service, General Services Administration, Room 5143, General Services Building, Washington, D. C., until 11:00 o'clock A.M., Eastern Standard Time, on May 24, 1950, for the construction of telephone and radio link facilities and buildings on the islands of St. Thomas and St. Croix (U. S. Virgin Islands) as follows:

PROJECT No. 53-113, ST. THOMAS TELEPHONE SYSTEM

(Project No. 13, Public Law 510, 78th Congress)
Subproject 13A—Outside Telephone Plant, St. Thomas
Subproject 13B—Inside Telephone Plant, Charlotte Amalie
Subproject 13C—Subscriber Telephone Plant, St. Thomas
Subproject 13R—Radio Link Stations, Virgin Islands
Subproject 13X—Telephone Exchange, Charlotte Amalie

PROJECT No. 53-509, ST. CROIX TELEPHONE SYSTEM

(Project No. 26, Public Law 510, 78th Congress)
Subproject 26A—Outside Telephone Plant, St. Croix
Subproject 26B—Inside Telephone Plant, Christiansted and Frederiksted
Subproject 26C—Subscriber Telephone Plant, St. Croix
Subproject 26X—Telephone Exchanges, Christiansted and Frederiksted,

at which time and place the proposals will be publicly opened and read aloud. Bids received after closing time of bid opening will be returned unopened.

Plans and specifications and other proposed contract documents are open for public inspection at the District Engineer's Office, Charlotte Amalie, St. Thomas, U. S. Virgin Islands; the District Engineer's Office, 501 Banco Popular Building, San Juan, Puerto Rico and Room 5130, General Services Building, Washington, D. C. A set of such documents may be procured from any of the above-listed offices upon deposit of $50.00, all of which will be returned to bona-fide bidders upon the return of plans and specifications, in good condition, within seven days of date of bid opening.

Each proposal must be accompanied by a bid security in an amount not less than 5 percent of the total bid.

Bids will be accepted on any single subproject or project.

The successful bidder(s) will be required to furnish performance bond(s) in an amount equal to 100 percent of his (their) bid(s) and payment bond(s) in an amount equal to 100 percent of his (their) bid(s); such bonds to cover full performance of the contract(s) and payment(s) for labor and materials.

No proposal may be withdrawn after the scheduled closing time for receipt of bids for at least 30 days.

The Government reserves the right to reject any and all proposals and to waive informalities with respect thereo.

PERE F. SEWARD,
Commissioner
(100)

Desirable positions at a New England Manufacturing plant specializing in Micro - wave Electron Tube Development and Manufacture.

SENIOR ELECTRONIC ENGINEER

EE or MS degree. 4 years experience in electronics, preferably high voltage pulse equipment as used for radar. A knowledge of pulse transformers, pulse lines, hard tube modulators, line type modulators, spectrum analyzers and micro-wave transmission lines. Will be responsible for the design and maintenance of pulse equipment for frequency, and DC test equipment and RF plumbing for the testing of micro-wave magnetrons.

JUNIOR OR SENIOR VACUUM TUBE ENGINEER

The openings are in the field of micro-wave vacuum tube development with special emphasis on magnetrons. Academic experience in micro-wave circuits, vacuum tube construction and design highly desirable. Additional training in theory and construction will be given new employees. The applicants for these positions should have been in the upper half of their class scholastically.

P-6252, Electronics
330 W. 42 St., New York 18, N. Y.

SENIOR ELECTRONIC CIRCUIT PHYSICISTS

for

Advanced Research and Development

MINIMUM REQUIREMENTS:

1. M.S. or Ph.D. in Physics or E.E.
2. Not less than five years experience in advanced electronic circuit development with a record of accomplishment giving evidence of an unusual degree of ingenuity and ability in the field.
3. Minimum age 28 years.

Hughes Aircraft Company
Attention: Mr. Jack Harwood
CULVER CITY, CALIFORNIA

RADAR, COMMUNICATIONS *and* SONAR TECHNICIANS WANTED

For Overseas Assignments

Technical Qualifications:

1. At least 3 years' practical experience in installation and maintenance.
2. Navy veterans ETM 1/c or higher.
3. Army veterans TECH/SGT or higher.

Personal Qualifications:

1. Age, over 22—must pass physical examination.
2. Ability to assume responsibility.
3. Must stand thorough character investigation.
4. Willing to go overseas for 1 year.

Base pay, bonus, living allowance, vacation add up to $7,000.00 per year. Permanent connection with company possible.

Apply by Writing to

A-1, P. O. Box 3414
Philadelphia 22, Pa.

Men qualifed in RADAR, COMMUNICATIONS or SONAR give complete history. Interview will be arranged for successful applicants.

SEVERAL ENGINEERS

needed by contractor for work at Naval Air Missile Test Center, 50 miles northwest of Los Angeles. College degree and several years experience essential. Radar, computer, or telemetering experience preferable.

ELECTRONIC ENGINEERING CO. OF CALIFORNIA
180 South Alvarado Street
Los Angeles 4, California

Positions Open for

PHYSICISTS
SR. ELECTRONIC ENGINEERS

Familiar with ultra high frequency and micro wave technique.
Experience with electronic digital and/or analog, computer research and development program.
Salaries commensurate with experience and ability. Excellent opportunities for qualified personnel.

Contact
C. G. Jones, *Personnel Department*
GOODYEAR AIRCRAFT CORPORATION
Akron 15, Ohio

SCIENTISTS AND ENGINEERS

Wanted for interesting and professionally challenging research and advanced development in the fields of microwaves, radar, gyroscopes, servomechanisms, instrumentation, computers and general electronics. Scientific or engineering degree or extensive technical experience required. Salary commensurate with experience and ability. Direct inquiries to Mgr., Engineering Personnel, Bell Aircraft Corporation, P. O. Box 1, Buffalo 5, N. Y.

ELECTRONIC ENGINEER

Must have M.S., Ph.D. preferred, in E.E. or Physics and not less than five years of practical circuit experience in the field of high speed electronic computers or pulse electronics. Salary commensurate with qualifications. Permanent position with medium size, progressive firm in New York area. Give complete details. Our employees have been notified.

P-6181, Electronics
330 W. 42nd St., New York 18, N. Y.

TELEVISION ENGINEERS

Several engineers experienced in either technical or commercial phases of television are required in the formation of a new department. Send resume of qualifications to

Personnel Department,
General Precision Laboratory, Inc.
63 Bedford Road Pleasantville, New York

TERRITORY AVAILABLE

We are manufacturers in the electronic measuring, communications, and control fields. We require several exceptional men in various sections of the country to handle our products in addition to their present lines. Better than average reward for those qualifying. Give full particulars in initial correspondence.

RW-2421, Electronics
520 N. Michigan Ave., Chicago 11, Ill.

SALES REPRESENTATIVE

required for promoting engineering sales of high frequency test instruments, handling customer engineering applications, minor instrument service. Applicant should be graduate EE with sales and engineering experience. Will consider manufacturer's representative or individual acting only for us. Location California.

KAY ELECTRIC COMPANY
PINE BROOK, NEW JERSEY

ELECTRICAL AND MECHANICAL PRODUCTION ENGINEERS

GUIDED MISSILE MANUFACTURE LOS ANGELES AREA

Experienced in development of processes and design of equipment and tooling for ULTRA-PRECISION MINIATURE MECHANISMS.

Also supervisory openings for top caliber men with wide knowledge of latest developments applicable to production of one or more guided missile components.

Send resume of your experience to

Dept. 29E
HUGHES AIRCRAFT COMPANY
Culver City, Calif.

Interviews will be arranged near your home if possible.

COMMUNICATIONS EQUIPMENT COMPANY

X BAND

Directional coupler, UG-40/U take off, 20 DB	$17.50
Directional coupler, APS-6, Type "N" take off, 20 DB, calibrated	17.50
Broad Band Directional coupler, type "N" take off, choke to cover, 23 DB, calibrated	18.50
Directional coupler, APS-31, type "N" take off, 28 DB	17.50
Bi-directional coupler, type "N" take off	22.50
Flexible Section 18" long	12.00
Straight Sections 2½ ft. long choke to cover, silver plated	6.50
Pressure Test Section with 15 lb. gauge and pressurizing nipple	10.00
Bulk Head Feed Through, choke to cover	12.00
Mitered Elbow, choke to cover or choke to choke	12.00
Right Angle Bend 2½" Radius, choke to cover	12.00
90° Twist, 6" long	7.50
45° Twist, 6" long	7.50
90° Twist, 5" long with pressurizing nipple	7.50
15° Bend 10", Choke to cover	4.50
5 ft. Sections UG-39 to UG-40, silver plated	9.50
180° Bend, 26" Choke to cover 2½" radius	5.00
SWR Measuring Section 4" long, 2 type "N" probes mounted full wave apart 1¼ x ⅝" guide	8.50
WE attenuator 0 to 20 DB, less cards, bell guide	size 12.50
90° Bend E Plane 18"	4.00
Rotary Joint, choke to choke	10.00
Rotary Joint, choke to choke with deck mounting	10.00
TR-ATR Duplexer Section for 1B24 and 724B	12.50
Wavemeter-Thermistor MTG Section	6.00
2K25/723 AB Receiver, Local Oscillator Klystron Mount, complete, with Crystal Mount, Iris Coupling and Choke Coupling to TR	22.50
TR-ATR Duplexer Section for above	8.50
723AB Mixer—Beacon Dual Oscillator Mount with Crystal Holder. Used	12.00
723AB Mixer—Beacon Dual Oscillator Mount with Matching Slugs and tunable termination, new	24.50
Bi-Directional Coupler, type "N" termination. 26 DB, calibrated, 1¼ x ⅝" guide	24.50
12" Flexible Section 1¼ x ⅝" guide	10.00
Crystal Mount in Waveguide	17.50
SO-3 Echo Box, Transmission type cavity with bellows	28.50
180° Bend with pressurizing nipple	5.00
"S" Curve 18" long	5.00
"S" Curve 6" long	3.25
APS-31 Mixer Section for mounting two 2K25s, Beacon Reference Cavity, 1B24 TR Tube	42.50
Transition 1 x ½ to 1¼ x ⅝", 14" long	8.00
Receiver Front End, complete, C/O Dual 723AB Klystron mount. TR-ATR Duplexer Section, 2 stage 30 MC. Preamplifier, new, with ALL tubes	59.50
Random Lengths of Waveguide 6 to 18" long	1.00 per ft.

RADAR SETS

SCR 663-T3 Sperry searchlight training, aircraft, tracking, 10 CM 360° horizontal sweep 90° vert. sweep. Used $450.00

APS15 Consists of transmit., mod. rec. ind. ant., 400 cy pwr unit, less control boxes & cable, new $400.00

Mark 8 Model 2 Gyro stable element designed for use in stabilizing large caliber naval gun $2,500.00

APS-2	Airborne	10 CM, Major Units	New	$500
APS-4	Airborne	3 CM, Compl.	Used	1800
APS-15	Airborne	3 CM, Major Units	New	500
SD-4	Submarine	200MC, Compl.	New	1100
SE	Shipboard	10 CM, Compl.	New	1200
SF-1	Shipboard	10 CM, Compl.	New	2800
SJ-1	Submarine	10 CM, Compl.	Used	1500
SL-1	Shipboard	10 CM, Compl.	Used	1700
SN	Portable	10 CM, Compl.	Used	600
SQ	Portable	10 CM, Compl.	Used	650
SO-1	Shipboard	10 CM, Compl.	Used	1500
SO-8	Shipboard	10 CM, Compl.	Used	1500
Mark 4	Gunlaying	800MC, Less Ant.	Used	850
Mark 10	Gunlaying	10 CM, Compl.	New	2000
		Less Rack	New	1500
		Less Rack	Used	1100
CPN-3	Beacon	10 CM, Major Units	Used	1200
CPN-6	Beacon	3 CM, Complete	New	Write
CPN-8	Beacon	10 CM, Complete	New	2000
		Less Ant.	New	1400
SCR-533	IFF/AIR Search Tracer	500MC,	New	1200
Airborne Radar Altimeter		500MC, Complete	New	175

200 MC COAXIAL PLUMBING

Right Angle Bend	$35.00
T Section	$55.00
T Section with Adapter to ⅞" in rigid coax	$65.00

MICROWAVE → COMPONENTS

COUPLINGS—UG—CONNECTORS

UG/15U	$ .75	UG 116 Cover & Coupling Ring	$1.95
UG206U	.90	UG 117 Choke	2.50
UG87U	1.25	UG 51 Cover	1.00
UG27U	1.69	UG 52 Choke	1.35
UG21U	.89	UG 210 Cover	1.85
UG167U	2.25	UG 212 Choke	2.40
UG29U	.90	UG 40U Special for Duplexer	.70
UG254U	1.69	⅞ Coax Female Ring Thd or unthd	.50
UG86U	1.40	⅞ Coax Male Fitting thd or unthd	.95
UG342U	3.25	X Band Circ. Choke Flange	.50
UG85U	1.45	X Band Flat Contact Flange Thk	1/8 .25
UG58U	.60	Contact Ring ¼" Thk 1⅛ dia. hole	.25
UG9U	.89	UG 53/U, Cover	$4.00
UG102U	.45	UG 54/U, Choke	4.75
UG103U	.45	UG 55/U, Cover	4.00
UG255U	1.65	UG 56/U, Choke	4.75
UG 40/U Speci. for Mixer Assy.	$ .75	UG 65/U, Contact	6.50
UG 40A	1.10	UG 149/U, Cover	3.00
UG 343 Cover	2.35	UG 148/U, Choke	4.00
UG 344 Choke	3.00	UG 150/U, Contact	3.00
UG 425 Contact	2.00	UG 39/U, Cover	.60
		UG 40/U, Choke	.80

Various other types available.

Write us your needs.

S BAND

90° Twist, circular cover to circular cover	$25.00
Magnetron to Waveguide Coupler with 721A Duplexer Cavity, gold-plated	$45.00
Waveguide Switch—Transposes one input to any of three outputs. Standard 1½" x 3" square flanges. Complete with 115V drive motor. Raytheon CRT24AAS, new	$150.00
721A TR Box complete with tube and tuning plungers	$12.50
McNally Klystron Cavities for 707B or 2K28. Three types available	$4.00
Right Angle Bend 5½ ft. over-all with 8" slotted section	$21.00
Pick-up Dipole in Lucite Ball with Sperry Fitting	$4.50
F-29/SPR-2 Filters, Type "N", Input and output	$12.50
726 Klystron Mount, Tunable output, to type "N", complete, with socket and mounting bracket	$12.50
WAVEGUIDE TO ⅞" RIGID COAX "DOORKNOB" ADAPTER, CHOKE FLANGE. SILVER PLATED BROAD BAND	$32.50
WAVEGUIDE DIRECTIONAL COUPLER, 27 db. Navy type CABV -47AAN, with 4 in. slotted section	$32.50
SQ. FLANGE to rd choke adapter, 18 in. long OA 1½ in. x 3 in. guide, type "N" output and sampling probe	$27.50
Crystal Mixer with tunable output TR pick up loop, Type "N" connections. Type 62ABH	$14.50
Slotted line probe. Probe depth adjustable, Sperry connector, type CPR-14AAO	$9.50
Coaxial slotted section, ⅝" rigid coax with carriage and probe	$25.00
Right Angle Bend 6" radius E or H plain	$27.50
Right Angle Bend 3" radius E or H pain—Circular flanges	$17.50
AN/APR5A 10 cm antenna equipment consisting of two 10 CM waveguide sections, each polarized, 45 degrees	$75.00 per set
PICKUP LOOP, Type "N" Output	$2.75
TR BOX Pick-up Loop	$1.25
POWER SPLITTER: 726 Klystron Input dual "N" output	$5.00
"S" BAND Mixer Assembly, with crystal mount, pick-up loop, tunable output	$3.00
721-A TR CAVITY WITH TUBE. Complete with tuning plungers	$12.50
10 CM OSC. PICKUP LOOP, with male Homedell output	$2.00
10 CM FEEDBACK DIPOLE ANTENNA, in lucite ball, for use with parabola ⅞" Rigid Coax Input	$8.00
PHASE SHIFTER. 10 CM WAVEGUIDE, WE TYPE FS-683816. E PLANE TO H PLANE, MATCHING SLUGS. MARK 4	$95.00
721A TR cavities. Heavy silver plated	$2.00 ea.

⅞" RIGID COAX

Directional coupler, Type "N" take off	$22.50
Magnetron Coupling with TR Loop, gold-plated	$7.50
Flexible Section Male to Female	$4.50
Right angle bend 15" over-all	$3.50
Sperry Rotating Bend, pressurized	$22.50
5 Ft. Lengths Stub Supported, gold-plated, per length	$7.50
Short Right Angle Bends (for above)	$2.50
Rigid Coax to Type "N" Adapters	$18.50
Test Block CU-60/AP	$8.00
CG-54/U—4 foot flexible section ¼" IC pressurized	$15.00
⅞ RIGID COAX. Bead Supported ¼" I. C.	$1.20
SHORT RIGHT ANGLE BEND ¼" I.C.	$2.50
Rotating joint, with deck mounting ¼" I. C.	$15.00

THERMISTORS

D-167332 (tube)	$.95
D-170396 (bead)	$.95
D-67613 (button)	$.95
D-104690 for MTG in "X" band Guide	$2.50
D-167018 (tube)	$.95

WRITE FOR C.E.C. MICROWAVE CATALOG NOW AVAILABLE

VARISTORS

D-170225	$1.25
D-167176	.95
D-168087	.95
D-171842	.95
D-171528	.95
D-168549	.95
D-168442	$3.00
D-163293	$1.25
D-98428	$2.00
D-16187A	$2.85
D-171121	.95
SA (12-43)	$1.50
D-167620	$3.00
D-105598	$2.25

RADAR

Completely New Listings

TEST EQUIPMENT

CG-176/AP Directional coupler X Band, 20 DB nominal, type "N" take off, choke to choke, silver-plated $17.50

X Band 1⅜" x ⅝" absorption type wavemeter, micrometer head, 0000 to 8500 mc. Demornay-Budd #358 ..... $185.00

C Band "T" gold-plated at $97.00

C Band Flap attenuator Demornay-Budd type # 339, gold-plated $100.00

X Band 1⅜" x ⅝" Klystron mount with tunable termination, gold-plated $75.00

X Band 1⅜" x ⅝" low power load, gold-plated $45.00

X Band 1⅛ x ½ waveguide to type "N" adaptor, gold-plated $22.50

X Band 1⅛ x ½ "T" Section, gold-plated $55.00

Dehydrator Unit CPD 10137 Automatic cycling. Compressor to 50 lbs. Compl. for Radar XSMN. Line. New $425.00

H. V. Pwr. Supply 15,000 V 30 MA. DC Bridge Rect. Pwr. Sply. Oper. FM. 115 V 60 cy $115.00

SO-3 RECEIVER—30 mc. IF, 6 stages 6AC7, 10 mc. Band width inpt. 5.1 mc B.W. per stg., 9.6 volt gain per stage as desc. in ch. 13 vol. 23 M.I.T. Rad. Lab. Series $99.50

APS-2 10CM RF HEAD COMPLETE WITH HARD TUBE (715B) Pulser, 714 Magntron 417A Mixer all ⅞" rigid coax, Incl. rcvr. front end $210.00

DE MORNAY BUDD — ALL FORMER STOCK AVAILABLE Through COMMUNICATION EQUIPMENT CO.

MODEL TS-268/U

Test set designed to provide a means of rapid checking of crystal diodes IN21, IN21A, IN21B, IN23, IN23A, IN23B. Operates on 1-1½ volt dry cell battery. 3 x 6 x 7, New $35.00

3 cm. wavemeter, Ordnance type micrometer head new: Absorption type $85.00

9000-9500 MCS Transmission type $92.50

SL wavemeter, Type CW60ABM $125.00

10CM ECHO BOX CABV 14ABA-1 of OBU-3, 2890 MC to 3170 MCS direct reading micrometer head. Ring prediction scale plus 9% to minus 9%. Type "N" input. Resonance Indicator meter. New and Comp. w/access. Box and 10CM Directional Coupler $350.00

10 cm horn assembly consisting of two 5" dishes with dipoles feeding single type "N" output. Includes UG28/U type "N" "T" junction and type "N" pickup probe. Mfg. cable. New $15.50

10 cm. cavity type wavemeters 6" deep, 6½" in diameter. Coax. output. Silver plated ..... $64.50 ea.

10 cm. echo box. Part of SFI Radar W/115 volt DC tuning motor Sub Sig 1118AO $47.50

THERMISTER BRIDGE: Power meter 1-203-A. 10 cm. mfg. W.E. Complete with meter, Interpolation chart, portable carrying case $72.50

W.E. 1138. Signal generator, 2700 to 2900 Mc. range. Lighthouse tube oscillator with attenuator & output meter. 115 VAC input reg. Pwr. supply. With circuit diagram $150.00

TS 89/AP Voltage Divider. Ranges 100: ½ for 2000 to 2000v. 10:1 for 200 to 2000v. Input Z 2000 ohms. Output Z 4 meg ohms flat response 150 cy to 5 meg cy $42.50

AS14A/AP—10 cm Pick up Dipole with "N" Cables $4.50

TS 235 UP Dummy Load $87.50

10 cm Wavemeter. WE type B 435490 Transmission type. Type N Fittings. Veeder Root Micrometer dial, Gold Plated W/Calib. Chart P/o Freq. Meter X66404A. New $99.50

K BAND

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
Directional coupler CU-103/APS 32	$49.50
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
Adaptor, round to square cover	$5.00
Feedback to Parabola Horn with pressurized window	$27.50
Low Power Load, less cards	$18.50
K Band Mixer Block	$45.00
Waveguide ½ x ¼"	$1.00 per ft.
Circular Flanges	$ .50
Flange Coupling Nuts	$ .50
Slotted line, Demornay-Budd #397, new	$450.00
90° Twist	$10.00
"K" Band Directional Coupler CU104/APS-34 20 DB	$49.50 ea.

All merch. guar. Mail orders promptly filled. All prices F.O.B. N. Y. C. Send MO or Chk. Only shipping chges sent C.O.D. Rated Concerns send P.O.

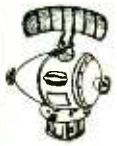
COMMUNICATIONS EQUIPMENT CO.

131 Liberty St., New York, N. Y. **Dept. E-5** P. J. PLISHNER **Phone: Digby 9-4124**

COMMUNICATIONS EQUIPMENT COMPANY

MICROWAVE ANT — RF EQUIPMENT

MICROWAVE ANTENNAS



AN-122 Dipole Assy.....$22.50
LP-21-A ADF Loop W-Selsyn and Housing. New.....$8.00
DAK Bellino Tossi DF Loops..$125.00
Adcock DF Arrays. Complete..$65.00
SA Radar 200 Mc Bed Springs, Complete with Pedastec, Less Drive.....$600.00
APS-15 Antennas. New.....$99.50
AN MPG-1 Antenna. Rotary feed type high speed scanner antenna assembly, including horn parabolic reflector. Less internal mechanisms. 10 deg. sector scan. Approx. 12'L x 4'W x 3'H. Unused. (Gov't Cost—$4500.00).....$250.00
APS-4 3 cm. antenna. Complete. 14½ dish. Cutler feed dipole directional coupler, all standard 1" x ½" waveguide. Drive motor and gear mechanisms for horizontal and vertical scan. New, complete..$65.00
AN/TPS3. Parabolic dish type reflector approx. 10' diam. Extremely lightweight construction. New in 3 carrying cases.....$89.50
RELAY SYSTEM PARABOLIC REFLECTORS: approx. range: 2000 to 6000 mc. Dimensions: 4' x 3' rectangle, now.....$35.00
TDY "JAM" RADAR ROTATING ANTENNA. 10 cm. 30 deg. beam. 115 v.a.c. drive. New.....$100.00
DBM ANTENNA. Dual, back-to-back parabolas with dipoles. Freq. coverage 1,000-4,500 mc. No drive mechanism.....$65.00
AS125/APR Cone type receiving antenna. 1080 to 3208 megacycles. New.....$4.50
140-600 MC. CONE type antenna, complete with 25 sectional steel mast, guys, cables, carrying case, etc. New.....$49.50
ASD 3 cm. antenna, used, ex. cond.....$49.50
YAGI ANTENNA AS-46A. APG-4, 5 elements..$14.50
Dish for Parabola 30".....$4.85
AS17/APS 10 CM Antenna, APS-2 30 Inch Dish with ⅞ Coax Dipole and fittings. New and Compl, with 24 V DC Drive motor, selsyn. 360 Deg. Rotation and Vertical Tilt.....$94.50
RC-224 Antenna, 10 CM, 30" Dish P/O. SCR-717 Radar, New and Complete.....$94.50

R. F. EQUIPMENT

LHTR. LIGHTHOUSE ASSEMBLY. Part of RT-39/APG 5 & APG 15. Receiver and Trans Cavities w/ assoc. Tr. Cavity and Type N CPLG. To Revr. Uses 2040, 2C43, 1B27, Tunable APX 2400-2700 MCS. Silver plated.....$49.50
APS-2 10CM RF HEAD COMPLETE WITH HARD TUBE (715B) Pulser. 714 Magnetron 417A Mixer all ⅞" rigid coax. incl. revr. front end.....$210.00
Beacon lighthouse cavity 10 cm with miniature 28 volt DC FM motor. Mfg. Bernard Rice.....$47.50 ea.
T-128-/APN-19 10 cm. radar Beacon transmitter package. Used, less tubes.....$59.50 ea.
Pre-Amplifier cavities type "M" 7410590GL, to use 446A lighthouse tube. Completely tunable. Heavy silver plated construction.....$37.50 ea.
RT/32APS 6A RF HEAD. Compl. with 725A Magnetron magnet pulse xfmr. TRA-ATR 723 A/B local osc. and beacon mount, pre amplifier. Used but Good cond.....$97.50
AN/APS-15A "X" Band compl. RF head and mod. incl. 725-A mag and magnet, two 723A/B klystrons (local osc. & beacon) 1B24, TR, revr and ampl. duplexer. HV supply blower, pulse xfmr. Peak Pwr. Out: 45 KW apx. input: 115, 400 cy. Modulator pulse duration .5-2 microsec., apx. 13KV. PK. Pulse, with all tubes incl. 715B, 829B, BKR 73, two 72's. Complete pkg.....$350.00
S BAND AN/APS2. Complete RF head and modulator, including magnetron and magnet, 417A mixer, TR receiver duplexer, blower, etc., and complete pulser. With tubes, used, fair condition.....$75.00
ASB-500 Megacycles Radar Receiver with two GI 446 lighthouse cavities, new less tubes.....$37.50
10 CM Rec Assy. Less Local OSC. Tube. Consists of mixer stabilizer cavity 30 MC preamp AFC. Inc. Amp. plugs & cables p/o APS2.....$37.50
#SCR-520 RF Head Compl. with Hard Tube Pulser c/o 2 Aluminum Drums MTD.
In Tandem. Compl. W/Tubes.....$350.00
Mark 4 Radar Console (FD) Compl "L" Band RF Pkg. c/o Magnetron CSC, Pulser, Revr. H.V. Power Supply. Complete.....$850.00
115 V. 60 cy. operation.

INDICATORS—SCOPES

BC 9318 420-50-100 mile range 5" scope w/mtg. rack, indicator amplifier, BC 932B, visor, New w/ tubes.....$24.50
BC 704A 9-36-90 mile range 5" scope.....$17.50
BC 937A & BC 938A 12" PPI & "A" scope. Complete desk Rack assy w/osc. control unit, rec., pwr. supls. in unused cond. but shelf worn.....$300.00
Radar indicator RW #81 mfg. by Research Enterprise Ltd. 5" scope.....$30.00

PRECISION CAPACITORS

D-163707: 0.4 mfd @ 1500-vdc. —50 to plus 85 deg C.....$4.50
D-163035: 0.1 mfd @ 600 vdc, 0 to plus 65 deg C $2.00
D-170808: 0.152 mfd, 300 v, 400 cy, —50 to plus 85 deg C.....$2.50
D-154960: 2.04 mfd @ 200 vdc, 0 to plus 55 deg C $2.50
D-158344: 2.16 mfd @ 200 vdc, 0 to plus 55 deg C $3.00
D-151555: .5 mfd @ 400 vdc, —50 to plus 85 deg C.....$3.00
D-161270: 1 mfd @ 200 vdc, temp comp —40 to plus 65 deg C.....$12.50

30 US ARMY SIGNAL CORPS RADIO MASTS

Complete set for erection of a full flat top antenna. Of rugged plymold construction telescoping into 3 ten-foot sections for easy stowage and transportation. A perfect set-up for getting out. Supplied complete: 2 complete masts, hardware, shipping crate. Shipping wt. approx. 300 lbs. Sig Corps #2A289-233-A. New.....$39.50 per set

YD-2 MARKER BEACON EQUIP. Compl. Installation in Trailer w/Gas Generator—WRITE.

MAGNETRONS

Ask for Qty. Price

Tube	Frq. Range	Pk. Pwr. Output	Price
2J27	2965-2992 mc.	275 KW.	$8.50
2J31	2820-2860 mc.	265 KW.	$25.00
2J21 A	9345-9405 mc.	50 KW.	$25.00
2J22	3267-3333 mc.	265 KW.	$25.00
2J26	2992-3019 mc.	275 KW.	$25.00
2J27	2965-2992 mc.	275 KW.	$8.50
2J32	2780-2820 mc.	285 KW.	$25.00
2J37			$45.00
2J38 Pkg.	3249-3263 mc.	5 KW.	$35.00
2J39 Pkg.	3267-3333 mc.	87 KW.	$35.00
2J40	9305-9325 mc.	10 KW.	$65.00
2J49	9000-9160 mc.	58 KW.	$85.00
2J34			$55.00
2J61	3000-3100 mc.	35 KW.	$65.00
2J62	2914-3010 mc.	35 KW.	$65.00
3J31	24,000 mc.	50 KW.	$55.00
5J30			$39.50
714AY			$25.00
718DY	2720-2890 mc.	250 KW.	$25.00
720BY	2800 mc.	1000 KW.	$50.00
720CY	2860 mc.	1000 KW.	$50.00
725-A	9345-9405 mc.	50 KW	$25.00
730-A	9345-9405 mc.	50 KW.	$25.00
728 AY, BY, CY, DY, EY, FY, GY			$50.00
700 A, B, C, D			$50.00
706 AY, BY, DY, EY, FY, GY			$50.00
Klystrons. 723A/B $12.50; 707B W/Cavity			$20.00
417A $25.00	2K41		$65.00

MAGNETRON MAGNETS

Gauss	Pole Diam.	Spacing	Price
4850	¾ in.	⅝ in.	$12.50
5200	¾ in.	⅝ in.	$17.50
1300	1⅝ in.	1⅛ in.	$12.50
1860	1⅝ in.	1½ in.	$14.50

Electromagnets for magnetrons.....$24.50 ea.
GE Magnets type M7765115, GI Distance Between pole faces variable. 2 1/16"(1900 Gauss) to 1½"(2200 Gauss) Pole Dia. 1⅝" Now Part of SCR 584.....$34.50

"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 $65.00
QK 915 Raytheon.....$150.00

FILAMENT TRANSFORMER

for above 115V/60 cy Pri; four 6.3V/4A Sec. 50000VT.....$27.50
Magnetron Kit of four QK's 2675-3375 inc. w/transformer.....$250.00

PULSE EQUIPMENT

MIT MOD. 3 HARD TUBE PULSER: Output Pulse Power 144 KW (12 KV at 12 Amp). Duty Ratio: 001 max. pulse duration: 5, 1.0, 2.0 microsec. Input voltage: 115v. 400 to 2400 cps. Uses 1-715B, 4-829-B, 3-'72's, 1-'73. New w/Tubes.....$110.00
APQ-13 PULSE MODULATION. 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
APS-10 Low voltage power supply less tubes....$18.50
BC 1283B Loran pulse modulator.....$125.00
BC 758A Pulse modulator.....$395.00
725A magnetron pulse transformers.....$18.50 ea.

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 ¼ microsec. @ 600 PPS.....$39.50
W.E. #D166173 Hi-Volt Input transformer, W.E. Impedance ratio 50 ohms to 900 ohms. Freq range: 10 kc to 2 mc. 2 sections paralled 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
G.E. #K2731 Repetition Rate: 635 PPS. Pri. Imp: 50 Ohms Sec. Imp: 450 Ohms. Pulse Width: 1 Microsec. Pri. Input: 9.5 KV PK. Sec. Output: 28 KV PK. Peak Output: 800 KW. Riflar 2.75 Amp.....$64.50
W.E. #D169271 Hi Volt input pulse Transformer.$27.50
G.E. K2450A. Will receive 13KV. 4 micro-second pulse on pri., secondary delivers 14KV. Peak power out 100KW G.E.....$34.50
G.E. #K2748A. Pulse Input, line to magnetron..$36.00
#9262 Utah Pulse or Blocking Oscillator XFMR Freq. limits 790-810 cy-3 windings turns ratio 1:1:1 Dimensions 1 13/16 x 1⅛" 19/32.....$1.50
Pulse 131-AWP L-421435.....$6.00
Pulse 134-BW-2F L-440895.....$2.25
RAY—WX4298F.....$39.50
G.E.—K6824730.....$50.00
G.E.—K9216945.....$50.00

PULSE NETWORKS

15A—1-400-50: 15 KV, "A" CKT, 1 microsec., 400 PPS, 50 ohms inp.....$42.50
G.E. #6E3-5-2000-50P2T, 6KV, "E" circuit, 3 sections, .5 microsecond, 2000 PPS, 50 ohms Impedance.....$6.50
G.E. #3E (3-84-810: 8-2-24-405) 50P4T; 3KV, "E" CKT Dual Unit: Unit 1, 3 Sections. .84 Microsec. 810 PPS, 50 ohms imp.: Unit 2, 8 Sections, 2.24 microsec. 405 PPS, 50 ohms imp.....$6.50
7.5E3-1-200-67P 7.5 KV, "E" Circuit, 1 microsec. 200 PPS, 67 ohms impedance, 3 sections.....$7.50
7.5E4-16-60.67P, 7.5 KV, "E" circuit, 4 sections, 16 microsec. 60 PPS, 67 ohms impedance.....$15.00
7.5E3-3-200-6PT. 7.5 KV, "E" Circuit, 3 microsec. 200 PPS, 67 ohms imp., 3 sections.....$12.50

DELAY LINES

D-163169 Delay Line Small quantity available...$50.00
D-168184: .5 microsec. up to 2000 PPS, 1800 ohm term.....$4.00
D-170499: .25/.50/.75. microsec. 8 KV. 50 ohms Imp.....$16.50
D-165997: 1¼ microsec.....$7.50

SONAR

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, nickle diaphragm plate, milled steel body unassembled.....65.00
Supersonic Oscillator RCA 17-27 Kc. Rec. Driver Csc. 116 v 60 cy. AC. Designed for use w/200 watt driver. 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
QCQ 2 Console Sub. Sig. Co.....$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/QJA adaptor kits w/cathode ray tube indication. Write
QCQ-2 Sonar Compl. Less Hoist—Write

I.F.F. 1 KW Pulsed Output Pkg. Tunable 154-186 mc. adj. modulating pulses 4-10 micro sec. comp. 115v 60cy ac pwr. supply.
Video output receiver. New w/tubes.....$350.00
Wavemeter for above.....$75.00
Dipole Array for above.....$85.00
BC 800 XMTR. RCVR. Unit New.....$55.00
BC 929 Indicator New.....$35.00

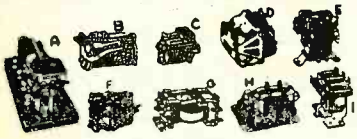
PULSE EQUIPMENT

All merch. guar. Mail orders promptly filled. All prices, F.O.B. N.Y.C. Send M.O. or Chk. Only shipping chgs. sent C.O.D. Rated Concerns send P.O.

COMMUNICATIONS EQUIPMENT CO.

131 Liberty St., New York, N. Y. Dept. E-5 P. J. PLISHNER **Phone: Digby 9-4124**

COMMUNICATIONS EQUIPMENT COMPANY



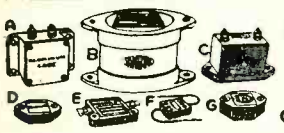
RELAYS

Contacts	Rating	Coil Ohms	Mfg.	Price
DPDT (SA)	24-28V vdc	170	GECR2791B 100F3	75¢
SPDT	28vdc	175	GECR2791B	75¢
3PDT	24-28vdc	175	GECR2791B	75¢
4PST	24vdc	180	GECR2791G	75¢
DPDT, 8PST	12 vdc	44	Leach 1067-490	1.25
DPDT	22-28 vdc	160	Leach	1.25
SPST	28 vdc	250	Allied BO48	.75
DPST	14 vdc	85	Price X20-A	.65
3PDT	24-28 vdc	280	Allied DOX-3	1.50
SPST	24-28 vdc	2400	GM 12917–1	75¢
DPDT	24vdc	280	Allied BO635	1.00
3PDT (10A)	26vdc	280	Allied KS 5910	1.10
DPDT	28 vdc	280	Allied BO 6D35	1.00
SPST (NC)	75MA	60	Allied KS 5863	.85
DPDT	20-30 vdc		Ounce 50XB	1.00
DPDT	10-14 vdc	Ounce	100AB	1.00
DPDT	24-28 vdc		PB21C057-A	1.00
3DPT	24-28 vdc		GECR2791	1.50
SPDT	24-28 vdc		GECR2791	1.00
DPDT	12 vdc		Ounce	1.49
SPDT	10–12v	125	Ounce	1.49
DPDT	27 5 vdc	400	Allied	1.10
DPDT	9–14 vdc		Allied	1.10
DPDT	24v60cy	50	Allied	1.40

MANY OTHERS—WRITE YOUR NEEDS

ARC 3 MINIATURE RELAYS

Can	SPDT	5 Prong.	GECR2791C104	1.95
SPDT, 6PST	28 vdc	300	RBM55342	35¢
	22–28 vdc	300	RBM5528	35¢
SPST	22–28 vdc	300	RPM55251	35¢
DPDT, DPST	22–28 vdc	300	RBM55531	35¢
SPDT,	22–28 vdc	300	RBM55526	35¢



H. V. MICAS
SEND FOR LISTS OF OTHERS

Fig.	Mfd.	Voltage	Price	2 For
D	.01	1200WVDC	$0.50	$0.95
E	.00025	2500TVDC	.29	.55
D	.00004	2500WVDC	.39	.75
E	.000047	2500WVDC	.39	.75
E	.01	500WVDC	.25	.45
C	.002	3000WVDC	1.05	2.00
C	.01	2000WVDC	1.50	2.90
C	.00003	2000WVDC	.49	.95
C	.00009	3000WVDC	.75	1.45
C	.00082	3000WVDC	1.00	1.95
C	.002	3000WVDC	1.00	1.05
C	.005	5000WVDC	1.65	3.25
C	.0004	6000WVDC	1.50	2.95
C	.0006	3000WVDC	1.00	1.95
C	.0008	3000WVDC	.95	1.85
E	.0016	3000WVDC	.65	1.25
E	.000090	3000WVDC	.40	.75
B	.08	1500VDC	10.00	19.00
B	.03	2000VDC	12.00	23.00
B	.045	2000VDC	12.00	23.00
B	.00015	20000VDC	24.00	47.00
B	.0001	20000VDC	24.00	47.00
B	.0012	20000VDC	24.00	47.00
C	.006	2500VDC	1.45	2.85
E	.00027	2500WVDC	.35	.63

LAMPS

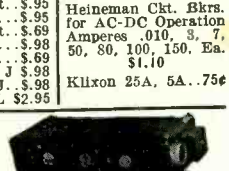
Tung Sol #1488 14v 10.....60¢
Mazda #623 24-28v 10.....60¢
Tung Sol #1251 24-28v 10..60¢
G.E. #LM37 13v 10.....60¢
Mazda 10w 60v Red.....10¢ ea.
Tung Sol 6CP-81, 6-8v ..15¢ ea.

WIRE WOUND POTS

20,000 ohms, 10%, 8 watt..$.95
5,000 ohms, 10%, 8 watt...$.95
15,000 ohms, 10%, 4 watt..$.69
Dual 250 ohms, 25 watt...$.98
50 ohms, 25 watt.....$.69
1000 ohms, 50 watt, mod J $.98
300 ohms, 50 watt mod J..$.98
5 ohms, 250 watt, mod L $2.95

Heineman Ckt. Bkrs. for AC-DC Operation Amperes .010, 3, 7, 50, 80, 100, 150. Ea. $1.10
Klixon 25A, 5A..75¢

INVERTERS



PE 218-E: Input: 25 28 vdc. 92 amp. Output: 115 v, 350-500 cy 1500 volt-amperes. Dim: 17"x6½"x10" $29.50
New (as shown)
PE 218-H: Same as above except size: 16½" x 6" x 10". New.....$29.50
PE 218H, used, good cond.....$22.00
PE 203: Input: 28 vdc, 38 amps. Output: 80 v, 300 cy, 500 volt-amps. Dim: 13" x 5½" x 10½". New.....$12.50
GE 5021NJ3A: Input: 28 vdc, 35 amp. Output: 115 v, 400 cy, 485 volt-amps. Dim: 9" x 1½" diam. New.....$49.95

STAND OFFS

w/alum base 1 1/4x8"	$1.25
w/alum base 1"x6"	98¢
w/alum base 1 1/4x5/	98¢
w/alum base 1x4"	70¢
w/alum base 1 3/4x3 3/8	1.69
w/alum base 1 5/8x3"	1.00
IN84 xS1, 2 1/4"	10¢
IN81 feed support 1 1/2"	8¢
IN82 feed support 3"	16¢
Stand off 3"x1"d	26¢
Stand off 6 3/4x1"d	40¢
Spreader 2 1/8x5/8 Sq	8¢
Spreader 2 11/16x7/16"d	10¢
Thru panel 1 1/4x3/4d	15¢
Bowl thru x53, 6 3/4x3"d	1.10
Antenna IN86	15¢

RF CHOKES

1Mhy/125MA	.23
1.9-2Mchy	.10
2.5Mhy/500Ma	.89
3.2Mchy	.10
3.3Mchy	.10
3.6Mchy	.10
5.2Mhy/200Ma	.39
5.5Mhy/500MA	.98
6.4Mchy	.10
10Mhy/350Ma	.39
20Mchy	.10
94Mhy	.10
100Mchy	.10
115Mhy/150Ma.	.39
185Mchy	.10
220Mchy	.18

Ceramicons

Mmt	
1	25
3	27
3.1	35
4	30
5	47
6	50
7	57
8.5	58
11	60
15	62
20	67
24	70
79	220
115	240
125	250
150	350
180	1000
200	Feed Thru
Button	
40 100	50
180 200	500
175 500	470
185	

COAX CABLE

RG 8/U. 52 ohm.....
RG 9/U. 52 ohms.....$.25/Ft.
RG 57/U. Twin Cond. 95 ohms $.55/Ft.
RG 23/U. twin coax. 125 ohm imp. armored .....$.50/Ft.
RG 28/U. 50 ohm imp. pulse cable Corona min. starting voltage 17 KV $.50/Ft.
RG 35/U. 70 ohm imp. armored $.50/Ft.
Many other Cables & Wire in stock. Write.

MAE WEST XMTTR

New w/wire tubes etc.....$3.49 ea.

733 Localizer Receiver $6.95

ARC/5 Equip Avail. Write for list of Parts and Equip.

