SEPTEMBER · 1949

electronics

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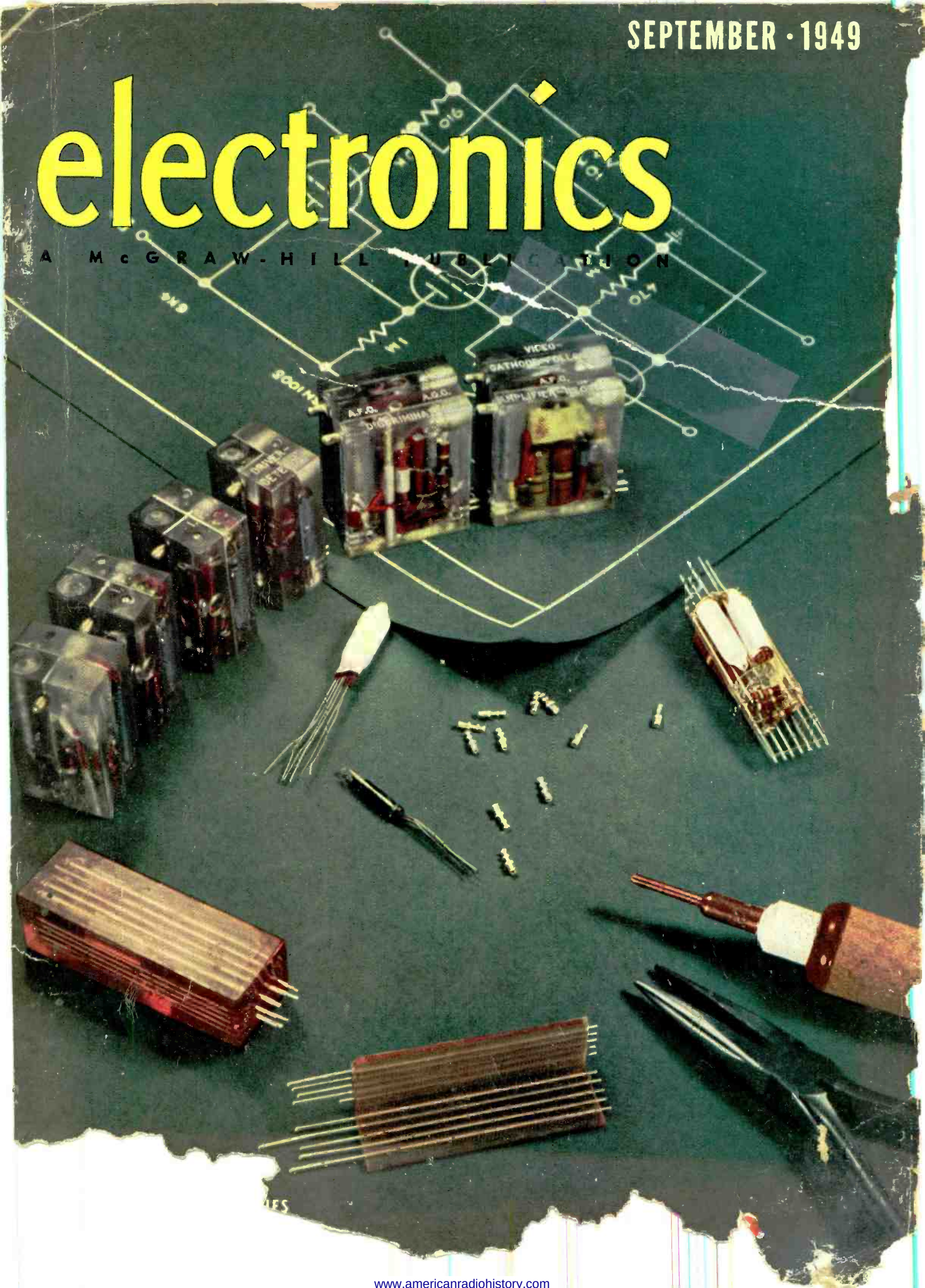
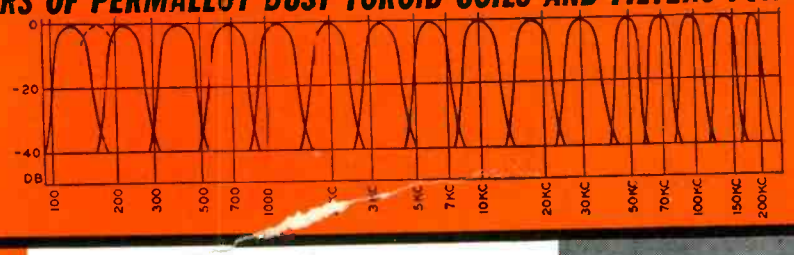
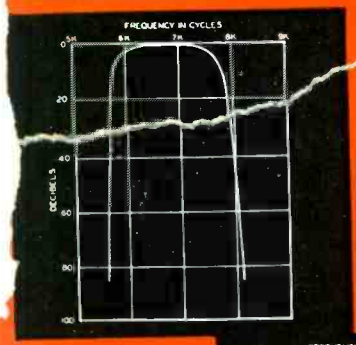


FILTER SPECIALISTS

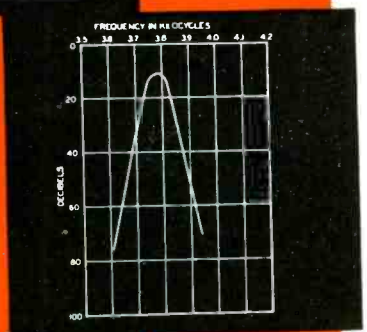
PRODUCERS OF PERMALLOY DUST TOROID COILS AND FILTERS FOR OVER A DECAD



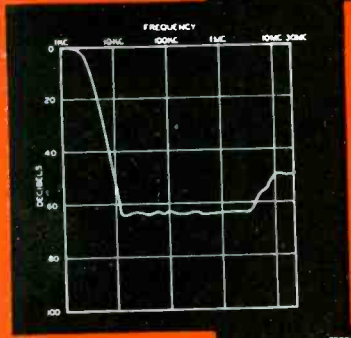
FOR FILTERS



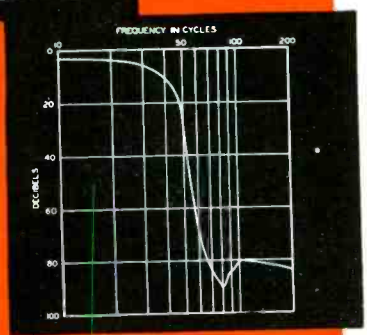
BROAD BAND SHARP CUTOFF FILTER



NARROW BAND SHARP CUTOFF FILTER



ATTENUATES 10KC TO 30 MEGACYCLES



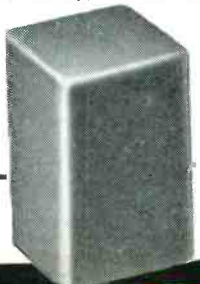
LOW FREQUENCY — LOW PASS FILTER

HQA, C, D
$1\frac{13}{16}$" Dia. x $1\frac{3}{16}$" High.

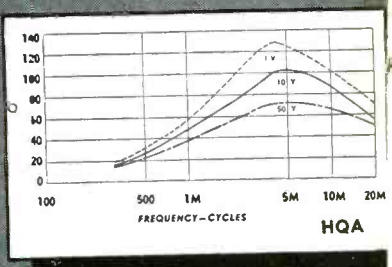
HQB
2 5/8" L. x 1 5/8" W. x 2 1/2" H.

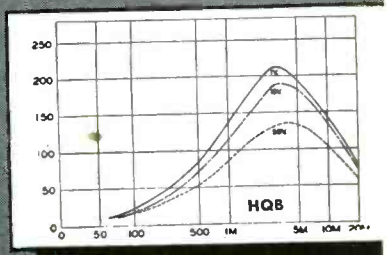
UNCASED TOROIDS

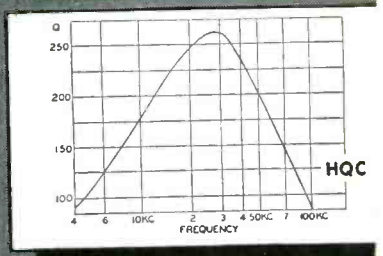
VIC
1 3/8" L. x 1 1/4" W. x 1 1/2" H.

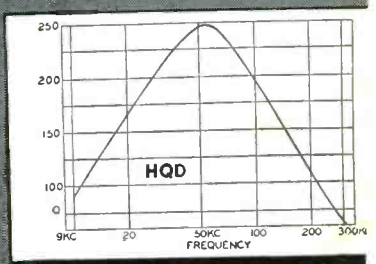


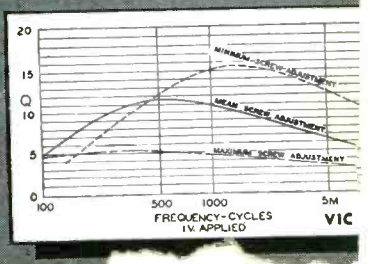
FOR HIGH Q COILS











SUB-OUNCER TOROID FILTERS

Filters employing SUB-OUNCER toroids and special condensers represent the optimum in miniaturized filter performance. The band pass filter shown weighs 6 ounces.

United Transfo

VARICK STREET

write for

electronics

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SEPTEMBER • 1949

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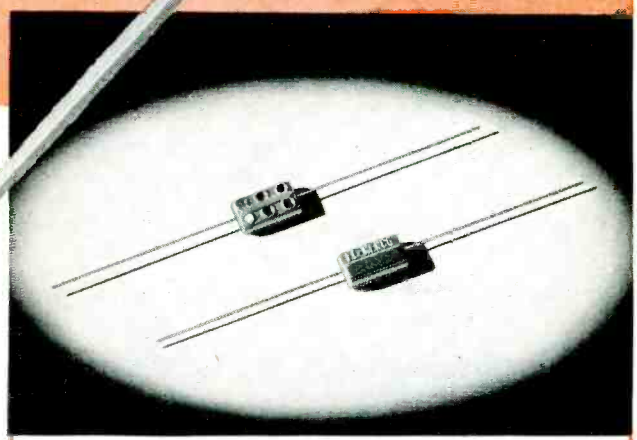

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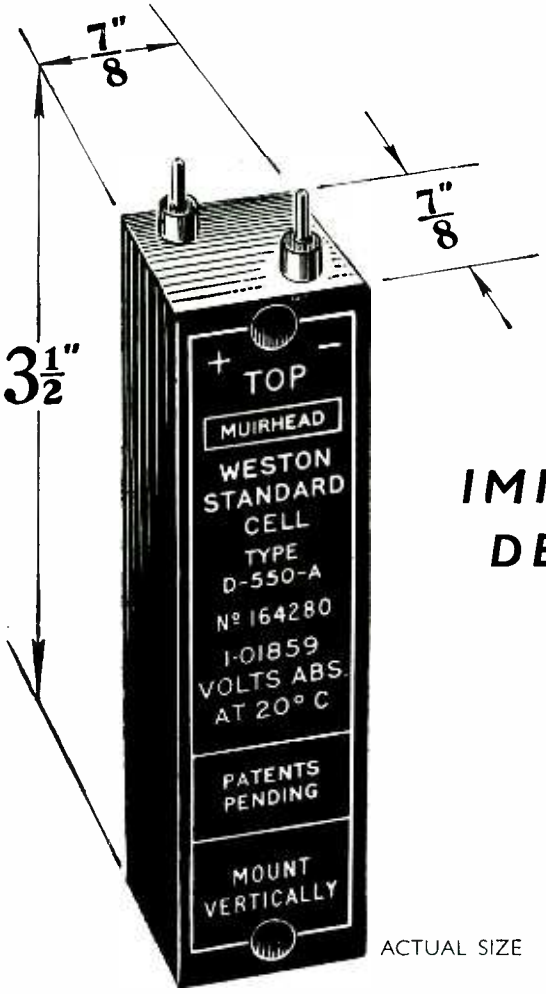

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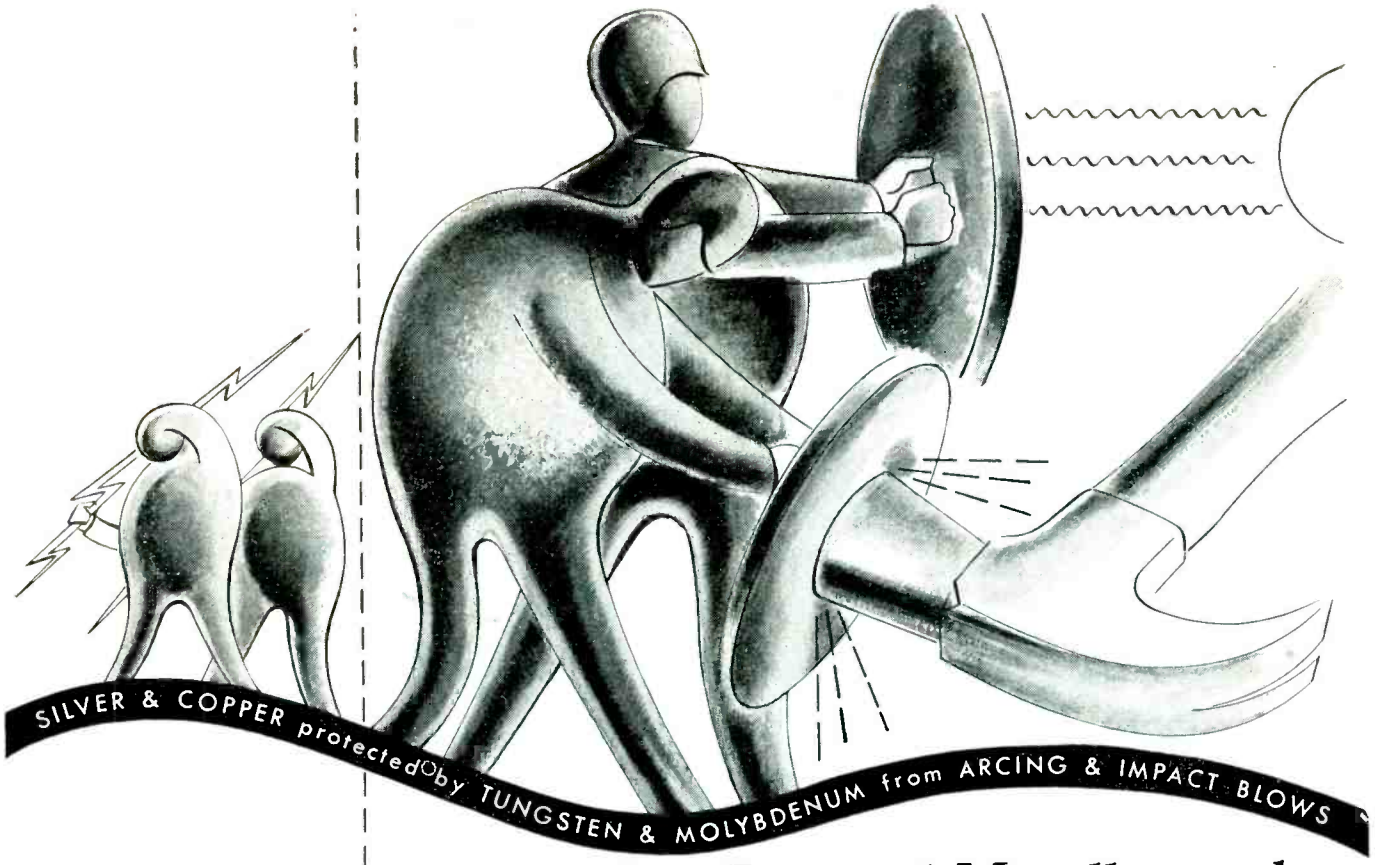

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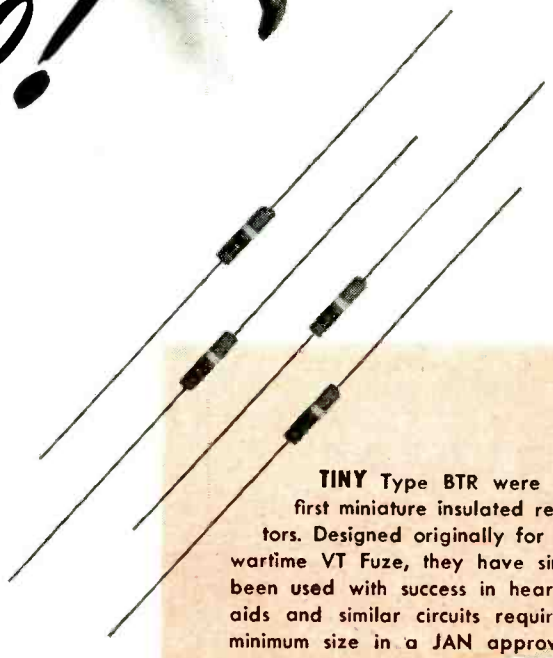

TINY Type BTR were the first miniature insulated resistors. Designed originally for the wartime VT Fuze, they have since been used with success in hearing aids and similar circuits requiring minimum size in a JAN approved resistor. ⅓ watt rat
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venient cou

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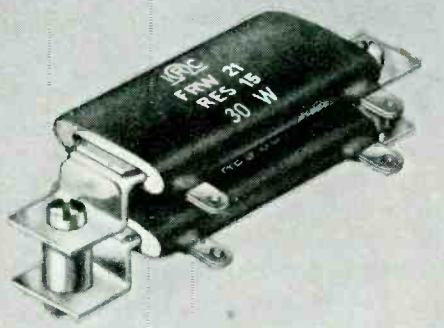
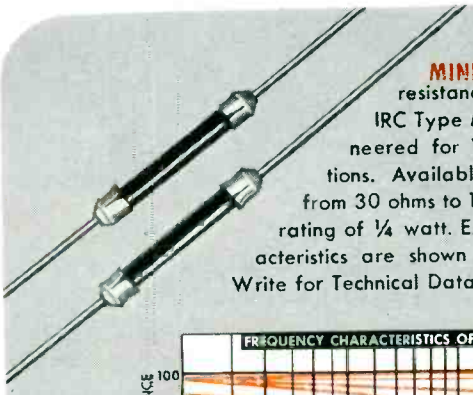
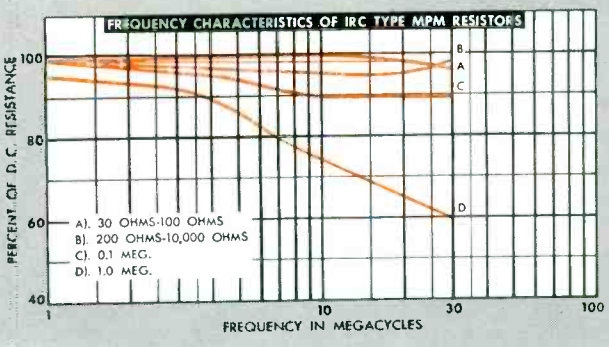
THIN AS A WAFER and no bigger than a nickel, IRC Type HB Fingertip Control features a quiet element, simplified construction and a unique rotating cover and contactor which permit ready resistance adjustment. It entirely eliminates the shaft, bushing and bulky knob of conventional-type controls. Four point switch of similar design is also available. Fully described in IRC Catalog Bulletin A-1.



FLAT POWER WIRE WOUND RESISTORS provide a higher space-power ratio than tubular types. Designed to satisfy requirements of high wattage dissipation in limited space applications, they can be mounted vertically or horizontally, singly or in stacks. The lightweight construction of these flat units includes non-magnetic mounting brackets which permit easy installation and transfer of heat to chassis. Flat FRW's are manufactured in fixed and adjustable types. Bulletin C-1 gives characteristics and specifications.



MINIATURE UNITS with active resistance section only ⅜" long, IRC Type MPM Resistors are engineered for VHF and UHF applications. Available in resistance values from 30 ohms to 1.0 megohm, at a power rating of ¼ watt. Excellent frequency characteristics are shown in the adjacent chart. Write for Technical Data Bulletin F-1.



When you are cramped for standard resistors in a hurry, IRC's Industrial Service Plan gives you the speedy service you need. For small orders of standard resistors for experimental work, pilot runs, maintenance, simply call your local IRC Distributor. We'll gladly send you his name and address.

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- ☐ Fingertip Controls
- ☐ Flat FRW Resistors
- ☐ MPM Resistors
- ☐ Name and address of local IRC Distributor

NAME.....

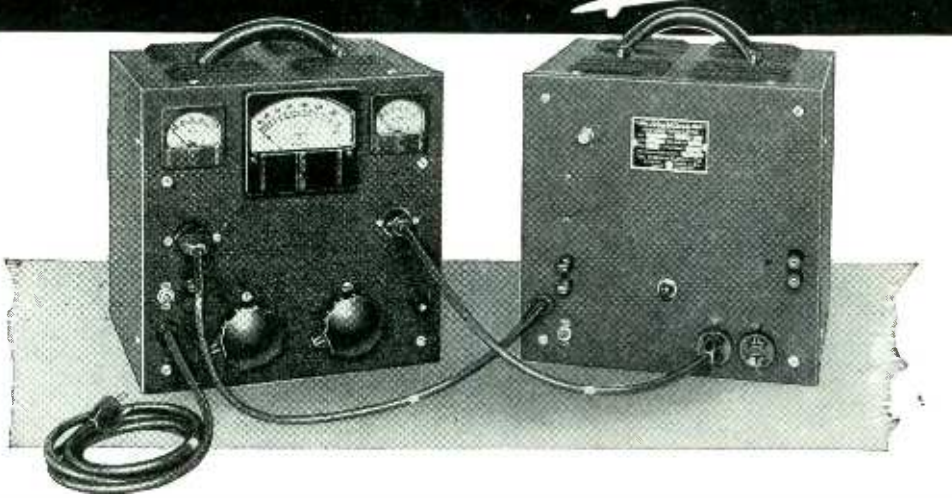
TITLE.....

COMPANY.....

ADDRESS.....

.....

MAKE THIS TEST *Yourself!*



The STABILINE Demonstrator, above left, was designed by our engineers to enable you to prove to yourself that — regardless of line or load variations — standard ¼ KVA STABILINE Type IE's, taken from stock at our distributors', perform as advertised. It works like this: The Demonstrator provides variable input voltage to the STABILINE Type IE51002 (right). It also acts as a variable load. The left meter on the Demonstrator shows input voltage, variable from 95 to 135 volts, applied to the STABILINE. The right meter indicates load variations, in amperes, variable from 0 to 2.1 amps. The middle meter shows that the output of the STABILINE remains constant — regardless of line or load variations.

Make this test yourself. Write for the name and address of the Superior Electric distributor in *your* area. He'll show you how — and you can make this test yourself — the Instantaneous Electronic STABILINE (Type IE) corrects line and/or load variations instantly, efficiently and dependably.

IE51002R

We've packed plenty of performance into the well-organized, skillfully-constructed ¼ KVA STABILINE Type IE51002R. It's a standard model — for quick, easy, convenient rack-mounting. It possesses all the superior inherent characteristics found in all STABILINE IE's.

HERE'S A *New* STABILINE TYPE IE

STABILINE Type IE51002R is specially designed for use when your requirements call for a standard-rack-mounting voltage regulator. It's compact — measures 19″ wide by 5¼″ high by 13⅛″ deep — gives you the same dependable and maintenance-free service you get from all Superior Electric STABILINES.

STABILINE VOLTAGE REGULATOR TYPE IE

RATINGS

Type	Input Voltage Range	Output Voltage Range	Frequency in Cycles	Load Range in Amperes	Load Power Factor Range	Rated Output KVA
IE51002	95-135	110-120	60 ± 10%	0-2.1	+.5 to —.9	.25
IE51002R	95-135	110-120	60 ± 10%	0-2.1	+.5 to —.9	.25
IE51005	95-135	110-120	60 ± 10%	0-4.3	+.5 to —.9	.5
IE5101	95-135	110-120	60 ± 10%	0-8.5	+.5 to —.9	1.0
IE5105	95-135	110-120	60 ± 10%	0-43.5	+.5 to —.9	5.0
IE5202	195-255	220-240	60 ± 10%	0-11.0	+.5 to —.9	2.5
IEL51005	95-135	110-120	50 ± 10%	0-4.3	+.5 to —.9	.5
IEL52005	195-255	220-240	50 ± 10%	0-2.1	+.5 to —.9	.5
IEL5101	95-135	110-120	50 ± 10%	0-8.5	+.5 to —.9	1.0
IEL5201	195-255	220-240	50 ± 10%	0-4.3	+.5 to —.9	1.0

Only in STABILINE Type IE's will you find the following characteristics to meet your need for dependable, conservatively rated automatic voltage regulation: Completely electronic operation • Waveform distortion *never* exceeding 3% • Stabilization of ± 0.1 of 1% of preset value • Regulation of ± 0.15 of 1% for any load current change from zero to full load, or any load power factor change from 0.5 lagging to 0.9 leading.

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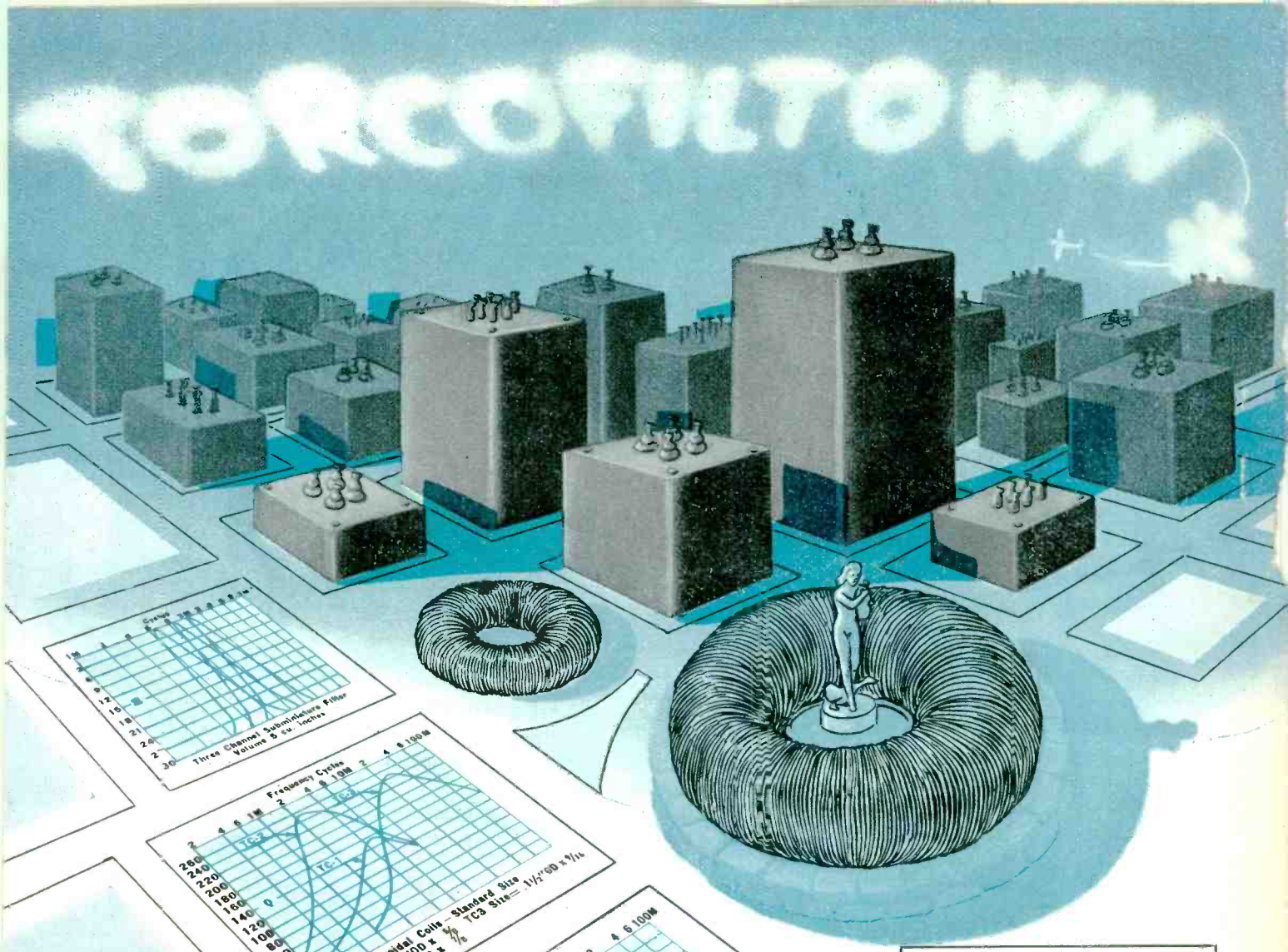

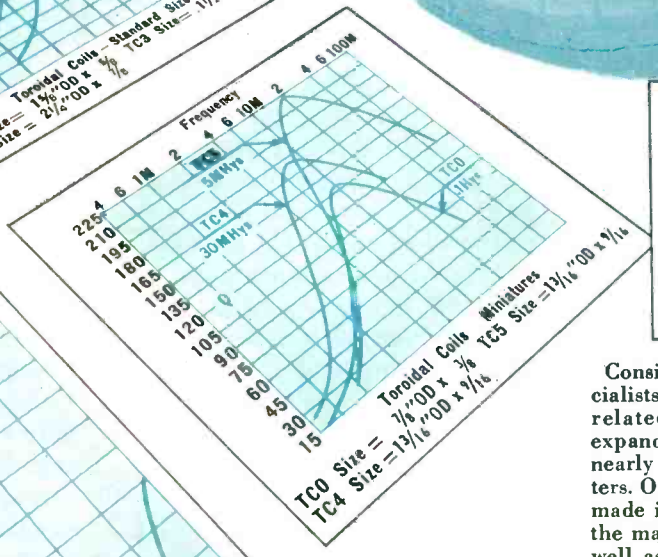

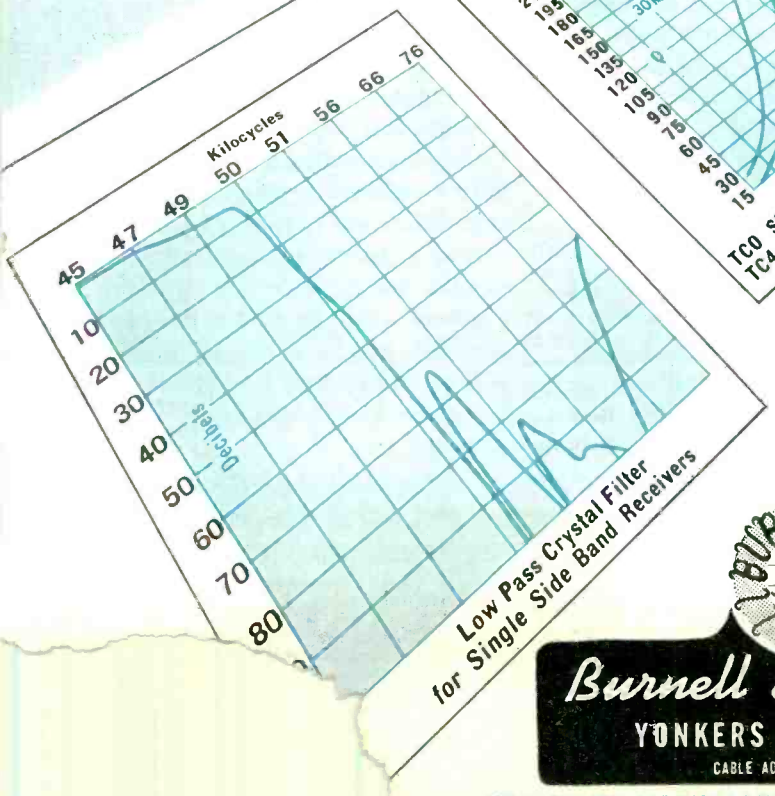

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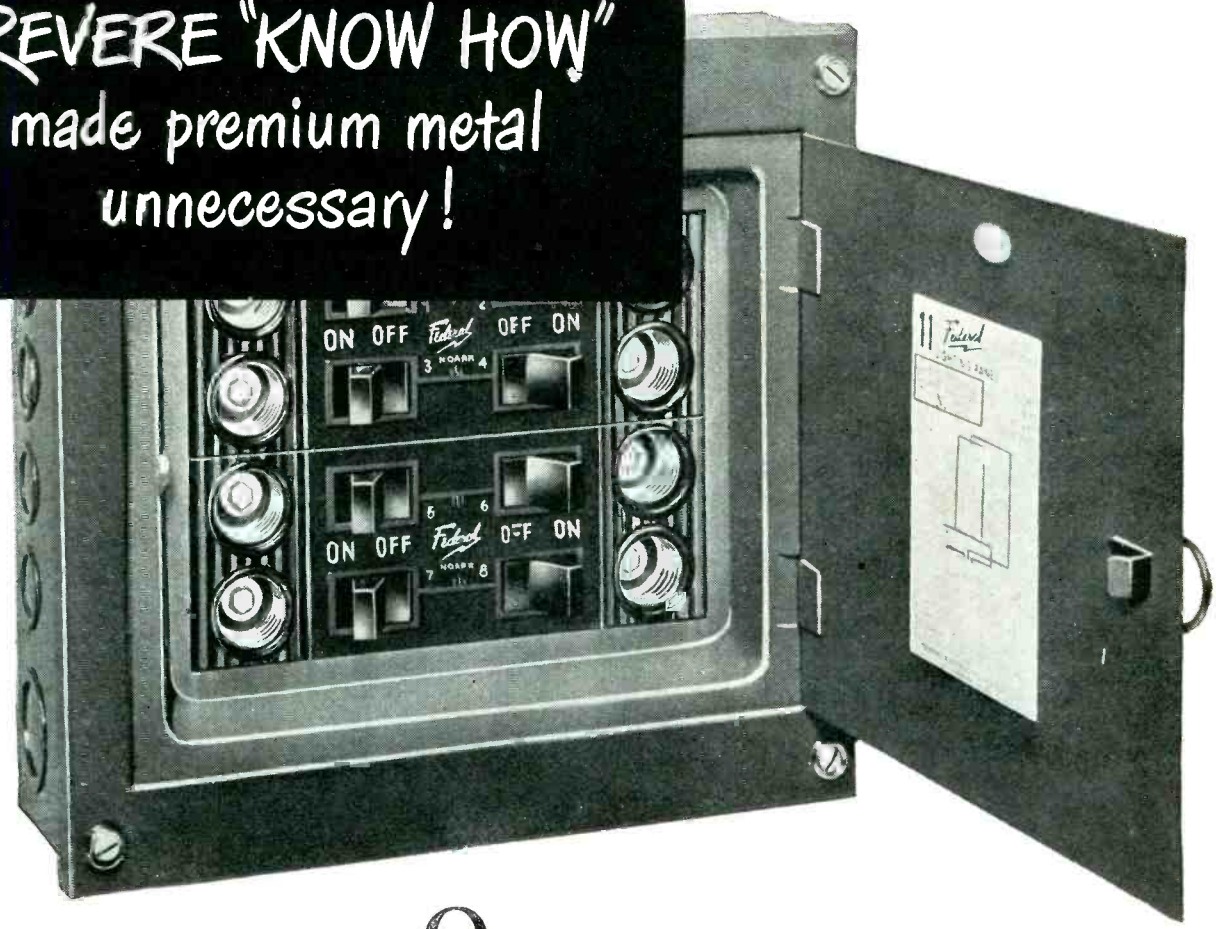
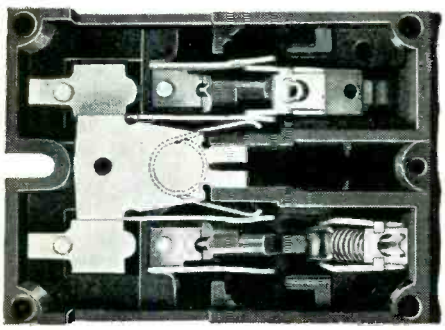
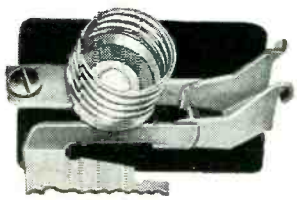


Federal Noark NTPS Panelboard, made by the Federal Electric Products Company, Newark 5, N. J.



Showing the sure-contact spring in switch assembly.



These are the three current-carrying parts.

Once in a while Revere recommends that a customer switch to a metal that costs more per pound, because its use will make the finished part more efficient or less costly. On the other hand, sometimes economy can be achieved by specifying a non-premium metal. It all depends upon the nature of the finished part, the fabrication methods, and the conditions of use. Take this Federal Noark Type NTPS panelboard, a combination fuse block and circuit switch. The contact fingers in this originally were to be made of a special spring alloy carrying a premium of about 13¢ per pound. The question was asked, naturally enough, if this was absolutely necessary. Federal and the Revere Technical Advisory Service collaborated closely, and it was decided that electrolytic copper should be perfectly satisfactory if supplied in the proper temper, hardness and grain size. Samples as recommended by the Revere Technical Advisory Service were tested rigidly, and were found to perform perfectly. Revere is proud of this example of constructive collaboration with a customer, especially since the panelboard is meant for heavy-duty light and power control, handling 30 amperes. Operation is exceptionally fast, due to a powerful spring-actuated make and break, which reduces or eliminates arcing. There are only three current carrying parts, each heavy and rugged for trouble-free service. . . . Revere will be glad to cooperate with you in a mutual search for the non-ferrous metal that will be most economical in your product.

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- Multicore's unique properties make perfect joints possible on difficult metals and alloys, even if oxidised.
- Ability to tin rapidly produces perfect joints with less solder. Greater coverage per pound.

ERSIN FLUX

- Ersin Flux is exclusive to Multicore and will not be found in any other solder. It is a high grade, water white rosin, homogeneously activated.
- Ersin Flux has a vigorous fluxing action and possesses the non-corrosive and protective features of the original rosin.
- Soldered joints made with Ersin Flux do not corrode even after prolonged exposure to any degree of humidity. It has been tested under climatic conditions ranging from the Arctic to the Tropics.
- Ersin Flux reduces the surface tension of molten solder, causing it to wet metals rapidly, increasing speed of operation with resultant production economies.
- Free from objectionable odor. Non-toxic in use.
- Leaves nothing but pure rosin on the work after soldering, and may be used wherever plain rosin is specified. Complies with all pertinent Federal Specifications.

THE ONLY 3 CORE SOLDER MADE WITH ERSIN FLUX

THE ORIGINAL NON-CORROSIVE EXTRA - ACTIVE FLUX

ERSIN Multicore THREE CORE SOLDER

PROVEN

BY USE FOR A DECADE ON THE ASSEMBLY LINES OF MANUFACTURERS OF THE FINEST ELECTRONIC EQUIPMENT

IMITATED

IN FLUX AND CONSTRUCTION BUT NEVER EQUALLED !

"There is hardly anything in this world that some man cannot make a little worse and sell a little cheaper and the people who consider only price are this man's lawful prey,"

— RUSKIN

Address U.S.A. and Canadian inquiries to

BRITISH INDUSTRIES CORP.

315, Broadway, New York 7, N.Y.

Inquiries regarding other territories to:

MULTICORE SOLDERS LTD.

Mellier House, Albemarle Street, London, W.1, England

EVERYTHING UNDER ONE ROOF!

for... Better, Faster Service

You don't get "Lost in the Shuffle" when you Come to INDIANA for PERMANENT MAGNETS

INDIANA, the nation's largest producer of permanent magnets, assures the fastest customer service by having all departments and facilities combined at *one* location. Prompt engineering recommendations always reflect the latest in research. Orders are entered, executed, and shipped as *one* responsibility. Thus, INDIANA does business man-to-man, and buyers like it.

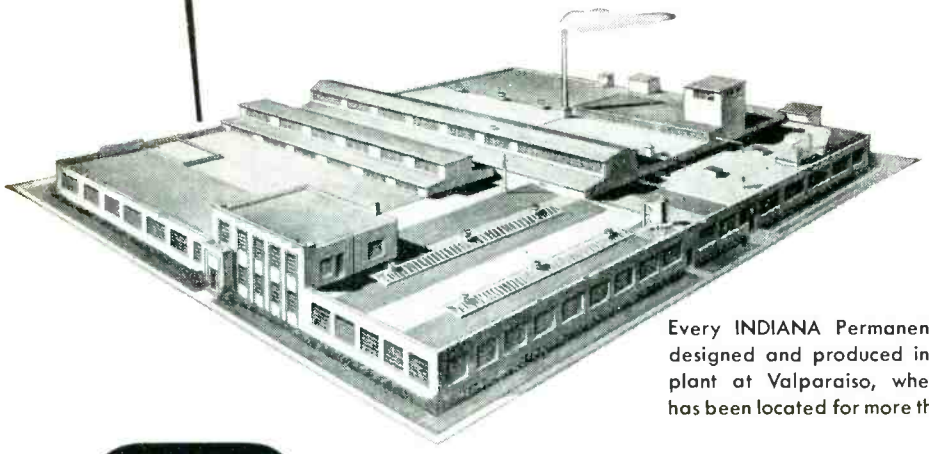
YOU SAVE VALUABLE TIME

That's why—whether your job is standard or "special"; whether you want design suggestions or quick quotations; whether you're placing orders or checking delivery—you can look to INDIANA for *on-the-spot* service and genuine personal interest.

YOU PROFIT MANY WAYS

When you deal with INDIANA, it's like adding the finest facilities as a department in your own organization—pattern making; casting; sintering; heat treating; finishing; magnetizing—plus technical knowledge with experience and foresight. You get helpful aid in designing to cut costs . . . uniform high energy for every application . . . magnets that are *right*. It pays to call in INDIANA. Do it now!

A request on your business letterhead will bring you INDIANA'S 32-page Permanent Magnet Design Manual. Please ask for Book 4E-99.



Every INDIANA Permanent Magnet is designed and produced in this modern plant at Valparaiso, where INDIANA has been located for more than 40 years.

INDIANA'S wide variety of magnet alloys permits precise selection for all uses.

CAST
Alnico I, II, III, IV, V, VI, XII
Cobalt
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SINTERED
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Indalloy
Vectolite

DUCTILE
Cunico
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Silmanal

FORMED
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INDIANA PERMANENT MAGNETS

THE INDIANA STEEL PRODUCTS COMPANY

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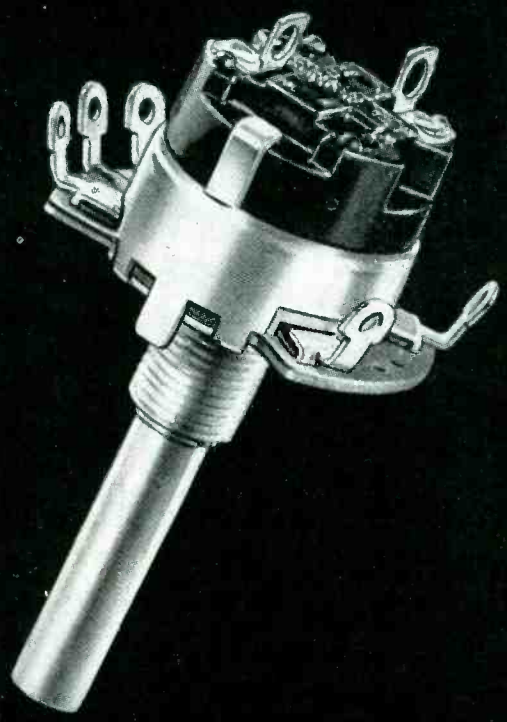
SPECIALISTS IN "PACKAGED ENERGY" SINCE [illegible]8

ADVENTURES IN ELECTRONIC DESIGN

Centralab Announces the NEW MODEL 2 RADIOHM CONTROL!



OTHER MODEL 2 RADIOHM CONTROLS

Left: plain type. *Right:* plain type — concentric shaft, twin with taps.

Left: switch type—with taps.
Right: switch type—twin.

ALL MODEL 2 CONTROLS ARE 15/16" IN DIAMETER — RATED AT ½ WATT.

HERE THEY ARE! Centralab's Model 2 Radiohm Controls. Designed by skilled Centralab engineers, these new quality controls are used in television, radio, sound, motion picture and other electronic equipment. Precision-built with a special composition resistance material securely bonded to a high quality phenolic base, they give you lower noise level . . . longer life. Yes — examine the new CRL Model 2 Radiohms and see why it will pay you to use these finer controls in the equipment you manufacture. See how Model 2's clinched terminals insure firm, positive connections. See how Model 2's complete line of 3 basic switches (5, 8 and 1 amp.) gives you 24 switch combinations for real flexibility in application and design. See how Model 2's tap positions at 37½, 50 and 62½ percent of rotation simplify wiring problems. Yes — check *all of the outstanding advantages* of Centralab's fine new Model 2 Radiohm Controls and you'll agree they're the right controls for you. For complete information, see your Centralab representative or write direct.

Centralab — DEVELOPMENTS THAT CAN HELP YOU

N INC. • Milwaukee

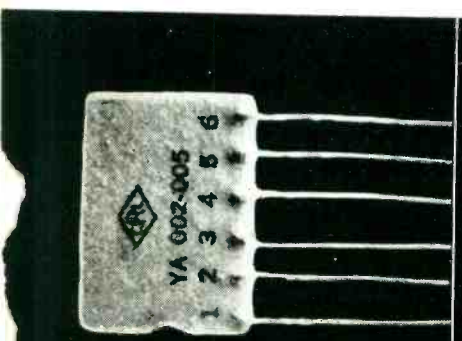
Centralab reports to

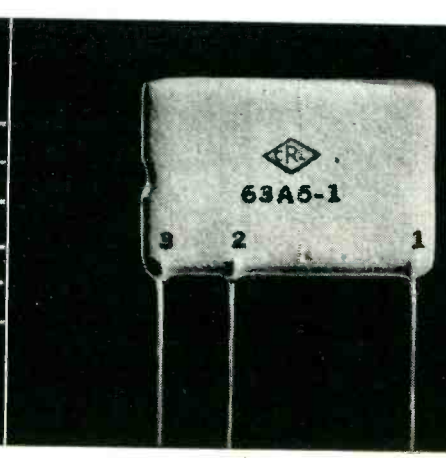
SEPTEMBER, 1949

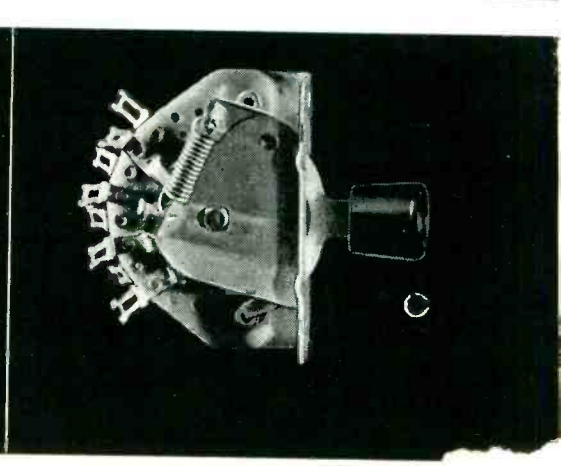
Exploded View Shows Why Centralab's New Model 2 Radiohm is Today's Finest Control!

14 Good Reasons Why CRL's Model 2 Radiohm is the Control for You!

1. *Switch* — with positive detent in both on and off positions. *Terminals* — with surfaces elevated to eliminate danger of shorting to cover legs . . . V_8" hole diameter for simplified wiring . . . hot tin dipped for easy soldering . . . mechanical lock to prevent loosening in soldering operations.
2. Cadmium plated steel *cover* completely shields resistor.
3. *Insulator's* high dielectric strength permits breakdown test at 1000 volts R. M. S. Dust and dirt can't get in.
4. *Stop,* of cup design, provides superior switch shielding . . . gives you excellent torque strength without distortion.
5. High grade laminated phenolic *shoe* maintains high insulation resistance (under humidity conditions.)
6. Contact Spring gives you double wiping contacts on both resistor and center terminal ring . . . is accurately formed to maintain uniform pressures and minimize noise.
7. Electro tin-plated *terminals* provide soldering ease. Tightly crimped, terminals give you direct contact to resistor . . . assure constant contact under humidity and soldering conditions.
8. *Resistor* is made of special resistance material bonded to high quality phenolic for smooth operation, low noise level, outstanding humidity characteristics.
9. Cadmium-tipped *center terminal* provides easy soldering . . . good shelf life without oxidation. Adequately lubricated for good rotation life, center terminal is finished to give you smooth take-off . . . minimum noise.
10. Laminated phenolic *base* maintains high insulation resistance (under humidity conditions.)
11. Cadmium-plated steel *ground plate* assures positive grounded cover.
12. Cadmium-plated steel *bushing* is accurately finished and fit to shaft for smooth rotation.
13. *Retaining ring.*
14. *Shaft.* Unlimited variations available to meet your specifications.





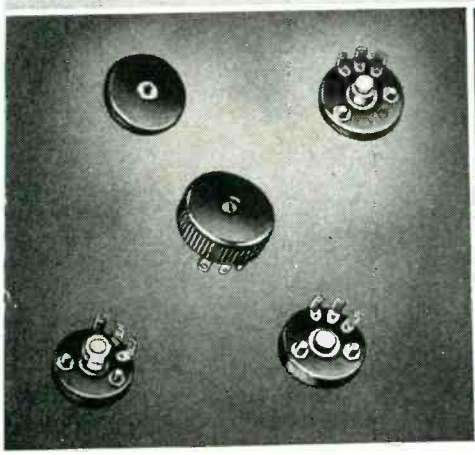


1 *Pentode Couplate* consists of plate lead and grid resistors, plate by-pass and coupling capacitors. Minimum soldered connections speed production.

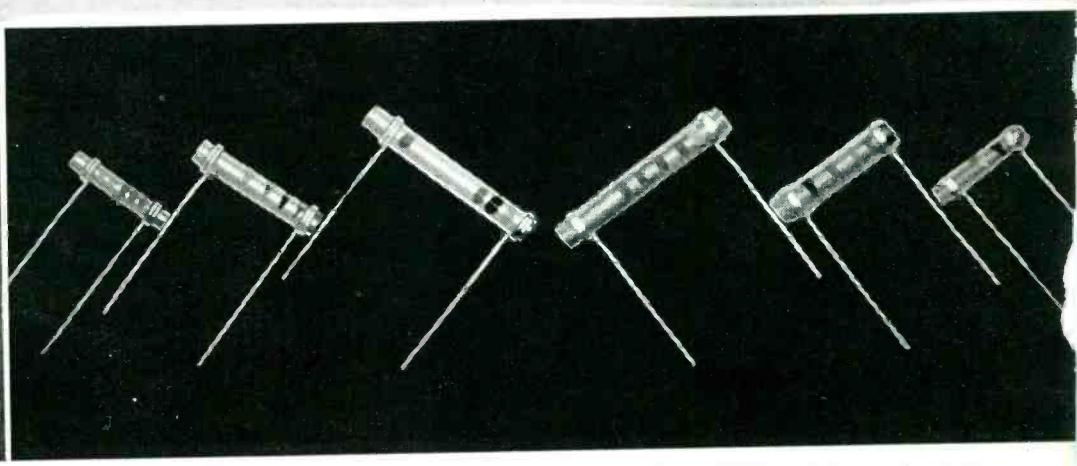
2 This is the new CRL *Vertical Integrator Network* used in TV sets. Variations of this Centralab *Network* are available on special order.

3 In its *Lever Switch,* Centralab antees a [illegible] life o[illegible] cycles. He[illegible] sive new

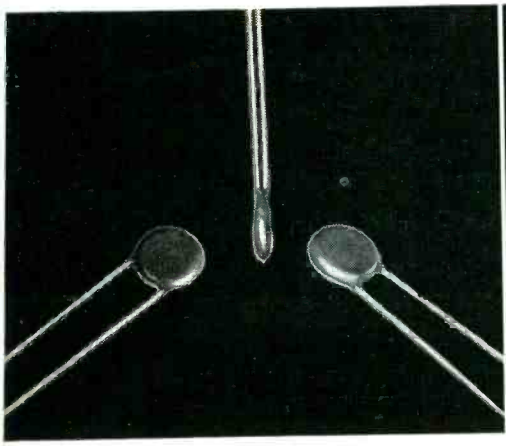
Electronic Industry



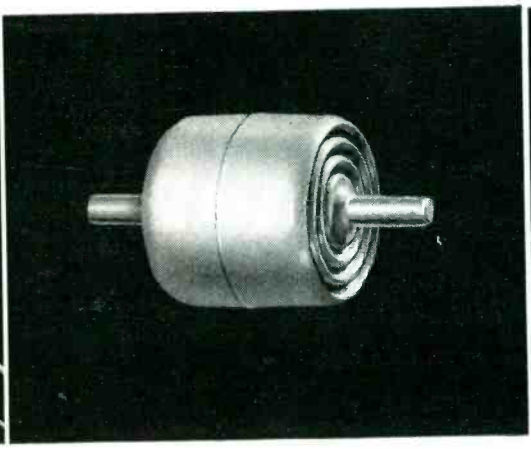
4 Model "1" *Radiohm* control — plain and switch types — is no larger than a dime. Especially designed for miniature applications.



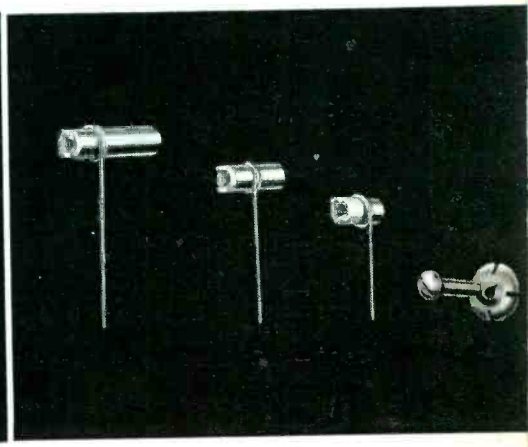
5 Centralab's TC (Temperature Compensating) Tubular *Hi-Kaps*, left, are the most stable capacitors available. With TC *Hi-Kaps*, there's practically no variation due to aging or changes in temperature or humidity. For applications where temperature compensation is unimportant, use Tubular BC *Hi-Kaps*, right.



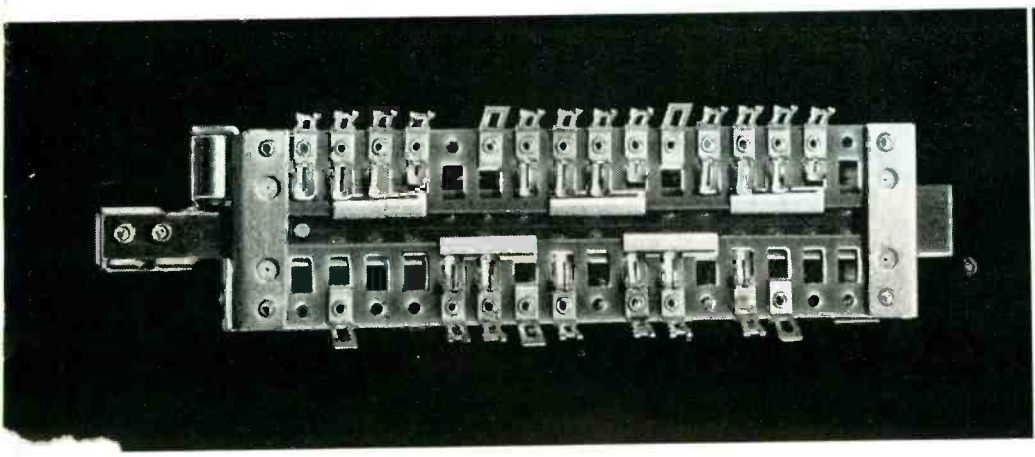
6 For by-pass or coupling applications, check Centralab's original line of ceramic disc *Hi-Kaps*. Disc *Hi-Kaps* are smaller than a dime!



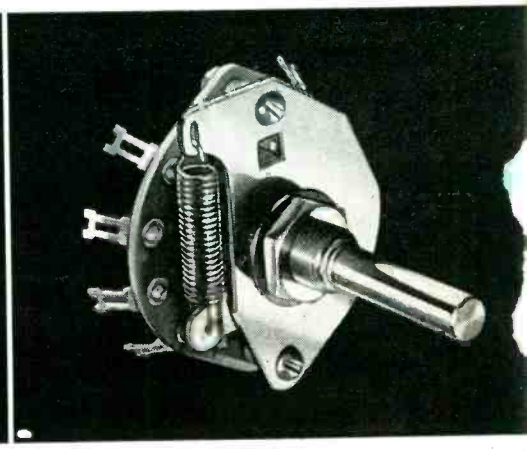
7 *Hi-Vo-Kaps* are filter and by-pass capacitors combining high voltage, small size and variety of terminal connections to fit most TV needs.



8 CRL's new Tubular *Trimmers* come in 3 basic types, 3 capacity ranges. Tinnerman locknut and adjusting screw available on special request.



entralab's development of a revolutionary, new *Slide Switch* gives you improved and FM nce! Flat, horizontal design saves valuable space, allows short ion to coils, reduced lead inductances for increased efficiency encies. CRL *Slide Switches* are rugged and dependable.



10 Great step forward in switching is CRL's New *Rotary Coil and Cam Index Switch*. Its coil spring gives you smoother action, longer life.

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General

26 — GENERAL CATALOG — Combines Centralab's line of products for jobber, ham, experimenter, serviceman or industrial user.

Look to CENTRALAB in 1949! 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.

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ATV 225

THE TESTED LEAD-IN LINE

Means More Set Sales

● Since late in 1947 Anaconda ATV* 225 Shielded Lead-In Lines** have been in operation in various sections of the United States.

Comparative results are now conclusive. ATV 225 means no more weather interference, no more moisture, or dirt troubles, no "snow," no "ghosts," no re-radiation from nearby installations, auto, truck or airplane ignition.

In a word, pictures are clear and clean as never before. And because service call-backs are negligible, (instead of ruinous) there's more time for selling sets. And there's lots of replacement business on out-of-date, unshielded lead-in lines . . . with scientific, time-*tested* ATV 225. It's now generally available. Order today.

Specifically, ATV 225 offers:

1. High impedance—matches receiver input circuit.
2. Extremely high signal to noise ratio.
3. Low attenuation—full signal strength.
4. Stable performance and long life under all weather conditions.
5. Fire resistant—meets Underwriters' requirements.
6. Operates in conduit without change in electrical properties.

49447

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ANACONDA
from mine to consumer

ANACONDA WIRE & CABLE COMPANY

25 BROADWAY, NEW YORK 4, N. Y.

DRIVER-HARRIS

Your dependable source for

Wire and Ribbon Resistor and Radio Alloys

FOR RESISTANCE

There are Driver-Harris Alloys for every electrical resistance requirement. Most widely used are:

. . . **Nichrome*** and **Nichrome* V,** for winding large value resistors where overall size is limited, but dependability is a must.

. . . **Manganin,** for fixed stability and constant resistance under normally variable operating conditions; examples being precision bobbins, potentiometers, National Bureau of Standards type resistance standards.

. . . **Advance*,** most frequently specified for precision resistors in electric meters and laboratory testing devices, because in its finer sizes it has a temperature coefficient of only ±.00002/°C.

. . . **Karma*,** high ohmage, 800 ohms/cmf at 20°C., makes possible extremely small resistors. Especially suitable for service in resistors requiring negligible temperature coefficient of resistance. Thermal e.m.f. against copper only .002 millivolts /°C. between 0°C. and 100°C. Where mechanical strength is important, larger diameter Karma wire can be used for a given resistance per foot.

. . . Plus a total of more than 80 *electrical heat and corrosion-resistant* alloys which singly, or in combination fill any electrical resistance specifications.

FOR RADIO

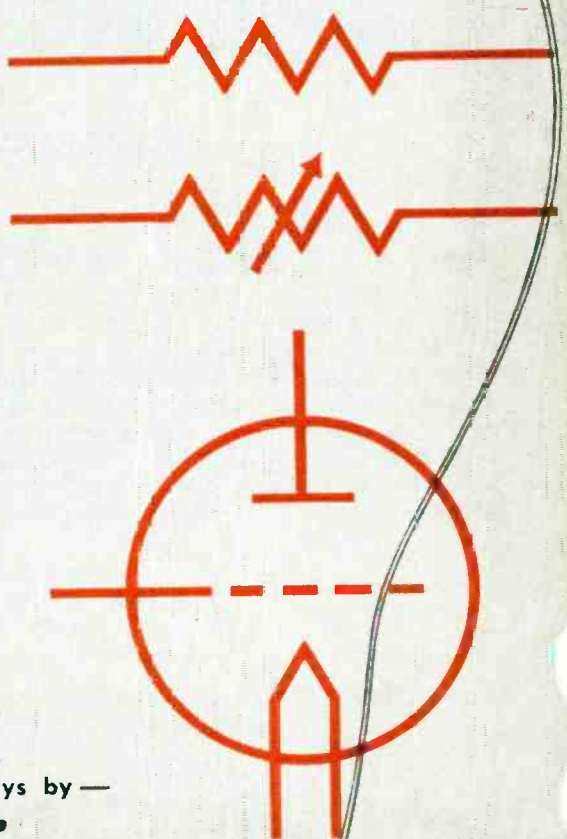
Always abreast of the latest developments in radio metallurgy, Driver-Harris has been headquarters for Radio Alloys since the earliest days of the industry. In greatest demand are:

. . . **Nickel and Nichrome*,** for plate strip. Thin but rigid, they take a tightly adhering heat radiation coat.

. . . **Gridnic* Alloys,** having a very low electron emission — especially suitable in tubes where back-emission is involved.

. . . **Cathode Sleeve Material:** special melted Nickel Alloys to meet any emission requirements.

Other widely accepted D-H Alloys, meeting or exceeding most radio specifications are: *Nilvar**, *#42 Alloy*, *#52 Alloy*, and *Nickel "A" "D", "E", "Z"*.



For efficiency and dependability —
Specify Electrical Resistance and Radio Alloys by —

Driver-Harris
COMPANY
HARRISON • NEW JERSEY

BRANCHES: Chicago • Detroit • Cleveland • Los Angeles • San Francisco • Seattle
The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

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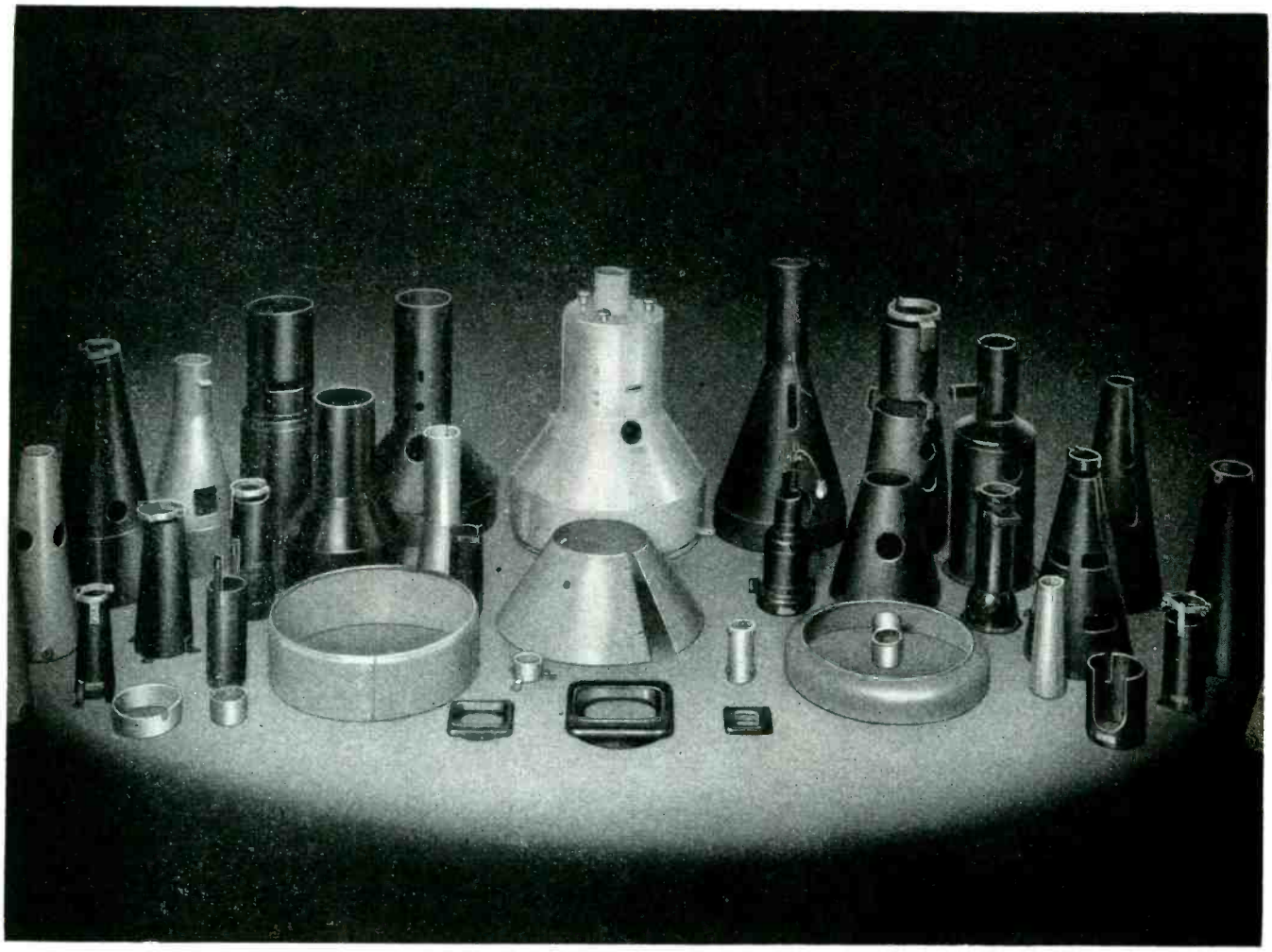


Designed for Application
MU METAL SHIELDS

The James Millen Mfg. Co. Inc. has for many years specialized in the production of magnetic metal cathode ray tube shields for the entire electronics industry, supplying magnetic metal shields to manufacturing companies, laboratories and research organizations. Stock shields are immediately available for all of the more popular sizes and types of cathode ray tubes as well as bezels for 2", 3" and 5" size tubes.

Many production problems, however, make desirable special shields designed in conjunction with the specialized requirement of the basic apparatus. Herewith, are illustrated a number of such custom built shields. Our custom design and fabrication department is at the service of our customers for the development and manufacture of magnetic metal shields of either nicoloi or mumetal for such specialized applications.

Millen magnetic metal shields are illustrated and described in the new printing of our Laboratory Equipment catalogue, a copy of which will be mailed upon request.

JAMES MILLEN MFG. CO., INC.

MAIN OFFICE AND FACTORY

MALDEN, MASSACHUSETTS, U.S.A.

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.

GENERAL ELECTRIC ANNOUNCES

ALNICO 5 DG

NEW VERSION OF PROVEN MAGNET NOW OFFERS GREATER AVAILABLE ENERGY THAN EVER BEFORE

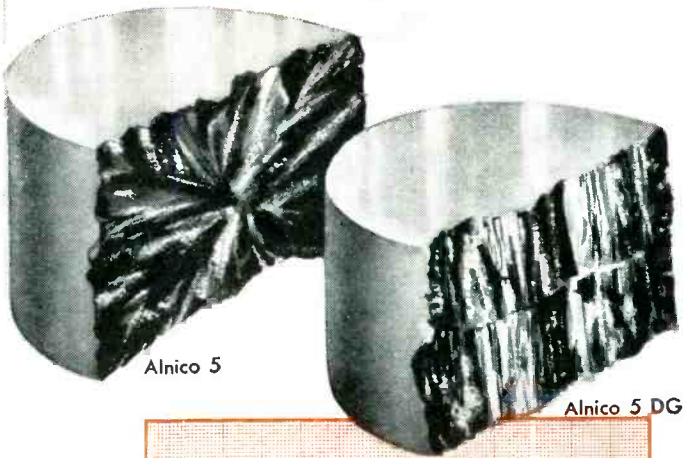
Now—the G-E Alnico 5 DG permanent magnet offers manufacturers greater available energy than ever before! Results of the continuing program of G. E. research and development—a change in the manufacturing process which aligns the crystal structure of the magnet in the direction of magnetization—has been incorporated in the product of Alnico 5 DG.

AVAILABLE IN CAST FORM, ALNICO 5 DG NOW OFFERS MANUFACTURERS THESE ADDITIONAL ADVANTAGES:

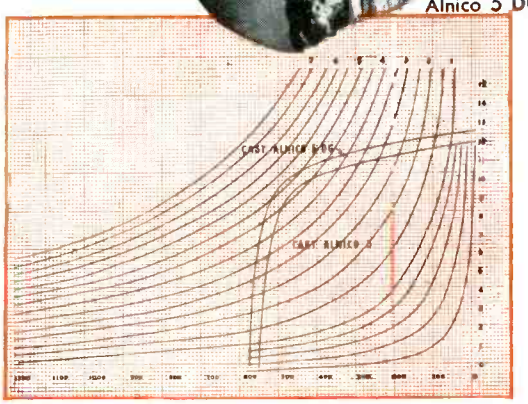
1. Use of smaller amounts of magnets to do the same job.
2. Reduction in equipment weight—opening new design and production savings possibilities.
3. Reduction in the size of magnetic frame, with corresponding cost reduction possibilities.

Available from production, cast Alnico 5 DG is ready to provide manufacturers of radio speakers, magnetic separators, meters, instruments, and other industrial products with the greatest external energy and residual induction of any permanent magnetic material known to us today.

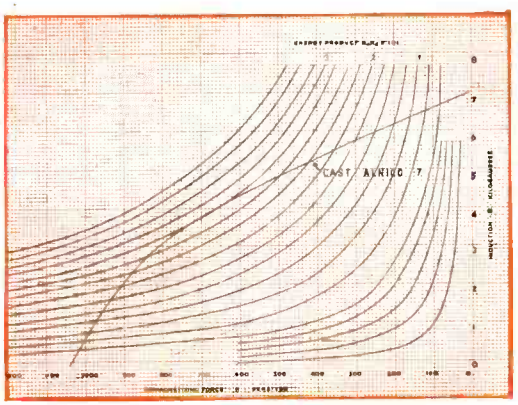
2 OUTSTANDING IMPROVEMENTS IN PERMANENT-MAGNET MATERIALS



Here is the Alnico 5 DG compared with Alnico 5. Note the directional grain structure that imparts a greater energy potential. Note the reduction of size in Alnico 5 DG.



Hysteresis and energy curves for Alnico 5 DG.



Hysteresis and energy curves for Alnico 7.

and NEW ALNICO 7

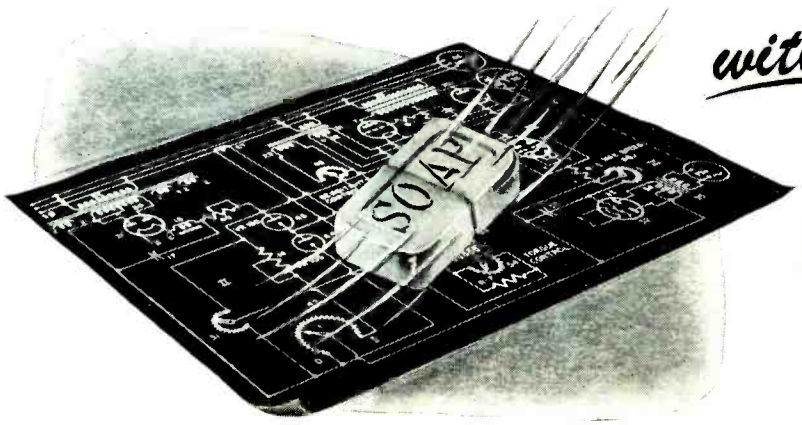
Here is a new permanent magnet specifically developed by G. E. for applications where a high demagnetization force is present. In such applications as motors, generators, and variable air gap devices, new Alnico 7 shows a higher coercive force than any other grade of Alnico.

For more information on these magnets or others in the G-E permanent magnet line, please write on your company letterhead to Section 14-9, Chemical Department, General Electric Company, Pittsfield, Mass.

GENERAL ELECTRIC

CD49-K2

PURITY IN POWER CONVERSION



with **BRADLEY SELENIUM RECTIFIERS**

Developed after five years of research, the Bradley Vacuum Process insures low cost selenium rectifiers with uniformity of rating. Power conversion is predictable, accurate and efficient. Improved product performance is assured.

The Bradley Vacuum Process removes impurities from the selenium and simultaneously prevents contamination during manufacture. Every production operation is precisely controlled — no hidden variables that necessitate exhaustive post-production inspection for uncertainties. Bradley Selenium Rectifiers perform according to rating.

Bradley makes selenium rectifiers to meet practically every power conversion need. A complete line of copper oxide rectifiers is also available. Our engineers will be glad to work with you on the selection or development of the *right* rectifier for your application. We can move fast on special requirements.

HIGH CURRENT USES

SE 11X-Series

These Bradley Selenium Rectifiers provide good efficiency and stability. Rated up to thousands of amperes.

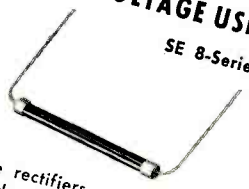
MEDIUM POWER USES

SE 11-Series

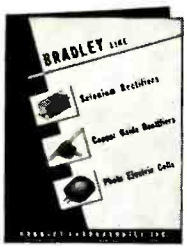
Rated from 50 ma up, these rectifiers are available hermetically sealed or protectively coated. Excellent thermal characteristics, economical in size and weight.

HIGH VOLTAGE USES

SE 8-Series



These rectifiers are designed to provide maximum rating and efficiency with minimum size. One model — SE-8L, rated 1.5 ma — is smallest completely sealed rectifier in class.



← **WRITE FOR YOUR COPY** of "The Bradley Line", booklet showing many additional rectifier and photocell models.

PHOTOELECTRIC CELLS

Bradley Luxtron® photocells convert light directly into electric energy without external power source. They are versatile, rugged, true to rating, simple to install. Wide range of models, sizes and shapes.

BRADLEY LABORATORIES, INC.

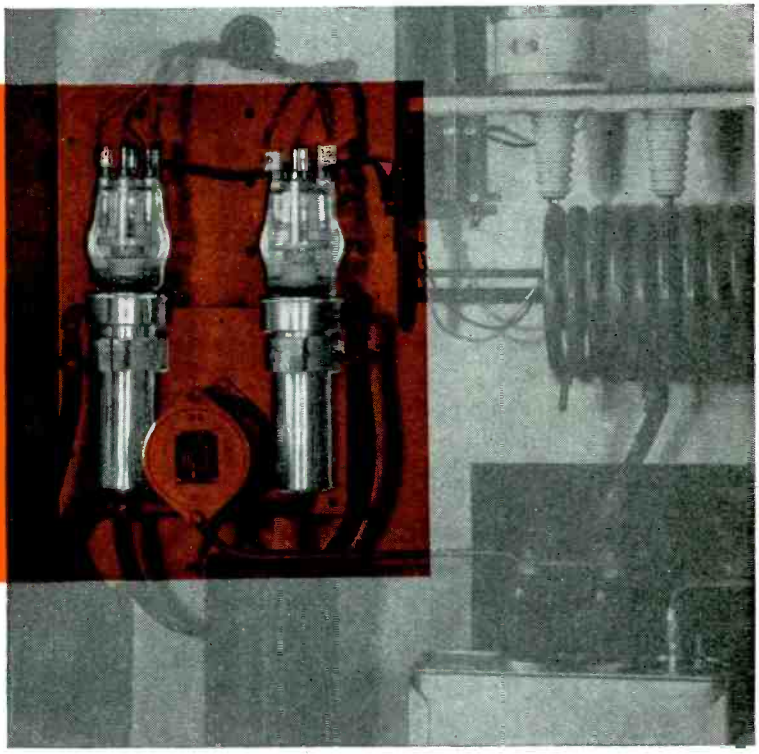
84 MEADOW STREET, NEW HAVEN, CONNECTICUT

A BETTER TUBE FOR EQUIPMENTS USING TYPE 892

ML-5668

(With Automatic-Seal Water Jacket)*

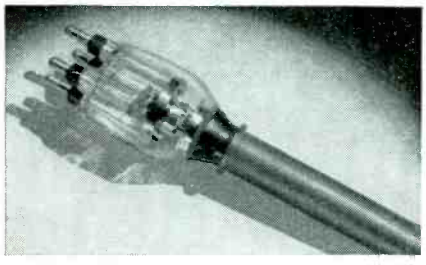
DEVELOPED BY MACHLETT FOR 10-20 KW ELECTRONIC HEATING EQUIPMENT



***Provides instant tube replacement without use of tools.**

The ML-5668 is "custom-made" to the requirements of R. F. Heating service. For this purpose it is superior in every respect—mechanical and electrical—to the 892 type, which heretofore has been the only tube available for these sockets. Like the ML-5666, (water-cooled version of the ML-5667), its design reflects the result of Machlett's analysis of the operating conditions electron tubes must satisfy to give satisfactory industrial service.

Replacement of tube 892 by the ML-5668 will assure you better—and lower cost—tube performance.



ML-5606

This tube is designed to supercede type 892 in R. F. Heating equipments and directly replaces it without equipment modifications. The ML-5606 incorporates all of the features of the ML-5668 except that it is provided with a standard type 892 anode to fit existing 892 sockets.

Machlett has developed a complete line of improved tubes for a wide range of power applications. These tubes and full details regarding their advantages in industrial service over standard communication types may be obtained from the Graybar Electric Company. If you are contemplating the use of electronic heating or merely replacing tubes in present equipment, we suggest you contact your nearest Graybar office.

MACHLETT LABORATORIES, INC.
Springdale, Conn.

HERE'S WHY THE ML-5668 WILL GIVE YOU SUPERIOR LOWER-COST PERFORMANCE

- **Specially processed heavy-wall anode. Increased plate dissipation capability—no hot-spotting or anode puncture due to transient overloads.**
- **Completely new and ruggedized electrode structure. Minimizes possibility of inter-element shorts resulting from rough handling or vibration.**
- **Kovar seals. Insure stress-free, sturdier metal-glass seals. Danger of breakage reduced over 75%. More stable internal structures.**
- **Machlett high voltage, high temperature exhaust. Cleanest possible internal parts—your assurance against tube gassiness and flash-arcing, which lead to early tube failure.**
- **Improved filament design eliminating troublesome guides and tension springs. Balanced magnetic stress contributes to uniform evaporation and longer filament life.**

Distributed by GraybaR ELECTRIC COMPANY

MACHLETT OVER 50 YEARS OF ELECTRON TUBE EXPERIENCE

MITCHELL-RAND features...

MIRAGLAS *Cords*

extremely low in cost... abundantly high in advantages

- VERY HIGH BREAKING STRENGTH
- WILL NOT STRETCH OR SHRINK
- WILL NOT ROT
- RESISTS OILS, CORROSIVE FUMES AND MOST ACIDS
- GOOD MOISTURE RESISTANCE

AND IS THE LOWEST-COST CORDAGE ON THE MARKET COMBINING ALL THESE ADVANTAGES

Manufacturers of electrical apparatus and appliances, repair and maintenance departments and rewind shops will find MIRAGLAS* CORDS ideal wherever a low-cost high quality binder twine or high strength tension member is required for . . .

banding field and armature coils... wrapping string bands on small armatures ...protecting front of commutator V-ring... reset strings...tying slot insulation . . . binding on V-ring extension...filling in winding coils...lashing ends of coils in large motors and generators – and when wax-treated for assembling and tying wire harnesses.

***MIRAGLAS* CORDS** are made by plying fine, strong, flexible fiberglas (filaments of glass) into twines ranging in size from .014" to .154" in diameter and available either treated or untreated. Treatments: oil, neoprene or wax.

*Woven of fiberglas

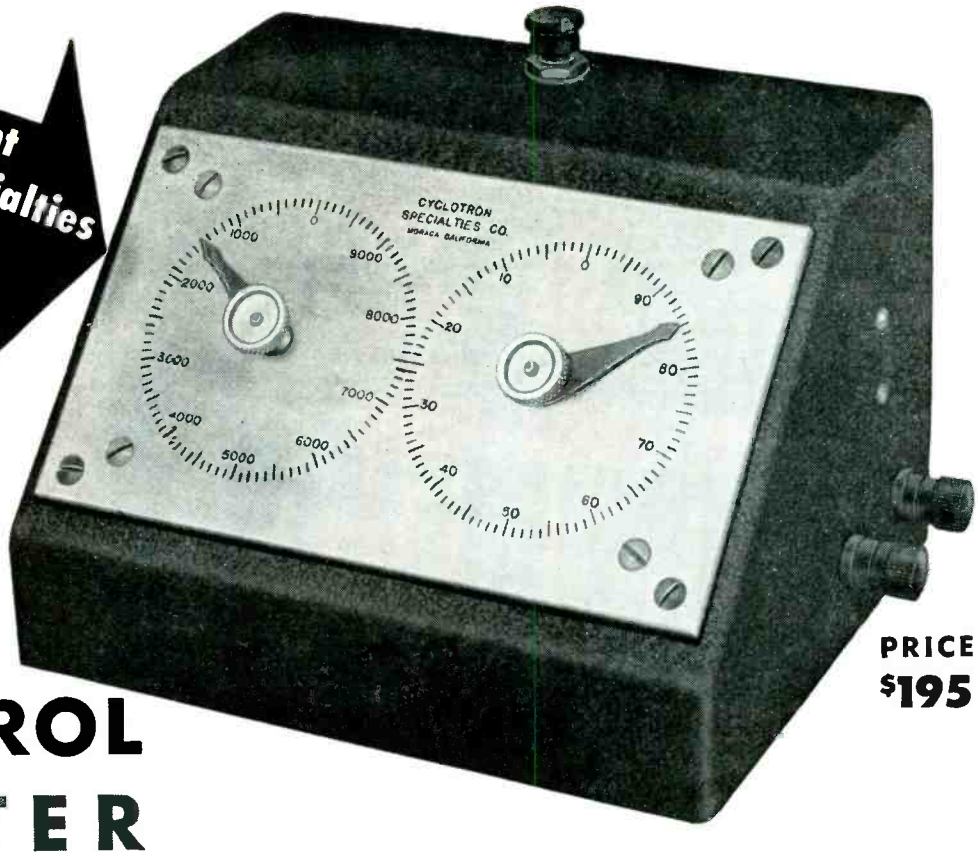
For MIRAGLAS* CORDS as for all other ELECTRICAL INSULATIONS you can depend upon MITCHELL-RAND "Electrical Insulation Headquarters" since 1889.

MITCHELL-RAND INSULATION CO. Inc.

51 MURRAY STREET • COrtlandt 7-9264 • NEW YORK 7, N. Y.

A PARTIAL LIST OF M-R PRODUCTS: FIBERGLAS VARNISHED TUBING, TAPE AND CLOTH • INSULATING PAPERS AND TWINES • CABLE FILLING AND POTHEAD COMPOUNDS • FRICTION TAPE AND SPLICE • TRANSFORMER COMPOUNDS • FIBERGLAS SATURATED SLEEVING • ASBESTOS SLEEVING AND TAPE • VARNISHED CAMBRIC CLOTH AND TAPE • MICA PLATE, TAPE, PAPER, CLOTH, TUBING • FIBERGLAS BRAIDED SLEEVING • COTTON TAPES, WEBBINGS AND SLEEVINGS • IMPREGNATED VARNISH TUBING • INSULATED VARNISHES OF ALL TYPES • EXTRUDED PLASTIC TUBING

A New Instrument by Cyclotron Specialties for Controlling Mechanical Cycles



PRICE $195

CYCLO-TROL REGISTER

The **CYCLO-TROL*** Register is the latest addition to the well-known line of Cyclotron Impulse Registers. The same principle of operation which has gained for these registers such wide use and recognition is applied in this new unit to provide accurate control over a wide range of mechanical cycles.

The **CYCLO-TROL** Register has two calibrated dials which can be instantly set by means of shaft thumbscrews to any number from 0 to 10,000. When pulsed by an external circuit, the **CYCLO-TROL** continues to register until the preset number of counts is reached. At this point, **CYCLO-TROL's** output circuit is completed and a contact is made to external circuit, thus actuating, as desired, operation under control.

The **CYCLO-TROL** can be reset to original setting by merely pressing the button on top of register. By this simple step, repeat cycles of control can be secured as many times as desired.

SPECIFICATIONS AND SPECIAL FEATURES

Counting Rate:	60 impulses per second maximum
Power Source:	115 volts A.C.
Power Supplied to Impulse Contact:	110 volts D.C.—self-contained
Output Circuit:	50 volts D.C. (direct or to auxiliary relay)
Dimensions:	7"x 4"x 4" high
Weight:	5 pounds (approx.)

APPLICATIONS OF CYCLO-TROL REGISTER

The **CYCLO-TROL** Register is made available because of insistent demand from users of other types of Cyclotron Specialties Registers. Here are only a few of the many applications of this new unit—

- ★ Counting problems involving positive, accurate control over any number of revolutions or cycles up to 10,000.
- ★ Electrical circuits may be opened or closed at any predetermined number of counts.
- ★ **Ideal for coil winding machines.** The exact number of turns can be preset and machine stopped at exact point, making possible any number of identical coils. Operator needn't watch counter...his attention can be concentrated on winding.

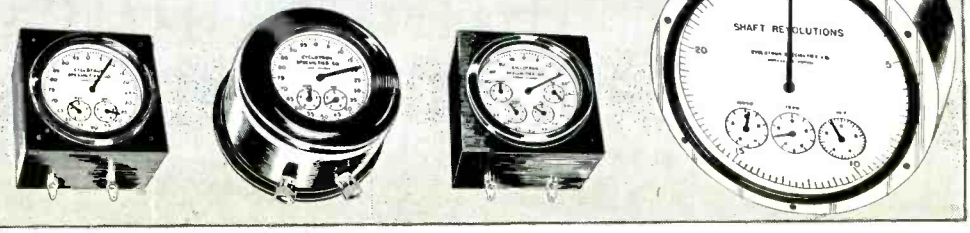
*Trade Mark

Immediate Delivery in Reasonable Quantities

Cyclotron Specialties Company

MORAGA 6, CALIFORNIA

Made by the Manufacturers of these Famous Impulse Registers



(Model 901) PORTABLE TEST INSTRUMENTS available in DC, Model 901—and AC, Model 904, single and multiple ranges of wide coverage. Excellent scale readability and shielding. Accuracy within ½ of 1%.

SENSITIVE RELAYS a line of sensitive relays including the Model 705 which provides positive control at levels as low as ½ microampere. Non-chattering magnetic contacts handle up to 10 watts at 120 volts.

(Model 622) ULTRA-SENSITIVE INSTRUMENTS portable DC and AC Thermo instruments for precision measurement of potentials and minute currents involving electronics, thermo-couples or laboratory research.

INSTRUMENTS

TO SPEED AND SIMPLIFY ELECTRONIC PRODUCTION AND MAINTENANCE

Illustrated are but a few of the many specialized instruments available from WESTON . . . all designed to simplify and speed-up electrical and electronic installations, production testing, and maintenance. For details, see your local representative, or write Weston Electrical Instrument Corporation, 618 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON *Instruments*

ALBANY • ATLANTA • BOSTON • BUFFALO • CHARLOTTE • CHICAGO
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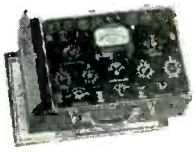
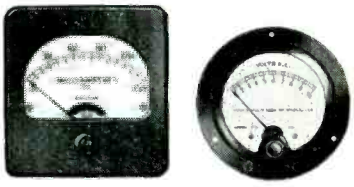
IN CANADA, NORTHERN ELECTRIC CO., LTD., POWERLITE DEVICES, LTD.

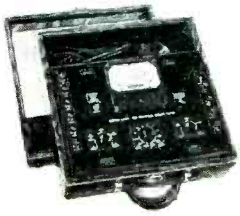


(Model 798) MULTI-PURPOSE TUBE-CHECKER offering provision for testing Receiving Tubes — Voltage Regulator Tubes—Light Duty Thyratron Tubes such as 2A4—6D4—884—885—2051. Scale is calibrated "Good-Bad" as well as in mutual conductance range.



PANEL and SWITCHBOARD INSTRUMENTS a complete line of instruments in all types, sizes and ranges required for switchboard and panel needs . . . including DC, AC power frequencies and radio frequency, rectifier types and D.B. meters.

(Model 697) VOLT-OHM MILLIAMMETER one of a line of pocket-size meters, Model 697 combines a selection of AC and DC voltage, DC current, and resistance ranges. Ideal for maintenance testing and many inspection requirements.



(Model 785) INDUSTRIAL CIRCUIT TESTER a versatile, portable tester for laboratory or maintenance needs, where an ultra-sensitive instrument is required. Provides 27 AC and DC voltage, AC and DC current, and resistance ranges. (DC sensitivity 20,000 ohms per volt.)

(Model 779, Type 1) SUPER-SENSITIVE ANALYZER small, light, compact, 26 range Volt-Ohm-Milliammeter with 5 DC voltage ranges, sensitivity of 1000 or 20,000 ohms per volt. AC temperature compensated. Self-contained power supply. Ideal for many production and test requirements.

(Model 769) ELECTRONIC ANALYZER incorporating a conventional Volt-Ohm-Milliammeter with self-contained power source—a high-impedance electronic Volt-Ohmmeter using 115 volt, 60 cycle power—a stable, probe-type, Vacuum Tube Voltmeter, for use to 300 megacycles.

WINDING HORIZONTAL SWEEP COILS FOR TELEVISION RECEIVERS

FOUR COILS WOUND AT ONCE ON UNIVERSAL NO. 84 MACHINE

The tremendous interest in television all over the country has created a large and attractive market for producers of component parts for TV receiving sets.

For complete assurance of high quality and production in coils for television sets, manufacturers are using Universal Coil Winders.

One of the most difficult coils to wind is the so-called horizontal sweep or fly-back transformer coil (Fig. 1). This can best be wound on the No. 84 Universal Coil Winder (Fig. 2), which makes it possible to wind one to four coils at once for each of the three sections.

The following technical data was prepared by our engineers and is intended as basic information when producing the horizontal sweep coil on the No. 84 machine.

Fig. 1. Horizontal Sweep Coil.

Another component coil for television is the focus coil, which is wound on the No. 102 machine.

Detailed information on recommended winding practice for both these coils is contained in *Getting the Most from Coil Winding* — copies of which we will be glad to send you. Ask for GMCW-L.

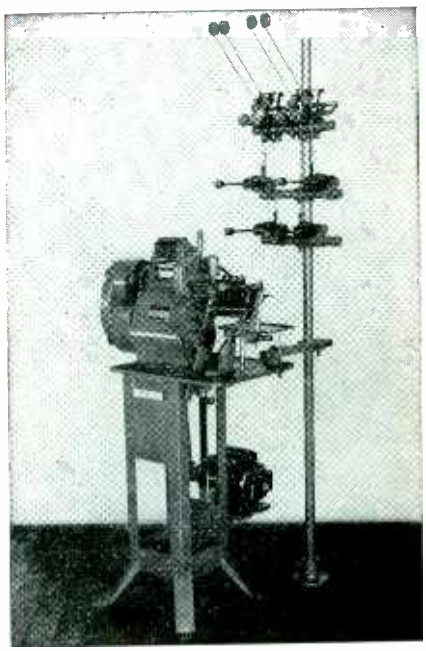


Fig. 2. No. 84 Coil Winder.

NO. 84 MACHINE SET-UP FOR TELEVISION HORIZONTAL SWEEP TRANSFORMERS

FIRST SECTION

Wire 375 turns of No. 28 single nylon and enamel covered wire (.0156 in. O.D.)

Cam 5/8 in. single throw.

Winding speed 750 rpm.

Wind 1½, using gearing 48 or 72 with any intermediate gear to mesh.

Wire guides .018 in. center slot.

Tension medium spring in fourth hole from top.

Pressure two weights on traverse frame cord.

Wind four coils at a time.

SECOND SECTION

Wire 1,000 turns No. 33 single nylon and enamel covered wire (.0099 in. O.D.)

Cam ½ in. single throw.

Winding Speed 750 rpm.

Wind 2/3, using gearing 119-80 with any intermediate gear to mesh.

Guides .018 in. center slot.

Tension sixth hole from top.

Pressure two weights on traverse frame cord.

Wind four coils at a time.

THIRD SECTION

Wire 1,000 turns No. 38 single silk and enamel covered wire (.0065 in. O.D.)

Cam 3/32 in. single throw.

Winding speed 400 rpm.

Wind 1/7th using gears 120-40-88-38. (With this compound gearing, use any small gear on the spindle shaft on the inside of the 120-tooth gear. The second and third gears will go on the intermediate stud with the 40-tooth gear on the outside and the 88-tooth gear on the inside. The 38-tooth gear will be on the clutch shaft, and should mesh with the 88-tooth gear.)

Wire guides .008 in. center slot.

Tensions light spring in about the third hole from the top.

Pressure one pressure weight on the traverse frame cord.

Wind one to four coils at a time.

COIL WINDING DEMONSTRATION ROOM

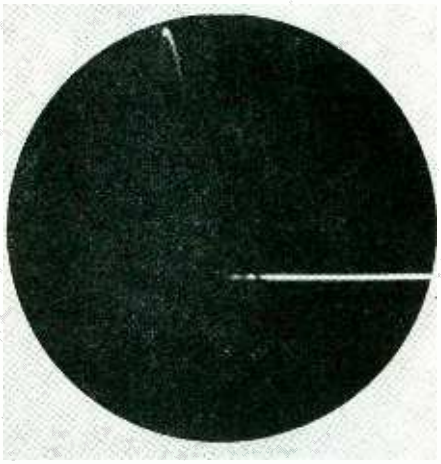
We have in our coil winding demonstration room the following complete line of coil winding machines: 84, 96, 98, 102, 103, 104 and 105.

We invite anyone who is interested to visit our demonstration room and view these machines in operation.

A transient signal . . .

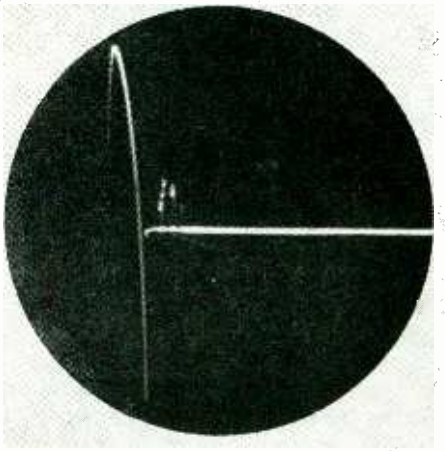
IMAGINED AT 4 KV . . . *but* . . . IMAGED AT 14 KV!

DU MONT OSCILLOGRAPHY *shows* the difference . . .



At low operating voltages the cathode-ray tube will respond to a high-speed transient signal, but—only at high voltages is the light output sufficient to SEE and *RECORD it.*

Du Mont high-voltage Oscillography shows you the difference with these actual (unretouched) oscillograms, and here's how it's done:



. . . with DU MONT HIGH-VOLTAGE CATHODE-RAY TUBES

Type 5RP-A is an intensifier-type, high-voltage cathode-ray tube featuring multiple accelerating electrodes for use with accelerating potentials up to 25,000 volts, without serious loss in deflection sensitivity. Writing rates in excess of 280 inches per microsecond have been recorded with this tube.

Type 5XP- has operating characteristics identical with those of the Type 5RP-A except for increased deflection sensitivity in one direction, provided by specially designed deflection plates. Especially suited for use with wide-band amplifiers. Types 5RP-A and 5XP- alike are capable of sufficient light output to allow projected oscillograms. Type 5XP- is interchangeable with Type 5RP-A except for slightly greater overall length.

. . . with these HIGH-VOLTAGE CATHODE-RAY INSTRUMENTS

Type 280-A is a high-voltage oscillograph for precision measurement of time. Originally designed to measure the composite television signal, it has found applications in many other fields. Time intervals of .025 microsecond can be measured, using time base variable from 1 to 15,000 microseconds. Calibrated delay circuit accurately delays sweep from 4 to 1,000 microseconds. Video-amplifier circuits provide uniform response up to 10 megacycles. Internal power supply provides accelerating potential up to 14,000 volts to a Type 5XP- tube.

Type 281-A is a basic cathode-ray indicator utilizing Type 5RP-A tube. Provision made for either capacitive or direct-coupling to all deflection plates. Displays single transient writing speeds up to 210 inches per microsecond. Internal power supply provides overall accelerating potential of 8,000 volts; external power supply can be used for higher voltages. The Type 286-A Power Supply is especially designed for use with the Type 281-A indicator, supplying overall accelerating potenial of 29,000 volts.

Type 250-AH is a high-voltage version of the versatile Type 250-A. High-voltage Type 5RP-A tube replaces Type 5CP-A. Provision is made for external high-voltage power supply. Type 250-AH is capable of recording writing speeds ten times those recorded by the Type 250-A. Using Type 263-B Power Supply, accelerating potentials as high as 13,000 volts may be applied. Sufficient light output to project oscillograms up to 30 feet with Type 2542 Projection Lens.

Type 248-A oscillograph is a favorite for high-frequency research. Self-contained, it offers a medium-voltage oscillograph for investigating pulses containing high-frequency components. Vertical amplifiers uniform in response within 30% from 20 cycles to 5 megacycles per second.

With addition of Type 263-B Power Supply, the Type 248-A becomes a high-voltage oscillograph for observation and photography of transients of short duration and extremely low repetition rates. Accelerating potentials up to 14,000 volts may be applied to a Type 5RP-A tube.

. . . with these HIGH-VOLTAGE POWER SUPPLIES

Type 286-A is a regulated rectified R-F type high-voltage power supply with adjustable output from 18,000 to 25,000 volts. Designed for use with Type 281-A indicator or wherever additional high voltage is required. Meter indicates output voltage.

Type 263-B is also a rectified R-F high-voltage power supply delivering from 6,000 to 12,000 volts. Designed for use with oscillographs employing 5RP-A or 5XP- tubes. Light in weight. Meter indicates output voltage.

For further details and prices, just address . . .

DUMONT *for Oscillography*

ALLEN B. DU MONT LABORATORIES, INC., *INSTRUMENT DIVISION*, 1000 MAIN AVENUE, CLIFTON, NEW JERSEY

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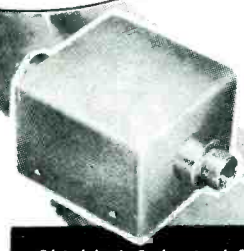
MEANS DEPENDABILITY • LIGHTER WEIGHT • QUALITY • STRICT ADHERENCE TO SPECIFICATIONS AND

RADIO INTERFERENCE-FREE PERFORMANCE

Filtered By Filtron . . . These planes, and others are equipped with electrical components which are Filtered By Filtron . . . Some with as many as twenty-seven "Filtrons" per plane. These planes represent America's most advanced engineering and design, and "Filtrons" represent the most advanced engineering and design of radio frequency interference filters. "Filtrons" are vital components not only in aircraft equipment, but in U. S. Navy and U. S. Army equipment as well . . . *wherever radio interference must be suppressed.* Filtron's engineering staff will design the *right* filter for your circuit conditions which will meet *size, weight* and *electrical characteristics*—and above all—will meet the *applicable radio interference specifications.* Our new, modern, completely equipped, specially designed, double shielded radio interference suppression laboratory is available for the radio frequency interference testing of your equipment.



Shielded Spherical-Seat Terminal Filtron—designed for continuous high attenuation from 150 kc to well above 200 mc

FILTERS FOR
28 VDC, 120 VDC, 60 cycle, 400 cycle and 1200 cycle military equipment

RADIO NOISE FILTERS FOR:
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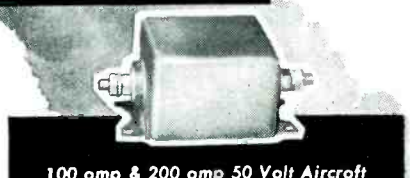
Electric Generators
Electronic Controls
Electronic Equipment
Fluorescent Lights
Oil Burners
Signal Systems
Business Machines
Electric Appliances
Electronic Signs
Electronic Heating Equipment



100 amp & 200 amp 50 Volt Aircraft Filtrons, size 3½" x 3½" x 2½"

2.5 amp Filtron for 50 V.D.C. operation size 1¾" x 1¼" x ⅞"

THE FILTRON CO., INCORPORATED
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AN INQUIRY ON YOUR COMPANY LETTERHEAD WILL RECEIVE PROMPT ATTENTION

LARGEST EXCLUSIVE MANUFACTURER OF RADIO INTERFERENCE FILTERS

No Tube Trouble.....

GATES
RADIO COMPANY
Manufacturing Engineers
QUINCY, ILLINOIS, U. S. A.

NO TUBE TROUBLE IN THIS 3 KW FM TRANSMITTER

If you are one of the many owners of FM transmitters where tube replacement cost has been heavily draining the reserve bank account, you will be particularly interested in the Gates BF-3D FM transmitter for 3000 watts power. The highly vulnerable power amplifier tubes which can be quickly damaged by changes in antenna characteristics, improper air circulation around the tubes and in some instances even low line voltage, have been engineered not only to good performance but to low maintenance cost.

On the attached brochure note the unique tank circuit design where the new 4-1000 power amplifier tubes are covered with a pyrex jacket which confines all of the air around the tube and finally concentrates it on the important end seal. Broadcasters are reporting from 2500 to 5000 hours of tube life and many purchasers of the BF-3D transmitter have the original set of tubes in the sockets after many months of use. To aid long tube life is a scientific air pressure control that immediately disconnects the plate voltage where the air for any cause reduces in pressure. Also a direct reading power and standing wave ratio indicator which tells the operator instantly if the antenna characteristics have changed because of icing or other reasons and is placing a heavy load on the power amplifier tubes.

The BF-3D, like all Gates products, is engineered not only for fine performance, meeting rigid FM requirements, but having the practical touch added by such things as longer tube life that means dollars to the broadcaster.

Further information about this fine transmitter that cannot be found in the attached brochure will gladly be given upon request.

Yours very truly,

GATES RADIO COMPANY

Sales Department

EIMAC 4-1000A TETRODE

*This letter was distributed with a brochure on the popular Gates BF-3D, 3KW FM transmitter.

Commercially proven . . . the Eimac 4-1000A is an outstanding high-power tetrode. Its rugged construction and stability of performance enable the country's leading transmitter manufacturers to enthusiastically expound the tubes' advantages in their key socket positions.

Consider the Eimac 4-1000A tetrode for your high-power equipment . . . frequency limits are well into the vhf. Complete data is available, please write direct.

Follow the Leaders to Eimac TUBES
REG. U. S. PAT. OFF.

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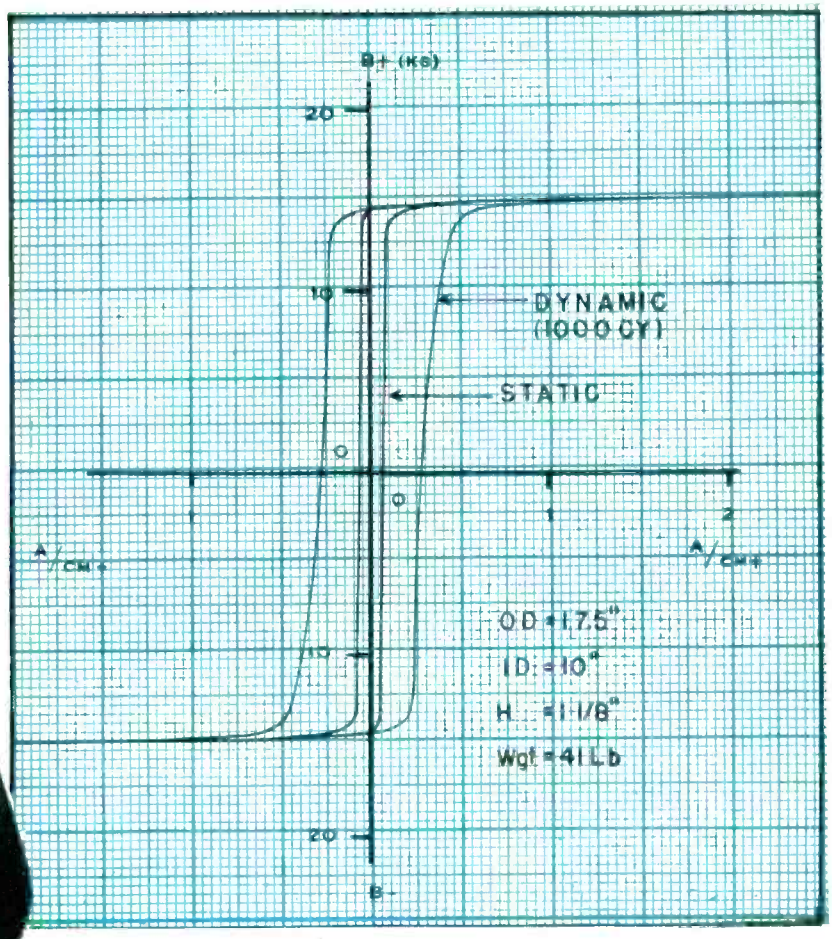
San Bruno, California

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



Take another look at Permeron*

. . . I-T-E'S NEW MAGNETIC CORE MATERIAL

Get the full significance of the static and dynamic (1000 cycle) magnetization characteristics of this new alloy. Examine the dynamic curve particularly — as this indicates how the material acts under actual operating conditions.

Note these facts:

1. Magnetic saturation is achieved with only the slightest change in magnetizing current.
2. The extremely low magnetizing current makes it possible to build smaller magnetic amplifiers of extreme reliability.
3. The knees of the saturation curve are sharp, even at higher frequencies.
4. The most important fact: all Permeron cores have identical magnetization characteristics. The dynamic characteristic of each core is checked by a "Vectormeter," specially developed for this purpose. This consistency allows designers to predict amplifier performance accurately and positively.

Permeron Cores are available now

in widths of 20 mm. and 30 mm., in any specified inside and outside diameters. Cores are delivered heat treated and insulated. They are always furnished in housings designed to protect the magnetic material against deformation.

Take Another Look at Permeron — and continue to look to I-T-E to bring you better equipment and better designs . . . *first!*

* Formerly known as "Permanite"

For Additional Information write — I-T-E Rectifier Division or consult your local I-T-E Representative

I-T-E PERMERON

I-T-E CIRCUIT BREAKER COMPANY
19th AND HAMILTON STREETS, PHILADELPHIA 30, PA.

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • RESISTORS • SPECIAL PRODUCTS • MECHANICAL RECTIFIERS

Federal SELENIUM RECTIFIERS

from Miniatures to Heavy Duty Stacks

Sizes and types of the Selenium Rectifier have multiplied to meet more and more requirements in almost unlimited fields of application. Federal introduced the Selenium Rectifier in the U. S. and continues to lead in developing and manufacturing this versatile circuit element.

Federal has cooperated with a host of engineers and designers in the development of a complete line of Selenium Rectifiers, ranging from tiny Miniatures to huge Stacks. There is a Federal Selenium Rectifier which will meet practically any power conversion need.

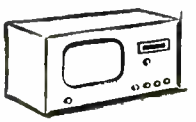
Wherever used, Federal Selenium Rectifiers bring important advantages of dependable power handling . . . instant starting . . . silent, efficient operation . . . long service life.

These typical applications may suggest a new use in your own product. A Federal Selenium Rectifier could be the solution to your own power conversion problem. Bring any question to Federal—America's oldest and largest manufacturer of Selenium Rectifiers. Direct your inquiries to Department E-313.

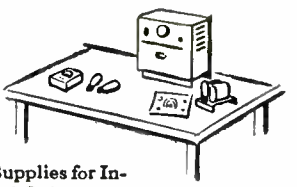
JUST OFF THE PRESS!
Federal's *new* Miniature Selenium Rectifier Handbook...48 pages of valuable design data. Available for 25 cents (coin only) from—

DO HUNDREDS OF POWER CONVERSION JOBS

more efficiently and economically than ever before!

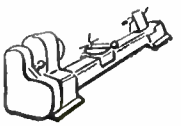


In television . . . radio . . . amplifiers and . . . intercommunication systems.

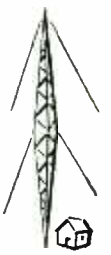


In Power Supplies for Industrial and Laboratory Use . . . Cathodic Protection . . . Electroplating.

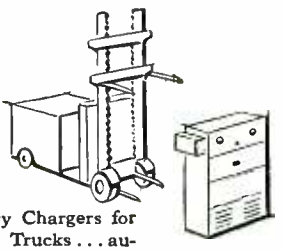
In fans . . . sewing machines . . . electric shavers . . . electronic organs . . . motion picture projectors . . . photo-electric cells.



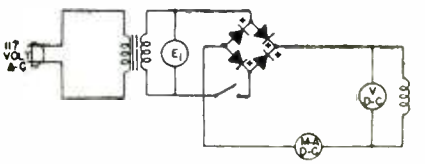
In machine tool controls . . . magnetic chucks . . . relay control systems . . . dial switching systems.



In High Power Communication . . . Broadcast Transmitters . . . Television Transmitters.



In Battery Chargers for Industrial Trucks . . . automobiles . . . telephone exchanges . . . and in Battery Eliminators.



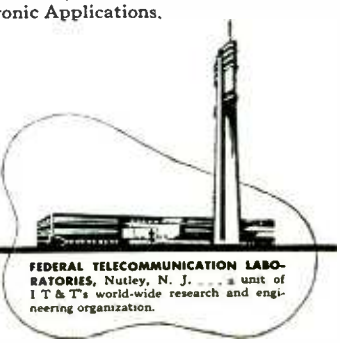
And In Many Specialized Electrical and Electronic Applications.

Federal
Telephone and Radio Corporation

SELENIUM and INTELIN DIVISION, 900 Passaic Ave., East Newark, New Jersey

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N.Y.

An IT&T Associate



FEDERAL TELECOMMUNICATION LABORATORIES, Nutley, N. J. . . . a unit of I T & T's world-wide research and engineering organization.

For Important *Rewind* Jobs—

NATVAR Slot Cell Insulation

Rewinding a 700 H.P., 900 RPM, 3 phase, 60 cycle, 6900 v., type ATI, G-E Synchronous Motor calls for painstaking skill, good shop equipment and good materials. In rewinding this big boy, Braunlich-Roessle used Natvar Slot Cell Insulation, Natvar Varnished Cambric Tape and Natvar Varnished Fiberglas Sleeving.

The Braunlich-Roessle Co., Pittsburgh, Pa., serves a large industrial area, and their motor repair shop has enjoyed a fine reputation for competent work for 34 years. To Mr. Braunlich, a past president of National Industrial Service Association, *all* rewind jobs are important, whether large or small. They use Natvar Slot Cell Insulation, and other Natvar insulations, because they know they can depend on their uniformity and satisfactory performance in the completed job.

Natvar Slot Insulation is composed of 100% rag paper stock to which a layer of Natvar V.C. is firmly bonded. This combination of the high dielectric strength and moisture resistance of Natvar V.C. with the toughness and abrasion resistance of 100% rag paper makes a rugged slot insulation which withstands pounding and chafing without impairment of electrical properties.

Prompt deliveries can be made from your wholesaler's stock 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 ond sleevings
- Extruded vinyl tubing and tape
- Extruded vinyl identification markers

Ask for Catalog No. 21

THE NATIONAL VARNISHED PRODUCTS Corporation

TELEPHONE
RAHWAY 7-2171

CABLE ADDRESS
NATVAR: RAHWAY, N. J.

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It's Amazing!

How Karp Makes Custom-Built Metal Cabinets and Boxes at Prices that Compete with those of Stock Items

The advantages and true economies of Karp custom-built cabinets, boxes, or housings over stock items are these:

- Your own exclusive design distinguishes and "styles" your product . . . gives it more market value.
- Flexibility of construction details speeds and simplifies your final assembly —saving you time and money.
- Our vast stock of dies can save you special die costs.
- Our 70,000 square feet of modern plant, with hundreds of craftsmen, means ample capacity for many types of work—simple or elaborate—at one time.
- Plant is fully equipped with every mechanical facility that aids economical production.
- Finishing is done in dustproof paint shop, with latest water-washed spray booths and gas-fired ovens mechanically and electronically controlled.
- We make no stock items or products of our own. Our plant, time and effort are 100% for our *customers'* work.
- Our engineering staff can help solve any possible design and production problems.
- It's results that count—and we give you the results you want.

Write for illustrated data book describing our facilities and showing the wide range of sheet metal fabrication we do.

CABINETS • BOXES • CHASSIS • HOUSINGS • ENCLOSURES

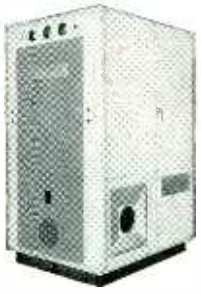
KARP METAL PRODUCTS CO., INC.

215 63rd STREET, BROOKLYN 20, NEW YORK

Custom Craftsmen in Sheet Metal

TV Monitor Console

Desk Panel Cabinet Rack



Induction Heater Housing

Chassis

Marine Radio Housing

Cabinet

the new RCA-5819 Multiplier Phototube for scintillation counters

RCA-5819 is a new Multiplier Phototube of the head-on type intended for use in scintillation counters for the detection and measurement of nuclear particle radiation, and in other applications involving low-level, large-area light sources. It has high sensitivity to blue-rich light and negligible sensitivity to infra-red radiation.

An outstanding feature of the RCA-5819 is its semi-transparent photocathode which has a diameter of 1½ inches and an area of 1.8 square inches. This relatively large cathode area permits very efficient collection of light from large-area light sources, such as are encountered in scintillation counters. The spectral sensitivity characteristic of the RCA-5819 peaks at about 4800 angstroms and cuts off at about 3100 and 6500 angstroms. It covers a region in which many organic and inorganic phosphors respond efficiently to radioactive emanations. By proper choice of phosphor, alpha particles, beta particles, gamma rays, X-rays, or neutrons can be detected.

Utilizing 10 electrostatically focused dynode stages, the RCA-5819 operated at 90 volts per stage is capable of multiplying feeble currents produced at the cathode under weak illumination by an average value of 400,000 times.

RCA pioneered in the development of multiplier phototubes. In addition to the 5819, four other types are available, as listed in the accompanying table of characteristics. For further information on any of these types write RCA, Commercial Engineering, Section 42IR, Harrison, N. J.

CHARACTERISTICS OF RCA MULTIPLIER PHOTOTUBES

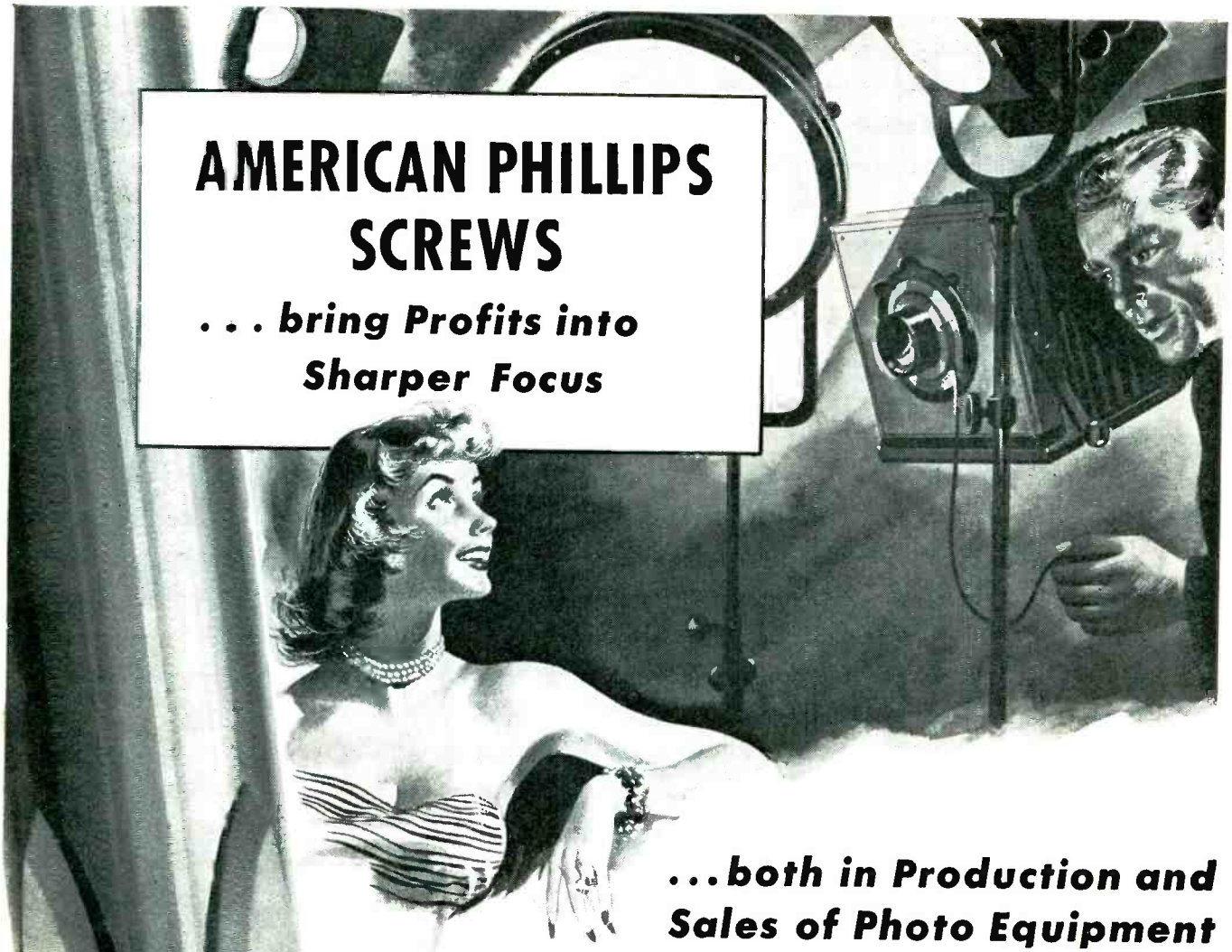
Tube No.	Spectral Response	Maximum Response Wave Length Angstroms	Sensitivity uA/uW	Minimum Luminous Detectivity Lumens
5819	S-9	4800	3100	2×10^{-11}
931A	S-4	4000	9300	1×10^{-11}
IP21	S-4	4000	37,000	1×10^{-12}
IP22	S-8	4200	370	1×10^{-10}
IP28	S-5	3400	5665	1×10^{-11} (1.5×10^{-14})*

*Ultraviolet detectivity in watts at 2537 angstroms

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

RADIO CORPORATION of AMERICA

ELECTRON TUBES **HARRISON, N.J.**



AMERICAN PHILLIPS SCREWS

. . . bring Profits into Sharper Focus

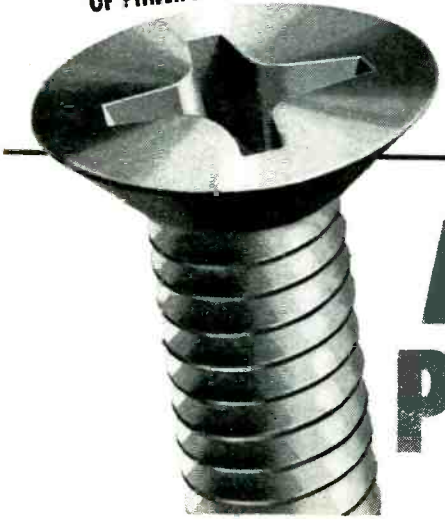
. . . both in Production and Sales of Photo Equipment

SHARP FOCUS ON COST-CONTROL: Lights, cameras, and other tools of the glamorizing trade are liberally studded with that modern quality-mark — the universal crossed recess of American Phillips Screws. Makers of this costly photographic equipment can't afford rejects or refinishing . . . and they can't afford slow, old-fashioned assembly with slotted screws. They find . . . as so many cost-conscious manufacturers in *all* lines have found . . . *that American Phillips Screws always cost least to use.* For time-savings alone run as high as 50%!

SHARP FOCUS ON SALES: American Phillips Screws have built up a huge and faithful public who know that the universal crossed recess means *quality throughout* . . . and that the product is put together to stay. These assurances, added to their definite decorative value, make American Phillips Screws a feature to be *profitably promoted* in any selling effort. Care to have us show *you* how? Just write:

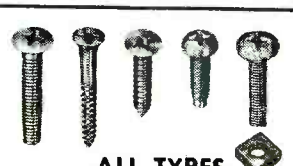
AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND

Chicago 11: 589 E. Illinois St. *Detroit 2:* 502 Stephenson Building



4-WINGED DRIVER CAN'T SLIP OUT OF PHILLIPS TAPERED RECESS

AMERICAN PHILLIPS *Screws*

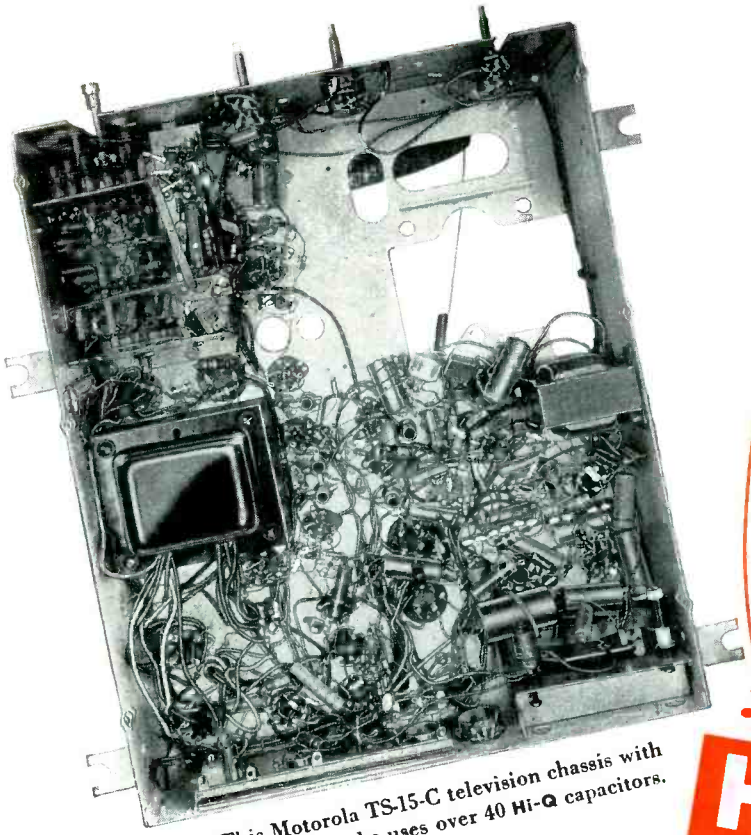


ALL TYPES

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

Electronic Manufacturers Specify Hi-Q COMPONENTS-

for Dependable Performance

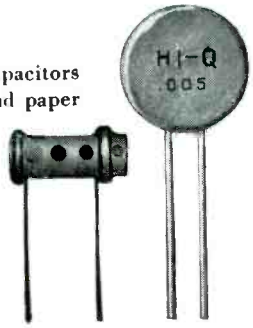


This Motorola TS-15-C television chassis with 12" picture tube uses over 40 Hi-Q capacitors.

● Motorola and practically all the rest of the industry's big names are among the more than 200 users of **Hi-Q** Components. They know from experience that they can depend upon **Hi-Q** for fine quality and strict adherance to ratings and tolerances . . . that **Hi-Q** contributes to the performance and long life of any electronic circuit.

Our engineers are always available to work with you in the development and production of capacitors, trimmers, resistors and choke coils to meet your specific needs. Write, wire or phone whenever you have a question concerning them.

Hi-Q general purpose ceramic capacitors have proven superior to mica and paper condensers of corresponding values. They are available in ratings of 5 mmf to 33,000 mmf. **Hi-Q** disc capacitors are high dielectric by-pass, blocking or coupling capacitors designed for use where their physical shape is more adaptable than tubular units.



HI-Q COMPONENTS BETTER 4 WAYS

PRECISION Tested step by step from raw material to finished product. Accuracy guaranteed to your specified tolerance.

UNIFORMITY Constancy of quality is maintained over entire production through continuous manufacturing controls.

DEPENDABILITY Interpret this factor in terms of your customers' satisfaction . . . Year after year of trouble-free performance. Our Hi-Q makes your product better.

MINIATURIZATION The smallest BIG VALUE components in the business make possible space saving factors which reduce your production costs . . . increase your profits.

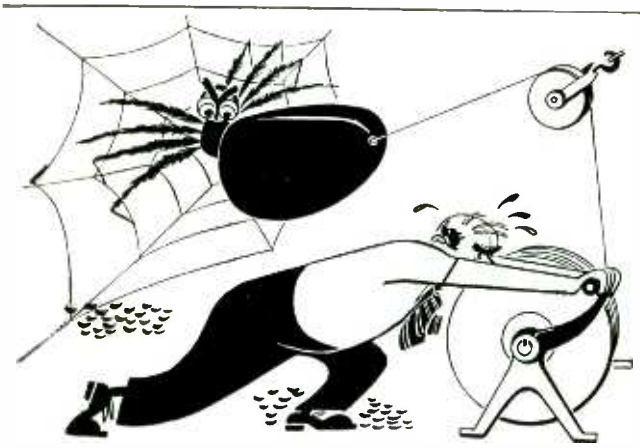
JOBBERS—ADDRESS: ROOM 1332
101 Park Ave., New York, N. Y.

Hi-Q Electrical Reactance Corp.
FRANKLINVILLE, N. Y.

Plants: Franklinville, N. Y.— Jessup, Pa.— Myrtle Beach, S. C.
Sales Offices: New York, Philadelphia, Detroit, Chicago, Los Angeles

What's your problem?

Fine Wire? Tungsten? Molybdenum?



Problem 1

The firm of AL LOYS & AL UMINUM were in urgent need of fine aluminum and aluminum alloy wire for a delicate production job. Fine Wire Headquarters assured them that it was no problem at all. The order was placed, the Fine Wire delivered, and it performed to the complete satisfaction of all concerned.

Problem 2

Mr. Hi Hott needed molybdenum sheets for forming into parts. High hot strength and good ductility were required. North American Philips supplied him with Elmet Molybdenum sheets that met his specifications exactly.

Problem 3

Mr. N. O. Emission, II, required plated grid wires. He solved his problem with a call to Fine Wire Headquarters. We shipped him some gold plated tungsten and molybdenum wires. Result: no secondary emission.

the answer

WHY not call Fine Wire Headquarters when you have a question about fine wire? We can't do the impossible, but we can do lots of things that can bring you the right fine wire for the job.

So—when you have a problem on Fine Wire, Tungsten or Molybdenum—wire, phone or write to North American Philips, makers of NORELCO Fine Wires, and ELMET Tungsten and Molybdenum products.

NORTH AMERICAN PHILIPS COMPANY, INC.

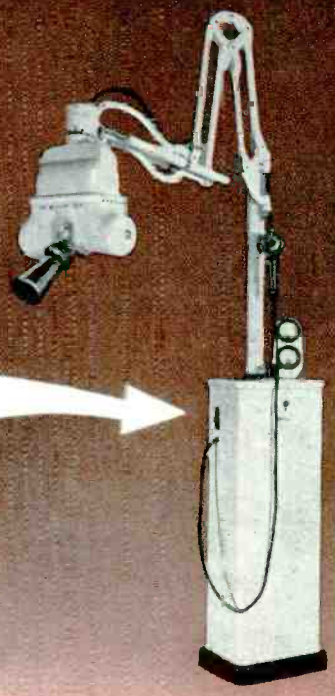
Factory and Main Sales Office: Lewiston, Maine

Export Representative • Philips Export Corporation • 100 East 42nd Street, New York 17, N. Y.

FINE EQUIPMENT DEMANDS COMPLETE PROTECTION—

Ritter X-RAY chose HEINEMANN MAGNETIC CIRCUIT BREAKERS

BECAUSE OF POSITIVE, QUICK ACTION



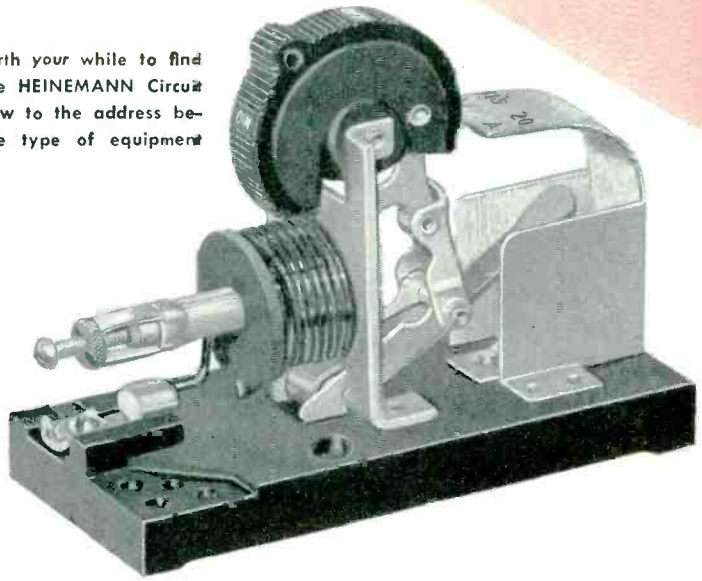
RITTER MODEL "B" SHOCKPROOF X-RAY UNIT. All electrical and high-tension terminals are concealed and insulated in the transformer and X-ray head. Instantaneous action of specially designed circuit breaker insures safety against uncontrolled overloads.

Ritter Co., Inc. of Rochester, in listing the points of superiority of their shockproof X-Ray Unit, has this to say:

"A circuit breaker of the quick-acting type is placed in the circuit to protect the tube and transformer. It is set at the factory and requires no adjusting. Therefore it is impossible to overtax or strain the vital elements electrically."

By "quick-acting" type, Ritter means the HEINEMANN *Magnetic* Circuit Breaker which, because it *is* magnetic, interrupts the current INSTANTANEOUSLY if a short occurs. NO HEAT is generated—therefore the breaker will carry 100% of rated capacity.

Wouldn't it be worth your while to find out more about the HEINEMANN Circuit Breakers? Write now to the address below, and state the type of equipment you make.



Special Purpose Type Fully Magnetic **HEINEMANN** *Circuit Breaker*

EST. HECO 1888

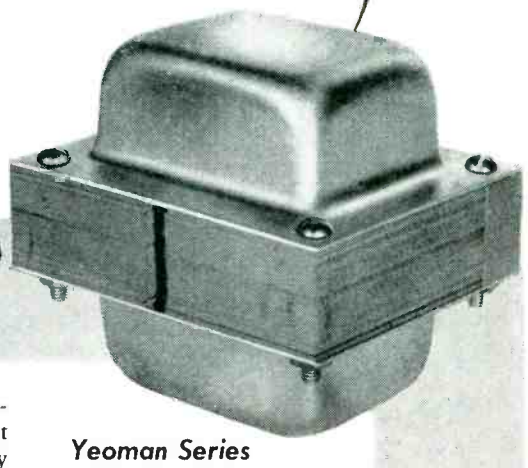
HEINEMANN ELECTRIC COMPANY

97 PLUM STREET **TRENTON, NEW JERSEY**

New *Yeoman* TRANSFORMER

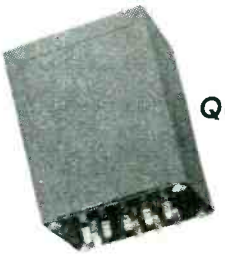
gives you **ADC** quality

at Low Cost



Yeoman Series

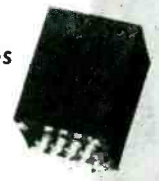
Designed to meet the needs of engineers, experimenters and amateurs who demand high quality at low cost, the new ADC Yeoman line provides many of the well-known performance standards of the Quality Plus and Industrial series, also several items not previously offered. This has been accomplished primarily by improved production engineering methods, standardization of parts and a simplified type of construction.



Quality Plus Series

The **ADC** Yeoman line includes:

- Output Transformers with carefully balanced windings offering unusually low distortion over a wide frequency range.
- Interstage Transformers with balanced humbucking features providing equal push-pull grid voltages at high audio frequencies for inverse feedback circuits.
- Power Transformers limited to 55°C. temperature rise and especially quiet in operation.
- Replacement Units for Audio and TV circuits, miniatures, filament transformers, reactors, and many others.



Industrial Series

ADC *invites your critical appraisal of this new Yeoman line.*

- Send for the new **ADC** catalog which you will find convenient to use in selecting almost any transformer you may need.

Special requirements not covered by the catalog will receive prompt attention.

Audio Develops the Finest **ADC**

Audio **DEVELOPMENT CO.**

2847 13th Avenue South, Minneapolis 7, Minn.

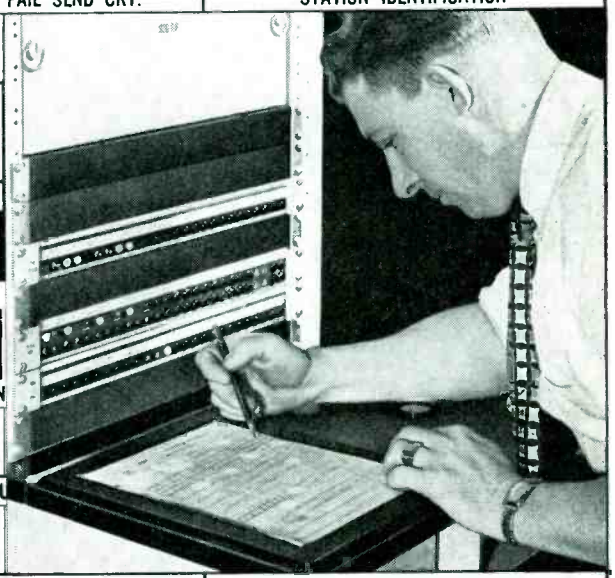
He can see a thousand miles

ALARM INDICATOR RECORD

TIME RECEIVED	A P	BY	TROUBLE FOUND	TIME	A P	BY
SENDING OFFICE			DATE OK			
RECEIVING OFFICE						

	SYNCHRONIZATION - START					CA FAIL SEND CKT.	STATION IDENTIFICATION
1	ON	ON	OFF	ON	ON	CHAN. 1 SECT	
	SYNCHRONIZATION - STOP						
2	ON	ON	OFF	ON	ON	FUEL GAS LOW	
	FUSES		24-VOLTS		ABS		
3	DISCH.	DIST.	H-L VOLT	REG. FAIL	24V 130V	48V	
	POWER CONTROL PANEL FAILURE						
4	201-202W	203-204W	205-206W	207-208W	201-202E	203-204E	
	ALT. CONT. BAY - NO VOLT. OUT.				NO VOLT. - TRAN		
5	201 202	203 204	205 206	207 208	201 202	203 204	
				RECTIFIER - INVERTER FAIL			
6	RECT. FAIL 24/130V	48 V H-L VOLT		NO. 1	NO. 2	NO. 3	

	64 KC PILOT ALARM AT NON-SW. MAIN								3096 (WKG. LINE) PILOT AT SW. MAIN			
7	201	202	203	204	205	206	207	208	201 203	205 207	202 204	206 208
	2064 KC PILOT ALARM AT NON-SW. MAIN								3096 (SP. LINE) PILOT AT SW. MAIN			
8	201	202	203	204	205	206	207	208	201 203	205 207	202 204	206 208
	3096 KC PILOT ALARM AT NON-SW. MAIN								SP. LINE FAIL AT SW. MAIN			
9	201	202	203	204	205	206	207	208	201 203	205 207	202 204	206 208
	TOT. LINE FAIL AT SW. MAIN				AUTO. SWITCH AT SW. MAIN				AUTO. SW. LOCKED AT SW. MAIN			
10	201 203	205 207	202 204	206 208	201 203	205 207	202 204	206 208	201 203	205 207	202 204	206 208



11 12 13 14

CARRYING hundreds of telephone calls, coaxial cable runs through many lonely miles. Far from towns and people, master amplifying stations stand guard with a new automatic alarm system developed by Bell Telephone Laboratories.

At a city terminal, the man on duty makes a check by laying a transparent log sheet over a glass window, and dialing a master station hundreds of miles away. At once the station begins to give an account of itself, lighting lamps under the log sheet to report any abnormal operating condition before it becomes an emergency.

But when something happens that threatens serious trouble, the apparatus acts at once — maybe by switching in a spare coaxial — and calls a distant test board by ringing a bell. Sometimes he can take further steps by remote control; if not, he knows exactly how to brief the nearest repair crew.

With this new alarm system, maintenance men need not be stationed at isolated points, just waiting for something to happen. Instead, they live in their home communities. This makes for better work . . . and better telephone service.

A B C D E F G H J K L M

BELL TELEPHONE LABORATORIES EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE.

C-D CAPACITORS MAY *LOOK* LIKE OTHERS, BUT...

SUPERFICIALLY, they may LOOK alike. But men like yourself don't judge performance by looks. You want to know how well they're *made*. And, equally important, *who* makes them.

The Cornell-Dubilier name on a capacitor does *more* than identify the product's maker. It identifies the capacitor as a product of 40 years' *specialized* capacitor experience, and a product which is *world famous*.

You are safe in joining the leading engineers who specify C-D.

C-D PAPER CAPACITORS

Typical of the line of C-D capacitors is the complete listing of capacitors made in accordance with joint Army and Navy specification JAN-C-25. These are completely covered in Cornell-Dubilier catalog #400 which is now available.

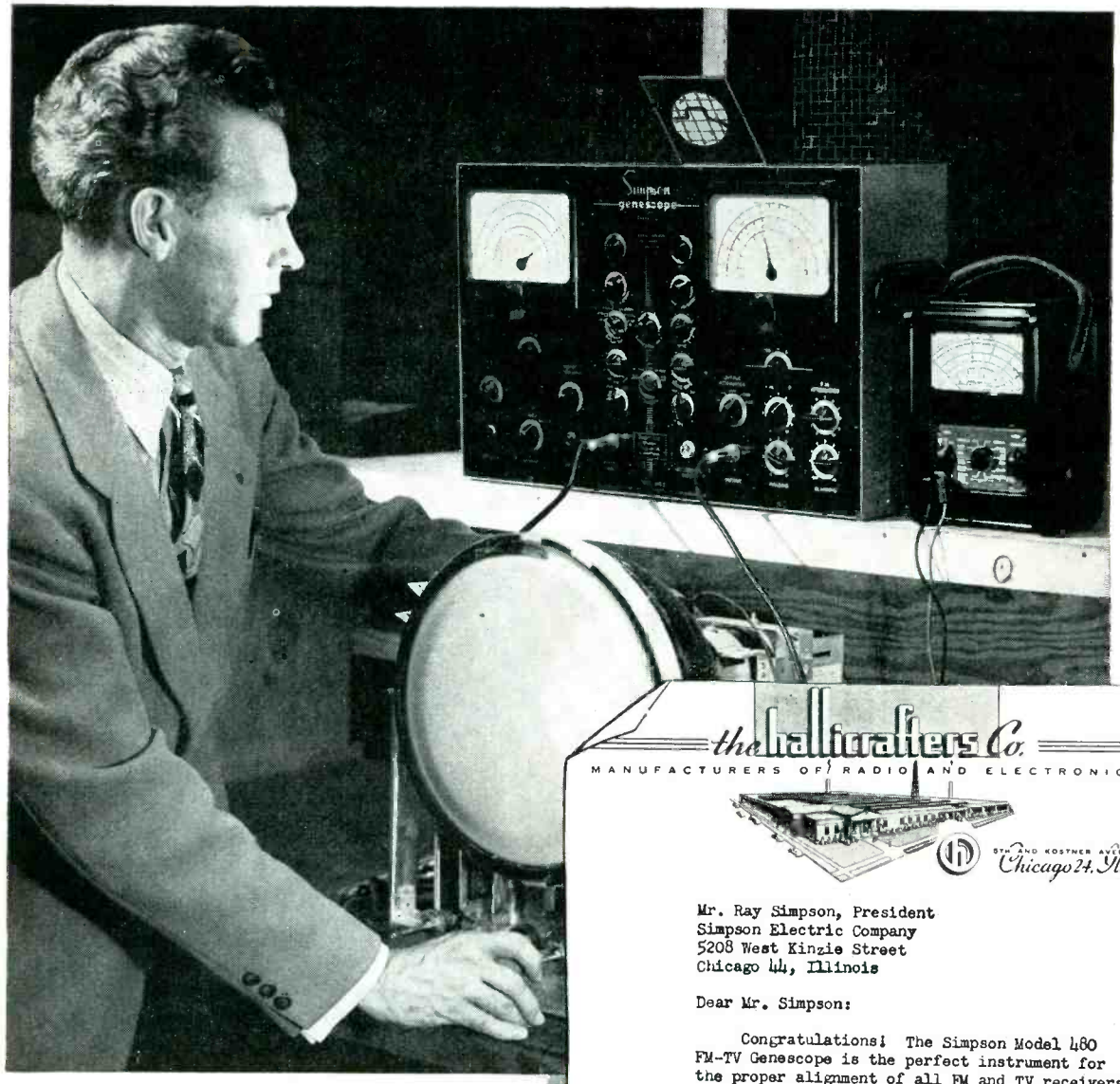
Cornell-Dubilier engineers will welcome the opportunity of assisting you with your capacitor problems.

Cornell-Dubilier Electric Corporation, Dept. KI-9, South Plainfield, New Jersey. Other plants in New Bedford, Brookline and Worcester, Mass.; Providence, Rhode Island; Indianapolis, Ind., and subsidiary, The Radiart Corp., Cleveland, Ohio.

1910 1949
Reg. U. S. Pat. Off.

CORNELL-DUBILIER
CONSISTENTLY DEPENDABLE.
★ CAPACITORS
★ VIBRATORS
★ ANTENNAS
★ CONVERTERS

C-D Best by Field Test!



the hallicrafters Co.

MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT

5TH AND KOSTNER AVENUES Chicago 24, Ill.

Mr. Ray Simpson, President
Simpson Electric Company
5208 West Kinzie Street
Chicago 44, Illinois

Dear Mr. Simpson:

Congratulations! The Simpson Model 480 FM-TV Genescope is the perfect instrument for the proper alignment of all FM and TV receivers.

In addition to providing all necessary signal sources, the new Simpson Genescope includes a hi

says EDWARD CROXEN

General Service Manager of Hallicrafters

In addition to providing all necessary signal sources, the new Simpson Genescope includes a high sensitivity oscilloscope of unique advanced design, complete in every detail. Sensitivity 25 millivolts per inch. Wide band response to 3 megacycles or more. Equipped with a high frequency crystal probe for signal tracing. AM and FM oscillator sections provided with large, easy to read dials with 20-1 vernier control and 1000 division logging scale. *Revolutionary, Ingenious, Exclusive* output termination provides for various receiver impedances, either direct or through an isolating condenser.

Step attenuator for control of output.

Size: 22"x14"x7½". Weight 45 lbs. Shipping Weight 54 lbs.

DEALER'S NET PRICE complete with Test Leads and Operator's Manual $375.00

CHECK THESE RANGES AND YOU WILL SEE HOW MUCH THE SIMPSON GENESCOPE CAN DO FOR YOU

RANGES FREQUENCY MODULATED OSCILLATOR	AMPLITUDE MODULATED OSCILLATOR
Band A—2-120 megacycles	Band A—3.2-16 megacycles
Band B—140-260 megacycles	Band B—15-75 megacycles
Sweep width variable from zero to 15 megacycles	Band C—75-250 megacycles
Sweep rate 60 cycles per second	30% modulation at 400 cycles or unmodulated
Specially designed frequency sweep motor	Continuously variable attenuator
Continuously variable attenuator	Visual method of beat frequency indication
Crystal calibrator—5 megacycles ± .05%	
Audio Oscillator 400 cycles	

Modern FM and TV development and servicing requires the use of test equipment made to exacting standards. With this in mind Simpson offers you the Genescope with the assurance that everything possible has been done to make it the most accurate, flexible and convenient instrument available. The Genescope will render many years of uninterrupted service and always produce accurate results.

HERE'S THE SIMPSON—MODEL 479 TV-FM SIGNAL GENERATOR

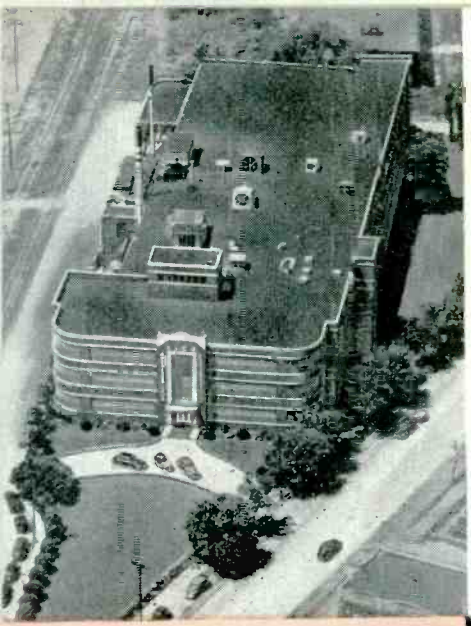
Exactly the same circuits, ranges and functions as the Model 480, described above, with the exception of the oscilloscope.

Size 17"x14"x7½". Weight 34 lbs. Shipping Weight 40 lbs.

DEALER'S NET PRICE with Test Leads and Operator's Manual $245.00

Simpson
INSTRUMENTS THAT STAY ACCURATE

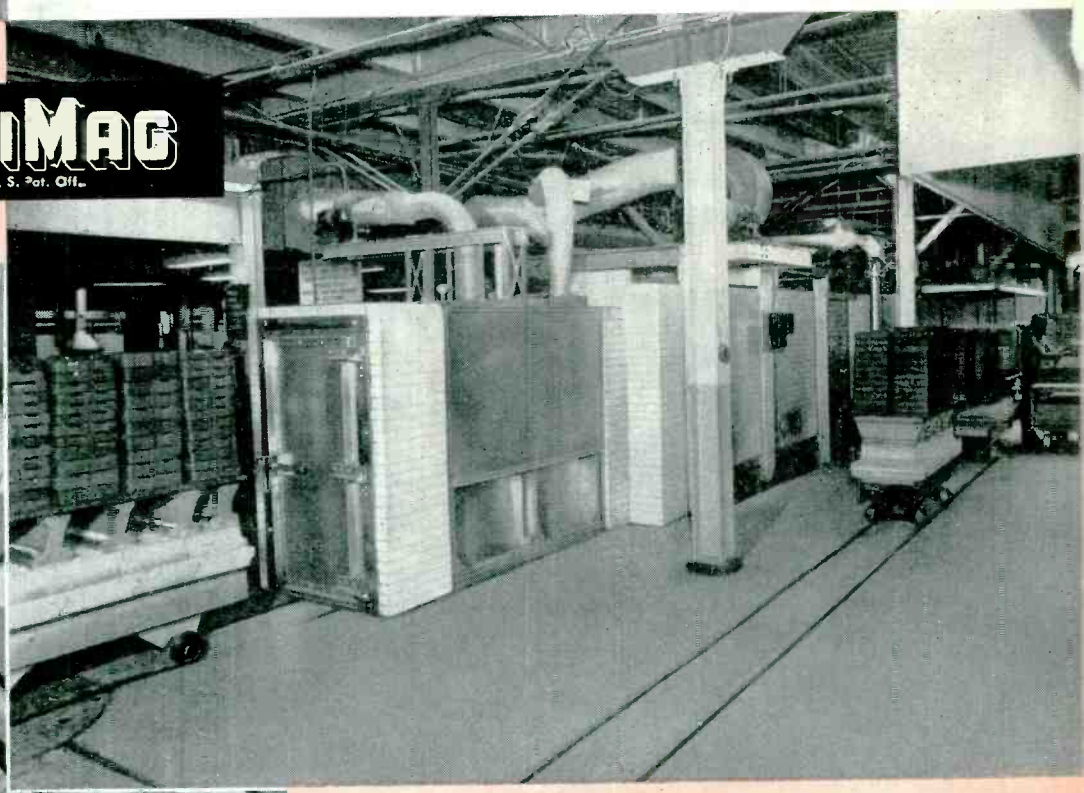
SIMPSON ELECTRIC COMPANY
5200-5218 WEST KINZIE STREET • CHICAGO 44, ILLINOIS
In Canada: Bach-Simpson, Ltd., London, Ont.

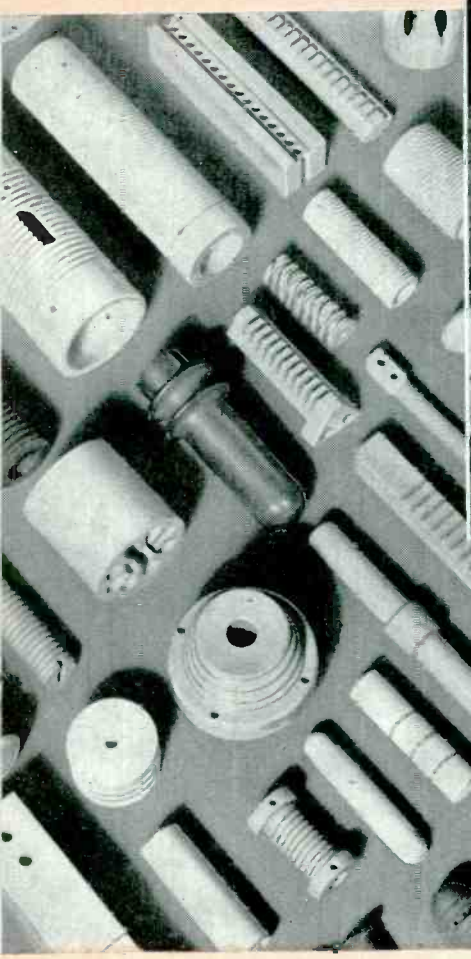


ample kiln capacity

safeguards AlSiMag quality and helps keep deliveries on schedule

AlSiMag
Reg. U. S. Pat. Off.





Side view of one of AlSiMag's tunnel kilns. All kilns, both circular and tunnel, are handled from one centralized control panel.

• Completely automatic controls hold firing temperatures within ± 2° C. in AlSiMag's kilns. As an extra safeguard, highly trained and skilled kiln operators are on duty every minute of the day and night. Recording instruments plus operator's hourly checks and records assure that all AlSiMag material is accurately fired.

AMERICAN LAVA CORPORATION

48TH YEAR OF CERAMIC LEADERSHIP

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
8 Brattle St., Cambridge, Mass., Kirkland 7-4498 • ST. LOUIS, 1123 Washington Ave., Garfield 4959

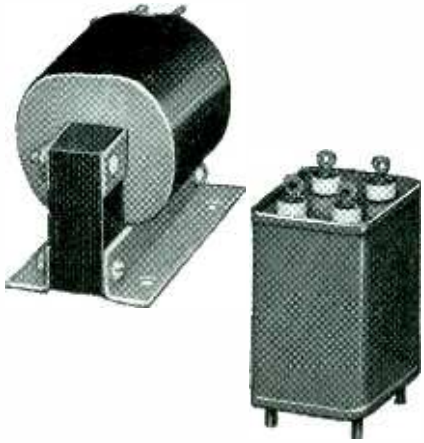
Digest

TIMELY HIGHLIGHTS ON G-E COMPONENTS

leaving only the upright scale divisions. New tapered pointer helps eye focus only on the reading. All but essential markings are masked by attractive case.

Internal mechanism is designed for extra reliability. High coercive Alnico magnet assures proper alignment, even under severe operating conditions. Large air gap reduces danger of stickiness caused by foreign particles. A variety of types and ratings in round or square cases are available for use in radio, television or testing equipment. Get complete details from Bulletin GEC-368.

DESIGNED FOR YOUR REQUIREMENTS



General Electric pulse transformers for radar and associated applications are designed to perform dependably in extremes of operating conditions. Many ratings in current production are of a special nature—designed to keep pace with rapidly changing requirements of the industry. However, for certain applications, they can be built to the specifications of electronic equipment manufacturers. Types available include interstage transformers, blocking oscillator transformers, charging chokes, current transformers, and pulse thyratron grid transformers. For a listing of available designs and ratings, send for bulletin GEC-481.

THEY'RE SMALL BUT THEY CAN TAKE IT

Cast-glass bushings with sealed-in nickel-steel hardware can be readily welded, soldered, or brazed directly to the apparatus, thus eliminating gaskets and providing a better seal. Small, compact structure often makes possible reduction of over-all size and weight of equipment. Practically unaffected by weathering, micro-organisms, and thermal shock, they're particularly well suited for use in electronic equipment and in installations where operating conditions are severe. Available in ratings up to 8.6 kv and for currents to 1200 amperes. Check Bul. GEA-5093.

RELY ON THESE FOR STABILITY

Fixed paper-dielectric capacitors are manufactured in accordance with joint Army-Navy specification JAN-C-25. They're constructed with thin Kraft paper, oil or Pyranol* impregnated, for stable characteristics and high dielectric strength. Plates are aluminum foil; special bushing construction provides for short internal leads, prevents possible grounds and short circuits. Cases have permanent hermetic seal.

Case style CP 63 (shown above) is rated 0.1–0.1 muf and 1000 volts. Other ratings range from .01 muf to 15 muf and from 100 to 12,500 volts. Write for detailed description and operating data in bulletin GEA-4357A.
*Reg. U.S. Pat. Off.

DOES A BIG JOB IN CLOSE QUARTERS

G.E.'s midget soldering iron can do a big job with only one-fourth the wattage usually used. This handy 6-volt, 25-watt iron is only 8 inches long with ⅛" or ¼" tips and weighs but 1¾ ounces. Designed for close-quarter, pinpoint precision soldering, the "midget" offers you all these advantages: low cost soldering; "finger-tip" operation; quick, continuous heat; easy renewal; long life; low maintenance. A real aid in designing radios, instruments, meters, electric appliances, and many other products requiring precision soldering. Available from stock. Check bulletin GEA-4519.

General Electric Company, Section F667-2
Apparatus Department, Schenectady, N. Y.

Please send me the following bulletins:

- ☐ GEA-4357A D-C Capacitors
- ☐ GEA-4519 Midget Soldering Iron
- ☐ GEA-5093 Glass Bushings
- ☐ GEA-5258 Selenium Stacks
- ☐ GEC-368 Panel Instruments
- ☐ GEC-481 Pulse Transformers

NAME .....

COMPANY .....

ADDRESS .....

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

Minimize Control Size!

REDUCE COST!

WITH THESE NEW ALLIED RELAYS

The Allied PO and POY relays, replacing the DO and DOY relays, save space, save cost. These advantages will have special appeal for engineers in electronic, aircraft and other industries requiring medium power, all-purpose relays.

POY RELAY

A semi-sensitive, dual coil relay for operation in vacuum tube or other limited power circuits. Same contact rating and arrangement as PO.

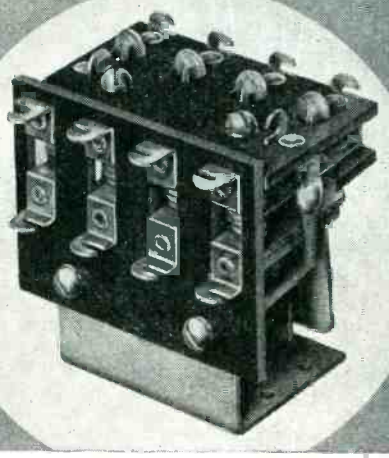
DIMENSIONS:
Same as PO.

COIL RATING:
Up to 110 volts D.C. at 600 milliwatts. Not supplied for A.C.

MOUNTINGS:
Standard, #6-32 tapped holes. Not supplied with stop nuts.

The PO & POY relays are adaptations of the well-known general purpose Allied BO relay, and like all other Allied relays may be obtained hermetically sealed.

Every part in these precision-built relays is designed to deliver thoroughly dependable service with extra long life. For complete information and operating characteristics of the new PO and POY and other precision-built Allied Relays, write us for latest Allied catalog.



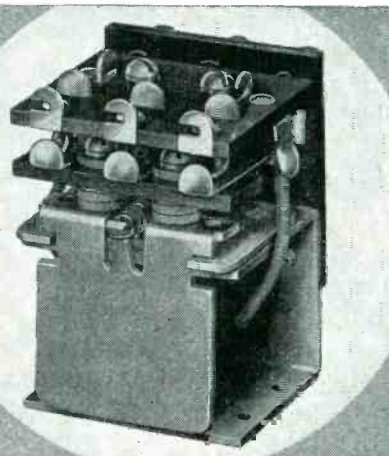
PO RELAY

This relay, shown above in the 4-pole model and shown below in the 5-pole model, is supplied in 2-, 3- and 4-pole normally-closed, normally-open or double-throw contacts. Its standard silver contacts have carrying capacity of 15 amperes at 24 volts D.C. or 110-volts A.C. non-inductive.

COIL RATING: A.C. 10.5 volt-amperes nominal or 17.5 volt-amperes maximum at 25 to 60 cycles and up to 220 volts.

D.C. Up to 120 volts at 1 watt minimum or 8 watts maximum.

MOUNTING. Standard #6-32 tapped holes. Also supplied with #6-32 stop nuts.



ALLIED CONTROL COMPANY, INC.

2 EAST END AVENUE, NEW YORK 21, NEW YORK

Collins 51J-1 0.5 to 30.5 mc radio receiver.
Normally furnished for rack mounting.

An ideal radio instrument for laboratory frequency measuring

The new Collins 51J-1 communications receiver is a double conversion superheterodyne of such extreme accuracy and stability that it is admirably suited for use in the laboratory as a dependable secondary frequency standard.

The 51J-1 is permeability tuned throughout. It is continuously tunable over a frequency range of 0.5 to 30.5 megacycles. This range is divided into 30 bands of 1,000 kc each. The tuning mechanism is based on a decade system in which the megacycle figure is set by means of a band switch. The 100 kc figure is indicated on the slide rule dial and the kilocycle figure on the circular dial. Under normal operating conditions and with a 10-minute warmup, the dial reading is within 2 kc of the receiver's exact frequency throughout the frequency range. Dial accuracy is improved by means of a crystal calibrator and dial corrector which are included.

Frequency over the temperature range −20°C to +60°C does not vary from the frequency at 20°C by more than 30 parts per million plus 1 kc; thus the frequency stability is within 2 kc at the highest operating frequency. Frequency does not vary more than 100 cycles from the frequency at 115 line volts when this voltage is varied through the range 105 to 125. Changes in atmospheric pressure from sea level to 10,000 feet altitude, relative humidity from 10 to 90%, and mild shock, do not vary the frequency of the 51J-1 by more than 500 cps.

This new time and labor saving instrument is also an excellent all around communications receiver of advanced design, with outstanding operating characteristics. We will be glad to give you more complete information on request.

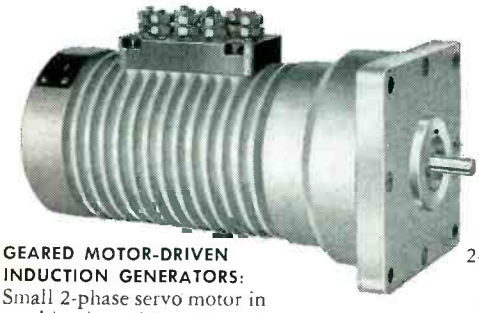
IN RADIO COMMUNICATIONS, IT'S . . .

COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 W. 42nd St.	2700 West Olive Ave.	M & W Tower	Talbot Bldg.	Fountain City Bank Bldg.
NEW YORK 18	BURBANK	DALLAS 1	DAYTON 2	KNOXVILLE

extreme precision, instant response in remote indication and control

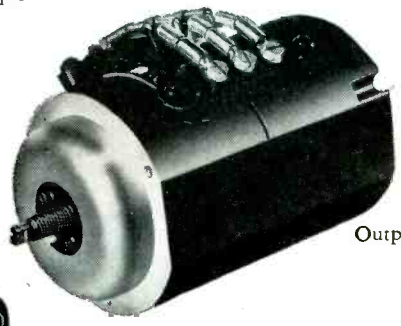


GEARED MOTOR-DRIVEN INDUCTION GENERATORS: Small 2-phase servo motor in combination with a compact gear-reducer and a low residual induction generator. Motor has high torque/inertia ratio and develops maximum torque at stall. Gear-reducer permits a maximum torque output of 25 oz. in. and is available in ratios from 5:1 to 75,000:1.

INDUCTION MOTORS: miniature 2-phase motors of the squirrel cage type. Designed specifically to provide fast response to applied control signals and maximum torque at zero r.p.m. Unit shown weighs 6.1 oz. and has stalled torque of 2.5 oz. in.

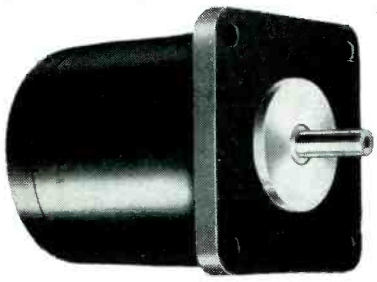
CIRCUTROL UNITS: rotary electromagnetic devices for use as control components in electronic circuits and related equipment. Single and polyphase rotor and stator windings are available in several frame sizes. Deviation from sine accuracy of resolver shown is ±0.3% of maximum output.

SYNCHRONOUS MOTORS: for instrumentation and other applications where variable loads must be kept in exact synchronism with a constant or variable frequency source. Synchronous power output up to 1/100 H.P.



SYNCHRONOUS DIFFERENTIAL UNITS: electro-mechanical error detectors with mechanical output for use in position or speed control servo systems. These torque-producing half-speed synchroscopes are composed of two variable frequency synchronous motors and a smoothly operating system of differential gearing.

Output: Speed $= \frac{N_1 - N_2}{2}$°: Torque up to 1.0 oz. in.



TELETORQUE UNITS: precision synchros for transmitting angular movements to remote points. Accurate within ±1°. May be actuated by mechanisms that produce only 4 gm. cm. (.056 oz. in.) of torque.

ADDITIONAL SPECIAL PURPOSE AC UNITS BY KOLLSMAN

With the recent addition of new units to Kollsman's already widely diversified line, the electronics engineer will find the solution to an even greater variety of instrumentation and control problems. These lightweight, compact units offer the high degree of accuracy and positive action essential in dealing with exact quantities. They are the product of Kollsman's long experience in precision instrumentation and aircraft control — and of considerable work done in this field by Kollsman for special naval and military application. Most units are available at various voltages and frequencies. 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

Here's the *Solution* to HIGH TEMPERATURE INSULATING PROBLEMS!

clue #1

Close woven fibrous glass yarn immune to high heat, resistant to abrasion, flexible, non-hygroscopic.

clue #2

Super-impregnated with the superior insulating varnish for minimum porosity, high dielectric strength, full flexibility.

—it's

TURBO FIBROUS GLASS TUBING

AVAILABLE IN FOUR GRADES

SINGLE SATURATED 1200 V. (ASTM)	TRIPLE STRENGTH 3500 V. (ASTM)
DOUBLE DIPPED 2000 V. (ASTM)	MAGNETO GRADE 7000 V. (ASTM)

SIZES AND SPECIFICATIONS

SIZES—28 DIAMETERS FROM .026 TO .625" I.D.

LENGTHS—ALL DIAMETERS AVAILABLE IN STANDARD BUNDLES OF 42" LENGTHS. SIZES 13 TO 24 OPTIONALLY AVAILABLE IN CONTINUOUS COILS ON SPOOLS.

COLORS—SIZES TO .085" IN BLACK, YELLOW, GREEN, BROWN, BLUE. LARGER SIZES BLACK AND YELLOW ONLY EXCEPT ON SPECIAL ORDER.

TURBO Fibrous Glass Tubing is fabricated of close woven fibrous glass yarn and thoroughly impregnated with a special TURBO insulating varnish. The natural insulating property of glass is thus reinforced by the varnish coating to yield a nearly ideal dielectric that is impervious to moisture and other deteriorating influences. This tubing offers unusual advantage where severe conditions of heat limit the use of ordinary insulations or where maximum dielectric strength must be effected with minimum bulk. Complete mechanical and electrical specifications will be furnished promptly on request.

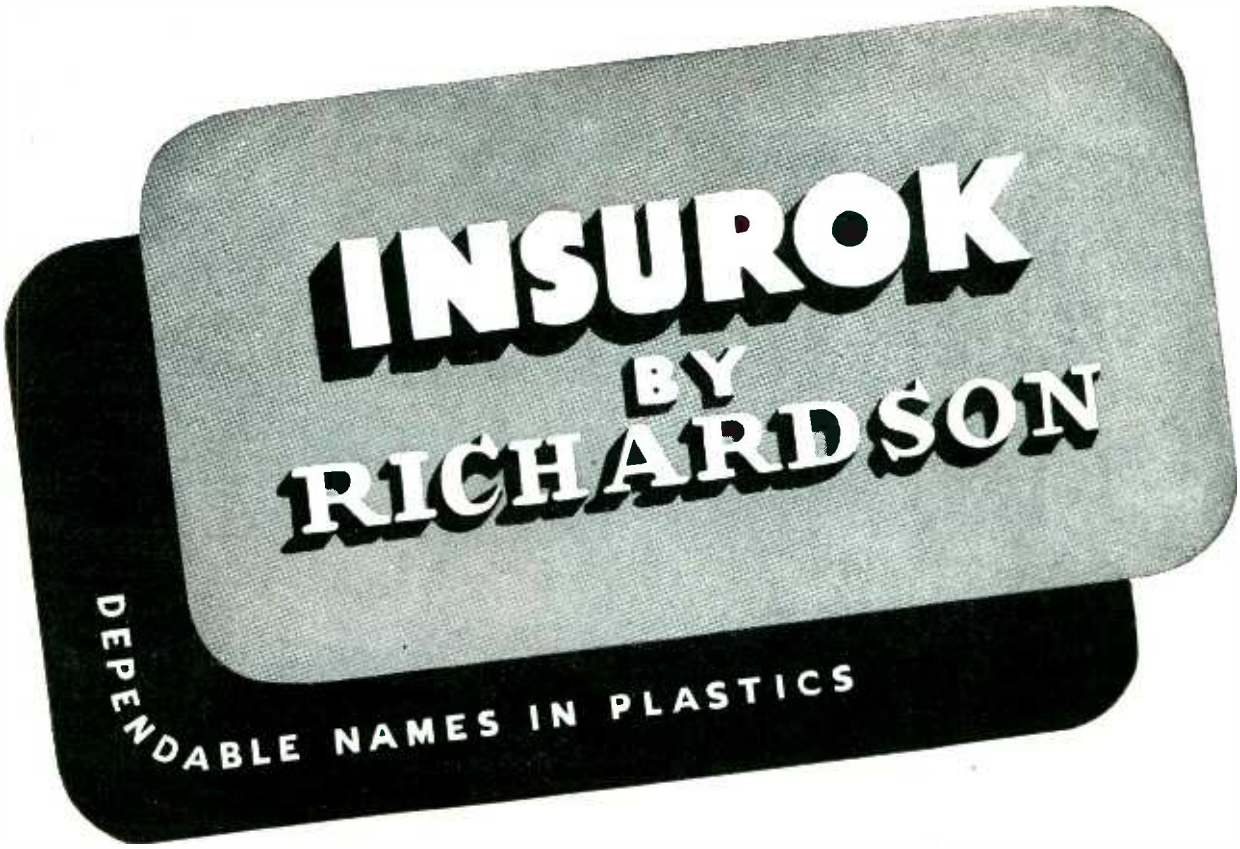
WRITE FOR FREE SPECIMEN BOARD

The TURBO Specimen Board contains samples of all the popular types and sizes of TURBO tubing. Simply address request on your company letterhead and it will be forwarded promptly without obligation.

WILLIAM BRAND & COMPANY

276 FOURTH AVE., NEW YORK 10, N. Y. • 325 W. HURON ST., CHICAGO 10, ILL.

Manufacturers of **TURBO FLEXIBLE VARNISHED SLEEVING, FIBROUS GLASS TUBING, TURBOTHERM REL-16A INSULATED WIRE, MICA AND MICA PRODUCTS, VARNISHED CAMBRICS, INSULATING PAPER & TAPES, WIRE MARKERS**



WORTHWHILE EXTRAS

We've learned over the years that "extra" precautions pay big dividends for our customers in the planning and production of parts from Laminated and Molded INSUROK. For example:

Richardson suggestions have led many customers to alter their original designs and/or materials specifications and thus obtain plastic parts better suited to the job at hand, at lower costs.

And Richardson production experience has, in many cases, pointed the way to substantial savings and advantages for customers.

These and other Richardson "extras" are not specified on customers' purchase orders, but you get all of them . . . every time. Why? Simply because we've found that these extras make friends for us, and hold friends over the years.

If you now use, or contemplate using plastics, we sincerely believe you want and need considerate and experienced handling of your requirements. And we invite you to look, with confidence, to The Richardson Company for your needs in plastics.

Why not send us specifications today? Learn without obligation how Richardson would handle your next need for plastics.

INSUROK is a registered trade-mark of The Richardson Company

The RICHARDSON COMPANY

GENERAL OFFICES: LOCKLAND, OHIO FOUNDED IN 1858

Sales Headquarters: MELROSE PARK, ILLINOIS

CLEVELAND • DETROIT • INDIANAPOLIS • MILWAUKEE • NEW BRUNSWICK, (N. J.) • NEW YORK • PHILADELPHIA • ROCHESTER • ST. LOUIS

Now

A 100% INCREASE IN THE GL-502-A's RATED CURRENT CAPACITY AT REDUCED VOLTAGES

0.2 amp average with 180 v on the anode!

"THIS COMPACT METAL THYRATRON WILL REPLACE GLASS TYPE 2050 IN YOUR CIRCUIT; YET IT'S ONLY HALF THE SIZE . . . AND SELF-SHIELDING!"

CONTINUOUS G-E improvement in design and production makes it possible to rate the GL-502-A thyratron, for low-voltage operation, at twice its former average current capacity, or .2 amp maximum.

Here is performance sure to be welcomed by the electronic designer. No change in size is involved; the GL-502-A (only 2 1/16 inches high when seated) continues to take up minimum space. Also, the tube's self-shielding characteristic, a feature of metal-envelope types, remains an important aid in simplifying circuit and panel design.

Much electronic control equipment is being built to operate at voltages at or near low power-supply potentials. The new, higher-rated current capacity of the GL-502-A under these conditions, gives the designer "more tube to work with." Glass Type 2050—twice the size of the GL-502-A—can be replaced by the smaller thyratron with no loss in tube performance, yet with a pronounced saving in space occupied.

Investigate this great little metal thyratron *now* . . . while your new control circuit is in the planning stage! You'll save in space, gain in economy and efficiency. Get the complete story from your nearby G-E electronics office. Or wire or write *Electronics Department, General Electric Co., Schenectady 5, New York.*

CHARACTERISTICS, TYPE GL-502-A

Max over-all height	2⅝ inches
Max over-all diameter	1 5/16 inches
No. of electrodes	4
Cathode voltage	6.3 v
current, approx	0.6 amp
heating time, typical	10 seconds min
Voltage drop, typical	8 v
Avg anode to control-grid capacitance	0.2 mmfd
Ambient temperature limits	−55 to +90 c

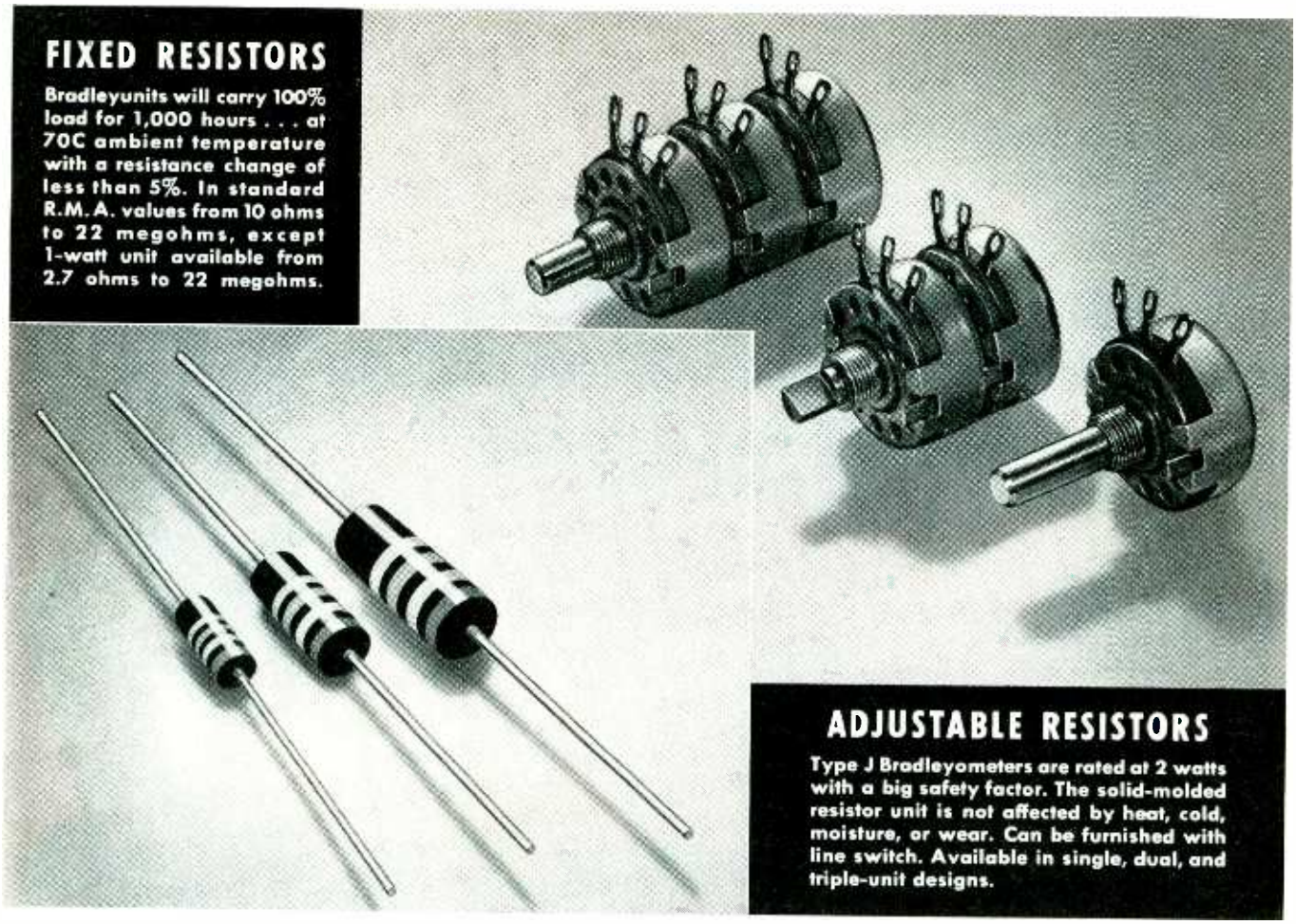
MAXIMUM RATINGS

	High-voltage operation	Low-voltage operation
Peak anode voltage, inverse	1,300 v	360 v
forward	650 v	180 v
Anode current, instantaneous	1 amp	1 amp
average	0.1 amp	0.2 amp
Time of averaging current	30 seconds	30 seconds

GENERAL ELECTRIC

180-H29

FIRST AND GREATEST NAME IN ELECTRONICS



For circuits that require resistors of unsurpassed quality ...Specify Allen-Bradley

BRADLEYUNITS are available in ½, 1, and 2-watt ratings. They have high mechanical strength and permanent electrical characteristics.

The leads are differentially tempered to prevent sharp bends near the resistor. The leads are easily formed to fit any spot.

All Bradleyunits are packed in convenient honeycomb cartons that keep the leads straight. Send for Allen-Bradley resistor chart.

TYPE J BRADLEYOMETERS have solid-molded resistor elements. They are thick rings, molded to provide any resistance-rotation curve. After molding, heat, cold, moisture, and hard use do not affect the resistor.

The resistor is molded as a single unit with insulation, terminals, face plate, and treaded bushing in ONE piece. There are no rivets, nor welded or soldered connections.

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

A-B Quality

ALLEN-BRADLEY

FIXED & ADJUSTABLE RADIO RESISTORS

Sold exclusively to manufacturers QUALITY of radio and electronic equipment

NEW -*hp*- ACCESSORIES INCREASE SCOPE OF YOUR -*hp*- VOLTMETERS

Extend the usefulness of your present -*hp*- voltmeters with these new precision-built -*hp*- accessories. Save time and work. Simplify tedious jobs. Make fast, accurate measurements far beyond the original range of your instruments.

-*hp*- 452A Capacitive Voltage Divider

For -*hp*- 400A, 400C and 410A Voltmeters. Safely measure power, supersonic and dielectric heating voltages to 25 kv. Accuracy ± 3%. Frequency range, 25 cps to 20 mc. Division ratio 1,000:1. Input capacity 15 μμf. Price $75.00.

-*hp*- 453A Capacitive Voltage Divider

For -*hp*- 410A Voltmeter. Increases range so transmitter voltages can be measured quickly, easily. Accuracy ± 1%. Division ratio, 100:1. Input capacity approx. 2 μμf. Max. voltage 2,000 v. For frequencies 10 kc and above. Price $20.00.

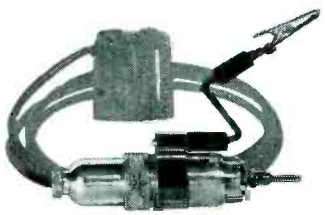
-*hp*- 470A—470F Shunt Resistors

For -*hp*- 400A or 400C Voltmeters, to measure currents as small as 1 μa full scale. Accuracy, ± 1% to 100 kc, ± 5% to 2 mc. Max. power dissipation 1 watt.

Instrument	*Value*	*Price*
-*hp*- 470A	0.1Ω	$7.50
-*hp*- 470B	1.0Ω	6.00
-*hp*- 470C	10.0Ω	6.00
-*hp*- 470D	100Ω	6.00
-*hp*- 470E	600Ω	6.00
-*hp*- 470F	1,000Ω	6.00

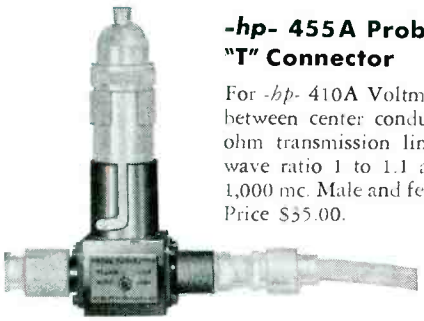
-*hp*- 454A Capacitive Voltage Divider

For -*hp*- 400C Voltmeters. Safely measure power, audio, supersonic and rf voltages. Accuracy ± 3%. Division ratio, 100:1. Input impedance 50 megohms, resistive shunted with 2.75 μμf capacity. Max. voltage, 1,500 v. Price $20.00.



-*hp*- 459A DC Resistive Voltage Multiplier

For -*hp*- 410A Voltmeter. Gives maximum safety and convenience for measuring high voltages as in television receivers, etc. Accuracy ± 5%. Multiplication ratio 100:1. Input impedance 12,000 megohms. Max. voltage 30 kv. Max. current drain 2.5 microamperes. Price $20.00.



-*hp*- 455A Probe Coaxial "T" Connector

For -*hp*- 410A Voltmeter. Measures voltages between center conductor and sheath of 50 ohm transmission line. Maximum standing wave ratio 1 to 1.1 at 500 mc; 1 to 1.2 at 1,000 mc. Male and female Type "N" fittings. Price $55.00.

-*hp*- 458A Probe Coaxial "N" Connector

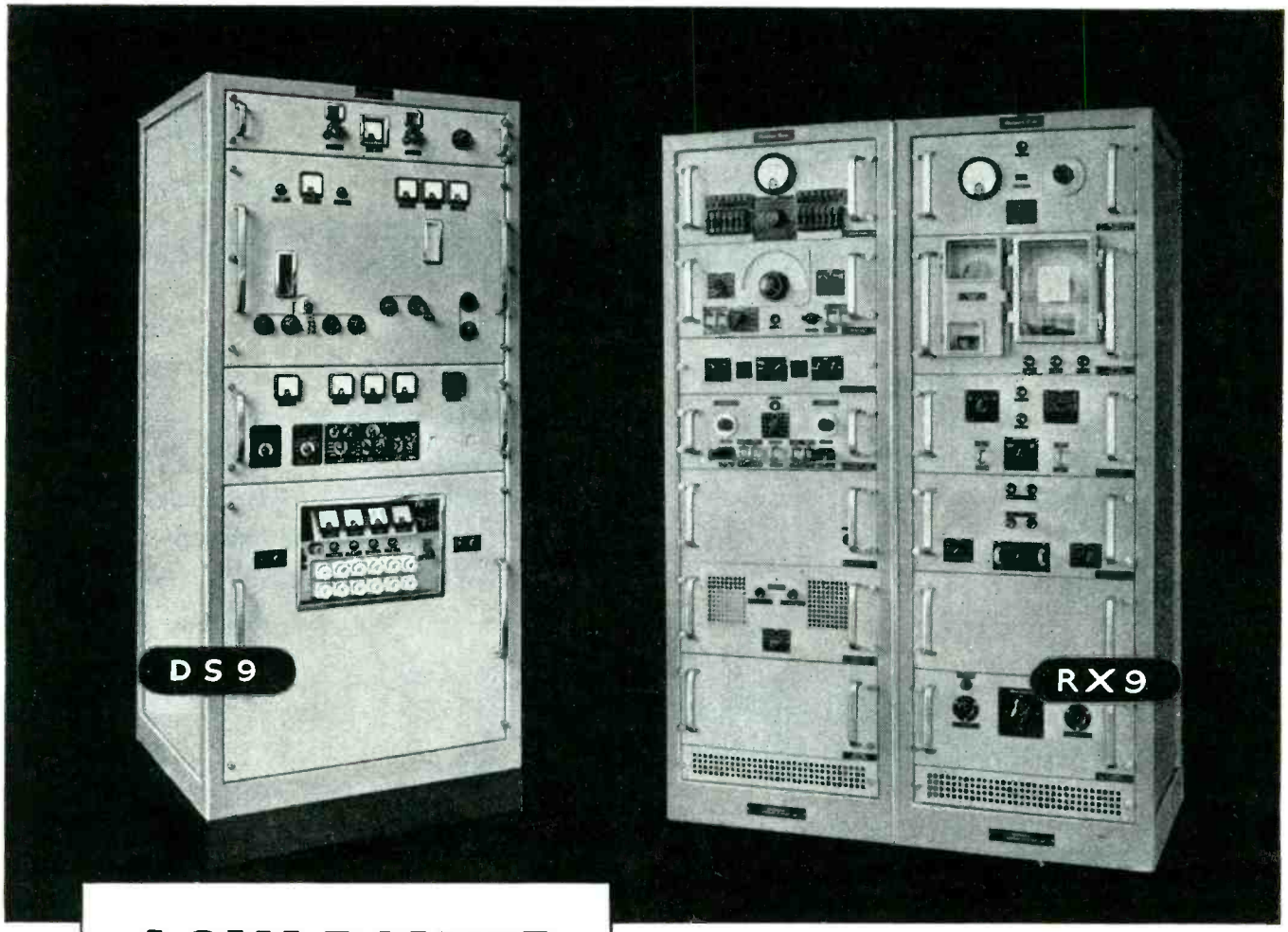
For -*hp*- 410A Voltmeter. Measures volts at open end of 50 ohm transmission line. (No terminating resistor). Uses female Type "N" fitting. Price $17.50.

All prices and data subject to change
Prices F. O. B. Palo Alto

Write for details or see your -*hp*- Representative.

HEWLETT-PACKARD CO.
1935A PAGE MILL ROAD • PALO ALTO, CALIFORNIA
Export Agents: Frazar & Hansen, Ltd.
301 Clay Street, San Francisco 11, California, U.S.A.

hp laboratory instruments
FOR SPEED AND ACCURACY



LOW POWER
SINGLE SIDEBAND RADIO SYSTEM

The *Standard* DS9 Transmitter and RX9 Receiver at last make it possible to plan the *shorter* H.F. radio links to give the higher reliability, better quality and increased number of channels which characterize the Single Sideband System.

Type DS9 Single Sideband Radio Transmitter Frequency Range 4—22 Mc/s. Power Output 300 watts. Two independent sidebands with reduced carrier. Total sideband width adequate for 3 telephone channels, many teleprinter channels or various combinations of telephone and teleprinter. Sideband generating equipment built into transmitter. Compact design and rugged construction with maximum accessibility from the front only.

Type RX9 Single Sideband Radio Receiver Frequency range 4—25 Mc/s. Independent sideband single sideband and double sideband reception. Crystal selectivity combined with sideband acceptance matching DS9 transmitter. Precision automatic frequency control. Full front accessibility using withdrawable and tilting units for maximum ease of servicing.

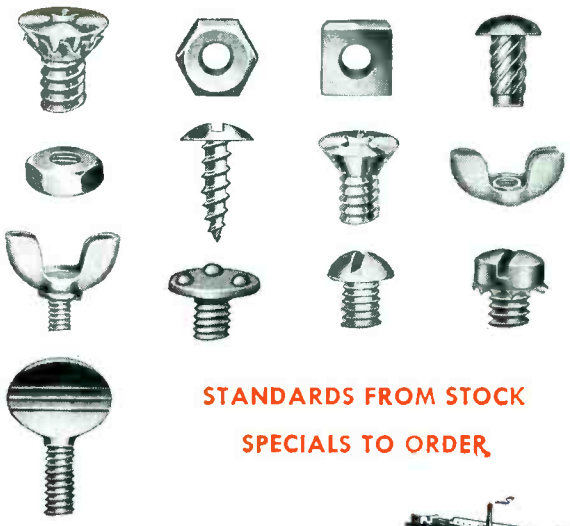
DESIGNED and BUILT by *Standard*

Standard Telephones and Cables Limited RADIO DIVISION

An I. T. & T. associate

OAKLEIGH ROAD · NEW SOUTHGATE · LONDON N11 · ENGLAND

Yes, Central makes those tiny precision screws for microphones—and in step with modern trends—also creates special mounting screws for attaching speaker and tube assemblies to plywood in television sets. These typify the versatility and wide range of fasteners available at Central. Whether your assembly requires *small* standard fasteners, "specials," or heavier duty items—Central has them or can produce them *fast*. Two hi-speed plants... one east, one midwest... eagerly await an invitation to help you meet and beat your production schedules.



Fast DELIVERIES...
FROM CENTRAL'S 2 BIG PLANTS

STANDARDS FROM STOCK
SPECIALS TO ORDER

A TWO-PLANT ORGANIZATION FOR QUICK NATION-WIDE SERVICE

"You Can Depend on Central"

CENTRAL SCREW COMPANY

3501 SHIELDS AVE., CHICAGO 9, ILL. • 149 EMERALD STREET, KEENE, N. H.

BUSINESS BRIEFS

By W. W. MacDONALD

Reading Field Reports, we get the impression that there will be a rash of redesigned and new products in our field this fall. Another sign of increased competition?

East-Coast Radar air-raid warning system recently set up for training purposes will use a lot of equipment. Manufacturers will find very little business in this particular project, however. Our Washington office tells us the equipment is practically all surplus.

Once Again we point out for those who may be interested that government agencies are asking manufacturers to bid on electronic apparatus that these same agencies placed on the surplus market not so long ago. The manufacturers are busy scouring the surplus market for the gear, hoping to avoid tooling up for its remanufacture.

Looking at the situation one way, you might say that the agencies lacked foresight and should have held on to the stuff. Looking at it another, it seems possible that no one could have anticipated so early a need for the equipment. Either way, the agencies are always up against it politically.

Complaint of one reader of advertisements is that many manufacturers offer component parts meeting Army-Navy-Airforce specifications but few have them in stock. It takes weeks or months to obtain a supply.

Preoccupation with mass production of components needed for commercial applications is normal for American business, so we can understand why manufacturers are reluctant to stock parts needed in smaller quantity for military gear despite the greater profit margin involved.

The solution to the problem is not apparent to us. We would be interested in hearing from anyone who thinks he has the answer.

Audio Trick reported by a California correspondent involves asking victims to recite a simple jingle into the microphone of a tape recorder while what they say is being played back to them via headphones after a ten-second delay. Nobody, but nobody, has so far recited through to the end without getting all balled up.

The object of the experiment, we must admit, is obscure to us. But some psychologist or medicine-man may think of a practical application, and if someone does we'd like to hear about it.

Auto Radios in metropolitan New York City total 1,440,000, or 72 percent of the total number of cars licensed in the area, according to WOR's research department.

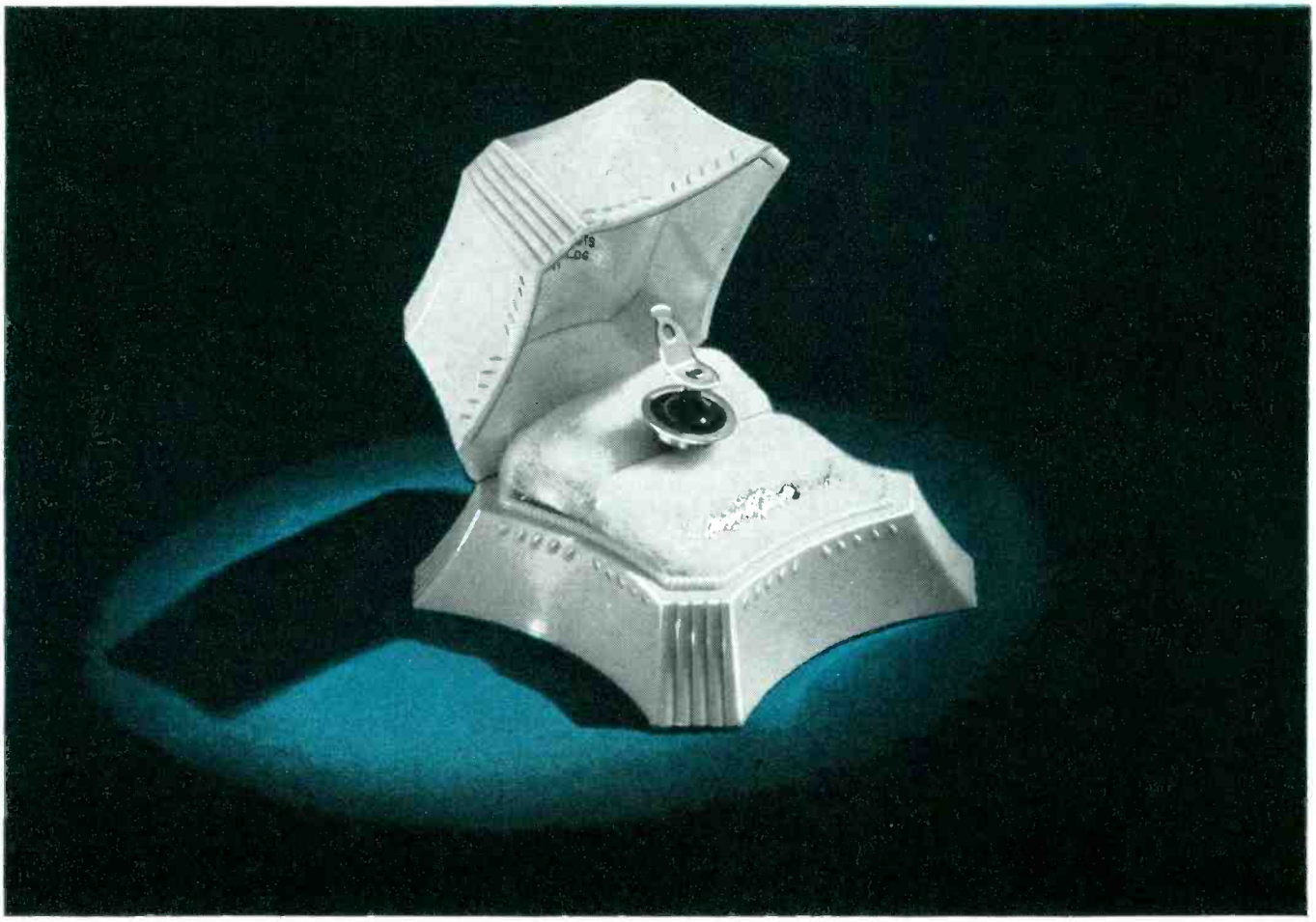
Electric Blowers ordinarily installed in cabinets to keep chassis cool have been very popular around Glenn Martin's Baltimore plant this summer. During a visit to the company's Electronics Section we saw quite a few of them up on benches cooling the worker rather than the work.

Several Patents covering a novel facsimile system with which nothing has been done are owned by a reader who thinks he has something with commercial possibilities, particularly for interoffice work. Proof that the system will work is available, but further development would have to be done before a production prototype could be built.

To manufacturers interested in investigating the subject further we will be glad to forward a list of patent numbers.

A West-Coast Firm equipped with electronic computers has just set itself up in the highly specialized business of turning out answers to highly complex mathematical problems for industry in general.

SMPE Members were poled recently to see what they wanted to read about most in the Journal of the Society of Motion Picture Engineers. Television easily



Why a Fusite Terminal Where a Diamond Ought To Be?

A Fusite Terminal would look much more natural performing its vital function in the hermetic sealing of your electrical product. But since it's every bit as valuable for 1000 other products that should be fusion sealed, we aren't playing favorites.

The smooth uniform interfusion of steel and inorganic glass that is a Fusite Terminal is as beautiful as a flawless diamond to any design engineer. In its own way, it's as rugged as the diamond used on the tip of a heavy duty drill.

It withstands the thermal shock of tortuous heat from soldering or welding and the rapid cooling that follows. It will carry up to 3000 A.C. volts (RMS) with a 10,000 megohms insulation factor after salt water immersion.

This is just one of a wide line of standard Fusite single and multiple electrode terminals.

Would you like to know more and see samples? Write to Dept. E.

TERMINAL ILLUSTRATED 112 HTL
SINGLE—HOLLOW TUBE ELECTRODE WITH LUG

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

THE FUSITE CORPORATION

CARTHAGE AT HANNAFORD, NORWOOD, CINCINNATI 12, OHIO

showed up in first place among 27 topics. Color came second and sound third.

A Lot Of People are saying: "How sad, television has pushed f-m into the background." Now that tele receiver makers are beginning to put f-m tuners into many of their sets as an added sales feature (it is cheaper than putting shortwave into a d-c set) the tables may be turned.

At least many more people will soon be able to tune in f-m programs on their television sets. Whether they do so, in view of the picture interest, remains to be seen.

Writes a maker of test equipment: "The elaborate setup down at the Glenn L. Martin plant, mentioned on p 63 of your July issue, is not at all unusual for aircraft companies, according to our records. You may also be interested in the fact that during the first quarter of 1949 we checked up on sales over $250 and found that we had sold test equipment to 484 separate industries, schools or branches of the government. Only 29 were made to people in the radio and television receiver manufacturing group. The largest group of customers numerically was in the educational institution category, which chalked up 95 orders."

An Editors' Note pointing out the probable future importance of magnetic amplifiers, on p 124 of our September 1947 issue, induced Press Wirless' K. A. Young to learn German so that he could read about early work in the original. We think the effort will pay off and Young evidently thinks so too for he is now writing a book on the subject for those who do not have the time to become bilingual.

Thumbnail Picture of Italian radio-receiver production looks like this: Some 40 firms, employing 25,000 people, turned out about 400,000 sets valued at 10 billion lire ($17,875,000) in 1948. Exports, valued at 930 million lire ($1,662,375), went chiefly to Egypt, Belgium, Sweden, Argentina, France,

the Low Countries and Turkey.

Production could readily be doubled if markets could be found but prices (25 times pre-war level) make the competitive going rough.

Radio Announcers earned an average of $7,100 in New York City during 1947.

Television Antennas represent one of the toughest design jobs ever faced by radio engineers. They must be efficient over an almost impossible frequency range, provide high orders of gain and directivity and minimize transmission-line loss. Compromise seems to be the only key consistent with consumer requirements, but we somehow have gotten the impression that it has been carried too far by too many people.

We're angling for a story stating fundamental requirements and suggesting possible approaches, by a leading antenna authority. If we get it this yarn alone ought to be worth the price of admission to our pages.

Subscriber Harry Schwartz of Montreal tells us that he and his partner have induced the local telephone company to include a heading for electronic engineers in the local classified book.

Wire Tapping by a visiting team interested in knowing whether a righthanded or lefthanded pitcher is warming up can't happen at Brooklyn's Ebbets Field. Hose-McCann has installed a no-party-line sound-powered telephone system similar to those used on many ships between the home-team dugout and bullpen, according to Bob Kuhn, who was one of the few men in the city to attend a recent Giant-Dodger game on legitimate business.

Hams employed by the William V. Stancil Company, building magnetic recorders out in North Hollywood, total six.

Personal: If any of you boys with boats in Long Island Sound hear the "Dolphin" (WC2600) on the ship-to-ship bands, or portable-marine W2TY on 75 phone give us a shout.

P.R. MALLORY & CO. Inc.

MALLORY Midgetrol

Has Designing Ways

MALLORY

sets the pace in carbon controls with the revolutionary Mallory Midgetrol.

NEW TELEVISION TYPES
Resistance stability specially provides for critical applications in television circuits. Insulated shafts are knurled for ease in adjustment. Shaft and current-carrying parts provide 2000-volt insulation.

NEW SMALL SIZE
The small size of 15/16" diameter saves precious space, can be specified where a 1⅛" diameter control ordinarily would be required.

NEW FLAT SHAFT
It makes possible a standardization of products which means faster production schedules and faster deliveries.

NEW TWO-POINT SHAFT SUSPENSION
Double bearing suspension of the new flat shaft eliminates shaft wobble. Assures smooth, even contact pressure on the resistance element. Improves the quality of the control mechanically and electrically.

NEW RESISTANCE ELEMENT
Resistance element is automatically machine-coated and electronically selected to eliminate any chance of human error.

NEW CONSTRUCTION
Use of phenolic material eliminates metal-to-metal contact, thus there's no chance for mechanical noise.

NEW CONTACT ASSEMBLY
The contact assembly is made of a special Mallory contact alloy. New contact design makes the Mallory Midgetrol the quietest, smoothest control by laboratory tests.

NEW TYPE END TERMINALS
End terminals are hot tinned—can be formed, bent, or twisted many times without breaking. Terminal holes are large enough to easily and quickly secure all leads.

NEW SWITCH
Designed and manufactured by Mallory under the highest quality standards. This new switch is built for a long, trouble-free life and eliminates many switch problems.

...It's the *little* Volume Control with *BIG* Advantages

Are you planning for smallness, and yet want to deliver big results? Well, here's an all-new revolutionary volume control that lives up to Mallory's name.

It's rugged. It can take it. It gives longer life and it is the quietest by actual tests. Yes, the Mallory Midgetrol has designing ways . . . and more and more designers have fallen in love with its nine big features.

Mallory Midgetrol is the crowning result of years of work to pack all the dependability, all the toughness and all the precision work that has made Mallory famous into SMALLER space.

We earnestly suggest you study the many extra features offered by the Mallory Midgetrol which are listed in the box here. They, in total, prove again that the Midgetrol is worthy of joining the big Mallory line of volume controls of every type for every use.

You Expect More And Get More From Mallory

Precision Electronic Parts—Switches, Controls, Resistors

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SERVING INDUSTRY WITH

Capacitors — Rectifiers
Contacts — Switches
Controls — Vibrators
Power Supplies
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CROSS TALK

► **ANGLO ANGLE . . .** As anticipated, our quarrel with the British television standards (this column, May issue) has touched off a friendly spark or two from the editors of *Wireless World*, who take us to task in their July issue. The points of controversy between us were, among many others, discussed at length last month in Zurich at the first meeting of the C.C.I.R.'s Study Group 11, a body set up to explore the possibility of international agreement on television standards. We attended this meeting as technical adviser to the U. S. Delegation, and learned much. On the theory that a report on this meeting would be more constructive than continued editorial discussion, we refer readers, including our colleagues of *Wireless World*, to our next issue, which will contain a full account of the Zurich meeting and what lies ahead.

► **DEFINITIONS . . .** Several professional groups are mulling over the old question of what "electronics" means. Time was when this was a simple matter: electron tubes make use of free electrons traveling in a vacuous or gas-filled space; electronics is the science and technology of electron tubes and associated apparatus. And that was that.

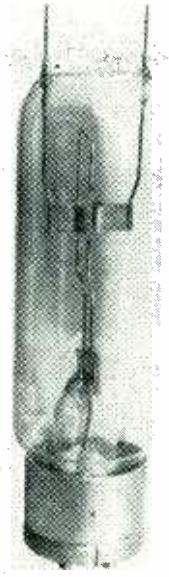
But along came the transistor, and with it a new appraisal of the semiconductor as an element in electronics. According to the old definition, a transistor, a thermistor, a barrier layer photocell, selenium and silicon rectifiers, are not electronic at all. But they are small-current devices which perform functions identical to, or closely related to, those of electron tubes.

A proposal made by one definition committee (which shall be nameless for the moment because its work is still in the preliminary stages) makes a lot of sense to us. This group proposes to define electronic conduction as including electron flow in a gas, a vacuum, or in a semiconductor. An "electron device" would be one in which conduction takes place through a vacuum, gas or a semiconductor. An electron tube would be such a device, in which the conduction takes place within a gas-tight envelope.

This all-inclusive definition puts the semiconductor devices where they belong. Moreover, it's based on a sound physical doctrine. Controlled electron flow in a gas requires attention to the same physical principles as controlled electron flow in a semiconductor. The lack of knowledge of the latter process is as profound as its inherent complexity is evident. But, in time, these questions will be answered. Quite possibly the control of electrons in a gas or vacuum will fall out as a special case of the general description of the domains of the solid state.

► **EARLIER . . .** In April we took note of the work of Otto Schade in testing lenses with a photoelectric scanner. We were soon reminded that Dr. Schade was not the first to use this method. Several months earlier, William Herriott had published in the JOSA a description of his photoelectric lens bench. So our praise is now directed in two directions. Having seen the Herriott bench in operation recently, we are more impressed than ever. We hope they've heard about it, by now, in Rochester, New York.

► **BASIS . . .** It is abundantly clear that the FCC has taken seriously its responsibility for proper planning of the future of television broadcasting. The statement of "proposed rule making", which will go before hearing a few days after this issue is published, is evidently an all-out attempt to avoid the mistakes made when sound broadcasting was first set up in 1925. The proposals have received careful scrutiny by many organizations, public and private, partial and impartial, who have filed notice of their intention to appear before the hearing. The issues are complex, the opinions diverse and strongly held. The decisions made will set the course, for good or evil, for a long time. We do not envy the Commissioners their task or their responsibility; we can only wish them Godspeed.



This GE type FH-11 split-anode magnetron was available commercially in 1930 but nobody wanted it

WHY DOES IT TAKE SO LONG?

Engineering executives ask this question today more than ever as high overhead charges accumulate month after month on an electronic development project. Here are the answers, with historical backing and practical suggestions for speeding recovery of development costs

By W. C. WHITE
Electronics Engineer
General Electric Research Laboratory
Schenectady, N. Y.

SOMEONE has said that life nowadays consists of a series of hectic rushes interspersed by exasperating waits. The latter often seem to predominate from the viewpoint of the executive interested in a technical development. The engineer in charge is also frequently exasperated by the length of time it takes to develop, design, manufacture and make a business of some new product. Usually the high cost of such a process is a cause of even greater mental anguish. This high cost is in turn due partly to the fact that time is money, particularly in these times when overhead charges are high and accumulate month after month regardless of the rate of progress of the project.

In the field of electronics, the time from idea to production is a very pertinent problem because progress and obsolescence are such pronounced factors. New developments often crowd one another, leaving all too few years during which the cost of the initial development may be recovered. Finally, after a development has been completed and one has the benefit of hindsight, it is often very difficult to explain and justify, even to oneself, the reasons why so much time was consumed in arriving at the goal. A few historical examples will show how long it took in the past to develop familiar products.

Let's first take a look at the development of the high-vacuum tube, which is the basis of our industry.

The Triode . . . 1883 to 1913

Starting with the Edison Effect in 1883, Edison was granted a patent in 1884 on a diode voltage regulator[1], Fleming used a diode as a radio detector in 1905, deForest brought out his audion in 1907 and the high-vacuum tube came in 1913.

It was not until World War I, however, that high-vacuum triodes were widely used and, of course, not until the advent of broadcasting in 1921 did they really reach the public. Thus, from Edison's discovery to World War I, use represented a lapse of over 30 years. It should be noted, however, that after 1912 when organized research became active in the development of the high-vacuum triode, progress was relatively rapid.

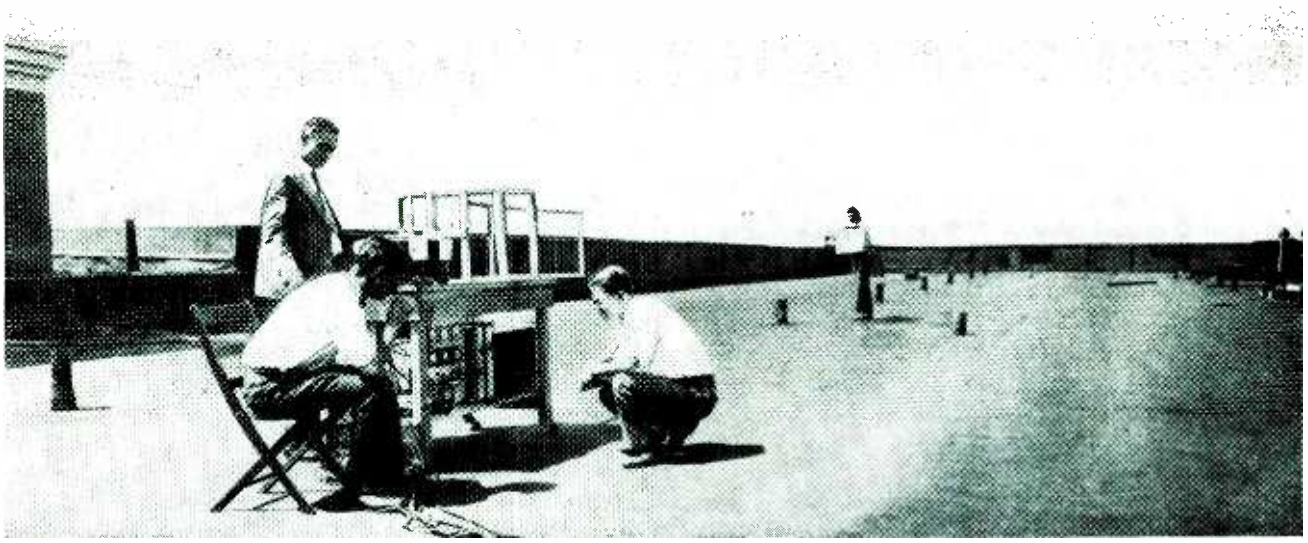
This development of the high-voltage triode, which has been taken as an illustration, involved a number of accomplishments that were necessary before the final result could be achieved.

Induction Heating . . . 1919 to 1939

One example involving the application of electron tubes is the development of high-frequency induction heating. In 1919, as a result of transmitting tube developments for World War I, fairly suitable tubes were available for commercial

SEVEN REASONS FOR DELAYS

- An engineer instinctively hangs onto a development until he understands everything about it
- Overlooked defects in design don't show up until the product is in the field
- Trial users are unsympathetic to new ideas
- Final product is not sufficiently visualized during design
- Routine business conferences and personal interruptions encourage natural *manana* inclinations
- General weariness and disgust with project after run of hard luck
- Natural opposition of production personnel to new products



Taken in 1928, this picture shows a laboratory test of the FH-11 oscillating magnetron being used as a voice-modulated microwave transmitter at 400 mc. The art was not ready for such a development, and many years had to pass before a radio transmitter operating at this frequency was greatly desired. This tube, incidentally, was described by the author in a three-page feature article in the first issue of ELECTRONICS (p 34, April 1930)

high-frequency induction heating. As a matter of fact, the writer built a high-frequency furnace unit in 1919. This was used regularly for laboratory melting of special alloys in a vacuum or controlled atmosphere. Many of the unique advantages of high-frequency induction heating were known at that time and yet it was not until about 20 years later that this application really became a business.

What can be done to shorten this period of incubation? This leads to the question of what are the causes of delays in a new development and its commercialization.

General Considerations

Many delays in development are largely psychological and only certain of them are susceptible to much near-future improvement.

The beginnings of a new development can usually be traced to someone's idea and the decision by the same or another person to do something about this idea. Of course, the first questions that arise are:

(1) Is there a profitable market for the product?

(2) Is the time propitious for the venture?

(3) What is the probable development cost and can it be recovered?

(4) Is the organization involved capable of doing the development plus manufacture and commercialization?

These are all of primary importance, of course, and much could be written on each of them. However, we will assume the answer to each has been in the affirmative and thus get on to our subject of delays.

Earlier in this article, the speeding up of high-voltage triode development through organized research was mentioned. This is an extremely important factor and should be considered under the broad heading of collective genius. Collective genius is a name for the idea that many human traits and abilities are necessary to complete a development successfully; so many, in fact, that it is practically impossible to accomplish the result with one or two individuals.

For a successful development, there must be enough individuals possessing the necessary abilities in the group to supply all the basic requirements. This general idea is fundamental and not new to modern organized industrial research, but it was brought out very interestingly in an article published a few years ago.[2] I would recommend that this article be read by everyone interested in advanced development.

Back of every successful development there is usually a dominant personality. This of itself does not insure a speedy and successful result, although it is one of the important factors necessary to success.

Delay No. 1—Engineering Instinct

The engineer in charge of the development is sometimes more interested in the technical how and why of the development than in speeding it to a practical completion in order to minimize outgo and to hasten the beginnings of income. Many scientists and some engineers have this feeling, but fortunately most of them keep it well under control. To others the idea of manufacturing and placing on the market some new product on which all of the technical problems are not thoroughly understood or charted is abhorrent. Certainly there must be sufficient knowledge to avoid pitfalls. On the other hand, if commercialization is postponed until all the science and engineering in-

volved are thoroughly understood, then probably a competitor will be the first one to make a business out of the development.

Delay No. 2—Overlooked Defects

All of us are familiar with products which when first commercialized show up some important defect or difficulty. To avoid this one must learn as early as possible in a development what are its key problems. Frequently the problems that at first were worried about the most do not materialize; instead, other difficulties or defects that were not suspected turn out to present the chief difficulties. This leads to the need for getting a few of the products out into the field just as soon as possible. There is no better way of uncovering defects than this procedure.

Delay No. 3—Attitude of Trial Users

In a field trial or early use, success or failure usually hinges on the attitude of the individual utilizing the trial installation. If he looks with suspicion on any new thing, it is sometimes better to look for a better location. On the other hand, a trial user who has enthusiasm, patience and tolerance is to be treasured as he is often the all-important factor in a quick and successful technical development.

Delay No. 4—Not Looking Ahead

In the vast majority of cases, the human mind seems to be incapable of clearly foreseeing or sensing two steps ahead on any problem. It is a common experience to design some fairly simple piece of new electronic equipment, giving thorough attention to what are apparently all the problems involved. When the first sample is delivered and sometimes even before a test is made, the designer finds to his dismay that, as soon as it is seen in being, one or more undesirable features are immediately apparent. In other cases, the initial test uncovers what seems like some perfectly obvious undesirable characteristic or defects and the designer wonders how he could have been so stupid as not to foresee this particular feature. Probably this factor is high in importance of the many that can cause costly and lengthy delays. There is nothing new in the discovery of this problem, and the use of mock-ups is sometimes employed to minimize this difficulty. However, it remains a severe psychological problem, the complete cure for which is none too apparent.

Delay No. 5—Interruptions

The *mañana* problem is as old as human nature, but it appears to have taken on many new and insidious forms in the past few years. There are thoroughly legitimate aspects to this factor. They are staff conferences, monthly reports, visits of VIP's and that yearly bugaboo, the budget. These are just a few to serve as examples. At least one comes up nearly every week in the life of a development engineer.

Probably more time consuming are the semi-personal or personal factors. Here the scope and variety are legion. One plans to take home some technical book, report or data so as to study it in peace and quiet. However: It is March 14 and the income tax return is due. Again upon arriving at home you are reminded that you promised to visit the Henry Doodles that night to see the Kodachrome slides of their trip to Florida. The reader can add to this list almost endlessly. Such interruptions invade even the office and laboratory with such things as weddings, storms, accidents and illness in the family. This is bad enough in one's own particular case, but remember that these same problems apply to each individual of the many connected with the job, from messenger boy to shop superintendent. During all the delays from these causes, salaries and overhead go merrily on.

Delay No. 6—General Disgust

From time to time during a difficult development when there has been an unusually long run of hard luck, it is suggested that it is time to stop fooling around with makeshift apparatus and do a really good job with the proper equipment. This tendency must be watched carefully as frequently it originates from weariness and disgust with the project rather than a real need. We all know that some of the outstanding developments in our science have been done with haywire apparatus built on breadboards.

Delay No. 7—Opposition to New Things

Unless the product under development solves some pressing current problem, it is usually very difficult to commercialize it. It is so much easier to keep on in the same manner rather than introduce the new or improved products that always involve risk, trouble and added effort. Furthermore, changes upset smooth factory operation which in times of pressing production problems is an all-important factor. The argument is sometimes advanced that an existing product should not be replaced by a new one until the cost of development of the present design has been recovered.

Timing New Developments

From an executive viewpoint, it is necessary to call a halt somewhere in the introduction of new ideas during any given period. In general, an organization simply does not have the manpower to handle more than a limited number of new ideas or developments at one time.

There are two particular times in the business cycle when it is difficult to promote an idea for a new development from research through to commercial form. The first is when business is good and the second when business is dull. This is not a facetious remark, but rather points out another psychological fact.

Good and Bad Times

In times of business prosperity, money for research and development is usually available and there is plenty of optimism. It is true that manhours are difficult to find for development purposes but probably the greatest difficulty is that managers are primarily interested in getting out present models on schedule and of proper quality. They cannot be expected to be particularly interested in a new product that is going to take many manhours to promote and sell and probably involve added problems in installation and engineering and customer complaints.

On the other hand, in periods of poor business conditions, money is hard to obtain for research, engineering and development, and pessi-

mism is usually rife. But there is one big favorable factor and that is that at such times managers are keenly on the lookout for a new or better product to catch a larger share of the limited available business or open up a new field. There are also manhours usually available on the part of engineers and commercial men to promote a new product.

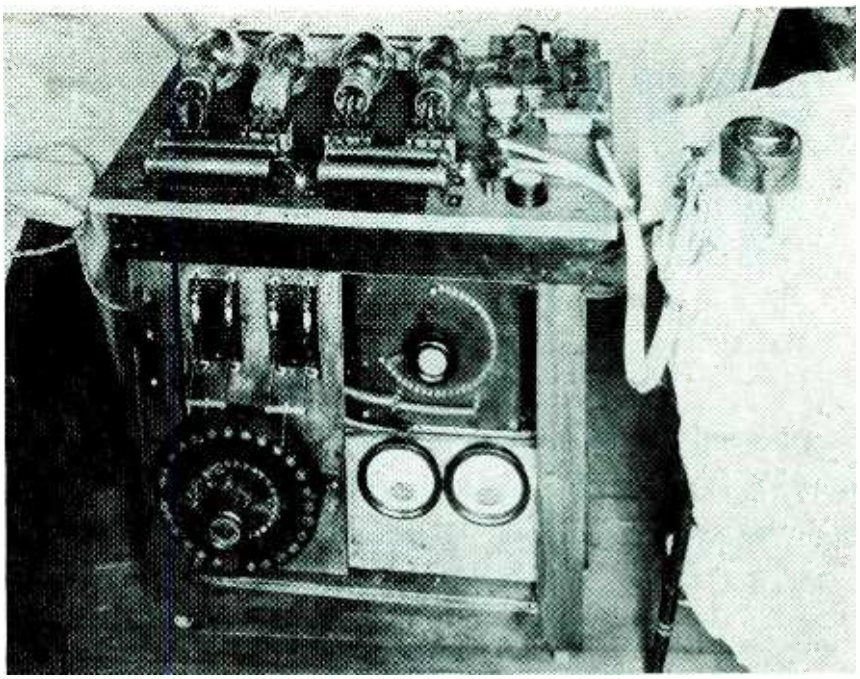
The answer to this timing problem is obvious. The basic research and advanced technical development work can and should be done in good times. Thus a good foundation is laid so that the final design and promotion may later be done with a minimum of time and expense when economy rules but new products are much to be desired. Industrial electronics grew up during such periods. Much of the basic research work on various new tubes and the circuits involved was done during the boom years of the late 20's whereas some of the most encouraging beginnings of commercial applications occurred during the depression years of the early and middle 30's.

During the next few years, it will be interesting to watch the extent to which some recently announced electronic research accomplishments come into profitable use. Examples of this are the traveling-wave tube[3], ceramic tubes[4] and the transistor[5]. In following such developments, it must be kept in mind that sometimes it is their by-products that turn out to be important rather than the form in which the initial development took place.

Expediting Procedures

It is essential that satisfactory operating samples of the device be available, as well as necessary associated items. One can never tell when conditions for getting approval of a new device will suddenly become favorable. The ability to follow up some suggestion promptly and actively when enthusiasm is fresh and high is a very important factor.

Complete information on a device, particularly as regards its operation, advantages, limitations and unusual characteristics, is essential. Again, everything should be done to make the initial trials or tests favorable as otherwise doubts are substituted for high hopes.



Built and successfully demonstrated by the author in 1919, this high-frequency induction heating unit was 20 years ahead of its time. Commercial acceptance did not come until about 1939 when industry realized its potentialities for surface hardening

No opportunity should be lost to tell as many people as possible about the device and demonstrate it to them. All the good ideas are not under one hat. In our field, there is probably no better way of telling the world than an article in ELECTRONICS. The more propositions entertained for a new device, the more likely a successful one will be found.

The initial applications chosen to be followed up actively should, if possible, be relatively simple ones. There will be enough complications and unforeseen problems without introducing extra or unnecessary ones.

It is often easier to introduce some radically new idea as an added feature of an existing product rather than attempt to force it through as an entirely new device. It is less upsetting to the factory and involves less commercial risk.

Conclusion

Radio engineers are born pioneers. They are always on the lookout for something new and very often will decide to incorporate a new thing in a product even before the engineer promoting the device feels it is ready to use. This adventuresome spirit in radio is undoubtedly a characteristic of a new art, but it is probably not so pronounced today as it was a number of years ago.

On the other hand, introduction of a new tube or application in the industrial field may meet with quite a different reception. There the attitude is more often to question the proposal on the basis of too high cost, fear of unreliability, unsatisfactory tube life and the many other factors involved. In other words, conservatism is a much more powerful factor than the pioneering spirit. Fortunately, this too has changed during the past few years and even now there is a tendency in some cases to think of doing it electronically first.

Two or three years may seem like a long time to realize a dream on even a simple idea, but a century ago the dreamer was lucky if he lived long enough to see it in successful use. Much progress has been made.

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(4) R. J. Bondley, Metal-ceramic Brazed Seals, ELECTRONICS, p 97, July 1947.
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WOR TV FM Design for

Engineered for maximum flexibility and operating economy, New York's newest vhf television transmitter overlooks the city from the New Jersey Palisades. Its 810-foot tower includes an f-m antenna. Microwave stl's, coaxial cable and high-quality telephone lines link studios and remote pickup points

THE completion of the WOR-TV television transmitter plant will interest radio engineers because of its several unique features. The latest of the New York stations to broadcast a television program from its own facilities, it has had the advantage of time and experience in planning an effective installation.

Although this article deals primarily with television equipment, the apparatus and its use have been carefully integrated into the whole field of radio entertainment. Television is the newest and most compelling of the radio mediums, but a-m and f-m will continue to serve for a long time. For that reason, the f-m transmitting facilities have been combined, from the operational standpoint, with those of television. Existing a-m facilities, requiring different terrain, are adequate, and satisfactorily located elsewhere (in Carteret, near Rahway, N. J.).

The facilities described in this article comprise television studios, which are located in New York City at 20 W. 67th St., and f-m and television broadcasting facilities installed in North Bergen, New Jersey. The television studio facilities are not yet completed, so that only a brief description of them is given. The television transmitter facilities, however, are now completed, and include a television transmitter, a source of auxiliary or emergency picture signal for that transmitter, and suitable microwave and other terminal equipment to enable television pictures to be brought to the transmitter. The f-m facilities include an f-m transmitter and suitable auxiliary equipment. All of these transmitter facilities are housed in a specially designed building. Adjacent to the building is the transmitter tower, which carries both the f-m and television antennas.

Choosing a Location

The proper siting of a radio transmitter is the most important decision a radio engineer can make for he must usually live with his decision a long time. Compromises among the factors of propagation, cost, or availability of a satisfactory site must always be made. However, in spite of the impossibility of obtaining CAA permission to erect a tower at the most favored spot in Fort Lee, New Jersey, the present approved North Bergen location is considered a satisfactory compromise, with the propagation factor weighing somewhat more favorably in the balance here.

The decision to locate the transmitter in New Jersey rather than in New York was predicated upon economic as well as engineering considerations. In the first place, although the states of New Jersey and New York are major political subdivisions, the populations are homogeneous. Nominal residents of either state are often employed in the other. So far as the whole geographical region is concerned, it is essentially one market area.

Because of their relative convenience to studios and talent, the New York skyscrapers were first used to support the high antennas needed for television. Only two vhf stations (both of them f-m broadcasters) have, until the advent of WOR-TV, exploited the natural elevation furnished by the Palisades, the rocky western bank of the Hudson River. This high ridge commands both the eastern shore of the Hudson, the flat land of Long Island and also the area to the west towards Pennsylvania. Immediately to the west are the Jersey Meadows, a low swampy region abounding in a-m stations.