SCR 522 VHF Xmtr Rcvr. 100-156 MC w/tubes $34.95

KS 9496—H1.F.. 60-15000 CPS 250 Watt Audio 9000 ohm PPT 9 ohm V. C. $10.95

Birtcher Tube Clamps

926C	
926-16	
926-B1	
926-B2	
926-B8	
926-C15	
926-C-13	926-B31
926B	926C-23
926-C-19	929-1
926B-16	926B-10
926A-14	926B-18
926A	926-K2
926C1	10 $1.40
926A11	100 $12.00
Each 15¢	

MOUNTINGS

MT-5/ARR2	FT-225A
MT-7/ARR2	FT-229A
MT-171A/U	FT-232A
FT-265A	FT-234A
FT-340	MT-85/ARC5
MT-167/U	MT-78/ARC5
FT-308A	MT-62/ARC5
FT-282A	
MT-80/ARC5	
FT-141	

VIBRATORS

TR 1210, 12 vdc, 5 pin $1.00
OAK V-6675. 24-32 vdc, 7 pin $1.00
Mal. Type G534C, 12 vdc, 5 pin $1.00
Mal. Type G629-C, 12 vdc, 4 pin $1.00
Mfrs. quantities in all types available.

WHOLESALE ONLY

Phone or Write for Quantity & Price
Digby 9-4124
ATT. MR. C. ROSEN

1,000,000 Bathtubs
4,000,000 Micas
300,000 Sil. Micas
100,000 Oil Cond.
4,000,000 Resistors
400,000 Electrolytics
400,000 H. V. Micas
5,000 K. V. Cond.
150,000 Prec. Resis.
500,000 Tube Clamps
1,000,000 An. Connectors
50,000 Dynamotors
20,000 Power Xfrmrs
20,000 Chokes
100,000 Antennas
50,000 Audio Xfrmrs
100,000 400 Cy Xfrmrs
100,000 Shock Mts.
25,000 Magnetrons
5,000 Magnets
50,000 Pulse Xfrmrs
50,000 Control Boxes
500,000 Tubes
300,000 Relays
500,000 Pots
35,000 Vibrators
200,000 UG Connectors
2,000 Scopes
1,500 Asst. Phones
20,000 Headsets
5,000 Mikes
100,000 Elements
Tons of Nuts & Bolts Screws, Etc.
1,000 Gibson Girls
500 BC 375 Complete
500,000 Insulators
150,000 Binding Posts
200,000 Wafer Switches
300,000 Ceramicons
500,000 Ferrule Resis.
50,000 PL 54
25,000 JK 26

R 5 / ARN7

Receiver w/ Tubes New $39.50
Control Box $3.95

AUDIO

UTC OUNCER PL to MULTI grids, 10K to 2-125K ohms Sec...$1.49
OUNCER PL TO LINE, Pri. 7K to 250 ohms Sec. Price .....49¢
PL to V.C., 7500 to 3½ ohms Sec. .....79¢
OUNCER PL TO H.S. or Line 10K to 4K ohms. Tapped at 250 ohms .....69¢
PL to HS, 14,200 ohms to 8000 ohms .....98¢
LINE TO GRID, 600 to 50K ohms. Price..$1.10
PL TO LINE, 8K to 250 ohms. Price $1.00
MIKE OR LINE TO GRID, 100 to 50K ohms. Tapped at 100 ohms. Price $1.39
U.T.C. 1:1 RATIO 50K ohms, 3db±1db. 50 to 8000 cy Ouncer'....98c
MANY OTHERS

Pioneer Autosyns AY 6H 26 VDC 400 cy 70 deg. .....$5.50 ea.

GE Motor DC 24 VDC 9 RPM 5BA25AJ32B ..$3.95

Yagi Switch encl in Jnct. Box 24 VDC for BC 929 Scope w/Toggle Sw. 6 Plugs, Shock Mts 5¾ x 5¾ x 7½..$3.95

WRITE YOUR MOTOR REQUIREMENTS

T.V. Transformer, 7" or 9" scope, 3000 v/5MA, 720vct /200MA, 6.4 / 8.7A, 6.4/6A, 5/3A, 1.25/3A, 115 V 60 cy input. Price $3.95

EE65E Telephone Test Set

To locate any kind of trouble on Tel lines; can be used as telephone. Includes ringing circuit etc. A valuable unit $18.95

EE89A Telephone Repeater

Used to extend range of field telephones. Simplex Teleg. and 20 cycle ringing possible over lines equipped with unit. Supplied w/3Q5 tube. Phone supplied (Featherweight ..$9.75

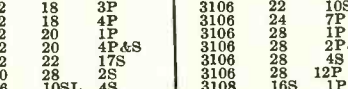
Loading Coil C114

Same as WE No. 632 but in waterproof case to counter balance cap. in line gives clearer signal. Army used W/ W150 & W130 wire 85¢ ea.

TIME DELAY RELAY VACUUM 45 Sec. 117v 60 cy Metal Tube 4 Prong. Edison. Price $1.95

GE Relay Herm. Sealed CR2791 5 prong 5 Amp. Cont. SPDT $1.25

2 KVA: 90 130v input 50-60 cycles, output 115v 2 kva type RH Amertran $7.95



CONNECTORS 80% OFF LIST

3102	14S	2P&S	3106	18	4S
3102	16S	3P	3106	18	11S
3102	18	1S	3106	18	1S
3102	18	3P	3106	22	10S
3102	18	4P	3106	24	7P
3102	20	1P	3106	28	1P
3102	20	4P&S	3106	28	2P&S
3102	22	17S	3106	28	4S
3100	28	2S	3106	28	12P
3106	10SL	4S	3108	16S	1P
3106	12	5S	3108	16S	4P
3106	14S	2P&S	3108	20	7S
3106	14S	5P&S	3108	20	11S
3106	18	5S	3108	20	17P
3106	14S	6S	3108	22	6P
3106	12S	3P	3108	22	8S

500,000 DIFFERENT TYPES IN STOCK

BATHTUB CAPACITORS

Fig.	Mfd.	Voltage	Terminal	Price
D	3 x .1	600VDC	3	33¢
E	3 x .1	400VDC	3	33¢
C	.1	400VDC	2	20¢
C	2 x .1	600VDC	3	29¢
E	.025	600VDC	2	18¢
A	.2	400VDC	2	40¢
C	.1	600VDC	2	25¢
E	2 x .25	600VDC	3	29¢
A	.5	1000VDC	2	45¢
D	.1	600VDC	2	25¢
E	3 x .1	600VDC	3	35¢
E	.5	200VDC	2	20¢
C	.05	600VDC	2	21¢
C	.5	600VDC	2	25¢
C	.5	120VDC	2	18¢
C	.1	600VDC	1	20¢
E	.4	50VDC	2	25¢
E	.1	400VDC	1	25¢
D	.1	600VDC	2	30¢
C	3 x .1	600VDC	3	33¢
E	2 x .25	400VDC	3	27¢
D	.5	600VDC	2	25¢
D	2 x .1	600VDC	3	29¢
D	.5	600VDC	1	20¢
E	2 x .1	200VDC	2	20¢
C	.5	400VDC	1	20¢
	.1	100VDC	2	15¢
A	.02	1500VDC	2	45¢
C	.5	600VDC	2	25¢
C	.5	200VDC	2	20¢
E	20	50VDC	2	25¢

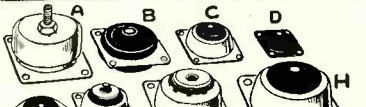
UPRIGHT OIL CAPACITORS
STANDARD BRANDS

Fig.	Mfd.	Voltage	Terminals	Price
B	1	600VDC	2	35¢
E	.25	400VDC	2	39¢
E	.5	600VDC	2	35¢
B	1	600VDC	2	39¢
D	2 x .5	600VDC	3	49¢
B	3 x .1	600VDC	3	55¢
B	.25	400VDC	2	39¢
D	.5	600VDC	2	35¢
B	.5	600VDC	2	35¢
E	1	400VDC	2	35¢
B	.1	400VDC	2	40¢
B	.4	600VDC	2	39¢
D	.1	600VDC	2	45¢
B	2 x .1	600VDC	2	50¢
E	1.75	400VDC	2	35¢
D	3 x .1	600VDC	3	55¢
A	2 x .5	600VDC	3	49¢
B	.1	600VDC	2	45¢
B	.1	600VDC	2	45¢
D	.1	500VDC	2	45¢
A	.1	500VDC	2	45¢
B	.1	600VDC	2	45¢

OIL FILLED CONDENSERS

.1—.1	MFD	7000 VDC	$3.27, 2 for $6.50
.1	MFD	6000 VDC	2.60, 2 for 5.00
.5	MFD	1000 VDC	57c, 2 for 1.05
—.5	MFD	2000 VDC	$1.15, 2 for 2.25
2x.5	MFD	1000 VDC	95c, 2 for 1.80
1	MFD	1500 VDC	95c, 2 for 1.80
2	MFD	1000 VDC	67c, 2 for 1.30
4	MFD	1000 VDC	87c, 2 for 1.70
6	MFD	600 VDC	65c, 2 for 1.25
7	MFD	800 VDC	95c, 2 for 1.80
10	MFD	1000 VDC	$1.75, 2 for 2.50
15	MFD	1000 VDC	$2.25, 2 for 4.50

WRITE FOR LIST OF MANY OTHERS INCL. HIGH VOLTAGE



SHOCK MOUNTS

D	Lord	#1	1 1/4x1 1/4x3/8H 10¢
D	Lord	#6	1 1/4x1 1/4x3/8H 10¢
D	Lord	#5	1 1/4x1 1/4x3/8H 10¢
B	Lord	#15	1 3/4x1 3/4x5/8H 15¢
B	Lord	#12	1 3/4x1 3/4x9/16H 15¢
B	Lord	#35	2 1/4x2 1/4x1"H 18¢
G	U. S.	#5150-C	2 3/8x2 3/8x1 1/8H 55¢
F	Lord	#4	1 23/32x1 23/32x1"H 35¢
C	Lord	#1	1 11/16x1 11/16x3/4"H 14¢
C	Lord	#10	2 3/8x2 3/8x1 1/16H 25¢
C	Lord	#8	2 3/8x2 3/8x1 1/16H 20¢
H	Lord	#35	3x3x1 1/2H 45¢
H	Lord	#20	3x3x1 5x8H 39¢
H	Lord	#25	3x3x1 5/8H 45¢
H	Henrite	#55	3x3x1 5x8H 49¢
H	Lord	#15	3x3x1 1/2H 35¢
H	Lord	#45	3x3x1 1/2H 49¢
A	Barry	#C2070	3x3x1 1/2H 55¢
A	Barry	#C2060	3x3x1 1/2H 55¢
A	Barry	#C2090H	3"x3"x1 1/2H 55¢

Shaft 6 1/8"Lx3/8" Dia. Thread both sides with nuts, washer, and two woven leads.....ea. 35¢
WRITE FOR TYPES NEEDED

All merch. guar. Mail orders promptly filled. All prices F.O.B. N. Y. C. Send M.O. or Chk. Only shipping chgs. sent C.O.D. Rated Concerns send P.O.

COMMUNICATIONS EQUIPMENT CO.

131 Liberty St., New York, N. Y. Dept. E-5 MR. CHAS. ROSEN **Phone: Digby 9-4124**

AIRCRAFT METERS

ALL AIRCRAFT METERS listed are 2½" Square flush type, 4 hole mounting with Black Scales unless noted otherwise.

0-30 Volt D.C. General Electric.....@ $4.50
0-30 Volt D.C. Westinghouse AX-33.....@ $4.50
0-30 Volt D.C. Triplett M102, 3½" R-M with an adjustable extra pointer to show range to be maintained A.C. Type B-1.....@ $4.00
40 Volt A.C. Weston 517, 2½" R-M, 3 hole mounting calibrated for 400 cycles.....@ $3.50
40 Volt A.C. Westinghouse NA-33, 2½" R-M, 3 hole mounting calibrated for 400 cycles.....@ $3.50
40 Volt A.C. Westinghouse NA-33, 2½" R-M, 3 hole mounting adjusted for operation on 60 cycles @ $3.95
0-30 Amp D.C. Westinghouse AX-33 (USNC-30) with internal shunt.....@ $5.00
30-0-30 Amp D.C. Weston 606, with internal shunt.....@ $5.00
20-0-100 Amp D.C. Hickok, 2½" R, 3 hole mounting, with external shunt.....@ $5.50
0-120 Amp D.C. Westinghouse AX-33, with external shunt.....@ $5.50
120-0-120 Amp D.C. Westinghouse AX-33 with external shunt.....@ $5.50
0-240 Amp D.C. Sutton-Harsley (British) with external shunt.....@ $5.50
0-240 Amp D.C. Westinghouse AX-33 with external shunt.....@ $6.50
240-0-240 Amp D.C. General Electric with external shunt.....@ $6.50
0-300 Amp D.C. Westinghouse, E-1, 3½" R-M, with external shunt.....@ $7.50
0-480 Amp D.C. Westinghouse AX-33 with external shunt.....@ $8.50
30 Volt 60 Amp D.C. General Electric, AN connector type, with connector, with external shunt, push button for volts.....@ $5.50
30 Volt 120 Amp D.C. Westinghouse AX-33 with external shunt, push button for volts.....@ $6.00
30 Volt 120 Amp D.C. General Electric, AN connector type, with connector, with external shunt, push button for volts.....@ $6.00
30 Volt, 240 Amp D.C. Westinghouse AX-33 with external shunt, push button for volts.....@ $7.50

A.C. VOLTMETERS

15 Volts General Electric AO-22, 3½" R-B, black scale, MR35B015ACVV.....@ $3.00
15 Volt, Weston 476, 3½" R-B.....@ $4.50
15 Volt, Westinghouse NA-35 3½" R-B, MR35015 ACVV.....@ $3.95
15 Volts, AC-DC, General Electric AW-41, 2½" R-B, black scale, Signal Corps IS-122...@ $2.50
15 Volts AC-DC, General Electric AW-41, 2½" R-B, black case, with markings and calibration at 0, 10, & 15 only, Signal Corps IS-122....@ $2.00
15 Volt General Electric AW-41, 2½" R-B, black scale, red mark at 10 volt, calibrated for 800 cycle.....@ $3.00
40 Volt Westinghouse NA-33, 2½" R-M, black scale luminous markings designed for aircraft 400 cycle, but calibrated for 60 cycles.....@ $3.95
40 Volt Westinghouse NA-33, 2½" R-M, black scale, luminous markings, calibrated for 400 cycles @ $3.50
40 Volt Weston 517, 2½" R-M, black scale, luminous markings, calibrated for 400 cycles...@ $3.50
75 Volt Weston 517, 2" R-M, ring clamp type mounitng.....@ $2.95
150 Volt Weston 517, 2½" R-B, MR24W150 ACVV.....@ $4.50
150 Volt General Electric AO-25, 3" S-B.....@ $5.50
150 Volt Triplett 332-JP, 3½" R-M.....@ $4.00
150 Volt Triplett 332-JP, 3½" R-B.....@ $4.50
150/300 Volt DUAL RANGE Triplett 331-JP, 3½" R-B with external resistor for 300 volts, scale calibrated 150, double scale indication for 300 volt use.....@ $5.50
300 Volt Triplett 232-C, 2½" R-M.....@ $6.00
300 Volt Burlington 22A, 2½" R-M.....@ $6.00

A.C. AMMETERS

10 Amp, General Electric AO-25, 3" S-B, expanded between 4 & 7 amps. Scale calibrated 100 Amps, for direct reading divide scale reading by 10 @ $4.95
30 Amp, Triplett 332-JP, 3½" R-M.....@ $3.50
30 Amp, Triplett, 331-JP, 3½" R-B.....@ $4.00
60/120 Amp, DUAL RANGE Burlington 32XC, 3½" R-B, with external current transformer....@ $7.50
150 Amp, MULTRANGE, General Electric AO-22, 3½" R-B, 5 Amp movement with external current transformer. Complete with simple circuit diagram illustrating how to use this combination to make a multirange A.C. Ammeter containing any or all of the following ranges—5, 15, 30, 50, 75, & 150 Your cost only.....$7.50

R.F. AMMETERS

All units are complete with internal thermocouple unless indicated otherwise
500 Milliampere, Weston 425, 3½" R-B with external thermocouple.....@ $12.50
1 Amp. General Electric DW-44, 2½" R-B, black scale.....@ $2.95
1 Amp. General Electric DW-44, 2½" R-B..@ $3.50
1 Amp. General Electric DO-44, 3½" R-B..@ $11.50
1 Amp. Weston 425, 3½" R-B.....@ $11.50
1.5 Amp. Westinghouse RT-35, 3" S-B.....@ $5.50
1.5 Amp. General Electric DO-44, 3½" R-B..@ $5.50
1.5 Amp. General Electric DW-52, 2½" R-M, black scale.....@ $2.95
2 Amp. Westinghouse NT-35, 3½" R-B, with external thermocouple.....@ $6.50
2 Amp. Westinghouse RT-35, 3" S-B.....@ $5.50
2 Amp. Simpson 135, 2½" R-B.....@ $3.50
2 Amp. Weston 425, 3½" R-B.....@ $8.50
2.5 Amp. McClintock MD3001, 3½" R-B, Signal Corps IS-111.....@ $4.50
2.5 Amp. Simpson 35, 3½" R-B.....@ $4.95
2.5 Amp. Weston 425, 3½" R-B.....@ $8.50
2.5 Amp. Westinghouse NT-35, 3½" R-B....@ $5.50
3 Amp. Weston 507, 2½" R-B, black scale..@ $3.95
3 Amp. Weston 425, 3½" R-B, with external thermocouple.....@ $9.50
3 Amp. Westinghouse NT-35, 3½" R-B, MR35W003 RFAA.....@ $5.50
5 Amp. Westinghouse, RT-35, 3" S-B.....@ $7.50
5 Amp. General Electric DO-44, 3½" R-B...@ $7.50
5 Amp. General Electric DO-44, 3½" R-B, with external thermocouple.....@ $8.50
6 Amp. General Electric DW-44, 2½" R-B, black case @ $2.50
8 Amp. Westinghouse RT-35, 3" S-B.....@ $7.50
8 Amp. General Electric DW-44, 2½" R-B, black scale.....@ $2.95

D.C. MICROAMMETERS

0-100 Microamps. Weston 301, 3" S-B....@ $14.50
0-200 Microamps. Weston 506, 2" S-B.....@ $5.50
0-200 Microamps. Westinghouse NX-35, 3½" R-B, MR35W200DCUA approximately 230 ohms, 43 M.V.....@ $8.50
0-200 Microampere, Superior 4" x 4⅝" flush bakelite case, approximately 500 ohms resistance. Special scale calibrated in ohms, Caption, Insulation Tester.....@ $7.50
0-400 Microampere movement, Welch 7½" Switchboard meter, round metal case. With internal resistor & scale calibrated for 40 volts D.C. @ $17.50
0-500 Microampere movement, General Electric DO-53, 3" S-B, Special scale with caption "Channel" with paper V.O.M.A. scale.....@ $4.50
0-500 Microampere movement, General Electric DO-41, 3½" R-B, scale calibrated 0-20 kilovolt D.C. With paper V.O.M.A. scale.....@ $4.95
0-500 Microampere movement, General Electric DO-53, 3" S-B, scale calibrated 0-15 K.V., with paper V.O.M.A. scale.....@ $4.95
0-500 Microampere, DeJur Amsco 210, 2½" R-B @ $3.00
0-500 Microampere, Simpson 125, 2½" R-B..@ $3.50

D.C. MILLIAMMETERS

0-1 M.A. Weston 301, 3½" R-B.....@ $7.50
0-1 M.A. Westinghouse NX-35, 3½" R-B MR35W001 DCMA.....@ $7.50
0-1 M.A. Westinghouse NX-33, 2½" R-B, special black scale calibrated 200 MA, PA, Plate, & Grid.....@ $3.00
0-1 M.A. DeJur Amsco, 3½" R-B, scale calibrated 0-4 KV, with paper V.O.M.A. scale and parts list, circuit diagram for making a V.O.M.A.....@ $4.50
0-2 M.A. Westinghouse NX-35, 3½" R-B MR35W002 DCMA.....@ $5.50
0-3 M.A. Weston 506, 2½" R-B.....@ $3.95
0-3 M.A. Gruen GW-580, 2½" R-B, scale calibrated 30, 450 MA and 3000 volts.....@ $3.50
0-3 M.A. Simpson 126, 2½" R-B, MR25W003DCMA @ $3.95
0-5 M.A. Simpson, 2" S-B, with red mark at 3 volts @ $3.50
0-5 M.A. Westinghouse RX-33, 2" S-B with red mark at 3 volts.....@ $3.50
5-0-5 M.A. Western Electric, 3½" round concentric style meter. Scale calibrated 50-0-50 with red marks at 18 MA and 115 volts.....@ $3.00
0-15 M.A. Simpson 26, 3½" R-B, MR35WO15DCMA @ $4.95
0-20 M.A. General Electric DO-53, 3" S-B..@ $3.75
0-20 M.A. Westinghouse NX-35, 3½" R-B, MR35W 020DCMA.....@ 4.95
0-30 M.A. General Electric DO-41, 3½" R-B @ $3.50
0-50 M.A. General Electric DO-41, 3½" R-B @ $4.00
0-80 M.A. General Electric DO-41, 3½" R-B @ $3.75
0-150 M.A. Gruen 508, 2½" R-B.....@ $3.00
0-200 M.A. Gruen GW-511, 2½" R-B, MR25W200 DCMA.....@ $3.00
0-200 M.A. General Electric DO-41, 3½" R-B @ $4.50
0-200 M.A. Simpson 26, 3½" R-B, MR35W200DCMA @ $4.95
0-200 M.A. Marion, 3½" R-B.....@ $3.50
300-0-300 M.A. General Electric DO-40, 3" R-B, ring clamp mounted, (non flanged case)..@ $3.00
0-500 M.A. Westinghouse NX-33, 2½" R-B..@ $3.95
0-500 M.A. DeJur Amsco 312, 3" S-B.....@ $4.50
0-500 M.A. DeJur Amsco, 3½" R-B.....@ $4.50
0-800 M.A. General Electric DO-41, 3½" R-B @ $5.50
0-1000 M.A. DeJur Amsco, 3½" R-B.....@ $4.50

D.C. VOLTMETERS

0-5 Westinghouse NX-33, 2½" R-B, 200 ohms per volt.....@ $3.50
0-30 DeJur Amsco 210, 2½" R-B.....@ $3.50
0-30 Triplett M 102, 3½" R-B, black scale, with pointer set, A.C. type B-1.....@ $4.00
0-40 Sun 3AP597, 3½" R-B, 100 ohms per volt @ $4.95
0-150 General Electric DW-41, 2½" R-B....@ $3.95
0-150 Simpson 23, 3½" R-M.....@ $6.00
0-150 Weston 301, 3" R-M, 200 ohms per volt @ $4.50
0-150 Weston 301, 3½" R-B, 200 ohms per volt @ $5.50

D.C. KILOVOLTMETERS

All meters are 1000 ohms per volt complete with external precision, wire wound, non-inductive, hermetically sealed ferrule type multipliers JAN type MAF with mounting hardware, unless specified otherwise.

0-1 K.V. Weston 301, 3" S-B or 3½" R-B...@ $9.50
0-1.5 K.V. Weston 301, 3" S-B or 3½" R-B..@ $9.50
0-1.5 K.V. Westinghouse NX-35, 3½" R-B..@ $7.50
0-2 K.V. Weston 301, 3" S-B or 3½" R-B..@ $10.50
0-3 K.V. Weston 301, 3" S-B or 3½" R-B..@ $11.50
0-3.5 K.V. Weston 301, 3" S-B or 3½" R-B @ $11.50
0-4 K.V. Weston 301, 3" Square or 3½" R-B @ $11.50
0-4 K.V. DeJur Amsco, 3½" R-B.....@ $8.50
0-4 K.V. DeJur Amsco, 3½" R-B, without resistor @ $4.50
0-5 K.V. Weston 301, 3" S-B or 3½" R-B..@ $12.50
0-5 K.V. Westinghouse NX-35, 3½" R-B..@ $11.00
0-7.5 K.V. Weston 301, 3" S-B or 3½" R-B @ $14.50
0-10 K.V. Weston 301, 3" S-B or 3½" R-B @ $17.50
0-15 K.V. Westinghouse NX-35, 3½" R-B, without resistor.....@ $4.95
0-20 K.V. Weston 301, 3" S-B or 3½" R-B..@ $23.50
0-20 K.V. General Electric DO-41, 3½" R-B @ $19.50
0-20 K.V. General Electric DO-41, 3½" R-B, 500 microampere movement without resistor...@ $4.95
0-35 K. V. Westinghouse NX-35, 3½" R-B, 2 milliampere movement, without resistor.....@ $4.50

SPECIAL METERS

SENSITROL RELAY 0-50 Microampere Sensitivity. Ideal for any application where a high sensitivity, and high contact capacity D.C. Relay is specified. Weston 707 type 5, Single fixed contact with 110 volt A.C. solenoid reset and adjustable index to indicate operating point. Has two scales, one for setting index and the other for reading pointer position. Contact closes on decreasing value and has a capacity of 5 watts at 110 volts. Comes in a 3" round surface mounted metal case with the solenoid unit projecting through the rear.
Current List Price $68.50 Your Cost Only **$27.50**

FREQUENCY METER, DUAL RANGE covers frequency range from 48 to 52 and 58 to 62 cycles. Dual element, vibrating reed type. Operates from 100 to 150 volts, 3½" round flush metal case. If you have a generating system or for any reason must maintain a constant frequency on your equipment, this is the ideal meter for you.
A real value at only.....$5.95

FREQUENCY METER, RANGE 55 to 60 CYCLES James Biddle Company type MF-11, Frahm vibrating reed type, 11 reeds, 100 to 150 volt operation, 3½" round flush bakelite case. At only $7.50

SIGNAL STRENGTH "S" METER
Use this on the plate circuit of your receiver to show the relative strength of incoming signals. Scale calibrated minus 6 to 100 DB above 1 microvolt. 5 M.A. zero right movement with TRANSLUCENT SCALE, REAR MOUNTED INTERNAL SOCKET, AND 6 VOLT LAMP TO ILLUMINATE SCALE. A Simpson model 25, 3½" round flush bakelite case meter. Full details and circuits can be found in the Radio Amateurs Handbook. A really nice meter to dress up your radio shack. Only $4.50

RECTIFIER TYPE MILLIAMMETER 270 degrees wide angle movement, Weston model 545 type 81, Concentric scale, 4½" Aircraft type. Full scale is 1.1 M.A. AC with a 940 microampere 70 ohm D.C. movement and rectifier, black scale calibrated directly in degrees 0-270.....@ $6.50

RECTIFIER TYPE MILLIAMMETER, McClintock, 2" Round flush metal case ring clamp mounted (non-flanged case) 1 MA A.C. has a 700 microampere D.C. movement with a half wave rectifier. @ $2.50

RPM INDICATOR zero center, D.C. milliammeter, movement 1-0-1 MA Weston model 502, 6" square flush metal case. Black scale calibrated 900-0-900 R.P.M.....@ $18.00

RPM INDICATOR, zero center D.C. Milliammeter, movement 2.4-0-2.4 MA, Westinghouse SX, 7½" round surface mounted case.....@ ——

MULTIRANGE, HIGH SPEED DECIBEL METER AN IDEAL METER FOR RECORDING SOUND; BROADCASTING, TELEPHONE, AND TELEGRAPH APPLICATIONS, Weston 301 type 61, can be supplied in either the 3½" round or 3" square flush bakelite case, minus 10 to plus 6 DB, 6 M.W. in 600 ohms, zero DB equals 1.9 volts, and 5000 ohms. High speed type .29—.35 Seconds to final reading. Only 2—6% overthrow, 16-50 Damping factor. Complete with 3 external wire wound precision resistors to extend the range.
Total List Price $37.50 A Real Buy at Only $11.50

DECIBEL METER, GENERAL PURPOSE TYPE, Weston 301 type 21, minus 10 to plus 6 DB, zero DB equals 1.9 volts at 5000 ohms, 6 M.W. in 600 ohms. In a 3½" round flush bakelite case @ $8.50

DECIBEL METER, GENERAL PURPOSE type, Weston 301 type 23, minus 10 to plus 6 DB zero DB equals 0.6 volts, 6 MW in 600 ohms, 3½" round flush bakelite case.....@ $8.50

DECIBEL METER General Electric type DO-46, minus 10 to plus 6 DB, zero DB equals 1.9 volts & 5000 ohms, 6 MW in 600 ohms. 3" square flush bakelite case.....@ $7.95

PORTABLE TACHOMETERS

0-20,000 RPM Range, Jaeger #43 A-6 Chronometric type.....$24.50
300-1200, 1000-4000, 3000-12000 RPM, Jones Motorola Co., Multiple Range, Continuous indicating.....$24.50
300-1500, 1000-5000, 3000-15000 RPM, Jones Motorola Co., Multiple Range. Continuous Indicating.....$25.00

SOCKET SELECTOR SET WESTON 666 TYPE 1C

Designed for purpose of taking readings of currents, voltages and resistance and other electrical measurements in a vacuum tube circuit. It can be used with many Western Analyzers or other make multirange volt-ohmi-milliammeters. To test a tube circuit the tube is plugged into the appropriate adapter and the test plug inserted in the tube socket. This brings all currents and voltages out through a cable where they may be measured with an analyzer.
Complete with Tube Base Data Connections and Chart, 15 Adapters, pin leads and test block.
List Price $30.00.....Your Cost $9.50

COMBINATION OFFER

150 VOLT A.C. METER Triplett 331-JP, 3½" Rd flush case | 30 AMP A.C. METER Triplett 331-JP, 3½ Rd flush case
Both meters for $7.95

ALL ITEMS ARE BRAND NEW-SURPLUS-GUARANTEED. All materials shipped from stock same day as order received, subject to prior sale. 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.

MARITIME SWITCHBOARD

338 CANAL STREET

NEW YORK, 13, N. Y.

Worth 4-8217

TESTED NEW PANEL METERS

EACH METER TESTED BEFORE SHIPMENT. CALIBRATIONS ARE FOR NON-MAGNETIC PANELS. IF METERS ARE FOR USE ON MAGNETIC PANELS SPECIFY PANEL THICKNESS AND WE WILL CALIBRATE ACCORDINGLY AT NO EXTRA CHARGE. All meters have white scale and are flush mounted unless specified otherwise.

S—Square | M—Metal | sc—scale
R—Round | r/V—Ohms per volt | surf—surface mounted
B—Bakelite | bl—Black

FULLY GUARANTEED BRAND NEW SURPLUS OFFERED BY A LEADING

A.C. MOTORS

5071930, Delco, 115 V., 60 Cycle, 7000 r.p.m. **Price $4.50 each net.**

36938-2, Haydon Timing Motor, 110 V., 60 cycle, 2.2 w.; 4/5 r.p.m.

Price $3.00 ea. net.

Type 1600 Haydon Timing Motor—110 V., 60 cycle, 3.2 w., 4 r.p.m., with brake. **Price $4.00 each net.**

Type 1600 Haydon Timing Motor—110 V., 60 cycle, 2.2 w., 1/240 r.p.m. **Price $3.00 each net.**

Type 1600 Haydon Timing Motor 110 V., 60 cycle, 2.3 w., 1 r.p.m. **Price $2.70 each net.**

Type 1600 Haydon Timing Motor, 110 V., 60 cycle, 2.2 w., 1 1/5 r.p.m. **Price $2.70 each net.**

Type 1600 Haydon Timing Motor 110 V., 60 cycle, 3.5 w., 1 r.p.m. With shift unit for automatic engaging and disengaging of gears. **Price $3.30 each net.**

Type 1600 Haydon Timing Motor, 110 V., 60 cycle, 2.2 w., 1/60 r.p.m. **Price $3.00 each net.**

Eastern Air Devices Type J33 Synchronous Motor 115 V., 400 cycle, 3 phase, 8,000 r.p.m. **Price $8.50 each net**

Telechron Synchronous Motor, Type B3, 115 V., 60 cycle, 2 r.p.m., 4 w. **Price $5.00 each net.**

Barber-Colman Control Motor, Type AYLC 5091, 24 volts D.C. .7 amps 1 R.P.M., Torque 500 in. lbs. Contains 2 adjustable limit switches with contacts for position indication. Ideal for use as a remote positioner or a beam or television antenna rotator, will operate on A.C. 60 cycle. **Price $6.50 each net.**

SERVO MOTORS

CK 1, Pioneer, 2 phase, 400 cycle. **Price $10.00 each net.**

CK 2 Pioneer, 2 phase, 400 cycle. **Price $4.25 each net.**

10047-2-A Pioneer 2 phase, 400 cycle, with 40:1 reduction gear. **Price $7.25 each net.**

FPE-49-6 Diehl, Low-Inertia, 115 V., 60 cycle, 2 phase, .3 amps., 10 watt, output. **Price $34.50 each net.**

FPE-25-16 Diehl Low-Intertia 20 V., 60 cycle, 2 phase, 1600 r.p.m., .85 amps. **Price $10.00 each net.**

CK 2, Pioneer, 2 phase, 400 cycle, with 40:1 reduction gear. **Price $6.50 each net.**

MINNEAPOLIS-HONEYWELL TYPE B Part No. G303AY, 115 V., 400 cycle, 2 phase, built-in gear reduction, 50 lbs. in torque. **Price $8.50 each net.**

AMPLIFIER

Pioneer Gyro Flux Gate Amplifier, Type 12076-1-A.
Price $17.50 ea. net, with tubes.

REMOTE INDICATING MAGNESYN COMPASS SET

Pioneer Type AN5730-2 Indicator and AN5730-3 Transmitter 26 V., 400 cycle.
Price $40.00 per set new sealed boxes.

Kollsman Remote Indicating Compass Set Transmitter part No. 679-01, indicator part No. 680k-03, 26 V., 400 cycle. **Price $12.50 each net.**

GYROS

Schwein Free & Rate Gyro type 45600. Consists of two 28 V. D.C. constant speed gyros. Size 8" x 4.25" x 4.25". **Price $10.00 ea. net.**

Schwein Free & Rate Gyro, type 46800. Same as above except later design. **Price $15.00 ea. net.**

Sperry A5 Directional Gyro, Part No. 656029, 115 volts, 400 cycle, 3 phase. **Price $17.50 each net.**

Sperry A5 Vertical Gyro, Part No. 644841, 115 V., 400 cycle, 3 phase. **Price $20.00 each net.**

Sperry A5 Amplifier Rack Part No. 644890. Contains Weston Frequency Meter. 350 to 450 cycle and 400 cycle, 0 to 130 voltmeter. **Price $10.00 each net.**

Sperry A5 Control Unit Part No. 644836. **Price $7.50 each net.**

Sperry A5 Azimuth Follow-Up Amplifier Part No. 656030. With tube. **Price $5.50 each net.**

Pioneer Type 12800-1-D Gyro Servo Unit. 115 V., 400 cycle, 3 phase. **Price $10.00 each net.**

Norden Type M7 Vertical Gyro. 26 V., D.C. **Price $19.00 each net.**

Allen Calculator, Type C1 Bank and Turn Indicator, Part No. 21500, 28 V. D.C. Contains 28 V. D.C. constant speed gyro. **Price $10.00 each net.**

D.C. MOTORS

5069625, Delco Constant Speed, 27 V., 120 r.p.m. Built-in reduction gears and governor. **Price $3.90 each net.**

A-7155, Delco Constant Speed Shunt Motor, 27 V., 2.4 amps., 3600 r.p.m., 1/30 h.p. Built-in governor. **Price $6.25 each net.**

C-28P-1A, John Oster Series Motor, 27 V., 0.7 amps., 7000 r.p.m., 1/100 h.p. **Price $3.75 each net.**

Jaeger Watch Co. Type 44-K-2 Contactor Motor, Operates on 3 to 4.5 volts D.C. Makes one contact per second **Price $2.00 each net.**

General Electric Type 5BA10AJ52C, 27 V. D. C., 0.65 amps., 14 oz. n. torque, 145 r.p.m. Shunt Wound, 4 lead reversible. **Price $5.00 each net.**

General Electric Type 5BA10AJ37C, 27 V. D. C., 5 amps., 8 oz., in. torque, 250 r.p.m. Shunt Wound, 4 leads reversible. **Price $6.50 each net.**

D.C. ALNICO FIELD MOTORS

5067043 Delco 12 volts, 10,000 r.p.m. **Price $5.50 each net.**

5069466, Delco, 27 V., 10,000 r.p.m.

Price $3.50 each net.

5069370, Delco, 27 V., 10,000 r.p.m. **Price $5.00 each net.**

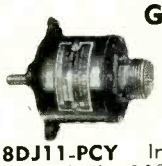
S. S. FD6-16, Diehl, 27 V., 10,000 r.p.m. **Price $4.00 each net.**

S. S. FD6-18, Diehl, 27 V., 10,000 r.p.m. **Price $4.00 each net.**

S. S. FD6-21, Diehl, 27 V., 10,000 r.p.m. **Price $4.00 each net**

Sampsel Time Control Inc. Alnico Field Motor, 27 V. D.C. Overall length 3 5/16" by 1⅜". Shaft ⅝" long by 3/16", 10,000 r.p.m. **Price $4.50 each net.**

GENERAL ELECTRIC D. C. SELSYNS



8TJ9-PDN Transmitter, 24 V. **Price $3.75 each net.**

8DJ11-PCY Indicator, 24 V. Dial marked—10° to +65°. **Price $4.50 each net.**

8DJ11-PCY Indicator, 24 V. Dial Marked 0 to 360°. **Price $7.50 each net.**

RELAYS

Type B4 28 volts D.C., 200 amps. continuous duty. Electric Auto-Lite Co. Part no. WSN4001. **Price $2.50 each net.**

Type B5B, 28 volts D.C., 50 amps., continuous duty Hart Mfg. Co. Part no. 692R6 **Price $1.85 each net.**

Type B8, 28 volts D. C., 250 amps., in termittent duty Cutler-Hammer. Part no. 6041H139A **Price $2.50 each net.**

INSTRUMENT ASSOCIATES

37 EAST BAYVIEW AVE., GREAT NECK, N. Y
Telephone IMperial 7-1147

Write for Catalog NE100

U. S. Export License-2140

SUPPLIER OF ELECTRONIC & AIRCRAFT EQUIPMENT

IMMEDIATE DELIVERY

INVERTERS

Wincharger Corp. Dynamotor Unit. PE 101-C. Input 13, V.D.C. or 26 V.D.C. D.C. AT, 12.6 or 6.3 amps. Output 400 V.D.C. AT. 135 amps., 800 V.D.C. AT. .02 amps., 9 V.A.C. 80 cycle at 1.12 amps.
Price $10.00 each net.

153F, Holtzer Cabot, Input, 24 V.D.C. Output 115 V., 400 cycle, 3 phase, 750 V.A. and 26 V., 400 cycle, 1 phase, 250 V.A. Voltage and frequency regulated also built in radio filter.
Price $115.00 each net.

149H, Holtzer Cabot. Input 28 V. at 44 amps. Output 26 V. at 250 V.A., 400 cycle and 115 V. at 500 V.A., 400 cycle. **Price $40.00 each net.**

149F, Holtzer Cabot. Input 28 V. at 36 amps. Output 26 V. at 250 V.A., 400 cycle and 115 V. at 500 V.A., 400 cycle. **Price $40.00 each net.**

12117, Pioneer. Input 12 V.D.C. Output 26 V., 400 cycle, 6 V.A.
Price $22.50 each net.

12117-2 Pioneer. Input 24 V.D.C. Output 26 V. 400 cycle, 6 V.A.
Price $20.00 each net.

12116-2-A Pioneer. Input 24 volts D.C., 5 amps. Output 115 volts 400 cycle single phase 45 watts.
Price $100 each net.

5D21NJ3A General Electric. Input 24 V.D.C. Output 115 V., 400 cycle at 485 V.A. **Price $12.00 each net.**

PE218, Ballentine. Input 28 V.D.C. at 90 amps. Output 115 V., 400 cycle at 1.5 K.V.A. **Price $50.00 each net.**

METERS

Weston Frequency Meter. Model 637, 350 to 450 cycles, 115 volts.
Price $10.00 each net.

Weston Voltmeter. Model 833, 0 to 130 volts, 400 cycle. **Price $4.00 each net.**

Weston Voltmeter. Model 606, Type 204 P, 0 to 30 volts D. C.
Price $4.25 each net.

Weston Ammeter. Model 506, Type S-61209, 20-0-100 amps. D. C.
Price $7.50 each net with ext. shunt.

Weston Ammeter. Type F1, Dwg. No. 116465, 0 to 150 amps. D. C.
Price $6.00 each net.
With ext. shunt $9.00 each net.

Westinghouse Ammeter. Type 1090-D120, 120-0-120 amp. D. C.
Price $4.50 each net.

Weston Model 545. Type 82PE Indicator. Calibrated 0 to 3000 RPM. 2¾" size. Has built-in rectifier, 270° meter movement.
Price $15.00 each net.

VIBRATOR

Rauland Corp. vibrator non-synchros type Stock No. 3H6694-11; 6, 12 or 24 V.D.C., Input. Frequency 200 cycle.
$3.50 each net.

Sperry Phase Adapter. Part No. 661102. Used for operating three-phase equipment from a single phase source. 115 volts 400 cycle. Maximum load 500 watts. **Price $15.00 each net.**

PIONEER AUTOSYNS

AY1, 26 V., 400 cycle.
Price $5.50 each net.

AY14D, 26 V., 400 cycle, new with calibration curve.
Price $15.00 each net.

AY20, 26 V., 400 cycle.
Price $7.50 each net.

AY5 26V., 400 cycle. Has hollow shaft.
Price $7.50 ea. net

PRECISION AUTOSYNS

AY101D, new with calibration curve.

PRICE—WRITE OR CALL FOR SPECIAL QUANTITY PRICES

AY131D, new with calibration curve.
Price $35.00 each net.

AY130D, new. **Price $35.00 each net.**

PIONEER AUTOSYN POSITION INDICATORS

Type 5907-17. Dial graduated 0 to 360°, 26 V., 400 cycle.
Price $15.50 each net.

Type 6007-39, Dual, Dial graduated 0 to 360°, 26 V., 400 cycle.
Price $30.00 each net.

PIONEER TORQUE UNIT

Type 12602-1-A.
Price $40.00 each net.

Type 12606-1-A. Price $40.00 each net.
Type 12627-1-A. Price $80.00 each net.

MAGNETIC AMPLIFIER ASSEMBLY

Pioneer Magnetic Amplifier Assembly Saturable Reactor type output transformer. Designed to supply one phase of 400 cycle servo motor.
Price $8.50 each net.

PIONEER TORQUE UNIT AMPLIFIER

Type 12073-1-A, 5 tube amplifier, Magnesyn input, 115 V., 400 cycle.
Price $17.50 each net with tubes

BLOWER ASSEMBLY MX-215/APG

John Oster, 28 V.D.C., 7000 r.p.m. 1/100 h.p. **Price $4.50 each net.**

Westinghouse Type FL Blower, 115 V., 400 cycle, 6700 r.p.m., Airflow 17 C.F.M. **Price $3.70 each net.**

RATE GENERATORS

PM2, Electric Indicator Co., .0175 V. per r.p.m. **Price $8.25 each net.**

F16, Electric Indicator Co., two-phase, 22 V. per phase at 1800 r.p.m.
Price $12.00 each net.

J36A, Eastern Air Devices, .02 V. per r.p.m. **Price $9.00 each net.**

B-68, Electric Indicator Co., Rotation Indicator, 110 V., 60 cycle, 1 phase.
Price $14.00 each net.

Weston Tachometer Generator (aircraft type) model 752-J4 single phase. A.C. output **Price $17.50 each net.**

SINE-COSINE GENERATORS (Resolvers)

FPE 43-1, Diehl, 115 V., 400 cycle.
Price $20.00 each net.

SYNCHROS

1F Special Repeater, 115 V., 400 cycle. Will operate on 60 cycle at reduced voltage.

Price $15.00 each net.

7G Generator, 115 V., 60 cycle.
Price $30.00 each net.

2J1F3 Selsyn Generator 115 volts, 400 cycle. **Price $5.50 each net.**

2J1M1 Control Transformer 105/63 V., 60 cycle. **Price $20.00 each net.**

2J1G1 Control Transformer, 57.5/57.5 V., 400 cycle. **Price $1.90 each net.**

2J1H1 Selsyn Differential Generator, 57.5/57.5 V., 400 cycle.
Price $3.25 each net.

W. E. KS-5950-L2, Size 5 Generator, 115 V., 400 cycle.
Price $4.50 each net.

5G Generator 115 volts, 60 cycle.
Price $50.00 each net.

5G Special, Generator 115/90 V., 400 cycle. **Price $15.50 each net.**

5SF Repeater, 115/90 V., 400 cycle.
Price $19.00 each net.

2J1F1 Selsyn Generator, 115 V., 400 cycle. **Price $3.50 each net.**

5SDG Differential Generator 90/90 V., 400 cycle. **Price $12.00 each net.**

1CT Control Transformer. 90/55 volts, 60 cycle. **Price $40.00 each net.**

POSITION TRANSMITTER

Pioneer Type 4550-2-A Position Transmitter, 26 volts 400 cycle, gear ratio 2:1. **Price $15.00 each net.**

ALL PRICES F. O. B. GREAT NECK, N. Y.

INSTRUMENT ASSOCIATES

37 EAST BAYVIEW AVE., GREAT NECK, N. Y.
Telephone IMperial 7-1147

Write for Catalog NE100

Western Union address: WUX Great Neck, N. Y.

OUTSTANDING VALUES NOW AVAILABLE

- AMPLIFIERS
- AN CONNECTORS
- CABLE
- CAPACITORS
- CHOKES
- CIRCUIT-BREAKERS
- COAX-CONNECTORS
- COILS
- CORDS
- CRYSTALS
- DELAY LINES
- FILTERS
- FUSES
- HANDSETS
- INVERTERS
- JACKS
- KLYSTRONS
- KNOBS
- MAGNETRONS
- MAGNETS
- MICROPHONES
- METERS
- MOTORS
- POTENTIOMETERS
- POWER PLANTS
- POWER SUPPLIES
- PROJECTION LAMPS
- RECORDERS
- RESISTORS
- SELSYNS
- SCOPE ACCES.
- SHOCK MOUNTS
- SOCKETS
- SWITCHES
- TELEPHONE EQUIP.
- TEST EQUIPMENT
- TRANSFORMERS
- TRANSMITTERS
- TUBES
- WAVEGUIDE
- WAVEMETERS
- WIRE

RADIO HAM SHACK broadcasts its sincere thanks to all its old friends and a hearty welcome to new ones.

TO OUR OLD FRIENDS. It is not news that **RADIO HAM SHACK** is the house of value. They know that our mass purchasing policy of vast quantities of surplus equipment and the maintenance of one of the largest stocks of radio tubes and electronic components in the United States enables us to offer them low, low prices that are difficult to beat anywhere in the world.

TO THE NEW FRIENDS we should like to meet, we extend our services and facilities to bring them the best of equipment at the lowest prices. Deal with us in confidence, secure in the knowledge that our tubes, components and equipment are of standard manufacture, rigidly inspected and securely packed to insure that only first **QUALITY, BRAND NEW MERCHANDISE** reaches you.

Send for our monthly value packed flyer. Your requirements for immediate quotation will receive a prompt reply.

REMINDER—RADIO HAM SHACK is a **BIG BUYER** of tubes, components and equipment. Submit your surplus stock inventory to us for fast action. No lot too large—none too small.

WIRE! WRITE! today for latest prices. **SPECIAL DISCOUNTS** for large quantity purchases.

OVERSEAS BROADCAST!! WE SHIP ALL OVER THE WORLD!! SPECIAL HANDLING BY OUR EXPORT DIVISION INSURES SWIFT, CHEAP DELIVERIES TO ALL DESTINATIONS. CORRESPONDENCE IN ALL LANGUAGES. CABLE ADDRESS: HAMSHACK—NEW YORK.

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

OA3/VR75	$1.05	3C22	$39.50	227A/5C27	$2.69	816	.99	9006	.15	0B2	$1.67	5Z4	.77	6SN6GT	.97	12SR7	.49
OB3/VR90	.65	3C23	2.19	249C	1.49	826	.39	C1JA	9.95	0Z4	.57	6A3	.92	6SN7GT	.54	12Z3	.69
OC3/VR105	.69	3C24/24G	.35	250R	5.95	828	10.95	C5B	6.95	01A	.39	6A4LA	1.09	6SQ7	.45	14A4	.79
OD3/VR150	.48	3C30/809	1.89	250TH	18.95	829	7.45	C6A	7.95	1A3	.44	6A6	.79	6SR7GT	.52	14A7	.52
1B21/GL471A	2.87	3C31/C1B	2.98	250TL	18.95	830B	3.19	C6J	3.65	1A4	1.09	6A7	.69	6SS7	.49	14B6	.67
1B22	2.87	3C45	12.95	274B	2.69	832A	4.89	C100D	.98	1A4P	.97	6A8	.75	6ST7	.72	14F7	.69
1B23	8.75	3CP1	1.39	293A	2.98	833A	33.95	CK502AX	2.25	1A5GT	.49	6AB7	.79	6SU7GTY	1.25	14F8	.79
1B24	4.59	3DP1	1.79	294A	2.95	836A	1.97	CK503AX	1.95	1A6	.79	6AC7	.74	6SV7	.79	14H7	.59
1B26	2.79	3DP1-S2A	2.79	300B	9.95	837	1.19	CK505AX	2.25	1A7GT	.67	6AD7G	1.09	6T7G	.89	14J7	.87
1B27	7.95	3D21A	.98	304TH	3.49	838	1.98	CK506AX	1.95	1AB5	.59	6AF6G	.79	6U5G	.65	14N7	.85
1B29	.79	3EP1	2.59	304TL	1.29	841	.29	CK507AX	1.95	1B3/8016	1.15	6AG5	.69	6U6GT	.63	14Q7	.53
1B32	1.89	3EP9	8.95	305A	24.95	843	.29	CK512AX	2.25	1B4	1.19	6AG7	.98	6U7G	.49	14R7	.67
1B36	3.95	3FP7	.97	307A	3.69	845	4.25	CK571AX	8.45	1B5/25S	.89	6AH6	1.29	6V6	.89	19	.69
1B38	36.50	3GP1	5.95	316A	.29	851	12.95	CK1005	.09	1C5GT	.59	6AJ5	.79	6V6GT	.57	24A	.49
1B38	3.95	3HP7	3.95	327A/5C37	2.75	860	14.95	CK1006	.85	1C6	.89	6AK5	.85	6W4	.63	25L6GT	.53
1D21	3.75	4-65A	14.21	331A	12.95	861	9.95	CK1007	.89	1C7G	.89	6AK6	.79	6W7G	.77	25Z5	.44
1N21	.49	4-125A	26.05	350A	1.98	864	.29	E1148	.29	1D5GP	.97	6AL5	.59	6X4	.57	25Z6GT	.43
1N21A	.89	4-250A	36.25	350B	1.39	865	.79	EF50	.39	1D7G	.89	6AQ5	.49	6X5GT	.47	26	.49
1N21B	1.39	4AP10	1.98	368A/S	4.98	866A	1.05	F123A	7.95	1D8GT	.95	6AQ6	.59	6Y6G	.67	27	.42
1N22	.98	4B22	9.98	371B	.49	866JR	1.05	F127A	15.95	1F4	.75	6AR5	.52	6C7G	.98	28D7	.35
1N23	.79	4B24	1.98	388A	.47	869B	26.50	F128A	69.50	1F5G	.75	6AT6	.44	6ZY5G	.59	30	.37
1N23A	.79	4B25	7.95	393A	3.69	872A	1.12	F606	37.50	1G4GT	.69	6AU6	.59	7A4/XXL	.49	31	.59
1N23B	1.89	4B26	4.49	394A	3.69	874	.39	F660	49.50	1G6GT	.65	6AV6	.47	7A6	.59	32	.85
1N27	1.29	4B28	2.47	417A	9.95	876	.29	F862A	397.50	1E7G	1.15	6B4G	.89	7A7	.53	32L7GT	.89
1N34	.82	4B32	9.95	446A	1.25	878	1.98	FG17	2.69	1H4G	.55	6B6G	.79	7AG7	.72	33	.69
1P23	2.49	4C35	19.38	446B	1.79	884	1.19	FG27A	6.95	1H5GT	.54	6B7	.87	7B4	.53	34	.37
1P24	.59	4D22	9.95	450TH	19.95	885	1.19	FG32	4.95	1H6GT	.87	6B8G	.69	7B5	.67	35/51	.57
1P36	2.85	4D32	9.95	450TL	44.50	902	3.39	FG33	7.95	1J6G	.75	6BA6	.55	7B6	.56	35A5	.63
1S21	3.95	4E27/257B	12.45	527	5.95	905	2.49	FG57	12.95	1L4	.48	6BE6	.52	7B7	.59	35B5	.55
2AP1	3.89	5AP1	2.95	559	.98	908	4.95	FG81A	3.29	1LA4	.79	6BF6	.57	7C4	.34	35C5	.59
2C21/RK33	.24	5AP4	2.95	575A	11.95	918	1.49	FG105A	8.95	1LA6	.89	6BG6G	1.47	7C5	.48	35L6	.52
2C22/7193	.15	5BP1	2.29	631P1	3.75	919	1.95	FG172	13.95	1LB4	.89	6BH6	.59	7C7	.59	35W4	.39
2C26A	.15	5BP4	2.39	700A	19.95	923	.79	FG190	12.95	1LC5	.69	6BJ6	.57	7E5	.67	35Y4	.49
2C34/RK34	.22	5CP1	1.29	700B	19.95	927	1.25	GL146	9.95	1LC6	.79	6C4	.19	7E6	.54	35Z3	.57
2C39	17.95	5CP7	2.95	700C	19.95	930	.98	GL434A	2.69	1LD5	.79	6C5	.47	7E7	.62	35Z4	.44
2C40	4.95	5D21	24.45	700D	19.95	931A	2.98	GL471A	2.85	1LE3	.69	6C6	.57	7F7	.59	35Z5	.39
2C43	7.95	5FP7	1.19	701A	3.95	954	.16	GL562	89.50	1L5	.79	6C8G	.69	7H7	.59	36	.67
2C44	.98	5GP1	2.98	702A	2.69	955	.25	GL697	69.50	1LH4	.79	6D6	.44	7K7	.89	37	.35
2C46	6.95	5JP1	39.50	703A	1.89	956	.25	HF100	6.95	1LN5	.67	6D8G	.79	7L7	.69	38	.37
2C51	5.95	5JP2	8.95	704A	1.49	957	.22	HF125A	14.95	1N5GT	.59	6E5	.69	7N7	.67	39/44	.27
2D21	.89	5JP4	39.50	705A	.69	958	.22	HF200	14.95	1P5GT	.67	6F5	.47	7Q7	.59	41	.49
2D29	1.39	5J23	12.95	706B	18.95	959	.35	HF300	17.45	1Q5GT	.67	6F6	.57	7R7	.69	42	.49
2E22	1.19	5J29	12.95	706CY	18.75	991/NE16	.24	HY114B	.69	1R4	.59	6F6GT	.57	7V7	.87	43	.49
2E26	3.39	5J30	47.50	706FY	47.50	1613	.49	HY115	.59	1R5	.69	6F7	.69	7W7	.79	45	.52
2E30	2.39	5LP1	12.95	706GY	47.50	1614	1.35	HY615	.19	1S4	.59	6F8G	.87	7X7	.79	45Z3	.57
2J21A	7.95	5MP1	9.95	707B	14.95	1616	.49	KU610	6.95	1S5	.49	6G6G	.69	7Y4	.47	45Z5	.55
2J22	7.95	5NP1	4.98	708A	3.59	1619	.17	KU627	6.95	1T4	.53	6H6	.39	7Z4	.57	46	.62
2J26	6.95	6C21	19.69	713A	.79	1624	.67	KC4/ML100	37.50	1T5GT	.69	6H6GT	.37	12A	.57	47	.69
2J27	12.75	6F4	5.59	714AY	3.59	1625	.19	1U4	.59	6J5	.47	12A6	.17	49	.85		
2J30	49.50	6J4	4.49	715A	5.49	1626	.25	ML101	49.50	1V	.57	6J5GT	.39	12A7	.89	50	1.39
2J31	8.49	7BP7	9.95	715B	6.59	1629	.19	MX408U	.39	2A3	.87	6J6	.77	12A8GT	.49	50A5	.69
2J32	12.95	9GP7	8.95	715C	19.95	1630	.49	REL21	.98	2A4G	1.07	6J7	.67	12AH7GT	.80	50B5	.53
2J33	18.75	9JP1	6.95	717A	.49	1631	.98	RK59	1.69	2A5	.69	6J7GT	.65	12AT6	.44	50L6GT	.52
2J34	18.95	9LP1	19.95	721A	1.98	1632	.69	RK60	.42	2A6	.79	6K5GT	.79	12AT7	.79	50Y6	.57
2J36	97.50	9LP7	1.98	723A/B	12.95	1633	.79	RK65	24.50	2A7	.79	6K6GT	.44	12AU6	.57	53	.87
2J37	12.95	10BP4	19.69	724A/B	2.95	1634	.98	RK72	.59	2V3G	.69	6K7	.49	12AU7	.67	56	.45
2J38	11.95	10Y	.19	725A	6.45	1635	1.09	RK73	.59	2X2	.37	6K8	.79	12AV6	.54	57	.45
2J39	19.95	12DP7	14.95	726A	6.75	1636	1.98	RX21	2.39	2X2A	.65	6L5GT	.79	12BA6	.55	58	.49
2J40	24.50	12GP7	12.75	726B	29.50	1638	.65	RX120	8.95	3A4	.34	6L6	1.05	12BE6	.49	59	.89
2J46	49.50	12HP7	13.95	726C	49.50	1644	.98	V70D	7.35	3A5	.79	6L6G	.99	12C8	.34	70L7	.99
2J48	12.75	12LP4	24.95	730A	9.95	1654	2.45	VCR138	5.95	3A8	1.59	6L6GA	.85	12F5GT	.58	71A	.59
2J49	39.50	15E	1.19	750TL	69.50	1665	1.10	VR53	.19	3B7/1291	.29	6L7	.79	12H6	.27	75	.53
2J50	22.50	15R	.49	800	1.49	1851	.69	VR78	.29	3D6/1299	.29	6L7G	.87	12J5GT	.34	76	.44
2J54B	22.50	16AP4	49.50	801A	.19	1960	.89	VT127A	2.19	3LF4	.79	6N7	.75	12J7GT	.67	77	.43
2J55	69.50	19T8	.89	802	4.19	2050	1.19	VT158	14.95	3Q4	.47	6Q7	.64	12K7GT	.52	78	.44
2J61	34.50	23D4	.29	803	2.95	2051	.39	VU111	.49	3Q5GT	.67	6R7	.79	12K8	.59	80	.37
2J62	34.50	28D7	.29	804	7.95	8005	4.75	WL468	5.95	3S4	.57	6S7G	.79	12Q7	.49	81	1.25
2K25	22.50	28D7	.29	805	3.65	8011	.25	WL530	12.75	3V4	.67	6S8GT	.77	12SA7	.57	82	.84
2K28	24.95	30SP	.19	807	1.09	8012	1.39	WL531	4.75	5R4GY	1.09	6SA7	.44	12SC7	.54	83	.75
2K29	24.50	35TG	5.95	808	.99	8013	1.39	WL532	1.89	5T4	.87	6SC7	.59	12SF5	.59	83V	.89
3AP1	4.59	45SP	.19	809/3C30	1.89	8014	22.50	WL616	37.50	5U4G	.49	6SD7GT	.44	12SF7	.54	84/6Z4	.56
3B22	1.98	53A	5.95	810	7.95	8020	.89	WL619	18.95	5V4G	.87	6SF5	.49	12SG7	.52	85	.69
3B24	1.49	75TL	5.95	811	1.98	8025	3.69	WL677	34.50	5W4	.67	6SF7	.59	12SH7	.35	89Y	.35
3B25	4.87	100R	.97	812	2.45	9001	.32	WL681/686	22.50	5X4G	.57	6SG7	.59	12SJ7	.47	117L7/M7	1.19
3B26	1.49	100TH	9.95	812H	6.86	9002	.25	WL710A	.25	5Y3GT	.39	6SH7	.37	12SK7	.57	117N7	1.19
3B27	1.95	100TS	2.25	813	6.85	9003	.33	OA2	1.29	5Y4G	.49	6SJ7	.47	12SL7	.59	117P7	1.19
3B28	7.95	211	.25	814	1.98	9004	.24	OA4G	.89	5Z3	.52	6SK7GT	.44	12SN7	.52	117Z3	.49
3BP1	2.39	217C	9.95	815	1.59	9005	1.35					6SL7GT	.59	12SQ7	.49	117Z6	.65

RADIO HAM SHACK Inc.
189 GREENWICH STREET . NEW YORK, N. Y.

PHONE DIGBY 9-0347
WRITE FOR QUANTITY PRICES
Prices Subject to Change Without Notice
All Merchandise Guaranteed
F.O.B. N.Y.C.

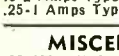
OUR MAY SPECIAL
Non Inductive Resistor.
500 Ohms 100 Watts
88¢ ea.

PEAK ELECTRONICS CO.
188 Washington St., New York 7, N. Y.

GUARANTEED SURPLUS

WESTINGHOUSE OVERCURRENT RELAY
Push Button Reset. Glass Enclosed.
.5-2 Amps Type SC-1 ..... 5.95
.25-1 Amps Type MN 5.95

MISCELLANEOUS BARGAINS
.02 400 volt dc tubulars ..... 15 for .99
2mfd 250 volts ac oil cond ..... 6 for .99
10 meg 10 watt resistor ..... 2 for .99
Heineman 25 amp 110 volt ac ckt breaker 1.19
Ceramicon .0005 mfd ..... 20 for .99
.01 600 volt dc pigtail micas ..... 10 for .99
.001 600 volt dc pigtail micas ..... 15 for .99
.006 600 volt, pigtail micas ..... 12 for .99
Butterfly cond. 2 to 11 mmf ball brngs ... 3 for .99
CD type 4 micas .001 600vdc ..... 10 for .99
250 mmf variable cond. (mc250s) ..... .59
10,000 ohm potentiometers ..... 6 for .99
.5 meg potentiometers ..... 5 for .99
Trimm "Commercial" Headphones ..... 3.75 ea.
16 mfd 450 volt electrolytic (EB9160) .... 3 for .99
Var. cond. 150 mmf .07 spacing ..... 2 for .99
Variable ceramicon 20 to 125 mmf type 823 5 for .99
Western Electric silver varble .5 to 2.5 mmf 8 for .99
G.E. weatherproof switch DPDT 20amp 120vac .99 ea.
50 K 1% W. W. Resistors, Precision ..... $ .14
.07 MFD 1000 VDC Type C Mica ..... .39
.35 at 16 KV plus .75 at 8 KV Oil Cond 3.95
.1 MFD 7500 VDC Oil Cond ..... .89
.05 MFD 7500 VDC Oil Cond ..... .75
7 MFD 330 VAC Oil Cond ..... .69
Meter Multiplier 2 MEG. ½ of 1% 2KV 1.49



50 megohm 35 watt Resistor with mount ... $1.49 each; 10 for $9.90
10 Meg 10 Watts ... .49; 2 Meg 5 Watt ..... .35

30 WATT WIRE WOUND RESISTORS
Ohms: 100-2000-2500-3k-4k-4500-5k-5300
10k-15k-18k ..... .15 ea. 8 for .99

ADJUSTABLE RESISTORS
20 Watt: 1, 5, 50 Ohms ..... .25
50 Watt: 80, 100, 500 Ohms ..... .35
75 Watt: 40, 80, 100, 150, 200 Ohms ..... .39
100 Watt: 20, 50, 75, 120, 180 Ohms ..... .49
150 Watt: 50, 100 Ohms ..... .59

WIRE WOUND RESISTORS
5 Watt type AA, 20-25-50-200-470-2500-4000 ohms ..... $.09 ea.
10 watt type AB, 25-40-84-400-470-1325-1000-2000-4000 ohms ..... .15 ea.
20 watt type DG, 50-70-100-150-300-750-1000-1500-2500-2700-5000-7500 10000-16000-20000-30000 ohms ..... .20 ea.

MIDGET VARIABLE CONDENSERS
Steatite Insulation
15 MMF (HF 15) ..... .39
Dual 15 MMF (HF 15 D) ..... .69
250 MMF (MC 250 S) ..... .69
325 MMF ..... .79

CERAMICONS
MMF: 1.5, 2, 3, 8, 10, 20, 22, 120, 500 ..... .05 ea.

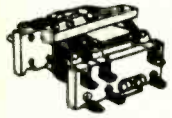
General Electric Overload Relay. Electrical Reset 110 Volts 60 Cycle

Breaks at 640 Milliamps but easily adjustable for other currents. Terrific values at only $2.95

10 for 25.00

MINIATURE HEADPHONES
250 ohms imp. Can be used for sound power Telephones, etc.
Type HS 30 ..... .69 ea.
10 For 5.99
Hi Imp Transf. for above ... .45

GENERAL PURPOSE TRANSFORMERS
Ideal for Bias, Filament, Isolation, Stepdown, etc. 2 isolated 110V Pri. Sec. 110V at 900 ma plus 6.3 @ 2 amps. Fully cased ..... New $1.49 ea.



ADVANCE D.P.D.T ANTENNA RELAY
110 V. 60 cycle coil Steatite Insulation. Only $1.95 each.

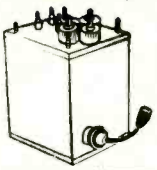
W. W. POWER RHEOSTATS
25 Ohms 25 Watt ..... .39
250 Ohms 50 Watt ..... .59
300 Ohms 50 Watt ..... .59
Dual 200 Ohms 50 Watt ..... .79
100 ohm 100 watt ..... .99
200 ohm 100 watt ..... .99

PANEL METERS
BRAND NEW
Govt Surplus

2" Beede 0-200 Microamps $3.95
2" Gruen 0-500 Microamps (Volt Scale) 3.25
2" Weston 0-1 MA (26 ohms res.) 3.50
2" GE 0-1 MA (Volt Scale) 2.50
2" GE 0-5 MA (Amp Scale) 1.95
2" Simpson 0-5 MA, Basic, Square 2.25
2" Westinghouse 0-10 MA 2.25
2" Simpson 0-20 MA (Amp Scale) 1.95
2" Sun 0-25 MA (0-100 Scale) 1.95
2" GE 0-50 MA 2.45
2" Gruen 0-50 MA 1.95
2" Sun 0-50 MA (Volt Scale) Square 1.95
2" GE 0-1 Amp RF 1.95
2" Simpson 0-2 Amp RF (Square) 1.95
2" GE 0-4 Amp RF 1.95
2" GE 0-250 MA AC 3.50
2" Sun 0-20 Volts DC 1.75
2" Weston 0-20 Volts DC 2.45
2" GE 0-30 Volts DC (1000 ohms/volt) 2.95
2" Triplett 0-300 Volts AC 2.95
2" GE 0-30 Amps DC 1.95
2" GE 0-25 Volts AC, Linear (0-100 Scale) 3.50
3" Weston 0-200 Microamp Mod 301 Square 7.95
3" Simpson 0-1 MA (0-100 Scale) 3.95
3" Westinghouse 0-2 MA 3.75
3" Westinghouse 0-15 MA (Square) 3.75
3" Westinghouse 0-20 MA 3.75
3" Western Electric 0-80 MA 2.75
3" GE 0-200 MA DC 3.75
3" Triplett 0-75 Amps AC 2.95
3" GE 0-500 Volts AC (External Multip.) 4.50
3" GE 0-15 Volts AC 3.95
3" GE 0-1 Amp DC 3.95
3" Westinghouse 0-2 Amps DC 3.95
3" Westinghouse 0-1 MA (Basic) KV Scale 3.95
3" Westinghouse 0-750 Volts DC (1000 Ohms/Volt 4.50
3" Weston 0-1 Volt DC 3.95

SCOPE TRANSFORMERS
Pri 110V 60CY—Hermetically Sealed
2500 V @ 12MA $2.95
1050V @ 20MA, 20V 4.5A, 2.5V 5A 4.75

SCOPE AND FIL. TRANSFORMERS



Pri. 115 volts, 60 cycles. Sec. 4400 volts RMS 4.5 MA., 5 volts CT 3 amps. Fil. Ins. 15 KV RMS test. Hermetically sealed. Has insulated plate cap for rectifier. Made by Raytheon. 4½ x 5 x 5½ ..... Only $4.95

5 for $22.50

HIGH CURRENT MICAS
Type G4 Ceramic Case 5¾" High, 5" Diameter Tolerance 5% or Better.

CAP MFD	Amps 1 Mc	Amps 300 Kc	KV DC	Price Each
.08	60	42	4	$27.50
.1	70	50	4	29.50
.65	60	42	5	24.50
.037	45	35	6	26.50
.02	40	30	9	29.50
.02	55	38	10	29.50
.0117	40	27	14	24.50
.0075	39	27	15	24.50
.009	40	25	15	29.50
.00978	40	25	15	29.50
.011	43	28	15	29.50
.0025	23	15	20	29.50
.00315	26	18	20	29.50
.004	30	20	22	33.50
.0033	25	16	25	35.50
.00082	14	8	30	27.50

TYPE G3 4" HIGH, 5" DIAMETER

.0013	15	9	15	14.50

TYPE G2 3" HIGH 3½" DIAMETER

.00057	8	4	10	6.95

Type G1 ½" High 2/16 DIAMETER

.00024	4	2	6	3.95

SILVER MICA CAPACITORS
MMF: 10, 47, 50, 60, 240, 750, 780, 1000 ... .09 ea.

Precision 15 Meg. 1% Accuracy Resistor, Non-inductive, 1 watt, hermetically sealed in glass .25 ea. 10 for $1.90

Thermal Time Delay Relay. 15 to 3 seconds, plugs into 4 prong Tube Socket Glass Enclosed 250 V ... .75

PRECISION 1% W.W. RESISTORS
Ohms: 2K, 2500, 5K, 8500, 95K, 750K .... .25 ea.

OIL CONDENSERS

42	mfd	440 vac—6.95	8	mfd	2000 vdc—5.95
2	mfd	600 vdc— .39	10	mfd	2000 vdc—6.95
4	mfd	600 vdc— .59	2	mfd	4000 vdc—4.95
6	mfd	600 vdc— .79	1	mfd	5000 vdc—4.50
3/3	mfd	600 vdc— .79	.1/.1	mfd	7000 vdc—2.25
10	mfd	600 vdc— .89	2	mfd	6000 vdc—9.95
4	mfd	1000 vdc— .95	1	mfd	7500 vdc—9.25
5	mfd	1000 vdc—1.39	.01/.01	mfd	12kv
10	mfd	1000 vdc—1.99			dc—5.75
2	mfd	1500 vdc—1.25	.005/.01	mfd	12 kv
4	mfd	1500 vdc—2.25			dc—5.50
6	mfd	1500 vdc—2.95	65	mfd	12,500 vdc—12.95
1	mfd	2000 vdc—1.45	2	mfd	18 kv dc—49.55
2	mfd	2000 vdc—2.25	1	mfd	15 kv dc—15.95

HIGH VOLTAGE VACUUM CONDENSER
50 MMF 32KV EIMAC VC 50-32 ..... 5.75
12 MMF 32 KV EIMAC VC 12-32 ..... 4.95

FILAMENT TRANSFORMERS
110 V 60 CY Pri. Cased.
5 Volt 15 Amp $2.75
2.5 Volt 10 Amp 3.49
2.5 Volt CT 21 Amps 4.75
5¼V CT 21A, 7.5V 6A, 7.5V 6A 4.95
5 Volt 4A, 6.3V, 3A 2.45
2.5V CT 20A, 2.5V CT 20A 6.95

CHOKE BARGAINS
6 Henry 50 ma 300 ohms ..... 3 for $0.99
8 Henry 150 ma 140 ohms ..... .99
1.5 Henry 250 ma 72 ohms ..... .59
Swing 1.6/12 Henry 1 Amp/100 ma 15 ohms ... 19.95

HEAVY DUTY RHEOSTAT
25 Ohms, 675 Watts Max. with Knob and Hardware $3.95
10 for $29.50

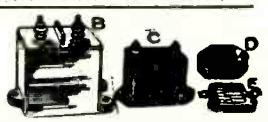
FILAMENT TRANSFORMER
6.3 volts at 12 amps. Primary 110 volts 60 cy. Size 3¼"H x 2⅞"W x 3"D. WT 3½ lbs. As Illustrated. While they last ..... $1.69 ea.

SENSITIVE RELAY
Breaks at 3 MA. Beautifully Constructed and delicately pivoted. Approx. 2000 ohms resistance. Housed in dustproof aluminum can. Plugs into 5 prong socket. Only ..... .99 ea.

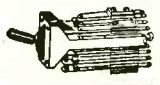
PLUG IN CAPACITOR
8 x 8 Mfd 600 volts DC. Oil filled. Plugs into standard 4 prong socket. 3¾ h x 3⅛ w x 1⅞ d $1.39

GENERAL ELECTRIC Type PBC Instantaneous Overcurrent Relay. Adjustable from 100 to 200 MA. Electrical and Manual Reset, 4 PDT, Reset 110 Volts 60 Cycles $7.95

BAKELITE CASED MICA



MMF	VDC	Price	MMF	VDC	Price
D .001	600	$ .18	C .001	3KV	.90
E .01	600	.26	C .002	3 KV	.95
D .02	600	.26	D .005	3 KV	.70
E .027	600	.26	C .005	3 KV	1.24
C .01	1 KV	.45	C .006	3 KV	1.50
C .056	1 KV	.50	D .002	3 KV	.70
C .07	1 KV	.55	C .0001	5 KV	.70
D .02	1200	.35	C .0005	5 KV	.85
C .024	1500	.65	C .0015	5 KV	1.60
C .033	1500	.75	C .003	5 KV	1.90
C .015	2 KV	.80	C .005	5 KV	2.50
C .02	2 KV	.90	C .002	6 KV	2.90
D .002	2500	.45	B .007	5 KV	2.75
E .005	2500	.55	B .0005	8 KV	2.90
C .025	2500	1.25	B .002	12 KV	6.50



MOSSMAN SWITCHES
4 Pole Single Throw ... $1.10
3 PDT. plus 6 PST 1.75

Heavy Duty Tap-Switch Ohmite Model 412
Single Pole 6 Positions, Non-Shorting 50 amp. contacts. Vitreous Enamel case. List $16.00 ..... Only $2.95

Mallory Vibropack Kit. 6 Volt Input. Output 300 Volts at 100 MA. Transformer & Vibrator. $5.95 for both

High Current Plate Transformer 810 volts CT at 7.75 MA. Pri. 110/220 v. 60 cy. Wt. 36 lbs. Fully cased $6.95

Tremendous stocks on hand. Please send requests for quotas. Special quantity discounts. Price f.o.b. N. Y. 20% with order unless rated, balance C. O. D. Minimum order $5.00.

PEAK ELECTRONICS CO.
188 Washington St., New York 7, N. Y.

Phone CO 7—6486
—6443
DEPARTMENT EA

Latest WELLS Tube Price List

Many Types Are Now Scarce At These Low Prices. Check your requirements at once for your own protection. All tubes are standard brand, new in original cartons, and guaranteed by Wells. Order directly from this ad or through your local Parts Jobber.

TYPE.	PRICE EA.
0A4G	.95
01A	.45
EI-C1A	3.95
1A3	.60
1A5GT	.65
C1B/3C31	4.85
1B4P	1.75
1B21A/GL471A	2.55
1B22	3.40
1B23	7.50
1B32/532A	1.85
1B42	5.25
1B48	9.90
EL1C	4.85
1C5GT	.65
1C6	.75
1C7G	.85
1D8GT	.95
1E7GT	1.95
1F4	.90
1G6	.65
1H4G	.80
1H6G	.80
1I4	.50
1LC6	.75
1LN5	.65
1N5GT	.75
1P24	2.50
1Q5GT	.85
1R4	.55
1S5	.70
1T4	.75
2A3	1.05
2A7	.75
2AP1	4.75
2B7	.75
2B22/GI559	3.25
2C22/7193	.35
2C26	.30
2C26A	.40
2C34	.40
2C44	1.25
2J21	10.45
2J21A	11.45
2J22	9.85
2J26	8.45
2J27	12.95
2J31	9.95
2J32	12.85
2J33	18.95
2J34	17.50
2J37	13.85
2J38	6.95
2J48	12.95
2J61	24.50
2J62	14.95
2X2	.55
2Y3G	1.20
3A4	.35
3A4/47	.45
3B7	.45
3B22	2.35
3B24	1.75
3BP1	3.75
EI-3C	3.95
3C21	5.00
3C24/24G	.50
3C31-C1B	4.85
3CP1-S1	1.95
3DP1	3.75
3D6/1299	.45
3FP7	1.85
3FP7A	4.95
3GP1	4.50
3H17	1.00
3HP7	2.95
3Q5	.90
3Q5GT	.90
3S4	.75
6A4	2.00
REL5	14.95
VT5/215A	1.20
5AP1	3.95
EI-C5B	4.25
5BP1	2.75
5BP4	3.95
5CP1	3.75
5D21	24.75
5FP7	2.75
5GP1	2.75
5HP4	4.75
5J23	14.25
5J29	13.45
5V4G	1.07
5W4	.76
5Z3	.80
5Z3G	.75
6-4	.35
6-7	.35
EI-C6A	2.00
6A3	.80
6A6	.65
6AB7	.95
6AC7	.90
6AE6G	.85
6AG5	1.20
6AH6	1.10
6AK5	1.20
6AK6	.80
6AL5	.95
6AU6	.95
6AV6	.81
6B4G	.95
6B7	.75
6B8	.95
6B8G	.95
6BA6	.95
6BE6	.65
6C4	.40
6C6G	1.05
6C21	19.25
6D6	.50
6F5	.85
6F6	.60
6F6G	.60
6F8G	.95
6G6G	.80
6H6	.45
6J6	.90
6J7GT	.70
6J8G	.95
6K6GT	.55
6K7	.80
6K7G	.80
6L6G	1.35
6L7	.75
6N7	.75
6N7/GT	.75
6Q7	.55
6R7G	.75
6SA7	.65
6SC7	.75
6SC7GT	.70
6SF7	.80
6SF5	.65
6SG7	.65
6SH7	.40
6SH7GT	.40
6SJ7	.60
6SJ7GT	.60
6SK7	.60
6SK7GT	.60
6SL7GT	.60
6SN7GT	.85
6SQ7	.60
6SQ7GT	.60
6SR7	.60
6SR7GT	.60
6SS7	.60
6U7G	.85
6V6GT	.75
6W5G	.80
6X5GT	.73
6Y6G	.65
7-7-11	.35
7A4/XXL	.60
7A5	.80
7A6	.75
7A7	.60
7B4	.60
7B6	.60
7B8	.60
7BP7	4.95
7C4/1203A	.35
7C5	.65
7C7	.65
7E5/1201	.60
7E6	.60
7F7	.70
7H7	.70
7L7	.70
7N7	.70
7T7	.90
7Y4	.90
9-3	.45
10	.55
10 ACORN	.65
10 (VT-25A)	.55
10E/146	1.00
10T1	.60
10Y (VT-25)	.45
12A5	.25
12A6GT	.25
12A7	.80
12AH7GT	1.12
12AU7	.96
12AX7	1.20
12BD6	1.20
12C8	.50
12F5GT	.65
12H6	.40
12J5GT	.40
12J7GT	.70
12K8	.65
12Q7GT	.75
12SA7	.73
12SC7	.75
12SF7	.60
12SG7	.65
12SH7	.40
12SJ7	.73
12SK7	.60
12SK7GT	.60
12SL7GT	.60
12SN7GT	1.10
12SQ7GT	.60
12SR7	.60
12X825-2AMP. TUNG.	1.95
12Z3	.90
13-4	.35
14A7	.90
14B6	.75
14F7	.90
14H7	.90
14Q7	.90
14R7	.90
15E	1.50
15R	1.20
16X879-2AMP. TUNG.	1.95
FG17/967	3.25
19	1.20
20-4 BALLAST.	.45
21-2 BALLAST.	.45
REL21	2.75
23D4	.45
RK24	1.75
24A	.75
RK25/802	2.85
VT-25-A/10	.55
25Z5	.73
25Z6GT	.55
25Z6G	.55
26	.65
27	.50
28D7	.40
30/VT-67	.75
30 (NOT VT-67)	.75
33	.75
34	.35
GL34	1.50
RK34/2C34	.45
35/51	.60
35L6GT	.73
35W4	.73
35Z5GT	.62
36	.40
37	.40
38	.40
39/44	.35
41	.55
42	.50
43	.50
45 SPEC.	.50
46	.75
EF50	.45
UH50	1.00
50B5	1.00
50L6GT	.95
56	.65
57	.45
58	.50
RK60/1641	.65
VT62 (BRITISH)	1.10
65	1.25
66B4	.90
VT67/30	.90
70L7	1.05
71A	.75
CEQ72	1.50
CRP72	.95
CYN72	1.75
RKR72	.90
RKR73	1.25
75	.89
76	.55
77	.55
78	.50
VR78	.65
80	.45
FG-81-A	3.95
83V	.90
89	.73
89Y	.40
VR90	.65
VT90 (BRITISH)	2.55
VR92	.66
FG95/DG1295	9.95
VT98/REL5	14.95
100R	2.75
100TH	11.50
101/837	1.65
102F	3.55
FG105	9.75
VR105	.85
VU-111-S	.55
114B	1.20
121A	2.65
122A	2.65
VT127 (BRITISH)	.35
VT127A	2.95
VR150	.50
VT158 (HK)	14.95
FG172	19.75
205B	1.45
211 (VT-4-C)	.60
215A (VT5)	1.20
CEP220	2.00
221A	1.75
227A	4.75
231D	1.20
RX233A	1.95
250R	9.00
257A	3.00
268A	2.95
282B	4.25
287A/722A	9.50
304TL	1.75
304TH	5.75
307A	4.25
316A	.55
327A	2.50
350B	2.55
354C	14.95
356B	4.95
368AS/703A	3.95
371A/VT62	.95
371B	.85
388A	3.95
393A	4.65
395A	4.95
MX408U-BALLAST.	.30
417A	14.50
434A	3.40
446A	1.55
446B	1.55
450TH	17.95
GI451	1.90
GL471A	2.55
SS501	3.00
527	9.95
WL530	5.00
WL531	12.95
WL532	1.85
532A/1B32	3.55
GL559	3.75
KU610	7.45
HY615	1.05
WL632A	8.75
700	7.95
700B	7.95
700C	7.95
700D	7.95
701A	3.00
702A	2.95
703A/368AS	3.95
704A	1.75
705A	1.55
706AY	17.50
707A	14.00
707B	15.00
708A	3.75
709A	4.75
710A	2.45
713A	1.50
714AY	3.75
715B	9.75
717A	.85
718BY	15.00
718EY	15.00
721A	3.75
721B	3.95
722A/287A	9.50
723AB	14.95
724A	4.25
725A	9.95
726A	12.50
726B	13.50
730A	9.95
801	.50
801A	.70
803	5.25
804	8.95
805	5.95
807	1.25
808	1.65
809	2.50
812	2.95
813	7.85
814	3.75
815	2.85
826	.75
830B	3.95
832A	7.95
834	5.75
835/38111A	1.10
836	1.35
837	1.65
838	3.25
841	.50
842	2.75
843	.50
851	39.00
852	6.25
861	29.45
864	.45
865	2.55
866-JUNIOR.	.85
866A	1.30
869	19.75
869B	27.25
872A	2.45
874	1.95
876	.50
878	1.95
879/2X2	.55
902	3.50
923 (PHOTO)	1.35
930	1.00
931A	3.95
954	.35
955	.55
956	.55
957	.45
958	.55
958A	.55
959	.55
96 7/FG17	3.25
991/NE-16	.24
1005	.35
1007	4.50
1148	.35
1201	.45
1203	.55
1203A	.65
1294	.55
DG1295	9.95
1299/3D6	.45
1613-SELECT. 6F6	.55
1616	1.25
1619	.35
1624	1.25
1625	.35
1626	.35
1629	.35
1630	3.95
1638	.90
1641/RK60	.65
1642	.50
1852/6AC7	.90
1853/6AB7	.95
1960	1.35
1961/532A	1.85
2050	.75
2051	.75
UX6653	1.20
7193	.35
8011/VT90. BRITISH	2.55
8012	3.25
8013	1.25
8013A	1.50
8019	1.75
8020	3.25
8025	6.75
9001	.65
9002	.45
9003	.60
9004	.40
9006	.40
38111A/835	1.10

XTAL DIODES

1N21	.65
1N21A	.95
1N21B	1.20
1N22	.80
1N23	.80
1N23A	.85
1N27	.85
1N29	.85
1N51 (GE)	.75
1N48 (GE)	.75
1N52 (GE)	1.00

JUST OUT — CATALOG H500

Manufacturers, Distributors and Amateurs: Write for the brand new Wells Electronic Catalog H500. It's full of Tremendous values in highest quality components.

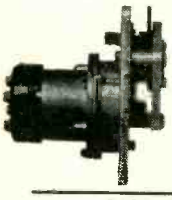
PARTS SHOW VISITORS: Be Sure to See Our Huge Display at Our LaSalle Street Show Rooms

WELLS SALES, INC.

320 N. LA SALLE ST. DEPT. SL, CHICAGO 10, ILL.

IMMEDIATE DELIVERY • LOW PRICES • FULLY GUARANTEED

AC-SERVO MOTORS

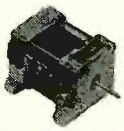


Pioneer Type CK-2. 26 v. 400 cycles fixed phase, var. phase 49 v. max. 40:1 gear reduction. Stock #SA-97A. **Price $6.50 each.** Also available less gear train. **Price $4.25 each.** Stock #SA-97.