It is well known that the ghosts that plague television reception in some locations are caused by signal reflections from obstacles, the reflected signal being weaker and delayed in time by the somewhat longer path it has traveled. The most troublesome interference by ghosts occurs when the receiving location is shielded in some way from the direct, or desired, ray. By locating the WOR-TV antenna well

the Future

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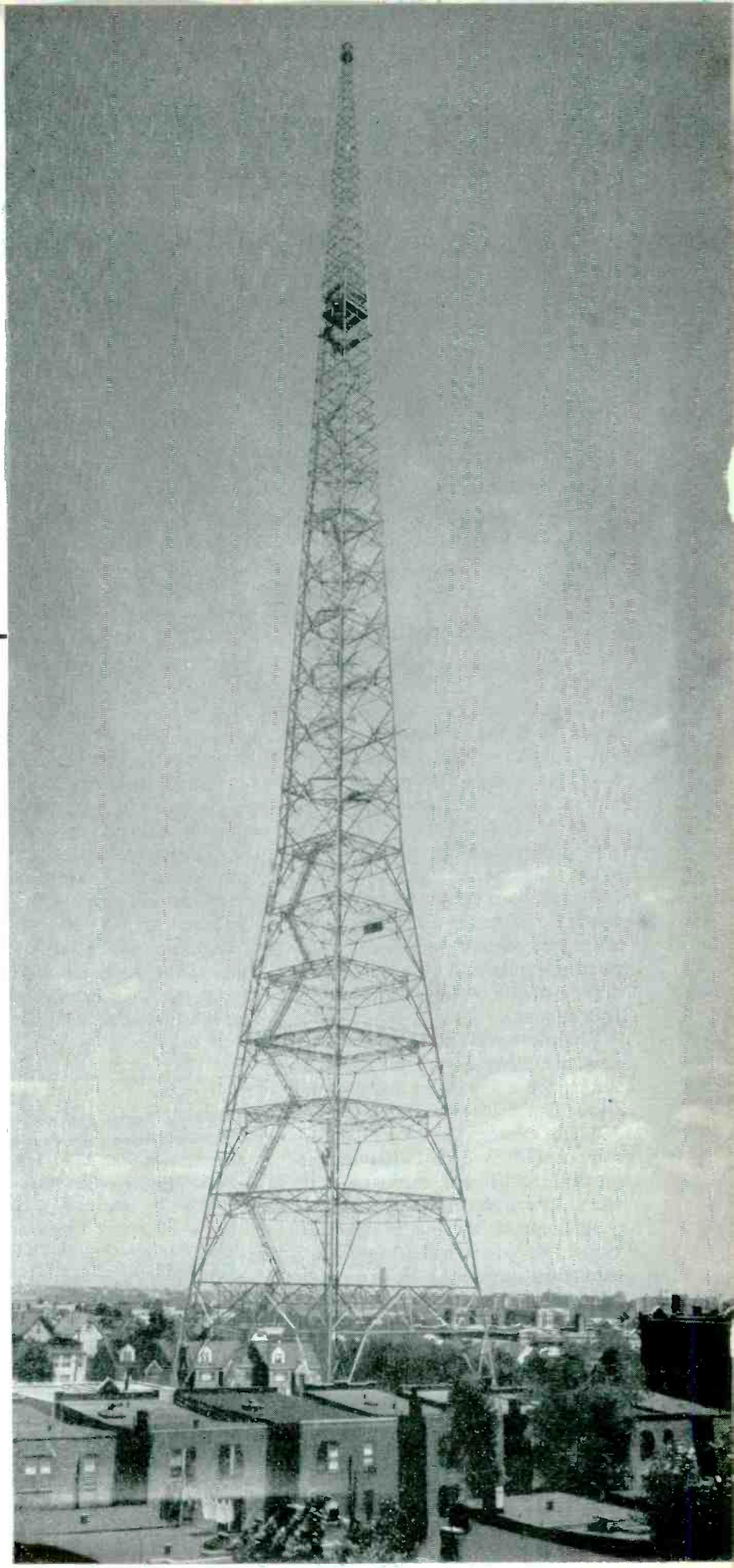
away from the tall buildings of New York City, it is expected that there will be few locations at which the direct signal is not obtained with very much greater signal strength than reflected signals.

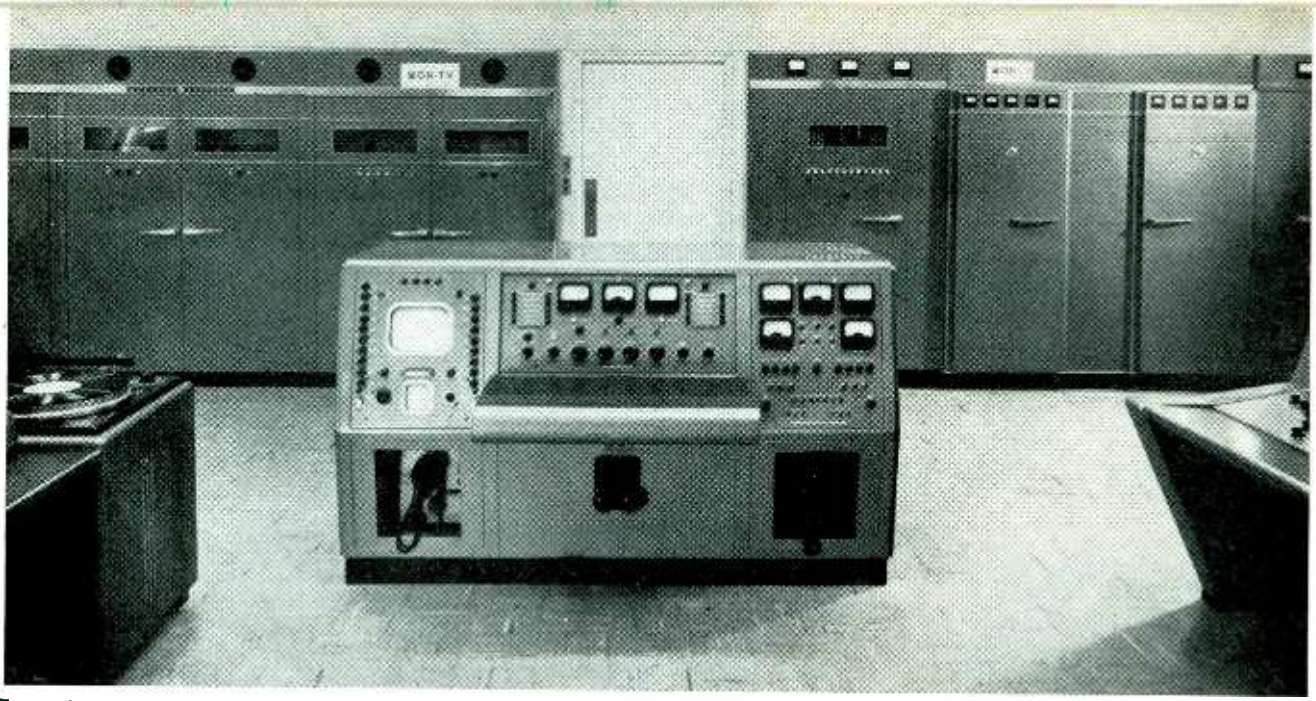
The 5,000 and 500-microvolt contours computed according to FCC formulas in application for construction permit are shown by solid lines in Fig. 1. An estimate of population served is also indicated.

The layout of the site is shown in Fig. 2. The transmitter building and the adjoining garage are modern one-story construction of brick, covering 5,000 square feet. Besides the transmitter cubicle space, equipment racks, and the control room, there are washroom, a dining space and kitchen, and an office. At the rear of the building are the utility room housing the ventilating and cooling equipment, and a well-equipped shop. The garage has space for three large remote pickup trucks.

The outdoor substation, surrounded by a wire fence, contains two banks of three 50-kva transformers, each bank connected to a different feeder. Power comes in at 440 volts and is stepped down to 120/208-volt 3-phase 4-wire circuits. In the event of a power failure on the line in use, the load is automatically and instantaneously switched to the transformer bank



WOR-TV-FM tower in North Bergen, N. J. overlooks New York City



Transmitter control is centered at console in foreground. Television transmitters at left and f-m at right. Turntables and cueing desk just show at left and camera control and mixer desks at right

that is fed from the alternate substation.

An important feature of the electrical installation is the ground system. An expanded-metal copper mat covers the ground beneath the tower. Tied in with this is a system of 20 radials extending from the tower base to the edge of the property. A main girdling system of 250-mcm bare copper cable extends the full perimeter of the property. All metal columns, conduits, equipment grounds, and even the window frames of the building are tied into this system.

The most striking feature of the external plant is the tower itself, visible for many miles in any direction. The fabricated portion rises 760 feet above the ground and is surmounted by a 50-foot pole supporting the f-m and television radiators. It weighs about 420 tons.

At the base, the legs of the quadrupod are spread out 96 feet apart on a side, narrowing at the top to 5 feet. Each leg is secured by eight steel bolts, each one 13 feet long and weighing 800 pounds. Steel-reinforced concrete bases are imbedded in the solid granite ledge that shows above ground.

The tower has been designed to withstand winds of 120 miles an hour. The maximum average wind velocity recorded in this area for a five-minute interval was 81 miles an hour during the hurricane of 1944. It is estimated that a wind of 35 miles an hour causes a sway at the top of only 7 inches.

By virtue of the antenna construction and the fact that the tower is tied into the extensive grounding system, the structure will probably tend to equalize opposing charges between the earth and the atmosphere. Although this condition constitutes no assurance that the tower will never suffer a severe lightning stroke, the chances of damage are minimized. Other features of the tower installation, such as the microwave relay station at the 555-foot level are discussed in detail below.

WOR-TV bears the curious distinction of being not the first, but the seventh and last of the New York VHF television transmitters allowed by present FCC allocations. There are many reasons for this situation, but the editors of ELECTRONICS are concerned mainly with the fact that here is a carefully designed installation that should profit from the mistakes as well as the good points of every comparable station that has already gone into regular operation. Of equal importance is the fact that after WOR-TV engineers decided what they needed, they had the relatively unlimited financial resources with which to back up their engineering decisions.—THE EDITORS

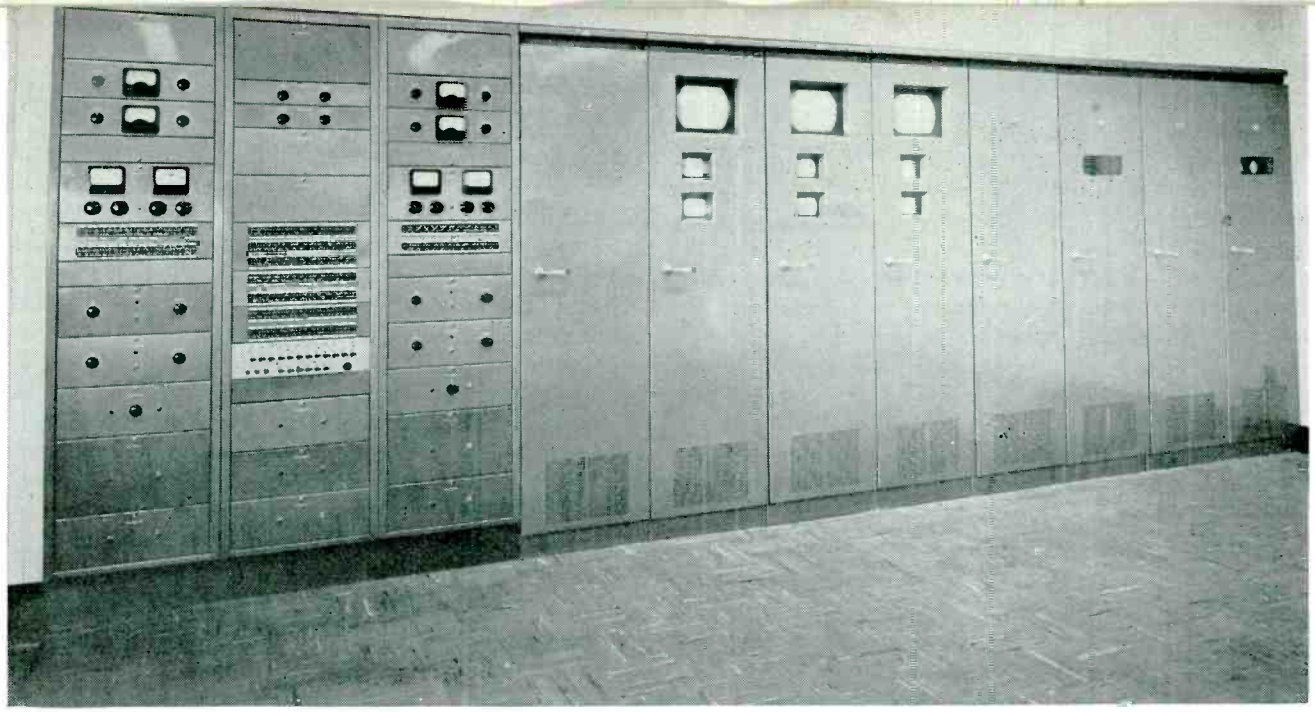
The top of the tower supports a one-bay circular antenna for WOR-FM and above this, a six-bay, super-turnstile antenna that is used for both television sight and sound from WOR-TV on Channel 9.

The f-m antenna is the doughnut, a special form of the folded dipole. The extreme ends of the folded dipole are joined by an adjustable capacitor that is factory tuned for the desired frequency. The center point of the larger ring, and one end of the lower ring are grounded, thus affording lightning protection.

A matching section is used between the 3⅛-inch line and the antenna. This type of antenna has a power gain of 0.79 referred to a half-wave dipole. The effective radiated power of 3.4 kw at 950 feet is attained with a transmitter output to the transmission line of 5.7 kw. The calculated coverage is shown by dashed lines in the contour map (Fig. 1).

Each bay of the six-bay super-turnstile antenna for television consists of four bat wing radiators mounted at 90-degree intervals about the supporting pole. These radiators are formed from seamless steel tubing and are attached at their top and bottom ends to the supporting pole.

The method of feeding the east-west pairs is shown in Fig. 3. The north-south pairs are similarly fed, but at 90-degree phase displacement. The horizontal pattern from



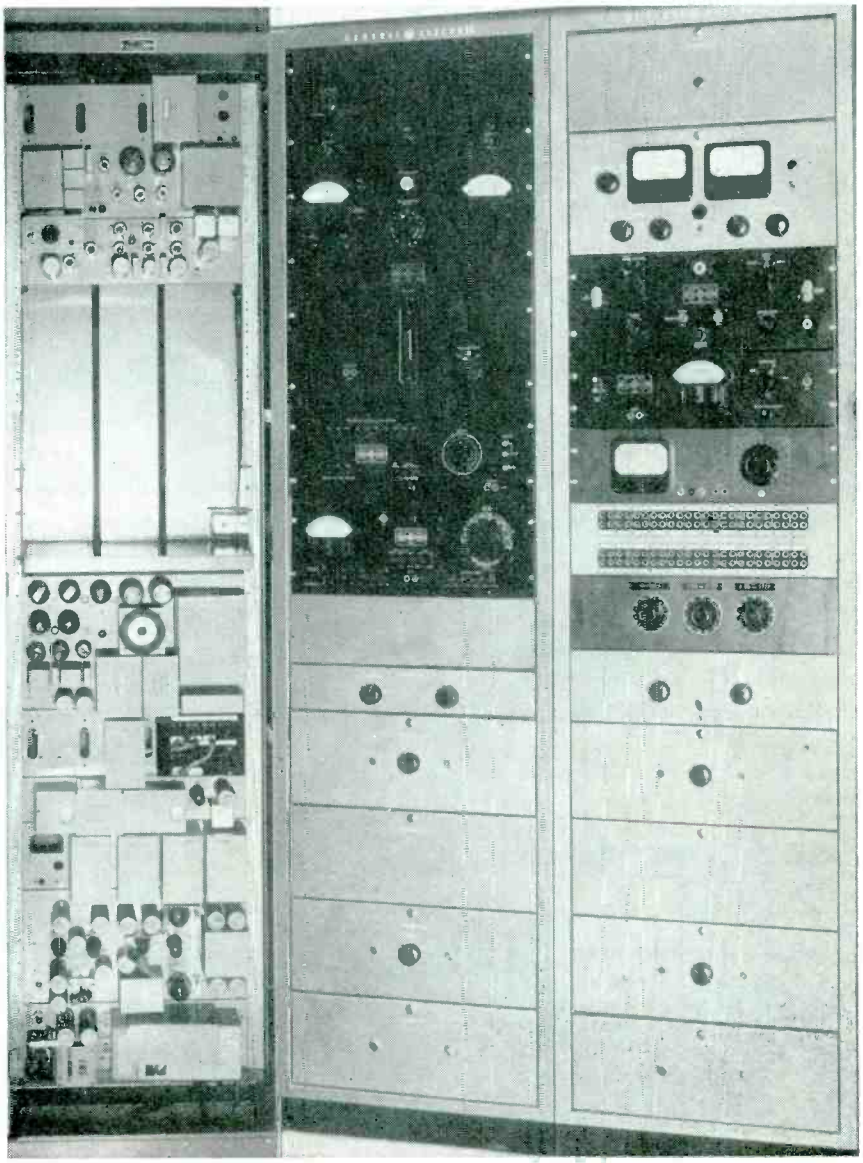
Audio equipment, video monitors, sync generator and associated equipment form the outer wall of the shielded room to the transmitter operator's right

this antenna is essentially circular deviating little more than plus or minus 0.5 db. For channel 9, the power gain over a half-wave dipole is 6.78. Combined sound and picture carriers from a diplexer unit near the television transmitter are fed through two 3⅛ inch copper coaxial lines up the south-west leg of the tower to the matching unit and junction for the antenna feed harness.

An interesting and important feature of the antenna installations is the means of keeping the radiating structures free of ice. This protection is essential not only because the ice may affect the characteristics of the antenna, but because the radiators are less rugged than the supporting structure. An accumulation of ice presents a greater wind surface as well as a greater weight.

The f-m ring antenna has heated capacitor plates and partially heated arms dissipating about 240 watts in all. If normal voltage is insufficient to melt ice, the voltage can be raised on the Calrod units until the power is approximately doubled, with no damage to the equipment.

A differently shaped 250-watt heating unit is built into the vertical portion (next to the mast) of each element of the six-bay turnstile. The whole assembly dissipates six kilowatts. It is possible to connect the individual units in parallel, series-parallel, or series, for different degrees of heat. There are two



One of the coaxial cable terminal racks (left) and monitoring equipment (right) are located in the hallway outside shielded room

controls for the heaters; an automatic thermostatic control and a manual control that shorts out the thermostat.

Icing, or the formation of hard rime, takes place over a very narrow temperature range near 32 F. It is caused by the deposition of supercooled water droplets on an obstacle. On this account, a thermostatically controlled heater is usually set to operate between the limits of 27 and 32 F. When the air is colder than 27 F, there is little danger of icing.

Rime, or frost feathers, is another source of trouble. This phenomenon is caused by a cloud of supercooled droplets (of a different character from an icing cloud) that freeze when they hit an obstacle and build out into the wind. Although lighter in weight, their wind resistance is likely to become greater than that of the icing deposition. Rime forms at temperatures from 32 to as low as minus 50 F, but the amount decreases as the temperature drops. Probably the manual control of the antenna heating will be seldom used to cope with any riming conditions.

As an additional aid to discourage the buildup of ice or rime, the antenna has been covered with three layers of special paint to give it a smooth surface.

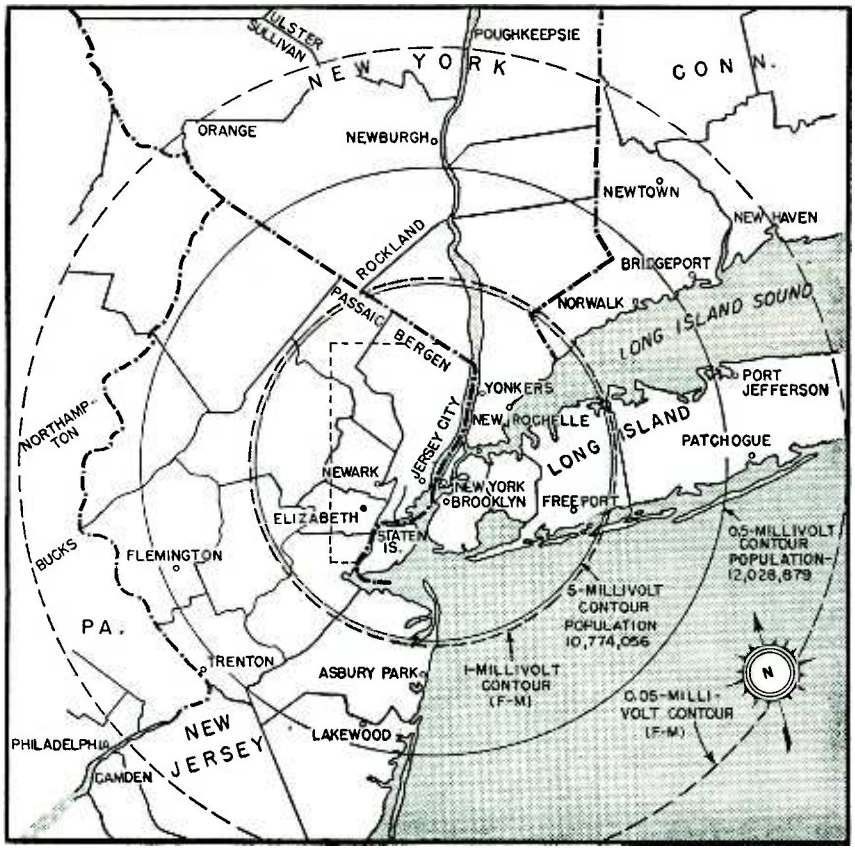


FIG. 1—Service areas for WOR-TV (solid lines) and WOR-FM (dashed lines). Note that the contours for tv and f-m are not directly comparable

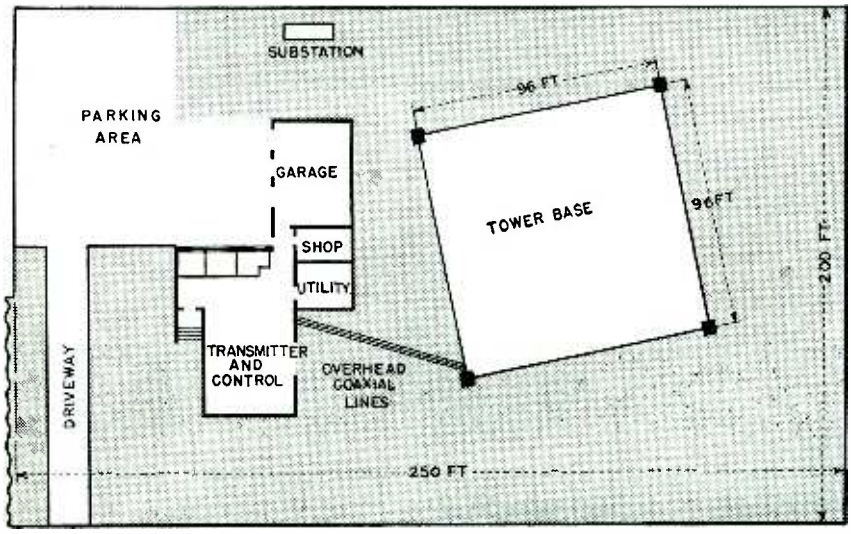


FIG. 2—Ground plan of the North Bergen property showing relation of the tower, transmitter building and power substation

Ground Plan of the Station

The layout of equipment and facilities within the station is shown in Fig. 4. Operating activities center at the transmitter control desk in the center of the operating room. The operator on duty normally faces the transmitters. Easily accessible are the turntables, to his left; the camera control and mixer desks (television sight and sound) to his right. Ordinarily, the television program is originated elsewhere and sent to the transmitter via television master control located at the main television studios at 67th Street in New York City. Similarly, f-m programs are routed through WOR-FM master control at 1440 Broadway. Emergency and testing operations only will require the use of the auxiliary equipment at the transmitter.

All television camera and slide projection equipment is effectively isolated in the shielded room to the right of the operator. The synchronizing, testing, monitoring, and all the audio equipment is at least partially shielded. Ceiling, walls and floor of the room are covered with fine copper screening heavily tinned so that the individual strands are joined one to another. This shielding, together with that afforded by the metal cabinets and doors on the operating-room side, cuts down direct radiation from the transmitters, the antennas, and also from the several a-m broadcasting stations in the vicinity

During construction of the tower, an intercommunication system employed between the hoisting engi-

neer and the top construction level picked up strong signals from these local a-m stations until the equipment and line were adequately shielded. Without proper shielding, a great many of the high-impedance, low-signal circuits, particularly in the camera equipment, would undoubtedly pick up strong signals.

Monitoring and testing equipment, along with telephone terminals, is in the broad hallway to one side and behind the transmitter cubicles. The utility room contains cooling and heating facilities for the building as well as high-and-low-pressure air for the transmitters, and cooling water for some of the tubes.

A well-appointed shop contains everything from hammers to lathes, from communications receivers to square-wave generator. Drawers and cabinets of spare parts line one wall.

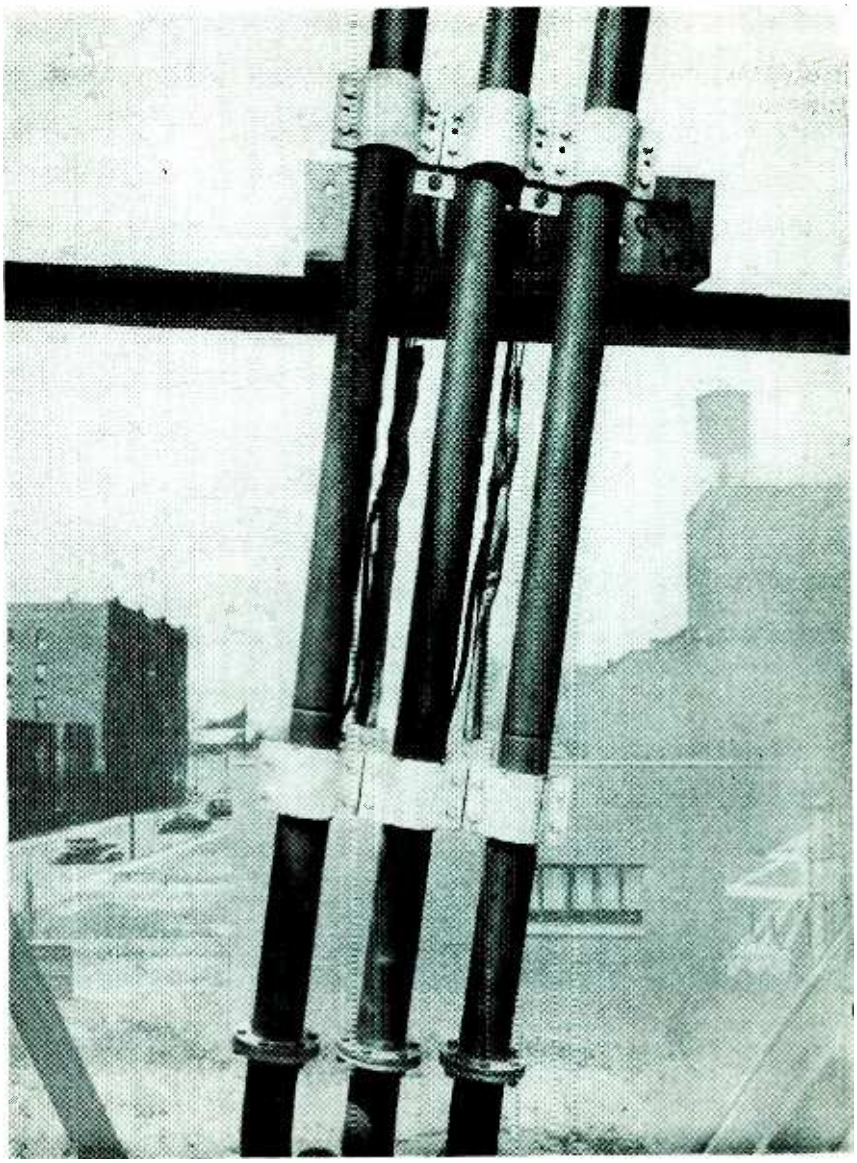
The Television Transmitters

The type TT-6-D comprises a 5-kw picture transmitter and a 2.5 kw aural transmitter in adjacent cubicles at the operator's left. This is standard equipment. The picture transmitter employs low-level plate modulation, five push-pull stages ending in a pair of 9C24 tubes that employ forced air and water cooling. No high-level sideband filter is required because all but the standard vestigial sideband signal is eliminated by the amplifier band-pass tuning.

When once adjusted it is the work of a few minutes to check the tuning of the amplifier stages, starting with the final and working back to the first stage. Crystal monitors are provided in each r-f amplifier stage, and there is a built-in sweep oscillator, as well as marker oscillators for use with an external oscilloscope, to give a visual indication of proper tuning.

The f-m sound transmitter employs the Phasitron circuit for phase-initiated frequency modulation. The carrier frequency is thus directly controlled by a crystal. Output of the transmitter comes from a pair of type 5513 forced air cooled tubes.

In practice, these transmitters will operate very much under their maximum power ratings. Television stations are licensed for a maximum of 50 kilowatts effective radiated picture carrier power at an antenna height of 500 feet, and 25 to 75 kw sound power on the same basis.

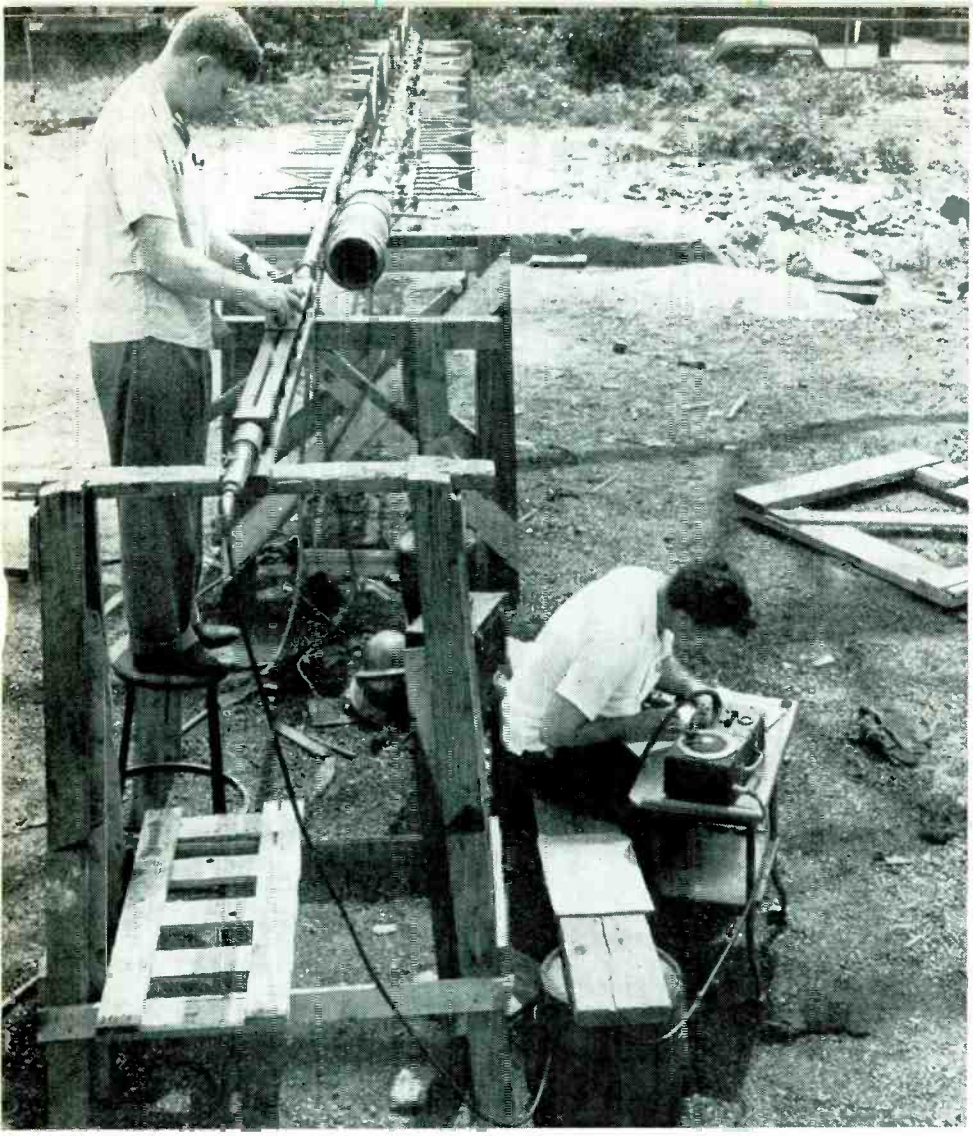


Coaxial cable hangers compensate different coefficients of expansion of steel tower and copper line. Upper clamps are merely lined with asbestos compound. Lower copper-lined clamps grip coax. Downward thrust is taken by springs. Ground is carried by the copper braid from lower clamp to tower

Since the effective height of the WOR-TV antenna is 975 feet above average terrain the effective radiated power has been restricted by FCC to 9 KW. To obtain this the operating power of the transmitter must be reduced to 2.04 KW. This computation includes a 35-percent loss in the transmission line and a power gain of 6.78 for the antenna. For similar legal reasons, the sound transmitter will operate at about 2.5 kw to give 11 kw erp at 975 feet (this includes a loss of 875 watts in the transmission line).

The f-m transmitter for WOR-FM operating at 98.7 mc (channel 254) and installed to the operator's right is standard commercial equipment. Styled the type BT-4-B, it comprises a Phasitron modulator, 250-watt amplifier, and 3-kw, followed by a 10-kw amplifier. Final tubes in this rig are a pair of forced-air cooled 5518's.

The output of each transmitter is converted to single-ended connection by means of a balun. Output from the WOR-FM transmitter is taken directly out of the building and up the tower through 3⅛-inch



Engineers making final tests of the six-bay superturnstile antenna just prior to hoisting it into place. Man at left reads meter indicating standing waves on slotted-line section. Signal generator on table (right)

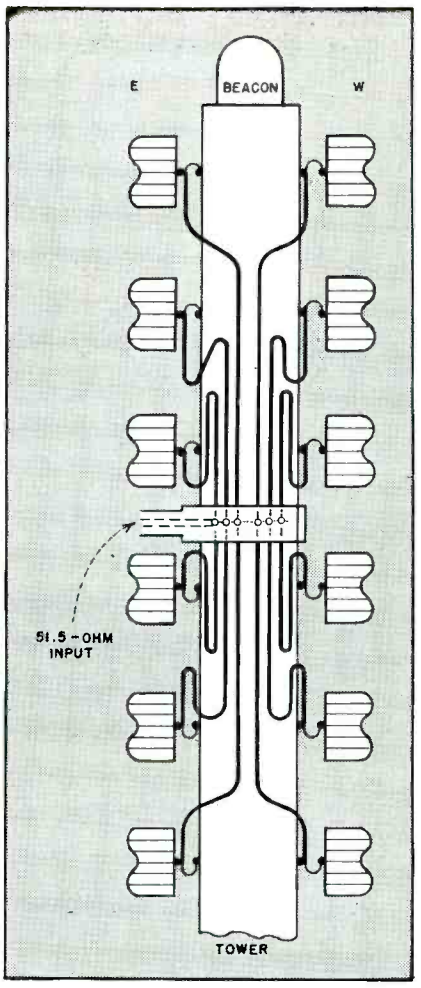


FIG. 3—Detail of the East-West feeder system to the television superturnstile. The North-South feeders are identical

coaxial line and fed into the single-bay circular antenna through a quarter-wave matching section.

Output from the picture and sound transmitters feeds into a diplexer or bridge circuit of which the two sets of radiators appear as resistive elements. The visual transmitter is fed across one diagonal of the bridge and the aural transmitter across the other. From the diplexer unit two 3⅛-inch lines run out and up the tower, one to the east-west elements and the other to the north-south elements. An additional quarterwave length of line is introduced in the north-south feed to obtain the desired quadrature effect between the sets of elements.

Provision is made for gassing the external lines with either dry nitrogen or dry air. The f-m line and the television pair each has its own compressor that draws room air through a silica gel filter. The machine automatically cycles so as to dry out the silica gel and discharge its moisture before another cycle of pumping into the line. Ordinarily, this equipment is adequate to handle routine pressurizing which need be very little more than atmospheric to prevent breathing of moist air.

In the event of trouble, compressed nitrogen from tanks can be introduced instead. The lines inside the building operate without pressure since the temperature of the air inside the building near the equipment tends to be higher than the dew point.

Dummy Load

The picture carrier output r-f line to the diplexer is so arranged that by loosening and swinging a 90-degree elbow this output can be fed instead into a dummy load in order to measure the r-f power generated by the transmitter. A water-cooled resistor of 51.5 ohms terminates the line in its characteristic impedance. Water flows around the resistor and is heated according to the power that the resistor dissipates. In practice, when the water flow is adjusted to 3.8 gallons per minute, the temperature difference directly indicates kilowatts of power dissipated.

Transmitter Controls

One of the fantastic aspects of television is its tremendous appetite for personnel. Covering a ball game in the good old days, an announcer and an engineer might arrive a half hour before the game time with a bagful of audio equipment. Television is certainly not this simple, and in order to avoid inordinate personnel costs, television equipment and its layout must be engi-

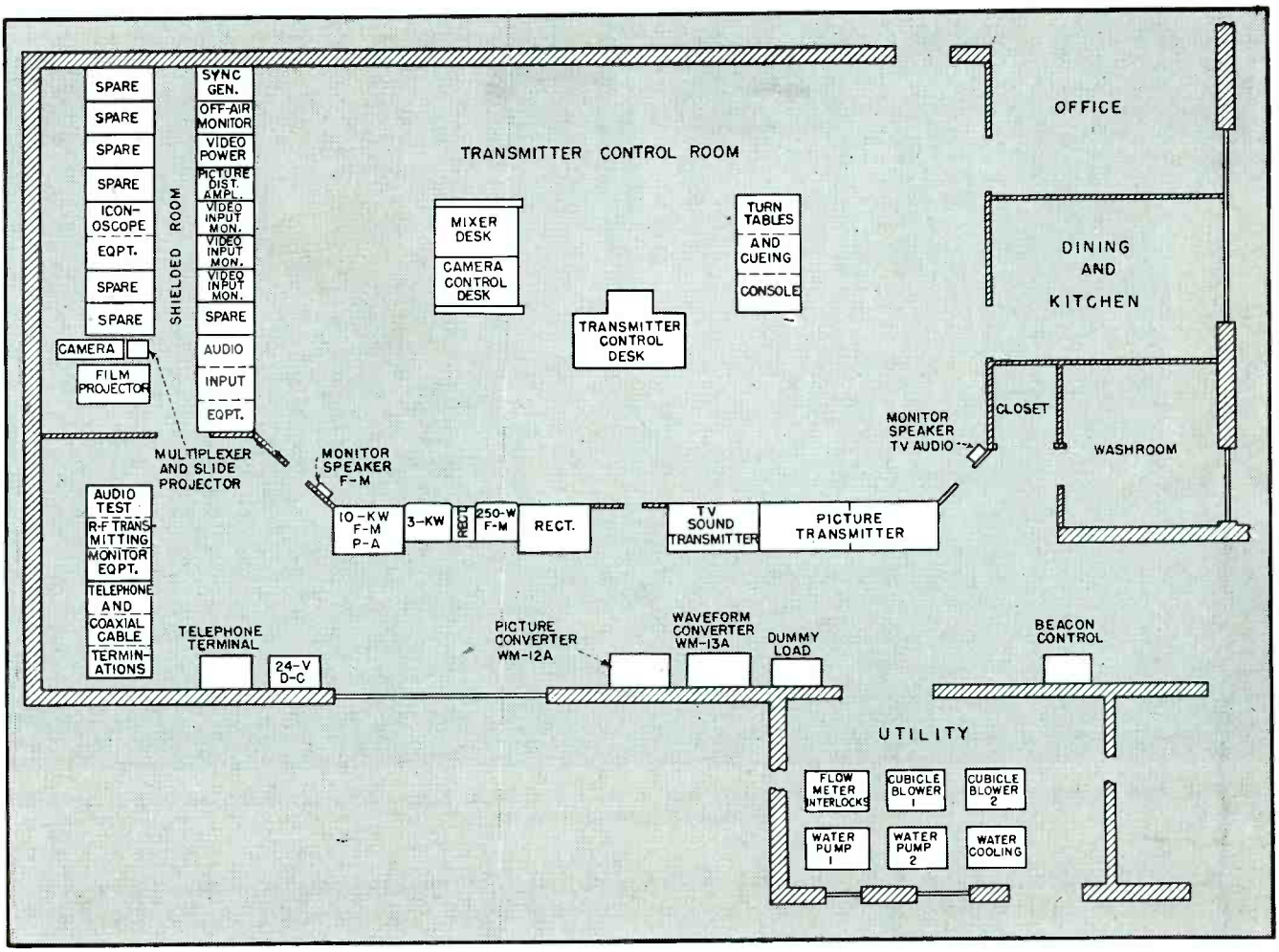


FIG. 4—Layout of equipment and facilities in the transmitter building

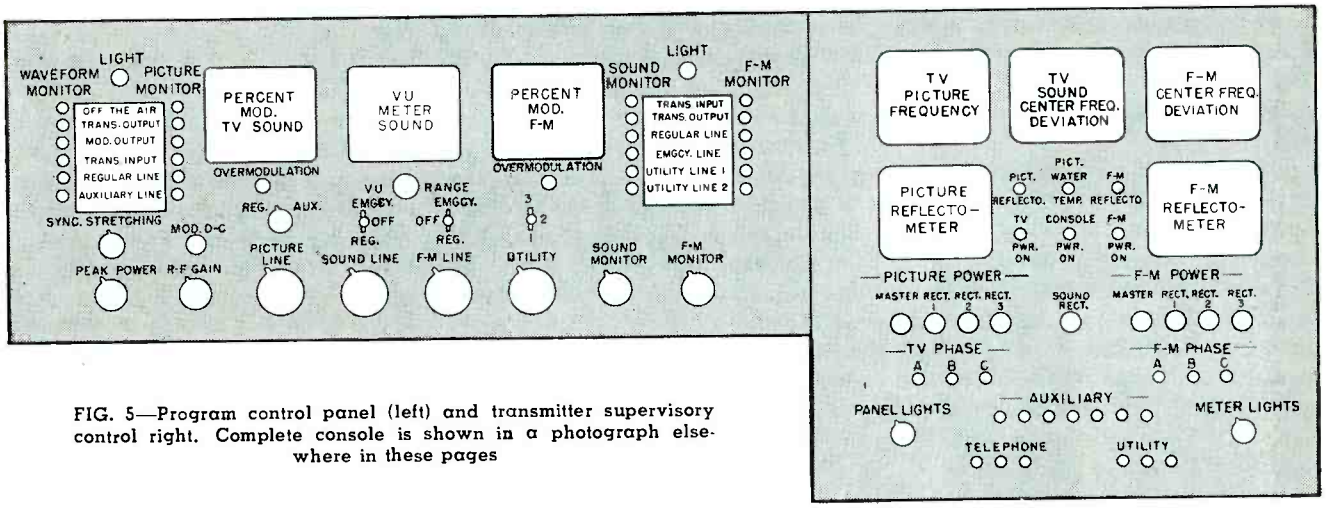


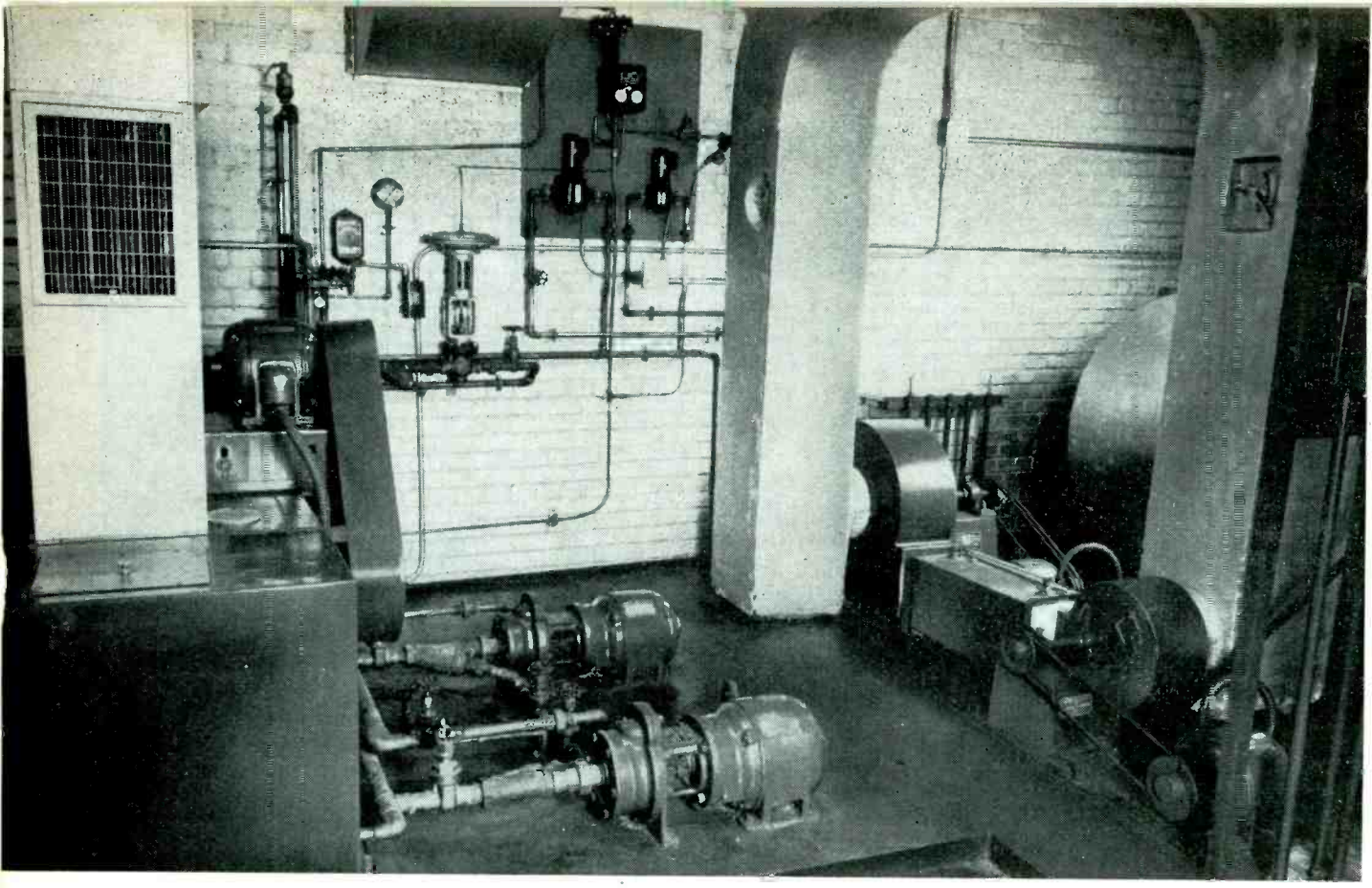
FIG. 5—Program control panel (left) and transmitter supervisory control right. Complete console is shown in a photograph elsewhere in these pages

neered very carefully with this thought in mind.

One-man operation of WOR-TV and WOR-FM is certainly not contemplated, but the transmitter operating console has been arranged so that in any emergency a single individual can adequately operate the television and f-m transmitters simultaneously.

An outline drawing of the transmitter and supervisory control panel is shown in Fig. 5. The three meters at the top indicate deviation from the assigned carrier frequency by television picture, television sound, and the f-m transmitters. The monitoring equipment, comprising a television frequency deviation monitor and two f-m combined frequency and modulation monitors, is remotely located.

The indicating meters on the console are repeaters, or auxiliary indicators supplementing self-contained meters in the equipment. The picture and f-m reflectometer meters indicate how well the transmitters are matched into their respective transmission lines. The



Distilled water cooler, water pumps and cubicle cooling fans in the utility room. Flow control equipment and safety interlocks are mounted on wall at the rear

operator will tend to catch incipient faults such as antenna icing and moisture in the coaxial lines by abnormal deflection of the reflectometer needles.

An automatic power cutoff operates if the line or antenna arcs over. The reason for the shutoff is indicated to the operator by a lighted pilot.

An interesting feature of the picture, sound and f-m power controls is that power can be turned on from the console but not turned off. Since the great problem in broadcasting is keeping the station on the air rather than taking it off, this arrangement makes good operating sense. Once the transmitter is on the air, accidental contact with the control buttons can not knock it off.

In front of the operator is the program control panel. As in the first panel, television functions are to the left and f-m to the right, corresponding to placement of the respective transmitters. Repeater meters that indicate percentage of tv sound and f-m modulation are placed on each side of the vu meter that is used primarily for television sound. The overmodulation lamps show when a preset level is being exceeded by the transmitter.

The four sets of vertical six-key monitor switches allow the operator to make a rapid check of overall performance for video (the picture is viewed on a large screen and the waveform on a smaller tube to to the left of the operator) and both sound and f-m transmitters. The interlocking switches have separate level controls beneath the hinged covers on which the designations appears. This feature allows the operator to equalize levels for monitor scopes and speakers. Normally an off-the-air monitor is viewed. When trouble develops, the operator checks back through various outputs and inputs until the source of the disturbance is localized.

Regular and auxiliary (or emergency) inputs are arranged to give the transmitter operator some flexibility without burdening him with control-room duties. A rotary switch is provided for input either from incoming line from master control in New York, or the output of the mixer desk at North Bergen. There are two telephone toggles for tv sound and f-m. The switch at the extreme right allows a selection of any three combinations that may be patched into the console for special events. The gain controls associated with these switches appear immediately below. The picture line fader is not a usual control but has been included here to increase flexibility.

Three other controls also of prime importance for the picture signal appear at the lower left. The sync stretcher permits adjustment in the sync amplitude relative to the picture. It might need adjustment, for example, when a remote program is put on the air following a local program, although ordinarily this will have been taken care of at master control. The peak power control sets the power output at synchronizing peaks so that the modulation envelope can be made to conform to FCC specifications. The r-f gain control adjusts the screen voltage in the first r-f stage and serves to raise or lower power output when the correct modulating conditions have been established.

There is a monitor speaker in the control room for each transmitter as shown in Fig. 5, with other monitor speakers mounted elsewhere in the building. It has been suggested

that those attempting to monitor two different audio programs may be in danger of developing a new form of schizophrenia or split personality. However, the practice of dual listening is not unknown in the radio art. An operator is usually unaware of or only passively interested in specific program content. But if noise develops or if the program is cut off he notices immediately. For example, an operator dozing on his own living room couch will probably spring to his feet if his wife suddenly switches off the radio midprogram!

Video Equipment

Facing the man at the video control desks are three type TA-153-A terminal facilities racks for incoming video signals. Each unit comprises a 12-inch picture monitor and two 5-inch waveform screens for both line and frame signal monitoring. Besides containing a sync stretcher, each unit has a special patch and switch panel in order to increase the flexibility of the equipment and facilitate its use at various points in the system.

The type TA-137-A picture distribution equipment contains a four-channel studio mixing line amplifier that is controlled by the switching unit in the mixer desk. The patch panel gives flexibility for special events or testing.

A single sync generator (type TA-107) is deemed sufficient for operation at the transmitter for testing and emergency operations.

All the above equipment, each unit in its own metal cabinet, forms the wall of the shielded room facing out on the transmitter control room. Within the shielded room, also enclosed in metal cabinets, are the iconoscope camera used with both the slide projector and the film projector, and the associated electronic equipment. This equipment, together with shading and other controls, is operated from the camera control desk. Six spare rack cabinets stand empty for future expansion.

Tower Control House

Some details of the microwave relay equipment have not yet been worked out. The tentative plan is to provide a 2-kilomegacycle and two 7-kmc links for remote pickups at North Bergen. The receiving dishes will be located on the tower and coaxial lines will feed the signal to the shielded room for monitoring and despatching to master control at the New York studios.

The control house itself is located at the 555-foot level of the tower, or 795 feet above sea level. It houses an electric winch and 600 feet of steel hoisting cable, serves as control point for the antenna heater thermostat control, and contains the microwave receivers and associate equipment. In addition, there is a 300-pound capacity block and tackle to aid in moving gear about the inside of the structure.

Although it is not expected that personnel will be stationed regularly at this point, the stairway up the tower is brought up to this level, with a vertical steel ladder going from here to the top of the tower. There is a steel grating around the house and a fence so that personnel can safely inspect the outside of the enclosure or set up experimental equipment in that area.

Above the roof of the control

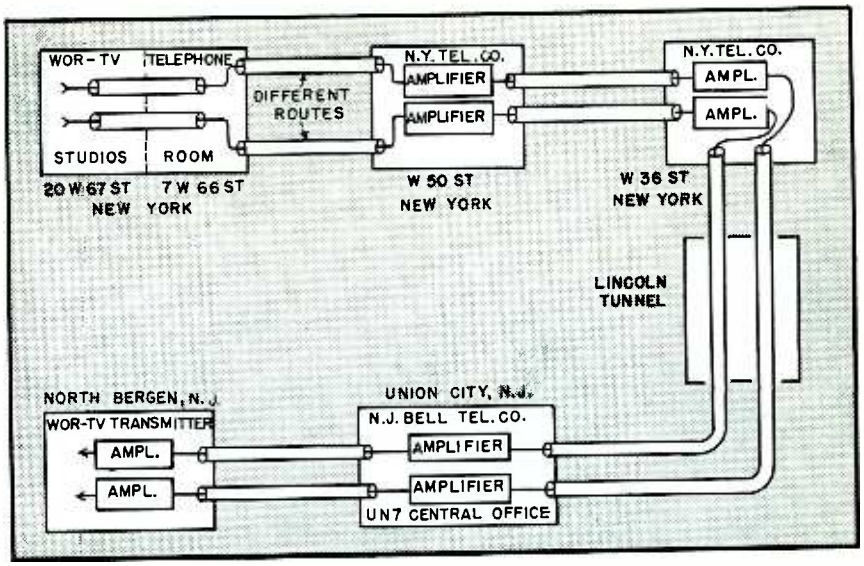


FIG. 6—Simplified diagram of the coaxial cable circuits between studios and transmitter

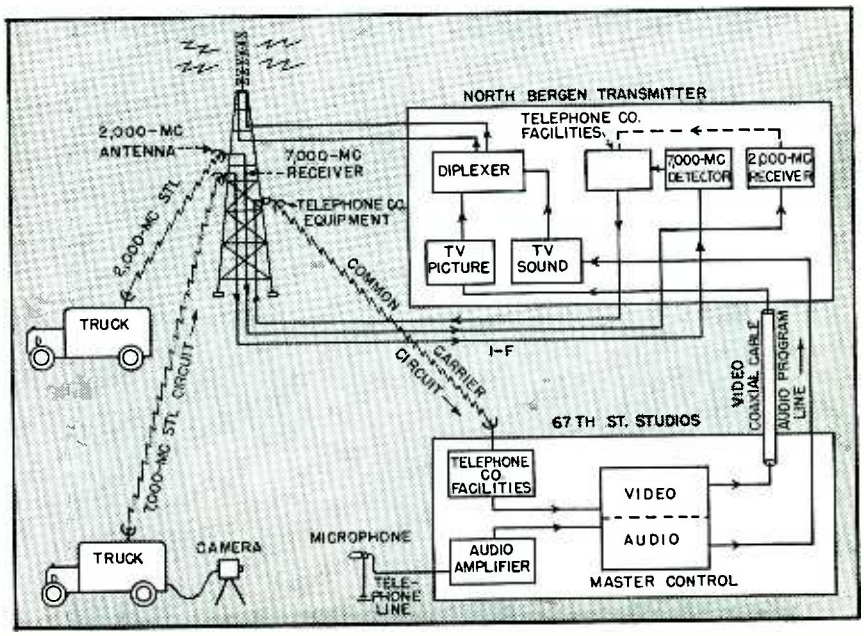


FIG. 7—Facilities are provided for carrying one remote while setting up for another simultaneously. Switching is done at studios and desired program fed back to transmitter

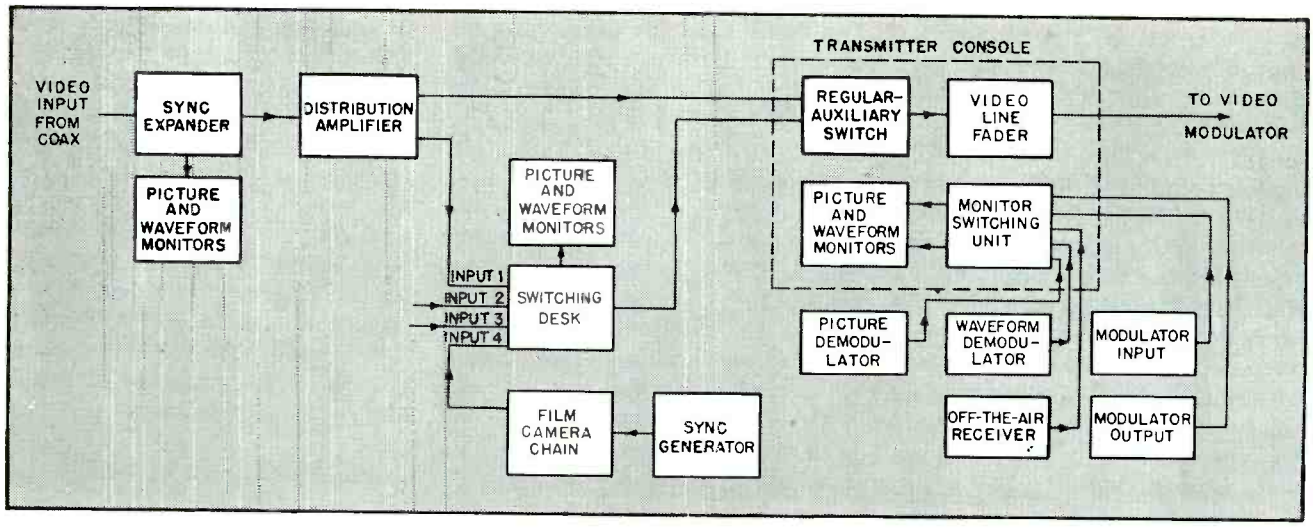
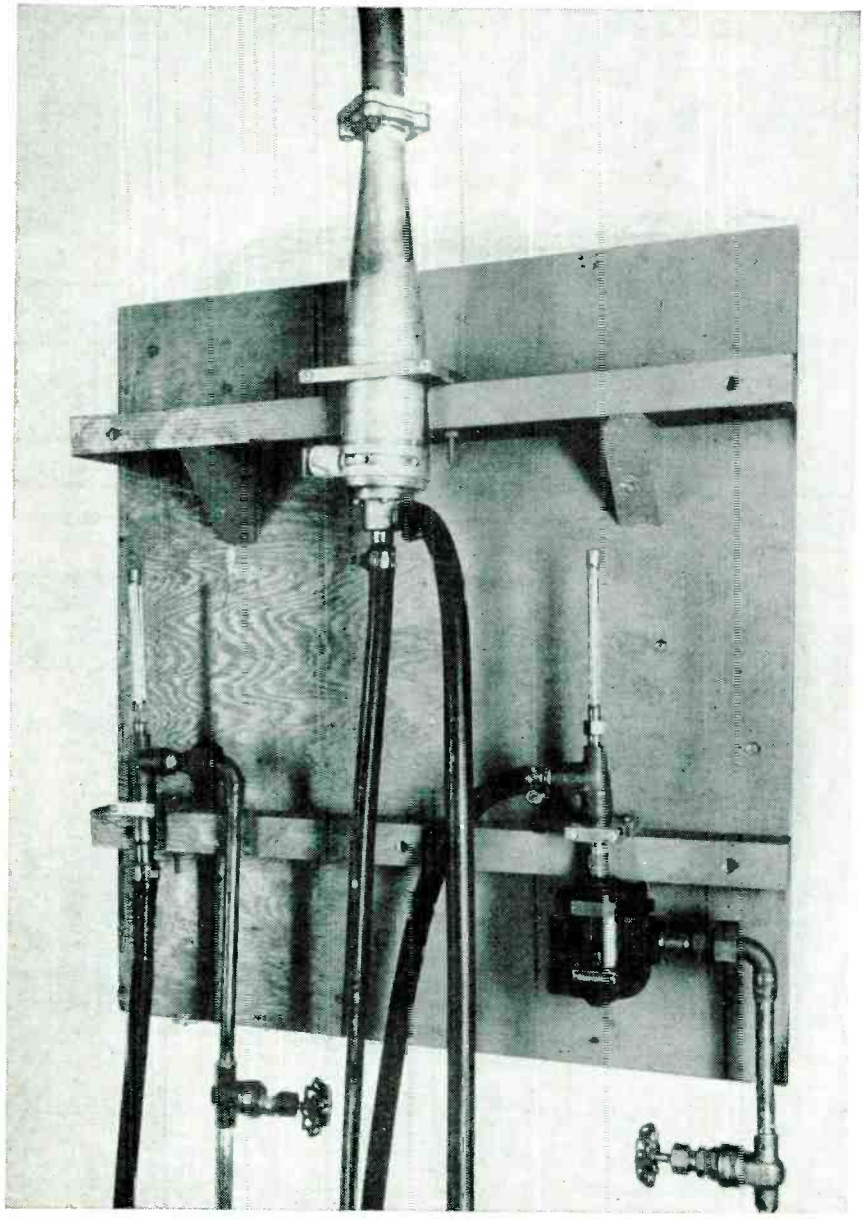


FIG. 8—Video signal switching and check points at the transmitter plant



Dummy load used for testing transmitters. Metered water flows over a power-dissipating resistor. Temperature difference of water between input and output shows power

house is another steel grating surrounded by a fence. This upper area is used for mounting the microwave dish antennas. A hinged trap door is provided for lowering equipment, and there is a 2 by 6 foot trap door in the house, near the winch and motor, to allow hauling equipment up to this level by power.

The house itself is 10 by 10 feet and has 8 feet headroom inside. The walls are RPM V-beam 22-gage siding with a half-inch lining of insulation. The proper closing and weatherproofing of this building is extremely important if it is reliably to perform its function of sheltering microwave circuit equipment. Temperature effects, either heat or cold as well as the effect of humidity, will be accentuated by the winds that will be considerably higher in velocity than those on the ground.

The exact placement of the microwave antenna dishes will not be settled until experience has shown both what is possible and exactly what the circuit problems will involve. In the early stages, manually adjustable dishes will be employed. The ultimate arrangement will involve antennas that can be remotely oriented both in azimuth and direction controlled from within the main transmitter building. These antennas in plastic radomes will shoot through the steel tower members in the desired direction. Experiments so far made indicate that at 2 kmc there will probably be no great difficulty in picking up remote transmitters with a receiving dish located inside the

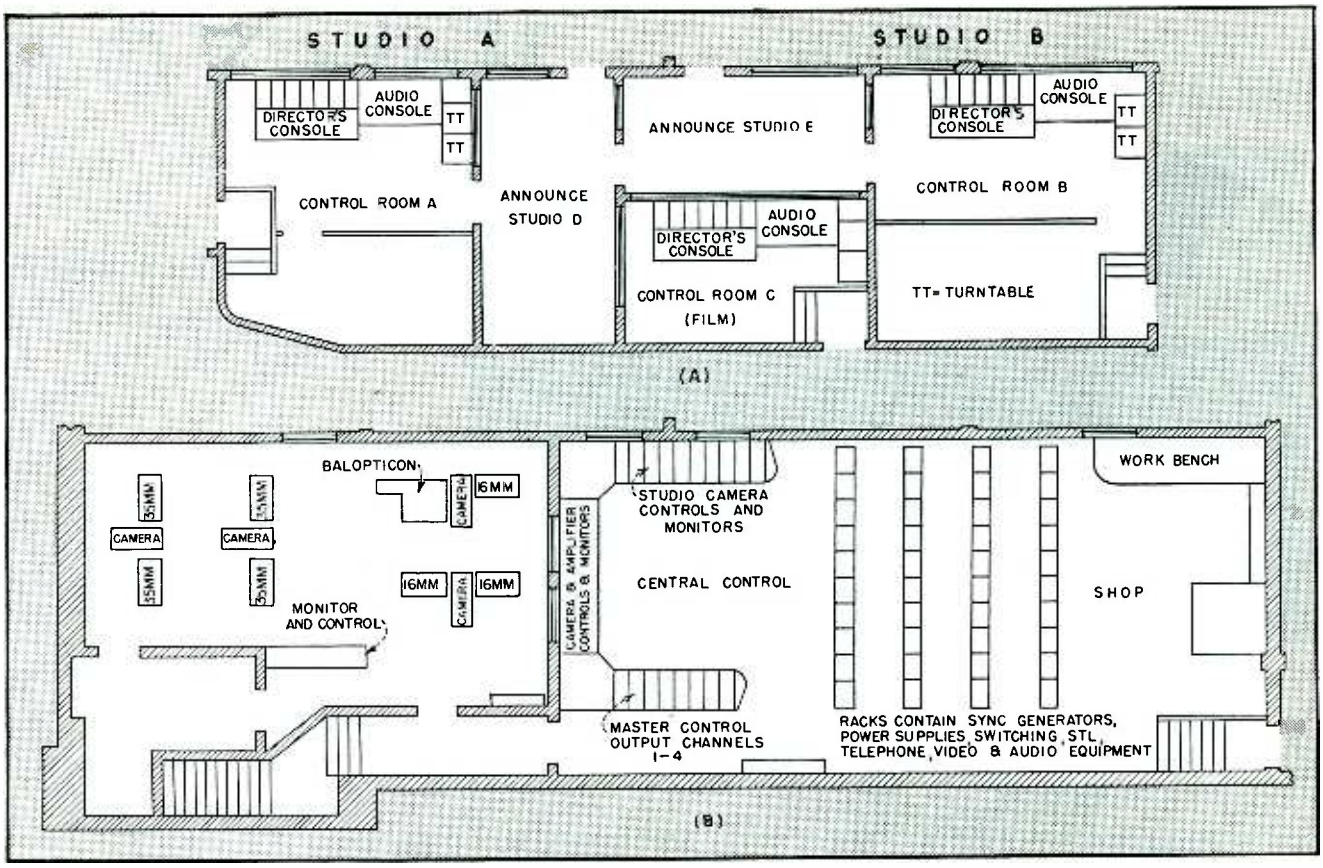


FIG. 9—Control areas in the studios. Program control rooms (A) are located at approximately studio floor level. Camera control and equipment (B) are located on floor above looking out over studios

tower. Whether or not this can also be done at 7 kmc has not been determined.

Wire facilities for WOR-TV and WOR-FM are of three types: subscriber's line for regular telephone conversations, high-quality audio program lines, and broadband video circuits for video signals. All of these facilities are leased from the Telephone Co.

There are two video circuits provided to convey signal from master control to the transmitter. In addition a third video circuit is being provided to convey signals from North Bergen to the studios in New York. This latter circuit will also be furnished by the Telephone Co., but will probably consist of a microwave link.

Regular telephone service is handled through the WOR PBX board at 1440 Broadway. Between 40 and 50 extensions will serve television operations, most of these lines being used at the studios and offices at 67th Street.

For f-m programming, there are two lines, one for regular service and a spare, between the 1440 Broadway studios and North Bergen via the Lincoln Tunnel. These lines are substantially flat from 40 to 15,000 cycles. A similar pair of program lines for television sound is provided between the 67th St. studios and the transmitter.

The two coaxial cable circuits are outlined in Fig. 6. They have a response essentially flat up to 4 mc.

Progress of a Program

Although it is intended to receive remote pickup signals at the transmitter, best operating practice dictates that they be returned to the studio for switching, both back to the transmitter and onto the network. It is therefore necessary to provide return circuits as shown in the tentative diagram of Fig. 7. This is the purpose of the third video circuit mentioned above.

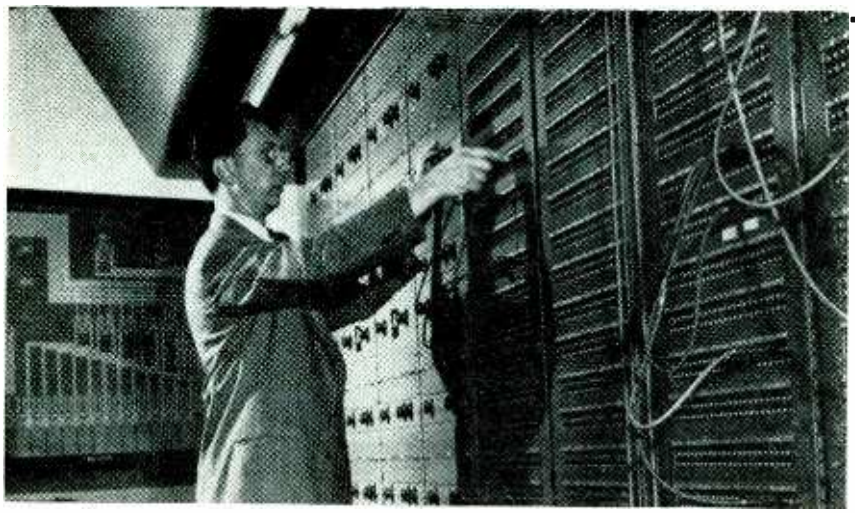
The progress of an incoming video signal from the coaxial line through the numerous switching and check points to the transmitter is shown in Fig. 8.

Studios

The studios at 67th Street are still under construction at this writing. They have been arranged to complete the overall plan for flexibility and economical operation. The control rooms outlined in Fig. 9 look out into studios that are about 45 by 60 feet. Equipment is kept to a minimum in the control rooms by eliminating camera control units from this area. They are centralized as described below. However, adequate monitoring is provided, the aim being to have not only one monitor available for each camera associated with the studio, but also one monitor for each additional picture source that might be used in a given program presentation. This is accomplished by having a director's console with seven monitors, which should give adequate flexibility in this respect, and avoid the confusion of continual switching of monitors.

The camera technical control is centralized on the second floor along with other programming functions that do not require a view of the studios. By means of good intercommunication and camera switching systems, the flexibility of equipment is enhanced and more than the normal four camera chains per studio can be employed.

How VOA



Master control jack field and program amplifiers at VOA, New York

By GEORGE Q. HERRICK

International Broadcasting Division
Department of State
New York, N. Y.

THE problems of international broadcasting are very different from those of commercial a-m broadcasting as practised in North America. Coverage is dependent, as it is in any service, upon field strength, signal-to-noise ratio, and interference. The selective fading

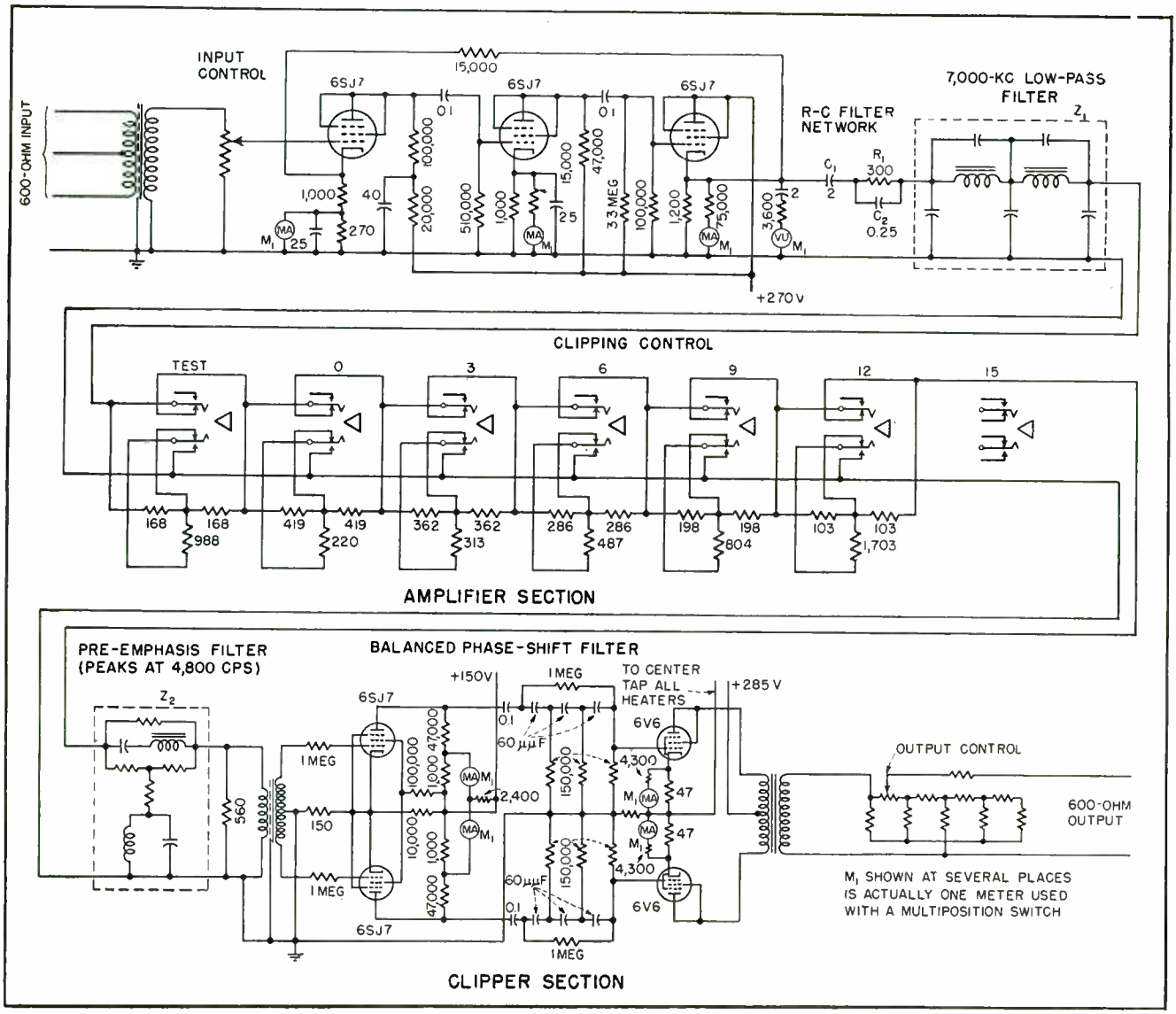


FIG. 1—Schematic circuit diagram of the audio peak clipping amplifier

Combats Jamming

Successful international broadcasting by the Voice of America depends upon many factors including choice of radio frequency, location of transmitters, and efficient modulation. The predistorter and peak limiter described accentuate speech intelligibility when multiple use of frequencies causes jamming

that is characteristic of skywave signals upon which international broadcasting depends sets a low maximum for signal quality. Particularly when it is desired to transmit speech with a maximum of intelligibility, wide departures from standards of broadcast music quality can be tolerated. The criterion for desirable transmission becomes one of efficiency, or optimum use of modulating power.

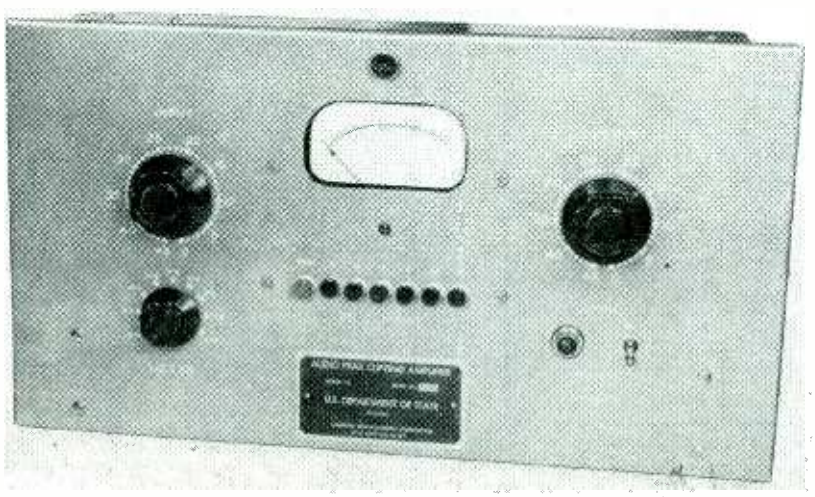
Speech Characteristics

Studies of speech characteristics indicate that most of the energy is carried in the lower frequency vowel sounds. Intelligibility of speech in almost all modern languages, however, resides in the higher frequency consonant sounds. These paradoxical factors have been reconciled in the design of an audio peak-clipping amplifier employed for broadcasting speech at the highest possible percentage of modulation and minimum distortion.

There are available a number of devices and circuits for limiting percentage of modulation that are satisfactory for standard broadcast or communications operations. When considered from the point of view of voice intelligibility they are inadequate. The lower frequency vowel sounds carry energy and are also impact vowels that act as the triggering pulses in the control circuit of automatic gain-control devices. Overmodulation transients are not automatically avoided with simple limiting or compressor circuits because all of the first peak is not limited. Time is required for gain reduction to occur. Moreover, in terms of intelligibility, it can be shown that although the average percentage of modulation of the transmitter is increased, the resulting signal loses in intelligibility.

The gain reduction of a limiting amplifier is initiated by peaks of the impressed signal caused by the low-frequency vowel sounds. Because the device requires a finite time to come into and go out of operation, not only does the peak of the action sound pass through the transmitter at full amplitude, but the compressor device is left in a low-gain state for the following consonants. As a direct result, the gain into the transmitter must be kept at sufficiently low level as not to cause overmodulation on peaks, and the consonants are, so to speak, doubly penalized by such a system.

In addition, the high frequency of occurrence of the impact vowels tends to keep the limiter, when operating with normally used gain restoration time constants, in a continuous state of gain reduction.



Front panel view of the audio peak clipping amplifier

Advantages of Clipping

The desirability of the clipping technique becomes apparent when it is realized that all usual limiting action involves finite time intervals, both for the attack and release, whereas clipping acts instantaneously. There is a consequent deterioration in intelligibility when limiting even though there may be an increase in the overall transmitted energy, whereas, with clipping there is an improvement in the intelligibility and an increase in the overall transmitted energy.

The equipment used at Voice of America increases both the intelligibility of the transmission and the average percentage of modulation (without danger of overmodulation) by a combination of two techniques. The audio signal is first predistorted and the resultant signal is then clipped.

Because of the greater amplitude of the low-frequency vowel sounds, most of the clipping takes place in that region and the consonant sounds are not normally affected. As a result, there is now a greater

relative amplitude of consonant than vowel sounds. Pre-emphasis of the higher frequencies, from 2 to 7 kc, again increases the relative amplitude of the consonants.

The four filters incorporated in the clipping amplifier are essential to its optimum operation. The first shown in Fig. 1 is the R-C network comprising R_1, C_1, and C_2. The effect of this network is to cause the low-frequency end to droop 8 db at 50 cycles. This characteristic not only improves the intelligibility, but also eliminates considerable distortion owing to clipping at these very low frequencies.

The second network, Z_1, is a tuned m-derived low-pass filter that cuts off sharply above 7,000 cycles. This circuit restricts the bandwidth of the radiated signal and eliminates adjacent-channel interference. The suppression of the higher-order frequencies before clipping eliminates potential high-order harmonic generation that might arise from clipping.

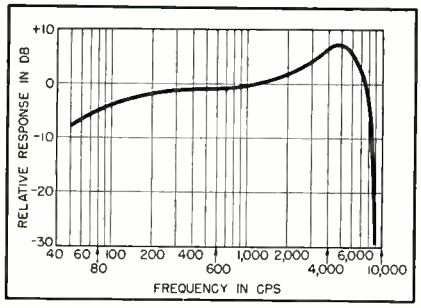


FIG. 2—Gain characteristic of the amplifier. At 1,000 cycles for 50 db the noise is 67 db below a milliwatt

Filter Z_2 is used for pre-emphasis of the frequencies between 2,000 and 7,000 cycles, peaking at 4,800 cycles. The overall resultant curve shown in Fig. 2 is complementary to the average energy curves for voice and music.

A fourth filter, following the clipper section, uses an R-C balanced phase shift filter to suppress high-order harmonics and transients that might otherwise cause interference on adjacent channels. An R-C filter was used in order to avoid the resonant transient effects inherent in the L-C type.

Point of Clipping

The point of clipping is arbitrarily defined as the point reached when a 10-db increase at the input to the device results in not less than a 9-db increase in the output, and beyond which the peak voltage output does not increase by more than approximately 10 percent regardless of increased signal input. The clipping action has been set at a predetermined point, up to which the amplifier is essentially linear with little distortion. For instance, using a 400-cycle tone, there is less than 1.25-percent distortion at 5 db below the point of clipping and less than 6 percent at the point of clipping. In application, this amount of distortion can be tolerated because of the distortion developed by the short-wave transmission paths and that inherent in many receivers. It should be noted, further, that the distortion curve shown in Fig. 3 is for single-tone sine-wave signals and therefore does not truly reflect the aural distortion experienced under actual conditions using complex program material, as can be proved by listening to one of the broadcasts.

It should also be noted that the input-output curve shown in Fig. 3 is based on measurements of rms amplitude and therefore in no way reflects the true peak clipping characteristics of the unit. Oscilloscope indications must be employed to show the comparison with rms readings.

In operation, three controls are used: the input, output and the mechanically interlocked clipping control. With a single tone of 1,000 cycles applied to the input of the clipping amplifier, the input control is varied until a deflection of 100 is indicated on the vu meter. With the output connected to the transmitter input, the output control is increased until the desired percentage of modulation (normally about 85 percent) is obtained. Under operating conditions with program input, an oscilloscope is required for determining the percentage of modulation. The usual modulation monitor reads rms values and hence any reading made while clipping will be high compared to the true peak percentage of modulation.

Adjustment and Operation

With normal program, the input control is again readjusted until peaks cause a meter deflection of 100. Ordinarily, 9 db of clipping is used. Beyond this point harmonic distortion becomes increasingly apparent. The 12- or 15-db switches are used only during periods of severe interference.

The equipment has been designed by International Broadcasting Division engineers of the State Department and manufactured by Langevin Mfg. Corp.

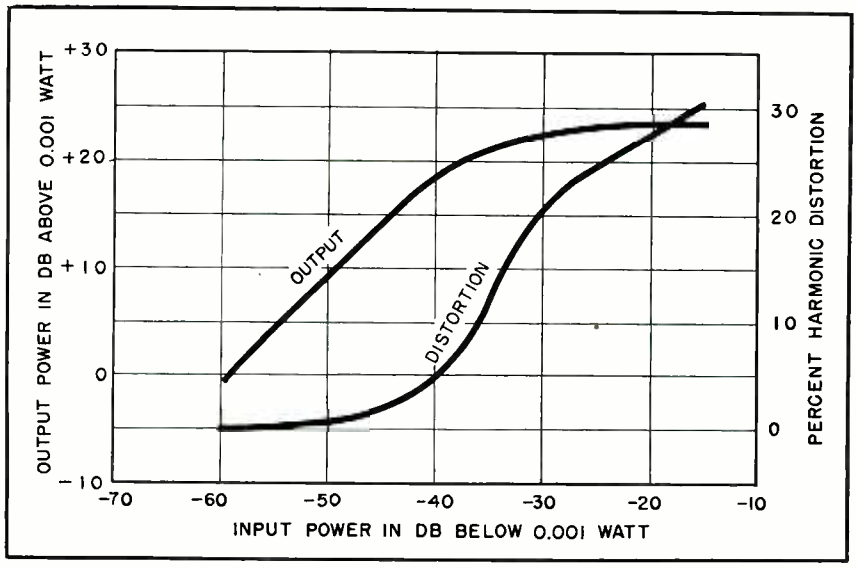


FIG. 3—Output and distortion curves of the clipping amplifier

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PHOTOCELLS
Measure and Control Gas

A metered flow of gas passes through chemically sensitized fabric tape which turns brown in the presence of hydrogen sulfide. The degree of stain is measured by a differential photometer consisting of two photovoltaic cells in a bridge circuit

By WILLIAM H. SCHAEFFER *Rubicon Company Philadelphia, Pa.*

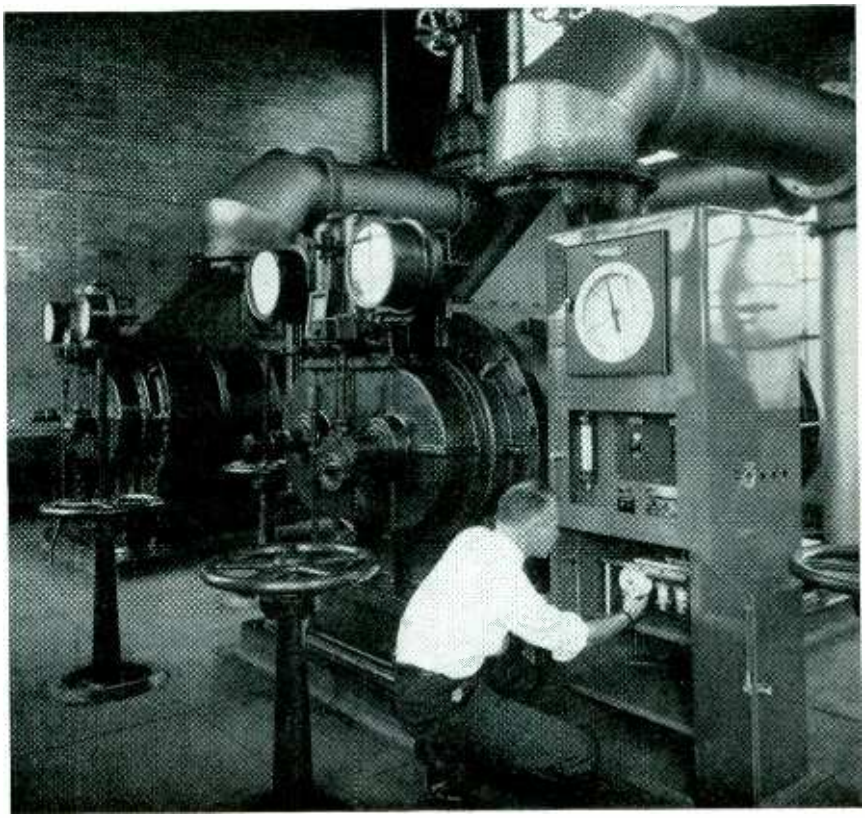
NOXIOUS QUALITIES of hydrogen sulfide in many phases of chemical technology, its corrosive action in gas storage and distribution systems, the corrosive character of its products of combustion, its contamination of furnace charges in metallurgical operations and other objectionable characteristics of this common constituent of both manufactured and natural gas have long been recognized. In the atmosphere its toxic effect is well known and is the subject of legislation defining the maximum permissible concentration for continuous exposure of the worker.

Despite the technical and hygienic significance of the control of hydrogen sulfide, no method for the automatic periodic measurement of its concentration in the ranges of interest was available prior to the advent of the photoelectric cell. Because of the very low concentration involved, of the order of a few parts per million or a few tenths of a grain of H_2S per 100 cubic feet, the more common methods of gas analysis based on the measurement of thermal conductivity, specific heat, heat of combustion, electrolytic conductivity of aqueous solutions of the gas, or other non-specific property cannot readily be employed.

Although lead acetate has been employed for many years in the detection of hydrogen sulfide by visual means, the conditions under which the test is normally made are conducive neither to sensitivity nor reproducibility. Credit for defining the conditions under which high sensitivity and accuracy can be attained, and for establishing the basic features of design of the automatic recording and controlling analyzer here described, is due D. V. Moses and his associates at E. I. du Pont de Nemours & Co.* The generous cooperation of this company is gratefully acknowledged.

Gas from a suitable sampling line is fed continuously into the analyzer

* U. S. Patent 2,232,622.



Installation of the analyzer in the metering room of a gas and coke producing company

and is there brought to a predetermined temperature and humidity. A metered flow of gas is then passed through a restricted area of a sensitized white fabric tape previously impregnated with lead acetate, glycerin and acetic acid. In its passage through the tape the hydrogen sulfide reacts stoichiometrically with the lead acetate, forming the characteristic brown lead-sulfide stain.

The area of the tape subjected to the flow of gas is illuminated with light of appropriate spectral quality and the relative reflectance, compared to a similar area of tape not exposed to the gas flow, is measured by a differential photometer consisting of two photovoltaic cells in a bridge-type circuit feeding into an automatic continuous-balance recorder of the null type. As the gas flow continues the lead-sulfide stain deepens, the reflectance decreases, and the recorder indicates the progress of the change. A schematic diagram of the apparatus is shown in Fig. 1.

At the conclusion of a preselected test period the photometer is automatically disconnected from the recorder whose indication remains at the position corresponding to the reflectance of the tape at the end of the test period. At the conclusion of a preselected cycling period an explosionproof motor releases the tape, advances it sufficiently to expose a new section, rewinds the used section, and reclamps it, all within approximately one second.

The recorder is automatically reconnected to the photometer, returns to zero indication, and the succeeding test period begins.

This cycle is repeated, resulting in a chart record consisting of a series of peaks or plateaus whose height is a measure of the total amount of hydrogen sulfide reaching the tape in the preceding test period. A typical record is illustrated in Fig. 2.

Means are provided for varying the test period and for repeating the entire measuring cycle as frequently as may be required. For gas of extremely low hydrogen sulfide concentration, of the order of 0.1 part per million or approximately 0.005 grain per hundred cubic feet, the test period may be continued for as long as two hours. For gas of moderate or relatively high concentration the test may be limited to as little as one minute or less.

The basic calibration, Fig. 3, of the analyzer relates reflectance or recorder readings to the absolute amount of hydrogen sulfide required to produce a stain of the corresponding reflectance. This relationship is similar to that between transmittance and concentration in conventional colorimetric analysis with transmission photometers. From the basic calibration, working calibrations for any given rate of gas flow and for any selected test period may be readily computed.

Gas Train Details

Gas entering the equipment passes first through a preliminary humidifier, after which a portion is allowed to escape through a spill bottle, thus establishing a constant-pressure head on the remainder of the gas train. The gas then proceeds successively through a trap, a stainless-steel needle valve and a flowmeter. From the flowmeter, the gas passes through a secondary humidifier and trap, thermostatically controlled at 35 C, and is then fed into an annular compartment surrounding the tape exposure cell which is also thermostatically controlled.

The secondary humidifier contains a saturated solution of ammonium nitrate over excess crystals of the salt and is thus capable of imparting a fixed water-vapor tension to the gas. The relative humidity is thereby controlled at approximately 60 percent. From the annular compartment, the gas passes through small orifices into the tape exposure cell, then through the tape which is tightly clamped above the cell, and then to exhaust.

Photometer Details

Two Mazda 1493 6.5-volt microscope illuminator lamps are employed, one for illuminating the test area and the other for illuminating the reference area of the tape. The lamps are series connected to assure that small current fluctuations will affect both lamps equally, thus maintaining proper balance in the bridge-type photocell circuit.

To avoid gross changes in lamp currents, the lamps are energized from a twelve-volt constant-voltage transformer designed for 115-volt 60-cycle frequency-regulated circuits. Provision for other circuits can be made when required. A variable resistor in series with the two lamps affords means for operating the lamps well below their rated voltage, normally at about 4.5 volts. The photometer lamps are stabilized by operation at 4.5 volts for 48 hours before installation.

The measuring and reference photocells are of annular shape and are placed in the thermostatted chamber, immediately below and facing the impregnated tape. Light

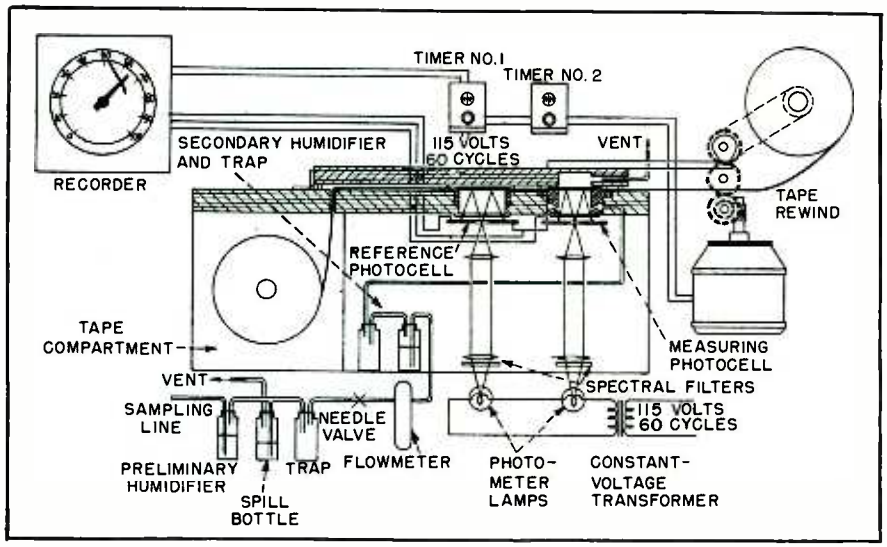


FIG. 1—Schematic diagram of hydrogen sulfide analyzer. The sensitized fabric tape passes through one chamber unchanged but turns brown in the one at right

beams from the two photometer lamps are filtered to isolate a spectral band corresponding to the absorption band of the lead sulfide and are then focused so as to pass through the openings in the annular photocells, diverging sharply beyond the cells to illuminate the exposed tape areas.

The light beams are diffusely reflected by the tape and are intercepted by the measuring and reference cells which are connected in the balanced bridge circuit shown in Fig. 4. Circuit parameters are so chosen that linearity in the current-illumination relationship is maintained.

Referring to Fig. 4, voltages derived from the loading circuits of the reference and measuring photocells are connected in opposition through the converter of the continuous-balance recorder. Any inequality in these voltages causes the recorder balancing mechanism to drive the slidewire in the appropriate direction until balance is restored. The system is initially balanced, with fresh tape in position above the reference and measuring cells, by manipulation of the zero adjustor until the recorder indicates a reading of 5 on its 100-division chart.

The zero adjustor permits balance to be achieved irrespective of inequality in sensitivity of the two photocells and of possible asymmetry in the optical system. Since the balance position, either in setting the zero or in indicating a measurement, is a function only of the ratio of the voltages, the accuracy of the analyzer is affected neither by the small lamp current changes which persist despite the use of the voltage-regulating transformer, nor by chance variation in the absolute reflectance of the tape from roll to roll.

The use of an isolated spectral band for the reflectance measurement not only increases the sensitivity of the analyzer but contributes also to permanence of calibration irrespective of color temperature changes in the lamps.

A chart reading of 5 for the photometer zero is chosen in order to permit automatic indication of any unusual condition which might disturb the initial setting. In the normal course of operation the recorder returns to the zero position of 5 (± 1 division representing random variation in reflectance from spot to spot on the tape) at the beginning of each test. The development of any condition affecting the zero balance is indicated on the succeeding test cycles by departure of the zero from its normal setting. As long as the zero remains on scale it is possible to calculate new reflectance values corresponding to the new zero position, thus permitting accurate evaluation of data obtained even before normal operating conditions are restored.

Because of the exponential relationship between the absolute amount of hydrogen sulfide passed through a given area of the tape and the relative reflectance of that area, the lower portion of the reflectance range becomes exceedingly crowded and cannot be used to advantage. For this reason the relative reflectance covered by the recorder scale (5 to 100) has been limited to the range from 100 percent down to 34.5 percent. Other ranges can be provided by changing the 20-ohm resistor at the lower end of the recorder slidewire to the appropriate value.

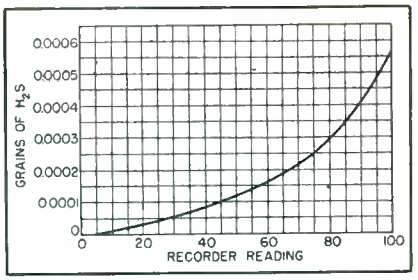


FIG. 3—Basic calibration of the analyzer

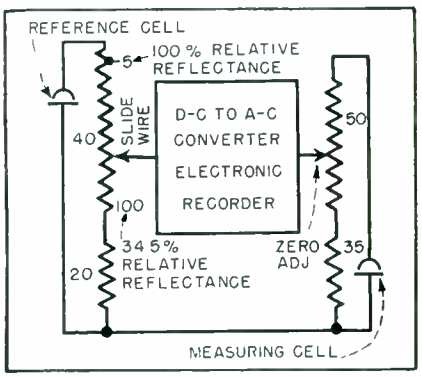


FIG. 4—Slide-wire photometer bridge circuit

Ranges

By changing the timer settings and the rate of gas flow, full-scale deflection of the recorder may be made to correspond to any chosen concentration of hydrogen sulfide between 2 and 500 parts per million. On the lower range a concentration of 0.04 part per million produces a deflection of 5 divisions on the recorder scale.

By appropriate modification of the basic design, concentrations as high as 25 percent of hydrogen sulfide can be readily handled. Equipment for use in the higher ranges is individually designed to meet the specified requirements for each installation.

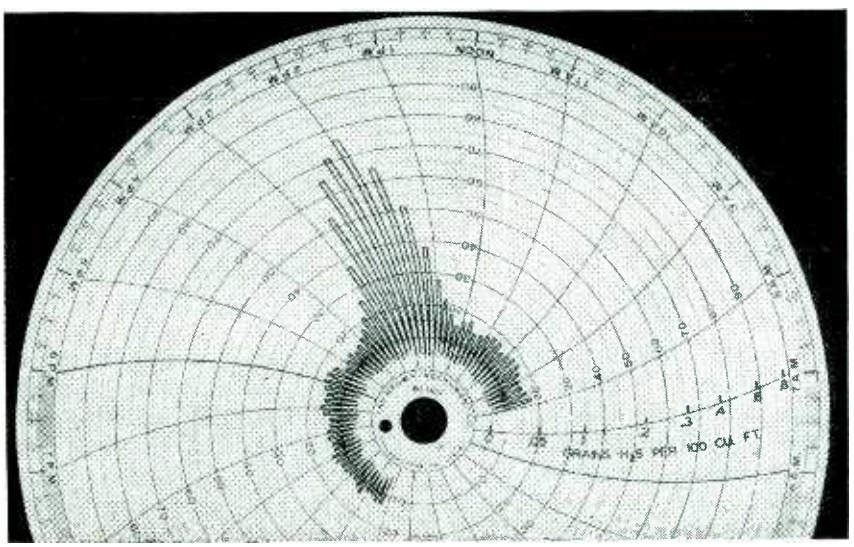


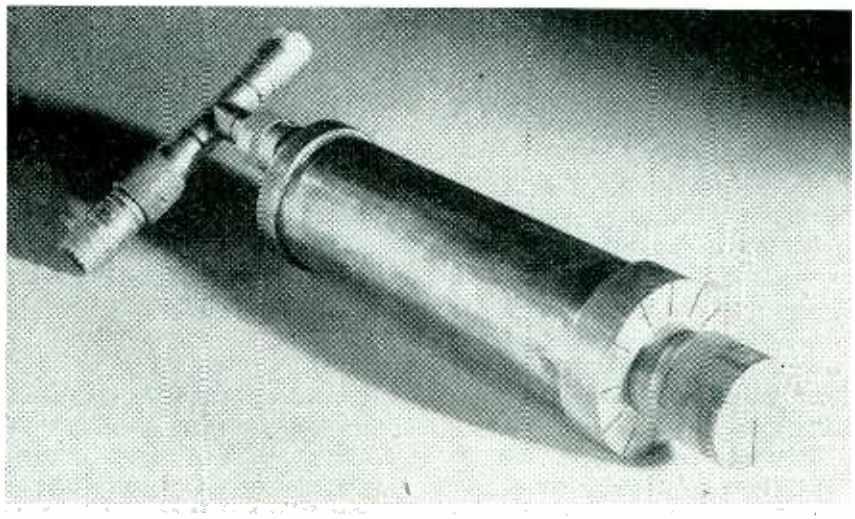
FIG. 2—Portion of a typical hydrogen sulfide analyzer record covering several hours showing a 10-minute test period in each 15-minute cycling period

CITIZENS RADIO

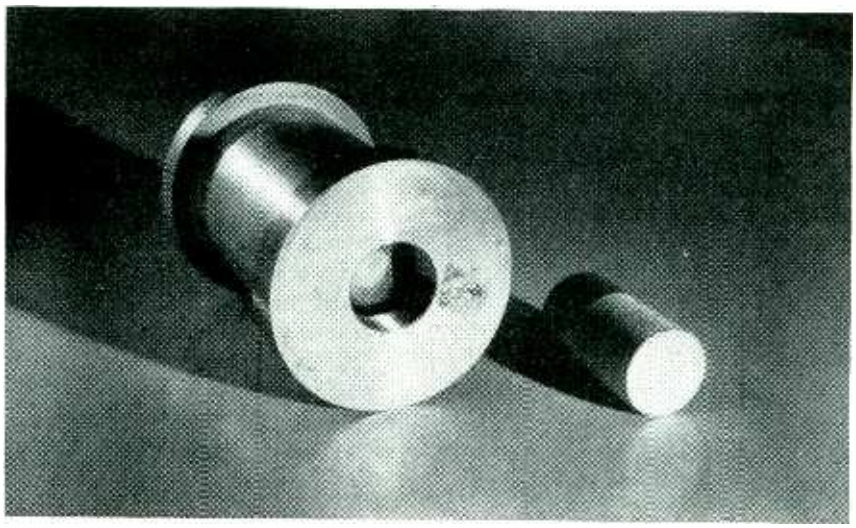
THE GRADUAL PUSH toward more widespread use of the frequencies above 300 megacycles by the general public, and by non-commercial and non-research organizations such as radio amateurs and owners of Citizens Radio Service equipment, has created a need for some means of checking transmitted frequency in this range.

Perhaps the simplest method is by means of a Lecher line, but this is subject to the limitations of maximum accuracy obtainable, susceptibility to external influence, maximum sensitivity, and fineness of tuning. For example, the AN/APT-5 radar jammer (recently available as surplus equipment) was furnished with a simple parallel-line wavemeter, calibrated directly in centimeters. By careful adjustment, this wavemeter should indicate the half-wavelength being monitored to ±0.2 cm, yielding a limiting accuracy at 50 cm (600 mc) of ±0.4 cm, or ±0.8 percent. The pilot-light indicator on this wavemeter requires only about 50 milliwatts for a reasonable indication. This type of device, however, can be thrown far off calibration by proximity effects and poor contacts on the slider. In fact, one commercial manufacturer of a similar instrument rates it at 2-percent accuracy.

Cavity frequency meters (more correctly, wavelength meters) should be inherently free from external influences, being entirely shielded. They may be made and calibrated as accurately as machine tools and temperature effects will allow and may be made as fine in tuning as machined screw threads can be fashioned.



Final coaxial-type wavemeter for the Citizens Band



Preliminary model of the wavemeter

Basic Design

Consider first a section of air-dielectric coaxial line, as shown in Fig. 1. For the physical constants shown, this section will have a characteristic impedance Z_o equal to 138 $\log_{10}(b/a)$. If this line is completely shorted at one end, and power is coupled in at that end, the cavity so formed will have a reactance X at any frequency f given by the relationship

$$X = Z_o \tan(2\pi l/\lambda) = Z_o \tan(2\pi f l/c)$$

If, now, a capacitance C is added across the open end from the center to the outer conductor, such that $X_c = -1/2\pi fC = -Z_o \tan(2\pi f l/c)$, the line will be tuned to resonance. If the capacitor is made variable, the whole instrument, when calibrated, comprises a wavemeter.

To improve the shielding, the open end of the line is usually closed by adding an end plate or disk, after which the simple calculation for unloaded resonant wavelength must be considered approximate, since the radial electric field near the end of the center conductor is distorted by the end disk. Further, the capacitance between the end disk and the center rod itself becomes a pertinent part of the loading or tuning capacitance. If the center rod is made larger in diameter, and its separation from the end disk made variable, this variable capacitance may be made to alter the resonant frequency of the unit, which now may be considered to be a loaded coaxial TE_M-mode cavity, with variable capacitance loading.

The amount of loading capacitance may be calculated as described above, from the equation

ELECTRONICS Articles

Transmitter	Nov. 1947
Receiver	Mar. 1948
Antennas	May 1948
Transceivers	Aug. 1948
Power Amplifier	Dec. 1948
Progress Report	June 1949

WAVEMETER

By WILLIAM B. LURIE*
W10XEM-W2XRW
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Two coaxial-type wavemeters are described in detail for guidance of experimenters developing equipment for the band from 460 to 470 mc. Accuracy may be made adequate for use with class B gear or, by greater construction precision, with class A transmitters

$$\left| \frac{1}{2\pi fC} \right| = \left| Z_o \tan (2\pi fl/c) \right|,$$

$$C = \frac{1}{2\pi f Z_o \tan (2\pi fl/c)}$$

Assuming that all of this capacitance will be provided between the center rod and the end disk, the approximate equation $C = 0.2235\ A/d$ for parallel-plate capacitors may be applied, giving

$d = 0.2235\ A \times 2\pi f Z_o \tan 2\pi fl/c = 0.447\pi A f Z_o \tan 2\pi fl/c$

where A is area of one plate in square inches and d is plate separation in inches.

Thus, all of the factors necessary for design of a simple cavity wavemeter may be calculated, with the exception of the effect of distortion of the field near the end plate. The coupling loop, for example, must not be too large, or the variable reactance of the cavity, while tuning, will be strongly reflected into the circuit being calibrated. This may cause detuning of the oscillator, or pulling, or cavity heating on a high-powered circuit.

A large loop will project out of the high-current high-magnetic-field end of the cavity, into the region where the radial electric field should be appreciable. Since a conductor cannot tolerate an electric field gradient along its length, the field must be distorted, and so one more error in the basic cavity calculation is introduced.

If the loop is too small, on the other hand, then it will not be able to cut enough lines of flux in the cavity to couple the cavity into the external circuit. This will result in too low an apparent Q, evidencing itself in extremely broad tuning, and a consequently inaccurate indication of resonance. A compromise must be effected on the undercoupled side, to prevent overcoupling, pulling, and a large error in the prediction of the range of operation.

Practical Design

In the 460-470 megacycle region, a quarter-wavelength is about 6.5 inches, and so an inside cavity length of about four inches was tried in the first experimental model. The length must be shorter than a quarter-wavelength so that it may be tuned to resonance by the addition of the loading capacitance.

For the cylinder, stock brass tubing 2¾-inch O.D., 2-9/16-inch I. D. was used. The center rod was a piece of 1¼-inch brass rod, with the end facing the plunger tapered to one inch. The characteristic impedance was calculated to be about 43 ohms. End pieces were machined from 3½-inch diameter brass rod, and the variable capacitance was provided by threading a 1¼-inch diameter rod into one end piece, at 48 threads per inch.

Power was coupled into the cavity by a coupling loop placed in a radial plane at the low-voltage-high-current end of the cavity. In addition, a fixed capacitance of about 3 micromicrofarads (Erie type NPOK) was soldered across as shown in Fig. 2.

Calibration was accomplished by loosely coupling the cavity as a shunt on the line from an oscillator to an antenna, and monitoring the radiated power with a broad-tuned radiated power meter and a Lavoie microwave frequency meter. A section of RG-21/U cable was used as an attenuator after the oscillator, to minimize pulling effect on the unstabilized BC-645 oscillator. The arrangement is shown in Fig. 3.

The cavity impedance was actually reflected, through the r-f transformer action of the coupling loop, back to the main line where it appeared as a shunt reactance. Standard r-f cable (RG-8/U) was used throughout, except for the section of high-attenuation cable mentioned. Standard type N fittings (UG-21/U, UG-58/U, UG-29/U and UG-107/U) were used.

No difficulty was experienced in determining the position corresponding to cavity resonance; a distinct dip in radiated power was observed. Care must be taken to avoid spurious responses, if other frequencies are present in addition to the fundamental. The curve of Fig. 4 shows the calibration of this first model. The tuning sensitivity near 465 mc is about 90 degrees plunger rotation for one megacycle, or about four megacycles per turn.

Second Model

On the basis of this rough model, a second cavity was built, as shown in Fig 5. Stock brass tubing of 1.75-inch O.D., 0.083-inch wall thickness was used as the cylinder. The center rod was machined down to 0.415-inch diameter, from 0.875-inch brass rod, leaving a ¼-inch portion at full diameter as a fixed capacitance plate.

All pieces were silver plated before assembly. After plating, the characteristic impedance was expected to be near 80 ohms, 77 ohms being the figure generally quoted as the impedance for optimum Q.

End pieces were machined from 2-inch O.D. brass disks ⅜-inch

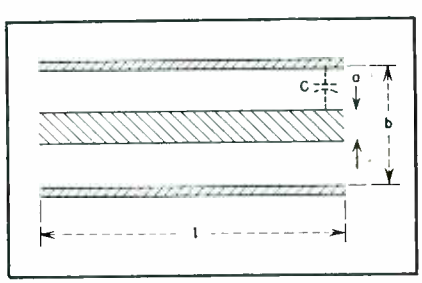


FIG. 1—Basic concept of coaxial line used to develop wavemeter

* Now with Machlett Laboratories, Inc., Springdale, Connecticut

thick; the variable capacitance was provided by threading a ⅜-inch diameter rod into one end piece, at 64 threads per inch.

Calibration was again accomplished by recording resonant frequency versus angular rotation of this plunger, instead of longitudinal displacement. A scribe mark was placed on the external portion of the plunger and the outer face of the end disk was marked off every 30 degrees, thereby providing a dial on which to read plunger rotation and, therefore, displacement.

Calculations from the formulas are as follows: $l = 5$ inches $= 12.7$ cm; $A = 0.6$ square inches, $Z_o = 80$ ohms. Then $1/C = 502\ f \tan 2.66 \times 10^{-3} f$.

In the region of 460–470 megacycles, a change of 10 mc should require a shift of 0.0096 inch, while one turn of the plunger at 64 threads per inch advances it 0.0156 inch. One turn, then, should be about 16 megacycles, at a center frequency of 465 mc, or about 13 mc at 475, 11 at 485, or 9.4 at 495 megacycles. Actual tuning as measured on the first cavity of these dimensions was 9 mc per turn at 465 megacycles, indicating that the effective capacitive effect of the field distortion at the high-voltage end was about 0.45 $\mu\mu$f, sufficient to shift the resonant frequency 30 megacycles.

Accuracy

Since the tuning sensitivity was 9 mc per turn, or per 360 degrees, the accuracy of scale reading should be better than ±5 degrees, or ±0.13 mc, or ±0.028 percent. Even allowing for ±10 degrees backlash in threads, ±.08 percent at any one temperature should be assured.

The question of temperature, however, is of major concern. Making all parts of brass, an expansion coefficient of about 18 parts per million per degree Centigrade may be expected (1.000018). Since the fundamental resonant wavelength is proportional to the physical length of the cavity (unloaded), the resonant frequency will lower 0.0018 percent per degree rise in temperature.

In the 5-inch long 460–470 mc cavity, the unloaded resonant frequency is 590 mc, and will therefore shift $590 \times 18 \times 10^{-6}$, or 10.62 kc per degree C. However, the spacing between the center rod and the plunger will increase in proportion, 0.0018 percent of 0.1292 inch, or 2.32×10^{-6} inch per degree C.

A tuning sensitivity of 9 mc per 15.6×10^{-3} inch has been observed, corresponding to 1.33 kc for 2.32×10^{-6}, giving an overall frequency shift of 9.29 kc per degree C. Over a range of 50 to 90 F, or about ± 10 C, a frequency uncertainty of ±0.093 mc, or ±0.02 percent is introduced, bringing the total to near 0.1 percent.

Using low-expansion coefficient material, a saving of only 0.002 percent per degree C may be realized, while backlash effects in worn or poorly machined threads can produce forty times this effect. Even so, an amateur machinist should be able to manufacture a cavity wavemeter which, after calibration, should meet the class B FCC tolerance of ±0.4 percent for Citizens Radio Service equipment.

Increased Sensitivity

An interesting design improvement is the substitution of a fixed capacitor for a portion of the loading capacitance. It has been calculated that 1.406 $\mu\mu$f is required at 470 mc, of which 0.45 $\mu\mu$f is supplied in stray and fringing capacitance, leaving 0.956 to work with. If 0.5 $\mu\mu$f of fixed capacitance is added in the form of a small ceramic capacitor, such as an Erie Ceramicon, type N330K, soldered directly across from the flared end of the center rod to the brass cylinder near the end plate containing the tuning screw (see Fig. 2), then distances d_1 in Table I are applicable, instead of d. These have been calculated assuming 0.45 + 0.5 or 0.95 $\mu\mu$f of fixed capacitance, plus 0.456 $\mu\mu$f of variable capacitance at 470 megacycles.