PIONEER CK-17

400 cycle 2 phase, 26 v. fixed phase. 45 v. max. variable phase. Built in gear reduction. Output shaft speed approx. 4 rpm. Stock #SA-287. **Price $12.50.**

FORD INS'T SERVO MOTOR



115 volt 60 cycle two phase low inertia motor. 15 watts output. BuOrd. 207927. Stock #SA-291. **Price $49.50 each.**

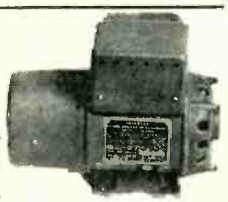
MINNEAPOLIS-HONEYWELL
Type G303AY2CA4

115 v. 400 cycles. Built in gear reduction. 50 in/lb. torque. Stock #SA-268. **Price $6.75 each.**

SAWTOOTH POTENTIOMETER
W.E. KS-15138

Type RL-B-R. 100 ohm element. Non linear ring gives linear output with CRT deflection coil load. Cont. rotation. 2 brushes 180 degrees opposed, 2 taps 180 degrees opposed. Stock #SA-288. **Price $5.50 each.**

INVERTER SPECIALS 400 Cycles



Leland SD-93 — (10285) — Input 28 volts DC at 60 amps. Output 115 volts three phase 400 cycles at 750 va. 0.90 P.F. Second output voltage of 26 volts 400 cycles at 50 V.A. Voltage and frequency regulated. Designed for use with various autopilots. Stock #SA-209. . . . **Price $79.50 each**

General Electric PE-218 D—Input 28 v. d-c @ 92 amps. Output 115 v. 400 cycles @ 1500 va. Power factor 0.90. Shipping wt. 100 lbs. New—Original Cartons. Stock #SA-112. **Price $39.50 each.**

Leland or Russell PE-218 E or PE-20.8H. Similar to PE-218D. Stock #SA-112A. **Special Price $29.50 each.**

General Electric 5D21NJ3A — Input 28 volts DC at 35 amps. Output 110 volts 400 cycles. 485 V.A. at 0.90 P.F. Weight 15 lbs. Stock #SA-41. **Price $12.50 each**

General Electric 5AS131NJ3 — Input 26 volts DC at 100 amps. Output 115 volts 400 cycles. 1500 V.A. 0.8 PF. Stock #SA-286. **Price $19.50 each**

SERVO AMPLIFIER

Minneapolis Honeywell 115 v. 400 cycle unit. For use with SA-268. Model G403ATCA3. Designed for use with A-C error signal from bridge circuit. Stock #SA-269A. **Price $8.50.**

DC SERVO MOTORS

Elinco B-64 DC Servo Unit — armature voltage, 80 v d-c max. 27.5 v. field 1/165 hp 3100 rpm. Field current 200 ma. Armature current 200 ma. at normal torque. Stock #SA-211. **Price $12.50 each.**

John Oster A-21E-12R — Split field series reversible motor. W.E. KS-5996-LO-4. 28 v. d-c at 0.4 amps. 2 watts output. 1½" diam. x 2½" lg. Ideal for relay or thyratron servos. Stock #SA-282. **Price $6.75 each.**

G.E. 5PS56HC18 — Split field series reversible motor. 60 v. d-c at 1.4 amperes. 5500 rpm. 3" diam. x 5" lg. Ideal for servo applications. Stock #SA-273. **Price $8.75 each.**

OSTER PM MOTOR
Alinco Field

27.5 v. d-c. Can also be used as rate generator. #SA-281. **$3.75 each**

MAGNETIC AMPLIFIER ASSEMBLY

Sperry 661824. Saturable reactor type output transformer. Designed to supply one phase of 400 cycle servo motor. Stock #SA-266. **Price $6.75 each.**

PIONEER TORQUE UNITS

Types:
12602-1-A
12604-3-A
12606-1-A
12627-1-A, 12627-7-A.

Prices On Request

Blower Assembly MX-215 APG

John Oster C-2P-1L 28 V. DC. 7000 RPM. 1/100 H.P. #2 L-R Blower. Stock #SA-202. **Price $4.75 each**

AC Motor Special Eastern Air Devices J-33 115 V. 400 cy. 3 phase synchronous. 8000 RPM. Stock #SA-59. **Price $8.00 each**

Compass Indicator I-82F Compass Indicator. 0-360°-5 in. dial. 26 v 400 cy. 8-12 v. 60 cy. Ideal position indicator. Stock #SA-284. **Price $6.50 each**

LP-21-LM Compass Loops

Motor driven loop enclosed in graphited zeppelin housing includes Autosyn transmitter.

New **$12.50 each**

G.E. Servo Amplifier—2CV1C1
Aircraft amplidyne control amplifier, 115 volt 400 cycles. Two channel. Uses 2 6SN7GT and 4 6V6GT tubes. Supplied less tubes. Stock #SA-168. **Price $9.50 each.**

1SF SYNCHRO SPECIAL

Navy Ordnance Type 1F Special. Designed for 115 volt 400 cycles operation. Use as either generator or repeater. May be used on 24-28 volts 60 cycles operation. Stock #SA 29. **Price $19.50 each.**

SYNCHROS

Navy Types

1G, 1F, 1CT, 5G, 5F, 5CT, 5DG, 5HCT, 5SF, 5HSF, 5SDG, 6DG, 6G, 6DG, 7G, etc.

Prices on Request

D.C. MOTORS

Universal Electric DC W.E. KS-5603-1-02,-28 v. d-c 0.6 amps. 1/100 hp. 4 lead shunt. Stock #SA-233. **Price $2.95 ea. plus 15¢ p.p.**

12 V.D.C. Motor
John Oster B-9-2
1.4 amps.
5600 rpm.

1¾" Diam. x 3¾" Lg. Spline shaft. C. W. rotation. Stock #SA-46. **Price $1.95 each**

DELCO CONSTANT SPEED MOTOR A-7155

1/30 hp. 27.5 v d-c 3600 rpm. Cont. duty. 2½" diam. x 5½" lg. ⅞" shaft extension, 5/32" diam. 4 hole base mounting. Stock #SA-94. **Price $4.75.**

Delco 506925 Constant Speed DC Motor, 27 v. d-c 120 rpm. Governor controlled. Stock #SA-249. **Price $3.95 each.**

General Electric 2 RPM Motor. Type 5BA10FJ228. 27 v. d-c @ 0.6 amps. 10 lb/in torque at 2 rpm. Shunt wound. D-C noise filter. Stock #SA-274. **Price $6.75 each.**

Synchron 10 RPM Timing Motor—24 V. Hanson Mfg. Co. Stock #SA-110. **Price $3.75 each.**

General Electric Type 5BA10AJ52C 145 rpm. 27.5 volt D-C motor. 0.65 amps. 14 in./oz. torque. Shunt wound four lead reversible. Stock #SA-218. **Price $4.75 each.**

D-C ALNICO FIELD MOTORS

Delco 5069456. 27.5 volts, 10,000 rpm. 1" x 1" x 2" lg. Stock #SA-236. **Price $6.75 each.**

Other models also available

Prices F.O.B. Paterson
Phone ARmory 4-3366
Teletype PAT. 199

WRITE FOR LISTING

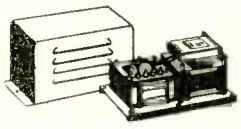
Servo-Tek products co.
4 Godwin Ave. Paterson, N. J.

SPECIALISTS IN FRACTIONAL HORSE POWER MOTOR SPEED CONTROL

LINE VOLTAGE STABILIZERS

RAYTHEON—Navy Type, CRP-301407 Input: 92-138V, 57/63 CPS., 1 PH. Output: 115V, 0.82 KVA., 1% Reg., 0.96 PF. Weight 385 lbs. Overall size—36" high x 20" wide x 12¼" deep. Enclosed in Navy Grey Ventilated Cabinet for Wall Mounting.

Brand New $69.50

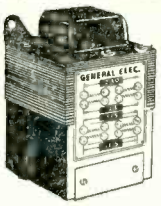


RAYTHEON Adj. input taps 95-130V., 60 cy. 1 Ph. Output: 115V., 60 Watts. ½ of 1% Reg. Wt. 20 lbs. 6⅛" H x 8¾" L x 4⅝" W. Overload protected. Sturdily constructed. Tropicalized.

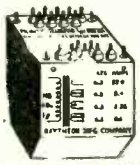
Special $12.50

TRANSFORMERS

1. 5 KVA Stepdown



General Electric Cat. No. 76G173. Input: 115 or 230 Volts, 60 cycles. Output: 23 or 11.5 volts at 1.5KVA. Either high voltage connection may be used with either low voltage connection. Weight 50 lbs. Brand new **$23.95**

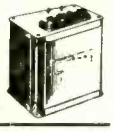


FILAMENT TRANSFORMER

Raytheon Hypersil core. Primary: 115V., 60 cycles. Sec: 6.3 at 22A., 6.3 @ 2.4A., 6.3 @ 2.25A., 6.3 at 0.6A., 1700V. INS.

Brand New $3.95

For type 866 tubes



Kenyon. Input: 115 volts. Output: 2.5 volts center tapped, at 10 amps. Glazed porcelain standoff insulated for high voltage breakdown.

Brand New $2.95

AUTO TRANSFORMER

G.E. 400 cy. Cat. No. 80G184 K.V.A. .945S—520P Volts 460/345/230/115 New..... **$3.45**

FILAMENT TRANS. 400/2600 cy.

Input: 0/75/80/85/105/115/125V. Output: 5V3A, 5V3A, 5V3A, 5V3A, 5V6A, 5V6A, 6.3V6A, 6.3V5A **$1.95**

THYRATRON POWER TRANS.

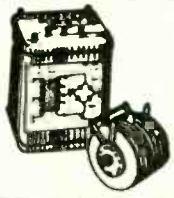
Raytheon UX8876, 400/1600 cy. PRI: 115V, 1 PH SEC: 50-050V at 0.5A, 6.3V 1.2A Test r.m.s. 1780 **$2.75**

PULSE TRANSFORMER

Utah No. 9350..... **$1.25**

BLOCKING OSC. TRANS.

Westinghouse #132 AWP Fosterized **$4.95**

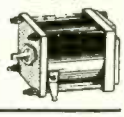


12 and 24 Volt POWER KIT

Consists of Power Trans. and full wave bridge selenium rectifier. Input: 115/230 A.C. Output: 12/24V D.C. at 1.1 amps. Fine for operating relays, small motors, dynamotors, or for low voltage D.C. source in laboratories, etc.

Brand New $7.95

SWEEP GENERATOR CAPACITOR



High speed ball bearings. Split stator silver plated coaxial type. 5/10 mmfd. Brand new. **$1.00**

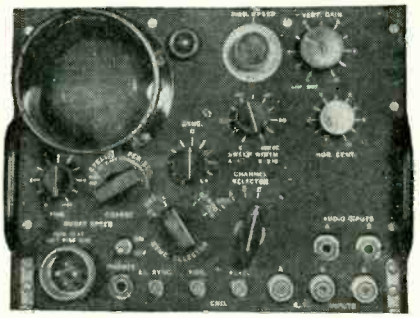
Differential Synchros

90/90 volts, 400 cycles. Brand new in sealed containers. Ford Inst. Co. type 5SDG. Brand new. **$12.50**

MICROWAVE RECEIVERS APR. 1, APR-4, APR-5A.

Tuning Units for APR-1 or APR-4, TN-16 (38-95 mc). TN-17 (74-320 mc.) TN-18 (300-1000mc.) These front ends may be used with any 30 mc. IF amplifier or as converters into receivers tuned to 30 mc.)

MODEL AN/APA-10 PANORAMIC ADAPTER



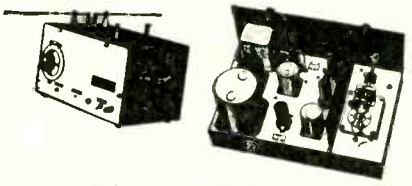
Provides 4 Types of Presentation:

(1) Panoramic (2) Aurol

(3) Oscillographic (4) Oscillosocopic

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.

Includes 80 page T. M..... $195.00



RADIO MODULATOR

Type BC-423-B, or tweeter, is a miniature keying unit, modulator and transmitter combined. A dipole mounted atop the tweeter case radiates a signal pulse at 205 megacycles modulated by pulses occurring at 4,098 CPS. Uses 2-6J7, 1-6F6, 1-955, 1-5W4 tubes. Operates from 115V, 60 cy. source. Brand new including tubes and instruction book.. **$19.50**

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**

MOTOR GENERATORS

Allis-Chalmers 115V. D.C. to 120V, 60 cy. 1 Ph. 1.25 K.V.A., P.F. .80 Centrifugal starter. Fully enclosed.

New $97.50

Same as above but for 230V. D.C. input **$125.00**

Spare Parts Kit for either machine.....$15.00

Diehl 120V. D.C. to 120V. A.C., 60 cy., 1 Ph., 2.5 K.V.A., P.F. .4. Complete with magnetic controller, 2 field rheostats and full set of spare parts including spare armatures for generator and motor.

New $185.00

O'Keefe and Merritt, 115V. D.C. to 120V. A.C. 50 cycles, 2 K. V. A., Pf. .9 Idles as a 3 phase synchronous motor on 208V. 50 cy.

New $165.00

Electrolux dynamotor 105/130V. D. C. at 6 amps. to 26 or 13V. D.C. at 20 amps or 40 amps. respectively. Fully filtered for radio use and complete with Square "D" lineswitch. Navy type CAJO-211444.

New $74.50

Shown above are selections from our inventory. A complete listing is now available. *Write for it today.*

MERCURY CONTACT VACUUM RELAYS

WE Type D-168479

Glass sealed, mercury-wetted contact switches surrounded by operating coils encased in metal housings on octal tube base. S.P.D.T. contacts. 2 coils, 700 and 3300 ohms. Operating current coils seriesed 6.6 MA releasing at 5.2MA. Operating life 1000 hrs. at 60 operations per sec. Used for: High Speed Keying • Tabulating • Sorting and computing machines • Relay amplifiers • Vibrator supplies • Servo Mechanisms, etc.

Send for 4 page data sheet

$4.75 ea.
Brand New

THERMOSTATIC TIME DELAY RELAY

Amperite type 115 No.—45 Heater voltage 115V. Normally open SPST contacts. 45 sec. delay. Contact rating 115V-3A., A.C. (or 440V., A.C. 2A) max. voltage on contacts—1000 max voltage bet. contacts and heater—1500. Size 3 9/32 x 1¼" overall. Made for U. S. Navy..... **$1.10**

CRYSTAL DIODE

Sylvania 1N21B. Individually boxed and packed in leaded foil. Brand new **$1.00**

High Voltage Capacitors

Oil Filled

.25 MFD., 20KV..... **$15.75**
.5 MFD., 25KV..... **$23.50**
1 MFD., 15KV..... **$16.50**
1MFD., 7.5KV..... **$4.95**

All brand new. Made by prominent manufacturers.

LAVOIE FREQ. METER MICRO-WAVE

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.

Write for descriptive circular..... **$49.50**

$5.50
Brand New

LINEAR SAWTOOTH POTENTIOMETER

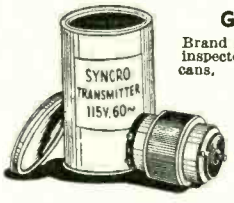
No. KS 15138

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. Size approximately 3¾" dia. x 3" deep x 4¾" long. Enclosed in die cast alum. frame with AN connector socket.

U. S. NAVY SOUND POWERED BATTLE PHONES

Western Electric No. D173312, Type O, Combination headset and chest microphone as illustrated. 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. **$13.50**



SYNCHRO GENERATORS

Brand new—Gov't. sealed and inspected—Packed in overseas cans, Synchro Transmitters 115V., 60 cy. operation. Precision accuracy made for gun fire control. Cost Gov't. $90.00 each. Wgt. 5 lbs. Dimensions: 4⅛"L x 3¼". Brand New Per Pair **$14.75**

All prices indicated are F O B Tuckahoe, New York. Shipments will be made via Railway Express unless other instructions issued.

ELECTRONICRAFT

INC.

5 WAVERLY PLACE TUCKAHOE 7, N. Y.

PHONE: TUCKAHOE 3-0044

All merchandise guaranteed. Immediate delivery, subject to prior sale.

All Prices Subject to Change Without Notice

GUARANTEED BRAND NEW

LECTRONIC RESEARCH TUBE SPECIALS

STANDARD BRANDS ONLY

RECEIVING TUBES		6BH6	.72	12SN7GT	.79
OZ4G	.59	6BJ6	.72	12SR7	.69
1A3	.45	6C4	.21	28D7	.61
1AB5	.73	6F6	.69	**Cathode Ray Tubes**	
1B3GT/8016	1.18	6H6	.49	2AP1	3.65
1L4	.66	6J5	.49	2AP5	5.95
1R4	.29	6J6	.89	3AP1	4.63
1R5	.69	6J7	.72	3AP4/906P4	5.94
1S4	.86	6K6GT	.52	3BP1	2.59
1S5	.64	6K7	.54	3CP1	1.87
1T4	.64	6K8	.83	3DP1A	5.75
2X2/879	.49	6L6	1.22	3EP1	2.92
2X2A	.79	6L6G	1.11	3HP7	4.91
3A4	.61	6L6GA	.87	4AP10	5.35
3A5	.96	6SB7Y	.79	5AP1	3.75
3A8GT	1.76	6SC7	.66	5AP4	4.75
3B7/1291	.29	6SG7	.69	5BP1	2.40
3D6/1299	.29	6SH7	.44	5CP1	2.87
3Q5GT	.79	6SJ7	.59	5CP7	3.76
3S4	.61	6SL7GT	.69	5FP7	.57
5R4GY	1.05	6SN7GT	.64	5HP4	3.35
5T4	.89	6SN7W	1.45	5JP4	9.55
5U4G	.59	6V6	1.07	5LP1	13.95
5V4G	.84	6V6GT	.59	5MP1	10.65
5Z3	.65	6W4GT	.65	7BP1	12.87
6AB7/1853	.99	6X4	.59	7BP7	4.95
6AC7/1852	.79	6X5GT	.59	7BP14	14.95
6AC7W	1.45	7F7	.79	9GP7	9.85
6AG5	.89	7N7	.79	9LP7	3.88
6AG7	1.19	10Y	.19	10BP4	24.66
6AJ5	.89	12A6	.24	10FP4	28.88
6AK5	.89	12AH7GT	.87	12DP7	12.85
WE-6AK5	1.35	12AT6	.59	12GP7	12.85
6AK6	.82	12AT7	.99	905	4.47
6AL5	.69	12AU6	.72	913	4.90
6AQ5	.72	12AU7	.86	**Photo Cells**	
6AQ6	.65	12AX7	.86	1P24	.29
6AS7G	4.22	12BA6	.64	918	.88
6AT6	.54	12BA7	.86	923	.97
6AU6	.72	12BE6	.64	927	1.67
6AV6	.55	12C8	.59	931A	3.22
6BA6	.65	12SG7	.69	1645	1.67
6BA7	.86	12SH7	.49		
6BE6	.65	12SJ7	.49		
6BG6G	1.72	12SK7	.59		
		12SL7GT	.69		

Thyratrons		2C44	.79	RK-25	2.11	304TL	1.25	714AY	6.95	874	1.65
OA4G	.95	2E22	1.25	FG-32	4.25	WE-310A	7.50	715A	6.75	876	.39
EL-C1A	3.35	2J21A	8.95	RK-34	.28	316A	.66	715B	9.95	878	1.85
2A4G	1.15	2J22	8.95	REL-36	.78	350A	2.80	717A	.97	954	.39
2D21	1.09	2J26	7.80	RK-47	4.92	350B	1.95	721A	3.93	955	.39
3C23	3.20	2J27	13.70	EF-50	.45	354C	19.50	723A/B	16.50	956	.49
4C35	19.77	2J31	9.60	VT-52	.36	WE-356B	4.45	724A	3.22	957	.49
EL-C5B	8.95	2J32	14.45	53A	3.82	361A	4.75	724B	3.22	958A	.49
C6J	4.44	2J33	19.90	RK-59	2.44	371B	.82	725A	8.95	991	.29
FG-17	2.89	2J34	19.90	RK-60/1641	.59	388A	2.95	726A	14.50	1005	.24
FG-33	11.95	2J37	13.70	RK-72	.92	417A	10.65	730A	10.95	1201A/7E5	.29
FG-67/1904	8.85	2J38	12.70	RK-73	.92	434A	3.65	731A	2.45	1203/7C4	.19
FG-81A	4.95	2J48	14.95	VR-75	.98	446A	.79	WL787	9.80	1294/1R4	.29
FG-105	9.95	2J61	36.20	75T	3.80	450TH	19.70	800	1.88	1299/3D6	.29
FG-172	14.50	2K23	23.95	VR-78	.34	451	1.75	801A	.48	1602	.68
WE355A	14.15	2X2/879	.49	VR-90/OB3	.81	471A	2.75	802	4.25	1613	.61
394A	3.77	2X2A	.79	VT-98 (BR)	29.90	503AX	1.47	803	4.87	1616	.87
KU-610	6.35	3B22/EL-IC	1.12	C100E	2.30	506AX	1.47	804	8.95	1619	.19
KU-634	17.20	3B24	1.25	100R	2.90	507AX	1.47	805	4.75	1624	.69
WL-677	24.00	3B27	1.29	100TH	10.25	527	9.75	807	1.15	1625	.19
873	6.95	3C24	.44	WE-101D	1.65	530	17.20	808	2.19	1626	.29
884	1.35	3E29	6.20	WE-101F	3.62	531	17.80	809	2.40	1629	.29
885	.88	3J31	39.25	VR-105/OC3	.72	532A	3.15	810	7.25	1630	3.11
1665	.97	SN-4/631-P1	3.77	WE-113A	1.32	559	1.41	811	1.91	1631	1.38
1904	8.85	4A1	.58	WE-124A	3.80	561	1.45	813	6.95	1636	3.77
2050	.83	4B22/EL-5B	5.20	VT-127A	2.40	579B	5.85	814	3.79	1638	.70
2051	.49	4B24/EL-3C	2.44	VR-150/OD3	.65	HY615	.29	815	1.72	1641/RK-60	.59
Transmitting & Special Purpose Tubes		4B25/EL-6CF	8.70	203A	6.40	631-P1	3.77	816	.97	1642	.39
OA2	1.32	4C28	8.85	203B	4.33	WL-670A	8.70	826	.57	1644	1.17
OB2	1.75	4E27	12.75	204A	27.90	700B	16.90	829	4.91	1960	1.21
1B22	3.87	5D21	26.50	WE-205B	1.70	700C	16.90	829B	6.20	UX-6653	.65
1B23	8.95	5J23	14.20	CE-206	3.15	700D	16.90	830B	3.35	7193	.22
1B24	4.90	5J29	14.20	211	.62	701A	3.67	832	3.95	8005	4.65
1B26	4.50	5R4GY	1.05	WE-215A	.24	702A	2.95	832A	4.91	8011	.87
1B27	4.50	6C21	19.88	221A	1.95	702B	3.87	836	.89	8012	1.45
1B29	2.90	6J4	5.20	227A	2.40	703A	3.90	837	1.38	8012A	1.91
1B32	3.15	10T1	.58	WE-231D	1.25	704A	2.75	838	2.93	8013	.92
1B36	4.50	10Y	.19	WE-245A	1.35	705A	1.17	841	.49	8013A	1.42
1B42	9.80	15E	1.25	WE-249C	1.88	706AY	45.00	843	.59	8014A	21.50
1H20	.58	15R	.75	WE-257A	2.77	706BY	45.00	851	27.50	8016	1.18
2B22	1.41	REL-21	3.25	WE-259A	4.22	706CY	17.95	852	6.40	8020	1.39
2C22	.22	24G	.44	WE-271A	6.75	706FY	45.00	860	4.50	8025	3.17
2C26	.27			WE-283A	1.27	707A	5.22	861	17.70	9001	.42
2C34	.28			304TH	3.86	707B	6.95	864	.19	9002	.39
						708A	4.85	866A	.95	9003	.39
						710A	2.25	869B	27.00	9004	.39
						713A	1.45	872A	1.88	9006	.29

SEND FOR OUR COMPLETE TUBE LISTING

CAPACITORS

MOLDED OIL-IMPREGNATED PAPER

.02 MFD	200 VDC	.04½ Ea.	$3.00 per 100
.05	200	.04½	3.00
.1	200	.04½	3.00
.25	200	.06	4.00
.1	400	.09	6.00
.005	600	.04½	3.00
.01	600	.07	4.75
.05	600	.08	5.50

FILTER CHOKES

ALL HIGH VOLTAGE INSULATION

13 H	250 MA	GEN. ELEC.	$3.22
10 H	400 MA	ACME	3.77
15 H	500 MA	AMERTRAN	9.20
14/7 H	130/570 MA	AMERTRAN	9.85
22/8 H	50/860 MA	AMERTRAN	18.75
.02 H	5 AMP	RCA	3.95

TEST EQUIPMENT

- Alfred W. Barber Labs. Mod. VM-25 VTVM $86.00
- General Radio Model P-500A Standard Signal Generator (Same as G. R. 805A except covers 9KC to 32 MC) $450.00
- Galvin Model CES-I Standard Crystal Test Set $45.00

TS-10A/APN Delay Line Test Set $25.00
TS-19/APQ-5 Calibrator $75.00
AT-48/UP "X" Band Horn $3.95
REL W-1158 Frequency Meter 160-220 MC $32.95
CWI-60AAG Range Calibrator for ASB, ASE, ASV and ACVC Radars $39.95
CRV-14AAS Phantom Antenna for Transmitters up to 400 MC $11.75

- Raytheon VR-5 Constant Voltage Transformer Input 95/130 V 60 cy—Output 115 V 500 W ... $38.50

Sola Constant Voltage Transformer Input 95/125 V 60 cy.—Output 15.8 V 285 VA $24.70
Federal Constant Voltage Transformer Input 95/135 V 50/60 cy—Output 115 V 210 W $34.00

- C-D Quietone Filter Type IF-16 110/220 V AC/DC 20 Amps $9.00

All Items New Except Where Noted. • (Exc. Used Condition)

PULSE TRANSFORMERS

UTAH 9262	$1.50
UTAH 9278	$1.50
G. E. 68G-627	$3.75
AN/APN-9 (901756-501)	$1.25
AN/APN-9 (901756-502)	$1.25
AN/APN-4 Block. Osc	.88

RADIATION COUNTER TUBES

IB98 GAMMA COUNTER $9.87
AMPEREX 75NB (Beta & Gamma) $9.90
Full Line of Amperex Radiation Counters In Stock

115 V 60 CY AC RELAYS

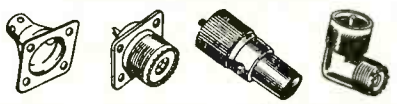
Westinghouse Type SG—DPST Normally Open 12 Amp Contacts $1.88
Struthers-Dunn Type 8HXX—SPST Normally Open 30 Amp Contacts $1.88
CRAMER Type C5M—Synchronous motor type 5 min. time delay—SPST normally open 10 Amp contacts $2.87

MONTHLY BULLETINS

SEND IN YOUR NAME AND ADDRESS TO GET ON OUR MAILING LIST

All material brand new and fully guaranteed. Terms 20% cash w/ order, balance C. O. D. unless rated. All prices F.O.B. our warehouse, Phila., Penna.

COAXIAL CONNECTORS



83-1AC	.42	UG-12/U	.63	UG-86/U	1.22
83-1AP	.09	UG-21U	.67	UG-87/U	.68
83-1F	1.12	UG-22U	.86	UG-171/U	1.33
83-1H	.10	UG-23U	.63	UG-175/U	.15
83-1J	.80	UG-24U	.67	UG-176/U	.15
83-1R	.28	UG-27U	.68	UG-180A/U	3.82
83-1SP	.28	UG-29U	.83	UG-191/AP	.57
83-1SPN	.28	UG-30U	.94	MX-195/U	.41
83-1T	1.12	UG-34/U	12.80	UG-197/U	1.33
83-22AP	.85	UG-35/U	12.80	UG-206/U	.58
83-22F	.88	UG-37/U	12.80	UG-255/U	.82
83-22R	.48	UG-58/U	.57	UG-264/U	1.74
83-22SP	.60	UG-85/U	.62	MX-367/U	.15

Full Line of JAN Approved Coaxial Connectors in Stock. Send us your inquiries.

TYPE "J" POTENTIOMETERS

38c each

Resis.	Shaft	Resis.	Shaft	Resis.	Shaft
100	SS	10K	SS	50K	SS
200	SS	15K	½"	100K	5/8"
500	½"	15K	SS	100K	SS
650	½"	20K	SS	150K	½"
1000	SS	25K	1½"	200K	SS
6500	SS	25K	SS	250K	SS
10K	3/8"	30K	1 1/8"	1 MEG	SS
10K	½"	50K	5/8"		

Triple 100K - 3/8" Shaft - 1.47
All shaft lengths beyond bushing - SS (screw slot)

UNIVERSAL OUTPUT TRANSFORMER

RCA 15 WATT HIGH FIDELITY
PRI—1000/2000/4000/8000/16000 Ohms
SEC—2/6/15 Ohms
$1.69 Each — $1.52 Ea. Lots of 10

IGNITRONS

GL-415/5550	$22.00
WL-681/5550	$22.00
WL-652/5551	$38.00

ROTARY CONVERTER

Janette Type CA-18 F with Filter Assy. Input—115 VDC. Output—110 V 60 cy 1.17A with spare brushes and brush-holders $28.80

PIONEER SERVO SYSTEM UNITS

- Type 12073-1A Torque Amplifier, Input 115 V 100 cy. Complete with Tubes $14.95
- Magnetic Amplifier Assy. Saturable Reactor Type to supply one phase of 400 cycle Servo Motor ... $5.95

OIL-FILLED CAPACITORS

50 MFD	220 VAC	$2.95
60 MFD	330 VAC	$4.89
32 MFD	2500 VDC	$10.80
7 MFD	660 VAC	$2.95
3.5-.5 MFD	1000 VDC	.95
.1 MFD	7000 VDC	$1.79
.045 MFD	16 KVDC	$4.70

SPECIAL
2 MFD 12, 500 VDC
INERTEEN TYPE FP
$23.95

SELENIUM RECTIFIERS

HALF-WAVE	130 VDC OUTPUT	
75 MA - .58	150 MA - .91	250 MA - 1.21
100 MA - .72		400 MA - 1.51

SOUND POWERED TELEPHONES

- U. S. INSTRUMENT Type A-260
- WESTERN ELECTRIC Type D-173013
- AUTOMATIC ELECTRIC Type GL-832BAO

U. S. NAVY TYPE M HEAD AND CHEST SETS
These are high quality heavy-duty units not to be confused with cheaper units now available. Designed to withstand exacting shock, vibration, salt water corrosion, temperature and pressure tests. ANY TYPE $14.88 ea., $28.00 per pair

SURPLUS EQUIPMENT TROUBLE SHOOTING MANUALS

(Includes Schematics)

BC-348 J, N, Q — SCR-522
BC-779 — BC-610
$1.00 Each

KOLLSMAN INSTRUMENT

Freq. Cycles	100	Res.—Phase 1	306Ω
Volts—Phase 1	85	Res.—Phase 2	776Ω
Volts—Phase 2	68	No. of Poles	4
Current—Phase 1—110MA		Speed—RPM	2650
Current—Phase 2— 40MA		Weight—Oz.	6.5
Input Watts—No Load 2650 RPM CW			5.8
Input Watts—Stalled			5.0
Torque Stalled—(Oz. In.)			.80
Temp. Rise (°C)—2650 RPM—No Load			54
Temp. Rise (°C)—Stalled			54
Reversing Time—(Seconds)			0.1
Moment of Inertia (G. CM.²)			6.7

Will Operate Satisfactorily at 60 Cycles
Original Price $34.50—Our Price—$8.22 ea.
$7.50 EACH—Lots of 10

SPECIAL! 1N34 GERMANIUM DIODES **69¢**

LECTRONIC RESEARCH LABORATORIES

1021-23 CALLOWHILL ST. PHILA. 23, PA.
Telephones - MARKET 7-6590 and 6591

ORDER from ARROW!

TEN TUBE SUPERHET RECEIVER

with crystal controlled local oscillator. Has provisions for six crystal channels between 108 to 112 MCPS complete with tubes and crystals but less dynamotor

New $7.95
Like New 5.95
Less Tubes and dynamotor but New 3.95

RECEIVER—Easily Converted for Use in Citizens Band Crystal Controlled Local Oscillator. Broad Band pass—20.7 MC IF.'s. Complete with 7-6AJ5, 1—12SR7, 2—12SN7, 1—28D7, relays, crystals. Schematic furnished. New $7.95

Westinghouse Auxiliary Relay Type MC

Style 423396 C—110 V 60 cycle 4 pole.
Enclosed in glass case.....New $7.50

HERMETICALLY SEALED CHOKES

10 H.	100 M.A.	59¢	**3.7 H.**	145 M.A.	59¢
59 H.	100 M.A.	95¢	**10 H.**	20 M.A.	39¢

.5x.5x1x1 H—4 winding layer wound.
.5 H at 3.56 A 140 ohms
1 H at 1.56 A 320 ohms New $0.49

BC-605 Interphone Amplifier

Easily converted to an ideal intercommunication set for office — home — or factory.

Original—New..... $4.95
Like New..... 3.95
(With Schematic)

All necessary parts and instructions to convert the above to AC operation with one remote station $8.25 additional.

BC-604 Transmitter FM 20-28 MC

11 and 15 meters. Can be operated on 10 meters—10 channel push button crystal. With all tubes and meter but less dynamotor.
Excellent Condition $12.95

Crystals—Set of 80..... 14.95
BC-603—Companion receiver to above with tubes but less dynamotor. Used $17.50

DYNAMOTORS

DM-28—For BC-348 with Mount and Filter	New	$6.95
	Used	3.95
DY-12—For ART-13 less filter and base	New	6.95
DM-35	Used	.95
	New	1.95
BD-77	New	5.95
PE-206	New	6.95
	Used	2.75
PE-101	New	2.75
PE-73	New	3.95
DM-53	New	3.95
	Used .95	(3 for $2.00)
DM-32	New	1.95
	Used .95	(3 for $2.00)

BEAM INDICATORS

I 82—5"	New	$4.95
Transmitter Selsyn for above		2.45
	both for	7.00
I 81—3"	New	3.45
Transmitter Selsyn for above		2.45
	both for	5.25
I 81	Used	2.45

T-85/APT5 UHF TRANSMITTER

operating over a frequency range of 300 to 1400 MCPC with a nominal output of from 10 to 30 watts. Unit is equipped with 110 V 60 CPS filament transformer; blower; lecher wire test frequency set, and 8 tubes—1-931A; 2-6AC7; 2-6AG7; 1-6L6G; 2-829B; 1-3C22 (GL522) (oscillator).

New in original box with Operating Instruction Manual..... $69.50

All shipments FOB Chicago. 20% Deposit required on all orders. Minimum order accepted—$5.00. Illinois residents, please add regular sales tax to your remittance.

TUBES Drastically Reduced from 10 to 50%— Nationally Advertised Brands

Type	Net Price	Type	Net Price	Type	Net Price	Type	Net Price	Type	Net Price
1A4P	$0.24	5FP7	.95	7C4/1203A	.24	30	.24	837	1.49
1A6	.19	5J23	5.95	7E5/1201	.39	304TL	1.29	841	.29
1B5/25S	.24	5T4	.49	10YVT25A	.19	32L7GT	.39	864	.29
1B22	1.49	5W4	.49	12A6	.34	33	.24	872A	.98
1B26	2.29	5Z4	.49	12A6GT	.34	34	.24	954	.19
1B29	.39	6AB7	.59	12A7	.34	35/51	.24	955	.34
1B32-532A	2.29	6AJ5	.89	12A8GT	.19	36	.24	957	.34
1C6	.19	6B8	.59	12F5GT	.29	37	.24	1625	.19
1C7G	.19	6C4	.29	12H6	.29	38	.24	1626	.24
1D5GP	.24	6D8G	.59	12J5GT	.24	39/44	.24	1629	.24
1D7G	.19	6F5GT	.39	12J7GT	.24	49	.39	1630	.29
1F4	.24	6F6G	.59	12K8GT	.24	50	.39	1636	2.95
1F5G	.24	6H6	.29	12Q7GT	.24	56	.24	1638	.69
1H4G	.24	6J7GT	.39	12SF5	.24	57	.24	1642	.29
1J6G	.24	6K6G	.59	12SF5GT	.24	76	.24	2050	.89
1J6GT	.24	6L5G	.39	12SF7	.24	77	.24	2051	.49
1P5GT	.24	6L7G	.39	12SH7	.24	211/Vt4L	.29	7193	.19
1V	.24	6R7	.34	12SR7	.24	316A	.34	9002	.34
2A6	.39	6SF5GT	.34	12SR7GT	.29	371B	.34	9003	.39
2A7	.24	6S7G	.39	12SN7GT	.89	700A	7.95	9006	.29
2C26A	.19	6S8GT	.59	12Z3	.29	703A	1.49	GL4A21	.29
2V3G	.49	6SG7	.59	15R	.19	705A	.79	Amperite	
2X2/879	.25	6SF7	.39	19	.59	714AY	5.95	10T1	.29
3FP7	.98	6SJ7	.69	2J22	.24	724B	4.95	Jan CRP72	.98
4AP10	.98	6T7G	.39	28D7	.34	801A	.39	REL36	.69
5BP4	2.95	6U7G	.29	30SPEC		813	5.95	VR150	.39
5CP1	2.95	6Z7G	.39	(Vt67)	.59	829	6.95	VR105	.69
5D21	9.95	6ZY5G	.29			832	4.95		

WRITE FOR QUANTITY PRICES

Miscellaneous SPECIALS

	Used	New
ID 6/APN 4 Scope, Excellent	$29.50	
R 7APS 2 Receiver-Indicator		$79.50
R 78/APS-15 Receiver-Indicator	34.50	
BC 1287 A Scope	75.00	
ASB 7 Indicator Scope	12.95	
SCR 522 Transceiver 100 to 150 MC	34.95	75.00
BC 1206 Receiver, 200 to 400 KC	3.95	5.95
MN 26 C or **Y** Receiver	17.50	24.95
RA 10 DA Receiver	17.50	24.95
T26/APT2 Transmitter	8.95	
RT7/APN1 Transceiver	5.95	9.95
APN 1 Complete		24.50
BD 71 6 Pos. Switchboard	9.95	12.95
EE 8 Field Phones	7.95	
BC 347 Interphone Amplifier		2.95
I-70 Tuning Meter		.89
AM 61 Indicating Amplifier		9.50
SCR 625 Mine Detector		39.50
PE 237 Power Supply		12.95
BC 461 Veeder Root Counter		.59
BC 442 Less Condenser	1.49	1.95
A 27 Rhantom Antenna		.98
APS 13 UHF Antenna, Pair		.98
Manual for **BC 312&342J**		1.00
Manual for **SCR 269 G**		2.50

	Used	New
FL 8 Filter	2.95	
I-97 Bias Meter	4.95	3.95
RM 29 Remote Telephone Control	7.95	9.95
BC 602 Control Box		.98
One Tube Interphone Amplifier — Small compact aluminum case fully enclosed. 2¼"x3¾"x5¾". Less Tubes		.79
BC 717 Transmitter, New but less Tubes		24.50.
96Q1 Complete Autotune assembly with motor and frame as used in **ARC-1** Transmitter		New 35.00
BC 709 Battery operated lightweight interphone amplifier. Complete with tube and shock mount, but less battery		New 3.95
SCR 183 Complete		New 49.50
Motor—Universal Electric, 24 VDC, will also operate on 24 VAC Diameter 1⅝"; Length 2-9/16", Shaft ¼" x ¾"		New 1.49
BC-746 Bantam one watt foundation (See QST Jan. 1948). Contains 2 crystals, coil, tuning condensers, etc. Numbers 1-7-10-11-12-13-76. Each		0.95
BC-1291 Control box contains motor rheostat control rated 10 ohms at 3.88 amps. Brand new with cord and plug-in ventilated, mounted case		1.95
MC-385A Headset Adapter		New .49

Information and Prices on Request

BC 639 Receiver with RA 42 Rectifier
RTA 1B Transceiver
TA 2J24 Transmitter and MP 10G Power Jack
SCR 269 Compass Installation
R 5/ARN 7 Compass Installation
MN 26 Compass Installation
I. L. S. Installation (R 89-BC733)
SCR 584 Components
R-132/TPS 10 Radar Receiver
MD-22-URA/T1 Radar Modulator
AN APR1 Receiver and Tuning Units
ASB7 Complete Radar Installation
TS-251 Test Set
BC 221 Freq. Meter

BC 620

Receiver-Transmitter—2 crystal channels — 20 to 27.8 MC FM—13 tubes. Metered, Plate and Filament..... New $14.95
Used 9.95
PE 97 Power Supply for above 6-12 volt vibrator type.
Used—complete $6.95
Used less tubes, vib. & cond..... 2.95
FT 250 Mount for both BC 620 and PE 97 New $1.50

BC 223

Brand new Transmitter with all three tuning units, two tuning unit cases, spare tube carrying case, shock mount and brace; but less tubes at new low price of $19.95
Set of 5 tubes..... $3.95
Tuning units are available separately at Ea. $2.50
Cases at ..... Ea. .95
PE 125—12-volt Vibrator Pack...New $12.95
Used 8.95
Spare parts kit for PE 125 containing 2 tubes; 2 vibrators and 13 fuses in metal container with handle and clasp (BX 41)..New $2.95

Model 15—Ground radar training unit complete. 115 V. 60 C.P.S. operated. Consists of 515 MC transmitter; power supply; and pulse generator. Trains operator to detect land, air or sea targets and can be adapted to various receiver-indicator sets operating at 515 MC. New, with instruction manual...$225.00

Send for free 8-page, illustrated BULLETIN #103 listing many exceptional values

ARROW SALES, Inc.

Dept. E5
1712-14 S. Michigan Ave., Chicago 16, Ill.
PHONE: HArrison 7-9374

COMMAND (SCR 274 N) EQUIPMENT

	Used	New
BC-453	$12.95	
BC-454	4.95	$6.95
BC-455	7.95	
BC-456	1.95	2.95
BC-457	5.95	
BC-458	5.95	
BC-459 (or T22)	9.95	
BC-696 (or T19)	14.95	24.95
BC-450—3 Receiver Remote Control	.89	1.95
BC-442		2.95
3 Receiver Rack	1.95	
2 Transmitter Rack	1.50	

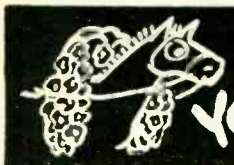
Complete Command set as removed from aircraft — 3 receivers — 2 transmitters — Relay unit—control boxes—mounting racks—plugs —modulator and dynamotors— crated. Set $34.50

HEADSETS—MIKES

HS-23 Hi Imp. Headsets	New	$2.95
HS-33 Lo Imp. Headsets	New	2.95
HS-30 Hi Imp. Headsets	New	1.50
	Used	.79
T-17D Carbon Mike	New	2.75
T-24 Hi Imp. Carbon Mike	New	1.19
T-30 Throat Mike	New	.98
T-45 (or Navy) Lip Mike	New	.98
CD-307 Extension Cord for Headsets	New	.59

CONDENSERS

	Each
2 mfd. 4000 VDC. OIL FILLED	$2.95
	4 for 10.00
1 mfd. 6000 VDC. OIL FILLED	1.98
.25 mfd. 15000 VDC. OIL FILLED	4.95
.00025 mfd. 25000 VDC. OIL FILLED	2.95
.4 mfd. 1500 VDC. OIL FILLED	.29
	10 for 2.49
2 mfd. 600 VDC. OIL FILLED	.39
	3 for 1.00
1 mfd. 600 VDC. OIL FILLED	.24
	5 for 1.00
.1x.1x.1—1200 VDC. OIL FILLED	.59
	2 for 1.00
50 mmfd—5KV—5 Amp. Vacuum Cond.	1.19



YOU'RE BEST BET IS LIFE ELECTRONICS

"UHF" COAXIAL CABLE CONNECTORS

No.	AN No.	Description	1-99	100-499	500 or over
83-1SP	PL259	Plug	.35	.28	.24
83-168	UG176U	Adapter	.15	.12	.11
83-185	UG175U	Adapter	.15	.13	.12
83-1SPN	PL259A	Plug	.35	.28	.24
83-776	UG203U	Plug	.61	.55	.53
83-1R	SO239	Receptacle	.40	.35	.28
83-1RTY	.....	Receptacle	.50	.45	.40
83-1H	UG106U	Hood	.12	.10	.09
83-1HP	.....	Hood	.27	.24	.21
83-765	UG177U	Hood	.31	.25	.22
83-1AC	.....	Cap and chain	.61	.50	.45
83-1BC	.....	Cap and chain	.38	.34	.31
83-1T	M358	"T" connector	1.12	.98	.90
83-1AP	M359A	Angle adapter	.35	.28	.24
83-1J	PL258	Junction	.85	.70	.65
83-1F	PL274	Feed thru	1.12	.98	.90
83-22SP	UG102U	Twin plug	.75	.68	.62
83-22R	UG103U	Twin recept	.50	.40	.36
83-22AP	UG104U	Twin ang. adapt.	.98	.80	.72
83-22J	UG105U	Twin junction	1.25	1.12	1.05
83-22T	UG196U	Twin "T"	1.65	1.50	1.35
83-22F	PL275	Twin feed thru	1.50	1.35	1.25
83-2SP	PL295	L'ge twin plug	1.94	1.75	1.55
83-2R	SO265	L'ge twin recept.	1.44	1.30	1.18
83-2H	M365	L'ge Hood	.24	.22	.20
83-2AC	.....	L'ge CAP and chain	.61	.55	.50
83-2AP	PL325	L'ge Twin angle adpt.	2.08	1.88	1.68
83-2J	PL305	L'ge twin junction	1.45	1.30	1.18

POTENTIOMETERS

TYPE "J" AND "JL"

Available in screw-driver and regular shafts locking and non-locking type bushings.
When ordering locking type bushing potentiometers, locking nuts are available at $.05 each.
Specify whether regular or screw-driver shaft is required.

PRICE SCHEDULE

Single Pots	$.50
Dual Pots	1.50
Triple Pots	2.50

SINGLE POTENTIOMETERS TYPE "J" AND "JL"

Ohms	Ohms	Ohms	Ohms
50	1300	20,000	200,000
60	1500	25,000	250,000
150	2000	30,000	500,000
200	2500	35,000	600,000
250	3000	50,000	750,000
400	5000	60,000	1.0Meg
500	6500	75,000	2.0Meg
			2.5Meg
600	10,000	100,000	3.0Meg
1,000	15,000	150,000	4.0Meg

DUAL POTENTIOMETERS TYPE "JJ"

Ohms	Ohms
60/60	10,000/25,000
100/100	20,000/35,000
500/500	20,000/700,000
600/600	25,000/25,000
1800/1800	50,000/50,000
2500/2500	75,000/75,000
3000/3000	100,000/100,000
5000/5000	200,000/200,000
7500/7500	500,000/500,000
10,000/10,000	1 Meg/1 Meg 5 Meg/5 Meg

TRIPLE POTENTIOMETERS TYPE "JJJ"

Ohms
150,000/150,000/150,000
500,000/500,000/500,000

COAXIAL CABLES

BRAND NEW!! JAN APPROVED !!

RG No.	Impedance	Price per Thousand Ft.
RG5U	52.5 ohms	$70.00
RG6U	76.0 ohms	150.00
RG7U	97.5 ohms	70.00
RG8U	52.0 ohms	60.00
RG9U	51.0 ohms	135.00
RG9AU	51.0 ohms	125.00
RG10U	52.0 ohms	125.00
RG11U	75.0 ohms	100.00
RG12U	75.0 ohms	190.00
RG13U	75.0 ohms	125.00
RG18U	52.0 ohms	450.00
RG19U	52.0 ohms	350.00
RG20U	52.0 ohms	450.00
RG22U	95.0 ohms	120.00
RG24U	125.0 ohms	240.00
RG25U	48.0 ohms	575.00
RG27U	48.0 ohms	290.00
RG29U	53.5 ohms	50.00
RG34U	71.0 ohms	175.00
RG38U	52.5 ohms	400.00
RG39U	72.5 ohms	180.00
RG41U	67.5 ohms	575.00
RG54U	58.0 ohms	65.00
RG54AU	58.0 ohms	75.00
RG57U	95.0 ohms	100.00
RG58U	53.5 ohms	50.00
RG59U	73.0 ohms	40.00
RG62U	93.0 ohms	50.00
RG65U	950.0 ohms	450.00
RG71U	93.0 ohms	175.00
RR74U	52.0 ohms	250.00
RG78U	48.0 ohms	80.00

Prices based on a minimum quantity of 500 ft. For cut lengths add 50% to prices shown.

SILICON DIODES

Type	Design Freq. (mc)	Price each
IN21	3,000	$.50
IN21B	3,000	1.00
IN23	10,000	1.25
IN23A	10,000	1.50
IN23B	10,000	2.00

GERMANIUM DIODES

Type	Price each
IN34	$.85
IN35	2.00

SEND FOR OUR FREE A.B. BULLETIN

COMING !!

OUR NEW COMPREHENSIVE FLYER #J666. GET ON OUR MAILING LIST NOW.

RESISTORS

EB½, GB1 and HB2

LIFE OFFERS THE MOST COMPLETE INVENTORY OF ½, 1 and 2 WATT RESISTORS IN 5% and 10% TOLERANCES IN THE COUNTRY

PRICE SCHEDULE

	Wattage	Tol.	Quantity per Type 1-49	50-499	500 or over
EB½	½ Watt	10%	.06	.04	.025
EB½	½ Watt	5%	.12	.08	.05
GB1	1 Watt	10%	.09	.06	.045
GB1	1 Watt	5%	.18	.12	.09
HB2	2 Watt	10%	.15	.10	.075
HB2	2 Watt	5%	.30	.20	.15

Prices shown are per size. Resistors may not be assorted for quantity price.

THE FOLLOWING VALUES ARE AVAILABLE IN 10% TOLERANCE:

Ohms	Ohms	Ohms	Ohms	Megs	Megs	Megs
10	100	1000	10000	.1	1.0	10.0
12	120	1200	12000	.12	1.2	12.0
15	150	1500	15000	.15	1.5	15.0
18	180	1800	18000	.18	1.8	18.0
22	220	2200	22000	.22	2.2	22.0
27	270	2700	27000	.27	2.7	
33	330	3300	33000	.33	3.3	
39	390	3900	39000	.39	3.9	
47	470	4700	47000	.47	4.7	
56	560	5600	56000	.56	5.6	
68	680	6800	68000	.68	6.8	
82	820	8200	82000	.82	8.2	

THE FOLLOWING VALUES ARE AVAILABLE IN 5% TOLERANCES:

Ohms	Ohms	Ohms	Ohms	Ohms	Megs	Megs	Megs
10	68	470	3300	22000	0.15	1.0	6.8
11	75	510	3600	24000	0.16	1.1	7.5
12	82	560	3900	27000	0.18	1.2	8.2
13	91	620	4300	30000	0.20	1.3	9.1
15	100	680	4700	33000	0.22	1.5	10.0
16	110	750	5100	36000	0.24	1.8	11.0
18	120	820	5600	39000	0.27	2.0	12.0
20	130	910	6200	43000	0.30	2.2	13.0
22	150	1000	6800	47000	0.33	2.2	15.0
24	100	1100	7500	51000	0.36	2.4	16.0
27	180	1200	8200	56000	0.39	2.7	18.0
30	200	1300	9100	62000	0.43	3.0	20.0
33	220	1500	10000	68000	0.47	3.3	22.0
36	240	1600	11000	75000	0.51	3.6	
39	270	1800	12000	82000	0.56	3.9	
43	300	2000	13000	91000	0.62	4.3	
47	330	2200	15000	0.1	0.68	4.7	
51	360	2400	15000	0.11	0.75	5.1	
56	390	2700	18000	0.12	0.82	5.6	
62	430	3000	20000	0.13	0.91	6.2	

KINGS — UG CONNECTORS — IPC


UG 88/U — Deduct 10% from prices shown on quantities of 100 or more of a type — UG 290/U

AN No.	Price ea.	AN No.	Price ea.	AN No.	Price ea.	AN No.	Price ea.	AN No.	Price ea.
UG.9/U	.95	UG37/U	16.00	UG98A/U	1.75	UG203/U	.61	UG260/U	.90
UG10/U	1.56	UG37A/U	16.00	UG100/U	2.34	UG204/U	2.55	UG261	.95
UG11/U	1.45	UG38A/U	20.00	UG100A/U	2.65	UG204A/U	2.25	UG262/U	1.05
UG12/U	.95	UG39/U	1.23	UG101/U	2.95	UG206/U	2.02	UG269/U	2.60
UG13/U	1.56	UG40/U	1.34	UG101A/U	3.20	UG207/U	18.00	UG270/U	6.50
UG14/U	1.45	UG45/U	2.00	UG107/U	2.25	UG208/U	18.00	UG271/U	6.50
UG15/U	.95	UG46/U	2.00	UG107A/U	2.30	UG212/U	4.50	UG272/U	16.00
UG16/U	1.56	UG57/U	1.75	UG107B/U	2.55	UG212A/U	4.09	UG273/U	1.22
UG17/U	1.45	UG57B/U	1.40	UG108/U	1.75	UG213/U	3.35	UG274/U	1.98
UG18/U	.99	UG58/U	.63	UG108A/U	2.25	UG213A/U	3.00	UG275/U	4.50
UG18A/U	1.05	UG58A/U	.73	UG109/U	1.85	UG215/U	3.35	UG276/U	4.50
UG18B/U	1.56	UG59/U	2.75	UG109A/U	1.75	UG216/U	8.70	UG279/U	2.40
UG19/U	1.26	UG59A/U	1.70	UG110/U	10.20	UG217/U	4.38	UG287/U	5.25
UG19A/U	1.36	UG60/U	1.90	UG114/U	1.50	UG218/U	6.50	UG290/U	.85
UG19B/U	1.45	UG60A/U	1.30	UG115/U	1.35	UG219/U	4.50	UG291/U	1.05
UG20/U	1.17	UG61/U	2.05	UG119U/P	6.50	UG220/U	6.50	UG306/U	2.03
UG20A/U	1.26	UG61A/U	1.80	CW123/U	.41	UG222/U	35.00	UG333/U	4.70
UG20B/U	1.41	UG62/U	28.00	UG131/U	3.75	UG224/U	1.14	UG334/U	5.75
UG21/U	.99	UG83/U	1.50	UG146/U	2.05	UG231/U	2.00	UG335/U	2.75
UG21A/U	1.05	UG85/U	1.65	UG154/U	5.35	UG233/U	13.00	UG349/U	2.34
UG21B/U	.99	UG86/U	1.69	CW155/U	.41	UG234/U	13.00	UG352/U	6.00
UG22/U	1.08	UG87/U	1.40	UG155/U	5.35	UG235/U	28.50	UG352A/U	6.50
UG22A/U	1.38	UG88/U	1.00	UG156/U	4.25	UG236/U	7.50	MT412/U	.75
UG22B/U	1.34	UG89/U	.95	UG157/U	4.25	UG237/U	13.00	UG414/U	2.34
UG23/U	.99	UG90/U	1.02	UG158/U	38.10	UG241/U	2.70	UG421/U	2.50
UG23A/U	1.26	UG91/U	1.25	UG149A/U	1.55	UG242/U	3.25	UG422/U	2.50
UG23B/U	1.29	UG91A/U	1.05	UG160A/U	1.90	UG243/U	3.75	UG423/U	4.65
UG27A/U	2.34	UG92/U	1.10	UG160A/U	1.55	UG244/U	3.50	UG475/U	20.00
UG27B/U	2.52	UG92A/U	1.30	UG166/U	38.10	UG245/U	2.25	UG479/U	20.00
UG28/U	2.34	UG93/U	1.25	UG167/U	3.00	UG246/U	2.45	UG482/U	20.00
UG28A/U	2.54	UG93A/U	1.37	UG167A/U	4.25	UG249/U	13.00	UG483/U	3.45
UG29/U	1.22	UG94/U	1.25	UG173/U	.30	UG250/U	13.00	UG484/U	4.30
UG29A/U	1.56	UG94A/U	1.05	UG174/U	16.00	UG251/U	13.00	UG486/U	1.65
UG29B/U	1.86	UG95/U	1.10	UG175/U	.15	UG252/U	4.50	UG487/U	4.90
UG30/U	1.75	UG95A/U	1.14	UG176/U	.15	UG253/U	4.25	UG491/U	1.60
UG32/U	16.00	UG96/U	1.25	UG188/U	.95	UG254/U	2.85	UG493/U	13.00
UG33/U	16.00	UG96A/U	1.25	UG195/U	.75	UG254A/U	2.75	UG494/U	3.65
UG34/U	17.50	UG97/U	3.20	UG197/U	5.00	UG255/U	1.40	UG495/U	6.00
UG35A/U	16.00	UG97A/U	3.40	UG201/U	1.65	UG256/U	11.00	UG496/U	2.34
UG36/U	16.00	UG98/U	1.55	UG202/U	2.75	UG257/U	11.00	mx504/U	.36

LIFE ELECTRONIC SALES • 91 GOLD STREET • NEW YORK 7, N. Y. • DIGBY 9-4154

Reliance Specials

HAYDON TIMING MOTORS

4 R.P.M., 115V., 60 Cycle.....$1.79

2/3 R.P.M., 115 V., 60 Cycle. 2 motors connected on one shaft to make unit reversible. ONLY.....$1.95

POWER RHEOSTATS
STANDARD BRANDS

25 WATT			25 WATT			123Ω	1/2"	79
Resist.	Shaft		3,000Ω	1/2"	69¢	1,250	1/2"	89
10Ω	1/8"	49¢	5,000	S.D.*	69	2,000	1/2"	89
15	1/8"	59				3,500	1/2"	89
25	1/8"	59	50 WATT					
145	1/2"	49				150 WATT		
	with switch		8Ω	S.D.*	79¢	8Ω	1/2"	$1.99
250	1/8"	59	20	1/8"	79			
370	1/2"	59	90	1/2"	79¢			

*S.D. Screw Driver Slot

UNIVERSAL JOINT
3/16" hole x 3/8" O.D.
1 1/8" long
Steel or Aluminum
50¢

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

CARBON RESISTOR ASSORTMENT

Color coded, insulated.....100 only $1.29

PULSE TRANSFORMERS

X 124 T2, UTAH, marked 9262, small gray case. Ratio 1:1:1, hypersil core.....$1.50

D161310, 50 Kc to 4 Mc. 1¾" dia. x 1⅞" high. 120 to 2350 ohms.....$1.50

352-7178—Spec. 10, 111 Chicago Trans. equivalent to 9262 (above).....$1.00

D166638 W.E. Permalloy core, Semi-toridal windings $1.25

KS9800, Ratio, 1:1:1, 2:1, Freq. range 380 to 520 C.P.S. $3.50

D106173, W.E. Freq. resp. 10KC to 2 MC.....$9.80

300 KVA GE K 2468B, 50 ohm pulse cable connection; 3,850 V. in., 17,300 V. out (250 KVA @ ¾ microsecond) $13.75

800 KVA G.E. K2731., 28000 Volt pk. output: Biflar; one microsecond pulse width.....$14.50

JONES BARRIER STRIPS

Type	Price	Type	Price	Type	Price
2-140Y	$.05	4-141W	.22	9-141¾W	$.47
2-140¾W	.10	4-141¾W	$.22	9-141Y	.47
3-140¾W	.13	4-141Y	.22	10-141¾W	.52
4-140	.13	5-141	.20	12-141	.44
8-140	.23	5-141Y	.27	14-140Y	.56
8-140W	.33	5-141¾W	.27	17-141Y	.87
10-140¾W	.40	7-141	.27	3-142	.15
13-140	.37	7-141¾W	.37	5-142	.24
2-141	.60	7-141Y	.37	6-142	.28
3-141¾W	.17			10-142¾W	.64
3-141W	.17	8-141	.30	2-150	.28
3-141Y	.17	8-141¾W	.42	4-150	.52

O-15A BASIC MOVE 12 Ma. 5" x 4" METAL CASE MIRROR SCALE DC AMMETER

Lots of 10—$34 $3.85 ea.

CHOKE 400 MA 12 Hy. 90 OHM 6,000 V. D. C. TEST

$3.85
10 for $34.00

PRECISION CONTROLS

6 WATT				4 WATT			
20,000	Muter	314A	*1.70	500Ω	Centralab	48-501	$.90
20,000Ω	GR	314A	2.50	50	De jur	292	.75
6,000	De jur	260	1.70	50	GR	301	1.10
6,000	Muter	314A	1.70	25	GR	301	1.10
5,000	Muter	314A	2.50	20	De jur	292	.75
5,000	GR	214A	1.40	12	GR	301	1.10
2,000	De jur	260	1.70				
				12 WATT			
25 WATT				10,000	Muter	471A	$2.00
100K	GR	433A	$4.95	10,000Ω	De jur	271T	2.00
				5,000	De jur	271T	2.00

7 Terminal Bakelite tie point.....35 for $1.00

VERNIER DIAL (From BC-221)

2 5/8" Dia. 0-100 in 360°. Black with silver marks. Has thumblock.....85¢

CARBON MIKE

T-17—Slightly used, guaranteed. 5 ft. cord & PL 68 69¢

FILAMENT TRANSFORMER

Amertran Type WS

For High Voltage Rectifiers. PRI. 115V., 50/60 Cycle.

SEC. 5V., C/T @ 10 Amp.

35 KV R.M.S. Test 12 KV D.C. Operating. Uses 872A Tube or other tubes.

NEW OVERSEAS PACKED $10.95

872-A Tube....$1.98

ALLEN SET SCREWS

4-40 x 1/8	8-32 x 1/8	8-32 x 5/16
4-40 x 3/16	8-32 x 3/16	8-32 x 3/8
ALL SIZES (Cup Point)		$1.50 per 100

GLYPTOL CEMENT 1 qt.....75¢

Wrapped—BALL BEARINGS—New

Mfg	ID	OD	Width	Price
Fafnir 33K5	3/16"	1/2"	5/32"	.25
N.D. 38	5/16"	7/8"	9/32"	.45
Fafnir K8A	1/2"	1 1/8"	5/16"	.60
N.D. 5202C13M	1/2"	1 3/8"	1/8"	1.00
Fafnir 7308W	1 37/64"	3 9/16"	5/16"	2.00
SKF 466430	6"	8"	1"	5.00
SKF170645	3 11/32"	4 1/8"	7/16"	1.50
Fafnir 545	2 1/16"	2 5/8"	15/32"	1.00

NEEDLE BEARINGS

B108 1/2" wide	5/8"	13/16"	30¢
GB34X 1/4" wide	3/16"	11/32"	25¢

SOUND POWERED HANDSET

Brand New! TS-10

Includes 6 ft. cord & spring clips
$8.92 ea. — $17.60 pr.

WALL HANGER — Navy type, for Sound Powered Phones (Shown above).....$1.00 each

FUSES

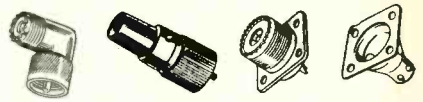
3AG		3AG	
⅛ Amp	$4.00 per 100	3 Amp	$2.50 per 100
¼	4.00	4	2.75
¾	4.00	5	2.50
1	2.50	10	3.00
1½	2.50	15	3.00

Fuse Holder—Littlefuse for 4AG fuse.....18¢

COAXIAL CABLE
RG 8/U 52 OHM
$55.00 per 1,000 feet

	Ohm	Price per 1,000 ft.		Ohm	Price per 1,000 ft.
RG5/U	53.5	$70.00	RG 27/U	48	$290.00
RG 7/U	97.5	60.00	RG 29/U	53.5	50.00
RG 8/U	52	50.00	RG 34/U	71	175.00
RG 9/U	51	135.00	RG 39/U	72.5	180.00
RG 10/U	52	125.00	RG 41/U	67.5	575.00
RG 11/U	75	100.00	RG 54/U	58	65.00
RG12/U	75	190.00	RG 54/AU	58	75.00
RG 13/U	74	125.00	RG 55/AU	53.5	60.00
RG 18/U	52	450.00	RG 57/U	95	100.00
RG 19/U	52	350.00	RG 58/U	53.5	50.00
RG 20/U	52	450.00	RG 59/U	73	40.00
RG 22/U	95	110.00	RG 62/U	93	50.00
RG 24/U	125	240.00	RG 74/U	52	250.00
RG 25/U	48	575.00	RG 77/U	48	100.00

COAXIAL CABLE CONNECTORS



Angle-Adapter	Plug	Socket	Hood
15¢	28¢	28¢	9¢
M-359	PL-259A	SQ-239	83-1H
83-1AP	83-1SPN	83-1R	

Adapter for PL-259 A for use on small coax. 12¢ each.....$10.00 per 100

83-1SP	$.28	83-22SP	.48	UG 27/U	.60
83-1J	.80	83-2J	1.50	UG 59/U	.60
83-1T	1.12	UG 13/U	.60	UG 61/U	.60
83-1F	1.12	UG 21/U	.60	UG 85/U	.60
83-22AP	.85	UG 22/U	.60	UG 87/U	.50
83-22R	.48	UG 24/U	.60	UG 167/U	2.00
		UG 25/U	.60	UG 281/U	.60

CAPACITORS

POSTAGE STAMP MICAS

MMF	MMF	MMF	MMF	MFD
8.2	60	250	620	.00136
10	62	300	650	.0015
15	68	350	680	.002
20	75	370	700	.0026
22	82	390	750	.0027
24	90	400	800	.003
25	100	430	820	.0033
30	110	470	900	.004
39	150	500	910	.005
40	160	510	MFD	.0068
47	200	560	.001	.0075
51	220	580	.0012	.0082
56	240	600	.0013	.01

Price Schedule

8.2 MMF to .001 MFD... 5¢
.0012 MFD to .002 MFD... 7¢
.0026 MFD to .0082 MFD...12¢
.01 MFD.....18¢

SILVER MICA

MMF	MMF	MMF	MMF	MFD
10	120	360	600	.0027
24	125	370	680	.003
30	150	390	700	.0033
40	180	400	820	.0039
50	200	430		.004
60	208	466	MFD	.0047
62	225	470	.001	.005
66	240	488	.0013	.0051
68	250	500	.0015	.006
75	300	510	.002	.0082
100	325	525	.0022	.01
110		560	.0024	

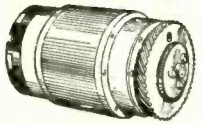
10 MMF to .001 MFD...10¢
.0012 MFD to .0027 MFD...20¢
.003 MFD to .0082 MFD...50¢
.01 MFD.....65¢

OIL FILLED

MFD	V.D.C.	Price
.375@	16,000 and	
.75@	8,000 (dual)	$6.95
.4	10,000	8.95
.5	7,500	23.95
.1	7,500	1.55
.1-.1	7,000	1.55
.02-.02	7,000	1.50
1	6,000	8.50
2	4,000	4.50
.25	3,000	1.95
2 x .1	2,000	.95
1	2,000	.95
4	1,000	.90
3	1,000	.80
2	1,000	.65
10	600	1.00
4	600	.69
2	600	.39

SELSYNS

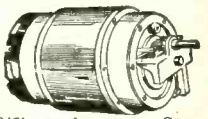
115 V., 60 Cyc.
#C78248
3⅜" dia. x 5⅜" long
$7.95 pair



Mounting Brackets — (Bakelite) for selsyns, and differentials shown above.....25¢ pair

DIFFERENTIAL

115 V., 60 Cyc.
#C78249
3⅜" dia. x 5⅜" long
$2.25 ea.



Used between two #C78248's as dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted.....$3.00)

WW PRECISION RESISTORS, 1% OR BETTER

¼ WATT—25c

6.68Ω	12.32Ω	16.37Ω	123.8Ω	414.3Ω
10.48	13.02	20	147.5	705
10.84	13.52	62.54	220.4	2193
11.25	13.89	79.81	301.8	10.000
11.74	14.98	105.8	366.6	59,148

½ WATT—25c

.250Ω	11.1Ω	210Ω	3,447Ω	8,500Ω
.334	13.15	235	4,000	14,825
.502	46	260	4,451	15,000
.557	52	270	5,000	15,750
.627	55.1	298.3	5,900	17,000
.76	75	400	6,500	30,000
1.01	97.8	723.1	7,000	100,000
1.53	125	2,500	7,500	
2.04	180	2,850	8,000	

1 WATT—30c

1.01Ω	5.21Ω	270Ω	7,000Ω	55,000Ω
2.58	10.1	1,250	9,000	65,000
3.39	10.9	3,300	18,000	70,000

1 WATT—40c

100,000Ω	128,000Ω	180,000Ω	522,000Ω
120,000	130,000	320,000	600,000
125,000	160,000	470,000	700,000

1 Megohm—1 Watt 1%—65c; 5%—40c

100 pieces—10% off; 1,000 pieces—20% off.

DELAY NETWORK—ALL 1400 Ω

T 113—Approx. 1.2 micro sec. delay.....85¢
T 114—Approx. 2.2 micro sec. delay.....85¢
T 115 Similar to T 114 with tap brought out.....85¢

MICRO AMMETER 0-500

2" round. Basic move. 500 micro amps. Used—Guaranteed.....$3.21 ea.

POSTAGE STAMP MICA ASSORTMENT

100 asst. regular and silver micas.....$3.29

10 Conductor shielded cable, 5 ft. long & complete 400 series Jones plug.....98¢

#18 SHIELDED WIRE—STRANDED

Single Conductor—100 ft.....$1.95 1,000 ft....$12.50
Two Conductor —100 ft.....$2.95 1,000 ft....$19.50

Write for Monthly Bulletin

Gear Assortment.....$6.50

Experimenters dream, 100 pieces, many stainless steel.

TRANSMITTING MICAS
UPRIGHT BAKELITE CASE

MFD	V. D. C.	Amps	KC	Price
.00032	5,000	2.5	1,000	$.89
.0005	5,000	4	1,000	.95
.0011	5,000	6	1,000	.99
.002	5,000	4	300	1.09
.015	2,000	12	300	1.09
.024	1,500	15	1,000	.99
.033	1,500	15	1,000	.99
.05	1,500	13	300	.99
.062	1,000	18	1,000	.99
.075	1,000	18		.99

CHROMALUX STRIP HEATER—115 V.A.C.

60 Cycle, 750 Watt, curved.....95¢

Minimum Orders $3.....All orders f.o.b. PHILA, PA.

RELIANCE MERCHANDIZING CO.

Arch St. Cor. Croskey Phila. 3, Pa. *Telephone RIttenhouse 6-4927*

BLOCKING OSC. TRANSFORMERS

C-12A. 3 windings. 5, 14 and 2 Ohms D.C. respectively. Completely shielded, wih mounting ears on base. Standoff terminals on side. Diagram on adjacent side.....95¢ ea.

SCANNING TRANSFORMER

#66021. 9 V. RMS. @ 10 Cyc. .12 Ohms D.C. Exc. Cur. 650 Ma. Sec.: 680 Ohms. 275 V. Open Frame. New .....85¢

TRANSFORMER ASSORTMENT

Ten Special Selected units, ideal for the Lab, experimenter, etc. A Value you can't afford to miss! The Cores are Worth More! All Good! Approx. 60 Lbs. $4.95. (Shipped Railway Express Only).

COAX CONNECTORS

10H/528—British Chassis Male.35¢ ea., 3 for $1.00
10H/529—British Elbow—Male to Male 35¢ ea., 3 for $1.00
QA-49547—British to Standard Male Adaptor 75¢ each, 3 for $2.00
UG-21/U—Ucinate Pin Connector 35¢ ea., 3 for $1.00
UG-27/U—90° Pin Elbow Male to Female. 75¢ ea., 3 for $2.00
M-359-A—90° Std. Elbow Male to Female. 75¢ ea., 3 for $2.00

TELEPHONE REPEATER COIL

C-161. 1:1 Ratio. One side center tapped for Feeding Keying Lines into telephone circuits. Completely shielded with terminals mounted on heavy insulated base. Diagram etched in metal cover plate. Like New.....$1.49 each

PIONEER TORQUE UNITS

Type-12603-4-A400 Cyc. 26 Volts, Brand New. Sealed in cartons .....$7.95 ea.

MAGNIFIER REFLECTOR

8" Dia. Parabolic. (Lancaster Lens) Metallic coated silver surface. Useful in photographic work. (Glass) Shpg. Wt. Approx. 1½ Lbs. New...$1.95

V.H.F. ANTENNA

AT-59/TRC-7 Telescopic. Adjustable from 15¼" to 27¾". Mounts with standard coaxial male connector. Two sections. Locks at any setting. Light weight and low wind resistance. New. Ideal for cabs, police cars, etc.....$1.39

SELENIUM RECTIFIERS

Half wave (Ratings with 500 Mfd. Cap. on output).
#1A5 . . A.C. Input: 18V., D.C. Output: 14V. @500 Ma. New .....$65¢
#1H4 . . A.C. Input: 28V., D.C. Output: 24V. @750 Ma. New .....75¢

MICROMETER

1" Brownie. Hardened Steel with polished Barrel and calibrations. Adjusting screw at end of Barrel. Without Ratchet. New.....$2.25

FILTER CHOKES

C-2308. 8 Hy. 300 Ma. 80 Ohms D.C. 3000 V. Ins. Completely shielded in upright case with leads coming from bottom. New.....$3.95
LC-0101. .077 Hy. 450 Ma. 3.5 Ohms D.C. Shielded. Upright can. New.....59¢ each

TELETYPE FILTER

W.E. 188A. Has 15 lugs topside, giving capacities: .0015, .003, .006, .012, .025, .05, and .1 Mfd. Size: 1¾" X 1⅝" X 3¼" H. Metal can with mounting lugs. New.....65¢ each
(15% discount in lots of 25 or more)

COMPASS INDICATOR

I 82-A 5" Dia. Face. Manually variable scale. Uses a PL-118 Plug. New, overseas packed.....$4.95

REEL CONTROL BOX

BC-461-A. Mounted in moulded bakelite case. Size: 5¾" L. X 3¼" W. X 2¾" H. Overall. Contains 3 Pos. Switch marked "in"; "off"; "out". Indicator Jewel Lite and 3 digit counter with manual reset wheel. SO-92 Connector and Spline cable fitting on end apron. Panel removable from base by removing 2 corner screws. New.....95¢

LINEN PHENOLIC TUBING

O.D. 1⅜" 3/32" wall. Over 3 Ft. long. Unvarnished orange linen finish.....45¢ per length

HAND COUNTER

3 digit with manual reset. Finger button lever in front. 1⅞" H. X 2" D. X 1 3/16" W. Finished in brown wrinkle. Stands on flat surface. New..$1.29

TORROIDAL POTENTIOMETER

No. KS-15138—Two rotating brushes take off Linear Sawtooth voltage from continuous resistance winding which is fed 24 V.D.C. to two taps 180° apart. Die cast aluminum case. Type AN Connector. Brand New $2.75

SHIELDED RHEOSTATS

Type "J" 90 ohms at 1.35 Amps. Max. Enclosed in ventilated metal housing with insulated terminals at the back. Shaft: ¼" X ½" L. ⅜" single hole mtg. New .....98¢

FILTER CRYSTALS

409.5 K.C. Mounted, with Terminal lugs on either end. Size: ½" X ½" X 1". New.69¢ ea., 3 for $2.00

ANTENNA ROTATOR—RL-42

A natural for Lightweight FM or TV Antenna. Approx. 12 R.P.M. Reversible. Magnetic Clutch. Motor operates on 24 V.D.C. @ 5.5 Amps. Operates on A.C. New, with bobbin on shaft.....$3.95

VIBRATORS

Type VB-11-A 24 V. Non-Sync. 9 pin offset base. New .....59¢
Type WE-KS-5566 12 V. 60 Cyc. Non-Sync. 4 pin Std. base. New.....69¢

COAX LEAD

19" length RG-8U with Silver plated PL-259 Male Conn. on one end and Heavy Copper Lugs spaced 1¾" apart at other end. Lugs have 3/16" hole. New .....79¢ each

RELAY SELECTOR UNIT

BC-685-A. Consists of two individual band-pass filters, 450 cycles and 700 cycles, each uses 3 25L6GT and 1-12H6 tubes. Components include 14 telephone type relays, 200 and 500 ohm coils, one 25 position 4 circuit rotary relay with 12 ohm coil, band-pass transformers, networks, resistors, condensers, etc., etc. Panel controls are missing. Heavy gauge chassis and panel. Size: 8¾" x 11¾" x 19". Metal hood encloses entire unit. Shpg. Wt. Approx. 55 Lbs. Express only. Like new, less tubes $14.95

H.V. RECTIFIER SOCKETS

Ceramic 4 Pr. large. Fits 705-A and similar tubes. New .....45¢ each

MARKER OSC. COIL

Type CAY. 82 K.C. Hermetically sealed in round drawn Aluminum container, 2" D. X 3" L. Slug tuned. Ceramic terminal board on bottom. New .....95¢ each

20-28 MC. OSC. COIL

For BC-603 Receiver. Silver wire wound on Ceramic or Mycalex form. Fungus treated; Temp. Compensated and tested. New overseas packing..69¢ each

JUNCTION BOX

J-66/A. For PE-218 Inverters. 1/16" Welded Aluminum Housing, 7½" L X 6¼" W. X 2¼" H. Has 3 AN Connectors in end aprons and two 6 terminal barrier strips inside. New.....79¢ each

SPECJAL CONDENSERS

500 MFD. 200 V.D.C. Round Drawn Aluminum can, 2" D. X 4½" L. with mounting base. Hermetically sealed. Terminals on top. May be inverted so terminals are on the bottom. Can not grounded. New .....95¢ each
(Discount 10% for lots of 25 or more)
40 + 40 MFD. 250 V.D.C.—Round drawn Aluminum can, 1¾" D. X 3¾" L.—Neg. not grounded to can. Herm. sealed. New.....65¢ each
(Discount 15% for lots of 25 or more)

BC-423 RADAR MODULATOR

A sturdy and beautifully built RF Osc. Variable: 125 to 210 Mc. (Approx.) pulse modulated at 4068 C.P.S. Uses 1-955, 2-6J7, 1-6F6 and 1-5W4. Operates at 115 V. 60 Cyc. May be modified for T.V. Generator, etc. New with tubes. Shpg. Wt. Approx. 45 Lbs.....$12.50

ARR-1 RECEIVER

Attractively built T.R.F. using 4-954 Acorn tubes. Originally operated on 234-258 Mc. Can be modified for converter on 6, 2 or 1 meters. Ganged permeability tuning. Shpg. Wt. Approx. 8 Lbs. Complete with tubes. New.....$5.75

HOOKUP WIRE

Cut lengths from 2" to 14" long in various sizes, colors and types of insulation. All ends stripped and tinned. A superb value! 3 Lbs. for.....$1.00 Quantity Prices on Request!! Write for our Latest Flyer!! Quantities Limited!! 50¢ packing charge on orders below $2.00. Minimum deposit 25% on C.O.D. orders. Prices F.O.B. Chicago. $50.00 Minimum Foreign Order Acceptable.

UNITED SURPLUS MATERIALS

312 S. Halsted Street — Chicago 6, Illinois

• TUBES •

1B3/8016	$1.49	6SH7	$0.45	2J21A	$10.95
5R4GY	1.10	6SJ7	.52	2J36	99.50
5T4	.75	6SK7GT	.49	2K25	23.50
5U4G	.59	6SL7GT	.64	2K45	99.50
5V4G	.88	6SN7GT	.59	283A	10.95
5W4	.72	6SQ7	.50	303A	3.95
5X4G	.62	6SS7	.55	307A	3.75
5Y3GT	.42	6V6	.94	316A	.49
5Z3	.69	6V6GT	.65	4–65A	14.10
6A7	.74	6W4	.69	4–125A	25.95
6AC7	.79	6Y6G	.69	GL502	1.90
6AG5	.74	7C5	.53	703A	1.95
6AG7	1.03	7E7	.64	707B	10.95
6AK5	.85	7N7	.73	715B	9.95
6AK6	.82	7Y4	.52	715C	24.50
6AL5	.62	7Z4	.62	723AB	11.95
6AQ5	.54	12A6	.21	725A	8.95
6AT6	.48	12AT6	.49	803	4.50
6AU6	.62	12AT7	.62	804	12.95
6B4G	.94	12AU6	.60	805	5.95
6B6G	.84	12AU7	.70	809	2.25
6BA6	.59	12BA6	.59	810	8.95
6BE6	.57	12BE6	.53	811	2.49
6BG6G	1.49	12SA7	.60	813	7.95
6BH6	.62	12SK7	.60	814	3.95
6C4	.25	12SQ7	.55	815	1.57
6C5	.49	25L6GT	.60	816	1.05
6C6	.52	25Z5	.49	826	.49
6C8G	.59	35W4	.45	829B	7.95
6D6	.49	35Z5GT	.47	830B	4.95
6F5	.52	50B5	.58	832A	4.95
6F6	.62	50L6GT	.58	836A	1.75
6F8G	.79	80	.49	837	2.45
6H6	.42	83	.79	845W	4.85
6J5	.49	117L7	1.29	866A	1.15
6J6	.89	0A2	1.55	872A	1.49
6J7	.72	0B2	1.76	892R	250.00
6K6GT	.49	VR75	.89	1625	.18
6K7	.53	VR90	.95	2050	1.20
6K8	.85	VR105	.89	2051	.85
6L6	1.19	VR150	.69	8025	3.75
6N7	.79	1N21	.65	9001	.39
6SA7	.50	1N23	.85	9002	.30
6SC7	.64	1N34	.80	9003	.40
6SF5	.53	1N35	2.05	9004	.29
6SG7	.64	2D21	.95	9005	1.40

3" METERS

0–20 ua DC WH	$18.50	0–30AMPACTRIP	$5.95
0–50 ua DC WH	17.50	0–50 AMP AC WH	5.95
0–200 ua DC WH	10.25	0–75AMPACTRIP	5.95
0–1 MA DC WH	7.50	JBT 31-F FR. MTR	7.95
0–1 MA DC S Scale	3.95		

2" METERS

0–200 ua DC	4.50	0–2 MA DC SIMP	3.95
0–500uaDCSPScale	4.25	0–5MA DC SP SCALE	2.95
0–1 MA DC 506	3.95	0–15 MA DC GE SQ	3.95
0–1 MA DC SUN	3.85	0–20 MA DC WH	3.95
0–5 MA SPScale SQ	2.49	0–30 MA DC GE	4.50
0–5MAGEAMPScle	2.49	0–50 MA DC WH	4.50
0–10 MA WH	2.49	0–80 MA DC WE	2.95
0–20 MA SP Scale	2.49	0–100 MA DEJ	4.50
0–25 MA SP Scale	2.49	0–150 MA DC WH	4.50
0–50 MA GE	2.49	0–200 MA DC GE	4.50
0–100 MA	2.49	0–750 MA DC GE	4.75
0–20 VDC WEST	2.75	0–1 AMP DC WH	4.95
0–30 VDC GE	3.25	0–2 AMP DC SIMP	5.95
0–10 AMP DC GE	3.50	0–300 VDC SUN	7.95
0–30 AMP DC GE	3.50	0–8 VAC WES 476	4.50
0–10 VAC GE	3.50	0–15 VAC GE	4.50
0–300 VAC TRIP	4.95	–10+5DB Wes 301	8.95
0–250 MA AC GE	3.95	0–150 VAC WH	5.95
0–2 AMP RF SQ	3.50	0–4 AMP RF GE	3.50
0–9 AMP RF WH	3.50	0–25 AMP AC WH	5.95
0–200 ua 4" SQ. Volt, Mil, Ohm scale			$7.95

CHOKES

200 HY 6 MA 620 OHM	$ .99
8 HY 50 MA 90 OHM	.39
10 HY 80 MA 240 OHM	.89
20 HY 110 MA SUB SIG HERM SEAL	3.45
10 HY 150 MA 140 OHM	1.39
5 HY 200 MA65 OHM SUB SIG	3.95
7 HY 200 MA 100 OHM HERM SEAL	2.49
4-16 HY 200 MA 140 OHM SW CH	3.85
1.5 HY 250 MA 72 OHM	1.25
3 HY 250 MA 15 OHM	1.65
15 HY 250 MA 60 OHM	2.95
3-14 HY 300 MA 80 OHM SW CH	5.60
8 HY 300 MA 80 OHM	5.55

OIL CAPACITORS

7 MF 330 VAC	$0.95	4 MF 1.5 KV DC	$2.49
.5 MF 600 VDC	.45	6 MF 1.5 KV DC	2.95
2 MF 600 VDC	.59	.1 MF 2000 VDC	.79
4 MF 600 VDC	.79	.25 MF 2000 VDC	.99
6 MF 600 VDC	.89	1 MF 2000 VDC	1.25
10 MF 600 VDC	1.10	2 MF 2000 VDC	2.45
1 MF 1KV WAX	.29	4 MF 2000 VDC	3.95
2 MF 1000 VDC	.90	8 MF 2000 VDC	5.95
5 MF 1000 VDC	1.79	.25 MF 3000 VDC	1.45
10 MF 1KV DC	2.49	2 MF 4000 VDC	3.95
15 MF 1KV DC	2.95	3 MF 4000 VDC	4.75
.5 MF 1.5 KV DC	1.25	2 MF 5000 VDC	6.95
2 MF 1.5 KV DC	1.45	.1 MF 7500 VDC	.79

110V Filament Transformers 60 CY

2.5 VCT 10 A. 10KV INSULATION	$3.95
5 VCT 3A. 2.5 KV INSULATION	2.10
5 V 15 A. 2.5 KV INSULATION	3.45
6.3 V 1.2 A	.85
6.3 V 3 AMPS	1.95
6.3 V 12 AMPS	1.75
6.3 V 3 AMPS, 6.3V 3 AMPS	3.40
6.3 V 3.5 A. 2 x 2.5 V 6 AMPS ea.	3.49
6.3 V 3A. 2.5 V 6 AMP HERM SEAL	3.49
10 VCT 10 A. 2.5 KV INSULATION	4.95

115V Power Transformers 60 CY

240 VCT 50 MA	$1.95
650 VCT 50 MA, 6.3V 2A, 5V 3A	2.75
700 VCT 90 MA, 6.3V 4A, 5V 3A	2.98
610 VCT 160 MA, 6.3V 3A, 5V 3A	3.95
650 VCT 250 MA, 5V 4A	2.95
800 VCT 200 MA, 6.3V 4A, 5V 3A	6.50
800 VCT 300 MA, 6.3V 10A, 6.3V 9A, 5V 3A	8.50
800 VCT 300 MA, 6.3V 10.8A, 5V 6A, 5V 2A	8.50
300 V 100 MA, 22VCT 100 MA, 6.3V 3.5A, 2.5V 10A	2.49

25% Deposit with order, balance C.O.D.

Send for "POLY-GRAM"

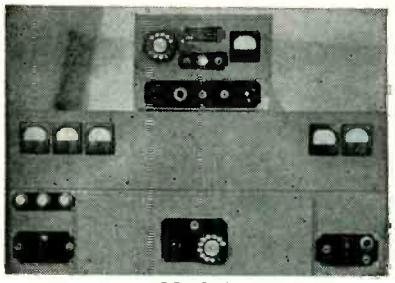
POLY-TECH N. Y.

919 Dawson Street, New York 59, New York

ATTENTION! TV Schools Studios Experimenters

TELEVISION CAMERA

Just arrived! Fills a raft of vital TV uses. Block 3. 350-lines resolution. Easily converted to present R.M.A. standards. Circuits available with cameras.



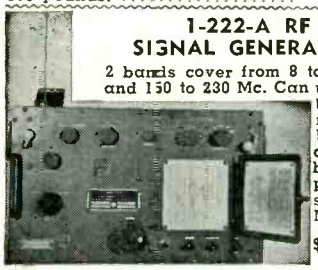
1100-A FOUR TRANSMITTERS IN ONE

Can be present on 4 bands. Has BFO or xtal on each from 1.5 to 10 mcs. Oscillators are all between 1.5 and 5 mcs. 6L6 osc. VR-150 regulator, buffer or doubler is a 6L6 into 3-807's in parallel. 125 watts on phone and 125 watts on cw, modulator has 4-6L6's in push-pull parallel. Rig has telephone dial on front for selecting any one of 4 transmitters, selecting phone, CW, turning heaters on, plate current, or turning everything off. Also has remote control unit for remote operation. Used, but in excellent condition. **$225.00** With Remote

SCS-528 FM RECEIVER & XMTR: Complete with 80 xtals for operation in the 20-27.9 mcs. Powered by 12 or 24 VDC, with crystals, dynamotors, rack, mike, headset, mast base and section. Used but excel. cond.