The tuning sensitivity near 465

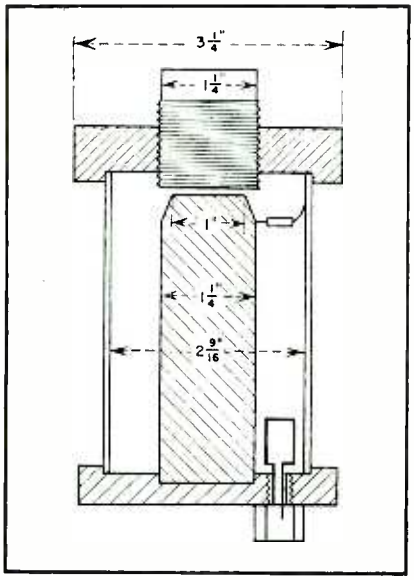


FIG. 2—Mechanical drawing of first model of cavity wavemeter

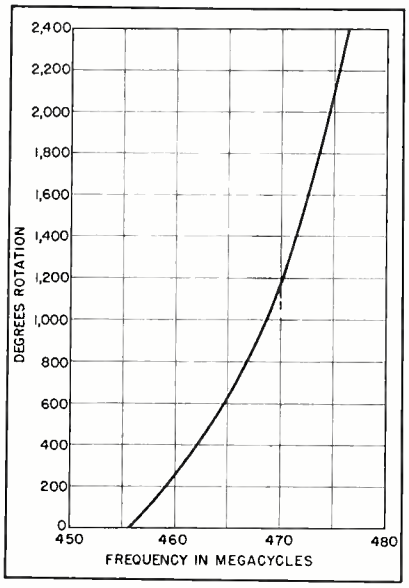
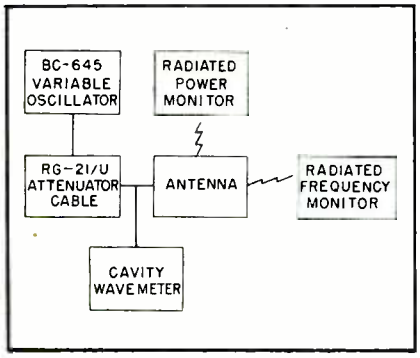


FIG. 4—Calibration curve of first model constructed



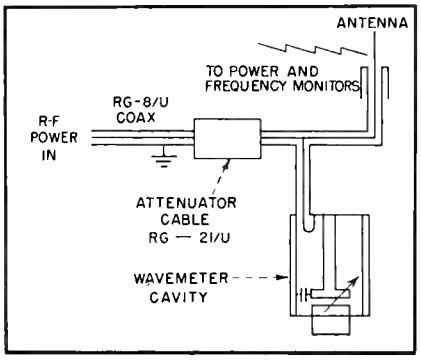


FIG. 3—Block diagram of setup for calibration and schematic circuit of cables to wavemeter

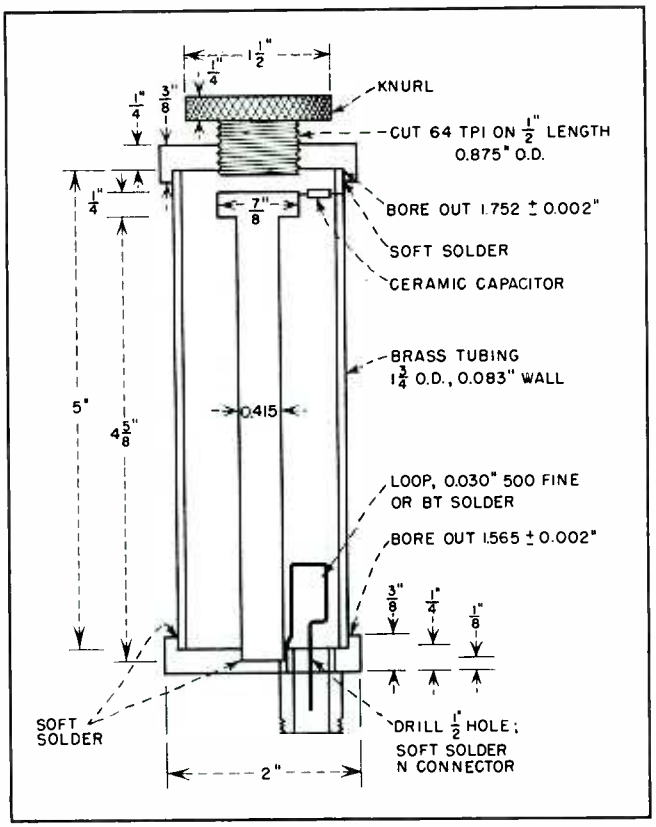


FIG. 5—Complete mechanical details of final wavemeter. All parts were silver plated before final assembly

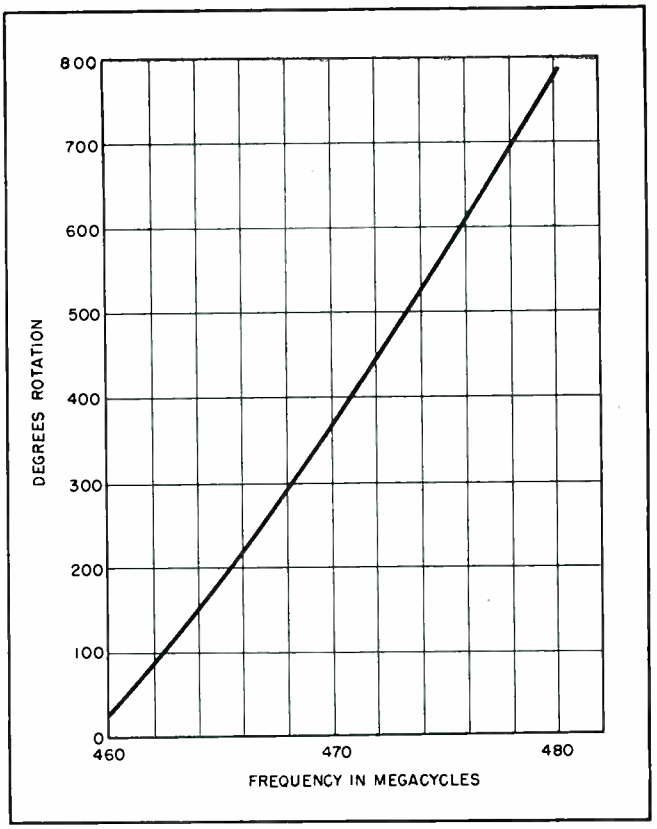


FIG. 6—Frequency calibration with a fixed capacitor forming a portion of the loading capacitance

mc has now been changed from 9 mc per turn (0.0156 inch) to about 2 mc per turn, and the error caused by ±15 degree plunger uncertainty has been reduced to ±87 kc, or ±0.0187 percent. Furthermore, use of a negative temperature coefficient capacitor of 0.5 $\mu\mu$f will provide some correction for thermal expansion of the cavity. The change of a 0.5 $\mu\mu$f N330K capacitor in one degree C is 165 × 10^{-6} $\mu\mu$f; the sensitivity to a capacitance shift is 10 mc per 0.156 $\mu\mu$f, or 10.57 kc for 165 × 10^{-6} $\mu\mu$f, very closely balancing the 9 to 10 kc calculated.

Another attempt at temperature compensation may be made by making certain portions of the cavity of material of thermal expansion coefficient different from that of brass. The center rod, for example, may be made in two pieces, one of brass, (of expansion coefficient about 18 × 10^{-6} per degree C), and one of steel (of expansion coefficient about 12 × 10^{-6} per deg. C.

Theoretically, by careful adjustment of the length of the steel section, the natural overall negative temperature coefficient of frequency may be exactly balanced, but actually this is not practicable. Furthermore, the effects of soldering, whether low-temperature or high-temperature, are such as to make the exact expansion coefficients unpredictable. Also, the mathematics of the capacitance-loading calculation shows that such a correction would only be effective over a narrow temperature range. In practice, it is wise to calibrate a cavity wavemeter at several temperatures.

Table I—Calculated Values

f in mc	tan 2.66 × 10^{-3} f	502 f (× 10^{12})	1/C (× 10^{12})	C in $\mu\mu$f	d in inches	d^1
450	2.55	0.2259	0.576	1.735	0.0771	0.171
460	2.77	0.2309	0.640	1.563	0.0858	0.219
470	3.105	0.2359	0.711	1.406	0.0954	0.294
480	3.312	0.2410	0.798	1.254	0.107	0.441
490	3.664	0.2460	0.901	1.110	0.1209	0.839
500	4.087	0.2510	1.026	0.975	0.1375	.....

Alternative Design

The last variable source of error may be eliminated by using a high-grade micrometer movement for the plunger, careful machining of the threads, or the use of two threaded pieces as a differential thread for the plunger movement, making one 26 and one 28 threads per inch, and making one left-handed and one right-handed. In large threads of this type, a tighter fit is allowable, and turning one turn on each will provide a net plunger movement, axially, of 0.03846 minus 0.03571 or 0.00275 inch, as compared with 0.01563 inch per turn on 64 turns per inch. This complicates calibration somewhat, but the improvement of accuracy by a factor of five would be highly desirable, and would bring the percentage error below 0.01 percent, suitable for use with class A Citizens Band equipment, required to be within ±0.02 percent.

Converters for UHF

By D. K. REYNOLDS and M. B. ADAMS

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IMMINENT POSSIBILITY of commercial television operation in the uhf band of 475 to 890 mc has made it highly desirable to investigate the problems of receiver circuit design peculiar to this region of the spectrum.

Within this awkward frequency range, conventional lumped constant circuits tend to become impractical, and likewise waveguides and cavity resonators tend to be unwieldy because of their large physical dimensions. A compromise must therefore be sought in which lumped elements are replaced in part by distributed circuits such as transmission lines or butterfly circuits.

One of the most important choices to be made in uhf converter design is that of an appropriate intermediate frequency. This choice will influence the image response, response to spurious signals, local oscillator radiation, tuning range required of the local oscillator, performance obtainable in the i-f amplifier, and receiver noise figure.

Fixed-tuned converter being tested in conjunction with a standard television receiver. Vernier tuning of the local oscillator is provided

I-F Problem

Table I illustrates the effects of a wide range of intermediate frequencies on various of the above factors. For the tuning range of 475 to 890 mc, local oscillator tuning ranges and image ranges are listed corresponding to four different intermediate frequencies. Image rejection is calculated for the case of a typical single tuned mixer input circuit with 10-mc bandwidth between 3-db points, tuned to 500 mc.

The values tabulated represent the ratio of impedance of the tuned circuit at resonance to the impedance at the image frequency, and do not take into account the mismatch arising from the frequency dependent source impedance of a typical antenna. Estimates of the best noise figures currently obtainable for the various i-f values are based on measurements made on low noise i-f strips by the Radiation Laboratory, M.I.T.[1], and do not include the noise figure of the mixer.

The first intermediate frequency listed is the existing standard for vhf television, and therefore implies the use of single conversion (one i-f) in the receiver. In this case the local oscillator must be higher in frequency than a received signal if the existing standards on the shape of the i-f pass band are to be preserved. It is evident from the table that image rejection is very poor, and high local oscillator radiation can be expected. Furthermore, most of the image range lies within the band tuned by the mixer.

While the local oscillator tuning ratio is only 1.82 to 1, the upper frequency limit of 911 mc precludes the use of any but a very few expensive tube types now existent. Improvement of the image rejection and reduction of local oscillator radiation could be accomplished only by means of complex input tuning networks which would materially increase the cost of the con-

The material described in this paper is derived from work performed at the Stanford Research Institute under the sponsorship of John H. Poole, Long Beach, California.

Table I—Effect of Choice of I-F on Converter Design

I-F Value in mc	Local Osc Tuning Range in mc	Local Osc Tuning Ratio	Image Range in mc	Ratio of Signal to Image	Estimated Best Noise Figure for I-F Amp
25.75	502–911	1.82	527.75–936.75	20.6 db	1.35 db
55.25 (Ch. 2)	421–830	1.97	365.75–779.75	28.0 db	2.1 db
175.25 (Ch. 7)	301–710	2.36	125.75–534.75	43.6 db	5.5 db
205.25 (Ch. 12)	271–680	2.51	65.75–474.75	48.6 db	6 db

TELEVISION RECEPTION

Arrangements of front ends described include semi-butterfly oscillator, tap-switch oscillator and cylinder oscillator. Crystal mixers for low noise employ a rolled-up line, a parallel line and a coaxial cavity

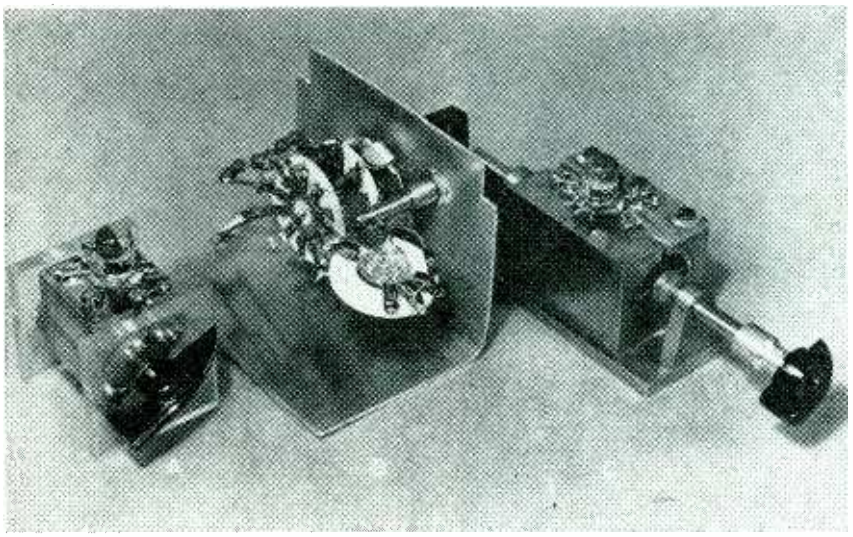


FIG. 1—A semi-butterfly oscillator is shown at *A*, a tap-switch oscillator at *B* and a cylinder oscillator at *C*

verter, and require great tracking accuracy between the local oscillator and mixer tuning.

A frequency in the order of 200 mc appears to offer a reasonable compromise between noise figure and image rejection. While this choice requires a local oscillator tuning ratio of 2.5 to 1, such ratios are readily obtainable with circuits of the butterfly and cylinder type, as shown in Fig. 1.

Considerations of circuit economy point toward the selection of one of the vhf television channels as the i-f for a uhf receiver, to obtain the high i-f required for good image rejection. The last three frequencies listed in Table I correspond to existing vhf channels 2, 7, and 12, and the choice of channel 12 appears to be optimum.

Restriction of the tuning range may effect considerable simplification in the converter, and materially reduce the production cost. Accordingly, local oscillator and mixer circuits corresponding to three different degrees of coverage will be described. These are complete coverage of the 475 to 890-mc band, coverage of the lower 200 mc of the band, and essentially fixed-frequency conversion.

For complete coverage of the 475 to 890-mc band with an i-f of 205 mc, the local oscillator tuning range is 271 to 680 mc, or 2.51 to 1. This tuning range is readily obtainable with the butterfly and cylinder oscillator circuits, both of which have been developed considerably in recent years.[2]

Local Oscillators

A cylinder oscillator designed for the above tuning range is shown in Fig. 1C, with the associated circuit diagram in Fig. 2. The frequency-determining element consists of a metal block of $1\frac{5}{8} \times 1\frac{5}{8}$ inch cross section, $2\frac{1}{2}$ inches long. A $1\frac{1}{4}$-inch diameter hole is bored longitudinally through the block, and a longitudinal slot is milled through one of the sides.

A type 6F4 acorn triode is mounted across the slot, the plate capacitively coupled to one side, and the grid connected directly to the other. The block behaves essentially as a single-turn coil, resonating with the tube capacitance plus the capacitance of the longitudinal slot.

Tuning is accomplished by means of a rotor consisting of a longitudinally slotted hollow metal cylinder, fitted concentrically within the hole in the block. The rotor varies the capacitance across the slit, and also effects a small

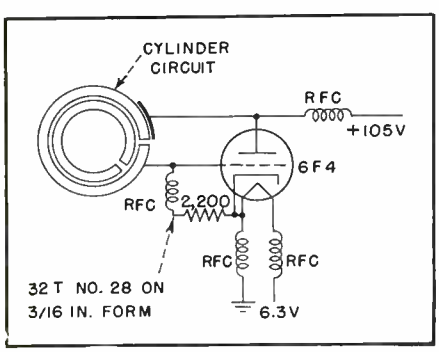


FIG. 2—Circuit of the cylinder oscillator

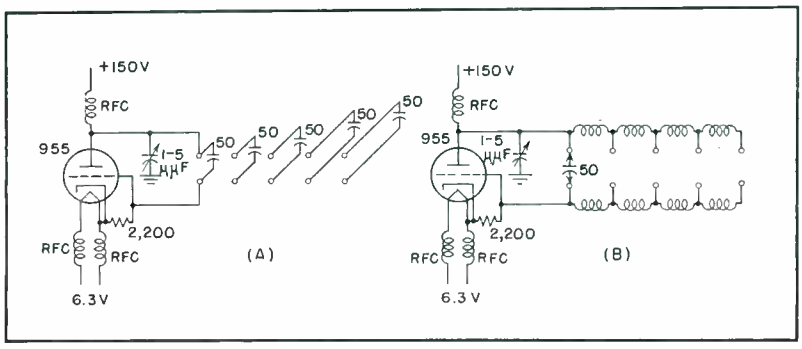


FIG. 3—Tap-switch oscillator circuits similar to that shown in Fig. 1B

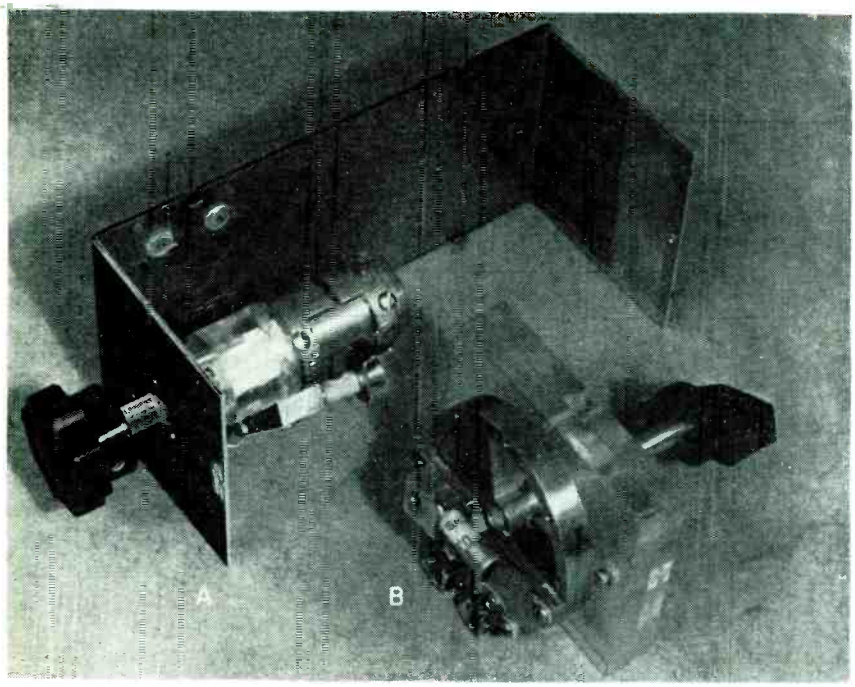


FIG. 4—A rolled-up line mixer is shown at *A* and a semi-butterfly mixer at *B*

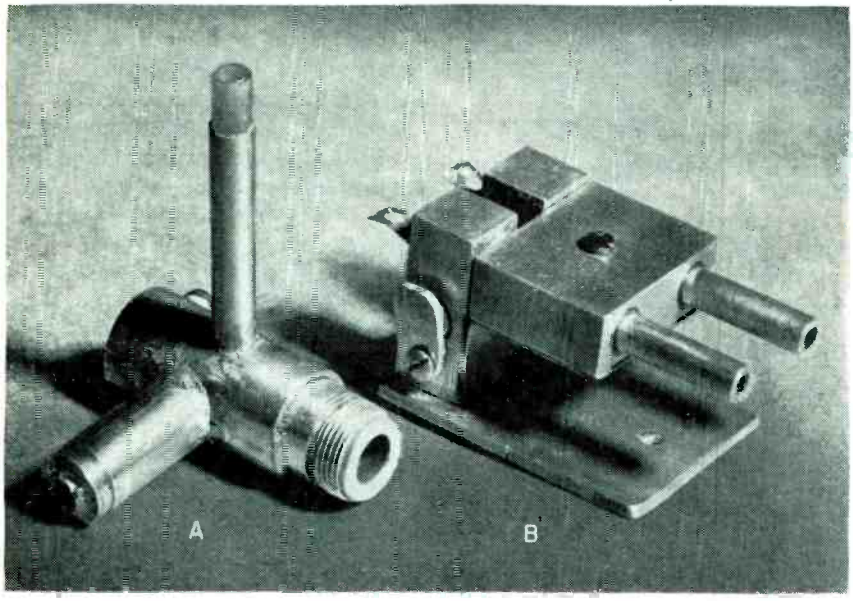


FIG. 5—A coaxial form of mixer is shown at *A* and a parallel-line mixer at *B*

change in the inductance of the block.

The tuning range obtained with the oscillator of Fig. 1C using a gap between cylinder and block of 0.015 inch was 300 to 640 mc (2.14:1), and with a gap of 0.004 inch it was 184 to 670 mc (3.64:1). From these data it may be concluded that a slight reduction in the diameter and a spacing of about 0.006 to 0.008 inch will give the desired tuning range.

Figure 1A shows an oscillator of the semi-butterfly type, adapted specifically for use with the 6F4. The circuit is made up of a slotted cylindrical stator, and a rotor consisting of a solid half-cylinder. End plates are connected to the stator and, in conjunction with the end faces of the rotor, provide capacitive loading across the stator slot at one end of the tuning range. At the other end of the tuning range, the capacitive loading is at a minimum, while the rotor acts to reduce the inductance of the stator cylinder. The 6F4 tube is mounted across the stator slot in the same manner as for the cylinder oscillator.

The oscillator of Fig. 1A tuned the range of 350 to 750 mc (2.14 to 1). While this is not sufficient for use with a 205-mc i-f, a number of small modifications to the design would undoubtedly produce the desired range.

When a high intermediate frequency such as 205 mc is used, the local oscillator for a converter tuning the lower 200 mc of the band becomes a much simpler device than the previously described cylinder circuits. Figure 1B illustrates a typical band-switching oscillator which covers a frequency range from 255 to 470 mc in seven steps. It utilizes a vernier tuning capacitor to tune the oscillator within each of the seven bands, and thus, in connection with a 205 mc i-f will give coverage of the uhf band from 460 to 675 mc.

Two alternative circuits which can be used in such an arrangement are given in Fig. 3. The circuit of Fig. 3A has the advantage that temperature compensation can be adjusted separately for each switch position.

Mixers

The selection of a tuned circuit suitable for use as a mixer is a fairly difficult problem if the entire 475 to 890-mc band is to be covered. A crystal mixer has been chosen because of the lower noise figure at these frequencies.

Figure 4A shows a typical mixer designed to tune 475 to 890 mc. This circuit is essentially a rolled-up parallel-strip transmission line with a half-cylindrical brass slug rotating in the center to vary both the inductance and capacitance of the line.[3] A diagrammatic sketch with some of the important dimensions is shown in Fig. 6. Such a circuit is particularly well suited for use with a balanced transmission line input, but can also be used with unbalanced inputs.

Another mixer circuit with wide tuning range is shown in Fig. 4B. This circuit is essentially a form of butterfly or cylinder and covers the frequency range of 270 to 850 mc when loaded with a 1N21 crystal as illustrated. The wide tuning range is a result of the variation of both capacitance and inductance achieved by the semi-cylindrical

rotor section. The high-frequency end of the range is reached when the rotor is completely outside of the stator end plates.

A straightforward approach to the problem of a mixer tunable over a portion of the uhf band is the parallel-line circuit illustrated in Fig. 5B. Here the crystal is tapped across the line near the shorted end and tuning is accomplished by means of a movable short. The frequency range of the model shown is 370 to 600 mc but a greater range is doubtless possible with this form of circuit.

A coaxial form of mixer has been constructed to investigate the possibility of tuning such a device by means of a section of line of variable length. Figure 5A shows one such circuit which has a restricted tuning range but is otherwise quite satisfactory. The coaxial mixer operates on the premise that the impedance of a 1N21 crystal has a resistive component in the vicinity of 50 ohms and hence the coaxial line input can be connected directly to the crystal.

In order that the mixer will be tuned, it is necessary to connect reactance across the crystal in such a manner that the impedance of the mixer is purely resistive at the desired frequency and is largely reactive at other frequencies. This result is accomplished by shunting the crystal with a short-circuited stub line which has a low value of inductive reactance at the operating frequency. Resonance is achieved by connecting another length of line across the crystal, so arranged that it presents an equal capacitive reactance.

The capacitive stub is an open-circuited line with a movable polystyrene cylinder between inner and outer conductor which varies both the effective length and characteristic impedance of the line. Such an arrangement is theoretically capable of giving an appreciable tuning range and consequently might be satisfactory as the mixer for a converter covering the lower 200 mc of the band.

A fixed-tuned, parallel-line mixer is sketched in Fig. 7. This mixer has been designed to be fabricated at low cost for use in a single-channel converter. A ceramic trimmer capacitor is used to select the exact resonant frequency, 530 mc in the model shown here. The crystal bypass capacitor is built into the circuit and is approximately 10 $\mu\mu$f. The capacitance of the bypass was chosen as a compromise between that necessary to provide a low impedance at the signal frequency and that which could be tolerated from the standpoint of input circuit bandwidth in the i-f amplifier.

Fixed-Tuned Converter

A simple, essentially single-channel converter has been developed for use in the field testing of an experimental uhf television station. This converter uses the parallel-line crystal mixer illustrated in Fig. 7 and a local oscillator consisting of a 955 acorn triode in a parallel-line circuit. The local oscillator is tunable over a small range by means of a two-plate variable capacitor. The intermediate frequency used is nominally 207 mc, corresponding to the center of vhf television channel 12.

Since a loss of from 6 to 8 db is suffered in a crystal mixer, it is important that the uhf converter incorporate an i-f amplifier with sufficient gain to overcome this loss. The amplifier described here accomplishes this successfully and provides performance at uhf which equals or exceeds that generally obtainable in a standard vhf television receiver. The circuit chosen for the i-f amplifier is the cascode, developed at the MIT Radiation Laboratory for use in low-noise radar i-f strips.[1]

The amplifier consists of two triodes connected in cascode, the output from the crystal mixer being connected through an autotransformer to the grid of the first stage, a triode-connected 6AK5. The complete circuit is shown in Fig. 8. The output from the plate of the

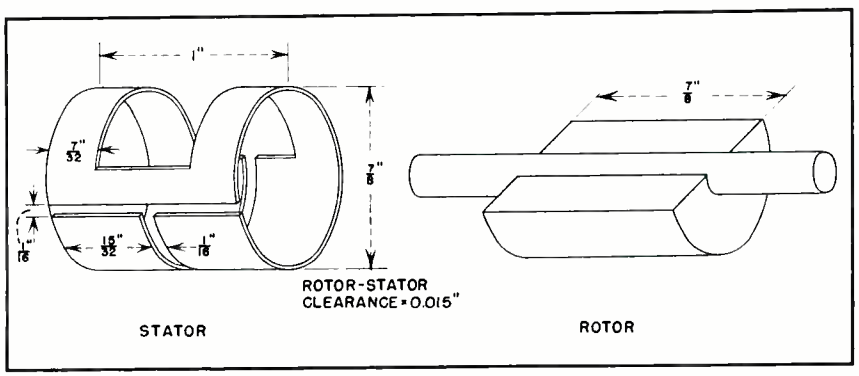


FIG. 6—Mechanical details of the rolled-up line

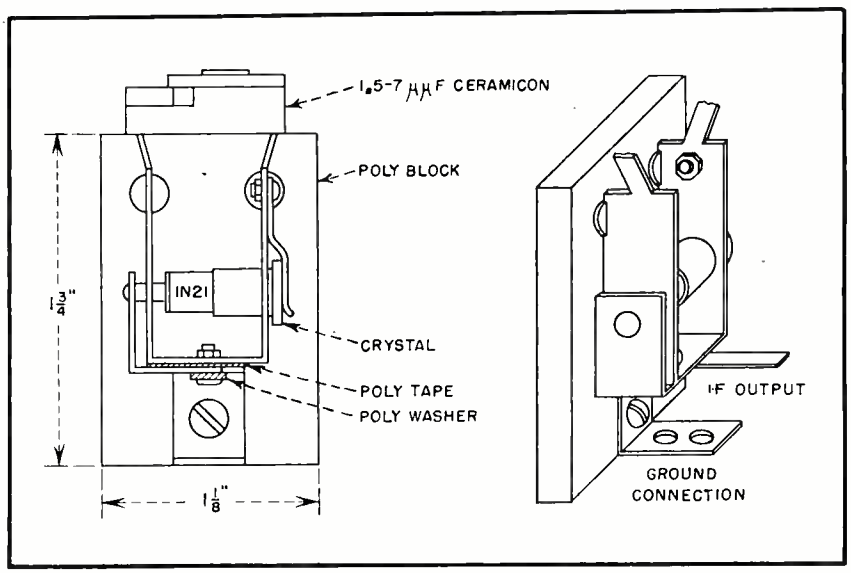


FIG. 7—Simple fixed-tuned mixer for 530 mc

6AK5 is coupled to the cathode of the second i-f stage, a 6J4 connected in a grounded-grid circuit.

The output tuned circuit of the 6J4 consists of a single-turn hairpin loop, coupled closely to a second hairpin loop in the output circuit. Coils of this type were found necessary to achieve the desired degree of coupling and at the same time provide a reasonably balanced output circuit.

Tuning of the i-f amplifier to its center frequency of 207 mc is accomplished with slug-tuned coils in the input and interstage circuits, and by small ceramic variable capacitors in the output circuit, as may be seen from Fig. 9, which is a bottom view of the i-f amplifier subchassis. The overall voltage gain was measured to be 7.7, a quite reasonable figure in view of the fact that there is a considerable voltage stepdown in the output circuit, necessitated by the impedance transformation between the 6J4 plate circuit and the 300-ohm balanced output.

The width of the pass band of the i-f amplifier is approximately 17 mc between 3-db points. Inasmuch as the mixer bandwidth is approximately the same, the converter may be tuned over this range merely by varying the local oscillator frequency. In the experimental applications for which the converter is designed, this degree of flexibility is an advantage, but in converters for use in areas where more than one or two stations may be broadcasting, a somewhat narrower bandwidth would be desirable.

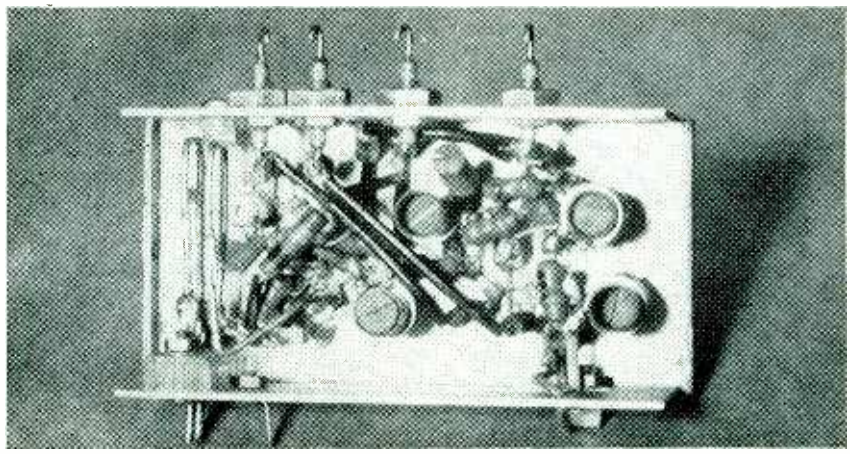


FIG. 9—Bottom view of 205-mc i-f amplifier. Chassis is approximately 2 inches wide and 4¾ inches long

Local oscillator injection is obtained by tapping a short length of RG-58/U coaxial line across the oscilllator circuit and capacitively coupling the center conductor to the mixer at the far end. The capacitance necessary is quite small and consists of about ¼ inch of the center conductor spaced ⅛ inch from the mixer circuit. Rectified crystal current is metered, and is adjusted to approximately 0.5 milliampere.

A standard A/N coaxial connector is provided for the uhf antenna input in anticipation that 50-ohm coaxial line will be used between antenna and converter. The coaxial input is coupled to the parallel-line mixer by a simple balance-to-unbalance transformer made from a short length of RG-58/U line.

In conjunction with a Meissner Model 24TV television receiver the noise figure of the combination was found to be 11 db approximately. The sensitivity is 190 microvolts for 40 volts peak-to-peak at the crt grid when maximum receiver gain is used. The image response is 42 db down from signal. Local oscillator radiation is 56 millivolts across a 50-ohm resistance connected to the antenna terminals of the converter. The bandwidth is essentially that of the tv receiver alone.

The noise figure of the combination was obtained by adding a three stage i-f amplifier with a bandwidth of 7 mc to the television receiver so that the noise level of the system could be measured by a barretter bridge connected into the last i-f stage. With the noise power initially measured, the amount of c-w signal at 530 mc required to double the power in the i-f was measured. This value of r-f signal was then compared with the theoretical amount based on the value of source resistance and the overall bandwidth to obtain the noise figure.

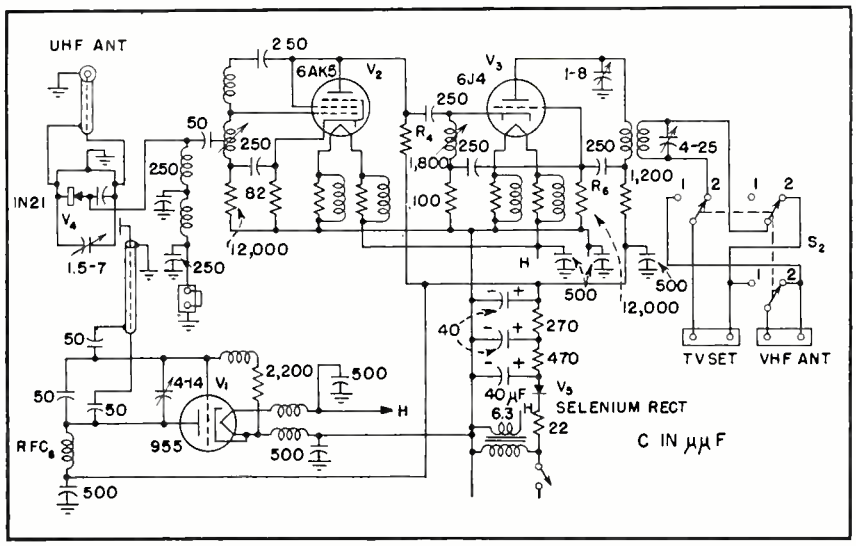


FIG. 8—Complete circuit of a converter with output on channel 12

References

(1) H. Wallman, A. B. Macnee and C. P. Gadsden, A Low-Noise Amplifier, *Proc. IRE*, 36, p 700, June 1948.

(2) E. Karplus, Wide Range Tuned Circuits and Oscillators for High Frequencies, *Proc. IRE*, p 426, July 1945.

(3) Everett, Tuned Circuits for UHF and SHF Bands, *Communications*, p 19, June 1946.

Instantaneous Deviation Control

Audio signal of an f-m transmitter is differentiated, clipped and integrated so that the output wave is identical to the input except for slope limiting. Transmitter frequency deviations are held to definite limits determined by the maximum allowable slope

By MARION R. WINKLER
Research Engineer
Motorola Inc.
Chicago, Illinois

A FEW YEARS ago the performance of a radio communications system depended primarily on two factors, the power of the transmitter and the sensitivity of the receiver.

Interference between stations or systems was no serious trouble because their operating frequencies were sufficiently separated with unused channels which acted as guard bands. As more services acquired frequency assignments, the number of guard bands decreased. The spectrum is now crowded and greater use of radio communication will be curtailed and limited unless greater use is made of available channels.

Concentrated attention has been given to control receiver images and spurious response, receiver radiation and transmitter harmonics. The selectivity of receivers has been greatly improved. The engineering art has reached a point where, today, alternate channels can be used successfully with adjacent channels serving as guard bands. It must be concluded, therefore, that half the available channel space is being wasted.

Phase-modulation transmitters are particularly vulnerable to over modulation. Without control, loud voices, sharp voices, transients, or noise pulses produce wide excursions of the transmitter frequency, extending the deviation into the adjacent channel and even into the alternate channel. For operation on the desired channel, this means loss of intelligibility and a decrease in the signal to noise ratio as the transmitter deviates beyond the pass band of the receiver. Adjacent channel operation will not be possible until the frequency deviation of all transmitters is kept within their assigned channel.

Principle of Operation

In attempting to control the frequency deviation of a phase-modulation transmitter, it is often customary to use conventional amplitude compressors. These devices are not instantaneous. The attack time is slow and the device remains paralyzed after a transient. Even if the audio amplitude is controlled the frequency deviation of the transmitter is not controlled because the frequency deviation of a phase-modulated transmitter is a function of both the frequency and the amplitude of the audio wave.

The desired answer to the problem of controlling frequency deviation would be a device which would virtually place a barrier or limit on the frequency excursions caused by the phase modulator. It is difficult to place such a barrier on the frequency after the radio waves have passed through the phase modulator. However, if an audio wave is synthetically produced, which would graphically look like the frequency deviations produced by the modulator, then barriers could be introduced which would hold the amplitude to certain prescribed limits.

After the audio wave has passed through the amplitude limiting barriers it might be restored by a reversible process to its original form and delivered to the phase modulator.

The manner in which this can be

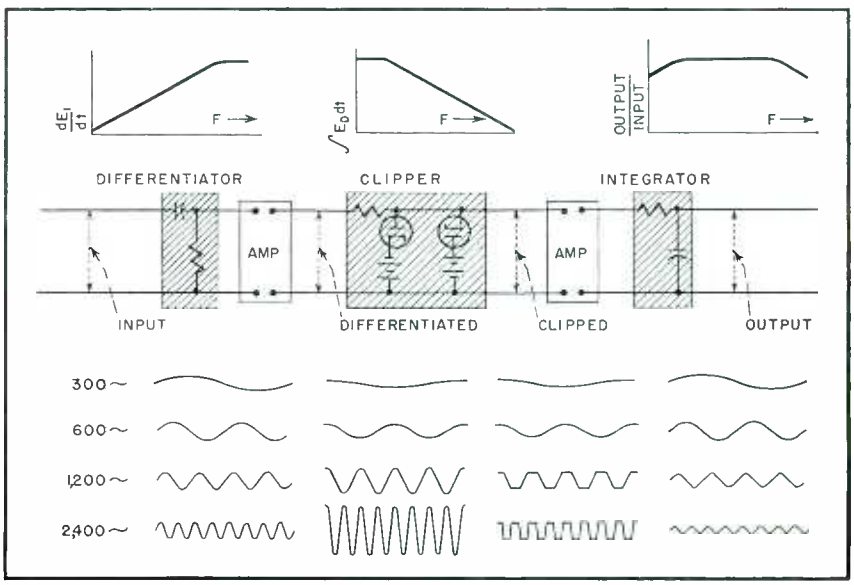


FIG. 1—Basic circuits illustrating the fundamental principle

done is illustrated in Fig. 1. This circuit provides instantaneous deviation control (IDC). The synthesized wave is produced by a differentiation circuit. This differentiator is a simple device consisting of only a resistor and a capacitor.

As shown in both the first graph and the second column of illustrated wave forms, the differentiated voltage is proportional to both the input voltage and the frequency; more precisely it is proportional to the slope or steepness of the input wave. Since the differentiator is a gain losing device it is usually desirable to use an amplifier to raise the signal to a suitable level for clipping. This also provides electronic isolation, with zero loading of the differentiator and a more suitable source impedance for the clipper.

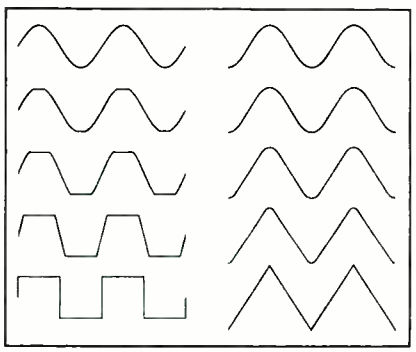


FIG. 2—Sine waves with various degrees of clipping, before and after integrating

The clipper may be a pair of biased diodes, also shown in Fig. 1, which become conducting when the instantaneous peak value of the differentiated wave exceeds the bias. One diode will clip positive peaks and the other the negative peaks. This is shown in the illustrated wave forms of clipped voltage.

After the wave has been operated on by the clipper, the differentiation process can be reversed by passing the wave through an integrator circuit. This is also a simple device consisting again of a resistor and a capacitor as shown in Fig. 1. The second graph shows the response of the integrator circuit to be inversely proportional to the frequency.

The output wave is now identical with the input wave except for the slope limiting. The transmitter frequency deviations will be held to very definite limits as dictated by the maximum allowable slope. The third graph indicates the overall fidelity of the instantaneous deviation control circuit to be flat over a wide band. The usable bandwidth will depend on accepted tolerances and the frequencies that need to be controlled.

The distortion caused by IDC is quite small. This is illustrated in the output voltage wave form shown in Fig. 1. Distortion is introduced only into those wave fronts which have a slope that exceed a predetermined amount. These distortions in general consist of higher order harmonics which fortunately are eliminated by the integrator to a point where they are readily tolerated.

The distortion introduced in a sine wave can best be understood from a graphical study as shown in Fig. 2. A moderate amount of clipping produces trapezoidal waves with curved sides. After integrating, the curved sides become the rounded extreme of the alternating current and the flat top becomes the straight line sides of the same current. The rounded portion is identical with the rounded part of the original sine wave before being applied to the differentiator. From a geometric standpoint the only distortion introduced has been over that part of the sine wave which had too great a slope.

Obviously the greatest distortion that can possibly exist would occur when the clipper produces square waves. The output from the integrator would then be a triangular wave having only odd harmonics. The third harmonic would be 1/9th of the fundamental, the fifth harmonic 1/25th of the fundamental and other harmonics trivial.

The distortion introduced by IDC into voice frequencies does not lend itself quite so well to such a simple analysis. Many voice frequencies are quite peaked and jagged and can pass through the IDC circuit

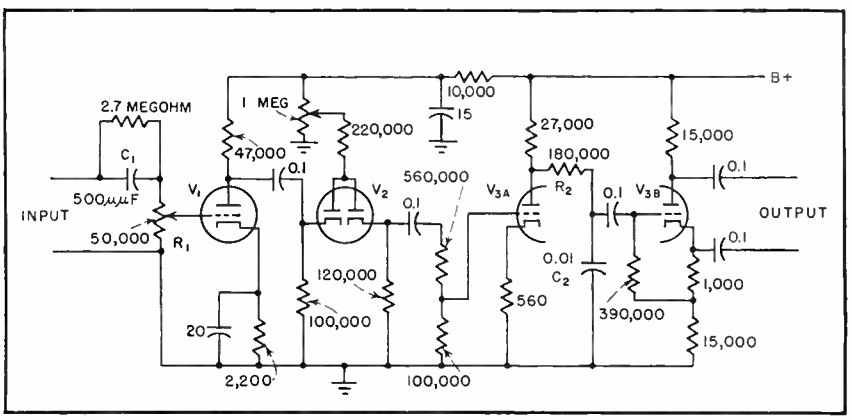


FIG. 3—Fixed station instantaneous deviation control circuit

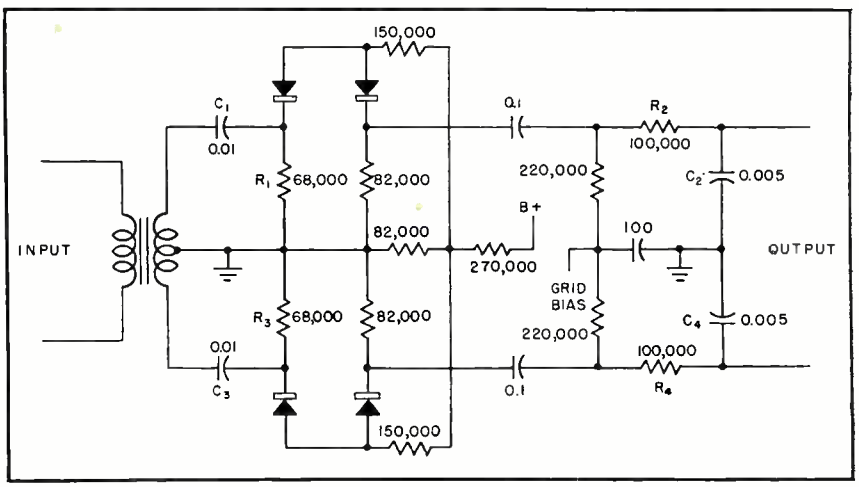


FIG. 4—Circuit of a mobile IDC unit

without having their intelligence content seriously altered yet the transmitter frequency deviation may be reduced by a large margin. The voice level between syllables is usually lower and experiences little or no clipping. It is therefore possible to provide greater deviation for the lower voice levels or greater overall average deviations without exceeding the desired or authorized deviation limits.

Commercial Equipment

In making a practical application of IDC to a transmitter there are a number of considerations which may dictate the final design.

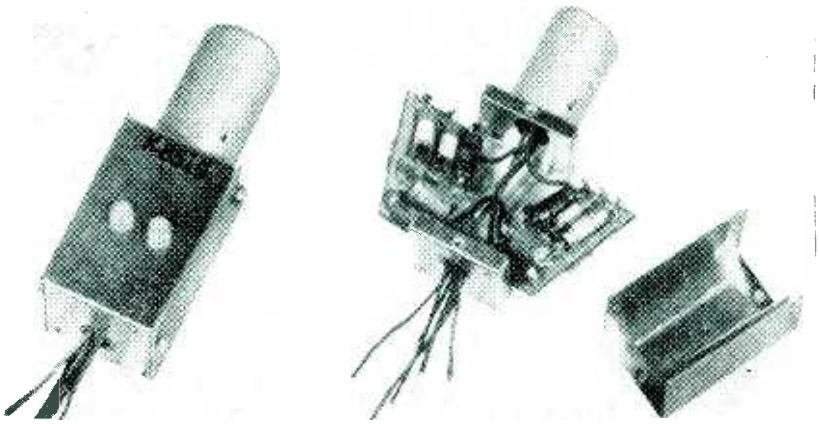
Size, cost, power drain, the fidelity desired and the range of offending frequencies will affect the choice of components and circuits. The type of differentiator, clipper, or integrator may vary considerably from the one illustrated in Fig. 1.

Figure 3 is the circuit diagram of a fixed station IDC unit. Differentiation is accomplished by the capacitor C_1 and the resistor R_1. The clipper circuit differs from that previously described.

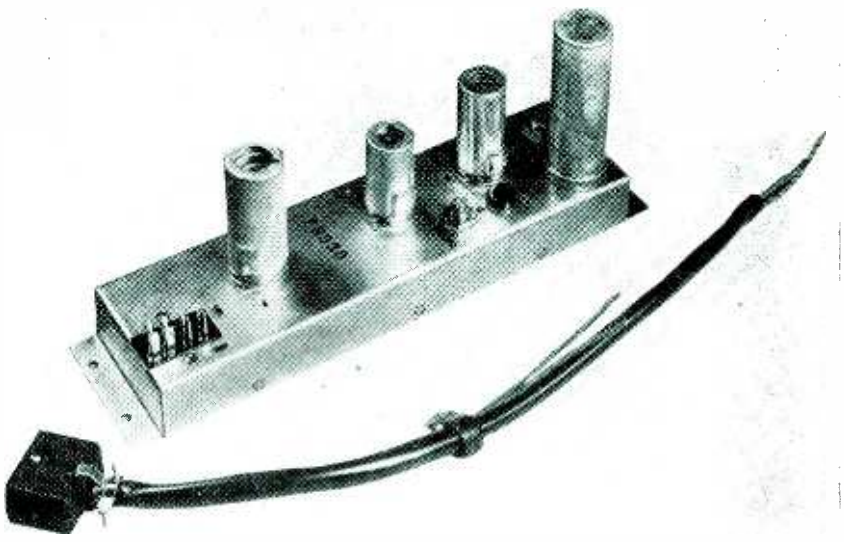
The combined diodes are fed a constant direct current. Normally half this current goes through each diode. Any small signal variation, positive or negative, applied to the cathode of the input diode, will normally cause the same variation at the cathode of the output diode. The diodes therefore serve to conduct the variations from input to output. However, if large variations of signal are applied at the input, the first diode will become nonconducting on positive peaks and the second will become nonconducting on negative peaks.

Integration is accomplished by the capacitor C_2 and the resistor R_2. The clipping level, or the deviation, is adjusted by a potentiometer regulating the diode current. The volume level is adjusted at the input where no interaction exists between it and deviation. A resistor shunting C_1 affords some bass compensation. The output is pushpull.

Figure 4 is the circuit diagram of a unit useful for mobile application because of its low cost, small space requirements and low power drain.



Complete IDC unit is shown at left and the internal construction at right



Complete IDC unit for a fixed station

This unit is designed to accommodate a carbon microphone in the input and deliver a balanced or pushpull output for the grids of the phase modulator tubes. No amplification is used within the circuit and clipping is performed with germanium crystal diodes. Differentiation is performed with the C_1-R_1 and C_3-R_3 circuits; integration with the C_2-R_2 and C_4-R_4 circuits.

Performance

When the action of an IDC circuit is observed on an oscilloscope connected to the discriminator of a good f-m receiver, the voice wave seems to strike an invisible barrier even when subjected to 20 or 30 db overload. The barrier remains fixed even when subjected to sudden bursts of signal or transients. There is no attack time or paralysis, it is instantaneous. This makes close talking possible thereby reducing background noise. It tolerates a wide range of audio level.

The control prevents transmitters on nearby channels from spilling over into the pass band of system receivers. But more important is the fact that it holds the system transmitted frequency within the associated receiver bandpass response, permitting a higher average modulation level. This results in an increased signal-to-noise ratio and improved reception in fringe area operation.

Adjacent channel operation in the mobile field is now a requirement and it is axiomatic that deviation control is necessary. Since IDC is quite simple, economical, and fool proof, it is destined to see wide application.

Acknowledgement is due John Hultquist who was the first to try the idea, and others who have contributed the commercial developments.

Metal Detector for

Features include a new bridge coil arrangement, designed to provide more uniform sensitivity to objects embedded in logs and lying at various angles in the logs. Complete circuit diagrams with values and pickup coil winding data are included

By CURTIS R. SCHAFER

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THE PROBLEM of detecting unseen metal fragments in logs is becoming increasingly important to the operators of small saw mills. In many areas of this country and Europe, farmers are harvesting second and third growth timber, which may and often does contain spikes, horseshoes, fragments of wagon tires, steel fence posts, sections of fence, knives and other metal objects. Even unexploded artillery shells have been found in logs from forest areas in the West.[1] When a rotary saw strikes something of this nature, the flying teeth are a real hazard to personnel.

Even the constant expectation of the saw hitting something is responsible for much nervous fumbling when feeding the saw, and this is an accident-producing factor in itself. Much timber which is actually free of metal objects is going to waste simply because the mill operator does not dare to process logs which are questionable.

Available Techniques

There are three basic and separate approaches to this problem. All make use of variations in the pattern of a magnetic or electromagnetic field: the first, by the variation in the self or mutual inductance of a coil system; the second, by detecting variations in the earth's magnetic field with a flux gate, cathode ray, or inductor compass; the third, by variations in the absorption or reflection of radio waves generated by a local oscillator and radiated by a local antenna system.

The operation of the radio method raises many difficulties. The radiation resistance of the antenna will depend upon the dielectric properties of the log, which in turn are determined by the moisture and mineral content of the wood. Also, the distance between the antenna and the surface of the log must be kept constant. The 300-mc radiation from the AN/PRS mine detector, for example, penetrates only a few inches of damp wood, and the instrument is sensitive only to relatively large pieces of metal.[2]

So far, any magnetic compass methods have not shown adequate sensitivity and stability.

Early electromagnetic methods used the Hay, Owen or Maxwell bridges to detect the increase in the self inductance of a coil when a magnetic metal was brought near, or the decrease in self inductance in the case of a non-magnetic metal.[3] In these systems, if the size of the metal piece is relatively small with regard to the radius of the coil, and if its distance from the coil is relatively great with respect to the radius of the coil, the variation in the self inductance of the coil is inversely proportional to the sixth power of the distance between the coil and the metal. A single coil may also be used in the resonant circuit of an oscillator; in this case the presence of metal within the field of the coil will be indicated by a change in the frequency of the oscillations, and may be detected by a frequency meter. The danger in the use of any single-coil method

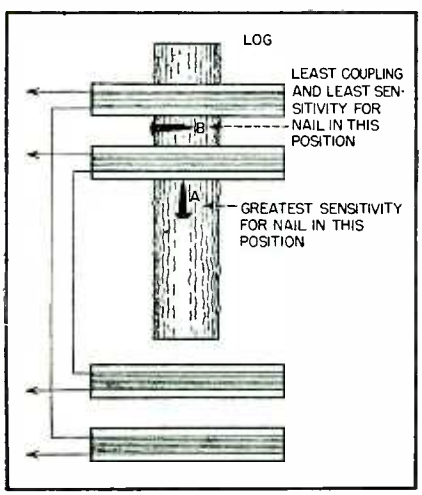


FIG. 1—Top view of two mutual inductance coils arranged in the regular way for use with the Felici mutual inductance bridge

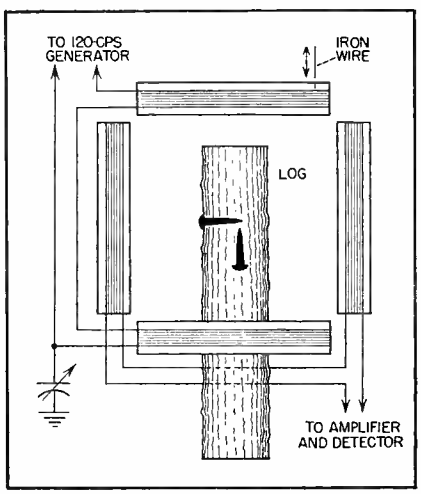
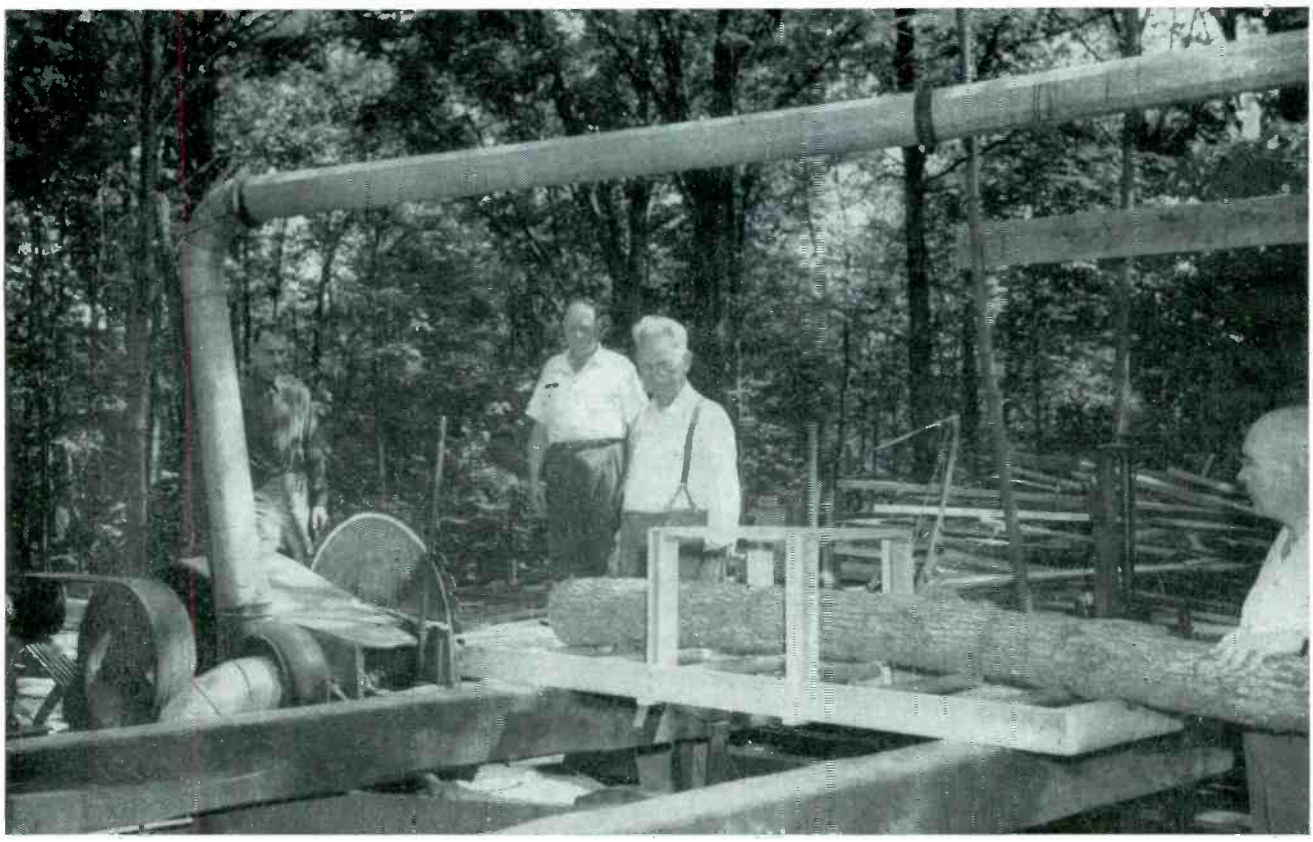


FIG. 2—Improved metal detection coil system which detects nails driven radially into a log as well as axially oriented objects

the Lumber Industry



The photograph shows a typical metal detector setup with the coils mounted to inspect the logs on their way to the saw

lies in the fact that for any specific frequency there is a certain size for magnetic objects at which the increase in self inductance due to the permeability of the material is exactly balanced by the decrease in self inductance due to the eddy-current losses, and no change in self inductance results. Again, there are certain conditions under which a magnetic object may act normally at a specified distance from the coil, but behave like a non-magnetic object at another distance, depending upon the way in which the electromagnetic field is intersected.[4]

Two-Coil Systems

Systems using two coils, or two pairs of coils, arranged so that their mutual inductance is zero in the absence of any metal in the field, have consistently shown the best sensitivity and stability. One of these systems was selected for the metal detector described in this paper. The Felici balance (or Hughes balance), the Campbell mutual inductance bridge, and the Carey-Foster bridge are all suitable for this purpose.[5,6] The Felici balance has the advantage of both electrical and mechanical symmetry, so that any variations in the coils themselves due to changes in ambient temperature and humidity are usually balanced out. The theoretical concepts involved are well treated in a paper by Leslie F. Curtis.[7]

The first and most important design step was the determination of the operating frequency. Previous designs have been based upon frequencies all the way from 60 cycles per second to several hundred megacycles. A popular army mine detector was operated at 1 kc, so that the unbalance signal denoting the presence of a mine would be audible in a pair of telephone receivers. In order to get valid preliminary design data, frequencies between 60 cps and 300 mc were tried, with the variations occurring in discrete steps of approximately one octave each. Coil systems, oscillators and detectors were constructed in accordance with the frequency used in each test. For magnetic metals it was found that general sensitivity is proportional to frequency; that is, the higher the frequency the higher the sensitivity. However, for nonmagnetic metals and water the sensitivity is proportional to the square of the frequency.

With the requirements of the lumber industry in mind (moisture content of green logs may run to 80 percent), a rather low frequency becomes the logical choice. Sixty cps and 180 cps were judged undesirable from the point of view of interference from power lines and motor fields at the fundamental and third harmonic respectively. Audio

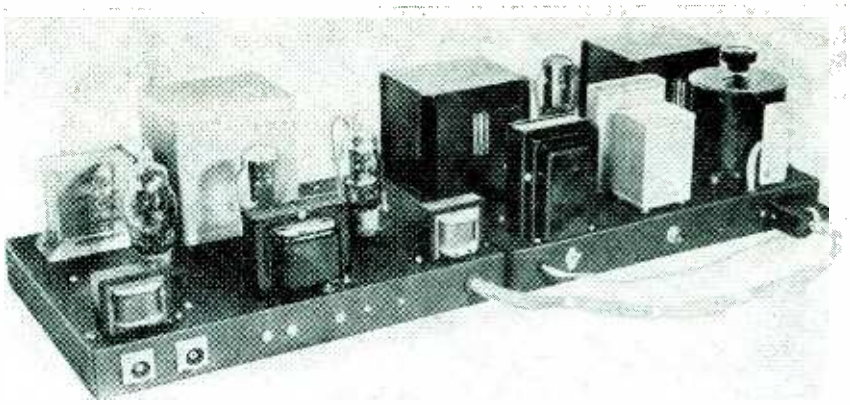
frequencies did not have to be considered from the standpoint of requiring an audible unbalance signal, so 120 cps was selected. A stable generator of this frequency is easily derived from the 60-cycle supply line. This frequency is low enough so shielding of coils in the bridge system is unnecessary. The small amount of capacitive coupling is balanced out with a small variable capacitor which requires adjustment only at the time the installation is made.

Various coil arrangements were tried next. The Felici bridge, with two identical pairs of coaxial coils, shows its greatest sensitivity to a nail whose axis lies parallel to the coil axes, and its lowest sensitivity to a nail whose axis is at right angles to the coil axes. This is illustrated in Fig. 1. Unfortunately most nails that are driven into trees are in the position shown at B, and the coil arrangements that have been used previously are at a disadvantage. This ratio of maximum to minimum sensitivity, according to the relative position of the nail, varies with the coupling coefficient of the pairs of coils used and the coupling coefficient between the nail and the coil nearest to it, but generally lies between a ratio of 8 to 1 and 10 to 1.

Four-Coil System

The four-coil arrangement shown in Fig. 2 was originated to overcome these variations in sensitivity; sensitivity is at a maximum both for nails whose axis is parallel to the coil axes and for those whose axis is at right angles to the coil axes. A deviation of 45 degrees from either position produces only a 20-percent decrease in sensitivity, and this is easily taken care of in the design of the detector. Each metal particle is detected twice as it goes through. In the interest of stability it was decided not to resonate the bridge coils; very little would have been gained by doing so anyway, for the Q of these coils at 120 cps is only slightly greater than unity.

The physical arrangement of the coils is such that the coefficient of coupling is zero in the absence of any metal in their fields. A piece of metal entering the effective area



Since space conservation is of no importance at lumber mills, no crowding of components was felt necessary, as may be seen from the above photograph of the metal detector oscillator chassis and power supply

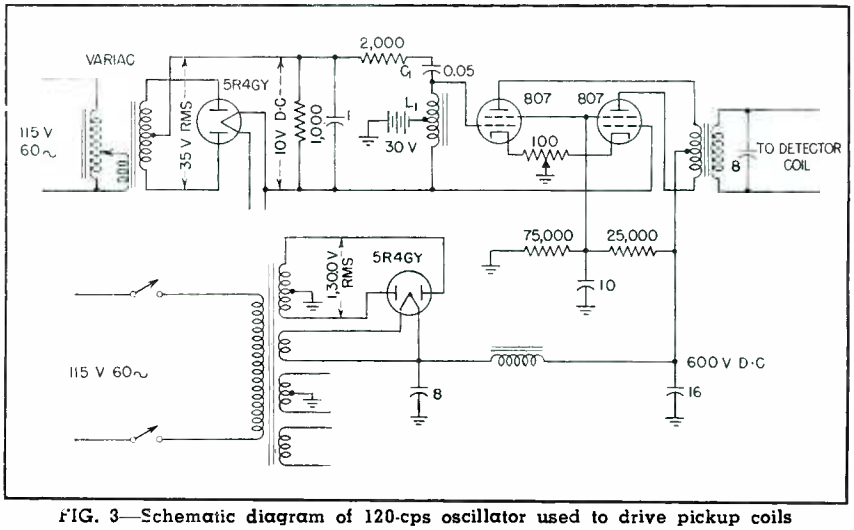


FIG. 3—Schematic diagram of 120-cps oscillator used to drive pickup coils

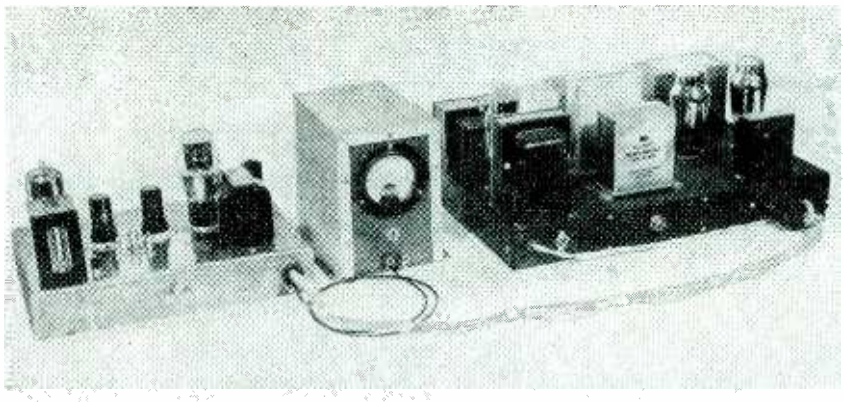
distorts the field in its vicinity, and an unbalance current flows in the detector coils, is amplified, rectified, and operates a sequence of relays which actuate warning devices.

To derive the maximum voltage from a slightly distorted field requires a great many turns. The two detector coils consist of 700 turns of No. 30 copper wire, Formvar insulated, layer-wound in ¼-inch deep grooves in a 24-inch square wooden form which has previously been impregnated with Bakelite varnish and baked at a low temperature to give it dimensional stability. (Molded Mycalex coil forms will be used for future models.) The two generator coils are wound on identical forms, but have 160 turns of No. 16 copper wire. One thickness of 0.005-inch Kraft paper is laid in between layers in both the detector and generator coils.

The 120-cycle generator of Fig. 3 is basically a full-wave rectifier whose power comes from the 60-cycle line through a Variac. The ripple frequency is fed into the series resonant circuit formed by C_1 and L_1, and feeds the push-pull grids of the 807 tubes with a 120-cycle voltage having excellent waveform. Forty watts of power is delivered to the bridge coils from this generator, although only about ten watts is actually radiated in the form of an electromagnetic field. The plate power supply and battery bias are conventional. The output is taken from two British-type coaxial connectors. Only JAN-approved resistors and oil-filled capacitors are used. The 8-μf capacitor across this output absorbs any transients or harmonics which may originate in the 807 tubes. The 100-ohm potentiometer in the cathodes of the 807 tubes is set for minimum second harmonic output.

Null Detector

A schematic of the amplifier and detector is shown in Fig. 4. The



Metal detector chassis, power supply and meter which is used to zero the instrument and to give an indication for extremely small metallic objects where the relay would not normally be operated

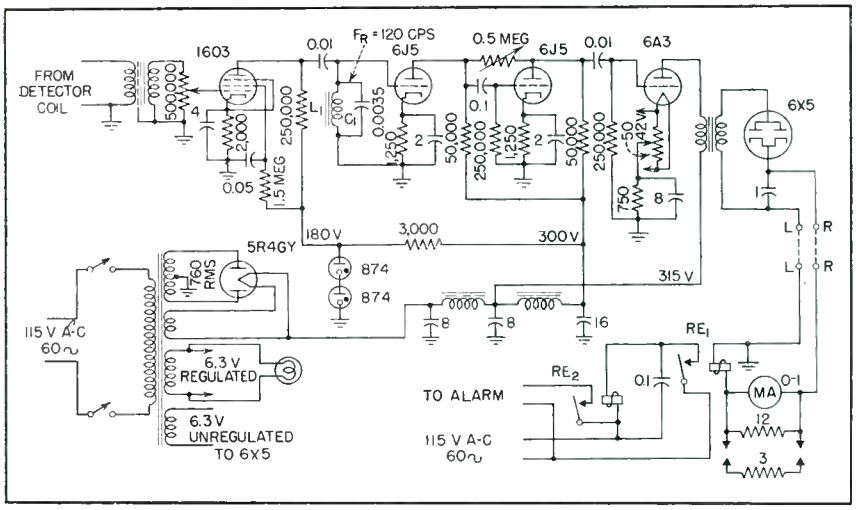


FIG. 4—Schematic diagram of metal detector amplifier and null detector

input transformer is a well-shielded (both magnetically and electrostatically) line-to-grid unit. The 1603 was selected as an input tube because it was found to inject a lower 120-cycle hum component into its output than any other types which were tried. The parallel resonant circuit following this stage has a 45-db rejection ratio to 60-cycle interference. As the heaters of all amplifier tubes are regulated by a small Sola transformer, and the plate and screen supply for the 1603 is stabilized with the two 874 regulator tubes, no inverse feedback was found necessary except that in the minor loop between the 6J5 plates, which actually is effective only in stabilizing the gain of the second 6J5.

A feedback loop that might have included the parallel resonant circuit at L_1-C_1 would have been undesirable because of the phase shift introduced by this circuit. A 9-percent change in overall gain is the maximum that results from a power line voltage variation of 100 to 125 volts.

It was decided to operate the first relay on a semi-power basis to insure positive operation, hence the use of a 6A3 and 6X5. Overall voltage gain to the 6A3 grid is 80 db with the gain control at maximum.

As this metal detector is to be used in lumber camps, where space is not at a premium, no consideration was given to the size or weight of any component. Rather, each item was selected with the idea that the equipment would require service only once a year with this service consisting mostly of tube replacements and the cleaning of relay contacts. Relay RE_1 is of the plate circuit type; RE_2 is energized by 115 volts, 60 cycles, and its contacts are designed to handle current for a large bell and warning light.

The 0-1 ma meter is useful in zeroing the bridge coil system, and also to give an indication of very small pieces of metal which normally would not actuate the relay. As the detector is usually set up, a piece of metal the size of a 16-penny nail is required to trip the relays, but the presence of a thin finishing nail or wire brad an inch long will give an easily visible deflection on the meter.

Special Problems

In order to keep the coil system free from components whose values might be altered by changes in temperature or humidity, no variable self or mutual inductances are used. Instead, the generator and detector coils are accurately matched when they are wound, and the final mutual inductance balance is achieved by a slight adjustment of the rigid mounting that holds the coils in place on the frame of the log carrier. In spite of these precautions, some rebalancing is required every day or two that the detector is in operation. This is accomplished by sliding a thin soft iron wire in or out of the field of one of the detector coils. This method of trimming a mutual inductance bridge has been known for many years, and no credit is claimed for its use here.

This detector may be operated by inexperienced personnel. It requires very little maintenance, and will give a rapid and positive warning of the presence of any metal objects large enough to damage a saw. Its operation is not affected by normal outdoor ranges of temperature and humidity, nor by relatively large variations in power supply voltage.

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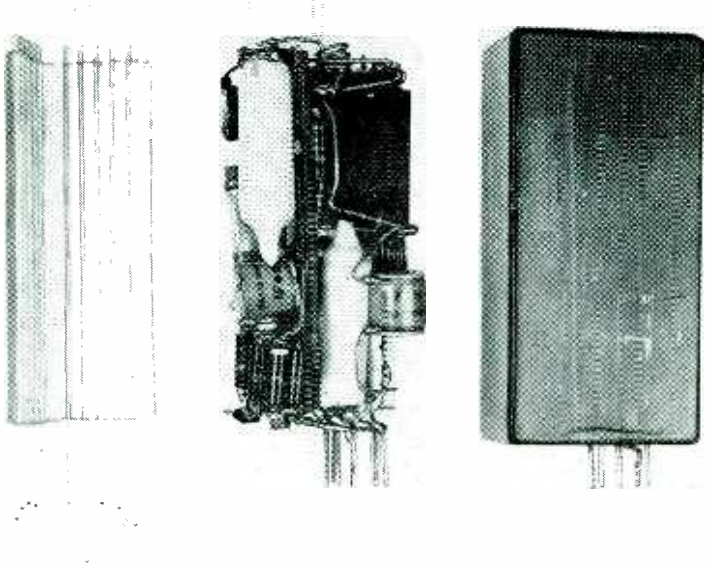
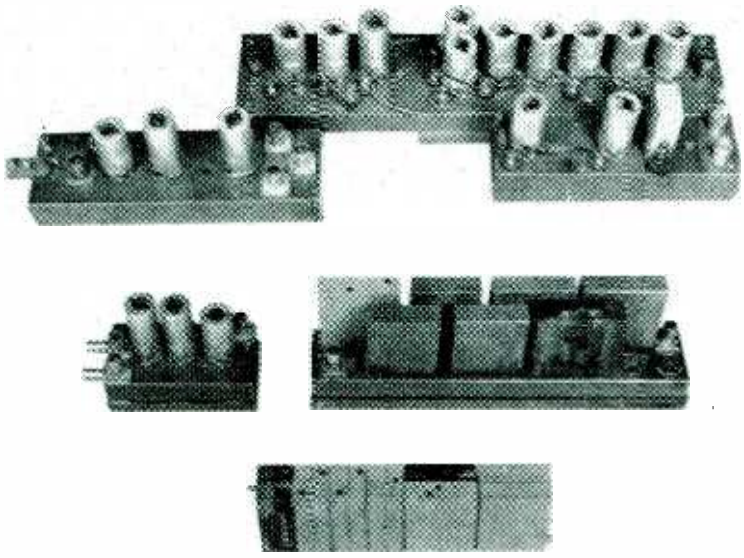
Potted Subassemblies for

Capsulation of amplifier and oscillator subassemblies in casting resin permits up to 500 tubes per cubic foot of space for computers, telemetering setups and other complex multi-tube equipment. Design and construction procedures for potting are fully covered



Steps in potting a three-tube strain gage amplifier. Left—casting-resin chassis with imbedded silver-clad beryllium-copper wires serving as stiffeners, tie points, plug prongs and lead wires. Center—assembled chassis with built-in limiter and voltag gain of 20,000, adjusted in production so all units have same gain within 1 percent. Right—complete plug-in unit as potted in casting resin. Other examples of potted plug-in units are shown in color on the front cover of this issue



Top—conventional construction of 14-tube wide-band i-f and video amplifier with afc and agc, for input frequency of 100 mc. Center—first step in miniaturization, using potted subassemblies but retaining the chassis and a conventional low-noise pre-amplifier. Bottom—final miniaturized assembly complete with preamplifier, with each unit plugging into its neighbor to eliminate the chassis. Most of the subassemblies are coated with silver shielding paint

DESIGN PROBLEMS of complex multi-tube equipment are simplified by using as few tubes as possible because the principal limiting factors are heating, circuit interaction, and density. In normal practice the use of a minimum number of tubes involves using carefully selected tubes and parts, with sacrifice of interchangeability. If cost factors warrant, these practices are tolerable in subminiaturized assemblies, providing the assemblies are potted to avoid component replacement, and providing no use is made of tube characteristics which change with age.

The use of the potted subassembly makes possible the design of a complete functional circuit as a subassembly. So long as each subassembly is completely interchangeable with others of the same type, internal differences are quite tolerable. This means, for example, that amplifiers may be built and adjusted to a known gain for use in a circuit. The matching of tubes with components makes possible a much more efficient use of both tubes and components in circuits. This can result in less heating, fewer circuits to interact with one another, and lower density.

The power supply forms a large proportion of the size and weight of all large equipment. Time and effort spent on improving the efficiency and decreasing the weight of power supplies probably pays bigger dividends than any other point. In this connection the use of high-temperature (200 C hot-spot) transformers and inductors will save almost 50 percent in the weight and volume of these units.

Since most subminiature tubes require but 100 volts plate supply, the conventional series regulator is extremely inefficient and bulky. The use of thyratron regulated supplies with miniature thyratrons as recti-

Subminiature Equipment

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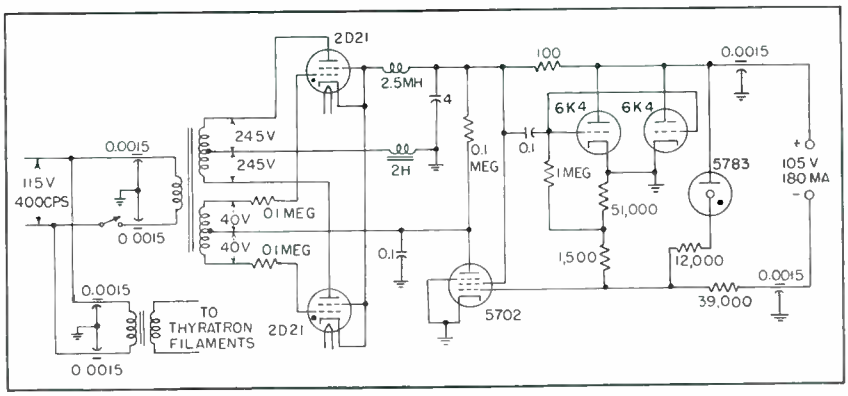

FIG. 1—Example of miniature thyratron regulated power supply circuit used with potted subassemblies to decrease size, weight and heating. Thorough shielding is necessary to avoid radiated noise from thyratrons. All 0.0015-μf capacitors are ceramic feed-through units to prevent conducted noise

fiers has been found to increase the efficiency of the 100-volt regulated power supply circuit in Fig. 1 by almost 50 percent, with a correspondingly large decrease in size and heating.

When printed circuits are used for miniaturization, it is always necessary to solder in tubes. It is usually necessary to solder in capacitors, and if accuracy is required, it is usually necessary to solder in resistors. It is practical to print wire and some inductors, however, and to use printed subassemblies whenever they are available commercially in the desired combinations of R and C.

Conventional circuit construction uses multitudes of terminal boards, terminal lugs, and other holding and mounting devices. These all add space and weight, and contribute little or nothing to the electrical performance of a circuit. A construction eliminating them, therefore, is a worthwhile advance.

Potted circuit technique or capsulation is such a construction. It permits selective assembly and use of nonweatherproof components, since the potting compound weatherproofs the entire assembly. This enables the use of smaller components, stripped of their weatherproof containers. All holding means except one plug and socket are eliminated.

Potted construction makes it possible to replace and design subassemblies on a unit basis, rather than as a miscellaneous collection of parts. It is further possible to modernize equipment from time to time by modernizing the individual subassemblies, only keeping them interchangeable electrically and mechanically with their predecessors.

It has been found essential to consider the design of a potted circuit as a unit. It is not practical to design a piece of equipment and then ship it to a chemist for potting. Each component must be selected for its compatibility with the potting compound. Those components which are not suitable for direct potting must be given a suitable pre-treatment, and the whole mechanical design must be considered integral with the potting process.

Components must be selected which will withstand the high ambient temperatures (105-115 C) concomitant to the operation of large miniaturized equipment. Tubes must be protected from shock by a resilient coating before mounting in the equipment. Many small points, too numerous to mention here, must be watched with care if a useful product is to result. A close liaison among chemists, mechanical designers, and electronic engineers has been found absolutely essential to insure good results.

A standardized form factor is useful in the production design of any complex assembly of subunits. Since most subminiature units are plug-in, a convenient socket to use is the standard nine-pin miniature tube socket. Typical units are one inch wide by either one or one and one-half inches deep, by three inches high. The wires forming the plug at the base of the unit are molded in place during the casting operation. A tapped reinforced hole at the top of the unit provides means for removing it from its socket. Units constructed in this way include strain gage amplifiers, video amplifiers, pulse generators, sawtooth generators, flip-flop multivibrators and bridge drive oscillators.

Potting Materials

No single plastic has been found suitable for all jobs. The NBS casting resin, while superb electrically, lacks temperature range. Five very different resins, each compounded to give good results for a specific type of operation, are currently being used. In general the polyesters are most versatile, although as a class they leave much to be desired and must be compounded to achieve satisfactory results.

Assemblies of the units described make possible the construction of equipment having a density (including power supply) of between 200 and 500 tubes per cubic foot. Shielding, where necessary, is provided by silver paint over the plastic. Internal temperature of the equipment is high, but careful construction can minimize the presence of hot spots.

Acknowledgement is due several individuals, co-workers at Melpar, Inc. for specific contributions. Notable are R. E. Cunningham, Chief Chemist, and J. L. Kiser, Production Engineer, and G. O. Glaze. Much of the work on this equipment has been supported by the Electronics Division of the Bureau of Ships under Navy Department Contract No. NObsr-39174.

Field Test of UHF TELEVISION

Report on field strength and picture quality at 60 locations in and near Washington, D. C. confirms need for high power to secure adequate service over 20-mile radius. Data obtained from NBC experimental picture transmissions on 505.25 mc

By JOSEPH FISHER

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THE PURPOSE of uhf television tests described in this paper was to study field coverage, multipath transmission, gain of various types of receiving antennas, and the reception of uhf signals when the receiving antenna is shaded from the transmitter by hills or buildings.

The tests utilized the standard black-and-white television signal transmitted by the experimental NBC station operating in the frequency band from 504 to 510 mc (picture carrier, 505.25 mc) with an effective radiated power of 3.6 kw.

Tests were conducted starting October, 1948, at sixty locations in the vicinity of Washington, D. C., at distances from the transmitter ranging from one and a half to twenty-three miles. The test locations were selected to provide the wide variety of receiving conditions typical of a large city and its adjacent communities. The field strength was measured and the television picture was analyzed at all test locations for degradation of picture quality due to multipath transmission, extraneous signals and receiver noise.

Receiving Equipment

Three antennas were used: a half-wave dipole, a Yagi array (folded dipole with two directors and one reflector) and an eight-element stacked array with screen reflector.

The antennas were adjusted to be resonant at 507 mc. The radiation resistance of the Yagi and of the eight-element array was approximately 90 ohms, while that of the half-wave dipole was 72-ohms. The Yagi antenna had a measured voltage gain, relative to a half-wave dipole, of 1.98 and a front-to-back voltage response ratio of approximately 10. The eight-element array had a voltage gain of 4.36 and a front-to-back ratio in excess of 20. Any of these antennas could be mounted on the top of a wooden pole twenty feet in length carried on a station wagon. The pole was so mounted that, when raised, the center of the antenna was approximately 23 feet above the ground. The lead-in consisted of 30 feet of RG-71/U coaxial cable (attenuation of a 30-foot length at 500 mc equal

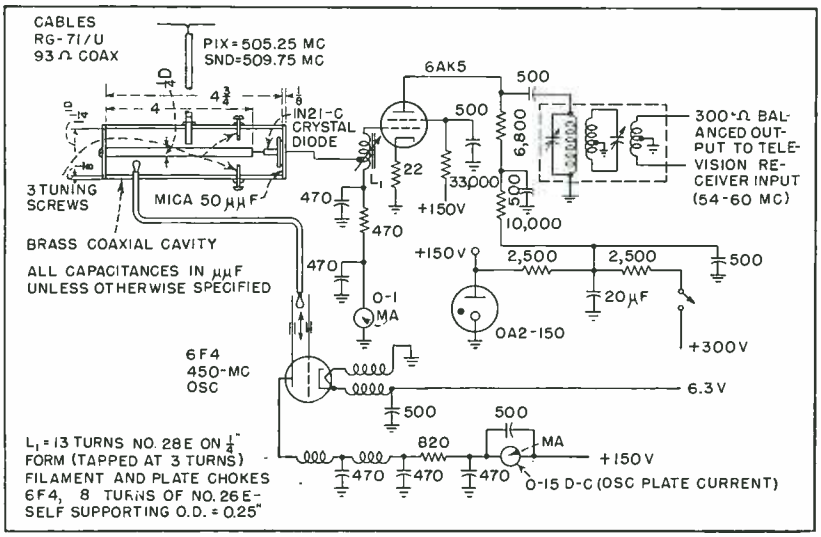


FIG. 1—Circuit diagram of the cavity-tuned 500-mc uhf television converter. The output is fed into a standard television receiver with 300-ohm balanced line

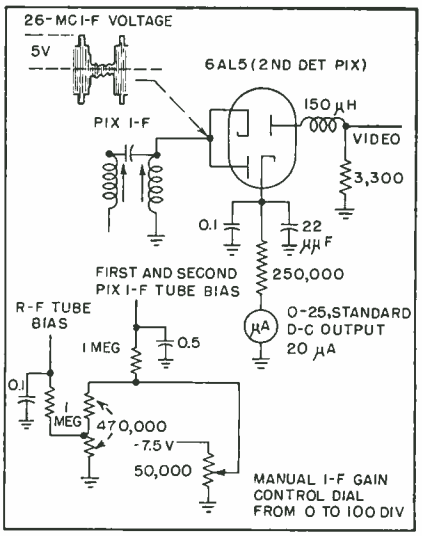
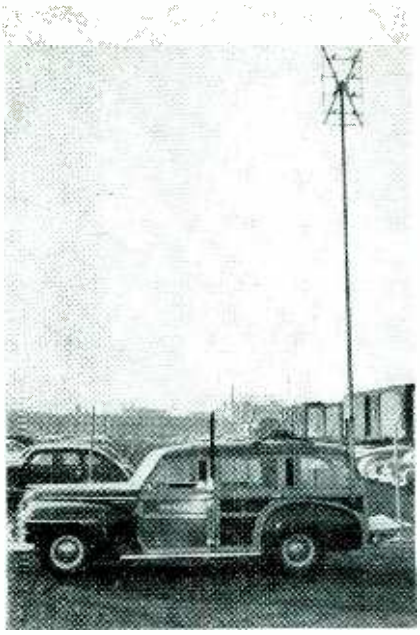
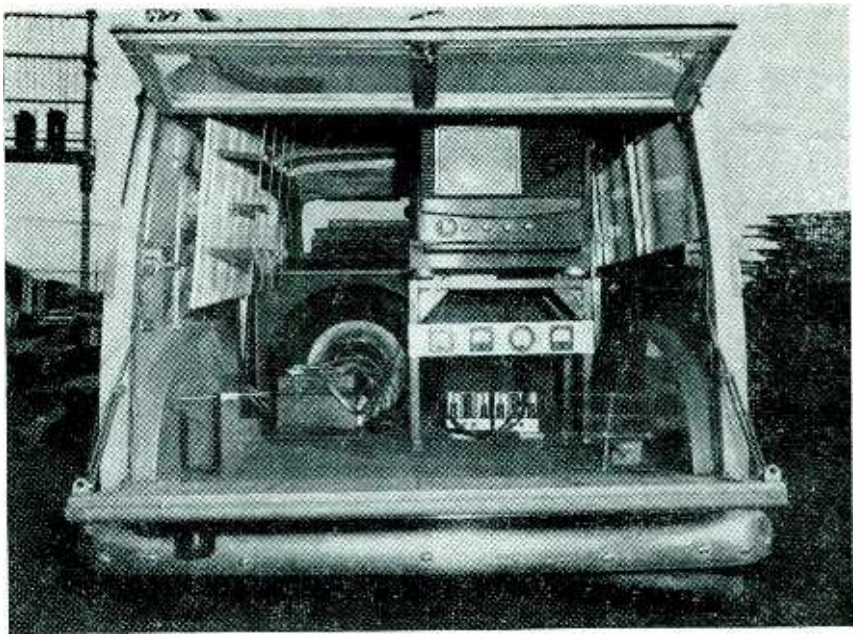


FIG. 2—Schematic diagram of special vtvm and manual gain control circuits



Photograph of the mobile receiving station used. The 8-element array is shown in place 23 feet above ground



Interior view of the mobile setup used in the Washington field strength measurements. The four meters mounted below the receiver read 450-mc local oscillator injection current and plate current, the receiver afc voltage and the field strength

to about 3.0 db). The characteristic impedance of RG-71/U cable (93 ohms) provided a good impedance match to the antennas used.

The converter was designed to produce an intermediate frequency of 54 to 60 mc (channel 2) from the 504 to 510-mc r-f signals. The converter (Fig. 1) includes a fixed-tuned coaxial cavity, a 1N21-C crystal mixer, a 6F4 local oscillator operating at 450 mc, and a single-tube 6AK5 i-f amplifier with a center frequency of 57 mc and a bandwith of 6 mc. The output of the converter is fed into the antenna terminals of a Philco model 48-1001 television receiver by means of a seven-inch length of 300-ohm balanced transmission line. The power supply of the 48-1001 was altered for vibrator operation from storage batteries. Meters were provided in the equipment to measure the 450-mc oscillator plate current, the 1N21-C crystal current, the afc voltage of the television receiver, and the field strength.

Calibration of Field Strength

To read field strength, a vacuum-tube voltmeter, (Fig. 2), consisting of a 6AL5 diode, a 250,000-ohm load resistor, and a 25-microampere d-c meter, was connected across the 26-mc i-f output of the receiver. The load resistor and meter were bypassed with a 0.1-μf capacitor, giving the circuit a long time constant, and allowing the capacitor to be charged by means of the diode to the peak value of i-f carrier during the time the sync pulses are transmitted. The indication of field intensity therefore did not depend on the percentage modulation of the television station at the time readings were being taken, but only on the peak value of carrier during the time sync information was transmitted. As indicated in Fig. 2, a calibrated manual gain control was used to vary the gain of the television receiver by applying a variable bias to the r-f and first two picture i-f tubes. The receiver was designed to operate with a composite video signal level of two volts peak-to-peak across the video detector load resistor, which corresponded to a reading of 20 microamperes on the vacuum-tube voltmeter when receiving an 85-percent modulated television picture. The reading of 20 microamperes was established as standard output for the field measurements.

The receiver was calibrated in the following manner: The converter was connected to the receiver and an unmodulated sound carrier at a frequency of 509.75 mc was applied to the input of the converter from a signal generator. The frequency of the 450-mc oscillator in the converter was then adjusted to produce zero afc volts. This insured that the signal output of the converter was at a frequency of 59.75 mc (channel 2 sound carrier). The 450-mc oscillator injection was adjusted to produce 0.5 ma of crystal current. Various levels of unmodulated picture carrier at a frequency of 505.25 mc were applied from the signal generator and the variable bias control setting was noted for standard output (20 microamperes). From these data a curve was plotted of dial setting versus microvolts input.

The following method was used to determine the noise figure of the receiver. The receiver was fed from a signal generator having an internal resistance of 93 ohms. A thermocouple meter connected across the final video amplifier plate load was used as an indicating device. Unmodulated carrier from the signal generator was applied to the receiver input and increased in amount until the noise power output stopped increasing, care being taken to insure that the second detector and the amplifiers were operating at normal signal levels. Sine wave modulation was then applied to the signal generator and the percent modulation required to double the reading of the output meter

observed and recorded.

The carrier open-circuit voltage from the 93-ohm generator was 67.2 microvolts and the necessary modulation was 10 percent. Hence the noise voltage was 6.72 microvolts, or 8.8 db greater than the theoretical noise of 2.44 microvolts across 93 ohms at 4-mc bandwidth.

Performance of Receiving Antennas

Any of the three antennas could be used to measure the field strength at locations where signal is being received from only one direction, a different calibration figure being required for each antenna to relate measured receiver microvolts to field intensity.

There are some locations, however, in which the situation is complicated by signals arriving at the receiving point from several different directions, some of which are unusable because of excessive delay. In locations of this sort a nondirectional antenna may deliver more power to the receiver than a much larger directional antenna. In some of these cases, the signal from the nondirectional antenna is perfectly satisfactory, but in other cases it is contaminated by intolerable ghost images.

Whether a particular indirect path signal is useful or detrimental depends on whether it lies within a certain area surrounding the receiving location. The boundary of this area is approximately a parabola, opening towards the transmitter and crossing the continuation of the direct line from transmitter to receiver at a point approximately 125 feet behind the receiver. The delineation of this boundary is based on the fact that video signal contributed by any scattering object within it will be delayed no more than about $\frac{1}{4}$ μsec, corresponding to approximately two picture elements displacement of information or about $\frac{1}{32}$ inch on a ten-inch cathode-ray tube. Scattering objects outside of this boundary may cause either loss of resolution or distinct ghosts.

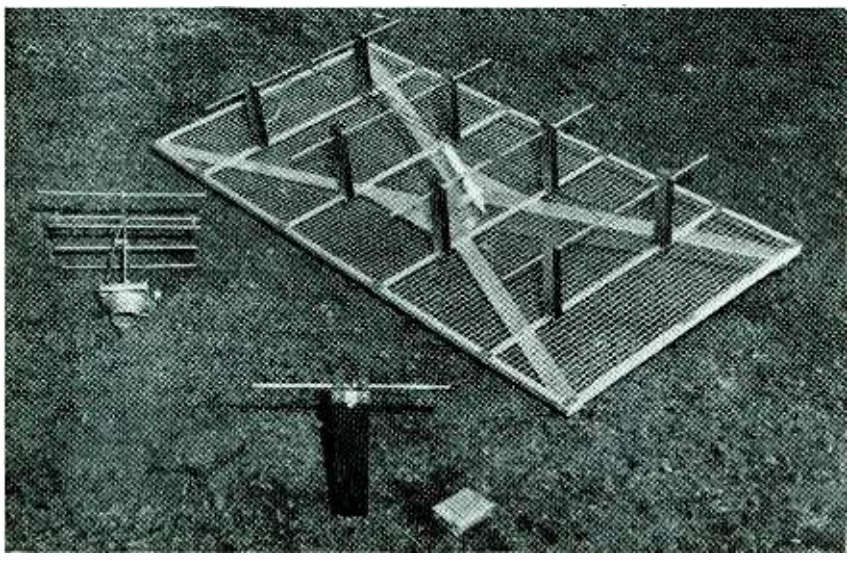
This boundary crosses the perpendicular to the direct line, erected at the receiving point, at a distance of about 250 feet and the area enclosed by the parabola continues to widen gradually as a function of distance towards the transmitter, as shown in Fig. 3.

A nondirectional antenna can receive signals from many scattering objects simultaneously, and if these objects lie principally in the useful area, a net gain in performance is contributed by the scattered signal. If on the other hand, a large proportion of the scattered signal is of the detrimental type, originating from outside of the boundary, then a nondirectional antenna, even though it delivers large power to the receiver, cannot be used. While a highly directional antenna cannot utilize scattered signals over a wide angle and therefore may not deliver the expected increase in power in such cases, yet the signal delivered by directional antennas as a rule has higher resolution and less ghost images than that from nondirectional antennas. It should be emphasized that these remarks pertain to only a small minority of field locations. In the vast majority, the directional antennas are superior in performance by an amount dependent upon their gain.

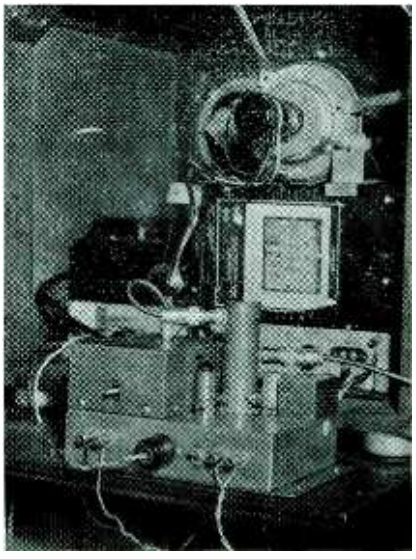
It can be seen that the field strength in microvolts per meter inferred from several antennas having different directivity will have different values. The field strength measured by a simple dipole will generally be larger because scattered signals are included. It is for this reason that the term "effective field strength" has been used in this report, different fractions of the received signal being effective with each type of antenna.

In the course of these tests very few locations were found in which the array failed to realize considerable gain over a dipole.

The open-circuit voltage across the terminals of a half-wave dipole resonant at 55 mc (television channel 2) is approximately twice the



The three types of receiving antennas used in the Washington, D. C. uhf television field strength measurements are shown above. They are the half-wave dipole, a 4-element Yagi and an 8-element array



The 500-mc converter used in making the uhf measurements. The coaxial input cavity is mounted next to the oscillator

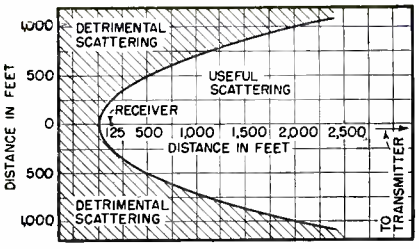


FIG. 3—Plan view of receiver vicinity showing areas of useful and detrimental scattering

field intensity in microvolts per meter. However, the open-circuit voltage across the terminals of a half-wave dipole resonant at 500 mc is approximately one-fifth the field intensity in microvolts per meter. For the same field intensity, at these frequencies, the ratio of voltages across the resonant half-wave dipoles will be approximately ten to one. Thus even over flat terrain either much higher transmitter power or high-gain receiving antennas are required for coverage on 500 mc comparable to that at 55 mc.

At 36 of the test locations two or more antennas were tried. At 32 of these locations the use of high-gain receiving antennas gave an increase in signal voltage applied to the receiver. There were four test locations where the use of an eight-element receiving array did not increase the signal voltage applied to the input. At one of these locations the Yagi antenna gave a gain over the dipole but the array produced a lower signal than the Yagi.

General Propagation Effects

The field strength in microvolts per meter at all locations plotted against distance between receiving and transmitter antennas is shown in Fig. 4. The theoretical curve for propagation over flat earth shows the received signal strengths to be much lower than that of the theoretical curve. The theoretical curve does not take into account the irregularities of the terrain between the transmitter and receiver, the ground contour at the point of reflection, and the phase relationship of the various signals arriving by multipath transmission. In addition, the shadowing effect of obstructions such as buildings and hills increases with frequency.

This is demonstrated by the reception at test location 1, 4,707 Windom Place which is only 2.4 miles from the transmitter. The ground contour of Fig. 5A, which does not show trees and buildings, places this location at a shadowed point, not line-of-sight. The field intensity with the array antenna was E_f = 1,306 microvolts per meter and, with a converter having a noise figure of 8.8 db above thermal noise, the reception was marginal. In comparison, the channel 4 television transmitter in Washington with its antenna located on the same tower as the 500-mc transmitting antenna, produced a noise-free picture at location 1. The power output of the channel 4 station was of course greater (approximately 5.7 to 1) but this alone does not account for the low field strength at this location.

As other investigators have reported, the decrease in received signals is caused by the increased shadowing effect at 500 mc when the receiving antenna is located behind a hill or building. Locations 10 and 12 are also shown on this same contour diagram (Fig. 5A), as they fell within a degree or two of the radial joining the transmitter and location 1. The field strength measured at location 10, Wriley Road, north of Massachusetts Avenue, 3.45 miles from the transmitter which was also a shadowed point (not line of sight), is low, producing a marginal picture. The effective field intensity, again with the array antenna, is E_f = 4,200 microvolts per meter at location 12 (the junction of routes 190 and 191, near Campbells Corner, 8.9 miles from the transmitter) on the same radial, in line of sight, and at a distance from the transmitter four times that of location 1. This signal resulted in a picture of excellent quality.

Figure 5B shows ground contours from the transmitter to locations 46, 33 and 16, all along approximately the same radial. The field strength of E_f = 3,150 microvolts per meter, resulted in a good quality picture at location 16 (Georgetown Preparatory School campus, near route 240, eight miles from the transmitter) the most distant of all three points. The ground contour for two miles in the direction of the transmitter from this location was relatively low and sloping upward to the receiving location which was within line of sight.

The reception at location 46, field strength E_f (Yagi antenna) = 4,530 microvolts per meter, (Connecticut Avenue and Northampton, near Chevy Chase Circle, 3.15 miles from the transmitter, line of sight) produced a good quality picture.

The picture quality at location 33, field strength E_f (array antenna) = 2,860 microvolts per meter, (6721 Fairfax Road, Bethesda, Maryland, 4.75 miles from the transmitter and line of sight) was good.

At locations 35 and 20, both on

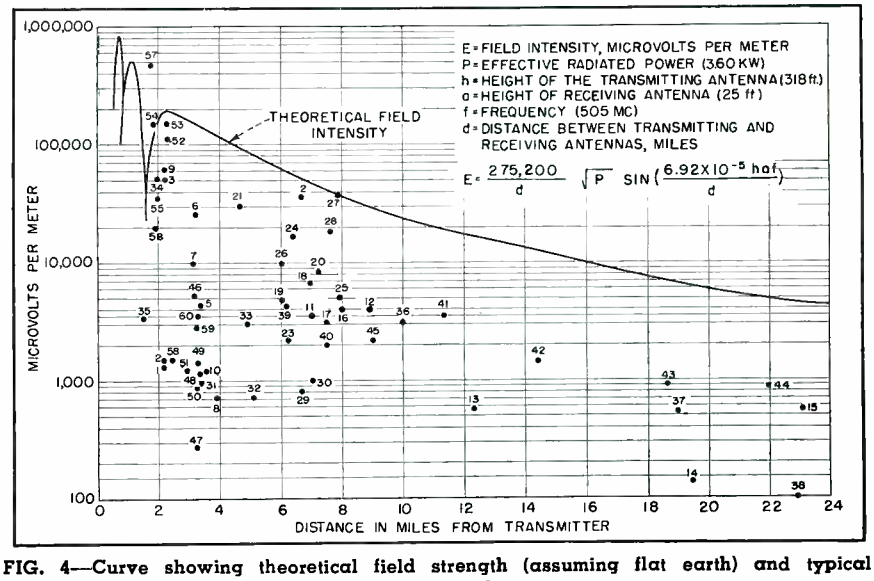


FIG. 4—Curve showing theoretical field strength (assuming flat earth) and typical measured values

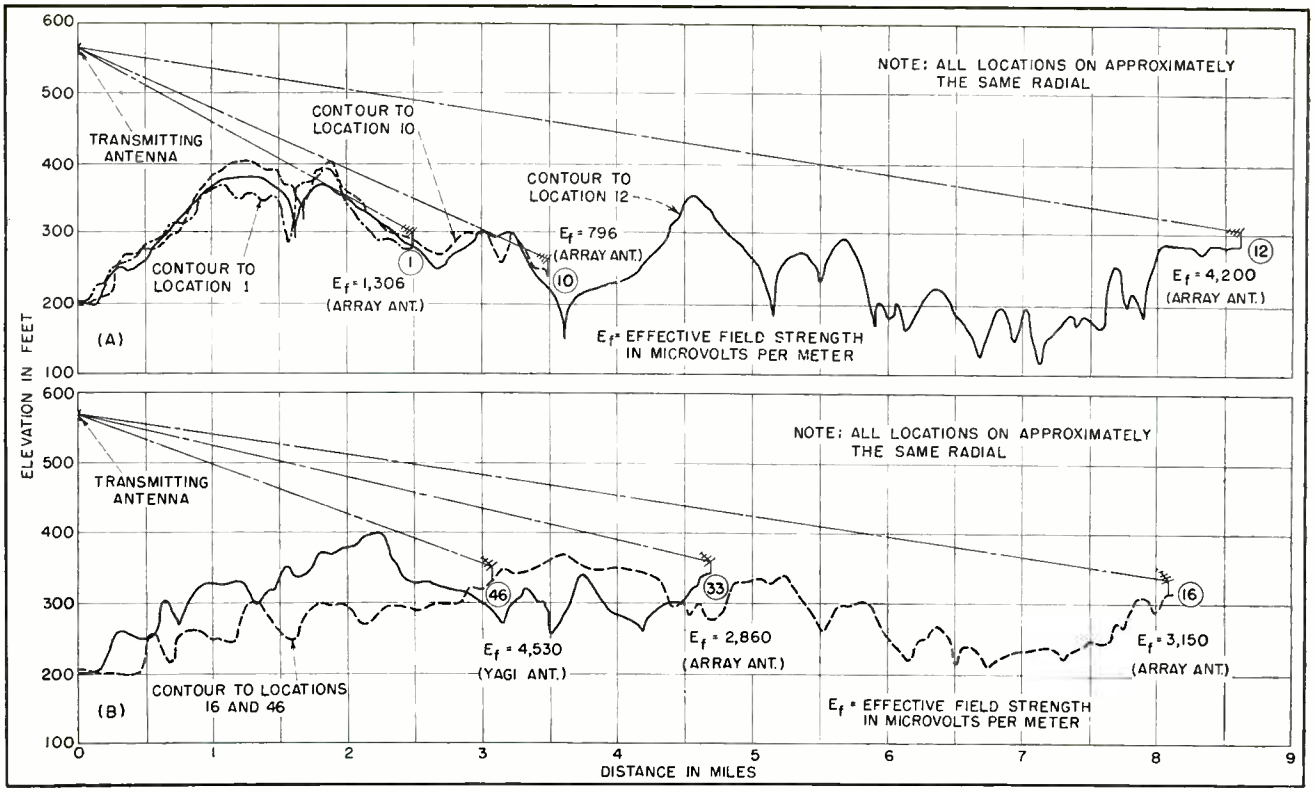


FIG. 5—Ground contours for radials containing typical measuring locations. It may be seen that the field strength at any location is highly affected by the existence of obstructions between transmitter and receiver

the same radial, the transmission paths were in the clear. The field strength at location 20 (University of Maryland campus, 7.2 miles from the transmitter, and line of sight) was E_f (Yagi) = 8,300 microvolts per meter. The ground contour for approximately one-half a mile in front of the receiving antenna was relatively low and flat. The field strength at location 35, (1,343 Perry Place, N. W., 1.4 miles from the transmitter), was E_f (array antenna) = 2,430 microvolts per meter and produced a good picture. The relatively low field strength at a location so close to the transmitter was caused by houses in front of and above the receiving antenna.

At locations 8 and 21 the paths were also in the clear, but on different radials, and approximately the same distance from the transmitter. The field strength at location 21 (the drill field at Fort McNair, 4.6 miles from the transmitter), was E_f (Yagi) = 29,600 microvolts per meter, producing an excellent picture. It is significant that the ground profile for 3½ miles in front of the receiving antenna was very low and flat. The field strength at location 8, (Lee Blvd and Filmore Street, Arlington, Virginia, 3.95 miles from the transmitter) was E_f (Yagi) = 713 microvolts per meter, producing a noisy picture. There was a row of houses approximately thirty feet high and one hundred feet in front of the receiving antenna which caused a shadowing effect.

Reflecting Surfaces

Tests were made at location 5, which is approximately 500 feet from the United States Capitol Building and 3.37 miles from the transmitter. With the eight-element antenna array oriented toward the transmitter, an excellent picture was obtained, the field strength measuring E_f = 4,200 microvolts per meter. The array was then turned 100 degrees clockwise to use the reflected signal from the Capitol Building and a good picture was obtained except for a slight leading ghost due to the directly transmitted signal.

At location 53, (23rd and Constitution Avenue), with the antenna array oriented toward the transmitter an excellent quality picture was obtained and the field strength was measured to be E_f = 147,000. The antenna was then turned 180 degrees and the reflected signal from the Lincoln Memorial produced a field intensity E_f = 18,500 microvolts per meter. The picture definition was marred to some extent by a number of closely-spaced following echoes, an effect which did not appear in the signal reflected from the dome of the Capitol Building. There was a prominent leading ghost, displaced three-eights of an inch to the left, caused by direct pickup from the back lobe of the antenna array. The front-to-back gain ratio of the antenna array was great enough so that the receiver was synchronized from the reflected signal.

In tests made at location 55 (16th and H Streets, N. W., 1.95 miles from the transmitter) the receiving antenna was surrounded by buildings, and all received signals were obtained by multipath transmission. The Yagi antenna was slowly rotated through 360 degrees and all positions gave high field strength readings; but a good quality of picture, not marred by multipath transmission, was obtained only over a 30-degree range, in the direction of the transmitter.

The shadowing effect caused by obstructions such as hills, buildings and trees, at 500 mc, is greater than at the lower frequency television channels. Reception at the higher frequency will be improved by increased transmitter power, but of perhaps equal importance is the elevation of the transmitting antenna above obstructions and average terrain.

The use of high-gain receiving antennas to build up the signal voltage applied to the input circuit is highly desirable in many locations, and our investigations showed that at 90 percent of the locations where such antennas were tried, there was a definite gain in signal applied to the receiver input with a consequent improvement of signal-to-noise ratio.

Multipath transmission is present at 500 mc but, even when using a half-wave dipole, seemed less than that experienced on the lower channels. The possibility of multipath signals degrading a picture is decreased by the use of high-gain directional receiving antennas, which were found to be generally desirable to provide a clean signal in locations where multipath reception was severe.

When the receiving antenna is shaded from the transmitter by hills and buildings it is sometimes possible to use a reflecting object such as a building as a signal source. However, the reflected signal suffers a definite attenuation due to scattering and absorption at the reflecting surface, and the general construction of the reflecting structure at times gives rise to a number of closely-spaced following ghosts which lower the overall definition of the picture.

Man-made noise, such as that from automobile ignition systems, affects picture quality a great deal less at 500 mc than at the lower frequency television channels. Therefore, when receiving in city locations, less received power is necessary to overcome man-made noise and provide reliable reception than is required on the low channels. Throughout these tests the limiting noise was receiver noise and not man-made interference.

There were many city locations in which an open-circuit voltage of 500 microvolts at the receiver end of the feed line provided a fair picture. Twice this value, or approximately 1,000 microvolts open-circuit voltage at the receiver end of the feed line, produced a good quality picture. This level of signal (1,000 microvolts open-circuit voltage out of 93 ohms) would require a field strength of 6,500 microvolts per meter when using a half-wave resonant dipole. If a high-gain receiving antenna were used the required field intensity in microvolts per meter would be reduced, in most locations, by the ratio of the voltage gain of the directional receiving antenna compared to a single half-wave dipole. In a few locations the usual types of high-gain antennas do not deliver their nominal gain, and it is felt that this matter should be further investigated. There is some indication that, in shadowed areas, vertical directivity is to be preferred to horizontal directivity as a means of obtaining antenna gain. Some of the scattered signals arriving from widely different directions in the horizontal plane contribute usefully to the output.

Table I—Field Strength vs Picture Quality

	Good to Excellent Picture Quality	Marginal Picture Quality	Poor to Unusable Picture Quality
Measured Open Circuit Voltage at Receiver End of Feed Line (Microvolts)	1,000 or over	300 to 1,000	Under 300
Field Strength Using a Halfwave Dipole and allowing for 3 db Feedline Loss (Microvolts per meter)	6,500 or over	2,000 to 6,500	Under 2,000

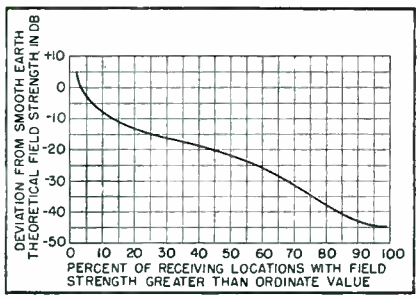


FIG. 6—Curve showing the relationship between the percent of receiving locations and the measured field intensity in db below theoretical for smooth earth

Since receiver noise limits quality of performance more than does man-made interference, converters should be designed with the best possible signal-to-noise ratio.

An evaluation of the picture quality in terms of receiver noise as noted by the observers is given in Table I.

Conclusions

The measured field strengths were generally lower than that calculated on the basis of smooth earth. The deviation of received field strength from the calculated value is plotted versus percentage of stations affected, in Fig. 6. While no complete theory of terrain effects exists at the present time, all indications are that these effects rapidly diminish as the transmitting antenna height is increased.

While the transmitter power required to give a predetermined percentage of coverage cannot be estimated reliably without involving matters such as population distribution which are beyond the province of this investigation, some facts bearing on coverage can be derived immediately from the above data. For example, to produce a field of 3,000 microvolts per meter in at least 55 percent of the receiving locations twenty miles from the transmitter with a dipole and reflector with a gain of 4 db for a receiving antenna, the transmitter effective radiated power must be 125 kw.