RAYTHEON RECTICHARGER W-3155

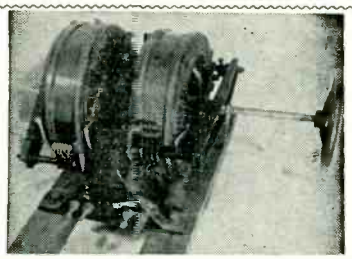
Supply current at a constant voltage and supplies current to a storage battery, providing an automatic AC-DC power system; No moving parts; No adjustments; Life of the battery increases as much as 40%; Eliminates voltage variations. 11/12 cells, 22-24 volts at 3 amp. output; Input 95-130 volts, 60 cycles; Weight 180 pounds. **$45.00**



1-222-A RF SIGNAL GENERATOR

2 bands cover from 8 to 15 Mc., and 150 to 230 Mc. Can use up to the 3-harmonic; 110 V, 60 cycles built in power supply. New, **$125.00**

APS-4 COMPONENTS: Indicators, control boxes, junction boxes, 800-1C inverters, amplifier boxes, cords and plugs.



VARIAC TRANSTAT AMERTRAN

Input 0-115 V., 50-60 cycle; output 115 V 100 amps. 11.5 Kva. Excellent condition **$75.00**

COLUMBIA ELECTRONICS Ltd.

524 S. San Pedro St., Los Angeles 13, Cal.
Cable Address: COLELECT
25% deposit with order. Balance C.O.D.
All items subject to prior sale.

TEST EQUIPMENT

X BAND SPECTRUM ANALYZER, 8500-9600 MC, calibrated below cut-off attenuator, calibrated frequency meter, I.F. frequency 20 mc, bandwidth 50 kc, 110-230 V 60-800 cps.

S BAND SPECTRUM ANALYZER, 2700-3400 MC, similar to above.

TS-36/AP X BAND POWER METER.

TS-125/AP S BAND POWER METER.

X BAND BELOW CUT-OFF WAVE GUIDE ATTENUATOR, with calibrated dial and built in line stretcher, type N input connector, output connects to ½" x 1" wave guide.....$55.00

APR-1 or APR-4 RADAR SEARCH RECEIVER, 30 mc I.F., 2 mc wide.

TUNING UNITS FOR APR-1 or APR-4 RECEIVERS (can be used with any 30 mc amplifier):
TN-19, range 1000-2000 mc, tuned mixer cavity $150.00
TN-54, range 2000-4000 mc, tuned mixer cavity $150.00

30 MC I. F. STRIP AND 110 VOLT 60 cps POWER SUPPLY, bandwidth 10 mc, complete, new (part of APR-5 Receiver) $65.00

TS-45A/APM-3 SIGNAL GENERATOR, 9200-9600 mc, 110 V, 60-800 cps

TS-155A/UP S BAND SIGNAL GENERATOR, pulsed, calibrated output, 110 V, 60 cy., NEW

TS-56/AP SLOTTED LINE, slot length 16", tuned probe and meter $100.00

TS-35/AP X BAND SIGNAL GENERATOR, pulsed, calibrated power meter, frequency meter, 8700-9500 mc

TS-13/AP X BAND SIGNAL GENERATOR, pulsed, calibrated output, 110 V, 60 cycles

TPS-51PB/20 S BAND 20 db PAD.....$20.00

X BAND PICK-UP HORN.....$10.00

X BAND VSWR TEST SET TS-12/AP, complete with linear amplifier, direct reading VSWR meter, slotted waveguide with gear driven traveling probe, matched termination and various adapters, with carrying case, NEW. UNITS I AND II are available separtely or together as a test set.

S BAND SIGNAL GENERATOR CAVITY WITH CUT-OFF ATTENUATOR, 2300-2950 mc, 2C49 tube, with modulator chassis.....$30.00

HIGH PASS FILTER F-29/SPR-2, cuts off at 1000 mc and below; used for receivers above 1000 mc $12.00

UPN-1 S BAND BEACON RECEIVER-TRANSMITTER $75.00

S BAND TEST LOAD TPS-55P/BT, 50 ohms $8.00

X BAND TEST LOAD, 50 WATTS.....$35.00

250 WATT X BAND TEST LOAD, VSWR less than 1.15 between 7 and 10 KMC.....$150.00

LAF-1 SIGNAL GENERATOR, 100-600 mc, CW & pulse modulation, calibrated output, good condition, 110 v, 60 cps operation

GENERAL RADIO SIGNAL GENERATOR MODEL 522, 250-1000 mc, good operating condition.

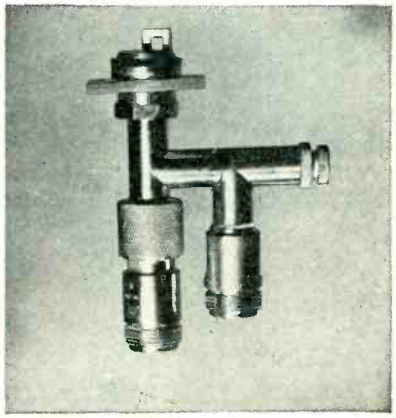
GENERAL RADIO PRECISION WAVEMETER TYPE 724A, range 16 kc to 50 mc, 0.25% accuracy, V.T.V.M. resonance indicator, complete with accessories & carrying case NEW...$175.00

GENERAL RADIO SIGNAL GENERATOR 605-B, good working order.....$300.00

GENERAL RADIO VACUUM TUBE BRIDGE, Model 561D $275.00

FEDERAL RADIO 605-CS, 9 kc to 50 mc SIGNAL GENERATOR (JAN version of G. R. 605.$350.00

HEWLETT-PACKARD AUDIO SIGNAL GENERATOR 205A $230.00



S BAND CRYSTAL MIXER (illustrated), Variable Oscillator Injection $12.50

TBN-3EV THERMISTOR BRIDGE

S BAND THERMISTOR BRIDGE CU-60 ABU, Part of LZ Radar.....$60.00

RADIO RECEIVER BC-967T2, 18-160 mc, 3 bands, FM/AM, 110 V, 60 cps.....$200.00

MEASUREMENTS 78E, 50-75 mc, calibrated output $100.00

FERRIS MODEL 22A SIGNAL GENERATOR, 85 kc to 25 mc. Output .2 microvolts to 1 volt, modulation variable, good working order $175.00

FERRIS MODEL 10B SIGNAL GENERATOR, 85 6c to 25 mc, calibrated output, good working order $100.00

STANDARD SIGNAL GENERATOR MEASUREMENTS 65B, 100 kc to 30 mc, 1-2,000,000 microvolts, good working order.....$400.00

LABORATORY RECTIFIER, SYLVANIA 541-A, 3500 volts at 2 amperes DC output.

LB-3 LIMIT BRIDGE, Industrial Products $60.00

SIGNAL GENERATOR, 1-72-K, 100 kc to 32 mc, output not calibrated, 110 V, 60 cps.....$35.00

AUDIO OSCILLATOR, HICKOK 198, RC tuned, 20-20000 cps $45.00

TEST SET TS-278/AP FOR AN/APS-13, synchronized, delayed pulse signal generator, 400-430 mc, calibrated waveguide below cutoff attenuator, synchronized marker generator, 115 V, 60 cps. NEW, COMPLETE.....$160.00

CLOUGH, BRENGLE RESISTANCE CAPACITY BRIDGE, model 230A, new.....$50.00

FIXED ATTENUATOR PADS, 20 db + 0 — 2 db, DC-1200 mc, 50 ohms, VSWP 1.3 or less, 2 watts average power $30.00

WAVEGUIDE BELOW CUT-OFF ATTENUATOR, type N connectors, rack and pinion drive, attenuation variable 120 decibels, calibrated 20-120 db. frequency range 300-2000 mc.....$32.00

WAVEGUIDE BELOW CUT-OFF ATTENUATOR, similar to above except upper frequency limit is 3300 mc $32.00

WAVEGUIDE BELOW CUT-OFF ATTENUATOR, same as above except input is matched in range of 2200-3300 mc. VSWR less than 1-2....$54.00

PULSE INPUT TRANSFORMER, permalloy core, 50 to 4000 kc impedance ratio 120 to 2350 ohms $3.00

PULSE TRANSFORMER, UTAH 9280.....$1.50

PULSE TRANSFORMER, 132-AWF.....$6.00

PULSE TRANSFORMER, GE 68G, 828G-1...$5.00

TS-10/AP CALIBRATED DELAY FOR APN-1. $25.00

TS-203/AP CALIBRATED SELSYN.....$10.00

UG-27/U TYPE N RIGHT ANGLE ADAPTERS 10 for $5.00; 1000 for $250.00

SD-3 SHIPBOARD RADAR, New and complete with test equipment.....$1050.00

SQ RADAR, used but in good working order, complete with antenna, control unit.....$650.00

SN RADAR, used, good working order, complete $550.00

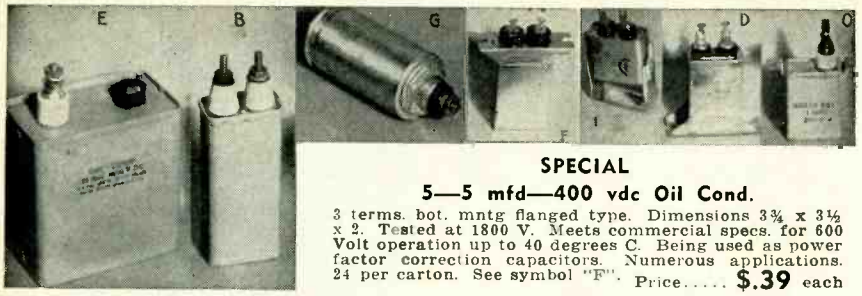
HYPERSIL CORE CHOKE, 1 Henry, Westinghouse L-422031 or L-422032.....$3.00

PULSE FORMING NETWORK, 20 kv. .92 microsecond, 50 ohms, 800 p.p.s. $40.00

ANCHOR SCREWS from AB26CR Mast Equipment .....$2.00 each

ELECTRO IMPULSE LABORATORY

P. O. Box 250 *Eatontown 3-0768* **Red Bank, N. J.**



SPECIAL

5—5 mfd—400 vdc Oil Cond.

3 terms. bot. mntg flanged type. Dimensions 3¾ x 3½ x 2. Tested at 1800 V. Meets commercial specs. for 600 Volt operation up to 40 degrees C. Being used as power factor correction capacitors. Numerous applications. 24 per carton. See symbol "F". Price..... **$.39** each

OIL CONDENSER—New

Symbol	Cap.	Voltage	Type	Price
B	.005-.005-.01	10 KV	26F344	2.50
I	.007	1,000V	Rev. bkt.	.08
E	.03	16KV	#26F380	3.00
B	.1	1,500V		.22
O	.1	2,000V		.32
F	.1	2,500V	#2516CB	.40
G	.1	3,500V		.55
B	.1	5,000V		.75
B	.1	7,000V	#25F744	1.00
G	.1	7,000V	Can 1 Term.	.90
B	.1	7,500V	#23F447	1.20
B	.1	10KV	#23F644	4.25
B	.1	15KV	#25F572	5.25
B	.2	10KV	#25F433	4.50
B	.25	3,000V		1.15
E	.25	6,000V	#23F659	1.25
B	.25	20KV		16.95
B	.3	2,000V		.49
B	.4	10KV	#14F267	4.75
D	.5	400V	#416MCT	.12
D	.5	500V	#9CE6A3	.14
B	.5	1,500V	Can	.25
B	.5	2,000V		.75
B	.5	3,000V		1.10
B	.5-.5	600V		.20
B	.75	1,000V		.17
F	1	400V		.16
D	1	500V	#23F266	.18
F	1	500V	#23F225	.18
F	1	600V	CP6881EF105	.24
B	1	600V		.20
B	1	1,000V	TJU10010G	.25
B	1	2,500V		1.15
B	1	10KV	#14F267	12.95
B	1	15KV		15.75
B	1.25-1.25	7,500V	#23F360	5.75
D	2	600V		.25
G	2	600V	TLA Type	.16
G	2	1,000V	TLA Type	.40
B	2	1,000V		.49
B	2	2,500V	Bkts	2.15
B	2	4,000V	#23F47G2	3.65
B	3	600V	Can	.25
B	3	4,000V		4.50
B	4	600V	#23F317	.48
B	5	600V		.52
F	5-5	400V		.39
B	6	2,000V		2.90
B	10	600V		.85
B	10	1,000V		1.95
B	15	1,000V	TJU10150	2.15

NEW MICA CONDS.

6, 15, 25, 30, 39, 75, 100, 140, 150, 185, 200, 230, 240, 250, 300, 350, 400, 500, 750, 1000, 1250, 1300, 1500, 3000, 3800, 4700, 5000, 6000 and 10,000 mmfd @ 500V. $3.50 per "C". Special, 100 assorted $2.95.

NEW S. MICA CONDS.

10, 20, 30, 50, 100, 120, 140, 150, 200, 240, 250, 300, 345, 400, 500, 670, 1000, 1800, 2000 and 2500 mmfd @ 500V. $7.00 per "C". Special, 100 assorted $5.95.

MOLDED PAPER CONDS.

.004, .01, .03, .05 mfd—600V.....$3.50 per "C"
.006, .01, .03, .05 mfd—400V.....$2.50 per "C"

TYPE "J" POTS

$.35

Symbols: LS=Locking Type Shaft, S=Screwdriver, R=Round Shaft

Ohms	Shaft	Ohms	Shaft
50	1/4S	25,000	1/8LS
200	1/8S	50,000	1/4S
500	1/8S	50,000	1/8S
500	1/2R	50,000	1 1/4R
1,000	1/8LS	50,000	1/8LS
2,000	3/8LS	100,000	1/8LS
3,000	1/8LS	100,000	1.0R
3,000	1/2R	100,000	1/4S
5,000	1/8LS	150,000	2 1/8R
5,000	1/4R	200,000	1/8LS
10,000	1/8LS	200,000	1/2S
10,000	3/8R	250,000	1/8LS
15,000	1/8S	250,000	1/8S
16,000	1 1/8LS	300,000 (2 Terms)	1/8S
20,000	1/8LS	1 Meg	1/8LS
20,000	1 1/4R	1 Meg	1/8S

TYPE "JJ"

$.70

Ohms	Shaft	Ohms	Shaft
1500	1/4R	100K	1/2LS
1K-5K	3/8R	100K	33/8LS

Available in other sizes

COAXIAL CONNECTORS

UG-10/U	.85	UG-30/U	.90	UG-201/U	.85
UG-12/U	.59	UG-30/U		UG-245/U	.59
UG-21/U	.59	Special	.90	UG-266/U	.59
UG-22/U	.59	UG-58/U	.56	PL54	.10
UG-23/U	.59	UG-59/U	.59	PL81	.40
UG-24/U	.59	UG-83/U	.59	83-1R	.28
UG-25/U	.59	UG-86/U	.98	83-1SP	.28
UG-27/U	.59	UG-167/U	1.75	83-1SPN	.28
UG-29/U	.65	UG-190/U	.85		

AN-3102-14S-5P..... .25
AN-3102-14S-2P..... .25
RC-10066-201P..... .25

TUBE—BRAND NEW

3C24	.24	90006	.15	12SN7	.50
12C8	.35	872A	1.00	832-A	3.95
954	.15	838	2.25		
CK1006	.35	1616	.50		

CERAMICON CONDS.

10, 56, 100, 250, 500, 1000 & 5000 mmfd $4.00 per "C"

METAL TUBULAR OIL CONDS.

.02. & .03 mfd..400V. .....$5.00 per "C"
.1 mfd—1000V. .....$6.00 per "C"

BATHTUB COND. SPECIALS

Cap.	Voltage	Terminals	Price
1 mfd	100V	ST.	.10
.25 mfd	300V	ST.	.10
2x.1 mfd	400V	TT.	.10
2x.1 mfd	400V	BT.	.10
3x.1 mfd	400V	ST.	.15
2x.1 mfd	1,000V	ST.	.19
1 mfd	300V	ST.	.15
.3 mfd	400V	ST.	.10

See Mar. edition for complete listing

55' STEEL MAST

Comprising 11 interlocking 5 foot sections, diameter 2" x 1/16" wall. Base mounting. 4 guy rings. Total weight 130 lbs. Price $18.00. Separately—Individual sections $2.00, base mounting $9.00.

Price F.O.B., 25% with order. Balance C.O.D. Minimum order $2.00.

MONMOUTH RADIO LABORATORIES

BOX 159 OAKHURST, N. J.

SPECIAL PURCHASE.....BAKELITE PANELS!!!!

These are very handy to have around the shop. Can be used for panels, insulators and many other applications. Easy to cut to desired size and shape. (All have fabric base except #B034 which is masonite die-stock).

Stock No.	Size	Net Wt.	Pr. Ea.	Per 10	Per 100
B564	5/64X6"X12-1/2"	5 Oz.	.15	1.35	11.00
B058	5/8"X5-1/2"X12"	2 Lb.	.40	3.40	30.00
Bo34	3/4"X6"X14"	4 Lb.	.80	6.80	60.00
Bo78	7/8"X6-3/4"X	5 Lb.	1.00	8.50	75.00

Write for free circulars showing bargains in tubes, condensers, TV equipment, transformers and many other items.

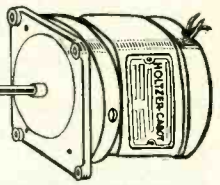
Terms: Cash with order or 25% deposit on C.O.D. orders. Net 10 days to rated concerns. All shipments F.O.B. Chicago, Ill.

IRVING JOSEPH RADIO PARTS, INC.

215 S. HALSTED ST. CHICAGO, ILL.

NEW HOLTZER-CABOT TOTALLY ENCLOSED MOTORS

50 R.P.M. Reversible Single Phase Capacitor-Run type. 115 Volts AC 60 cycle 0.3 Amp. Torque 100 oz. inches. 4¾" shaft ⅜" dia. 400 at $16.50 ea. SAMPLE $17.50



GRAIN OF WHEAT LAMPS

Used for illuminating meters, compass, dials, airplane instruments, etc. Soldering iron removes lamp from base to use in models, doll houses, miniature trains, Xmas trees, etc.
Mazda G.E. 323 3V..19.A
Mazda G.E. 328 6V..2A
Either type, doz. **$1.50**

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 **$3.90**

Also available in 15 min.-30 min.-1 hr. at $8.50

ISOLATION TRANSFORMER $1.95

Nat. known Mfgrs. 50 watt 2 windings, 115 V. to 115 V. 60 cy. Ideal to prevent shocks from small radios and medical and electronic devices. Shipping Weight 5 lbs.

Other sizes and 220-110 in stock.

Kilowatt Demand Meter Totalizer containing heavy duty TELECHRON B-7, 1 RPM motor and hundreds of watch size gears, clutches, springs, etc. Shipping weight 2 lbs. 5 for $10.00 **$2.50**

RADAR MAGNETS .....$5.00 to $17.50
Write for Sizes and Weights.
RCA 930 PHOTO TUBE.....$1.25
CRYSTAL DIODE IN 23..... .55
INSTANT REVERSIBLE 50 RPM SMALL 12V. DC-40 OHM RELAY.....5 for $1.00 Sample 50¢
ALLIANCE OR RUSSELL 110V AC MOTOR. $1.85; 3 for $5.00

GONIOMETER CFT—47263 CFT—47372

We are Authorized Wholesalers for Micro Switch Corp. and carry the largest stock of Allen-Bradley Solenoids. Potter & Broomfield Relays. Guardian Electric Co. Solenoids and Relays and Haydon Clock Motors in all speeds. Electric Counters.

EST. 1923 **BLAN** EST. 1923

Experimenters and Inventors Supplies

64 Dey St., New York 7, N. Y.

WANTED

(Additional Wanted Ads on opposite page)

WE BUY Electronic Parts

Write Condition and Prices

W-6279, Electronics
330 W. 42nd St., New York 18, N. Y.

CASH FOR

- Audio Oscillator
- Panoramic Audio Analyzer
- Wave Form Analyzer

W-6309, Electronics
330 W. 42nd St., New York 18, N. Y.

WANTED

Boonton 160A, 170A Q Meter; GR916A RF bridge, GR 736A Wave Analyzer

Give details to

Box W-6263, Electronics
330 W. 42nd St., New York 18, N. Y.

WANTED TO BUY

Large and small quantities of new or used electronic government or manufacturers' surplus tubes and equipment. Highest prices paid. State quantity, condition and best price in first letter.

W-2369, Electronics
330 W. 42nd St., New York 18, N. Y.

$ CASH PAID $

We will buy your stock of dynamotors, transformers, generator sets or any other surplus. Send us your descriptive lists.

William I. Horlick Company
407 Atlantic Ave.
Boston 10, Mass.

WANTED

BC 348Q } RADIO
BC 639 } RECEIVERS — Original condition

TITEFLEX, INC.
500 FRELINGHUYSEN AVENUE
NEWARK 5, NEW JERSEY

WANTED
TEST EQUIPMENT

state asking price, age and condition in first letter.

W-1150, Electronics
330 W. 42nd St., New York 18, N. Y.

WANTED
WESTERN ELECTRIC VACUUM TUBES

Types 101F, 102F, 272A, 274A or B, 310A or B, 311A, 313C, 323A, 328A, 329A, 348A, 349A, 352A, 373A, 374A, 393A, 394A, 121A Ballast Lamps.

W-6641, Electronics
330 West 42nd St., New York 18, N. Y.

WANTED

Teletypewriters complete, components or parts. Any quantity and condition.

W-6654, Electronics
330 West 42nd Street, New York 18, N. Y.

WANTED

COMPLETE LISTINGS OF SURPLUS MICA CONDENSERS STANDARD AND SILVER MICAS

Postage stamp and half postage stamp size.

Box E 1652
221 W. 41 St. N. Y. 18

WANTED
CAPACITANCE BRIDGE
RANGE TO 1000 MMFDS.
General Radio, Western Electric, or Equivalent

W-6224, Electronics
330 W. 42nd St., New York 18, N. Y.

• CONTACTS •

FOR THE FIELD OF ELECTRONICS

WANTED

• • •

RESISTORS

and

J POTENTIOMETERS

made by

Allen-Bradley Company

any wattage

any ohmage

any tolerance

We pay highest prices

• • •

LEGRI S CO., INC.

130 West 102 St., New York, N. Y.

Phone: ACademy 2-0018

BRAND NEW U. S. GOV'T. SURPLUS GUARANTEED

POWER RHEOSTATS

Ohms	watt	ea.	Ohms	watt	ea.
2	225	$4.95	150	150	$3.50
3	100	2.90	200	25	.98
3	225	4.95	200	150	3.50
4	225	4.95	225	50	1.24
5	50	1.24	250	25	.98
5	100	2.90	350	25	.98
5	150	3.50	350	100	2.70
6	25	.98	378	150	3.50
6	50	1.24	400	25	.98
7	25	.98	500	25	.98
8	50	1.24	500	75	2.49
10	25	.98	585	150	3.50
10	100	2.70	750	25	.98
12	25	.98	750	150	3.50
15	25	.98	1000	25	.98
16	50	1.24	1200	225	4.95
22	50	1.24	1250	50	1.24
25	25	.98	1250	150	3.50
32	300	5.25	1500	50	1.24
50	25	.98	2000	25	.98
50	50	1.24	2000	50	1.24
50	750	17.95	2500	100	2.90
60	25	.98	3000	25	.98
75	150	3.50	3000	100	2.90
80	50	1.24	3500	50	1.24
80	500	7.60	5000	25	.98
100	25	.98	5000	50	1.49
100	50	1.24	7500	50	1.63
100	225	2.70	7500	100	3.30
125	25	.98	10000	50	1.63
125	500	7.60	10000	100	3.50
150	50	1.24	20000	150	5.26

Specify whether shaft required is KNOB or SCREWDRIVER type (Discount to Quantity Users.)

SELECTOR SWITCHES

Pole	Pos.	Deck	Type	Each
1	6	1	bak-shtg	.31
1	12	1	cer-n/shtg	.55
1	21	3	bak-n/shtg	.69
1	24	2	bak-n/shtg	.79
2	2	1	cer-shtg	.39
2	6	2	bak-n/shtg	.49
2	8	2	bak-shtg	.54
2	11	2	bak-shtg	.60
4	4	2	cer-n/shtg	.54
4	11	4	bak-shtg	1.20
5	3	2	cer-n/shtg	.56
6	11	6	bak-n/shtg	1.98
10	5	5	cer-shtg	1.49
12	2	3	bak-shtg	.75
16	2	4	bak-n/shtg	.98

"AN" CONNECTORS

LARGE VARIETY AVAILABLE AT GREAT SAVINGS

Send your specs and let us quote

BIRTCHER TUBE CLAMPS

#926-A, #926-A1, #926-B, #926-B1, #926-B2, #926-B7 — 14¢ ea. — $12.00 per hundred — #926-B22, #926-C, #926-C1, #926-C5, #926-C10, #926-C24

OIL CONDENSERS

Mfd	VDCW	Each
.1	3000	.75
.1	6000	1.89
.1	20,000	18.95
.25	3000	1.10
.5	1500	.89
1	600	.35
1	2000	1.95
2	400	.35
2	600	.39
2	1000	.79
4	600	.69
6	400	.75
6	600	.79
10	600	.98
14	600	1.75
15	600	1.98
15	1000	3.25
2 x .1	7000	3.95
2 x .5	9000	14.95

BATHTUBS

mfd	vdcw	each
.033	400	.17
.05	200	.17
.05	400	.19
.05	600	.21
.1	400	.20
.1	600	.22
.1	1000	.32
.15	600	.22
.25	200	.19
.25	600	.23
.35	400	.22
.5	400	.23
.5	600	.25
.5	1000	.35
1	200	.29
1	600	.35
2	400	.44
2	600	.59
4	50	.25
8	500	.59
25	50	.28
25	75	.30
40	25	.27
50	25	.28
200	12	.35
300	6	.39
.05-.05	600	.29
.05-.05	1500	.45
.1-.05	200	.25
.1-.1	400	.26
.1-.1	600	.28
.16-.16	600	.28
.2-.2	600	.29
.25-.25	600	.30
.5-.5	600	.35
1.0-.1	300	.29
200-200	9	.49
3 x .05	600	.40
3 x .1	400	.42
3 x .1	600	.45
3 x .25	600	.50
3x 1.0	100	.40

Specify Top, Side, or Bottom Lugs.

"UG" Connectors

UG-12/U	$ .89
UG-13/U	1.49
UG-18/U	.89
UG-19/U	1.15
UG-21/U	.89
UG-22/U	.98
UG-24/U	.95
UG-25/U	1.15
UG-27/U	1.75
UG-57/U	.89
UG-58/U	.65

TYPE "J" POTENTIOMETERS

Specify whether regular or screwdriver shaft is required.

TYPE "J" 50¢

ohms	ohms	ohms
60	2000	20K
100	2100	25K
150	2200	30K
300	4000	50K
400	4700	75K
500	5000	80K
600	10K	100K
1000	11K	200K
1200	12K	250K
1400	15K	300K
1500	16K	1meg

When ordering locking type bushings, locking nuts are available in the following types:

Hex shaft lock @ .05
Acorn " " @ .10
Knurled " " @ .10

TYPE "JJ" $1.25

ohms	ohms
100-100	100K-100K
200-200	130K-130K
500-500	150K-150K
600-600	200K-200K
1500-1500	250K-250K
2000-2000	300K-300K
5000-5000	350K-5000
10K-10K	350K-25K
20K-2000	500K-500K
25K-10K	800K-75K
35K-5000	1meg-1meg
50K-50K	5meg-5meg

TYPE "JJJ" $2.25

ohms
20K-200K-20K
45K-27K-2500
700K-700K-700K
750K-750K-750K
800K-800K-800K
1meg-1meg-1meg

TRANSMITTING MICAS


Type 9


Type 4

mfd	vdcw	type	ea.	mfd	vdcw	type	ea
.00001	600	4	.18	.00162	600	4	.18
.00003	600	4	.18	.002	600	4	.20
.00005	600	4	.18	.002	1200	4	.48
.00005	2500	9	.31	.0022	2500	9	.78
.0001	600	4	.18	.0025	600	4	.23
.0001	2500	9	.31	.003	600	4	.25
.000152	600	4	.18	.0039	600	4	.25
.0002	600	4	.18	.005	600	4	.25
.00025	600	4	.18	.005	1200	9	.60
.0005	600	4	.18	.005	2500	9	1.18
.00051	2500	4	.43	.0062	600	4	.30
.0007	600	4	.18	.01	600	4	.40
.0008	600	4	.18	.01	600	9	.49
.0009	600	4	.18	.01	1200	9	.98
.001	600	4	.18	.0142	600	4	.45
.001	1200	4	.31	.02	600	4	.55
.001	1200	9	.31	.02	1250	9	1.36
.0013	600	4	.18	.027	600	4	.66
.0015	600	4	.18	.043	600	4	.99

"UHF" Coax Cable CONNECTORS


83-1R 83-1AP 83-1SPN

Cat. No.	Army No.	Type	Each	Per/C
83-1AP	M-359	Plug	.35	.28
83-1D	PL-271	Adap	1.25	1.00
83-1F	PL-274	Feed	1.10	.90
83-1R	SO-239	Rec.	.35	.28
83-1SPN	PL-259A	Plug	.35	.28
83-22R	SO-264	Rec.	.50	.40
83-22SP	UG-102/U	Plug	.68	.60

Open Accounts to Rated Concerns
Prices net FOB our whse NYC.
Send for our Catalog

ALEXANDER MOGULL CO., INC.

161 Washington St., N. Y. 6, N. Y. — WOrth 4-0865

GOVT SURPLUS

WE CARRY A LARGE AND VARIED INVENTORY WHICH INCLUDES:

- AN CONNECTORS
- CABLE
- CAPACITORS
- CHOKES
- CIRCUIT BREAKERS
- COAX-CONNECTORS
- COILS
- CORDS
- CRYSTALS
- DELAY LINES
- FILTERS
- FUSES
- INVERTERS
- KLYSTRONS
- MAGNETRONS
- MAGNETS
- MICROPHONES
- METERS
- MOTORS
- POTENTIOMETERS
- POWER SUPPLIES
- PROJECTION LAMPS
- SELSYNS
- SCOPE ACCES.
- SHOCK MOUNTS
- SOCKETS
- SWITCHES
- TELEPHONE EQUIP.
- TEST EQUIPMENT
- TRANSFORMERS
- TRANSMITTERS
- TUBES
- WAVEGUIDE
- WAVEMETERS
- WIRE

A PENNY POST-CARD WILL PUT YOUR NAME ON OUR MAILING LIST.

DUBIN

ELECTRONICS CO. INC.

Dept. E-550

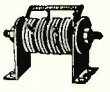
103-02 NORTHERN BLVD., CORONA NEW YORK

Telephones: HIckory 6-3066-7-8

MIRROR — front surface aluminized on optical glass 1 3/16" diameter 3/32" thick ..... $.50

PRECISION LEVEL — interior ground tube level with 4 adjusting screws. Overall length 1⅝". diam. 15/32". One end with shoulder ⅛" diam. $.85

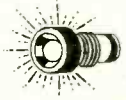
DELCO BLOWER — sirocco type D.C. Flange diameter 3½" blade 3-3/16" RPM @ 12 volts 3400 RPM @ 6 volts 1600 ..... $3.95



SELENIUM RECTIFIERS — G.E. model 6RS 5FB3 maximum A.C. volts 56 D.C. amps. 0.150 ..... $1.35

CIRCUIT BREAKER — 10 amp 30 volt D.C. C-H. Cat. #8751K4 ... $1.10

GLASS VIAL — to use as a permanent level on equipment $1.00



Miniature lamp T1¾, 3 volt .19 amp. Airplane Indicator, Amb. Ctd.
10 for ..... .85
100 for $7.50

Lamp Assembly C203 Genl. 1 Made by Eastman Kodak with Iris Diaphragm 12 volt lamp ..... each $1.95

DETROIT THERMOSTATIC EXPANSION VALVES #674-494 3-8" Inlet; 1-2" S A E Outlet; 7-32" Orifice for use with FREON, Maximum Operation 55 lbs. $4.50

SEND FOR FREE BULLETIN

TELEPHONE BEEKMAN 3-8623

A. Cottone & COMPANY — ELECTRONIC MECHANICAL & OPTICAL COMPONENTS

336-340 CARROLL ST., NEW YORK 31, N.Y.

ALL PRICES F.O.B. N. Y. CITY

ALLIED TYPE BO RELAYS 55 VAC DPDT. Operates on 12 VDC or 110 VAC intermit. duty (5 min). 2 units in series for 110 VAC for 4PDT oper. #R211 $1.10 ea. BO 6D29 6 VDC DPDT 14.2 ohms. #R212 $1.10 ea. BOX-103 24 VDC DPDT 230 ohms. #R04 ... $.89 ea. BO-12D35 24 VDC SPST NO Dble Br 230 ohms, #R06 $.79 ea.

Over 100,000 Relays In Our VAST STOCK

GUARANTEED— IMMEDIATE DELIVERY

Write us your needs for our quote

Write for Our Quote

SOLENOIDS

G. E. CR9533K100A2 240 ohm 24 VDC DPST N.C. & SPST n.o. 2 switchettes. Extra Long throw. #R132 ... $8.40

HART M569A CAT # 694R19 75 ohm 24 VDC 200 amp. cont. SPST n.o. #R127A $1.75

SINE - COSINE - SQUARE - WAVE POTENTIOMETER W.E. CO# D169100 for very low freq. sweep circuits $9.95 ea.

S.S. WHITE DENTAL LAB RESISTORS 1K, 4K, 60K, 100K, 500K. All 1 Watt $7.50/C

H-F TIE POST

LOW-LOSS BAKELITE INSULATION

$7.50/C $67.00/M

LARGE STOCKS OF

AN Connectors, APC's, Binding Posts, Cable, Capacitors, Ceramicons, Ceramics, Chokes, Circuit Breakers, Coils, Controls, Crystals, Filters, Fuses, Hardware, Knobs, Relays, Resistors, Shock-Mounts, Sockets, Spaghetti, Switches, Transformers, Tubes

Write Us Your Needs for Immediate Quote

Min. Order $2.50

Prices Net FOB Our Plant

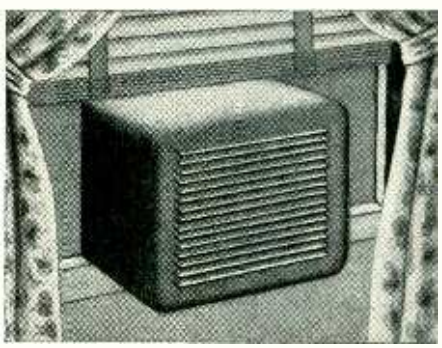
Moved to 324 Canal St.

Universal general corp.

New York 13, N. Y. — WAlker 5-9642

SAVE $180!
BANISH FOREVER HOT DAYS! NIGHTS!
VARIABLE ELECTRIC
(PATENTED FILTER)
USES NO WATER
FOR COOL—CLEAN AIR
WINTER & SUMMER

BRAND NEW



No Dirt—No Draft—No Noise
Continuous Variable Control

DELIVERS 695 (C. F. M.) CUBIC FEET PER MINUTE IN FREE AIR

PERFECT VENTILATION. Air filtration is assured by use of PATENTED FILTER for ELIMINATING DUST, DIRT, and POLLEN from outdoors.

Ventilates your room with CLEAN, COOL, FILTERED AIR . . . SUMMER or WINTER. Enables you to SUBDUE outside NOISES by keeping windows closed and to get the amount of air you want, whether calm or stormy.

Easily ADAPTED TO ANY WINDOW without cutting or marring; mounted flush with inside of window for pleasing appearance.

Cabinet is made of HEAVY STEEL with "BAKED ON" BRONZE HAMMERTONE FINISH. Will blend with all home, office, or factory surroundings.

HOMES
OFFICES
SCHOOLS
FACTORIES
SHOWROOMS

A SENSATIONAL BUY!
110V 60 Cycle AC
$44.95 F.O.B. N.Y.C.

220-250 V.D.C.	59.95
110 V.D.C.	59.95
220-230 V.A.C.	$59.95

(Plus 10% U. S. Excise Tax)

TERMS: 20% Deposit, Balance C.O.D., F.O.B. N. Y. C. Rated firms open a/c net 10 days

MANUEL KLEIN
74 CORTLANDT STREET
NEW YORK 7, N. Y. REctor 2-6460

SELENIUM RECTIFIERS and ASSOCIATED COMPONENTS

SINGLE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-18VAC		Output 0-12 VDC
Type No.	Current	Price
B1-250	250 MA.	$0.98
B1-1	1 AMP.	2.49
B1-1X5	1.5 AMP.	2.95
B1-3X5	3.5 AMP.	4.50
B1-5	5 AMP.	5.95
B1-10	10 AMP.	9.95
B1-20	20 AMP.	15.95
B1-30	30 AMP.	24.95
B1-40	40 AMP.	27.95
B1-50	50 AMP.	32.95

Input 0-36VAC		Output 0-26 VDC
Type No.	Current	Price
B2-150	150 MA.	$0.98
B2-250	250 MA.	1.25
B2-300	300 MA.	1.50
B2-2	2 AMP.	4.95
B2-3X5	3.5 AMP.	6.95
B2-5	5 AMP.	9.95
B2-10	10 AMP.	15.95
B2-20	20 AMP.	27.95
B2-30	30 AMP.	36.95
B2-40	40 AMP.	44.95

Input 0-115VAC		Output 0-90 VDC
Type No.	Current	Price
B6-250	250 MA.	$2.95
B6-600	600 MA.	5.95
B6-750	750 MA.	6.95
B6-1X5	1.5 AMP.	10.95
B6-3X5	3.5 AMP.	18.95
B6-5	5 AMP.	24.95
B6-10	10 AMP.	36.95
B6-15	15 AMP.	54.95

THREE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-234VAC		Output 0-250 VDC
Type No	Current	Price
3B13-1	1 AMP.	$22.00
3B13-2	2 AMP.	32.00
3B13-4	4 AMP.	56.00
3B13-6	6 AMP.	81.50
3B13-10	10 AMP.	105.00
3B13-15	15 AMP.	120.00

CENTER TAPPED RECTIFIERS SINGLE PHASE FULL WAVE

Input 10-0-10VAC		Output 0-8 VDC
Type No.	Current	Price
C1-10	10 AMP.	$6.95
C1-20	20 AMP.	10.95
C1-30	30 AMP.	14.95
C1-40	40 AMP.	17.95
C1-50	50 AMP.	20.95

RECTIFIER MOUNTING BRACKETS

For Types B1 through B6, and Type C1 . . . . . $ .35 per set
For Types 3B . . . . . 1.05 per set

SELENIUM RECTIFIER CATALOG

Write for our Catalog No. 719 which lists Selenium Rectifiers, associated transformers, condensers and filter chokes.

Minimum order $3.00. No C.O.D.'s. Add 10% for Prepaid Parcel Post and Handling. Terms: Net 10 days in the presence of approved credit.

All prices subject to change without notice. Prices and Delivery F.O.B. our NYC Warehouse. All merchandise subject to prior sale.

POWER SUPPLY KITS
24 to 28 VDC Filtered

Designed for continuous duty ground operation and bench testing of aircraft equipment, these kits provide a reliable means of obtaining a source of low ripple 24 VDC, from a 115 VAC 60 cycle line. Full wave bridge Selenium Rectifiers insure instantaneous and efficient operation. Adjustment of the DC output voltage is accomplished by transformer primary taps. Ripple is limited to within 2% of the average DC output by choke-input filters.

Kit No.	Amperes DC	Net Price
242	2.0	$16.39
245	5.0	22.39
2410	10.0	47.44
2420	20.0	79.44

Write for descriptive Bulletin No. 201

RECTIFIER CAPACITORS

CF-14	3000 MFD	12VDC	$1.69
CF-15	6000 MFD	12VDC	2.95
CF-1	1000 MFD	15VDC	.98
CF-2	2000 MFD	15VDC	1.69
CF-20	2500 MFD	15VDC	1.95
CF-3	1000 MFD	25VDC	1.25
CF-4	2X3500 MFD	25VDC	3.45
CF-6	4000 MFD	30VDC	3.25
CF-7	3000 MFD	35VDC	3.25
CF-8	100 MFD	50VDC	.98
CF-19	500 MFD	50VDC	1.95
CF-16	2000 MFD	50VDC	3.25
CF-21	1200 MFD	90VDC	3.25
CF-9	200 MFD	150VDC	1.69
CF-10	500 MFD	200VDC	3.25

Mounting clamps for above capacitors . . . 15c ea.

RECTIFIER TRANSFORMERS
All Primaries 115VAC 50/60 Cycles

Type No.	Volts	Amps.	Shpg. Wt.	Price
XF15-12	15	12	7 lbs.	$3.95
TXF36-2	36	2	6 lbs.	3.95
TXF36-5	36	5	8 lbs.	4.95
TXF36-10	36	10	12 lbs.	7.95
TXF36-15	36	15	20 lbs.	11.95
TXF36-20	36	20	30 lbs.	17.95
XFC18-14	18VCT	14	10 lbs.	5.95

All TXF Types are Tapped to Deliver 32, 34, 36 Volts. XFC Type is Tapped to Deliver 16, 17, 18 Volts Center Tapped.

RECTIFIER CHOKES

Type No.	Hy.	Amps.	Dc Res.	Price
HY5	.02	5	.25	$3.25
HY5A	.028	5	.20	3.95
HY10	.02	10	.30	9.95
HY10A	.014	10	.04	7.95
HY20A	.007	20	.02	12.95

Type "A" low resistance chokes are specially suited to circuits requiring excellent voltage regulation.

D-C PANEL METERS

Attractive, rugged, and reasonably priced. Moving vane solenoid type with accuracy within 5%.
0- 6 Amperes D-C
0-12 Amperes D-C
0-15 Volts D-C
Any range $2.49 each

Opad-Green COMPANY
71-2 Warren St. New York 7, N. Y.
Phone: BEekman 3-7385-6

WESTINGHOUSE HIPERSIL CORES

Over 25,000 units in 8 dimensions, several gauges; up to 12,000 units in some sizes. Available for immediately delivery. Send for list with complete description.

RAYTHEON MFG. CO.
Surplus Sales Dept., Waltham, Mass.
Tel. Waltham 5-5860—Ext. 2

D.C. MICROAMMETERS

0-200 ua 3" sq. G.E. DO 50 . . . . . $ 8.00
0-100 ua 3" sq. G.E. DO 50 . . . . . 10.00
0-50 ua 3" sq. G.E. DO 50 . . . . . 12.00

R.F. MILLIAMMETERS

0-115 Ma 3½" Weston 425 . . . . . $12.00
0-100 Ma 3½" Weston 425 . . . . . 12.00

PRECISION PORTABLE INSTRUMENTS
Single or multi-range

D.C. Microammeters, from 5 ua full scale. Thermo-couple Milliammeters, from 1.5 Ma. Thermo-couple voltmeters.

Precision Electrical Instrument Co.
146 Grand Street New York 13, N. Y.

LABORATORIES! MANUFACTURERS! TV EXPERIMENTERS!

RADAR SEARCH RECEIVER ARD-2

80 TO 3000 MCS

The requests for technical information on the ARD-2 equipment, have been overwhelming, to the point that we are describing it more fully below to further assist you.

MADE FOR: US Navy patrol aircraft. PURPOSE: To measure carrier frequencies from 80 to 3000 MCS and pulse rates from 50 to 8000 cycles per second. Signals can be located by calibrated charts.

EQUIPMENT: Consists of the following: 1 ANTENNA-DETECTOR (CMD-66AFH) has variable length antennas (2), diode detector, and silver plated tuning stub with calibrated scale; 1 AMPLIFIER (CMD-50ADC) has three stage pulse amplifier, a trigger circuit, a pulse rate counter circuit and audio amplifier, a visual signal indicator, and a rectifier power supply which is operative on 115 Volts AC, single phase, at 60 to 2400 cycle current, regulated; 1 TEST OSCILLATOR (CMD-60ABG) has carrier frequency of 400 cycles with selection of four pulse repetition rates.