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Choke-Input Filter Chart

For given bleeder current, chart gives optimum values of L and C, resulting output ripple and resonant frequency, and magnitudes of four significant transients for nine combinations of single-phase and polyphase rectifier circuits with various power input frequencies

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PREVIOUS charts for choke-input filters give the ratio of choke reactance to capacitor reactance or the LC product needed to attenuate the ripple to the required level, but individual values of L and C are not thereby determined. Where regulation is important, L and C must have definite values to avoid capacitance effect, or the tendency for the d-c voltage to rise at light loads.

For the circuit of Fig. 1 it can be shown that

$$R_1 = (X_L - X_C)/P_A \qquad (1)$$

where R_1 is maximum bleeder resistance to prevent voltage rise, X_L is choke reactance at fundamental ripple frequency, X_C is capacitor reactance at fundamental ripple frequency and P_A is peak amplitude of fundamental ripple frequency in the rectifier output, which depends on the type of rectifier.

Attenuation in this filter can be expressed by

$$\frac{P_A}{P_R} = \frac{X_L - X_C}{X_C} \qquad (2)$$

where P_R is the peak ripple amplitude in the load. Combining Eq. 1 and 2 gives $X_C = R_1 P_R$, and therefore

$$C = \frac{1}{\omega R_1 P_R} = \frac{1}{R_1}\left(\frac{1}{\omega P_R}\right) \qquad (3)$$

Description of Chart

For a given rectifier, filter capacitance C thus depends only on the bleeder resistance and percent ripple. Once capacitance is fixed, the minimum inductance is also fixed; these are the values plotted on the chart.

Abscissa values of the right-hand scale are bleeder conductance in milliamperes per volt; and of the left-hand scale, filter capacitance in microfarads. Ordinates of the lower vertical scale are inductance in henrys. Lines representing various amounts of ripple in the load are plotted in the first quadrant, labeled both in db and percent ripple. In the second quadrant, lines are drawn representing different types of rectifiers and supply line frequencies. A similar set of lines is shown in the fourth quadrant.

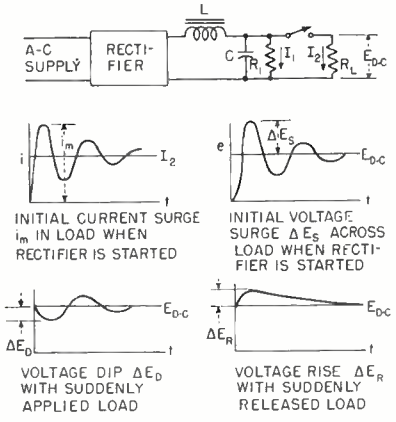

FIG. 1—Basic choke-input filter circuit, and curves illustrating four transient conditions affecting circuit design

Two orthogonal sets of lines are drawn in the third quadrant. Those sloping downward to the right represent resonant frequency of the filter L and C and also load resistance R_L. The other set of lines is labeled $\sqrt{L/C}$, which may be regarded as the filter impedance. It can be shown that the transient properties of the filter are dependent upon the ratio of $\sqrt{L/C}$ to R_L.

Ripple is plotted in two ways. Percent values are rms ripple voltage in the load divided by d-c voltage output $E_{d\text{-}c}$, according to the IRE standard definition; db values are equal to 20 $\log_{10}$ *(rms ripple)*/0.707 $E_{d\text{-}c}$. Instruments for measuring hum normally read the db value, which is the noise-to-signal ratio for 100 percent modulation of $E_{d\text{-}c}$, expressed in −db. It is 3 db less ripple than would be obtained by 20 times the logarithm of the percent ripple expressed as a fraction. This distinction should be borne in mind if an attempt is made to correlate the two methods of plotting ripple.

Use of Chart

In using the chart, it is well to start with bleeder resistance, or milliamperes bleeder current per volt $E_{d\text{-}c}$ and draw an ordinate to intersect the desired value of load ripple, trace horizontally to the type of rectifier, and read the value of C. Now return to bleeder resistance and trace downward to the type of rectifier, and read the value of L. More detailed step-by-step instructions are given under the chart.

The L scale requires a correction to compensate for the fact that ripple is not exactly a linear function of L, but rather of X_L-X_C. The curves in the lower part of quadrant IV give the amount of correction to be added when the correction is greater than 1 percent.

Bleeder current given is the minimum necessary for continuous current from the rectifier. Steady-state peak ripple current is read directly on the same scale.

The third quadrant has a series of lines labeled f_r, and the intersection of L and C thereon indicates the resonant frequency of the filter. It should be no higher than the value given in the small table in quadrant IV in order to avoid excessive ripple in polyphase rectifiers due to

Continued on page 114

CINCH TERMINAL STRIPS

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Eighteen years ago Cinch Engineers developed an idea . . . gave the Radio Industry its first terminal strips for practicable production.

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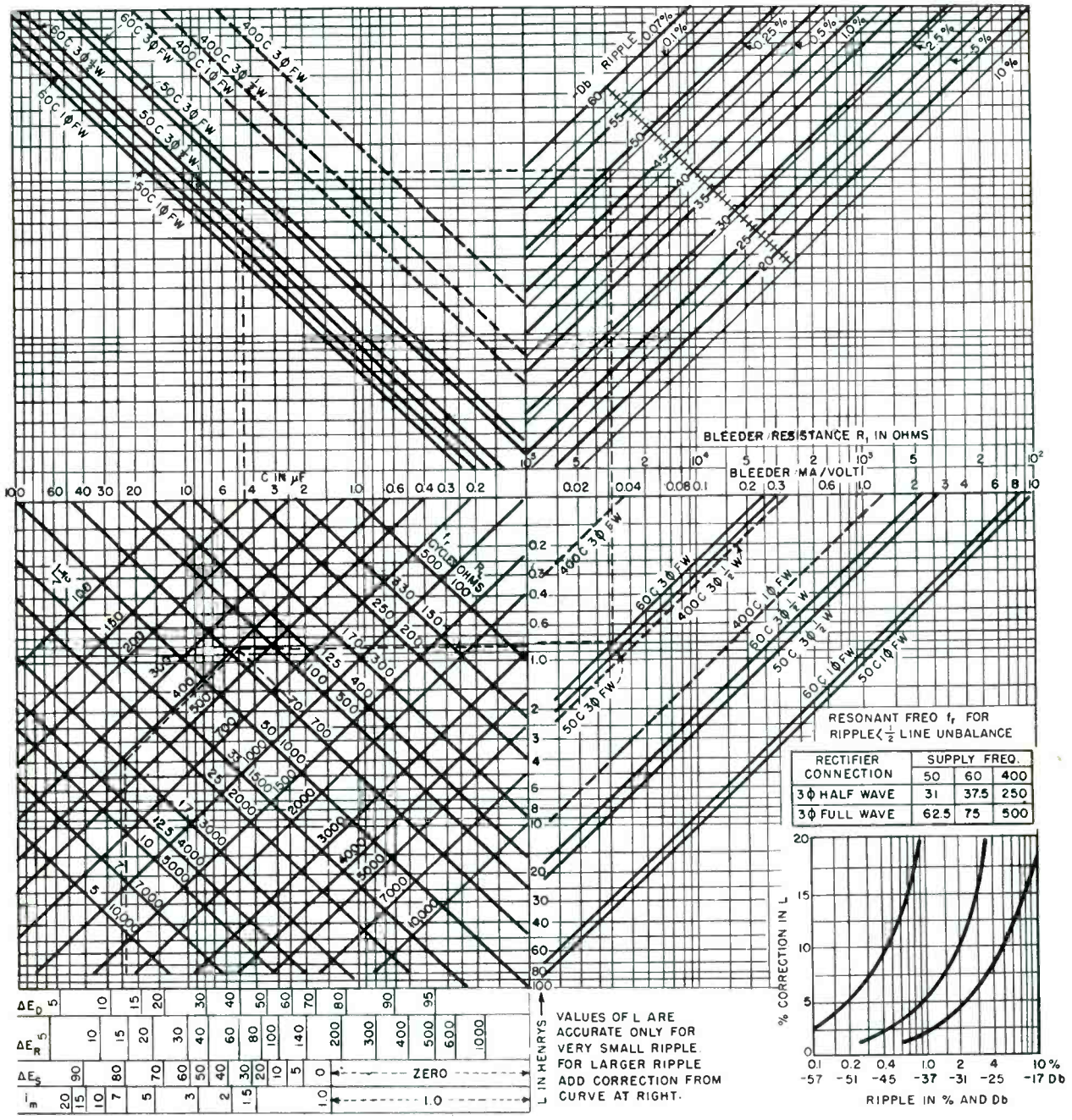
Choke-Input Filter Chart

(Continued from page 112)

supply-line phase unbalance.

If the supply voltage is suddenly impressed, or if the load varies suddenly, the filter is subject to transients. The bottom scales of quadrant III give the magnitudes of the four transients indicated on the curves in Fig. 1.

Additional data on the use of this chart for swinging-choke and shunt-tuned choke applications and for two-stage choke-input filters is given in the Electron Art department.



1. Assume suitable value of bleeder resistance or bleeder current I_1 in ma per volt of $E_{d\text{-}c}$. This is also steady-state peak ripple current in ma.

2. Trace upward on desired bleeder ordinate to intersect desired value of load ripple, and from here trace horizontally to the left to diagonal line for rectifier and supply frequency used. Directly under read value of C.

3. Trace downward on same desired bleeder ordinate to intersect diagonal line below for rectifier and supply frequency, and read value of L.

4. From desired ripple value, determine correction for L on graph at lower right, and add indicated correction to value of L.

5. Using corrected value of L and next standard value of C, find intersection in third quadrant and read maximum resonant frequency f_r.

6. Using same values of L and C as in 5, read value of ratio $\sqrt{L/C}$.

7. Under intersection of $\sqrt{L/C}$ with load resistance R_L read values of the four transients.

Example (shown dotted):

Three-phase full-wave 60-cycle rectifier; $E_{d\text{-}c} = 3{,}000$ v; $I_2 = 1$ amp; $I_1 = 96$ ma; load ripple $= -50$ db

Solution:

Bleeder ma/volt $= 0.032$

$C = 4.5$ μf (use 5 μf)

Scale value of $L = 0.78$ h; corrected value $= 0.82$ h

Resonant frequency $= 75$ cycles

Load resistance $R_L = 3{,}000$ ohms

$i_m = 7\ I_2 = 7$ amp; $\Delta E_S = 79\%$; $\Delta E_D = 12\%$ $\Delta E_R = 15\%$

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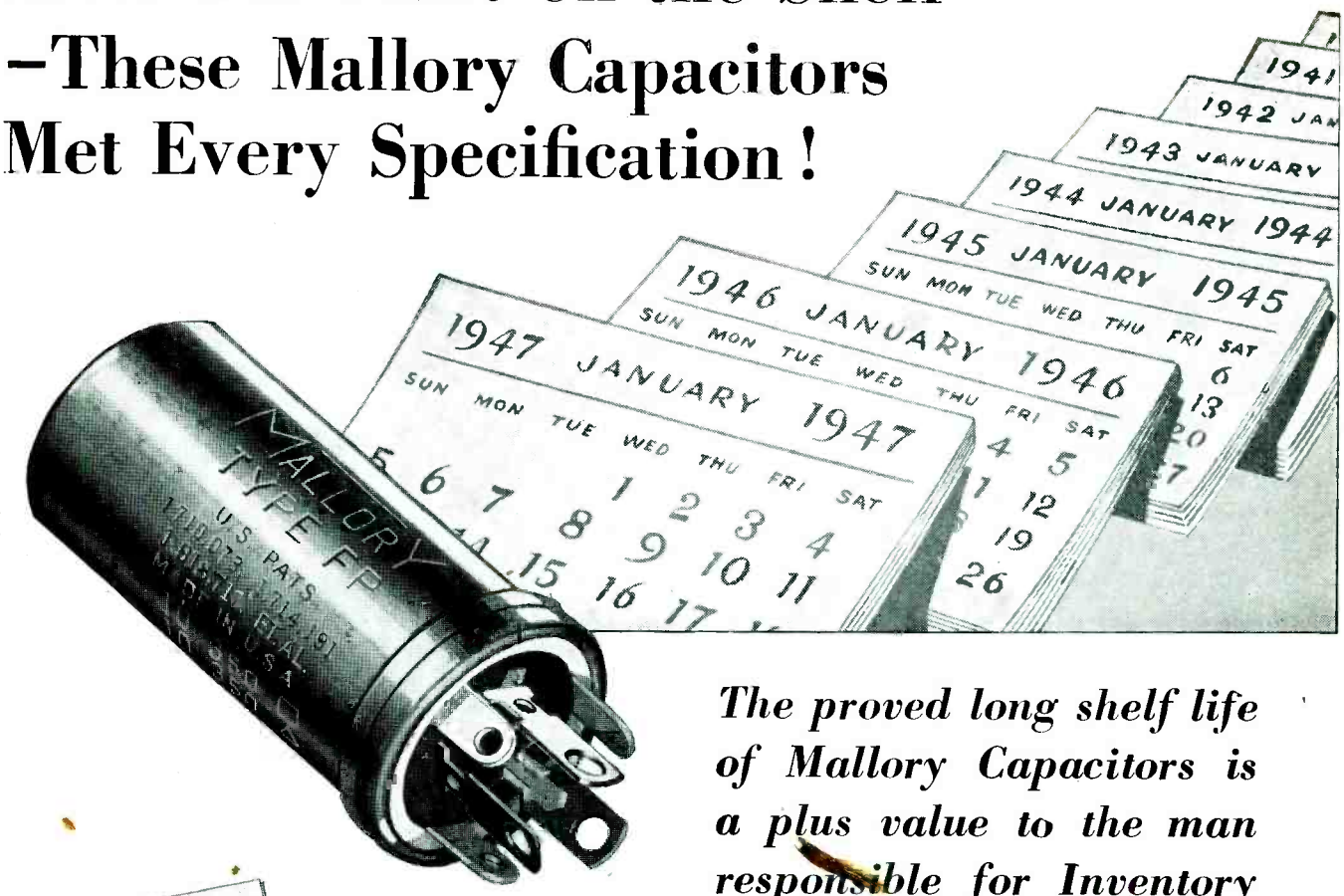

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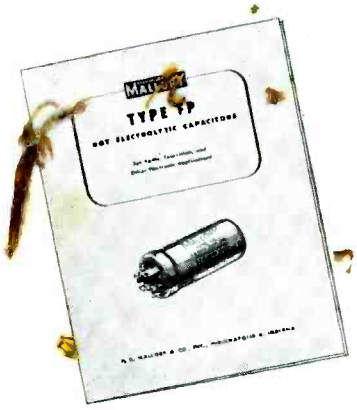

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Edited by VIN ZELUFF

Photoelectric Bus Washer

CLEANING of the outside of a bus in two minutes is being done by electronic equipment. The bus is driven between two guide rails that are spanned by the light beam of a photoelectric system. This enables the driver to ascertain when he is in the correct position for the washer to be operated. The position is not very critical since the washing machine is suspended from the roof and is free to align itself as it descends and embraces the bus.

The washing machine consists of a horizontally suspended rectangular trough, the inner surface of which is open. Shafting driven by motors extends all round this framework. The shafting carries a series of rubber fabric flaps which when rotated act as mops to swab the surface of the coachwork.

The trough is suspended from the garage roof and can be raised or lowered electrically. Beneath the flaps a horizontal water pipe is fitted from which water at gentle pressure can be sprayed through a number of fine holes.

When the framework is lowered over a bus, water first flows over the surface of the coachwork, followed by the revolving flaps which effectively loosen all mud and dirt. The framework after being lowered to the ground is raised again, during which operation the water spray gives a final wash.

When the bus is driven in, the light beam is interrupted and a red lamp signal shows up at the end of the garage. The driver then proceeds slowly until he is just free of the beam and the pilot lamp goes out.

The bus is then in the correct position for the washing machine to operate. Since the ground is often practically under water, the alternative use of contacts operated by the wheels of the chassis would offer some difficulty.

Four 1-hp, 3-phase motors are used to drive the flaps and a ¼-hp motor to operate the raising and lowering winch. Each traverse of the bus occupies about 35 seconds. A bus can be completed and cleaned every two minutes.

The Essex bus-washing machine is marketed by Messrs. Strathstone Ltd. of London and produced to the design of the chief engineer of the Eastern National Omnibus Co. of Chelmsford, Essex, England.

Both sides of the bus are embraced simultaneously by the trough while being washed

Coin-Operated Slave Television

WHETHER soda fountain coin-operated television will be practical or impractical will be determined by an experimental installation in a luncheonette in Hoboken, New Jersey. The system uses a master television receiver, located at some convenient place in the building, and a series of slave units, one mounted at each booth so that the screen can easily be viewed by the occupants.

The installation was made as an experiment, using General Electric equipment. The slave sets consist essentially of the standard GE model 810 chassis with the front ends, i-f amplifiers and audio discriminators removed. The master station is a standard receiver with the addition of a cathode-follower output tube fed from the grid of the picture tube.

The picture tubes in the slave units are mounted vertically, to conserve space, and the viewers actually see a reflected image from a slanting mirror. This method of viewing, of course, required the reversing of the picture tube image. This was accomplished by rotating the deflection yoke 180 degrees and reversing the vertical sweep electrically. The master set will power

SOLDERING TIPS

"We have been using a soldering paste plainly marked "Non-Corrosive," yet evidence of corrosion shows on the finished work. Why is this?"

There are a great many conventional soldering pastes on the market which are labeled "Absolutely Non-Corrosive." Whether the manufacturer in such cases is misrepresenting his product through ignorance or deliberate intent is, perhaps, a question for debate. Seemingly, there is no "law" that imposes any limitations on the "marking" of soldering paste containers. In fifty years of manufacturing solder and soldering fluxes, Kester has found that all pastes contain zinc chloride or amonium chloride emulsified with petrolatum. Properly mixed, this makes an excellent soldering flux, the residue of which is definitely CORROSIVE AND CONDUCTIVE.

For certain practical purposes, soldering fluxes may be divided into two classes, corrosive and non-corrosive. Of the second, or non-corrosive class, rosin occupies the entire field; all other fluxes, in spite of many extravagant claims to the contrary, are corrosive.

If corrosive or electrical loss is a vital factor, then there is no recourse except strict adherence to flux of the rosin type. Kester Solder Company manufactures over 50 external soldering fluxes, including a very fine soldering paste; however, no flux manufactured by Kester Solder Company is branded as NON-CORROSIVE until it has been thoroughly tested both in the laboratory and in the field. YOU CAN DEPEND ON KESTER.

If you are in doubt about the corrosive qualities of the flux you are now using, send a sample assembly, or soldered parts, to the Kester Solder Company. An accelerated humidity test as outlined in Army-Navy Aeronautical Specifications will be made, and you will be informed of the results. The test itself requires 72 hours, and since facilities are naturally limited, please allow plenty of time for making your tests. Of course, there is no charge.

"Soldering Tips" will be pleased to answer all inquiries pertaining to solder, soldering fluxes, and soldering technique. Merely address "Soldering Tips," Kester Solder Co., 4204 Wrightwood Ave., Chicago 39, Ill.

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Soda fountain customers witness coin-operated television for the first time in Hoboken, New Jersey

Voice-Controlled Intercom System

By John R. Cooney
Waldo Theatre Corp.
Waldoboro, Maine

The Problem of designing an intercommunicating system which does not require manual operation of a talk-listen switch is a rather interesting one, and can be approached in various ways. The system to be described represents a fairly straightforward development which has proved highly satisfactory after prolonged use under typical industrial operating conditions.

The installation and operation is exactly similar to that of the usual simple master-substation system, where the substations consist of simple p-m loudspeakers, except that the caller at the master station is not required to operate a talk-listen switch, the switching being accomplished electronically by the sound of his voice.

As in the case of the ordinary type of system, a remote station may be placed in any kind of location, and answered at almost any distance from the loudspeaker. The master station is expected to be installed in a relatively quiet situation, such as an executive's office, but the requirements for its successful operation are not critical.

After a given substation has been connected by operation of the usual selector switch, sounds originating at the substation are heard normally over the master loudspeaker. However instead of operating a talk-listen switch when he wishes to reply, the home operator has only to speak (above a certain low threshold level) and the system is instantaneously switched to the outgoing condition, returning to normal immediately after he stops talking.

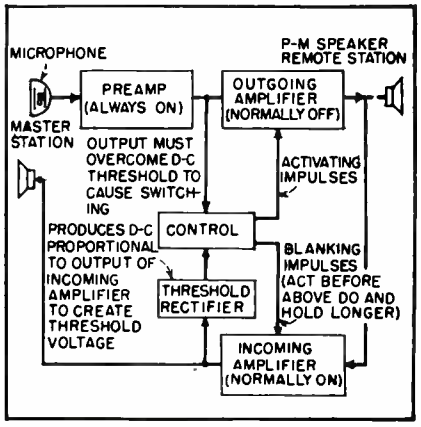


FIG. 2—Simplified block diagram of voice-controlled intercommunication system

Although the operator at the master station is expected to be within a few feet of his microphone (a normal situation if he is operating the selector switch anyway), the threshold adjustment can actually be set, in a quiet location, so that he can carry on a conversation as much as 30 feet away from it.

The principle involved in this system is simple, but the actual development of a workable circuit presented many problems, because of the necessity of precise timing of the sequence of events.

Circuit Details

The circuit details appear in Fig. 1 and the principle of operation is illustrated in Fig. 2 in simplified form.

The system consists roughly of three sections: an out-going amplifier, incoming amplifier, and a control section. The amplifying sections are conventional, except that

(Continued on p 132)

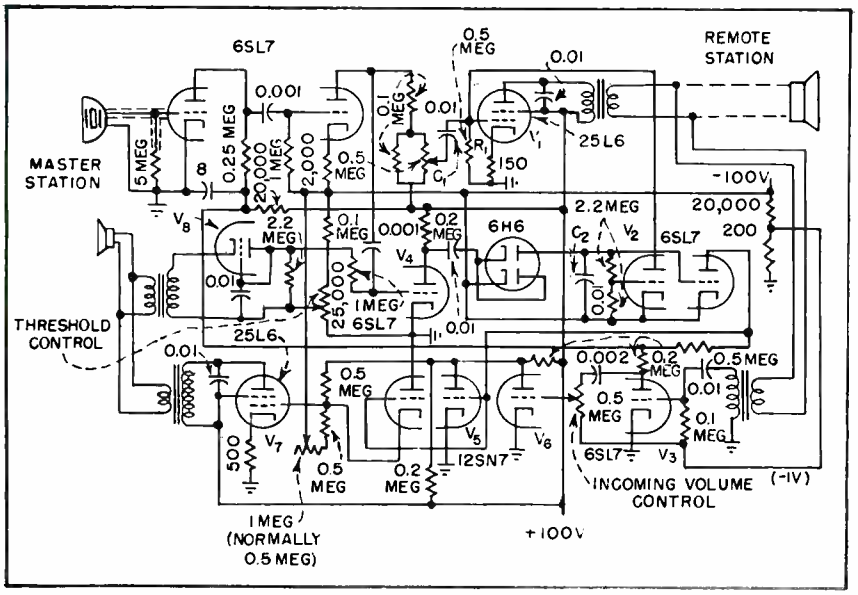
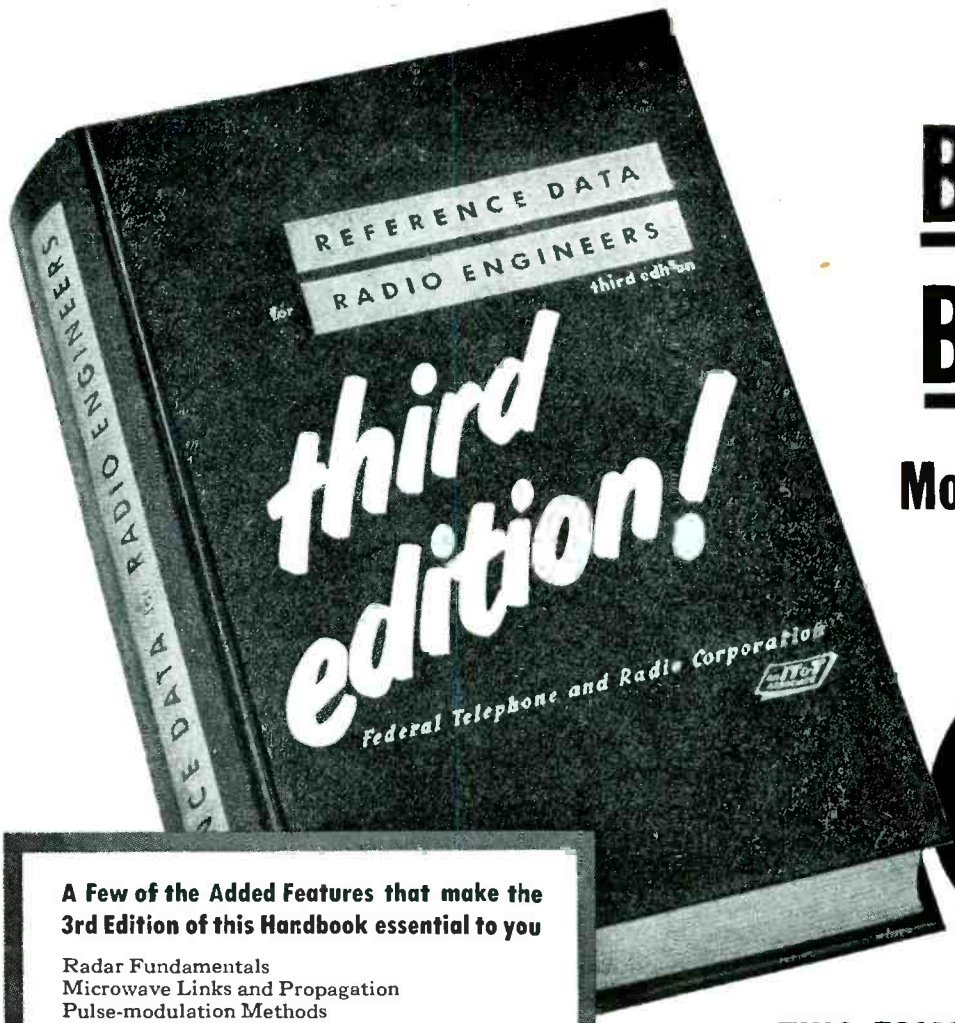


FIG. 1—Complete schematic diagram of automatic intercom system. Tubes in top row comprise outgoing amplifier; bottom row is incoming amplifier (normally on)



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THE ELECTRON ART

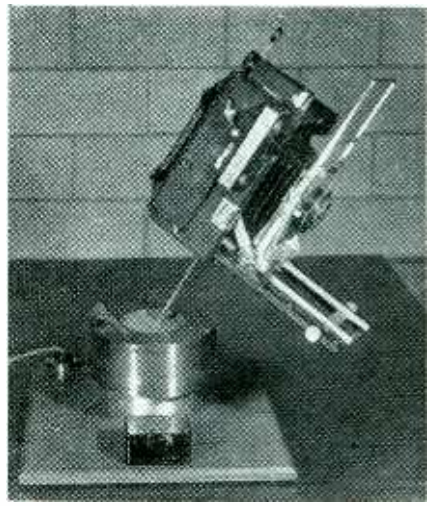
Edited by JOHN MARKUS

Magnetic Fluid Uses

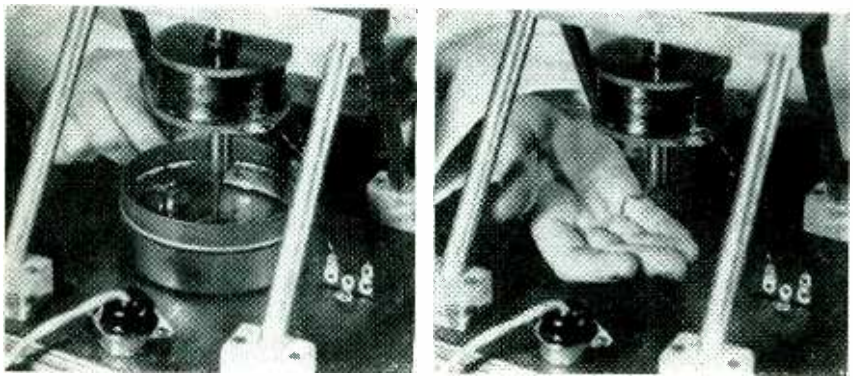
RECENT STUDIES of the iron-oil mixtures used in the electromagnetic fluid clutch developed by the National Bureau of Standards reveal that magnetic fluids can be employed to good advantage in hydraulic systems, shock absorbers, and dash pots, to form casting molds and as variable electrical resistors. The basic property on which all these applications depend is that the viscosity of a magnetic fluid is directly related to the strength of the applied magnetic field. The fluid may be changed from a liquid to a nearly solid state and back again at will.

An electrical resistor adapted to remote control can be made by immersing two electrodes in a magnetic fluid. When the fluid is in an unmagnetized condition, the resistance between the two electrodes will be extremely high because of the very loose contact among the conductive iron particles that are randomly distributed in the nonconductive oil. In the presence of a magnetic field, however, the iron particles apparently form chains along the lines of magnetic flux and draw into close physical contact. The flux density will determine the massiveness of the chain and, thus, the conductivity of the mixture. When the system is de-energized, the conductance does not drop back to its former very low level. This property of magnetic fluid resistors is attributed to the coherer effect that has been previously investigated by Branly, Marconi, and others.

Electromagnetic fluids are also being investigated for use in molding operations. A fluid is placed in a pot surrounded by a current-carrying coil, a model of the part to be cast is placed in the fluid, and the coil is then energized so that the fluid will solidify around the model. When the model is removed, a detailed impression remains outlined in the solidified magnetic fluid. Molding compound can then be poured into the mold and allowed to harden. After the coil current is turned off the molded replica can easily be removed from the liquid. In any application of this kind, the boiling point of the magnetic fluid must of course be higher than the temperature of the molten casting material.



Demonstration of use of magnetic fluid as universal positioning device for heavy camera. Fluid in nonferrous metal cup solidifies around camera support rod when coil surrounding cup is energized with d-c. Current is interrupted with switch in foreground whenever camera needs repositioning



Test setup for demonstrating solidification of magnetic fluid by a steady magnetic field. With coil deenergized at left, fluid flows into pan under pipe. When direct current is sent through coil, flow is cut off instantly and even fluid in air below pipe has hardened

Composition of Fluid

The success or failure of any device utilizing magnetic fluid will depend to a considerable extent on the particular components in the iron-oil mixture, the choice of suspension fluid and iron powder in large measure being determined by the application for which the mixture is intended. The iron powder is one component of the mixture not generally varied from one application to another. In order to achieve maximum magnetic efficiency the iron powder must have high permeability; to minimize wear and abrasion on moving parts the particles should have smooth, continuous exteriors; and the iron powder must be chemically stable, resisting oxidation in the suspension fluid. A great many powders have been tried, including pure iron, alloys, oxides, and ferrites. The powder which has proven most universally successful is a carbonyl iron in the form of particles about 8 microns in diameter.

The choice of a suspension fluid is not so simple. Some of the fac-

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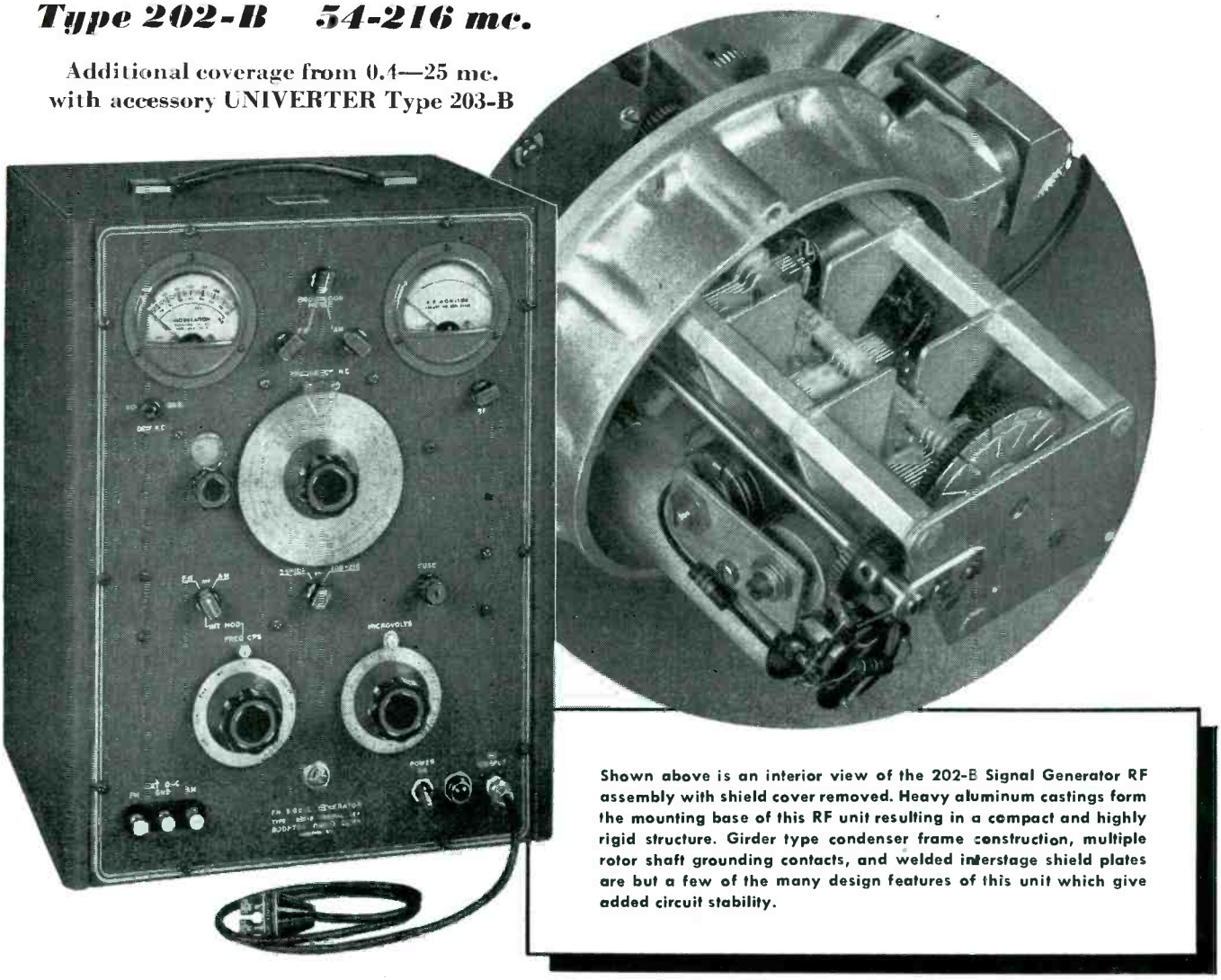

Shown above is an interior view of the 202-B Signal Generator RF assembly with shield cover removed. Heavy aluminum castings form the mounting base of this RF unit resulting in a compact and highly rigid structure. Girder type condenser frame construction, multiple rotor shaft grounding contacts, and welded interstage shield plates are but a few of the many design features of this unit which give added circuit stability.

Designed to meet the exacting requirements set forth by leading FM and television engineers throughout the country, the 202-B FM Signal Generator has found widespread acceptance as the essential laboratory instrument for receiver development and research work.

Frequency coverage from 54 to 216 megacycles is provided in two ranges, 54 to 108 megacycles and 108 to 216 megacycles. A front panel modulation meter having three deviation scales, 0-24 kilocycles, 0-80 kilocycles and 0-240 kilocycles, permits accurate modulation settings to be made.

Although fundamentally an FM instrument, amplitude modulation from zero to 50%, with meter calibrations at 30% and 50%, has been incorporated. This AM feature offers increased versatility and provides a means by which simultaneous frequency and amplitude modulation may be obtained through the use of an external audio oscillator.

The internal AF oscillator has eight modulation frequencies ranging from 50 cycles to 15 kilocycles, any one of which may be conveniently selected by a rotary type switch for either amplitude or frequency modulation.

The calibrated piston type attenuator has a voltage range of from 0.1 microvolt to 0.2 volt and is standardized by means of a front panel output monitor meter.

The output impedance of the instrument, at the terminals of the R.F. output cable, is 26.5 ohms.

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- R.F. Output: 0.1 microvolt to 0.1 volt. Also approximately 2 volts maximum (uncalibrated).

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tors which must be considered are chemical stability, flammability, vapor pressure, and viscosity. One type of fluid that is remarkably stable in the presence of iron powder is a silicone liquid that has a viscosity of around 50 centistokes at 25 degrees Centigrade. It is excellent with respect to nonflammability and vapor pressure, and this versatile fluid will serve satisfactorily in nearly all but extremely high temperature applications. When it is necessary to operate a magnetic fluid device at elevated temperatures, special compounds such as fluorinated and chlorinated fluids can be used, but special precautions must be taken with the seals since the vapors from these fluids are quite toxic.

Photoelectric Librarian

A PHOTOELECTRIC bibliography compiling machine developed by Engineering Research Associates, Inc., St. Paul, Minn., for the U. S. Department of Commerce and the U. S. Department of Agriculture, stores vast amounts of scientific information in its system and automatically delivers a microfilm record of all items on any selected subject.

Known as the Rapid Selector, the device was developed from principles originated before the war by Dr. Vannevar Bush, then at MIT. The prototype machine is now being tested for performance at the Agriculture Department library.

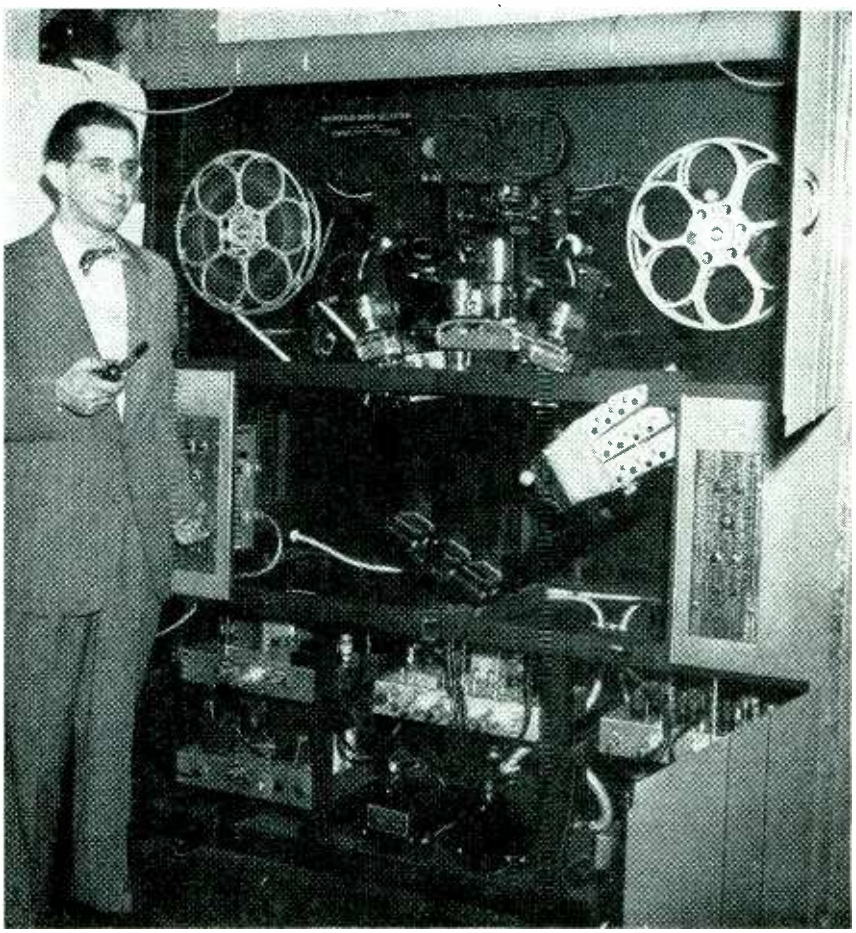
The Rapid Selector uses standard 35-mm motion picture films, on each reel of which can be stored 72,000 abstracts. This is equivalent to the contents of almost 500,000 conventional library cards since each abstract may have up to six subject classifications. Running time is 6.7 minutes per reel.

When the information is microfilmed, a predetermined code pattern, consisting of black and white squares representing up to six seven-digit numbers, is simultaneously printed on the film as shown in Fig. 1. To obtain everything the selector possesses on a particular subject, the operator places an interrogating punched card in the mechanism. A photo electric system then scans the film at a rate of more than 60,000 subjects a minute, automatically selects the desired frames, and copies them on a separate film through the use of high-speed repeating photoflash techniques. Selection is based on matching of transparent squares on the film with those on the master key card.

This development is of inestimable value in research where all references in a particular field must be thoroughly checked before undertaking new work. Depending on the subject matter and the extensiveness of previous researches, a conventional hunt for references varies from days to weeks. In contrast, it would take the Rapid Selector only about fifteen minutes to review all the entries that have appeared in the last thirty years in Chemical Abstracts, assuming they had first been transferred to microfilm and properly coded with light patterns for use in the machine. The selector can potentially be coded for ten million different subjects.

Before the machine could be put into operation a number of troublesome details had to be worked out. For example, as long as the abstracts selected by the machine for photographing were spaced a few inches apart, the machine photographed them at full speed. However, if the frames to be photographed were too close together, the mechanism could not move an additional frame of unexposed film into position quickly enough to photograph the second frame. The difficulty was solved by including a second photoelectric scanner that anticipates the approach of any frame which is too close to be photographed at high speed. The device slows down the whole machine

(continued on page 158)



Microfilm Rapid Selector as developed and constructed by Engineering Research Associates, Inc., St. Paul, under the supervision of Ralph R. Shaw (left), librarian of the Department of Agriculture. Film on reels is scanned by phototube system while running through optical system at 300 feet per minute. The twelve phototubes used are in the bright metal housing set at 45 degrees under right-hand film reel

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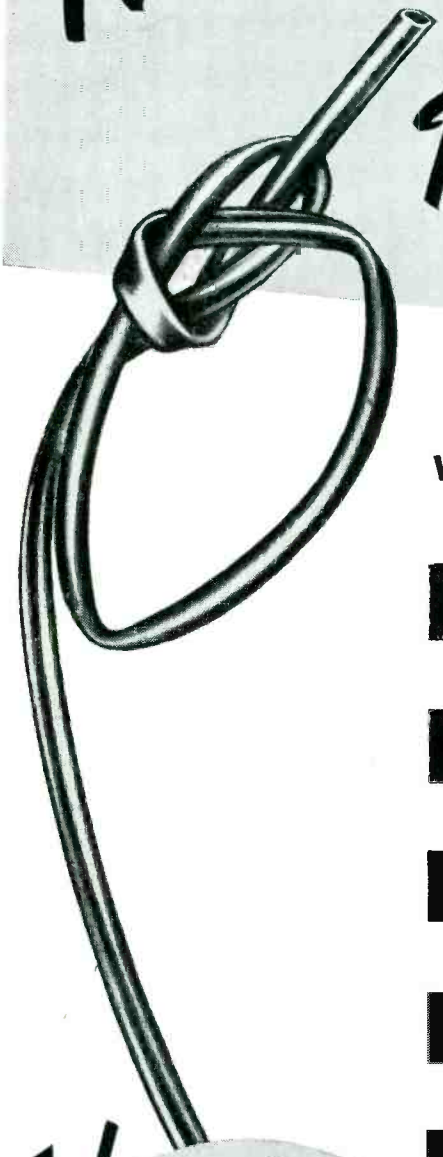

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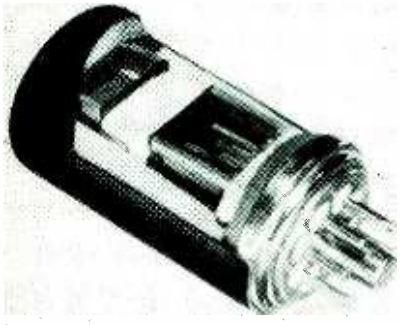
NEW PRODUCTS

Edited by WILLIAM P. O'BRIEN

Chopper Vibrator

AIRPAX PRODUCTS CO., 1024 Greenmount Ave., Baltimore, Md., has available a chopper vibrator with an operating coil of 2 to 40 volts a-c, and a frequency range of 0 to 450 cycles. Power handling capacity is 0 to 30 watts, and noise level is less than 1 mv. Simplest application is the amplification of minute d-c potentials such as the output of a thermocouple. Acting as a self-driven vibrator, the unit can generate its own control signal or provide a signal for another chopper.



It can be used to convert small d-c values to a-c, and can then rectify the amplified signal to produce d-c again whose polarity and level vary directly as the source.

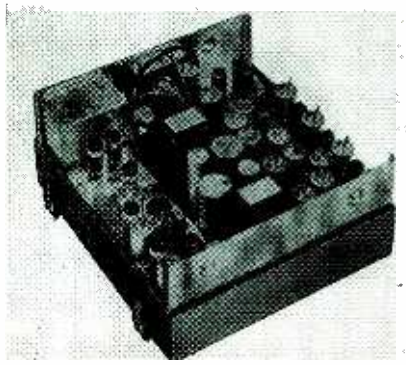
All-Record Pickup

THE ASTATIC CORP., Conneaut, Ohio, Model CLD phonograph pickup uses the LQD double-needle cartridge and plays the three types of recordings at 8-gram needle

pressure. Output voltages are 1.2 at 1,000 cycles with a 78-rpm record and 0.9 with a 33⅓-rpm record.

Mobile Radiotelephone

FEDERAL TELEPHONE AND RADIO CORP., 100 Kingsland Road, Clifton,



N. J. The FT-145-10 mobile radiotelephone unit has a power output of 10 watts at any frequency in the 152 to 162-mc band. It features modulation limiting as an integral part of its design, special vibration-proof r-f coils and a novel neon squelch circuit. The unit draws 7.3 amperes standby and 23.9 amperes transmit.

Highly-Sensitive C-R Tube

ALLEN B. DUMONT LABORATORIES, INC., 1000 Main Ave., Clifton, N. J. Type 5XP multiple-intensifier cathode-ray tube features a highly sensitive vertical-deflection system.

Potentials as low as 24 to 36 volts peak-to-peak are sufficient for one inch of vertical deflection on the screen. Because of the new deflection-plate design, the greater sensitivity of the tube is achieved with a plate-to-plate capacitance of only 1.7 $\mu\mu$f.

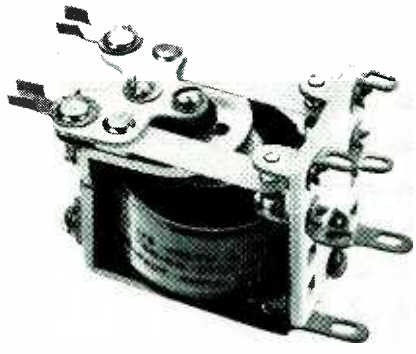
Keyboard Oscillator

WEINSCHEL ENGINEERING CO., 123 William St., New York 7, N. Y. Model 150-AO-1/100k is an improved and redesigned key-

board oscillator covering a range from 0.3 cycle to 100 kc with decades of pushbuttons. Frequency accuracy for the lower ranges up to 10,000 cycles is 0.1 percent plus 0.1 cycle. If there is no abnormal change in room temperature, frequency drift after a short warmup period is less than 0.02 percent per hour.

Midget Antenna Relay

ADVANCE ELECTRIC & RELAY CO., 1260 W. 2nd St., Los Angeles 26, Calif., has announced a new midget 300-ohm antenna relay. It is silicone glass-insulated on the arma-



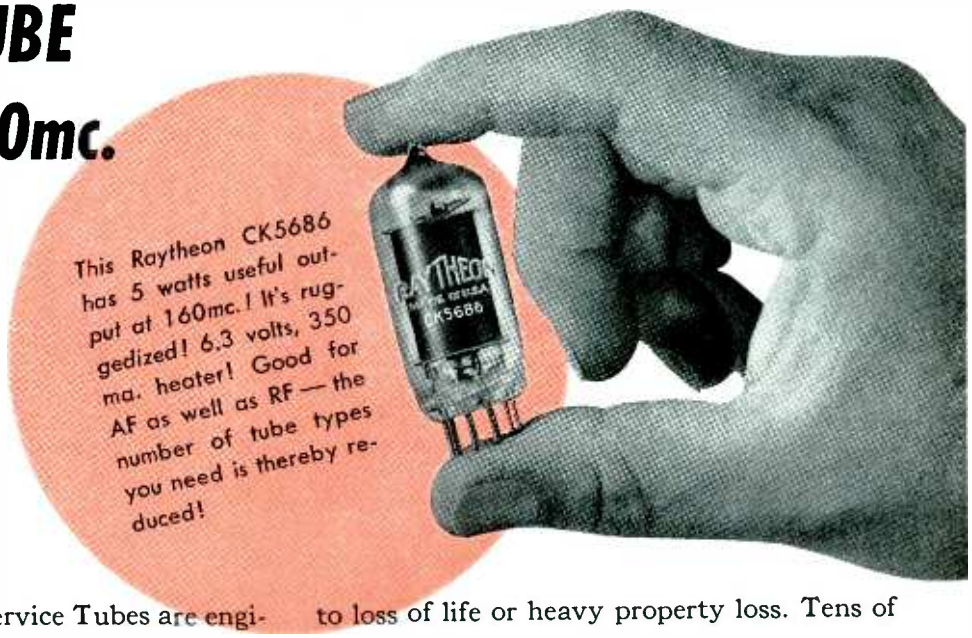
ture and stationary contact assemblies. Coil data: a-c coils, consuming approximately 4 volt-amperes, available up to 220 volts; d-c coils, consuming 1 to 2 watts, available up to 110 volts. Overall dimensions are 15/16 x $1\frac{7}{8}$ x $1\frac{9}{16}$ inches.

Polar and Rectilinear Recorder

SOUND APPARATUS CO., Stirling, N. J. Model PFR Polinear Recorder offers a means of recording complete characteristics of electro-acoustic and electronic devices in one instrument. The combined

TAKE THIS New RAYTHEON Aircraft and Mobile AMPLIFIER TUBE USABLE TO 160mc.

For Example:



RAYTHEON *Tough* Service Tubes are engineered and manufactured to meet commercial aircraft, industrial and military service conditions where a single tube failure might lead to loss of life or heavy property loss. Tens of thousands of these Raytheon Tough Service Tubes are on the job, putting on a daily demonstration of *reliability* and *stamina*.

Over 300 Raythean Special Purpase Tube distributors are ready to serve you. Application information on these tubes is available at Newtan, Chicago and Los Angeles.

LOOK OVER THIS LIST OF RAYTHEON RUGGEDIZED TUBES

Type	Description	Typical Service	Prototype	Construction	Heater Volts	Heater Amps.	Plate Volts	Plate Ma.	Grid Volts	Screen Volts	Screen Ma.	Amp. Factor	Mut. Cond.
2C50	Dual Power Triode	Aircraft Control Equip.	—	Bantal	12.6	0.3	300	12.5	−24	—	—	9.5	1750
2C52	Dual Amplifier Triode	Aircraft Control Equip.	—	Bantal	12.6	0.3	250	1.3	−2	—	—	100	1900
6AK5W	Pentode RF Amplifier	Military Ruggedized	6AK5	7 pin miniature	6.3	0.175	120	7.5	Rk 200	120	2.5	—	5000
6AL5W	Duol Diode	Military Ruggedized	6AL5	7 pin miniature	6.3	0.3	Max. Peak Inv. 330 Volts Max.			Io 9 ma. dc.			
6AS6W	Pentode RF Mixer	Military Ruggedized	6AS6	7 pin miniature	6.3	0.175	120	5.2	−2	120	3.5	—	3200
6C4W†	RF Power Triode	Military Ruggedized	6C4	7 pin miniature	6.3	0.15	250	10.5	−8.5	—	—	17	2200
6J5WGT	General Purpose Triode	Military Ruggedized	6J5GT	Standord glass	6.3	0.3	250	9	−8	—	—	20	2600
6J6W†	Dual AF-RF Triode	Military Ruggedized	6J6	7 pin miniature	6.3	0.45	100	8.5	Rk 50	—	—	38	5300
6SA7WGT†	Pentagrid Converter	Military Ruggedized	6SA7GT	Standord glass	6.3	0.3	250	3.5	Rg 20000	100	8.5	—	450 Conv. Cond.
6SJ7WGT	Pentode RF Amplifier	Military Ruggedized	6SJ7GT	Standord glass	6.3	0.3	250	3.0	−3	100	0.8	—	1650
6SN7W	Dual Triode	Military Ruggedized	6SN7GT	Standord glass	6.3	0.6	250	9.0	−8	—	—	20	2600
6X4W†	Fullwave Rectifier	Military Ruggedized	6X4	7 pin miniature	6.3	0.6	Max. Peak Inv. 1250 Volts Max.			Io 70 ma. dc.			
12J5WGT	General Purpose Triode	Military Ruggedized	12J5GT	Standord glass	12.6	0.15	250	9	−8	—	—	20	2600
CK5654	Pentode RF Amplifier	Commercial Aircraft Ruggedized	6AK5W	7 pin miniature	6.3	0.175	120	7.5	Rk 200	120	2.5	—	5000
CK5670	Duol Triode	Commercial Aircraft Ruggedized	2C51	9 pin miniature	6.3	0.35	150	8.2	Rk 240	—	—	35	5500
CK5686	AF-RF Output Pentode	Commercial Aircraft Ruggedized	—	9 pin miniature	6.3	0.35	250	25	per sect. −12.5	250	3	—	2700*
CK5694	Dual Power Triode	Industrial AF-RF Amp.	6N7G	Standord glass	6.3	0.8	294	7	−6	—	—	35	3200
CK5725	Pentode RF Mixer	Commercial Aircraft Ruggedized	6AS6W	7 pin miniature	6.3	0.175	120	5.2	−2	120	3.5	—	3200
CK5726	Dual Diode	Commercial Aircraft Ruggedized	6AL5W	7 pin miniature	6.3	0.3	Max. Peak Inv. 330 Volts Max.			Io 9 ma. dc.			

†Available during the latter part of 1949. *2.5 watts Class A output. 10 watts Class C input power to 160 mc.

Note: All dual section tube ratings are for each section.

ASK US if you don't find just the tube you need in the above chart. Raytheon engineers stand ready to develop additional types for your tough service applications.

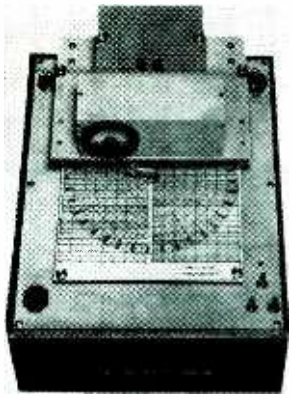
RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

SPECIAL TUBE SECTION · Newton 58, Massachusetts

SUBMINIATURE TUBES · SPECIAL PURPOSE TUBES · MICROWAVE TUBES · CATHODE RAY TUBES · RECEIVING TUBES



features of polar and rectilinear movement permit the recording of angular patterns, frequency response characteristics and other measurements. The instrument can record d-c or a-c voltages, selectable by the operator.

Noise and Interference Locator

TOBE DEUTSCHMANN CORP., Norwood, Mass. Model 248 portable locator is used for identifying the source of radio noise and television interference. It provides four-band coverage from 200 kc to 18 mc, plus

spot checks at 50 and 150 mc. Interference intensity is indicated in headphones and on a dual-scale meter having 0 to 100 and decibel graduations.

Magnetic Tape Splicer

PRESTOSEAL MFG. CORP., 38-01 Queens Blvd., Long Island City, N. Y. The MT-1 Presto-Splicer permits splicing of ¼-inch magnetic

recording tape without scraping, cementing, use of adhesives or loss of tape material. A plastic weld is obtained by a combination of electrically produced heat and precise pressure applied within an accurately controlled time cycle. The equipment is self-timing, operates on 115-v 50 or 60-cycle a-c, with automatic line-voltage compensation. Each splice takes from 4 to 5 seconds with 5 seconds required after splice to permit tape to cool off.

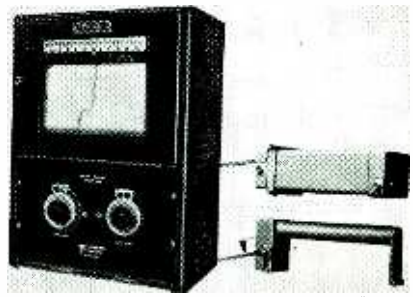
Vacuum Control Accessory

SKANEATELES MFG. CO., INC., 122 Dickerson St., Syracuse, N. Y. The new adjustable leak for control of vacuum or pressure source is based on the Bachman pulsed leak principle and is continuously adjustable over the range from completely closed to completely open. Operating on 110 v a-c it may be used

alone to give a desired vacuum by balancing leak rate against pump rate, or with Skanascope vacuum relay monitor to maintain the desired degree of vacuum regardless of varying conditions within the vacuum system.

Thickness Gage

TRACERLAB INC., 55 Oliver St., Boston 10, Mass., has announced the type SM-2 industrial recording thickness gage. The essential components of the gage are a source of beta radiation from Strontium-90 and a radiation detector. The sheet material to be measured is interposed between source and detector and part of the radiation is absorbed by the sheet material in proportion to its weight per unit



area. Weight per unit area or thickness is read on a calibrated recorder. No physical contact is made with the material being measured, causing no marking of delicate surfaces.

Subminiature Plug-In Amplifiers

THE WALKIRT CO., 5808 Marilyn Ave., Culver City, Calif., announces a series of plug-in amplifiers designed for use in computers and

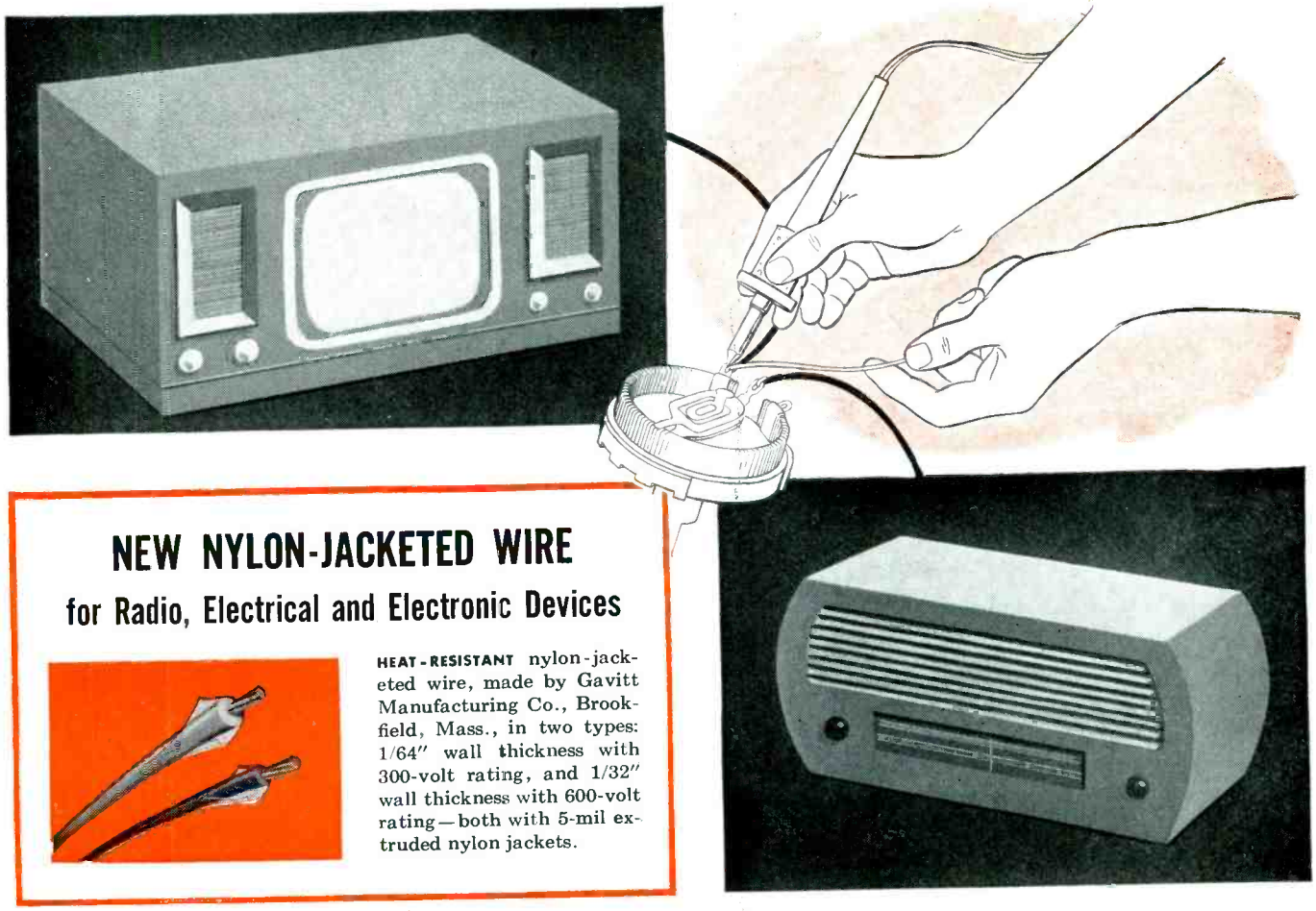
similar service. Amplification is substantially flat from 20 cps into the ultrasonic range. Voltage gains of 10, 100 and 1,000 are available.

Tele Antenna Rotator

THE RADIART CORP., 3571 W. 62nd St., Cleveland, Ohio, has developed the Tele-Rotor which rotates the antenna to the point affording clearest reception and simultaneously indicates the position of the

(Continued on p 178)

Hook-up wire jacketed with HEAT-RESISTANT DU PONT NYLON PLASTIC approved for temperatures to 90°C.



NEW NYLON-JACKETED WIRE

for Radio, Electrical and Electronic Devices

HEAT-RESISTANT nylon-jacketed wire, made by Gavitt Manufacturing Co., Brookfield, Mass., in two types: 1/64" wall thickness with 300-volt rating, and 1/32" wall thickness with 600-volt rating—both with 5-mil extruded nylon jackets.

Small diameter, light weight, and flexibility among the many *extra* advantages of nylon heat-resistant jackets

The first thermoplastic-insulated wire to receive Underwriters' approval for use in electrical appliances at temperatures to 90°C. is now being made by covering the wire with a jacket of Du Pont nylon plastic.

Only a thin coating of lightweight nylon is needed to provide this added heat-resistance, instead of the heavy asbestos jacket formerly used. Thus this wire has the advantages of *light weight*, *small diameter*, and *flexibility*.

And in addition to raising the heat-resistance of the primary insulation, nylon provides improved resistance to oils, chemicals, and abrasion . . . plus *extra smoothness* for easier pulling.

To help you make better products

Today, manufacturers of electrical wire are finding that a jacket of nylon reduces deformation under load at elevated temperatures, and they are using this property to help meet the increasing demand for heat-resistant wiring. Nylon can help you make many electrical products better. This Du Pont plastic can be extruded over bare wire or over primary insulation. It can be molded into thin sections and intricate shapes, and around metal inserts.

How can you take advantage of its unusual properties? To see how other manufacturers are using nylon profitably, and for valuable information on molding and extrusion of nylon, write for free booklets.

E. I. du Pont de Nemours & Co. (Inc.), Plastics Department.

MAIN SALES OFFICES: 350 Fifth Avenue, New York 1, N. Y.; 7 So. Dearborn Street, Chicago 3, Illinois; 845 E. 60th Street, Los Angeles 1, California.

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Plastics
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

NEWS OF THE INDUSTRY

Edited by WILLIAM P. O'BRIEN

IRE West Coast Convention

THE 1949 West Coast Convention of the IRE is being held in conjunction with the Fifth Annual Pacific Electronic Exhibit sponsored by the WCEMA, at the Civic Center, San Francisco, Calif., from August 30 to September 2. A tentative program of technical sessions is as follows:

Tuesday, Aug. 30

10:00 A.M.—Session I

An Application of Frequency Selective Negative Feedback, by J. Edwards and T. J. Parker of U. S. Navy Electronics Lab, San Diego, Calif.

The Constant-Voltage Audio Distribution System, by V. Salmon of Stanford Research Institute, Stanford, Calif.

Outlook for Miniature Electronics, by C. Brunetti of Stanford Research Institute, Stanford, Calif.

1:30 P.M.—Session II—Vacuum Tubes

High Current High Voltage Gas Discharge Tube, by W. R. Baker, Q. A. Kerns, J. Reidel and R. F. Edwards of Radiation Lab, U. of California, Berkeley, Calif.

High-Voltage Industrial Rectifier Tubes, Design Considerations for High-Power Applications, by M. H. Brown of Machlett Labs, Inc., Los Angeles, Calif.

The Effects of Contact Potential Difference on Electron Tube Characteristics, by G. D. O'Neill of Sylvania Electric Products, Inc., Bayside, N. Y.

The Transverse Current Amplifier, by L. M. Field of Stanford U., Stanford, Calif.

7:30 P.M.—Session III—Circuitry I

Graphical Analysis of Tuned Coupled Circuits, by A. E. Harrison and N. W. Mather of U. of Washington, Seattle, Wash.

Design of Wide-Band Feedback Pulse Amplifiers, by D. A. Watkins of Los Alamos Scientific Lab, Los Alamos, N. M.

Some Developments in UHF Power Oscillator Circuits, by D. H. Preist of Eitel-McCullough, Inc., San Bruno, Calif.

Front End Design in UHF Television Receivers, by D. K. Reynolds and M. B. Adams of Stanford Research Institute, Stanford, Calif.

Wednesday, Aug. 31

9:00 A.M.—Session IV—Instrumentation

Multi-Channel Recording of Physical Phenomena, by L. P. Robinson and R. L. Sink of Consolidated Engineering Corp., Pasadena, Calif.

Frequency Control With Synthetic Crystals, by C. E. Green of U. S. Navy Electronics Lab, San Diego, Calif.

The Measurement of Non-Linear Distortion, by A.P.G. Peterson of General Radio Co., Cambridge, Mass.

Use of Doppler Radar As Test Range Instrumentation for Missiles, by E. R. Toporeck of Naval Ordnance Test Station, Inyokern, Calif.

9:00 A.M.—Session V—Control Systems

Combination Open-Cycle Closed-Cycle Systems, by J. R. Moore of North American Aviation, Inc., Los Angeles, Calif.

Application of an Electro-Mechanical Feedback System to a Recording Manometer, by L. G. Walters of U. of California, Los Angeles, Calif.

Criteria Relating Steady-State Response to Transient Response of Closed-Loop Systems, by Robert M. Osborn of Aerophysics Lab, North American Aviation, Inc., Downey, Calif.

184-Inch Cyclotron Pulse Timing Equipment by W. R. Aiken and D. A. Mack of U. of California Radiation Lab, Berkeley, Calif.

7:30 P.M.—Session VI—Microwave Techniques and Applications

Use of the Phase Front Plotter to Observe Propagation, by H. Iams of Hughes Aircraft Co., Culver City, Calif.

Near Zone Field Studies of Quasi-Optical Antennas, by W. G. Sterns of U. of California, Berkeley, Calif.

Absorbing Surfaces, by L. E. Swarts of U. S. Navy Electronics Lab, San Diego, Calif.

Radio Circuits for Telephone and Television Service, A Progress Report, by D. I. Cone of The Pacific Tel & Tel, San Francisco, Calif.

Thursday, Sept. 1

9:30 A.M.—Session VII—Circuitry II

Unification of Basic Filter Viewpoints on the Complex Frequency Plane, by D. L. Trautman, Jr. of Stanford U., Stanford, Calif.

Steady State and Transient Response Obtained by means of a Two-Dimensional Potential Analogy, by H. A. Rosen of California Institute of Technology, Pasadena, Calif.

Analysis and Design of Trigger Circuits, by T. H. Meisling and D. R. Brown of U. of California, Berkeley, Calif.

Diode Phase-Discriminators, by R. H. Dishington of Rand Corp., Santa Monica, Calif.

SYMPOSIUM—Airborne Antennas

1:30 P.M.—Session VIII—Theoretical Problems

Frequency Analysis of Variable Networks, by L. A. Zadeh of Columbia U., New York, N. Y.

The External Field Produced in a Slot in an Infinite Circular Cylinder, by S. Silver and W. K. Saunders of U. of California, Berkeley, Calif.

Slot Radiators, by N. A. Begovich of Hughes Aircraft Co., Culver City, Calif.

Microwave Guiding by Single Corrugated Surfaces, by F. J. Zucker and W. Rotman of Electronics Research Labs, USAF, Cambridge Field Station, Cambridge, Mass.

SYMPOSIUM—Television

COSMIC RAY PROJECT

The equipment above, installed in a trailer, was recently taken by University of California scientists to a mountain top in the high Sierra for investigation of the behavior of cosmic rays under controlled conditions. It counts and identifies negative and positive mesotrons in the cosmic radiation. Cloud chambers in another trailer were used to measure momentum and mass of particles

Color TV Committee Formed

THE National Bureau of Standards recently organized a committee for the purpose of surveying the present status and future prospects of color television. Among other things this committee is concerned with problems of general policy in the radio communications field.

Membership of the color television committee is as follows:

E. U. Condon of the National Bureau of Standards, chairman; Newbern Smith of NBS, vice-chairman; Stuart L. Bailey of Washington, D. C.; W. L. Everitt of the University of Illinois; and Donald G. Fink, editor of ELECTRONICS.

The general scope of the committee's study will embrace (1) the necessary bandwidth for suitable color pictures; (2) prospective development of color television transmitting and receiving equipment; (3) radio propagation factors in the 174 to 216-mc and the 470 to

The NEW LAVOIE LA-239A VIDEO OSCILLOSCOPE Gives Quantitative Data (Amplitude and Time) In ONE Instrument.

● EASY OPERATION
● EASY MOBILITY

SINE WAVES OBSERVABLE
10 cycles to 5 megacyles per second

TRANSIENTS OBSERVABLE
Mimimum rise time—0.08 microsecond (10% to 90%)
Maximum square-pulse duration
5,000 microseconds

SIGNAL INPUT IMPEDANCE
Oscilloscope alone—300,000 ohms paralleled by 30 mmf.
Oscilloscope with probe—3 megohms paralleled by 12 mmf.

SYNCHRONIZING INPUT IMPEDANCE
Oscilloscope alone—300,000 ohms paralleled by 30 mmf.
Oscilloscope with probe—3 megohms paralleled by 12 mmf.

SIGNAL INPUT VOLTAGE AND SENSITIVITY, NOMINAL FOR IMAGE OF STANDARD AMPLITUDE 0. 6 INCH
Oscilloscope alone—0.1 to 100 volts, peak
With probe—Ten times voltage with oscilloscope alone with maximum limit of 450 volts, peak.

SWEEP TIME
0.5 to 50,000 microseconds per inch, continuous.

SWEEP CIRCUIT
Start-stop, each sweep independent of preceding.

SYNCHRONIZING MEANS AND VOLTAGE
Internal—Leading or lagging edge of pulse. Signal under observation or trigger generator.
External—Without probe—± 0.5 to ± 150 volts, peak.
With probe—± 5 to ± 450 volts, peak.

● *Write for quotation and any additional information*

CALIBRATING VOLTAGE
An internally generated square wave of approximately 150 cycles per second, adjustable from 0.1 to 1 volt peak-to-peak and applied directly to the input of the signal amplifiers, which follow the multiplier. A 75 volt square wave for calibrating vertical plate deflections, etc.

TIMING MARKERS
Synchronized with sweep and available at intervals of 0.2, 1, 10, 100 or 500 microseconds.

TRIGGER PULSE OUTPUT
± 25 volts, 4 microsecond pulses, occurring at 300, 800, 2,000 or 5,000 pps. and with rise time of ½ microsecond

SWEEP DELAY AND EXPANSION
Any portion of sweeps nominally over 10 microseconds may be delayed and expanded about 10 times for detailed examination of signal.

MEASURING SCALE
30 x 40 divisions, illuminated, optically produced, free from parallax and visible only when wanted, with any desired brightness.

EXTERNAL CONNECTIONS AVAILABLE
To vertical plate of cathode-ray tube. (Maximum peak voltage, 450)
Through 100,000 micromicrofarads with sensitivity of approximately 110 volts per inch deflection.
To horizontal amplifier. (Maximum peak voltage, 450)
Through potentiometer allowing sensitivity to be varied from approximately 8 to 200 volts per inch deflection. Band width 10 to 10,000 cycles.

TO CATHODE OF CATHODE-RAY TUBE (Z AXIS)
Through 10,000 micromicrofarads. Internal timing markers cannot be used simultaneously.

CATHODE-RAY TUBE—3JP1
POWER SUPPLY
Volts 115—50 to 1,600 cycles per second.

Lavoie Laboratories

RADIO ENGINEERS AND MANUFACTURERS
MORGANVILLE, N. J.

Specialists in the Development and Manufacture of UHF Equipment

890-mc bands affecting basic technical principles of frequency allocation for color television service; and (4) adaptability of present receivers to color use, or to receive in black-and-white a program being transmitted in color.

New JTAC Officers

THREE recent appointments to office in the Joint Technical Advisory Committee were made by the boards of directors of IRE and RMA. The officers for the term July 1, 1949 to June 30, 1950 are as follows:

Donald G. Fink, editor of ELECTRONICS, chairman; John V. L. Hogan of Radio Inventions Inc., vice-chairman; and Laurence G. Cumming, technical secretary of the IRE, reappointed secretary.

Formed jointly by the IRE and RMA in May 1948, JTAC reviews and evaluates technical and engineering information relating to electronics in order to advise government bodies and other professional groups. It has issued two reports on the use of uhf for television in connection with recent FCC hearings.

MEETINGS

AUG. 29-SEPT. 1: National Conference of Associated Police Communications Officers, Hotel New Yorker, New York City.

AUG. 30-SEPT. 1: Fifth Annual Pacific Electronic Exhibit sponsored by the WCEMA and the 1949 IRE western regional convention, Civic Center, San Francisco, Calif.

SEPT. 12–16: Instrument Society of America National Conference and Exhibit, Municipal Auditorium, St. Louis, Mo.

SEPT. 15–16: Sixth joint Canadian-U. S. industrial conference of RMA Board of Directors, Greenbrier Hotel, White Sulphur Springs, West Va.

SEPT. 26–28: National Electronics Conference, Edgewater Beach Hotel, Chicago, Ill.

SEPT. 27–29; Twenty-sixth Annual Session of the Communications Section, Association of American Railroads, Wentworth Hotel, Portsmouth, N. H.

SEPT. 28-OCT. 8: 16th National Radio Exhibition (Radiolympia), Olympia Exhibition Hall, London, England.

OCT. 10–14: ASTM 1949 West Coast Meeting, Fairmount Hotel, San Francisco, Calif.

OCT. 10–14: SMPE 66th Semiannual Convention, Hollywood-Roosevelt Hotel, Hollywood, Calif.

OCT. 12–15: Ninety-Sixth Convention of The Electrochemical Society, LaSalle Hotel, Chicago, Ill.

OCT. 17–21: Annual Meeting of the Society for Non-Destructive Testing, Public Auditorium, Cleveland, Ohio.

OCT. 31-Nov. 2: Second annual Conference on Electronic Instrumentation in Nucleonics and Medicine, Hotel Commodore, New York City.

OCT. 31-Nov. 2: 1949 Radio Fall Meeting of IRE and RMA engineering department, Hotel Syracuse, Syracuse, N. Y.

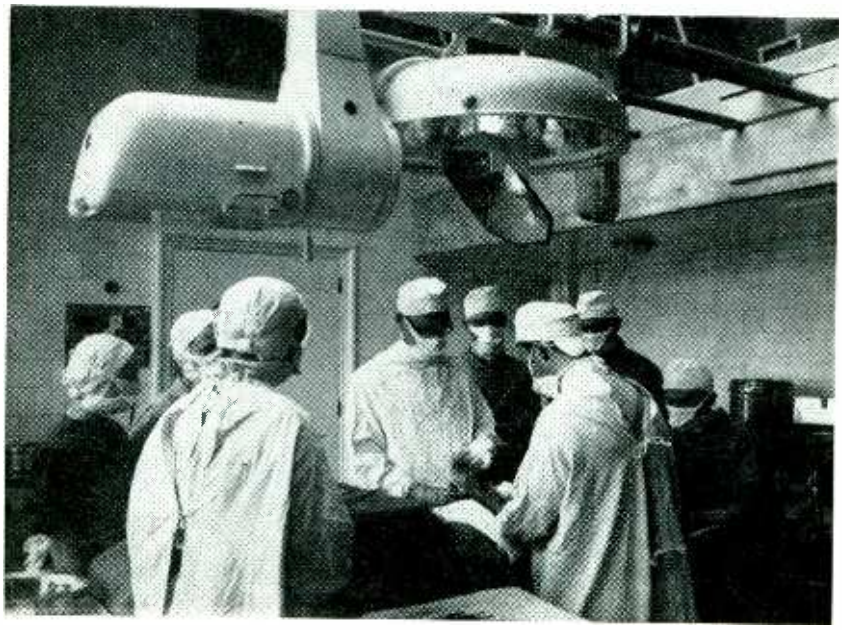
OCT. 31-Nov. 2: Fall Meeting of the URSI and IRE, National Academy of Sciences and State Dept. Bldg., Washington, D. C.

Nov. 14–18: 23rd NEMA Annual Meeting, Haddon Hall Hotel, Atlantic City, N. J.

Surgery Taught Via Television

TELEVISED operations have recently become standard training procedure at Guy's Hospital in London, thus enabling medical students to view advanced surgery without clustering around the operating table in the theatre.

The installation incorporates a C.P.S. Emitron camera fixed directly above the operating table, horizontally, with a mirror set at an angle of 45 degrees reflecting into the camera's lens the scene below. The camera is remotely controlled for lens selection and focussing. The area scanned depends upon the particular lens in use, there being a choice of life-size, three-to-one reduction, or three-fold magnification of an area five by six inches.



General view of the operating theatre in Guy's Hospital, London, shows the unobtrusive character of the television camera installation (upper left). The camera is attached to the lamp over the operating table and both are moved on an overhead track

A microphone located alongside the camera picks up the surgeon's running commentary. Camera and microphone are linked with remote receivers (in lecture rooms) by closed transmission circuits.

The hospital intends to prepare a repertoire of 30 or 40 standard operations, and then invite parties of surgeons from hospitals throughout England to come and watch the operations being televised. A film

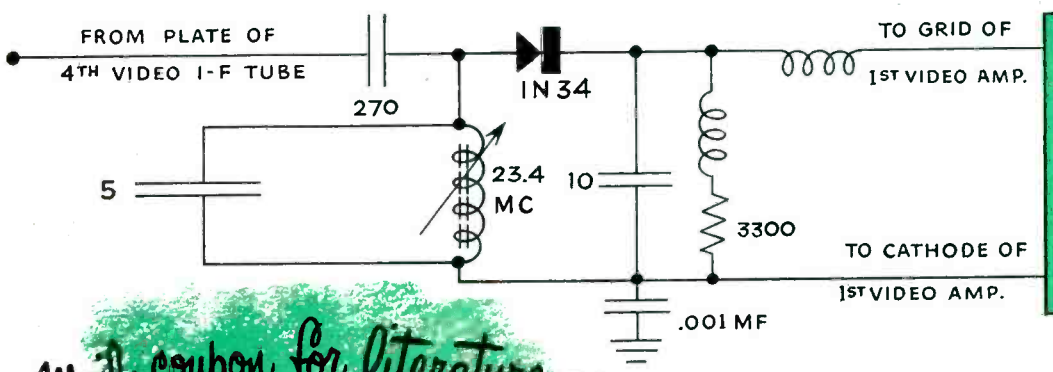
(continued on p 208)

Magnavox uses Sylvania 1N34 Germanium Diodes in all TV receivers for . . .

The Magnavox Company's famous Embassy Television Set—like all other models in the company's line of TV receivers—incorporates a Sylvania 1N34.

"Compactness, dependability, trouble-free operation"

Magnavox selected Sylvania 1N34's for use as video detectors in its television sets because, according to Mr. Antony Wright, Chief Engineer, "Their compact size, dependability and electrical characteristics are ideal for application to television signal detection. There is no doubt that they play their part along with the other quality products with which they are combined and which, as a whole, serve to produce high quality pictures." That's just one more of the outstanding jobs that Sylvania Germanium Diodes are doing! Why not plan to put these compact, heaterless components to work in *your* products?



Portion of diagram of the Magnavox Embassy, showing the 1N34 used as the video detector.

Mail coupon for literature on Sylvania Germanium Diodes

SYLVANIA ELECTRIC

Electronics Division
500 Fifth Avenue, New York 18, N. Y.

ELECTRONIC DEVICES, RADIO TUBES, CATHODE RAY TUBES, PHOTOLAMPS; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES, SIGN TUBING; LIGHT BULBS

Sylvania Electric Products Inc.
Electronics Division, Dept. E-2909
500 Fifth Avenue, New York 18, N. Y.

Gentlemen:

Please send me full information on Germanium Diodes, including data on TV applications. I am also interested in receiving literature on your other products in the fields of:

☐ Communications, Television and Industrial Electronics
☐ Radioactivity ☐ Radar and Microwaves

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City_____ State_____

Company_____

Position_____

low-frequency response is intentionally made very poor.

The out-going power amplifier V_1 is normally inoperable because its grid is held by the plate of V_2 down to the vicinity of −75 volts. Signals originating at the remote station then appear at the grid of V_3 and are heard over the home loudspeaker. The separate input transformer (or a separate winding on the output transformer of V_1 is necessary, rather than connecting the input of V_3 directly to the plate

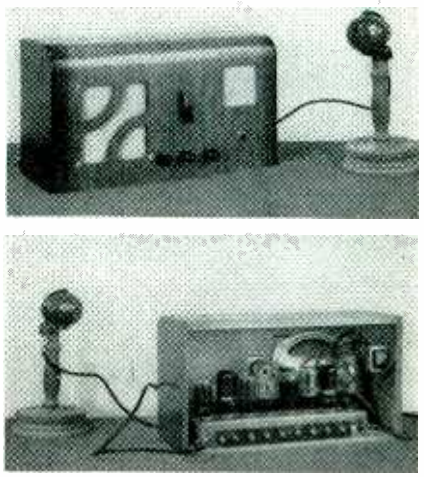

FIG. 3—Front and rear views of typical master station

of V_1, to prevent plate-supply disturbances from appearing at this high-gain input.

Sounds at the microphone are amplified, and any above a certain level (determined by the setting of the threshold control) are able to overcome the cut-off bias of V_4. The output of this high-μ triode is then rectified and instantly cuts off triode V_2, so that V_1 is quickly returned to operability, at a rate determined by RC. This time constant must be short enough so that the beginning of words is accurately reproduced, yet long enough to avoid a disagreeable thump at the receiving end.

Slightly before V_1 becomes operable (because there are no large time-constants to slow it up) the grid of V_5 (normally cut off) is driven positive, and the incoming amplifier completely and silently blanked. It is desirable that the

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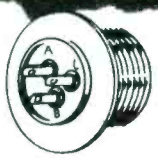

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blanking operation be complete and as silent as possible, as well as instantaneous; therefore the rather complicated arrangement shown is used.

The plate of V_6 is pulled to ground, making this tube inoperable as an amplifier, and at the same time the direct-coupled grid of V_7 is restrained from going any further negative than ground, so that no click is apparent.

When the sound at the microphone ceases, the negative charge leaks off C_2, V_1 is then instantly blanked, and the clamping of V_7 released shortly thereafter. (As all coupling time-constants are very small, the effect of the heavy overload on V_6 caused by the outgoing signal has been dissipated by the time V_7 returns to operability, so that no disturbances are heard over the loudspeaker.)

Operation

It is obvious that ordinarily sounds issuing from the home loudspeaker would be able to affect the home microphone as well as desired sounds (This would not cause howling as in an ordinary system, but a form of slow motor-boating as the system is periodically switched from one condition to the other). Therefore part of the output of V_7 is rectified (V_8) and applied in series with the normal d-c threshold bias to the grid of V_4. As this additional bias is always proportional to the amplitude of sound issuing from the loudspeaker, such sound can never be loud enough to take control of the system. This mechanism is aided by the slight acoustical lag before sound from the loudspeaker can reach the microphone.

In cases of loud ambient sound at the remote station, the home station operator has merely to talk slightly louder than the sound issuing at the moment from his loudspeaker to gain instant control at any time. However, it is found that most conversations are necessarily conducted with comparative quiet obtaining at both ends, so that the home loudspeaker is generally practically silent when the home operator wishes to talk.

For example, a machine tool op-

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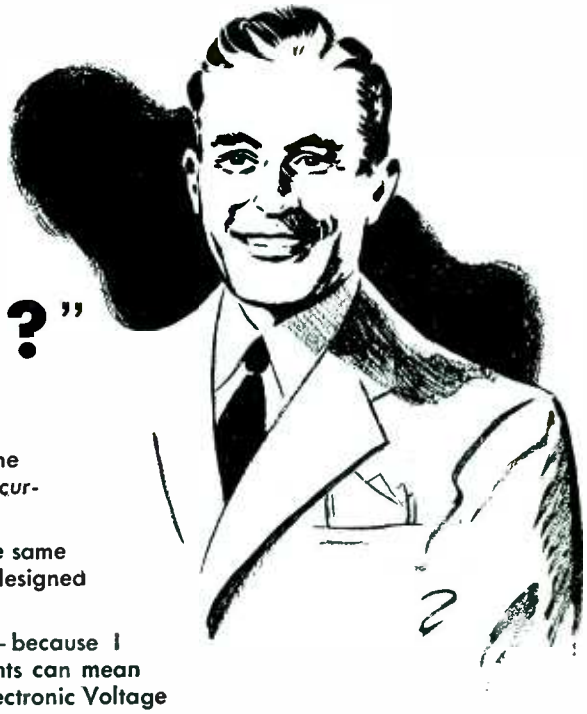

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Model in VA Capacity		150 500	250 1000	2000 3000	5000 10000 15000
Regulation Accuracy		± 0.1% against line or load			
Harmonic Distortion	Basic	5% max.	5% max.	5% max.	5% max.
	S	3% max.	2% max.	3% max.	3% max.
Input Voltage		95-130 VAC; also available for 90-260 VAC single phase 50-60 cycles			
Output Voltage		Adjustable between 110-120; 220-240 in 230 VAC models			
Load Range		0 to full load			
P.F. Range		Down to 0.7 P.F: all S models temperature compensated			
NOTE: REGULATORS CAN BE HERMETICALLY SEALED					

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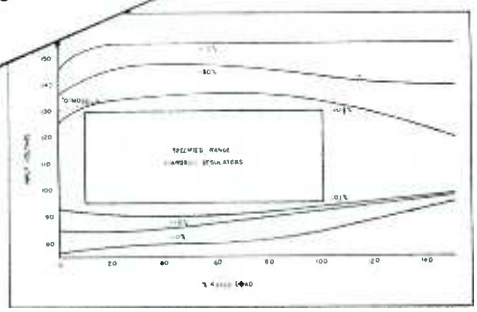

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375 Fairfeld Ave., Stamford, Conn.

erator at the remote end will always have to shut down his machine, or come closer in order to be able to hear above the din. The talker at the home station can also adjust his incoming volume control to give a level satisfactory for any particular conversation, although this is not usually necessary.

The microphone may be located very close to the home loudspeaker, even in the same cabinet if desired. However, better results are possible if they are separated by a few feet.

(A convenient arrangement which has been suggested would be to combine a small microphone with the selector pushbuttons in a compact unit for the desk, while the rest of the equipment could be installed in some out-of-the-way location nearby.)

The system described above was used for a prolonged period in a shipyard, the master station being located in the main office, with substations in a boat-shed, mill buildings, machine shop, blacksmith shop, and an outdoor location; and operation proved completely reliable and highly satisfactory under all circumstances.

In the interests of simplicity, unnecessary details, such as distribution switching and provision for initiating calls from the remote stations have been omitted from the schematic diagram.

Veneering Machine

By S. M. MILANOWSKI
Los Angeles, Calif.

TO PERMIT the edge-gluing of thin wood strips or veneers with greater speed and efficiency, a new electronic veneering machine has been developed for Anacortes Veneer, Inc., at Anacortes, Washington.

It is powered by a radio-frequency generator, and makes use of the Mann-Russell parallel bonding principle to heat-cure resin-coated wood surfaces at relatively low pressures without discrepancies in the alignment of the mated components. The latter comprise strips of wood ranging up to 10 feet in length, covered with heat-reactive adhesives such as phenol and urea formaldehyde resins.

As indicated in Fig. 1A, veneers are initially coated and loaded on

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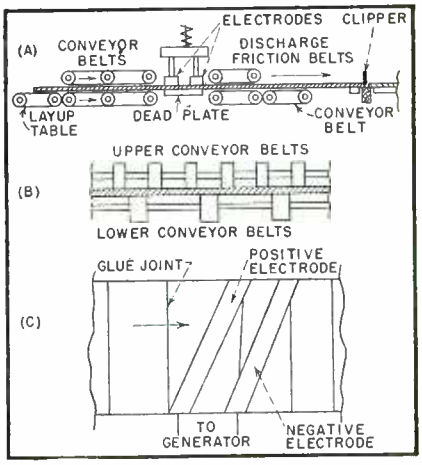

FIG. 1—Setup for r-f wood veneering machine

a layup table from which they are fed by friction conveyor belts through an electrostatic field created by a dead plate and two electrodes. Vertical spring pressure is exerted by the electrodes to maintain the horizontal alignment of veneer edges as curing action takes place, after which the veneered materials are passed through discharge friction belts to a conveyor belt for cutting to predetermined lengths with a clipper.

The fundamental arrangement of conveyor belts is indicated schematically in Fig. 1B. There are two upper belts for each lower belt and the former are actuated a few inches on either side of the lower conveyor. The upper belts exert spring pressure to maintain alignment by bending the veneers slightly before the latter are electronically adhered. In the discharge belt units, operational speeds are reduced to prevent crowding and vertical pressures are relatively slight.

Figure 1C shows how electrodes are positioned a few inches from one another at a twenty-degree angle to the conveyor system. The aforementioned dead plate is directly below these electrodes, and each glue line in its forward travel passes progressively through the r-f field so that the energy of the latter will be concentrated between alternating positive and negative plates.

Both the electrodes and the dead plate are made of corrugated aluminum for over-and-under threading action as veneers are passed through and aligned in the electrostatic field. Such corrugated platens

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Capacity Ranges: 0.5-5 MMF & 1-8 MMF
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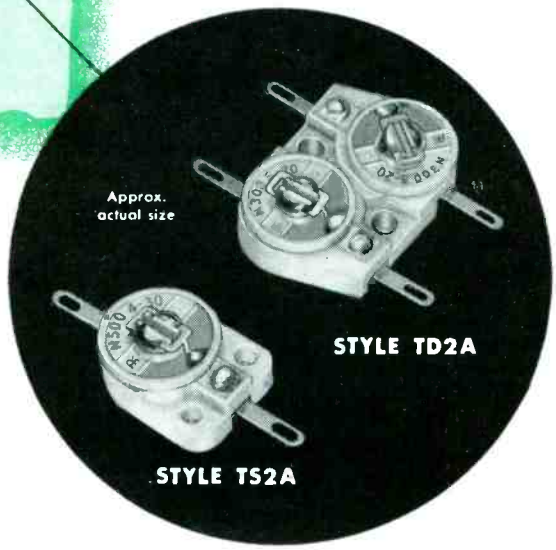
Max. Temperature: 75°C
Q Factor @ 1 MC.: 1,000 min.
Initial Leakage Resistance: 10,000 megohms min.
Styles: 531 for panels .015" to .039"; 532 for .040" to .065"



STYLES TS2A and TD2A

Capacity Ranges:
Zero Temp. Coeff. 1.5-7 MMF & 3-12 MMF
N300 Temp. Coeff. 3-13 MMF & 5-20 MMF
N500 Temp. Coeff. 4-30 MMF & 7-45 MMF
Working Voltage: 500 V.D.C.
Q Factor @ 1 MC.: 500 min.
Initial Leakage Resistance: 10,000 megohms min.
Styles: TS2A, Single Condenser;
TD2A, Dual Condenser

STYLES 554 and 557

Capacity Ranges:
Zero Temp. Coeff. 1.5-7 MMF, 3-12 MMF & 5-25 MMF
N750 Temp. Coeff. 5-30 MMF & 8-50 MMF
Working Voltage: 350 V.D.C.
Q Factor @ 1 MC.: 500 min.
Initial Leakage Resistance: 10,000 megohms min.
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have a special advantage in that their troughs can be readily cleaned when sizeable quantities of squeezed-out resinous adhesives accumulate therein.

Production data indicate that a three to four percent ratio of waste materials is being eliminated through use of the machine in place of previous taping techniques, and that the machine operates as rapidly as heated-drum veneering units without demonstrating the latter type's inherent splicing difficulties.

The machine is being used primarily for the production of clear face stock, but should be readily adaptable to the production of core stock from waste wood materials.

Vacuum Capacitor Voltage Dividers

By E. F. KIERNAN
Research Division
U. S. Navy Electronics Laboratory
San Diego, California

THE VACUUM-TUBE VOLTMETER has been applied extensively to the measurement of potential differences in the research laboratory, in radio servicing and in the field of electronics generally. The popularity of this instrument is due primarily to its high input impedance which allows measurements to be made with a minimum of disturbance to the circuit. High input impedance is achieved by the use of diode vacuum tubes of small interelectrode capacitance and restricted physical dimensions which allow the tubes to be contained in compact probes.

While small physical dimensions facilitate measurements in tight places, they impose limits on the maximum voltage which can be applied. The upper voltage limit gen-

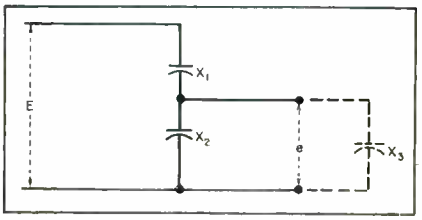

FIG. 1—Vacuum capacitor voltage dividers can be used to extend the range of vacuum-tube voltmeters, and similar indicating devices, without destroying their high-impedance characteristics

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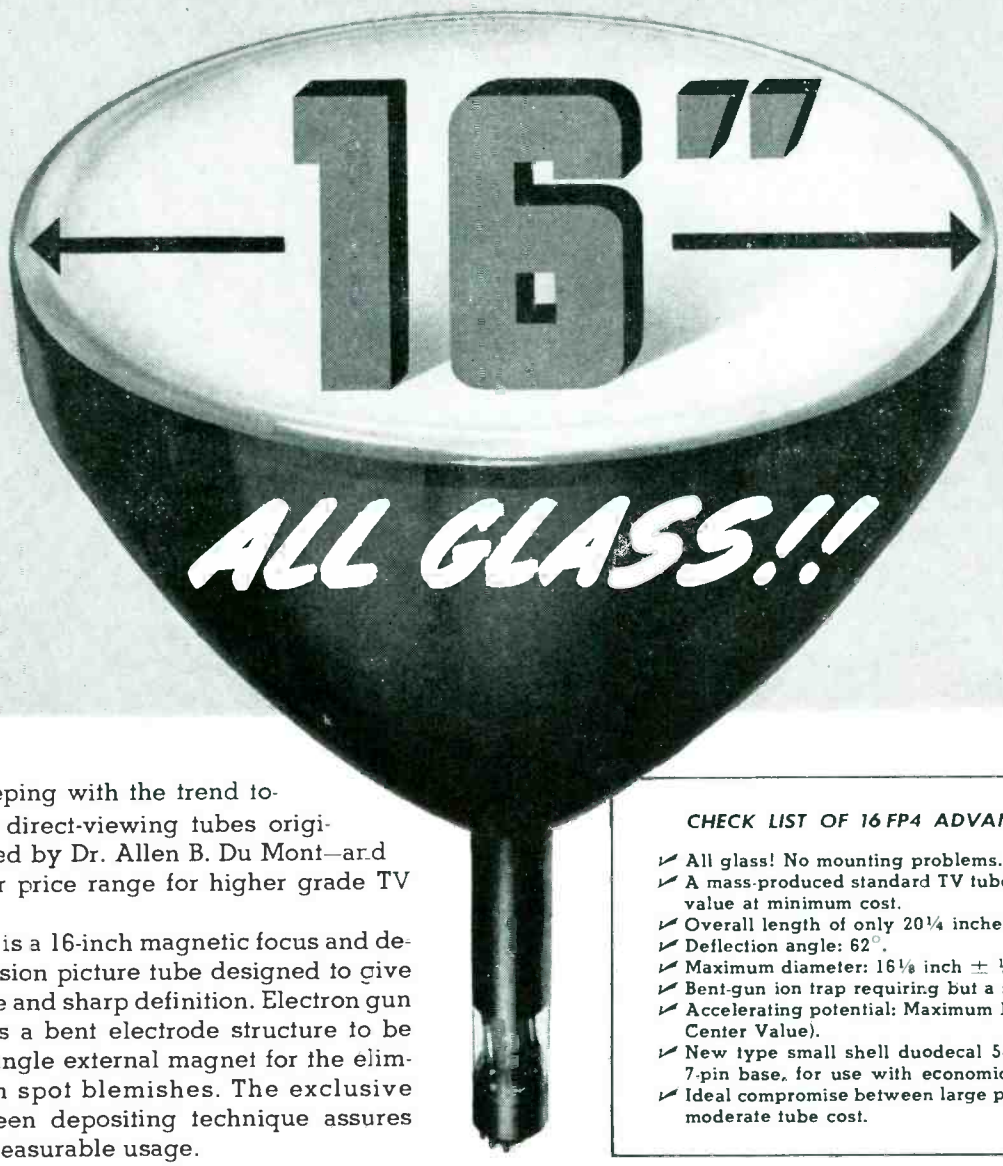

Fully in keeping with the trend towards larger, direct-viewing tubes originally pioneered by Dr. Allen B. Du Mont—and also the lower price range for higher grade TV offerings.

Type 16FP4 is a 16-inch magnetic focus and deflection television picture tube designed to give high brilliance and sharp definition. Electron gun design utilizes a bent electrode structure to be used with a single external magnet for the elimination of ion spot blemishes. The exclusive Du Mont screen depositing technique assures the longest pleasurable usage.

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- All glass! No mounting problems.
- A mass-produced standard TV tube for maximum value at minimum cost.
- Overall length of only 20¼ inches.
- Deflection angle: 62°.
- Maximum diameter: 16⅛ inch ± ⅛ inch.
- Bent-gun ion trap requiring but a single magnet.
- Accelerating potential: Maximum 16 KV; (Design Center Value).
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- Ideal compromise between large picture size and moderate tube cost.

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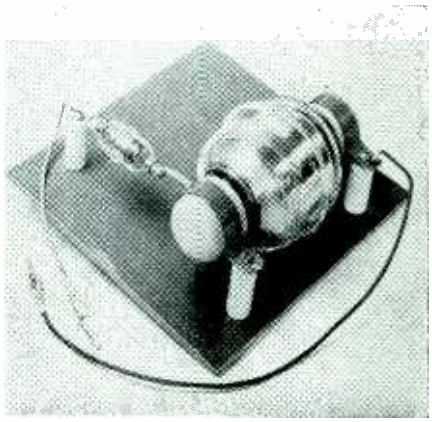
erally does not exceed 300 volts rms, and in many instruments is much lower.

The problem of extending the range of a vacuum-tube voltmeter, while at the same time preserving its high-impedance characteristics has not received a great deal of attention. This writer has found that the recent appearance on the market of a variety of compact vacuum capacitors provides components which can be assembled into voltage dividers which will not only extend the a-c ranges of a vacuum-tube voltmeter up into the kilovolts but will also increase the input impedance as well.

The vacuum capacitor voltage di-



Photograph of a vacuum capacitor voltage divider. The values of the capacitors shown are 5 and 500 $\mu\mu$f with 17,500-volt ratings—*Official Photograph U. S. Navy*

vider may be used in conjunction with a variety of indicators including the electrometer, the cathode-ray oscilloscope, the vacuum-tube voltmeter and the electrostatic voltmeter. In conjunction with an electrostatic voltmeter, it can be used for d-c measurements[1].

Typical Divider

Although dividers may be fabricated by assembling a series of standard transmitting vacuum tubes, using the interelectrode capacitances in various combinations, the vacuum capacitor is much more adaptable. These capacitors may be obtained in values ranging from 1 to 1,000-$\mu\mu$f or more; and in ratings of from 10 to 30,000 volts or higher.

The dividers consist of two sections in series. The voltage division

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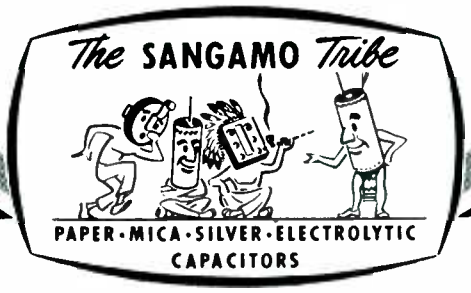

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across the divider is proportional to the reactance of the sections. For instance a 5-$\mu\mu$f section in series with a 100-$\mu\mu$f section would divide the applied voltage in the ratio of twenty to one. If 100 volts were applied across the divider there would be a reactive drop of 95.239 volts across the 5-$\mu\mu$f section and a drop of 4.761 volts across the 100-$\mu\mu$f section, neglecting the shunt capacitance of a probe.

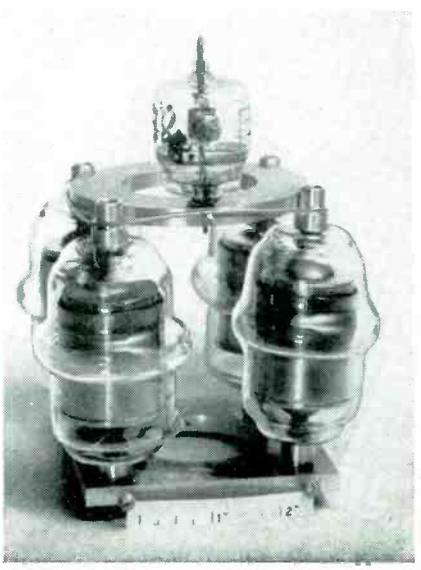
In practice, representative probe capacitance will vary between 3- and 9-$\mu\mu$f, depending on the type of diode used. In low-ratio dividers this shunt capacitance connot be neglected.

In Fig. 1, suppose X_1 is the reactance of a 5-$\mu\mu$f capacitor, X_2 is the reactance of a 50-$\mu\mu$f capacitor and X_3 is the shunt capacitance of a probe, say 6-$\mu\mu$f. If the reactance of X_1 is given the value of 1, then the relative reactance of the other section will be

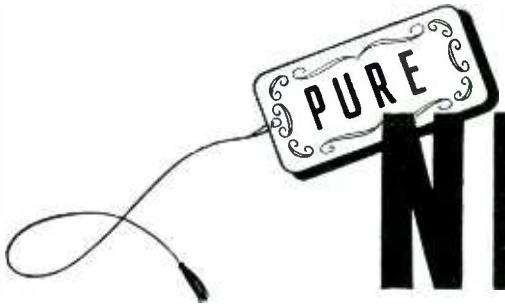
$$\frac{1}{\frac{C_2 + C_3}{C_1}} = 0.0893$$

The total reactance across the divider, relative to the 5-$\mu\mu$f section, would be 1 + 0.0893, or 1.0893. The percentage drop across X_2 of any voltage E applied across the divider would be 0.0893/1.0893 × 100 or 8.2 percent. In other words, if E equals 100 volts, e would be 8.2 volts.

Since the leakage resistance of



Vacuum capacitor voltage divider using tube plate-to-filament capacitance in series with four 50-$\mu\mu$f vacuum capacitors connected in parallel—*Official Photograph U. S. Navy*



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**Including cobalt*

PHYSICAL CONSTANTS

Specific Gravity	8.89
Density, lb. per cu. in.	0.321
Melting Point	2615-2635°F. / 1435-1445°C.
Specific Heat at (80-212°F.)	0.130
Heat Expansion Coefficient at (80-212°F.), per °F	0.0000072
Thermal Conductivity at (80-212°F.), Btu/sq. ft./hr./°F./in.	420
Electrical Resistivity at 32°F., ohms/cir. mil. ft.	63
Temperature Coefficient of Electrical Resistivity per °F	0.0022-0.0028
Modulus of Elasticity in tension, psi	30,000,000
in torsion, psi	11,000,000
Poisson's Ratio	0.31

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vacuum capacitors can be maintained well up in the megohm region, the effective load presented to a source of potential by a vacuum capacitor voltage divider is purely reactive from the low commercial frequencies well up into the megacycles.

The use of these dividers is not restricted to sinusoidal waveforms since pulse voltages may be divided without alteration of the pulse shape.[2] In applications involving very high voltages it is not necessary to locate the indicator adjacent to the divider; standard concentric cables may be used with remote indicators. If it is desirable to adjust the division ratio to some exact value, variable vacuum capacitors make such an adjustment simple.

Although, to the best of this writer's knowledge, there are no commercial vacuum capacitor voltage dividers on the market at the present time, this situation will probably be remedied in the near future. An especially designed unit wherein the two sections, one adjustable in capacitance, are enclosed in one envelope could be made very compact.

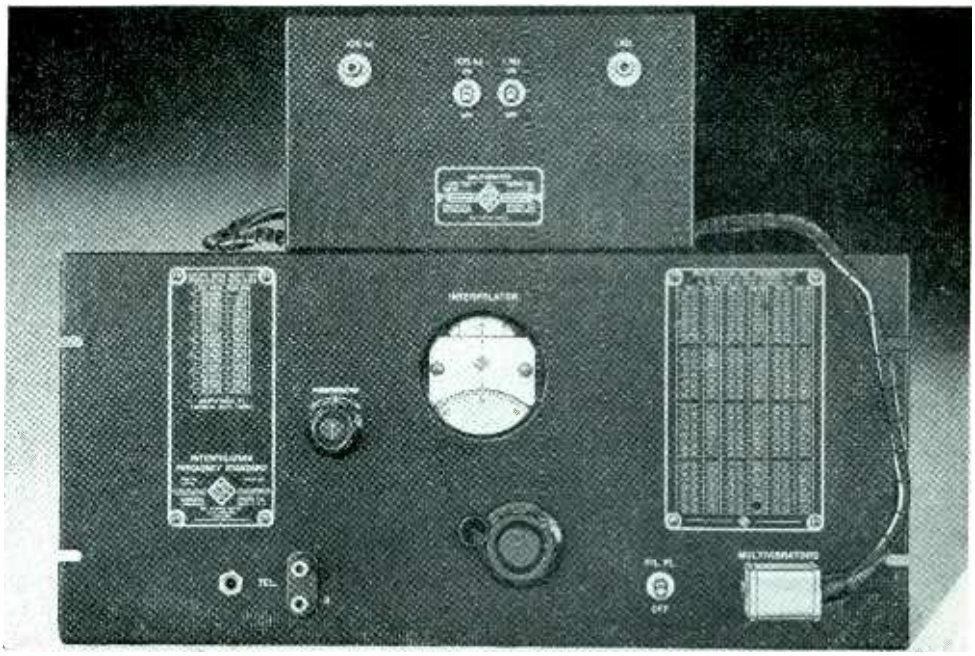
REFERENCES

(1) A Meter for High Voltage Measurement, *R. S. I.*, **10**, Oct. 1946.
(2) 100,000 Volt Pulses Measured With Capacitance Voltage Divider, *G. E. Rev.* May 1948.

Control Wood Press

FOUR MEN now do a job that formerly required the full-time services of twenty employees at Pallet Manufacturing Co. of Lebanon, Oregon.

Purpose of the press is to assemble wood conveyor pallets—each of which comprises a 2 x 4 wood beam with a length of 48 inches, on which two-block assemblies with overall dimensions of 7 x 4 x 2¾ inches each are adhered at one center and two end locations. Assemblies of this type would ordinarily be produced by brush-coating the requisite wood surfaces with cold-setting adhesives, and stacking the wood components one over the other for a period of about 12 hours (or until the adhesives produced an adequate sequence of



FREQUENCY MEASUREMENTS UP TO 3,000 MC WITH ACCURACY OF ±25 PARTS PER MILLION

•Between 100 and several thousand megacycles, the present accuracy of heterodyne frequency meters ranges between 0.01 and 0.1 per cent. Continually increasing importance of frequencies within this range call for increased accuracy of measurements.

A reference standard and precise interpolation offer the simplest, most inexpensive and most direct method of increasing the accuracy of heterodyne frequency meters.

The Type 1110-A Interpolating Frequency Standard is composed of two units: a frequency standard variable over a range of 1000 to 1010 kc (1%), and a multivibrator unit for frequencies of 1 Mc and 100 kc. The frequency standard consists of a temperature-controlled 950 kc crystal oscillator, a highly-stable 50-60 kc bridge-type variable-frequency L-C oscillator, a modulator and a filter for selecting the sum of the two frequencies at the final output.

When the 100 kc multivibrator is used, the 100th harmonic has a range of 1% as the standard frequency is changed over the full range of the dial, covering 10.0 to 10.1 Mc. The multivibrator harmonics give complete frequency coverage from 100 Mc upward for the 1 Mc unit, and from 10 Mc upward for the 100 kc unit.

FEATURES

ACCURACY OF MEASUREMENT: over-all accuracy is ±25 parts per million using oscillator dial directly. If oscillator is carefully trimmed in terms of the crystal, the over-all accuracy is limited principally by the error of the crystal, or about ±10 parts per million at room temperatures.

SIMPLE TO CHECK ABSOLUTE ACCURACY: harmonics of multivibrators fall at all WWV standard frequencies. With suitable receiver the absolute accuracy, including that of the 950-kc crystal, may be checked readily.

ZERO BEAT ADJUSTMENTS: no need for wide-band circuits or wide-band interpolating methods.

The Type 1110-A Interpolating Frequency Standard can be used for frequency measurements with high-frequency receivers provided the receiver calibrations can identify frequencies if separated by as little as 1 per cent.

TYPE 1110-A INTERPOLATING FREQUENCY STANDARD $725.00

TYPE 720-A HETERODYNE FREQUENCY METER

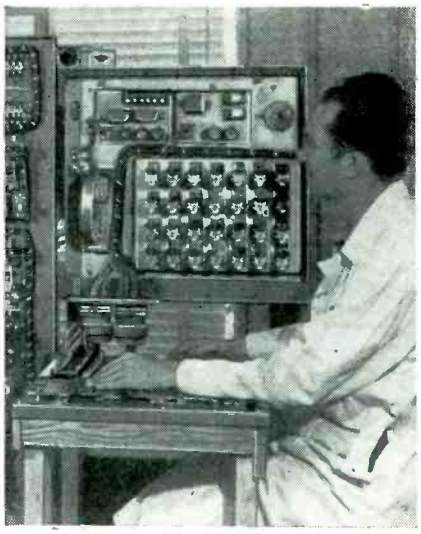
As a companion to the Type 1110-A instrument, this heterodyne frequency meter will be found to be particularly useful at frequencies up to at least 3000 Mc. It employs a butterfly-type tuning circuit, the oscillator frequency being continuously adjustable and direct-reading, from 100 to 200 Mc. A silicon crystal detector is used, with a 3-stage audio amplifier. The output of the amplifier operates a panel meter and a built in loudspeaker. For head-telephone detection of weak signals, a jack is provided on the panel. The entire unit is battery-operated and completely self-contained

TYPE 720-A HETERODYNE FREQUENCY METER $360.00

GENERAL RADIO COMPANY

Cambridge 39, Massachusetts

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



Electronic controls for wood gluing press are tested at the Los Angeles plant of Industrial Electronic Engineers

bonds). With the electronic press equipment, 18 different wood surfaces can be automatically coated with heat-setting resins, clamped between the press platens with an overall pressure of 150 psi, and cured with high-frequency heat—so that three complete assemblies can be simultaneously ejected from the machine, ready for shipment, every six seconds.

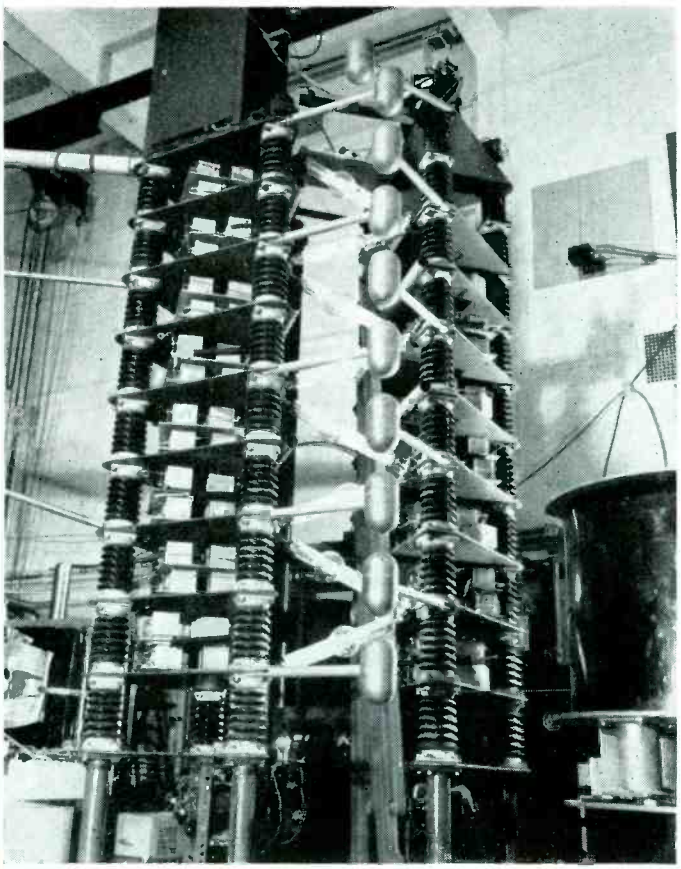
Three men load the three press hoppers with raw wood materials while a fourth man stacks the ejected assemblies for shipment. It is estimated that resultant production has lowered manufacturing costs by at least $15 per hour.

Mechanical components of the assembly press are actuated at precision-timed intervals by means of sense elements, comprising limit switches and potentiometers. The latter are wired to a master terminal board and energized by means of telephone-type relays actuated by a pair of vacuum tubes, whose output is adjusted by means of switches and dials on a control panel.

Tubes in the control system comprise a 6SN7 and a 2050 thyratron. Nine 833-A power triodes provide high-frequency heat for the three pairs of press platens.

Impulses from the tube controls are limited for an adequate margin of safety by the sense elements, and when the time comes for each predetermined operation of the assembly press an appropriate circuit

600,000 Volt Power Supply -



An 8 stage capacitor-rectifier multiplier. This unit is used in the "Racetrack" Synchrontron of the University of Michigan

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is actuated by a contactor so that three-phase power flows from the factory line to motors controlling the machine's operational components for a suitable period of time.

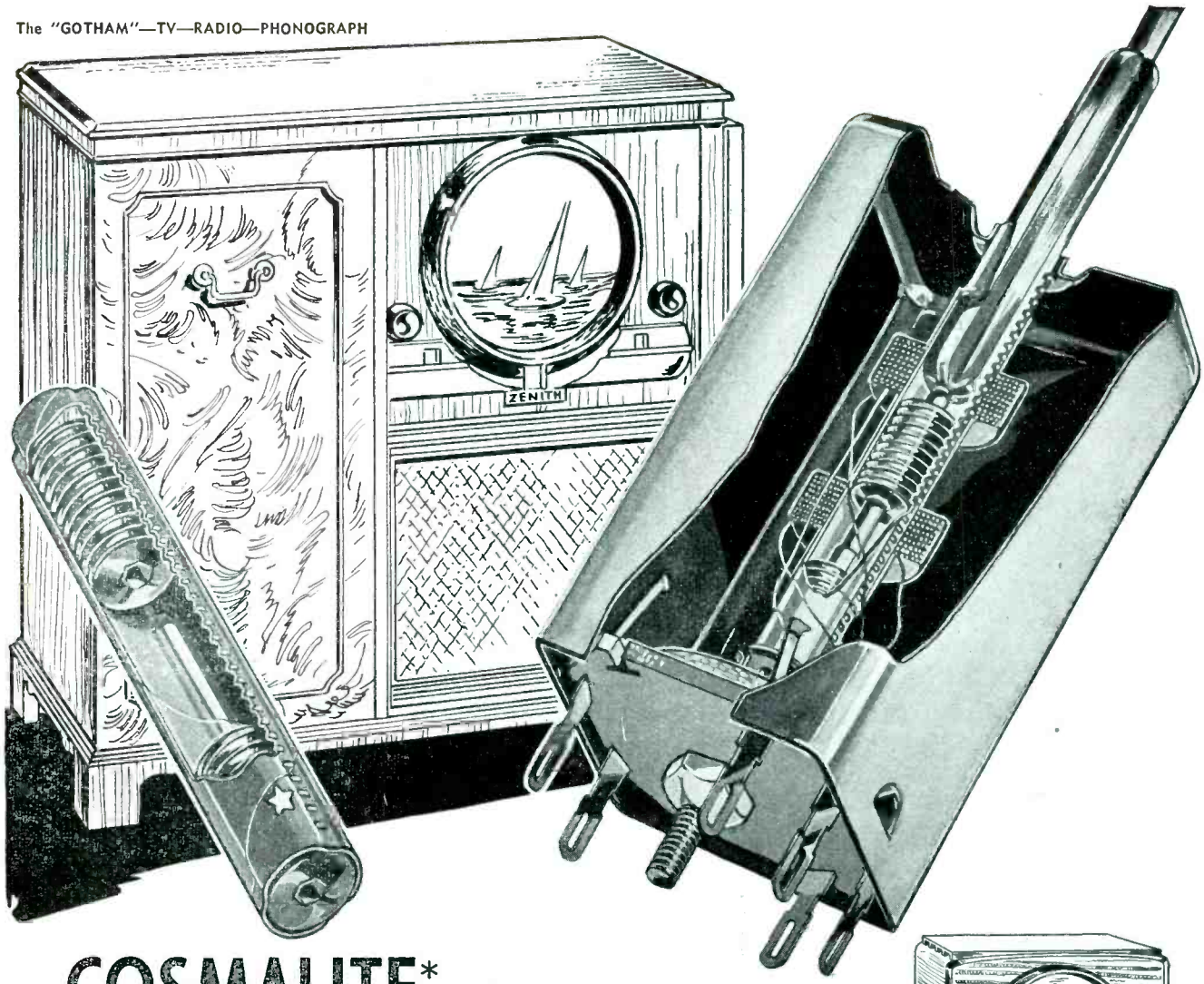
Signal lights are arranged on the control panel so that operating personnel will be immediately informed if any mechanical or control unit should fail to function properly, but the equipment has been in constant operation for several months without requiring repairs of any type.

Washing Clothes with Sound Waves

A PAIR OF Australian inventors have recently announced the development of a device which employs sound waves to enhance the time-honored art of clothes washing. The apparatus, shown in the accompanying photograph, is immersed in the wash tub along with the clothes to be washed. The 100-cycle sound waves produced by the device cause the clothes to oscillate back and forth a few thousandths of an inch, and this vibration shakes the dirt particles loose and holds them in suspension in the water. The entire cleansing process takes less than

Electrosonic clothes washer produces sound waves in wash tub which vibrate clothes to shake dirt particles loose

The "GOTHAM"—TV—RADIO—PHONOGRAPH

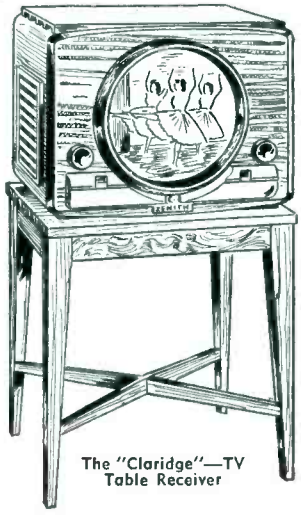


COSMALITE* gives

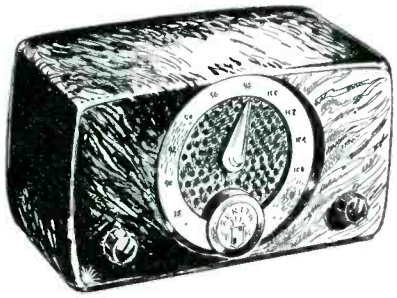
STAR performance in the new ZENITH

This internally threaded Cosmalite coil form of cloverleaf design in the very heart of the Zenith Television Transformer, permits quick tuning of both primary and secondary frequencies through the upper end. The hexagon shaft of the frequency setter easily passes through the upper core and engages in the lower core . . . adjusting the frequencies of both coils with the greatest ease.

Consult us on the many uses of Cosmalite (low cost phenolic tubing) in television and radio receivers.



The "Claridge"—TV Table Receiver



Cosmalite coil forms are also used in transformers of Zenith's table radios, such as the new Super-Sensitive "Major" FM receiver, above.

*Reg. U. S. Pat. Off.

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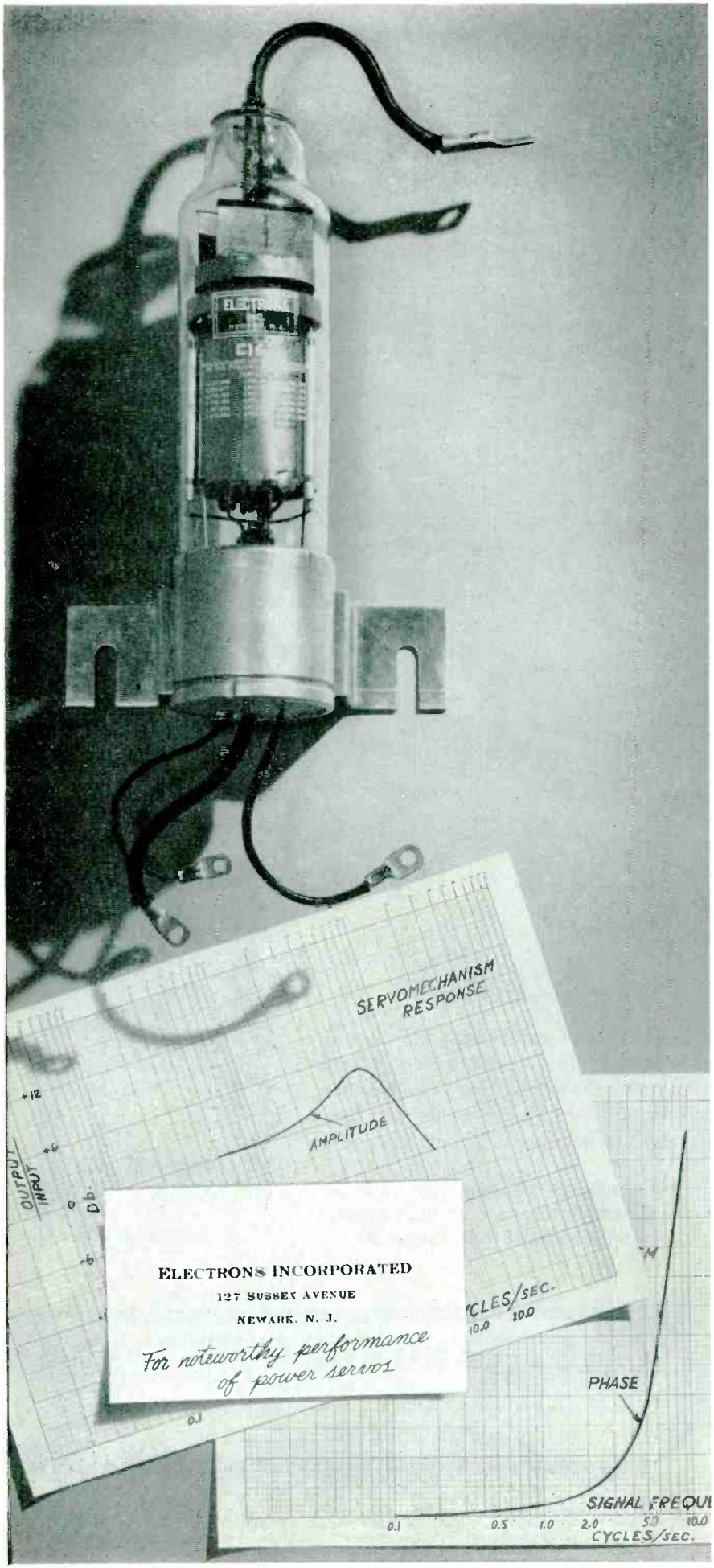


five minutes in most cases.

The transducer is contained in a metal cylinder about 8 inches in diameter and 16 inches long. The power unit is an electromagnet which has no moving parts and therefore does not deteriorate with prolonged use. This electromagnet vibrates a circular diaphragm $7\frac{1}{2}$ inches in diameter which imparts the wave motion to the water when immersed.

In use, the clothes are packed around the machine and the tub filled with enough hot water to cover the clothes. The usual amount of flake or powdered soap is then added, and the vibrator goes to work.

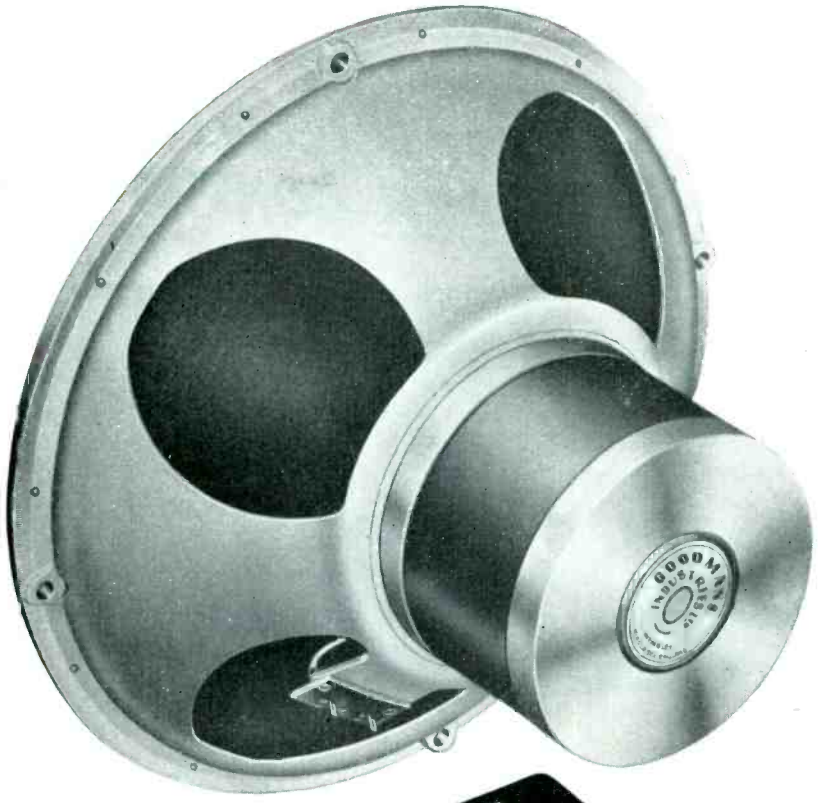
For safety, the machine is operated with a step-down transformer which drops line voltages to about 32 volts. The inventors claim that this voltage makes the machine absolutely safe to use. The unit is being manufactured by a firm registered in Melbourne, Australia, in the names of the inventors, J. E. Excell and H. J. Jones. Special models have been prepared for export.

High-Speed Rotation Counter

HIGHLY ACCURATE and convenient high-speed rotation counting is made possible by a recently developed tachometer shown in the photograph. The device, a product of the General Electric Company, consists of a high-frequency pulse generator which produces pulses in accordance with the speed of the rotation being measured, an electronic counting circuit, and a pair of speed-indicating units, one for local and one for remote indication.

The instrument has the advantage that readings are taken every second and rotational velocity is indicated directly in revolutions per minute usually with an accuracy of better than 1 revolution per minute.

In counting high-rotational speeds, a magnetic pulse generator is used which fits on the periphery of a drum that is attached to the shaft of the machine being tested. The drum is magnetized, one side containing 150 magnetic poles and the other side 1,500. When rotated,



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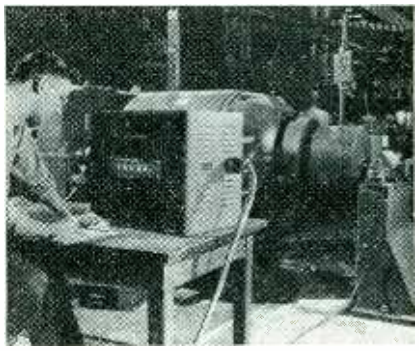
GOODMANS R22

20-WATT
12" P.M. FULLY DUSTPROOF
Loudspeaker

SPECIFICATIONS:

R22/1205/15.		R22/1206/15.	
Overall Diameter	12.5/16"	Overall Diameter	12.5/16"
Overall Depth	7"	Overall Depth	7"
Fundamental Resonance	75 c.p.s.	Fundamental Resonance	55 c.p.s.
Voice Coil Impedance	15 ohms at 400 c.p.s.	Voice Coil Impedance	15 ohms at 400 c.p.s.
Maximum Power Capacity	20 watts Peak A/C	Maximum Power Capacity	20 watts Peak A/C
Total Flux	195000 Lines	Total Flux	195000 Lines
Nett Weight	18 lbs. 4 ozs.	Nett Weight	18 lbs. 4 ozs.

GOODMANS INDUSTRIES LTD., • Lancelot Road, • WEMBLEY, Middx., ENGLAND



The rotational speed of the turbine is being indicated in the electronic pulse counter. The pulse pickup is mounted on the shaft at the right

the drum generates electrical impulses in the magnetic pickup, and these pulses are carried to the electronic circuit where they are counted at speeds up to 50,000 per second. The indicators do the necessary calculation and interpolation, and flash on an opal glass screen the speed of revolution in rpm. The numbers change once every second in accordance with speed changes.

Other Uses

The pulse generator mentioned above is quite unique in counting revolutionary speeds because it has two speed ranges, one when the pickup is brought close to the 150-pole drum, and one when it sees the 1,500-pole side. Any device capable of producing pulses of the proper amplitude and polarity could be used in conjunction with this counting and indicating system. For instance, the shaft of the machine to be tested could be marked and viewed by a phototube.

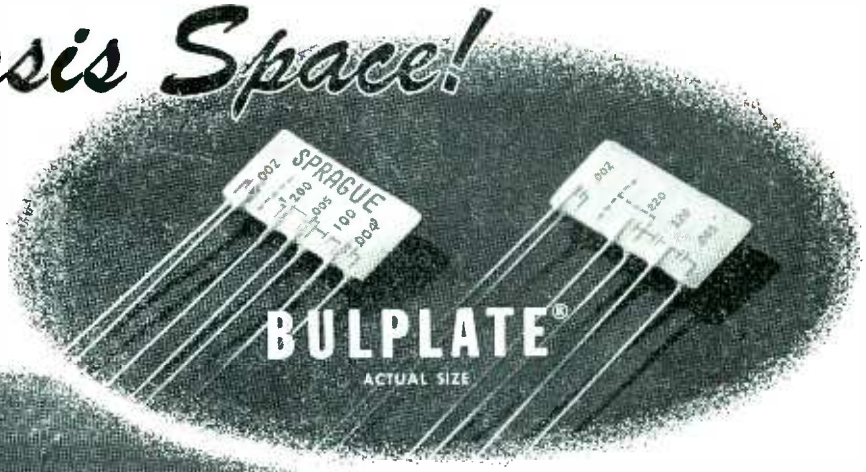
Television in Industry

INCREASED EFFICIENCY and safety in boiler operation have been made possible through the use of a special television system installed at the American Gas and Electric Service Corporation in Detroit. The system enables the control room operator to check boiler pilot burner flame conditions by actual observation without the necessity of having an observer present on the firing floor.

As illustrated by the accompanying photographs, the television camera views the pilot burner flames of a group of furnace ports through a

Save Chassis Space!

and Improve Performance!



Reduce Assembly Operations!

SPRAGUE — HERLEC — High-K Ceramic Capacitors

● Sprague-Herlec high-K ceramic capacitors for bypass and coupling applications offer the designer of television and F-M receivers savings in both chassis space and in component and wiring costs.

● Disc Types 29C and 36C capacitors are extremely small round wafer-shaped units. Mounted across miniature tube sockets with extremely short leads, they result in improved v-h-f bypassing. Both single and dual capacitors are available on one disc.

● Bulplate Type 34C multiple capacitors are rectangular wafers with as many as five capacitor sections. One rugged, ceramic Bulplate may combine into a single, compact integral assembly all the capacitors and related wiring in one or more stages of electronic circuits. In combination with miniature resistors, Bulplates make more stable and reliable network assemblies than do completely printed R-C circuits. Closer electrical tolerances are more economically obtained and circuits may operate at a higher power level.

● All Sprague-Herlec ceramic capacitors are protected by a tough, moisture-resistant insulating coating.

● A constant and reliable supply of capacitors is assured by operation of two manufacturing plants in two widely separated locations.

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THE HERLEC CORPORATION • MILWAUKEE 3, WISCONSIN
(Wholly owned Sprague Subsidiary)

Six glowing discs represent six different flames as viewed by a remotely located camera on the furnace floor

system of mirrors. Thus as many as six flames may be observed simultaneously. The monitor, or receiver, is built into the control panel where six glowing discs indicate to the operator that all pilot burners are lighted and the main burners can be turned on with safety.

The television system used bears the name Utiliscope and is a product of the Diamond Power Specialty Corporation of Detroit, Michigan. The pictures are sent over a video line instead of by radio waves, thereby eliminating the costly feature of television.

Among the other applications of this type of television system suggested by the producers are, the observation of radioactive material from behind barriers, breakdown testing, watching traffic in vehicular tunnels, reproducing readings from electric meters and liquid level or temperature gages located in remote or inaccessible places.

One television camera may be used to monitor as many as six flames through the use of the mirror system pictured above

BUY THE BEST • THE V.O.M.A. THAT DOES MORE

MORE FOR YOUR MONEY

Triplett Model 630

$37.50 Dealer Net

In the relatively short time since Model 630 was introduced to the trade it has steadily risen to the top in sales. The reason is obvious. Here is a Volt-Ohm-Mil-Ammeter that does more . . . has proven components . . . and will give a lifetime of satisfaction. All the engineering skill and facilities of the industries' largest manufacturer of Volt-Ohm-Mil-Ammeters joined forces to make it outstanding in every way. Look over all the features and you too will buy Model 630.

NOTE THESE SENSATIONAL IMPROVEMENTS:

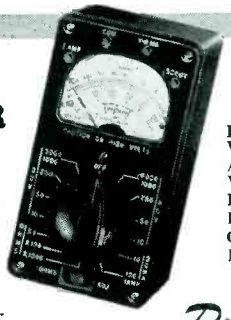
- ★ Individual Scales with separated spacing are easy to read.
- ★ Large 5½ Inch Meter In Special Molded Case Under Panel.
- ★ Resistance Scale Markings from .2 Ohms to 100 Megohms—Zero Ohms Control Flush With Panel.
- ★ Only One Switch—Has Extra Large Knob 2½" Long—Easy To Turn—Flush With Panel Surface.
- ★ Enclosed New Molded Selector Switch and insulated resistor housing in unit construction.
- ★ All Resistors Are Precision Film or Wire Wound Types For Permanent Accuracy.
- ★ Batteries Easily Replaced—Balanced Double-Contact Grip. Spiral Spring—Battery for Ohms test due to low drain insures shelf-life usage.

TECH DATA

D.C. VOLTS: 0-3-12-60-300-1200-6000 at 20,000 Ohms/Volt
A.C. VOLTS: 0-3-12-60-300-1200-6000 at 5,000 Ohms/Volt
D.C. MICROAMPERES 0-60 at 250 Millivolts
D.C. AMPERES 0-12 at 250 Millivolts
D.C. MILLIAMPERES 0-1.2-12-120, at 250 Millivolts
OHMS: 0-1000-10,000; (44 Ohms and 44 Ohms center scale)
MEGOHMS: 0-1-100 (4400-440,000 at center scale)
DECIBELS: —30 to +4, +16, +30, +44, +56, +70
OUTPUT: Condenser in series with A.C. Volt ranges
High voltage Probes available, extra; also plug-in shunts for other current measurements to suit special needs.

Laboratory Standard Model 630-A—All scales on this model are hand drawn and hand stepped, used with mirror for extreme accuracies, beyond the average servicing needs of the model 630.

Triplett Model 630-A **Dealer Net $47.50**



VOMA JR.—A NEW VOLT-OHM-MIL-AMMETER

Handy "POCKET-SIZE LABORATORY" By Triplett

VOMA Jr. MODEL 666-R has many of the design features of the popular Model 630:

1. Switch and controls flush with panel.
2. Enclosed molded selector switch.
3. Exclusive Unit construction-resistor housing integral with switch.
4. Resistors Precision wire wound and permanent film type.
5. Resistance Measurements to 3 Megohms.
6. Batteries with spiral spring contacts, easily replaced.

VOMA Jr. MODEL 666-R . . . $24.50
U.S.A. Dealer Net Price

Note: *Model 666-HH The Original Pocket-Size Lab—still a favorite with many. U.S.A. Dealer Net $22.00.*

TECH DATA

D.C. VOLTS: 0-10-50-250-1000-5000, at 1000 Ohms/Volt
A.C. VOLTS: 0-10-50-250-1000-5000, at 1000 Ohms/Volt
D.C. MILLIAMPERES: 0-10-100, at 250 Millivolts
D.C. AMPERES: 0-1, at 250 Millivolts
OHMS: 0-3000-300,000 . . . . (20-2000 at center scale)
MEGOHMS: 0-3 . . . . . (20,000 ohms center scale)

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TRIPLETT

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In Canada: Triplett Instruments of Canada, Georgetown, Ontario

(continued from p 122)

sufficiently to enable the unexposed film to be moved in time to make the photograph. After the second picture is taken the machine resumes its normal speed.

Photoelectric Systems

The main hit detector is an assembly of four gas-type phototubes, each of which scans one-quarter of the projected code area after screening by the interrogating card, together with vacuum-tube circuits which recognize simultaneous blackout of all four phototubes and furnish an actuating pulse to the flashtube and recopying camera circuits.

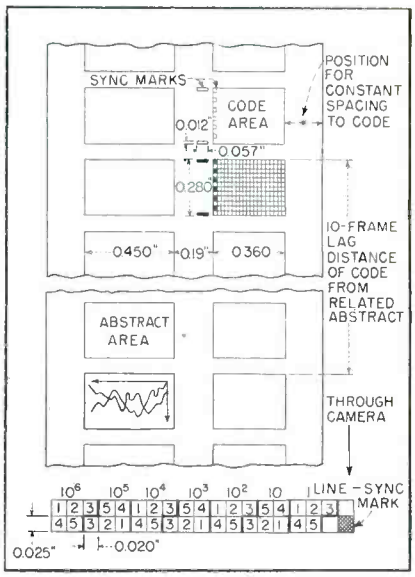

FIG. 1—Arrangement of abstract and code areas on master film, and method of assigning code numbers to squares to accommodate 10,000,000 different subjects

The hit detector operates in conjunction with the framing-mark detector. In order that the abstract may be properly framed, it is necessary that the flashtube and recopying camera be actuated by the uniformly-placed framing mark rather than the hit itself. Hence, the occurrence of a hit merely arms a storage system, which is subsequently triggered by the next succeeding framing mark to produce an actuating pulse.

Each phototube in the hit detector watches one-fourth of the projected code area, and must, therefore, distinguish between blackout and one to four basic light units. The original plan called for

hallmark of a specialist

You would expect the same care and workmanship that goes into all Crucible specialty steels to be found in Crucible Permanent Alnico Magnets. Over the years, users of Crucible Magnets have found that this is true — that from Crucible they get a better magnet with *higher gap flux per unit weight.*

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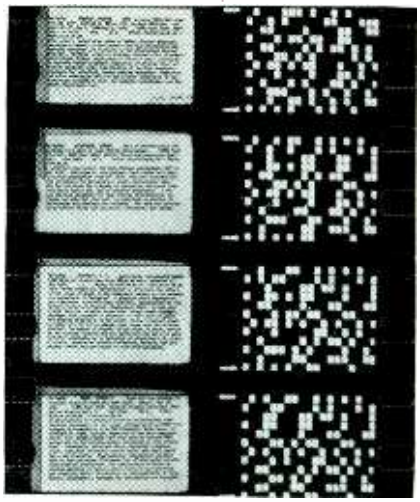


Sample of coded master 35-mm film. Wide dashes in middle are for frame sync, and first vertical row of squares to the right is for line sync to identify the horizontal rows to be paired in searching for a blackout. Each pair of rows is a subject code number, hence six pairs permit coding each abstract under up to six different subject headings

a single phototube for the whole area, but tests showed that the requirement of distinguishing between blackout and one to fifteen light units rendered unduly severe the problems of stray light, partial transmission of light through nominally black code areas, diffraction of light rays by dust particles on the lenses, and frequency limitations of the gas phototubes.

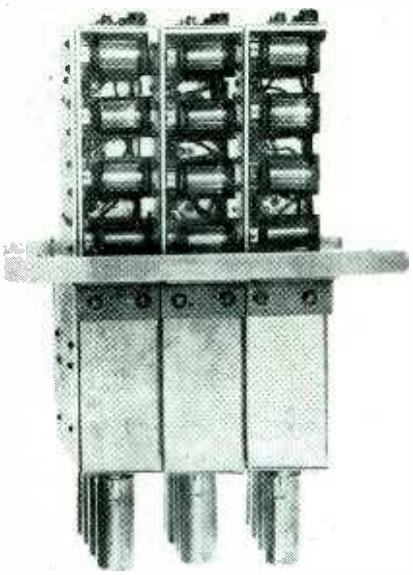
As finally constructed, each photoelectric circuit produces a signal of 3 to 4.5 volts for one unit of incident light. This swing is sufficient for direct interpretation of the blackout signal by means of clipping circuits, which produce outputs only when the signal is under 3 volts. The frequency response of the circuit is adequate for film speeds from 20 to 500 ft per min.

Anticipation of Hits

The two anticipatory hit detectors are identical to the main hit detector up to the point of interpretation and use of the blackout signals.

The interpretation circuits for the anticipatory hit detectors maintain a continuous watch on the time interval between consecutive hits. Whenever this time interval is less than the 1/30th of a second required for the recopying camera to

advance, a pulse is generated which commands an abrupt slowdown of the film drive from the normal speed of 300 feet per minute (180 frames per second) to a low speed of 50 feet per minute (30 frames per second). During the short interval in which low speed is maintained (about a second) and for a brief period thereafter, the critical time interval for slowdown is automatically increased somewhat, to avoid the possibility that two hits



Phototube assembly with cover removed. Center row of four type 921 gas phototubes reacts when code dots on interrogating card correspond to those for an abstract on the film. Other two rows of phototubes anticipate hits for either direction of film travel and slow down film whenever abstracts to be recopied are too close

which pass the anticipatory detector at a spacing slightly greater than 1/30th per second may, owing to acceleration of the film, arrive at the main hit detector with less than this required spacing.

A separate framing mark is displayed at each end of the code area. The one which is effective in any case is the mark nearest the trailing edge of the code area.

Amplidyne Drive System

The two film reels are separately driven by individual amplidyne-motor systems. The direction and speed of the drive and the tension in the film are maintained very precisely and flexibly by two speed-sensing generators and a tension-sensing rocker arm.

Each amplidyne is actuated by a

These Stackpole Specialties

SIMPLIFY DESIGN *and* CONSTRUCTION

TINY "GA" CAPACITORS

. . . that cost no more than "gimmicks"

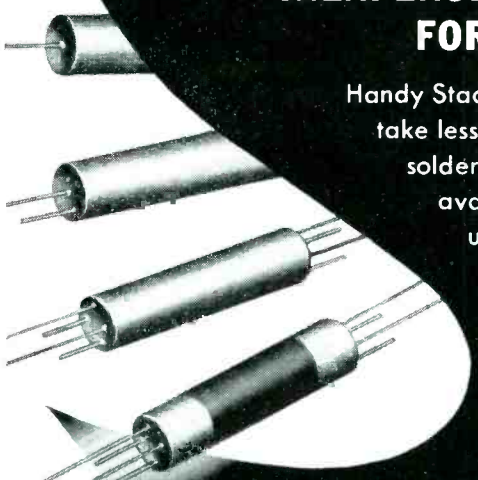
These sturdy little capacitors cost no more than flimsy, twisted wire "gimmicks," are non-inductive and assure greater stability, higher Q, better insulation resistance and higher breakdown voltage. Standard capacities include .5—.68—1.0—1.5—2.2—3.3 and 4.7mmfd. types.

WRITE FOR CATALOG RC7

Stackpole fixed and variable resistors—Iron cores for practically any need—Inexpensive line and slide switches.

INEXPENSIVE SUPPORTS FOR WINDINGS

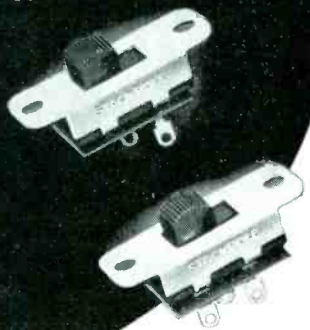
Handy Stackpole molded Bakelite coil forms take less space and require one-third fewer soldered connections. Standard forms are available for universal, solenoid, tapped universal and multiple windings. Molded iron center sections can also be provided.

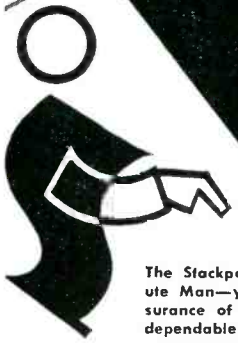


DEPENDABLE, LOW COST SLIDE SWITCHES

for 3 ampere, 125V. A. C. use

The new Stackpole Type SS-26 Switch is just the thing for electrical appliances and equipment of all sorts! Construction is exceptionally durable and the switches are readily adaptable to various mounting arrangements. Underwriters approved and conservatively rated for 3 amperes at 125 volts A.C. (or 1 ampere at 125 volts D.C.). Single-pole single-throw and single-pole double-throw types available.





The Stackpole Minute Man—your assurance of prompt, dependable service

STACKPOLE

Electronic Components Division

STACKPOLE CARBON COMPANY • ST. MARYS, PENNA.

d-c amplifier whose input represents the algebraic summation of the following signals: (1) An externally supplied reference voltage, which determines the speed of the drive by its magnitude and the direction of the drive by its polarity; (2) a voltage from the associated speed-sensing generator, which is belt-driven from an idler riding on the film to generate a voltage proportional to the film velocity; and (3) an error signal, derived from a potentiometer coupled to the spring-loaded tension rocker, which is proportional to the displacement of the rocker from its normal equilibrium position. The tension error signal is fed in opposite polarity to both amplidyne amplifiers, and constitutes the only link between the two reel drives to keep them in step and maintain constant film tension.

Reversal of the film direction calls simply for a reversal in polarity of the controlling reference voltage. The abrupt reduction in speed required for closely-spaced hits is achieved merely by a proportional sharp reduction in the reference voltage, under control of a relay operated from the anticipatory hit detector and its interpreting circuits.

Flashtube Circuit

Light for recopying selected items is supplied by the discharge of a 0.1-μf capacitor charged to 2,000 volts and discharged through a GE type FT-108 flashtube. Triggering is accomplished by a metallic yoke around one end of the glass envelope, coupled to the output of a high-voltage triggering transformer. The primary of the transformer is energized by a capacitor discharge through a low-voltage thyratron upon receipt of a command pulse from the main hit detector.

Recopying Film Drive

The high-speed film-advance mechanism of the recopying camera is based on a quick-acting dual electromagnetic clutch, the plate of which is keyed directly to the film-driving sprocket. The action of the control circuit transfers the clutch plate from a fixed clutch surface to a constant-speed rotating clutch surface for a sufficient time

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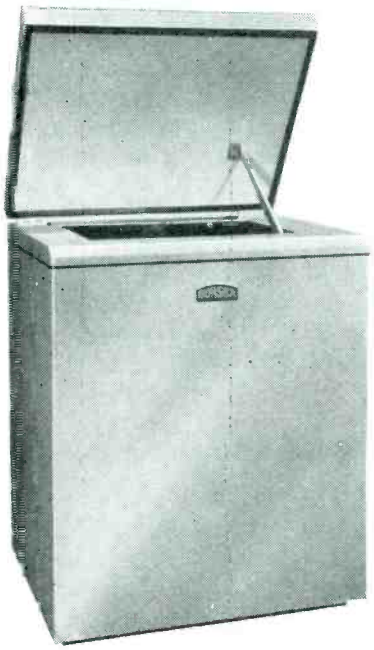

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5. **ALTITUDE — VACUUM UNITS** . . . for the user whose products or testing requirements are not affected by temperature or humidity, but who is primarily interested in noting the effect of varying atmospheric pressures. A typical application . . . testing and proving the advantages or limits of vacuum packaging, as well as standard aircraft testing.

BOWSER, INC. REFRIGERATION DIVISION — 420 LEXINGTON AVE., N. Y. C.

IN CANADA, S. F. BOWSER CO., LTD., 344 SHERMAN AVE., HAMILTON, ONTARIO

interval to produce a one-frame advance of the sprocket, after which the plate is returned to the fixed surface.

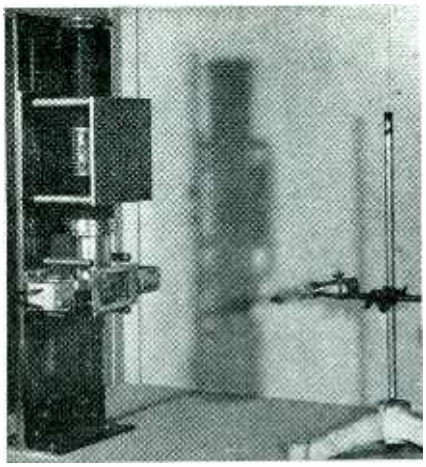
The control circuit automatically performs this function following receipt of a command pulse from the main hit detector. The basis of the circuit is a self-returning or one-shot multivibrator driving a pair of 6V6 output tubes in push-pull fashion. The two clutch coils are the plate loads for the output tubes. The multivibrator return time constant governs the active interval of the clutch and hence the amount of advance of the film.

The major difficulties encountered with electronic components thus far stem from electron tube variability. In particular, the type 921 phototubes were found to vary widely in sensitivity. A selection process is necessary in order to obtain a properly matched set, as about 78 percent of the tubes tested proved unsuitable. Serious difficulty was also encountered with the type 12AX7 tubes used as cathode-followers immediately following the phototubes; about 75 percent of the tubes which were received for this installation were so far short of the published emission and transconductance ratings as to be unusable.

The basic features of the machine are unpatented and in the public domain. Original drawings of mechanical details for the Selector are available for inspection at the Office of Technical Services in Washington. A report describing the Rapid Selector in detail and accompanied by illustrations (PB 97535, $2.50 per copy) is available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

Measurement of Intense Low-Voltage X-Rays

MEASUREMENT of intense x-rays generated by voltages below 50 kilovolts has always been a problem. In recent years the situation has become acute because of two tube developments, a contact therapy tube in which the ray-producing target is placed against the skin or even inserted into the body cavities, and a beryllium-window tube yield-



Experimental arrangement used at National Bureau of Standards to expose a nylon thimble chamber to x-rays from a beryllium-window x-ray tube mounted behind a solenoid shutter control which admits definite amounts of radiation to the thimble ionization chamber

ing 10,000 times the output of an ordinary x-ray tube. In the first of these, the radiation in the tissues is very intense near the target and it is therefore essential to accurately measure and control the dosage. The second type is used primarily for skin therapy, biological research, and for some industrial purposes where high output is useful.

Studies of the measuring problem by the National Bureau of Standards have had two principal directions: first, designing and constructing improved performance standards and, second, obtaining data to permit the approximate correction of standard dosage meter readings for very soft x-rays.

Ionization Chambers

The problem of devising a small free-air standard ionization chamber turned out to be not too difficult for radiation intensities up to 1,000 roentgens per minute. However, in the use of such a chamber, absorption of the very soft radiation between the diaphragming and measuring point may be very large and this loss must be known with an accuracy equal to that desired in the final measurement. A large series of such air absorption coefficients has been determined using a beryllium-window x-ray tube with voltages ranging from 10 to 200 kv in small increments. Since the coefficient of air absorption varies

rapidly with the wavelength distribution in the x-ray beam, the results are critically dependent upon the waveform of the voltage used to produce the x-rays. At the Bureau a constant-potential excitation has been used in order to obtain a describable radiation quality.

For radiation intensities above 1,000 roentgens per minute, the simple standard could not be used in the normal way. The principal problem was to measure all of the ions produced in the chamber. Because of the very high concentration of ions along the beam, a substantial fraction of the ions is lost by recombination. At the highest usable electric fields in the chamber (4,000 volts per cm) the losses range from 1 percent at 10,000 roentgens per minute to 10 percent at 300,000 r per min with a normal beam of about 8 mm diameter. Reducing the beam diameter to 0.5 mm permits 100 percent of the ions to be pulled away and measured at field strengths of only 500 volts per cm.

This nylon thimble chamber with a capacity of 250 roentgens is one form of ionization chamber used in the measurement of intense low-voltage x-rays. The wall of this chamber is made of nylon only 0.005 inch thick

A successful standard embodying this modification has now been constructed for calibrations in the range of 5 to 50 kv. Accurate calibrations have now been made with this standard, for all the commercially available dosage meters, even though the standard was not originally intended for use at such low energies. When properly calibrated, these ionization chambers can be used safely with soft radiations if the intensities are not too great and if the voltage waveform during calibration and subsequent use are the same.

Thimble Chambers

Inherent limitations of the thimble chambers have been discovered for the measurement of high-in-

tensity x-rays (above 1,000 r per min) in air. Most such chambers operate with an electrode potential ranging from 200 to 400 volts. This voltage is insufficient to pull all of the ions to the collecting electrode before some are lost by recombination. At an intensity of say 5,000 r per min the loss may be 5 percent while at 500,000 r per min it may be as much as 70 percent.

Since with present instruments there is no way of substantially increasing electrode potential, the Bureau has experimentally determined saturation curves for high radiation intensities, from which it is possible to obtain fair corrections for the loss of ions. Since this correction cannot be relied on in all situations met in practice, careful determinations have been made of the limitations and intensity range of such chambers. Although a thimble chamber has not been perfected for every use, it has been established clearly for the first time just when these chambers can be used safely.

Out of these NBS studies have come design principles leading to the possibility of a new type of small ionization chamber suitable for measuring the extremely high intensities yielded by the low-voltage beryllium-window tubes.

Television Receiver Focus Compensation

By Earl M. Underhill
Chief Engineer
Magnet Division
Crucible Steel Company of America
Harrison, N. J.

Most of the present day popular-sized television receiving sets employ magnetic type kinescopes with electromagnetic focussing. The focussing device consists ordinarily of a coil of wire carrying an adjustable value of direct current and mounted in a steel case which provides a fixed air gap in the proper position adjacent to the neck of the tube. More recently a focussing device which is a combination of a permanent-magnet and an electromagnet (the ratio of p-m flux to e-m flux varying between differ-

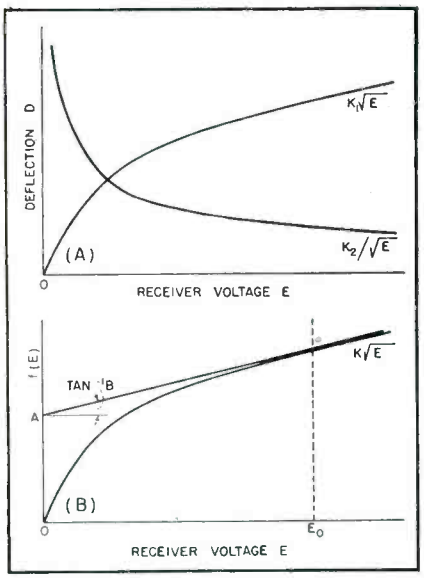


FIG. 1—Curves for determining the ratio of p-m to e-m magnetic field for combination focus compensation of television receivers

ent makes) has become popular. Some manufacturers are even considering a device employing only a permanent magnet with a steel sleeve and steel end plates, focus adjustment being attained by varying the length of the air gap between the sleeve and one end plate.

When choosing the proper type of focus device, many factors must be considered, among the more important of which are original cost, power consumption, heat dissipation and compensation for voltage variation. This latter item becomes most important when little or no voltage stabilization is provided by the set. Ordinary household voltages may easily vary plus or minus 10 percent, and a great deal less variation may cause either a very unpleasant picture or the necessity for frequent refocussing. Consequently, each type of focus device should be examined in the light of this requirement.

Analysis

Focus compensation is best analyzed by examining the deflection to which a single electron or a beam of electrons is subjected when passing through the focussing device under given conditions of field strength and accelerating voltage. If this deflection remains constant when the applied voltage to the receiver varies, the picture will remain in focus; if not, it will de-focus. It

may be readily demonstrated that

$$D = KH/\sqrt{E} \quad (1)$$

where D is the deflection of electron beam passing through the focus device and subject to action of field strength H and accelerating voltage E', H is the magnetic field strength produced by the focus device, E is the applied voltage to the receiver, and K is the constant of proportionality including that relating E to E'.

Field Strength

The field strength H produced by an electromagnetic focus device will be directly proportional to the direct current I flowing through its windings. This in turn (disregarding circuit nonlinearities) will be directly proportional to the applied voltage to the receiver, or $H = C_1E$. Hence, for this case $D = K_1\sqrt{E}$. This relation is shown by the appropriate curve of Fig. 1A.

The field strength H produced by a permanent-magnet focus device will be constant with respect to impressed voltage variations. For this case $D = K_2/\sqrt{E}$. This relation is also shown in Fig. 1A. Obviously, neither of these relations present a desirable condition and both will result in picture defocusing upon relatively slight variation in impressed voltage.

Combined Field Strength

The field strength H produced by a combination p-m and e-m unit will consist of the summation of two factors, one of which is constant with respect to E and the other of which varies directly with E, or,

$$H = A + BE \quad (2)$$

Referring to Eq. 1, for D to remain a constant the following relation must hold:

$$A + BE = C\sqrt{E} \quad (3)$$

Since A, B and C are constants, this equality is not maintained over all values of E; in fact, the equality exists at a maximum of only two values of E, one of which may be imaginary. The right-hand side of Eq. 3 is shown plotted in Fig. 1B. The left-hand side of Eq. 3 is the expression for a straight line of slope B and vertical ordinate intercept A. By proper choice of the constants A and B this line may be

placed anywhere on the graph that is desired. The closest approximation to the condition of Eq. 3 over a voltage range on either side of the mean impressed voltage E_o is attained by making the straight line $A + BE$ tangent to the curve $C\sqrt{E}$ at the point $[E_o, f(E_o)]$. This line is also shown in Fig. 1B.

Now, the mean value of field strength H_o produced by the combination p-m and e-m focus device with a mean value of impressed voltage E_o applied to the receiver is (from Eq. 2)

$$H_o = A + BE_o \qquad (4)$$

From Fig. 1B it is seen that B is equal to the slope of the curve $C\sqrt{E}$ at the point E_o.

$$\frac{d(C\sqrt{E})}{dE} = \frac{C}{2\sqrt{E}}$$

$$B = \frac{C}{2\sqrt{E_o}} \text{ and } BE_o = \frac{C\sqrt{E_o}}{2} \qquad (5)$$

Since the two curves of Fig. 1B intersect at the point E_o, this point is a solution of Eq. 3 and we may write

$$A + BE_o = C\sqrt{E_o} \qquad (6)$$

Substituting Eq. 5 into Eq. 6 we get

$$A = \frac{C\sqrt{E_o}}{2} = BE_o \qquad (7)$$

Referring back to Eq. 4, the above relation indicates that the best possible focus compensation with voltage variation is supplied by a combination p-m and e-m focus device so designed that the permanent magnet supplies 50 percent of the focussing magnetic field when nominal voltage is applied to the receiver.

Additional Uses for Rectifier Filter Chart

BY REUBEN LEE
Advisory Engineer
Westinghouse Electric Corp.
Baltimore, Md.

THE CHOKE-INPUT filter chart given in the Reference Sheet for this issue can be applied to swinging chokes, shunt-tuned chokes and two-stage filters by making certain corrections as set forth here.

Swinging Choke

If the choke in the filter swings to S times the full-load value in henrys, the regulation is improved

considerably without affecting the full-load ripple. The chart may still be used for this case with certain corrections. At least this is true for the single-phase full-wave rectifier, which is where the swinging choke is used most commonly. The swinging choke requires less bleeder current for a given number of henrys at full load, but capacitance C is not appreciably affected.

Since use of the chart starts with bleeder current, it is necessary to multiply the capacitance obtained from the chart by the ratio S, but to it must be added nearly the same percentage the chart gives in the curve of corrections for L.

The value of L obtained by projecting the bleeder current downwards is the maximum or swinging value. It must be divided by S to obtain the full-load value. Transient conditions may be approximated closely by using the full amount of capacitance in the filter and the full-load value of henrys in the choke. Peak ripple current is dependent on the full-load value of henrys and is therefore S times the bleeder current.

Shunt-tuned Choke

If the filter choke is paralleltuned to the fundamental ripple frequency, the ripple and regulation are less than they would be with an untuned choke. The inductance of the choke is held as constant as is practicable from bleeder load to full load, so that approximately the same ripple is obtained at all loads. With practicable tolerances on choke inductance and tuning capacitance, the choke impedance is effectively increased 3 to 1, hence $R_1 = (3X_L - X_C)/P_A$, and the ratio $(P_A/P_R$ is equal to $(3X_L - X_C)/X_C$. Combining gives $X_C = P_R R_1$, and the chart can be used directly for capacitance C. The values of inductance, however, must be divided by 3 in order to obtain the actual henrys in the choke. This lower value of henrys and the capacitance C across the load determine transient conditions as shown by the third quadrant of the chart. Peak ripple current is limited by tuning capacitance.

Two-Stage Filters

In a two-stage filter of the choke-input type, the most economical use

of material occurs when both stages of the filter are alike. The chart can be used for such filters if it is recognized that the ripple is that on the load side of the first choke. The ripple across the load is not twice this amount in negative db.

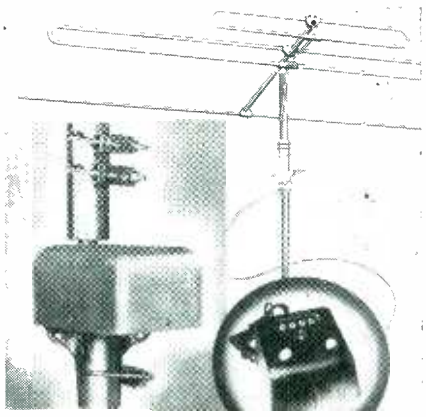
For example, if the filter consisted of two stages both equal to that in the example given in the Reference Sheet, the ripple would not be — 100 db, but some lower figure, because of the fact that the rectifier output is less than 100 percent ripple. In the case of the three-phase full-wave rectifier this is 4.2 percent rms, or —25 db on the usual ratio of hum to maximum signal. Hence the net hum across the load, if two sections like that in the example were used, would be — 50 db — 25 db = — 75 db. The following table gives the amount of ripple reduction which must be applied to each of the three kinds of rectifiers shown on the chart in order to arrive at the ripple across the load with a two-stage filter having like sections.

Type of Rectifier	db	rms
Single-Phase Full-Wave	3.5	0.47
Three-Phase Half-Wave	12	0.18
Three-Phase Full-Wave	25	0.04

Instead of subtracting db, the chart value in percent may be divided by that given in this table, for the second stage.

The regulation in a two-stage filter, as far as capacitance effect is concerned, depends upon the inductance of the first choke as in a single-stage filter. Therefore the chart applies directly to the inductance and capacitance of the first stage. The peak ripple current likewise depends upon the inductance of the first choke, regardless of the location of the bleeder resistor.

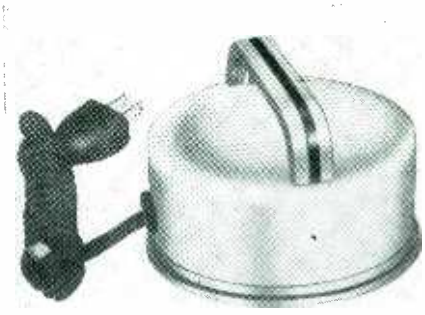
Transients are more complicated, due to the fact that the two stages interact under transient conditions. The various transient properties of voltage and current obtained from the chart apply approximately to a two-stage filter; that is, the L and C of one stage roughly determine them. Considerable refinement must be used to obtain more accurate answers.



antenna by lights on a remote control unit. It features 375-degree rotation in either direction at 1 rpm, positive electrical stop at the end of the rotation, cast aluminum frame that will take 150-pound load and up to 1½-inch diameter mast, and corrosion-resistant components. Power consumption is 20 watts.

Tape Eraser

AMPLIFIER CORP. OF AMERICA, 398-7 Broadway, New York 13, N. Y. The Magnerasor provides complete and instantaneous erasure of normal and overloaded signal from all types



of recorded tape, and lowers residual noise level as much as 3 to 6 db below that of unused tape. The unit operates on a line voltage of 100 to 130 volts, 25 to 60 cycles.

Three-Way Air Meter

ANEMOSTAT CORP. OF AMERICA, 10 E 39th St., New York 16, N. Y. The Anemotherm, a new three-way air meter, gives air velocity, air temperature and static pressure readings at the turn of a knob. It measures air velocity from 10 to 5,000 feet per minute; air temperature, from ± 30 to ± 155 F; static pressure from 0.05 to 10 positive

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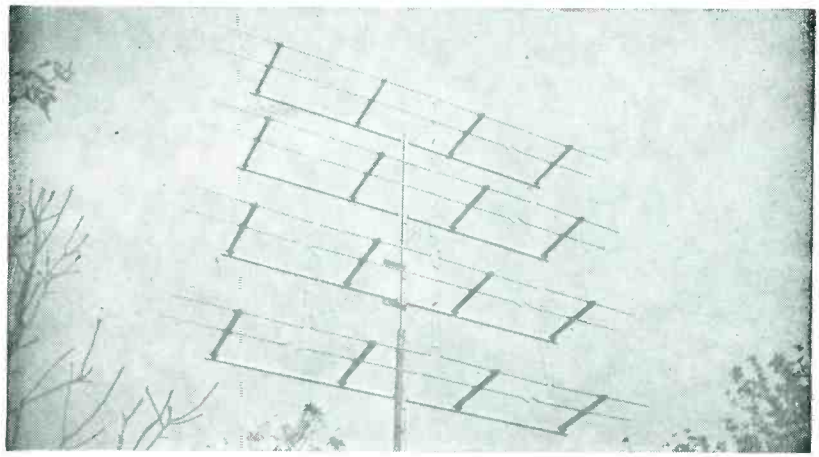

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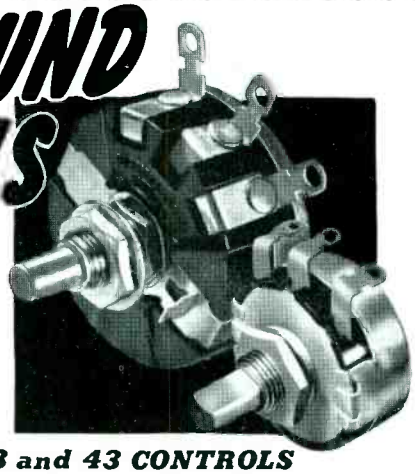

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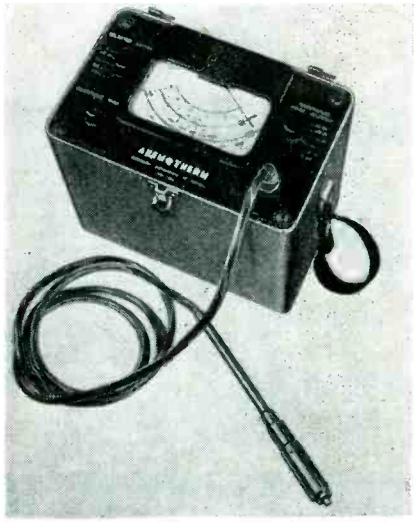


and 0.05 to 4 negative. The unit is useful for adjusting and testing equipment used for heating, ventilating and air conditioning.

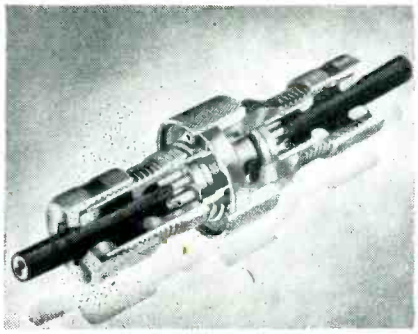
Subminiature Tubes

SYLVANIA ELECTRIC PRODUCTS INC., 500 Fifth Ave., New York 18, N. Y., announces four types of subminiature tubes for portable battery-operated radio receivers. The group includes a 1AD5 sharp cutoff r-f pentode; 1E8 pentagrid converter; 1T6 diode pentode; and 1AC5 output pentode. Filaments are rated

at 1.25 v and 40 ma d-c. Plate voltage ranges from 30 to 67.5 volts, and plate currents, from 0.30 ma to 2.0 ma.

Waterproof Electrical Coupling

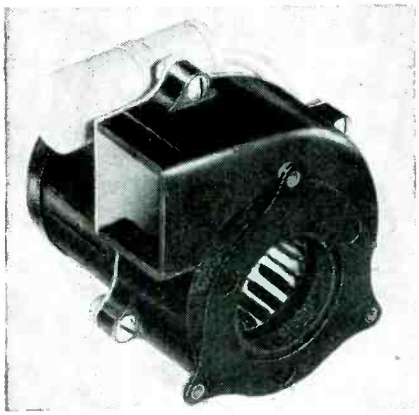
ROYLYN INC., 718 West Wilson Ave., Glendale 3, Calif. The 1600 Series is a quick-disconnect electrical coupling for all-weather and submarine applications. The coup-



lings are provided either with pressure-tight cable seals or are threaded for attachment to conduit, bulkheads or panels. Series 1600 has wide applications including the electronics field, geophysical uses, and telephone and coaxial cables.

Small Centrifugal Blower

FAIRCHILD CAMERA AND INSTRUMENT CORP., 88-06 Van Wyck Blvd.,



Jamaica 1, N. Y. Model 805J is a small centrifugal blower designed for electronic tube cooling and for ventilating small enclosed areas. Performance data are as follows: voltage, 115, 60-cycles a-c; current, 0.150 amp; speed, 3,599 rpm; input, 15 watts, power factor, 85 percent; capacitor required, 0.5 μf, 300 volts a-c. Weight is 24 ounces.

Gamma Detector Tube

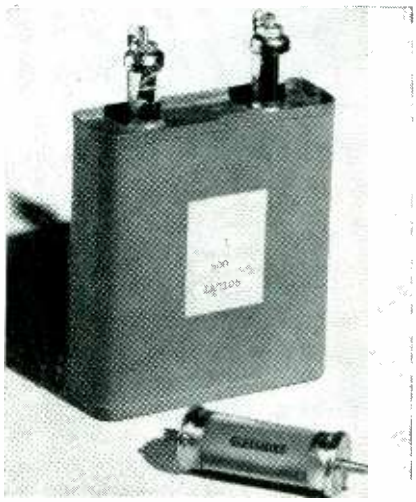
SYLVANIA ELECTRIC PRODUCTS INC., 500 Fifth Ave., New York 18, N. Y. The new GG306 gamma-ray detection tube's compactness and high sensitivity make it suitable for use by the medical profession. Chief features are as follows:

It is self quenching; operates at 960 volts; has an average Geiger threshold of 900 volts; provides

810 counts per minute from 5 micrograms of radium filtered through ⅛ in. of lead 12 inches from the end; has a maximum recovery time of 800 microseconds; a maximum dead time of 100 microseconds; is suitable for an input circuit impedance of 5 megohms; and has an ambient temperature rating of +40 to −70 C.

Lab Capacitors

CONDENSER PRODUCTS CO., 1375 North Branch St., Chicago 22, Ill. Laboratory-grade capacitors have lower dielectric absorption, low dissipation factor, constant Q and capacitance, high insulation resistance and negative temperature co-



efficient. Typical uses are in electronic computers, differential analyzers and bridge standards. A complete data sheet may be had by a request on company letterhead.

Miniature Terminals

CHICAGO TRANSFORMER DIVISION, ESSEX WIRE CORP., 3501 W. Addison St., Chicago 18, Ill. Now available is a new miniature terminal construction for use in hermetically sealing transformers to meet JAN-T-27

and other stringent specifications. Shown in the illustration are ten terminals mounted in a 1¾-in. case cover. They can be used with transformer designs requiring high potential tests of up to 1,000 volts.

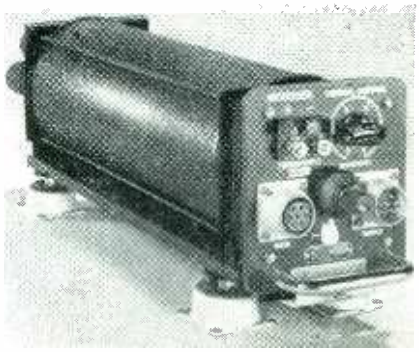
Speed-Controlled D-C Motor

BENDIX AVIATION CORP., Red Bank, N. J., recently introduced a new speed-controlled d-c motor designed for special airborne recording equipment. The continuous duty motor has an input of 28 volts d-c

and is rated at 0.018 horsepower. Normal speed is 3,600 rpm. Performance curves and other technical data will be furnished on request.

Control Amplifier

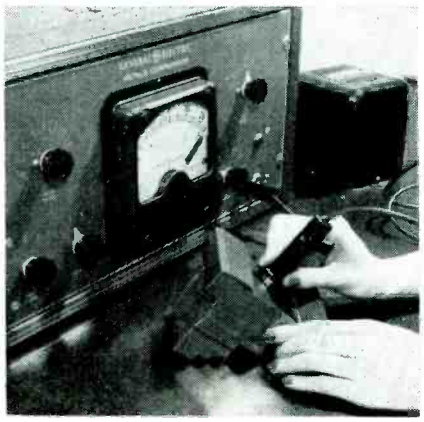
MANNING, MAXWELL & MOORE, INC., 11 Elias St., Bridgeport 2, Conn. Type 141 Microsen control amplifier



is specifically designed to meet stringent aircraft ambient conditions. It includes a highly sensitive electromechanical d-c amplifier as an input circuit and a power output stage to drive a two-phase 400-cycle servo motor.

Comparator Test Head

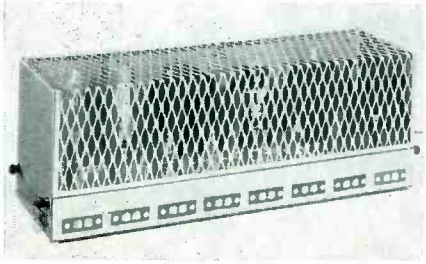
GENERAL ELECTRIC Co., Schenectady 5, N. Y. Designed particularly for use on large specimens such as forgings, machine tool beds, and other parts which cannot be inserted in the test coil, the new test head has greatly extended the usefulness of the metals comparator. The contact face consists of a



ring separated from a concentric core by an air gap, thereby forming a radial magnetic path across which the test piece is placed. Three inches long, it can be supplied in various face diameters depending upon the application.

Tele Distributing System

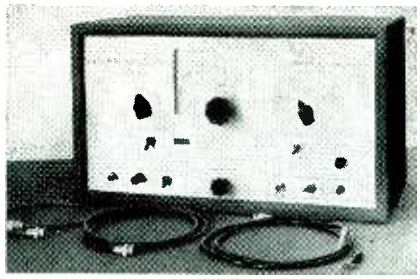
ELECTRO ENGINEERING & MFG. Co., 627 West Alexandrine, Detroit 1, Mich. The TVD-8 television distribution system operates up to 8 receivers from one antenna. It is used for dealer showrooms and is also useful in small apartment houses and wherever a good antenna can be installed in a location



providing 5,000 to 10,000-μv signal strength. The unit uses eight 6J6 tubes in a circuit arranged to provide balanced 300-ohm input and output facilities, and operates from a 115-volt 60-cycle supply line.

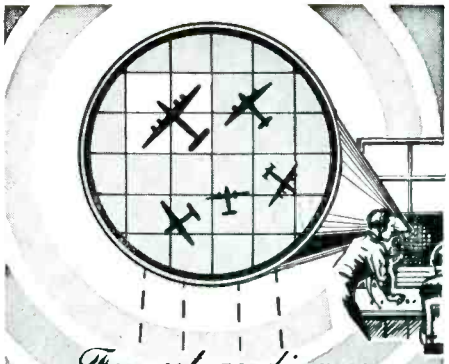
TV Marker Generator

GENERAL ELECTRIC CO., Syracuse, N. Y. Type ST-5A marker generator is designed for television maintenance and development work where an accurate source of markers is required to mark specific frequency allocations on a tuned circuit response curve when presented on an oscilloscope. From one to five markers may be used simultaneously, at the same time permitting complete freedom of the positioning of markers in the 20 to 50-mc range.



Television Transformers

MERIT COIL & TRANSFORMER CORP., 4427 N. Clark St., Chicago 40, Ill. The Mounting J blocking oscillator television replacement transformers are used in types A-4000 vertical and A-4002 horizontal. Turns ratio for the former primary to secondary is 1 to 4.2; for the latter, 2 to 1. Other specifications for both are:



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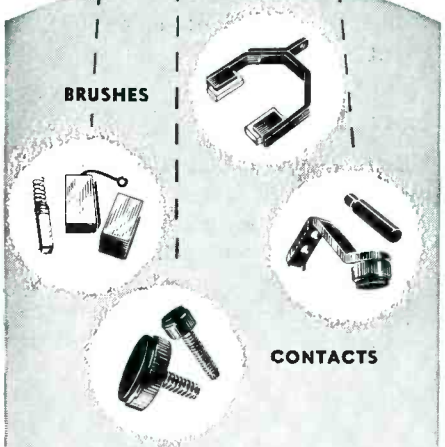

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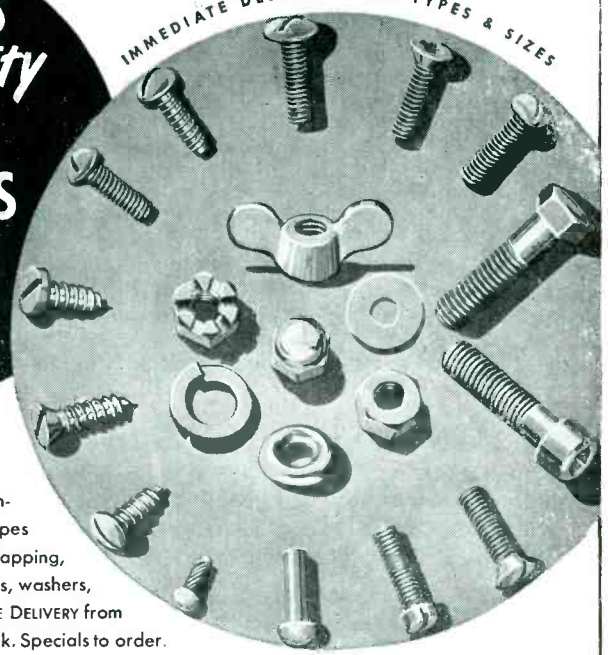

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MANUFACTURERS SINCE 1929

ALLMETAL Screw Products Co., Inc.

33 GREENE STREET, NEW YORK 13, N. Y.

mounting center, 1 15/16 in.; height, 1¾ in.; width 2 5/16 in.; depth, 1½ in.

Proportional Counter

NUCLEAR MEASUREMENTS CORP., 3339 Central Ave., Indianapolis 5, Indiana. Model PC-1 Alpha-Beta-Gamma proportional counter is designed for biological tracers, chemical assay and industrial sampling. It features a built-in automatic timer adjustable up to 56 minutes.

The alpha plateau extends from about 1,100 to 1,400 v, and the beta plateau from about 1,700 to 2,000 v. Tilt of either is less than 2.0 percent per 100 v average. Sample table will accommodate 1½-in. diameter samples up to 3/16 in. thick. A scale of 512 with a resettable 6-digit counter counts up to 500,000 counts per minute.

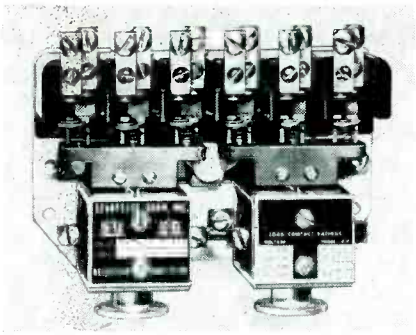
Core Solder

KESTER SOLDER CO., 4201 Wrightwood Ave., Chicago 39, Ill., announces the Resin-Five core solder. Non-corrosive and non-conductive, it is used to solder such metals as zinc, brass, nickel-plate, copper and ferrous alloys. It is supplied in

the usual diameters of 0.092 and 0.062 inch on 1, 5 and 20-pound spools.

Reversing Contactor

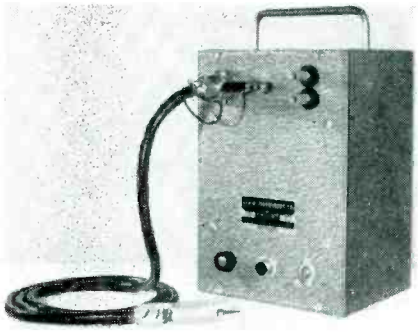
STRUTHERS-DUNN, INC., 150 N. 13th St., Philadelphia 7, Pa. Type



175KXX contactor comprises two 3-pole solenoids for forward and reverse operation mounted on a common frame and mechanically interlocked to prevent simultaneous closure. Designed particularly for service in the control of single horsepower motors, the use of the contactor is completely described in bulletin 7100.

A-F Bridging Unit

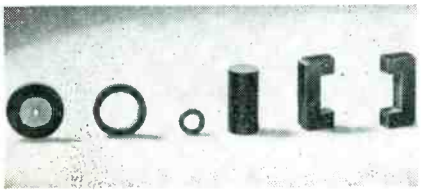
AUDIO INSTRUMENT CO., 1947 Broadway, New York 23, N. Y. Model 100 Bridger provides means for bridging a vtvm, distortion meter or oscilloscope across any part of an audio-frequency circuit through a well-shielded cable, yet



without imposing any of the load of the meters or cable on the circuit. Input impedance is 100 megohms in parallel with 6$\mu\mu$f when using 3-ft shielded input cable. Output impedance is 200 ohms with one side grounded.

Lightweight Magnetic Cores

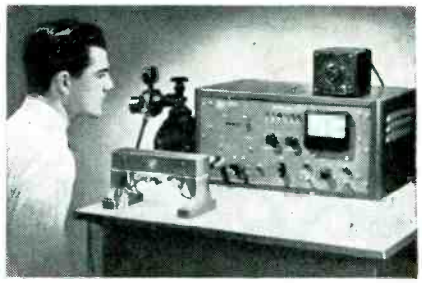
GENERAL CERAMICS & STEATITE CORP., Keasbey, N. J. Ferramics,



a nonmetallic substance possessing ferromagnetic properties, is extremely light in weight and is said to out-perform powdered iron, volume for volume, in core applications. The material is of uniform structure and will not decompose at elevated temperatures. Readers are invited to request bulletin No. 1.

Scaling Unit

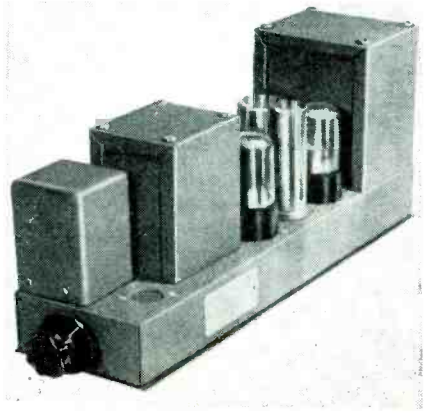
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223–233 W. Erie St., Chicago 10, Ill. Model L-163 Radioisotope Analyst is especially designed for the analysis of radioactivity. It includes a complete automatic scaler plus the Q-Gas counter. Designed



for precise work, with low-activity, low energy samples, the unit is suited for medical, chemical and physical research work.

High-Fidelity Amplifiers

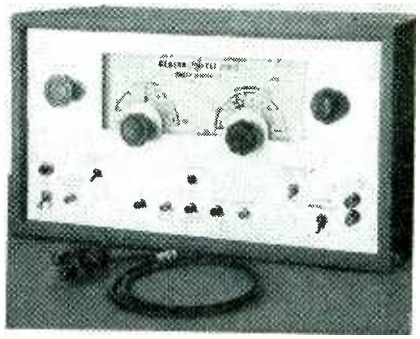
AUDIO DEVELOPMENT CO., 2833-13th Ave. South, Minneapolis, Minn. Type 71 high-fidelity amplifiers are designed for use by broadcasting studios and installations where bridging or line inputs are required. Power output is 8 watts with nominal distortion of not more than 2 percent at any frequency between 50 and 12,000 cps. Response is flat within 0.5 db over the same range. Hum level is over



78 db below full output. Gain control range is 38 db for bridging or 50 db for line applications.

Sweep Generator

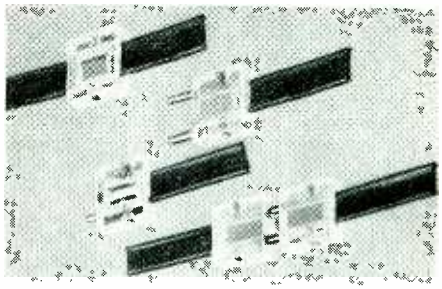
GENERAL ELECTRIC Co., Syracuse, N. Y. Type ST-4A electronic sweep generator uses a variable permeability type sweep and has no moving components. Frequency is continuously variable from 4 to 110 mc



and from 170 to 220 mc with a linear sweep width of from 500 kc to greater than 15 mc. High output voltage is available over the entire range.

Twin-Line Connectors

PRODUCTS ENGINEERING Co., 4753 North Broadway, Chicago 40, Ill. The twin-line connectors illustrated are small, polystyrene blocks drilled



to hold stripped ribbon leads, with a small set screw to maintain contacts. They accommodate standard 300-ohm line and require no splicing, soldering or taping.

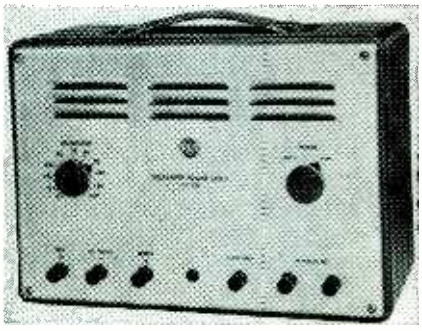
Power Converter

THE RADIART CORP., 3571 W. 62nd St., Cleveland, Ohio, announces a new Vipower line for d-c to a-c power conversion, available to furnish 110-volt, 60-cycle a-c current from 6, 12, 32 or 110-volt d-c sources. Various models will handle power requirements ranging from

50 to 350 watts. A variable frequency vibrator control allows for setting frequency to prevent wave-like picture distortion in tv set reception.

D-C Power Supply

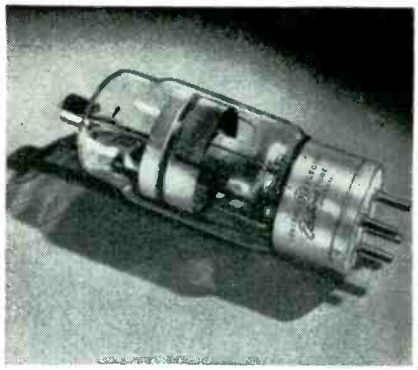
RADIO CORP. OF AMERICA, Camden, N. J. The WP-23A regulated power supply furnishes a d-c voltage continuously adjustable from 0 to 300 volts and virtually constant. The unit delivers 60 ma over an output voltage range from 0 to 60 volts; 80



ma from 60 to 120 volts; and 120 ma from 120 to 300 volts. Regulation is better than 1 percent from no load to full load above 30 volts output. Ripple voltage is less than 8 rms millivolts. An auxiliary unregulated output of 5 amp at 6.3 v is also available.

Industrial Thyratron

GENERAL ELECTRIC Co., Schenectady, N. Y. A new thyratron tube for industrial applications, type GL-5544, requires no snubber circuit for most motor control applications. Filament voltage is 2.5 v; current, 12 amp; peak anode voltage forward



and inverse is 1,500 v; peak cathode current, 40 amp; average cathode current, 3.2 amp; current averaging time, 15 seconds; ambient temperature range, minus 55 to plus 70 C.

Test Oscilloscope

ELECTRONIC INSTRUMENT CO., INC., 276 Newport St., Brooklyn 12, N. Y. Model 400, a new 5-inch oscilloscope, is available both as a kit and a fully wired and tested instrument. Designed for a-m, f-m and tv work,

it has a horizontal sweep circuit of 15 to 30,000 cps. Frequency response of horizontal and vertical amplifiers is 50 cycles to 50 kc. It has an input impedance of 1 megohm and 50 μμf, and a deflection sensitivity of 0.30 volt per inch full gain.

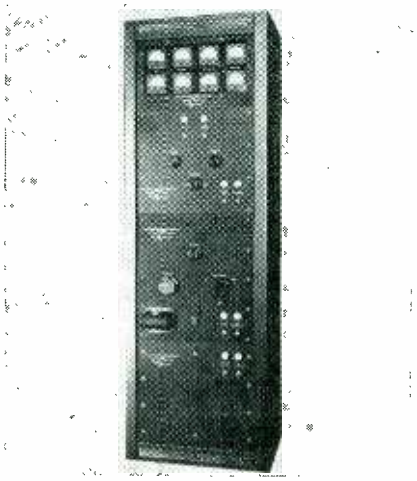
Fixed Resistors

STACKPOLE CARBON CO., St. Mary's, Pa. New 2-watt molded carbon composition resistors are available in a complete range from 10 to 100,000 ohms and in standard tolerances of ± 5, 10, or 20 percent as required. Designed to meet JAN specifications they are fully in-

sulated and highly moisture resistant. The new resistors are 11/16 in. long by 0.312 in. in diameter.

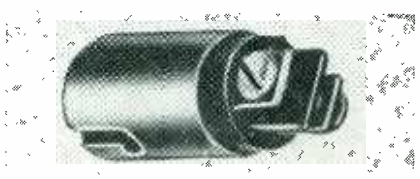
Klystron Power Supply

FURST ELECTRONICS, 12 S. Jefferson St., Chicago 6, Ill. Model 910 klystron power supply delivers all voltages and currents for the operation of a high-power klystron. It consists essentially of a beam supply, reflector supply, control electrode supply and filament supply. The first three units, delivering d-c power, are well regulated; the fourth, delivering a-c power, is not regulated.



Pilot Lamp Socket

COLE-HERSEE CO., 20 Old Colony Ave., Boston 27, Mass., are now manufacturing sockets for the new GE 10-watt 115-volt double contact bayonet base pilot lamp. The new lamp, type 10C7DC replaces the type 7C7 and the 10C7 candelabra screw base lamps.



H-F Millivolt Meter

MILLIVAC INSTRUMENTS, P. O. Box 3027, New Haven, Conn. The MV-18A vtvm, applicable for tv, f-m and radar, measures r-f voltages down to a single millivolt from 1 to

200 mc flat within 10 percent. The unit can also be used with a calibration chart for frequencies as high as 2,500 mc, with 10 mv being the lowest readable voltage.

Literature

Tube Price Sheet. Eitel-McCullough, Inc., San Bruno, Calif., has issued a new sheet for catalog insertion giving technical data, drawings and prices on a line of transmitting tubes, rectifiers, vacuum capacitors, heat-dissipating connectors, diffusion pumps, air-system sockets and vacuum switches.

Transmitter Mica Capacitors. Cornell Dubilier Electric Corp., South Plainfield, N. J. A single-sheet bulletin covers the Faradon NF transmitting mica capacitors with universal mounting. Rating, dimensions, outstanding features, description and uses are outlined.

Aluminum Cable Manual. Reynolds Metals Co., Customers Service Dept., 2500 So. Third St., Louisville 1, Ky. The new manual on steel-reinforced aluminum cable includes full technical data, a comprehensive collection of sag-tension charts, staking tables and stringing-sag tables, with explanatory material on line design and line erection. Formal requests for the manual will be filled.

Transformer Catalogs. Chicago Transformer Division, Essex Wire Corp., 3501 W. Addison St., Chicago 18, Ill. A revised and expanded catalog of new equipment

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- Cotton-Interwoven
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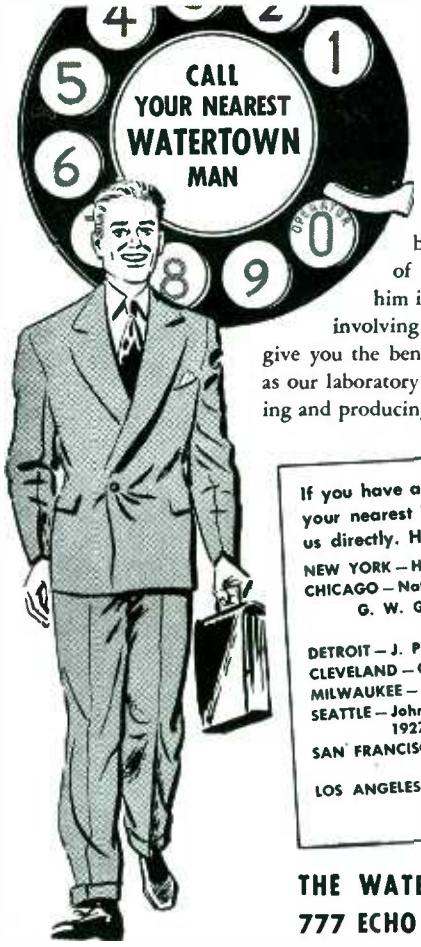

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MILWAUKEE — Roger L. Miller, 729 N. Broadway
SEATTLE — John W. Witherow, National Vulcanized Fibre Co. 1927 First Ave., South
SAN FRANCISCO — G. W. Harmssen, National Vulcanized Fibre Co. 273 Seventh Ave.
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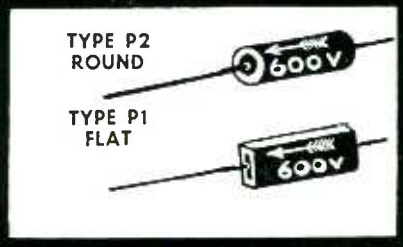

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200 MC BAND WIDTH AMPLIFIERS

MODEL 202 WIDE BAND CHAIN AMPLIFIER

Band width — 100 KC to 200 MC. Gain — 20 db. Response — ± 1.5 db. Impedance — 200 ohms. Standing wave ratio — Less than 1.5 db.

By employing a traveling wave circuit — a new principle of amplification — the SKL Model 202 Wide-Band Chain Amplifier achieves a very wide bandwidth at a low impedance. Two stages of six 6AK5 tubes are coupled into two delay lines of 200 ohms impedance thus making possible use of existing coaxial cables. The flat transmission characteristic makes the Model 202 ideally suited for use as a pre-amplifier for signal generators, vacuum tube voltmeters, sweep generators, mercury and crystal delay lines. Its extremely fast rise time makes this unique amplifier invaluable in oscillography, nuclear instrumentation and television testing.

Makers of: Wide-Band Chain Amplifiers, Temperature Controls, Variable Electronic Filters

SKL SPENCER-KENNEDY LABORATORIES, INC.
187 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.

transformers has 16 pages of tables and illustrations presenting a complete line of audio and power transformers and reactors. Also available is a four-page illustrated folder covering a catalog line of hermetically sealed transformers.

Air Meter. Anemostat Corp., of America, 10 E. 39th St., New York 16, N. Y. Bulletin 25A tells how the Anemotherm air meter measures air velocity, air temperature and static pressure. Included are illustrations of the instrument in operation for each of its functions.

Insulation Measurement. Associated Research, Inc., 3758 West Belmont Ave., Chicago 18, Ill. Bulletin 209 covers the Vibrotest, an insulation and resistance measuring instrument. Specifications of all models from 100 to 50,000 megohms are listed. Also shown are the advantages of a self-contained power unit eliminating hand cranking.

Apparatus Notes. Andrew Technical Service, 4747 N. Damen Ave., Chicago 25, Ill. Bulletin 504 of the Apparatus Notes series is devoted to stop watches, interval timers, circuit control timers and chronographs. Bulletin 515 deals with a variety of technical device including temperature recorders, immersion heaters and manometers. Prices of all instruments are included.

Sweep Signal Generator. The Triplett Electrical Instrument Co., Bluffton, Ohio, recently issued a catalog sheet on the model 3434 television and f-m sweep signal generator with built-in markers. Illustration, general description and frequency coverage are given.

Mobile Communication Equipment. Radio Corp. of America, Camden, N. J. Form 2J4628 is an 8-page folder giving an illustrated description of the Carfone which features "31 Circuit" selectivity for interference-free operation in the 152 to 174-mc f-m band. Complete specifications are listed.

Low-Frequency Oscilloscopes. Smith & Stone Ltd., Georgetown,

Ontario, has available a brochure giving a detailed technical description of models L-22 and L-24 low-frequency oscilloscopes which are especially designed for the precise study of transient or recurring phenomena from O to 200 cps.

Broadcast • Engineers Manual. Hewlett-Packard Co., Palo Alto, Calif., is offering free on request to all radio station chief engineers a 37-page manual to aid broadcast engineers in making FCC-required station performance measurements. The manual states each requirement for both a-m and f-m broadcasters, lists equipment needed to make appropriate measurements, and gives in detail proper procedures for measuring, recording, tabulating and presenting the required data.

Battery Eliminator. Raytheon Mfg. Co., Waltham 54, Mass., has published a brochure including illustrations, diagrams, schematics and full specifications of the new Rectifilter, the battery eliminator that has no moving parts, requires no adjustments and practically no maintenance.

Selenium Rectifiers. Standard Arcturus Corp., 54 Clark St., Newark 4, N. J. Three recent bulletins describe and illustrate a variety of selenium rectifiers for all electronic and industrial applications. Voltage regulation curves and specifications for half-wave strip, half-wave stack and power rectifiers are given.

Broadcast Equipment. Radio Corp. of America, Camden, N. J. Five new brochures describe the latest broadcast station equipment. Form 2J-4864 deals with broadcast microphones and accessories; Form 2J-4910, magnetic tape recorders; 2J-4784, professional recorder; 2J-4770, portable remote amplifier; and 2J-4771, Duo-cone monitoring loudspeaker. Also available are catalog sheets on a studio consolette, tone generator and field intensity meter.

Radio Timers. Telechron Inc., 285 Union St., Ashland, Mass. A recent bulletin includes illustrations, dimensional drawings, and

descriptions of four types of radio timers: the Station Preselector, the Sleep Switch, the Radio Alarm Clock and the Auto-On. The bulletin also carries an account of a free engineering service for radio engineers and manufacturers.

Electrical Contact Metals. Fansteel Metallurgical Corp., North Chicago, Ill. Technical data bulletin 7.101 is a 12-page booklet dealing with Fastells, a group of materials made from metal powders for use as electrical contacts. Information and data of basic importance to design and production departments, as well as explanatory illustrations, are included.

Image Orthicon Data. Radio Corp. of America, Harrison, N. J. Three 12-page booklets of television camera tube data are available. They cover the 5655, for applications with artificial illumination; the 2P23, for outdoor pickup; and the 5769, for outdoor and studio pickup.

Solder Manual. Kester Solder Co., 4204 Wrightwood Ave., Chicago 39, Ill. A comprehensive reference book now available on request is Solder and Soldering Technique. It gives a complete analysis of the properties of soft solder alloys and soldering fluxes.

Magnetic Materials. The Arnold Engineering Co., 147 E. Ontario St., Chicago 11, Ill. Issue No. 1 of the Magneteer gives 8 pages of technical information on Remalloy. Future issues will be concerned with the fabrication, utilization and application of magnetic materials.

Miniature Power Pentode. Tung-Sol Lamp Works Inc., 95 Eighth Ave., Newark 4, N. J. Electron tube bulletin No. 1 is a catalog sheet describing the new tube type 5A6, a miniature power pentode intended for use as a Class C power amplifier or oscillator. Filament voltage rating, power output and tube dimensions are given.

Decoder Chart. Aerovox Corp., 740 Belleville Ave., New Bedford,

Mass., has issued the Duranite decoder chart printed in colors and showing the RMA color band coding for molded tubular paper capacitors, with corresponding numerical values of capacitance, tolerance and voltage. It enables the reader to match colors and read exact values.

Thermostatic Bimetal. The H. A. Wilson Co., 105 Chestnut St., Newark 5, N. J., has available a 4-page pamphlet on the thermostatic bimetal known as Thermometal R-16. The material described was developed primarily for application in high-capacity circuit breakers and similar devices where low electrical resistance is required.

Television Film Projector. Radio Corp. of America, Department 522, Camden, N. J. An eight-page descriptive brochure (Form 2J-4685) provides comprehensive information on the 35-mm television projector. The publication is well illustrated and gives complete operating data, suggested studio layout and simplified line drawings.

Printed Circuits. Haas Bros., 75 West St., New York 6, N. Y. A 6-page reprint covers the practice of printed circuits. Also available is bulletin No. 1 which is descriptive of the Elargol process, developed in England during the war, for the mass production of printed circuits on chassis. With the process described it is possible to print on both sides of the chassis, the only requirement being a black and white drawing of the type of circuit desired.

Camera and Recording Equipment. J. A. Maurer, Inc., 37-01 Thirty-first St., Long Island City 1, N. Y. A 27-page cardboard-covered booklet with spiral-type binding thoroughly describes a 16-mm motion picture camera, sound-on-film recording system and film phonograph. The booklet is profusely illustrated.

A-C Generators. Kato Engineering Co., 1415 First Ave., Mankato,

Minn., recently issued literature on a-c generators with speeds from 720 to 1800 rpm. Bulletin 3149 describes those ranging from 5 to 175 kw at 60 cycles; and bulletin 21749, those in the 150 to 300-kw range.

Voltage Regulators. Union Electric Products Co., Inc., 24 Edison Pl., Newark 2, N. J. A single catalog sheet describes and gives illustrations and ratings for a line of step-down auto transformers and voltage regulators. Inquiries are invited for voltages and ratings not listed.

Electrical Insulation. Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6, Ill. Available widths and thicknesses for four types of woven glass tapes are shown in a one-sheet bulletin. The tapes described are designed to provide better insulated and longer lasting electrical products.

Liquid Level Gage. The Vapor Recovery Systems Co., P. O. Box 231, Compton, Calif. An illustrated account of the Electronic Gauger, a remote-reading liquid level gage, is given in a recent 8-page folder. With the instrument described it is possible to gage tanks accurately to within ± 1/8 inch of tank level on a centrally located panel.

Portable Geiger Counter. Nuclear Instrument & Chemical Corp., 223-233 West Erie St., Chicago 10, Ill., has issued a bulletin describing the Sniffer, a two pound Geiger counter which is powered by two flashlight batteries. Chief features and method of operation are outlined.

Electric Control Devices. Ward Leonard, Electric Co., 31 South St., Mount Vernon, N. Y. Bulletin No. 100,000 describes and illustrates a complete line of electric control devices for industrial and commercial control applications. Devices covered are rheostats, resistors, relays, motor starters, contactors, control accessories and dimmers.

library of standard operations is also being accumulated.

IRE-AIEE Nucleonics Symposium

ELECTRONIC instrumentation in nucleonics and medicine will be the subject of a conference at the Hotel Commodore, New York, on October 31, November 1 and 2. This is the second annual conference on the subject to be sponsored jointly by the IRE and AIEE.

The conference program will be similar to the one held last year in that the first day will be devoted to electronics in medicine, the second day to nucleonics in medicine, and the third day to the physical aspects of nucleonics instrumentation.

Some of the topics to be discussed are: audible interpretation of electroencephalograph; high - fidelity electrocardiography; electrical methods of blood-pressure recording; stable d-c amplifiers for biological recordings; design of c-r oscillograph; medical applications of ionizing radiation; dosage measurements of ionizing radiation; scintillation counters; measurements of low-energy beta-ray emitters; criteria in the selection of radioisotopes for industrial use; and desirable improvements in nuclear instruments.

Electronics Attracts Vets

MORE than 136,000 World War II veterans are studying radio and television in schools and colleges under the G. I. Bill and Public Law 16. This figure was recently disclosed in a Veterans Administration Study as of Dec. 1, 1948.

Of the above number, 55,761 were studying electrical engineering—including radio engineering—in colleges and universities under the G. I. Bill; 2,944 were training to become electrical engineers under Public Law 16; and 76,920 were taking courses in radio and television in trade and vocational schools under the G. I. Bill. Of the 76,920 students, 51,236 were training as radio and television mechanics, 1,856 as radio operators, 195 as ship radio operators, 151 as air-

craft radio operators and 23,482 were taking other courses in radio and communications. An additional 335 veterans were taking on-the-job training under the G. I. Bill, 125 as radio operators and 210 as workers in the field of radio and phonograph manufacturing.

Eligibility for G. I. Bill training consists of (1) active military service some time between Sept. 16, 1940 and July 25, 1947; (2) service of at least 90 days, or a discharge for a service-connected disability if released before 90 days service; and (3) a discharge under conditions other than dishonorable.

For Public Law 16, requirements are (1) military service between and 1940 and 1947 dates; (2) a discharge other than dishonorable; (3) a compensable service-connected disability; and (4) V.A's determination that training is necessary to overcome a handicap.

Railroad Radio Progress

SYSTEM-WIDE railroad radio communication was recently demonstrated by the Chicago, South Shore and South Bend R. R. The primary purpose in covering the entire 77-mile operating area between Kensington, Ill., and South Bend, Ind., was to facilitate service and maintenance operations along the road and to provide instant communication with any of the railroad's mobile units in case of emergency.

The vhf system demonstrated was planned and developed by the South Shore engineering department in cooperation with the Bendix Radio Division of Bendix Aviation Corp. It solved the problem of greater coverage by installing remotely-controlled, unattended relay stations. The relay stations, strategically located so that their service areas overlap, receive and transmit messages automatically. Two separate frequencies provide dual-channel operation.

The central operating office and mobile units can communicate with each other without the use of relay stations within a 15 to 20 mile radius. Mobile units up to 30 miles apart can communicate through the relay stations. For greater distances communication betwen mo-

bile units can be manually relayed by the dispatcher situated at the line's half-way mark.

BUSINESS NEWS

LENKURT ELECTRIC CO., San Carlos, Calif., has incorporated a subsidiary company with its plant at Vancouver, B. C., to be known as Lenkurt Electric Co. of Canada, Ltd.

AMERICAN TELEVISION INC., Chicago, Ill., manufacturers of cathode-ray tubes, recently began the manufacture of direct-view television receivers.

BATTELLE INSTITUTE, Columbus, Ohio, recently completed a new laboratory area and enlarged its electrical engineering staff to provide adequate facilities for companies not equipped to conduct research on complex electrical engineering problems.

ATWATER TELEVISION CO., has moved to new and larger quarters at 360 Furman St., Brooklyn, N. Y., to increase production of large-screen television sets.

RADIO STATION KUSN, an independent a-m and f-m station in San Diego, Calif., recently purchased KYOR and has switched to the latter's frequency of 1,130 kc as well as its construction permit for day and night operations at 5,000 watts. KUSN also has applied for a change of call letters to KSDO.

ISOLANTITE MFG. CORP. has moved from Lyndhurst, N. J., to its new plant in Stirling, N. J., enlarging its production capacity for steatite products and porcelain insulators.

JENSEN MFG. CO., a subsidiary of the Muter Co., Chicago, Ill., has purchased the fixed assets and inventory of Radio Speakers, Inc., Chicago, from Emerson Radio & Phonograph Corp., New York City.

PERSONNEL

J. GRAYSON JONES, formerly chief engineer of Peyton Television, has been appointed chief engineer of Conrac, Inc., Glendora, Calif., tele-

vision receiver and component manufacturers.

ROSS GESSFORD has been promoted from engineering specialist in cathode-ray tubes to chief engineer for the television picture tube division of Sylvania Electric Products Inc., Seneca Falls, N. Y.

R. Gessford S. A. Schelkunoff

SERGEI A. SCHELKUNOFF of Bell Labs has been awarded the Stuart Ballantine Medal of the Franklin Institute in Philadelphia for his outstanding contributions to the extension of the electromagnetic wave theory.

H. S. OSBORNE, chief engineer of the American Telephone and Telegraph Co., has been elected chairman of the United States National Committee of the International Electrotechnical Commission.

ROBERT G. BRECKENBRIDGE, formerly assistant professor of electrical insulation at MIT, was recently appointed to the staff of the National Bureau of Standards to take charge of a special study on the electrical properties of semiconducting materials.

VIRGIL H. DISNEY, formerly an assistant section head in research at the airplane division of the Curtiss-Wright Corp., Dayton, Ohio, has been named a supervisor of electronics at Armour Research Foundation of Illinois Institute of Technology.

WARREN S. MASTER was recently promoted from rectifier engineer to chief engineer of the Richardson-Allen Corp., New York City, manufacturers of selenium rectifiers.

VICTOR B. COREY, formerly supervisor of research and development,

has been appointed manager of the engineering physics division of Fredric Flader, Inc., North Tonawanda, New York.

ALFRED O. C. NIER, first man to isolate uranium 235, has become associated with Minneapolis-Honeywell Regulator Co. on a consulting basis to assist in research on supersensitive mercury switches.

DONALD L. BENEDICT, during the last year a special consultant to Raytheon Mfg. Co. working on microwave tubes and dielectric heating for specialized applications, has been appointed assistant chairman of the department of electrical engineering of Stanford Research Institute, Stanford, Calif.

D. L. Benedict

H. Jacobs

HAROLD JACOBS, formerly with Sylvania Electric Products, Inc., has joined the Thermionics Branch, Signal Corps Engineering Laboratories, Belmar, N. J. He is in charge of tube processing research and development.

L. E. RECORD, formerly supervisor of the tube development laboratory, has been appointed supervisor of the tube development and testing laboratories of the Tube Division, General Electric Co., Schenectady, N. Y.

ROYAL C. BERGVALL, after 11 years as assistant to the vice-president in charge of engineering, has been named engineering manager of industrial products at Westinghouse Electric Corp., Pittsburgh, Pa.

LEO L. BERANEK, associate professor of engineering at MIT, was awarded a grant-in-aid by the Dept. of State to lecture on electroacoustics at the Institute of Radio Technology, Buenos Aires, during the summer months.

NEW BOOKS

Electronics Manual for Radio Engineers

BY VIN ZELUFF AND JOHN MARKUS. *McGraw-Hill Book Co., Inc., New York, N. Y.*, 1949, 879 *pages*. $9.50.

THIS BOOK of nearly 900 pages contains 289 articles selected by the authors from issues of ELECTRONICS. The page size is the same as in the periodical.

The authors have wisely not gone back of 1940 in selecting their material and, as a matter of fact, there are relatively few reprinted that appeared earlier than 1944. Thus, this volume contains only modern material. The articles selected are of a practical nature, of primary interest to engineers and, in general, with little mathematical content.

Even if one carefully keeps his ELECTRONICS month by month and remembers that a particular article was published a few years back, that reference is usually difficult to find without scanning a considerable number of indices.

The extent of the cross referencing in the index of this book is indicated by the fact that it has approximately 1,200 entries or better than four references to each article.

The Table of Contents is divided into 16 groups including, as examples, such divergent subjects as antennas, components, tubes, production, microwaves and d-c amplifiers. In addition to these several aids in finding a desired reference, there is an author index.

A collection of reprinted articles of this sort has a further advantage over a text prepared by one or a few authors. Each title is accompanied by a sub-title that, for quick reference, gives a further insight as to the information that follows.

In this book, it is the authors individually and collectively that determine the quality but in this case the two compilers deserve much credit for the selection of articles, their grouping and the excellent index.

This volume forms a sort of companion book to "Handbook of Industrial Electronic Circuits" gotten out by the same publisher and authors last year. The present

volume also deserves a comment made about the other volume that "one article alone, available when needed, can justify a place for this book on an engineer's desk."—W. C. WHITE, *Electronics Engineer, Research Laboratory, General Electric Co., Schenectady, N. Y.*

Elektronenstrahl-Oszillographen

BY PAUL E. KLEIN. *Weidmann Pub. Co., Berlin*, 1948, 210 *pages, DM* 19.

THIS German-language book treats the subject of cathode-ray oscilloscopes. Main chapters cover the cathode-ray tube, power supply, deflection system, brightness control, amplifiers, sweep circuits, representation of multiple phenomena, photographic recording, and construction and operation of complete oscilloscopes. There are many subchapters with useful graphs and formulas. The author endeavored to give a working knowledge of c-r tubes, and associated circuits, with most of the space being devoted to the subject of amplifiers. The book fulfills this aim, although certain chapters such as those on electron lenses and c-r tube construction are treated too sketchily. Other chapters include too much detailed information, as on stem mounting of electron guns and on rectification. The book requires a good knowledge of the German language (Laufzeit = transit time; Summer = buzzer). It is regrettable that the book is confined to the German art and omits references to important foreign literature.—E. B. STEINBERG, *Remington Rand Inc., South Norwalk, Conn.*

Micro Waves and Wave Guides

BY H. M. BARLOW, *Prof. of Elec. Eng., University College, London. Dover Publications, Inc., New York*, 1949, 122 *pages*, $1.95.

THE OPENING chapters of this well-illustrated little book provide an approach to waveguide modes through familiar conventional transmission line concepts. The following mathematical analysis of electromagnetic fields in guides is then quite straightforward, and is comparable in many respects to ordinary trans-

mission line theory, with the coaxial cable serving as the common meeting ground of waveguide modes and the simple transverse electromagnetic wave.

In his nomenclature, the author has adopted the practice of the telecommunications engineer when dealing with transmission along wires, by taking the x axis in the direction of propagation of the wave, whereas most authors use the z axis for the direction of propagation.

A final chapter on microwave measurements and applications deserves commendation for the quality and number of illustrations of specific applications. For its price, this book is definitely a bargain to student and engineer alike.—J.M.

Electromechanical Transducers and Wave Filters

BY W. P. MASON, *Bell Telephone Laboratories, Inc. D. Van Nostrand Co., Inc., New York, 2nd edition,* 1948, 419 *pages,* $6.00.

ALTHOUGH a second edition, this book incorporates 88 pages of important new material that has entered the art of designing transducers during the war. For example, the gyroscope, although long used in automatic pilots but only recently generally appreciated, is treated as a circuit element. A number of additional topics on propagating and filtering acoustic waves have been introduced. Crystals and techniques used in such applications as sonar are discussed. A paragraph on mercury illustrates how its high impedance suits it for use with crystals in wideband systems.

As a matter of publishing expediency the new material has been printed at the back of the book but numbered so it fits in with the content of the first edition. It follows the same pattern of basic analysis that characterizes the old material. For the graduate student and research engineer this book, first published in 1942, presents a unified and fundamental approach to several fields (electric circuits, acoustics, mechanics) that are usually treated separately. As such, it is quite in the growing spirit of view-

ing the various aspects of the electronic arts as different applications of a single set of principles.—F. H. ROCKETT, JR., *Airborne Instruments Laboratory, Inc.*

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Books Received for Review

PHYSICS PRINCIPLES AND APPLICATIONS. By Henry Margenau, W. W. Watson and C. G. Montgomery. McGraw-Hill Book Co., Inc., 1949, 373 pages, $5.00. Covering both classical and modern physics, this textbook is designed for college sophomores who require a thorough and accurate introduction to engineering and the physical sciences.

INTRODUCTION TO RADIOCHEMISTRY. By G. Friedlander and J. W. Kennedy. John Wiley & Sons, Inc., New York, 1949, 412 pages, $5.00. Describes the nature and application of the entire field of radioactivity without assuming previous knowledge of nuclear physics. Each chapter has a separate bibliography of standard works on allied topics in recent literature. There are numerous illustrative examples and exercises to aid the reader in understanding the material presented.

HOW TO KEEP INVENTION RECORDS. By H. A. Toulmin, Jr. Research Press, Inc., Dayton, Ohio, Second Edition, 1948, 78 pages, $2.50. Specific instructions for keeping adequate records to help in obtaining valid patents, preventing costly litigation and reducing costs of fighting unavoidable litigation. Samples of needed forms are included.

TERRESTRIAL MAGNETISM AND ELECTRICITY. Edited by J. A. Fleming. Dover Publications, Inc., New York, 1949, 794 pages, $4.95. Reprint of first edition published in 1939 by McGraw-Hill Book Co. Twelve chapters by members of various National Research Council Committees and others, covering: The Earth's Magnetism and Magnetic Surveys; Magnetic Instruments; Magnetic Prospecting; Atmospheric Electricity; Instruments Used in Observations of Atmospheric Electricity; Earth-Currents; on Causes of the Earth's Magnetism and Its Changes; Some Problems of Terrestrial Magnetism and Electricity; Radio Exploration of the Earth's Outer Atmosphere; The Upper Atmosphere; The Aurora Polaris and the Upper Atmosphere; Thunder-clouds, Shower-clouds and Their Electrical Effects. There are also 1523 selected references arranged by subject matter, plus extensive bibliographical notes.

INDUCTION HEATING. By N. R. Stansel. McGraw-Hill Book Co., Inc., New York, 1949, 212 pages, $3.50. Electrical and thermal principles involved in the use of eddy currents for heating service, as generated by rotating equipment. Shows relationships between electric, magnetic and thermal properties of conductive materials in equations and curves. High-frequency electronic heating by induction is not taken up.

PHOTOFACT TELEVISION COURSE. Based on a series of lectures by Albert C. W. Saunders. Compiled and published by Howard W. Sams & Co., Inc., Indianapolis, Ind., 1949, 215 pages, $3.00. A well illustrated treatment designed to familiarize experienced radio technicians with the basic principles of practical television theory and operation.

OUR SUN. By D. H. Menzel, Harvard College Observatory. The Blakiston Co., Philadelphia, Pa., 1949, 326 pages, $4.50. Basic research methods used, evaluation as a natural resource, and effect of sun on radio transmission.

HANDBOOK OF PATENTS. By H. A. Toulmin, Jr. D. Van Nostrand Co., Inc., New York, 1949, 800 pages, $9.00. Essentials of patent law, presented accurately and simply for reference by lawyers as well as laymen. Many specific references to leading cases.

Backtalk

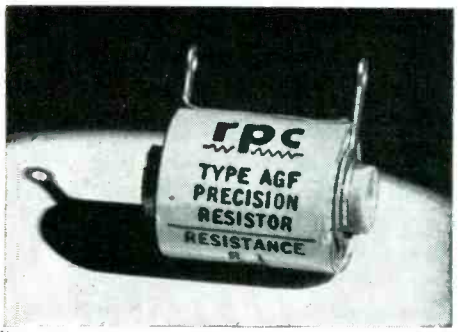
This department is operated as an open forum where our readers may discuss problems of the electronics industry or comment upon articles which ELECTRONICS has published.

Author's Answer

DEARS SIRS:

I HAVE READ D. J. Braak's letter (*Backtalk*, August 1949) with great interest. Braak is correct within 1db in his statement that the a-m/f-m crossover occurs at 10 db output s/n ratio with perfect limiting. Figures 6, 15, and 16 in the original manuscript on "A-M and Narrow-Band F-M" (ELECTRONICS, Feb. and Mar., 1949) show that the point is close to +11 db output s/n ratio, as is also stated in the text. Ideal limiting, however, results in serious vulnerability to detuning in the system considered, a factor which must be taken into account. All the superiority of f-m with perfect limiting over a-m is lost with comparatively small off-center drifts, for example, with only 23 kc detuning of the f-m signal when the carrier-to-noise (c/n) ratio is +6 decibels, as illustrated in Fig. 19. Detuning of 23 kc at a carrier frequency of 328 mc amounts to only 0.007 percent or 70 parts per million, which must include the combined drifts of the transmitter, the local receiver heterodyne and i-f amplifier system, and the discriminator circuits of the f-m detector, as well as an allowance for crystal grinding tolerances in a crystal-controlled system. Unfortunately, the f-m system's vulnerability to drift is greatest at c/n levels which give the lower values of output s/n ratio.

Considering the proposed system with 60-kc bandwidth, a deviation of ±20 kc would represent 67-percent modulation of the receiver's pre-detector bandwidth, as compared to about 11 percent for ±7 kc deviation in a bandwidth of 125 kc. The increased modulation per-



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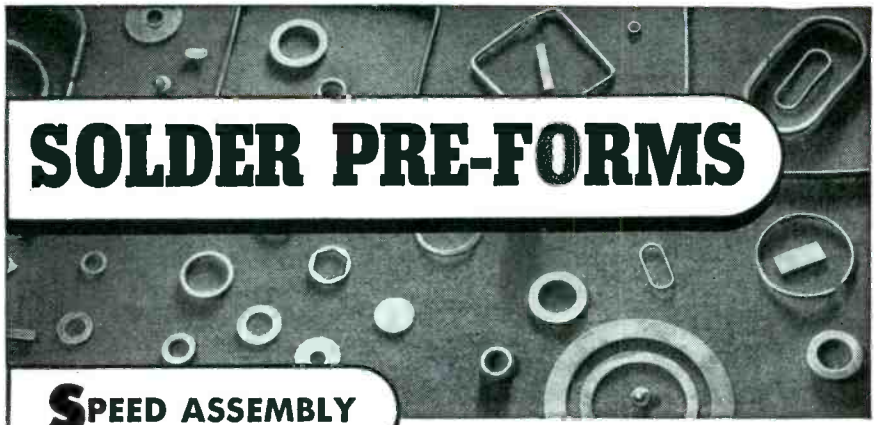

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centage will make the system less vulnerable to detuning, and it will change the a-m/f-m crossover to ±7.5 decibels output s/n for perfect f-m limiting, as against +11 decibels for the 125-kc narrow-deviation system. (There seems to be a small error in Mr. Braak's Fig. B, which indicates the crossover for the 60-kc system to be +5 decibels. In any case, however, the s/n ratio for crossover is lower for the narrower bandwidth system.)