With the above are included all cables with fittings, accessories, and shock mounted rack, a steel chest with complete spare parts and 200% additional tubes and 2 technical manuals. Gross weight 113 pounds.

BRAND NEW! ORIGINAL PACKING! COMPLETE!

Price, each.....$175.00

RECEIVER-TRANSMITTER COMBINATIONS

SCR-508/528 FM at 35 Watts output: 20.0-27.9 Mcs., complete with receiver and transmitter, dynamotors, control boxes, crystals, antennas.

SCR-608/628 as above, except for frequency of 27.0-38.9 Mcs.

TCS Mfged by Collins 40/20 W. Phone & CW for 12 V. DC, 1.5 to 12.0 Mcs. with all accessories.

AVT/R/A Mged by RCA, 6-10 Watts phone and CW 2300 to 6700 Kcs. Small compact for 6 & 12 V.D.C. NEW & COMPLETE with power supply, mike, key & antenna.

TRANSMITTERS

BC-610 Hallicrafter, 2.0-18.0 mcs. 450 watts CW 350 watts phone. Antenna tuner & speech amplifier, cables, manuals, complete. Wt: 446 lbs net.

BC-365 Federal Tel. & Tel. 150 to 550 Kcs. 350 watts CW. for Radio Range or carrier communication. Complete. Wt: 629 lbs net.

BC-325 Federal Tel. & Tel., 1.5-18.0 Mcs. 400 W. phone 100 W. CW. complete with remote control. Wt: 900 lbs net.

TDE Westinghouse Mfg. 300 to 18,100 Kcs., 125 W. A1; 35 W. A2 A3; for naval or shore use. Complete in several input voltages. Wt: 672 lbs net.

Western Electric WE-34A; R.C.A. ET-8019; Westinghouse TCE; and others.

MOBILE EQUIPMENT

For 6 Volt DC operation, in 30 to 40 Megacycle band. Receivers and transmitters mfged by RCA, LINK, Motorola, NEW.

TAPE FACSIMILE EQUIPMENT

Model RC-58-B will transmit messages, handwritten or typed on a paper tape by direct wire or via radio. Complete with amplifier, recorder scanner, accessories, and spares. NEW in one case.

RADIOTELEPHONES

5 WATT, Model JT-52 by Jefferson-Travis, 2 channel, crystal controlled recvr-transmitter, built-in speaker, hand microphone, 6 Volt DC power supply. Freq: 2000-3000 KCS, in compact steel cabinet, complete less xtals. New in original cartons. In dealer quantities.

50 WATT, MTR-5032 by Harvey-Wells, SIX channel xtal controlled recvr-transmitter, 2000-3000 Kcs, with built-in speaker, telephone hand set, (provisions for selector-ringer and external deck calling system) in handsome steel cabinet. for 32 Volt DC input. Complete, less crystals. NEW.

50 WATT, MTR-5011, as above, but for 115V DC.

75 WATT, MTR-7532, similar to above, with same features, for 32 Volts DC input.

75 WATT, MTR-7511, as above, but for 115 V. DC.

Other models in various wattages in stock. Dealer inquiries invited.

LORAN

DAS/DAS-2 Mfged. by General Electric Co. for US Navy. A shipboard installation requiring no modifications. For 115 and 230 V. AC input at 50-60 cycles. Has four channel selector. COMPLETE and BRAND NEW in one case. Price $395.00

WALKIE-TALKIES HANDY TALKIES

Many types to choose from in new and complete condition and guaranteed. Bulletins on request.

PORTABLE RADAR

SN RADAR, Mfged. by Gen. Elec. Co. for US Navy portable use. An excellent 10 CM equipment self contained and complete with all accessories. Input: 110 V AC, (and 110 V DC—with generator included). Ranges on 5 & 25 mile scales on 5" scope. Complete accessories, complete equipment spares, 200% tube spares, cables. All complete & NEW.

DESCRIPTIVE LITERATURE ON REQUEST

Cable: COMMUNIDEV

COMMUNICATION DEVICES CO.

2331 TWELFTH AVENUE — NEW YORK 27, N. Y.

Tel: AD-4-6174, 5

NEW YORK'S RADIO TUBE EXCHANGE

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
OA4G	$.72	4B30	1.75	250TH	$19.25	720DY	$45.00	975A	12.50
C1B	3.95	4C21	1.25	250TL	15.00	721A	2.40	991	.25
1B22	2.95	4C27	29.95	250R	5.95	722A	3.95	CK1005	.35
1B23	8.95	4C30	1.25	HK253	6.95	723A	6.95	CK1006	.95
1B24	4.95	4C35	19.95	274B	1.75	723A/B	10.95	1280	.99
1B26	2.95	4J25	95.00	287A	3.95	724A	2.95	1611	1.50
1B35	19.95	4J26	95.00	CE303	3.95	724B	3.95	1613	.75
1B38	32.50	4J31	95.00	304TH	3.95	725A	12.95	1616	1.10
1B42	7.95	4J35	195.00	307A	4.25	726A	9.95	1619	.50
1B56	45.00	4J38	95.00	310A	4.50	726B	19.95	1622	1.50
1B60	45.00	4J40	195.00	316A	.69	726C	36.00	1624	.99
1N21	.85	4J52	250.00	350A	2.40	728AY	45.00	1625	.45
1N21A	.95	5BP1	2.75	350B	1.80	730A	6.95	1626	.45
1N21B	1.50	5BP4	3.95	368AS	2.40	801A	.69	1629	.45
1N23	.85	5C30	9.95	371B	.89	802	4.50	1631	.89
1N23A	.95	5CP1	1.95	388A	1.80	803	4.50	1641	1.00
1S21	3.75	5D21	19.95	393A	4.95	804	10.95	1851	1.10
2AP1	3.50	C5B	9.95	394A	4.95	805	4.95	1852	.99
2C23	.75	5FP7	1.95	417A	12.95	807	1.35	1853	.90
2C33	1.95	5JP1	45.00	434A	3.50	808	2.75	2050	.99
2C40	5.75	5JP2	10.95	450TL	37.50	809	2.75	2051	.55
2C43	12.50	5JP4	25.00	446A	.90	810	7.50	8012A	3.95
2C44	1.25	6CA	7.95	446B	1.80	811	2.11	8013A	2.75
2C51	7.50	6AC7	.90	WL468	5.95	813	7.95	8014A	25.00
2D21	1.08	6AC7W	1.75	WL469	2.75	814	2.95	8016	1.25
2J21	9.95	6AK5	1.16	WL525	2.75	815	1.50	852	9.95
2J22	9.95	6C21	19.95	527	7.95	827R	90.00	860	3.75
2J26	8.75	6F4	5.95	WL530	12.95	829B	7.50	861	19.95
2J27	9.75	6J4	4.95	WL531	7.95	832	3.95	866A	1.15
2J31	9.75	6-8	.95	WL532	2.95	832A	4.50	869B	29.95
2J32	12.95	6SU7GTY	1.25	533	39.95	834	7.50	872A	2.75
2J36	105.00	7BP7	4.95	WL535	7.75	836	1.10	874	1.95
2J38	7.95	7DP4	12.50	WL538	1.25	837	1.95	876	.75
2J40	25.00	10Y	.59	GL570	1.25	838	3.75	878	2.25
2J42	150.00	15E	1.50	575A	12.50	845	4.50	8019	1.75
2J49	24.50	15R	1.00	579B	5.95	849	19.95	8020	2.95
2J50	24.50	RX21	2.50	700A to B	19.50	851	19.95	8021	1.75
2J55	55.00	5C22	45.00	701A	3.95	884	1.45	8022	1.00
2J61	45.00	CV35	35.00	703A	2.40	885	1.25	8025	3.75
2J62	45.00	RK72	.95	705A	.75	931A	3.95	9001	.55
2K25	19.95	RK73	.95	707A	6.95	954	.45	9002	.35
2K28	19.95	OK77	249.00	707B	9.95	955	.45	9003	.55
2K29	24.95	OK47	55.00	710A	1.25	956	.45	9004	.45
2K45 on Request		OK59	59.00	714AY	4.95	957	.25	9005	1.50
2X2A	.69	OK61	49.50	715A	6.95	958A	.55	9006	.25
2V3G	.99	RK39	2.25	715B	9.95	959	.75		
2Y48	29.95	RK49	2.40	715C	24.95				
3A4	.75	VR53	.29	717A	.95				
3A5	.95	VR95	.45	720AY	45.00				
3AP1	4.95	100TH	10.95	720BY	45.00				
3BP1	3.95	VR105	.79	720CY	45.00				
3B24	1.50	F123A	8.95						
3C23	3.95	VR150	.63						
3C24	.95	VT98	39.95						
3C31	3.95	X99	.75						
3C45	13.95	203A	3.95						
3DP1A	3.25	211	.75						
3E29	7.50	217C	6.95						
3J31	59.95	242C	7.50						
4A1	.95	249C	3.75						

350A is a long life WE807
350B is a long life WE6L6G
WE 701A can be used for a Super 813

$10 Minimum Order

LIST OF TEST EQUIPMENT

Micro-Wave Test Equipment

K Band Spectrum Analyzer
X Band Spectrum Analyzer
X Band Signal Generator Types
TS 13 — TS 12 UNIT # 1 and 2
TS 16AA — TS 45
TS 33 — TS 146
TS 35 — TS 263
TS 36
X Band Magic T
X Band Crystal Tunable Mounts
RF 4 Echo Box S Band
S Band Signal Generators PE 102, BC 1277/60ABQ1
S Band Power Meter

Oscilloscopes

TS 34
BC 1287A
Cossor Two Beam

Standard Broadcast and Short Wave Equipment

TS 69
Ferris 20B Microvolter
Rider 162C Chanalist
Rider S.W. Adaptor for Chanalist
RCA Audio Chanalist
Measurement Corp. 65 B Signal Gener.
Measurements 58 Model
New Boxed Motor Generator Sets delivering 1200 W., at 400 cy. and 100 W. 28 V.D.C. from 110 v., 220 V., 60 cy., to operate on the ground aircraft equipment.

Meters

TS 15/AP Gauss Meter
General Radio Tube Voltmeter Type 728A to 3000 volt
Airradio Millivolter 0-2 Millivolt
Model 617-F Shallcross, Percent Limit Bridge
Model 40 Pyrometer, Elematic Equipment Co.
Light Spot Galvanometers, General Scientific Co.
Microammeter Rollers 0-10 Micramp.

Radar Sets

APS Complete and Parts — SCR 284
APS4 Complete and Parts

ATTENTION PURCHASING AGENTS SCHOOLS, MFRS. ETC.
We buy your Surplus Inventories for CASH In Tubes, Parts and Test Equipment.

LIBERTY ELECTRONICS, INC.

PHONE WORTH 4-8262 — 135 LIBERTY ST., NEW YORK 6, N.Y.

SOUNDTRONICS SPECIALS

SA3 RADAR ANTENNA ROTATOR, will rotate largest Navy type mattress..$115.00

6 V. 12 Amp. TRANS. 115 V. 60 Cy. Imp. Open Frame 2½" x 3" x 3½".....$1.65

REMOTE CONTROL M2 AMPLIFIER 115 V. 60 Cy. Input. 2 channels of Class B. Amp. Uses 1-5V4 & 4-6N7 Tubes. Has 4-1A57 Thordarson Bantam Audio Trans. Less Tubes ...$8.75

14 PIN T. V. SOCKET for 3BP1 & 7JP4, etc. Black Bakelite ....28¢ Mica Filled....18¢

U.T.C. CHOKES P. A. CASES
10 HY. @ 66 MA...$ .97 10 HY. @ 110 MA...$1.40
5 HY. @ 150 MA... 1.85 10 HY. @ 150 MA... 2.25

TG 10 KEYERS w/TUBES.....$24.95

3 CM. FLEX. WAVE GUIDE SECTION 2" long sq. to sq. flange.....$1.75

#22 AEROGLAS WIRE 1250 Volt Insul. white with tracer—100'...59¢, 1000'...$4.50

AEROVOX TYPE 1084 TUBULAR COND. .MFD 1000 Volt.....7¢ ea., Per C.....$5.90

TRANSFORMER POWER SUPPLY 115 V. 60 Cy, 300 V. @ 55MA. 6.3 V. @ 2 Amps. Has 5Y3, 2-8 HY. Chokes, 3-30 MFD Filters, Pilot Assy., Term. Strip. Meas. 5" x 5" x 8". Completely wired $6.85

TELEGRAPH, TELEPHONE FILTER UNIT. F-2/GG. Brand New $18.50

FOLLOWING EQUIP. USED BUT LIKE NEW

U.H.F. SIGNAL GENERATOR Similar to RCA type 710A 370 to 560 Meg. Output 1 Microvolt to .09 Volts, 400 Cy. Int. Mod. Dial Cal. Directly in Meg. Cavity Tuner, Cal. Piston Atten. Ideal for Citizens Band $145.00

TRANSTATS—3.9 KVA 1 Phase 50/60 cy. fixed winding 115/230 V. output 0-260 V., Max amps. 15 .....$42.00

5.85 KVA 1 phase 50/60 cy. fixed winding 115/230 V. Output 0-260 V., Max amps. 22.5 $52.00

MEMOVOX AP-ERP1 RA-345 Constant Groove Speed 16" Portable Play Back Units, with Reproducer. Less Cutters Each $125.00

20 Meg. SLUG TUNED I.F. COIL in 1/16" solid copper can 1½" x 3" similar to type used on BC 406 35¢ ea.....3/$1.00

SECTIONS FOR SCR 296 RADAR

SA3 RADAR UNIT complete except for mattress $550.00

SL RADAR UNIT complete.....$550.00

LARGE QUANTITY OF SEMI-PRECISION FACTORY TEST EQUIP. Pulse Gen. Pulse amp., Multi-Vib., Sig. Gen., Wavemeters, Delay lines, etc. Write requirements.

SOUNDTRONICS LABS.
632 Arch St., Phila. 6, Pa. MA 7-2775

COMET RECORD SMASHING VALUES!

EXTRA SPECIAL VALUES

LECTURE TYPE GALVANOMETER

- DC Galvano-Volt-Ammeter ● Scale 5-0-5
- Complete with shunts
- DIMENSIONS: 15" Lg. x 14½" H x 7½" W

Mfg'r Cence #82145
BRAND NEW—SPECIAL **$68.00**

Esterline-Angus Twin Chart Graph Recorder Model AWT-N Twin Flush Graph DC Milliameter feeds hourly - ¾" - 1½" - 3" - 6" - 12"

Minute ¾" - 1½" - 3" - 6" Scale Range 2.5-0-2.5 MA Writing Door—Synchronous Clock on each meter — Chronograph pen on each meter. Complete with Pens, Filler, Graphic Meter, Ink Charts, etc.
Brand New **$450.00**

SENSATIONAL VALUES

- TCS-12 Transceiver Freq. Range 1.5 to 12MCS. Brand new with 110VAC power supply, operating accessories, complete spares for transceiver and power supply. Original export packing. **$450.00**
- TBL-13 Transmitter and spares. Brand new. Export packed. **$450.00**
- BC-325 Transmitter. Brand New **$750.00**
- PPI Receiver Indicator Console includes: BC-988A Calibrator, BC-981A Receiver, BC-986 Oscilloscope, PE-138A Power Supply. Export Packed. **$350.00**

SOUND ON FILM

Hartron Recorder-Reproducer-Records up to 4 hours on a 62 foot loop of film—Plays back immediately—No processing of film required. Brand New. **$150.00**

AIRCRAFT EQUIPMENT

PROPELLER CONTROL

The Hydromatic type Constant Speed Control is a self-contained governor which automatically brings about the adjustments in propeller blade pitch necessary to maintain constant engine speed under varying flight conditions.
BRAND NEW $49.50

Send your inquiries for aircraft hardware and radio equipment.

DAB-3 DIRECTION FINDING

Frequency Range 2000-18100 KC bearing indication—visual, phase comparison. Brand New. Complete.

HIGH VOLTAGE TEST SET

General Electric Type K 0.75 KVA 115V 60 Cycle Range of voltage break-down 750-1500-3000 Volts used. Excellent condition. $49.95

TEMPCO 1 KW TRANSMITTER

CW transmission frequency range 2000-16000 KC. Pierce Crystal Oscillator. Model 1000 AG-CW Complete. Brand New.

AMERICAN BLOWER AND MOTOR

⅛ HP GE motor 115V 1 phase 60 cycle, 1725 RPM CW rotation —Assembly is 10¼" wide, 12" high —Air intake 6" dia.—Air output 4¾" x 4¾". Brand New $19.95

SPECIALS

80.86 KC crystal with holder $1.50
NE-2 Neon lamp.....05
Battery tester 0-10V, 0-35A .85
33 mmf—440 mmf variable condenser 1750V test.....69
24-750 mmf tapered rotor plates .90
7-100 mmf 1000 V peak, cond .69
50 watt tube socket 872, 211 .19

CIRCUIT BREAKERS

24 VDC .220 Amp. Heine..$0.49
110 VAC 3 Amp Curve 3 Heine.....69
115 VAC 4 Amp Curve 1 2 Pole.....1.40
115 VAC 25 Amp 1 Pole Westing.....1.25

SPECIALS

TRANSMITTING MICA AEROVOX

.0012 MFD 20,000 VDC
Brand New.....$10.95

TIME DELAY LINE

1 micro second 15 KVA 400 cycle 50 ohm. Brand New $4.95

DE-ION LINE STARTER

DPST 115V 60 cy 15A 1 H.P. rating Westinghouse New $3.25

WESTON #666 SOCKET SELECTOR UNIT

Measures current, voltage, resistance, etc. In a vacuum tube circuit. Brand New $9.95

INERTEEN CAPACITOR

1.0 MFD 7500 VDC
Brand new $5.25 ea/2 for $4.45 ea

FILTER REACTORS

.4 HY 4.5 amp DC 3 ohms 1230 RMS to ground test GE
Brand New $39.00

1.7 HY with .02 amp DC and not less than 0.3 HY with 2 amp DC ripple. 9000 V DC circuit GE Y3464A Brand New $75.00

CHOKES

.25 HY 4 amp .5 ohm DC resistance. 20,000 V test GE
Brand New $24.95

1HY 3.2 amp DC 3.5 ohm GE 69G459 Brand New $34.95

GENERATOR VOLTAGE REGULATOR

115 volt 400 cycle GE GBA 20C New $10.95

ALUMINUM MAST

76 feet telescopic aluminum mast fully collapsed only 11 ft. Dia. at base 7", tapers to 3½" at top—with guys, erection poles and lights. $175.00

RELAYS

12 VDC DPST Box 32.....$ .65
24 VDC Solenoid operates two Switchetts 1.25
110 VAC DPDT RF antenna change-over 3.50
110 VAC DPDT 2.95
110 VAC DPST S-D CXA 1970 2.45
115 VAC DPST S-D CXA 2997 2.75
220 VDC DPDT S-D CX 2122 3.00
230 VAC DPDT GE 12HGA11A2 enc. in bakelite case 4.25

ROUND PANEL METERS

.5 Volts RF Output 50 Micro Amp. Weston 2½" $4.75

0–4	RF	Amps	GE 2"	3.95
0–5	RF	Amps	Weston 3½"	4.50
0–300	MA	DC	Simpson 2½"	3.75
0–300	MA	DC	Westing 2½"	3.75
5–0–5	MA	DC	Weston with 50 MA shunt 3½"	4.25
0–8	Amps	DC	McClin 2½"	1.95
0–50	Amps	DC	Weston 3½"	4.75
0–100	Amps	DC	Hoyt 3"	3.00
0–15	Volts	AC	GE 3½"	4.94
0–3	Volts	DC	Sun 2½"	1.95
0–2500	Volts	DC	Simpson 3½" with 2500 Volt Multiplier	5.95
0–5 KV		DC	0–10 MADC 3½	5.75
0–150	Volts	DC	Hoyt 3½"	3.95
10–0+6	DB		Weston 2½"	4.50

PORTABLE METERS

0–10	m	DC	Weston 489	7.50
0–3–6–30	Volts	DC	Weston 280	17.50
0–25	Amps	AC	Weston 433	23.95
0–1.5–6	Volts	AC	Output meter Weston 571	10.95

NAVY RDF RECEIVER

Fixed tuned freq. range 200-550 KC operates on 110 VAC. Brand new w/6" speaker and spares.....$39.95

TIME DELAY SWITCHES

1 minute 115 VAC 60 cy Enc. in waterproof metal case .....New $2.95
3 micro switches make contact at 40-41-42 sec. time delay 110 VAC motor New $4.00
30-40 Sec. mercury time delay relay 110 VAC .....New $5.95
Thermo switch 50°F to 300°F, 115VAC @ 6A, 230VAC @ 5A. Breaks contact with increase in temperature New .95

TUBES

2C34	.25	CK–1005	.20
2X2A	.55	CK–1007	.90
2X2/879	.35	1626	.25
3C24	.38	1629	.25
7C4/1203A	.35	2051	.40
10Y	.45	7193	.20
15E	1.20	8011	2.00
15R	.60	9002	.30
39/44	.25	9003	.35
45 Spec	.28	9006	.25
HK54	1.65	C5B	6.90
211	.40	CEQ72	1.30
713A	.90	CK–70	3.50
717A	.55	E–1148	.35
801A	.25	HY615	.70
803	4.00	RK–73	.75
804	8.50	VT–127A	2.25
805	3.65	VT–1	.50
826	.40	3BP1	2.50
864	.35	5CP1	1.95
869B	25.00	5BP4	2.90
872A	1.45	5FP7	1.00

TERMS Minimum order $5.00—mail orders promptly filled—all prices F.O.B. Boston, Mass. Send M.O. or check Shipping charges sent C.O.D. 25% deposit required on all C.O.D. orders.

INQUIRIES FROM DEALERS, SCHOOLS AND INDUSTRIAL FIRMS INVITED

COMET ELECTRONIC SALES CO.
22 WASHINGTON ST. BRIGHTON 35, MASS.
BEACON 2-7863

SHEET METAL MACHINERY

NEW and Used—Brakes—Shears
Forming Rolls — Folders — Punches — Di-Acro, Pexto, Niagara & Whitney Equipment.

B. D. BROOKS CO., INC.
HAncock 6-5200
361 Atlantic Ave., Boston 10, Mass.

"AN" CONNECTORS

LARGE QUANTITIES IN STOCK
WILGREEN
74 Cortlandt St., N. Y. 7, N. Y. Br. 7-4862

CLARE STEPPING SWITCHES

Type SD-14, 20 steps. 6 levels. Coil 12V, DC. Lists at $40.26; our low price $13.00. Brand new in original boxes—not war surplus. Quantities of four or more, $12.25 each. Satisfaction guaranteed or money refunded.

NEOMATIC, INC.
879 Wellesley Ave., Los Angeles 49, Cal.
ARizona 3-4897

ATTENTION FOREIGN BUYERS

WE HAVE RC52F TRANSMITTERS

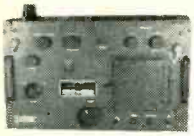
completely rebuilt and guaranteed, priced at $1250.00. This fine unit is suitable for international CW and phone transmissions, airport traffic control and general commercial use.

WESTON LABORATORIES
WESTON 93, MASS.

ALVARADIO SUPPLY CO.

341 S. Vermont — Los Angeles 5, Calif.

SIGNAL GENERATORS



I-222-A RF SIGNAL GENERATOR

Covers two bands—8-15 mc., 150-230 mc. Can use up to third harmonic. Built-in 110 V., 60 cycle power supply. In good condition.....$77.00

I-122 Sig. Gen., 15-26 mc., 95-130 mc., with built-in pwr. supply, good condition $77.00

I-126 Sig. Gen., 15-26 mc., 180-235 mc., with built-in pwr. supply. Good condition $77.00

GENERAL RADIO 804-CS1 SIGNAL GENERATOR

UHF generator. Has range from 8-330 mc. In good condition. A real buy at this price $177.00

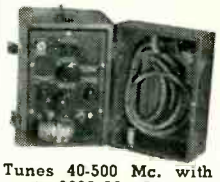
BOONTON MODEL 78D SIGNAL GENERATOR

An excellent precision instrument. Good condition $125

AN/ARM-1—Test set for ARC-3. Only $150.00

IE-19—Test set for SCR 522. Complete, good used condition. A real bargain at only $125.00

TEST OSCILLATORS



TS-47/APR TEST OSCILLATOR

Complete with self-contained power supply and power cord. Tunes 40-500 Mc. with usable harmonics up to 3000 Mc. In good used condition. A real precision instrument priced well below its original cost.

$125.00

TS 164/AR FREQUENCY METER

Airborne version of BC-221. With original calibration book.

$75.00

TS-10/APN	$40.00
TS-16/APN	$75.00
TS-23/APN	$75.00
TS-61/AP	$100.00
TS-62/AP	$100.00
TS-74/UPM	$10.00
TS-92/AP	$50.00
TS-102A/AP	$125.00
TS-126/AP	$100.00
TS-204/AP	$10.00

RECEIVERS

BC-639. VHF RECEIVER

Complete with RA-42 power supply. An excellent buy in good used condition.

$175.00

BC-638A FREQUENCY METER

BC-678A RELAY UNIT

RM-25A CONTROL UNIT

RM-26A CONTROL UNIT

RM-27A CONTROL UNITT

EE-99A TELEPHONE REPEATER UNIT. NEW $19.95

APR-5A RECEIVER—Used, excell. condition.

MG-149H INVERTER $22.50

A-62 PHANTOM ANTENNA. New .$2.00

T-85/APT5 TRANSMITTER. In good condition. Complete with tubes..$39.50

BC-376H. Good condition $75.00

R-78/APS-15A. Used $34.50

AN/CRT3 .....$60.00

ALVARADIO

Dept. L-3, 341 S. Vermont
Los Angeles 5, Calif.
Phone DUnkirk 8-2211

All items subject to prior sale. Prices subject to change without notice.

METERS:

0-150 Volt AC 3" Round.....$3.95
0-150 Volt 400 Cycle 2½" Round..... 2.95
0-5 Amp. AC 3" Rd. 0-100 A. Scale..... 3.95
0-5 Amp. AC 3" Rd. 0-75 A. Scale..... 3.95
0-5 Milliamp AC 2½" Square..... 2.95
0-500 Microamp 2½" Rd. w/0-15 & 0-600 DC Volt Scale 3.95

METER SWITCH—Battery Balancing Switch used to read battery voltage and to switch load from one battery to another. Contains Weston 2" Meter 0 to 15 DC Volts, switch DPDT—20 amp. 125 V. pilot light indicator and pull sw. Case size: 4" x 6¼" x 2¾". Price: NEW.....$2.95

DYNAMOTORS:

Input	Output	Stock No.	Price
9 V. DC	450 V. 60 MA.	DM-9450	
@ 6 V. DC	275 V. 50 MA.	w/Blower	$.395
12/24 V. DC	440 V. 200 MA.		
	220 V. 100 MA.	D-104	9.95
18 V. DC	450 V. 60 MA.	DM-175	2.95
12 V. DC	600 V. 300 MA.	BD-86	7.95

PERMANENT MAGNET FIELD DYNAMOTORS:

12/24 V. DC	275 V. 110 MA.	USA/0516	3.95
12/24 V. DC	500 V. 50 MA.	USA/0515	2.95

PM FIELD DYNAMOTOR POWER SUPPLY—Completely filtered. Has two PM Dynamotors as listed directly above $5.00

WRITE TODAY FOR QUOTATION ON OTHER DYNAMOTOR OR INVERTER NEEDS!

GENERATOR—12 Volt 100 Amp. Mfg. by Emerson. 5400 RPM with ⅝" x ¾" shaft and 4 mtg. holes on each end for right or left. Motor size: 8⅜" x 4¾". Price: $12.95

Address Dept. E. • • • All Prices Are F.O.B. Lima, O. • 25% Deposit on C.O.D. Orders

CONDENSER ASSEMBLIES:

5 GANG—

with vernier tuning 25 MMFD to 450 MMFD each section. Size: 7½" x 3½" x 3½". Price: $2.95

3 GANG—

25 MMFD to 450 MMFD each section. Size: 6" x 3¼" x 3". Price.....$1.95

WHIP ANTENNA EQUIPMENT

MAST BASES—INSULATED:

MP-132—1" heavy coil spring, 2" insulator. Overall length: 11½", Weight: 2¾ lbs. Price.....$3.95
MP-22 Spring action direction of bracket. 4" x 6" mounting. Price $2.95

MAST SECTIONS FOR ABOVE BASES:

Tubular steel, copper coated, painted, 3 foot sections, screw-in type. MS-53 can be used to make any length, with MS-52-51-50-49 for taper. Price, per section ..... 50¢

SECTIONS MS-54—55 Larger than MS-53....75¢ ea.

BAG BG-56 for carrying 5 mast sections.....50¢ ea.

GEARED MOTOR

Ideal reversible motor for rotating antennas, displays, etc. (Similar to illustration) Weight: 4 lbs. Overall size: 7" long, less shaft. Gear Box size: 3¼" x 3¼". Motor size 4" x 2½". Shaft size: ⅜" x 1½" threaded. Operates from 24 volt DC, 219 A., 9 RPM or 36 volt AC at 75 lbs. torque per inch. Price $5.95
36 Volt Transformer.....$2.95
RHEOSTAT to control speed. 120 ohm. 50 Watts..... .97¢

FAIR RADIO SALES

132 SOUTH MAIN ST. — LIMA, OHIO

MAY SPECIALS

Shock Mounts #C-2060.
Price....$1.25 doz.

Shock Mounts mounted on frame. #C-2060
(frame 3⅛" x 17")
Price....$2.25 pr.

Parabolic Reflectors
Price....$2.25 pr.

Handles (heavy duty, drop handles)
Price....$1.50 doz.

T.V. vertical output transformers.
Price....$1.50 ea.

Hermetically sealed matching Transformers, primary 800, Secondary 5,000
Price....3 for $1.25

"Write for our list of Power Transformers and Oil filled condensers."

Schools—Colleges—Manufacturers
Please contact us if you have any surplus parts or materials that you no longer need.

"WRITE FOR OUR CATALOG"

AMERICAN SALES COMPANY

1811 W. 47th St. — Chicago 9, Ill.

TUBES—New, Branded, Famous Make!
75¢ Each—2A3 1632 5V4G 1633
1N23A.....98¢ 724B.....$2.39
12DP7.....$9.95
Very Limited Quantities
Best Prices Paid for Small Inventories.

BETZ
73 Caroline Ave. — Yonkers 5, N. Y.

We Buy & Sell
TUBULARS—BATHTUBS
CERAMICONS—RESISTORS
Trimmers, Spkers., Pots, Micas, etc.
GOULD GREEN
252 GREENWICH ST. — N. Y. C. 7

FOR SALE
REACTOR TRANSFORMER KITS

Two complete reactor transformer kits for use with PW40A transmitter. Over forty pieces per kit including the 67KV plate transformer. For details address

FS-6262, Electronics
330 W. 42nd St., New York 18, N. Y.

If there is anything you want

or something you don't want that readers can supply—or use—*advertise it in the*

Searchlight Section

METER MULTIPLIER

Westinghouse R5, 1 meg., w.w., noninductive ½% tol. $.90 each, 10 for $7.50 or 10 multipliers plus a Weston or Westinghouse 3", 1 ma. meter.....$10.00

RECTIFIER

Copper Sulphide, F.W.B., 3.5 v. a-c in, 1.8 v. d-c @ 1 amp out. (Fine for 1.5 v. d-c filaments). New, boxed. $.60 each, 10 for $5.00, 100 for $40.00.

TUBES:

Discount 20% on orders over $50.00

1B22	$4.25	714AY	3.75
1N21	.40	715A	7.50
1N23	.50	715B	6.50
2J62	37.50	719A	9.50
3B22	2.50	721A	2.75
250TL	19.50	722A	7.50
316A	.35	724B	2.50
388A	2.75	725A	8.50
700A	9.75	730A	10.50
701A	3.50	846	47.50
702A	2.75	872A	1.75
703A	2.75	C5B	7.75
704A	1.00	C6A	8.25
706BY	12.50	C6J	4.75
706EY	12.50	FG81A	3.75
707A	12.50	WE-203A	8.75
707B	7.00	VT98 (Br.)	12.50
708A	2.75		
713A	.75		

NEW!
- low prices
- 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.

SPECIAL: Rectigon, Westinghouse Battery Charger Tube, 6 amp. 65 v., Cat. #289414/JAN4B28. New, orig. box. $1.50 each, 4 for $5.00.

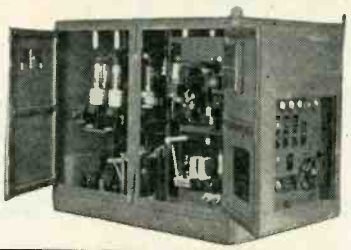
Immersion heater, Westinghouse, low surface, 3 heat, oil type, 115 v. 200, 400, and 800 watt. 1¼" male pipe connection with calrod elements projecting 9". List $17.20. Our price $6.50 each, 2 for $10.00.

VACUUM CAPACITOR: 50 mmfd. 32,000 v. d-c. New, original carton. $4.50 each, 4 for $15.00.

TRANSTAT. 115/220 v. 50/60 c., 0-260 v. 2½ amp. cont. 5 amp. max. output. New. Original packing. List $43.00. $17.50 each, 2 for $30.00.

NEW RA-38 RECTIFIERS

115 v., 60 cy. 1 phase input, output 0-15,000 v. d-c @ 500 ma. Write for detailed information.



ASD RADAR TRANSMITTER & MODULATOR

3 centimeter: complete with 725A magnetron, cavity, two 723A/B Klystrons, one RKR73, four 72's, one 715B, one 829B, two 724B's, two 6AC7's, one 1N23 crystal diode, high voltage supply, two cooling blowers, etc. Input: 115 v. 400 c. N-2 condition $39.50
Preamp assembly: includes plumbing (2) 723 A/B's, (2) 6AC7's, (2) 724B's, 1N23, etc. $17.50

Filament Transformer

HIGH VOLTAGE FILAMENT TRANSFORMERS: Amertran Type W.S. .050 KVA, 50/60 c., 1 phase; 35 KV test, 12 KV d-c operating; sec. 5 v c-t @ 10 amps. Has socket that takes 872A, 250T, 371, 5563 etc., rectifiers. Net Wt. 16 lbs. $12.50 each, 2 for $22.50, 4 for $40.00.

GENERAL ANNOUNCING SYSTEM

Ideal for public address application in Factories, Airport Hangars and Warehouses. Besides excellent fidelity and volume (140 watts output) of voice and sound, two different alarm signals (1000 cycle tone and bell-tone) are available for fire warnings, starting and quitting time, emergency calls, etc.

MANUFACTURED BY STROMBERG-CARLSON FOR THE U. S. NAVY. They are New and in original Packing.

Works from 110 volts A.C.

The basic unit, consisting of two channels with separate amplifier units, two signal generators and associated switches, relays and meters, measures 72 inches high, 30 inches wide and 18 inches deep.

BASIC UNIT.....$500.00
Includes 2 Amplifiers, 2 Signal Generators, complete with Cabinet, Spare Parts and Transmitter Control Station, which consists of Microphone, Speaker Group Selector and Volume Indicator.

SPEAKER $15.00
Waterproof Construction, 12 inches.

SPEAKER $10.00
Waterproof Construction, 9 inches.

Numerous other items of Electronic Equipment: Transmitters, Receivers, Radar, Sonar, Facsimile Equipment, Radio Marine Telephones.

CALL . . . . PHONE . . . . WRITE

PHADICK SALES CORP.
165 Broadway, New York 6, N. Y.
WOrth 4-3782

TELEVISION TUBE MACHINERY

8-HEAD MACHINE, for button stems.

TUBE STEM MACHINES Mfd. by Kahle Eng. Co. 4-5-6-7-8 positions with Geneva movements.

HYDROGEN FURNACES Complete with automatic controls, 20" x 7" x 4". Brick-lined, with two Bristol automatic controllers, Brown pyrometers.

EXHAUST MACHINE 32 head, capacity 60 tubes per hour, 60 W. type B174 Sealiex chassis.

VACUUM FIRING EQUIPMENT Mfg. by GE. SEALING & STEM MACHINE 16 head, mfd. by GE.

EXHAUST MACHINE 16 head, mfd. by GE, can be converted to standard tube production.

Many other items of good, used glass-working equipment. Please write for details:

HAYDU BROTHERS
Plainfield, New Jersey

ELECTRONIC TUBE-MAKING MACHINERY

For manufacturing radio tubes, electronic tubes, cathode-ray tubes, lamps. New and used. Reasonably priced, satisfaction guaranteed.

AMERICAN ELECTRICAL SALES CO.
67 E. 8th St. New York, N. Y.

NEW "SEARCHLIGHT" ADVERTISEMENTS

received by May 2nd will appear in the June issue subject to limitations of space available. Address copy to the

Classified Advertising Division

ELECTRONICS

330 W. 42nd St., New York 18, N. Y.

USED RA 38

Good Condition

0-15000 volts dc at 500 Ma 7.5KW 0-15KV output. Rectifier Power Supply. Price $300.00 F.O.B. Stamford, Conn.

C. G. S. LABORATORIES, INC.
36 Ludlow St. Stamford, Conn.

Quick ANSWERS to your business problems . . .

HUNDREDS of miscellaneous business problems can be quickly and easily solved through the use of the Searchlight Section of this or other McGraw-Hill publications.

When you want additional employees or a position, want to buy or sell used or surplus equipment, want products to manufacture, seek new capital or have other business wants — advertise them in the Searchlight Section for quick, profitable results!

The SEARCHLIGHT SECTIONS OF McGRAW-HILL PUBLICATIONS

Classified Advertising

American Machinist
Aviation Week
Business Week
Bus Transportation
Chemical Engineering
Coal Age
Construction Methods & Equipment
Electrical Construction & Maintenance
Electrical Merchandising
Electrical World
Electronics
Engineering and Mining Journal
E. & M. J. Metal & Mineral Markets
Engineering News-Record
Factory Management and Maintenance
Food Industries
Nucleonics
Operating Engineer
Power
Product Engineering
Textile World
Welding Eng.

Classified Advertising Division

McGRAW-HILL PUBLISHING CO., Inc.

330 West 42nd Street

NEW YORK 18, N. Y.

ELECTRO—THE BEST FOR ELECTRONIC SURPLUS

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 ..... $8.95

6904X-27, 24 VDC @ 1 Amp., 150 in/lbs. torque, 2½" RPM reversible. Complete w/limit switch, relays and selenium rectifiers same as above $9.95

DICTOGRAPH INTER-COMMUNICATION SETS

Designed to bring to homes and offices the conv. of two-way, convers. w/o the use of telephone, household elec. current, or radio. Efficient to 800 ft. off flashlight batteries. New. Pair $9.95

DAVEN SOUND ATTENUATORS

Type 350-A. Network, ladder, linear imped. 30/30 ohms. 2DB attenuation. 10 W dissipation. Brand new $3.95

HEAVY DUTY RHEOSTATS

High shock rheostats, four 13" plates, 100 ohms 8-2A, 175-345 V connected in series. Assembled for back of board mtg. or by reversing the supporting brackets for floor or table oper. New $19.75

RETARD CHOKE COILS

Amertran, Disc Type Line voltage 15,000; ripple freq. 120. Oil-filled: .020A DC @ 200H @ 48% ripple. 52A DC @ 25H @ 48% ripple 17"x17"x22" w/term. 10" above base. 40°C temp. rise $34.00

MILLIAMMETERS

150-0-150 MA DC. Accuracy ½ of 1%. Scale length 4⅛", Wt. 3½ lbs. 6" x 2½" x 4⅛". Like New.. $2.50

SPERRY A-5 VERTICAL GYRO UNIT

#644841. 115 V. 400 CY 3 phase. Contains gyro assembly, erection motor, erection relay assembly, pick-off assembly, elevator and aileron limit switches, and roll axes. 15 x 12 x 9. New $27.50

QBE-1 Underwater Sound Equipment

Type CBM 55681 Indicator Unit—Ranges 0-1000 yds. and 0-5000 yds., Visual & Audio Indication Synchronous motor driven, input 115/1/60. 20 x 16 x 8½ $25.00

BATTERY CHARGER

Ideal for your car, for the serviceman and ham. Selenium—transformer type, 7½ x 4½ x 4¾. Portable metal container. Input 115, VAC output 6.5 V. @ 2 amps $7.25

DIEHL MOTORS

Normally 110V. 60 cy. 3 ph. units. Will operate satisfactory on 110V, 60 cy. 1 Ph. by addition of capacitors across one of the other phases. 1/40 HP, cont. duty, 3450 RPM. 1¾ x ⅝" D shaft. Motor dimensions: 4" H x 5"W x 5"D. Wgt. 10 lbs. $5.50

AUTOSYNS, INVERTERS AND DYNAMOTORS

PE 206-Inverter, input 27 Volts DC, output 80 Volts, 800 Cycle 500 Va $10.00

PE 218 Inverter, input 27 Volts DC, output 115 Volts, 400 Cycles. 1500 VA Rebuilt. L.N. ... 15.00

G. E. Dynamotor, 5D48E8A input 14 V. D. C. output 1000 V. at 350 Ma. with filter 5.00

MG-132A Inverter, input 11.5 V DC, output 140 V AC, 1.2 Amps. 350 cy. 1800 RPM 100% PF. 19.95

AY—1 Autosyn indicator 26 V 400 Cy. 400 AY—14 Trans. Autosyn 26V 400 Cy. new/calibration chart 10.95

AY—20 26 V Trans. Autosyn 26 V 400 Cy 6.50

AN80 ANTENNA. ¼ Wave length trans. receiving 500 MC 5" Blade TypeMtg. in Isolante form .. 75¢

CHOKES AND TRANSFORMERS

Raytheon S. M. Chokes, UX7776, 1.28 Henries 130 MA 57 ohms ..... $ 1.75

Raytheon S. M. Choke, #X867S. 15 Henries 28MA 1050 ohms ..... .50

Raytheon S.M. Choke, UX9116, .03 Henries 2A (Rectifier Choke) 2.25

Raytheon Choke Assembly, CRP30509, 1.8 Henries 0.384A 1.50

Raytheon Dual Choke, WX5146, 1.5 Henries 400 MA 1.5 Henries @400 Ma 1.95

Raytheon S. M. Choke, (Rectifier) UX9114A, 0.100 Henries 1.4 Amps 2.00

G. E. #7385576, 87.9 Henries @ .0672 Amps. 7.5 KV DC Test Volts 10.00

Amertran, 20 Henries @ 45 MA ..... .75

Sprague, 15-E4-91-400-50P 4.95

East. 15-E-5-1.33-700-50P2T (Z1743) 3.00

Raytheon, UX7361A, blocking oscillator, 3 windings, 2-3 micro seconds, peak pulse 300-400. Repetition rate up to 4000 Cy 1.75

Raytheon, Input, UX9216A, Pri. 10,000 ohms impd. Sec. 2x 25,000 ohms 1.00

Raytheon Sweep, UX8725A, Pri #1 1600-0-1600 turns. Sec. #2 800-0-800 turns. Sec. #3 & #4 1600 turns 1.00

Raytheon, Auto, UX7548, Pri. 26V Sec. 10.8V 400-800 cy 1.00

Raytheon, Interstage, UX7587C. Pri. #1 & #2 15,000 ohms impd, Sec. 67 .500 ohms 1.00

Raytheon, Phasing, UX8724, Pri. 115 VAC, 60 cy. Sec. 15V 0.5MA 1.25

Raytheon, Interstage, UX8442, Pri. Minus 40V Sec. plus 40V 1.00

Raytheon AC-RC UX7858, Pri. 115 VAC 400 Cy. Sec. 6500V, .005A 2.50

Raytheon Filament UX8486A. Pri. 115 VAC 400 Cy. Sec. 5V @ 5A, 13500 WVT 1.50

Raytheon, Output UX7489A. Pri. 3600 Ohms. Sec. 720 Ohms 1.25

Raytheon Plate & Fil. UX8547. Pri. 115V 400 Cy. Sec. 1000V 25MA. Sec. #2 6.15 V 0.7A ... 1.95

Raytheon Pulse Transformer WX5137, Pri. 4 KV. 1 MU, Sec. 16 KV 16 Amps. Fil. Trans. Pri. 115V 60 Cy 3.95

Raytheon Fil. Type U-8370 Uri-220/440 60 Cy. Sec. #1, #2, #3-2.5 Volts @ 5 Amps. Sec. #4 2.5 Volts @ 15 Amps. 3 KV Test 6.50

Raytheon Dist Type CRP-30382. Pri. 220/440 V 1.71 A. Sec. 145 V @ 6.53 A. 4000 V.T. ... 14.50

Raytheon Fil. U-5083 Pri: 220/400 V 60 Cy. Sec. 5 Volt @ 30 Amps. 1780 test Volts 14.50

YJ RADIO EQUIPMENT. Two Channel, automatic responding Radar Beacon or Racon. Designed for shore installation. Automatically transmits coded signals in reply to interrogating signals from craft equipped with radar or IFF equipment. Replies to interrogating signals in the (A) Band 176 MC, (B) Bank, 515 MC. Rectifier power unit; A and B Band transpondors, transmitter and receiver complete with 30 tubes, 115/1/60 36" L. -8" H. 17" W. Wgt. 270 lbs. LN. Price $65.00

HOT SPECIALS—CONDENSERS—Standard Brands

2x50 MFD @ 150 WVDC TUBULAR ..... @ 50¢

40 MFD. @ 200 WDC TUBULAR ..... @ 35¢

16 MFD. @ 150 WVDC TUBULAR ..... @ 20¢

.1 MFD. @ 600 WVDC TUBULAR ..... @ ea. 15¢

.25 MFD. @ 600 WVDC OIL IMPREG TUBULAR CAW 481074 17¢ ea.; 10 for $1.50

Same as above but 400 volt 15¢ ea.; 10 for $1.35

.01 MFD @ WVDC PAPER TUBULAR HERM. SEALED, 10¢ ea.; 10 for $1.50

RAYTHEON DEFLECTION COILS. #U8820 for 5FP7. CRT. Metal Cased $1.85

COMMAND SET EQUIVALENT—BC 430, Excellent VFO using 2 Type 45's and 2 Type 10 tubes, 40 WATTS CW with one coil. (COIL RANGES: 2 - 2.5, 2.5 - 3.2, 3-3.6, 3.6 - 4.5, 4 - 4.8, 6 - 7.3, and 7.3 - 9 MC. Your choice of coil $6.95

COMMAND TRANSMITTERS—2 - 3 MC, LN $7.95, 3-4 MC LN $12.95, 4 - 5.3MC LN $7.95, 5.3 - 7 MC LN $7.95.

SCR 178—TRANSMITTER RECEIVER. 2400-3700 KCS 10 W OUTPUT w/spare parts PHONE, AND CW opt. $45.00

RL-42B ANTENNA REEL—w/MOTOR AND GEAR BOX—Perfect Beam rotators. Wt. 4 lbs. magnetic clutch. Reversible with SPDT switch $3.95

"BEAM INDICATOR" SELSYNS—GE model 2J1G1. Operates from 57.5/57.5 V. 400 cy w/wiring diagram for 110 V 60 CY oper. $2.50 pair. Also available GE Model 2J1F1 115/57.5 V 400 CY ..... pair $3.00

ANTENNA CHANGE OVER SWITCH—SPDT. Knife operated. Heavy duty. Isolantite insulation ..... 39¢

HEAVY DUTY AIR COOLED RESISTORS .52 ohms or 10 ohms 1000W. Your choice $1.50

REMOTE CONTROLS. RM29A Telephone Units, no ext. power nec. Good up to 50 miles, self contained Magneto ..... pair $17.95

CALROID HEATERS GE. #5A760 115V 200W ..$1.50

GE. 5A699 65W 57.5V ..... 75¢

G.E. FUSE HOLDERS TYPE EL-1. Neon lamp indicating Midget size #6328725G1, 15A ..... 49¢

G. E. 6227889G1, 60A ..... 69¢

TRANSMITTER AND RELAY RACK CABINETS—Chrome decorated hinged door on top and back with Catch Amateur or W.E. notched. Black crackled 28½" H. 18" D Panel space 26⅛" LN $10.00 ea.; 2 for $17.50

WESTERN ELECTRIC PRECISION CRYSTALS—40 Meter Band 7270 KC 95¢ ea. 2 for $1.75

25' EXTENSION LIGHT heavy duty cord. Switch on handle. Metal bulb protector $1.65

HEINEMAN CIRCUIT BREAKERS—24 VDC @ .220 A., SPST 95¢ ea.; 0311 M-10, 24 VDC @ 10 A. SPST $1.45, 0322M-10-24 VDC @ 15 A. DPDT $2.25

GUYWIRE—1/16" Dia. Galv Perf Steel. Excellent elasticity. Rust proof. Ideal for TV antenna installations. 1000 ft. rolls $3.90/M

FRACTIONAL HORSE POWER MOTORS—OSTER 27.5 VDC 1/20 HP 3600 RPM SHUNT Wound. $7.55

UNIVERSAL ELECTRIC 115 VDC. 12 AMPS .003 HP 5000 RPM $4.50

OSTER 6 VDC 1.8 AMPS 5000 RPM 6 oz./in. torque W/BLOWER Size 1½ AND IMPELLER $4.50

EMC 110 VAC 60 cy. 1/40 HP 1725 RPM. LN.. $4.50

OSTER 27.5 VDC1/100 HP. Series 7000 RPM ... $2.50

UNIVERSAL ELECTRIC 28 VDC. 0.6 AMPS 5000 RPM 1/100 HP $2.50

EMERSON—24 VDC 24 AMPS. Series wound. 100 RPM 160 OZ/FT torque $7.95

GE 27VDC. 5 AMPS 250 RPM 8 OZ/IN LN ... $3.50

PHONO MOTORS—GENERAL IND 115 V 60 cy; .5 A. 80 RPM Minus turntable $2.50

CHOKES—2.5 H @ 700 MILS, 14 OHMS $5.95

20 HENRIES @ 45 MILS, 500 OHMS ..... 60¢

40 HENRIES @ 20 MILS ..... 80¢

150 HENRIES @ 1 MIL. 7,000 OHMS ..... 45¢

TRANSFORMERS—Pri: 115 V 60 Cy.

THORDARSON (70R62) 350-0-350

145 MILS; 5V @ 3 A; 6.3 VCT @ 4.5A $4.25

JEFFERSON FIL—20 Volts @ 10 A $3.95

OPEN CORE POWER, 18 V @ 6 A $2.95

STANDARD BRAND CAPACITORS

Inerteen type FL. 7500 VDC. 135 MFD. 13.5 Meg. resistance. Style 1227191-A. Precipitron Service. New $6.95

Synchro Capacitor Cat. #25F613. Rated at 90 volts 3 ph. 60 cy., 30 Mu-f. New $4.95

Cat. #14F201. Rated at 16-8 KV., .375-.75 Mu-f. New $9.95

Bathtub #42308. Rated 5-3-1-1 Mu-f., 150 VDC. New $1.00

Fast High Voltage type AE6734. Rated 1.0 Mu-f. 25 KV. Oil-filled. New $60.00

Cat. #25F774. Rated 0.1-0.1 Mu-f. 7000 VDC ... $2.95

Motor Starting Capacitor #S25784-1. Rated 2 x 160 Mu-f. 150 VDC. New $2.90

Fast High Voltage Oil Filled #A7548. Rated at 0.25-0.25 Mu-f. 6-12 KV. New $14.95

Mica type PL1159-30H. Cap. 0.115 mfd. 2000V. 15A @ 3000 KC, 20A @ 1000 KC, 20A @ 300 KC. New. $3.95

TRANSTAT VOLTAGE REGULATORS

Amertran type RH. Input: 115 V. 400 cy. 0.5 KVA, 5.5 max. amps. Output: 92-115V. 5½x4½x3¾. $1.95

0.25 KVA Fixed winding 115/1/60. Commutator range 103-126 V. 2.17 Max. Amps $9.45

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 7½" D. brass feed thru rod 10½" L. Insul. dist. between top bell and flange 6½" ... $3.50

DYNAMOTOR GENERATOR

Model 3975-1. Electric Sprayit Co., p/of "Gibson Girl". Input 28 VDC @ .75 amps. Output 300 VDC @ .040 amps. 5" L. 3¼" D. ..... $1.00 ea.

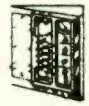
SELECTOR SWITCHES

Heavy duty, U. S. N. Control any type of multi-circuit devices. Removable contacts enabling any comb. of closed and open circuit. The following available: 5 section-10 pole or 10 section-20 pole. $1.50 ea. Case lots of (8) $8.00 or (5) cases, special $32.50

MINE DETECTOR SCR 625

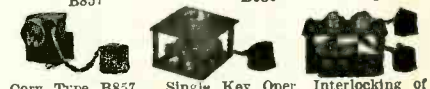
Detects metallic objects (ferrous or non-ferrous) to a depth of approx. 6 ft. Find outboard motors on the bottom of lakes, locate underground piping, treasure, metallic fragments in lumber, etc. New, complete with inst. book, $65.00. Used but like new $45.00

B. C. 604 F. M. TRANSMITTER



Wide or narrow band FM. 30 watt power output. Excellent possibility for ten or eleven meter exciter. Freq. 20-27.9 MC. Working space permits modification. W/ tubes but less power supply and xtls. LN $11.50. Complete with Crystal, $25.00

NEW SWITCH INTERLOCKS



Cory Type B857. Single Key Oper. Interlocking of doors, vaults, reactor or resistor-enclosures, oil circuit breakers, etc. $1.98

Cory Type B936, Single Key Oper. SPST SW w/Yale Cyl Lock 60A tumbler lock $2.49

Cory Type B1536, Supervisory Oper. 2 key type.. $2.95

DELCO CONSTANT SPEED MOTOR

Type A-7155, 27 VDC, 2.4 A 1/30 HP. 3600 RPM. 2½" Diam. x 5½ L. ⅜" Sh. Ext. Cont. Duty. Base mounted ..... $4.25 ea.

VIBRATOR POWER SUPPLY (PE 204A)

Used with Telephone Repeater EE-99A. Input 12 VDC. Output 2 windings @ 4.3 VDC @ 50 MA; 2 @ 45 VDC @ .5 MA; 2 @ 85 VDC @ 5 MA. Loaded with parts. New $1.95

WEST WATT HOUR METERS

Type CS, 240V/60cy/1ph 15 Amp., 3 Wire $12.50

Type CS, 120V/60cy/1ph 15 Amp., 2 Wire 9.50

Type CA, 120V/60cy/1ph 15 Amp., 2 Wire 9.50

HARDWARE BY THE POUND—Our assortment of screws, nuts, washers, cable clamps, lugs, spacers, springs, etc.

10 lbs. assortment $5.00

25 lb. assortment $10.00

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.

399-405 ATLANTIC AVENUE Dept. E-5 BOSTON 10, MASSACHUSETTS LIBERTY 2-7890

"TAB" THAT'S A BUY TUBES
Tested—Guaranteed

OA3/VR75	$.98	2C43/464A	9.39	6AD7	1.17	6SN7GT	.59	12Q7GT	.55	48	1.56
OA4G	.94	2C44	1.69	6AF6G	.77	6SN7WGT	.89	12S8GT	.79	50	1.49
OB2	1.72	2C51	8.10	6AG5	.59	6SQ7GT	.43	12SA7GT	.55	EF50	.40
OB3/VR90	.74	2D21	1.10	6AG7	.97	6SR7	.56	12SC7	.55	50A5	.73
OC3/VR105	.75	2E5	.89	6AH6	.89	6SS7	.57	12SF5GT	.54	50B5	.54
OD3/VR150	.47	2E22	1.15	6AJ5	.73	6ST7	.75	12SF7GT	.50	50C5	.59
OZ4	.56	2E24	4.50	6AK5	.80	6SU7GTY	.85	12SG7	.52	50C6	1.18
C1A	4.80	2E25/HY65	4.00	6AK6	.81	6SV7	.75	12SH7	.34	50L6GT	.52
C1A	.45	2E26	3.45	6AL5	.55	6T7G	.84	12SJ7GT	.45	50X6	.98
1A3	.42	2E30	2.35	6AL7	1.00	6T8	.89	12SK7GT	.51	50Y6	.63
1A4	1.00	2G5	.98	6AN5	1.08	6U5/6G5	.63	12SK7M	.52	53	.84
1A5GT	.48	2J21	11.45	6AQ5	.47	6U6GT	.89	12SL7GT	.54	57	.47
1A6	.78	2J21A	11.45	6AO6	.54	6U7G	.48	12SN7GT	.47	58	.53
1A7GT	.63	2J22	9.75	6AR5	.50	6V6GT	.52	12SQ7GT	.45	59	.84
1B3/8016	.81	2J26	8.45	6AS5	.59	6V6GTY	.90	12SR7	.48	RK61	1.98
1B4	.98	2J27	14.50	6AS6	2.89	6V7G	1.18	12X3	.90	RK65	24.95
1B5/25S	.84	2J31	9.95	6AS7G	4.29	6V6M	.98	12Z3	.72	HY69	2.29
1B7GT	.98	2J32	14.85	6AT6	.40	6W4GT	.59	14A7/12B7	.67	70A7	1.49
1B21/471A	2.85	2J33	18.95	6AU6	.53	6W7G	.87	14AF7	.86	70L7GT	1.10
1B22	4.50	2J34	17.50	6AV6	.43	6X4	.52	14B6	.65	71	.65
1B23	9.00	2J37	13.85	6AW6	.89	6X5GT	.42	14B8	.77	72	.95
1B24	4.65	2J38	12.70	6B4G	.84	6Y5	1.85	14C7	.86	CRP72	1.37
1B26	4.50	2J39	29.00	6B6	.75	6Y6G	.65	14F8	.75	73	1.67
1B27	8.49	2J47	49.95	6B7	.89	6Y7G	.98	14H7	.63	NR74	.29
1B29	3.39	2J48	45.00	6B8G	.65	6Z7G	1.08	14J7	.80	75	.53
1B32/532A	2.75	2J49	22.50	6BA4	1.08	6Z5/12Z5	1.18	14N7	.86	76	.38
1B37	45.00	2J50	39.00	6BA6	.49	6ZY5G	.57	14Q7	.55	77	.45
1B38	36.00	2J56	81.00	6BA7	.79	7A4/XXL	.57	14R7	.65	78	.45
1B41	49.95	2J61	39.00	6BD6	.69	7A5	.65	14X7	.98	79	.84
1B42	7.50	2J62	39.00	6BE6	.49	7A6	.65	15E	1.44	80	.35
1B53	49.95	2K25	23.75	6BF6	.52	7A7	.56	15R	.75	81	1.29
1B54	49.95	2K28	24.89	6BG6G	1.39	7A8	.69	FG17	3.98	FG81A	4.45
1B56	49.95	2K29	24.95	6BH6	.52	7AF7	.70	RK18	.98	82	.84
1C5	.86	2V3G	.49	6BJ6	.55	7AG7	.69	19	.95	82V	.95
1C6	.87	2W3GT	.98	6BQ6GT	.89	7B4	.55	19BG6G	1.98	83	.99
1C7G	.89	2X2	.36	6C4	.29	7B5	.70	19T8	.89	83V	.89
1D5GP	.95	3A4	.32	6C5	.45	7B6	.58	20	1.17	84/6Z4	.56
1D7G	.84	3A5	.75	6C6	.52	7B7	.57	RK20A	6.98	85	.57
1D8GT	.94	3B5	.98	6C6G	.55	7B8	.70	PJ21	4.98	89	.32
1E5	1.08	3B7/1291	.29	6C7	1.26	7C4/1203A	.36	REL21	4.85	VR92	.25
1E7G	1.00	3B22	2.64	6C8G	.65	7C5	.44	RX21	3.20	FG104	14.98
1F4G	.75	3B24	1.75	6C21	23.95	7C6	.69	PJ22/CE1C	1.49	FG105	10.75
1F7GT	1.55	3B25	4.85	6CB6	.69	7C7	.57	24A	.40	VU111	.49
1G4GT	.69	3B28	5.89	6D4	2.75	7C23	69.00	24G/3C24	.45	HY114B	.81
1G5G	.98	3C23	3.98	6D6	.47	7E5/1201	.65	25A6	1.04	HY115/145	.80
1G6GT	.63	3C31/C1B	3.75	6D7	.98	7E6	.57	25A7	2.98	117L7	1.23
1H4G	.87	3C45	12.85	6D8	.75	7E7	.59	25AC5GT	1.08	117N7GT	1.36
1H5G	.54	3D6/1299	.29	6E5	.69	7F7	.58	25B5	1.39	117P7GT	1.20
1H6G	.99	3D21A	1.20	6E7	1.20	7F8	1.03	25B6	1.49	117Z3	.49
1J5G	.98	3E29/829B	7.98	6F5	.47	7G7/1232	.98	25C6	1.18	117Z6GT	.77
1J6	.72	3LF4	1.25	6F6	.55	7H7	.64	25BQ6GT	.89	117Z7GT	1.49
1L4	.45	3Q4	.45	6F6GT	.52	7J7	.98	25L6GT	.49	F127A	16.95
1LA4GT	.99	3Q5GT	.65	6F7	.80	7K7	1.05	25W4GT	.70	CV148	7.90
1LB4	.99	3S4	.54	6F8	.84	7L7	.67	25N6	1.69	155	.98
1LC5	.64	3V4	.67	6G6	.99	7N7	.65	25Y5	1.08	FG166	49.00
1LC6	.75	4C33	81.00	6H6	.45	7Q7	.57	25Z5	.40	FG172	19.50
1LE3GT	.85	4C35	19.30	C6J	3.90	7R7	.63	25Z6GT	.47	FG190	12.98
1LH4	.64	4J31	95.00	6J4	4.65	7S7	.89	26	.42	205B/VT2	1.69
1LN5	.62	4J32	95.00	6J5GT	.37	7T7	1.03	FG27A	9.50	211/VT4C	.42
1N5GT	.59	4J42/700	29.85	6J6	.70	7V7	.85	28D7	.35	RX215	9.95
1N6G	.98	4J47	98.00	6J7	.65	7W7	.85	30	.39	WE215A	.25
1P5GT	.54	4T4/2	9.95	6J7GT	.59	7X7/XXFM	.85	31	.49	227A	2.90
1P24	.85	5C22	47.00	6J8GT	.95	7Y4	.44	32	.89	231	1.20
1P25	59.50	5C30/C5B	8.49	6K5GT	.79	10Y	.55	FG32	4.98	250TH	24.98
1P25A	98.00	5D21	24.50	6K6GT	.42	12A6	.60	32L7GT	.85	250TL	24.98
1Q5GT	.96	5J23	13.45	6K7	.48	12A7	.17	33	.63	282B	8.49
1Q26	75.00	5J29	17.39	6K8	.75	12A8GT	.96	FG33	8.49	304TH	3.70
1R4/1294	.65	5J32	99.00	6L5	.84	12AH7GT	.48	34	.33	304TL	1.39
1R5	.59	5R4GY	1.08	6L6	.98	12AL5	.99	35/51	.59	307A/RK75	3.60
1S4	.96	5T4	.86	6L6G	.82	12AT6	.72	35A5	.65	316A	.49
1S5	.48	5U4G	.47	6L6GA	.82	12AT7	.43	35B5	.54	327A	2.70
1T4	.51	5V4G	.88	6L7	.77	12AU6	.70	35C5	.49	350	1.23
1T5GT	1.05	5W4	.66	6N4	1.08	12AU7	.52	35L6GT	.53	350B	1.88
1U4	.49	5X4G	.71	6N7GT	.90	12AV6	.62	35W4	.38	355A	14.15
1U5	.69	5Y3GT	.38	6P5G	.81	12AX7	.50	35Y4	.49	368AS	3.75
1V	.49	5Y4	.45	6Q7	.57	12AW6	.81	35Z3	.61	371B	.84
1X2	.78	5Z3	.51	6R7	.77	12BA6	.55	35Z4GT	.49	380A	.79
1Z2	3.98	5Z4	.74	6R8	.79	12BA7	.56	35Z5GT	.49	388A	.89
2A3	.84	C6A	7.85	6S7	.85	12BD6	.75	REL36/6J4	.59	393A	3.65
2A4G	1.04	6A3	.98	6S8GT	.75	12BE6	.59	36	.61	394A	3.65
2A5	.65	6A4	1.29	6SA7GT	.43	12BF6	.45	37	.36	395A	4.95
2A6	.78	6A6	.88	6SB7Y	.81	12C8	.54	38	.34	417A	19.95
2A7	.75	6A7	.68	6SC7	.57	12E5	.32	39/44	.25	GL434	2.90
2B7	.78	6A8GT	.70	6SD7GT	.45	12E5	.98	CRC40	.54	446A/2C40	1.17
2B22/GL559	.73	6AB4	.69	6SF5	.48	12F5	.55	41	.49	446B	1.80
2C21/1642	.81	6AB5/6N5	.88	6SF7	.58	12H6	.27	42	.47	450TH	17.75
2C22/7193	.15	6AB7/1853	.77	6SG7	.57	12J5GT	.33	43	.49	450TL	49.95
2C26	.25	6AC5GT	.89	6SH7	.35	12J7GT	.52	45S/VT52	.27	GL451	1.90
2C34/RK34	.27	6AC7	.70	6SJ7GT	.45	12K7GT	.57	45Z3	.54	460/HF200	9.98
2C39	21.00	6AD5	.98	6SK7GT	.40	12K8	.59	45Z5	.51	WL531	1.98
2C40	5.50	6AD6G	.81	6SL7GT	.58	12L8GT	1.59	46	.65	CK533AX	1.49
										GL534/1S21	3.98
										544	4.98
										GL546	1.69
										550P1	19.95
										CK551AXA	1.69
										575A/975	12.65
										601B	.19
										HY615	.24
										WL619	19.75
										KU627	7.49
										631P1/SN4	3.98
										WL632A	8.98
										701A	2.90
										702A/702B	2.75
										703A	3.75
										704A	1.08
										705A/8021	1.05
										707	7.98
										710A/8011	.65
										713A	1.49
										715B	6.95
										717A	.61
										721A	2.65
										722A/287A	9.95
										723A	6.95
										723A/B	14.95
										724A/B	3.90
										725A	6.90
										726A	4.98
										726C	29.98
										730A	10.90
										801A	.45
										802	4.15
										803	3.45
										804	6.90
										805	3.59
										807	1.49
										808	1.25
										809	2.70
										810	7.90
										811	2.45
										812	2.98
										813	8.90
										814	2.61
										815	2.40
										816	1.05
										826	.39
										SD828	2.98
										829B	7.29
										832A	4.87
										836	.98
										837	2.35
										838	3.20
										842	2.75
										843	.39
										845	3.95
										851	13.95
										860	2.98
										861	10.79
										864	.45
										865	1.90
										866A	1.04
										866Jr	1.00
										868/PJ23	1.90
										869	30.00
										872A	1.49
										GE872A	2.98
										874	.55
										876	.36
										878	1.95
										884/6Q5G	1.59
										885	.87
										920	2.70
										922	1.19
										923	.85
										927/CE25	1.26
										929	1.39
										930	.80
										931A	3.95
										954	.18
										955	.24
										956	.24
										957	.20
										958	.35
										SD968	2.95
										991	.23
										1000UHF	59.95
										FM1000	.95
										CK1005	.18
										CK1006	.64
										CK1089	3.98
										CK1090	2.69
										R1100	5.00
										R1130B	12.00
										1609	5.98
										1613/6F6X	.45
										1614	1.42
										1616	.75
										1619	.16
										1620	4.95
										1622	1.75
										1624	1.25
										1625	.33
										1626	.35
										1629	.23
										1632	.89
										1633	.97
										1635	1.49
										1641/RK60	.48
										2050	.93
										2051	.36
										R4340	36.00
										5514	4.85
										5516	5.85
										5517/CK1013	1.39
										UX6653	.69
										8012A	1.35
										8013A	2.50
										8020	.97
										9001	.34
										9002	.23
										9003	.30
										9004	.34
										9006	.17

C-Ray Tubes

2AP5/1814P5	7.98
3AP1	4.63
3BP1	2.55
3BP1A	7.98
3CP1	2.65
3CP1-S1	2.49
3DP1	3.75
3EP1	2.65
3FP7A	.98
3GP1	8.95
3HP7	4.80
3HP14	9.98
4AP10	4.70
5AP1.1805	3.75
5BP1	1.98
5BP4	4.50
5CP1	1.75
5CP7	3.70
5FP5	6.49
5FP7	1.26
5FP14	18.95
5GP1	6.95
5HP1	4.95
5HP4	6.75
5JP2	11.75
5LP1	18.00
5MP1	4.75
7BP7	4.65
7CP1	12.95
7HP7	5.95
9GP7	12.33
9LP7	18.00
10BP4	20.95
10FP4	24.50
10HP4	27.50
12DP7	12.49
12GP1	49.98
12GP7	18.00
12JP4	27.00
12KP4	34.00
12LP4	27.45
12QP4	32.00
12RP4	36.00
15DP4	56.00
16AP4	55.00
16DP4	49.98
16FP4	52.50
16RP4	49.98
16TP4	49.98
19AP4	96.00
19CP4	85.00
902	3.15
905	2.90
910/3AP1	4.63
912	89.98
914	45.00

Tungar Bulbs

16X897	2.49
29X672	2.95
189048GE	3.49
199698	2.95
289881	2.50
859483	3.98

Ballast

1P1	.49
PM3	.98
4A1	1.29
6-11	.49
PM5	.98
PM6	.98
PM7	.98
PM8	.98
9-3	.49
10-4B	.49
13-4	.49
20-4	.49
K49A	.36
K55B	.36
M55B	.36
L62A	.49
K80B	.36
WL121A	2.61
C376	2.98
ZB583	3.98

Mazda Pilots

44, Box 10	.50
49, Box	.60
55, Box 10	.50
64,Each	.07
S6/T4/3W	.18
100W/20V	.25
291, Box 10	.36
311/28V	.15
313/28V	.15
323/3V	.10

Sylvania S6/6W/120V — Wstghs C7/7W/120V .09

Med. Scr. Base

15W/125V	.08
25W/125V	.08

Neon Bulbs

NE2, 100 for	3.98
NE16/991	.23
NE32	.35
NE45/¼W	.27
NE51/NE20	.07

Bull's Eyelite DialcoType Less Bulb, Chromed 59¢; 2 for .98

Tel. Slide Lamps 6/12/24/48/55V Each .18

Xtal Diodes

1N21	.39
1N21A	1.00
1N21B	1.98
1N22	1.39
1N23	1.39
1N23A	1.50
1N23B	2.49
1N25	2.69
1N26	2.69
1N27	1.75
1N32	18.00
1N34	.67
1N35	2.79
1N48	1.15
1N51	1.08

Thermistors

D167019 Vol. Limiter	2.95

D168391 Thermal Comp .90

D168392 Thermal Comp 2.00

D170396 HF Pwr Meas .90

1C Bulb Time Delay .90

Varistor USN CW20259/38C 2.95

Xtal Frequency Standards

100Kc	7.98
200Kc	3.98
1000Kc	2.95
4700Kc	.98

HeaterOven Xtals

5010/5025/5055 Kc, Ea	14.98

Tubes Gtd Exc Open Fil & Breakage Shipped R'Exp Only Min Order $5.

Basic Photoflash Kit. Complete Pwr Supply with cndsrs, lamp, data, etc. 115 VAC $29.95

Studio Kit Air Corps 1169 set 115VAC or Batt w/2amps $53.95

1169AirC Flash Pwr Pack, NEW, Incl. Data $19.95

Photoflash Condensers—Film.

15 mfd 330vac/1800vdc INT $3.49
25mfd/330vac/1800vdc INT 6.49
16mfd/600vac/2800vdc INT 5.98
16mmPAN50filmGSAPcamera54rolls $5.49

Hi-V P'Flash Pwr Kit Ideal 1800V DblrCkt; 115VACinpt; Outpt—900V/35 ma&2x2.5V/2Aca Wndg/4KV insSigC spec H'Sld PLUS 2x25mfd/90watt-Sec Flash Cndsrs&Data for Flash...$17.98 W/Flash Lamp $26.98

"SUNFLASH" SPECIAL! 100to300W-Sec Inpt Non-Darkening, Shock Mtd, 100000orMoreFlashes 4-prg Base Int Chngble w/5804X Data $10.98

SylvaniaR4330 12million lumens, 100W-Sec $14.98

X-400 Air Corps Lamp $14.98

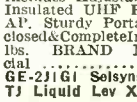
G-E Portable Radio Batty 2V/25AH Perf Subst Fits Ident Space GE Radio 25-2 (6x2½x2⅛) Leads Adaptable. Each $2.98; 2 for $5.49

Transformers—115V/60cycInput 2240vct/.5A, 12v/14.25A, 19v-18v-17v/2.5A, 2.5v/10A, 30v/.05A, AutoformerOnPri..$19.98
7500v or 15000V'Dbler/35Ma 18.95
1320v&375vct/110Ma, 5v/3A, 2.5V/3.25A, 6.3v/2.75A 7.25
1000vct/200Ma, 90vBias, 6.3v/5A, 5v/16A, 18v/.55A 6.95
420vct/85Ma, 6.3v/1.9A, also Pri 6-12-24-115 vdc&230vac $2.39; 2/4.39; 10/19.98
3000v/10Ma, Csd HiV Ins 4.50
1200vct/300Ma, 18v/1A Csd HVins 6.95
2x330vct/10Ma(or660vct)CsdHVins .98
2.5V/1.75A, 4v/16A, 20KVins 4.95
7.5vct/12A..$6.95; 6.3V/.6A 1.39
12.6vct/1.25A, Csd HiV ins 1.49
6.3vct/4A Gud6.5A 1.69
5v/60Amps...$7.95; 5v/15Amps.. 12.95
90v/1.1Amps, Taps 80-70V HiV.. 2.95
2000 Watt AutoformerInput—90/100/110/115/200/215/225 Volts; Output—115V/18Amps 19.95

MODULATION AUDIO XFORMERS MODULATION STANCOR USN H'Sld P'P parallel 807'sToP'P807's RF/2000 ohm Load 240 Watts Peak $4.95
P'P807'sto829RCA5500 to 2600 ohms$4.50
Amertran USN 3600 or 900 to 30 or 60 ohms/500 Watts $12.95
UTAH 12W UnivOutpt 5999 Any Tube Any Voice Coil $1.39

Sig Corps Dry Batteries—Gtd BRAND NEW Shelf Dated—Tested

BA34 7½/6/4½/3/1½ NegV ..... 35¢
BA35 1½VsImBURG 4FH ..... 35¢
BA36 45, 22½V BURG5308 ..... 79¢
BA37 1½V Walky-Talky ..... 29¢
BA38 103½V Walky-Talky $1.49
BA39 150/7½VBurgFSA100 ..... $1.29
BA40 90/1½VBurg4GB60 ..... 89¢
BA43 90/45/1½V ..... 98¢
BA205U 3V Burg F2BP ..... 8 for $1.00



Microwave Lighthouse Assy 2.500 Mc $29.95
3 CM X-Band Wave-Meter $16.95

UHF Freq Meter TS69/AP, Brand New! 341 to 1000 Mc on FUNDAMENTALS. Precision Micro-Vernier Tunable Resonant Cavity Built Exacting Army-Navy Electro-Mechanical Specs. Calibrated To 1 Megacycle! Exact Frequency Rdng Interpolated From 4-place Veeder Root Counter. Protected InBiltCharts. SensitiveUHF Crystal, 0-200Microamp Mtr Includes Adjustable MicrowaveAntenna, Insulated UHF Probe Antenna AS122/AP. Sturdy Portable Metal Case. Enclosed&CompleteInWoodCase. Approx30 lbs. BRAND NEW, "TAB" Special $59.95

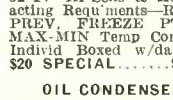
GE-2J1G1 Selsyns, Used, Good, 2/1.49
TJ Liquid Lev Xmitter, NEW...2/89¢

Heineman Magn Ckt Bkrs for AC/DC oper Amps: .22, .5, 2, 3, 5, 7, 8, 9, 10, 15, 20, 30, 35, 40, 80, 180 Amps. Special. Ea. $1.49; 10/$12.98; 100/$120.00.

Klixon Thermal Push Button C'Bkrs. Amps: 5, 10, 15, 30, 35 Amps. Ea. 79¢; 10/$5.98; 100/$45.00.

Square-D ToggleSw ANtype ClBkrs. Amps: 5, 10, 20, 25 Amps.....Ea. 89¢ 10 for ....$7.98; 100 for.....$69.00

NAVY LINE FILTER 10 amp/130V AC DC Cased 0.1 to 1000 mc's $1.29



Mercury Thermo-Regulator Instant Action. Dual Ckt 105°F& 32°F. HI-Sens & Accy—for Most Exacting Requirements—RESEARCH, FIRE PREV, FREEZE PT CONTROL, or MAX-MIN Temp Control. Brand New. Individ Boxed w/data&ckt; List over $20 SPECIAL.....98¢; 12 for $10.00

OIL CONDENSER SPECIALS!

2x5mfd (10mfd) OIL FILLED to W.E. spec KS8976, 400 wvdc —65 to +65°C. Gtd Usable 600wvdc.....2 for 98¢
2x0.1mfd/2000wv Famous Make, Common OFF Gnd....Ea. $1.08; 2 for $2.00

"TAB" — Specialists in Industrial Electronic Equipment. Tell Us Your Needs. Write for Your Free "TABOGRAM"

THAT'S A BUY "TAB" THAT'S A BUY

DEPT. 5E SIX CHURCH ST. NEW YORK 6, N.Y., U.S.A. - CORNER CHURCH & LIBERTY STS. ROOM 200

"TAB" MONEY BACK GUARANTEE $3 MIN. ORDER F.O.B. N.Y.C. ADD SHIPPING CHARGES AND 25% DEPOSIT. PHONE WO. 2-7230

INDEX TO ADVERTISERS

SEARCHLIGHT SECTION
(Classified Advertising)

ADVERTISERS INDEX

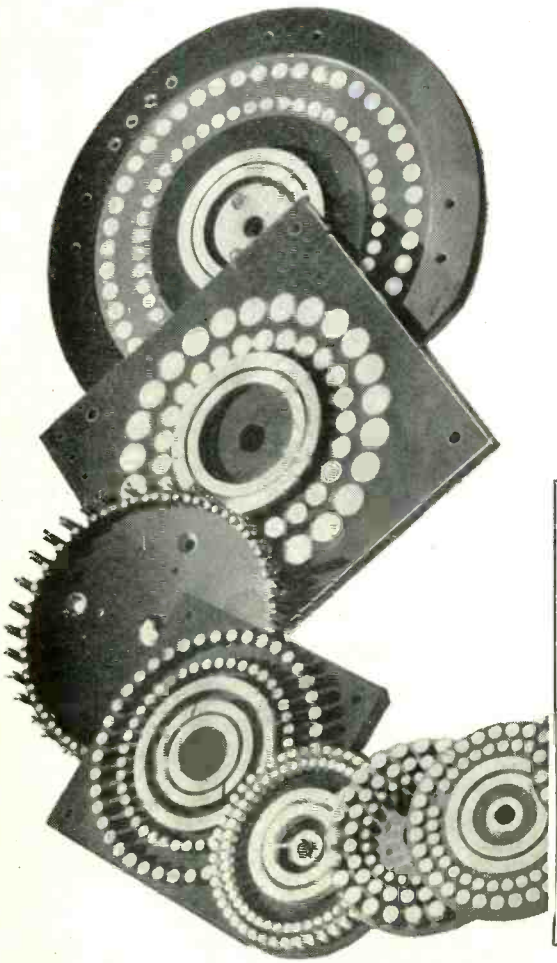
This index is published as a convenience to the readers. Every care is taken to make it accurate, but ELECTRONICS assumes no responsibility for errors or omissions.

. . . FOR THOSE TOUGH "Switching" PROBLEMS TRY DAVEN!

Whether you use switches for industrial applications, communications or laboratory work, a Daven constructed unit will give maximum performance. Many years of engineering experience and skilled workmanship have been combined to make a truly superior switch.

Daven switches are the rotary selector type—outstanding in design and capable of withstanding the most critical tests. They are preferred by engineers who want the best.

WRITE FOR YOUR COPY OF OUR NEW SWITCH BULLETIN



Some outstanding features are—

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

A full line of standard switches are available. Listed below are a few of the popular types.

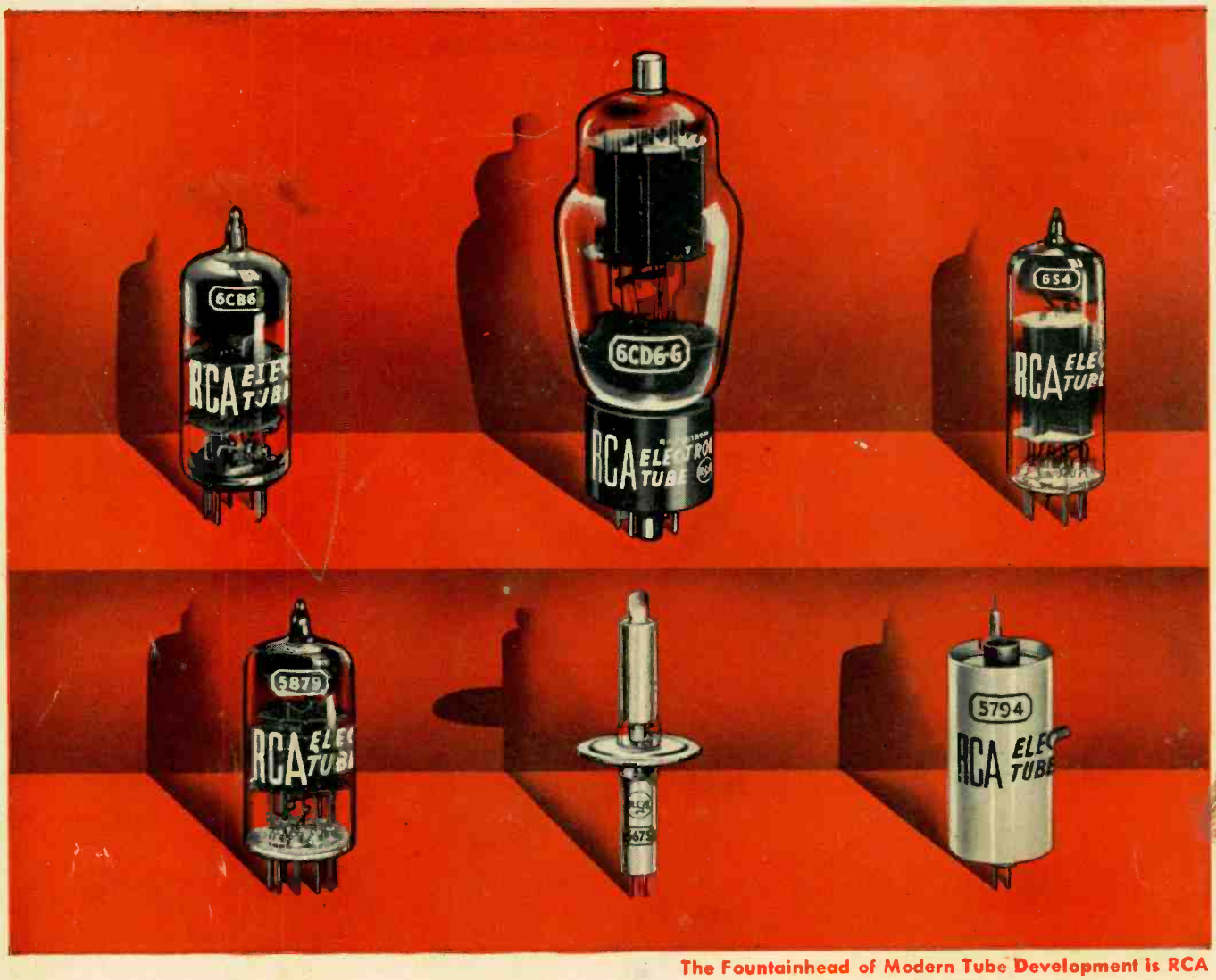
Type	Operation	Maximum No. of Positions (per pole)	Maximum Poles per Deck	Deck Size
C1A	make before break	31	1	1 3/4"
C2B	break before make	15	1	1 3/4"
C7A	make before break	11	2	1 3/4"
C8A	break before make	5	2	1 3/4"
D1A	make before break	47	1	2 1/4"
D7A	make before break	14	4	2 1/4"
D9A	make before break	9	5	2 1/4"
D10B	break before make	5	5	2 1/4"
E3A	make before break	47	2	2 3/4"
E4B	break before make	23	2	2 3/4"
E7A	make before break	23	4	2 3/4"
E8B	break before make	12	4	2 3/4"
F2B	break before make	30	1	3"

Single Deck Switches Are Round — Multi Deck Switches Are Square

DAVEN has a standard switch for your special requirements.
Our engineers will be glad to offer suggestions on *your* problems.

Send your detailed information to Department E-1.

THE DAVEN CO.
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY



The Fountainhead of Modern Tube Development is RCA

DEVELOPED BY RCA...

symbols of RCA's engineering leadership

The tubes illustrated, and described in the adjoining columns, are a few of the more recent types designed by RCA engineers. Each represents a distinct advancement over previous comparable types . . . either by virtue of its improved performance or its contribution to the simplification of circuit design.

These tubes . . . and other new RCA tubes like them . . . provide wide design latitudes . . . aid in reducing equipment manufacturing costs. They can be used with confidence in new circuit designs.

In the future, as in the past, the vast engineering resources of RCA will be directed toward the development of tubes best suited to meet the cost and performance requirements of equipment designers.

RCA-6CB6 Sharp-Cutoff Pentode. A miniature type, designed for use as an i-f amplifier operating at frequencies in the order of 40 Mc., or as an r-f amplifier in vhf television tuners. Its transconductance is 6200 micromhos.

RCA-6CD6-G Horizontal-Deflection Amplifier. For 16GP4 systems, and for other similar wide angle systems, it makes possible the design of efficient horizontal-deflection circuits in which the plate voltage for the tube is supplied in part by the circuit and in part by the power supply.

RCA-6S4 Vertical-Deflection Amplifier. A high-perveance miniature triode of the heater-cathode type. In suitable circuits it will deflect fully a 16GP4 or similar kinescopes having a deflection angle of 70 degrees and employing an anode voltage up to 14,000 volts.

RCA-5879 Sharp-Cutoff Pentode. Of the 9-pin miniature type, the 5879 is designed for a-f applications where reduced microphonics, noise, and hum are essential. It is especially useful in the input stages of medium-gain amplifiers.

RCA-5675 "Pencil-Type" Triode for UHF. Employs double-ended coaxial-electrode structure, for use in grounded-grid circuits. As a local oscillator, it will deliver 475 milliwatts at 1700 Mc. and about 50 milliwatts at 3000 Mc.

RCA-5794 Fixed-Tuned Oscillator Triode. Designed for Radiosonde Service, the 5794 employs two resonators integral with the tube. The output resonator is tuned to 1680 Mc. by means of an adjusting screw. The useful power output is in the order of 500 milliwatts.

For data on any of the tubes described above, write RCA, Commercial Engineering, Section E42R, Harrison, N. J.

RADIO CORPORATION of AMERICA

ELECTRON TUBES — **HARRISON, N. J.**