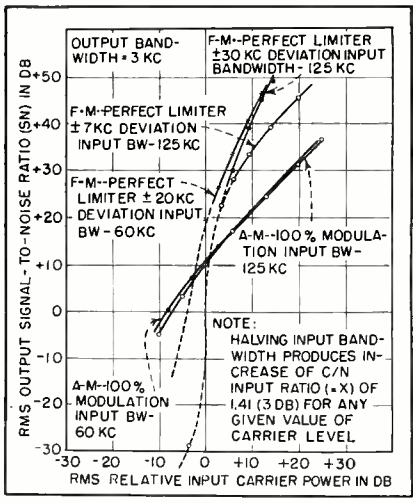
The 60 kc-wide system with ±20-kc deviation just accommodates the sidebands of the signal, which has components of more than 1 percent of maximum out to ±30 kc. If distortion is a criterion, there then remains no allowance for system frequency drift, since any such drift would result in sideband cutting on one side or the other of the carrier. Assuming, however, that a symmetrical sideband clipping from ±30 to ±20 kc is accepted, we then have ±10 kc possible drift before more serious distortion is encountered. For a carrier of 328 mc, this represents a stability of only 0.003 percent, a tolerance which must be divided at least six ways. Thus each contributing drift source must be less than ±0.0005 percent or ±1.7 kc, if the tolerance is divided equally amongst them.

Such an individual accuracy and stability for normal feasible designs is extremely difficult to obtain and maintain. Even afc circuits are very difficult to stabilize and maintain to within ±10 kc under most operational conditions with carrier frequencies above 100 mc, and in vhf/uhf equipment, they practically force the use of a double-heterodyne receiver, with a considerable increase of complexity, size and weight, and to some extent increase in spurious responses.

It must also be remembered that reducing the pre-detector bandwidth of a superheterodyne receiver often requires lowering the i-f amplifier center frequency so as to insure desirable values of transformer coupling coefficient and adjacent channel selectivity. If it is not feasible to increase the i-f transformer circuit Q values so as to approach double what they were, a change of bandwidth from 125 to 60 kc may require reduction of the i-f amplifier center frequency to

as low as one-half its former value. This would, of course, result in much poorer image rejection and a general increase in vulnerability to various other undesired responses.

The figure shown below is a comparison between the 125 and 60 kc bandwidth ideal cases as regards output s/n ratio. It should be noted that the abscissa is relative input carrier power, so that the comparison is on the basis of any given value of carrier power input to the detectors rather than input c/n ratio. This type of presentation is necessary to determine relative performance for a particular set of conditions in which the transmitter, the antennas, the orientation, and the distance are all held constant, and only the pre-detector bandwidth and the frequency deviation vary for any given level of radiated carrier power. This sort of comparison cannot be made on the basis of various given levels of c/n ratio, because changing the pre-detector bandwidth changes the noise factor, resulting in a new value of c/n. The curves show that changing the input bandwidth from 125 to 60 kc affects the a-m system very little, whereas the f-m system benefits considerably from the change, mainly because of lowering of the capture transition point (c = n or c/n = 0 db), which comes about from the reduction in noise consequent to reduction of bandwidth. The change in noise power is directly proportionate to the change in bandwidth, so that halving the



Comparison of theoretical a-m and f-m range performance with decrease of input bandwidth and different frequency deviations

bandwidth reduces n by 3 decibels.

If off-centering, de-tuning, and drift in general did not enter the picture, the narrower bandwidth and wider deviation system would certainly be preferable. With such limitations, however, there seems to be little prospect of utilizing the narrower bandwidth, unless large amounts of distortion are tolerable and the operating situation is not particularly rigorous as regards ambient conditions.

It is possible to use a greater deviation. This would provide better output s/n ratio, as illustrated, but only at c/n ratio values for which the output s/n is already satisfactory with ±7-kc deviation. The main advantage of the greater deviation would be a considerable improvement as regards s/n deterioration with detuning, but the tolerance for drift without considerable distortion would then be reduced from ±55 kc with the smaller deviation to ±33 kc. Even ±55 kc is feasible only with excellent crystals in the uhf region of the radio spectrum. (Incidentally, test and maintenance equipment presents quite a problem for such small percentage frequency tolerances).

No figures of measured harmonic distortion are at present available to the writer for the 60-kc bandwidth ±20-kc deviation cases, however severe distortion could be expected in the 60 kc-wide, ±20-kc deviation system for only 10-kc detuning.

Attractive as it seems at first glance, I am afraid that Braak's suggestion of narrowing the predetector bandwidth and increasing the deviation will run into engineering and operational difficulties which would more than nullify its advantages of lower input s/n ratio for a-m/f-m crossover and decreased susceptibility to detuning. I am glad, however, that Braak has brought up so interesting and informative a point for discussion, and am also pleased that he has found the equations (which were developed by Robert M. Maiden of this Laboratory) useful for implementing his suggestions with figures.

EMERICK TOTH

Naval Research Laboratory
Washington, D. C.

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ELECTRONIC ENGINEER desires position with company making electronic equipment. Consider development, laboratory, service or sales. Ten yrs. experience, prefer midwest. PW-9127, Electronics.

SERVOMECHANISMS AND Instrumentation Engineer. BS MS in EE. Technical experience in research and development of servos, control systems, simulators, gyros, computers, and wind tunnel instrumentation. Patent and technical publications in these fields. Administrative experience includes supervising groups of 15-30 men and establishing and maintaining operating budget. PW-9590, Electronics.

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● This advertisement is addressed to a graduate radio engineer between the ages of 25 and 50 who has had a minimum of five years practical commercial radio experience either before, during or after his college education.

He is of an amiable disposition, gets along well with people, has the ability to organize and works well under adverse conditions. He can teach or be taught and can give and take orders. He is accustomed to a good salary and is willing to fully accept the responsibilities necessary to earn it.

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WANTED
W.E. 984 or LINK MODEL 9 MODULATOR
STATE PRICE & CONDITION
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330 W. 42nd Street, New York 18, N. Y.

WANTED, AIRCRAFT RADIOS
AN/ART-13, BC-348, RTA-1B, AN/APN-9, R5A/ARN-7, AN/ARC-1, AN/ARC-3, BC-788-C, I-152, MN-26, Test Sets with TS- or I- prefix, Dynamotors, Control Boxes, Transmitters, Receivers, Power Supplies, etc. State quantity, condition and best price first letter.
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IN ANY CONDITION
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"K" BAND FEEDBACK TO PARABOLA HORN. with pressurized window.....$30.00
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TR/ATR SECTION choke to cover.....$4.00
FLEXIBLE SECTION 1" choke to choke.....$5.00
ADAPTER, rd. cover to sq. cover.....$5.00
MITRED ELBOW and S sections choke to cover $4.50
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K BAND CIRCULAR FLANGES.....50¢
3J31 **"N" BRAND MAGNETRON**.....$55.00

3 CENTIMETER

(STD. 1" x ½" GUIDE UNLESS OTHERWISE SPECIFIED)

723 A/B Klystron mixer section with crystal mount, choke flange and Iris flange output.....$22.50
TR-ATR Section for above with 724 ATR Cavity $8.50
CU105/APS31 Directional Coupler 25 DB...$25.00
90 degree twist, 6 inches long.....$8.00
723 AB Mixer—Beacon Dual Oscillator Mount with crystal holder.....$12.00
2 Way Wave directional coupler, type N fitting 1 ⅜ x ¾" guide 26DB.....$18.50
CG 98B/APQ 13, 12" flexible section 1 ¼" x ⅝" OD.....$10.00
TR-ATR Section, APS 15, for 1B24, with 724 ATR Cavity with 1B24 and 724 tubes. Complete $21.00
Crystal mount.....$17.50
Stabilizer Cavity with bellows.....$21.50
3 cm. 180° bend with pressurizing nipple..$6.00 ea.
3 cm. 90° bend, 14" long 90° twist with pressurizing nipple.....$6.00 ea.
3 cm. "S" curve 18" long.....$5.50 ea.
3 cm. "S" curve 6" long.....$3.50 ea.
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CIRCULAR CHOKE FLANGES, solid brass.. .55
SQ. FLANGES, FLAT BRASS.....ea. .55
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TRANSITION 1 x ½ to 1¼ x ⅝, 14 in. L..$8.00
"X" BAND PREAMPLIFIER, consisting of 2.72" A/B local oscillator-beacon feeding waveguide and TR/ATR Duplexer sect. incl. 60 pic IF amp.....$67.50
Random Lengths wavegd, 6" to 18" Lg....$1.10/Ft.
WAVEGUIDE RUN, 1¼" x ½" guide, consisting of 4 ft. section with Rt. angle bend on one end 2" 45 deg. bend other end.....$8.00
WAVEGUIDE RUN, 1¼" x ½" guide, consisting of 4 ft. long.....$10.00
"X" BAND PRESSURIZING gauge section w/15-lbs. gauge & Pressurizing Nipple.....$18.50
45 DEG. TWIST 6" Long.....$10.00
12" SECTION 45 deg twist, 90 deg bend....$6.00
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5 FT. SECTIONS choke to cover. Silver Plated.....$14.50
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WAVEGUIDE SECTIONS 2½ ft. long silver plated with choke flange.....$5.75
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ROTARY JOINT choke to choke with deck mounting.....$17.50
3 cm. mitred elbow "E" plane unplated..$6.50 ea.

200 MC COAXIAL PLUMBING

Right Angle Bend.....$35.00
T Section.....$55.00
T Section with Adapter to ⅞" in rigid coax..$65.00

10 CENTIMETER

WAVEGUIDE TO ⅞" RIGID COAX "DOORKNOB" ADAPTER. CHOKE FLANGE. SILVER PLATED. BROAD BAND...149.50 EACH

THERMISTORS		VARISTORS	
D-167332 (tube)	$.95	D-170225	$1.25
D-170396 (head)	$.95	D-167176	$.95
D-167613 (button)	$.95	D-168687	$.95
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WAVEGUIDE DIRECTIONAL COUPLER. 27 db Navy type CABV-47AAN, with 4 in. slotted section.....$42.50
SQ. FLANGE to rd choke adapter, 18 in. long OA 1½ in. x 3 in. guide, type "N" output and sampling probe.....$32.00
Crystal Mixer with tunable output TR pick up loop Type "N" connectors. Type 62ABH.....$14.50
Slotted line probe. Probe depth adjustable, Spec. connector, type CPR-14AAO.....$9.50
Coaxial slotted section, ⅞" rigid coax with carriage and probe.....$25.00
Waveguide Transition from 1½" x 3" to 2" x 1".....$45.00
Right Angle Bend 6" radius E or H plain..$27.50
Right Angle Bend 3" radius E or H plain—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
APN-7 McNally Cavity for 707B, with tuning slugs.....$5.50 each
"S" BAND CRYSTAL MOUNT, gold plated, with 2 type "N" connectors.....$12.50
PICKUP LOOP, Type "N" Output.....$2.75
TR BOX Pick-up Loop.....$1.25
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"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. McNALLY CAVITY Type SG.....$3.50
WAVEGUIDE SECTION, 3" thick, ft. bend, 5¼" ft. OA. 8" slotted section.....$21.00
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10 CM DIPOLE WITH REFLECTOR in lucite ball, with type "N" or Sperry fitting.....$4.50
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 ES-683816. E PLANE TO H PLANE MATCHING SLUGS.....$95.00
721A TR cavities. Heavy silver plated...$2.00 ea
10 cm. horn and rotating joint assembly, gold plated.....$65.00 ea

⅞" RIGID COAX—⅜" I.C.

⅞" rigid coaxial tuning stubs with vernier stub adjustment. Gold Plated.....$17.50
⅞ RIGID COAX ROTARY JOINT. Pressurized. Sperry #810613. Gold Plated.....$27.50
Dipole assembly. Part of SCR-584.....$25.00 ea.
Rotary joint. Part of SCR-584.....$35.00 ea.
RIGHT ANGLE BEND, with flexible coax output pickup loop.....$8.00
SHORT RIGHT ANGLE BEND, with pressurizing nipple.....$2.00
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STUB-SUPPORTED RIGID COAX, gold plated 5" lengths. Per length.....$5.00
RT. ANGLES for above.....$2.50
RT. ANGLE BEND 15" L. OA.....$3.50
FLEXIBLE SECTION. 15" L. Male to female.....$4.25
MAGNETRON COUPLINGS to ⅞" rigid coax with TR pickup loop, gold plated.....$7.50
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⅞ RIGID COAX. Bead Supported.....$1.20
SHORT RIGHT ANGLE BEND.....$2.50
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RIGID COAX slotted section CU-60/AP.....$5.00

WAVEGUIDE

¼" x ¼" ID	$1.00 per foot
½" x ½" OD	1.50 per foot
¾" x 1 ¼" OD	1.65 per foot
¾" x 1 ¼" OD Aluminum	.75 per foot
1¼" x 3" OD	3.00 per foot
2½" x 3" OD	3.50 per foot
1" x ½" OD Flexible	4.00 per foot
¾" rigid coax ¼" IC	1.20 per foot
(Available in 10FT to 15 ft. lengths or smaller.)	
UG 65/U 10CM flanges	$8.50 each
UG 53/U Cover	4.00 each
UG 54/U Choke	4.50 each

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Type "N" patching cord UG11/U female to UG9/U using RG5/U cable 12" long....$2.25 ea.
AN/TPS-1B flanged nipple and insert assembly for rotary coupling.....$3.75 ea
Pulse connector Navy type 49579.....$1.50 ea
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Holmdell Jack Western Electric BO-12962-1 D. B #J-102X.....$3.75 ea.
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ADAPTER TYPE "N" TO RG-7I/U CONNECTOR.....$5.50
F-29/SPR-2 HIGH PASS FILTER P/O AN/APR-5AX. TYPE "N" CONNECTORS...$12.50
Magnetron coupling to ⅝ rigid coax.....$5.00 ea.
Hand pumps for pressurizing transmission line with humidity indicator.....$12.50 ea.

TEST EQUIPMENT

TS-117/GP 10 CM WAVEMETER TEST SET, Mfg. "Sperry" 2400-3400 MC. Micrometer Adj. Coaxial Cavity. Freq. Meas. by absorption or transmission method. Mounts Crystal Current Meter & Calib. Chart.....$175.00
VSWR AMPLIFIER TS-12/AP. Unit 1 3 stages of Amplif. and Diode Rectifier w/direct VSWR. reading on meter, 115 volts 60 cyc. AC operation w/Inst. BK and CCT diag. New...$285.00
SLOTTED LINE PROBE and Matched Termination incld'g Accessories TS-12/AP Unit 2 incl. UG81/U, CG92/U, CG91/U, CG89/U, UG79/U, CG87/U, MX158/U, CG88/U, CG90/U, UG80/U plus Tools. New.....$200.00
COMPLETE TS-12/AP UNITS 1 AND 2 $450.00

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 1½ volt dry cell battery. 3x6x7.

New..... **$35.00**

10CM ECHG 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 10 CM Directional Coupler.....$350.00
3 CM RECEIVER. SG-3. Complete with W.G. Mixer Assy (723-A/B). Reg. Fil. Power Supply 6 stages IF (6AC7).....$99.50
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.....$5.56 ea
10 cm. cavity type wavemeters 6" deep, 6½" in diameter, Coax. output. Silver plated.$64.50 ea.
10 cm. echo box,
volt DC timing
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3 cm. Wavemeter: 9200 to 11,000 mc. transmission type with square flanges.....$15.00
3 cm. stabilizer cavity, transmission type...$20.00
3 cm. Wavemeter. Micrometer head mounted on
TS-108A/P DUMMY LOAD.....$65.00
3 CM. HORN AT-48/UP model 710. Type "N" input Hvy. silver plated.....$6.50
AT-68/UP 3 CM Horn with type N fitting....$5.00
DBM Antennas. Microwave direction finder, frequency coverage 1000-4500 megacycles. Dual back to back paradolas, complete with drive.....$150.00
SA-1, 200Mc Bedspring Antenna with pedestal $4.50

TUNABLE PKGD. "CW" MAGNITRONS

QK 61 2975-3200 mc. **QK 62** 3150-3375 mc.
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Provides 200-4,000 PPS. Sweeptime: 100 to 2,500 microsec. in 4 steps, fixed mod. pulse, suppression pulse, sliding modulating pulse, blanking voltage, marker pulse, sweep voltages, calibration voltages, fil. voltages. Operates 115 vac. 50-60 cy. Provides various types of voltage pulse outputs for the modulation of a signal generator such as General Radio #804B or #804C used in depot bench testing of SCR 695, SCR 595, and SCR 585. New as shown.....$125.00

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QCU Magneto striction head RCA type CR 278225—New.....$75.00
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/QCB Magneto striction head coil plate assembly.....$14.50

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PULSE EQUIPMENT

MIT. MOD. 3 HARD TUBE PULSER: Output Pulse Power 144 KW (12 KV at 12 amp). Duty Ratio: 001 max. Pulse duration: 5, 1.0, 2.0 microsec. Input voltage: 115 v. 400 to 2400 cps. Uses 1-715-B, 4-829-B, 3-'72's, 1-'73. New $110.00

APQ-13 PULSE MDDULATOR. Pulse Width .5 to 1.1 Micro Sec. Rep. rate 624 to 1348 Pps. Pk pwr. out. 35 KW Energy 0.018 Joules.....$49.00

TPS-3 PULSE MODULATOR. Pk. power 50 amp. 24 KV (1200 KW pk); pulse rate 200 PPS, 1.5 microsec. pulse line impedance 50 ohms. Circuit—series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New with all tubes.....$49.50

APS-10 MODULATOR DECK. Complete, less tubes $75.00

BC 1203B Loran pulse modulator.....$125.00

BC 758A Pulse modulator.....$395.00

APS-10 Low voltage power supply, less tubes.$18.50

725A magnetron pulse transformers.....$18.50 ea.

PULSE NETWORKS

15A—1-400-50: 15 KV. "A" CKT. 1 microsec., 400 PPS, 50 ohms imp.....$42.50

G.E. #6E3-5-2000-50T2T, 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

7.5E3-3-200-67T 7.5 KV, "E" Circuit, 3 microsec, 200 PPS, 67 ohms imp., 3 sections.....$12.50

DELAY LINES

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

PULSE TRANSFORMERS

G.E.K.-2745.....$39.50

G.E.K.-2744-A, 115 KV high Voltage, 3.2 KV Low Voltage @ 200 KW oper. (270 KW max.) 1 micro sec, 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 parallel connected, potted in oil.....$36.00

W.E. KS 9800 Input transformer, Winding ratio between terminals 3-5 and 1-2 is 1.1:1, and between terminals 6-7 and 1-2 is 2:1. Frequency range: 380-520 c.p.s. Permallov 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 Rifilar 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.....$4.50

G.E. #K2748A Pulse Input, line to magnetron $36.00

#9280 Utah Pulse or Blocking Oscillator XFMR Freq. limits 790-810 cy-3 windings turns ratio 1:1:1 Dimensions 1 13/16 x ⅛" 19/32.....$1.50

Raytheon U X 8093 3x32 Turns T.V. 1000 RMS $4.95

G.E. 9318 Pulse Xfrmr 1:1:1.....$1.50

UX 1350.....$5.95

WILCOX CS390 CONTROL EQUIPMENT

FOR AIRPORT CONTROL GROUND STATION—Standard relay rack housing, monitor loud speaker, dual channel receiver amplifier, Type 109 A control panel, microphone speech amplifier, etc., spare parts, new and complete.....$750.00 each

400 CYCLE TRANSFORMERS

352-7273: Pri: 115V, 400 cy. Sec: 6.3V,2.5 Amp 6.3V, .06 Amp: 6.3V, .9 Amp: 5V, 6 Amp: 700 VCT. 2-5U4's. For **APS-15. T201**.....$4.75

352-7176: Pri: 115V, 400 cy. Sec: 6.3V, 20 Amp: 6.3V, .5 Amp; 6.3V, .5 Amp; 320V (2-6x5's) For **APS-15. T202**.....$5.25

352-7278: Pri: 115V, 400 cy. Sec: 2.5V, 1.75 Amp, 3500V (2x2), For **APS-15. T203** (Anode #2) 5FP7.....$5.85

352-7070: Pri: 118V, 440 cy. Sec. 2.5V, 2.5 Amp: 2.5V, 2.5 Amp; (2000V, Ins.); 6.3V, 2.25 Amp: 1200V, Tpd at 1000 and 750V, P/o **AN/APS 15** $4.95

#7469105: Pri: 115V, 400 cy. Sec: Tpd. to give 742.5V. 50 MA; 709V, .0477 A, 671V. .045 A $2.95

M-7474319: Pri: 115V, 400 cy. Sec: 6.3V, 2.7 Amp: 6.3V, 66Amp; 6.3V, 21 Amp.....$2.95

32332: Pri: 115V, 400-2400 cy. Sec: 400 Vct, 35 MA: 6.4V, 2.5 Amp: 6.4V, .15 Amp.....$2.25

332-7138M: Pri: 115V, 400-2400 cy Sec: 640 V, .5 MA: 2.5V, 1.75 Amp.....$3.85

352-7179: Pri: 115V, 400-2400 cy. Sec: 6.5V, 12 Amp. Ct. 250V, 100 MA: 5V, 2 Amp.....$3.50

#9069: Pri: 115/80V, 400-2600 cy. Sec: 650 Vct, 50 MA; 6.3 Vct, 2 Amp: 5 Vct, 2 Amp.....$2.45

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SO-1 AND SO-8 RADAR SETS, Complete, in Used but Excellent Condition. 10 CM Surface Search using 2J26 or 2J27 Magnetron. 707B Mixer. PPI Indicator. Input 115VDC. Used on Merchant Ships throughout the world. FCC Approved. Guaranteed.....$1250.00

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10 CM surface search using PPI and "A" Scope. 115 VDC input, complete with spares. 14 cases $2800.00

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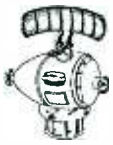

SO-3 RADAR 3 CM. SURFACE SEARCH ANTENNA. Complete with 24 VDC Drive Motor, Selsyn, Gear Mechanisms, "X" Band Slotted "Peel" Reflector. Less Plumbing.....$135.00 As Shown

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: 4½' x 3' rectangle, now.....$85.00

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ASD 3 cm. antenna, used, ex. cond.....$49.50

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TS-235/Up Dummy Load.....$75.00

F29/SPR-2 High Pass Filter.....$12.50

CPN-6 3CM RADAR BEACON EQUIPMENT

Complete sets available in unused condition. Write for price and information.

VOLTAGE REGULATORS

Mfg. Raytheon: Navy CRP-301407: Pri: 92-138 v. 15 amps, 57 to 63 cy. 1 phase, Sec: 115 v, 7.15 amp. .82 KVA. .90 PF. Contains the following components:

REGULATOR TRANSFORMER: Raytheon UX-9545. Pri: 92-138 v. 60 cy. 1 PH. Sec: 200/580 v. 5.5/5.26 amps. 4000 v. rms test.

FILTER REACTOR: .156 hy. 5 amps, 4000 v. test. Raytheon UX 9547.

TRANSFORMER: Pri: 186 v. 5 amps; Sec: 115 v. 7.2 amps. Size 12" x 20" x 29". Net Wt. approx. 250 Lbs.

Entire unit enclosed in grey metal cabinet with mounting facilities. New, as shown.....$99.50

CROSS POINTER INDICATOR

ID 24-ARN-9 Dual 0-200 microamp. movement in 3" case. Each movement brought out to 6-term receptacle at rear. Originally used in ILS equipment New.....$5.50

ZA Type.....$10.00

TEST SET 159 TPX

Measures frequency between 150 & 200 mc. by heterodyne method. Power of Xmtr can be directly measured. Measures DC voltages up to 500 Volts. Original Operation on 110 V. 400 cy. but conversion kit makes it operable on 110 V. 60 cy. new, and complete with tubes, crystal, cal. chart, antenna, meter.....$29.95

Typewriter Desk Wells Mounted on Steel Panel for Standard Rack Mfg 10½" H x 19" W x ⅛" Thick. Well is 22" Wide, 20" Deep. Affording Full Working Space. Grey Crackle Finish. New ea. $8.95

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Navy take IA, Lawrence Model 30 D, 10 horsepower 2 cylinder, 4 Stroke cycle air cooled engine, for use with 1.71 KWDC and 1.22 KWAC aircraft generator, new, in original cellophane packing $425.00

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Tube	Freq. Range	Pk. Pwr. Out	Price
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.	$25.00
2J32	2780–2820 mc.	285 KW.	$25.00
2J34			$55.00
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
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, A			$20.00
718DY			$25.00
720BY	2800 mc.	1000 KW.	$50.00
720C.Y			$50.00
725-A	9345–9405 mc.	50 KW.	$25.00
750-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 $20.00 2 K41 $65.00

MAGNETRON MAGNETS

Gauss	Pole Diam.	Spacing	Price
4850	3, 4 in.	5 8 in.	$12 50
4200	21, 32 in.	3, 4 in.	$17.50
1300	1 5/8 in.	1 5/16 in.	$12.50
1800	1 5/8 in.	1 1/2 in.	$14.50

Electromagnets for magnetrons 700A $24.50 ea.

R. F. EQUIPMENT

LHTR. LIGHTHOUSE ASSEMBLY. Part of RT-30, APG-5 & APG-15. Receiver and Transmitter Lighthouse Cavities with assoc. Tr Cavity and Type N CPLG. To Recr. Uses 2C40, 2C43, 1B22., Tuneable AFX 2400-2700 MCS. Silver plated. $49.50

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APS-2 100M RF HEAD COMPLETE WITH HARD TUBE (715B) Pulser. 714 Magnetron 417A Mixer all ⅞" rigid coax, incl. recr. 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.....$69.50 ea.

SO-3 "X" band 3cm RF package, new complete, including receiver unit as illustrated on Page 237, Volume 23 RAD LAB Series.....$375.00 ea.

Pre-Amplifier cavities type "M" 7410590GL to use 446A lighthouse tube. Completely tunable. Heavy silver plated construction.....$37.50 ea.

RT32/APS 6A RF HEAD, Compl. with 725A Magnetron magnet pulse xfmr. TRA-ATR. 723 A/B local osc. and beacon mount, pre amplifier. Used but exc. cond.....$97.50

AN/APS-15A "X" Band compl. RF head and modulator, incl. 725-A magnetron and magnet, two 723A/B klystrons (local osc. & beacon), 1B24, TR, recr-ampl. duplexer, HV supply, blower, pulse xtmr. Peak Pwr Out: 45 KW apx. Input: 115, 400 cy. Modulator pulse dummy with all tubes incl. 73, two 72's. Complete.....$210.00

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Serial RC 25
General Electric 250 Watt Exciter
Model 4BT1A1 Type 3T1A
Serial CC833
General Electric Station Monitor
Model 4BM1A1 Type BM1A
Serial WC268
General Electric Power Supply
Model B1241 Type BF2A
Serial WC547
General Electric Transmitter Console
Model 4BC3A1 Type BC3A
Serial WC5
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100 Feet of 1 ⅝ coax. transmission line including 90° elbows.
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Desk and Chair for Transmitter Console.

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PE 218-H: Same as above except size: 16½" x 6" x 10". New.....$49.95

PE 218H, used, good cond.....$25.00

PE 206: Input: 28 vdc, 38 amps. Output: 80 v, 800 cy, 500 volt-amps, Dim: 13" x 5½" x 10½". New.....$12.50

GE 5D21NJ3A: Input: 28 vdc, 35 amp. Output: 115 v, 400 cy, 485 volt-amps. Dim: 9" x 4½" diam. New.....$49.95

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36938-2, Haydon Timing Motor, 110 V., 60 cycle, 2.2 w., 4/5 r.p.m.

Price $3.00 ea. net.

Haydon Timing Motor—110 V., 60 cycle, 3.2 w., 4 r.p.m., with brake. **Price $4.00 each net.**

45629R Haydon Timing Motor, 110 V., 60 cycle, 2.2 w., 1/240 r.p.m. **Price $3.00 each net.**

36938-3, Haydon Timing Motor, 110 V., 60 cycle, 2.2 w., 1 1/5 r.p.m. **Price $2.70 each net.**

36228 Haydon Timing Motor, 110 V., 60 cycle, 2.2 w., 1/60 r.p.m. **Price $2.70 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.**

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CK1, Pioneer, 2 phase, 400 cycle. **Price $10.00 each net.**

CK2, Pioneer, 2 phase, 400 cycle. **Price $4.50 each net.**

10047-2-A Pioneer 2 phase, 400 cycle, with 40:1 reduction gear. **Price $7.25 each net.**

FPE-25-11, Diehl, Low-Inertia, 75 to 115 V., 60 cycle, 2 phase. **Price $16.00 each net.**

FPE-49-7 Diehl, Low-Inertia, 115 V., 60 cycle, 2 phase, 3.0 amps., 10 w. output. **Price $34.50 each net.**

FP-25-2, Diehl, Low-Inertia, 20 V., 60 cycle, 2 phase. **Price $9.00 each net.**

FP-25-3, Diehl, Low-Inertia, 20 V., 60 cycle, 2 phase. **Price $9.00 each net.**

CK2, Pioneer, 2 phase, 400 cycle, with 40:1 reduction gear. **Price $6.70 each net.**

MINNEAPOLIS-HONEYWELL TYPE B Part No. G303AY, 115 V., 400 cycle, 2 phase, built-in gear reduction, 50 in. lbs. torque. **Price $7.50 each net.**

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Price $40.00 per set new sealed boxes

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Sperry A5 Amplier 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 $8.00 each net.**

Norden Type M7 Vertical Gyro. 26 V., D.C. **Price $19.00 each net.**

Norden Type M7 Servo Motor. 26 V., D.C. **Price $20.00 each net.**

Allen Calculator, Type C10 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

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. in. torque, 145 r.p.m. Shunt Wound, 4 lead reversible. **Price $4.70 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. 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 Shunt Motor, 27 V., 0.7 amps., 7000 r.p.m., 1/100 h.p. **Price $3.75 each net.**

D.C. ALNICO FIELD MOTORS

5069456, Delco, 27.5 V., 10,000 r.p.m. **Price $4.70 each net.**

5069600, Delco, 27 V., 250 r.p.m. **Price $4.70 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 $4.70 each net.**

5069230, Delco, 27 V., 145 r.p.m. **Price $5.00 each net.**

S. S. FD6-16, Diehl, 27 V., 10,000 r.p.m. **Price $3.75 each net.**

S. S. FD6-18, Diehl, 27 V., 10,000 r.p.m. **Price $3.75 each net.**

S. S. FD6-21, Diehl, 27 V., 10,000 r.p.m. **Price $3.75**

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.**

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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 $35.00 each net.**

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12117-2, Pioneer. Input 24 V.D.C. Output 26 V. 400 cycle, 6 V.A. **Price $20.00 each net.**

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Type 12627-1-A. Price $80.00 each net.

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SYNCHROS

1F Special Repeater, 115 V., 400 cycle. Will operate on 60 cycle at reduced voltage.

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7G Generator, 115 V., 60 cycle. **Price $30.00 each net.**

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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 $3.50 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 $15.30 each net.**

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3B13–15	15 AMP.	120.00

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C1–30	30 AMP.	14.95
C1–40	40 AMP.	17.95
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C1–80	80 AMP.	26.95
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B1–250	250 MA.	$ .98
B1–500	500 MA.	1.95
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
B1–15	15 AMP.	13.95
B1–20	20 AMP.	15.95
B1–30	30 AMP.	24.95
B1–40	40 AMP.	27.95
B1–50	50 AMP.	32.95
B1–60	60 AMP.	36.95
B1–80	80 AMP.	44.95

Input 0–36VAC Type #	Current	Output 0–26*VDC Price
B2–150	150 MA.	$.98
B2–250	250 MA.	1.25
B2–300	300 MA.	1.50
B2–450	450 MA.	1.95
B2–1	1 AMP.	3.95
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
B2–15	15 AMP.	24.95
B2–20	20 AMP.	27.95
B2–30	30 AMP.	36.95
B2–40	40 AMP.	44.95

Input 0–54VAC Type #	Current	Output 0–38*VDC Price
B3–150	150 MA.	$1.25
B3–250	250 MA.	1.95
B3–600	600 MA.	3.25
B3–5	5 AMP.	13.95
B3–10	10 AMP.	24.95

Input 0–72VAC Type #	Current	Output 0–50*VDC Price
B4–600	600 MA.	$3.95
B4–3	3 AMP	14.95
B4–5	5 AMP.	17.95
B4–10	10 AMP.	27.95

Input 0–115VAC Type #	Current	Output 0–90*VDC Price
B6–150	150 MA.	$1.95
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

Input 0–234VAC Type #	Current	Output 0–190*VDC Price
B13–600	600 MA.	$12.95
B13–1X5	1.5 AMP	19.95
B13–3	3 AMP	35.95
B13–5	5 AMP	48.95
B13–10	10 AMP.	69.95

**Select Proper Capacitor to Obtain Higher VDC Than Indicated.*

RECTIFIER CAPACITORS

CF–13	6000 MFD	10VDC	$2.49
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–5	1500 MFD	30VDC	2.49
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
CF–12	125 MFD	350VDC	2.49

RECTIFIER TRANSFORMERS

All Primaries 115VAC 50/60 Cycles

Type #	Volts	Amps.	Price
XF15–12	15	12	$3.95
TXF36–2	36	2	3.95
TXF36–5	36	5	4.95
TXF36–10	36	10	7.95
TXF36–15	36	15	11.95
TXF36–20	36	20	17.95
XFC18–14	18 VCT	14	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		Amps.	Price
HY5	.02 Hy	5	$3.25
HY8X5	.02 Hy	8.5	7.95
HY10	.02 Hy	10	9.95
HY12	.02 Hy	12	12.95
HY15	.015 Hy	15	13.95

RECTIFIER MOUNTING BRACKETS

For Types B1 through B6, and Type C1 ..... $ .35 per set
For Types B13 ..... .70 per set
For Types 3B ..... 1.05 per set

RECTIFIER KIT

6 and 12 VDC at 10 Amps.

This unit will deliver unfiltered direct current for operation of motors, dynamotors, solenoids, electroplating, battery charging and similar equipment.
The following components are supplied:

1 ea. Full Wave Bridge Rectifier
1 pr. Rectifier Mounting Brackets
1 ea. Transformer 115 VAC 50/60 CPS
3 ea. Silver-Plated Binding Posts
1 ea. 4-position Tap-Switch
1 ea. Fuse and Fuse Holder
1 ea. Line Cord and Plug
1 ea. Pilot Light Assembly and Bulb

The primary of the transformer is multi-tapped permitting adjustment of the DC output voltages.
Complete with schematic diagram **$15.95**

Filter Kits For Above

1 Section choke input, 10% ripple ..$ 9.64
2 Section choke input, 2% ripple .. 19.28

SYNCHRO MOTORS

Type 1F Special—KS-5949, Li Western Electric 115/90 VAC—400 Cycles
Brand new, boxed.
Price Each **$8.00**

WRITE FOR SELENIUM RECTIFIER CATALOG #719 ON COMPANY LETTERHEAD

VACUUM CAPACITORS

Standard Brands

12 Mmfd	20 Kv.	$1.95
50 Mmfd	20 Kv.	4.95
50 Mmfd	32 Kv.	5.95

SILVER CERAMIC TRIMMERS

820-Z	5–20 Mmfd Zero Temp	24¢
822-N	5–20 Mmfd Neg 300	24¢
822-AZ	4.5–25 Mmfd Zero Temp	24¢
823-AN	20–125 Mmfd Neg. 650	33¢

OIL CONDENSERS

2 Mfd 200VDC Bathtub	$ .20
.5 Mfd 400VDC telephone type	.20
2 Mfd 400VDC Bathtub	.30
2X.1 Mfd 600VDC Bathtub	.39
6 Mfd 600VDC w/mtg. Clamp	.79
10 Mfd 440VAC/1500VD w/Brkts	1.55
8 Mfd 660VAC/2000VDC w/Brkts	3.50
15-.15 Mfd 8000VDC Voltage Doubler Type 26F381 w/Brkts	3.95

ATTENTION!!!

Bulletin #713, listing various government and commercial surplus items, is now available upon request.

VOLTAGE REGULATORS

These solenoid operated carbon pile regulators will stabilize the output of 12-18 VDC power supplies, simply by connecting the coil leads across the output of the rectifier, and the carbon element leads in series with the load.
Price each **$2.49**

D-C POWER SUPPLY FTR 3377-AS

Rating 115 VAC to 115 VDC, .77 Amperes. Operates fans, motors, magnetic chucks, business machines, relays, etc. Descriptive literature available.
Complete, ready to operate..... **$16.50**

D-C PANEL METERS

Attractive, rugged, and reasonably priced. Moving vane solenoid type with accuracy within 5%.

0-6 Amperes D-C	Any range
0-12 Amperes D-C	$2.49 each
0-15 Volts D-C	

Minimum order $3.00. No C.O.D.'s under $25.00. 25% deposit on C.O.D. 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.
Orders Promptly Filled from Our Stocks
All Prices F.O.B. our NYC Warehouse

OPAD-GREEN COMPANY
71 Warren St.
New York 7, N. Y.
Phone: BEekman 3-7385-6

We Can't Eat 'Em So We've Priced 'Em to SELL*

Deduct 5% From All Items in This Column

ADVANCE D.P.D.T. ANTENNA RELAY

110 V. 60 cycle coil Steatite insulation. Only $1.95 each.

DUNCO RELAY 6 volt 60 cycle coil DPST.... $1.39

SCOPE TRANSFORMERS

Pri 110V 60Cy — Hermetically Sealed

2500V @ 12Ma.....$3.95
2300 @ 4 MA, 2.5 Volts @ 2 Amps.....4.95
1050V @ 20Ma, 20V 4.5A, 2.5V 5A.....4.75

PLATE AND FIL. TRANSF. PRI 110 v 60 cy. sec. 1120 volts CT @ 600 ma. 6.3v CT # 3A, 2x5VCT @ 6A Hermetically sealed.....$9.95 ea.

1500, 5000 Ohm 100 Watt Ferrule Resistors.
20,000 Ohm 50 Watt Ferrule Resistors.
Any Types only .10 ea. Min. Order 50.

HS 30 HEADPHONES

250 ohms imp. Can be used for sound power Telephones.

Brand new .....69 ea.

LARGE QUANTITY AVAILABLE AT REDUCED PRICE

PHASE SHIFT CAPACITOR

4 Stator Single Rotor. 0-360 Degrees Rotation .....Only $2.95 each

ODDS AND ENDS BARGAINS 1000 VDC

.004 1000 VDC Micas.....9 for .99
.01 600 VDC Mica Cond.....9 for .99
GE 24V DC Relays.....5 for .99
.02 400 V DC Tubulars.....15 for .99
1000 MFD 25 Volt Electrolytic.....2 for .99
25 MFD 25 Volt Elect. Tubular.....6 for .99
JAN 6CX Tubes, New, Boxed.....4 for .99
.05 600 VDC Oil Tubular.....10 for .99
10 MMF Midget Variable Cond.....4 for .99
Heineman 5 Amp 110 VAC CKT Breaker.....99
Heineman 25 Amp 110 VAC CKT Breaker.....1.49
2 MFD 250 VAC Oil Cond.....5 for .99
Solar .02 600 VDC Dominoes.....9 for .99
Erie .0005 N750D Ceramicons.....15 for .99
.1x.1 2 KV DC Oil-Condenser.....79
H&H SPST P.B. Switch N.O.....5 for .99
1/40 Amp (25 Ma) Littlefuses.....15 for .99
.25 MFD 600 V. Tubulars.....6 for .99
C-D 1 MFD 400 V Oil Tubulars.....9 for .99
Butterfly Cond 2-11 MMF Ball Bearings...2 for .99
50 MFD 50 Volt Elect. Tubulars.....5 for .99
.0015 5% Silver Micas.....9 for .99
Midget Closed CKT Jacks.....7 for .99
CD Type 4 .001 600 VDC Micas.....50 for 4.99

WIRE WOUND RESISTORS

5 Watt type AA, 20-25-50-200-470-2500-4000 ohms ..... .09 ea.
10 watt type AB, 25-40-84-400-470-1325-1900-2000-4000 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.

30 WATT WIRE WOUND RESISTORS

Ohms: 100-150-1500-2500-3k-4k-4500-5k-5300-10k 15k-18k-40k ..... .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

1% PRECISION RESISTORS

2000-2500-5000-8500-10,000 ohms.....ea. .25
50000-95000 ohms .....ea. .29
10000-750000-1 meg .....ea. .69

Precision 15 Meg. 1% Accuracy Resistor. Non-inductive, 1 watt, hermetically sealed in glass. .29 ea. 10 for.....$2.50

50 megohm 35 watt Resistor with mount...$1.95 each; 10 for $15.00

Deduct 10% from All Items in THIS Column

GENERAL PURPOSE TRANSFORMERS

Ideal for Bias, Filament, Isolation, Stepdown, etc. 2 isolated 110v pr. sec. 110v at 900 ma plus 6.3 @ 2 amps. Fully cased .....Now $1.49 ea.

FILAMENT TRANSFORMERS

110V COCy Pri. Fully Cased.

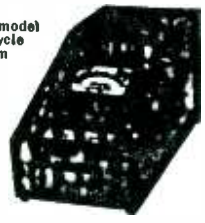
5 Volt 15 Amp.....$2.75
2.5 Volt 10 Amp..... 3.49
2.5 Volt CT 21 Amp..... 4.75
6.3 Volt 10 Amp..... 1.89

MULTIPLE SECONDARIES

5¼V CT 21A, 7.5V 6A, 7.5V 6A.....$4.95
6.3V 21 Amp. 6.3V 2A, 2.5V 2A..... 3.95
5 Volt 4A, 6.3V, 3A..... 2.45
2.5V CT 20A, 2.5V CT 20A..... 6.95
2.5V CT 10A, 10V 3A, 5V 3A, 5V 3A..... 3.95

MEGOHM METER

Industrial Instruments model L2AU 110/220 volts 60 cycle input. Direct reading from 0-100000 megohms on 4" meter can be extended to 500000 megohms with external supply. Sloping harwood Cabinet 15"x8"x10x. Brand new with tubes plus running spare parts including extra tubes. Great value Only $69.50.



HIGH VOLTAGE—CURRENT MICAS

	MMF	VDC	Price		MMF	VDC	Price
D	.001	600	$ .18	C	.006	3 KV	$1.50
E	.01	600	.26	D	.002	3 KV	.70
E	.02	600	.26	C	.0001	5 KV	.76
E	.027	600	.26	C	.0005	5 KV	.85
D	.039	600	.30	C	.0015	5 KV	1.60
C	.01	1 KV	.45	C	.003	5 KV	1.90
C	.056	1 KV	.50	C	.005	5 KV	2.50
C	.07	1 KV	.55	B	.007	5 KV	2.75
D	.02	1200	.35	B	.002	6 KV	3.50
C	.024	1500	.65	B	.003	6 KV	3.75
C	.033	1500	.75	A	.004	6 KV	4.95
C	.015	2 KV	.80	B	.006	6 KV	4.25
C	.02	2 KV	.90	B	.0005	8 KV	2.90
D	.002	2500	.45	B	.001	8 KV	3.25
E	.005	2500	.55	B	.002	8 KV	4.00
C	.025	2500	1.25	B	.003	8 KV	4.75
C	.001	3 KV	.90	B	.004	8 KV	5.59
C	.002	3 KV	.95	A	.0098	15 KV	32.50
D	.005	3 KV	.70	A	.0059	18 KV	28.50
C	.005	3 KV	1.24	A	.0013	30 KV	36.50

OIL CONDENSERS

20 mfd 330 vac—1.85
5 mfd 150 vac— .49
1 mfd 600 vdc— .29
2 mfd 600 vdc— .39
4 mfd 600 vdc— .59
6 mfd 600 vdc— .79
3/3 mfd 600 vdc— .79
10 mfd 600 vdc— .89
2 mfd 1000 vdc— .79
4 mfd 1000 vdc— .95
15 mfd 1000 vdc—2.95
2 mfd 1500 vdc—1.25
6 mfd 1500 vdc—2.95
1 mfd 2000 vdc—1.45
2 mfd 2000 vdc—2.25
6 mfd 2000 vdc—3.95
2 mfd 4000 vdc—4.95
1 mfd 5000 vdc—4.50
.1/.1 mfd 7000 vdc—2.25
.1 mfd 7500 vdc—1.95
1 mfd 7500 vdc—9.25
.01/.01 mfd 12 kv dc—5.75
.005/.01 mfd 12 kv dc—5.50
.65 mfd 12,500 vdc—12.95
.75/35 mfd 8/16 kv—7.95
2 mfd 18 kv dc—59.50

WESTINGHOUSE

Type MN Overcurrent Relay, Adjustable from 250 ma. to 1 amp. External Push Button Reset. Enclosed in glass case. Hand calibrated adjustments, only $5.95

*PRICES EFFECTIVE FOR SEPT ONLY.

Sorry—But We're Scraping the Bottom in This Column

PANEL METERS—BRAND NEW

2" WESTON .0-1 Ma DC 26 ohms res.....$3.50
2" GE 0-1 Ma DC (volt scale)..... 2.95
2" GE 0-5 Ma DC (amp scale)..... 1.95
2" WESTINGHOUSE 0-10 Ma DC..... 2.45
2" GE 0-500 Ma DC..... 1.95
2" GE 0-10 Volts AC..... 2.50
2" GE 0-30 Volts DC 1000Ω/v..... 2.50
2" WESTON 0-250 Volts DC..... 2.50
2" WESTON 150-0-150 Micoamps DC..... 3.49
2" GE 0-30 Amps DC..... 2.45
2" GE 0-1 Amp RF (Internal Thermo)..... 2.45
2" WESTON 0-1 Amps RF (Internal Thermo).. 2.50
3" WESTINGHOUSE 0-2 Ma DC..... 3.95
3" GE 0-15 Ma DC (Square Case)..... 3.95
3" WESTERN ELECTRIC 0-80 Ma DC..... 2.95
3" DEJUR 0-100 Ma DC..... 2.95
3" GE 0-200 Ma DC..... 3.95
3" WESTINGHOUSE 0-50 Amps AC..... 3.95
3" WESTON 0-50 Amps AC..... 4.95
3" TRIPLETT 75 Amps AC..... 2.95
3" WESTINGHOUSE 0-20 Ma DC..... 3.95
3" WESTINGHOUSE 0-150 Volts AC..... 3.95

2" GE 0-200 MICROAMPS

Model DW51 .....$4.50 ea.

H.V.-H. CURRENT PLATE TRANS.

1500-0-1500 volts at 1.5 amps. Tapped at 1350 and 1250. Pri. 110/220 volts 50/60 cycles in 2 separate windings. Built to rigid Navy specs by Amertran. Suitable for broadcast transmitters, induction heating, etc. Continuous duty. 10 x 10 x 7. swt 125 lbs.

New only 39.50

A GREAT VALUE

As illustrated above. 1500-8-1500 volts at 600 ma. Pri. 110/220 v. 50/60 cycles. 8 x 8½ x 7 s.w.t. 78 lbs. Made by Amertran. Only.....19.95

HIGH CURRENT TRANSF. 820 Volts CT at 775 Ma. Pri. 110/220 Volts 60 cycles.
Fully Cased 5.95

MALLORY VIBROPACK

6.3 Volt input—output 300 Volt @ 100 ma. Complete only .....each $8.95

MALLORY TRANSFORMER & 534C Vibrator as used in above. Both for.....$5.95

UTC type PA 5000 ohm plate to 500 ohm line and 6 ohm voice coil. 10 watts. 60 to 10,000 cps +1 DB. GREAT VALUE.....ea. $2.75

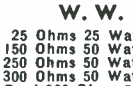
THORADARSON PLATE TRANSF. 2370 volts CT at 250 MA tapped at 300-0-300 volts, plus 215 volts 55 MA bias winding. 110 volt 60 cy. pri. Fully shileded .....ea. $11.95

CHOKE BARGAINS

6 Henry 50 ma 300 ohms.....3 for $0.99
6 Henry 80 ma 220 ohms.....2 for .99
8 Henry 160 ma 140 ohms..... .99
1.5 Henry 250 ma 72 ohms..... .59
6 Henry 300 ma 65 ohms..... 3.75
4.3 Henry 620 ma 42 ohms..... 6.95
Swing. Choke 1.6/12 Henry 1 Amp/100 ma 15 ohm 17.95

U. H. F. COAX. CONNECTORS

831AP-UG12U—UG21U-UG-14U-831 R-83ISP .35 ea.



FEDERAL ANTI-CAPACITY SWITCH. Double Pole. Double Throw .....85¢ each; 10 for $7.50

W. W. POWER RHEOSTATS

25 Ohms 25 Watt..... .49
150 Ohms 50 Watt..... .59
250 Ohms 50 Watt..... .59
300 Ohms 50 Watt..... .59
Dual 200 Ohms 50 Watt..... .79
8 Ohms 150 Watts..... 1.79

WESTERN ELECTRIC MOTOR

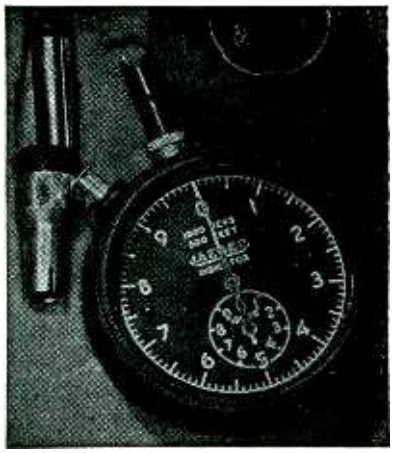
Input 110 volts 60 cycles. 11 watts: Torque 75 oz. in. 0.65 RPM. Ideal for driving H.F. Antenna, Condenser, etc. 3" diam., 3½" long. Complete with capacitor .....$3.75 each

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-7-6443
DEPARTMENT EA
SEND FOR BULLETIN



PORTABLE (CHRONOMETRIC) TACHOMETER

Jaeger Watch Co. Model #43A-6

- Can be used for speeds up to 20,000 R.P.M.
- Can be used for lineal speed measurements to 10,000 F.P.M.
- Ideally suited for testing the speeds of motors, particularly of fractional horse power, generators, turbines, centrifugals, fans, etc.
- Very small Torque—requires practically no power to drive.
- Unequalled Readability 2" Open face dial—each division on large dial equals 10 R.P.M.; each division on small dial equals 1,000 R.P.M.
- Greatest Accuracy—meets Navy specifications—guaranteed to be within ½ of 1%.
- Results of test reading remain on dial until next test taken.
- Push button for automatic resetting.
- Complete with the following accessories.
  1—Large pointed rubber tip
  1—Large hollow rubber tip.
  1—6" circumference Wheel tip
  1—Operating Instructions.
  1—Temperature Correction chart.

The combination of the above features will give accurately, within a few seconds, by direct reading, the R.P.M. of shafts or the lineal speeds of surfaces without any accessories or timing of any kind. Each unit comes complete in a red velvet lined carrying case 5"x3½"x1½". Net List Price..... $70.00
Your Cost $24.50

PORTABLE TACHOMETER

Multiple Range Continuous Indicating

This unit is of the centrifugal mechanical type and is designed to show INSTANTANEOUSLY and CONTINUOUSLY the speed or change in speed of any revolving shaft or surface. No stop watch or other mechanism required.

- Three ranges in R.P.M. and three in F.P.M.
  Low Range 300-1,200 (Each division equals 10 R.P.M.)
  Medium Range 1,000-4,000 (Each division equals 10 R.P.M.)
  High Range 3,000-12,000 (Each division equals 100 R.P.M.)
- Large open dial 4" diameter.
- Ruggedly constructed for heavy duty service.
- Ball bearing and oilless bearings—require no lubrication whatsoever.
- Readily portable—Fits neatly into hand.
- Gear shift for selecting low, med., high ranges.

Made by Jones Motorola, Stamford, Connecticut. Comes complete in blue velvet lined carrying case: 7⅛"L x 4"H x 5"W. Your cost.....$24.50

A.C.-D.C. VOLTMETER

WESTON 341

0-150 Volts. Electrodynamometer type, ¼ of 1% Accuracy on D.C. AND A.C. FROM 25 to 1200 CYCLES. Indicates true r m s voltage. Shielded movement, 3.9 V.A. power consumption. Complete in mahogony carrying case with cover.. Even though these instruments are Brand New Surplus, we had Weston check each and every unit and furnish a NEW Certificate to guarantee the accuracy of each instrument. Ideal for use in conjunction with model 311 Potential Transformer to extend the range to 750 & 1500 volts.

New in original manufacturers boxes.

List Price $226.50 Your Cost Only $115.00

WESTON MODEL 311 PORTABLE POTENTIAL TRANSFORMER

To be used to extend the range of any precision laboratory standard 150 Volt A.C. meter.

Maximum potential ratio of 1500 and 750 volts to 150 Volts.

Normal potential ratio of 1150 and 575 volts to 115 Volts.

Frequency rating from 25-125 cycles. Maximum secondary burden of 15 volt-ampere. Ratio accuracy is within 1/5 of 1% when used with model 341 or 326 meters. Complete in polished oak case with removable cover, lock and carrying strap.

List Price $247.50

Net Price $90.00 F.O.B. N. Y.

PORTABLE CURRENT TRANSFORMER

Weston Model 461 Type 4 (see illustration). This unit can be used with any precision 5 Amperes A.C. Meter to extend the ranges of the meter to 50, 100, 200, 250, 500 or 1000 Amperes A.C. Accuracy within ¼ of 1%; Normal Secondary Capacity = 15 Va; Binding Posts for 50 Ampere tap; Inserted primary for 100, 200, 250, 500 and 1000 Amperes; Insulated for use up to 2500 volts. List Price $98.00 .....NET fob, NY $35.00

PORTABLE CURRENT TRANSFORMER

WESTON 327 TYPE 2

5 Amp Secondary, 10/20/50 & 100 Amps on binding posts & 200/300/400/600/1200 Amps with inserted primary. Capacity 25 V.A., 2500 volt insulation, 25-133 Cycles. Ratio Accuracy on 60 cycle within 1/20 of 1%, on 25-60 cycle 1/5 of 1%. Phase Angle error will not exceed 5 minutes.

New in original manufacturers boxes.

List Price $206.25 YOUR COST ONLY $72.00

PORTABLE CURRENT TRANSFORMER

WESTON 539

2/5/10/20 Amps on binding post and switch. Inserted primary for 50/100 & 200 Amps. Capacity 2 V.A., Accuracy within 1%. Secondary 1 Amp for use with 1 Amp laboratory standard instruments.

New in original manufacturers boxes.

List Price $61.50 YOUR COST ONLY $26.50

CURRENT TRANSFORMER, General Electric P-3 Cat #248747, 5 Amp Secondary, binding posts for 15/20/30/40/60 and 80 Amps. 2500 volt insulation.

List Price $140.00 YOUR COST ONLY $32.50

"VIBROTEST" INSULATION RESISTANCE and A.C.-D.C. VOLTAGE TESTER

RESISTANCE RANGE: 0-200 Megohms (at 500 volt test potential) 0-2000 ohms.

VOLTAGE RANGE: 150-300-600 Volts D.C.
150-300-600 Volts A.C.

Push button action for resistance readings. Operates from internal power supply off two #6 dry cells. Large 4" meter and knife edge pointer insure accurate readings. Complete with test leads and instructions in metal carrying case.

Associated Research Model #201.
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931A	4.95
950	.98
954	.75
955	.75
956	.75
957	.75
958A	.75
959	2.95
991	.75
1608	4.95
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1613	.75
1614	1.75
1616	1.39
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1624	1.75
1625	.49
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HY615	1.25
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KU610	9.95
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REL36	.98
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RK25	2.95
RK33	.98
RK34	.59
RK39	1.75
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RK60	.79
RK65	24.95
RK72	1.95
RK73	3.95
RX120	10.00
SD809	4.95
T20	1.58
T55	3.95
T200	10.95
TZ20	1.50
TZ40	2.95
UH50	5.95
V70D	6.95
VR75	.98
VR78	.75
VR90	.75
VR91	1.49
VR105	.98
VR150	.75
VT127A	3.00
VU111	1.19
WL460	14.95
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Z225	1.95
ZH120	6.95
ZP477/12DP8	14.95
0A2	1.69
0A3/VR75	.98
0A4G	1.06
0B2	2.05
0B3/VR90	.75
0C3/VR105	.98
0D3/VR150	.75
OY4	.88
0Z4	.88
PZ4G	.88
O1A	.50
1A3	.72
1A4	1.28
1A4P	1.56
1A5GT	.72
1A6	1.28
1A7GT	.80
1B3GT	1.49
1B4	1.56
1B5/258	1.28
1B7GT	1.06
1C5GT	.88
1C6	1.28
1C7G	1.28
1D5GP	1.55
1D7G	1.28
1D8GT	1.56
1E5GT	1.38
1E7G	1.56
1F4	1.06
1F5G	1.06
1F6	1.56
1F7G	1.56
1G4GT	1.06
1G6GT	1.06
1H4G	.88
1H5GT	.66
1H6G	1.28
1H6GT	1.28
1J6GT	1.28
1L4	.80
1LA4	1.06
1LA6	1.06
1LB4	1.06
1LC5	1.06
1LC6	1.06
1LD5	1.06
1LE3	1.06
1LG5	1.06
1LH4	1.06
1LN5	1.06
1N5GT	.80
1P5GT	1.06
1Q5GT	1.06
1R4	1.06
1R5	.80
1S4	.96
1S5	.72
1T4	.80
1T5GT	1.06
1U4	.80
1U5	.72
1V	.88
2A3	1.28
2A4G	1.28
2A5	.88
2A6	1.06
2A7	1.06
2B7	.88
2V3G	1.98
2X2A	1.25
3A4	.39

Type	Price
3A5	$ 1.49
3A8GT	1.98
3B7	.36
3D6	.36
3LF4	1.28
3Q4	.88
3Q5GT	.96
3S4	.80
3V4	.80
5AZ4	.50
5R4GY	1.15
5T4	1.28
5U4G	.60
5V4G	.96
5W4	1.06
5W4GT	.66
5X4G	.72
5Y3GT	.42
5Y4G	.60
5Z3	.72
5Z4	1.06
6A3	1.28
6A6	1.06
6A7	.80
6A8	.80
6A8GT	.80
6AB5/6N5	.88
6AB7/1853	1.06
6AC5GT	1.16
6AC7/1852	1.16
6AD6	.88
6AD7G	1.28
6AF6	1.25
6AG5	1.06
6AG7	1.28
6AH6	1.56
6AJ5	.99
6AK5	1.56
6AK6	.96
6AL5	.80
6AL7GT	1.06
6AQ5	.80
6AQ6	.72
6AQ7GT	.88
6AR5	.66
6AS7G	4.95
6AT6	.60
6AU6	.80
6AV6	.60
6B4G	1.28
6B5	1.56
6B6G	.88
6B7	1.28
6B8	1.28
6B8G	1.28
6BA6	.80
6BE6	.72
6BG6G	1.92
6BH6	.80
6BJ6	.80
6C4	.39
6C5	.66
6C5GT	.66
6C6	.80
6C7	1.28
6C8G	1.28
6D6	.66
6D8G	1.28
6E5	.85
6E6	1.06
6F5	.66
6F5GT	.66
6F6	.80
6F6GT	.66
6F7	1.06
6F8G	1.28
6G6G	1.06
6H6	.60
6H6GT	.60
6J5	.54
6J5GT	.54
6J6	1.16
6J7	.80
6J7GT	.80
6J8G	1.28
6K5GT	.96
6K6GT	.60
6K7	.66
6K7GT	.66
6K8	.96
6K8GT	.96
6L5G	1.06
6L6	1.42
6L6G	1.16
6L6GA	1.16
6L7	.96
6L7G	1.16
6N6G	1.56
6N7	.96
6N7GT	.96
6P5GT	.96
6Q6G	1.06
6Q7	.80
6Q7GT	.72
6R7	1.06
6R7GT	1.06
6S7	1.28
6S7G	1.28
658GT	1.06
6SA7	.66

Type	Price
6SA7GT	$ .66
6SB7Y	.88
6SC7	.72
6SD7GT	.49
6SF5	.66
6SF5GT	.72
6SF7	.80
6SG7	.80
6SH7	.39
6SJ7	.66
6SJ7GT	.66
6SK7	.66
6SK7GT	.66
6SL7GT	.96
6SN7GT	.88
6SQ7	.60
6SQ7GT	.60
6SR7	.72
6SR7GT	.72
6SS7	.66
6ST7	.88
6SV7	.88
6T7G	1.24
6U5/6G5	.72
6U6GT	.72
6U7G	.72
6V6	1.28
6V6GT	.80
6W7G	.88
6X4	.60
6X5GT	.60
6Y6G	.96
6Y7G	.88
6Z7G	1.28
6ZY5G	.88
7A4/XXL	.72
7A5	.72
7A6	.72
7A7	.72
7A8	.72
7AD7	1.06
7AF7	.72
7AG7	.88
7AH7	.88
7B4	.72
7B5	.72
7B6	.72
7B7	.72
7B8	.72
7C4/12303A	.39
7C5	.72
7C6	.72
7C7	.72
7E5/1201	1.66
7E6	.72
7E7	.88
7F7	.88
7F8	1.06
7G7/1232	1.06
7H7	.80
7J7	1.06
7K7	1.06
7L7	.88
7N7	.88
7Q7	.72
7R7	.88
7S7	1.06
7V7	1.06
7W7	1.06
7X7/XXFM	1.06
7Y4	.72
7Z4	.72
10	.69
12A	.60
12A6	.39
12A6GT	.29
12A7	1.28
12A8GT	.80
12AH7GT	.88
12AL5	.80
12AT6	.60
12AT7	1.16
12AU6	.80
12AU7	.96
12BA6	.72
12BE6	.72
12C8	.69
12F5GT	.72
12H6	.39
12J5GT	.39
12J7G	.80
12J7GT	.80
12K7GT	.66
12K8	.88
12K8GT	.96
12Q7GT	.72
12SA7	.66
12SA7GT	.66
12SC7	.72
12SF5	.80
12SF5GT	.80
12SF7	.80
12SF7GT	.80
12SG7	.72
12SH7	.39
12SJ7	.66
12SJ7GT	.66
12SK7	.66
12SK7GT	.66
12SL7GT	.88

Type	Price
12SN7GT	$ .80
12SQ7	.60
12SQ7GT	.60
12SR7	.39
12SR7GT	.39
12X3	.98
12Z3	.88
14A7/12B7	.88
14AF7/XXD	.88
14B6	.88
14B8	.88
14C5	.88
14C7	.88
14E6	.72
14E7	.88
14F7	.88
14F8	1.06
14H7	.88
14J7	1.06
14N7	1.06
14Q7	.88
14R7	.88
14S7	1.06
14W7	1.06
14X7	1.06
14X4	.88
19	1.28
19T8	1.56
22	1.28
24A	.88
25A6	1.06
25A6G	1.06
25AC5GT	1.16
25L6GT	.66
25Y5	1.16
25Z5	.60
25Z6GT	.60
26	.72
27	.60
28D7	.39
30	.39
31	.39
32	1.28
32L7GT	1.28
33	.39
34	.38
35/51	.80
35A5	.72
35B5	.80
35L6GT	.66
35W4	.46
35Y4	.72
35Z3	.72
35Z4GT	.60
35Z5GT	.50
36	.39
37	.39
38	.39
39/44	.39
41	.66
42	.66
43	.66
45	.66
45Z3	.60
45Z5GT	.72
46	1.06
47	.96
49	.88
50	1.56
50A5	.88
50B5	.66
50L6GT	.66
50Y6GT	.72
53	1.06
56	.72
57	.80
58	.80
59	1.06
70L7GT	1.56
71A	.80
75	.66
76	.66
77	.66
78	.66
79	.88
80	.46
81	1.56
82	1.06
83	1.06
83V	1.28
84/6Z4	.72
85	.88
89	.72
89Y	.39
117L7GT	1.56
117M7GT	1.56
117N7GT	1.56
117P7GT	1.56
117Z3	.60
117Z4GT	1.16
117Z6GT	.96
FM-1000	1.28
UX120	1.38
UX200	1.28
9001	.89
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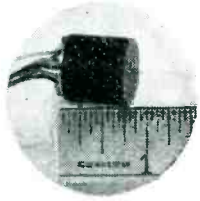

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W.E. D-168479

Millisecond switching at up to 60 c.p.s. Technical data on request. Stock #SA-259. **Price $4.75 ea. Special qty. prices.**

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General Electric ½ HP D-C Motor. Type 5BA50LJ66. Armature voltage 60 v. max. field 27 v. Armature current 9.25 amps. field 2.3 amps. 4600 rpm. 7" lg. x 4¼" diam. with 2½" worm gear shaft 5/8" diam. Stock #SA-270. **Price $12.50 each.**

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W.E. KS-5603-L02, 28 v. DC 0.6 amps. 1/100 hp. 4 lead shunt. Stock #SA-233.
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Delco 5069466 Motor

Alnico PM field, 27.5 v. DC, 1" x 1" x 2" lg. Pinion gear on shaft. Stock #SA-65. **Price $3.75 each plus 15¢ p.p.**

DELCO CONSTANT SPEED MOTOR A-7155

1/30 hp. 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** each.

Delco 506925 Constant Speed DC Motor, 27 v. DC. 120 rpm. Governor controlled. Stock #SA-249. **Price $3.95 each.** Qty. prices on request.

DC SERVO MOTORS

C-1 Autopilot Servo Unit—28 v. DC Shunt motor. 2250 rpm. 2 magnetic clutches, reduction gear, differential and 2 magnetic brakes. Output shaft 15 rpm. Torque 225 in/lbs.
Stock #SA-180 **Price $19.50 each**

Elinco B-64 DC Servo Unit—80 v. DC max. armature voltage, 27.5 v. field. 1/165 h.p. 3100 rpm. Field current 200 ma. Armature current 200 ma. at normal torque.
Stock #SA-211 **Price $12.50 each**

MICROWAVE ANTENNA

AS-217/APG 15B. 12 Cm dipole and 13 inch Parabola housed in weatherproof Radome 16" dia. 24 v. DC spinner motor for conic scan. Stock #SA-95. Shipping wt. 70 lbs.

Price $6.95 ea.

All prices F.O.B., Paterson.
Teletype PAT. 199
Phone ARmory 4-3366
Write for Listing.

Servo-Tek products co
4 Godwin Ave. Paterson, N. J.

RADAR TUBES

2J62 Magnetron 2914-3010 mc., 35 K.W..... $49.50
4C35 Thyratron..... $22.50
7BP7 Cathode Ray..... $7.50

MODEL AN/APA 10 PANORAMIC ADAPTER

Provides 4 Types of Presentation:
(1) Panoramic (2) Aural
(3) Oscillographic (4) Oscilloscopic

Designed for use with receiving equipment AN/ARR-7, AN/ARR-5, AN/APR-4, SCR-587 or any receiver with I.F. of 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

AN/APA-10 POWER SUPPLY

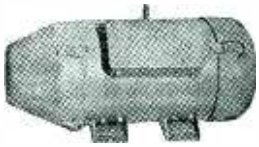
Input:
80 or 115 volts, 400 to 2600 cycles

Output:
1200 volts D.C. at 1.5 MA.
400 volts D.C. at 130 MA.
6.4 A.C. volts at 0.8A (ins. for 1500 v. D.C.)
Includes tubes; 1—5R4GY, 1—2x2, 1—6AK5, cathode ray tube socket, resistance capacitance filter, two focus controls, an intensity control and 6AK5 reinserter circuit.
Brand new. Complete..... $8.95

VOLTAGE REGULATOR CHASSIS AN/APA-10

Consists of 3 filter capacitors, choke, 2-VR150 tubes, etc. Can be used to regulate any 300 volt, power supply and provides 300 and 150 volt regulated taps. Complete as shown.
Price $4.95

NAVY 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 230 V. D.C. input $125.00

O'Keefe and Merritt, 115V. D.C. to 120V. A.C., 50 cycles, 2 K.V.A., Pf. .9.
New $165.00

Diehl 120V. D.C. to 120V. A.C., 60 cy., 1 Ph. 2.5 K.V.A. Complete with magnetic controller, 2 field rheostats and full set of spare parts including spare armatures for generator and motor.
New $185.00

Electrolux Dynamotor 105/130 V. 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

MERCURY CONTACT RELAYS

WESTERN ELECTRIC
TYPE D-168479

These relays are glass sealed, mercury-wetted contact switches surrounded by operating coils and encased in metal housings, mounted on an octal tube base.

TYPICAL APPLICATIONS

- High speed keying
- Tabulating, sorting and computing machines
- Relay Amplifiers
- Vibrator Power Supplies
- Servo-mechanisms

CHARACTERISTICS

- High speed of operation
- Constant operating characteristics
- Freedom from chatter
- High current capacity
- Long, trouble-free service

Single Pole, Double Throw Contacts. Two coils of 700 ohms and 3300 ohms. Operating current with coils connected in series 6.6 ma. Release current 5.2 ma.

When operated under specified conditions this relay has a life expectancy of 1000 hours at 60 operations per second.

Overall length—3-3/8". Overall dia.—1-5/16"

Brand new Priced at a fraction of Government cost $4.75

Send for 4 page Technical data

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 1 ¼" overall. Made for U. S. Navy.
New Surplus $1.10

LINEAR SAWTOOTH POTENTIOMETER

W.E. No. KS 15138

Input 24 volts D.C. Output varies in accordance with linear sawtooth wave.
Brand New $5.75

SELENIUM RECTIFIER

Bridge Type

Input: 36 V. AC.
Output: 28 V. DC., 1.1 Amps.
Brand New. . $2.75

STEPDOWN TRANSFORMERS

Input: 115 V. 60 cycles.
Output: 20 V., at 10 amps.
Also tapped at 6V., for pilot light. Ideal for Selenium Rectifier Applications, etc.
Brand New. . $2.45

RELAY

Clare octal base Relay No. 30FMX 115V. 60 cy. 0.140 amp. Res. 75 ohms. Makes two breaks one.
Brand New $1.45

SHOCK MOUNTS

Lord #20, 3" x 3" x 1¾"..... .30
U. S. Rubber #5150 C, 2⅜" x 2⅜" x 1⅛"..... .20
Lord 15, 2⅜" x 2⅜" x 1⅛"..... .20
Lord #10, 1¼" x 1¼" x ⅝"..... .10
Lord #3, 1¼" x 1¼" x ⅜"..... .10

PARABOLOIDS

17½" diameter, spun magnesium dishes, 4 inches deep. Reinforced perimeter. Two sets of mounting brackets on rear. Opening at apex for waveguide dipole assembly 1⅛" x 1⅝".
Brand new, per pair, $8.75

SOUND POWERED FIELD SETS

TYPE TP-3
No batteries needed. Brand new in Waterproof fabric carrying case with strap.
Per Unit $29.50
Per Pair 55.00

W. E. CRYSTAL UNITS TYPE CR-1A/AR

Available in quantity—following frequencies
5910 - 6350 - 6370 - 6470 - 6510 - 6610
6670 - 6690 - 6940 - 7270 - 7350 - 7380
7390 - 7480 - 7580 - 9720 - Kilocycles
Brand New..... $1.00 each

25,000 Volt Inerteen Filled ½ MFD. Type FP CAPACITORS

Brand New . . $23.50
Shipping weight 35 lbs.

SYNCHROS in Stock

Navy Types, 5F, 5DG, 5SF, 5SDG, 6DG
Prices on request

WESTERN ELECTRIC

Type O #D173312
SOUND POWERED CHEST SETS
No Batteries Required
Ideal for television installers, or any antenna measurement work. Leaves hands free to make adjustments. Consists of microphone and headset as illustrated.
Brand New Each $19.50

RADAR COMPONENTS

CRP-23AGC Load Dividers for use with S.G. Modernization Kits. New.
CBM-50AFO Navy type Radar Repeater Adapters. New and complete with 14 tubes, coax fittings, installation plans and wiring diagrams.
SO Series Radar P.P.I. Units and accessory Control Panels. New.
Syncho Amplifiers. New.
Type CARD 23AEK Bearing Control Units. New.
Type T.D.Y., SO-1, SO-13, SO-3 Radar Antenna Assemblies. New.
Radar Crystals Raytheon 98.35 KC.
Type SO-11 Radar Modulator.
Type SO-1 and SO-13 Transmitter Receivers.

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

RELIANCE SPECIALS

COAXIAL CABLES

RG 8/U 52 OHM—Per 1,000 ft. $50.00
RG 22/U 95 OHM (2 cond.) per 1000 ft. . .$120.00
RG 62/U 93 OHM per 1000 ft. $ 40.00

COAXIAL CABLE CONNECTORS

Angle Adapter	Plug	Socket	Hood
15c	28c	28c	9c
M-359	PL-259	SO-239	83-IH
83-IAP	83-ISP	83-IR	

Adaptor for PL-259/A for use on small coax. 812¢ each .....$10.00 per 100

3-1SPN	$.28	UG 13/U	$.60	UG 59/U	$.60
83-1J	.65	UG 21/U	.60	UG 60/U	.60
83-1T	1.12	UG 22/U	.60	UG 61/U	.60
3-22AP	.85	UG 24/U	.60	UG 85/U	.60
83-22J	.85	UG 87/U	.50	UG 167/U	2.00
83-2J	1.50	UG 25/U	.60	UG 281/U	.60
83-22R	.40	UG 27/U	.60		

"AB" CARBON RESISTORS

½ Watt Resist	Tol.	½ Watt Resist	Tol.	1 Watt Resist	Tol.
1,300Ω	5	180KΩ	10	360Ω	5%
1,600	5	300K	5	560	5
3,300	10	390K	10	3,300	10
3,600	10	1.3 meg.	10	5,600	5
12K	10	3 meg	10	10K	5
30K	10	$3 PER HUNDRED		18K	10
33K	10			$4 PER HUNDRED	
33K	5	1 Watt		2 Watt	
39K	10			6.8 meg.	10
75K	10	27 Ω	10	$5 PER HUNDRED	
150K	10	43	5		

POWER RHEOSTATS

Resist.	Mfg.	Shaft	
25 WATT			
10Ω	Clarostat	1/16"	$.49
15	Ohmite	1/16"	.59
25	IRC	S.D.	.49
35	Ohmite	1/16"	.59
50	Clarostat	1/16"	.49
145	Grimes Mfg.	½" with switch	.49
200	IRC	1/16"	.49
250	Ohmite	1/16"	.59
370	IRC	½"	.49
1,500	Clarostat	1/16"	.49
2,000	Ohmite	1/16"	.69
2,500	Ohmite	S.D.*	.69
3,500	Ohmite	1/16"	.69
5,000	Ohmite	S.D.*	.69
50 WATT			
2	Ohmite	1/16"	.69
6	Ohmite	1/16"	.69
8	Ohmite	S.D.*	.69
10	Ohmite	1/16"	.69
12	Ohmite	1/16"	.69
20	Ohmite	1/16"	.69
50	Ohmite	1/16"	.69
50 WATT			
90Ω	Clarostat	½"	$.59
123	IRC	½"	.59
1,250	Ohmite	½"	.79
2,000	Ward Leonard	½"	.79
3,500	Ohmite	⅛"	.59
100 WATT			
2Ω	Ohmite	½"	.59
25	Ohmite	½"	.59
10,000	Ohmite	S.D.*	.79
150 WATT			
8Ω	Ohmite	½"	1.99
75	Ohmite	1/16"	1.99
100	Ohmite	1/16"	1.99
300 WATT			
100Ω	Ohmite	2"	3.75
150	Ohmite	2"	3.75
400 WATT			
500Ω	Ohmite	2"	6.75

*S.D. Screw Driver Slot

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	235Ω	4,451Ω	15,000Ω
.334	13.15	260.4	5,000	15,750
.502	46	270	5,900	17,000
.557	52	298.3	6,500	30,000
.627	55	400	7,000	100,000
.76	75	723.1	7,500	150,000
1.01	97.8	2,500	8,000	
1.53	125	2,850	8,500	
2.04	180	3,427	10,000	
	21	4,000	14,825	

1 WATT—30c

1.01Ω	5.21Ω	1,250Ω	9,000Ω	55,000Ω
2.58	10.1	3,300	18,000	55,000
3.39	10.9	7,000	50,000	70,000
5.05	270			

1 WATT—40c

100,000Ω	128,000Ω	180,000Ω	522,000Ω	700,000 Ω
120,000	130,000	320,000	600,000	
125,000	160,000	470,600		

1 Megohm—1 Watt 1%—65c; 5%—40c
Orders for 100 pieces—10% off;
Orders for 1,000 pieces—20% off.

CAPACITORS

POSTAGE STAMP MICAS

8.2 mmf	50 mmf	240 mmf	650 mmf	.002 mfd
10	56	350	680	.0026
18	60	370	800	.0027
20	68	400	.001 mfd	.003
22	90	470	.0012	.0039
25	100	500	.0013	.005
39	150	510	.00135	.008
40	160	560	.0015	.01
47	220	600	.00136	

Price Schedule

8.2mmf to .001mfd 5c .0026mfd to .008mfd 12c
.0012mfd to .002mfd 7c .01 mfd 18c

SILVER MICAS

10 mmf	150 mmf	390 mmf	600 mmf	.002 mfd
39	180	400	620	.0024
50	200	430	665	.0025
62	208	466	680	.0027
66	240	470	700	.003
68	250	488	750	.0033
100	300	500	820	.0039
110	330	510	.001 mfd	.004
120	360	525	.0012	.005
125	370	560	.0013	.0051
			.0015	.01

Price Schedule

10mmf to .001mfd 10c .003mfd to .0051mfd 50c
.0012mfd to .0027mfd 20c .01 60¢

OIL FILLED

MFD	V.D.C.	Price
.1	25,000	$14.95
.03	16,000	4.50
.375@	16,000 and	
.75@	8,000(dual)	8.95
5	7,500	23.95
.1	7,500	1.85

2 mfd. 4,000 V. D. C. #23F47 SPECIAL $4.50

MFD	V.D.C.	Price
.1-.1	7,000	$1.95
.1	7,000	1.75
.02-.02	7,000	1.65
1	6,000	8.50
.1	6,000	1.75
.03-.03	6,000	1.65
2	4,000	4.50
.25	3,000	1.75
.2	750 V.A.C. (2,200 V.D.C.)	.39
1	2,000	.95
10	1,000	1.70
4	1,000	.90
3	1,000	.80
2	1,000	.65
1	800	.40
10	600	1.00
4	600	.69
2	600	.39

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. 3201	15/32"	1 1/4"	3/8"	.60
N.D. 5202C13M	1/2"	1 3/8"	1/8"	1.00
Fafnir 7308W	1 37/64"	3 9/16"	15/16"	2.00
SKF 466430	6"	8"	1"	5.00
SKF 170645	3 11/32"	4 1/8"	7/16"	1.50
Fafnir K37B	2 5/16"	3 1/16"	11/32"	1.00
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¢

TIME DELAY RELAY

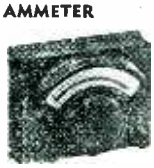
Raytheon CPX 24166
KS 10193-60 Sec.

- 115 V., 60 Cycle
- Adj. 50-70 Seconds
- 2½ seconds recycling time, spring return
- Micro Switch Contact, 10A
- Holds On as long as power is applied. Fully Cased

ONLY $6.50

GEAR ASSORTMENT — Experimenter's dream. Approx. 100 pieces, many stainless steel and brass.....$6.50

DC AMMETER
O-15A BASIC MOVE. 12 Ma 5" x 4" METAL CASE MIRROR SCALE Lots of 10—$34



$3.85 ea.

CHOKE
400 MA 12 H 90 Ω 6,000 V.D.C. TEST $3.85

10 for $34.00

CARBON MICROPHONE—T 17 and matching transformer $1.49
AN CONNECTORS. Large stock on hand. Inquiries welcomed.

PULSE TRANSFORMERS

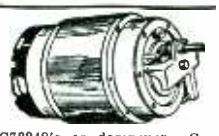
X 124 T2, UTAH, marked 9262 or 9280, small gray case 1⅞" high x 1⅛" x ⅝" with two 6-32 mtg. studs. Ratio 1:1:1, hypersil core....$1.50
352-7178—Spec. 10, 111 Chicago Trans., equivalent to 9262 (above).....$1.50
TR 1048, Dinion Coil Co.....$1.25
TR 1019, Dinion Coil Co.....$1.25
352-7250-2A, cased 15/16" dia. x 1⅝" high, DC 10 ohm, 3½ ohm, 140 cy. to 175 KC.....$1.25
352-7251-2A, similar—shorter pulses.....$1.25
D161310, 50 Kc to 4 Mc. 1¾" dia. v 1⅞" high, 120 to 2350 ohms.....$3.00
KS9800, Ratio, 1.1:1, 2:1, Freq. range 380 to 520 C.P.S.....$3.50
D166173, W. E. Freq. response 10KC to 2 MC $9.80
300 KVA GE 7557296, 50 ohm pulse cable connection; 3,850 V. in., 17,300 V. out. (250 KVA @ ¼ microsecond) $11.75
800 KVA G.E. K2731, 28,000 Volt pk, output; Bifilar, pulse width; one-microsecond..$14.50

SELSYNS

115 V., 60 Cyc.
3¼" dia. x 4½" body
#C78248
$7.25
pair

DIFFERENTIAL

115 V., 60 Cyc.
#C78249
$2.25
ea.



Used between two #C78248's as dampener. Can be converted to a 3600 RPM Motor in 10 Minutes. Conversion sheet supplied
Mounting Brackets—(Bakelite) for selsyns, and differentials shown above.....25¢ pair

ALLEN SET SCREWS

4-40 x 1/8	6-32 x 1/8	8-32 x 5/16
4-40 x 3/16	8-32 x 1/8	8-32 x 3/8

ALL SIZES (Cup Point).....$1.50 per 100

UNIVERSAL JOINT

ALUMINUM
1⅛" long x ½" O. D. ¼" ID
ONLY **40c**

PRECISION POTENTIOMETERS

6 WATT				**4 WATT**			
20,000Ω	Muter	314A	$1.70	500Ω	Centralab	48-501	$.90
20,000	GR	314A	2.50	50	De jur	292	.75
6,000	GR	314A	2.50	50	GR	301	1.1
6,000	De jur	260	1.70	25	GR	301	1.10
6,000	Muter	314A	1.70	20	De jur	292	.70
5,000	Muter	314A	2.50	20	GR	301	1.15
5,000	GR	314A	2.50	12	GR	301	1.10
5,000	GR	214A	1.40				0
2,000	De jur	260	1.70	**12 WATT**			
600	GR	314A	2.25	10,000Ω	GR	471-AS15	3.50
200	GR	214A	1.40	10,000	De jur	271T	2.00
40	GR	214A	1.40	5,000	De jur	271T	2.00

JONES BARRIER STRIPS

Type	Price	Type	Price	Type	Price
2-140 Y	$ .05	15-140 Y	$ .59	4-142	$ .19
3-140	.10	4-141	.16	5-142	.21
3-140	.12	5-141	.19	7-142	.32
4-140	.13	5-141-¾W	.27	8-142	.39
4-140 Y	.17	5-141 Y	.25	9-142	.41
5-140 Y	.21	6-141	.23	10-142	.45
6-140	.18	7-141 Y	.37	11-142	.48
6-140 Y	.25	8-141 ¾W	.38	11-142 ¾W	.57
7-140	.21	9-141	.37	12-142	.53
8-140	.23	9-141 Y	.42	13-142	.57
10-140	.41	10-141 ¾W	.47	13-142 ¾W	.82
10-140 Y	.40	11-141	.40	14-142	.61
13-140	.36	12-141	.43	15-142 ¾W	.94
		17-141 Y	.78	17-142 Y	.97

Any order for 100 pieces—10% off

FERRILE RESISTOR ASSORTMENT

The surplus buy of a lifetime!

35 Ferrile Resistors from 15 Watts to over 100 Watts. Big resistance range.....$5.00

MINIMUM ORDERS $3. All orders f.o.b. PHILA., PA.

RELIANCE MERCHANDIZING CO.

12th St. Cor. Buttonwood, Phila. 23, Pa. *Telephone MArket 7-2401*

SALE BELOW WHOLESALE of Brand New Burlington Panel Instruments

A huge special purchase by Boston's famous RADIO SHACK brings you precision instruments at startling savings! Each is brand new (not surplus) in original carton, with such proud BURLINGTON features as: aligned jewel supports, precision machined pole pieces, ceramic pointer stops, non-shifting balance weights, black bakelite housing, accuracy within 2% of full scale at any point on scale! AC is repulsion vane type. DC have Alnico magnets, soft iron pole pieces, magnetic shunt.

AC AMMETERS

RANGE	DESCRIPTION	MODEL	PRICE
0-1	3" sq.	532	$3.95
0-1	3½" rd.	432	4.25
0-1	4¼" sw. board	142	4.25
0-1	4¼" rect.	742	4.25
0-1	2½" rd.	422	3.25
0-1.5	2½" sq.	522	3.25
0-1.5	3" sq.	532	3.95
0-1.5	3½" rd.	432	4.25
0-1.5	4¼" rect.	742	4.25
0-3	2½" sq.	522	3.25
0-5	2½" sq.	522	3.25
0-5	3" sq.	532	3.95
0-5	3½" rd.	432	3.95
0-5	4¼" sw. board	142	4.50
0-5	4¼" rect.	742	4.50
0-5	3" sq.	532	3.50
0-10	3½" rd.	432	3.50
0-10	4¼" sw. board	142	3.50
0-10	4¼" rect.	742	3.50
0-10	4½" rd.	442	3.50
0-10	2½" sq.	522	2.95
0-15	3" sq.	532	3.50
0-15	3½" rd.	432	3.50
0-15	4¼" sw. board	142	3.50
0-15	4¼" rect.	742	3.50
0-15	4½" rd.	442	3.50
0-25	2½" rd.	422	2.95
0-25	2½" sq.	522	3.50
0-25	3" sq.	532	3.50
0-25	4¼" sw. board	142	3.50
0-25	4¼" rect.	742	3.50
0-25	2½" rd.	422	2.95
0-30	2½" sq.	522	2.95
0-30	3" sq.	532	3.50
0-30	3½" rd.	432	3.50
0-30	4¼" sw. board	142	3.50
0-30	4¼" rect.	742	3.50
0-50	2½" sq.	522	2.95
0-50	3" sq.	532	3.50
0-50	3½" rd.	432	3.50
0-50	4¼" sw. board	142	3.50
0-50	4¼" rect.	742	3.50
0-50	4½" fan shaped	842	3.50
0-50	4½" rd.	442	3.50
0-75	2½" rd. (5 amp. mov't)	422	2.95
0-75	2½" sq. (5 amp. mov't)	522	2.95
0-75	3" sq. (5 amp. mov't)	532	3.50
0-75	3" sq. (75 amp. mov't)	532	3.50
0-75	3½" rd. (5 amp. mov't)	432	3.50
0-75	3½" rd. (75 amp. mov't)	432	3.50
0-75	4¼" rect. sw. board (75 amp. mov't)	142	4.25
0-75	4¼" rect. (75 amp. mov't)	742	3.50
0-75	4½" rd. (75 amp. mov't)	442	4.95
0-100	2½" rd. (5 amp. mov't)	422	2.95
0-100	2½" sq. (5 amp. mov't)	522	2.95
0-100	3" sq. (5 amp. mov't)	532	3.50
0-100	3½" rd. (5 amp. mov't)	432	3.50
0-100	4¼" sw. board (5 amp. mov't)	142	3.50
0-100	4¼" rect. (5 amp. mov't)	742	3.50
0-100	4½" fan shaped	842	3.50
0-100	4½" rd. (5 amp. mov't)	442	4.95

AC AMMETERS

RANGE	DESCRIPTION	MODEL	PRICE
0-150	2½" sq. (5 amp. mov't)	522	$2.95
0-150	3" sq. (5 amp. mov't)	532	3.50
0-150	3½" rd. (5 amp. mov't)	432	3.50
0-150	4¼" sw. board (5 amp. mov't)	142	3.50
0-150	4¼" rect. (5 amp. mov't)	742	3.50
0-150	4½" fan shaped	842	3.50
0-200	2½" rd. (5 amp. mov't)	422	2.95
0-200	2½" sq. (5 amp. mov't)	522	2.95
0-200	3" sq. (5 amp. mov't)	532	3.50
0-200	3½" rd. (5 amp. mov't)	432	3.50
0-200	4¼" sw. board (5 amp. mov't)	142	3.50
0-250	3" sq. (5 amp. mov't)	532	3.50
0-250	4¼" sw. board (5 amp. mov't)	142	3.50
0-250	4¼" rect. (5 amp. mov't)	742	3.50
0-300	2½" rd. (5 amp. mov't)	422	2.95
0-300	2½" sq. (5 amp. mov't)	522	2.95
0-300	3" sq. (5 amp. mov't)	532	3.50
0-300	3½" rd. (5 amp. mov't)	432	3.50
0-300	4¼" sw. board (5 amp. mov't)	142	3.50
0-300	4½" rect. (5 amp. mov't)	742	3.50
0-300	4½" fan shaped	842	3.50
0-400	4¼" sw. board (5 amp. mov't)	142	3.50
0-400	4¼" rect. (5 amp. mov't)	742	3.50
0-500	4¼" sw. board (5 amp. mov't)	142	3.50
0-500	4¼" rect. (5 amp. mov't)	742	3.50
0-600	4¼" sw. board (5 amp. mov't)	142	3.50
0-1000	4¼" sw. board (5 amp. mov't)	142	3.50

AC MILLIAMMETERS

RANGE	DESCRIPTION	MODEL	PRICE
0-10	2½" rd.	422	2.95
0-10	2½" sq.	522	2.95
0-10	3" sq.	532	3.50
0-25	2½" rd.	422	2.95
0-25	2½" sq.	522	2.95
0-25	3" sq.	532	3.50
0-25	3½" rd.	432	3.50
0-50	2½" rd.	422	2.95
0-50	2½" sq.	522	2.95
0-50	2½" rd.	422	2.95
0-100	2½" sq.	522	2.95
0-100	2½" sq.	532	3.50
0-250	3" sq.	432	3.50
0-250	3½" rd.	432	3.50
0-400	3½" rd.	422	2.95
0-500	2½" rd.	522	2.95
0-500	2½" sq.	532	3.50
0-500	3" sq.	432	3.50
0-500	3½" rd.	432	3.50

AC VOLTMETERS

RANGE	DESCRIPTION	MODEL	PRICE
0-1	2½" sq.	522	$2.95
0-1	3" sq.	532	3.50
0-1	3½" rd.	432	3.50
0-1	4¼" sw. board	142	3.50
0-1	3½" rd.	432	3.50
0-3	4½" rect.	742	3.50
0-3	2½" sq.	522	2.95
0-5	2½" rd.	422	2.95
0-5	3½" rd.	432	3.50
0-5	4¼" sw. board	142	3.50
0-5	4¼" rect.	742	3.50
0-10	2½" sq.	522	2.95
0-10	2½" rd.	422	2.95
0-10	3" sq.	532	3.50
0-10	3½" rd.	432	3.50
0-10	4¼" sw. board	142	3.50
0-10	4¼" rect.	742	3.50
0-15	2½" sq.	522	2.95
0-15	2½" rd.	422	2.95
0-15	3" sq.	532	3.50
0-15	3½" rd.	432	3.50
0-15	4¼" sw. board	142	3.50
0-15	4¼" rect.	742	3.50
0-25	2½" sq.	522	2.95
0-25	2½" rd.	422	2.95
0-25	3" sq.	532	3.50
0-25	4¼" sw. board	142	3.50
0-25	4¼" rect.	742	3.50
0-30	2½" sq.	522	2.95
0-30	2½" rd.	422	2.95
0-30	3" sq.	532	3.50
0-30	3½" rd.	432	3.50
0-30	4¼" sw. board	142	3.50
0-30	4½" rd.	442	3.50
0-30	4½" rect.	522	2.95
0-50	2½" sq.	522	2.95
0-50	2½" rd.	422	2.95
0-50	3" sq.	532	3.50
0-50	3½" rd.	432	3.50
0-50	4¼" sw. board	142	3.50
0-50	4½" rect.	742	3.50
0-50	3½" rd.	432	3.50
0-75	2½" sq.	522	2.95
0-100	2½" sq.	422	2.95
0-100	2½" rd.	532	3.50
0-100	3" sq.	432	3.50
0-100	3½" rd.	142	3.50
0-100	4¼" sw. board	442	3.50
0-100	4½" rd.	522	3.25
0-100	2½" sq. (metal case)	422	3.25
0-150	2½" rd.	422	3.25
0-150	3" sq.	532	4.50
0-150	3½" rd.	432	4.50
0-150	4¼" sw. board	142	4.50
0-150	4½" rect.	742	4.50
0-150	4½" fan shaped	842	4.50
0-150	4½" rd.	442	4.50
0-250	2½" rd.	422	3.50
0-250	4¼" sw. board	142	5.25
0-300	2½" sq.	522	2.95
0-300	2½" rd.	422	2.95
0-300	3" sq.	532	4.50
0-300/600	3½" rd. (300v. mov't) w/res.	432	4.50
0-300	4¼" sw. board	142	4.95
0-300	4½" rect.	742	4.50
0-300	4½" fan shaped	842	4.25
0-300	4½" rd.	442	4.50
0-500	4¼" sw. board	142	4.95
0-500	4½" rect.	742	4.95
0-500	4½" fan shaped	842	4.95
0-500	4½" rd.	442	4.95
0-600	2½" sq.	522	3.50
0-600	3½" rd. (150v. mov't) w/res.	432	4.50
0-600	3½" rd. (300v. mov't) w/res.	432	4.50
0-600	3½" rd. (600v. mov't) w/res.	432	4.50
0-600	4¼" sw. board	142	4.95
0-600	4½" rect.	742	4.95
0-600	4½" rd.	442	4.95

DC AMMETERS

RANGE	DESCRIPTION	MODEL	PRICE
0-1	2½" rd.	421	$2.95
0-1	2½" sq.	521	2.95
0-3	2½" sq.	521	2.95
0-25	2½" rd.	521	2.95
0-200	2½" rd. (50 m.v. mov't)	421	2.95
0-200	2½" sq. (50 m.v. mov't)	521	2.95
0-500	2½" rd. (50 m.v. mov't)	421	2.95
0-500	2½" sq. (50 m.v. mov't)	521	2.95
0-1000	2½" sq. (50 m.v. mov't)	521	2.95
0-1000	2½" rd. (50 m.v. mov't)	421	2.95
0-1500	2½" rd. (50 m.v. mov't)	421	2.95
120-0-120	2½" sq. (50 m.v. mov't)	521	2.95

DC MILLIAMMETERS

RANGE	DESCRIPTION	MODEL	PRICE
0-5	2½" rd.	421	2.95
0-5	2½" sq.	521	2.95
0-10	2½" sq.	521	2.95
0-15	2½" sq.	421	2.95
0-30	2½" rd.	421	2.95
0-100	2½" rd.	521	2.95
0-100	2½" sq.	421	2.95
0-200	2½" rd.	521	2.95
0-200	2½" sq.	521	2.95
0-750	2½" sq.	421	2.95
0-1000	2½" rd.	521	2.95
0-1000	2½" sq.	521	2.95

DC MICROAMMETERS

RANGE	DESCRIPTION	MODEL	PRICE
0-50	2½" sq.	521	6.95
0-50	2½" rd.	421	6.95
0-100	2½" sq.	521	5.50
0-100	2½" rd.	421	5.50
0-300	2½" sq.	521	3.95
0-300	2½" rd.	421	3.95
0-500	2½" rd.	421	3.95

DC VOLTMETERS

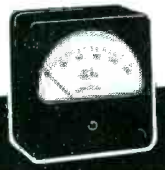
RANGE	DESCRIPTION	MODEL	PRICE
0-3	2½" sq.	521	2.95
0-5	2½" sq.	521	2.95
0-5	2½" rd.	421	2.95
0-15	2½" sq.	521	3.50
0-40	2½" sq.	521	2.95
0-100	2½" sq.	521	2.95
0-200	2½" sq.	521	2.95
0-300	2½" sq.	521	2.95
0-300	2½" rd.	421	2.95

RF AMMETERS

RANGE	DESCRIPTION	MODEL	PRICE
0-5	2½" sq. w/simpson 0-006115 ext. thermocouple	523	4.95
0-5	3" sq. w/simpson 0-006115 ext. thermocouple	533	4.95
0-10	3" sq. w/simpson 0-006158 ext. thermocouple	533	4.95
0-10	3" sq. w/simpson 0-006159 ext. thermocouple	533	4.95


ROUND


RECTANGULAR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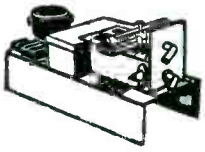

420—750 MC OSCILLATOR.

Compact, beautifully built line oscillator employing two W.E. 368AS (703A) "doorknob" tubes in push pull. Exceptionally stable. 5W output at 420mc, 2W at 700 mc. Independent grid and plate tuning. Adjustable output coupling and tuning assembly. Coaxial output connection. Built-in blower may be operated from 110VAC. Power requirements: 300VDC/150ma, 1.2V/4A, 1.2V/4A. 5¼"x6½"x11½". 7 lb. Supplied complete with tubes. Ideal for 420mc amateur operation or for use in the 460-470mc citizens radio band. **Stock No. APO-66...$8.95**
Spare 368AS/703A tubes.....**$1.69 ea.**

UHF 50 OHM COAXIAL POWER MEASURING ASSEMBLY. Panel with integrally coupled crystal mounting, silver-plated assembly mount. Type "N" UG-58U female receptacle (easily replaced by SO-239). Originally designed for power measurement at frequencies up to 700 mc. **Stock No. AMP-89** **$3.95**
MATING TYPE "N" MALE PLUG. For use with above. **Stock No. PCM-17**.....**$0.49**

SPERRY MODEL 12 KLYSTRON TUNER for use with 2K39, 2K42, 2K43, 2K44, 417A. **Stock No. VKT-27** **$1.95**
MAGNETRON MAGNET 1900 GAUSS. Pole dia. 1-⅝. Gap 1½". **Stock No. UMM-21** **$5.75**
MAGNETRON MAGNET 4800 GAUSS. Pole tip dia. ¾". Gap 0.635". **Stock No. UMM-48** **$7.00**

50 OHM COAXIAL RELAY. Double coil actuating relay operates from either 12VDC/120ma or 24 DC/60ma. May be operated in plate return circuits to provide automatic transmitter-receiver antenna changeover. Supplied with British type connectors which are easily replaced by standard SO-239 (83-1R) receptacles or soldered to directly. Completely enclosed in compact housing. 2-¾" x 3" x 4-¾". An outstanding buy at **$2.49. Stock No. KDC-723.**

VARIABLE INDUCTOR. 67 microhenries max. Minimum near **zero.** Wheel type **sliding short.** Ceramic **insulation.** Quality construction. Barker-Williamson #1565. Originally used as transmitter plate tank coil to tune from 1½ to 20mc. Ideal for pi-networks, antenna tuners and plate tanks. **Stock No. LRF-32**.....**$1.95**

APC AIR TRIMMER. 35 mmf max. Screw slot adjustment. **STOCK NO. CAV-105. 10 for** **$1.00**
APC AIR TRIMMER. Two separate trimmers on ceramic base. Shield between sections. Each section 25 mmf max. **Stock No. CAV-104** .....**10 for $1.00**
AIR CAPACITOR 100 MMF MAX. ¼" dia. shaft. **Receiving type Ceramic insulation.** Standard Brand. Similar to MC-100-M. Straight-line capacity. **Stock No. CAV-15** **$0.72**

SUPER-FLEXIBLE PIGTAIL WIRE. Sperry Special. Part No. P55357. Consists of 350 strands of 0.002" diameter soft copper wire. Total diameter: 1/32". Useful in applications where electrical connection is to be made to moving parts, e.g., variometers, variable capacitors, motor-brushes, etc. **Stock No. WFP-350. 10 foot rolls. $0.69 per roll.**

750 CPS BANDPASS TRANSFORMER. Center frequency adjustable over a small range. Input 23,000 ohms. Output 225,000 ohms. Triple alloy shielded. 1¼" x1½"x2". **Stock No. ZBP-750** **$2.49**

BLOCKING OSCILLATOR TRANSFORMER. Two winding 1.35:1. Ideal for television sweep oscillators. Compact. **Stock No. TFF-64 $0.95.**

INVERTER PE 218D. Output 115V/400 cps/1500VA/1ph. Input 24-28 VDC. Made by Wincharger. Complete with starting relays, hash filters, voltage and speed regulators. 5½"x11"x15". Brand new in original packings. **Stock No. GAC-10**.**$27.50**

3" SCOPE INDICATOR. 3BP1 cathode ray tube mounted in a mu-metal housing with an adjustable light shield. May be mounted on a panel, tabletop or clamped to a bar. When mounted on a table top or wall, the scope housing may be tilted at any angle up to 45° from the mount for comfortable viewing. Ideal for remote scope indicators. An outstanding buy at $5.95. Stock No. AS1-35.

Tube Specials

1A7GT	$0.72	6SA7GT	.60	211	.25
1G6GT	.49	6SC7	.69	215A	.95
1V	.49	6SF7	.72	304TH	7.75
2A3	.98	6SH7GT	.39	304TL	1.95
2C4	.95	6SJ7	.59	316A	.89
2C21/1642	.29	6SJ7GT	.49	350A	2.95
2C34/RK34	.29	6SK7	.72	417A	14.95
2C40	1.98	6SL7GT	.69	559	1.19
2C44	.75	6SN7GT	.79	705A	2.95
2D21	1.49	6SR7	.67	723A/B	12.95
2J26	14.95	6SU7GT/Y	1.29	725A	14.95
2J38	14.95	6V6GT	.79	730A	12.50
2J48	15.95	6V6	1.09	801	.79
2K28	15.95	6X4	.69	805	3.95
2X2	.69	6X5GT	.63	807	1.19
3B7/1291	.39	6Y6G	.88	811	1.95
3C23	2.95	6ZY5G	.81	813	7.95
3D21A	1.95	7C7	.81	814	3.95
3FP7	1.95	7E6	.72	815	1.95
3Q4	.69	7G7	1.06	837	1.49
4A1	.49	7H7	.72	861	15.00
5BP1	1.95	7Q7	.72	872A	1.69
5CP1	1.95	7V7	.72	874	.59
5R4GY	1.09	7Y4	.72	902A	3.95
5U4G	.65	7Z4	.72	931A	3.95
5V4G	1.09	12SP7	.59	954	.39
5Y3GT/G	.49	12SQ7	.59	955	.39
6AC7	.79	12SH7	.59	956	.49
6AE5GT	.79	12SJ7	.59	957	.39
6AG7	1.29	12SL7GT	.79	958A	.39
6AK5	1.29	12SQ7	.65	959	.39
6AU6	.95	12SR7	.72	991/NE-16	.29
6C4	.49	14F7	.72	1625	.49
6C8G	.72	14H7	.79	1626	.39
6F6	.89	14N7	.72	1629	.29
6F8G	.89	RK21	.95	1641/RK60	.95
6G6G	.49	25Z5	.59	2050	.79
6H6	.49	25Z6GT	.59	8013	1.49
6H6GT/G	.29	35W4	.49	9001	.39
6J5	.57	46	.72	9002	.39
6J6	1.15	EF50	.49	9003	.39
6J7	.69	RK69	1.49	9004	.39
6K6GT/G	.65	RKR72	1.49	9006	.39
6K8	.88	RKR73	.39	VR90	.89
6L6	1.28	80	.45	VR105	.89
6L6GA	.89	85	.72	VR150	.69
6L7	.98	89Y	.54	VR75	1.09
6N7	.95	117Z6GT/G	.88		
6Q7	.72	FG178	1.95		

OIL—FILLED CAPACITORS

Mfd	Rating	Price	Mfd	Rating	Price
2-2	600 VDC	$0.75	0.1	5000 VDC	$1.95
4	600 VDC	.84	2	5000 VDC	7.30
7	600 VDC	1.15	1	6000 VDC	6.95
10	600 VDC	1.37	.1-.1	7000 VDC	1.95
50	330 VAC	4.95	.05	7500 VDC	1.75
2	1000 VDC	.95	2½	7500 VDC	11.95
4	1000 VDC	1.19	.02	10 KV DC	2.95
8	1000 VDC	1.71	1	15 KV DC	19.95
0.25	2500 VDC	1.06	0.25	20 KV DC	15.95
2	4000 VDC	4.95	15	440 VAC/1500 VDC	
3	4000 VDC	5.95			

Note: 10 or more capacitors of a type 10% dis.

RF and DC PANEL METERS

Stock	Description	Price
MAD-251	0-2 ma DC Westinghouse 3½" round	$3.95
MAD-262	0-20 ma DC Westinghouse 3½" round	3.95
MAD-265	0-80 ma DC W. E. 3½" round	3.49
MAD-503	0-1000 ma DC DeJur 3½" round	3.95
MAD-276	0-30 A DC GE 2½" round	2.95
MRT-355	0-100 ma RF Weston 425 3½" round	11.95
MRT-372	0-120 ma RF Weston 507 2½" round	8.95
MRT-367	0-1A RF GE 2½" round	2.95
MRT-394	0-20A RF GE 3½" round	6.95

Wide Range Butterfly Wavemeter & Oscillator Elements

Precision wide range butterfly circuit elements. Sturdily constructed. Mounted in ball bearings. Suitable for motor drive. Ideal for use as wavemeters and oscillators (see description below).

Stock No.	Freq. (mc.)	Notes*	Unit Price
TN-20	105-330	1, 3	$4.95
TN2A	75-300	1, 4	4.95
TN-30	135-485	2, 3	5.95
TN3A	300-1000	2, 5	6.95

Brand new, in original packing.

*NOTES: 1) Aluminum construction
2) Silver-plated brass
3) Designed as oscillator element (955 acorn triode)
4) Has diode socket mounted on unit (955 as diode)
5) Has crystal diode mount for 1N21 crystal

BLILEY SMC-100 100 AND 1000KC CRYSTAL. Regularly sells for $8.75. **Stock No. QCM-19** **$5.95**

HAMMARLUND CERAMIC ACORN SOCKETS. 5 contact. Silver-Plated. **Stock No. XRT-25** .....**20 for $1.00**

CINCH MICA FILLED OCTAL SOCKETS. 1" dia. 1-5/16" mtg ctrs. **Stock No. XRT-20. 20 for** **$1.00**

DELAY LINE. 2 microsecond (one direction). 1500 ohms. Bandwidth 1mc. 8 section tapped. **Stock No. ZAL-22**.....**$1.69**
DELAY LINE. 1¼ microsecond (one direction). 1500 ohms. Bandwidth 1mc. 6 section tapped. **Stock No. Zal-13**....**$1.49**
DELAY LINE. 5 microsecond (one direction). 1500 ohms. Bandwidth ½mc. **Stock No. ZAL-14** **$0.89**

4200 VOLT TELEVISION OR SCOPE TRANSFORMER. Primary: 115V/60c. Secondary: 3000VRMS (4200 Volts Peak) 10ma. Hermetically sealed. 4½"x4-¾"x5⅛". **Stock No. TFF-83** **$5.95**

HV TFMR. 10,000-0-10,000 VOLTS @ 42 MA. Pri. 115 V.—50-60 cy. Oil-filled, hermetically sealed. 11"x13"x6". **Stock No. TFF-451** **$29.95**

FILTER CHOKES

Stock No.	Description	Price
LFF-45	10H/120ma/600 ohms	$0.95
LFF-21	20H/300ma/125 ohms/5000V	9.95
LFF-144	2½H/700ma/16 ohms/1500V	4.95

MULTIPLIER PHOTOTUBE HOUSING. Cast aluminum cylindrical housing containing a submagnal 11 pin socket (for 931A, 1P21, 1P22) and a dynode voltage divider network. Moisture proof construction. An integral 6 volt pilot lamp provides light source when used as a noise generator. A window may be drilled in the housing for use with an external light source. Operates with approximately 700 volts at 3-4ma. 2" dia x 4" long. Supplied less phototube. **Stock No. AMP-65** **$3.95**

PRECISION HIGH TORQUE TYPE 5 SELSYNS. Bronze housing 4½" dia. x 5" long. 115V/60c operation. Brand new in original packing. Stock No. SEL-44.....**$4.95 each**

110/60CPS/0.38A BLOWER. Exceptionally quiet. 50 cu. ft. min. **Stock No. BLR-344**..**$8.95**

- TERMS -

Delivery: Immed. from stock (subj. to prior sale). **Minimum Order: $5.00.**

Terms: Rated organizations (U. S. and Canada), Open account.

Others: Cash with order, or 20% with order, balance C. O. D.

Foreign: Payment in U. S. funds with order or irrevocable letter of credit payable against documents in U. S. funds at New York.

Condition of material: The major portion of the material listed above is brand new. Some of the items have been removed from new equipments. **We guarantee material to be clean and in perfect operating condition.**

All prices above are quoted domestic packed f.o.b. our warehouse, Corona, New York.

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Cable: "Dublectron, New York". We will be pleased to send our bulletins to you regularly. Write or phone Dept. E-8 for our latest catalog.

ELECTRONICS CO. INC., 103-02 NORTHERN BLVD., CORONA, N. Y.

LIFE ELECTRONICS Offers

AVAILABILITY THAT MEANS SERVICE AT PRICES THAT MEAN SAVINGS

Lee Machin
Seymour Schwartz

ALLEN BRADLEY POTENTIOMETERS

Allen Bradley type 'J' Pots Available in the following values from stock.

VALUE,	OHMS,	SINGLE
50	2000	35000
60	2500	50000
150	3000	60000
200	5000	70000
250	6500	100000
400	10000	200000
500	15000	250000
600	20000	500000
1000	22000	600000
1300	25000	1 MEGOHM
1500	30000	

PRICE EACH $.50

DUAL POTS.

10,000	100,000
25,000	500,000
50,000	1 MEG.
	5 MEG.

PRICE EACH $1.50

Specify whether regular or screwdriver shaft is required.

Crystal Diodes

1N21	.50
1N21B	1.00
1N23A	1.50
1N23B	2.00
1N34	.95

RESISTORS

Life Electronic Sales is the leading source of "hard to get" industrial electronic components, has available from stock a complete line of standard brand ½, 1 and 2 Watt resistors in 5% and 10% tolerances. These resistors meet the following Jan spec

RC20-½ Watt RC30-1 Watt RC40-2 Watt

Watt	Tol	1–99	100 or more
½ Watt	10%	$.06	$.04
½ Watt	5%	.12	.08
1 Watt	10%	.09	.06
1 Watt	5%	.18	.12
2 Watt	10%	15	.10
2 Watt	5%	.30	.20

Ohms	Ohms	Ohms	Ohms	Megs	Megs	Megs
10	100	1000	10000	0.1	1.0	10.0
11	110	1100	11000	0.11	1.1	11.0
12	120	1200	12000	0.12	1.2	12.0
13	130	1300	13000	0.13	1.3	13.0
15	150	1500	15000	0.15	1.5	15.0
16	160	1600	15000	0.16	1.8	16.0
18	180	1800	18000	0.18	2.0	18.0
20	200	2000	20000	0.20	2.2	20.0
22	220	2200	22000	0.22	2.2	22.0
24	240	2400	24000	0.24	2.4	
27	270	2700	27000	0.27	2.7	
30	300	3000	30000	0.30	3.0	
33	330	3300	33000	0.33	3.3	
36	360	3600	36000	0.36	3.6	
39	390	3900	39000	0.39	3.9	
43	430	4300	43000	0.43	4.3	
47	470	4700	47000	0.47	4.7	
51	510	5100	51000	0.51	5.1	
56	560	5600	56000	0.56	5.6	
62	620	6200	62000	0.62	6.2	
68	680	6800	68000	0.68	6.8	
75	750	7500	75000	0.75	7.5	
82	820	8200	82000	0.82	8.2	
91	910	9100	91000	0.91	9.1	

"UHF" COAXIAL CABLE CONNECTORS

83-1T

83-1SPN

No.	AN No.	Description	Price Each	Price Per C
83-1SP	(PL259)	Plug	.35	.28
83-168	(UG176U)	Adapter	.15	.12
83-185	(UG175U)	Adapter	.15	.13
83-1SPN	(PL259A)	Plug	.35	.28
83-776!	(UG203U)	Plug	.61	.55
83-1R	(SO239)	Recept.	.35	.28
83-1RTY	.....	Recept.	.66	.60
83-1H	(UG106U)	Hood	.12	.10
83-765	(UG177U)	Hood	.31	.25
83-1AC	.....	Cap & Chain	.61	.50
83-1BC	.....	Cap & Chain	.38	.34
83-1T	(M358)	T Connect.	1.12	.98
83-1AP	(M359A)	Angle Adapt.	.35	.28
83-1J	(PL258)	Junction	.85	.70
83-1F	(PL274)	Feed-Thru	1.12	.98
83-22SP	(UG102U)	Twin Plug.	.50	.40
83-22R	(UG103U)	Twin Recpt.	.50	.40
83-22AP	(UG104U)	Twin Adapt.	.98	.80
83-22F	PG275	Twin Feed Thru	1.50	1.35
83-22J	UG105/U	Twin Junction	1.25	1.12
83-22T	UG196/U	Twin "T"	1.65	1.50

UG TYPES CONNECTORS

UG 30/U

Deduct 10% from prices shown on orders of 100 or more per type

UG 88/U

UG 290/U

UG 336/U

UG 352/U

AN #	Price ea.	AN #	Price ea.
UG- 9/U	$ .95	UG-96A/U	$1.45
UG-10/U	1.56	UG-97/U	3.50
UG-11/U	1.45	UG-98/U	1.55
UG-12/U	1.14	UG-100/U	2.34
UG-13/U	1.56	UG-101/U	2.95
UG-14/U	1.45	UG-102/U	2.25
UG-15/U	.95	UG-108/U	1.75
UG-16/U	1.56	UG-109/U	1.75
UG-17/U	1.45	UG-114/U	1.50
UG-18/U	.99	UG-115/U	1.35
UG-18A/U	1.05	CW-123/U	.45
UG-18B/U	.99	UG-155/U	.40
UG-19/U	1.28	UG-154/U	5.35
UG-19A/U	1.38	UG-155/U	5.35
UG-19B/U	1.45	UG-156/U	4.25
UG-20/U	1.17	UG-160/U	1.90
UG-20A/U	1.26	UG-160A/U	1.55
UG-20B/U	1.41	UG-167/U	3.00
UG-21/U	.99	UG-173/U	.30
UG-21A/U	1.05	UG-176/U	.15
UG-21/BU	.99	UG-188/U	.95
UG-22/U	1.08	UG-201/U	1.83
UG-22A/U	1.38	UG-202/U	2.75
UG-22B/U	1.34	UG-206/U	1.02
UG-23/U	.99	UG-208/U	28.50
UG-23A/U	1.26	UG-212/U	4.50
UG-23B/U	1.29	UG-213/U	4.50
UG-27A/U	2.25	UG-215/U	3.35
UG-28/U	2.34	UG-216/U	8.70
UG-29/U	1.22	UG-213/U	3.10
UG-30/U	1.75	UG-218/U	6.50
UG-32/U	20.00	UG-222/U	35.00
UG-33/U	20.00	UG-231/U	2.00
UG-34/U	17.50	UG-236/U	11.75
UG-35A/U	16.00	UG-241/U	2.20
UG-36/U	16.00	UG-242/U	2.50
UG-37/U	16.00	UG-243/U	2.75
UG-37A/U	16.00	UG-244/U	2.50
UG-57/U	.99	UG-245/U	1.25
UG-58/U	.65	UG-246/U	1.45
UG-59/U	2.75	UG-252/U	4.50
UG-59A/U	1.70	UG-254/U	1.82
UG-60/U	1.90	UG-255/U	1.85
UG-60A/U	1.30	UG-260/U	.99
UG-61/U	2.05	UG-261/U	.95
UG-61A/U	1.80	UG-262/U	1.05
UG-61/U	28.00	UG-269/U	2.60
UG-83/U	1.50	UG-273/U	1.50
UG-85/U	1.65	UG-274/U	1.98
UG-86/U	1.69	UG-290/U	.85
UG-87/U	1.40	UG-291/U	1.05
UG-88/U	1.17	UG-306/U	2.03
UG-89/U	.95	UG-333/U	4.70
UG-90/U	1.05	UG-334/U	5.75
UG-91/U	1.25	UG-352/U	6.00
UG-91A/U	1.05	UG-287/U	5.25
UG-92/U	1.10	UG-270/U	6.50
UG-92A/U	1.35	UG-259/U	4.10
UG-93/U	1.25	UG-279/U	2.40
UG-93A/U	1.45	UG-157/U	4.25
UG-94/U	1.25	MX-195/U	.75
UG-94A/U	1.05	UG-197/U	5.00
UG-95/U	1.10	UG-235/U	28.50
UG-95A/U	1.35		
UG-96/U	1.25		

COAXIAL CABLES

No.	Impedance	Price per M ft.
RG5U	52.5 ohms	$70.00
RG6U	76.0 ohms	120.00
RG7U	97.5 ohms	70.00
RG8U	52.0 ohms	55.00
RG9U	51.0 ohms	135.00
RG9AU	51.0 ohms	135.00
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	320.00
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
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	55.00
RG59U	73.0 ohms	45.00
RG62U	93.0 ohms	50.00
RG71U	93.0 ohms	175.00
RG74U	52.0 ohms	185.00

Minimum quantity 500 ft. per type. For cut lengths add 50% to prices shown.

UPRIGHT TRANSMITTING CAPACITORS

National Manufactures

Stock No.	Capacity	Voltage	Price each
TJU 6005	0.5	600	$.85
TJU 6010	1.0	6000	1.05
TJU 6020	2.0	600	1.30
TJ 6040	4.0	600	1.65
TJU 6050	5.0	600	1.90
TJU 6060	6.0	600	2.50
TJU 6100	10.0	600	2.75
TJU 10005	0.5	1000	.90
TJU 10010	1.0	1000	1.15
TJU 10020	2.0	1000	1.50
TJU 10040	4.0	1000	1.90
TJU 20010	1.0	2000	1.65
TJU 20020	2.0	2000	1.95

FUSES AND FUSE POSTS

3AG Fuses 32 Volts	Price ea.
5 Amps.	$ .03
10 Amps.	.03
20 Amps.	.03
3 AG Fuses 250 Volts	
¼ Amps.	.05
½ Amps.	.05
⅝ Amps.	.05
¾ Amps.	.05
1 Amps.	.03
2 Amps.	.03
3 Amps.	.03
8 Amps.	.05

4 AG Fuses	Price ea.
½ Amps.	$ .05
1 Amps.	.05
2 Amps.	.05
3 Amps.	.05
5 Amps.	.05
10 Amps.	.05
15 Amps.	.05
20 Amps.	.05
8AG Fuses	
1/200 Amps.	.10
⅛ Amps.	.07
¼ Amps.	.04
½ Amps.	.04
2 Amps.	.03
5 Amps.	.03

FUSE EXTRACTOR POSTS

3AG Post-Finger Grip Type	$ .18
3AG Post-Screw Driver Type	.18
4AG Post-Finger Grip Type	.20
4AG Post-Screw Driver Type	.20

TUBE SPECIALS

2K25	$24.95	807	$1.25
2K28	15.00	813	6.95
2J32	24.00	861	24.95
2J61	39.00	866A	1.25
725A	15.00	3AP1	4.95
1B22	3.00	872A	2.50
4C35	29.95	5BP4	4.95
350B	2.50	304TL	1.75

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Engineering–Hand Selected–Government Surplus

EVERY ITEM PERSONALLY SELECTED BY OUR ENGINEERS

Unconditionally guaranteed.

UHF & MICROWAVE EQUIPMENT

FREQUENCY METERS

Field Strength-Frequency Meter. I-95BM 100 to 155 Mc. Cavity Type-Battery Operated. Now being used by CAA and Airlines. Complete in case—New.....$21.50

Wave Meter-BC906D. 160 to 220 Mc. Absorption type consisting of coaxial wave meter, diode rectifier, amplifier and individual calibration charts. Complete in black crackle case with antenna....$29.50

Lavoie Frequency Meter. 375 to 725 Mc. Model 105SM. 0.1% accuracy. Covers new citizen band, Aircraft, Amateur, New Television band, Government bands. Precision Equipment. Individually calibrated. Complete with instruction manual and cable. New, $59.50 Case scratched but otherwise perfect $49.50

Resonance Cavity "S" Band Wavemeter Manf. by Western Electric. Resonance absorption type cavity. Coaxial input and output loops. Rotary calibrated indicator and calibration charts.....$29.50

2650 Mc to 3000 Mc Band. Western Electric I 140A Resonance cavity, micrometer tuning, crystal rectifier and micrometer. Each unit individually calibrated.

Used but good condition.....$39.50
Used but fair condition.....$29.50
Used but poor condition.....$19.50

R.F. POWER SOURCE

Klystron R.F. Generator 10 CM. Complete with WL 417A Klystron. Regulated power supply (115 V A.C. 60 cycle). I.F. Strip—30 Mc. Entire unit self contained. Size 19x14x9. New $89.50

X Band Oscillator, Preamplifier and Plumbing. R.F. head from DOG-1 unit. Consists of 2-723A/B tubes, (Local oscillator-Beacon) Waveguide, TR/ATR box with 721, 60 MC. Preamplifier. Complete with tubes $39.50

MAGNETRONS & EQUIPMENT

Complete Magnetron Package "S" Band. Consists of: **Magnetron—2J32, Magnetron Magnet, Magnetron Fil. Trans.** Complete package $30.00

Magnetron—2J32, 2780 to 2820 Mc. Fil. Voltage—6.3V at 1.5 Amps. Pulse Voltage—18-22 Kilovolts. Average Ma. 12.5-25. Average Power Out—285 Watts. Peak Power Out—285 KW. Band Width—2.5 Mc. Duty Cycle 1000/1. New JAN—1 boxed $19.95

Magnetron Magnet—2000 Gauss. Pole Dia. 1-⅝", Spacing 1-½". Boxed—two to a crate $10.00

Magnetron Filament Transformers. Specially designed for magnetron. Use by Raytheon. JAN-1 Low capacity—High Voltage Insulation. 115V A.C. 60 cycle primary. 6.3V at 1.5 amps. 19,000 Volts Insulation. $5.95

Magnetron Filament Transformer. Same as above except multiple secondary. 4 windings—each of 6.3 Volts at 4 Amp each. 5000 Volts. Insulation.....$7.95

MULTI CONDUCTOR CABLE

MILLION FEET AVAILABLE

9 CONDUCTOR—#20 str. plastic, 2 vinyl jacket. Shield ½" G.E. Reel Lengths—.08/ft. 100 ft. .11/ft.

10 CONDUCTOR—#20 Solid. Plastic vinyl jacket. ½" dia. On steel reels. Reel lengths .07/ft. 100 ft. .10/ft.

28 CONDUCTOR—#20 stranded plastic vinyl jacket ⅞" dia. Reel lengths. 20/ft. 100 ft. .24/ft.

4 CONDUCTOR. Each cond. ¼" dia. Std Double plastic Ins. Heavy Duty Power Cable—Extremely flexible. 1-¼" Dia. Reel lengths Approximately 250 ft. .26/ft.

3 CONDUCTOR—#18. Shield Jacket. .05/ft.

2 CONDUCTOR—#20 Shield Jacket. .04/ft.

GRID DIP OSCILLATOR. See August Issue Electronics Pg. 176, "New Products". An all around Lab.

Instrument for measurement of resonant frequency, Circuits Q, RF. voltages, antenna and many other purposes. 3 MC. to 250 Mc. or other extended ranges. Compact and complete in kit form. Instruction book and application book sent free on request. Complete Kit.....$21.50

BIRD WATTMETER. 5 to 500 watts of R.F. Measures MF, HF, VHF and UHF. Write for full description. Only two units left.....$75.00 each

DAVEN ATTENUATION BOX Model HA-740 110 DB attenuation in 1 Db steps 600/600 ohm input and output. New. Three left.....$59.00 each

TELRAD FREQUENCY STANDARD. Self contained, dual 100/1000 Kc XTL, Multivibrator and Harmonic Amp. Calibrate with WWV or Broadcast for high accuracy. 100 to 45,000 KC check points every 100/1000 KC. Now $29.50

COAXIAL CABLE

RG-77/U Federal .....$.06/ft.
RG8/U Amphenol. 50 ft. lengths with 831 SP connectors on each end.....$2.69
RG/58U ⅛" dia..... .12/ft.
RG/59U ¼" dia..... .12/ft.

WIRE

#20 **HV** str. white plastic.....$4.95/M
#20 str. white lacquer..... 3.50/M
#20 str. red lacquer..... 3.50/M
#20 str. green lacquer..... 3.50/M
3/16" magnet DCC rect..... .35/lb
#20 **SSE Magnet**..... .60/lb
¼" tin shield braid..... .30/lb

OIL CAPACITORS

2 **MFD** 5500VDC Inerteen	$5.80
2 **MFD** 6000 V DC Inerteen	6.50
1 **MFD** 7500V DC Inerteen	5.80
1 **MFD** 5000V DC 5009	3.95
0.1 **MFD** 7000V DC B5B1170-CD	1.95
.25 **MFD** 4000V DC G.E. 20F767	2.85
.15 **MFD** 4000V DC G.E. 26F386	2.10
.1 **MFD** 3600V DC 8412	3.10
10 **MFD** 1000V DC G.E. 22F47	2.45
4 **MFD** 1000V DC G.E. 23F252	1.15
10 **MFD** 600V DC A1000	1.25

SPECIAL

.005-01 MFD 12KV G.E. 15F646	$4.75
.02 MFD 20,000V BT-15G	5.95

MICA'S AT 90% DISCOUNT

Types—Fil, XR. etc.

Cap.	Wk.Vo.	Pr.	Cap.	Wk. Vo.	Pr.
750	5,000	.75	200	3,000	.70
560	5,000	.75	100	3,000	.55
375	5,300	.75	90	3,000	.50
.001	4,500	1.10	50	3,000	.50
.002	3,500	.95	.025	2,500	1.10
.003	3,000	.95	.006	2,500	.75
700	3,000	.60	30	2,000	.40
500	3,000	.70	.015	1,500	.75
400	3,000	.55	.12	500	1.15

Type H-A2

Cap.	Wk. Vo.	Pr.	Cap.	Wk. Vo.	Pr.
.002	3500 #9	.60	350	2500 #9	.35
.005	2500 #4	.45	.002	1000 #4	.25
400	2500 #4	.30			

CERAMICONS

50 mmf Feedthru	.06
50 mmf 7,500V DC	.30

RELAYS-CONTACTORS

Type	Coil	Contacts	Price
CH contactor.	115V AC	4PST, 30A	$7.95
West. MC gl.	encl 115"	4PST, 20A	7.50
Allied Bo.	5V DC	DPDT 10A	.75
Advance min.	45000hm	12V DC SPST 5A	.60
G.E. PJC Adj.	Overload	4-12A ac-DC	12.50
G.E. PJC Adj.	Overload	2-8A ac/dc	12.50
G.E. PJC Adj.	Overload	0.5-1.5A ac-dc	7.95

VOLTAGE REGULATOR

Manf. guaranteed 1% regulation. Primary 92-138V 57-63 cycles. 1 Phase Secondary 115V 1% regulation 96 PF Navy Gray Cabinet. Shipping wt. 250 lb. Size 36x20x12. Limited quantity $97.50

STEPDOWN TRANSFORMERS

440 to 110V AC 50 KVA G.E. oil filled. Steel Tank. Write for full Specs.....$200.00
440 to 220 to 110-5 KVA. Complete encased-G.E. Explo. Proof. Can be used as 4/1 or 2/1 ratio step-up or down, 60 cps. Size 20x11x10. Weight 225 lbs. Navy gray finish, integral junction box and mounting frame....$75.00
440 to 220 to 110-2 KVA. Same specifications as above except 2 KVA. Size 12x11x10. Wt. 93 lbs. Only 5 units left.....$29.50
220 to 110 500 Watts 60 cycles complete encased. New $11.50
Auto transformer. 220 or 110 Voltage range of 50%. Write for complete specifications. $12.50

BROADCAST MODULATION TRANSFORMER

R.C.A. 833'As to pair 833'As, as used in R.C.A. Commercial 1 K.W. Broadcast Transmitters. Transformer being used in U.S. Broadcast stations. New fully guaranteed. Primary 15,000 ohms Secondary 5,030 ohms. .86 KVA Audio. Size 12x10x13. Wt—uncrated 153 lbs. Limited Qty. available $75.00

POWER TRANSFORMER

440/220 3 Phase. A husky brute for induction heating. Primary 440/220 3 phase. Secondary. Each phase 1365V at .67 Amps. Manf. by Raytheon. This transformer and a pair of 304's will give 2.5 KW output at a total cost of less than $50.00. Special—while they last—Only $42.50

POWER TRANSFORMER

440 or 220 1 phase Filament transformer. 440/220 Pri. Secondary 5.0 V at 30 Amp. 1500 volt insulation. Herm. Sealed Navy Specs. $7.95
Plate Transformer. 200/220/240 Pri. Secondary 1400V Ct. at 350 ma. Gray Hermetically sealed $6.70
Filament Transformer 200/220/240 Pri. Secondary 6.3V at 2.7 Amps. Matched unit for above $2.45

POWER TRANSFORMERS 110V AV 60 Cycle

3700-0-3700 at 500 ma	$59.00
2500-0-2500 at 500 ma	39.50
1800-0-1800 at 350 ma	17.50
740-0-740 at 1.2 amps	17.50
36 Volts at 10 Amps	5.95
11.5 @ 11.5 amps	4.95
10V @ 20 Amps. (for 304, 833A's, 813's, etc.)	4.95
2.5V at 10 Amps—10 KV Ins	3.75
4500V at 4.5 ma. 5V at 3 Ma	7.95
3750V @ 2 ma	4.50
1200V @ 2 ma 6.3V @4A, 5V @3A, 1100V ct @200Ma. 6.3V @4A, 6.3V @4A, 5.0V @3A	3.95
	7.50
850V @ 150 Ma	2.50
750V @ 300 Ma	3.50
78V @ 1.34 Amps	3.50

FILTER CHOKES

Audio Reactor 1 Hy. 800 ma 15KVA Ins. Amertran—size 5½x8. Wt 85 lbs.	$7.50
10H/75ma/260 ohm herm	.70
4-20H/100ma/120 ohm, herm	.95
10H/100ma/260 ohm, herm	.90
5H/130ma/100 ohm, herm	1.20
10-14H/145-200 ma/100 ohm	1.95
5H/200 ma/70 ohm	1.95
3-3H/200 ma/60 ohm, herm	2.50
6H/350ma/82 ohm	4.50
16H/450ma/112 ohm, herm	9.50
8H/500ma/80 ohm	8.50
5-20H/500ma/80 ohm	8.25
8H/700ma/60 ohm	12.75
5-20H/700ma/60 ohm	12.50
3H/275ma, 17H/175ma,17H/125 ma	3.75
4H/85ma, 6H/90ma, 12H/65ma	2.10

ALL MATERIAL NEW AND GUARANTEED

10% Discount on order over $100.00.
15% Discount over $500.00.

Large quantities available. Quotes on request.

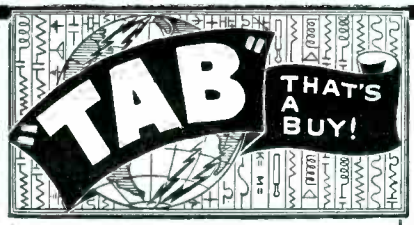
ELDICO OF NEW YORK, INC.

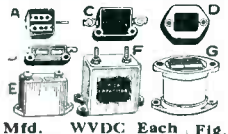
44-31 DOUGLASTON PKWAY., DOUGLASTON, L.I., N.Y., U.S.A. Cable Address. ELDICOINC

BAYSIDE 9-8686

TUBES . . . "TAB" TESTED & GUARANTEED

OB2	$1.69	6AQ5	.63	35Y4	.70	1616	1.36
OZ4	.87	6AS7G	4.68	35Z5GT	.46	1619	.25
1A3	.59	6AT6	.45	37	.36	1620	4.95
1A4	1.26	6AU6	.63	38	.39	1622	1.75
1A5GT	.70	6B4G	.96	39/44	.39	1624	.75
1A6	1.26	6B8G	1.05	41	.58	1625	.39
1A7GT	.69	6BA6	.59	43	.63	1626	.45
1B3/8016	.81	6BE6	.59	45S/VT52	.30	1629	.49
1B21/471A	2.95	6BF6	.59	46	.81	1633	1.19
1B22	4.50	6BG6G	1.49	48	1.20	1641/RK60	.75
1B24	4.89	6BH6	.79	50	1.49	2050	.59
1B27	4.65	6BJ6	.59	50B5	.54	2051	.42
1C5	.86	6C4	.25	501.6	.63	7193	.18
1C6	1.26	6C5	.47	70L7GT	1.39	8012A	1.49
1C7G	1.27	6C6	.55	73	1.67	8013A	3.95
1D5GP	1.25	6C8G	1.05	75	.56	8020	3.49
1E5	1.38	6C21	24.75	76	.47	9001	.39
1E7G	1.17	6D6	.45	77	.45	9002	.37
1F4G	1.05	6E5	.81	78	.45	9003	.29
1F7GV	1.55	6E6	1.05	80	.35	9004	.27
1G4GT	1.05	6F6G	.59	81	1.49	9006	.25
1G6GT	.98	6F8G	1.04	82	.98	CIA	9.95
1H4G	.87	6G6G	1.05	83	.75	C6A	12.95
1H5G	.65	6H6GT	.38	83V	1.05	C6J	4.95
1H6G	1.27	6J5	.45	84/6Z4	.65	CK1005	.25
1J6G	1.27	6J6	.78	117N7GT	1.49	CRC40	.54
1L4	.69	6J7	.75	117Z6GT	.85	CRD72	1.85
1LA4GT	1.05	6K5GT	.86	117Z7GT	1.49	CRP72	1.37
1LB4	1.05	6K6GT	.45	205B/VT2	1.98	EF50	.72
1LC6	.85	6K7G	.55	211/VT4C	.95	F127A	16.95
1LE3GT	.96	6K8	.86	231	1.39	FG17	2.98
1LH4	1.05	6L5G	.98	250TH	19.44	FG27A	9.90
1LN5	.75	6L6	.98	250TL	18.98	FG104	14.95
1N5GT	.69	6L7	.83	304TH	5.95	FG105	11.95
1P5GT	.69	6N7GT	.90	304TL	1.98	FG166	49.00
1P24	.85	6P5G	.81	307A/		FG190	12.98
1Q5GT	.96	6Q5G/884	1.27	RK75	3.95	GL434	3.90
1R4/1294	.98	6Q7	.75	316A	.59	GL534/	
1S5	.54	6R7G	1.05	327A	2.90	1S21	1.95
1T4	.54	6S7	1.19	350	1.45	GL546	1.69
1T5GT	1.05	6S8GT	.79	350B	1.98	HY114B	.81
1U4	.69	6SA7GT	.45	371B	.85	HY115/145	.89
1V	.87	6SC7	.65	380A	.79	HY615	.98
1Z2	1.98	6SD7GT	.45	388A	.40	KU627	7.49
2A3	1.25	6SF5	.55	393A	5.95	NR74	.29
2A4G	1.08	6SF7	.78	446A/2C40	1.49	O1A	.45
2A5	.86	6SG7	.65	450TH	18.27	PJ21	4.98
2A6	1.05	6SH7	.38	460/		PJ22/	
2A7	1.05	6SJ7GT	.59	CE1C	1.49	CE1C	
2B7	.85	6SK7GT	.45	HF200	11.98	REL36/6J4	.81
2B22/		6SL7GT	.55	527	11.95	RK65	22.98
GL559	.73	6SN7GT	.55	530	4.90	RX21	3.20
2C21/		6SQ7GT	.47	531	1.80	RX215	9.95
1642	.81	6SS7	.63	534	2.45	UX6653	.69
2C26	.25	6T7G	1.19	550P1	19.95	VR75	.95
2C34/		6T8	.98	575A/975	13.89	VR90	.74
RK34	.55	6U5/6G5	.72	601B	.19	VR92	.23
2C39	19.00	6U6GT	.69	631P1/		VR105	.60
2C40	6.49	6U7G	.58	SN4	3.98	VR150	.54
2C43/		6V6GT	.65	701A	3.95	WE215A	.25
464A	8.98	6X4	.49	702A/702B	3.49	WL468	8.98
2C44	1.69	6X5GT	.55	703A	2.79	WL531	1.95
2D21	.98	6Y6G	.87	704A	1.08	WL619	20.00
2E5	.86	6Z7G	1.23	705A/8021	1.65	WL632A	8.98
2E22	1.34	7A4/XXL	.70	707B	7.98	C'RAY TUBES	
2E24	2.98	7A6	.69	710A/8011	.75	2AP1	4.98
2E25/		7A8	.69	713A	1.59	3BP1	2.98
HY65	2.98	7AG7	.85	715B	7.29	3BP1A	7.98
2J21	11.98	7B5	.70	717A	.65	3CP1	2.75
2J21A	11.98	7B7	.69	721A	1.95	3DP1	1.62
2J25	34.95	7C4/1203A	.38	722A/287A	9.95	3EP1	3.49
2J26	8.89	7C5	.70	723A	6.95	3FP1	1.49
2J31	9.95	7C6	.69	723AB	14.95	3GP1	6.95
2J33	29.98	7E5/1201	.89	724	4.90	3HP7	3.49
2J34	23.98	7E6	.69	725A	9.00	4AP10	5.98
2J38	13.89	7E7	.85	726A	7.29	5BP1	1.95
2J47	39.95	7F7	.85	803	7.95	5BP4	3.95
2J48	45.00	7G7	1.03	804	11.98	5CP1	2.98
2J50	45.00	7L7	.86	805	4.50	5CP7	12.95
2J61	39.95	7N7	.85	807	1.15	5FP5	6.49
2J62	39.95	7Q7	.72	808	1.50	5FP7	1.26
2K28	24.89	7V7	1.04	809	2.90	5HP1	4.95
2K29	24.95	7Y4	.69	810	6.95	5JP2	10.95
2V3G	1.05	10Y	.60	811	2.20	5LP1	11.00
2X2	.49	12A6	.23	812	2.85	5LP5	14.00
3A4	.38	12A8	.78	813	8.90	7BP7	4.75
3A5	1.20	12AH7GT	.87	814	2.61	7HP7	5.95
3B7/1291	.95	12AT6	.45	815	2.45	9CP7	13.98
3B24	1.85	12AU7	.69	816	.98	9LP7	2.98
3B25	4.95	12AX7	.89	826	.47	12DP7	12.49
3B28	5.89	12BA6	.70	SD828	3.78	12GP7	12.80
3C23	2.48	12BA7	.89	829B	4.95	12LP4	34.00
3C31/C1B	1.69	12BE6	.45	832	2.45	16AP4	55.00
3D6/1299	.85	12C8	.36	832A	4.50	902	5.49
3D21A	1.37	12H6	.36	836	.95	905	4.89
3D22	7.49	12J5GT	.36	837	2.35	912	79.95
3Q4	.54	12K8	.85	838	2.79	TUNGAR	
3S4	.79	12S8GT	.79	842	2.75	20X672	2.95
3V4	.69	12SA7GT	.55	843	.59	189048GE	3.49
4B27/201	2.49	12SC7	.70	845	4.75	199698	2.95
4C33	81.00	12SG7	.69	851	16.95	289881	2.50
4C35	22.95	12SH7	.39	860	1.62	MAZDA	
4D32	7.98	12SJ7GT	.46	861	10.26	PILOTS	
4J42/700A	29.85	12SK7GT	.58	864	.45	44 Box 10	.50
4J47	45.00	12SL7GT	.63	865	.95	49 Box 10	.60
4T4/2	9.95	12SN7GT	.54	866A	.99	55 Box 10	.50
5C30/C5B	9.95	12SQ7GT	.54	866Jr	1.00	64 Each	.07
5D21	24.95	12SR7GT	.39	868/PJ23	1.90	S6/T4 Ea.	.15
5J29	17.98	12X3	.90	872A	2.45	100W/20V	.25
5R4GY	1.12	12Z3	.86	874	1.49	313/28V	.15
5T4	.80	14B6	.81	876	.36	323/3V	.10
5U4G	.46	14R7	.85	878	2.29	Sylvania	
5V4	.95	15R	.98	884/6Q5G	1.27	S6/6W/	
5W4	.87	19T8	.98	885	.95	120V	.15
5X4G	.71	20	1.17	922	1.19	Wstghs C7/	
5Y3GT	.38	24G/3C24	.54	923	.85	7W/120V	.09
5Z3	.81	25A6	1.04	927/CE25	1.26	NEON BULBS	
5Z4	.88	25B6	.49	930	.89	NE2 100/3.98	
6A3	.98	25L6GT	.55	931A	3.95	NE16/991	.25
6A4	1.29	25Y5	1.08	954	.16	NE45/¼W	.24
6A6	1.02	25Z5	.46	955	.18	NE51/NE20	.07
6AB7/1853	.84	25Z6GT	.59	956	.27	TEL Slide-	
6AC7	.85	28D7	.36	957	.25	lamps	
6AF6G	.87	30	.36	958	.25	6, 12, 24, 48, 55V	
6AG5	.78	31	.36	SD3968	4.95	Each	.18
6AG7	1.00	32	1.17	991	.25	Tubes Gtd, Esc	
6AH6	.98	32L7GT	1.08	1000UHF	59.95	Open Fil &	
6AJ5	.85	35A5	.69	1603	3.98	Breakage C'R	
6AK5	.78	35C5	.69	1609	5.98	Tubes Gtd	
6AK6	.81	35L6GT	.63	1613/6F6X	.55	Only Via	
6AL5	.63	35W4	.45	1614	1.50	R'Exp.	





MICA RCVNG & XMITTING CAPACITORS
Brand New! Famous Mfrs Rigid Specs.

Mfd.	WVDC	Each
Type A (*Silver Mica)		
.000015*	500	$.09
.00002	500	.04
.000022	500	.04
.000024*	500	.09
.000025*	500	.09
.00004	500	.04
.00005*	500	.09
.000082	500	.04
.0001	500	.04
.0001*	500	.09
.0002	500	.04
.0002*	500	.09
.0003	500	.04
.00042	500	.04
.00047	500	.04
.001	500	.04
.001*	500	.09
.0011	500	.04
.0011*	500	.09
.0012*	500	.18
.002	500	.06
.00224*	500	.18
.0025	500	.18
.003	1000	.20
.003	500	.10
.0033*	400	.25
.004	500	.10
.004*	500	.35
.005	500	.10
.006	500	.10
.01	300	.08
.01	500	.15
.01	600	.17
Type B or Similar		
.001	500	.04
.006	500	.10
.01	500	.15
Types C and D		
Fig. Mfd.	WV	Each
CD.0001	600	.20
D .0004	2500	.35
C .00047	2500	.35
D .00055	600	.30
D .00082	2500	.35
D .00085	600	.20
C .001	600	.20
D .001	1200	.30
D .0012	600	.20
C .002	600	.25
CD.002	1200	.30
D .002	2500	.75
D .0022	2500	.75
CD.003	600	.25
C .003	1200	.35
D .0035	2500	.75
D .0036	2500	.75
C .004	600	.27
C .004	1200	.40
D .0043	2500	.95
CD.005	600	.27
C .005	1200	.40
D .005	2500	.75

Fig. Mfd.	WV	Each
D .005	3000	1.25
D .006	1200	.35
C .006	600	.25
D .006	2500	.98
D .0062	1200	.40
D .0068	1200	.45
C .008	600	.25
C .01	600	.30
CD.01	1200	.50
D .01	2500	1.25
D .013	1200	.65
D .015	600	.35
D .015	2500	1.30
CD.02	600	.45
CD.03	600	.98
D .03	1200	1.45
D .033	600	.98
D .033	1200	1.90
D .039	600	1.60
D .04	600	1.65
D .05	600	1.90
Mfd. WV		Each
Type E—Approx. 3"H		
.000033	3500	.65
.00005	3000	.65
.00009	5000	.75
.0001	3000	.90
.0001	6000	3.49
.00015	5000	1.89
.0002	5000	.90
.00025	5000	.90
.0004	3000	.85
.0006	6000	3.49
.0007	3000	.90
.0015	5000	1.95
.0025	2500	.90
.003	2000	.90
.005	5000	2.40
.006	2000	.81
.006	2500	1.35
Type F or Similar		
.000033	3500	.95
.0003	8000	3.00
.0005	8000	3.00
.0006	8000	3.00
.001	10000	4.15
.001	8000	3.95
.0012	8000	3.95
.0015	8000	3.95
.002	8000	4.25
.0025	8000	4.25
.003	6000	3.65
.006	5000	1.85
.4	600	3.95
.01	5000	9.95
Type G		
.0003	10000	4.75
.005	5000	4.75
.041	1000	5.75
.09	1500	9.95
.0006	6000	4.95
.00025	10000	8.95

DAVEN ATTENUATORS Brand New

P250pot5000ohms/20pos $1.98
CP252pot200Kohms/20pos 1.98
CP630pot5000 ohms/30pos 2.49
T320"Tee"dual5000/20pos 2.98
IRC 100Kohm/20pos 1.98
IRC 250Kohm/20pos 2.49

STANDARD JAN "AB" RESISTORS—New!
10 ohms to 22 megohms

Value Only					
AB Type	Toler	100 For	GB 1W	5%	10.00
EB ½W	5%	$6.00	HB 2W	5%	15.00
EB ½W	10%	3.00	HB 2W	10%	7.00

Write Qty. Prices—RMA Ranges. Ask for complete Listing of "AB" Potentiometers.

CIRCULAR SLIDE RULE—12" Equiv.

Only 2-⅛" radius. Laminated—Print Stays On! Mult. Div. Sq. Cubes, Roots, Log& DecScale. Data & Case ..... 98¢
GLYPTALcement 4 jars ..... 98¢
VRENCHES, hardened Elec 9/32&11/32, ¼&15/64 — Two For ..... 25¢
PLIERS, Side Cutting BERNARD hardn'd Steel 6½". 2/$2
LINE FILTER 100 amp GE&2x5mf/50VOilCndsrs 110vacdc, SPECIAL ..... 89¢; 2/$1.49
CONSTANT VOLTAGE REGULATOR New Raytheon Inpt 95-130V/60cyc; Out 115V/60cyc $10.95
ConstV'Reg Raytheon Inpt 198-242V/50-60 cyc; Out 220V/500W/½% RgltnRackMtg. $36
ConstV'Reg SOLA USN Csd Inpt 95-190V/50-60 cyc; Output 115V/2KW/17.4A ConstDty1%Rgltn LN* $130; SameNEW$369USCost, Only $162
ConstV'Reg SOLA Inpt 92-138V/60cyc; Out 115V/26.1A/3KVA. NEW $185
Const V'Reg SOLA inpt 105-125V/60cyc; Out 115V/80Watt. NEW $16.95
ConstV'Reg G-E Inpt 95-130V/57-63cyc; Out 113/115/117V. 0.78KVA at 0.80PF. Used. Gtd $54; NEW $79

CRYSTAL DIODES
THERMISTORS, VARISTOR

IN21	$1.00	D167019 Vol Limiter	$2.95
IN21A	1.00	D168391 Therm Comp	.90
IN21B	1.75	D168392 Therm Comp	2.00
IN22	1.50	D170396 HF Pwr Meas	.90
IN23	1.50	IC Bulb Time Delay	.90
IN23A	1.50	USN CW20259 Var. 38C	2.95
IN23B	3.00	Crystal Freq Standards	
IN26	3.00	81.95 Kc	$1.98
IN27	1.75	200 Kc	3.98
IN34	.85	500 Kc	12.98
IN35	2.79	1000 Kc/FT-243 Mtd	2.95
IN48	1.15	4700 Kc	.98
IN51	1.08	Xtal Htr Oven4-28VACDC/FT243	.98

Blowers—Cool That Tube!

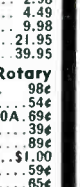
10CFM/28vacdc $3.49
70CFM115V400cycUSN 4.49
100CFM/12vacdc 5.95
100CFM/28vacdc 4.95
XFMR StepUp12or28Vto115vac 1.98
100CFM/115vacdc, HvyDty 7.98
180CFM/115vacdc, HvyDty 10.98
250CFM/28vacdc 9.95
250CFM/28vacdc&XFMR28to115vac 11.95

Mercury Thermo-Regulator

Instantaneous Action Dual Ckt, 105°F&32°F. Extremely Sensitive & Accurate—for Most Exacting Requ'ments—RESEARCH, LAB, FIRE PREV. FREEZE PT CONTROL, or MAX-MIN TEMP Control. Brand New, Individ Boxed w/data&ckt. LIST OVER $20. "TAB" SPECIAL 98¢; 12for$10. Qty Limited.

METER SPECIALS! Cased New!

DC AMMETERS		DC VOLTMETERS	
1¼MaDC Miniature DipperMtr	$3.49	9AmpRF2½"Wstg	$2.49
15A,2½"Hoyt	2.95	1 Amp RF2½" GE	3.95
30A,2½"WE/Wstg	2.49	200V, 3½"WE	4.95
60A2½"Wstg	2.98	500V,3½"WE	10.98
120A,2½"Wstg	3.98	AC VOLTMETERS	
240A,2½"w/oShnt	2.49	7½V,3"Wstg	3.98
300A,3"w/oShunt.	4.49	15V,3"SqWstn	4.95
RF Mtr 0-120Ma 3½" Weston Accy to 65Mc	12.95	150V2½"Wstg/GE Many Others—Write!	3.49



ANTENNA UHF 12"/30cm AT5/ARR1 Usable Citzn&HamBand Insltd Coax Term SilvPlCont wpfGask Flange & hardwareMOBILEmtg. New 49c; 3/$1
PL 259 for Above ..... 29¢
ANT AN130B 33" Whip ..... 98¢
ANT MS49to52, 12½ft $1.69
ANT MS49to53, 16 ft. 2.49
ANT MS49to53&xtra53, 19ft 3.69
ANT MS49to56(2-53's), 26½ft 5.98
ANT AN13IA, 11ft 8sections 1.89
ANT NETWK 100IA, HiPwr Variable 1KW HF RF 1.5to7mc's Convertible HiFrens. A GOLD MINE of BRAND NEW PARTS, Mtr, Etched Dials, RibbonCoil etc. Dmgd Coil Form $8.95
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PwrPack Kit 350VDC/125maFils&FItr 4.49
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MU/leafSw 3½"DPNO&NC/15A ..... 98¢
MicroSw PinPlungerSPDT/10A ..... 54¢
MicroSw Plunger SPDT/10Aor8PNO/10A. 69¢
ArrowH&H Plunger SPNO/6A ..... 39¢
MicroSwRollerSPNC/10A ..... 89¢
AH&HToggle DPDT/6A..30¢; 4 for $1.00
MicroSw PlungerSPNO'NC ..... 59¢
Mu&MicroSw SPDT w/reset ..... 65¢
MicroSw Plunger Button SPDT ..... 69¢
MicroSw SPNC/30A/Cased ..... 98¢
Switchette DPNO&NC ..... 30¢; SPNO ..... 25¢
SQ'D/B30/Start&Stop Push Button ..... 98¢
RotarySw 6Deck5Pos(2-5pos sw ea deck) ..$1.49
RotarvSw 4Deck7Pos. 5Ckt&On/OffCkt 1.29
MTRorHAM CERAMIC Sw 7Deck5PosHIV 1.49
VOM Switch SP 21pos, SilvPl. Cont ..... 36¢

Heineman Magn Ckt Bkrs forAC/DC Opert'n AMPS: .01, 22, 2, 3, 7, 7.9, 15, 20, 30, 35, 40, 80, 180&220Amps. SPECIAL, ea. ..... $1.49; 10/12.98; 100/$120
Klixon Therma Push-Button C'Bkrs AMPS: 5, 10, 15, 30, 35 Amps, Ea. 79¢; 10/5.98; 100/$45
Square-D ToggleSw ANtype C'Bkrs AMPS: 5, 10, 20, 25 Amps, Ea. 89¢; 10/$7.98; 100/$69

Rectifiers, Bridge

In	Out	Amps	Ea.
18V	14V	1.35	$2.49
18	14	3.5	3.29
18	14	5.	4.25
18	15	11	9.95
18	15	18	14.95
18	15	27	22.95
36	28	.32	1.49
36	28	3.5	6.49
36	28	5.	7.25
36	30	11	17.95
36	30	18	26.95
36	30	27	36.95
90	75	1.5	1.49

SelenFEDERAL 100ma, 72c; 200ma ..... 98¢
SelCT18V/12V/1½A 1.49

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BB206U $1.89
2V'27AH Willard
BB54 ..... $1.89
4V/40AH Willard
TBY ..... Used $3.95
6V/6AH Willard
NT6/BB214U $1.75
6V/25AH Willd $3.98
6V/40AH Willard
ER10-6 ..... $6.98
36VminBR18/BB52 ..... 12 for $10
BRAND NEW SigC DryBatts—Shelf Dated—Tested—Gtd
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CLARE A-12280 3SPDT&3SPNC $2.98
CLARE Octal based DPNC&SPNO 3.98
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S'DUNN 17AXX109 SPNO/6to30A cts. 1.98
LEACH DPDT/10 Amp Contacts 1.98
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CLARE DS-11 Automatic Stepping 24/32 VDC 3-lever 10 steps 7.95
Write for Complete Relay Listing.

SURPLUS BARGAINS - - NOW ! !

GE #K2731 PULSE TRANSFORMER

Pri. Imp. 50 Ohms
Sec. Imp. 450 Ohms
1 Micro-second, 635 PPS, Pri. Input 9.5 KV PK, Sec. Input 28 KV PK, BWR Out 800 KW, *Bitiliar 2.75A.*

A buy at $17.50

HIGH VOLTAGE TRANSFORMER

GE Cat No. 7470609 can-enclosed with insulators
PRI—115/230 V. 50/60 Cycles
SEC—14000 V., Rating 1.4 Kva
Dimensions: 16"H x 12"W x 10"D.
Shipping Weight: 178 lbs.

A buy at $45.00

GE TRANSFORMER TYPE M

CAT. 61G5—ISOLATION TYPE
PRI.—230 V. SEC. 115 V.
60 Cycles 250 Watts. 8" x 5" x 4½"
Net weight—14 lbs.—

NEW—$6.50

STEP DOWN TRANSFORMERS SPECIAL

Made by GE, heavy duty, considerable over-design, open frame, ideal for rectifier application, size: 3½" x 3½" x 4".
PRI—115 Volts 60 Cycles
SEC—15 V at 12 Amps

$3.75

HIGH VOLTAGE CAPACITORS

1	MFD 20 KV DC	18"x13½"x5".			$25.00
1	MFD 25 KV DC-13"x7"x4".				9.85
.001	MFD 50 KV DC-5½"x7¼"x4" insulators				
	4" dia. x 7" high.				12.50
Cap Mfd.	Volts D.C.	Height	Width	Length	Price
10	1000	5-7/8 x	1-3/4 x	3-7/8"	$1.85
4	1000	5-7/8 x	2-3/4 x	1-1/4"	.85
1	1000	3-5/7 x	2 x	1-1/16"	.50
1	500	2" x	1-1/4" x	1-1/16"	.25
.25	1000	1-1/2 x	1" x	3/4"	.25

RACK PANEL CABINET

42" H x 22" W x 16½" D

Heavy Gauge Metal, Black Wrinkle Finish, shipped knocked down, ready to assemble with rear door and hardware. Front Panel not included. Panel size 19⅛" x 36¾". Shipping weight 99 lbs.

NEW! A REAL BUY $17.50

L & N MICROMAX MODEL S

REBUILT, RECONDITIONED ADJUSTED ELECTRICALLY AND MECHANICALLY

Single Point, Curve Drawing, Continuous Line, One set HIGH, COMMON, LOW Contacts. 110V AC Motor.

RANGES:

0—1200°F C/A	1000—2000°F C/A
0—1500°F C/A	1000—3000°F Plat./ 10%R
0—1800°F C/A	

PRICE $210.00

L & N MICROMAX MODEL R

REBUILT, RECONDITIONED ADJUSTED ELECTRICALLY AND MECHANICALLY

Single Point, Curve Drawing, Continuous Line. Chart speed—1 RPM/24 hrs. 1 set H.C.L. Contacts. 110V AC Motor.

RANGES:

700-1400°F C/A
200-2000°F C/A
1000-2400°F C/A

PRICE $135.00

BC 403E OSCILLOSCOPE

Made for Signal Corps by RCA for use in SCR-270D Radar—Can be converted to other uses — A Gold Mine for Parts — Shipping Weight: 400 lbs—Without Cathode Ray Tube 5BP4 ..... **New! $57.50**

A. T. R. INVERTER

Model RSA Type 12
Input—12V DC. Output—110V AC.
50/60 cycles. 125 W Intermittent,
100 W Cont. 8½"x8"x4½"—Net 15 lbs.

New, $16.50

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INCLUDE SUFFICIENT FOR POSTAGE

WESTON MODEL 271 Microammeter

Another of the famous Weston fan shaped line. Very large scale 5.8" long. These meters were made by Weston to General Radio specifications, with special mirrored scale and knife edge pointer. Accuracy 1%.
0-600 Microamps
170 M.V.
Coil Res: 250 Ohms

Your Price $22.50

WHSE PORTABLE GALVANOMETER

Type PX-12, Movement 7 MA, special scale, solid connecting terminals, contains a 1 Volt internal cell which can be easily removed for conversion to DC AMMETERS & VOLTMETERS, with leather case and canvas carrying strap.

A BUY AT $4.95

DUMONT Model 164-E 'SCOPE

Used! Guaranteed

3" CRT operates at accelerating potential of 1100 V—brilliant well - defined trace Vert amp voltage gain approx 43, horiz amp voltage gain approx 55, Freq. range vert. & hor. amp both uniform ±3 DB from 5-100,000 CPS Input impedance 1 megohm vert, .8 megohm hor. Operates 115 V, 40-60 cycle.

Price New $115.00
Your Cost $77.50

POWERTRON Electrical Equipment Co.

117 LAFAYETTE STREET — *Phone:* WOrth 2-8610 — NEW YORK 13, N. Y.

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R1396—At last, a blocking oscillator transformer to give shorter pulses than the 9280. Designed for the SR, it can deliver .18 microsecond pulses as fast as 250KC. Fully closed with ceramic terminal board, 1⅜" dia. x 2⅛" high—Westinghouse..$1.65
9262, Utah $1.50
9318, Utah $1.50
9280, Utah $1.50

WIRE WOUND POTENTIOMETERS

I am proud to offer this selection of Chicago Telephone controls. They are unquestionably the finest available. All have shafts long enough for a knob. 2 watt sizes: 75, 200, 500, 3500, 5K, 10K ohms. 4 watt sizes: 30, 100, 1K, 4K, 5K, 10K, 15K, 20K. These excellent wire wound pots are only.....45¢

IN21 crystal diode up to 3000 Mc., 8.5db conversion loss, 4.0 output noise ratio, burn out test 0.3erg
SPECIAL .....49¢
IN34 .....$1.09

26 CONDUCTOR CABLE made up by Western Electric in 50 foot lengths with S324CCT connectors on each end. Each conductor is #22 stranded and rubber covered. Although the O.D. is only 9/16 inches there is a heavy live rubber jacket. Complete with two mating P324AB connectors ONLY $7.50
Same in 100 ft lengths.....$15.00

GEAR DIFFERENTIAL

GE ASM 8640201 G1 IBM—A beautifully made geared unit from the B29 computer, inputs and outputs on the same axis. 1 11/16" OD by 2½" overall length of shaft.....$3.85

Excellent service on: AN connectors, mica condensers, tubes, small pulse transformers, chassis, toggle switches, etc. All material is new and guaranteed.

HAROLD H. POWELL
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PRECISION resistor WIRE

Advance • Copnic • Cupron
Copper-nickel alloy—low temp. co-ef .00004

Size	Ohms per ft.	Ft. per lb.	Price/lb.
#22 dcc	.459 (180 alloy)	515	$1.20
#24 dcc	.728	820	1.35
#25 dcc	.917	1,029	1.50
#26 dcc	1.163	1,305	1.58
#27 dcc	1.458	1,536	1.70
#28 dcc	1.852	2,078	1.90
#29 dcc	2.302	2,584	2.00
#30 dcc	2.940	3,300	2.20
#33 dcc	5.833	6,546	2.35
#35 dcc	9.375	10,522	3.90
#34 S.E.	7.408	8,314	$3.25
#35 S.E.	9.375	10,522	3.90
#36 S.E.	11.76	13,200	4.60
#39 S.E.	24.00	26,930	8.50
#40 S.E.	30.59	34,330	10.50

ORDERING INSTRUCTIONS Unless specified we will ship any of the types advertised above.
MINIMUM ORDERS D.C.C. #22 to 35, 1 lb.+30% —15%, respooled from original 3 lb. av. spools.
ENAMELED #34-35-36, min. order 1 lb., ±30%; sizes 39 & 40, ½ lb., ±30% min. Enameled wire is spooled on mfgr's precision spools. All guar'd.

ATLANTIC INDUSTRIAL CO.
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ONE-HALF MILLION BATHTUB CONDENSERS

- OIL IMPREGNATED -

.1 —400V	.25—600V
.1 —600V	.5 —400V
2 x .1 —400V	.5 —600V
2 x .1 —600V	1.0 —600V
3 x .1 —400V	4.0 — 50V
3 x .1 —600V	2 x .25—600V
2 x .05—600V	2 x .5 —230V

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Many Others Not Listed Above, in Stock
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For manufacturing radio tubes, electronic tubes, cathode-ray tubes, lamps. New and used. Reasonably priced, satisfaction guaranteed.

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Dynamotor DM-33A: 28 V-5 A; 575V-.16A.....1.50
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BATHTUB COND. 3X.1 mfd-400VDC; also .1X.1 .14
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COIL SET & HAND CALI. CHART; 16 steps; 2500-3200 KC; for GF Eq. WE # 47136..... 1.30
FUSES: Bussman 4AG5 (5 amps.) 25 to Box... 5.00
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304-TH	9LP7	371B	.70
5CP1	3DP1	371A	.75
5AP1	8013	2X2	.25
5AP4	878	800	.65
4AP10	3B24	8013-A	1.50
$1.95	95¢	9GP7	3.50
		864 per 100	4.85
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GOULD GREEN 254 Greenwich St. N. Y. C. 7

Nobody but ARICO has "hard-to-get" items—

SPARE PARTS ARE HARD-TO-GET

RADAR AN/APS-2C or
2E SPARES including:

1 ea B-201 Blower Motor, 1 ea B-801 Blower Motor, 1 ea B-802 Blower Motor, 3 ea Crystal IN-21 and the following tubes: 3 ea 6AC7, 2 ea 6H6, 3 ea 6SN7, 3 ea 6L6GA, 2 ea 2AP1, 2 ea 5FP7, 2 ea VR-105-30, 2 ea 5U4G, 2 ea 6X5GT, 2 ea 2X2, 2 ea 829, 2 ea RKR72, 2 ea 715-B, 2 ea 2J-22, 2 ea 417-A, 2 ea 721-A, plus misc. fuses, brushes, valve core, dehydrator, etc. Brand new, packed in grey chest with description list.

$89.00 Complete Set

Aircraft Radio Industries, Inc.
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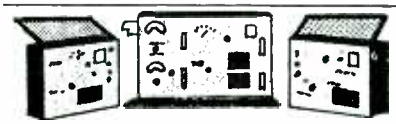
OVER $1,000,000.00 IN SURPLUS!

FOR YOUR EVERY NEED



NEW BC 223 AX TRANSMITTER

801 Oscillators and 801 power amplifiers, 2-46 modulators and 1-46 speech amplifier 4 Xtal frequencies and master oscillator on selector switch. 30 Watts output. Tone voice or C.W. Mod. Ideal for 80 meter band. Comes with 3 coils TU 17A 2000-3000 Kc. TU 25 3500-5250 Kc. Black crackle case. Includes two separate cases to store extra coils. Frequencies chart and tubes included, packed in original cases, less crystals at this low price. **$39.95**

MODULATION TRANSFORMER AND DRIVER TRANSFORMER

RC 1206 modulation transformer. 815 Class AB2, 56W. audio. RC 1205 driver transformer, 6SN7 to 815, Class AB2—Companion to RC 1206.

ONLY **$4.95** FOR BOTH UNITS

MICA CAPACITATOR

.002 MFD 3000 W.V.D.C. **69¢**

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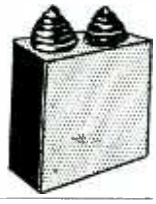

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SPRAGUE CONDENSERS

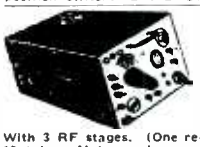
.1 MFD 7000 Volts **$1.95**

COAXIAL FITTINGS

5c	25c	35c	20c
HOOD	SOCKET SO-239 83-1R	PLUG PL-259 83-1SP	ANGLE-ADAPTER M-359 83-1AD

BK 22 K RELAY

$2.95 Used in conjunction with SCR-269F, changeover contains 28V. step relay 5 deck, 6 position switch. 12V. DPST.



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HALLICRAFTER SX 28A

$129.00

With 3 RF stages. (One re-readiation suppressor R-F.) 12 tubes. Motor and manual tuning. S-meter. F-selectivity control. Crystal Filter. AVC, phasing control, ANL, etc. Also furnishes video output for scope, and panoramic output for scanning. Complete with tubes and Xtal, but without power supply. Power requirements, 270V.D.C. at 135 MA. and 6V.A.C. 6 Amps. New, in sealed cases.

ULTRA HIGH-FREQUENCY TRANSMITTER T-85/APT-5

BRAND NEW! ONLY **$95.00**

1500 Megacycle Transmitter, made for U.S. Government, complete with the following tubes: 2-6AC7, 1-6L6, 2-829, 1-931A, 1-6AG7, 1-522 Ultra high freq. tube. Complete with high freq. cavity, 1 Blower to cool the 522, 1 time delay relay, 2 filament trans. cond. and many other component parts for ultra high frequency work. It has a frequency checker, complete Lecher wires, with slider and sensitive bulb for checking the wave length. The Lecher wires are so calibrated that the setting of the slider may be read directly in Centimeters. Operates on 115V. AC for filaments only. Does not include any plate supply. The tubes alone are worth many times more than what we are selling the complete transmitter for. Packed in original case—contains instruction book. Wgt 118 lbs.

T-17 CARBON MIKE

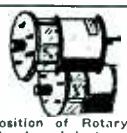
79¢ LIKE NEW

SCOPE TRANSFORMER

$3.95 Primary 110V. 60 Cy. Sec. 4000V. at 10 MA. Size 6x4x3½".

SELSYN MOTORS

TWO FOR **$3.95**



The ideal way of indicating the position of Rotary beams, wind indicator, etc. Line chord and instructions for 110 AC operation furnished on request.

IRC TYPE HE

100W. Bleeder consisting of 5 sections; 750 ohms, 23 ohms, 23 ohms, 7500 ohms, 300 ohms, Total—11,296 ohms. **49¢**

304TL

75c

Just the tube for that 1KW final — typical operation 2500 volts at 400 MA. An ideal tube for that induction heater or dielectric heater. Efficient operation at 1500V. to 3000V.

TUBES

815	$1.95	VR150	69	9006	.44	RK60	$ .95
3BP1	1.95	955	.65	50B5	.89	1T4	.44
5FP7	.95	9002	.44	35W4	.69	3Q4	.44
7BP7	1.49	12X3	.44	872A	1.95	3S4	.44
9LP7	2.95	9004	$ .44	1H5	$ .69	1N5	.69
				3Q5	.69	VT25	
				6L6GA	.95	(210)	$.44
				5U4G	.44	5W4	.44
				6SA7	.44	2X2	.95

C E PHOTOCELL . . 95c
Type used in movie projectors, burglar alarms, etc.

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Oscillator assembly 76 to 300 MC with acorn tube socket mounted on condenser $3.95

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BC4 Antenna condenser 105-330 MC.. 3.95

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6-12V. 60 Cy. 5" Indicator with 0-360 Degree Dial. **$4.95**

Circuit Breaker, 24V, 20 Amp.

AN 3160 Square D. Co. **$1.49**

Banana Jack and Plug

75¢ Dozen Sets

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Normally opens at 95° F85-1 H5 **49¢**

30 MC-1F, Silver-Slugged, 35¢

HEINEMANN CIRCUIT BREAKER

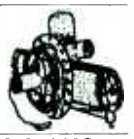
115 V. 5 Amp. **95¢**

110 V. 15 Amp. **$1.95**

110 V. 20 Amp. **$1.49**

Klixon 110 V. 5 Amp. Adjustable **95¢** Aircraft

A-5 AUTOMATIC PILOT



Servel—100 pounds max., to use as a steering device. or compass control on ships. **$9.95**

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Made by General Electric. Contains

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F301 20A 250V G.E. CAT. GE 1025

INDICATOR LAMP
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J302 2 POLE HART & HEGEMAN °F7723
J303 2 POLE HART & HEGEMAN °7723
J304 4 POLE RUSSELL STOLE °8087

RELAY
K301 120V 60n STRUTHERS DUNN °AS8X1

SWITCHES
S301 ALLEN BRADLEY CAT. 2AS
S302 INTERLOCK 10A 250V

PRICED AT ONLY **$4.95**

No. MX16 Cross pointer 3½" Meter. Two 200 microamp movements, Brand new $2.95

500 ohm to grid matching transformer No. 81749 ..... 69c

Ceramic mica Padder single 5 to 20 MMFD ..... per doz. 50c

Choke—300MA 20HY. Insulated for 5000V. Heavy Porcelain Insulators. Very conservatively rated. Idle for KW rig. $8.95

PHILCO FURNITURE OR REFRIGERATOR POLISH

Reg. 49c value for **19¢** each 8 oz. Can

Mfgd. by Philco Radio & Television Co. $3.50 for Case of 24

Don't Miss These Special Savings!

Powdered iron, ¾ slug	10c
Jacks for PL55	10c
Ass't mica condensers—per 100	$ 1.95
Pin straightener for miniature tubes	25c
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Beautiful DETROLA Record Changer

Handles 12-10" records or 10-12" records. Automatic Changer — Only

$9.95

Be a "Forty-Niner" in '49

THE "FORTY-NINER" GEIGER COUNTER

$89.50

- Light weight uranium detector.
- Detects beta and gamma rays.
- Equipped with 36 inch search probe.
- Contains two 67½ volt Minimax batteries in the well-known type of relaxation oscillator supply.

Weight 4½ lbs. complete; size 4"x5"x6" Beautifully finished case with handle.

Complete with four tubes, including Geiger tube, batteries, search probe and ear-phone.

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20 MC TO 27.9 MC **$9.95**

This Xtal controlled FM set has 13 tubes and has dual Xtal controlled channels. It also contains built-in Fil. and Plate Meter. Tubes used: (4)1LN5, (1)1LC6, (1)1LH4, (2)1291, (4)1299, (1)1294. Ideal for communication between trucks, boats, etc. Used, in good condition. Less power supply. Wt. 38 lbs. Complete with carrying case and diagrams.

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All orders F.O.B. Detroit—Minimum order $2.00—Michigan customers add 3% sales tax—20% payment must accompany all orders.

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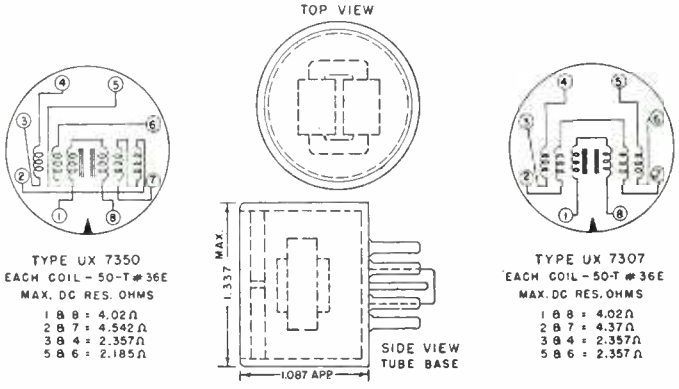
Tube base plug in type

Here are precision made, high quality compact pulse transformers wound on hypersil cores. They are built in octal bakelite tube bases and can be adapted to many uses. Kindly distribute this data to key personnel in your Electrical Engineering Department, to your Technical Library, to your Electronic Equipment Buyers and to any person who should have knowledge of this item.



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★—Completely impregnated and sealed.
★—Physically small, measuring only 1.377" dia. x 1.087" high.
★—Convenient to use—merely plug into an octal socket—simplifies production.
★—The two types UX7350 and UX7307 differ only by placement and termination of windings.
★—Schematic of winding sequence and connections pressed into disc covering top of tube base. Schematic designates socket connections.
★—The coils are wound on high-grade tested hypersil cores.
★—Used in some of the Navy's modern and highly accurate Radar and Direction Finding Equipment.
★—Standard types—manufactured by Raytheon Manufacturing Company.
★—Quantities available—immediate delivery.

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★—Blocking Oscillator, Multivibrator and Scope Circuits.
★—Wherever Accurate Timing and Triggering are necessary.
★—Unexcelled in circuit applications for generating low power and low voltage pulses.
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PRICE: $3.95 EACH

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THE UNUSUAL 50 KW MODULATION TRANSFORMERS

Three General Electric 37.5 KVA brand new, original crate, for RCA 50 KW broadcast transmitter, $1,800 each

Three GE 24 henrys reactors for above, $1,000 each

300 BD-71 and BD-72 switchboards, good condition, $12 each

40,000 feet 7/8" copper coaxial 72 ohm transmission line, 20 foot rigid lengths, 45c foot

SCR 643/644 Bendix 50 watt 100-156 mc transmitter and receiver ground station, complete, with masts, cables, power plants, $1,000

350 foot Truscon self supported insulated base tower, $5,500

300 reels, brand new, CC-358, spiral four telephone cable, original pack, $40 per quarter mile reel.

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BRAND NEW — GENUINE
WESTERN ELECTRIC
DRIVER UNIT with REFLEX PROJECTOR

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$19.95 F. O. B. N. Y. C.
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A Blast-Proof, Blare-Proof Reflex Speaker, with a Projector especially designed for use with the famous *WESTERN ELECTRIC DRIVER UNIT*.

Heavy gauge metal construction throughout, including the main trumpet section, gives you peak performance without blaring or blasting.

Excellent for Concessions—Ball Parks—Schools—and P.A. Work.

SPECIAL! 25% DEPOSIT WITH ORDER, BALANCE C. O. D.

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General Radio		
Inductance bridge	667-A	$250.00
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0-200 ua 3" sq. G.E. DO 50	$ 8.00
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0-50 ua 3" sq. G.E. DO 50	12.00

R.F. MILLIAMMETERS

0-115 Ma 3½" Weston 425	$12.00
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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.

GENERAL UTILITY STEEL CABINETS
FOR SALE

Dimensions 23 wide x 20½ deep x 32 high; shipping weight 123 lbs. Provides 30" of panel height in standard 19" width. Finished in gray crackle and provided with 2 sets of shelf brackets and hinged rear door. Only $15.00 f.o.b. Weston.

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EXCESS LABORATORY EQUIPMENT

General Electric Type YYZ-1 Decade Scaling Unit. New Perfect Condition $400.00
General Radio Type 605-B Standard Signal Generator Used. Guaranteed Perfect $250.00

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EXPORT FACTORS, Moraga, Calif.

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Link Radio Transmitter-Receivers Type 50 UFS	Price on Request
Radar Type SF, complete with all components	$1,480.00
R5/ARN-7 Radio Compasses, complete	125.00
BD-72 Field Telephone Switchboards	37.50
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TDE Radio Transmitters	675.00
Type SCR-522's—(Slightly Used)	65.00
Collins TCS's Navy units	575.00
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Telegraph Transmitters — Model ET-8023 D1	425.00
Generator Lighting Plants—Type PE197, 5KW, 120 Volt AC, 50/60 Cycle, Single Phase	675.00
Generator Gasoline Engine Driven Lighting Plants Type 5KW, 110 Volt AC, 50/60 Cycle, Single Phase	550.00
Reading Storage Batteries, 185 amp-hours, 6 volts	7.50
Exide Storage Batteries, 150 amp-hours, 12 volts	17.50
Prism Binoculars—7 x 50 Navy Type—Regular Optics 30 per case	* 44.00
NEW—Not Surplus	
Prism Binoculars—7 x 50 Navy Type—Coated Optics 20 per case	* 54.00
NEW—Not Surplus	

TUBES

Type		Type	
10Y	$ .55	805	3.80
211	.85	807	1.14
250TH	21.30	808	2.80
304TL	1.10	810	5.50
450TH	22.75	836	.95
450TL	36.50	861	27.50
803	4.50		

*Plus 20% Federal Excise Tax

All Equipment Subject to Prior Sale

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405 Lexington Avenue
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Oregon 9-3650
Cable Address: Frexvan, N. Y.

INDUSTRIAL POWER SUPPLY EQUIPMENT

for worthwhile savings to you

T-102 — Filament Transformer, American Transformer Co. Spec. 29106, Type WS .050 KVA, 50/60 cyc. Single phase, 35 KVA test, 12 KV D.C. operating. Primary 115 V., secondary 5 V., 10 amps with integral standoff insulator and socket for 250 T, 371, 872 and 5563, etc. rectifier tubes $12.50 Net Wt. 15¾ lbs. Dim 6½" W x 6" D x 12" H.O.A.

WIRE

600 volt Simplex Type S (19) conductor #18 AWG ..... $170.00 per M*
3000 volt Simplex underground single conductor #8AWG ..... $140.00 per M*
No. 18 AWG single conductor, solid, annunciator wire 7-lb spool ..... $2.90. 10 spools $27.00
*Above cable in full spools only, i.e. 1000 to 1200 feet.

ASD 3CM Radar Transmitter & Modulator, N-2 cond $110.00
Also parts for this equipment.
Details or prices on request.

NEW RA-38 RECTIFIERS

115 v., 60 cy. 1 phase input, output 0-15,000 v. d-c @ 500 ma
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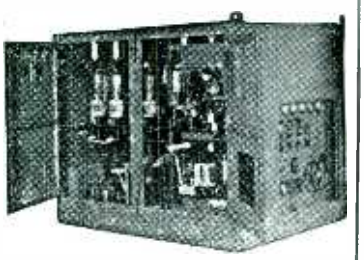

CONSTANT VOLTAGE TRANSFORMERS

95 to 125 volt 50 cycle single phase input; 115 volt output:
60 va ..... $ 8.40 — 380 va $27.00
120 va ..... 13.20 — 500 va 34.00
190 to 250 volt input; 220 volt output:
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RAYTHEON

198 to 242 volts 50/60 cycle single phase input; 220 volt 500 watt output $38.00

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2 mfd 600 v. d-c tubular ..$.30; 10 for $2.50; $20.00 per C.
3.5/.5 mfd 1,000 v. d-c ..$.90; 4 for 3.00.
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1.25/1.25 mfd 7.5 kv d-c or .625 mfd 15 kv d-c; Pyranol $12.50
.25/.25 mfd 7.5 kv d-c or .125 mfd 12 kv d-c $3.75
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.001 mfd 25 kv d-c mica; 25 A. @ 3,000 kc, 18 A. @ 1,000 kc, 11 A. @ 300 kc. $25.00
50 mmfd 32 kv d-c tubular vacuum $4.95

METERS
Weston or Westinghouse

3" 0-120 a-c amps, w/current transf $ 8.50
3" 0-20 kv d-c w/precision multiplier 18.00
3" 0-4 kv d-c w/precision multiplier 9.50

SPECIALS

Westinghouse Meter Multiplier: 1 meg., ½% tol., w.w. noninductive $1.25
Running Time Meter: Cramer RT3H; 220 v., 60 c; 3" square; five figure $6.95
Filament Transformer: Constant current; 110/220 v., 50/60 c; sec. 21.5 v. 40.5 A $17.50
Tube WL 386/ML-3W; 125 KV X-ray oil immersion rect.; 10 v. 11.6. A. fil $32.00
CRAMER Time Delay Relay: TD2 120S; 0-120 sec., 115 v. 60 c., syn. motor-driven; 10 A., 115 v., S.P.N.O contact $4.95
Motor: 27 v. d-c, 0.7 A., 110 R.P.M., 1 oz./ft. torque $3.50
Solenoids: 115 v., 60 c; continuous, wt. 5¼ lbs. $2.75
intermittent, wt. 9 lbs. $2.75

TUBES

All Tubes are New, of Standard Mfg., in original boxes.

Type	Price
1B22	$5.75
1B23	9.75
2D21	1.25 ...70.00/C
2I62	47.50
3B22	2.75
3B24	1.75
3C23	3.75
4B28	2.75
15E	1.25
VT127A	2.50
250R	7.50
250TL	19.50
*304TL	7.50
307A/RK75	4.50
316A	.75
371B	2.75
388A	2.75
450TH	22.50
700A	37.50
701A	4.75
702A	3.75
703A	4.75
704A	2.25
705A	2.25
706BY	17.50
706EY	19.50
707A	14.75
707B	16.50
708A	4.75
713A	1.25
714AY	5.75
715A	9.50
717A	.75
719A	11.75
721A	2.75
722A	13.75
725A	17.50
730A	19.50
750TL	47.50
811	1.75
830B	4.75
872A	2.25
921	1.25
931A	2.75
C5B	8.50
C6A	8.50
C6J	9.50
FG81A	4.75
WE-203A	4.75
WL-531	17.50
WL-533	17.50

Includes 115 v 60 c H.V. fil. trans & socket.

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9:12 mfd 1265 v a-c, 60 c, 1 ph, 5 kilovolt amps reactance. New G.E. Pyranol $17.50

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115 v. 50/60 c; 0-115 v. 100 amp output $95.00
115 v. 50/60 c; 0-130 v. 10 amp output $24.50
115 v. 60 c; 103-126 v. 2.17 amp output ..... $ 9.50
115/230 v. 50/60 c; 0-260 v. 2.5 amp output $21.50

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115 v. 60c. primaries
Amertran: 17,600 v' @ 10.4 K. V. A. cont. $65.00
Amertran: 8,800-0-8,800 v. @ 10.4 K.V.A. cont. $75.00
Westinghouse: 18,400-0-18,400 v. @ 9 K.V.A., cont., plus 2 WL-531 rect. tubes, fil. transf. & 50 h 575 ma choke $160.00
Kenyon: 2.5 v. c-t @ 10 amps, 15,000 v. test $4.50
Kenyon: 7.5 v. c-t @ 12 amps, 15,000 v. test $6.50
24 v. @ 1 amp, uncased $1.69

RELAYS

Westinghouse Type SC-M Overcurrent relay, 2 to 1 A., 8 A. cont. rating 20-40% drop out ratio $12.95
A-B 810 Overload Relay. 6.3-18.1 A., 600 v. max. $7.95

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Amertran: Swinging, 900 h @ 16 ma, 25 h @ 525 ma, 35,000 v. test $42.00
Keyon: 20 h @ 30 ma, 15,000 v. test $12.00

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A-B #RC-3301; 115 v. 60 c. coil, D.P.S.T. 15 amp contactor $4.95
Monitor: 115 v. 60 c. coil, N.C.D.P. contactor, 100 A. 600 v. N. C. 15,000 v. 1.0A. contact. One N. O. & one N. C. interlock w/150 A & 30A, renewable fuses $8.95

RESISTORS

200 watt wire wound resistors, ferrule ends 160,000 ohm, 5,000 ohm, or 1,000 ohm $1.00

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0-150 Volt 400 cycle black background luminous needle & scale, mounts in 2¼" hole. Accurate on 60 cycle. Brand New..... **$2.98**

D.C. ammeter 0-300 Type #E-1 Mounts in 2⅝" hole. Black background with luminous pointer and scale. Complete with external shunt **$2.95**

SELENIUM RECTIFIER

Full-wave bridge rated 90 VAC input 65 VDC output at 150 mills continuous duty..... **$1.19**

FULL WAVE RECTIFIER

Mallory bridge #1S36B7M rated 32 VAC input 7 amps continuous & 15 amps intermittent output at 14 VDC resistive & 22 VAC capacitive load. Brand New **$4.95**

METER RECTIFIER

full-wave selenium bridge rated 10 volts @ 30 mills. Brand New..... **39c**

F. W. SELENIUM RECTIFIER

Mallory 120 VAC input 85 VDC output at 15 mills **59c**

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#2401-514 SPST NO locks in closed position until locking relay coil is actuated to release. 24 VDC coils. 10A contacts. Brand New , ea.. **$1.49**

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12 volts at 600 Amps. and 24 volts at 300 Amps. momentary, 12 volts at 130 Amps. and 24 volts at 65 Amps. continuous, 220 volts 60 cycle 3 phase input O.D. 18 x 22 x 34" ea. **$175.00**

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MICA TYPE F CONDENSERS
CM 65 & CM 70—Very Special Low Price

Cap.	Volt.	Each	Cap.	Volt.	Each	Cap.	Volt.	Each
.1	1000	$1.26	.00025	3000	$ .73	.0004	5000	$ .77
.05	1500	1.32	.0004	3000	.73	.0005	5000	.84
.075	1500	1.36	.00075	3000	.77	.0006	5000	.84
.00008	2000	.50	.001	3000	.79	.0008	5000	.84
.01	2000	1.08	.0035	3000	1.08	.001	5000	.94
.00003	3000	.58	.0001	5000	.77	.0012	5000	.94
.000075	3000	.58	.0002	5000	.77	.0015	5000	.94
.0001	3000	.58	.00025	5000	.77	.00004	6000	1.11
.0002	3000	.73	.00032	5000	.77			

83-1SP 83-1SPN 83-1R 83-1AP

"UHF" COAXIAL CONNECTORS

No.	AN #	Type	Each	Per 100
83-1H	UG-106U	Hood	$.12	$.10
83-1R	SO-239	Rec.	.35	.28
83-1AP	M-359	Ang. Adap.	.35	.28
83-1T	M-358	Conn.	1.12	.98
83-1J	PL-258	Junction	.80	.70
83-22R	UG-103U	Rec.	.50	.40
83-22P	UG-102U	Plug	.45	.40
83-1SP	PL-259	Plug	.35	.28
83-1SPN	PL-259A	Plug	.35	.28
83-168	UG-176U	Red. Adap.	.15	.12

FP CONDENSERS STANDARD BRANDS

SINGLE SECTION

Cap.	Volt.	Each
2,000	15	$.29
1,000	25	.74
10	450	.34
20	450	.39
20	475	.47
30	450	.49

DUAL SECTION

Cap.	Volt.	Each
40-20	25	$.39
80-80	25	.49
20-20	250	.54
40-40	250	.79
10-40	300-25	.49
90-10	350	.69
40-20	450	.79
40-40	450	1.09
20-20	450	.49
50-50	450	1.19

TRIPLE SECTION

Cap.	Volt.	Each
90-40-20	200-200-50	$.89
30-15-10	350-300-25	.59
10-10-20	350-350-25	.51
30-15-10	350-300-300	.69
15-10-10	400-400-350	.62
15-10-10	350-350-250	.64
40-40-20	400-300-250	.89
10-10-20	450-450-25	.69
15-15-10	450-400-350	.73
30-10-10	450-450-350	.79
30-30-10	450-450-25	.89
60-20-20	450-450-400	1.19

QUADRUPLE SECTION

Cap.	Volt.	Each
80-30-100-40	150-150-25-25	$.79
40-40-20-200	150-150-50-10	.79
40-50-20-20	300-250-250-25	.79
10-30-20-20	350-300-25-25	.69
40-20-10-40	300-300-300-250	.89
20-20-20-20	450-450-450-450	1.29
20-20-20-20	475-475-475-450	1.34

ALLEN-BRADLEY CONTROLS

Ohmage	Shaft	Bushing
50	5/8" reg.	3/8" L.B.
500	3/8"	1/4"
500	1/4" s.s.	3/8"
1000	3/8"	3/8"
1000	3/16" s.s.	1/2" L.B.
2000	1/8" mill	1/4"
2500	3/8" reg.	3/8"
3000	1/2" mill	1/4"
5000	2 13/16"	1/2"
5000	1/8" s.s.	1/4"
6500	1/8" s.s.	1/4"
10,000	1/8" s.s.	1/2" L.B.
15,000	1/8" s.s.	1/4"
20,000	1/8" s.s.	1/2" L.B.
25,000	1/8" s.s.	1/2" L.B.
40,000	1/8" s.s.	1/2" L.B.
50,000	5/8" reg.	1/2" L.B.
50,000	1/8" s.s.	1/2" L.B.
50,000	1 3/16" mill	3/8"
50,000	3/8" reg.	1/4"
60,000	1/2" mill	1/4"
100K	1/8" s.s.	1/2"
250K	1/8" s.s.	1/4"
500K	1/4"	1/2"
500K	1/2"	1/4"
1 meg.	1/8" s.s.	3/8"
1 meg.	1/8" s.s.	1/2"
6.25 meg.	3/8"	1/4"

50c each

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15-A-1-400-50. H-500. 15,000 volts. 50 ohms imp. 1 microsecond delay. 400 pulses per sec. ea. **$12.95**

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Cap.	Volt.	Each
4	600	$.59
5	600	.69
6	600	.79
7	600	.89
2	1000	.79
4	1000	.99
8	1000	1.29
8x1	1000	1.39
10	1000	1.69
15	1000	2.89
2x4	1500	1.95
.25	3000	1.19
1.0	3000	1.95
0.1	3500	.79
.15	4000	1.49
0.5	5000	1.99
2	5000	5.95
30	90v AC 3 Phase	3.95

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OUTPUT—Volts-515/1030/2/8
Milliamperes—215/260
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4	65	5	solder	$7.50
5	12	2	pigtail	5.50
10	5	10	plated	4.50
12	20	5	solder	6.50
20	65	10	solder	8.50
50	4	10	pigtail	7.50
126	7	2	solder	4.75
470	10	5	pigtail	6.50
3600	50	5	solder	9.75
5000	40	5	ferrule	9.75
15000	15	2	solder	9.75
399M	½	3	solder	9.75

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44—Conductor Copper, 1 Square MM (equal to #17 AWG) 4/64" watertite insulation cabled together.
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S BAND SIGNAL GENERATOR CAVITY with cut-off attenuator, 2300-2950 mc, 2C40 tube, with modulator chassis **$30.00**

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LOSSY LINE ATTENUATOR, consisting of RG-21/U cable rolled in metal box with UG-10/U connectors, furnished in any attenuation up to 20 db at 3000 mc **$15.00**

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0-350 VOLTS, WESTINGHOUSE NX-35 METER, 1000 ohms per volt....**$4.50**

1-0-1 MA, MARION SEALED METER HM3, scale 100-0-100 ma, and 115-0-115 volts, 3½".....**$4.50**

PULSE INPUT TRANSFORMER, permalloy core, 50 to 4000 kc impedance ratio 120 to 2350 ohms.....**$2.00**

PULSE TRANSFORMER, UTAH 9280 $1.50

PULSE TRANSFORMER 132-AWP..**$6.00**

PULSE TRANSFORMER, GE 68G, 828G-1 $5.00

PULSE TRANSFORMER, Westinghouse 145-EWP **$10.00**

CONNECTORS:

UG-18/U	.80	UG-86/U	1.00
UG-12/U	.80	UG-167/U	2.00
UG-21/U	.80	UG-190/U	1.00
UG-22/U	.80	UG-201/U	.60
UG-24/U	.80	UG-245/U	.60
UG-25/U	.80	M-359	.28
UG-27/U	.50	UG-266	1.00
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UG-30/U	1.00	PL 54	.10
UG-30/U special	1.00	PL 81	.50
UG-58/U	.60	AN-3102-14S-5P	.25
UG-59/U	1.00	AN-3102-14S-2P	.25
UG-83/U	1.00	RC-10066-20-1P	.50

PE-206 INVERTER, 800 cps, 24 V input, output 80 V New.....**$10.00**

PE-103A POWER UNIT, 6 V or 12 V in, output 500 V at 160 ma; new, complete with filter and cables.....**$20.00**

ELECTRO IMPULSE LABORATORY

P. O. Box 250 Red Bank, N. J.

Eatontown 3-0768

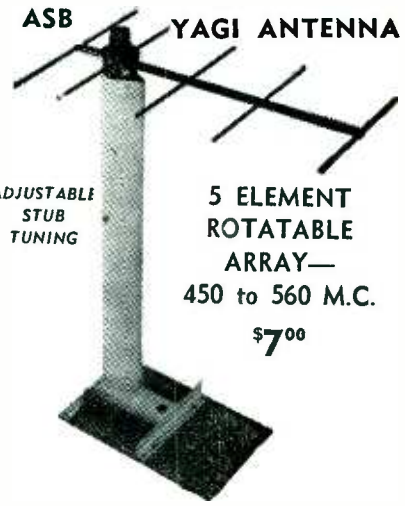
YAGI ANTENNA

DOUBLE STACKED 6 ELEMENT ROTATABLE ARRAY

ASB (450-560MC) **$12.70**

ASA (370-430MC) **$29.40**

ASB YAGI ANTENNA



5 ELEMENT ROTATABLE ARRAY— 450 to 560 M.C.

$7.00

COAXIAL CONNECTORS

83-1AP	.09	UG-12/U	.63
83-1H	.10	UG-21/U	.67
83-1J	.68	UG-23/U	.63
83-1R	.28	UG-24/U	.67
83-1RTY	.45	UG-27/U	.68
83-1SP	.28	UG-30/U	.94
83-1SPN	.28	UG-58/U	.57
83-1T	1.12	UG-85/U	.62
83-22AP	.48	UG-86/U	1.22
83-22F	.88	UG-87/U	.68
83-22R	.52	UG-206/U	.58
83-22SP	.48	UG-255/U	.82

Antennas for AN/APR-4 Receivers

AT-38A/APT—(70 to 400 MC).....$13.70
AT-49/APR-4—(300 to 3300 MC).....$13.70

AT-48/UP—3CM ANTENNA HORN for receiving or transmitting $3.95
FILTER CHOKE—10H 400MA DC Res. 90 ohms—hermetically sealed $2.93
Kollsman 2 Phase Low Inertia motors—Type 937-0240 .....$8.22
Model ASB-4 Radar Equipment—Complete..$69.75
CW1-60 AAG Range Calibrator for ASB....$39.95

GENERAL ELECTRIC FG-172 THYRATRONS

$14.50 EA.

$10.00 EA.

IN LOTS OF 10 BRAND NEW ORIGINAL CARTONS FULLY GUARANTEED

SOUND POWERED PHONES

RCA or Western Electric Navy Head and Chest sets—Brand New $14.88

Western Electric Chest Mike with 20 ft. cable $3.88

Allen Bradley Potentiometers in stock.

LECTRONIC RESEARCH LABORATORIES

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Telephones: Market 7-6590 and 6591

POINT-TO-POINT RADIOTELEPHONE

Using the 20.0 to 27.9 Mc channels, the SCR-528 is consistently proving itself for broadcast relay, mobile, and general industrial communications. Ideal also for teletype via radio as well as interconnecting with telephone lines. COMPLETE for 12 or 24 Volt DC operation. Special AC power pack for above also available. Bulletin sent on request.

PORTABLE POWER SUPPLY—AVA-126A, RCA Mfg. for mobile, boats, planes. In grey crackle steel box 7"7"7½" wt. 10 lbs. Input 6 or 12 Volts DC and delivers 320 V. at 110 Ma. with taps for revr or transmitter. Has OZ4GT rect. 3 built-in relays, complete filters, 2 vibrators (6 & 12 V) and mfg accessories. BRAND NEW.....$14.95

RADIO DIRECTION FINDERS

RCA and Bludworth models for marine use.

PORTABLE EQUIPMENT

SCR-511 (2.0 to 6.0 Mcs) with a multitude of accessories and spares. Gross weight 104 lbs. Weight in use 8 lbs. NEW.....$100.00

HANDY-TALKIES & WALKIE-TALKIES

The famous SCR-536 in stock, plus others, with test equipment and accessories.

TRANSMITTERS

Wide variety of Westinghouse, RCA, W.E., Meissner, Collins, Hallicrafter, etc. in stock in varied power outputs.

TDE, Westinghouse Mfg., designed for US Navy, 300 to 18,100 Kcs, CW, ICW & Phone. For use on ships or land stations. In most input voltages.

RADAR

Western Electric and Raytheon Mfg. Co. equipment in brand new condition and complete.

HIGH VOLTAGE Oil Filled Condensers—Standard Brand—.25 Mfd x 20,000 Volts in the better brands. Brand NEW in cartons. Low priced at.....$12.95

BULLETINS on request.

Cable: Communidev
Tel: AD-4-9277

COMMUNICATION DEVICES CO.

2331 TWELFTH AVENUE NEW YORK 27, N. Y.

Subject to prior sale.
FOB: WHSE

RADIO TUBE EXCHANGE
SELLING AND BUYING
AVAILABLE AT PRESENT

Minimum order $10.00
Add postage or tubes will be sent by Express Collect.

Magnetron		701A	6.00	394A	3.95	705A	1.25
2J26	$18.00	715A	6.00	885	1.45	719A	14.95
2J31	18.00	715B	9.00	**Rectifier**		866A	1.50
2J32	18.00	5D21	25.95	2X2	$.45	872A	2.50
2J40	54.00	**Thyratron**		2X2A	.75	869B	29.95
2J49	36.00	C1B	$3.95	371B	1.25	1616	1.95
2J50	45.00	3C23	3.95	5R4GY	1.25	8020	2.95
2J61	45.00	3C31	3.95	RK72	1.25	**Power**	
2J62	45.00	393A	7.95	RK73	1.75	2C40	3.60
714AY	4.00					2C44	.75
725A	15.00					350B	2.40
730A	12.00					368AS	1.80
Klystron						388A	1.80
2K25	$19.95						
2K28	19.95						
707A	9.95						
707B	9.95						
723A	7.95						
723A/B	8.95						

446A	1.80	851	19.95
450TH	19.95	1624	.69
WL468	8.95	8012A	1.95
703A	1.80	8025	3.95
802	4.25	**Acorn**	
803	5.25	1A3	$.29
807	1.35	954	.45
813	6.95	955	.45
814	2.95	956	.45
832A	3.95	957	.35
834	7.95	958A	.45
845	3.25	959	.55
849	29.95	9001	.55
		9002	.35
		9003	.45
		9004	.45
		9006	.35
		C.R. Tubes	
		5BP1	2.75
		5BP4	4.75

LIBERTY ELECTRONICS, INC.

135 LIBERTY STREET NEW YORK 6, N. Y.
PHONE WORTH 4-8262
ASK FOR FREE CATALOG

TRANSFORMERS

115V 60cy. INPUT
Equip. Conservatively Rated

FILAMENT TRANSFORMERS

5 Volts 6 Amp	$2.25
F083: 6.3VCT/6A. 5V/2A	1.85
F- 2.5VCT/6.5A	3.25
F- 6.3VCT-2A. 6.3VCT/2A	2.45
F087: 6.3VCT/1A. 6.3VCT/7A	2.75
F123: 6.3VCT/5A. 6.3V/1A	2.25
F127: 6.3VCT/3.2A. 6.3VCT/1A	2.25
F674: 8V/1.5A	2.75
F- 2.5/1.75A, 6.5/8A, 5V/3A, 6.5/6A	3.95
F414: 2 x 2.5VCT/6.5A	3.25
5—VCT/13.5A, 2x5VCT/6.75	6.95
10—VCT/13.5A, 10VCT/3.25	6.95
F38A: 6.3V/2.5A, 2 x 2.5V/7A	3.25
KS9905 6.3/6A	1.95

PLATE TRANSFORMERS

P410: 800VCT/40MA, 760VCT/500MA	6.50
P415: 690V/450MA	4.95
P699: 2 x 300VCT/25A	1.65
P403: 70V/1A	2.25
P413: 510VCT/150MA, 650VCT/15MA	4.95
P842: 600VCT/.0166A, 250VCT/.077A	2.95
P885: 1620VCT/400MA HV 1NS	11.95
825VCT/190MA, 5VCT/3A	3.95
P450: 2 x 150V/940MA	4.50
P371: 246VCT/830MA	3.95
P345: 1470VCT/1.2A, 3500T	24.00
P823: 222VCT/.3A	2.95
P30B: 58V/2.2A	2.25
P328: 115V/2.2, 40V/2.2	4.49

COMBINATION TRANSFORMERS

C965: 78V/600MA, 6.3V/2A	$3.95
C111: 2 x 300V/42MA, 55V/125MA 45V/3.5 Amp	3.95
800VCT/150MA, 5V/3A, 2.5V/2A	3.95
C931: 585VCT/86MA, 5V/3A, 6.3V/6A	3.95
C055: 525VCT/75MA, 5V/2A. 6.3V/1.8A 10V/2A	4.45
T102: 1080VCT/55MA, 2 x 6.3V/2A	5.95
C848: 600VCT/155MA, 6.3VCT/5A 5VCT/3A HV Ins.	3.95
C899: 2 x 110VCT/.01A, 6.3V/1A 2.5VCT/7A	4.50
C760: 6.3VCT/10A, 65V-1A, 100VCT/.1A.. 40V/.1A, 18VCT/.1A, 18V 6V/.1A, 6.3V/.1A	5.50
C367: 5VCT/3A, 580VCT/.040A	2.95
T160: 1120VCT/770MA, 590VCT/.082A HV Ins.	12.75
C579: 24V/900MA, 770V/.0025, 2.5V/3A HV Ins.	4.25
T378: 2300V/.004A, 2.5V/2A HV Ins.	8.95
C375: 1120VCT/600MA, 2 x 5VCT/6-2A 6.3VCT/3A, 6.3V/300MA	14.95
C434: 40V/.01A, 6.3V/1.25A	1.95
250VCT/300MA, 5VCT/6A	2.29
6HV/150MA	.99
C821: 1500V/.4A, 6.3V/.6A, 2.5V/1.75A 3500T	8.95

PRECISION RESISTORS

1.01	125	1450	20000
3	128	1900	25000
5	150	2230	30000
5.05	200	4300	33000
10	250	5000	35000
10.1	300	7000	40000
18	430	7500	50000
43.5	468	8500	55000
50	800	10000	57000
75	920	12000	75000
82		17000	Ship type
120	1100	17300	In stock

Above Ea..30¢ Ten For..$2.50

100000	150000		250000
120000	170000	220000	500000

Above Ea..40¢ Ten For..$3.50
1,000,000 ohms.....Each 75¢

SHOCK MOUNTS

Lord	#1	10¢
Lord	#6	10¢
Lord	#5	10¢
Lord	#15	15¢
Lord	#12	15¢
Lord	#35	18¢
U. S.	#5150-C	55¢
Lord	#4	35¢
Lord	#1	14¢
Lord	#10	25¢
Lord	#8	20¢
Lord	#35	45¢
Lord	#20	39¢
Lord	#25	45¢
Henrite	#55	49¢
Lord	#15	35¢
Barry	#C2070	55¢
Barry	#C2060	55¢
Barry	#C2090H	55¢

OIL CONDENSERS

Capacity	VDC	
.0016 MFD	15000	$8.00
.015 MFD	16000	7.00
.01–.005–.005	10000	4.75
.1 MFD	2500	1.25
.1–.1 MFD	7000	3.49
.1 MFD	6000	2.97
.1 MFD	7500	3.00
2 x .1 MFD	4800	3.00
.15 MFD	4000	3.00
.15–.15 MFD	6000	4.00
2 x .15 MFD	8000	5.00
.25 MFD	1500	1.05
.4 MFD	5000	3.00
.5 MFD	1000	.70
.5 MFD	750	1.75
1 MFD	600	.49
1 MFD	2000	1.00
1 MFD	1500	.89
1.5 MFD	1500	.95
2 MFD	1500	1.05
4 MFD	1000	.98
6 MFD	600	1.05
6 MFD	1500	2.25
7 MFD	600	1.05
7 MFD	800	1.25
10 MFD	1000	1.95
15 MFD	220	2.29
15 MFD	1000	2.25

WRITE FOR LIST

AN CONNECTORS AT 80% OFF LIST

3102—	14S—	2P&S
3102—	16S—	3P
3102—	18—	1S
3102—	18—	3P
3102—	18—	4P
3102—	20—	1P
3102—	20—	4P&S
3102—	22—	17S
3102—	28—	2S
3102—	28—	4S
3102—	32—	7P
3102—	28—	17P
3102—	28—	20S
3102—	32—	8S
3102—	36—	1S
3102—	36—	7S
3102—	40—	1P
3102—	10SL—	4S
3106—	12—	5S
3106—	14S	2P&S
3106—	18—	5S
3136—	14S	5S
3106—	12S	3P
3106—	14S	9P
3106—	18—	4S
3106—	18—	11S
3106—	20—	4S
3106—	20—	27S
3106—	22—	10S
3106—	24—	5P&S
3106—	24—	7P
3106—	28—	1P
3106—	28—	2P&S
3106—	28—	4S
3106—	28—	12P
3106—	28—	16P
3106—	28—	17S&P
3106—	28—	20P
3106—	36—	1P&S
3106—	40—	1S
3106—	36—	15P&S
3108—	14S	2S
3108—	22—	5P
3108—	20—	13S
3108—	28—	4S
3108—	28—	16P
3108—	28—	17P

Write for many others in stock

H. V. Oil Condensers

1.5 MFD	6000 VDC	10.00
.1 MFD	15000 VDC	32.50
.5 MFD	25000 VDC	37.50
1 MFD	25000 VDC	85.00
.1 MFD	10000 VDC	15.00
.06 MFD	15000 VDC	8.00
.25 MFD	20000 VDC	17.50
15 MFD	5000 VDC	27.50

MICA

Mfd	Voltage	Price
.01	1200WV 2 for	95¢
.00025	2500TV 2 for	55¢
.00004	2500WV 2 for	75¢
.000047	2500WV 2 for	75¢
.01	500WV 4 for	95¢
.002	3000WV 2 for	$2.00
.01	2000WV 2 for	2.90
.00003	2000WV 2 for	95¢
.00009	3000WV 2 for	1.45
.00082	3000WV 2 for	1.95
.002	3000WV 2 for	1.95
.005	5000WV 2 for	3.25
.0004	6000WV 2 for	2.95
.0006	3000WV 2 for	1.95
.0008	3000WV 2 for	1.85
.0016	3000WV 2 for	1.25
.000090	3000WV 2 for	75¢
.08	1500WV 2 for	19.50
.03	2000WV 2 for	23.50
.045	2000WV 2 for	23.50
.00015	20KV 2 for	47.50
.0001	20KV 2 for	47.50
.006	2500WV 2 for	2.85
.00027	2500WV 2 for	.65

Send for Lists of Others

UPRIGHT OILS

Mfd.	Voltage	Price
.1	600VDC 3 for	$1.00
.25	400VDC 3 for	1.10
.5	600VDC 3 for	1.00
.1	600VDC 3 for	1.10
2 x .5	600VDC 3 for	1.45
3 x .1	600VDC 2 for	1.05
.25	400VDC 3 for	1.10
.5	600VDC 3 for	1.00
.1	400VDC 3 for	1.00
.1	400VDC 2 for	75¢

TRANSTAT AMERTRAN

Input: 0.115 v. 50-60 cycle. Max. output: 115 v. 100 amp.
All units are new, guaranteed $95
2 KVA: 90-130v input 50-60 cycles, output 115v 2kva type RH Amertran .....$29.95 each

KITS POWER SUPPLY

Basic TV 5" & 7" Pwr Supply

Consists of xfrmr 2300v/4MA, 2.5v/2A, 1 condenser .1.1 mfd 7500 Pyr., 2x2 tube, socket 100K ohm resistor price $8.95
5BP1 $1.95 5BP4 $4.95 5CP1 $3.75

Basic TV 3" & 5" Pwr Supply

Consists of xfrmr 1080v/55MA, 2x6.3v/1.2A, 1 Cond. .1.1 mfd 7500 Pyr., 2x2 tube, socket 100 K ohm resistor. Price.....$6.95
3BP1 $2.25 3DP1 $2.25 3EP1 $2.95

3" Oscilloscope Kit

BC929 uses 9 tubes 3BP1, 6SN7, 6H6, 6B6G, 6X5 2X2 (now 400 cy) easily converted to 115v 60 cy New Complete w/tubes & conver. inst. $22.50

5" Oscilloscope Kit

BC 704 Less Pwr Supply Kit includes 8 tubes. 5BP1, 6AC7, 6H6 w/wooden Case & Diag....$29.50

MISCELLANEOUS

15 Watt Power Supply

Consists of xfmr 600 vct/155MA, 6.3v/5A, 5v3A, 2.7mfd 600v, dual 10 hy 200MA choke, 1-ST4; 1-socket. Price $7.95

50 Watt Power Supply

Consists of xfmr 880vct/150MA, 5v/3A, 6.3v/6.25A, 2-7 mfd 800v 1-5T4, socket. Price $9.95
Filter Line Ge 100amp w/2x5 mfd 50v 0.1 Cond. operates on 110vdc $1.98
Filter Line 1kw. Clean up your BCI & TV1. Easy to mount, uses 4-.002 Cond. Complete.....$4.25
Deflection Yoke for 5" to 12" tube RAY20A $4.49
T 311 3000v/5MA, 720vct/200MA 6.4v/8.7A, 6.4v/6A, 6.5v/3A, 1.25v /.3A Scoop $6.95
T-462 10000v 5MA for 10"x15" $10.95

INDEX TO ADVERTISERS

ADVERTISERS INDEX

A "Brand New" SOLUTION TO YOUR AUDIO MEASUREMENT PROBLEMS

FEATURES

FREQUENCY RANGE: 20 cycles to 20 KC.

ACCURACY: Accuracy is ± 0.1 db, from 20 cps to 20 KC.

OUTPUT LEVELS: Ranges of output level: +4 to —110 db and —10 to —124 db in steps of .1 db.

ACCESSIBILITY: All components accessible from front of rack panel — for ease of servicing.

IMPEDANCE RANGES:
(a) *Sources Section* — 600-150 ohms internally terminated.
600-250-150-30 ohms unterminated.
(b) *Load Section*—600-250-150-16-8-4 ohms.

Daven's Moderate Priced Transmission Measuring Set

This is the instrument for which you have been waiting! For accuracy and efficiency, the Daven Type 11 A gain set, will fill your bill. Incorporating many of the features employed in more expensive models, this unit may be used to make all the precise measurements required by the FCC. This is a direct reading instrument, entirely eliminating time-consuming computations.

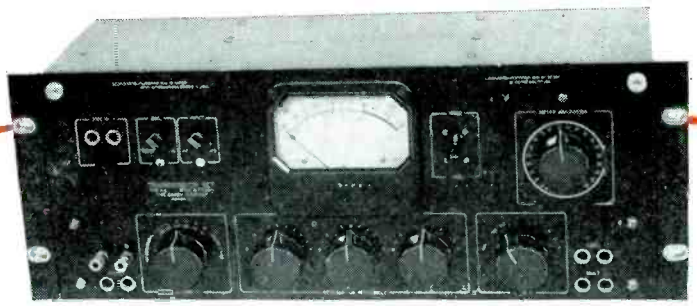
A new design feature, permits the servicing and inspection of all components from the front of the panel, with a maximum of ease and in a minimum of time.

It is no longer necessary to use makeshift equipment for determining the transmission characteristics of audio systems. The Type 11 A gain set has been priced low enough to put it within the reach of the most limited budget.

APPLICATIONS

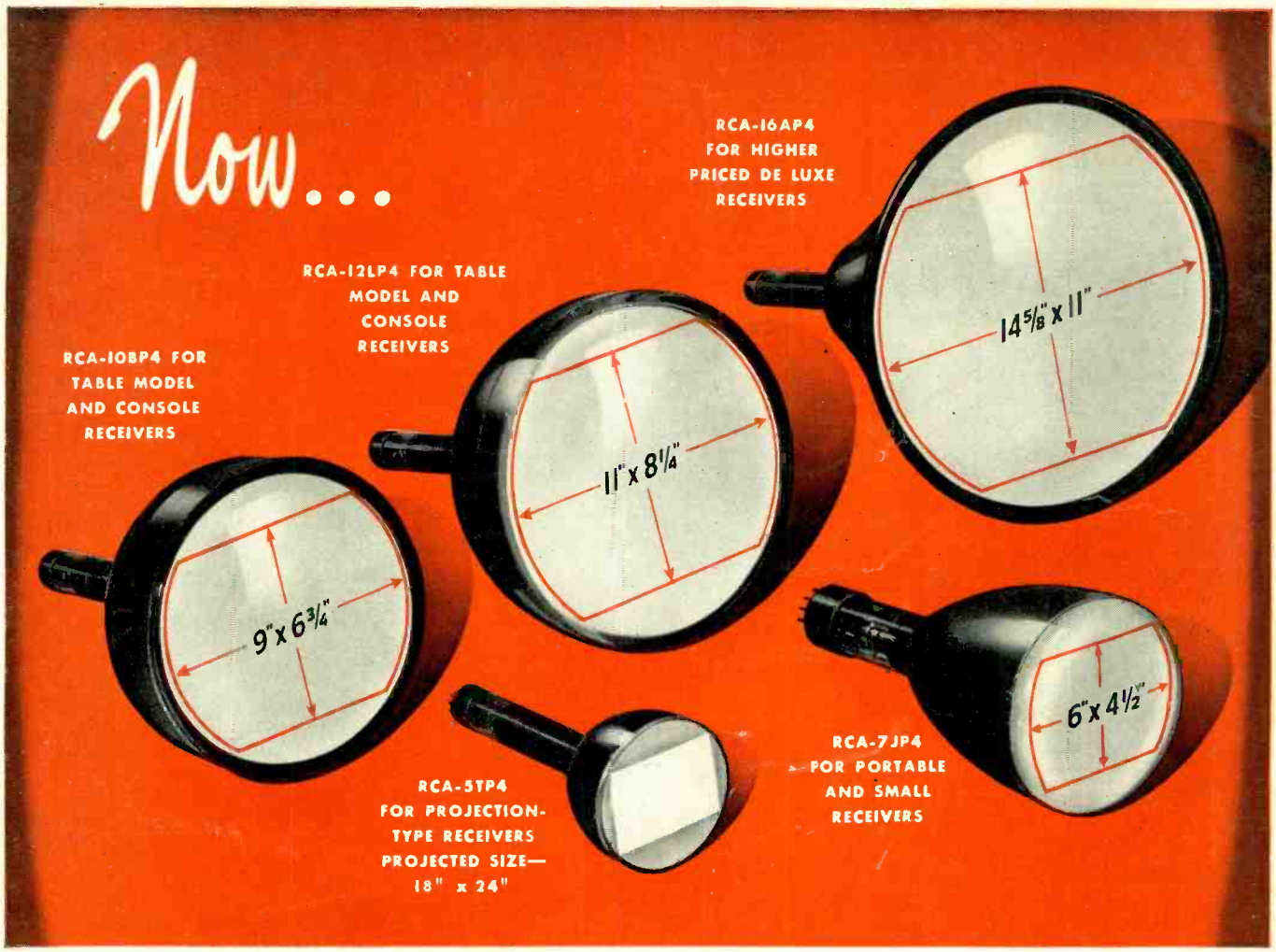
- Audio gain measurements.
- Audio loss measurements.
- Measurements of matching and bridging devices.
- Complex circuit measurements.
- Measuring mismatch loss.
- Frequency response measurements.
- Checking cable loss.
- Telephone repeater data

WRITE TO DEPT. E-1 FOR ADDITIONAL INFORMATION.



Always Specify Daven For Precision Equipment

THE DAVEN CO.
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY



THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

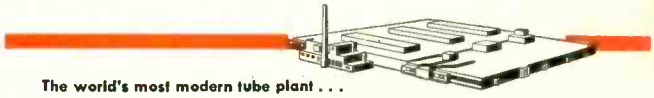
. . . the five most popular kinescopes ___from one dependable source

RCA now has a popular type of kinescope to accommodate television receiver designs in practically every class and price range.

Concentrated production on these five accepted types results in longer production runs, which in turn, make possible lower cost, more uniform, and better quality tubes for our customers.

All five types are currently being mass-produced at the famed RCA tube plant in Lancaster, Pennsylvania. In addition, a large new plant is under construction at Marion, Indiana, where the production will be centered on the RCA-16-inch metal-cone kinescope.

RCA Application Engineers are ready to cooperate with you in applying these kinescopes and their associated components to your specific designs. For further information write RCA, Commercial Engineering, Section 42IR, Harrison, N. J.



The world's most modern tube plant . . .
RCA, LANCASTER, PA.

RCA **RADIO CORPORATION of AMERICA**

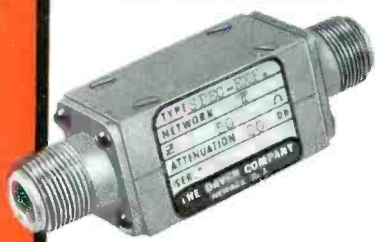
ELECTRON TUBES HARRISON, N. J.

SEARCHLIGHT SECTION
(Classified Advertising)

NEW!... R. F. AND VIDEO COMPONENTS FOR PRECISE CONTROL

In keeping with the Daven policy of continually developing new components to meet the electronic industry's new needs, we are once again first to offer video and radio frequency fixed and variable attenuators. These units embody the characteristics which have come to be synonymous with the name DAVEN . . . excellence of workmanship, top-notch design, finest materials and accurate, efficient performance.

R. F. FIXED ATTENUATORS



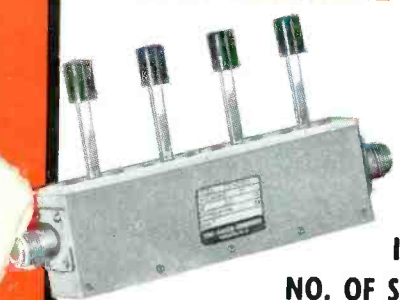
TYPE RF-155

CIRCUIT: π network.

IMPEDANCE: 50 ohms.

LOSS: 5 to 20 DB.

R. F. VARIABLE ATTENUATORS



SERIES RF-540

CIRCUIT: π network.

IMPEDANCE: 50 ohms.

NO. OF STEPS: 4 (push-buttons.)

RESISTOR ACCURACY: ±5% at D.C.

IMPEDANCE ACCURACY: Terminal impedance will not vary more than ±2% from 0-225 MC. Slightly greater variation to 216 MC.

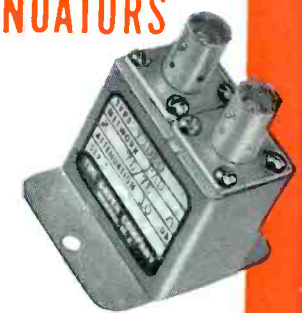
LOSS:
Type RF-540 — 1, 2, 3, 4 DB (10 DB total.)
Type RF-541 — 10, 20, 20, 20 DB (70 DB total.)

SUGGESTED APPLICATIONS

- In signal generators.
- In field strength measuring equipment.
- Nucleonic and atomic research.
- Television receiver testing.
- Wide-band amplifiers.
- Pulse amplifiers.
- Any application where attenuation of UHF is required.

VIDEO FIXED ATTENUATORS

TYPE V-154



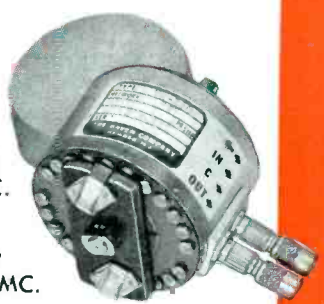
CIRCUIT: "T" network or equivalent.

IMPEDANCE: 75 ohms.

LOSS: 1 to 20 DB.

VIDEO VARIABLE ATTENUATORS

SERIES V-250



CIRCUIT: "T" network.

IMPEDANCE: 75 ohms.

RESISTOR ACCURACY: ±1% at D.C.

FREQUENCY CHARACTERISTICS: Essentially flat to 10 MC.

TYPE	NO. OF STEPS	DB PER STEP	TOTAL DB
250	10	1	10
251	10	2	20
252	20	1	20
253	20	2	40

These units will be supplied with co-axial connectors or regular terminal boards with lugs.

NOTE: *A video push-button control, similar to the R.F. push-button unit shown, is available.* ***Additional information will be furnished on request.***

SUGGESTED APPLICATIONS

- In television video circuits where a wide frequency range without change of impedance is of special importance.
- Wide-band amplifiers.
- Pulse amplifiers.

Patent applied for.

THE DAVEN CO.
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY

RCA-the pioneer in miniatures-

. . . presents three new types of major importance

● Here are three new miniature tubes . . . additions to RCA's large family of miniature types . . . that have particular significance in FM receiver design and voltage reference applications.

RCA 6BA7 and 12BA7 are pentagrid converters—alike except for heater ratings. They have high conversion gain, because of their high conversion transconductance; and a separate connection for direct grounding of the suppressor. These features in combination with the short internal leads characteristic of miniature tubes, result in efficient operation of either type in the 88 to 108-megacycle FM band. In addition to realizing substantial gains at the higher frequencies, the RCA 6BA7 and 12BA7 contribute a highly favorable signal-to-noise ratio.

RCA-5651 is a voltage reference tube of the cold-cathode, glow-discharge type. It maintains a dc operating potential of 87 volts, has an operating current range of 1.5 to 3.5 ma., an operating characteristic essentially independent of ambient temperature, and a voltage stability at any current level of better than 0.1 volt.

• • •

RCA Application Engineers will be pleased to consult with you on the incorporation of these new miniatures in your equipment designs. For further information write RCA, Commercial Engineering, Section KR40, Harrison, N. J.

RATINGS AND CHARACTERISTICS

6BA7 and 12BA7 Pentagrid Converters

	6BA7	12BA7	
Heater Voltage (ac or dc)	6.3	12.6	Volts
Heater Current	0.3	0.15	Ampere

Characteristics — Separate Excitation*

Plate Voltage	100	250	Volts
Grid No. 5 and Internal Shield	Connected directly to ground		
Grids No. 2 and No. 4	100	100	Volts
Grid No. 3	—1.0	—1.0	Volt
Grid No. 1 Resistor	0.02	0.02	Megohm
Plate Resistance (Approx.)	0.5	1.0	Megohm
Conversion Transconductance	900	950	Micromhos
Conversion Transconductance (approx.) Grid No. 3 at —20 volts	3.5	3.5	Micromhos
Plate Current	3.6	3.8	Ma.
Grids Nos. 2 and 4 Current	10.2	10	Ma.
Grid No. 1 Current	0.35	0.35	Ma.
Total Cathode Current	14.2	14.2	Ma.

*Characteristics correspond very closely with those obtained in a self-excited oscillator circuit operating with zero bias.

5651 Voltage-Reference Tube

	Min.	Av.	Max.	
DC Starting Voltage	—	107	115	Volts
DC Operating Voltage	82	87	92	Volts
DC Operating Current	1.5	—	3.5	Ma.
Regulation (1.5 to 3.5 Ma.)	—	—	3	Volts
Stability*	—	—	0.1	Volt
Ambient Temperature Range	—55 to +90° C			

*Defined as the maximum voltage fluctuation at any current level within operating current range.

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

TUBE DEPARTMENT

RADIO CORPORATION of AMERICA

HARRISON, N. J.